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Date: July 1, 2005
Refer to: ER2005-0402

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

RECEIVED
JUN 2005
NMED Hazardous Waste Bureau

SUBJECT: RESPONSE TO THE NOTICE OF DISAPPROVAL FOR THE INVESTIGATION WORK PLAN FOR MATERIAL DISPOSAL AREA A AT TECHNICAL AREA 21, SOLID WASTE MANAGEMENT UNIT 21-014

Dear Mr. Bearzi:

Attached are two hard copies with electronic files of the Los Alamos National Laboratory and the Department of Energy's Response to the New Mexico Environment Department's (NMED's) notice of disapproval for the "Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014." This notice of disapproval was received on June 3, 2005.

This submittal includes revised sections of the investigation work plan and the historical investigation report. Where text was deleted, a red bar appears in the margin. Where text was inserted, red underlined text and a red bar in the margin appear. A table cross-referencing changes to the original document and copies of three requested references are also included. The final revised documents will be prepared and submitted once the attached draft revisions are approved by NMED.

If you have questions, please contact Ron Rager at (505) 665-4065 (rrager@lanl.gov) or Woody Woodworth at (505) 665-5820 (lwoodworth@doeal.gov).

Sincerely,

David McInroy, Deputy Program Director
Environmental Remediation & Surveillance
Los Alamos National Laboratory

Sincerely,

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

RR/sm/jk

Enclosures: 1) Response to the notice of disapproval for the "Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014"
2) Certification by the ENV-ERS Program Technical Representatives

Cy: (w enclosure)
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B. Rich, ADO, MS A104
L. Trevizo, NMED-HWB
D. Pepe, NMED-OB

CERTIFICATION

CERTIFICATION BY THE ENVIRONMENTAL STEWARDSHIP– ENVIRONMENTAL REMEDIATION & SURVEILLANCE PROGRAM TECHNICAL REPRESENTATIVES

Document Title: **Response to the Notice of Disapproval for the Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014**

I certify under penalty of law that these documents and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

Name: _____ Date: 6/30/05

David McInroy, Deputy Program Director
Environmental Remediation & Surveillance Program
Los Alamos National Laboratory

or

_____ Date: _____

Ken Hargis, Division Leader
Environmental Stewardship Division
Los Alamos National Laboratory

_____ Date: 6/30/05

David Gregory, Federal Project Director
Environmental Restoration Program
Department of Energy/Los Alamos Site Office

or

_____ Date: _____

John Ordaz,
Assistant Area Manager of Environmental Projects
Department of Energy/Los Alamos Site Office

Response to the Notice of Disapproval for the Investigation Work Plan for Material Disposal Area A at Technical Area 21 Dated June 1, 2005

INTRODUCTION

This is the response of Los Alamos National Laboratory (the Laboratory or LANL) and the Department of Energy to the "Notice of Disapproval for the Investigation Work Plan for Material Disposal Area A, at Technical Area 21," issued by the New Mexico Environment Department (NMED) Hazardous Waste Bureau on June 1, 2005, and received by the Laboratory on June 3, 2005. The "Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014" (LA-UR-05-0094, 87453) was submitted by the Laboratory to NMED in January 2005.

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. The Laboratory's responses follow NMED's comments. This response also contains the following attachments:

- Attachment 1 contains Table 1 which cross-references NMED comments with sections revised in the investigation work plan and historical investigation report.
- Attachment 2 provides the revised investigation work plan sections including revised text, figures, tables, and appendices.
- Attachment 3 contains the revised historical investigation report sections.
- Attachment 4 contains relevant pages of the DOE (1987, 08664) reference.
- Attachment 5 includes a copy of the Balo and Warren (1982, 07205) reference.
- Attachment 6 includes a copy of the Francis (1997, 76126) reference.

GENERAL COMMENTS

NMED Comment

1. *The administrative authority (AA) is used to refer to NMED, EPA, and the Laboratory throughout the MDA Work Plan. In the future, the Permittees must use the appropriate designations.*

LANL Response

1. Comment noted.

NMED Comment

2. *Neither the Historical Investigation Report (HIR) nor the work plan indicates the depth from the top of the ground surface to the top of the Central or the Eastern Pits. The HIR (Table 2.2-1) indicates that in 1946 crushed fill was used to backfill the trenches at the Eastern Pits and in 1978 a soil cover of crushed fill was placed over the Central Pit. There is no documentation regarding the depth or volume of fill that was placed over the pits. The Permittees must provide additional information pertaining to how much fill was placed at MDA A.*

LANL Response

2. No additional information has been identified in the available references pertaining to the depth or volume of fill placed over the eastern disposal pits or the central disposal pit. Clarification on cover/fill material sampling activities, as related to thickness of the cover/fill material, is provided in the response to Specific Comment 1.

SPECIFIC COMMENTS

NMED Comment

1. Section 4.2 MDA A Investigation Activities, Soil and Sediment, page 20-21, paragraph 5:

Permittees' Statement: "Eight fill/soil samples will be collected from the MDA A cover. Samples will be collected from two depth intervals at each sampling location (0-0.5 ft and 1.5-2.0 ft)."

NMED Comment: The Permittees are proposing to sample cover/fill material. Fill material cannot be used to represent releases from this site. NMED requires sampling of native soil or other media that existed during the operation of MDA A. Because the depth to the native soil is unknown the Permittees must sample in intervals until native soil is reached and can be sampled.

LANL Response

1. The Laboratory is proposing to collect samples of the cover/fill material at the borehole locations in conjunction with borehole drilling within the MDA A fence because of the potential for surface water runoff to dislodge potentially contaminated surface soil and transport soil particles off-site (i.e., the fill soils are not presumed to be clean). The sample collection objectives are to (1) characterize potential presence of COPCs in the cover/fill material, (2) determine the thickness of the cover/fill material, and (3) evaluate if the cover/fill material may be utilized in closure.

   These samples were originally proposed as surface samples (0–0.5 ft and 1.5–2.0 ft). However, to avoid a terminology conflict with final approved authorization basis safety documents, the revised text and work plan treats samples of cover/fill collected deep than 1 ft below the existing ground surface as subsurface sample collection in the borehole sample summary. Samples collected from 0–0.5 ft are still referred to as surface samples.

   The spade or scoop method will be utilized to collect the surface samples (0–0.5 ft). In order to more closely define the contact between the cover/fill and the native soil, a hand auger will be used to collect subsurface cover/fill samples and to sample the native soil at the interface of the cover/fill with the native soil. Once the native soil at the interface is sampled, a hollow-stem auger drilling rig will be utilized to complete the borehole.

   Subsurface cover/fill samples will be collected from a 1.5–2.0 ft interval depending on cover/fill thickness and composition. The cover/fill thickness may be variable at the site, but is anticipated to be less than 4 ft. Sampling text has been revised in Section 4.2, Section 4.6, Table 4.6-1, and Table 4.11-1 (see Attachment 2).

NMED Comment

2. Section 4.4 Number, Depth and Location of Boreholes, page 22-23:

NMED Comment: NMED agrees with the depth of the proposed boreholes. The Permittees may need to advance proposed boreholes to the Cerro Toledo based on the results of the MDA T boreholes. Several wells have a proposed depth, this depth may change because all boreholes will be advanced at least 20 ft below the base of the nearest disposal unit and a vertical depth of 25 ft below the last field-screening detection.

LANL Response

2. Comment noted. The nature and extent of contamination at MDA T will be assessed for impacts to MDA A. All borehole depths are considered approximate minimum depths.

NMED Comment

3. Section 4.8 Perched Water Sampling, page 24:

Permittees' Statement: "A monitoring well design will be submitted to the AA in accordance with Section 5.6 of this work plan"

NMED Comment: This statement needs further clarification because Section 5.6 of this work plan does not seem relevant to groundwater. The Permittees must submit a groundwater work plan, including well design if perched groundwater is encountered, according to Section IV.C.2.c.vii of the Consent Order.

LANL Response

3. Section 4.8, Perched Water Sampling, incorrectly referenced Section 5.6 of this work plan. The correct reference is Section 5.7, Collection of Perched Water Samples. Section 5.7 has been revised to state that a monitoring plan design will be prepared in accordance with the requirements of §IV.C.2.c.vii of the Consent Order. See Attachment 2.

NMED Comment

4. Section 4.6 Surface and Near-Surface Sampling, page 24:

NMED Comment: The Permittees plan to characterize cap material placed in 1987. Again, there is no documentation on how thick the cap material is. In 1985 cap material was also placed at MDA A and this material should be characterized as well. The Permittees must explain why they are planning on sampling fill material.

LANL Response

4. See response to Specific Comment 1. As presented in Section 2.2 of the HIR, the entire site was covered with crushed tuff when the site was closed in 1978. In 1985, surface contamination was removed, fill material placed on top, and the site recontoured and seeded. The 1987 activity consisted of adding seed and fertilizer. The date for fill material placement given in Section 4.6 of the work plan has been revised to 1985. The Laboratory is proposing to characterize all cover/fill material as one unit because individual layers associated with the 1978 and 1985 cover placement activities are likely not distinguishable because of the recontouring. See Section 4.2, 4.6, Table 4.6-1, and Table 4.11-1 of Attachment 2.

NMED Comment

5. Section 4.7 Subsurface Vapor Monitoring, page 24:

NMED Comment: The Permittees must collect vapor monitoring samples according to section IX.B.2.g of the Consent Order.

LANL Response

5. Section 4.7 is revised to describe what will be conducted for subsurface vapor monitoring as presented in the bulleted lists of section IX.B.2.g of the Consent Order. The cross reference to

Section 5.5 for how the sampling is to be performed is already contained in this section of the work plan.

NMED Comment

6. Section 4.9 Field Screening, page 25:

NMED Comment: The Permittees propose to continuously screen for radiological contamination and, therefore, must provide additional information regarding the methods and procedures that will be utilized for the proposed field screening activities. This information must include which instrumentation will be utilized, how measurements will be determined in the field, a list of radionuclides that will be screened and QA/QC protocols.

LANL Response

6. Additional information has been added to Section 4.9.3 and Section 5.2 of the work plan to describe the radiological field screening methods for gross alpha, beta, and/or gamma radiation. Information added includes the following:

- Instrumentation—Eberline E-600/SHP380AB (both Section 4.9.3 and Section 5.2).

- Measurement procedures and QA/QC protocols—Procedures ESH-1-07-85, R.1, Operational Checks of Beta/Gamma Survey Instruments; ESH-1-07-89.1, Operational Checks of Alpha/Beta Dual Use Probes; and HSR1-INS-009, Radiation Detection Instrument Manual (Section 5.2).

- Radionuclides screened—Specific radionuclides are not identified by the Eberline E-600/SHP380AB. It does identify alpha, beta, or gamma radiation activity that may be indicators of radionuclides present at MDA A. The radionuclides thought to be present at MDA A are alpha radiation emitters (americium-241, plutonium-239/240, plutonium-238, and uranium) and beta emitters (strontium-90, and tritium) (Section 4.9.3).

NMED Comment

7. Section 4.11.1 Tuff, Soil and Sediment Samples, page 25-26:

NMED Comment: The Permittees must complete full analytical suites for each sample. This suite must include VOCs, SVOCs, explosive compounds, PCBs, dioxins, furans, nitrates, perchlorate, TAL metals, cyanide, and radionuclides. Because the disposal history is similar to MDA B where "several cartons of waste caused minor explosions and, on one occasion, a cloud of pink gas arose from the debris in the dump", the Permittees must include analysis of explosive compounds. The analysis may be limited to the boreholes surrounding the central and eastern disposal pits and must include the samples collected from the hillside. Also, because the operational history of the site includes "unidentified chemicals," the Permittees must also analyze for dioxins/furans and PCBs. The Permittees propose analyzing for dioxins/furans only if these constituents are detected during the MDA T investigation. According to the MDA T Investigation Work Plan, MDA A and the Generals Tanks are unrelated to MDA T. The Permittees must provide further justification for not including these constituents in their analysis.

LANL Response

7. The Laboratory proposes to collect pore-gas samples for analysis of VOCs in lieu of VOC analysis of soil and tuff samples. Pore-gas samples will be collected from each depth interval selected for core analyses for a minimum of 6–7 pore-gas samples instead of the two samples proposed in the original work plan. VOC analyses are not proposed for surface (0–0.5 ft) samples

on the cover/fill material or hill slope samples for the following reasons: (1) historical surface soil data from the MDA A area of influence indicate that VOCs are not COPCs in the hillslope surface, (2) low vapor pressure organic compounds are unlikely to have been retained in the upper 6 in. of hillslope soil over the last 20 yr since the MDA A cover was emplaced, and (3) the surface soil on the MDA A cover was imported crushed tuff and not representative of site conditions.

The Laboratory proposes to perform SVOC, pH, nitrate, perchlorate, TAL metal, cyanide, total uranium, iodide, and radionuclide analyses on all samples.

The Laboratory proposes to perform explosive compounds analyses on the upper 20% of the highest detections for samples from boreholes 2 through 10 and borehole 12, and all surface samples on DP Canyon slope, based on HE (RDX and TNT) field analytical results (see Section 4.10) and Comment Response 10. While the disposal history at MDA A is similar to MDA B, the documented gas emission at MDA B was likely due to chemical incompatibility and not the presence of explosive compounds as there are no documented historical processes at DP East involving explosives. Section 4.11 and Table 4.11-1 have been modified to reflect the revised analytical requirements (see Attachment 2).

The Laboratory proposes to perform PCB field analytical screening for all samples collected in boreholes adjacent to the disposal pits (boreholes 2 through 10 and borehole 12). All samples with field analytical detections will be selected for analysis of PCBs at an off-site laboratory. Boreholes 6 and 8 will have samples selected for PCBs analyses at the native soil contact (beneath the cover/fill) and from the base of the disposal units, even if there are no field analytical detections at these depths (base of the central disposal pit and base of the eastern disposal pits). All subsurface samples collected from borehole 12 will be analyzed for PCBs. (See Section 4.10, Table 4.11-1, and Table 4.13-1 in Attachment 2 and Comment Response 10). The Laboratory believes the closest potential source of dioxins/furans is from the incinerator (salamander) waste oil burning that occurred at MDA T. If the chemicals are only detected in close proximity to the burning location at MDA T because of the limited mobility of dioxins and furans, there will be low potential for detection at MDA A. Because of the complexity of the field analytical screening procedure for dioxin, the Laboratory is not proposing to perform this screening. However, based on the NMED comment, the Laboratory proposes to perform dioxin/furan analyses on native soil samples representing the former MDA A landfill surface (samples collected from the native soil directly beneath the cover/fill as determined from hand augering through the material). In addition, the Laboratory proposes to perform dioxin/furan analyses on samples collected from the depth interval corresponding to the base of each waste unit (central disposal pit and eastern disposal pits) from boreholes adjacent to the waste units (boreholes 2 through 10 and borehole 12). In addition, borehole 12, which is located directly adjacent to the central disposal pit and between the two eastern pits (Figure 4.4-1, Attachment 2), will be drilled to the Cerro Toledo interval and is most likely to encounter possible migrated contaminants. All subsurface samples collected from borehole 12 will be analyzed for full analytical suites as described above including total iodide and radionuclide analyses. In addition to sample intervals selected based upon field screening and field analytical screening results, samples in borehole 12 will be collected from (1) the base of the eastern pits, (2) the base of the central pit, (3) the highest permeability zone, and (4) the total depth of the borehole.

NMED Comment

8. Section 5.0 Investigation Methods, page 27:

NMED Comment: The Permittees must provide a brief description of each cited SOP in accordance with Section IX.A, Standard Operating Procedures in the Consent Order. The description must include sufficient details of all investigation, sampling and analytical methods in order for NMED to evaluate their use.

LANL Response

8. Table 5.0-1 has been replaced with a bulleted list of ENV-ECR QPs and SOPs in Section 5.0 of the work plan. A new Table 5.0-1 provides a brief summary of the field investigation methods identified in this work plan. This table includes modifications for a similar table in the DP Site aggregate area work plan. See Attachment 2.

NMED Comment

9. Section 5.6 Collection of Pore-Gas Samples for Tritium Analyses, page 31:

Permittees' Statement: "Pore-gas samples for tritium analyses will be collected in conjunction with samples for VOC analyses from two depths in all proposed boreholes."

NMED Comment: In deeper boreholes the Permittees may need to collect more than two samples in order to satisfy the requirements of two samples for every 100 ft.

LANL Response

9. Pore-gas samples (in lieu of core samples) will be collected from each of the boreholes for analysis of tritium at the same depth interval that is collected for VOCs pore gas analysis. Pore-gas samples will be collected for tritium and VOCs analyses at each depth interval collected for core analyses at an off-site laboratory, with a minimum of 6–7 samples per borehole, more than two samples per borehole proposed in the original work plan (see Tables 4.11-1 and 4.13-1).

NMED Comment

10. *Table 4.13-1, Consent Order Specifications and LANL Proposed Alternatives (Based on September 1, 2004, Draft Compliance Order on Consent), pages 77-86:*

10a) *Item: Drilling Explorations*

NMED Comment: *As an alternative to the proposed angled borehole and the adjacent vertical borehole, the Permittees shall drill three shallower angled boreholes adjacent to the General's Tanks to intersect the tuff directly beneath and between the General's Tanks. The boreholes shall be advanced to 25 feet below the deepest detected contamination, in accordance with Section IX.B.2.b.i of the Consent Order.*

LANL Response:

Three shallow, angled boreholes (BH-1 [moved], BH-14 [moved], and BH-16 [new]) will be drilled in the vicinity of the General's Tanks to intersect the tuff directly beneath the tanks. The boreholes will be advanced to 25 feet below the deepest detected contamination based upon field screening measurements. See Figure 4.4-1 and Table 4.11-1 in Attachment 2.

10b) *Item: Soil and Rock Sampling #6*

NMED Comment: *Section 2.4.1, MDA A Source of Contamination, states that, "because a complete waste inventory for MDA A does not exist, additional chemicals for potential concern (COPCs) may be identified." Based on this statement,NMED requires that the Permittees select their most contaminated sample based on field screening results and complete a full analytical suite on the selected sample. See Comment # 7 also.*

LANL Response:

The Laboratory will perform full-suite analyses (VOC analysis of pore gas in lieu of VOC analysis of core samples) on the most contaminated samples based on field screening and field analytical screening results. The Laboratory proposes to perform field analytical screening for HE (RDX and TNT) on all samples from boreholes 2 through 10. Based on the field analytical screening results, the upper 20% of the highest detections of samples from each of these boreholes will be analyzed at an off-site laboratory for explosive compounds. If there are no field analytical screening detections for HE, 20% of the samples identified for off-site analyses will be selected for explosives analysis. Field analytical screening for PCBs will be performed on all samples from boreholes adjacent to the disposal pits (boreholes 2 through 10 and borehole 12) and all detections of PCBs will be analyzed at an off-site laboratory. Boreholes 6 and 8 will have samples selected for PCB analysis at the native soil contact and from the base of the disposal units. Section 4.10 has been revised to include field analytical screening in the MDA A investigation. See Comment Response 7.

10c) *Item: Groundwater monitoring*

NMED Comment: *NMED agrees that the groundwater samples obtained from Los Alamos Canyon monitoring wells can be collected under the approved Interim Facility-Wide Groundwater Monitoring Plan due to NMED June 9, 2005. The groundwater data specified above and in Section IV.C.2.c.ix of the Consent Order, should also be documented in the MDA A Investigation Report due to NMED on August 31, 2006.*

LANL Response:

Section 6.0 and Table 4.13-1 of this work plan have been revised to state that relevant data collected under the approved "Interim Facility-Wide Groundwater Monitoring Plan" will be included in the MDA A Investigation Report. See Attachment 2.

NMED Comment

11. Table 5.0-1 Summary of Applicable SOPs and QPs, pages 87-92:

The summaries do not provide an adequate description of methods and procedures used as part of this investigation. The Table only provides a general description of the type of information found in each SOP. Section IX.A of the Consent Order requires the Permittees provide descriptions of all investigation, sampling and analytical methods and procedures with sufficient detail for NMED to evaluate the quality of the acquired data. The Permittees must resubmit the required information following the descriptions/table submitted as part of the response to the Approval with Modifications for the investigation Work Plan for the DP Site Aggregate Area.

LANL Response

11. See Comment Response 8.

NMED Comment

12. Appendix B Management Plan for Investigation Derived Waste, pages B-1 to B-4:

NMED Comment: If the Permittees are contemplating using an area of contamination (AOC) then NMED requires the Permittees to submit a request to NMED for approval of an AOC designation and use. The approval of this work plan is not an approval for the AOC designation. Delineation of an AOC must be reviewed and approved by NMED prior to implementation of this work plan.

EPA defines AOCs as certain discrete areas of generally dispersed contamination that can be equated to Resource Conservation and Recovery Act (RCRA) units or landfills. AOCs may be either used to consolidate waste or treat waste in-situ within the AOC without triggering RCRA requirements. Neither of these actions is proposed at MDA A. NMED has therefore determined the Permittees are not applying the AOC concept properly to this site.

The Permittees must provide a detailed description of the methods and procedures used to characterize the waste streams. As stated in section IX.A of the Consent Order, the Permittees cannot substitute a reference to their SOPs and website for a description of procedures.

Whether the waste is RCRA hazardous or low-level only, the Permittees may not return environmental media to the point of origin because, by doing so, the Permittees may change the hydraulic characteristics of the unit(s) and may provide a conduit for contaminant migration. All boreholes must be properly plugged and abandoned following Section X.D of the Consent Order. If the Permittees are requesting a "no longer contained-in" determination for contaminated media, each sample collected must be analyzed for Appendix VIII constituents (40 CFR Part 261) and the results must be submitted to NMED before a "contained-in" determination can be made. Furthermore, if the Permittees plan to use existing data to characterize IDW, then associated QA data must be provided in conjunction with existing data.

LANL Response

12. Attachment 2 to this response contains the revised IDW Management Plan. The revisions include removal of text related to the area of contamination. Additional details on the procedures to characterize the waste streams have been included. The Laboratory had not proposed returning environmental media to the point of origin in the MDA A investigation work plan submitted in January, 2005, (Section 5.8) and all boreholes were originally proposed for plugging and abandonment utilizing a tremie pipe and a bentonite/grout mixture consistent with §X.D of the Consent Order. IDW characterization will be achieved through existing data and/or documentation, direct sampling of the IDW, or sampling of the media being investigated (e.g., surface soil and subsurface soil). If sampling is necessary, it will be described in the Waste Characterization and Strategy Form.

NMED Comment

13. HIR Section 2.2.1 The General's Tanks, page 2-3:

NMED Comment: The Permittees must provide more clarification as to how the General's Tanks received rainwater in 1985. Also, the Permittees must provide documents referenced in regards to the General Tanks receiving rainwater, specifically: DOE, 1987 (08664) and Balo and Warren, 1982 (07205).

LANL Response

13. The Department of Energy (1987, 08664) states there is some evidence that rainwater has been leaking into the tanks since the recovery operations. Further information in a memo written by William C. Francis (Francis 1997, 76126) describes the 16-in.-diameter holes that were cut into the top of each tank to allow the drainage of the tanks to Building 21-257. These holes were left open and rainwater that may have entered the holes was pumped out of the tanks on an as-required basis. When the holes were backfilled around 1979, the steel plate covers over the 16-in.-diameter openings were not welded to the tanks nor were the holes in the concrete slab patched and sealed before the backfilling operation started. This additional information about rainwater infiltrating the General's Tanks has been added to Section 2.2.1 of the HIR. Revised pages of the Section 2.2.1 of the HIR are provided in Attachment 3.

    Because the aforementioned DOE document (DOE 1987, 08664) has been previously submitted to NMED and because of the large size of the document, only copies of pages relevant to MDA A and referenced in the work plan have been provided with this response. These pages are provided in Attachment 4. A copy of Balo and Warren (1982, 07205) was provided in Volume 1A of the main reference set for TA-21, and therefore was not included in the MDA A supplemental reference set. However, an additional copy of Balo and Warren (1982, 07205) is provided in Attachment 5.

Attachment 1

Cross-Reference of NMED NOD Comment (June 1, 2005)
And Revisions to the Investigation Work Plan for MDA A

Table 1
Cross-Reference of NMED NOD Comments (June 1, 2005) and Revisions to the Investigation Work Plan for MDA A, LA-UR-05-0094 and Historical Investigation Report, LA-UR-05-0095 [1,2]

NMED NOD Comment No.	MDA A Investigation Work Plan Comment Reference	Page(s) Revised (Original)[3]	Page(s) Revised (Draft)	Nature of Work Plan Revision
General Comments				
1	No revision required.	n/a	n/a	n/a
2	No revision required.	n/a	n/a	n/a
Specific Comments				
1	Section 4.2 Soil and Sediment Sampling and Analysis (Unnumbered)	21	21, 22	Text added to Section 4.2 to specify objectives of cover/fill material sampling.
		24	25	Text added to Section 4.6 to specify objectives of cover/fill material sampling and methodology. Table 4.11-1 footnote.
2	No revision required.	n/a	n/a	n/a
3	Section 4.8, Perched Water Sampling	24	26	Text in Section 4.8 corrected to reference Section 5.7.
	Section 5.7, Collection of Perched Water Samples	31	44	Text revised in Section 5.7 to reference the requirements of §IV.C.2.c.vii of the Consent Order.
4	Revision identified in Specific Comment No. 1	2	2	Text in Section 2.1 corrected for 1987 cover maintenance event.
		21	21, 22	Text in Section 4.2 has been revised to clarify how the cover/fill unit will be sampled and the sampling objectives.
		24	25	Text in Section 4.6 has been revised to clarify how the cover/fill will be sampled and characterized.
		74	74	Table 4.6-1 has been revised to include only nine sample locations based on new and relocated borehole locations.
		75, 76	75, 76	Table 4.11-1 has been revised to include surface sampling depth only (subsurface samples are now included in borehole sample summaries).

Table 1 (continued)

NMED NOD Comment No.	MDA A Investigation Work Plan Comment Reference	Page(s) Revised (Original)[3]	Page(s) Revised (Draft)	Nature of Work Plan Revision
5	Section 4.7, Subsurface Vapor Monitoring	24,26, 30, 31	25, 27–29, 34, 35	Text revised in Section 4.7 to indicate that all tritium samples will be collected from the same depth intervals as VOC samples and references Section 5.5 and 5.6 regarding the investigation methods. Sections 4.11.2 and 5.5 state that the subsurface vapor monitoring is compliant with the requirements of §IX.B.2.g of the Consent Order.
6	Section 4.9, Field Screening 4.9.3 Radioactivity	25	36	Text revised in Section 4.9 to specify equipment used for radiological screening. Radionuclides relevant to MDA A are included as gross alpha, beta, and/or gamma radiation emitters.
		27, 29	33	Radiological screening methodology, procedures, and QA/QC protocol have been added to Section 5.2, Collection of Tuff Samples.
7	Section 4.11.1, Tuff, Soil and Sediment Samples	vi	vi	Text revised in Executive Summary to indidcate VOC vapor sample collection.
		21	21	Text revised in Section 4.2 to include field analytical screening for HE (RDX and TNT) and PCBs.
		21	21,22	Text in Section 4.2 revised to indidcate pore=gas sampling for VOCs in place of fixed lab samples.
		25	27	Text in Section 4.10 revised to include field analytical screening for HE (RDX and TNT) and PCBs for sample selection and analyses at off-site laboratories.
				Section 4.10.1, HE Field Analytical Screening and Section 4.10.2, PCB Field Analytical Screening added to work plan.
		25, 26	27, 28	Text revised in Section 4.11.1, Tuff, Soil, and Sediment Samples to include field analytical screening of samples for HE (RDX and TNT) and PCBs for sample selection. Text has been added for additional analytical methods (explosive compounds, PCBs, and dioxins/furans).

Table 1 (continued)

NMED NOD Comment No.	MDA A Investigation Work Plan Comment Reference	Page(s) Revised (Original)[3]	Page(s) Revised (Draft)	Nature of Work Plan Revision
7 (continued)		27	30	Text in Section 4.13 has been revised to reflect additional analytical methods (explosive compounds, PCBs, and dioxins/furans).
		28	32	Text in Section 5.1 has been revised to reflect additional analytical methods (for explosive compounds, PCBs, and dioxins/furans).
		28	32, 33	Text in Section 5.2 has been revised to reflect additional analytical methods (for explosive compounds, PCBs, and dioxins/furans).
		75, 76	75, 76	Table 4.11-1 has been revised to reflect additional analytical methods (explosive compounds, PCBs, and dioxins/furans).
		77–86	80–82	Table 4.13-1, Consent Order Specifications and LANL Proposed Alternatives, Soil and Rock Sampling and Sediment Sampling. Item 2 has been revised to include HE (RDX and TNT) screening and PCBs screening. Item 6 has been revised to include expanded analytical suites including explosive compounds, PCBs, and dioxins/furans.
8	Section 5.0, Investigation Methods	27	30, 31	Table 5.0-1 has been replaced with a bulleted list of ENV-ECR QPs and SOPs in Section 5.0 of the work plan. Table 5.0-2 has been added to provide a brief description of the field investigation methods described in this work plan.
9	Section 5.6, Collection of Pore-Gas Samples for Tritium Analyses	31	44	Text revised to indicate that all tritium samples will be collected from same depth intervals as VOC samples.

Table 1 (continued)

NMED NOD Comment No.	MDA A Investigation Work Plan Comment Reference	Page(s) Revised (Original)[3]	Page(s) Revised (Draft)	Nature of Work Plan Revision
10	Table 4.13-1, Consent Order Specifications and LANL Proposed Alternatives Item: Drilling Explorations	vi	vi	Text revised in Executive Summary to reflect additional boreholes.
		21	21	Text revised in Section 4.2 to reflect additional borehole and one relocated borehole. Number of cover/fill samples updated (collected in conjunction with borehole drilling within perimeter fence).
		23	23, 24	Text revised in Section 4.4 to reflect additional borehole and relocated borehole.
		28	32	Text revised in Section 5.1 to reflect additional borehole and relocated borehole.
		61	n/a	Figure 4.4-1 revised to show new and relocated boreholes.
		62	n/a	Figure 4.4-2 revised per relocated borehole locations.
		75, 76	75, 76	Table 4.11-1 revised to show new borehole sampling and analysis.
		78	78	Table 4.13-1 revised to reflect additional borehole locations. Note: no revisions were made to Appendix B of the IDW Management Plan as total footage proposed (volume of IDW drill cuttings generated) is comparable.
	Table 4.13-1, Consent Order Specifications and LANL Proposed Alternatives Item: Soil and Rock Sampling #6	21	21	Text revised in Section 4.2 to include field analytical screening for HE (RDX and TNT) and PCBs.
		25	27	Section 4.10.1, HE Field Analytical Screening and Section 4.10.2, PCB Field Analytical Screening added to work plan.
		26	28	Text revised in Section 4.11.1, Tuff, Soil, and Sediment Samples to include field screening of samples for explosive compounds and PCBs for sample selection. Text has been added for additional analytical methods (explosive compounds, PCBs, and dioxins/furans).

Table 1 (continued)

NMED NOD Comment No.	MDA A Investigation Work Plan Comment Reference	Page(s) Revised (Original)[3]	Page(s) Revised (Draft)	Nature of Work Plan Revision
10 (continued)		27	30	Text in Section 4.13 has been revised to reflect additional analytical methods (explosive compounds, PCBs, and dioxins/furans).
		28	32	Text in Section 5.1 has been revised to reflect additional analytical methods (for explosive compounds, PCBs, and dioxins/furans).
		29	33	Text in Section 5.2 has been revised to reflect additional analytical methods (for explosive compounds, PCBs, and dioxins/furans).
		75, 76	75, 76	Table 4.11-1 has been revised to reflect additional analytical methods (explosive compounds, PCBs, and dioxins/furans).
		77–86	80-82	Table 4.13-1, Consent Order Specifications and LANL Proposed Alternatives, Soil and Rock Sampling and Sediment Sampling. Item 2 has been revised to include explosives screening and PCBs screening. Item 6 has been revised to include expanded analytical suites including explosive compounds, PCBs, and dioxins/furans.
	Table 4.13-1, Consent Order Specifications and LANL Proposed Alternatives Item: Groundwater monitoring	32	36	Text revised in Section 6.0, Ongoing Monitoring and Sampling Program to state that data collected under the approved Interim Facility-Wide Groundwater Monitoring Plan will be included in the MDA A IR.
		85	86	Table 4.13-1 revised to state that data collected under the approved Interim Facility-Wide Groundwater Monitoring Plan will be included in the MDA A IR

Table 1 (continued)

NMED NOD Comment No.	MDA A Investigation Work Plan Comment Reference	Page(s) Revised (Original)[3]	Page(s) Revised (Draft)	Nature of Work Plan Revision
11	Table 5.0-1, Summary of Applicable SOPs and QPs	n/a	94–96 (new)	New Table 5.0-1 is included to provide a brief description of the field investigation methods. The table includes methods from response to approval with modifications for the DP Site Aggregate Area to include radiological screening information.
12	Appendix B Management Plan for Investigation Derived Waste, pages B-1 to B-4:	All of Appendix B	All of Appendix B	Appendix B revised to remove AOC designation language, revise waste characterization methods, and remove "no longer contained-in" discussion. No environmental media will be returned to the MDA A site.
13	HIR Section 2.2.1, The General's Tanks	3 (HIR)	3 (HIR)	Text revised in Section 2.2.1 to add clarification on nature of rainwater entering the General's Tanks based upon Francis 1997 (76126).
		16 (HIR)	17 (HIR)	Citation added to reference section. Documents requested DOE 1987 (08664) [relevant pages only]; Balo and Warren 1982 (07205); and Francis 1997 (76126) are provided in Attachments 4, 5, and 6, respectively.

[1]This cross-walk reflects work plan changes in response to NMED comments and the Consent Order requirements. Minor editorial changes made to the work plan document have not been included in this table.

[2]Page 1, Introduction, is revised to reflect the approved Compliance Order on Consent (not an NMED comment).

[3]Revised pages reflect the original work plan pages submitted to NMED in January 2005 document (LA-UR-05-0094).

n/a=not applicable

Attachment 2

Investigation Work Plan for MDA A
Revised Text, Figures, Tables, and Appendices

LA-UR-05-0094
January 2005
ER2004-0561

Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014

Los Alamos
NATIONAL LABORATORY
EST. 1943

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Prepared by
Environmental Stewardship–Environmental Remediation and Surveillance~~ervices~~

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LA-UR-05-0094
ER2004-0561

Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014

January 2005

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EXECUTIVE SUMMARY

This investigation work plan presents an approach for characterizing potential contamination at Material Disposal Area (MDA) A, Solid Waste Management Unit (SWMU) 21-014, which is located within Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory) in Los Alamos, New Mexico. The investigation activities proposed herein are required under the Compliance Order on Consent and are ~~Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) process, which is~~ currently being conducted by the Laboratory's Environmental Stewardship–Environmental Remediation and Surveillance~~ervices~~ Program~~project~~ (formerly the Environmental Restoration Project).

MDA A is a Hazard Category 2 nuclear facility comprised of a 1.25-acre fenced and radiologically controlled area situated on the east end of Delta Prime (DP) Mesa. It is bounded by DP Canyon to the north and Los Alamos Canyon to the south. Historically used to dispose of wastes generated during TA-21 operations, MDA A currently contains the features described below.

- Two storage tanks (referred to as *the General's Tanks*) that were buried within the MDA. They contain residual sludge from waste solutions contaminated with plutonium-239/240 and americium-241.
- Two vertical shafts that were drilled to clarify rinse water generated by cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. The General's Tanks were never filled with cement paste so the vertical shafts were not used. The vertical shafts were filled with soil in 1977.
- Two eastern pits that contain solid waste potentially contaminated with polonium, plutonium, uranium, thorium, and other unidentified chemicals associated with Laboratory operations.
- One central pit that contains TA-21 decontamination and decommissioning debris potentially contaminated with radionuclides.
- A former surface storage area that was used to store drums of sodium hydroxide solution and stable iodine contaminated with plutonium and possibly uranium.

Based on the MDA A historical data review, there is evidence that radionuclide and inorganic chemicals are potentially present within MDA A, in both the surface and subsurface, at concentrations above background and fallout values. Of primary concern are plutonium-238, plutonium-239/240, uranium-235, depleted uranium, americium-241, and metals. The presence of organic chemicals is unknown. The DP Canyon hillslope north of MDA A may have been influenced by historic operations at ~~solid waste management units~~SWMUs 21-011(k), 21-004(b)-99, and 21-024(h), as well as potential releases from MDA A. In addition, soils at MDA A may have been affected by a tritium plume(s) associated with historic operations at DP East and the Tritium System Test Assembly Facility.

The data requirements, as determined from the historical data review and outlined in this plan, include field surveys and surface and subsurface sampling to define the lateral and vertical extent of contamination at MDA A. The investigation activities presented in this plan have been designed to address these data requirements. The activities include

- a site-wide radiation mapping survey to document the current surface conditions of the site and to help focus surface sample collection activities. Due to the ubiquitous low levels of radionuclides present in the soils within and surrounding TA-21 and the chemicals historically associated with MDA A, both the MDA A disposal area and the DP Canyon slope immediately north of MDA A (the area of influence) will be surveyed for beta and gamma radiation coupled with a global positioning system unit.

- subsurface characterization sampling to obtain analytical data needed for characterizing potential releases from MDA A. Samples will be collected from ~~1~~3 angled and 13~~14~~ vertical boreholes that are proposed for locations around and beneath the MDA A tanks, pits, and shafts. The boreholes will be continuously cored down to a point below the base of the target waste unit, to a vertical depth 25 ft below the last field-screening detection. A minimum of six samples from each borehole will be submitted for analysis. Vapor samples will be collected from each borehole~~for volatile organic compounds and tritium~~. The presence of perched water and bedrock fractures will also be evaluated in the one deep borehole (the borehole will penetrate the Cerro Toledo interval within the Bandelier Tuff).
- surface characterization sampling to obtain data needed for characterizing the nature and extent of potential contamination on the DP Canyon slope immediately north of MDA A and the MDA A cover. At least 25~~4~~ locations will be sampled. To capture surface flow runoff generated from the MDA A site, characterization sampling will target areas of deposition along existing drainages. Sampling will also be performed at select historical RFI sample locations to determine if the historical data are representative of the existing site.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the US Department of Energy (DOE) and managed by the University of California. The Laboratory is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 30 mi northwest of Santa Fe. The Laboratory covers 40 mi^2 of the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons containing perennial and intermittent streams running from west to east. Mesa tops range in elevation between 6200 ft and 7800 ft above sea level (asl).

The Laboratory's Environmental Stewardship–Environmental Remediation and Surveillance~~Services~~ (ENV-ERS) Program~~project~~, formerly the Environmental Restoration (ER) Project, is participating in a national effort by the DOE to clean up sites and facilities formerly involved in weapons research and development. The goal of the ENV-ERS Progam~~project~~ is to ensure that past operations under the DOE do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, the ENV-ERS Program~~project~~ is currently investigating sites potentially contaminated by past Laboratory operations. The sites under investigation are designated as either solid waste management units (SWMUs) or areas of concern (AOCs).

The SWMU addressed in this investigation work plan, SWMU 21-014, is potentially contaminated with both hazardous and radioactive components. Depending upon the type(s) of contaminant(s) present and the history of the site, either the New Mexico Environment Department (NMED) or the DOE has administrative authority (AA) over the work performed by the ENV-ERS project at the site. Under the New Mexico Hazardous Waste Act, NMED has authority over cleanup of sites with hazardous waste or certain hazardous constituents, including the hazardous waste portion of mixed waste (i.e., waste containing both radioactive and hazardous constituents). The DOE has authority over cleanup of sites with radioactive contamination. Radionuclides are regulated under DOE Order 5400.5, "Radiation Protection of the Public and the Environment," and DOE Order 435.1, "Radioactive Waste Management."

Corrective actions at the Laboratory are subject to the Compliance~~an~~ Order on Consent (hereafter, the Consent Order) entered into on March 1, 2005 by ~~the~~ NMED~~-~~, ~~the~~ DOE, the Regents of the University of California, and the State of New Mexico Attorney General. ~~(NMED 2005, 88027)~~ The Consent Order was drafted~~issu~~ed pursuant to the New Mexico Hazardous Waste Act (HWA), NMSA 1978, § 74-4-10, and the New Mexico Solid Waste Act (SWA), NMSA 1978, § 74-9-36(D). This work plan describes proposed work activities that will be executed and completed in accordance with the Consent Order ~~(NMED 2005, 88027)~~.

~~NMED enforces the Hazardous and Solid Waste Amendments Module of the Laboratory's Hazardous Waste Facility Permit, hereafter referred to as Module VIII. Module VIII specifies the conditions and requirements for investigation and cleanup activities at the Laboratory. The US Environmental Protection Agency (EPA) issued Module VIII on May 23, 1990, and revised it on May 19, 1994 (EPA 1990, 01585; EPA 1994, 44146). NMED is currently revising the Hazardous Waste Facility Permit.~~

~~In accordance with Module VIII, the nature and extent of releases of hazardous waste or hazardous constituents are determined through the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) process.~~

1.1 General Site Information

Material Disposal Area (MDA) A is a Hazard Category 2 nuclear facility (DOE 2003, 87047) comprised of a 1.25-acre fenced and radiologically controlled area situated on the east end of Delta Prime (DP) Mesa.

It is bounded by DP Canyon to the north and Los Alamos Canyon to the south. Figure 1.1-1 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 on Figure 1.1-2. Historically used to dispose of wastes generated during TA-21 operations, MDA A currently contains the features described below:

- Two storage tanks (referred to as *the General's Tanks*) that were buried within the MDA. They contain residual sludge from waste solutions contaminated with plutonium-239/240 and americium-241.
- Two vertical shafts that were drilled to clarify rinse water generated by cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. The General's Tanks were never filled with cement paste so the vertical shafts were not used. The vertical shafts were filled with soil in 1977 (Shaw Environmental, Inc. 2004, 87448).
- Two eastern pits that contain solid waste potentially contaminated with polonium, plutonium, uranium, thorium, and other unidentified chemicals associated with Laboratory operations.
- One central pit that contains TA-21 decontamination and decommissioning debris potentially contaminated with radionuclides.
- A former surface storage area that was used to store drums of sodium hydroxide solution and stable iodine contaminated with plutonium and possibly uranium.

The relative locations of the General's Tanks, the vertical shafts, the pits, and the former drum storage area with respect to the MDA A fence line, additional site features, topography, and other SWMUs/AOCs are shown in Figure 1.1-3.

1.2 Investigation Objectives

The objectives of this investigation are (1) to determine the nature and extent of contamination at the site, and (2) to provide general site characterization data for the evaluation of remedial alternatives.

To help achieve these objectives, this investigation work plan will

- identify additional characterization data requirements based upon a review of MDA A historical data;
- establish the rationale for characterization data collection and analysis; and
- identify appropriate methods and protocols for collecting and analyzing samples to finalize the characterization of MDA A.

2.0 MDA A BACKGROUND

This section summarizes the historical and current characteristics of MDA A. The historical investigation report (HIR) presents a review of MDA A's structural and operational history (LANL 2005, 87452).

2.1 Site Description and Operational History

TA-21 is comprised of two operational areas, DP West and DP East, both of which produced liquid and solid radioactive wastes. Operations at DP West included plutonium processing, and operations at DP East included production of weapons initiators. MDA A was first used to bury solid waste that

potentially contained polonium, plutonium, uranium, thorium, and other unidentified chemicals. This solid waste was placed in the pits at the eastern end of MDA A between 1945 and July of 1946. Liquid waste was stored in the General's Tanks at the western end of MDA A between 1945 and 1983, pending future improvement in the extraction process for recovery of plutonium. On December 3, 1975, two vertical shafts were excavated (McGinnis 1976, 00954). In 1969, the central pit was excavated to receive decontamination and decommissioning debris from TA-21 (Meyer 1971, 00557). The central pit was enlarged in 1972 and was used until late 1977 (Desilets 1972, 00484). MDA A was decommissioned in May 1978 and a crushed tuff cover was placed over the entire site in 1985 (Gerety et al. 1989, 06893, p. 3). Site stabilization activities such as removing surface contamination, adding cover material, recontouring, and reseeding were performed in 1985 (Gerety et al. 1989, 06893, p. 4). In 1987, isolated areas at MDA A were reseeded and fertilizer was applied. Gravel mulch was also spread on the north side (Salazar 1987, 00491)~~. Additional cover material was added in 1987 (Salazar 1987, 00491; Gerety et al. 1989, 06893, p. 4)~~.

2.1.1 General's Tanks

In 1945, two 50,000-gal. cylindrical steel tanks (the General's Tanks) were buried at the west end of MDA A (Figures 1.1-3 and 2.1-1) to receive waste solutions containing plutonium-239/240 and americium-241. Liquid waste was to be stored until improved chemical recovery methods could be developed for extracting and recovering plutonium-239/240. A Los Alamos Scientific Laboratory (LASL) engineering drawing, ENG-C-2076, shows the two cylindrical tanks as 12 ft in diameter and 62 ft 10 in. long (LASL 1945, 24448). The tanks were placed on concrete piers that extend approximately 1 ft above the bottom of the excavation. The tanks were buried approximately 20 ft apart in excavations approximately 12 ft deep, 15 ft wide, and 86 ft 10 in. long. An 8-in.-thick concrete pad was poured over the top of the tanks. The pad is 58 ft wide and 68 ft 10 in. long. A 5-ft-high earthen berm was placed on top of the concrete pad to form a mound from 2.25 to 5.75 ft above grade (Figure 2.1-1).

Liquid waste was eventually removed from the tanks in 1975 and 1976 (McGinnis 1976, 00954). An unknown volume of sludge remains in the bottom of the tanks.

2.1.2 Vertical Shafts

In 1975, two 4-ft-diameter vertical shafts were excavated to a depth of approximately 65 ft, south of the General's Tanks (Figure 1.1-3) (Warren 1976, 00508; McGinnis 1976, 00954). The shafts were drilled to clarify rinse water generated by cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. There were plans to coat the shafts with asphalt (Warren 1976, 00508), but the plans were not implemented (Shaw Environmental, Inc., 2004, 87448). The General's Tanks were never filled with cement paste, so the vertical shafts were not used. In 1977, the vertical shafts were filled with soil (Shaw Environmental, Inc., 2004, 87448). The locations of the two vertical shafts are illustrated in ENG-R-4457 (LASL 1976, 24891).

2.1.3 Eastern Pits

In 1945, the eastern pits were excavated into Unit 3 of the Tshirege Member of the Bandelier Tuff to receive radioactive solid waste from DP East (Bolton 1952, 00555). The location of the eastern pits is shown on Figure 1.1-3. Early engineering drawings (ENG-1266 [LASL 1970, 24374]; ENG-C-2076 [LASL 1945, 24448]) indicate the pits to be approximately 18.0 ft wide by 125 ft long by 12.5 ft deep. In 1946, after the pits were full, crushed Bandelier Tuff was used to backfill and cover the pits.

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 being conducted at TA-21 (Figure 1.1-3). In a memo dated November 9, 1972 (Desilets 1972, 00484), the pit was reported to be 40 ft long and wide and 22 ft deep. A request was made to enlarge the existing central pit (Desilets 1972, 00484) to provide approximately 6000 yd^3 of additional burial space for building materials from Building 21-012 at TA-21 (Desilets 1972, 00484). An engineering drawing from May 1976 shows the pit to be 172 ft long by 134 ft wide (LASL 1976, 24891).

In July 1972, exhaust ductwork from Building 21-005 was placed in the west end of the pit, covered with about 1 ft of dirt, and then the ductwork was crushed (Enders 1972–1975, 00514, p. 2). Between February and July of 1973, the pit received plutonium-contaminated building debris from the demolition of Building 21-012 (Christensen et al. 1975, 05481, pp. 6–7). 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 pit until late 1974, when demolition work was completed. However, waste of an unspecified nature was placed in the unfilled parts of the pit (LANL 1991, 07529, p. 16-244) until 1977 when 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 associated with the waste. The pit was decommissioned in May 1978 when a soil cover (crushed tuff) was placed over the pit (Environmental Surveillance Group 1985, 06610, p. 66).

In 1985, final site-stabilization activities for the MDA A cover were conducted (Gerety et al. 1989, 06893, p. 4). These included removing surface contamination, adding cover material, recontouring, and reseeding. Additional soil was placed on the site again in 1987 (Salazar 1987, 00491).

2.1.5 Former Drum Storage Area

Emelity (1978, 00487) refers to the storage of several hundred 55-gal. drums containing iodide waste on the surface at the east end of MDA A in the late 1940s and early 1950s. The stored drums can be seen at the east end of MDA A on a 1949 aerial photograph and on a subsequent 1950 photograph (LANL 2005, 87452, Figure 2.2-3). These drums contained sodium hydroxide (NaOH) solution and stable iodine, which were used to scrub ventilation exhaust air that contained plutonium and possibly uranium (LANL 1991, 07529, p. 16-244). Corrosion of the drums resulted in liquid releases to the surface soil at MDA A (Emelity 1978, 00487).The drums were removed in 1960 and the storage area was paved.

2.2 Relationship to Other SWMUs and AOCs

MDA A is one of five MDAs at TA-21 that received wastes from TA-21 operations. The five are MDA A (SWMU 21-014), MDA B (SWMU 21-015), MDA T [SWMU 21-016(a)-99], MDA U [SWMU 21-017(a)-99], and MDA V [SWMU 21-018(a)-99] (Figure 1.1-2). In addition to MDA T, which is located west of MDA A, SWMUs and AOCs in the vicinity of MDA A include 21-004(b)-99, 21-011(b), 21-011(k), 21-012(a), 21-012(b), 21-024(h), 21-025(a), C-21-005, C-21-023, and C-21-026 (Figure 1.1-3). Of these, SWMUs 21-004(b)-99 and 21-011(b) are active sites and not currently under investigation or corrective action. SWMU 21-011(k) has been remediated. SWMUs/AOCs 21-012(a), 21-025(a), C-21-023, and C-21-026 have been approved for no further action (NFA). SWMUs 21-012(b) and 21-024(h) are included in the DP Site Aggregate Area work plan (LANL 2004, 87461). C-21-005 is included in the investigative

work plan for MDA T (LANL 2004, 85641). Unless otherwise cited, brief descriptions of these SWMUs and AOCs are excerpted from the database and the "TA-21 Delta Prime Site Aggregate Area Work Plan" (LANL 2004, 87461) and are provided below. Locations of the SWMUs and AOCs with respect to MDA A are presented in Figure 1.1-3.

2.2.1 SWMU 21-004(b)-99

Consolidated SWMU 21-004(b)-99 is an active site consisting of two aboveground stainless-steel tanks located within an asphalt berm and a drainline from a sump pump to the outfall area in DP Canyon. The sump pump is connected to the TA-21 acid waste line, which carries wastewater produced at DP East to the TA-21 wastewater treatment plant (Building 21-257). Historically, waste may have been contaminated with tritium, polonium, actinium, plutonium, uranium, thorium, and mercury.

2.2.2 SWMU 21-011(b)

SWMU 21-011(b) is a currently active sump (Structure 21-223) located approximately 400 ft east of the TA-21 wastewater treatment plant (Building 21-257). The sump was installed in 1965 and transports wastewater from DP East to the wastewater treatment plant through a 3-in. cast-iron line. The waste is stored in two tanks (Structures 21-110 and 21-111) located immediately west of Building 21-257, treated in this wastewater treatment plant, and subsequently transported by truck to either TA-43 or TA-50, depending upon waste composition. The sump receives wastewater from Buildings 21-152, 21-155, and 21-209, through 6-in. cast-iron drainlines. The sump may have discharged to DP Canyon through a drainpipe before the installation of two 3000-gal. holding tanks [Structure 21-346, SWMUs 21-004(b) and 21-004(c)] that serve as emergency storage if the sump becomes inoperative or overflows. The holding tanks and outfall are designated as SWMU 21-004(b)-99.

2.2.3 SWMU 21-011(k)

SWMU 21-011(k) is the outfall discharge line that carried industrial wastewater from the two holding tanks (21-112 and 21-113) associated with the industrial wastewater treatment plant (Building 21-257) to a discharge point on the south slope of DP Canyon. The outfall is no longer active. The liquid waste remaining after treatment potentially contained a variety of radioactive and chemical constituents. Untreated waste from the former industrial wastewater treatment plant (former Building 21-35) was also discharged to the area of the outfall.

An interim action was completed in 1997 to remove a portion of the outfall area and to install stormwater control measures as a best management practice (LANL 1997, 55648). A voluntary corrective measure was conducted in 2003 to reduce concentrations of cesium-137 and americium-241. The voluntary corrective measure activities included excavating part of the outfall drainline and contaminated soil, tuff, and sediment; disposing of the drainline and contaminated material at Area G within TA-54; restoring the site; and installing stormwater run-on and runoff controls (LANL 2003, 82260, pp. 11-28).

2.2.4 SWMU 21-012(a)

SWMU 21-012(a) is identified as a dry well inside Building 21-357, the new TA-21 steam plant. The SWMU report (LANL 1990, 07512) also identified another dry well [SWMU 21-012(b)] associated with the former steam plant, Building 21-9. The former steam plant at TA-21 was torn down in 1985 and replaced with a new steam plant that went on-line in 1985. During two site visits (May 11, 1990, and August 8, 1990), investigating personnel found no indications of a dry well anywhere within the interior of the new

steam plant. The discrepancy is attributed to the assumption that the new steam plant installation included a system similar to that of the former steam plant that contained dry well SWMU 21-012(b). SWMU 21-012(a) was approved for NFA by the AA and removed from the Laboratory's Hazardous Waste Facility Permit on December 23, 1998 (NMED 1998, 63042).

2.2.5 SWMU 21-012(b)

The former steam plant at TA-21 began operation in 1945, was torn down in 1985, and replaced with a new steam plant that went on-line in 1985 (LANL 2004, 87461). SWMU 21-012(b) is an inactive dry well that received boiler blow-down from the former steam plant (Building 21-9) from 1980 to 1985. The well, which is 4 ft long by 4 ft wide by 54 ft deep, was installed south of the 2500-gal. blow-down tank to replace a seepage pit. A 3-in. perforated pipe was suspended vertically into the dry well to a depth of 49 ft. The space surrounding the perforated pipe was filled with large gravel. Underground piping connected the well and the blow-down tank. When the former steam plant was removed and replaced by the new steam plant (Building 21-357), the area was regraded. There is no visible evidence of the former steam plant or of the concrete manhole cover for the dry well. At the time the Operable Unit (OU) 1106 RFI work plan was written (LANL 1991, 07529), it was unclear if underground piping from the 2500-gal. tank had been removed during the demolition of Building 21-9. The dry well may have remained, as is evidenced by an area of pavement that remains frost- and ice-free except after heavy snows or very cold temperatures. Although no data exist regarding potential contamination in the area of the former steam plant dry well, common constituents in boiler blow-down include sulfite, copper salts, and chromates. No contaminant releases from the dry well and related structures have been documented. The SWMU is currently proposed for a removal action under the DP Site Aggregate Area work plan (LANL 2004, 87461, p. 109).

2.2.6 SWMU 21-024(h)

SWMU 21-024(h) is a septic system that discharged sewage from an administrative building and shop (Building 21-151) through a septic tank (Structure 21-163) to the surface on the north rim of DP Mesa above DP Canyon (Engineering Drawing ENG-C-2213 [LASL 1945, 24459]). The system was constructed in 1945, later became inactive, and was left in place in 1966 (LANL 1991, 07529, p. 15-94). Above-background concentrations of americium-241, tritium, and plutonium-239/240 were associated with this SWMU. In 1996, a voluntary corrective action was conducted which included regrading, reseeding, and restoring the area to its original site conditions. The site is proposed for additional corrective action in the DP Site Aggregate Area work plan (LANL 2004, 87461, p. 109).

2.2.7 SWMU 21-025(a)

SWMU 21-025(a) is the location of a former Tritium System Test Assembly (TSTA) Facility (Building 21-155). The TSTA Facility tested tritium-control systems for the nuclear fusion program, prepared targets containing tritium for laser fusion research, and handled tritium for defense programs. Building 21-155 was completed in 1982 and operations began in 1984. The facility included an off-gas system used to vent gas containing small amounts of tritiated water after treatment. Releases from the off-gas system are identified as SWMU 21-019 (LANL 1991, 07680, p. 20-1). SWMU 21-025(a) and SWMU 21-019(a–m) were approved for NFA by the AA (EPA 2004, 87296).

2.2.8 AOC C-21-005

AOC C-21-005 is the location of a release of americium-241 and plutonium on the west side of a waste treatment plant [Building 21-257, SWMU 21-011(a)]. The spill resulted from a 1959 fire in a filter in a

former laboratory building (Building 21-5). The resulting contamination was cleaned up at that time. This AOC is included in the investigation work plan for MDA T and will be investigated along with MDA T Boreholes 6 and 9, in conjunction with Building 21-257 (LANL 2004, 85641, p. 50).

2.2.9 AOC C-21-023

AOC C-21-023 is the former location of a laboratory (Building 21-54) and its associated soil. The laboratory was demolished and disposed of at TA-54, Area G. This site was discussed in the RFI work plan for OU 1106 as one of a group of AOCs at which no documented releases had occurred or where releases had occurred but cleanup had been conducted and documented (LANL 1991, 07680, p. 19-1). A permit modification request for NFA for this AOC was submitted in 1995 and approved by the AA (EPA 2004, 87296).

2.2.10 AOC C-21-026

AOC C-21-026 is the former location of an administrative building, with shops, removed in 1966 (LANL 1991, 07680, p. 19-1). Information from the TA-21 RFI work plan indicates that AOC C-21-026 is one of several AOCs where no documented releases have occurred, or where releases have occurred but cleanup has been conducted and documented (LANL 1991, 07680, p. 19-1). Approval for NFA was granted by the AA (EPA 2004, 87296).

2.3 MDA A Area of Influence

In June 2004, field reconnaissance was conducted on the DP Canyon hillslope immediately north of MDA A to define the area of surface drainage from MDA A into DP Canyon. During this reconnaissance, topography, slope, and drainage channels (both natural and human-made) were considered while defining the area. This hillslope drainage area is designated as the MDA A “area of influence” and is shown on Figure 2.3-1. The purposes of designating the MDA A area of influence are (1) to identify all relevant historical surface and near-surface sampling locations on a geographical basis, regardless of SWMU designation within the Laboratory data management system; (2) to spatially identify analytical data needs for the DP Canyon hillslope; and (3) to bound the extent for additional near-surface sampling.

The western, eastern, and southern boundaries of the area of influence are defined based on the ground surface slope of that portion of DP Mesa. The natural slope in this area is toward the north into DP Canyon, and even though the cover material of MDA A has created a localized radial flow off the cover, all surface runoff eventually flows north once it reaches the toe of the cover. The northern border of the MDA A area of influence is approximately 15 ft from the center of the channel in DP Canyon. The channel in DP Canyon has been investigated under the approved work plan and addendum for Los Alamos and Pueblo Canyons (LANL 1995, 50290; LANL 2002, 70235). The results of the DP Canyon investigation indicated that SWMU 21-011(k) was the major contributing source of contaminants to DP Canyon (LANL 2004, 87390, p. 9-1). The investigation concluded that human health risks are within acceptable risk ranges for current-day and reasonably foreseeable future land uses in the Los Alamos and Pueblo watershed, which includes DP Canyon. In addition, adverse ecological effects were not observed within terrestrial and aquatic systems in the watershed (LANL 2004, 87390, p. 9-3).

The MDA A area of influence overlaps with the eastern portions of SWMU 21-011(k), which is located on the hillslope northwest of MDA A (Figure 2.3-1). Surface contamination associated with SWMU 21-011(k) has been remediated (LANL 2003, 82260, p. 56); therefore, any hillslope areas within the SWMU 21-011(k) boundary are not included in the MDA A area of influence. Other SWMUs, such as 21-024(h) and 21-004(b)-99, are also contained within the MDA A area of influence, near the eastern

boundary (Figure 2.3-1). Any contribution and migration of contaminants from these SWMUs to the MDA A area of influence will be considered in subsequent decision-making and will be based on historical and future data collected in support of those SWMU-specific investigations.

2.4 Conceptual Site Model

A conceptual site model (CSM) is based on the existing knowledge about a site and describes potential contaminants, environmental media to which individuals may be exposed, media through which chemicals may be transported to potential receptors, and any currently uncontaminated media that may become contaminated in the future due to contaminant migration (EPA 1989, 08021, p. 4-10). The current CSM for MDA A includes both surface and subsurface sources of potential contamination. The following subsections describe the current CSM for MDA A.

2.4.1 Source of Contamination

All contamination associated with MDA A would have originated from one of four identified waste areas: the General's Tanks, the central pit, the two eastern pits, or the former drum storage area. Potential contaminants include radionuclides, metals, and organic chemicals from the General's Tanks and eastern pits; radionuclides and metals from the central pit; and radionuclides (plutonium and uranium) contained in the NaOH solution and iodine stored in the former drum storage area. Because a complete waste inventory for MDA A does not exist, additional chemicals of potential concern (COPCs) may be identified. A list of process chemicals used at TA-21 during the operational period of MDA A (1945–1978) is provided in Table 2.4-1.

The CSM for COPCs at MDA A may be revised pending trenching of the pits at MDA B, which is scheduled to occur concurrently with the implementation of the investigation proposed in this work plan. After the MDA A eastern pits were filled and closed, the pits at MDA B were excavated to continue receiving process waste from TA-21 operations (LANL 1991, 07529, p. 16-25). Therefore, the waste at MDA A should be similar in nature to that at MDA B.

2.4.2 Transport Mechanisms

The following transport mechanisms may lead to the exposure of human and/or ecological receptors:

- Vaporization and gaseous diffusion and advection of contaminants in air
- Dissolution and/or particulate transport of surface contaminants during rainfall and snow melt runoff events, prior to placement of clean fill
- Airborne transport of contaminated surface soils, prior to placement of clean fill
- Continued dissolution and advective/dispersive transport of chemical and radiological contaminants contained in subsurface soil and bedrock
- Biotic perturbation and translocation of contaminants in subsurface waste

The four waste units at MDA A (General's Tanks, eastern pits, central pit, and former drum storage area) received solid and/or liquid waste that may have contributed to soil contamination beneath the facility. Since the pits at MDA A are unlined, there is the potential for infiltration of surface water through the cover material into the waste units. Additionally, the Bandelier Tuff at TA-21 is highly fractured, which may allow water to leach through the buried waste into the subsurface below the pits. Fractures may be

pathways for volatile organic compounds (VOCs) and tritium vapors in the subsurface, if present, through soil/gas interactions.

Additional preferential contaminant migration pathways include a paleochannel identified during previous geophysical surveys conducted at MDA A. This paleochannel, if proximal to waste units, could provide a preferential pathway for soil vapors. The paleochannel would not be likely to provide a contaminant migration pathway for groundwater because it is stratigraphically located above the MDA A waste units, occurring less than 15 ft below ground surface (bgs). The depth to groundwater at MDA A is estimated to be 1200 ft bgs (see Section 3.2.3.3).

Transport of surface contamination off-site through surface runoff or atmospheric transport from MDA A is currently a minor pathway because the site has been covered with clean fill. However, before the cover was installed, surface runoff may have migrated into DP Canyon.

2.4.3 Potential Receptors

Currently, MDA A is a radiologically controlled site with access restrictions maintained by a chainlink fence that separates MDA A proper (former drum storage area, pits, shafts, and the General's Tanks) from the surrounding public lands of DP and Los Alamos Canyons. DP Canyon, immediately north of MDA A, is open to the general public and is currently used for recreational purposes only.

The following groups of human receptors could be reasonably expected to be present at MDA A or off-site areas affected by contaminants from MDA A:

- Industrial workers
- Recreational users

Potentially complete exposure pathways by which current or future human receptors could be exposed to chemical and/or radiological constituents from MDA A include

- Ingestion, dermal, and inhalation exposure to chemicals and/or radionuclides in surface soil transported off-site (current/future);
- Inhalation of volatile chemicals in ambient air (current/future);
- Ingestion, dermal, and inhalation exposure to chemicals and/or radionuclides in subsurface soil that has been excavated and deposited on the surface (future); and
- Direct external irradiation (current/future).

Because it is unlikely that MDA A wastes have affected groundwater, human receptors are not expected to be exposed to contaminants via groundwater ingestion, dermal contact, or volatile inhalation exposure pathways.

The contaminants associated with chemicals in surface or subsurface soil from MDA A may be available to biological receptors through the following exposure pathways:

- Rain splash or saltation-creep of contaminated off-site surface soil onto plants
- Ingestion, dermal, and inhalation exposure to chemicals and/or radionuclides in surface soil transported off-site or in subsurface soil excavated and deposited on the MDA A surface
- Food web transport (consumption of contaminated plants and animals)

- Direct exposure to off-site surface soil and/or on-site subsurface soil containing gamma-emitting radioactive contaminants
- Deposition of particulates in off-site surface soil or on-site subsurface soil that has been excavated and deposited on the surface and subsequently ingested by animals during grooming.

Exposure to groundwater at MDA A is an incomplete pathway for ecological receptors.

2.5 Waste Inventory

It is estimated that approximately 12 to 25 Ci (200 to 400 g) of plutonium-239/240 were placed in the General's Tanks (LANL 1991, 07529, p. 16-245). It is not known if this estimate also includes americium-241 (ingrowth from plutonium-241 decay) or if it is just for plutonium-239/240. It is known that plutonium-241 is formed along with plutonium-239/240 in the production reactor and inseparable from this isotope. Some estimates of the activity in the tanks (Voelz 1973, 00483) indicate that about one-third of the radioactivity is americium-241. It is also possible that the sludge contains inorganic chemicals used in plutonium processing (LANL 1991, 07529, p. 16-244). There is no evidence that the General's Tanks leaked (Balo and Warren 1982, 07205, p. 34).

No documentation has been found that details the types of chemicals and quantities of radionuclides and/or chemical contamination that were disposed of in the two eastern pits. Radionuclides present in the waste include plutonium, polonium, uranium, americium, curium, radium-lanthanum, and actinium (Meyer 1952, 28154). Polonium and plutonium-239/240 are the major contaminants in the waste. Only plutonium would be present at the site because of the short half-life of polonium (138.4 days). The waste types disposed of in the pits included laboratory equipment, building construction material, paper, rubber gloves, filters from air cleaning systems, and contaminated or toxic chemicals generated during chemistry and metallurgy research operations (Meyer 1952, 28154).

The quantities and concentrations of contaminants (radioactive and nonradioactive) that were placed into the large central pit are unknown. However, Rogers (1977, 05707, p. A-7) indicates that building debris put into the pit was contaminated with plutonium-239/240, plutonium-238, uranium-235, and depleted uranium, along with other unidentified radioactive isotopes. It is unknown if nonradiological hazardous wastes are present in this, or any other, disposal pit at MDA A. The Radioactive Waste Management Site Plan from July 1973 states that MDA A was reactivated with the addition of the central pit to be used for burying debris from the TA-21-012 demolition project (LASL 1973, 08902, p. 29). This debris was contaminated with transuranic elements at levels of less than 10 nCi/g (LASL 1973, 08902, p. 29). Another reference (Balo and Warren 1982, 07205, p. 85) stated that pressurized gas cylinders were buried in the pits, although the specific pit (central or eastern) was not specified.

An unknown amount of NaOH solution and iodine contaminated with plutonium and possibly uranium was released to the surface soils of MDA A from corroded drums in the former drum storage area (LANL 1991, 07529, p. 16-244).

2.6 Historical Releases

There is no documented information that releases occurred from the General's Tanks, the eastern pits, or the central pit. The vertical shafts never received waste. The drums stored in the former surface storage area near the eastern pits were reportedly corroded and leaking by the time they were finally removed (Emelity 1978, 00487). The drums contained an NaOH solution and iodine contaminated with plutonium and possibly uranium (LANL 1991, 07529, p. 16-244).

2.7 Summary of Historical Investigations

Historical investigations at MDA A, ~~which are~~ detailed in the HIR (LANL 2005, 87452), are categorized as pre-RFI (prior to 1992) or RFI.

Pre-RFIs were conducted in 1969 (Purtymun 1969, 00519); 1974 (Wheeler 1976, 00486); 1980 (LANL 1991, 07529, pp. 16-245 to 16-246); 1983 (LANL 1991, 07529, p. 16-247); 1984 (LANL 1991, 07529, pp. 16-246 to 16-247); 1985 (LANL 1991, 07529, p. 16-267); 1986 (LANL 1986, 00477); and 1990 (LANL 1991, 07529, p. 16-250; LANL 1997, 62292). These investigations generally focused on radiological sampling of the General's Tanks. RFIs were performed in 1992 (LANL 1994, 26073) and 1994 (LANL 1997, 62292).

Additionally, geophysical surveys were conducted at MDA A during 1989 (Gerety et al. 1989, 06893); 1996 (LANL 1996, 64694); 1999 (Johnson 1999, 87457; Martin 1999, 87458; Quesada, 1999, 87456; Young 1999, 87459); and 2003 (AGS 2003, 81176). These geophysical surveys were performed to delineate and confirm subsurface features at MDA A, including pits and tanks, as well as identify natural features such as paleochannels. The HIR provides a complete review of the structural and operational history of MDA A (LANL 2005, 87452). A brief summary of these investigations is presented below.

2.7.1 Surface Soils, Alluvium, and Fill

Pre-RFI surface soil investigations were performed in 1980 (LANL 1991, 07529, pp. 16-245 to 16-246), 1984 (LANL 1991, 07529, pp. 16-246 to 16-247), and 1990 (LANL 1991, 07529, p. 16-250; LANL 1997, 62292). The sample locations for the 1980, 1984, and 1990 investigations are described in the HIR (LANL 2005, 87452) and shown on HIR Figures 3.2-2, 3.2-4, and 3.2-5 (LANL 2005, 87452). A total of 78 surface or shallow subsurface samples were collected during these three investigations. All samples were analyzed for radiological constituents only. Based on the information collected during these three investigations, it was determined that impacts on surface and shallow subsurface soils are widespread in the area surrounding MDA A. Concentrations of plutonium-238, plutonium-239/240, americium-241, uranium, and tritium were above established background values (BVs) in most sample locations in the area surrounding MDA A (LANL 2005, 87452).

RFI surface soil investigations were performed in 1992 (LANL 1994, 26073) and 1994 (LANL 1997, 62292) in the areas outside of the MDA A fence line, both immediately surrounding and downslope from the facility to the north (Figure 2.7-1). Surface and shallow subsurface soil samples were collected at depths up to 1.5 ft bgs. Samples were analyzed for radionuclides, metals, VOCs, and semivolatile organic compounds (SVOCs). As with previous investigations, americium-241, plutonium-238, plutonium-239/240, uranium, and tritium were detected in most samples above BVs. Several metals, including arsenic, cadmium, lead, and mercury, were detected above background levels in several of the samples collected downslope from the facility. SVOCs and VOCs, including bis(2-ethyhexyl)phthalate, acetone, and methylene chloride, were detected in a small number of these samples.

2.7.2 Subsurface Tuff

Pre-RFI subsurface investigations were conducted in 1969 (Purtymun 1969, 00519); 1974 (Wheeler 1976, 00486); and 1983 (LANL 1991, 07529, p. 16-247), all within the fenced perimeter. The 1969 investigation was an evaluation of fracture and joint patterns that was conducted during the excavation of the central disposal pit. The 1974 and 1983 investigations included the installation of 10 boreholes (4 in 1974 and 6 in 1983) with augers near the General's Tanks, with the purpose of determining if the tanks had leaked (Figure 2.7-1). The ten 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; the 1983 samples were submitted for plutonium-238 and plutonium-239/240 analyses. Results from these two sampling events indicated that the tanks had not leaked (as of 1983), and the only detections noted were plutonium-239/240 in the shallower (0- to 3-ft) intervals.

2.7.3 Geophysical Surveys

Geophysical surveys were conducted at MDA A in 1989 (Gerety et al., 06893); 1996 (LANL 1996, 64694); 1999 (Johnson 1999, 87457; Martin 1999, 87458; Quesada 1999, 87456; Young 1999, 87459); and 2003 (AGS 2003, 81176). 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. These methods included a time domain electromagnetic system, seismic refraction, ground penetrating radar, resistivity, and induced polarization. Results of these surveys indicated that even though the General's Tanks locations were correct, the three waste pits are actually located 15 ft further east than what is shown on early engineering drawings. Four strongly magnetic anomalies were identified in the central pit (C1 through C4 in Figure 2.7-2) and are likely associated with buried steel exhaust ductwork or similar materials. Three small undocumented subsurface anomalies (D1, D2, and D3) were also detected inside the fenced area (Figure 2.7-2). Two paleochannel areas (Figure 2.7-1) were located north (Johnson 1999, 87457, p. 6; Martin 1999, 87458, p. 5; Quesada 1999, 87456, p. 4) and southeast of the facility (AGS 2003, 81176, Figure 11 and p. 10); these may be related to a paleochannel that was previously verified to the southwest at MDA T in Borehole 21-05051 (LANL 2004, 85641, p. B-28).

2.8 Historical Data Quality and Interpretation

2.8.1 Data Quality

To determine the environmental impacts associated with waste units at MDA A, several investigations have been conducted within the facility and on the hillslope north of MDA A. Within MDA A, all soil and tuff samples that have been collected to date are pre-RFI (prior to 1992), and all data associated with these samples are unqualified. In addition, these samples were analyzed for radionuclides only, and not for hazardous constituents. The surface soil data collected from the 1990 investigation are qualitative only because a sample location map is unavailable. Therefore, there is currently no data of defensible quality that adequately characterizes the surface and subsurface of MDA A within the MDA A perimeter fence.

To date, the most reliable data collected are those that were collected during the 1992 and 1994 investigations. Surface and near-surface samples were collected during these RFIs. However, no subsurface tuff samples were collected. Chemical Science and Technology Forms were present for each request number, but there was no additional documentation for a majority of the request numbers. For inorganic chemical analyses, matrix spike and blind (quality control) QC sample results were available; however, laboratory blank, calibration and interference check, laboratory control, and serial dilution sample results were not included in the data package. For radiological analyses, laboratory duplicate and blind QC sample results were available; however, blank, tracer recovery, and laboratory control sample results were not included in the data package. Furthermore, no documentation of the minimum detectable activity is available. For organic chemicals, surrogate recovery and matrix spike sample results were available; however, blank, mass spectrum confirmation, initial and continuing calibration, internal standard, and laboratory control sample results were not included in the data package. Overall, the RFI data are determined to be of adequate quality to be usable; however, to fully ascertain the nature and

extent of potential contamination from MDA A, additional surface and near-surface samples are needed in drainage channels downslope from MDA A.

2.8.2 Nature and Extent of Contamination

The nature and extent of contamination from MDA A was evaluated in two components: (1) the waste units comprising MDA A and the subsurface tuff below these waste units, and (2) the DP Canyon slope area north of MDA A.

2.8.2.1 MDA A Waste Units and Subsurface Tuff

Historical data collected within MDA A are limited to unqualified pre-RFI data (prior to 1992) and limited to radiological analyses. There are no inorganic or organic chemical analyses available for surface or subsurface samples within MDA A. Subsurface tuff has been sampled within shallow boreholes in the vicinity of the General's Tanks to a maximum depth of 35 ft bgs. All shallow borehole samples (to a depth of 3 ft bgs at the time of sampling) contained plutonium-238 and plutonium-239/240. One borehole detected these radionuclides at a depth interval of 27–30 ft bgs (LANL 2005, 87452, p. 8). There are no qualified data regarding the presence of hazardous constituents in MDA A or the potential migration of hazardous constituents from the waste units.

2.8.2.2 DP Canyon Slope Soil and Sediment

Data available from the 1992 and 1994 RFIs are limited to surface and near-surface samples collected outside of the MDA A perimeter fence. Additional samples collected within the area of influence from other SWMU investigations [e.g., SWMU 21-024(h)] were also reviewed. The historical data summarized below support the interpretation that no migration of hazardous constituents from MDA A resulted from surface runoff or air deposition. However, since the DP Canyon slope is subject to erosional and depositional processes, the collection of soil and sediment samples is proposed to determine if hazardous constituents are contained in hillslope drainages and if the historical data are still representative of current surface conditions. New sample locations in active drainages within the area of influence are proposed. The results of the historical RFIs (1992 and 1994) are summarized below.

Inorganic Chemicals

Surface soil and sediment samples were collected adjacent to, and downslope from, MDA A and analyzed for inorganic chemicals during the RFIs. The results of these investigations indicated that arsenic, cadmium, calcium, chromium, copper, lead, manganese, mercury, silver, sodium, uranium, vanadium, and zinc were detected above their respective soil and sediment BVs in (LANL 1998, 59730). Table 2.8-1 summarizes the sample locations where inorganic chemicals exceeded BVs. The table also compares the results to NMED or EPA Region 6 soil screening levels (SSLs) (NMED 2004, 85615, Table A-1; EPA 2003, 81724) in samples within the area of influence for MDA A. Appendix B of the HIR provides all tabulated analytical results (LANL 2005, 87452).

Uranium is detected above the BV of 1.82 mg/kg in sample locations throughout the area of influence (LANL 2005, 87452, Figure 4.1-1). Uranium and cadmium are typically two times higher than BVs, and silver and zinc are slightly higher than BVs directly below the SWMU 21-011(b) outfall. All detected concentrations of chromium, copper, manganese, mercury, and vanadium above BVs are associated with soil and sediment samples (21-02574 and 21-01869, respectively) collected in the drainage below the outfall for SWMU 21-024(h). These anayltes are likely to be associated with discharge from this SWMU or from SWMU 21-011(b) (located in upper part of the same drainage) and not with surface runoff from

MDA A. Lead, zinc, and uranium were also detected above BVs in these same outfall drainage samples. Arsenic is the only inorganic chemical that was detected (in one sediment sample location [21-01689]), with a maximum detected concentration of 5.3 mg/kg above the residential SSL of 3.9 mg/kg and below the industrial SSL of 17.7 mg/kg (NMED 2004, 85615, Table A-1).

The spatial distribution of cadmium, lead, mercury, and arsenic in soil and sediment is shown on bubble plots (Figures 2.8-1 through 2.8-4). The bubble plots show the maximum concentrations at each location for a particular chemical. The size of the bubble is proportional to the concentrations in the data set. Additional information regarding the bubble plot presentation is provided in the HIR (LANL 2005, 87452) As described above, these figures illustrate that above-BV concentrations of inorganic chemicals are primarily confined to the drainage channel downslope from SWMUs 21-011(b) and 21-024(h) and do not appear related to MDA A. However, since not all drainage channels downslope from MDA A were investigated in the RFIs, additional surface and near-surface sampling in these areas is warranted.

Organic Chemicals

Surface soil and sediment samples were collected surrounding, and downslope from, MDA A and were analyzed for organic chemicals during the RFIs. Table 2.8-2 summarizes the information about those sample locations where organic chemicals were detected in surface soils and sediment and compares them to NMED SSLs (NMED 2004, 85615, Table A-1). Results of these investigations indicate detected concentrations of bis(2-ethylhexyl)phthalate in 2 of 83 samples, with a maximum concentration of 2.9 mg/kg; acetone in 24 of 26 samples, with a maximum concentration of 0.11 mg/kg, and methylene chloride in 7 of 26 samples, with a maximum concentration of 0.018 mg/kg. The sample locations with detected acetone and methylene chloride concentrations were downslope from SWMUs 21-011(b) and 21-024(h) (LANL 2005, 87452, Figure 4.1-9). The SSLs were not exceeded for any of the detected organic chemicals. Appendix B of the HIR provides all tabulated analytical results (LANL 2005, 87452).

Radionuclides

Surface soil and sediment samples were collected adjacent to, and downslope from, MDA A and were analyzed for radionuclides during the RFIs. The results of these investigations indicated that americium-241, plutonium-238, plutonium-239, thorium-228, tritium, and uranium-235 were detected above their respective BVs/fallout values (LANL 1998, 59730). Table 2.8-3 summarizes the information about those sample locations where radionuclides were detected above background or fallout values within the area of influence for MDA A and compares them to screening action levels (SALs) (LANL 2002, 73705). Appendix B of the HIR provides all tabulated analytical results (LANL 2005, 87452). Figure 4.1-5 of the HIR shows the locations where radionuclides were detected above the background or fallout value within the area of influence for MDA A (LANL 2005, 87452).

Americium-241 (by alpha spectroscopy) was detected above the fallout values of 0.013 pCi/g (soil) and 0.04 pCi/g (sediment) in 18 of 40 samples. Americium-241 (by gamma spectroscopy) was detected above the fallout value in 13 of 40 samples. The maximum americium-241 concentration was 1.424 pCi/g at location 21-01166. No americium-241 concentration exceeded the residential SAL of 39 pCi/g.

Plutonium-239 was detected above the fallout value of 0.054 pCi/g (soil) in 82 of 100 samples and above the fallout value of 0.068 pCi/g (sediment) in 3 of 3 samples. The maximum plutonium-239 concentration was 33 pCi/g at location 21-01414. No plutonium-239 concentration exceeded the residential SAL of 44 pCi/g.

The spatial distributions of americium-241 and plutonium-239 in soil and sediment adjacent to, and downslope from, MDA A are shown in Figures 2.8-5 and 2.8-6, respectively. These figures show that

higher concentrations of americium-241 and plutonium-239 are located on the upper hillslope adjacent to DP Mesa but that, in general, americium-241 and plutonium-239 are detected in historical sampling locations throughout the hillslope, a distribution pattern most indicative of particulates dispersed by air. Since all drainage channels downslope from MDA A were not investigated in previous RFIs, additional samples are proposed for characterizing radionuclides in these areas.

Plutonium-238 was detected above its fallout value of 0.023 pCi/g (soil) or the fallout value of 0.006 pCi/g (sediment) in 43 of 103 samples. The maximum concentration of plutonium-238 was 0.914 pCi/g at location 21-01413. No plutonium-238 concentration exceeded the residential SAL of 49 pCi/g.

Thorium-228 was detected slightly above its soil BV of 2.28 pCi/g in 1 of 30 samples. Thorium-228 was detected at a concentration of 2.99 pCi/g at location 21-01409, downslope from SWMU 21-011(b). Thorium-228 is the only radionuclide to exceed the residential SAL of 2 pCi/g.

Tritium was detected above its soil fallout value of 0.76 pCi/mL in 49 of 52 samples on the hillslope north and northwest of MDA A (LANL 2005, 87452, Figure 4.1-5). The maximum concentration (1700 pCi/mL) was detected at sample location 21-01408. Two other sample locations in this small area (21-01409 and 21-01407) contain elevated tritium above the fallout value. Figure 2.8-7 shows the spatial distribution of tritium above fallout values in the MDA A area of influence. Assuming a soil moisture content of 10%, the conversion of the maximum tritium value from pCi/mL to pCi/g would result in a maximum concentration of 188 pCi/g, which is below the residential SAL of 890 pCi/g (LANL 1998, 59730).

Uranium-235 was detected above its soil BV in 1 of 6 soil samples (LANL 2005, 87452, Table 4.1-3). The maximum concentration detected was 0.4855 pCi/g at sample location 21-02574, in the drainage below the SWMU 21-024(h) outfall.

2.8.2.3 Summary

Based on a review of pre-RFI historical data collected within the MDA A perimeter fence, radionuclides are present in both the surface and subsurface at concentrations above background and fallout values. The radionuclides of primary concern are plutonium-238 and plutonium-239/240. Based upon information from historical documents, inorganic chemicals and organic chemicals have also been placed in the waste units. There are no historical inorganic or organic chemical analyses from soil and tuff beneath MDA A. The lateral and vertical extent of subsurface contamination associated with MDA A is currently unknown.

During previous RFIs, extensive surface and near-surface sampling has been conducted in the area of influence downslope from MDA A. These investigations show that arsenic, cadmium, calcium, chromium, copper, lead, manganese, mercury, silver, sodium, uranium, vanadium, and zinc were detected above their respective BVs in soil and sediment (LANL 1998, 59730). However, many of these elevated concentrations are associated with locations below the outfall for SWMUs 21-024(h) and 21-011(b). Arsenic is the only inorganic chemical that exceeded its residential SSL (at one sediment sampling location). Additional sampling for inorganic chemicals is warranted in drainage channels downslope from MDA A.

Americium-241, plutonium-239/240, plutonium-238, tritium, and uranium-235 were detected at concentrations greater than background and fallout levels in samples from most sampling locations. Thorium-228 was detected above background at only one sampling location and was the only radionuclide to exceed a residential SAL. While some of these radionuclides may be a result of waste practices historically implemented at TA-21, there are indications that operations conducted at other

SWMUs downslope of MDA A have also impacted the MDA A area of influence. Additional sampling for radionuclides is needed in drainage channels downslope from MDA A.

Bis(2-ethylhexyl)phthalate, methylene chloride, and acetone were detected downslope from SWMUs 21-011(b) and 21-024(h). No organic chemicals exceeded a residential SSL. Although there is no indication from historical surface and near-surface sampling that organic chemicals are associated with MDA A, samples collected from the drainage channels downslope from MDA will be analyzed for SVOCs.

3.0 SITE CONDITIONS

This section describes the current surface features at, and the existing subsurface geologic characteristics beneath, TA-21 in general and MDA A in particular. The known surface and subsurface traits and their potential effects on the occurrence and concentration of contaminants include

- a canyon-mesa terrain that affects meteorological conditions and ecological habitats at the surface;
- a semiarid climate with low precipitation and a high evapotranspiration rate that limits the extent of subsurface moisture percolation, and this limits the amount of moisture available to leach radionuclides or other hazardous waste constituents; and
- a thick, relatively dry unsaturated (vadose) zone that greatly restricts or prevents downward migration of contaminants in the liquid phase through the vadose zone to the regional aquifer.

These and other elements of the environmental setting at MDA A are useful when evaluating site investigation data with respect to the fate and transport of contamination from historical site activities.

3.1 Surface Conditions

The elevation of DP Mesa in the vicinity of MDA A ranges from 7125 ft to 7135 ft asl, with a gentle slope to the north. The canyon slope ranges in elevation from 7035 ft asl in the bottom of DP Canyon to 7125 ft asl 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% downward across the site from south to north. Approximately 30 ft north of the site, the slope increases to approximately 30°. MDA A is located in the 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 west end and 60 ft north of MDA A's east end.

3.1.1 Surface Water

Mesas of the Pajarito Plateau are generally dry, both on the surface and within the bedrock forming the mesa. Canyons range from wet to relatively dry; the wettest canyons contain continuous streams and perennial groundwater in the canyon-bottom alluvium. DP Mesa is bounded on the north by DP Canyon and on the south by Los Alamos Canyon and BV Canyon, which flows into Los Alamos Canyon near MDA V. DP and Los Alamos Canyons have intermittent flow sufficient to support alluvial groundwater systems (LANL 1998, 59599, Figures 2-7, 2-8, and pp. 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 at the toe of the mounded cover in a drainage ditch and diverted north into DP Canyon through a culvert. Currently, shallow diversion channels are present on the south, west, and east sides of the facility and are used to move water around the base of the facility, toward the north, and to prevent run-on to MDA A. During July 2001, a surface water site assessment was conducted for MDA A in accordance with ENV-RS standard operating procedure (SOP) 02.01. The results of the assessment documented an erosion potential score of 15.8, indicating a low erosion potential at MDA A (LANL 2001, 87375, p. 5).

3.1.2 Soils

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. They tend to be sandy in texture near the surface and more clay-like 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 ER Project's installation work plan (LANL 1998, 62060, p. 2–21) and in Nyhan et al. (1978, 05702, pp. 24–25).

3.2 Subsurface Conditions

3.2.1 Stratigraphy

The generalized stratigraphy of DP Mesa in the area of MDA A is shown in Figure 3.2-1. 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: 4, 3, 2, and 1v/1g (Broxton et al. 1995, 50121, 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- to 40-ft-thick sequence of volcaniclastic sediments deposited in braided stream systems. The 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, 49682, p. 7). The basal Guaje Pumice Bed of the Otowi Member separates the Bandelier Tuff from the underlying clastic fanglomerate sediments of the Puye Formation (Tp). This feature may be locally absent in portions of TA-21 (LANL 2004, 87291, p.13).

Previous geophysical studies conducted at MDA A have determined that there are at least two paleochannel areas in the subsurface near or below MDA A (AGS 2003, 81176, p. 10; Johnson 1999, 87457, p. 6; Martin 1999, 87458, p. 5; Quesada 1999, 87456, p. 4). The two paleochannel areas, north and east of MDA A (see Figure 2.7-1), may actually be an eastern bifurcation of the primary paleochannel that is located at MDA T. Previous drilling activities (Borehole 21-05051) have verified the presence of the paleochannel located at MDA T (LANL 2004, 85641, p. B-28); however, the areas identified to the north and east of MDA A have not been verified.

3.2.2 Cliff Retreat and Fractures

According to the article "Geomorphic Studies at DP Mesa and Vicinity," (Reneau 1995, 50143, pp. 65–92), tributary stream systems and their canyons (possibly including BV Canyon and the upper

reaches of DP Canyon) developed prior to incision of Los Alamos Canyon and minimal cliff retreat has occurred in these canyons since then. The article indicates that 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 years. Fracture characteristics of unit 2 of the Tshirege Member, which was the focus of the study, are very similar to previous fracture studies of unit 3, allowing for extrapolation of results to the rocks directly below TA-21.

An additional fracture study was conducted in June 1969 during excavation activities at the MDA A central disposal pit (Purtymun 1969, 00519). Although findings of this study are similar to those discussed in a 1995 study (Wohletz 1995, 58845, pp. 19–31), with fracture sets oriented in a northerly direction, there were other fracture orientations noted from N40°E to N60°E and from N70°E to N80°E. It was also noted that these fractures/joints contained a dark brown to gray clay plating.

3.2.3 Hydrogeology

3.2.3.1 Infiltration

Surface and near-surface conditions (topography, precipitation, surface runoff) control water infiltration to the subsurface and the transport of contaminants into the shallow subsurface. In this respect, the climate behavior of mesas and canyons forming the plateau differ from one another (LANL 1998, 59599). Mesas are generally quite dry, both on the surface and within the rock forming the mesa. Canyons range from wet to relatively dry; the wettest canyons contain continuous streams and perennial groundwater in the canyon-bottom alluvium. Dry canyons have only occasional stream flow and may lack alluvial groundwater.

Relatively small volumes of water move beneath mesa tops under natural conditions because of low rainfall, run-off into canyons, high evaporation, and efficient water use by vegetation. Liquid water generally infiltrates the mesa, and water vapor generally moves upward, undergoing evaporation and transpiration (or “evapotranspiration”) along the top and sides of the mesa. Air circulates through the mesa-top units because of the relatively dry pore spaces and the topographic relief. Air circulation may be driven by temperature variations, barometric pumping, or surface winds. This process promotes atmospheric evaporation, which may extend deep within the mesa and further inhibit the downward liquid-water flow.

The proposed hydrogeologic conceptual model for the Pajarito Plateau (Figure 3.2-2) (LANL 1998, 59599, p. 5), including MDA A, predicts infiltration of water into the subsurface and subsequent transport of water, vapor, and solutes through the upper regions of the vadose zone. This process is heavily influenced by surface conditions such as topography, surface water flow, and precipitation. The natural source of moisture in the vadose zone is precipitation, most of which is removed as runoff, and evaporation and transpiration (LANL 1997, 63131, pp. 2–27). The subsurface movement of the remaining moisture (often referred to as recharge) is predominantly vertical in direction and is influenced by properties and conditions of the vadose zone.

Differences in degree of surface disturbance and the geologic properties of the tuff lead to differences in recharge rates. Mesa-top recharge can be locally significant when vegetation is removed, soil and near surface bedrock are disturbed, or water is artificially added to the local hydrologic system by activities such as effluent disposal.

Two geologic properties of the Bandelier Tuff that significantly influence recharge rates are the degree of welding and devitrification, both effects of prolonged presence of residual gases and high temperatures following deposition. Because different tuff units were deposited at different temperatures, and because

individual units were laid out in variable thicknesses over different landscapes, cooling was not uniform. Consequently, welding varies spatially, both between and within separate depositional layers. Welded tuffs tend to be more fractured than nonwelded tuffs. Fractures within the tuff do not enhance the movement of dissolved contaminants unless saturated conditions exist. Under unsaturated conditions, most of the open fractures beneath the site are expected to be completely dry, and the water will exist in the tuff matrix only. Only in situations when substantial infiltration occurs from the ground surface will the fractures become wet and conduct water. However, modeling studies predict when fractures disappear at contacts between stratigraphic subunits, when fracture fills are encountered, or when fracture coatings are interrupted, fracture moisture is absorbed into the tuff matrix (Soll and Birdsell 1998, 70011, pp. 193–202).

3.2.3.2 Perched Groundwater

Observations of perched intermediate groundwater in Laboratory wells are rare on the Pajarito Plateau. Perched waters 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. The Cerro Toledo interval, Guaje Pumice Bed, and Puye Formation are local examples.

Figure 3.2-3 shows a hydrogeologic cross-section through TA-21. The Cerro Toledo interval was drilled through to a depth of 293 ft bgs at borehole LADP-4 which was located immediately north of TA-21 in DP Canyon (Figure 3.2-4), but groundwater was not observed and the Guaje Pumice Bed was encountered between 545 ft and 573 ft bgs and contained no perched water (Broxton et al. 1995, 50119, pp. 98–99). Saturated conditions were not encountered in the borehole at location 21-02523 near MDA V (LANL 2004, 87291, p. 14). This borehole was drilled into the Otowi Member of the Bandelier Tuff to a depth of 660 ft bgs (approximately 6500 ft asl). Perched intermediate groundwater has been observed at some locations on the plateau, including at borehole LADP-3 (in the Guaje Pumice Bed at 6430 ft asl) and at well Otowi-4 on the eastern base of DP Mesa east of TA-21 (in the Puye at 6380 ft asl) (Broxton et al. 1995, 50119, pp. 93–109; LANL 1998, 59599, Figure 2-8 and p. 4-52). Figure 3.2-4 shows groundwater elevations at the Laboratory. Perched groundwater was encountered at R-6, located northwest of Otowi-4 in DP Canyon, at approximately 603 ft bgs (Vaniman 2004, 87463).

3.2.3.3 Regional Aquifer

The regional aquifer in the Los Alamos area slopes eastward towards the Rio Grande within the Santa Fe Group into the Puye Formation beneath the central and western portion of the Pajarito Plateau. Depth of the regional aquifer decreases from about 1200 ft bgs along the western margin of the plateau to about 600 ft bgs along the eastern margin. The regional aquifer was encountered in deep wells proximal to MDA A at 5870 ft asl (R-7), 5850 ft asl (Otowi-4), and 5835 ft asl (R-8) (Figures 3.2-3 and 3.2-4), resulting in an approximate depth to groundwater at MDA A of 1265 ft bgs (Broxton et al. 1995, 50119, pp. 93–109; LANL 2002, 72878, pp. 26–33; LANL 2003, 79594, pp. 18–26). Preliminary data from the drilling of R-6 indicate that the depth to regional aquifer is approximately 1180 ft at an elevation of 5815 ft. The groundwater in the regional aquifer is separated from alluvial and perched groundwater by 350 to 620 ft of tuff and volcanic sediments (Purtyman 1995, 45344, p. 29).

4.0 SCOPE OF ACTIVITIES

This section describes the specific activities that will be performed during the field investigation of MDA A. The primary goal of this investigation is to determine how buried waste materials which were disposed of at the MDA A facility may have migrated into soil and subsurface bedrock in the area and the extent of

the migration. The main activities associated with this investigation are (1) surveying to locate waste unit perimeters for drilling setbacks associated with DOE requirements (see Section 4.1) and sampling locations; (2) radiological surveying of surface radiation; (3) drilling boreholes and sampling soil/tuff; (4) collecting pore-gas vapor samples; (5) collecting surface and near-surface samples in the MDA A area of influence; and (6) installing vapor monitoring wells (if required). If groundwater is encountered at any time during the field investigation, groundwater monitoring wells may be installed and samples collected. Concurrently with the MDA A sampling and drilling activities, activities such as collection of field-screening data, collection of survey data, and management of investigation-derived waste (Appendix B) will also be conducted.

4.1 MDA A Nuclear Hazard Category and Considerations for Investigation Activities

MDA A has been categorized by the DOE as a Hazard Category 2 nuclear facility (DOE 2003, 87047). Facility categories are determined by 10 Code of Federal Regulations (CFR) 830, Subpart B, and requirements set forth in DOE-STD-1027-92, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports, and Documented Safety Analyses (DSA). A Hazard Category 2 nuclear facility is a facility for which a hazard analysis shows the potential for significant on-site consequences.

DOE nuclear safety requires that a safety basis be prepared and maintained for the range of planned operations at MDA A. The safety basis prepared for the General's Tanks and pits will include reliance upon hazard controls to provide adequate protection of workers, the public, and the environment. Hazard controls at MDA A include the geophysical verification surveys of waste units and the establishment of benchmark controls. The safety basis must be kept current and must consider any changes to the facility, the facility operations, or the facility hazards as they are analyzed. The DSA for MDA A will be prepared by the Laboratory for the DOE and is not part of this document. The MDA A DSA will contain controls to protect the public, workers, and the environment from the hazards associated with MDA A's postulated inventory, which may include both hazardous chemicals and radionuclides. Work conducted as part of this investigation will be performed in accordance with the controls established by the DSA as well as any resultant technical safety requirements. The controls will be incorporated into the site-specific health and safety plan required by 29CFR1926, integrated work documents, and other site-specific procedures.

Characterization of waste in the disposal units will not be conducted as part of the field investigation described in this work plan. The characterization of the residual radioactive waste contained in the General's Tanks will be conducted during a radioactive waste stabilization investigation. Building demolition waste placed in the central pit has been documented with photographs as shown in the MDA A HIR (LANL 2005, 87452). Characterization of the waste in the eastern pits is pending receipt of data obtained from the trenching operations proposed for MDA B (LANL 2004, 87290, p. 14). At this time, the waste contained in the MDA B pits is thought to be comparable in nature to the waste placed in the MDA A eastern pits. When the eastern pits at MDA A were quickly filled from TA-21 operations, the pits at MDA B were excavated to hold the waste from the continuing operations (LANL 1991, 07529, p. 16-25). Current information about the vertical shafts indicates that no waste was placed in the shafts and that the shafts were filled with soil.

All drilling and sampling activities will be tailored to achieve the specific investigation objectives identified and outlined in Section 1.2. As part of this investigation, drilling will be employed for the following reasons:

- to establish the lateral and vertical extent of potential contamination at MDA A with shallow angled and shallow and deep vertical boreholes;

- to collect subsurface geotechnical, lithologic, stratigraphic, and analytical data; and
- to characterize potential releases from individual waste units.

4.2 MDA A Investigation Activities

The field investigation of MDA A will consist of the activities summarized below. Details regarding the specific proposed methods for implementing each of these activities are described in Section 5.

Field survey—The exact location of each waste pit, the General's Tanks, the vertical shafts, and the borehole/soil sampling locations will be determined with a geodetic survey. Utility surveys will be performed as part of the excavation permitting process. Each location will be thoroughly examined to identify potential hazards for subsurface drilling.

Radiological surface survey—Radiological walkover surface surveys will be performed prior to initiation of any field activities. Beta/gamma surveys will be conducted on 10-ft interval transects.

Installation of 16~~5~~ boreholes—Three~~One~~ angled and 13~~14~~ vertical boreholes will be installed at MDA A. The angled boreholes will be installed adjacent to the General's Tanks ~~in conjunction with a paired vertical borehole~~ to determine the lateral and vertical extent of potential chemical migration ~~from the General's Tanks~~. All other waste units will be investigated by using vertical boreholes to determine the lateral and vertical extent of potential chemical migration from MDA A. Boreholes will be advanced at the angle and to the depths and lengths specified in Section 4.3.

Collection of core samples for analysis—Continuous core samples will be collected from each borehole. Core will be visually inspected and field screened for VOCs and alpha and beta/gamma radioactivity. Lithologic descriptions and fracture-characterization data will be recorded for each borehole. Tuff samples will be collected at specified intervals. ~~Field analytical screening will be performed on all samples from all boreholes for HE (RDX and TNT).~~ Field analytical screening for PCBs and HE (RDX and TNT) will be performed on all samples from boreholes located adjacent to the disposal pits (boreholes 2 through 10 and borehole 12). Four sample intervals~~s~~ will be collected for laboratory analysis from each borehole based on the following criteria: (1) the highest field-screening or field analytical detection; (2) the maximum depth of a field-screening or field analytical detection; (3) the base depth to pits, vertical shafts, tanks, or other structure of potential concern; and (4) the total depth (TD) of the borehole. A fifth sample, representing the native soil immediately underlying the cover/fill, will be collected from boreholes 2, 6, 7, 8, 9, 10, 11, 12, 14, and 16. Additional subsurface cover/fill samples will be collected from a depth of 1.5~~–~~–2.0 ft depending on the cover/fill thickness composition. The thickness of the cover/fill is variable and thought to be less than ~~4four~~ ft. For each borehole less than 100 ft in TD, two additional samples will be collected from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals. For boreholes exceeding 100 ft in TD, four additional samples will be collected from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals. However, if subsurface conditions are extremely variable, additional samples may be collected. All samples will be analyzed by an off-site laboratory in conformance with ENV-ECR~~RS~~ quality procedures (QPs) 7.1 and 7.2.

Soil and sediment sampling and analysis—Ten soil and sediment locations will be sampled at two depths (0~~–~~–0.~~-~~5 ft and 1.5~~–~~–2.0 ft) from the DP Canyon hillslope north of MDA A. Samples will be collected in drainages and other areas of deposition to determine if there is downslope migration of contaminants from MDA A. In addition, six historical RFI sampling locations will be resampled sampled at two depths (0~~–~~–0.~~-~~5 ft and 1.5~~–~~–2.0 ft) to verify if the data are still

representative of hillslope surface conditions. Table 4.11-1 summarizes the analytical requirements for soil and sediment samples.

MDA A cover/fill sampling and analysis—Nine~~Eight~~ cover~~soil~~/fill samples will be collected from the surface off~~from~~ the existing MDA A cover (0–~~-~~0.5 ft) in conjunction with the boreholes located within the perimeter fence (boreholes 2, 6, 7, 8, 9, 10, 11, 12, 14, and 16). Borehole 9 will not have a surface sample collected due to the existence of an asphalt pad at the location.~~.~~ The sample collection objectives are to (1) ~~to~~ characterize the potential presence of COPCs in the cover/fill material, (2) determine the thickness of cover/fill material, and (3) evaluate if the cover/fill material may be utilized in closure. Table 4.11-1 summarizes the analytical requirements for soil and sediment samples.

~~Samples will be collected from two depth intervals at each sampling location (0–0.5 ft and 1.5–2.0 ft).~~

Geophysical logging and fracture characterization—Geophysical logging and fracture characterization will be conducted on all boreholes.

Pore-gas~~Vapor~~ and groundwater sampling—After drilling is completed, subsurface pore-gas~~vapor~~ samples will be collected from ~~all boreholes~~ each depth interval selected for core analyses at an off-site laboratory. ~~at a depth that corresponds to the base of the nearest waste unit (e.g., tank, pit, or vertical shaft) and at TD.~~ If perched groundwater is encountered during implementation of the field investigation described in this work plan, perched groundwater samples will be collected.

4.3 Field Surveys to Locate Waste Units and Topographic Benchmarks

The location and survey of the waste units have been defined by reviewing historic photos and documents. Engineering drawings and all 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. In general, the waste unit locations as defined from most of the previous geophysical surveys have been consistent with the design drawings. The interpreted boundaries identified by the geophysical surveys will be used to identify the waste unit locations to guide the selection of borehole locations. Because of uncertainty associated with the waste unit boundaries, appropriate setbacks for drilling will be applied.

A field reconnaissance was conducted during June 2004 to determine the area of influence from the MDA A facility. During this reconnaissance, topography and drainage channels (both natural and human-made) were considered. Using a global positioning system (GPS), a survey was conducted in July 2004. During this survey, three of four brass survey monuments were located at three of the MDA A fence corners. The coordinates from these benchmarks were used to tie historical geophysical data to the current base map.

4.4 Number, Locations, and Depth of Boreholes

To define the nature and extent of contamination at MDA A, 16~~5~~ boreholes will be installed. The boreholes will provide information about MDA A's subsurface stratigraphy, potential migration pathways (e.g., paleochannels and fractures), and geotechnical data. The borehole locations proposed in this

investigation work plan are based on an evaluation of access limitations, safety, historic data, and other relevant information. The proposed drilling activities will accomplish the following objectives:

- define the nature and extent of possible contamination in subsurface tuff, including
    - lateral and vertical extent of contamination in tuff beneath the General's Tanks, the central pit, the two eastern pits, the drum storage area, and the two vertical shafts, and
    - concentrations and spatial extent of potential contaminants such as VOCs and tritium in the vapor phase in subsurface tuff;
- identify perched groundwater beneath MDA A; and
- obtain information about hydrogeologic properties and fracture characteristics of the vadose zone in support of contaminant transport modeling.

Proposed borehole locations are shown in Figure 4.4-1. Proposed borehole locations were determined using the following considerations: (1) data requirements; (2) access constraints, including setback requirements (no-drill zones) for the waste units within the MDA; (3) drilling equipment limitations; (4) geophysical anomalies identified during geophysical surveys; and (5) other factors such as subsurface utilities. All boreholes will be drilled using a hollow-stem auger drilling rig. If drilling difficulties are encountered (e.g., refusal) for particular boreholes, the boreholes will be completed using an air-rotary drilling rig. The rationale for the installation of each borehole is presented below.

Borehole 1: A 45° angled borehole will be advanced below the lateral extent of the General's Tanks. The borehole will be advanced from the north side of the tank area, outside of the perimeter fence and immediately north of the General's Tanks (Figure 4.4-1). The borehole will be installed in a north-south direction with a maximum vertical target depth of 50~~82~~ ft when terminated at the mid-point of the bedrock under ~~south end of~~ the General's Tanks. This borehole entry location and orientation will verify potential tank releases and provide a sufficient safety factor margin to adequately address the radiological concerns associated with tank integrity. ~~A paired vertical borehole (Borehole 14 described below) will be installed to assess the vertical extent of potential hazardous or radiological releases from the tanks.~~

Borehole 2: This borehole will provide information about subsurface conditions adjacent to the vertical shafts. The borehole will be advanced northwest of the shaft area (shafts filled with clean soil) to parallel fracture trends at the site. The vertical shafts extend to a depth of approximately 65 ft bgs. The borehole will be advanced to a target depth of 85 ft bgs.

Boreholes 3, 4, and 5: These boreholes will provide information about the lateral and vertical extent of releases from the central disposal pit. These boreholes are placed to align with the predominant northwest fracture orientation and will be installed to a target depth of 45 ft bgs.

Boreholes 6, 7, and 8: These boreholes will provide information about the lateral and vertical extent of releases from the eastern pits. These boreholes are placed to align with the predominant northwest fracture orientation and will be installed to a target depth of 35 ft bgs.

Borehole 9: This borehole will be installed in the former drum storage area to determine if releases from leaking drums have impacted the underlying soil/tuff. The borehole will be installed to a target depth of 35 ft bgs to determine the vertical extent of potential releases from the former drum storage area. The borehole also will provide information about the lateral extent of potential chemical and radiological releases associated with the eastern disposal pits.

Boreholes 10 and 11: These boreholes will be installed south (Borehole 10) and northeast (Borehole 11) of the former drum storage area to determine the lateral extent of chemical and radiological potential releases from the former drum storage area and the eastern pits. The borehole locations align with the predominant northwest~~east~~ fracture orientation and will be drilled to a target depth of 35 ft bgs.

Borehole 12: This deep borehole will be installed 10 ft beyond the Cerro Toledo/Otowi contact adjacent to the central disposal pit and between the two eastern pits. The target depth for this borehole is 335 ft bgs. This borehole will provide information about the subsurface conditions and possible perched groundwater zones beneath the MDA A waste units.

Borehole 13: This borehole will be located southeast of the MDA A perimeter fence in a possible paleochannel area, as identified by a 2003 geophysical survey (AGS 2003, 81176, p. 10), to verify if the paleochannel is present and to define the lateral extent of potential releases from MDA A to the southwest. This borehole will be drilled to a target depth of 45 ft bgs.

Borehole 14: This 45° angled borehole will be advanced from the south side of~~drilled adjacent to~~ the General's Tanks~~,~~ inside the perimeter fence ~~and east of, Borehole 1 (an angled borehole)~~ to determine if there have been ~~the vertical extent of~~ chemical and radiological ~~potential~~ releases from the General's Tanks. The borehole will be ~~will~~ installed in a south-north direction with a maximum vertical depth of 40 ft when terminated at the mid-point of the General's Tanks. ~~The borehole will be drilled to a target depth of 280 ft bgs.~~

Borehole 15: This borehole will be located north of the MDA A perimeter fence in a possible paleochannel identified by a geophysical survey in 1999 (Johnson 1999, 87457, p. 6; Martin 1999, 87458, p. 5; Quesada 1999, 87456, p. 4). Information from the borehole will help the assessment of the lateral extent of migration from the General's Tanks and verify if the paleochannel exists as a preferential migration pathway. This borehole will be drilled to a target depth of 45 ft bgs.

Borehole 16: This 45° angled borehole will be advanced from the west side of the General's Tanks ~~,~~ inside the perimeter fence to determine if there have been chemical and radiological releases from the General's Tanks. The borehole will be~~will~~ installed in a west-east direction with a maximum vertical depth of 65 ft when terminated ~~on~~ beyond the west side of the General's Tanks.

4.5 Soil and Rock Sampling from Boreholes

B~~All b~~oreholes will be continuously cored and samples will be field screened on 5-ft intervals as discussed in Section 4.9~~8~~. Field analytical screening for HE ~~will be performed on all samples from all boreholes.~~ and PCBs ~~field analytical screening~~ will be performed on samples from boreholes adjacent to the disposal pits (boreholes 2 through 10 and borehole 12). Field analytical screening is described in Section 4.10. Four samples will be collected from each borehole for laboratory analysis, using the following criteria: (1) the highest field-screening or field analytical detection; (2) the maximum depth of a field screen or field analytical detection; (3) the base depth to pits, vertical shafts, tanks, or other structure of potential concern; and (4) the TD of the borehole. A fifth sample, representing the native soil immediately underlying the cover/fill, will be collected from boreholes 2, 6, 7, 8, 9, 10, 11, 12, 14, and 16. Additional subsurface cover/fill samples will be collected from a depth of 1.5 to ~~-~~2.0 ft depending on the cover/fill thickness composition. The thickness of the cover/fill is variable and thought to be less than ~~4four~~ ft. Additional samples will be collected from fractures, fracture-fill materials, moist zones, and surge beds/higher permeability intervals, if encountered. To define vertical extent, the continuation of the boreholes beyond the target depths will be based on the presence of elevated field screening, field

analytical screening, and/or field observations (such as unusual staining). All boreholes will be advanced 25 ft beyond the last field-screening or field analytical screening detection (see Section 4.9 and 4.10). Sample selection and drilling depth related related strictly to field detections will be based on the following field screening/field analytical screening hierarchy:

1) field scfield[DJ1] screening for VOCs and field analytical screening for HE (RDX and TNT) and PCBs.

2) radiological screening for alpha and beta/gamma radiaton. If the highest detections and/or the maximum depth of radiological screening occurs at different depth intervals than 1) above, additional samples will be collected from these depths for radiological analyses.

3) If field screening and/or field analytical screening is negative in 1) above, sample selection and borehole depth and may be determined by radiological screening only..

Field documentation of samples collected from fracture zones will include a detailed physical description of the fracture fill material and rock matrix sampled. The volumes of fracture-fill and rock-matrix material included in the sample will be estimated from field measurements. An additional sample will be collected from the rock matrix adjacent to the fracture-sample material to allow for comparison. The fractures and matrix samples are paired and will be assigned unique identifiers.

4.6 Surface and Near-Surface Sampling

Surface and near-surface samples will be collected within the MDA A area of influence. Proposed sample locations are shown in Figure 4.6-1. These sampling activities will be performed with the following objectives:

- To confirm if the 1992/1994 RFI sample results are representative of current hillslope conditions. Six of the 66 historical sample locations will be resampled in the surface (0–0.50 ft) and near-surface soil (1.5–2.0 ft). Previous RFI sample results are depicted in Figures 4.1-1, 4.1-5, and 4.1-9 of the HIR (LANL 2005, 87452).

- To identify surface/drainage impacts downslope from MDA A in DP Canyon. Ten locations will be selected within obvious drainages and depositional areas north of MDA A. Surface (0–0.50 ft) and near-surface (1.5–2.0 ft) samples will be collected.

- To characterize the cover/fillcap material used to stabilizecover MDA A in 19857. Nine surface samples (0–0.5 ft) will be collected of the cover/fill from boreholeEight locations within the perimeter fence on the MDA A cover will be sampled.(boreholes 2, 6, 7, 8, 9, 10, 11, 12, 14, and 16). Borehole 9 will not have a cover/fill sample collected because ofdue to the existence of an asphalt pad at the location. The spade or scoop method will be utilized to collect the surface sample (0–0.5 ft). In order to more closely define the contact between the cover/fill and the native soil, a hand auger will be used to collect subsurface cover/fill samples and to sample the native soil at the interface of the cover/fill with the native soil. Once the native soil at the interface is sampled, a hollow-stem auger drilling rig will be utilized to complete the borehole (see Section 4.4) Surface (0–0.50 ft) and near-surface (1.5–2.0 ft) soil samples will be collected.

-

The surface and near-surface sampling is summarized in Table 4.6-1. All samples will be field screened as discussed in Section 4.98. No field analytical screening will be performed on surface and

near-surface samples. Samples will be ~~be collected and submitted~~ analyzed at~~to~~ an approved off-site laboratory as discussed in Section 4.11. A ~~and a~~ summary of analyses is provided in Table 4.11-1.~~8~~.

4.7 Subsurface Pore-Gas Samples~~Vapor Monitoring~~

Subsurface pore-gas samples for VOCs, ~~and~~ tritium, and percent moisture will be collected from all boreholes~~, following the current version of ENV-RS-SOP-06.31~~ after completion of drilling activities. For each borehole, subsurface pore-gas ~~two~~ samples will be collected from each depth interval also selected for core analyses at an off-site laboratory~~collected~~ ~~(1) beneath the base of the nearest disposal unit, and (2) at TD.~~
Pore-gas sample collection~~Vapor monitoring~~ will be conducted in conformance with §IV.B.2.g of the Consent Order and field measurements will include:

- Percent oxygen
- Organic Vapors
- Percent Carbon Dioxide
- Static Surface Pressure

Methods for pore-gas sample collection are~~as~~ described in Section 5.5 and 5.6. If VOCs are detected in the vapor samples following drilling, a vapor-monitoring plan will be submitted to NMED~~the AA~~ as described in §IV.C.2.c.vi of the Consent Order~~Section 5.5~~.

4.8 Perched Water Sampling

Borehole 12 will extend through the Cerro Toledo to determine if perched groundwater is present below MDA A. If saturation is encountered as the borehole advances, drilling will be stopped to determine whether sufficient water volume is available to analyze the water quality. If sufficient volume exists, a groundwater sample will be collected and analyzed for metals, anions, perchlorate, alkalinity, total organic carbon, total inorganic carbon, and total dissolved solids. A monitoring well design will be submitted to the NMED~~AA~~ in accordance with Section 5.7~~6~~ of this work plan

4.9 Field Screening

~~Section~~ §IV.C.2.c.iv, Items 2 and 4, of the Consent Order ~~NMED September 1, 2004, draft Compliance Order on Consent s~~specifies that core samples be screened using the methods described in ~~Section~~ §IX.B. ~~Section~~ §IX.B.2.d of the Consent Order specifies that all core samples be screened by (1) visual examination, (2) headspace vapor screening for VOCs, and (3) metals screening using x-ray fluorescence (XRF). Additional screening for release-specific characteristics, such as high explosives (HE), shall be conducted where appropriate. ~~Section~~ §IV.C.1.c.iv, Item 6, of the ~~proposed~~ Consent Order indicates that screening results from the samples collected in the field be used to identify samples for laboratory analysis.

The Laboratory's field-screening approach will be to (1) visually examine all samples for evidence of contamination; (2) screen for organic vapors at 10-ft intervals; and (3) continuously screen for radiological contamination. This approach differs from that specified in the Consent Order by not using the Order-specified field-screening methods for metals as a basis for identifying samples to be submitted for laboratory analysis.

To provide a detailed justification for the Laboratory's chosen approach, the limitations of field-screening methods for various classes of analytes specific to MDA A are discussed below.

4.9.1 VOCs

VOCs will be screened at a minimum 10-ft interval in all boreholes. Screening will be accomplished through headspace analysis and using a photo-ionization detector (PID) capable of measuring quantities as low as 1 ppm. VOC screening will be used to guide drilling beyond the target depth. Boreholes will be advanced 25 ft beyond the last field-screening detection.

4.9.2 Metals

Because the concentrations of metals detected in the historical samples are low (near or below background), XRF methods are not useful as a guide to planned sample-collection activities, and they will not be used to screen surface and subsurface soil/rock samples.

4.9.3 Radioactivity

Radiation screening of all samples will be used for health and safety purposes and for identifying samples for laboratory analysis. All samples will be continuously field screened ~~for gross alpha and~~ using an Eberline
E-600/SHP380AB. The field screening ~~-~~detects both alpha and undifferentiated beta/gamma gross readings ~~for beta/gamma radiation. There is no real-time field-screening method for tritium.~~ Specific radionuclides are not identified by the ~~an~~ Eberline E-600/SHP380AB. It does~~,~~ identify~~ies~~ alpha, beta, or gamma radiation activity that may be indicators of radionuclides present at MDA A.
The radionuclides thought to be present at MDA A are alpha radiation emitters (americium-241, plutonium-239/240, plutonium-238, and isotopic uranium) and beta emitters (strontium-90 and tritium).

4.10 Field Analytical Screening

4.10.1 HE Field Analytical Screening

~~No field analytical screening is proposed for the MDA A investigation. There are no documented processes that involve HE at MDA A.~~ Because of~~Due to~~ the period of operation at MDA A, if HE is present~~,~~ it is most likely to contain RDX or TNT. Strategic Diagnostics, Inc., D-Tech ~~RDX~~ immunoassay test kits will be used to field screen both soil and tuff samples for RDX and TNT. Immunoassay field screening results will be recorded on the field boring logs. A field duplicate sample will be screened with every set (typically 10) of characterization samples. Field calibration standards for quantitative field screening methods will be run daily or as prescribed in the manufacturer's instructions. The quantitative field analytical methods for RDX and TNT are EPA SW-846 Methods 4051 and 4050, respectively (EPA 1997, 57589). The detection limit for RDX and TNT in soils is approximately 1 ppm.

For ~~all~~ boreholes 2 through 10, and all DP slope surface samples, the upper 20% of highest detections for the samples from each borehole, based upon the highest field analytical screening, will be selected for explosive compounds analysis at an off-site laboratory. If there are no field analytical screening detections for HE (RDX and TNT) in a given borehole, 20% of the samples identified for off-site analyses (based upon other criteria) will be selected for explosives analyses. Explosive analyses will be required~~are mandatory~~ for all subsurface samples from~~on~~ borehole 12~~.~~ ~~No HE field analytical screening will be performed on surface and near-surface soil/sediment samples.~~

~~%a~~ (see Section 4.11).

4.10.2 PCB Field Analytical Screening

~~of~~Visual and olfactory field observations will be recorded on field boring logs for each sampling location. Strategic Diagnostics, Inc. RaPID Assay® enzyme immunoassay test kits will be used to field screen both soil and tuff samples for total PCBs. ~~-~~A field duplicate sample will be screened with every set (typically 10) of characterization samples analyzed. The field analytical method for total PCBs (as Aroclor 1254) is EPA SW-846 Method 4020. The test kit detection limit for total PCBs is 0.5 ppm~~arts per million~~. ~~-~~Surface soil and subsurface soil or tuff samples will be field screened for PCBs in accordance with SOP 10.01,~~,~~ ~~"~~Screening for Polychlorinated Biphenyls in Soil.~~".~~

PCB field analytical screening will be performed on all samples collected from boreholes 2 through 10 and borehole 12. All samples with field analytical detections will be selected for analysis of PCBs at an off-site laboratory. ~~-~~Boreholes 6 and 8 will have samples selected for PCBs analysis at the native soil contact (beneath the cover/fill) and from the base of the disposal units, even if there are no field analytical screening detections at these depths. ~~-~~All subsurface samples collected from borehole 12 will be analyzed for PCBs. No PCB field analytical screening will be performed on surface and near-surface soil/sediment samples (see Section 4.11).

~~(see 4.11)~~

~~%~~

4.11 Analytical Suites

4.11.1 Tuff, Soil, and Sediment Samples

Borehole Sampling Locations

S~~All s~~oil/tuff samples collected from the boreholes adjacent to the disposal pits (boreholes 2 through 10 and borehole 12) ~~-~~will be analyzed for the full analytical suite specified in §IV.C.2.c.~~ii.~~v.6 of the Consent Order. This suite includes VOCs (pore-gas only) ~~VOCs,~~ SVOCs, explosive compounds, pH, PCBs, dioxins/furans, nitrates, perchlorate, total uranium, target analyte list (TAL) metals, and cyanide~~. In addition, total iodide analyses and radionuclide analyses will be performed. The radionuclide analyses include gamma spectroscopy and isotopic analyses of americium, plutonium, uranium, strontium, and tritium. Explosive compounds, dioxin/furans, and polychlorinated biphenyl (PCB) analyses will not be performed as there is no operational history to indicate that these materials were disposed of at MDA A (Table 2.4-1). However, if analytical results from the MDA B investigation identifies these chemicals, the MDA A analytical program will be modified. Dioxin/furan analyses will only be performed if the MDA T investigation documents the presence of dioxins/furans. If present at MDA T, then MDA A core samples collected from depths that represent the former operational surface of MDA A will be analyzed for dioxins/furans. A summary of the borehole soil/tuff analytical requirements for MDA A is provided in Table 4.11-1.~~

Volatile organic compound~~OC~~ analyses of pore-gas samples will be performed in lieu of VOC analyses of soil and tuff samples. ~~–~~Explosive compounds will be performed on the upper 20% of samples based on field analytical results. ~~-~~Polychlorinated biphenyls~~CB~~ analyses will be performed on selected samples from boreholes 6
and 8 and all subsurface samples from borehole 12. Dioxin/furan analyses will be performed on native soil samples representing the former MDA A landfill surface (samples collected from the native soil directly beneath the cover/fill as determined from subsurface augering), and on samples collected from

the depth interval corresponding to the base ~~of each~~ of each waste unit (central pit and eastern pits) from all boreholes adjacent to the waste units (boreholes 2 through 10 and borehole 12).~~.~~ In addition to the analyses required in §IV.C.2.ci.v.6 of the Consent Order, total iodide analyses and radionuclide analyses will be performed. The radionuclide analyses include gamma spectroscopy and isotopic analyses of americium, plutonium, uranium, strontium, and tritium (pore-gas only).

B~~In b~~orehole 12, located directly adjacent to the central pit and between the two eastern pits (Figure 4.4-1),~~ and~~ will be drilled to the Cerro Toledo interval and~~,~~ is the most likely to encounter possible migrated contaminants. All subsurface samples collected from borehole 12 will be analyzed for full analytical suites as described above including total iodide and radionuclide analyses. In addition to sample intervals selected based upon field screening and field analytical screening results, samples in borehole 12 will be collected at ~~from~~ (1) ~~at~~ the ~~ee~~base of the eastern pits, (2) ~~at~~ the base of the central pit, (3) ~~at~~ the highest permeability zone, and (4) the total depth of the borehole. Volatile organic compund~~OC~~s analyses will be performed on pore-gase samples in lieu of core samples. A summary of the borehole soil/tuff analytical requirements for MDA A is provided in Table 4.11-1.

Soil/Sediment Sampling Locations

All soil and sediment samples collected from the hillslope will be analyzed for SVOCs, pH, perchlorate, ~~total uranium~~, TAL metals, and cyanide~~, and TAL metals~~. Explosive compounds analyses will be performed on the upper 20% of samples based on field analytical results. In addition, total iodide analyses and radionuclide analyses will be performed. The radionuclide analyses include gamma spectroscopy and isotopic analyses of americium, plutonium, uranium, strontium, and tritium. ~~Explosive compounds and PCB analyses will not be performed as there is no operational history to indicate these types of chemicals were disposed of at MDA A (Table 2.4-1).~~

VOC analyses will not be requested for surface and near-surface soil samples for the following reasons: (1) historical surface soil data from the MDA A area of influence indicate that VOCs are not COPCs in the hillslope surface, (2) low vapor pressure organic compounds are unlikely to have been retained in the upper 6 in. of hillslope soil over the last 20 yr since the MDA A cover was emplaced, and (3) the surface soil on the MDA A cover was imported crushed tuff and not representative of site conditions.

Dioxins/furans analyses will not be requested for the surface and near-surface samples ~~for the following reasons:~~because ~~-~~(1) within the MDA A perimeter fence, the surface samples represent~~s~~ imported tuff that would not have been impacted by historical operations at MDA T, and (2) hillslope surface samples are a distance away from MDA T and not likely to have been impacted.

PCBs analysis will not be requested for surface and near-surface samples because~~ for the following reasons:~~ (1) ~~)~~ within the MDA A perimeter fence, the surface samples represent imported tuff, ~~–~~and (2) PCBs are relatively insoluble ~~-~~and would not ~~be~~ likely be transported from beneath the cover/fill material to the surface of the hillslope adjacent to MDA A.

~~Explosive comounds analysis will not be requested for surface and near-surface soil samples for the following reasons: (1) within the MDA A perimeter fence, the surface samples represent imported tuff, (2) explosive compounds would not be likely transported from beneath the cover/fill material to the surface of the hillslope adjacent to MDA A, and (3) biodegradation and chemical weathering of the potential explosives compounds over the last 20 years since the MDA A cover was emplaced.~~

A summary of the surface/near-surface analytical requirements for MDA A are provided in Table 4.11-1.

4.11.2 Pore-gas Monitoring and ~~Vapor~~ Sampling~~es~~

Pore-gas samples will be collected from all the boreholes for field measurements of percent oxygen, organic vapors, percent carbon dioxide, and static subsurface pressure. Vapor samples will also be collected for laboratory analysis of percent moisture, VOCs, and tritium. Details of the sample collection procedures ~~and analyses~~ are provided in Section 5.5 and comply with the requirements of §IX.B.2.g of the Consent Order.

4.11.3 Groundwater Samples

Groundwater samples from wells in DP, Pueblo, and Los Alamos Canyons are collected as part of the interim site-wide monitoring program. In addition, any perched groundwater encountered during the implementation of the field investigation described in this work plan will be analyzed for perchlorate, total uranium, TAL metals, cyanide, VOCs, SVOCs, and explosive compounds. In addition, the groundwater samples will be analyzed for total iodide, pH, americium-241, isotopic plutonium, isotopic uranium, strontium-90, tritium, and gamma spectroscopy.

4.12 Geotechnical Testing

Tuff samples will be collected above the Qbt2/Qct contact and analyzed for permeability. Borehole 12 is proposed to intercept this contact. Permeability analyses from MDA T proposed Borehole 2 and Borehole 3, located 300 and 500 ft east of MDA A, respectively, and from MDA U proposed borehole BH-4, located 430 ft east of MDA A, will provide additional permeability data (LANL 2004, 85641; LANL 2004, 87454.3). Additional geotechnical data collected from cores at MDA T, such as saturated and unsaturated hydraulic conductivity, porosity, partition coefficient, bulk density, permeability, and moisture content, will also support future transport modeling.

4.13 Justification of Alternate Scope of Work

The proposed work scope contains differences from that presented in the proposed Consent Order. The proposed alternatives are detailed in Table 4.13-1, along with a justification for each alternative. The significant deviations from the proposed Consent Order are described below.

- No direct characterization of the waste pit inventory. The MDA B investigation will trench the waste pits and characterize waste inventory. Since the MDA B pits were filled with a continuation of the TA-21 waste stream originally placed in MDA A pits, the MDA B investigation should provide adequate information about the waste pit inventory at MDA A. The MDA B inventory will be used to identify additional COPCs at MDA A.

- A reduction from three to one deep borehole penetrating the Cerro Toledo interval at MDA A. Additional boreholes are not necessary because of MDA A's proximity to MDA T proposed deep Boreholes 2 and 3, which are less than 300 and 500 ft west of MDA A, respectively (LANL 2004, 85641). In addition, the MDA U deep borehole, BH-4, is located 430 ft east of MDA A (LANL 2004, 87454.3). With an approximate 350 ft depth to the Cerro Toledo at MDA A, the boreholes at MDA T and MDA U are sufficiently proximate to MDA A to define nature and extent of contamination encountered at depth by drilling a single borehole within the MDA A boundary. As a result, only one additional sample will be collected for permeability analyses from the tuff overlying the Qbt2/Qct contact.

- Proposed COPC-specific analyte list for tuff, soil, and sediment samples. Analyses for explosive compounds and PCBs will be performed on selected -samples based upon field analytical screening. –Volatile organic compounds~~OC~~ analyses of pore-gas samples will be performed in lieu of VOC analyses of core samples. -Polychlorinated biphenyls ~~CB~~ and dioxin/furan analyses will be performed on the original MDA A surface samples and depth intervals near the base of waste units only in boreholes 6 and 8.~~Specifically, there is no operational information to indicate that explosive compounds, PCBs, or dioxin/furans were disposed of in the MDA A pits. If these explosive compounds or PCBs are detected in the MDA B investigation, and/or if dioxin/furans are detected in the MDA T investigation, the MDA A analyte list will be modified.~~ All native soil and rock samples in b~~B~~orehole 12 will also be analyzed for PCBs and dioxins/furans. Additional analyses for total iodide and radionuclides have been proposed because of the nature of suspected waste at the site.

- All boreholes will be continuously cored to TD. Continuous coring is preferable for fracture analysis and identification of perched zones, and it provides better stratigraphic data than sample collection at discrete intervals. Discrete samples will be collected from specific depths and submitted for analytical testing.

- Installation and monitoring of any regional groundwater wells associated with MDA A will be performed in conjunction with the Laboratory hydrogeologic work plan (LANL 1998, 59599). However, perched groundwater monitoring wells will be installed if saturated conditions are encountered.

5.0 INVESTIGATION METHODS

The current versions of the ENV-ECR~~S~~ SOPs, QPs, and the ENV-ERS Quality Management Plan, which are available at http://erproject.lanl.gov/documents/ procedures.html, are applicable to the investigation methods proposed in this investigation work plan and are detailed in Table 5.0-1. Additional procedures may be added as necessary to describe and document quality-affecting activities.

- SOP-01.01 General Instructions for Field Investigations
- SOP-01.02 Sample Containers and Preservation
- SOP-01.03 Handling, Packaging and Transporting Field Samples
- SOP-01.04 Sample Control and Field Documentation
- SOP-01.05 Field Quality Control Samples
- SOP-01.06 Management of Environmental Restoration Project Wastes
- SOP-01.08 Management of Environmental Restoration Project Wastes
- SOP-01.10 Waste Characterization
- SOP-02.01 Surface Water Site Assessments
- SOP-03.11 Coordinating and Evaluating Geodetic Surveys
- SOP-04.01 Drilling Plan Development
- SOP-04.04 Contract Geophysical Logging
- SOP-05.07 Operation of LANL Owned Borehole Logging Trailer
- SOP-06.01 Purging and Sampling Methods for Single Completion Wells
- SOP-06.03 Sampling for Volatile Organic Compounds in Groundwater
- SOP-06.09 Spade and Scoop Method for the Collection of Soil Samples
- SOP-06.10 Hand Auger and Thin-Wall Tube Sampler
- SOP-06.24 Sample Collection from Split-Spoon Samplers and Shelby-Tube Samplers
- SOP-06.26 Core-Barrel Sampling for Subsurface Earth Materials
- SOP-06.31 Sampling of Subatmospheric Air

- SOP-06.33 Headspace Vapor Screening with a Photoionization Detector
- SOP-07.05 Subsurface Moisture Measurements Using a Neutron Probe
- SOP-10.14 Performing and Documenting Gross Gamma Radiation Scoping Surveys
- SOP-12.01 Field Logging, Handling, and Documentation of Borehole Materials
- QP-2.2 Personnel Training Management
- QP-3.4 Corrective Action Process
- QP-4.4 Record Transmittal to the Records Processing Facility
- QP-4.12 Documenting Oral Communication
- QP-5.2 Control of Measuring and Test Equipment
- QP-5.3 Readiness Planning and Reviews
- QP-5.7 Notebook Documentation for Environmental Restoration Technical Activities
- QP-7.1 Procurement
- QP-7.2 Supplier Evaluation
- QP-10.3 Stop Work and Restart
- QMP Quality Management Plan for LANL RRES-RS Project

Additional procedures utilized:

- ESH-1-07-85, R.1 Operational Checks of Beta/Gamma Survey Instruments
- ESH-1-07-89.1, R.Operational Checks of Alpha/Beta Dual Use Probes
- HSR1-INS-009 Radiation Detection Instrument Manual

5.1 Drilling Methods for Boreholes

All boreholes will be drilled using the hollow-stem auger method because it allows for collecting undisturbed samples of core and subsurface vapors within the Tshirege Member of the Bandelier Tuff. Each borehole will be logged with caliper, camera, neutron and natural gamma tools according to the current revision of ~~ENV-RS-~~SOP-04.04.

The boreholes will be drilled using a hollow-stem drilling rig with 10-in.-diameter auger flights with a split-core barrel sampler to TD. A hollow-stem auger consists of a hollow steel shaft with a continuous spiraled steel flight welded onto the exterior site of the stem. The stem is connected to an auger bit, and it transports cuttings to the surface when it is rotated. The hollow stem of the auger allows drill rods, split-spoon core barrels, Shelby tubes, and other samplers to be inserted through the center of the auger so the samples may be retrieved during drilling operations. The hollow stem also acts to case the borehole temporarily so that the casing (riser) may be inserted through the center of the augers once the desired depth is reached, thus minimizing the risk of possible borehole collapse. A bottom plug or pilot bit can be fastened onto the bottom of the augers to keep out most of the soils and/or water that tend to clog the bottom of the augers during drilling. Drilling without a center plug is acceptable provided that the soil plug formed in the bottom of the auger is removed before sampling or installing well casings. The soil plug can be removed by washing out the plug using a side-discharge rotary bit or by augering out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger.

If drilling difficulties or refusal is encountered in any borehole, the drilling will be converted to air-rotary drilling. The air-rotary method uses a drill pipe or drill stem coupled to a drill bit that rotates and cuts

through soil and rock. The cuttings produced from the rotation of the drilling bit are transported to the surface by compressed air, which is forced down the borehole through the drill pipe and returns to the surface through the annular space (between the drill pipe and the borehole wall). The circulation of the compressed air not only removes the cuttings from the borehole but also helps to cool the drill bit. The air-rotary drilling method is best suited for hard rock formations. In soft unconsolidated formations, casing is driven to keep the formation from caving. When using the air-rotary method, the air compressor will have an in-line organic filter system to filter the air coming from the compressor. The organic filter system will be inspected regularly to ensure that it is functioning properly. In addition, a cyclone-velocity dissipator or similar air-containment/dust-suppression system will be used to funnel the cuttings to one location instead of allowing the cuttings to discharge uncontrolled from the borehole. An air-rotary method that employs the dual-tube (reverse circulation) drilling system is acceptable because the cuttings are contained within the drill stem and are discharged through a cyclone-velocity dissipator to the ground surface.

A minimum of six~~six~~ samples per borehole (nine~~eight~~ if a borehole is greater than 100 ft in TD) will be collected as specified in Section 4.5. Samples may be collected at additional depths depending upon field screening and field analytical screening results. All samples will be field screened for VOCs and radioactivity. Field analytical screening will be performed ~~on all borehole samples~~ for HE (RDX and TNT) and PCBs on~~for~~ samples collected from boreholes 2 through 10 and borehole 12. In addition, the samples will be visually inspected and geologically logged. All drilling activities will be performed in accordance with appropriate Laboratory procedures to ensure health and safety issues are reviewed and addressed during field operations.

The three~~one~~ angled boreholes (b~~B~~oreholes 1, 14, and 16) beneath the General's Tanks will be installed in such a way as to collect a representative sample below the tank bottoms, while maintaining the necessary margin of safety to ensure that the tanks are not contacted. The integrity of the General's Tanks will be ensured with (1) a combination of field surveys prior to drilling, (2) initiation of the borehole a minimum of 20 ft from the ends of each tank and located between the two tanks, and (3) drilling at a 45° angle to preclude contact with the bottom of either tank. ~~A paired vertical borehole (Borehole 14) will be drilled to determine the vertical extent of potential chemical or radiological releases from the General's Tanks.~~

The exact location of each borehole will be determined using GPS field surveys of the pits and General's Tanks boundaries, utility locations identified as part of the excavation permitting process, and other access-restrictive surface conditions. In addition, the location of each borehole will be determined after extensive and careful review of the potential risks and access limitations. Pits, vertical shafts, and General's Tanks boundaries will be mapped using a differential GPS survey, following the current revision ~~of ENV-RS-~~SOP-03.11, to further refine borehole locations. A line location survey will also be conducted to further define potentially dangerous utility lines in the work area. Each location will be thoroughly examined to identify potential hazards for subsurface drilling. All boreholes will be field-verified, surveyed in advance relative to disposal features, and recorded in field notebooks.

All boreholes will be advanced at least 20 ft below the base of the nearest disposal unit and a vertical depth of 25 ft below the last field-screening or field analytical screening detection.

5.2 Collection of Tuff Samples

All boreholes will be cored continuously to TD. The cores will be geologically logged to TD following the current versions of ~~ENV-RS-~~SOP-04.01 and ~~ENV-RS-~~SOP-12.01. Following the current revision of ~~ENV-RS-~~SOP-06.26, subsurface tuff samples will be collected from core retained in a split-spoon core

barrel and placed into sealed sleeves or core-protect bags to preserve core moisture. The analytical suites for the samples from each borehole are listed in Table 4.11-1.

The primary field screening methods to be used include (1) visual examination, (2) radiological screening, and (3) vapor screening for VOCs. In addition, field analytical screening will be performed ~~on all samples frol all boreholes~~ for HE
(RDX and TNT) and PCBs on samples collected from boreholes adjacent to the disposal pits (boreholes ~~-~~2 through 10 and 12) ~~for PCBs~~.~~All boreholes will be advanced 25 ft beyond the last field-screening detection~~.

~~Radiological screening shall target gross alpha, beta, and gamma radiation. Field screening for alpha, beta, and gamma radiation will be conducted within 6 in. from the core material. All instrument background checks, background ranges, and calibration procedures will be documented daily in the field logbooks.~~All borehole samples will be continuously field screened using an Eberline E-600/SHP380AB ~~-~~to detect both alpha and undifferentiated beta/gamma gross readings. Core samples are screened by holding the probe <1 ~~-~~in.~~ch~~ away from the core. The core will be screened immediately after removal from the ground and before logging, sampling, etc. Measurements are determined by a quick scan to find the highest initial reading, After logging the core, a 1-min.~~one-minute~~ reading will be performed to ~~-~~determine gross alpha and beta/gamma radiation levels. All screening data will be recorded on the Radiation Control Technician field log as well as the lithologic boring logs. Procedures for equipment calibration, QA/QC, background determination, and instrument use are included in the following:

- ESH-1-07-85, R.1 ~~"~~Operational Checks of Beta/Gamma Survey Instruments~~"~~
- ESH-1-07-89.1 ~~"~~Operational Checks of Alpha/Beta Dual Use Probes~~"~~
- HSR1-INS-009 ~~"~~Radiation Detection Instrument Manual~~"~~

Vapor screening of subsurface core for VOCs will be conducted using a PID equipped with an 11.7 electron volt lamp. The maximum value and the ambient air temperature will be recorded on the field borehole ~~or test pit~~ log for each sample. The PID will be calibrated each day to the manufacturer's standard for instrument operation (all daily calibration results will be documented in the field logbooks). Field screening for VOCs will be accomplished using headspace analysis on 10-ft intervals in each borehole.

All field analytical screening methods will be performed in accordance with ~~the~~ EPA methods and manufacturers' instructions.

All boreholes will be advanced 25 ft beyond the last field-screening or field analytical screening detection. ~~The boreholes will be advanced 25 ft beyond any positive detection by field screening.~~ If a positive field-screening result is detected within 25 ft of the target depth, the borehole will be advanced in 10-ft intervals until no positive field-screening result is detected over a 25-ft interval.

Based on this field screening and field analytical screening, samples with the highest ~~field~~ screening results and with the deepest detected ~~field~~ screening results will be submitted for laboratory analysis. Samples collected at key locations (e.g., below the base of each waste unit, fracture zones, TD, etc.) will also be submitted for laboratory analysis, regardless of screening results. All samples submitted to the laboratory will be analyzed for the constituents listed in Table 4.11-1.

Quality assurance (QA)/QC samples will include (1) field duplicate samples to evaluate the reproducibility of the sampling technique and (2) rinsate blanks to evaluate decontamination procedures. These samples

will be collected following the current revision of ~~ENV-RS-~~SOP-01.05 and will comply with a field duplicate collection frequency of 10% of total samples collected.

Following the current version of ~~ENV-RS-~~SOP-12.01, field documentation of samples collected from fractures will include a detailed physical description of the fracture-fill material and rock matrix sampled. The volumes of fracture-fill and rock-matrix material included in the sample will be estimated from field measurements. An additional sample will be collected from the rock matrix adjacent to the fracture sample material, thus allowing for comparison.

Field documentation will also include detailed borehole logs for each borehole drilled. The borehole logs will document the matrix material in detail and will include the results of all field screening; fractures and matrix samples will be assigned unique identifiers. Field documentation will be completed in accordance with the current revision of ~~ENV-RS-~~QP-5.7.

5.3 Collection of Soil and Sediment Samples

While surface samples will be collected during drilling activities (collected from the 0- to 0.5-ft interval of the core barrel), the most common method for collecting surface and near-surface soil samples will be the spade-and-scoop method, as described in the current revision of ~~ENV-RS-~~SOP-06.09. All soil and sediment samples will be collected from two sample depths, 0–0.5 ft and 1.5–2.0 ft. Stainless-steel shovels, spades, scoops, and bowls will be used for ease of decontamination. Disposable tools made of polystyrene or Teflon will also be used, if necessary. In some cases, hand-augering tools will be used to collect shallow subsurface samples if geologic material conditions permit. The tools to be used and their applicability is described in the current version of ~~ENV-RS-~~SOP-06.10. If the surface location is at bedrock, an axe or hammer and chisel will be used to collect samples.

Soil and sediment samples will be field screened for health and safety purposes prior to collection, then placed in zippered bags and/or sample jars as grabs derived from hand augers, scoops, or chiseling devices, in accordance with the sampling guidance document and appropriate ~~ENV-RS-~~SOPs (the SOP-01.01 through SOP-01.08 series).

5.4 Collection of Geotechnical Data

All boreholes will be cored continuously to TD and will be geologically logged in accordance with American Society for Testing and Materials (ASTM) D2487 and ASTM D2488, including lithology, apparent moisture, structural features, and core recovery compared to interval drilled, per the current versions of ~~ENV-RS-~~SOP-12.01 and ~~ENV-RS-~~SOP-04.01. Rock quality designation (RQD) will also be documented in the field. The RQD is expressed as a percentage of solid core obtained and is defined as the collective length of core in excess of 2 by 4 in. The RQD is dependent upon the strength and number of discontinuities in the rock mass. Low RQDs reflect incompetent, heavily fractured, or sandy formations. High RQDs indicate competent formations. If the RQD is consistently decreasing in a borehole, then brass sleeves will be used to enhance core recovery. At b~~B~~orehole 12, brass sleeves will be used in the relatively unconsolidated Cerro Toledo interval to improve recovery and maintain structural integrity for geophysical characterization, and permeability analyses will be performed on tuff samples collected above the Qbt2/Qct contact using analytical methods specified by contract requirements of the Laboratory's Sample Management Office (SMO) (LANL 2000, 71233). QC will conform to the applicable ASTM methods.

5.5 Collection of Pore-Gas Samples for VOC Analyses

Subsurface pore-gas ~~vapor~~ samples will be collected~~-~~ from all boreholes in compliance with the requirements of §IX.B.2.g of the Consent Order ~~-and~~~~in accordance with~~ the current version of ~~ENV-RS-~~ SOP-06.31~~,~~. Pore-gas samples will be collected after allowing for equilibration of pore gases at the completion of drilling activities. In each borehole, pore-gas ~~one~~ samples will be collected at each ~~the~~ depth interval where core samples were selected for off-site laboratory analyses~~of the nearest adjacent disposal unit; the second sample will be collected at TD~~ (pore-gas VOC analyses are performed in lieu of VOC analyses on core samples). ~~.~~ Pore-gas samples will be collected using a straddle packer to isolate discrete depths within the borehole. Each interval will be purged prior to sampling until measurements of carbon dioxide and oxygen are stable and representative of subsurface conditions. 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 (carbon dioxide and oxygen) are monitored continuously during this pre-sampling cycle. Once indicator gas concentrations are stable, proper purge is achieved and formation vapor sampling can proceed. Subsurface pore-gas samples will be collected in SUMMA canisters and submitted for VOC analysis using EPA Method TO-15~~4~~.

QA/QC samples for VOCs in pore gas will consist of an equipment blank and field duplicate. After sampling and purge decontamination, the equipment blank will be collected by pulling zero gas (99.9% ultrahigh purity nitrogen) through the packer sampling apparatus. This sample will be used to evaluate decontamination procedures. The field duplicate sample will be used to evaluate the reproducibility of the sampling technique. QA/QC samples will be collected according to the current version of ~~ENV-RS~~ SOP-01.05.

5.6 Collection of Pore-Gas Samples for Tritium Analyses

Pore-gas samples will be collected in all boreholes for tritium analyses~~ will be collected~~ at the same depth interval as those collected for VOC pore~~-g~~ gas ~~in conjunction with the samples for VOC~~ analysis~~es from two depths in all proposed boreholes~~. These samples will be collected by pulling pore gas through columns filled with absorbent silica gel, following the current version of ~~ENV-RS~~ SOP-06.31. After allowing time for equilibration, the newly drilled~~completed~~ boreholes will be sampled ~~at the depth equal to the base depth of the adjacent disposal unit and at TD. Samples from the newly completed boreholes will be collected~~ using an inflatable straddle packer. All samples will be analyzed at an off-site fixed laboratory by EPA Method 906.0. QA/QC samples and field duplicates will be collected per applicable SOPs.

5.7 Collection of Perched Water Samples

During drilling operations, zones of elevated moisture content, localized saturation, and groundwater may be encountered. These zones may not be assignable to either an alluvial or regional groundwater system and may represent a localized phenomenon. If saturation is encountered as a borehole advances, drilling will be stopped to determine if sufficient water volume is available for analyzing the water quality. Generally, the total water volume required is approximately 0.5–1 L. If this minimum volume of groundwater cannot be collected, the borehole will be advanced to the targeted depth or until saturation is encountered again and the process is repeated, or until the required TD is achieved. A porous cup lysimeter or absorbent membrane will be installed at the depth of saturation to monitor the zone if the borehole is completed for pore-gas monitoring. Insufficient water sample volumes from discrete depths will not be composited to make up the required volume for screening analysis.

If a sufficient volume exists, a groundwater sample will be collected and analyzed for metals, anions, perchlorate, alkalinity, total organic carbon, total inorganic carbon, and total dissolved solids, on a rapid turnaround basis at a LANL-certified geochemistry laboratory. Typically, results of groundwater screening samples are available within 48 hr. During this time, the borehole may be advanced to the targeted depth, and the perched zone (and any subsequent perched zones encountered during drilling) will be isolated to prevent downhole migration.

Geophysical logging of the borehole will determine the thickness of the zone of saturation and the characteristics of the perching horizon. A monitoring well will be designed and submitted to NMED for approval. Following approval of the design, the well will be installed and a groundwater monitoring plan, consistent with the requirement of §IV.C.2.c.vii of the Consent Order, will be included in the MDA A investigation report.

5.8 Borehole Abandonment

All boreholes, except those identified for completion as vapor-monitoring wells or perched groundwater-monitoring wells, will be abandoned in accordance with §X.D of the Consent Order by filling the borehole with a bentonite/concrete mixture. A tremie pipe will be used to fill the boreholes upward from the bottom of the borehole to the surface. All cuttings will be managed as investigative-derived waste as specified in Appendix B of this document. All borehole abandonment information will be provided in the MDA A investigation report.

~~Backfilling (abandonment) of boreholes will be conducted according to the current version of ENV-RS-SOP-05.03. The procedure takes into account any subsurface characteristics (perched zones, etc.) requiring isolation if the decision to abandon versus installing a well has been made. The use of backfill materials such as bentonite and concrete will be documented in a field logbook with regard to volume (calculated and actual), intervals of placement, and additives used to enhance backfilling.~~

5.9 Equipment Decontamination

Following drilling and sampling activities, project personnel will decontaminate all equipment involved in drilling and sampling activities. Residual material adhering to equipment will be removed using dry decontamination methods such as the use of wire brushes and scrapers (~~ENV-RS-~~SOP-01.08). If equipment cannot be free-released using dry decontamination methods, wet decontamination methods will be used. Pressure washing of equipment will be performed on a temporary decontamination pad with a high-density polyethylene liner. Cleaning solutions and wash water will be collected and contained for proper disposal. Decontamination solutions will be sampled and analyzed to determine the final disposition of the wastewater and the effectiveness of the decontamination procedures. All parts of the drilling equipment, including the undercarriage, wheels, tracks, chassis, and cab, will be thoroughly cleaned. Air filters on equipment operating in the exclusion zone will be considered contaminated and will be removed and replaced before equipment leaves the site. Equipment ready for demobilization will be surveyed by a Health and Safety Radiation Control Division technician before it is released from the site.

6.0 ONGOING MONITORING AND SAMPLING PROGRAM

Currently, there is no ongoing groundwater monitoring at MDA A. Existing wells will be sampled as part of the interim site-wide monitoring program; however, there are no plans to develop and maintain an active MDA A-specific groundwater monitoring program at this time. If groundwater is encountered and monitoring wells are installed, a formal groundwater monitoring program will be developed and submitted

to NMED for approval. However, all relevant data collected under the approved "Interim Facility-Wide Groundwater Monitoring Plan" (LANL 2005, 88789) will be included in the MDA A Investigation Report.

Although vapor-monitoring wells may be installed as part of the activities proposed in this investigation work plan, the implementation of a formal vapor-monitoring program is not anticipated. The results of the investigation will determine if a vapor-monitoring program is warranted; if so, a vapor-monitoring plan will be developed and submitted to NMED for approval.

7.0 SCHEDULE

The ~~planned date for~~ submittal of the MDA A investigation work plan to NMED wa~~i~~s January 31, 2005. A 105-day approval period of the plan by NMED would allow field activity preparation and performance to commence. The start of fieldwork (any intrusive sampling within the MDA A proper) is dependent upon the finalization of the authorization basis documentation process required for this Hazard Category 2 nuclear facility environmental site (Section 4.1). Preparation activities and implementation of the fieldwork are anticipated to require approximately 90 days through demobilization from the site. Sample submittals to the SMO should be completed by that time. Receipt of investigation results is anticipated 30 days after demobilization. The MDA A investigation report is scheduled to be submitted by August 31, 2006.

8.0 REFERENCES

The following list includes all documents cited in this work plan. Parenthetical information following each reference provides the author, publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the ENV-RS Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the ENV-RS project reference set titled "Reference Set for Material Disposal Areas, Technical Area 21."

Copies of the reference sets are maintained at the NMED Hazardous Waste Bureau; the DOE Los Alamos Site Office; US EPA, Region 6; and the ENV-RS project. The sets were developed to ensure that the AA has all material needed to review this document, and they are updated periodically as needed. Documents previously submitted to the AA are not included.

AGS (Advanced Geological Services), December 4, 2003. "Geophysical Surveys of the Paleochannel Beneath MDAs T, A, and V at TA-21," report prepared for Washington Group International, Inc., by Advanced Geological Services, Malvern, Pennsylvania. (AGS 2003, 81176)

Balo, K. A., and J. L. Warren, December 1982. "Waste Management Site Plan," Los Alamos National Laboratory document LA-UR-82-3666, Los Alamos, New Mexico. (Balo and Warren 1982, 07205)

Bolton, J., January 30, 1952. "Location of Classified and Contaminated Dumps in Los Alamos Area," Los Alamos Scientific Laboratory memorandum to Carroll L. Tyler from John Bolton (Engineering), Los Alamos, New Mexico. (Bolton 1952, 00555)

Broxton, D., G. Heiken, S. Chipera, and F. Byers, Jr., June 1995. "Stratigraphy, Petrography, and Mineralogy of Bandelier Tuff and Cerro Toledo Deposits," in *Earth Science Investigations for Environmental Restoration—Los Alamos National Laboratory Technical Area 21,* D. Broxton and P. Eller, Eds., Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico, pp. 33–63. (Broxton et al. 1995, 50121)

Broxton, D., P. Longmire, P. Eller, and D. Flores, June 1995. "Preliminary Drilling Results for Boreholes LADP-3 and LADP-4," in *Earth Science Investigations for Environmental Restoration—Los Alamos National Laboratory Technical Area 21,* D. Broxton and P. Eller, Eds., Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico, pp. 93–109. (Broxton et al. 1995, 50119)

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, 05481)

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, 00484)

DOE (US Department of Energy), November 26, 2003. "New Categorization of Existing Nuclear Facilities at LANL," memorandum from Christopher M. Steele, Senior Authorization Basis Manager, DOE-LASO, to Jim Holt, Associate Laboratory Director of Operations, Los Alamos National Laboratory, Los Alamos, New Mexico. (DOE 2003, 87047)

Emelity, L. A., April 20, 1978. "Your Memo of 23 March 1978," Los Alamos Scientific Laboratory memorandum H7-78-143 to Margaret Anne Rogers (H-12) from L. A. Emelity (H-7 Alt. Group Leader), Los Alamos, New Mexico. (Emelity 1978, 00487)

Enders, J., July 1972 to December 1975. "Delivery of Material to Area A," Los Alamos Scientific Laboratory personal notes (handwritten), Los Alamos, New Mexico. (Enders 1972–1975, 00514)

Environmental Surveillance Group, April 1985, "Environmental Surveillance at Los Alamos During 1984," Los Alamos National Laboratory report LA-10421-ENV, Los Alamos, New Mexico. (Environmental Surveillance Group 1985, 06610)

EPA (US Environmental Protection Agency), December 1989. "Risk Assessment Guidance for Superfund Vol. I, Human Health Evaluation Manual (Part A)," Interim Final, EPA 540/89/002, Office of Solid Waste and Emergency Response, Washington, DC. (EPA 1989, 08021)

EPA (US Environmental Protection Agency), April 10, 1990. "Module VIII of RCRA Permit No. NM0890010515, EPA Region 6, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990," EPA Region 6, Hazardous Waste Management Division, Dallas, Texas. (EPA 1990, 01585)

EPA (US Environmental Protection Agency), April 19, 1994. "Module VIII of RCRA Permit No. NM0890010515, EPA Region 6, new requirements issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 19, 1994," EPA Region 6, Hazardous Waste Management Division, Dallas, Texas. (EPA 1994, 44146)

EPA (US Environmental Protection Agency), March 1996. "Use of the Area of Contamination (AOC) Concept During RCRA Cleanups," US Environmental Protection Agency memorandum from M. Shapiro, Director, Office of Solid Waste, and S. Luftig, Director, Office of Emergency, Washington, DC. (EPA 1996, 82288).

EPA (US Environmental Protection Agency), May 1997. "Test Methods for Evaluating Solid Waste, Laboratory Manual, Physical/Chemical Methods, SW-846," Third Edition, Update III, Washington, DC. (EPA 1997, 57589)

EPA (US Environmental Protection Agency), December 2003. "EPA Region 6 Human Health Medium Specific Screening Levels," EPA Region 6, Dallas, Texas. (EPA 2003, 81724)

EPA (US Environmental Protection Agency), August 2004. "EPA's Prior Decisions on SWMU/AOC Sites at Los Alamos National Laboratory (LANL)," Environmental Protection Agency memorandum to J. Bearzi, Chief, New Mexico Environment Department, Hazardous Waste Bureau, from L. F. King, Chief, EPA Federal Facilities Section (6PD-F), Dallas Texas. (EPA 2004, 87296)

Gerety, M., J. 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, 06893)

Goff, F., June 1995. "Geologic Map of Technical Area 21," in *Earth Science Investigations for Environmental Restoration—Los Alamos National Laboratory Technical Area 21,* D. Broxton and P. Eller, Eds., Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico, pp. 7–18. (Goff 1995, 49682)

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, 87457)

LANL (Los Alamos National Laboratory), May 17, 1986. "Surface Reconnaissance Data Sheet, Area A, DP, TA-21," Los Alamos National Laboratory data sheet produced by HSE-8 and HSE-12 (handwritten), Los Alamos, New Mexico. (LANL 1986, 00477)

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report: Los Alamos National Laboratory," Vol. II, prepared by International Technology Corporation, Los Alamos National Laboratory document LA-UR-90-3400, Los Alamos, New Mexico. (LANL 1990, 07512)

LANL (Los Alamos National Laboratory), May 1991. "TA-21 Operable Unit RFI Work Plan for Environmental Restoration," Vol. II, Los Alamos National Laboratory document LA-UR-91-962, Los Alamos, New Mexico. (LANL 1991, 07529)

LANL (Los Alamos National Laboratory), May 1991. "TA-21 Operable Unit RFI Work Plan for Environmental Restoration," Vol. III, Los Alamos National Laboratory document LA-UR-91-962, Los Alamos, New Mexico. (LANL 1991, 07680)

LANL (Los Alamos National Laboratory), January 28, 1994. "Phase Report IB, TA-21 Operable Unit RCRA Facility Investigation: Operable Unit-Wide Surface Soil, Deposition Layer and Filter Building Investigation, Vol. I of I," Los Alamos National Laboratory document LA-UR-93-4390, Los Alamos, New Mexico. (LANL 1994, 26073)

LANL (Los Alamos National Laboratory), November 1995. "Task/Site Work Plan for Operable Unit 1049: Los Alamos Canyon and Pueblo Canyon," Los Alamos National Laboratory document LA-UR-95-2053, Los Alamos, New Mexico. (LANL 1995, 50290)

LANL (Los Alamos National Laboratory), September 1996. "Final Report on Geophysical Investigation of Material Disposal Areas A and T (TA-21-016[a-c] and TA-21-011[c])," report prepared for Los Alamos National Laboratory by Geophex, Ltd., Los Alamos, New Mexico. (LANL 1996, 64694)

LANL (Los Alamos National Laboratory), 1997. "Interim Action Report for Potential Release Site 21-011(k) Discharge System Field Unit 1, April 1997," Los Alamos National Laboratory report, Los Alamos, New Mexico. (LANL 1997, 55648)

LANL (Los Alamos National Laboratory), September 1997, "Field Summary Report, 1994 Site Investigation Activities at Field Unit 1, TA-21, Material Disposal Area (MDA) A, PRS 21-014," Rev. 0, report prepared for Los Alamos National Laboratory by ERM/Golder, Los Alamos, New Mexico. (LANL 1997, 62292)

LANL (Los Alamos National Laboratory), March 1997. "Performance Assessment and Composite Analysis for Los Alamos National Laboratory Material Disposal Area G," Los Alamos National Laboratory document LA-UR-97-85, Los Alamos, New Mexico. (LANL 1997, 63131)

LANL (Los Alamos National Laboratory), May 1998. "Hydrogeologic Workplan, Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-01-6511, Los Alamos, New Mexico. (LANL 1998, 59599)

LANL (Los Alamos National Laboratory), November 1998. "Installation Work Plan for Environmental Restoration Project, Revision 7," Los Alamos National Laboratory document LA-UR-98-4652, Los Alamos, New Mexico. (LANL 1998, 62060)

LANL (Los Alamos National Laboratory), September 22, 1998. "Inorganic and Radionuclide Background Data for Soils, Sediments, and Bandelier Tuff at Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-98-4847, Los Alamos, New Mexico. (LANL 1998, 59730)

LANL (Los Alamos National Laboratory), December 1, 2000. "University of California Los Alamos National Laboratory (LANL), I8980SOW0-8S Statement of Work for Analytical Laboratories, SOW Revision 1," Los Alamos, New Mexico. (LANL 2000, 71233)

LANL (Los Alamos National Laboratory), July 17, 2001. "Surface Water Site Assessment for PRS 21-014," Los Alamos, New Mexico. (LANL 2001, 87375)

LANL (Los Alamos National Laboratory), February 2002. "Los Alamos and Pueblo Canyon Work Plan Addendum, Surface Water and Alluvial Groundwater Sampling and Analysis Plan," Los Alamos National Laboratory document LA-UR-02-759, Los Alamos, New Mexico. (LANL 2002, 70235)

LANL (Los Alamos National Laboratory), April 2002. "Characterization Well-R-7 Completion Report," Los Alamos National Laboratory report LA-13932-MS, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2002, 72878)

LANL (Los Alamos National Laboratory), December 2002. "Updates to the Radionuclide Screening Action Levels (SALs) Based on RESRAD 6.21," Los Alamos National Laboratory memorandum from R. Mirenda, RRES-R, to the RRES-R Risk Assessment Team, Los Alamos, New Mexico.(LANL 2002, 73705)

LANL (Los Alamos National Laboratory), June 2003. "Characterization Well-R-8 Completion Report," Los Alamos National Laboratory report LA-UR-03-1162, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2002, 79594)

LANL (Los Alamos National Laboratory), October 2003. "Voluntary Corrective Measure Completion Report for Solid Waste Management Unit 21-011(k) at Technical Area 21," Los Alamos National Laboratory document LA-UR-03-7297, Los Alamos, New Mexico. (LANL 2003, 82260)

~~LANL (Los Alamos National Laboratory), December 2003. "2003 Pollution Prevention Roadmap," Los Alamos National Laboratory document LA-UR-03-9021, Los Alamos, New Mexico. (LANL 2003, 85205)~~

LANL (Los Alamos National Laboratory), December 2003. "Los Alamos Canyon and Pueblo Canyon Intermediate and Regional Aquifer Groundwater Work Plan," Los Alamos National Laboratory document LA-UR-03-9191, Los Alamos, New Mexico. (LANL 2003, 82612)

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

LANL (Los Alamos National Laboratory), June 2004. "Investigation Work Plan for Solid Waste Management 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, 87291)

LANL (Los Alamos National Laboratory), June 2004. "Investigation Work Plan for Material Disposal Area B at Technical Area 21, Solid Waste Management Unit 21-015," Los Alamos National Laboratory document LA-UR-04-3713, Los Alamos, New Mexico. (LANL 2004, 87290).

~~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), August 2004. "TA-21 Delta Prime Site Aggregate Area Work Plan," Los Alamos National Laboratory document LA-UR-04-5009, Los Alamos, New Mexico. (LANL 2004, 87461)

LANL (Los Alamos National Laboratory), November 2004. "Investigation Work Plan for Material Disposal Area U, Solid Waste Management Unit 21-017(a)-99, at Technical Area 21," Los Alamos National Laboratory document LA-UR-04-7268, Los Alamos, New Mexico. (LANL 2004, 87454.3)

LANL (Los Alamos National Laboratory), December 2004. "2004 Pollution Prevention Roadmap," Los Alamos National Laboratory document LA-UR-04-8973, Los Alamos, New Mexico. (LANL 2004, 88465)

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, 87452)

LANL (Los Alamos National Laboratory), May 2005. "Interim Facility-Wide Groundwater Monitoring Plan," Los Alamos National Laboratory document LA-UR-05-3443~~XXXX~~, Los Alamos, New Mexico. ~~-~~(LANL 2005, 88789)

LASL (Los Alamos Scientific Laboratory), May 30, 1945. "Sanitary Sewers and Drains," Engineering Drawing ENG-C-2213, Los Alamos, New Mexico. (LASL 1945, 24459)

LASL (Los Alamos Scientific Laboratory), January 24, 1945. Engineering Drawing ENG-C-2076, sheet number 1 of 3, Los Alamos, New Mexico. (LASL 1945, 24448)

LASL (Los Alamos Scientific Laboratory), December 22, 1970. Engineering Drawing ENG-1266, Los Alamos, New Mexico. (LASL 1970, 24374)

LASL (Los Alamos Scientific Laboratory), July 1, 1973, "Radioactive Waste Management Site Plan," Los Alamos Scientific Laboratory report, Los Alamos, New Mexico. (LASL 1973, 08902)

LASL (Los Alamos Scientific Laboratory), March 1976. Engineering Drawing ENG-R-4457, Los Alamos, New Mexico. (LASL 1976, 24891)

Martin, M., July 1999. "A Qualitative Integration of Geophysical Methods," unpublished report prepared for the Summer of Applied Geological Experience (SAGE), Los Alamos, New Mexico. (Martin 1999, 87458)

Meyer, D. D., January 31, 1952. "Location of Contaminated Waste Burial Pits," Los Alamos Scientific Laboratory memorandum to Salvatore E. Russo (ENG-4) from Dean D. Meyer (H-1 Group Leader), Los Alamos, New Mexico. (Meyer 1952, 28154)

Meyer, D. 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 Dean D. Meyer (H-1 Group Leader), Los Alamos, New Mexico. (Meyer 1971, 00557)

McGinnis, P., February 3, 1976. "Activities at Area T, TA-21 During 1975," Los Alamos Scientific Laboratory memorandum to Margaret Anne Rogers (H-8) from Paul E. McGinnis (H-7), Los Alamos, New Mexico. (McGinnis 1976, 00954)

NMED (New Mexico Environment Department), December 1998. "Approval: Class III Permit Modification to Remove Ninety-Nine (99) Solid Waste Management Units from the Department of Energy/Los Alamos National Laboratory Permit NM0890010515," New Mexico Environment Department letter to T. Taylor, DOE LAAO, and J. Browne, LANL, from E. Kelley, NMED-HRMB, Santa Fe, New Mexico. (NMED 1998, 63042)

NMED (New Mexico Environment Department), August 2004. "Technical Background Document for Development of Soil Screening Levels, Revision 2.0, Appendix A: NMED Soil Screening Levels, Table A-1, Hazardous Waste Bureau, Groundwater Quality Bureau, and Voluntary Remediation Program," Santa Fe, New Mexico (NMED 2004, 85615)

~~NMED (New Mexico Environment Department), March 2005. "Final Compliance Order on Consent between NMED, the US Department of Energy, and the Regents of the University of California," Santa Fe, New Mexico. (NMED 2005 88207)~~

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 informal report LA-6779-MS, Los Alamos, New Mexico. (Nyhan et al. 1978, 05702)

Puglisi, A., February 13, 1996. "No Discharge Plan Required for Disposal of Sampling Tool Decontamination Rinse Water," Los Alamos National Laboratory memorandum (ESH-18/WQ&H-96-0057) from A. Puglisi (ESH-18), Los Alamos, New Mexico. (LANL 1996, 87472)

Purtymun, W. D., June 30, 1969. "Materials Waste Pit, Area 'A', TA-21—excavated April 1969," United States Geological Survey (USGS) letter to William Kennedy (H-6 Group Leader) from William E. Hale (District Chief, USGS), prepared by W. D. Purtymun, Los Alamos, New Mexico, (Purtymun 1969, 00519)

Purtymun, W. D., January 1995. "Geologic and Hydrologic Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs, and Surface Water Stations in the Los Alamos Area," Los Alamos National Laboratory report LA-12883-MS, Los Alamos, New Mexico. (Purtymun 1995, 45344)

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, 87456)

Reneau, S., June 1995. "Geomorphic Studies at DP Mesa and Vicinity," in *Earth Science Investigations for Environmental Restoration—Los Alamos National Laboratory Technical Area 21,* D. Broxton and P. Eller, Eds., Los Alamos National Laboratory report LA-12934-MS, Los Alamos, New Mexico, pp. 65–92. (Reneau 1995, 50143)

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 and II, Los Alamos Scientific Laboratory report LA-6848-MS, Los Alamos, New Mexico. (Rogers 1977, 05707)

Salazar, M., May 7, 1987. Untitled Los Alamos National Laboratory memorandum to Paul Jones (TA-21 Engineering Coordinator) from Miguel Salazar (HSE-7) to initiate work order to remediate MDAs A, V, U, and T at TA-21, Los Alamos, New Mexico. (Salazar 1987, 00491)

Shaw Environmental, Inc., November 8, 2004. "Interview and telephone conversation with David Moss regarding the pug mill and vertical shafts adjacent to the General's Tanks at Material Disposal Area A (MDA A)," and November 12, 2004 "Telephone conversation with David Moss regarding the date the vertical shafts adjacent to the General's Tanks at Material Disposal Area A (MDA A) were filled," Los Alamos, New Mexico. (Shaw Environmental, Inc., 2004, 87448)

Soll, W., and K. Birdsell, February 1998. "The Influence of Coatings and Fills on Flow in Fractured, Unsaturated Tuff Porous Media System," *Water Resources Research*, Vol. 34, No. 2, pp. 193–202. (Soll and Birdsell 1998, 70011)

Vaniman, D., November 30, 2004. Preliminary data re R-6 well location, personal communication (e-mail) between Devon Jercinovic (Shaw Environmental, Inc.) and David Vaniman (EES-6), Los Alamos, New Mexico. (Vaniman 2004, 87463)

Voelz, G. L., October 30, 1973. "Waste Storage Tanks," Los Alamos Scientific Laboratory memorandum to E. E. Wingfield (Chief, Operations Branch, AEC-LAAO) from George L. Voelz (Health Division Leader), Los Alamos, New Mexico. (Voelz 1973, 00483)

Warren, J., January 22, 1976. "Disposal Shafts at Area A and Area T," Los Alamos Scientific Laboratory memorandum H7-SW-682 to M. Wheeler and M. A. Rogers (H-8) from J. Warren (H-7), Los Alamos, New Mexico. (Warren 1976, 00508)

Wehling, C., April 16, 1991. "LDR Applicability for Investigation Derived Waste," US Environmental Protection Agency memorandum to S. Golian, Chief, Remedial Guidance Section, from C. Wehling, Solid Waste and Emergency Response Division, Washington, DC. (Wehling 1991, 87382)

Wheeler, M., June 21, 1976. “Test Borings at Area A, TA-21,“ Los Alamos Scientific Laboratory memorandum H8-WS-610 to file (H-8) from M. Wheeler (H-8), Los Alamos, New Mexico. (Wheeler 1976, 00486)

Wohletz, K. H., September 1995. “Fracture Characterization of the DP Tank Farm,” Los Alamos National Laboratory report, Los Alamos, New Mexico (Wohletz 1995, 58845)

Young, G., July 1999. “Applications of GPR at a Radioactive Waste Disposal Facility,” unpublished report prepared for the Summer of Applied Geological Experience (SAGE), Los Alamos, New Mexico. (Young 1999, 87459)

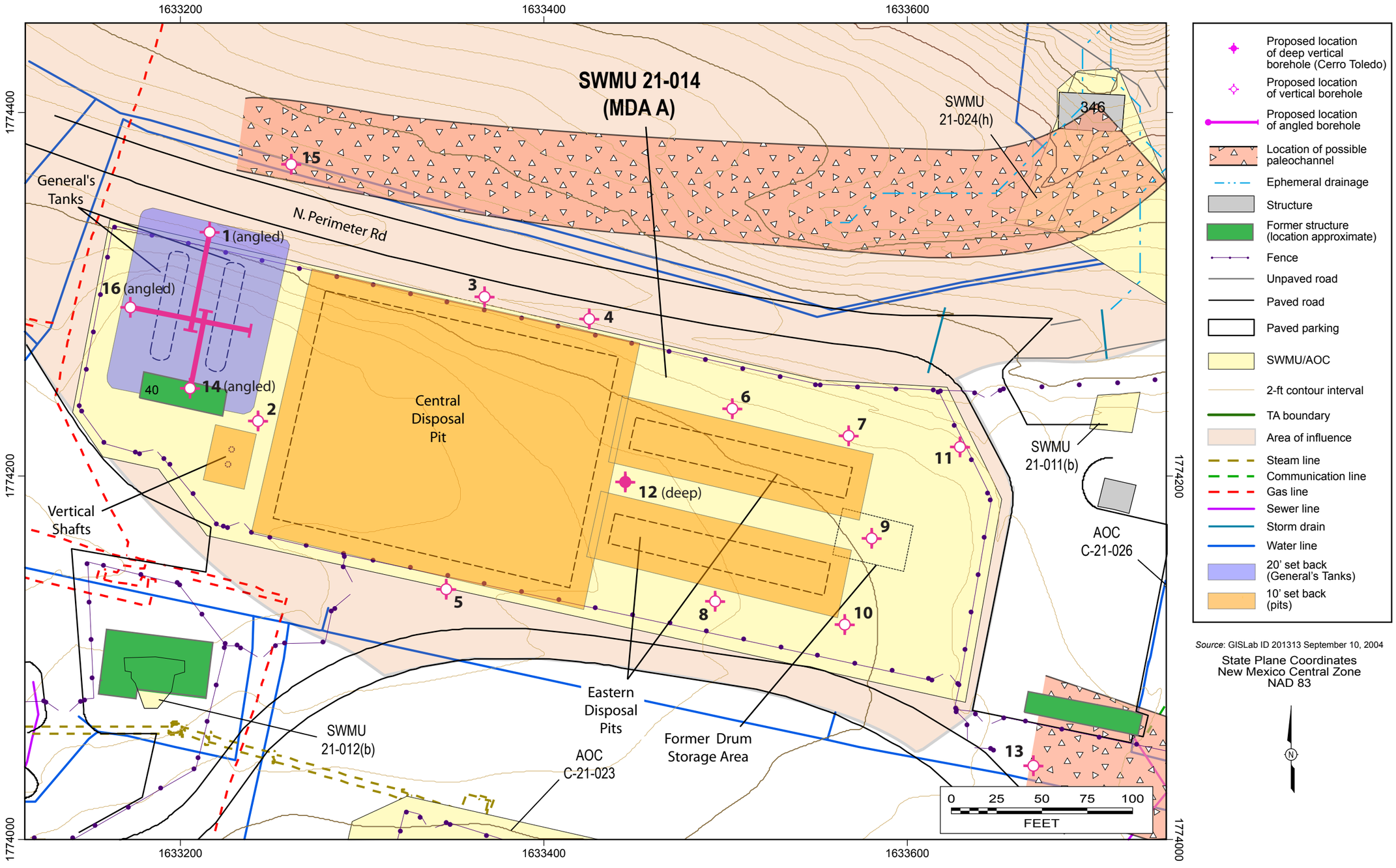

Figure 4.4-1. Locations of proposed boreholes at MDA A

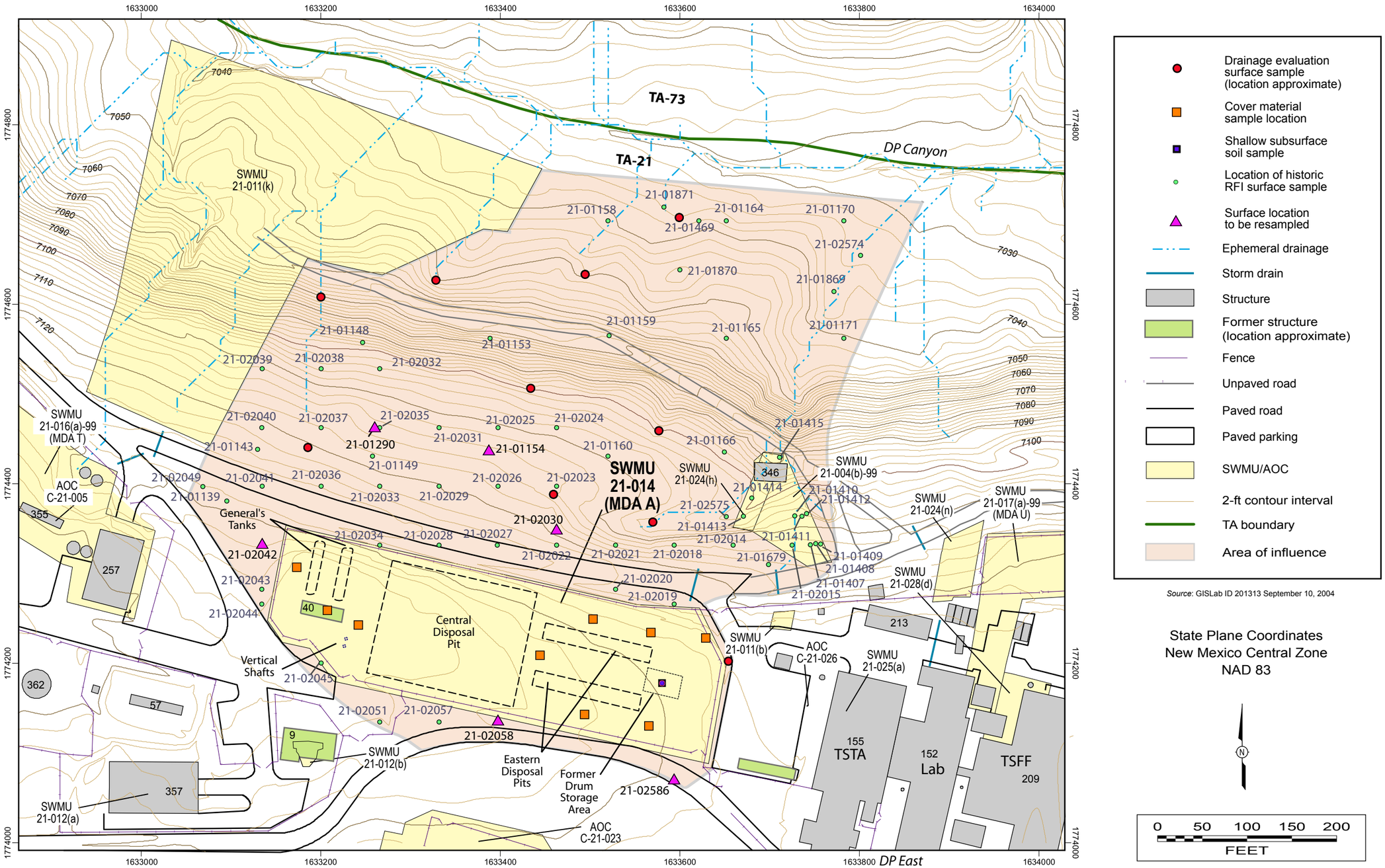

Figure 4.6-1. Proposed surface and near-surface sampling locations for soil at MDA A

Table 4.6-1
Proposed Surface and Near-Surface Sample Summary and Sampling Rationale

Location ID	Previous Chemical Concentrations	Previous Radionuclide Concentrations	Sampling Rationale
1992 and 1994 RFI Investigation Resample Locations–Soil Samples			
21-01154 (two samples)	Non detect for all COPCs	Plutonium-239 (15.31 pCi/g)*	Third highest plutonium-239 detection in the area of influence (two highest in drainage below outfall associated with SWMU 21-024(h)
21-02030 (two samples)	Non detect for all COPCs	Plutonium-239 (12.6 pCi/g)*	High plutonium-239 detection immediately downslope of MDA A
21-01290 (two samples)	Non detect for all COPCs	Americium-241 (1.313 pCi/g)* Plutonium-239 (2.894 pCi/g)*	Second highest americium detected in area of influence. Highest detection downslope of SWMU 21-024(h)
21-02586 (two samples)	Non detect for all COPCs	Non detect for all COPCs	Confirmation of previous non detects
21-02058 (two samples)	Only minimal detections at this location	Only minimal detections at this location	Confirmation of previous non detects
21-02042 (two samples)	Only minimal detections at this location	Only minimal detections at this location	Cross gradient point to complete 5% resample commitment
Cover/Fill Sample Locations–Soil/Crushed Tuff Samples			
~~8~~9 locations (9~~16~~ samples)	No previous data available	No previous data available	Characterization of current MDA A cover/fill ~~material~~
Downslope Drainage Locations–Sediment Samples			
10 locations (20 samples)	No previous data available	No previous data available	Characterization of surface soils in drainages emanating from MDA A

Notes: The results listed in this table do not represent all of the chemical detections at these sample locations. All analytical results are summarized in the MDA A historical investigation report (LANL 2005, 87452).

All concentrations shown above are established site-wide background values.

*See Table 5.2-4 of LANL 2005, 87452

Table 4.11-1
Summary of Borehole Drilling, Sampling, and Analyses Proposed for MDA A

Site / Issue Addressed	Borehole ID	Location Description	Borehole Declination from Horizontal (degrees)	Borehole Length (ft)	Borehole Total Depth (ft)	Geologic Units Encountered	Minimum Number of Samples Estimated for Fixed -Laboratory Analysis	Fixed-Laboratory Analysis																	
								VOCs (SW-846 8260B) (Pore-Gas Sa,mples Only)	SVOCs (SW-846 8270C)	PCBs (SW-846 8082)	Explosive Compounds (SW-846 8321A)	Dioxins/Furans (SW-846 8290)	Total Iodide (by ICPMS)	pH (SW-846 9045C)	Total Uranium (SW-846 6020)	TAL Metals (SW-846 6010B or SW-846 6020)	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (EPA Method 314 or SW-846 8321A)	Gamma Spectroscopy (EPA Method 901.1)	Americium-241 (HASL-300)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905	Tritium (EPA Method 906) (Pore-Gas Samples Only)
General's Tanks; release from tanks (base of tanks 12 ft below original ground surface)	**1**	North to south under General's Tanks	45	71	50	Qbt 3	6	X	X	—	—	—	X	X	X	X	X	X	X	X	X	X	X	X	X
Vertical shafts, confirmation of non-use, cover thickness, fracture analysis (total depth 65 ft below original ground surface)	**2**	Northeast of vertical shafts	90	85	85	Qbt 3, Qbt 2	7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Central disposal pit; vertical extent, horizontal extent, cover thickness, base of pit 22 ft below original ground surface	**3**	North side of central pit	90	45	45	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Central disposal pit; vertical extent, horizontal extent, cover thickness, base of pit 22 ft below original ground surface	**4**	North side of central pit	90	45	45	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Central disposal pit; vertical extent, horizontal extent, cover thickness, base of pit 22 ft below original ground surface	**5**	South side of central pit	90	45	45	Qbt 3	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern pit (north); vertical extent, horizontal extent, cover thickness (base of pit 12.5 ft below original ground surface)	**6**	Adjacent to eastern pits (north)	90	35	35	Qbt 3	7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern pit (north), vertical extent, horizontal extent, fracture analysis, cover thickness (base of pit 12.5 ft below original ground surface)	**7**	Adjacent to the eastern pits (north)	90	35	35	Qbt 3	7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern pit (south), vertical extent, horizontal extent, cover thickness, base of pit 12.5 ft below original ground surface	**8**	Adjacent to the eastern pits (south)	90	35	35	Qbt 3	7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Former drum storage area; vertical extent, horizontal extent from eastern pits, cover thickness	**9**	Center the former drum storage area	90	35	35	Qbt 3	7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Former drum storage area vertical extent, horizontal extent	**10**	South of former drum storage area	90	35	35	Qbt 3	7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Former drum storage area vertical extent, horizontal extent	**11**	Northeast of former drum storage area	90	35	35	Qbt 3	7	X	X	—	—	—	X	X	X	X	X	X	X	X	X	X	X	X	X
MDA A (all units); vertical extent (Cerro Toledo-Deep)	**12**	Between the three pits	90	~335	~335	Qbt 3. Qbt 2, Qct, Qbo	9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern pits; horizontal extent southeast of MDA A, verification of possible paleochannels	**13**	Southeast of MDA A fence corner	90	45	45	Qbt 3	6	X	X	—	—	—	X	X	X	X	X	X	X	X	X	X	X	X	X
General's Tanks; vertical extent of releases, fracture analysis	**14**	South to north under General's Tanks	45	57	40	Qbt 3	7	X	X	—	—	—	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 4.11-1 (continued)

Site / Issue Addressed	Borehole ID	Location Description	Borehole Declination from Horizontal (degrees)	Borehole Length (ft)	Borehole Total Depth (ft)	Geologic Units Encountered	Minimum Number of Samples Estimated for Fixed-Laboratory Analysis	Fixed-Laboratory Analysis																
								VOCs (SW-846 8260B) (Pore-Gas Samples Only)	SVOCs (SW-846 8270C)	PCBs (SW-846 8082)	Explosive Compounds (SW-846 8321A)	Dioxins/Furans (SW-846 8290)	Total Iodide (by ICPMS)	pH (SW-846 9045C)	Total Uranium (SW-846 6020)	TAL Metals (SW-846 6010B or SW-846 6020)	Cyanide (SW-846 9012A)	Nitrates (EPA Method 300.0)	Perchlorate (EPA Method 314 or SW-846 8321A)	Gamma Spectroscopy (EPA Method 901.1)	Americium-241 (HASL-300)	Isotopic Plutonium (HASL-300)	Isotopic Uranium (HASL-300)	Strontium-90 (EPA Method 905	Tritium (EPA Method 906) (Pore-Gas Samples Only)
General's Tanks; horizontal extent, verification of possible paleochannel if contaminants detected in Boreholes 1 and 14	**15**	North of North Perimeter Road; north of MDA A	90	45	45	Qbt 3	6	X	X	—	—	—	X	X	X	X	X	X	X	X	X	X	X	X	X
General's Tanks; vertical extent of releases, fracture analysis	**16**	West to east under General's Tanks	45	92	65	Qbt 3	7	X	X	—	—	—	X	X	X	X	X	X	X	X	X	X	X	X	X
Historical RFI Sample Locations Resample 6 locations from 1992/1994 sample events to verify hillslope conditions	n/a	Various (see Table 4.6-1)	n/a	n/a	0.0-0.5 and 1.5-2.0	Soil and sediment	12	—	X	—	X	—	X	X	X	X	X	—	X	X	X	X	X	X	—
DP Canyon Hillslope Sample 10 locations downslope of MDA A to define surface impacts related to run-off from MDA A	n/a	Drainages and areas of deposition downslope from MDA A	n/a	n/a	0.0-0.5 and 1.5-2.0	Soil and sediment	20	—	X	—	X	—	X	X	X	X	X	—	X	X	X	X	X	X	—
MDA A Cover/Fill Sample current MDA A cover/fill at 9 locations to characterize cover	n/a	Surface sample at borehole locations within MDA A fence (excluding borehole 9)	n/a	n/a	0.0-0.5	Cover material	9	—	X	—	—	—	X	X	X	X	X	—	X	X	X	X	X	X	—
Perched Groundwater Sampling (Includes general chemistry per Section IX.B of Consent Order)	TBD	TBD	n/a	TBD	TBD	Varies with borehole Qbt 3, Qbt 2, Qct, Qbo	TBD	X (H_2O only)	X	—	X	—	X	X	X	X	X	—	X	X	X	X	X	X	X (H_2O only)

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, four samples will be collected for fixed-laboratory analysis including (a) base depths of the nearest waste units (pits, vertical shafts, General's Tanks), (b) maximum reading of field screen detection or field analytical detection, (c) maximum depth of positive field screening or field analytical detection, and (d) total depth. A fifth sample, representing the native soil immediately underlying the cover/fill will be collected from boreholes 2, 6, 7, 8, 9, 10, 11, 12, 14, and 16.
3. From all boreholes less than 100 ft TD, two additional samples will be collected from preferential flow pathways (fractures, fracture fill, moist zones, surge beds/higher permeability zones).
4. From all boreholes greater than 100 ft TD, four additional samples will be collected from preferential flow pathways (fractures, fracture fill, moist zones, surge beds/higher permeability zones).
5. Tuff samples will be collected directly above the Qbt2/Qct contact and analyzed for permeability in boreholes that pass into the Cerro Toledo interval (likely only borehole 12).
6. All borehole locations outside the perimeter fence will also be sampled at the existing surface, if warranted by the results from walkover radiological surveys.
7. Shallow soil sampling will continue at depths greater than 2.0 ft if positive field screening or field analytical screening is detected.
8. PCB field analytical screening will be performed on all samples collected from boreholes 2 through 10 and borehole 12. All samples with field analytical detections will be selected for analysis of PCBs at an off-site laboratory. Boreholes 6 and 8 will have samples selected for PCBs analyses at the native soil contact (beneath the cover/fill) and from the base of the disposal units, even if there are no field analytical screening detections at these depths (base of the central disposal pit and base of the eastern disposal pits). All subsurface samples collected from borehole 12 will be analyzed for PCBs.
9. Explosive compounds analyses will be performed on the upper 20% detections for samples from boreholes 2 through 10 based upon field analytical screening results. If there are no field analytical screening detections for HE (RDX and TNT), 20% of the samples identified for off-site analyses (based upon other criteria above) will be selected for explosives analyses. Explosive analyses are mandatory for all subsurface samples on borehole 12.
10. Dioxins/furans sampling analyses will be performed on samples collected from (1) the recognized former operational surface (native soil underlying cover/fill) and (2) at the base of waste disposal units in boreholes adjacent to the central disposal pit and eastern disposal pits (boreholes 2–10 and borehole 12).
11. Radiological screening will be used for selection of sample intervals for radionuclide analyses only, and potentially additional intervals for pore-gas samples for tritium analyses. If radiological screening is less than 2 times background, samples for radiological analyses will be selected from the sample intervals specified in 2 (above).
12. Groundwater samples will also be analyzed for general chemistry (e.g., anions, alkalinity, total organic carbon, total inorganic carbon, and total dissolved solids) and explosive compounds.

n/a = Not applicable.
Qbt 2 = Bandelier Tuff, Tshirege Member, Unit 2.
Qbt 3 = Bandelier Tuff, Tshirege Member, Unit 3.
Qct = Cerro Toledo interval.
Qbo = Bandelier Tuff, Otowi Member.
TBD= To be determined.
X= Analysis to be performed.
— = No analysis to be performed.

Table 4.13-1
Consent Order Specifications and LANL Proposed Alternatives
~~(Based on September 1, 2004, Draft Compliance Order on Consent)~~

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Disposal Units	**IV.C.2.c.ii MDA A Survey of Disposal Units** In accordance with Section IV.C.2.c.ii, the Respondents shall conduct a survey of the disposal units comprising MDA A. The Respondents shall determine the dimensions and total depth of each disposal trench, absorption bed, shaft, pit, and other unit at MDA A into which waste was disposed; and the base profile, topography, low elevation point, and downslope end of the base of each disposal trench, shaft, pit, and absorption bed at MDA A into which waste was disposed. The dimensions and base elevations of each trench, absorption bed, pit, shaft, and other disposal unit at MDA A shall be determined using as-built construction drawings and boring logs. If unavailable, ground penetrating radar, magnetic surveys, or other methods shall be used. The survey shall be completed prior to implementation of the drilling explorations under Section IV.C.2.c.iii.	There are no as-built drawings or borehole logs available for MDA A. LANL will utilize a combination of design drawings, historical geophysical surveys, and geodetic surveys to identify locations and configurations of each of the disposal units prior to all field investigation activities. Engineering design drawings and numerous geophysical surveys were used to determine the depths and dimensions of the waste units for this investigation work plan.	Four separate geophysical surveys were conducted in 1989, 1996, 1999, and 2003. These geophysical surveys were performed to delineate and confirm subsurface features including pits, tanks, and paleochannels. Several of the geophysical surveys indicate that disposal unit dimensions and locations are only slightly modified from original design drawings. Therefore, a current geodetic survey in combination with historical documentation is adequate to survey the disposal units.

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Drilling Explorations	**IV.C.2.c.ii MDA A Drilling Explorations** The Respondents shall conduct subsurface explorations as specified in the approved work plan in order to obtain sufficient data to characterize the extent of contamination, and to characterize fracture density, fracture orientation, and fracture fill material or the absence of fracture fill material in bedrock underlying MDA A. The fracture characterization of the rock formations underlying MDA A shall be completed utilizing data acquired from outcrops, cores, and downhole geophysical and video log data. A discussion of the sampling methods and potential locations for collecting rock fracture data shall be included within the required Investigation Work Plan for MDA A. The Department, prior to field investigation and data collection activities, shall approve the methods and locations for the fracture investigation activities. Pursuant to the procedures in Section III.M of this Consent Order, the Respondents shall submit to the Department for review and written approval a work plan for subsurface investigation activities at MDA A. Implementation of the approved work plan shall meet the following requirements, subject to the procedures in Section III.M of this Consent Order:	Vertical and angled boreholes are proposed for the subsurface characterization of MDA A. Three~~he one~~ angled boreholes are~~is~~ proposed beneath the General's Tanks where access is limited. ~~The angled borehole will be paired with a deep vertical borehole to determine vertical extent beneath the General's Tanks.~~ The angled boreholes will allow characterization of the area beneath the tanks without buried utility obstructions and will provide a sufficient safety factor margin to adequately address the radiological concerns associated with tank integrity. If physical obstructions or slope angles prevent drilling as listed, the Permittees will work with NMED to determine appropriate drilling locations. As part of this investigation, a fracture analysis will be conducted in each of the boreholes. Previous fracture studies have been conducted at MDA A and TA-21 (Woehletz, 1995, 58845; Purtymun 1969, 00519). Geophysical and video logging will be performed on selected boreholes.	Not applicable (n/a)

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Drilling Explorations (continued)	1. Fifteen (15) borings, or the number defined in the Department-approved MDA A Investigation Work Plan, shall be advanced using hollow-stem auger drilling methods where practical or other drilling methods approved by the Department. Three of the borings shall be advanced to the base of the Cerro Toledo interval. All borings shall be drilled in accordance with Section IX of this Consent Order. The Department, prior to drilling, shall approve the location of the borings and the drilling method.	1. Six~~Fif~~teen boreholes (three~~one~~ angled and thirteen~~fourteen~~ vertical), including one deep vertical borehole advanced through the Cerro Toledo interval are proposed.	1. Since no liquid waste was associated with the MDA A waste units, only one deep borehole to the Cerro Toledo (instead of three) is proposed directly in the center of the MDA. The proposed Boreholes 2 and 3 in the MDA T investigation are less than 300 and 500 ft west of the MDA A perimeter, respectively, and will penetrate the Cerro Toledo interval (LANL 2004, 85641). The proposed borehole, BH-4, at MDA U is located 430 ft. east of MDA A and will penetrate the Cerro Toledo interval (LANL 2004, 87454.3)
	2. Selected boreholes shall be characterized using geophysical logging techniques approved by the Department.	2. No deviation.	2. n/a
	3. A monitoring well shall be installed if groundwater (perched or regional) is encountered during drilling activities or if geophysical results indicate possible zone(s) of saturation. The wells shall be constructed in accordance with Section X of this Consent Order.	3. No deviation.	3. n/a
	4. Vapor monitoring wells shall be installed in the borings if vapor-phase contamination is detected during drilling activities.	4. No deviation.	4. n/a
	5. All borings not completed as monitoring wells (vapor or groundwater monitoring wells) shall be properly plugged and abandoned as described in Section X.D. Documentation of proper well abandonment shall be submitted to the Department as an appendix to the investigation report.	5. No deviation.	5. n/a

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Soil and rock sampling	**IV.C.2.c.iv MDA A Soil and Rock Sampling** Pursuant to Section IV.C.2.c.i and the procedures in Section III.M of this Consent Order, the Respondents shall submit to the Department for review and written approval a work plan for conducting soil and rock sampling during subsurface explorations activities at MDA A. Implementation of the approved work plan shall meet the following requirements, subject to the procedures in Section III.M of this Consent Order:	n/a	n/a
	1. Soil samples shall be collected continuously for the first 40 ft and at ten-ft intervals there after.	1. All boreholes will be continuously core sampled to the total depth of each borehole.	1. Continuous coring is preferable for fracture analysis, identification of perched zones, and provides better stratigraphic data than sample collection at discrete intervals.
	2. Samples shall be collected and screened in accordance with the methods described in Section IX.B of this Consent Order.	2. Samples will be field screened for volatile organic compounds (VOCs) and radioactivity. X-ray fluorescence (XRF) screening for metals will not be conducted on any samples. ~~Field analytical screening will be performed for HE (RDX and TNT) on all boreholes.~~ Field analytical screening for PCBs and HE (RDX and TNT) will be performed in boreholes adjacent to the disposal pits (boreholes 2 through 10 and borehole 12).	2. XRF screening for metals will not be conducted due to low concentrations detected in historical samples.

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
	3. A minimum of four core samples from the tuff overlying the Cerro Toledo shall be collected and submitted for laboratory permeability testing in accordance with Section IX.B of this Consent Order.	3. One core sample from Borehole 12 will be submitted for permeability analyses.	3. No other boreholes are proposed with target depths anticipated to penetrate Qbt2 (directly above the Cerro Toledo interval). Permeability data will be available from deep Boreholes 2 and 3 at MDA T, less than 300 and 500 ft west of MDA A, respectively, (LANL 2004, 85641) and BH-4 at MDA U, located 430 ft. east of MDA A (LANL 2004, 87454.3)
Soil and rock sampling (continued)	4. Field screening and laboratory sample selection shall be biased toward evidence of contamination, lithologic contacts, fractures, fracture fill material, surge beds and other higher permeability units identified during investigation activities. The samples shall be collected and screened in accordance with the methods described in Section IX.B of this Consent Order.	4. No deviation.	4. n/a
	5. Sediment, soil, and rock samples shall be obtained from the intervals described in Paragraph 1 above and from the bedrock directly below the base elevation of each absorption bed or shaft. A sample also shall be obtained at the maximum depth of each boring.	5. No deviation.	5. n/a

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
	6. A minimum of four samples shall be selected from each boring for submittal to a laboratory for analysis of VOCs, SVOCs, explosive compounds, pH, PCBs, dioxins, furans, nitrates, perchlorate, TAL metals, and cyanide. The sample exhibiting the highest field screening detection; the sample obtained from the maximum depth in each boring that displays field screening evidence of contamination; the sample located immediately below the base of any pit, tank or other structure; and the sample from the total boring depth shall be submitted for laboratory analysis.	6. Four samples will be analyzed from each borehole. In addition to the four samples specified herein, additional samples (2 from boreholes less than 100 ft TD and 4 from boreholes greater than 100 ft TD) will be collected from fracture zones, fracture fill, moist zones, and/or surge beds/high permeability zones. For boreholes penetrating the cover/fill of the MDA, an additional sample~~s~~ of the native soil will be collected ~~of the native soil~~ immediately underlying the cover/fill. VOC analyses of pore-gas samples will be performed~~collected~~ in lieu of VOC analyses on~~f~~ core samples. Dioxin/furan analyses will only be performed on all samples collected of the native soil underlying the cover/fill and from depth intervals at the base of disposal units in adjacent boreholes.~~if detected during the MDA T investigation.~~ All samples will be also be analyzed for specified radionuclides and total iodide~~. PCBs and~~ E~~e~~xplosive compounds will ~~not~~ be analyzed in the upper 20% of detections for samples from ~~all~~ boreholes 2 through 10 based upon the results of field analytical screening.~~.~~ PCB analyses will be performed on selected samples from boreholes adjacent to the disposal pit based upon the results of field analytical screening. Explosive compounds will be analyzed in the upper 20% of detections for surface samples on the slope. No field analytical screening or analyses is proposed for explosive compounds, PCBs, or dioxin/furans for surface and near-surface soil/sediment samples.	6. There are no historical data to indicate that explosive compounds, PCBs, or dioxin/furans are chemicals of potential concern at MDA A. Therefore, field screening will be performed for HE (RDX and TNT) and PCBs. Dioxin/furans will be analyzed in selected samples where dioxins/furans would ~~be~~ most likely be present. ~~a modified analytical suite is proposed.~~ Additional analyses are required for radiological COPCs and total iodide. Because~~Since~~ borehole 12 is located between all three disposal pits and the deepest vertical borehole, it is probable that~~to find~~ migrated contaminants would be found in this borehole if present~~.~~.Therefore, borehole 12 will have a minimum of 4 samples analyzed for the full analytical suite, Due to the 20-year period since the MDA A cover has been emplaced and the limited mobility of particles or dissolved constituents to move from beneath the cover to the surface of the adjacent hillslope, no high explosives, PCB, or dioxin/furan analyses will be performed on these samples.

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Sediment sampling	**IV.C.2.c.v MDA A Sediment Sampling** The Respondents shall investigate contaminant transport from MDA A to canyon alluvial sediments through the implementation of the Work Plan for Los Alamos and Pueblo Canyons, dated November 1995, and the addendum to the Work Plan, dated February 2002, as described in Section IV.B.1.b.i of this Consent Order. The work plan and addendum were approved by the Department in June 1997 and May 2002, respectively. Pursuant to the EPA-approved RFI Work Plan for OU 1106, the Respondents investigated sediments in drainage channels leading from MDA A to DP Canyon. The investigation work plan shall include requirements for sediment sampling and characterization of drainages at MDA A in accordance with Section IV.A.4 of this Consent Order. If, after completion of the investigation of canyon sediments pursuant to the Work Plan for Los Alamos and Pueblo Canyons and addendum, the nature and extent of contaminant releases from MDA A drainages to DP Canyon have not been established, the Department will require additional sediment investigations of the drainages leading from MDA A.	To supplement the Work Plan for Los Alamos and Pueblo Canyons surface/drainage impacts downslope of MDA A will be characterized by collecting additional soil samples at ten locations (2 samples each) within obvious drainages and depositional areas north of MDA A. Another six sample locations from historical RFI sampling events will be resampled to determine if surface conditions (via soil erosion) have changed significantly.	The Work Plan for Los Alamos and Pueblo Canyons does not characterize minor drainages contributing to DP Canyon.

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Vapor monitoring	**IV.C.2.c.vi MDA A Subsurface Vapor Monitoring** Pursuant to Section IV.C.2.c.i and the procedures in Section III.M of this Consent Order, the Respondents shall submit to the Department for review and written approval a work plan to collect subsurface vapor samples from discrete zones in each subsurface vapor monitoring well or boring at MDA A, at depths approved by the Department, for field and laboratory analyses. The samples shall be collected and analyzed in accordance with Section IX.B of this Consent Order. Implementation of the approved work plan shall meet the following requirements, subject to the procedures in Section III.M of this Consent Order:		
	1. Subsurface vapor samples shall be collected from all newly drilled borings during site investigation activities.	1. No deviation.	1. n/a
	2. An investigation vapor monitoring and sampling plan shall be prepared in accordance with the format described in Section XI.B of this Consent Order and submitted by the Respondents to the Department for approval.	2. No deviation.	2. n/a
	3. Subsurface vapor sampling shall be conducted at MDA A in each existing and newly constructed vapor well and boring specified in the approved work plan.	3. No deviation.	3. n/a
	4. Samples of subsurface vapors shall be collected by the Respondents from subsurface vapor monitoring points at discrete zones selected based on investigation and monitoring results. The monitoring points must be approved by the Department prior to sample collection.	4. No deviation.	4. n/a
	Based on the results of the investigation vapor monitoring, a long-term subsurface vapor monitoring and sampling work plan shall be submitted to the Department for review and approval.		

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Intermediate groundwater	**IV.C.2.c.vii MDA A Intermediate Groundwater Well Installation** If intermediate zone groundwater is encountered or if geophysical or other evidence suggests the presence of intermediate perched groundwater during the required subsurface investigations for MDA A, the Department may require a work plan for the installation of intermediate groundwater monitoring well(s). The minimum depth of the subsurface investigations for MDA A will be the base of the Cerro Toledo interval. If groundwater is detected, these monitoring wells shall target all potential intermediate perched water bearing intervals identified during subsurface explorations at MDA A. If perched groundwater is encountered in sufficient quantities to allow sampling, the Respondents shall sample and analyze the water in accordance with the characterization requirements in the approved work plan and provide recommendations for a long-term groundwater monitoring plan in the MDA A investigation report required under Section IV.C.2.c.x.	No deviation. Monitoring well(s) will be installed if perched groundwater is encountered in quantities sufficient for sample collection in the deep borehole installed through the Cerro Toledo	n/a
Regional groundwater	**IV.C.2.c.viiii MDA A Regional Groundwater Well Installation** If the Department determines the need for additional wells intersecting the regional groundwater aquifer associated with TA-21 based on investigation data, the Respondents shall submit to the Department for review and written approval a work plan for the installation of such wells. The wells shall be installed according to the requirements in Section X of this Consent Order.	No regional groundwater investigations will be performed as part of this work plan. Regional groundwater investigations are being conducted in accordance with the Hydrogeologic Work Plan (LANL 1998, 59599) approved by NMED and the Los Alamos Canyon and Pueblo Canyon Intermediate and Regional Groundwater Work Plan (LANL 2003, 82612)	Installation of regional groundwater wells would be duplicative of work being done under the Hydrogeologic Work Plan (LANL 1998, 59599) and the Los Alamos Canyon and /Pueblo Canyon Intermediate and Regional Groundwater Work Plan (LANL 2003, 82612)

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Groundwater monitoring	**IV.C.2.c.ix MDA A Groundwater Monitoring** The Respondents shall monitor and sample all wells specified below containing alluvial, intermediate, and regional groundwater in accordance with the Interim Plan approved by the Department under Section IV.A.3.b that meets the requirements listed below, subject to the procedures in Section III.M of this Consent Order. Such monitoring and sampling shall also be conducted in accordance with Section IX of this Consent Order. Based on the results of the investigations and after completing the installation of all additional monitoring wells in the Los Alamos Canyon watershed as described in Section IV.B and subject to the procedures in Section III.M of this Consent Order, the Respondents shall submit to the Department for review and written approval a watershed-specific long-term groundwater monitoring plan for Los Alamos Canyon. Upon Department approval of the long-term monitoring plan for the Los Alamos Canyon watershed, the requirements of the long-term monitoring plan shall apply and shall supersede the requirements of the Los Alamos Canyon watershed section of the Interim Plan.	Any groundwater data collected as part ofin conjunction with the- "Interim Facility-Wide Groundwater Monitoring Plan" (LANL 2005, 88789) that is relevant to MDA A will be included in the MDA A Investigation Report.n/a	n/a

Table 4.13-1 (continued)

Item	Consent Order Specification	LANL Proposed Alternative	Justification for Alternative
Groundwater monitoring (continued)	1. Groundwater samples shall be obtained from Los Alamos Canyon monitoring wells LAO-1.6(g), LAO-2, LAO-3A, LAO-4.5C, LAO-5, LAO-6, LAO-6A, LAUZ-1, LAUZ-2, LADP-3, R-9i, R-5, R-7, R-8, R-9, TW-3, and any wells installed in the future determined by the Department to be required and at the frequency described in Section XII of this Consent Order. As described in Section IV.B.1.b.iv,, TW-3 shall be plugged and abandoned according to the procedures in Section X.D. Groundwater shall be monitored from TW-3 until the well is properly abandoned.	1. No groundwater sampling of existing wells will be performed as part of this work plan. The wells identified in IV.C.2.c.ix.1 will be monitored as specified in the "Interim Facility-Wide Groundwater Monitoring Plan" (LANL 2005, 88789)~~facility-wide groundwater monitoring plan~~ required under Section IV.A.3 of the Consent Order. However, data collected as part of this monitoring plan will be included in the MDA A i~~I~~nvestigation r~~R~~eport.	1. Groundwater investigations would be duplicative of work required under Section IV.A.3 of the Consent Order.
	2. The groundwater sampling shall be conducted in accordance with Section IX.B of this Consent Order.		2. See justification 1above.
	3. Groundwater samples shall be collected from the Los Alamos Canyon monitoring wells for submittal to a laboratory for analysis of general chemistry parameters as described in Section IX.B of this Consent Order, perchlorate, TAL metals, cyanide, VOCs, SVOCs, explosive compounds, and for other analytes specified by the Department.	2. See alternative 1 above. 3. See alternative 1 above.	3. See justification 1 above.

~~Table 5.0-1~~
~~Summary of Applicable SOPs and QPs~~

~~Procedure~~	~~Title~~	~~Summary~~
~~SOP-01.01~~	~~General Instructions for Field Investigations~~	~~Provides an overview of instructions regarding activities to be performed before, during, and after field investigations. It is assumed that field investigations involve standard sampling equipment, personal protective equipment, waste management, and site control equipment/materials. Procedure covers: pre-mobilization activities, mobilization to the site, documentation and sample collection activities, sample media evaluation, surveying, and completing lessons learned.~~
~~SOP-01.02~~	~~Sample Containers and Preservation~~	~~Describes the specific requirements/process for sample containers, preservation techniques, and holding times as specified by field regulations and guidance documents. The use of specific types of sample container, and preservation techniques is mandatory for hazardous site investigations because the integrity of any sample is diminished over time. Physical factors (light, pressure, temperature, etc.), chemical factors (changes in pH, volatilization, etc.), and biological factors may alter the original quality of the sample. Because the various target parameters are uniquely altered at varying rates, distinct sample containers, preservation techniques, and holding times have been established to maintain sample integrity for a reasonable and acceptable period of time. Procedure covers: documenting SOP deviations, using proper sample containers and preservatives, performing data entry, implementing containment procedures, preserving samples, implementing holding times, completing documentation, implementing post-operation activities, and performing lessons learned.~~
~~SOP-01.03~~	~~Handling, Packaging and Transporting Field Samples~~	~~Directs field team members in the preparation of environmental and waste characterization samples for transportation to the Sample Management Office or an approved radiation screening laboratory. In general, samples taken are expected to have a low concentration of potential contaminants, although higher concentrations will be present in some cases. These low-concentration samples that do not satisfy the DOT hazard class definitions are classified as environmental samples and are not subject to DOT regulations. Historical data, knowledge of processes, and field screening results will assist the team members in making decisions as to whether a sample can be designated as "environmental" or needs to be treated as a DOT-regulated material. Procedure covers: transportation of environmental and DOT-regulated samples.~~
~~SOP-01.04~~	~~Sample Control and Field Documentation~~	~~Describes the process for documenting samples collected using sample control and field documentation, specifically, container labels, sample collection logs, chain of custody (COC)/request for analysis forms, and daily activity log forms or field notebooks. Procedure covers: performing request notification, generating sample control and field documentation, completing sample collection logs, using field chain of custody forms, delivering samples to the sample management office, delivering samples to another analytical laboratory, using custody seals, collecting the samples, completing sample control and field documentation, completing field investigation summaries, and performing field closeouts.~~

~~Table 5.0-1 (continued)~~

~~Procedure~~	~~Title~~	~~Summary~~
~~SOP-01.05~~	~~Field Quality Control Samples~~	~~Describes the requirements for the collection of field quality control (QC) samples to ensure the reliability and validity of field and laboratory data. Field QC samples shall be collected as described in this procedure and taken to the Los Alamos National Laboratory Sample Management Office (SMO) with the regular field samples for subsequent chemical and physical testing. Procedure covers: pre-operation activities, collecting and preparing each type of QC sample including equipment rinsate blank, field duplicate, and trip blank.~~
~~SOP-01.06~~	~~Management of Environmental Restoration Project Wastes~~	~~Describes the process for managing waste generated during corrective action activities. This procedure outlines the preparation, approval, and retention of all required documents associated with waste generation. Procedure covers: waste identification and characterization, waste minimization/recycling, waste generation/storage, segregation, waste treatment, authorized release limits, packaging/transportation, disposal options, and specific policies including area of contamination policy, environmental media, and contained in policy.~~
~~SOP-01.08~~	~~Field Decontamination of Drilling and Sampling Equipment~~	~~Describes the process for the general field decontamination of drilling and sampling equipment. It is intended to help ensure the integrity of soil, sediment, rock, water, and other samples collected from potentially contaminated sites and to minimize the potential for cross contamination between sampling locations. Implementation of this procedure will help protect site and community personnel, requiring that equipment not be removed from a controlled area without proper decontamination. Procedure covers: set up of dry and wet decontamination areas, drilling/excavation equipment decontamination, and sampling equipment decontamination.~~
~~SOP-01.10~~	~~Waste Characterization~~	~~Describes the development of a strategy for characterizing wastes generated during projects performed at the Laboratory. Specifically, the SOP 1) identifies the steps involved in waste identification and characterization as delineated by Laboratory requirements, and 2) provides instructions for completing a Waste Characterization Strategy Form (WCSF). A WCSF is required for projects that include (but are not limited to) site investigations, corrective actions, drilling, closures, and decommissioning projects.~~
~~SOP-02.01~~	~~Surface Water Site Assessments~~	~~Describes the process for determining whether a site has the potential to adversely affect surface water quality. The procedure identifies responsible participants and provides a detailed checklist to evaluate the erosion potential at a site that does not meet the criterion for No Further Action. SWMUs with highest priority are those adjacent to drainages and canyon systems or those with an erosion matrix score greater than 40 based on an evaluation of erosion/sediment transport potential. Erosion matrix scores range from 1 to 100 and are qualitatively determined based on a systematic assessment of the site. The assessment involves an evaluation of the site setting, examination of the site for evidence of runoff and erosion, and documentation of structures and/or operations that are directing storm water onto the site.~~
~~SOP-03.11~~	~~Coordinating and Evaluating Geodetic Surveys~~	~~Describes the methodology for coordinating and evaluating geodetic surveys and establishing quality assurance (QA) and control for geodetic survey data. Procedure covers: evaluating geodetic survey requirements, preparing to perform a geodetic survey, performing geodetic survey field activities, preparing geodetic survey data for QA review, performing QA review of geodetic survey data, and submitting geodetic survey data.~~

~~Table 5.0-1 (continued)~~

~~Procedure~~	~~Title~~	~~Summary~~
~~SOP-04.01~~	~~Drilling Plan Development~~	~~Describes the responsibilities and process for developing drilling plans to meet subsurface sampling requirements required by the New Mexico Environmental Department (NMED) Consent Order or radioactive contaminated sites regulated by the Department of Energy (DOE). The proper steps include developing a drilling plan, performing pre-operation drilling activities, mobilizing the drilling rig and participants to the drilling site, and performing drilling operations, performing post-operation activities.~~
~~SOP-04.04~~	~~Contract Geophysical Logging~~	~~States the responsibilities and describes the general process for obtaining borehole logging data of acceptable quality regardless of logging system or logging contractor, to meet site - characterization and/or subsurface sampling requirements of the investigation. Borehole- logging techniques are used in situ to determine physical, chemical, geological, and hydrological conditions in an open borehole. Procedure covers: pre-contract considerations, pre-operation activities, borehole geophysical logging activities, and post-operation activities. Main concerns during logging activities are: monitoring the logging equipment as it emerges from the borehole or before it leaves the work site for contamination, verifying field calibration both immediately before and immediately after a logging run or runs with a given logging tool, and ensuring that the logging equipment is decontaminated between sampling events.~~
~~SOP-05.07~~	~~Operation of LANL Owned Borehole Logging Trailer~~	~~Describes the process for operation and maintenance of the borehole video/geophysics logging trailer. Procedure covers: running the borehole video camera system, running the borehole caliper tool, running the borehole conductivity/resistivity (induction) tool, running the gamma tool, and running the borehole spontaneous potential/single point resistance tool.~~
~~SOP-06.01~~	~~Purging and Sampling Methods for Single Completion Wells~~	~~Describes methods used for evacuating stagnant water from a well bore in sufficient quantities so that the water samples that are collected afterwards are representative of the formation interval open to the well bore. Groundwater that is stagnant in the well bore is subject to chemical reactions that may significantly alter the composition of the formation water. Prior to collecting a representative ground water sample for laboratory analysis, ground water must be purged. Procedure covers: preliminary activities, pre-operation field activities, well purging operations, water sampling operations, and post-operation activities.~~
~~SOP-06.03~~	~~Sampling for Volatile Organic Compounds in Groundwater~~	~~States the responsibilities and describes the process for sampling for volatile organic compounds (VOCs) in groundwater. This SOP also describes the selection of equipment and materials used in the sampling process. The objectives are to collect valid samples for volatile organic analysis (VOA) and to subject samples to the least amount of turbulence and subsequent possible aeration. Procedure covers: conducting pre-operation activities, sampling, preparing documentation, and conducting post-operation activities.~~
~~SOP-06.09~~	~~Spade and Scoop Method for the Collection of Soil Samples~~	~~Describes the process for spade-and-scoop collection of shallow (i.e., typically 0 to 12 inches) soil samples. The "spade-and-scoop" method involves digging a hole to the desired depth, as prescribed in the sampling and analysis plan, and collecting a discrete grab or portion of a composite sample. Procedure covers: pre-sampling activities, sampling activities, and post-sampling activities.~~
~~SOP-06.10~~	~~Hand Auger and Thin-Wall Tube Sampler~~	~~States the responsibilities and describes the process for collecting surface and subsurface (up to about 15.) soil samples with a hand auger and thin-wall tube sampler. This procedure describes the selection and use of sampling methods and equipment at sites that may include contamination with hazardous or radioactive materials. Procedure covers: pre-sampling activities, sampling activities, collecting field duplicates, and post-sampling activities.~~

~~Table 5.0-1 (continued)~~

~~Procedure~~	~~Title~~	~~Summary~~
~~SOP-06.24~~	~~Sample Collection from Split-Spoon Samplers and Shelby-Tube Samplers~~	~~States the responsibilities and describes the process for collecting soil and sediment samples using either split-spoon samplers or Shelby-tube samplers. A split-spoon sampler is used to take subsurface soil or sediment samples by forcefully driving the sampler into the soil or sediment at the bottom of a borehole. The Shelby tube is a similar type of sampling apparatus. The split-spoon is a multi-piece sampler; the Shelby tube is a single-piece metal tube of thinner gauge. Procedure covers: pre-sampling activities, sampling activities, and post-sampling activities.~~
~~SOP-06.26~~	~~Core-Barrel Sampling for Subsurface Earth Materials~~	~~Describes the process for collecting core-barrel samples of subsurface earth materials. This procedure is limited to sampling of subsurface sediments for radionuclides (including tritium), metals, polychlorinated biphenyls, total petroleum hydrocarbons, and volatile and semivolatile organic compounds. The field team may sample for other constituents under this SOP (or modifications thereof) at the discretion of the field team leader and project leader. Procedure covers: pre-sampling activities, sampling activities, and post-sampling activities.~~
~~SOP-06.31~~	~~Sampling of Subatmospheric Air~~	~~Describes the process of sampling subatmospheric air from vapor ports in monitoring wells and boreholes. Procedure covers: pre-sampling activities, B&K sampling to detect and quantify gaseous organic concentration in air, SUMMA sampling (a passive collection and containment system of laboratory-quality air samples), adsorbent column sampling, sampling through the packer system (a sampling system that uses inflatable bladders to seal off a desired interval in an open borehole, or at the end of drill casing, in order to obtain a sample from a discrete section), and post-sampling activities.~~
~~SOP-06.33~~	~~Headspace Vapor Screening with a Photoionization Detector~~	~~Describes the process for screening headspace vapor for volatile organic compounds (VOCs) in soil samples with a photoionization detector (PID). The PID is a portable, nonspecific, vapor/gas detector employing the principle of photoionization to detect and measure real-time concentrations of a variety of chemical compounds, both organic and inorganic, in air. Procedure covers: performing field calibration, operating, and post-operating activities.~~
~~SOP-07.05~~	~~Subsurface Moisture Measurements Using a Neutron Probe~~	~~Describes the process of collecting subsurface moisture measurements using a neutron probe. A neutron probe is used to measure the subsurface moisture, utilizing a probe containing a source of high-energy neutrons and a slow neutron detector. Procedure covers: performing a daily field standard count, preparing instrument for field measurements, taking a field measurement, and documenting the results of the field measurement.~~
~~SOP-10.14~~	~~Performing and Documenting Gross Gamma Radiation Scoping Surveys~~	~~Describes the process for performing and documenting gross gamma radiation scoping surveys in buildings and soil. Scoping surveys are conducted after an assessment of the site history is completed and consist of judgmental measurements based on historical site information and data. If the scoping survey locates contamination, a characterization survey is typically performed.~~

~~Table 5.0-1 (continued)~~

~~Procedure~~	~~Title~~	~~Summary~~
~~SOP-12.01~~	~~Field Logging, Handling, and Documentation of Borehole Materials~~	~~Prescribes the specific borehole material management methods to be followed, and documentation to be prepared, during handling and field logging of selected borehole materials identified in the site guidance documents and waste characterization strategy form. This procedure is limited to the activities necessary to take custody of core and cuttings from drill rig personnel, conduct field screening, remove time sensitive analytical samples and subsamples for preliminary characterization, complete photo documentation when necessary, perform field structural and lithologic description, and mark, package, and temporarily store the borehole materials at a drill site borehole material storage trailer. This procedure describes the handling of the subset of borehole materials to be curated from the time they are withdrawn from the borehole to the time they are ready to be transported to the Field Support Facility (FSF) for curating and archiving. For the purposes of this SOP, borehole material may also refer to other solid materials, such as drive samples or augured materials. Procedure covers: borehole material staging, temporary packaging of time sensitive analytical samples, measurement and determination of material loss, marking core (depth notation and stripes), core photography, core logging, removal of analytical samples (core), and core box loading and storing.~~
~~QP-2.2~~	~~Personnel Training Management~~	~~Describes the responsibilities and process for managing personnel training. This QP integrates the criteria of the Quality Management Plan (QMP) for LANL RRES-RS Project. The QP discusses site specific training, subcontractor personnel training requirements, Laboratory personnel training requirements, documenting procedural training, processing completed training documentation forms, and performing work.~~
~~QP-3.4~~	~~Corrective Action Process~~	~~Describes the responsibilities and process for providing consistency in identifying, logging, resolving, and reporting conditions adverse to quality. Informed decisions can then be made in terms of efficient resourcing and systemic problem solving. The procedure describes discovering and reporting a nonconformance, noncompliance, or deficiency, performing a Price-Anderson Amendment Act of 1988 (PAAA) determination, performing a health, safety, and radiation (HSR) review, implementing a corrective action report (CAR) disposition, logging and numbering a CAR, initiating a CAR closeout, reporting an overdue corrective action, changing a CAR, resolving a dispute regarding a CAR, and developing a trend report.~~
~~QP-4.4~~	~~Record Transmittal to the Records Processing Facility~~	~~Describes the responsibilities of transmitting records to the Records Processing Facility (RPF) and describes the process for transmitting documents to RPF. The procedure defines what types of information the term "records" includes, which records should be submitted, and details the steps necessary to submit records.~~
~~QP-4.12~~	~~Documenting Oral Communication~~	~~Describes the process for documenting oral communications that represent evidence of quality or safety concerns, organizations, functions, policies, decisions, procedures, operations, or other activities or that contain valuable information. The procedure describes determining whether or not documentation is required, documenting oral communication, and transmitting an oral communication record to the Records Processing Facility (RPF).~~
~~QP-5.2~~	~~Control of Measuring and Test Equipment~~	~~Describes the process for identifying, maintaining, and managing Measuring and Test Equipment (M&TE). Use of this mandatory procedure and its attachments ensures individual M&TE accuracy by determining proper status of the equipment prior to use. Note that this procedure does not include calibration instructions for M&TE.~~

~~Table 5.0-1 (continued)~~

~~Procedure~~	~~Title~~	~~Summary~~
~~QP-5.3~~	~~Readiness Planning and Reviews~~	~~Describes the responsibilities and defines the process for conducting readiness planning and reviews. The procedure is used as a planning tool for preparing fieldwork, as a method to ensure compliance with all identified requirements, and to gain consensus on key preparations before field activities can proceed. The QP defines the personnel responsible for the various readiness planning and review activities. The procedure also presents the criteria in determining whether or not a readiness review meeting is necessary as well as details the process for conducting such a meeting. A readiness review checklist is required in order to assure that all requirements are met as well as to assign responsible personnel for meeting the requirements.~~
~~QP-5.7~~	~~Notebook Documentation for Environmental Restoration Technical Activities~~	~~Describes the responsibilities and process for properly documenting environmental restoration technical activities. The procedure defines the requirements for documenting field activities including those for notebooks, notebook entries, notebook attachments, notebook data evaluation, technical review of notebooks, Quality Integration and Improvement (QII) review of notebooks, and notebook submission as a record.~~
~~QP-7.1~~	~~Procurement~~	~~Describes the responsibilities and process for procurement of quality-affecting items and services). The QP details the processes for initiating a procurement, procuring built-to-order items, procuring non-analytical services, procuring internal and external analytical services, procuring calibration standards, reviewing documents for the procurement of services, purchase requisitions, and material receipt inspection. The procedure necessitates a graded approach in implementing its requirements. The QP provides an example services statement of work (SOW) checklist and a "guidance document" statement of technical and quality requirements for purchase requisitions to use in following the procedure's requirements.~~
~~QP-7.2~~	~~Supplier Evaluation~~	~~Describes the requirements and process for evaluating and approving potential suppliers of items and/or services. The QP also describes the requirements and process for implementing and maintaining the Qualified Suppliers List (QSL). The procedure specifically excludes certain items to which the QP does not apply.~~
~~QP-10.3~~	~~Stop Work and Restart~~	~~Describes the responsibilities and process for issuing and controlling formal Stop Work and Restart processes (SWRs). All personnel have the authority and the responsibility to stop work if adverse work conditions are identified. Personnel supervisors must be included in any stop-work action to ensure that a greater hazard is not created in stopping work. The procedure also describes the method for following up and/or restarting work after a stop-work action.~~
~~QMP~~	~~Quality Management Plan for LANL RRES-RS Project~~	~~Establishes the principles, requirements, and practices necessary to execute a constructive quality assurance program. The document is based on the ten criteria of 10 Code of Federal Regulations (CFR) 830 Subpart A, "Quality Assurance Requirements" and US Department of Energy (DOE) Order 414.1, "Quality Assurance," as directed by Laboratory Performance Requirement (LPR) 308-00-00, "Institutional Quality Management."~~

Table 5.0-1

Brief Description of Field Investigation Methods

Method	Summary
Spade-and-Scoop Collection of Soil Samples	This method is typically used for collecting shallow (i.e., approximately 0–12 in.) soil or sediment samples. The "spade-and-scoop" method involves digging a hole to the desired depth, as prescribed in the sampling and analysis plan, and collecting a discrete grab sample. The sample is typically placed in a clean stainless-steel bowl for transfer into various sample containers.
Hand Auger Sampling	This method is typically used for sampling soil or sediment at depths of less than 10–15 ft but may, in some cases, be used for collecting samples of weathered or nonwelded tuff. The method involves hand-turning a stainless-steel bucket auger (typically with a 3–4-in. inner diameter), creating a vertical hole which can be advanced to the desired sample depth. When the desired depth is reached, the auger is decontaminated before advancing the hole through the sample depth. The sample material is transferred from the auger bucket to a stainless-steel sampling bowl before filling the various required sample containers.
Split-Spoon Core-Barrel Sampling	In this method, a stainless-steel core barrel (typically with a 4-in. inner diameter and 2.5 ft long) is advanced using a powered drilling rig. The core barrel extracts a continuous length of soil and/or rock that can be examined as a unit. The split-spoon core barrel is a cylindrical barrel split lengthwise so the two halves can be separated to expose the core sample. Once extracted, the section of core is typically screened for radioactivity and organic vapors, photographed, and described in a geologic log. A portion of the core may then be collected as a discrete sample from the desired depth.
Headspace Vapor Screening	Individual soil, rock, or sediment samples may be field-screened for volatile organic compounds by placing a portion of the sample in a plastic sample bag or in a glass container with a foil-sealed cover. The container is sealed and gently shaken, and allowed to equilibrate for 5 min. The sample is then screened by inserting a photoionization detector probe into the container and measuring and recording any detected vapors.
Radiological Screening	Samples may be continuously field screened using an Eberline E-600/SHP380AB to detect both alpha and undifferentiated beta/gamma gross readings. Core samples are screened by holding the probe <1 in. away from the core. The core is screened immediately after removal from ground before logging, sampling, etc. Measurements are determined by a quick scan to find the highest initial reading. After logging the core, a one-minute reading is performed to determine gross alpha and beta/gamma radiation levels. All screening data will be recorded on the Radiation Control Technician field log as well as the lithologic boring logs.

Method	Summary
Portable XRF Field Screening	A portable XRF analyzer may be used to measure metals content in soils in the field to provide screening data and guide sample collection to determine the extent of metals contamination. The instrument includes sealed radioactive sources and can identify and quantify 26 elements. The instrument must be properly warmed up and calibrated according to the manufacturer's directions before use. Soil samples should be homogenized and have large rocks, vegetation, and any foreign objects removed (samples may be sieved); the sample surface should be flattened or smoothed with a trowel or similar tool. For quantitative work, reference standard materials should be analyzed and the precision of the instrument determined at least once per day or once for every 20 samples. Precision may be determined by performing multiple analyses of certified reference standard materials.
Handling, Packaging, and Shipping of Samples	Field team members seal and label samples before packing and ensure that the sample and transport containers are free of external contamination. Field team members package all samples so as to minimize the possibility of breakage during transportation. After all environmental samples are collected, packaged, and preserved, a field team member transports them to either the Sample Management Office (SMO) or an SMO-approved radiation screening laboratory under chain-of-custody. The SMO arranges to ship samples to analytical laboratories. The field team member must inform the SMO and/or the radiation screening laboratory coordinator when levels of radioactivity are in the action-level or limited-quantity ranges.
Sample Control and Field Documentation	The collection, screening, and transport of samples is documented on standard forms generated by the SMO. These include sample-collection logs, chain-of-custody forms, and sample-container labels. Collection logs are completed at the time of sample collection and are signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. The corresponding labels are initialed and applied to each sample container, and custody seals are placed around container lids or openings. Chain-of-custody forms are completed and assigned to verify that the samples are not left unattended.
Field Quality Control Samples	Field quality-control samples are collected as directed in the Consent Order as follows: Field Duplicate: At a frequency of 10%, collected at the same time as a regular sample and submitted for the same analyses. Equipment Rinsate Blank: At a frequency of 10%, collected by rinsing decontaminated sampling equipment with deionized water, which is collected in a sample container and submitted for laboratory analysis. Trip Blanks: Required for all field events that include the collection of samples for volatile organic compound (VOC) analysis. Trip blanks containers of certified clean sand are opened and kept with the other sample containers during the sampling process.

Method	Summary
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination is the preferred method to minimize the generation of liquid waste. Dry decontamination may include using a wire brush or other tool to remove soil or other material adhering to the sampling equipment, followed by using a commercial cleaning agent (nonacid, waxless cleaners) and paper wipes. Dry decontamination may be followed by wet decontamination, if necessary. Wet decontamination may include washing with a nonphosphate detergent and water, followed by a water rinse and a second rinse with deionized water. Alternatively, steam cleaning may be used.
Containers and preservation of samples	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on Environmental Protection Agency guidance for environmental sampling, preservation, and quality assurance. Specific requirements for each sample are printed on the sample collection logs provided by the SMO (size and type of container, e.g.,~~i.e.~~, glass, amber glass, polyethylene, preservative~~, etc.~~). All samples are preserved by placing in insulated containers with ice to maintain a temperature of 4˚C. Other requirements, such as nitric acid or other preservatives, may apply to different media or analytical requests.

Appendix B

Management Plan for Investigation-Derived Waste

This appendix to the work plan describes how investigation-derived waste (IDW) generated during the investigation of Material Disposal Area (MDA) A at Los Alamos National Laboratory (~~LANL or~~ the Laboratory) will be managed. IDW is solid waste generated as a result of ~~by~~ field-investigation activities and ~~it~~ may include, but is not limited to, drill cuttings; purge water; contaminated personal protective equipment (PPE), sampling supplies, and plastic; fluids from the decontamination of PPE and sampling equipment; and all other waste potentially contacting contaminants. IDW generated during the investigation of MDA A will be managed to protect human health and the environment, comply with applicable regulatory requirements, and adhere to the Laboratory waste minimization goals.

~~Certain field-investigation activities may also displace environmental media, which are defined as naturally occurring materials indigenous to the environment, including groundwater, surface water, surface and subsurface soil, rock, bedrock, and gravel. In most cases, environmental media are not subject to Resource Conservation and Recovery Act (RCRA) regulation because they do not meet the definition of solid waste (i.e., they are not discarded, abandoned, recycled, or inherently waste-like). According to the US Environmental Protection Agency (EPA) area of contamination (AOC) policy, environmental media are not considered to be waste (and, hence, not IDW) if they are returned to their points of origin (EPA 1996, 82288). EPA AOC guidance indicates that moving hazardous waste from an AOC into a drum, followed by replacing it in the AOC, does not constitute "land disposal" for RCRA purposes (Wehling 1991, 87382). Therefore, nonhazardous media will be returned to their points of origin. The Laboratory does not expect any of the environmental media or IDW generated under this investigation to be characterized as hazardous waste. IDW generated during the investigation of MDA A will be managed in a manner that protects human health and the environment, complies with applicable regulatory requirements, and adheres to the Laboratory waste-minimization goals.~~

All IDW generated during the MDA A field-investigation activities will also be managed in accordance with applicable Environmental Stewardship–Environmental Charact~~g~~erization and Remediation ~~Services~~ (ENV-ECR~~S~~)
~~Program s~~~~S~~standard o~~O~~operating p~~P~~procedures (SOPs). These SOPs incorporate the requirements of all applicable Enviro~~or~~nmental Protection Agency (EPA) and New Mexico Environment Department (NMED) regulations, Department of Energy (DOE) orders, and Laboratory Implementation Requirements (LIRs). The ENV-ECR~~S~~ SOPs applicable to the characterization and management of IDW are

- ECR-SOP-01.06, Management of Environmental Restoration Project Waste, and
- ECR-SOP-01.10, Waste Characterization.

These SOPs are among the SOPs applicable to the investigation at MDA A and are available at http://erproject.lanl.gov/documents/procedures.html. Before the start of field investigation activities, a Waste Characterization Strategy Form (WCSF) will be prepared and approved per requirements of ECR-SOP 01.10. The WCSF will provide detailed information on IDW characterization, management, containerization, and possible volumes. IDW characterization will be completed through review of existing data and/or documentation, by direct sampling of the IDW, and/or by sampling the media being investigated (i.e., surface soil, subsurface soil, etc.). If direct waste characterization sampling is necessary, it will be described in the WCSF.

The Laboratory's 2004 Pollution Prevention Roadmap will be implemented during field investigations at MDA A to minimize waste generation~~Investigation activities will be conducted in a manner that minimizes the generation of waste. Waste minimization will be accomplished by implementing the requirements of the ENV-RS portion of the "2003 Pollution Prevention Roadmap"~~ (LANL 2004~~3~~, 8846~~5205~~). The roadmap is updated annually to meet a requirement of Module VIII of the Laboratory's Hazardous Waste

Facility Permit~~, which was issued by the EPA on May 23, 1990, and modified on May 19, 1994 (EPA 1990, 01585; EPA 1994, 44146)~~.

The IDW waste streams associated with the investigation of MDA A are identified in Table B-1 and are briefly ~~that will be generated and managed during the field investigation at MDA A are~~ described below.Table B-1 also summarizes the waste type, estimated volume, characterization method, method of site management, and expected disposition.

Drill cuttings. The drill cuttings waste stream will consist of cuttings from boreholes ~~that will be~~ drilled during field activities~~and instrumented for vapor monitoring at MDA A~~. Drill cuttings will be collected and containerized~~placed in containers~~ at the point of generation (i.e., at the drill rig). The drill cuttings waste stream will be characterized with~~using~~ analytical results from core samples ~~which will be~~ augmented by direct sampling of the containerized waste, if needed. ~~Contaminants of concern are expected to include radionuclides and possibly inorganic metals and volatile organic compounds.~~ The maximum detected concentrations of radionuclides will be compared with background/fallout values. If maximum concentrations are above background/fallout values, the waste cuttings will be designated as low-level radioactive waste. Total concentrations of toxicity characteristic leaching procedure (TCLP) constituents will be compared with ~~Maximum concentrations of toxicity characteristic leaching procedure (TCLP) constituents will be compared with~~ 20 times the TCLP regulatory level~~limit~~. If total concentrations are less than 20 times the TCLP regulatory level~~limit~~, the waste cuttings will be designated nonhazardous by characteristic. If concentrations exceed 20 times the regulatory level~~limit~~, the waste will be sampled and analyzed using the TCLP to determine if it is hazardous by characteristic. If potential listed waste constituents are detected~~ in tuff samples~~, ~~the maximum concentrations will be compared to NMED soil screening levels (SSLs) (NMED 2004, 85615). If concentrations are less than SSLs, a "no-longer-contained-in" determination will be requested from NMED. If concentrations exceed SSLs, the wastes will be designated as listed hazardous waste.~~ the Laboratory will conduct a review of historical records and data in an effort to determine whether the source of each constituent was a listed hazardous waste at its point of generation. If the source is determined to be a listed hazardous waste, the cuttings will be managed as hazardous or mixed waste (depending on the levels of radioactivity). Otherwise, the cuttings will be managed as nonhazardous solid waste or low–level waste (~~–~~LLW), ~~(~~depending on the levels of radioactivity~~)~~. Based on the results of previous investigations, the Laboratory expects these wastes to be designated as nonhazardous waste~~LLW~~~~nonhazardous waste~~ that will either be used for cover material at Technical Area (TA) 54 or be disposed of at the Waste Management Landfill in Rio Rancho, New Mexico. If the waste is nonhazardous LLW, it will either be disposed at TA-54, Area G or an approved off-site LLW disposal facility.

Spent PPE. The spent PPE waste stream will consist of PPE that has potentially "contacted" contaminated environmental media (e.g., core and/or drill cuttings) and cannot be decontaminated. The bulk of this waste stream will consist of protective clothing such as coveralls, gloves, and shoe covers.~~, and (if required) respirator cartridges~~. Spent PPE will be collected in containers at personnel decontamination stations. Characterization of this waste stream will be performed through acceptable knowledge ~~(AK)~~ of the waste materials, the methods of generation, and the analytical results from the sampling of the environmental media with which the materials were in contact~~and the levels of contamination observed in the environmental media~~. The Laboratory expects these wastes to be designated as nonhazardous waste~~LLW~~~~nonhazardous waste~~ that will be disposed of at the Waste Management Landfill in Rio Rancho, New Mexico~~TA-54 the Waste Management Landfill in Rio Rancho, New Mexico.~~~~or at an off-site LLW disposal facility~~. If the waste is nonhazardous LLW, it will either be disposed at TA-54, Area G or an approved off-site LLW disposal facility.

Disposable sampling supplies. The disposable sampling supplies waste stream will consist of all equipment and materials necessary~~eded~~ for collecting~~on of~~ samples that come into direct contact with contaminated environmental media and that cannot be decontaminated. This waste stream also includes

wastes associated with dry decontamination activities. This waste stream will consist primarily of paper and plastic items collected in bags at the sampling location and transferred to accumulation drums. Characterization of this waste stream will be performed through acceptable knowledgeAK of the waste materials, the methods of generation, and the analytical results from the sampling of the environmental media with which the materials were in contactand the levels of contamination observed in the environmental media. The Laboratory expects these wastes to be designated as LLW that will be disposed of at TA-54 or at an off-site LLW disposal facility.nonhazardous that will be disposed of at the Waste Management Landfill in Rio Rancho, New Mexico. If the waste is nonhazardous LLW, it will either be disposed at TA-54, Area G or an approved off-site LLW disposal facility.

nonhazardous waste which will be disposed of at the Waste Management Landfill in Rio Rancho, New Mexico.

Decontamination fluids. The decontamination fluids waste stream will consist of liquid wastes from decontamination activities (e.g., decontamination solutions and rinse waters). Consistent withFollowing waste-minimization practices, the Laboratory employs dry decontamination methods to the extent possible. If dry decontamination cannot be performed, liquid decontamination wastes will be collected in containers at the point of generation and transferred to accumulation drums. If less than 6 gal. of decontamination fluids are generated per day and these are determined to be nonhazardous, they may be disposed of by discharge 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 1996, 87472). Otherwise, the decontamination fluids waste stream will be accumulated in drums and and characterized using analytical results from direct sampling of the containerized waste. The Laboratory expects that these wastes would be designated as lnonhazardous, potential iquid LLWnonhazardous liquid waste that would be sent to the rRadioactive lLiquid wWaste tTreatment fFacility at TA-50 for disposal.

All wastes will be managed in accordance with applicable federal, state, DOE, and Laboratory requirements. Waste streams, expected waste types, estimated waste volumes, and other data are listed in Table B-1.

All waste drums will remain on site until analytical results have been received and a waste characterization has been conducted. Drill cuttings and other IDW will be managed as low-level waste in a radioactive waste storage area within the AOC boundary, due to the possible presence of radionuclides in the waste streams.

Prior to the start of field-investigation activities, a waste characterization strategy form (WCSF) will be prepared and approved per the requirements in the current revision of SOP-01.10. The WCSF will provide detailed information about IDW characterization, management, containerization, and potential volume generation.

IDW characterization will be achieved through existing data and/or documentation, direct sampling of the IDW, or sampling of the media being investigated (e.g., surface soil, subsurface soil, etc.). If sampling is necessary, it will be described in a sampling and analysis plan that will be developed in conjunction with the WCSF.

Some wastes will be characterized on the basis of AK rather than direct waste analysis. AK will consist of the results of analyzing the environmental media associated with each waste stream. For example, spent PPE and disposable sampling supplies that have potentially come in contact with contaminated media will be characterized by the results of analyzing that media. Similarly, borehole cuttings will be characterized by the 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, quantities less than 6 gal. per day of decontamination fluid can be discharged to the ground in accordance with the existing NOI.~~

The selection of waste containers will be based on appropriate U.S. Department of Transportation requirements, waste types, and estimated volumes of IDW to be generated. Immediately following containerization, each waste container will be individually labeled with a unique identification number and with information regarding waste classification, item(s), radioactivity (if applicable), and date generated. If wastes are pending analytical results to make a final characterization determination, the containers will be labeled as such until analytical results are available. The wastes will be contained in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on the type of IDW and its classification. Container and storage requirements will be detailed in the WCSF and approved before any waste is generated.

~~The selection of waste containers will be based on the appropriate Department of Transportation (DOT) requirements, and on the type and amount of IDW that is planned to be generated. Immediately following containerization, each waste container will be individually labeled as to the waste classification, item identification number, radioactivity (if applicable), and date of generation. Waste containers will be managed in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements will be based on IDW type and classification. Container and storage requirements will be detailed in the WCSF, based on requirements outlined in the most recent versions of LIR 404-00-03, Hazardous and Mixed Waste Requirements; LIR 404-00-04, Managing Solid Waste; LIR 404-00-05, Managing Radioactive Waste; and LIR 405-10-01, Packaging and Transportation. Prior to waste generation, the WCSF will be approved by the process detailed in SOP-01.10, Waste Characterization.~~

~~Transportation of IDW will comply with appropriate DOT requirements. Depending upon waste classification, disposal of solid IDW will take place either on-site at TA-54 Area G or at an approved off-site disposal facility. Liquid IDW may be processed at the TA-50 Radioactive Liquid Waste Treatment Facility or at the TA-46 Sanitary Wastewater Systems Plant. Hazardous and/or mixed waste may be transported to, and stored at, TA-54 Area L prior to off-site disposal. Transportation and disposal requirements will be detailed in the WCSF and approved prior to the generation of waste.~~

Table B-1
Summary of Estimated IDW Generation and Management

Waste Stream	Expected Waste Type	Estimated Volume	On-Site Management	Expected Disposition
Drill cuttings*	Solid, low-level waste (LLW) or solid nonradioactive	25 yd^3	55-gal. drums, covered roll-off containers, or cubic-yard soft-sided containers	LANL, TA-54, or off-site waste disposal facility~~, Area G~~
Spent PPE and disposable sampling supplies	Solid, LLW or solid nonradioactive	9 yd^3	Accumulation in 55-gal. drums	LANL, TA-54~~, Area G~~ or off-site waste ~~LLW~~ disposal facility
~~Decontamination fluids (< 6 gal./day)~~	~~Liquid, LLW~~	~~< 6 gal./day~~	~~Discharge to ground~~	~~Discharge to ground~~
Decontamination fluids ~~(> 6 gal./day)~~	Liquid, LLW	300 gal.	Accumulation in 55-gal. drums	LANL, TA-50, Radioactive Liquid Waste Treatment Facility

*Estimated *total* volume of cuttings expected to be generated.

Attachment 3

Historical Investigation Report for MDA A
Revised Text

at Building 21-257 (McGinnis 1976, 00954; Rogers 1977, 05707, p. A-7). Then approximately 9000 gal. were transferred from the east tank to the west tank (Rogers 1977, 05707, p. A-7). Subsequently, the east tank was to be used for disposal of nonretrievable cement paste generated at Building 21-257 before July 1, 1976 (Rogers 1977, 05707, p. A-7; McGinnis 1976, 00954). Cement paste was never disposed of in the east tank. From 1975 to 1983, the liquid wastes stored in the tanks were removed and processed at the Building 21-257 waste treatment facility (LANL 1991, 07529, p. 16–244). An unknown volume of sludge in the bottom of the tanks has never been removed. A 1973 memo (Voelz 1973, 00483) indicated that less than 1% of the radioactivity in the tanks was associated with the liquids and was processed for disposal. This indicates that most of the radioactivity remaining in the tanks is in the sludge. When it was decided to drain the General's Tanks and transfer the waste to Building 21-257, a hole about 16 in.~~"~~ in diameter was cut in the top of each tank. The details of this process are described in a memo written by William C. Francis (Francis 1997, 76126). The memo also describes that the excavated holes were left open for four or five years and rainwater collected in the tanks. The excavated holes were backfilled in 1979, but the steel plate covers over the 16-in.~~"--~~diameter openings were not welded to the tanks nor were the holes in the concrete slab patched and sealed before backfilling operation started. The Los Alamos CEARP Phase I draft state~~ss that~~ ~~-~~there ~~i~~is some evidence that rainwater had~~s~~ been leaking into the tanks since the recovery operations. I~~, and I~~in 1985, ~~there was evidence that rain water was seeping into the tanks; subsequently,~~ the openings in the General's Tanks were sealed and covered to prevent any further water entry (DOE 1987, 08664, p. MDA A -1).

2.2.2 Vertical Shafts

On December 3, 1975, two 4-ft-diameter vertical shafts were excavated approximately 65 ft deep south of the General's Tanks (Warren 1976, 00508; McGinnis 1976, 00954). There were plans to coat the shafts with asphalt (Warren 1976, 00508), but the plans were not implemented (Shaw Environmental, Inc. 2004, 87448). The shafts were drilled to clarify rinse water generated from cleaning cement paste from the transfer hose between the pug mill and the General's Tanks. The General's Tanks were never filled with cement paste so the vertical shafts were not utilized. The vertical shafts were filled with soil in 1977 (Shaw Environmental, Inc. 2004, 87448). The approximate locations of the two vertical shafts are illustrated on Figure 2.2-13 (Drawing ENG-R 4457 [LASL 1976, 24891]) and Figure 2.1-3.

2.2.3 Eastern Pits

The eastern pits were constructed in 1945. There is a discrepancy as to the exact number of pits that exist at the east end of MDA A, and no as-built drawing has been found. However, based on the following documentation, the current interpretation is that only two eastern pits exist. A construction plan for MDA A (Drawing ENG-C 2076 [LASL 1945, 24448]) illustrates two pits with two dirt storage piles. Subsequent engineering drawings dated 1956 (Drawing ENG-R 185 [LASL 1956, 24794]) and 1976 (Drawing ENG-R4457 [LASL 1976, 24891]) illustrate two disposal pits at the east end of MDA A. However, four pits were illustrated for the eastern end of MDA A on a 1970 engineering drawing (Drawing ENG-1266 [LASL 1970, 24374]). The geophysical survey conducted in 1987 indicates that only two pits are present at the eastern end of MDA A (Gerety et al. 1989, 06893, p. 24). The geophysical survey results and multiple engineering drawings indicate only two pits exist at the east end of MDA A. The pits were excavated into Unit 3 of the Tshirege Member of the Bandelier Tuff. The estimated size of the pits illustrated on the early engineering drawings (Drawing ENG-1266 [LASL 1970, 24374] and Drawing ENG-C 2076 [LASL 1945, 24448]) is approximately 18.0 ft wide by 125 ft long by 12.5 ft deep. The pits were filled at a

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, 05481)

Desilets, J. L., November 9, 1972. “Material Disposal Area ‘A,’ DP West,” Los Alamos Scientific Laboratory memorandum to C. A. Reynolds from J. L. Desilets, Los Alamos, New Mexico. (Desilets 1972, 00484)

DOE (US Department of Energy), October 1987, “Comprehensive Environmental Assessment and Response Program, Phase I: Installation Assessment, Los Alamos National Laboratory, Volume 2 of 2,” draft, Albuquerque Operations Office, Environment and Health Division, Environmental Programs Branch, Albuquerque, New Mexico. (DOE 1987, 08664)

DOE (US Department of Energy), November 26, 2003. “New Categorization of Existing Nuclear Facilities at LANL,” memorandum from Christopher M. Steele (Senior Authorization Basis Manager, DOE-LASO) to Jim Holt (Associate Laboratory Director of Operations, Los Alamos National Laboratory), Los Alamos, New Mexico. (DOE 2003, 87047)

Dow, D., July 5, 1945. “New Disposal Pit for CM Division,” Los Alamos Scientific Laboratory memorandum to Colonel G. R. Tyler from David Dow, Los Alamos, New Mexico. (Dow 1945, 00525)

EG&G Engineering, September 12, 1974. TA-21 aerial photograph, Los Alamos National Laboratory Environmental Stewardship Division Records Processing Facility, Los Alamos, New Mexico. (EG&G Engineering 1974, 17085)

Emelity, L. A., April 20, 1978. “Your Memo of 23 March 1978,” Los Alamos Scientific Laboratory memorandum H7-78-143 to Margaret Anne Rogers (H-12) from L. A. Emelity (H-7 Alt. Group Leader), Los Alamos, New Mexico. (Emelity 1978, 00487)

Enders, J., July 1972 to December 1975. “Delivery of Material to Area A,” Los Alamos Scientific Laboratory personal notes (handwritten), Los Alamos, New Mexico. (Enders 1972–1975, 00514)

EPA (US Environmental Protection Agency), December 2003. “EPA Region 6 Human Health Medium Specific Screening Levels,” EPA Region 6, Dallas, Texas. (EPA 2003, 81724)

Environmental Surveillance Group, 1974. “Environmental Surveillance at Los Alamos During 1974,” Los Alamos National Laboratory document LA-5977-PR, Los Alamos, New Mexico. (Environmental Surveillance Group 1974, 05488)

Environmental Surveillance Group, December 1987. “Environmental Surveillance at Low-Level Radioactive Waste Management Areas at Los Alamos During 1986,” Los Alamos National Laboratory document LA-UR-87-4121, Los Alamos, New Mexico. (Environmental Surveillance Group 1987, 07431)

Francis, W. C., March 21, 1997. “History of the General’s Tanks, SWMU 21-014 and Acid Waste Sump Pump; Structure TA-21-223, SWMU 21-011(b),” Los Alamos National Laboratory memorandum ER-WCF-97-22 to C.arl Newton (EES-1) from W. C. Francis (CST-18), Los Alamos, New Mexico. (Francis 1997, 76126)

Gerety, M., J. 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, 06893)

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, 87457)

Attachment 4

Relevant Pages of DOE (1987, 08664) Document Referenced in the Historical Investigation Report for MDA A

Excerpt from Section V.B

MATERIAL DISPOSAL AREA A

DISCUSSION

Background--Inactive Material Disposal Area A, located at TA-21, consists of five pits and two storage tanks and is described in detail in Rogers (1977). The storage tanks are known as the "General's Tanks" after Maj. Gen. Leslie R. Groves, head of the Manhattan Engineering District during World War II. Waste solutions containing plutonium and americium were stored in these tanks with the hope that chemical recovery processes would improve so that the plutonium in them could be recovered. Liquids in the tanks were removed for processing in 1983. The tanks presently contain a few inches of semisolid precipitate (Balo and Warren 1983). There is some evidence that rainwater has been leaking into the tanks since the recovery operations.

Site stabilization was done in FY 1985 and included sealing and covering openings in the General's Tanks to prevent any further water entry, removing surface contamination, adding cover material, and recontouring and reseeding the area. The reseeding operation was largely unsuccessful.

Four small disposal pits are believed to contain solid waste contaminated with polonium (now decayed away), trace amounts of beta-gamma activity, and probably some trace amounts of long-lived alpha emitters (probably plutonium). These pits were used between 1944 and 1947. A larger pit, constructed in 1969, contains building debris from the decommissioning of several facilities at TA-21. This pit was covered over in May 1978 (Balo and Warren 1983).

Additionally, hundreds of drums of radioactive iodide waste were stored on the surface at Area A; some of the drums were leaky. The drums were hauled to TA-45 in 1960. Residual radioactive iodide would have decayed by now.

This site undergoes routine radiological monitoring sponsored by the Interim Waste Management Program (IWMP) of DOE's Office of Defense Waste and Transportation Management.

CERCLA Finding--Positive for FFSDIF, PA, and PSI; HRS/MHRS Migration Mode Score is 13.8 (Appendix B). Area A was scored with Areas T and U because they are on the same mesa and share a common watershed.

Planned Future Actions--This site will be evaluated primarily for radiological constituents under CEARP Phase II to determine whether future action is warranted under CEARP Phase III.

FIGURE

Figure MDA-A: Material Disposal Area A

Attachment 5

Copy of Balo and Warren (1982, 07205) Referenced in the Investigation Work Plan for MDA A

Los Alamos Environmental Restoration Records Processing Facility

ER Record I.D.# 0007205

LA-UR - 82 - 3666

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TITLE: WASTE MANAGEMENT SITE PLAN
LOS ALAMOS NATIONAL LABORATORY
DECEMBER 1982

AUTHOR(S): KAREN A. BALO
JOHN L. WARREN

SUBMITTED TO: US DEPARTMENT OF ENERGY

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Los Alamos Los Alamos National Laboratory
Los Alamos, New Mexico 87545

FORM NO 836 R4
ST NO 2629 5/81

WASTE MANAGEMENT
SITE PLAN

Los Alamos National Laboratory
University of California
Los Alamos, New Mexico

December 1982

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I. GENERAL WASTE MANAGEMENT

I.1 Site

The Los Alamos National Laboratory and the resident communities of Los Alamos and White Rock are located in north central New Mexico on the Pajarito Plateau, situated west of the Rio Grande on the eastern slopes of the Jemez Mountains (Fig. 1). The Laboratory was established here during World War II in part because of the mild climate and relative isolation of the location. The Laboratory site covers about 111 km^2* (27 500 acres) in and adjacent to Los Alamos County. The surrounding area, including most of Los Alamos County and portions of Sandoval, Rio Arriba, and Santa Fe Counties, is largely undeveloped except for those areas occupied by Laboratory facilities and the associated communities. Large tracts of land in the Jemez Mountains to the north, west, and south of the Laboratory site are held by the US Forest Service and US National Park Service. This land is largely covered by pine, fir, and aspen forests and supports the usual variety of western mountain wildlife. Agriculture is limited to home gardens and some cattle grazing. In the river valleys to the east, agriculture is limited to the cultivation of relatively small, irrigated plots. Primary crops are corn, chili, tree fruits, and alfalfa. Milk is not produced in commercial quantities in the immediate vicinity of Los Alamos. A more detailed description of the geology, climatology, and economy of the area is given in the Los Alamos Final Environmental Impact Statement.[1]

The principal mission of the Laboratory is the design and development of weapons for the nation's nuclear arsenal; however, considerable research and development (R&D) is directed toward the development of the peaceful uses of nuclear energy including research on controlled thermonuclear reactions, fission reactors, nuclear safeguards, laser fusion, and medium energy

* In keeping with Laboratory policy, metric dimensions are used throughout this text with English conversions given in parentheses.

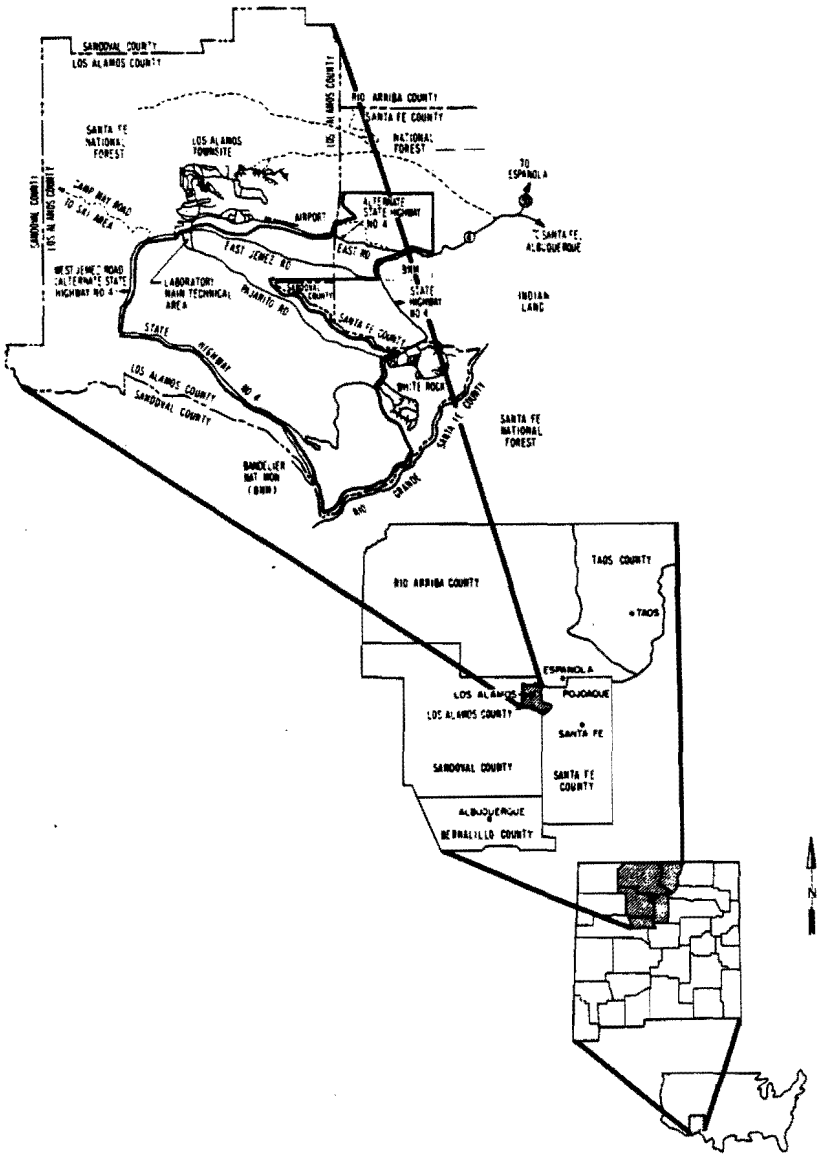


Fig. 1. Location of Los Alamos

physics. Extensive basic research programs in physics, chemistry, metallurgy, mathematics and computers, earth sciences, and electronics support these efforts. Biomedical and environmental research includes programs in molecular biology, radiobiology, cancer therapy, radioecology, and industrial hygiene. Rapid expansion into nonnuclear areas is represented by applied technology development of solar and geothermal energy and superconducting power transmission lines. Laboratory activities are located in 33 technical areas (TA) widely spread over the site, as shown in Figs. 2 and 3.

I.2 Responsible Office

The Laboratory is operated for the US Department of Energy (DOE) by the University of California under Contract W-7405-ENG-36. The University is responsible to DOE's Los Alamos Area Office (LAAO), which reports to the DOE Albuquerque Operations Office (ALOO).

I.3 Contractors

The Los Alamos National Laboratory is the prime contractor for operations involving waste generation and management. The Zia Company, under prime contract to DOE, provides the major support work for the Laboratory, and also generates waste from its operations.

The current organizational structure of the Laboratory is shown in Fig. 4. Overall responsibility for Waste Management is with the H-7 Waste Management Group in the Health (H) Division, under the direction of the Associate Director for Technical Support, as shown in Fig. 5.

Waste Management operational responsibilities are divided among many Laboratory organizations. Generators of radioactive wastes are responsible for the proper identification, segregation, and documentation of their wastes for disposal. Waste packaging activities are carried out in large part by Zia Company janitorial personnel, although some effort is required by Laboratory operating groups personnel for certain wastes [e.g., transuranic (TRU) wastes]. On-site waste transport primarily is carried out by Zia personnel and under the guidelines established by

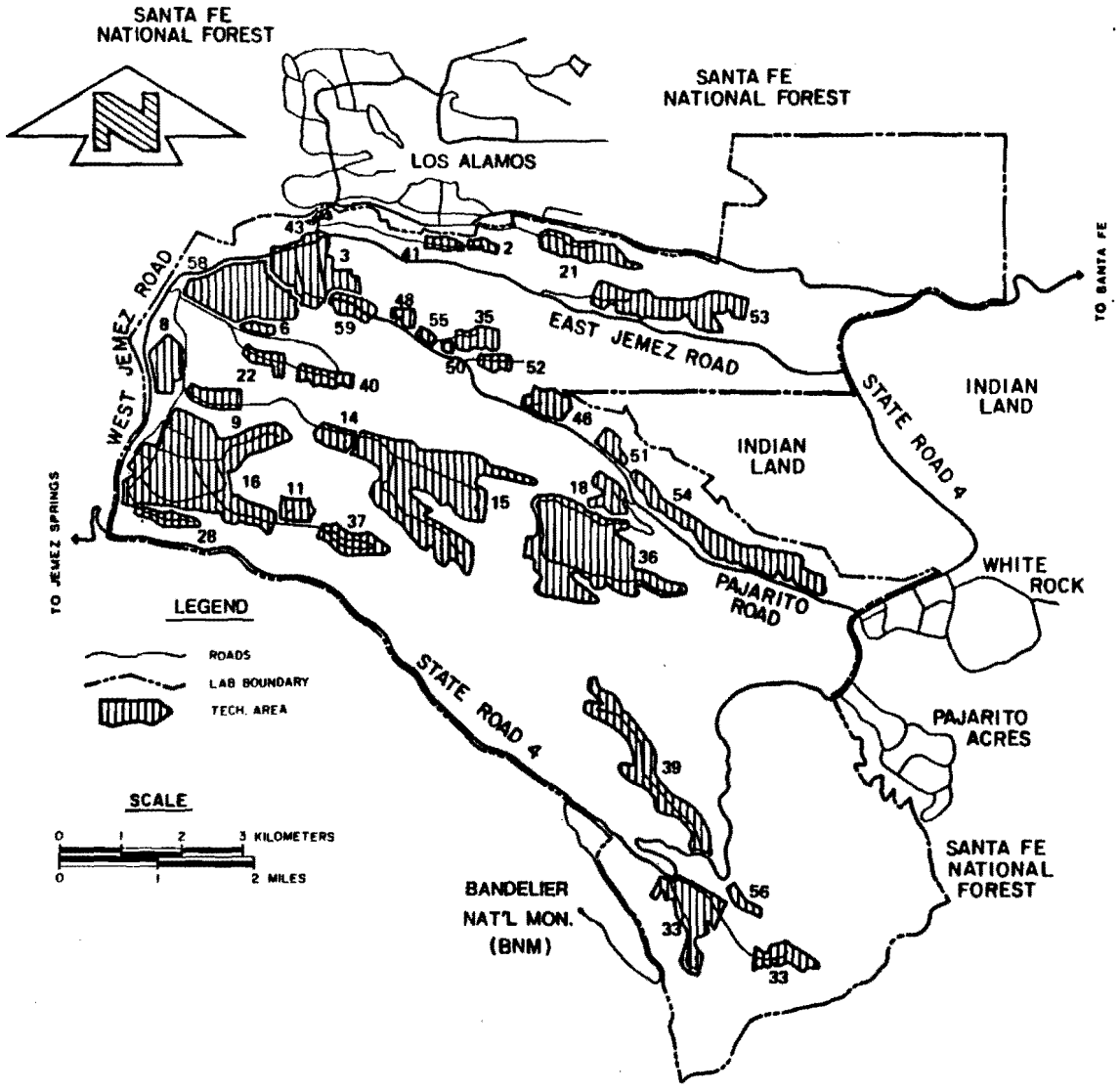


Fig. 2. Los Alamos National Laboratory - technical areas and adjacent communities

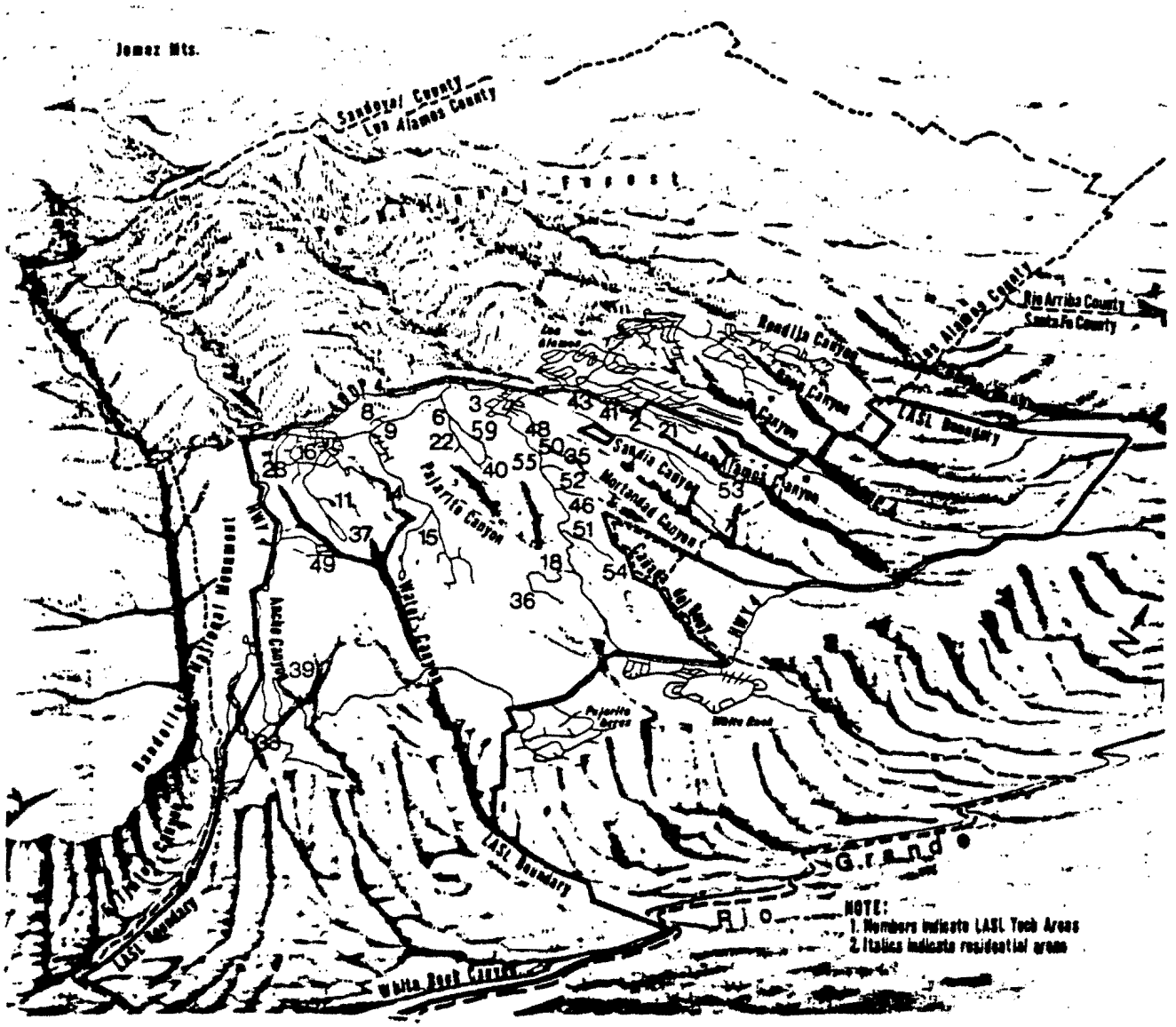


Fig. 3 Topography of the Los Alamos area.

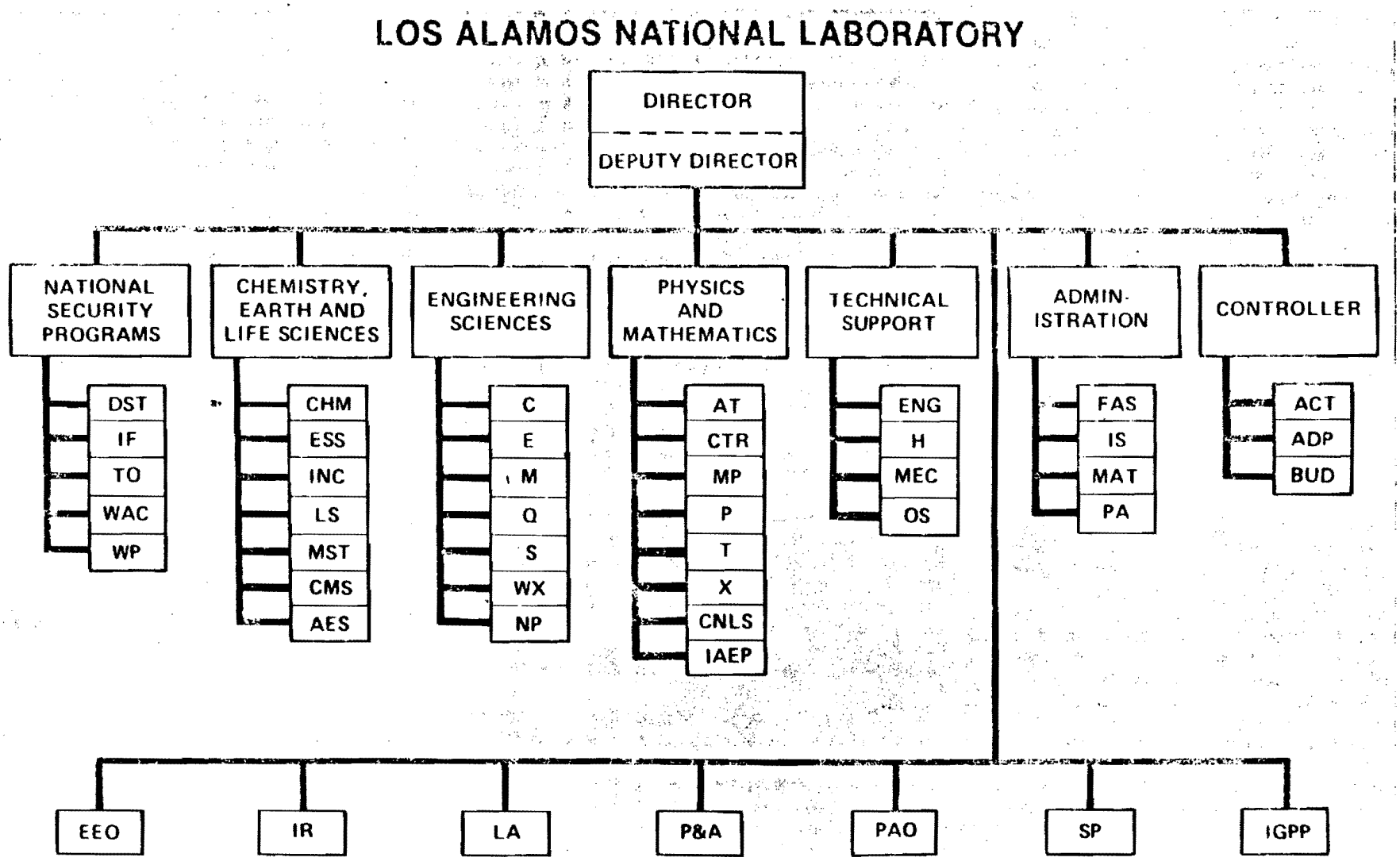


Fig. 4. Los Alamos National Laboratory organizational structure.

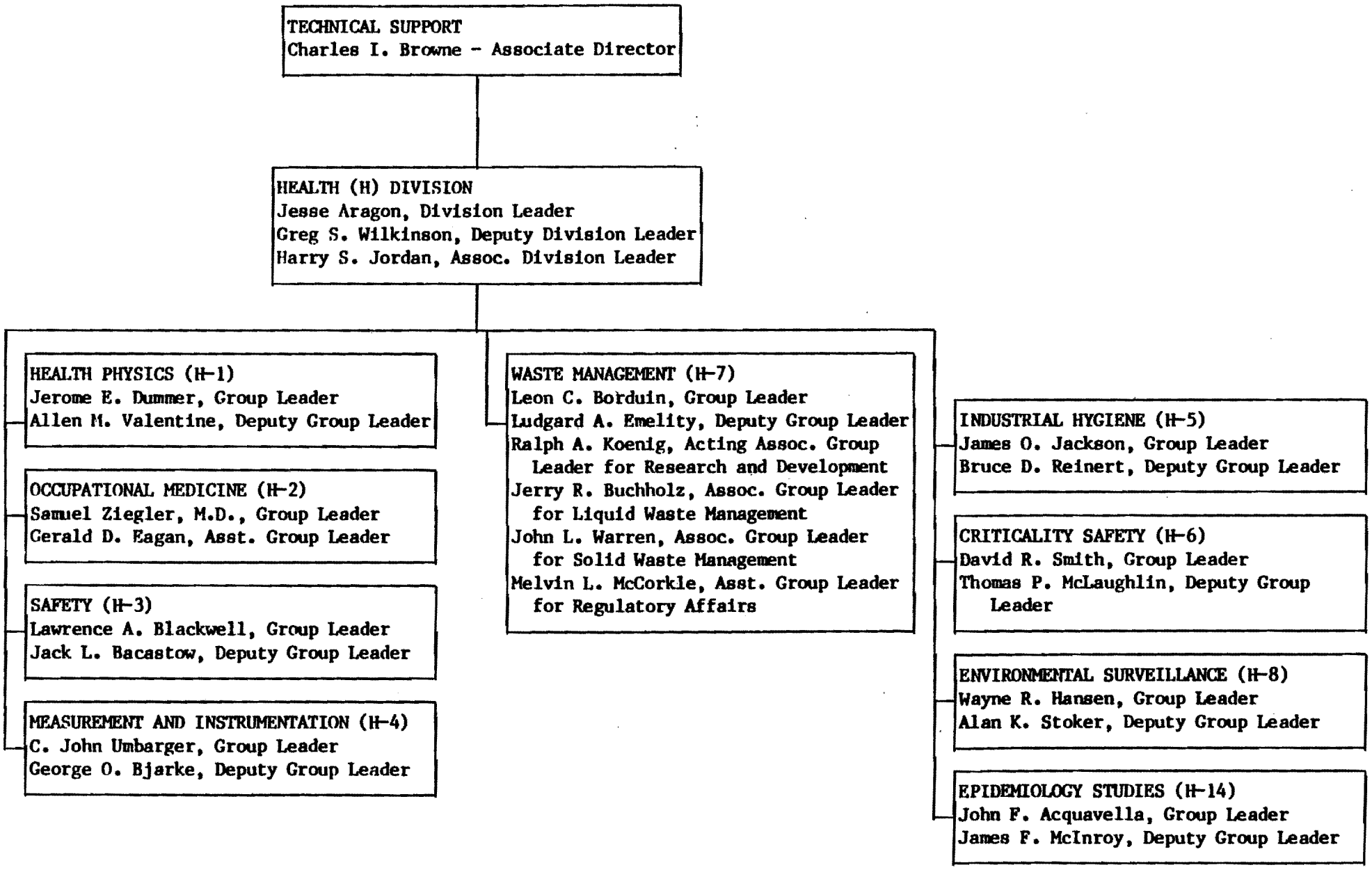


Fig. 5 Los Alamos National Laboratory - Waste Management organizational structure within Health Division

H-7 Waste Management and H-1 Health Physics personnel. Group H-1 provides general Laboratory support in the areas of monitoring and general waste controls, as well as direct support at the burial/storage site.

Activities within H-7 include liquid waste treatment, hazardous chemical waste packaging, transport, treatment and disposal, chemistry laboratory support services, operation of the radioactive and hazardous chemical waste disposal sites, and the monitoring of overall Laboratory compliance with environmental regulations related to hazardous materials disposal. Environmental monitoring at the present and old burial sites is conducted by the H-8 Environmental Surveillance Group.

Overall in FY 1982, an estimated 87 equivalent man-years were used in operational waste management activities at Los Alamos. A breakdown of this work by activity is provided in the table below.

Activity	Estimated Total Effort in Man-Years
Radioactive Waste Segregation, Packaging, Documentation	30
On-site Transport	2
Health Physics Support	10
Liquid Waste Treatment	9
Analytical Laboratory Support	9
Solid Waste Treatment, Disposal, Storage	13
Stack Monitoring	3.5
Environmental Monitoring	3
Environmental Regulation Compliance	6
Hazardous Waste Treatment, Disposal	1

I.4 Lead Responsibility for Site Plans

DOE-ALOO: Mr. R. Y. Lowrey, Director
Waste Management & Transportation
Development Division

DOE-LAAO: Mr. Harold E. Valencia, Manager
Los Alamos Area Office

I.5 Funds for Waste Management

Funding for Waste Management operations at Los Alamos is derived in part from Laboratory overhead, program operating funds, and directly from DOE-ASDP. The latter, a Work Element Plan (WEP) project, provided the Laboratory operations program with $1320K in FY 1982 and $1890K in FY 1983. This money is used for the direct operation of the radioactive solid waste burial/storage areas. Additional waste management costs are from group operating funds and Laboratory overhead charges. The following table lists an approximate breakdown of the total FY 1982 Los Alamos Laboratory budget, with each program area contributing a proportionate share to fund those waste management operations budgeted from overhead charges.

Budget Category	Program	Percentage of Laboratory Budget
ASDP	Defense Programs	53
ASNE	Nuclear Energy	8
DER	Energy Research	14
ASEV	Conservation	3
ASRA	Fossil	1
	Other DOE	8
	Reimbursable Work	13

Funding for the handling and disposal of most air, radioactive liquid, and hazardous nonradioactive wastes at Los Alamos is derived from Laboratory overhead charges. Program funding (ASDP-Defense Programs) is used for the treatment, handling, and disposal of explosives wastes.

II. Radioactive Hazardous Waste Management

II.1 Description of Radioactive Waste Generating Processes

Significant waste-generating processes at the Laboratory are concentrated in 9 technical areas; TA-2, Omega Site; TA-3, South Mesa, (mainly the Chemistry and Metallurgy Research (CMR) Building and the Sigma Complex); TA-21, DP-Site; TA-35, Ten-Site; TA-46, WA-Site; TA-48, Radiochemistry Laboratory; TA-50, Waste Management Site; TA-53, Meson Physics Facility; and TA-55, Plutonium Facility. Waste generating processes at these technical areas (excepting TA-50) are discussed in this section; liquid waste processing plants at TA-21 and TA-50 are discussed in Sec. II.2.2.

Flow diagrams of the generation and disposition of radioactive solid waste at the Laboratory are presented in Fig. 6. Waste packaging in most instances serves to meet requirements of safe on-site handling and transport. Routine low-level solid wastes, i.e., paper, plastic, glassware, rags, etc., are separated into compactible and noncompactible materials. Then they are packaged in 0.06 m^3 (2 ft^3) plastic-lined cardboard boxes and placed in Dempster Dumpsters for transport to TA-54 for compaction/burial. Large equipment items and much of the decontamination/decommissioning wastes are not packaged but are delivered to the burial site in covered or enclosed vehicles. Other waste packagings used as required include metal or fiber drums, wooden crates with and without a protective coating of fiberglass, and plastic bags and wrap. Routine aqueous radioactive liquid wastes are transferred from the generator to either the TA-50 or TA-21 treatment plant via a tank truck or pipeline (see Fig. 9). Organic solvents and oils are solidified and packaged for disposal according to standard procedures at the generator's site.

AEC/ERDA/DOE has required, since 1971, that TRU solid wastes be segregated from low-level wastes and be specially packaged, handled, and stored retrievably. TRU solid wastes at Los Alamos include essentially the same materials as low-level waste, but contain contamination in excess of specified levels. Through

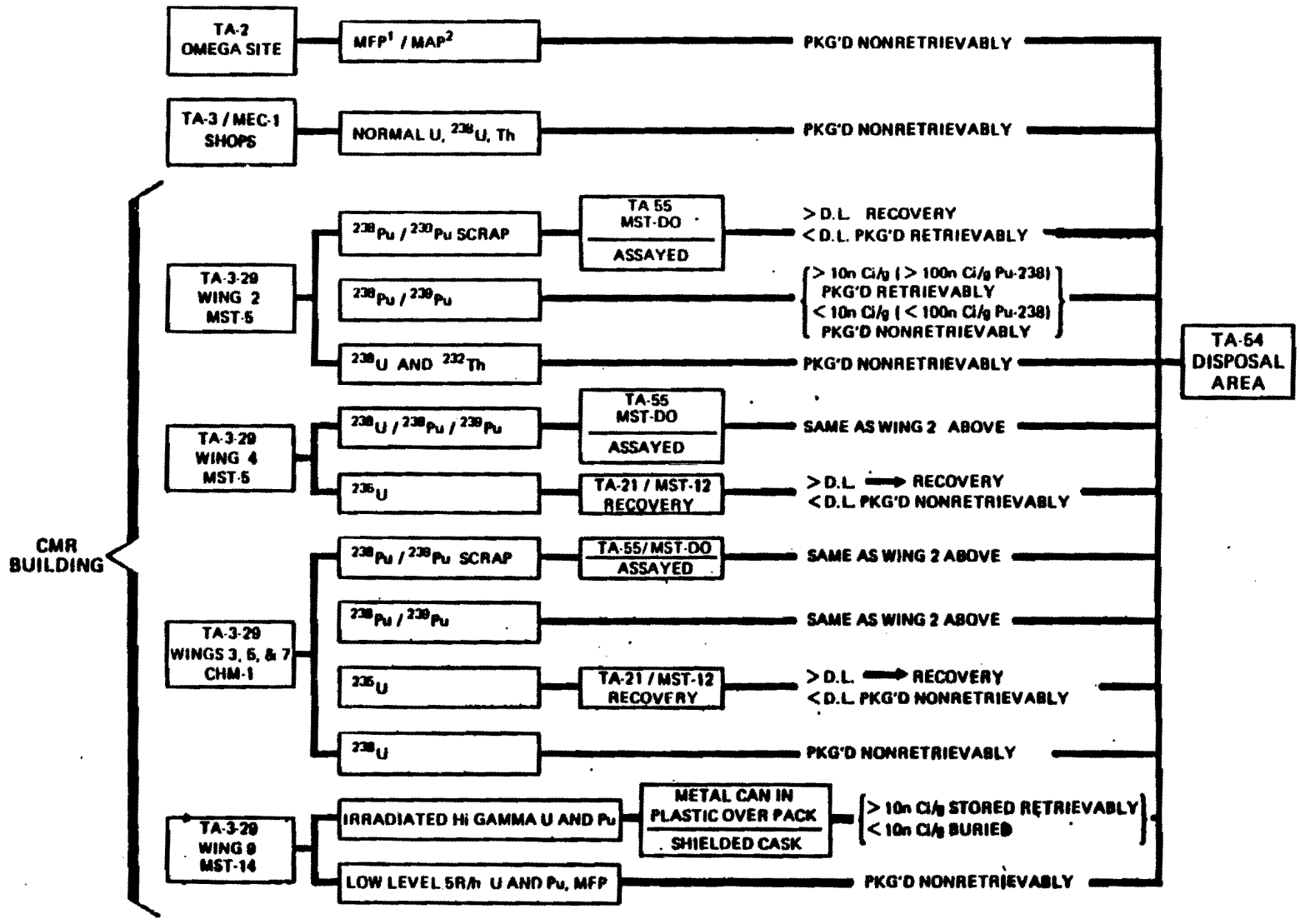


Fig. 6. Flow sheet for Los Alamos radioactively contaminated solid waste.

(continued on next 3 pages.)

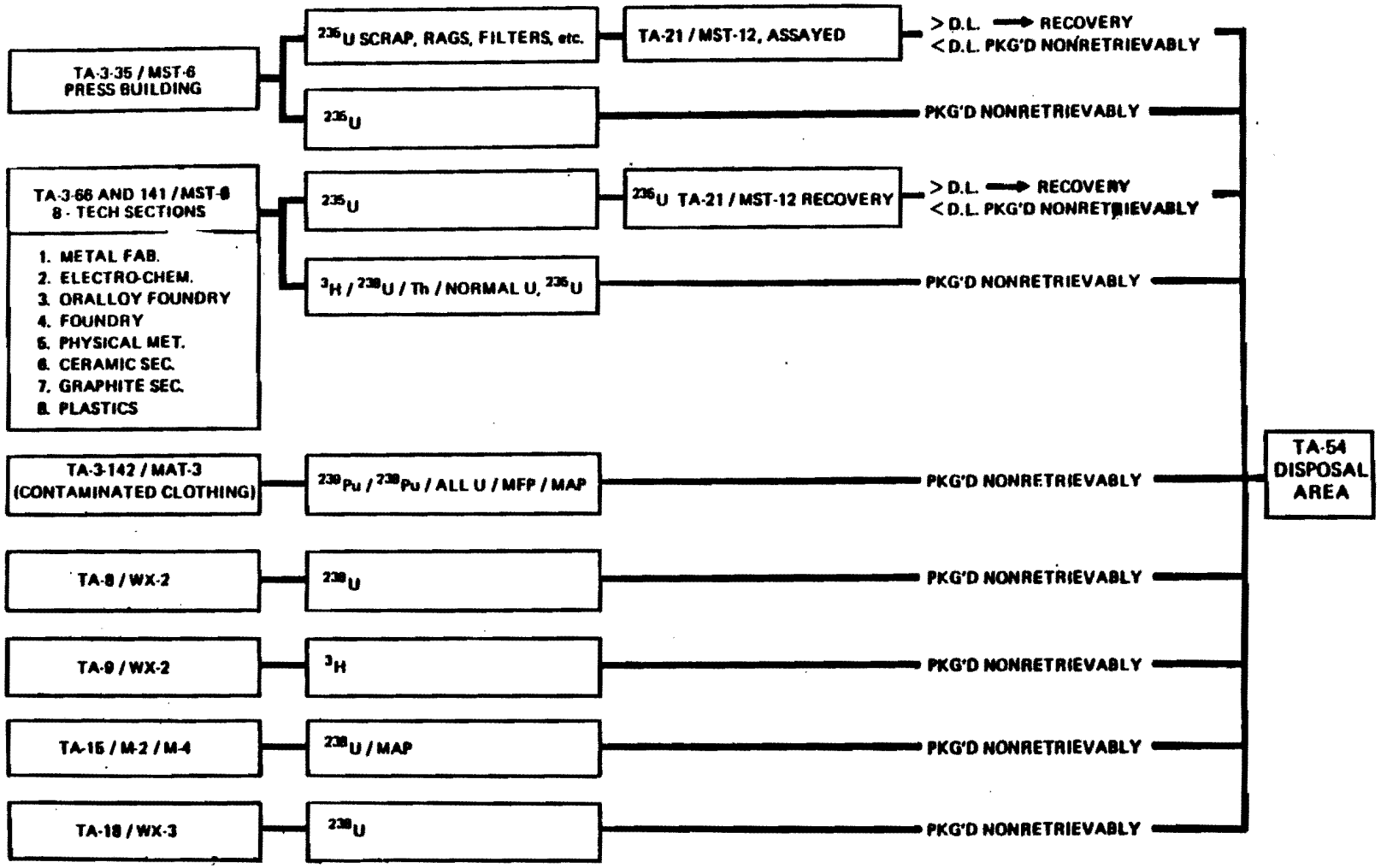

TA-3-35 / MST-6
PRESS BUILDING
^{235}U SCRAP, RAGS, FILTERS, etc.
TA-21 / MST-12, ASSAYED
> D.L. → RECOVERY
< D.L. PKG'D NONRETRIEVABLY
^{235}U
PKG'D NONRETRIEVABLY
TA-3-66 AND 141 / MST-8
8 - TECH SECTIONS
1. METAL FAB.
2. ELECTRO-CHEM.
3. ORALLOY FOUNDRY
4. FOUNDRY
5. PHYSICAL MET.
6. CERAMIC SEC.
7. GRAPHITE SEC.
8. PLASTICS
^{235}U
^{235}U TA-21 / MST-12 RECOVERY
> D.L. → RECOVERY
< D.L. PKG'D NONRETRIEVABLY
^{3}H / ^{238}U / Th / NORMAL U, ^{235}U
PKG'D NONRETRIEVABLY
TA-3-142 / MAT-3
(CONTAMINATED CLOTHING)
^{239}Pu / ^{239}Pu / ALL U / MFP / MAP
PKG'D NONRETRIEVABLY
TA-8 / WX-2
^{238}U
PKG'D NONRETRIEVABLY
TA-9 / WX-2
^{3}H
PKG'D NONRETRIEVABLY
TA-15 / M-2 / M-4
^{238}U / MAP
PKG'D NONRETRIEVABLY
TA-18 / WX-3
^{238}U
PKG'D NONRETRIEVABLY
TA-54
DISPOSAL
AREA

Fig. 6. (cont)

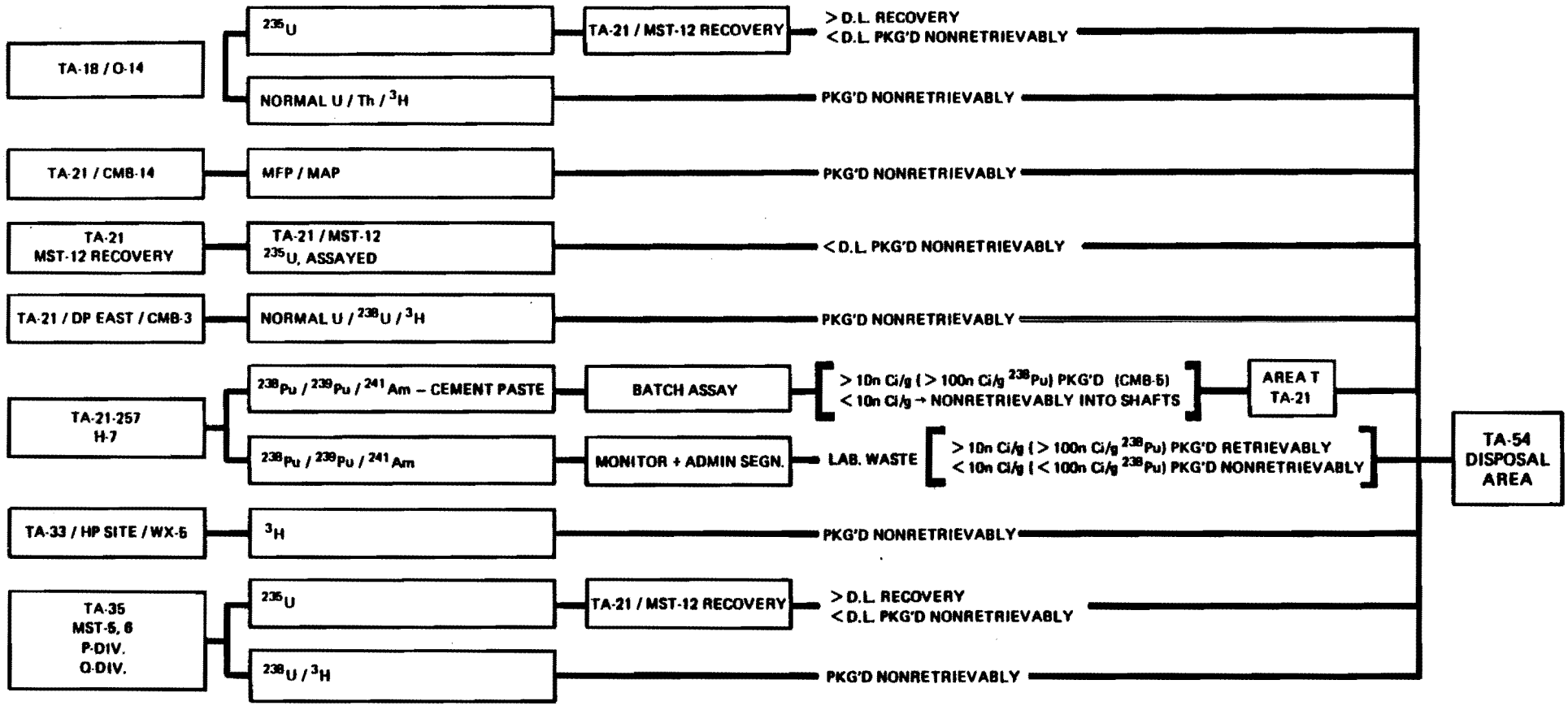

TA-18 / O-14
235U
TA-21 / MST-12 RECOVERY
> D.L. RECOVERY
< D.L. PKG'D NONRETRIEVABLY
NORMAL U / Th / 3H
PKG'D NONRETRIEVABLY
TA-21 / CMB-14
MFP / MAP
PKG'D NONRETRIEVABLY
TA-21
MST-12 RECOVERY
TA-21 / MST-12
235U, ASSAYED
< D.L. PKG'D NONRETRIEVABLY
TA-21 / DP EAST / CMB-3
NORMAL U / 238U / 3H
PKG'D NONRETRIEVABLY
TA-21-257
H-7
238Pu / 239Pu / 241Am – CEMENT PASTE
BATCH ASSAY
> 10n Ci/g (> 100n Ci/g 238Pu) PKG'D (CMB-5)
< 10n Ci/g → NONRETRIEVABLY INTO SHAFTS
AREA T
TA-21
238Pu / 239Pu / 241Am
MONITOR + ADMIN SEGN.
LAB. WASTE
> 10n Ci/g (> 100n Ci/g 238Pu) PKG'D RETRIEVABLY
< 10n Ci/g (< 100n Ci/g 238Pu) PKG'D NONRETRIEVABLY
TA-54
DISPOSAL
AREA
TA-33 / HP SITE / WX-5
3H
PKG'D NONRETRIEVABLY
TA-35
MST-5, 6
P-DIV.
O-DIV.
235U
TA-21 / MST-12 RECOVERY
> D.L. RECOVERY
< D.L. PKG'D NONRETRIEVABLY
238U / 3H
PKG'D NONRETRIEVABLY

Fig. 6. (cont)

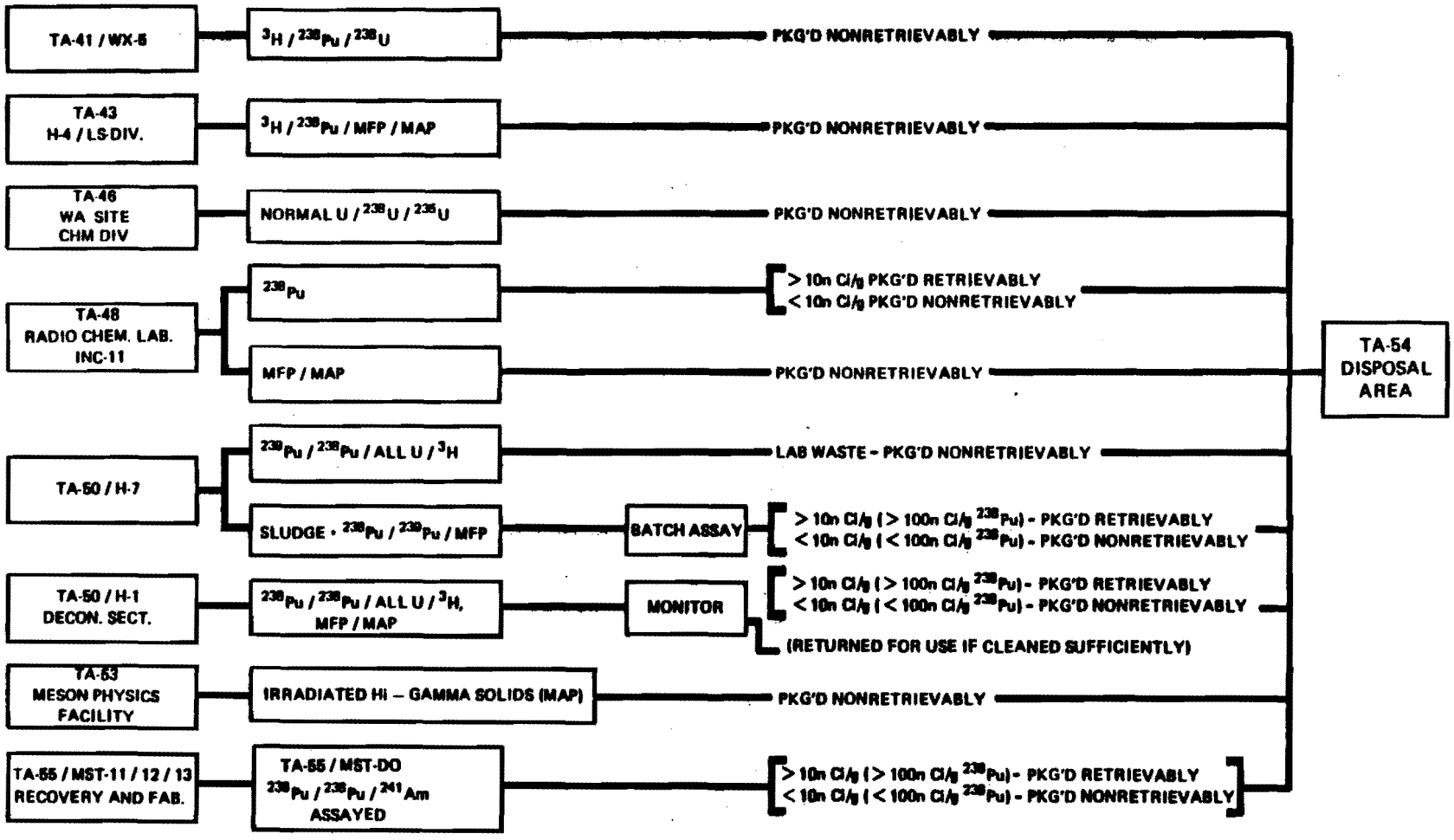

TA-41 / WX-5
^{3}H / ^{238}Pu / ^{238}U
PKG'D NONRETRIEVABLY
TA-43
H-4 / LS DIV.
^{3}H / ^{238}Pu / MFP / MAP
PKG'D NONRETRIEVABLY
TA-46
WA SITE
CHM DIV
NORMAL U / ^{238}U / ^{235}U
PKG'D NONRETRIEVABLY
TA-48
RADIO CHEM. LAB.
INC-11
^{238}Pu
> 10n Ci/g PKG'D RETRIEVABLY
< 10n Ci/g PKG'D NONRETRIEVABLY
MFP / MAP
PKG'D NONRETRIEVABLY
TA-54
DISPOSAL
AREA
TA-50 / H-7
^{239}Pu / ^{238}Pu / ALL U / ^{3}H
LAB WASTE - PKG'D NONRETRIEVABLY
SLUDGE - ^{238}Pu / ^{239}Pu / MFP
BATCH ASSAY
> 10n Ci/g (> 100n Ci/g ^{238}Pu) - PKG'D RETRIEVABLY
< 10n Ci/g (< 100n Ci/g ^{238}Pu) - PKG'D NONRETRIEVABLY
TA-50 / H-1
DECON. SECT.
^{238}Pu / ^{239}Pu / ALL U / ^{3}H,
MFP / MAP
MONITOR
> 10n Ci/g (> 100n Ci/g ^{238}Pu) - PKG'D RETRIEVABLY
< 10n Ci/g (< 100n Ci/g ^{238}Pu) - PKG'D NONRETRIEVABLY
(RETURNED FOR USE IF CLEANED SUFFICIENTLY)
TA-53
MESON PHYSICS
FACILITY
IRRADIATED HI – GAMMA SOLIDS (MAP)
PKG'D NONRETRIEVABLY
TA-55 / MST-11 / 12 / 13
RECOVERY AND FAB.
TA-55 / MST-DO
^{238}Pu / ^{239}Pu / ^{241}Am
ASSAYED
> 10n Ci/g (> 100n Ci/g ^{238}Pu) - PKG'D RETRIEVABLY
< 10n Ci/g (< 100n Ci/g ^{238}Pu) - PKG'D NONRETRIEVABLY

Fig. 6. (cont)

FY 1982, this level was 10 nanocuries of alpha activity per gram (nCi/g) of waste. In accordance with the original AEC/ERDA Manual, Chapter 0511, Los Alamos obtained approval to store its ^{238}Pu wastes over 100 nCi/g, and bury wastes below this level as low-level. DOE Order 5820, effective 9/30/82, defines TRU wastes as solid materials contaminated with TRU radionuclides in excess of 100 nCi/g. The following description of Los Alamos Waste Management operations is based on the earlier DOE definitions of TRU wastes.

II.1.1 TA-2, Omega Site

Primary facilities located at the Omega Site and operated by the Reasearch Reactor Group (INC-5) are the Omega West Reactor (OWR) and an equipment building. The OWR is a water-cooled uranium-fueled reactor facility used for research and irradiation studies. The equipment building houses the ion-exchange columns used for cleanup of primary circulating cooling water and make-up water. These operations generate small quantities of solid, liquid, and gaseous wastes contaminated with mixed fission and activation products. Gaseous effluents are monitored for radioactivity and vented to the atmosphere after an approximate 1-h delay.

II.1.2 TA-3-29, Chemistry Metallurgy Research (CMR) Building

The CMR Building, located in TA-3, is an R&D facility composed of six interconnected wings. Wing 9 houses an irradiated-fuel examination facility; the other five (wings 2, 3, 4, 5, and 7) house numerous and varied R&D and analytical chemistry operations. Significant volumes of solid, liquid, and gaseous wastes with significant levels of radioactivity are generated by these operations.

Solid radioactive wastes from all wings are packaged and transported to TA-54 for disposal or retrievable storage. Liquid wastes are discharged to holding tanks that drain to an underground pipe-line system terminating at TA-50. Gaseous wastes from wings 2, 5, 7, and 9 pass through high-efficiency particulate air (HEPA) filters before release to the atmosphere. In wings 3 and 4, Aersel 95 filters are used.

II.1.2.1 TA-3-29 (Wings 2 and 4)

The Physical Metallurgy Group (MST-5) conducts a variety of operations within these two wings. Basic physical metallurgical research includes the determination of thermochemical, physical, and mechanical properties, often at very high pressures, and crystal structures. Applied physical metallurgical research encompasses safety analyses, compatibility investigations, structural and mechanical property determinations, and production of new metastable alloy phases by splat cooling techniques. Group MST-5 also operates a facility for heat treating and testing SNAP $^{238}PuO_2$ fuel spheres and samples. Substantial amounts of depleted uranium alloys and compounds are prepared in these wings and occasionally small amounts of enriched uranium are used for preparations or experiments. All recoverable amounts of ^{238}Pu, ^{239}Pu, and enriched uranium, whether liquid or solid, are sent to the Plutonium Process Technology Group (MST-12) for recovery.

The Physical Chemistry Group (CHM-2) also has activities in these wings but is not a major waste generator.

II.1.2.2 TA-3-29 (Wings 3, 5, and 7)

The Analytical Chemistry Group (CHM-1) is responsible for furnishing analytical chemical services and the analysis of radioactive materials from research, production, and recycle operations for the entire Laboratory. Again, all recoverable amounts of plutonium and uranium are sent to MST-12 for recovery.

II.1.2.3 TA-3-29 (Wing 9)

The Irradiated Materials Examination Group (MST-14) conducts examinations of irradiated reactor-fuel rods which include physical measurements, specimen cutting and preparation, and examination of fuel rod specimens by photomicrography. During these operations, varying quantities of gamma-active wastes that require special handling procedures are generated. Gamma-active solid waste exceeding 5 R/hr at the package surface and gamma-active TRU solid waste exceeding approximately 25 R/hr at the package surface require special handling and are transported in a cask to TA-54 for shaft burial/storage. Lower level gamma-active

TRU solid wastes are packaged in 210-L (55-gal) drums with internal shielding to allow contact handling. Filled drums are transported to TA-54 for storage.

Some small volumes of solutions generated in the hot cells--plutonium etchant, uranium/fission product solutions, and reacted Na and NaK solutions--require special handling, packaging, and disposal. These solutions are poured into dry vermiculite and packaged in a 3.8-L (1-gal) can containing dru vermiculite. Handling and disposal by shaft burial or storage of these cans is according to the same procedures for the higher level solid wastes described above.

Other beta-gamma-contaminated liquid wastes from the hot-cell operations are collected in stainless steel storage tanks at the site. Tank contents can be treated by cation exchange and transferred to concrete storage tanks for low-level ($<10^{-3}$ Ci/m^3 alpha and/or $<10^{-2}$ Ci/m^3 beta) wastes or they can be pumped to a portable steel tank for delivery to TA-50 for treatment. Wastes in the concrete tanks, from laboratory sinks, decontamination operations, etc., are sampled and then discharged to the industrial waste sewer system for treatment at TA-50.

II.1.3 TA-3-35, -66, and -141, Sigma Complex

The location consisting of buildings SM-35, -66, and -141 of TA-3 is commonly called the Sigma Complex and is operated by the Materials Techology Group (MST-6), develops and fabricates materials for the many Laboratory programs. A brief summary of the scope and type of radioactive material processing within this group is included on a section-by-section basis.

The Ceramics-Powder Metallurgy Section processes ^{238}U, ^{235}U, and ^{232}Th in the forms of carbides, oxides, nitrides, or hydrides. The Metal Processing Section performs a variety of metal processing steps on ^{235}U, ^{238}U, ^{232}Th and, on occasion, metal containers for ^{3}H. The uranium can be hot-rolled, warm- and cold-rolled, swaged, forged, drawn, or extruded. The Plastics Section has never been required to process radioactive material. The Electrochemistry Section performs electropolishing and acid etching on ^{238}U, ^{235}U, and ^{232}Th. The ^{238}U and ^{232}Th

The only radioactive material is tritium, which is used as the fuel in laser fusion targets. In FY 1982, targets contained 0.5 to 1.5 mCi of tritium as deuterium-tritium (DT) gas, but previous targets and target prototypes have also contained Li (D,T) or (-CDT-)n. The quantity of tritium per target is not expected to increase over the next several years.

Targets are filled with DT gas in Building TSL-2, which employs secondary containment with intermediate air scrubbing. Air scrubbing consists of catalytic oxidation followed by absorption on molecular sieve; occasional sieve replacement is necessary. Tritium content of a sieve column is estimated to be 1 to 10 Ci. When the target is irradiated by one of the lasers, the vacuum pumps that are vented directly to the air. A maximum of about 5 mCi of tritium now vaporized in the target chambers each day could increase to 15 mCi/day in FY 1983.

II.1.6 TA-46, WA-Site

The principal project of the Chemistry (CHM) Division at TA-46 during FY 1982 continued to be the uranium laser isotope separation program. CHM Division buildings at TA-46 (Buildings 30, 31, 41, 59, 75, 76) can potentially have small amounts (less than 1 gram quantities) of radioactive materials in closed-loop experiments on natural uranium. The exceptions to natural uranium are Building 76 with millicurie amounts of ^{14}C, and Building 31 with gram quantities of 50% enriched uranium. The ^{14}C in Building 76 is used as a laser gas in a closed-loop system. The natural uranium in the other buildings will be contained in a portable recirculating closed loop (minipulser).

II.1.7 TA-48-1, Radiochemistry

Building RC-1 at TA-48 houses nuclear and radiochemistry operations conducted by the Medical Radioisotopes Research, Isotope Geochemistry, and Nuclear Radiochemistry Groups (INC-3, -7, and -11). This work concerns the application of radioactivity measurements to Laboratory programs and with the study of nuclear reactions and structure. One of its primary functions is to obtain information on the yield and other performance parameters of nuclear test devices by analyses of debris samples collected from

underground tests at the Nevada Test Site. Similar diagnostic services, and some radiochemical preparations, are also provided for other research and development programs. Of these latter programs, probably the most important from a waste management viewpoint is the production of a variety of purified radioisotopes for medical applications from targets bombarded with protons at the LAMPF beam stop. The medical radioisotopes research project primarily in Group INC-3 now is in full-scale operation. The groups additionally conduct basic nuclear research in the areas of neutron and charged-particle excitation functions, decay schemes and level structures, stripping reactions, synthesis and properties of heavy element isotopes, various aspects of the fission process, and other investigations oriented toward geo- and cosmochemistry.

The radioactive wastes generated by these groups fall roughly into two categories: those from the diagnostic work, which are essentially fission-product mixtures with small amounts of heavy elements, and those from the radioisotopes project, which are spallation-product nuclides of mass number up to about 200. These operations are carried out almost exclusively at TA-48, Building RC-1. The limited work performed at other sites, such as Omega, Pajarito, and trailers located at TA-48 or Kirtland AFB results in no significant release of radioactive waste materials.

Gaseous waste materials from alpha activity areas leave TA-48-1 by HEPA filter-equipped ventilation stacks. Small volumes (<5 L) of gamma-active liquid wastes (from 5-50 R/h on contact) are absorbed on vermiculite and transported in a shielded cask truck to TA-54 for shaft burial.

II.1.8 TA-53, Meson Physics Facility

The Medium Energy Physics (MP) Division operates the Clinton P. Anderson Meson Physics Facility (LAMPF) which is used by both Laboratory staff and visiting scientists to conduct experiments in medium-energy physics and nuclear chemistry, for the production of radioisotopes for nuclear medicine, and for clinical experiments in the treatment of certain types of cancer with

negative pi mesons. Radioactive solids, liquids, and gases requiring disposal are generated by (1) proton and neutron spallation and activation within accelerator-related materials (shielding, structural and experimental equipment, targets, and beam stops and associated water cooling systems) and surrounding air, and (2) nuclear chemistry operations.

The following radionuclides having a half-life in excess of 10 days have been detected in the waste:

^{110m}Ag	^{51}Cr	^{22}Na	^{46}Sc	^{88}Y
^{7}Be	^{55}Fe	^{83}Rb	^{182}Ta	^{65}Zn
$^{56,57,58}Co$	^{54}Mn	^{124}Sb	^{48}V	^{203}Hg

The production rates of most of these radionuclides are not great; however, a gradual increase of activity (build-up) can be expected with continued accelerator operation. Large contaminated items (up to several thousand R/h on contact) occasionally are removed from the accelerator; curie content is estimated to range from 10-1000 Ci/m^3. These items are held in a shielded enclosure at this siteto permit some decay before disposal at TA-54.

Radioactive liquid waste resulting from LAMPF operations consists of the activated water in cooling systems. Activation is primarily the result of spallation occurring within the water (long-lived spallation products from ^{16}O being ^{7}Be and ^{3}H). Small quantities of ^{22}Na and cobalt activities are also seen, due to corrosion in some of the cooling systems. The cooling-water systems each contain ion-exchange columns for continuous purification of a fraction of the stream to remove the ^{7}Be and other activities, except for the tritium. Estimated annual maximum tritium generation throughout this system is about 110 Ci. Leaks have developed in the circulating cooling-water systems resulting in substantial volumes (up to 28 000 L/day) of dilute radioactive waste being released to the liquid radioactive waste holding tanks. This very dilute waste has been transferred to the sanitary sewer system and thence to the two 1-acre sanitary lagoons at TA-53. During most of the year there is an overflow to a normally dry arroyo.

During operation, beam loss in accelerator structures and target areas will give rise to radioactive gases formed by the interaction of secondary particles in air. The predominant radioactive gases and their half-lives thus formed will be ^{41}Ar ($t_1/_2$ ~1.8 h), ^{11}C ($t_1/_2$ ~20 min), ^{13}N ($t_1/_2$ ~10 min), ^{15}O ($t_1/_2$ ~2 min), ^{203}Hg ($t_1/_2$ ~46.6 d), ^{197}Hg ($t_1/_2$ ~64 h), ^{197m}Hg ($t_1/_2$ ~24 h). Radioactive particulates, such as activated dust, are removed by HEPA filters and thus are not discharged to the environment. It is estimated that a few microcuries of noble gases may be released per year.

The LAMPF site also contains a Group INC-11 area including a separate laboratory and several other sample-handling facilities for the Group's research program in nuclear chemistry. This program covers a broad range of experimental studies including cross-sections and mechanisms of reactions induced by pions, muons and medium-energy neutrons and protons; the decay of spallation-produced nuclides; meson-induced fission processes; and the analysis of fast neutron spectra by radioactivation detectors. Radioactive samples are processed primarily in four standard radiochemistry rooms in the chemistry wing (D wing) of the Laboratory Office Building. The wastes are essentially all beta- and gamma-emitters; no significant quantities of alpha-emitters are processed here. Liquid wastes are fed to basement storage tanks and pumped into a tank truck for delivery TA-50. Other processing is conducted in a laboratory in the Merrimac Area (Beam Area A). Liquid radioactive wastes are drained to a neutralization-storage system in the basement below the laboratory for eventual tank truck transfer to TA-50.

II.1.9 TA-55, Plutonium Facility

The Laboratory's main plutonium facilities are located at TA-55 in Building PF-4. Plutonium operations at the site involve R&D, oxide production, metal preparation, and fabrication and recovery work with ^{238}Pu and ^{239}Pu materials. Most residues and waste materials generated by these operations are sent (along with residues from other Laboratory plutonium operations) to the chemical processing section.

Materials containing ^{238}Pu are assayed and are either sent to Savannah River for recovery, placed into the appropriate Laboratory retrievable-storage facility, or buried when the ^{238}Pu content of the waste is <100 nCi/g.

All containers of ^{239}Pu material are measured for Pu content by one or more nondestructive assay techniques. Materials that contain more plutonium than the ALO-approved discard limit are processed through scrap recovery. Process waste of lower concentrations is sent to retrievable storage. Leached process solids are sent to retrievable storage when the plutonium concentration is <4 g/kg.

Room-trash boxes are monitored by a neutron counter or a low-energy gamma scanner. Those found to be >10 nCi/g are repackaged and placed into retrievable storage. Room trash containing <10 nCi/g is sent to TA-54 for burial. Figure 7 shows the flow sheet for the processes[2-5]. Liquid discard streams from TA-55 are transferred through special stainless steel waste lines to TA-50 for final treatment.

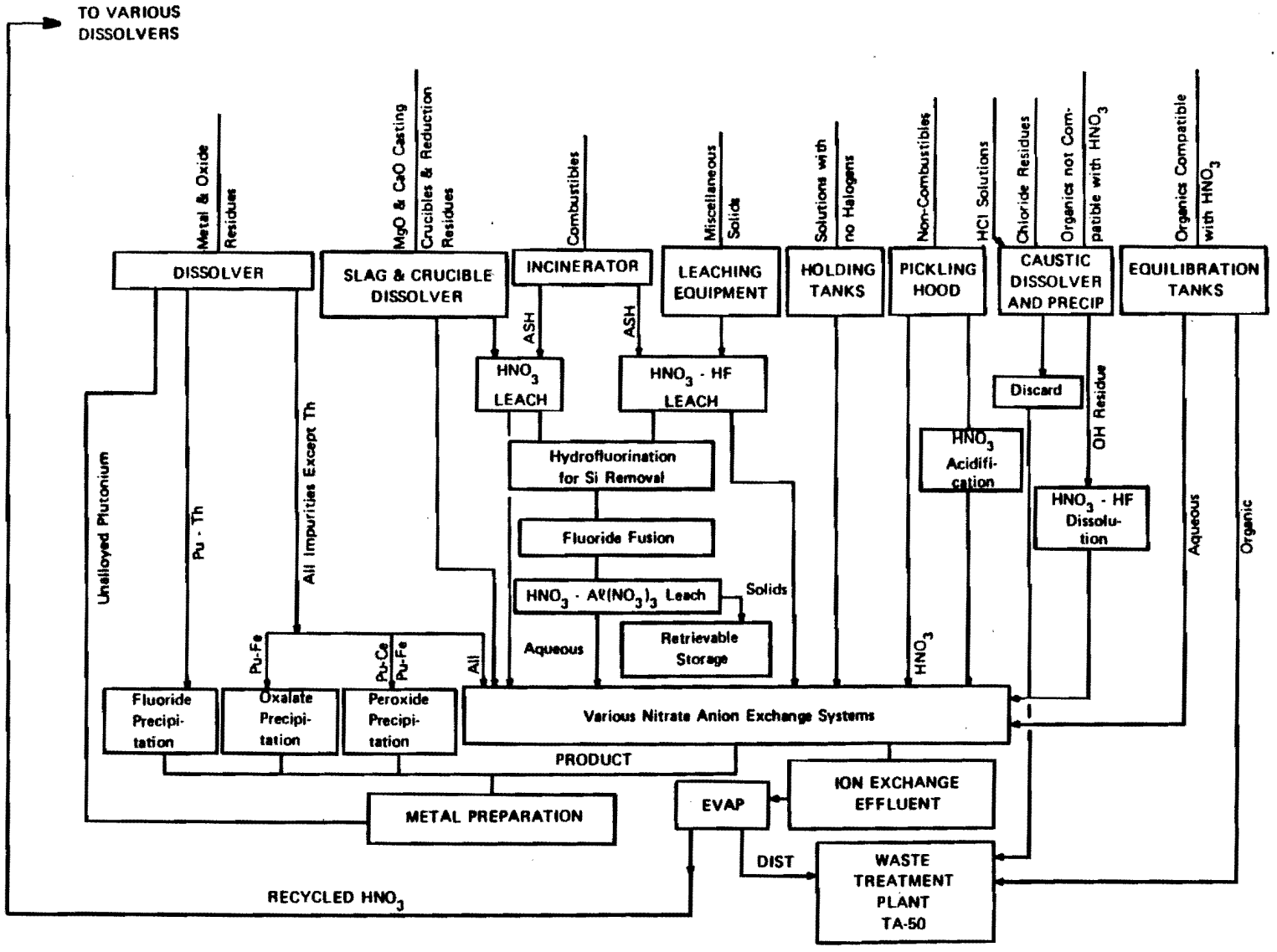


Fig. 7. Flow (top to bottom) of material in TA-55 plutonium processing areas.

II.2 Waste Management Facilities

II.2.1 Locations

Locations of major radioactive waste management facilities are shown in Fig. 8. Facilities include liquid waste treatment plants with associated effluent control systems, waste storage or burial locations, and locations of major airborne contamination release points and their associated effluent control systems, that is, filtration units and monitoring equipment.

II.2.2 Treatment Facilities

Liquid waste treatment facilities at the Laboratory include a 950-L/min (250-gal/min) chemical-treatment and ion-exchange plant at TA-50, a 475-L/min (125-gal/min) chemical treatment plant and a waste-cement fixation plant at TA-21, Building 257, and a large number of building storage, neutralization, and/or pumping stations. Figure 9 indicates the sites served directly by the TA-50 plant, with the exception of TA-55, which is served by a direct line. The Building 257 plant serves TA-21 only.

II.2.2.1 TA-50

The TA-50 facility [6-10] (Fig. 10) provides a bar screen, grit chamber, raw waste storage tanks, flash mixers, chemical feeders, flocculator-clarifiers, gravity filters, distributor for CO_2, ion-exchange columns, spent regenerant storage- treatment tank, sludge storage tanks, vacuum filter, and treated waste storage tanks. Chemicals used for separation and concentration of alpha-emitting radionuclides include ferric sulphate, lime, trisodium phosphate, and coagulant aids.

The sludge produced by chemical treatment is dewatered by vacuum filtration to 25-40% solids, placed in lined 215-L (57-gal) steel drums if the transuranium radionuclide activity is >10 nCi/g or ^{238}Pu activity is >100 nCi/g, and forwarded to the solid waste disposal/storage area at TA-54 (Area G). The sludge in the drums looks like wet clay, but no free water is apparent. To further insure the absence of free water, about 10 pounds of Portland cement powder is placed in the bottom of the drum liner

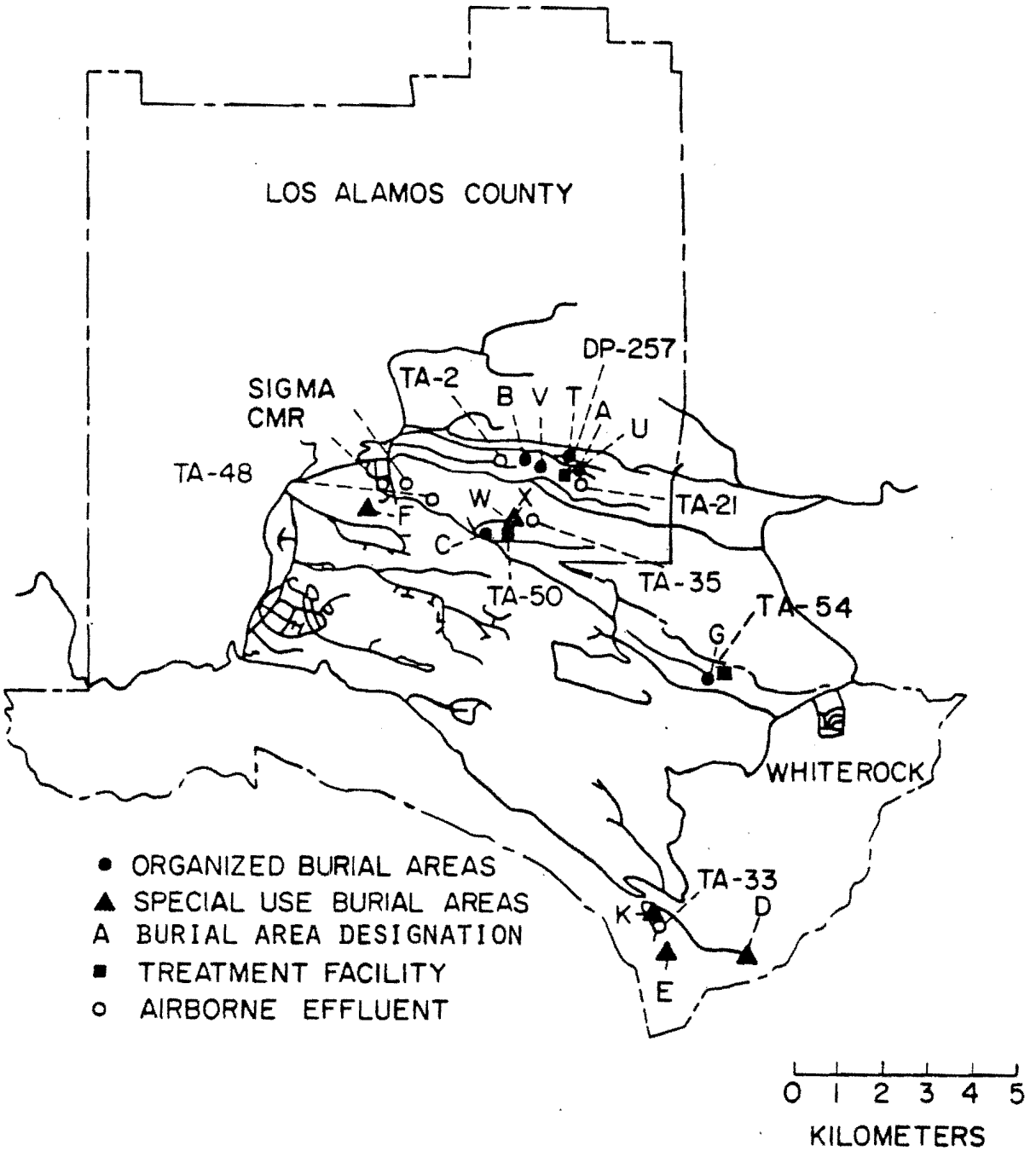


Fig. 8. Radioactive Waste Management facilities

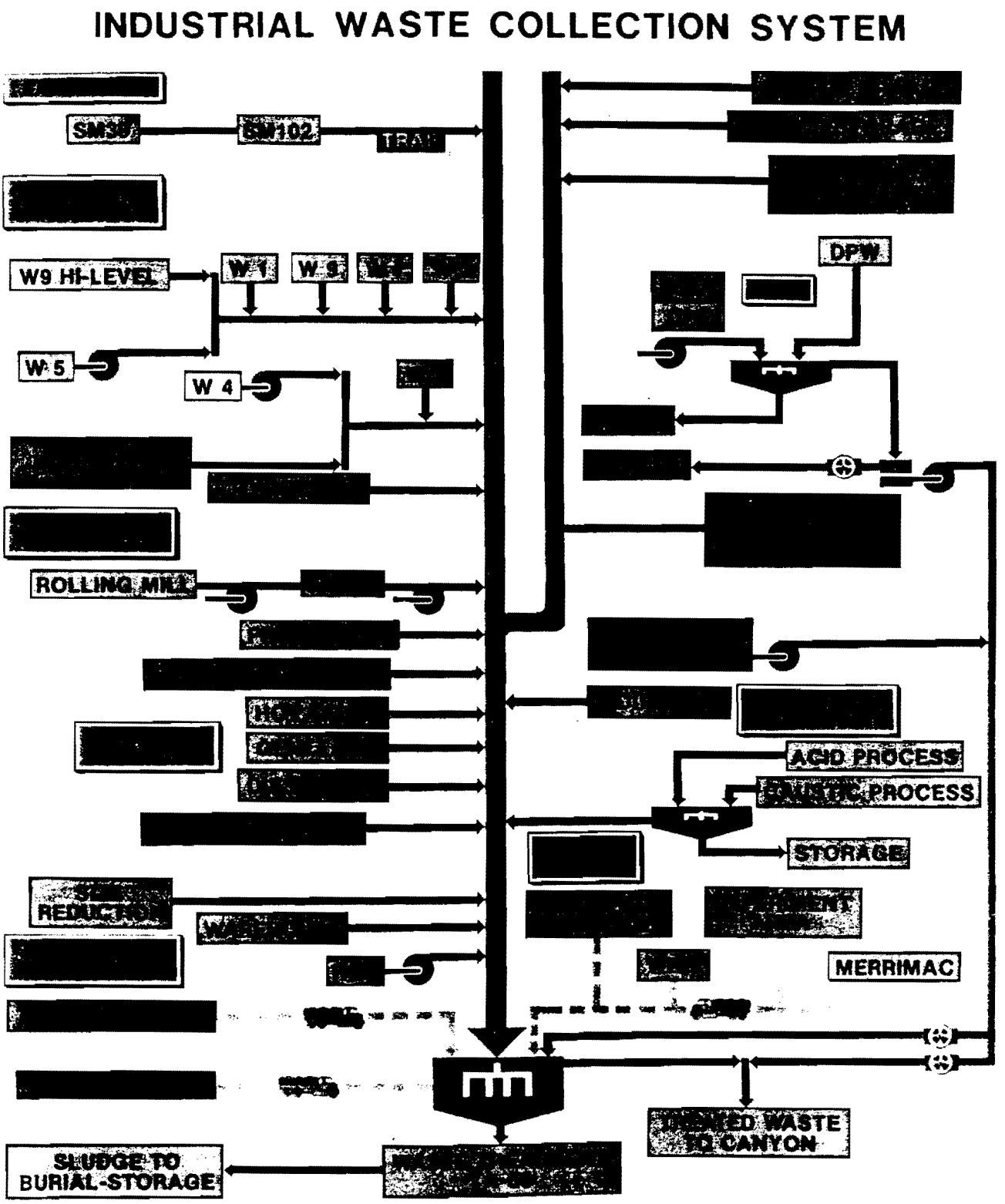


Fig. 9. Central waste collection system discharging to TA-50.

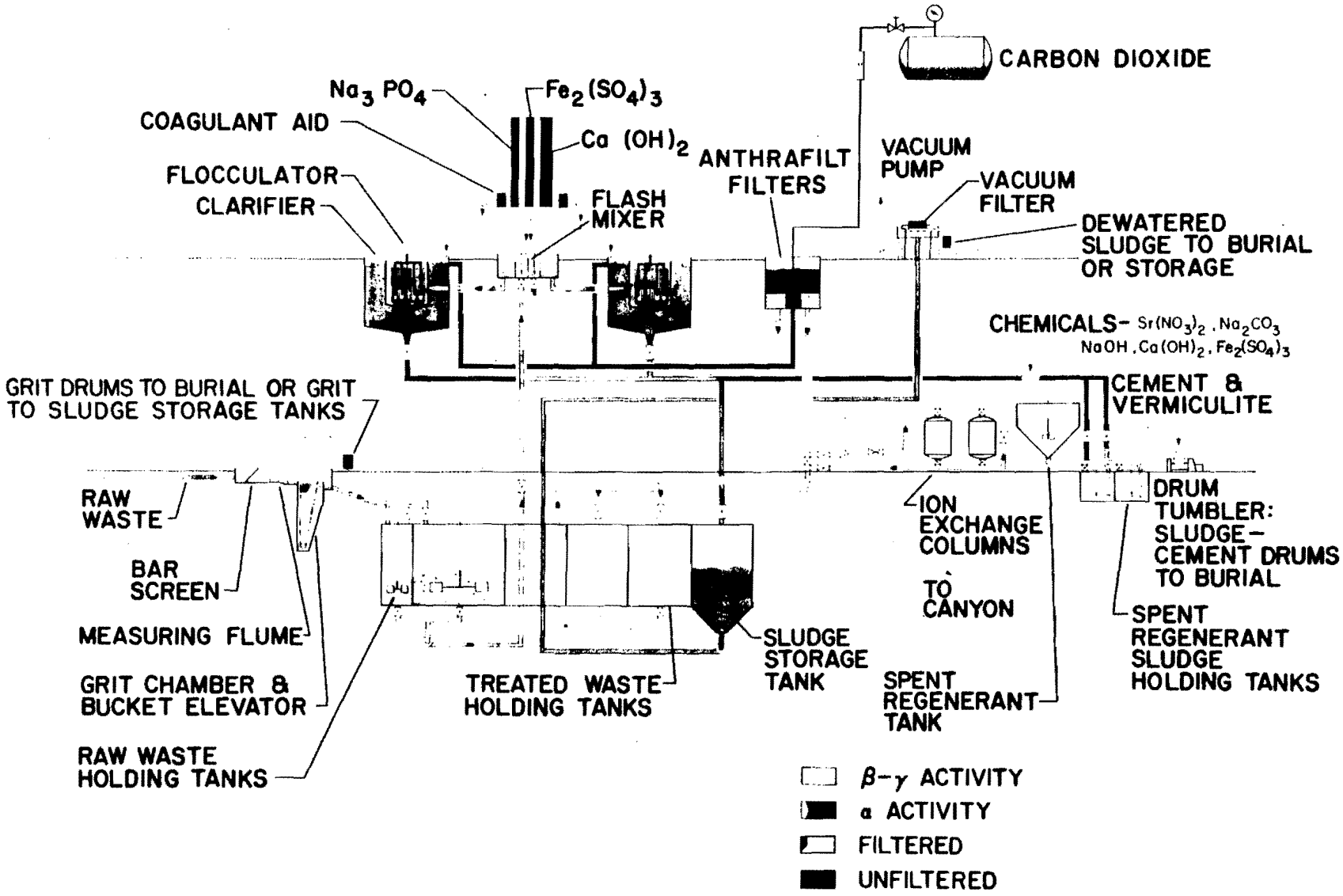


Fig. 10. Contaminated Liquid Waste Treatment Plant, TA-50, schematic flow diagram for normal operation.

filter, and treated waste storage tanks for treatment of low-level radioactive wastes. In CY 1981, 4.51×10^6 L (1.19×10^6 gal) of waste containing about 5.35 Ci of alpha radioactivity were treated. About 6.41 mCi of gross-alpha activity were discharged from this facility.

Other concrete and stainless steel storage tanks are provided at Building 257 for a variety of higher level batch wastes. Most of these are treated by neutralization, if necessary, in special stainless steel water-cooled tanks. Neutralized and alkaline wastes are transferred to a mixer-equipped feed tank, then fed to a pug mill where cement from a silo is added (Fig. 12). Nonretrievable cement paste is discharged to large shafts in Area T west of the building. The system was modified in late FY 1975 to provide for storage of the paste requiring retrievability in 6.1-m (20-ft)-long by 0.76-m (2.5-ft)-diameter galvanized, welded, corrugated-metal pipe (CMP) sections. Sludge from the chemical treatment plant providing feed to the pug mill system does not require retrievability; it is discharged to asphalt-lined shafts in the tuff in Area T. Appropriate samples are taken at all phases of the operations.

In CY 1981, 5.2×10^4 L (1.38×10^4 gal) of waste produced 63.7 m^3 (2.23×10^3 ft^3) of cement paste waste containing about 2.01 Ci of alpha activity, most of which was ^{241}Am. Of the 63.7 m^3 (2249 ft^3) of total paste, 25.1 m^3 (886 ft^3) were placed in the CMP sections; this paste contained almost all of the alpha activity. These figures reflect a trend in decreasing volume of waste and decreasing activity level in the waste, which will continue for several years. This is primarily a result of the move of the plutonium processing facility from TA-21 to TA-55. With the new 100 nCi/g definition of TRU waste, all future cement paste from this facility will be buried as low-level waste.

II.2.3 Disposal/Storage Facilities

Thirteen separate areas at Los Alamos contain known or suspected subsurface radioactive contamination (Fig. 8). Continuing environmental surveillance of these sites shows contaminant releases to range from nondetectable to, at most, several orders

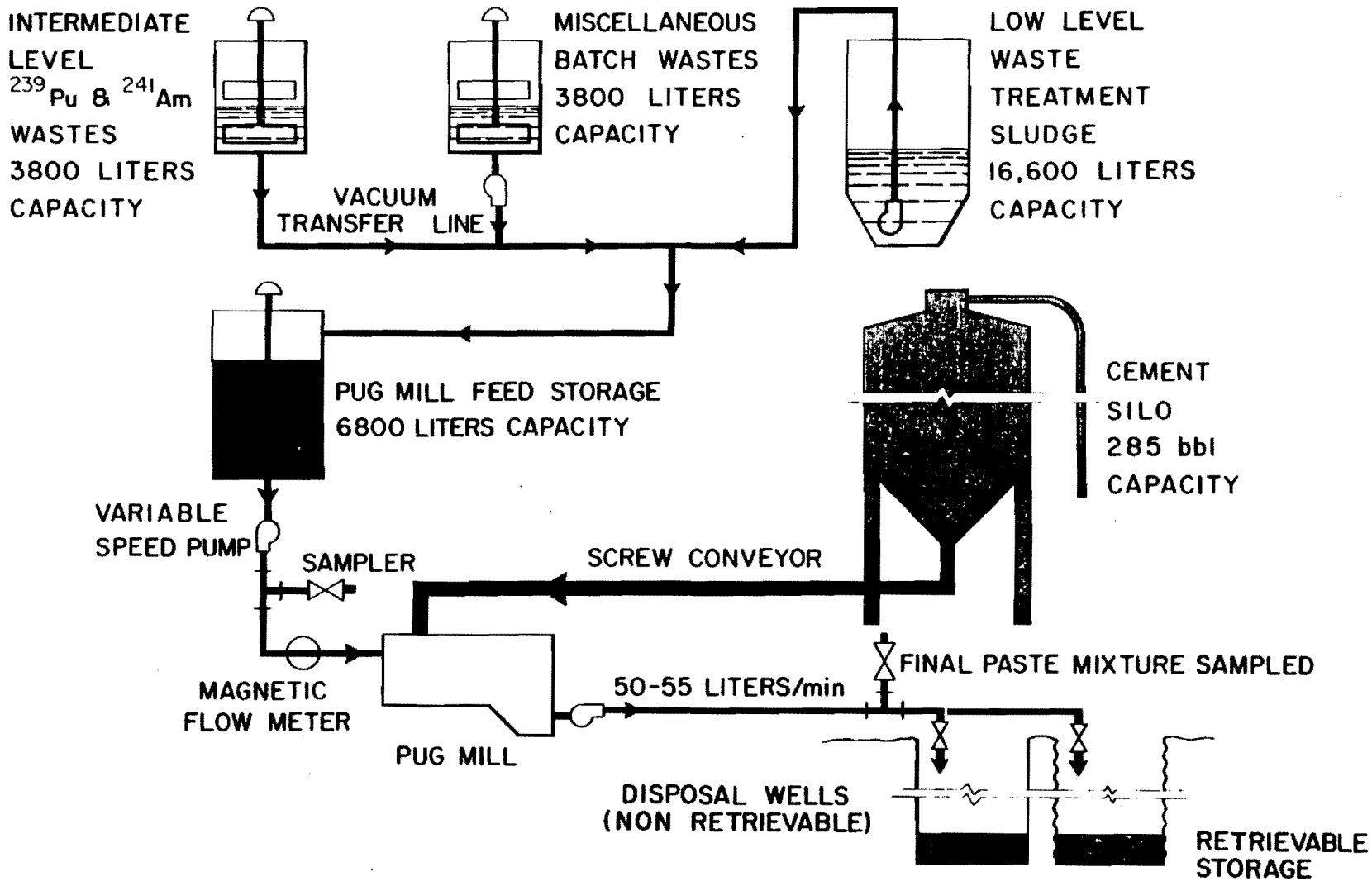
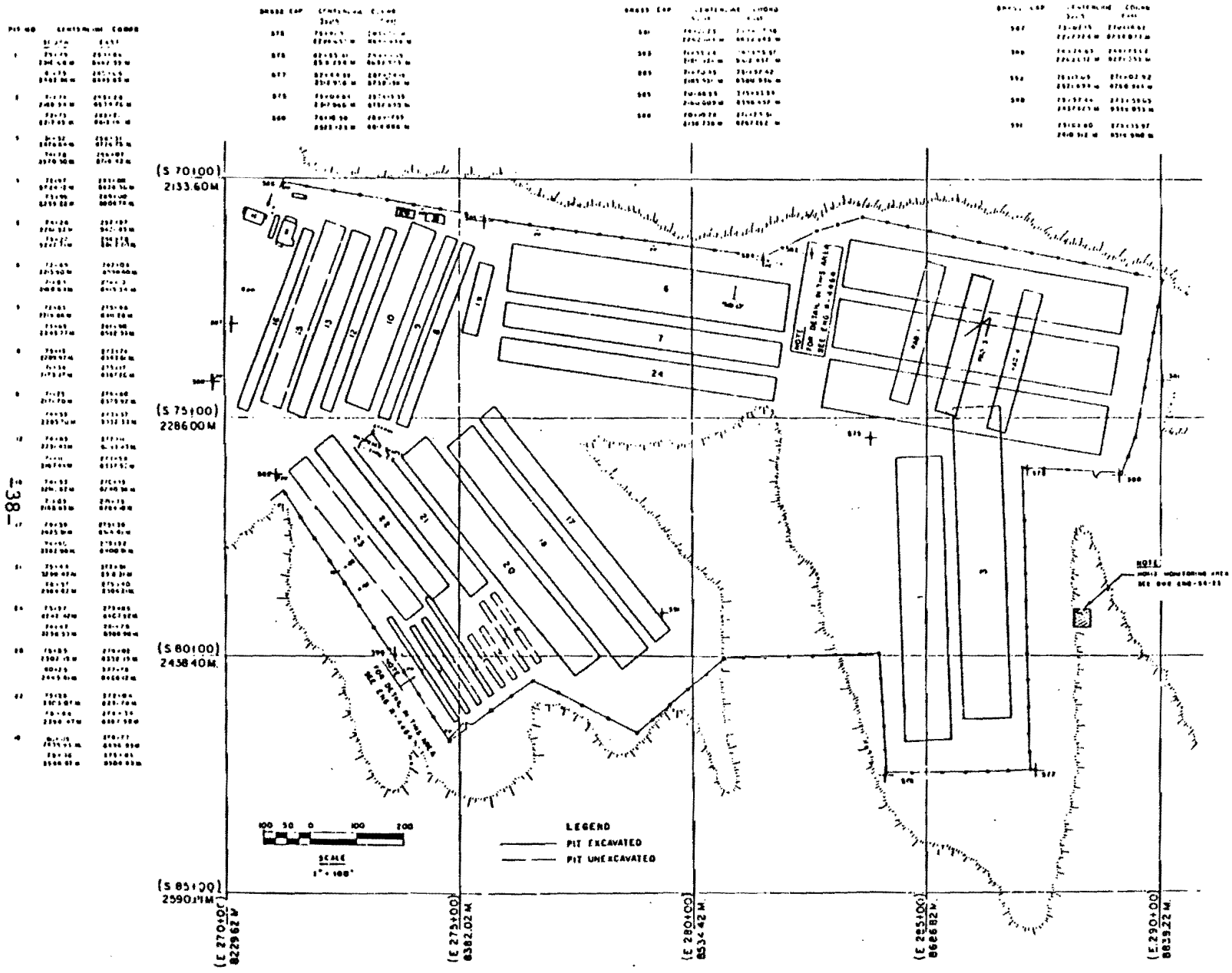


Fig. 12. Contaminated Liquid Waste Treatment Plant, TA 21, DP-257, pug mill cement fixation.



SITE FACILITIES

2-Compactor/Shop bldg.

8-TRU drum storage shed

10-Meteorological station

11-Office/change bldg.

PP-Power pole

Fig. 14. Layout of older portion of Area G, including Site facilities.

are located there. From 1952 to 1967, the beds were used infrequently for overflows and for wastes that were not treated adequately. In 1968, the area between the absorption beds was chosen for a shaft field for disposal of cement paste waste from the waste treatment plant TA-21-257. This paste has been pumped into 1.2-m (4-ft) to 2.4-m (8-ft)-diameter by 18.3-m (60-ft)-deep disposal shafts. A retrievable storage pit was dug in late 1974 beyond the shaft field in the western portion of the area. This pit contains the corrugated metal pipes filled with retrievable cement paste.

II.2.3.10 **Area U**

This area, located on the north side of DP-East, TA-21, covers 1.2×10^3 m^2 (0.3 acre) and contains several absorption beds similar to those in Area T. The beds were used for subsurface disposal of contaminated liquid wastes between 1945 and 1968. The primary contaminant was ^{210}Po. No records exist of the amount discharged; however, the short half-life of the material has by now resulted in decay to innocuous levels. During 1953, approximately 2.5 Ci of ^{227}Ac were discharged into these pits.

II.2.3.11 **Area V**

This area is located southwest of TA-21, and was used for the disposal of contaminated liquid waste from laundry operations between 1945 and 1961, using absorption beds similar to those at Area T. The area covers approximately 4×10^3 m^2 (1.0 acre) and received wastes containing an estimated total of 3 Ci of ^{89}Sr, ^{140}Ba, and ^{140}La. Small quantities of ^{90}Sr and ^{239}Pu were also contained in the waste.

II.2.3.12 **Area W**

At this location at TA-35 are two buried 0.20-m (8-in)-diameter x 30-m (100-ft)-long stainless steel tanks. When the LAMPRE reactor was shut down in 1964, the sodium coolant was drained into these tanks and the tanks were sealed. Each tank contains 100-150 L (25-40 gal) of irradiated sodium known to be contaminated with ^{137}Cs, ^{22}Na, and ^{239}Pu. Work was completed in early FY 1980 to "entomb" the tops of the tanks (at ground level) in a reinforced concrete structure.

II.2.3.13 Area X

Also located at TA-35, Area X is a 2×10^2-m^2 (0.05-acre) tract that is the burial site of the containment shell of the LAPRE II reactor decommissioned in 1959 and buried in 1960. The site is now paved.

II.2.4 Effluent Control Systems

II.2.4.1 Liquid Effluent Systems

At both the TA-50 and TA-21 treatment plants, treated waste streams are sampled continuously, proportional to the flow, using a timer-solenoid arrangement on sample pump discharge lines. The treated waste streams are collected in storage tanks, and after a tank has been filled, a portion of the composite sample is assayed for gross-alpha activity in proportional counters. The emphasis in plant operations is removal of a maximum amount of radioactivity because of the possible buildup of certain radionuclides in the environment; effluent guidelines based on ecological considerations are being reexamined. Treatment plant effluent is discharged to Mortandad Canyon from TA-50 and to DP Canyon from DP-257. The laboratory at TA-50 analyzes the daily samples for gross-alpha, -beta, and -gamma radioactivity, and for strontium. In addition, a weekly composite sample is analyzed for similar radiochemical characteristics plus ^{238}Pu, ^{239}Pu, ^{241}Am, ^{137}Cs, U, $^{89,90}Sr$, and a number of chemical and physical characteristics such as pH, total solids, total hardness, CN, SO_4, Cl, F, NH_3, PO_4, NO_3, alkalinity, Hg, Cd, Pb, Zn, Cu, Ca, Mg, and Na. Analyses of a monthly composite provide ^{238}Pu, ^{239}Pu, ^{241}Am, ^{234}U, ^{3}H, ^{90}Sr, and ^{137}Cs data, as well as data for Se and As.

Overflow of raw wastes to the environment is unlikely because of the treating capacities of the plants and the storage capacities in the systems. At TA-50, 3.8×10^5 L (1×10^5 gal) of raw waste storage is available. However, if these tanks overflow, the wastes pass to the two 9.5×10^4 L (2.5×10^4 gal) effluent storage tanks. In addition, tanks with capacities varying from 1.9×10^4 to 1.9×10^5 L (5000 to 50 000 gal) are located at the facilities producing the wastes.

At DP-257, 1.02×10^5 L (2.7×10^4 gal) of storage are available for wastes from DP-East and about 2.1×10^5 L (5.6×10^4 gal) of storage for those from DP-West.

Information regarding sample types, sample frequency, sample location, and annual quantities of radioactivity released can be obtained for the years 1973 to present from the DOE-F-5221.1 forms (formerly 789A/789B/789T) which the Laboratory submits in accordance with DOE 5484.1, Chapter IV.

II.2.4.2 **Airborne Effluent Systems**

At 86 sampling points throughout the Laboratory, gaseous effluents with a potential for radioactive material contamination are discharged. These effluents are monitored continuously, using particulate and/or gas monitoring methods. HEPA filters are used extensively to control the emission of plutonium and other particulate radioactive materials. The new tritium research facility at TA-21 is equipped with an oxidizing microsieve exhaust air treatment system that effectively reduces airborne tritium effluent releases.

Where HEPA filters are specified, the system is tested in place in accordance with ANSI Standard 101.1. All filters used meet the specification required by DOE Health and SafetyBulletin 306 and military specifications MIL-F-510686, and are installed in accordance with the recommendations included in ORNL-NSIC-65. Information regarding sample types, sample frequency, sample location, and annual quantities of radioactivity released can be obtained for the years 1973 to present from the DOE-F-5221.1 forms submitted by the Laboratory in accordance with DOE 5484.1, Chapter IV.

II.2.5 **Site Administrative Limits on Effluents**

The prevalent Laboratory philosophy is that radioactivity levels in airborne and liquid effluents should be as low as reasonably achievable and in accord with various DOE directives. An extensive monitoring program[14], conducted by H-8, has shown that environmental levels of radioactivity are well below levels of concern. This program consists of various routine and special purpose types of monitoring, including collection of air,

water, soil, sediment, milk, and biotic samples, and measurement of external radiation levels in the Los Alamos vicinity and at points as distant as 4864 km (30-40 miles). Results have shown that the levels of radioactivity and concentrations of radiocontaminants are generally about the same as worldwide fallout levels.

All radioactive liquid wastes are managed in accordance with guidelines established by Group H-7. In recent years, radiochemical separations have shown alpha activity to be due almost entirely to ^{241}Am, ^{239}Pu, ^{238}Pu, or ^{234}U. In many instances, when time and storage space permit, treated waste streams are recirculated on the basis of the Laboratory and DOE policies of discharging a minimum amount of radioactivity. Annual averages of alpha activity in liquid wastes discharged to the onsite environment have been a small percentage of the DOE values for uncontrolled areas in recent years.

Before disposal of property in the townsite, the liquid effluents from TA-43 (Health Research Laboratory) were transported through industrial waste sewer lines to a treatment plant in Acid Canyon. After AEC disposal of land in the townsite and relocation of the waste treatment plant, the industrial waste sewer line from HRL was disconnected and all drains were connected to the sanitary sewer system that originally belonged to the AEC but now belongs to Los Alamos County. Composite samples of these wastes were collected continuously and analyzed for radioactivity. Since FY 1975, procedures for local collection have been initiated to reduce further the quantity of radioactive material released; i.e., liquids known to contain radioactive material are collected in containers located in designated HRL laboratory rooms and filled containers are transported to TA-50 or TA-21-257 for treatment and disposal. In FY 1982, all waste from the HRL was diverted to the TA-3 sanitary sewage treatment plant. All radioactive liquids are still collected and sampled, but the risk of an accidental release to the Los Alamos County system has been eliminated.

II.3 Radioactive Waste Disposed of or Stored

II.3.1 High-Level Waste

Not applicable.

II.3.2 Solid Radioactive Waste Other than High-Level Waste

Actual volumes and activities of solid waste generated and disposed of or stored at Los Alamos are submitted quarterly as part of the DOE Solid Waste Information Management System (SWIMS). A summary of the information submitted to SWIMS for FY 1982 is presented in Table I. Projections for FY 1983 are presented in Table II, and long-term projections for FY 1984 and beyond are listed in Table III. The sometimes large variations in waste volumes and radioactive content at the Laboratory result primarily from program changes, facility decontamination and decommissioning (D&D) activities, and general Laboratory area cleanup programs.

In FY 1982, the trend toward an increase in the plutonium content and in the volume of routine Laboratory-generated TRU waste continued as indicated below:

	FY 1980		FY 1981		FY 1982	
Site	# Drum	Pu (kg)	# Drums	Pu (kg)	# Drums	Pu (kg)
TA-55	768	22.8	1094	22.0	1155	46.3
TA-50	885	0.2	1401	1.0	991	8.5

This trend was the result of increased production requirements and higher economical recovery limits at the Los Alamos TA-55 Plutonium Facility. In addition, higher concentrations of plutonium and americium in aqueous wastes sent to the TA-50 Liquid Waste Facility resulted in the continuing generation of TRU sludge and cement paste as retrievable wastes. This trend will continue at least through FY 1983 for the TRU waste volume, and through the forseeable future for the higher TRU content of this waste. A significant decrease in TRU waste volume is anticipated by FY 1984 when the new pretreatment plant at TA-50 begins operations (sec. II.4.3).

TABLE I

WASTE BURIED/STORED AS REPORTED TO SWIMS

FY 1982

Waste Category	Buried (B) Stored (S)	Volume (m^3)	Radio-activity (Ci)[a]	Radionuclide Content (g) Pu	Am	U/Th
1 - TRU	S	576.7	28210	55170	62.9	44208[b]
2 - U/Th	B	987.0	1.6			723000
3 - MFP	B	297.1	0.4			
4 - MAP	B	145.0	547.9			
5 - H-3	B	108.9	36246			
6 - β/γ-TRU	S	6.5	422.2	149		533
7 - Alpha	B	3625.1	3.2	21.3	0.3	744
	TOTALS	5746.3	65431.3	55340.3	63.2	768485

[a] Total activity of all contaminants.

[b] Includes 4.4 g ^{233}U.

TABLE II

FY 1983 PROJECTIONS OF WASTE BURIED OR STORED

Waste Category	Buried (B) Stored (S)	Volume (m^3)	Radio-activity (Ci)[a]	Radionuclide Content (g) Pu	Am	U/Th
1 - TRU	S	540	33000	55700	100	
2 - U/Th	B	980	2			1205000
3 - MFP	B	344	10			
4 - MAP	B	238	2000			
5 - H-3	B	200	60000			
6 - β/γ-TRU	S	5	500	200		600
7 - Alpha	B	3600	5	20		750

[a] Total activity of all contaminants.

TABLE III

PROJECTIONS OF WASTE BURIED/STORED AT LOS ALAMOS[a]

FY 1984 AND BEYOND

Waste Category	Buried (B) Stored (S)	Volume (m^3)
1 - TRU	S	375
2 - U/Th	B	1000
3 - MFP	B	350
4 - MAP	B	250
5 - H-3	B	400
6 - β/γ TRU	S	5
7 - Alpha	B	3000

[a] Exclusive of any major D&D project(s) that may be added, but which are not currently planned, and of any significant volume of off-site waste.

An increase in the tritium content and volume also should be evident in FY 1983. Although there is an overall increase in the amount of tritium work conducted at the Laboratory, this increase will primarily be a result of the startup of the TSTA Facility (sec. II.1.4.2).

Compaction of nonretrievable laboratory trash-type wastes has continued, with 840.3 m^3 (29 663 ft^3) reduced to a burial volume of 172.7 m^3 (6096 ft^3) during FY 1982. This represents a volume reduction factor of 4.9:1 for this waste stream. A reduction in the TRU waste volume will occur in FY 1983 as the Size Redtion Facility begins processing TRU waste already in storage. The anticipated volume reduction factor is 4:1.

II.3.3 Waste Volume Reduction Program

Since the 1973 issuance of a formal Los Alamos policy statement, reduction of the volume of radioactive waste buried or stored has been a primary Waste Management objective of the Laboratory. To date, the waste volume has been reduced by issuing

and enforcing Waste Management requirements for generators, monitoring and controling systems used for waste disposal, waste assay, and treatment through compaction and size reduction of bulky metallic items. Specific volume reduction activities in each of these overall program areas and planned modifications are documented below.

II.3.3.1 Waste Generator Requirements

Laboratory policy on Waste Management states:

> "Disposal or discharge of radioactive and potentially hazardous materials....will be kept to the lowest level technically and economically feasible. In pursuit of this policy, all activities in the Laboratory will be conducted in such a way as to minimize the generation of hazardous waste, including solid waste, liquid waste and gaseous emissions."

Since 1979, the waste management requirements and procedures which generators must follow to implement this policy have been part of the Laboratory Health, Safety, and Environment Manual. In addition to the usual distribution of the Manual to the supervisory level of Laboratory management, these radioactive waste documents (including the Policy) are printed in a booklet format for Laboratory-wide distribution. As a first step in implementing additional volume reduction efforts, this radioactive waste management documentation is being revised; the revision is scheduled for distribution in mid-1983.

Specific modifications of the requirements related to reducing waste volumes are described below:

1. Audit of Waste Generator Procedures

Since 1974, all operating groups generating radioactive wastes have been requested to document their waste management procedures in approved Standard Operating Procedures (SOPs). Informal annual "audits" of waste generator operations have been conducted by Waste Management staff. These have been accomplished in conjunction with the required annual review and approval of the generator Waste Management SOPs. A proposed modification will be to formalize and document all such generator audits by Waste Management.

2. Waste Management Coordinator

A "Waste Management Coordinator" is being requested for each facility or area generating radioactive waste. It is anticipated that through interaction with such individuals, better communication with and among the many Laboratory generators can be implemented.

3. Volume Reduction Procedures

Also in accordance with the revised Manual, generators will be required to include specific actions addressing volume reduction in their Waste Management procedures. Areas to be addressed include:

* Exclusion of office wastes from Laboratory radioactive work areas.
* Concentration of work areas involving radioactive materials.
* Special provisions for handling large volumes of packaging materials.
* Special requirements applicable to general area cleanup wastes.

II.3.3.2 **Systems Monitoring and Control**

In the past, radioactive waste volumes have been substantially reduced by the proper monitoring and control of the "system" involved in generation and handling of wastes. Identified changes in this area include the following:

1. Locked Dumpsters

All radioactive waste dumpsters must be locked and under the direct control of generator area Health Physics monitors. One intent of this action has been to prevent possible mixing of radioactive and nonradioactive wastes. The status and use of all such dumpsters is being reviewed by Waste Management staff. This effort will be expanded to include review of access control to assure that only "legitimate" radioactive wastes are being disposed of.

2. Review of Work Orders

Experience has shown that nonroutinely generated wastes often are not handled with the same degree of control as

are routine wastes. Specific examples of such nonroutine wastes include area cleanup wastes and wastes from building or facility modifications. At Los Alamos, these types of activities generally are conducted by Zia Company personnel through a Work Order initiated by the Laboratory organization needing the work. To properly monitor and provide guidance in planning and accomplishing these tasks, a request has been made to the Laboratory's Site Engineering Division (ENG-DO) to route all Work Orders that could possibly result in radioactive waste generation to Waste Management staff for review. It is hoped that this effort will reduce radioactive waste generation by improving waste segregation and overall materials-handling practices.

3. Liquid Waste Generation Monitoring

A Line Item ($9M) Radioactive Waste Line Improvement Project is nearing completion at Los Alamos. Included as part of this project is a computer system that will monitor radioactive liquid waste flows from all Laboratory facilities on the collection system. The computer will be programmed to alarm when a flow exceeds the normal range for a given source. This will allow Waste Management staff to contact the source immediately to determine the cause and whether the flow is necessary. This monitoring will result in improved control of radioactive liquid waste generation and, therefore, the volume of solid radioactive waste produced by treating such liquid waste will be reduced. This system is scheduled to begin operation in FY 1983.

II.3.3.3 Waste Assay

A waste assay room is under construction in CMR Building. When operational, a Multi-Energy Gamma Assay System (MEGAS II) will be used to assay all radioactive wastes generated to segregate TRU from low-level waste. Administrative segregation based on waste origin now makes this determination. Although operation of the new assay system will not reduce overall waste generation, it should result in significant reduction of TRU waste.

II.3.3.4 Waste Treatment

Operational and planned radioactive waste volume reduction treatment operations are discussed below.

1. Compaction

Since April 1977, appropriate low-level wastes have been compacted/baled prior to burial. The results of this operation are presented in the table below.

CY	Generated m^3	Buried m^3	Ratio
1977	649.4	125.3	5.2:1
1978	924.3	176.2	5.3:1
1979	725.8	148.9	4.9:1
1980	649.2	130.2	5.0:1
1981	829.1	171.6	4.8:1
Totals	3777.8	752.2	5.0:1

As part of the overall volume reduction effort, compaction operations will be reviewed to assure that the maximum possible benefit is being obtained. In particular, this review will include a determination that all appropriate compactible wastes are being segregated and treated.

2. New Liquid Waste Batch Treatment Plant

The liquid process streams from the Laboratory Plutonium Facility (TA-55) have far exceeded both the volume of waste and the concentrations of ^{239}Pu and ^{241}Am that were originally predicted. It has been possible to treat most of these wastes by blending them with the main stream of liquid waste entering to the primary Laboratory Liquid Waste Treatment Plant (TA-50-1). Although this has enabled safe treatment in existing facilities, it has resulted in all solid waste (chemical precipitate or sludge) from the plant becoming TRU waste. A small pretreatment plant has been constructed to isolate these TA-55 process streams, and its operation is projected to reduce the TRU waste generated at TA-50-1 to less than 100 drums/year. Some decontamination operations may be necessary on the existing treatment plant and tanks to enable the chemical precipitate to once again become nonretrievable.

3. Size Reduction of TRU Waste

Operation of the Size Reduction Facility (SRF) with contaminated waste was initiated in January 1982. Treatment of actual TRU waste is expected to begin by July 1983, pending approval of a Safety Analysis Report. At that time, all currently generated TRU waste requiring size reduction treatment will be processed, and previously generated wastes, primarily from the decontamination of the old Los Alamos Plutonium Facility, will be retrieved from storage for appropriate processing. All SRF-processed TRU waste will be WIPP certified. An overall volume reduction of 4:1 is anticipated for the SRF-treated wastes.

II.3.3.5 <u>Other Potential Means of Volume Reduction</u>

The Los Alamos Controlled Air Incinerator (CAI), located in the TA-50 Treatment Development Facility (TDF), can significantly reduce the volume of combustible radioactive waste requiring burial or storage. A net overall volume reduction of 50:1 (following immobilization) is estimated for waste processed in this manner. Waste management records show that approximately 180 m^3 (6350 ft^3) of combustible TRU waste were placed in retrievable storage during CY 1981, and projections indicate that the annual rate will increase to a 240 m^3/yr average over the next 10 years due to changing program and production requirements. In addition to the treatment of combustible TRU wastes, other potential operational uses of the CAI can be determined. Tests are being conducted to evaluate CAI effectiveness for thermal destruction of hazardous chemicals such as polychlorinated biphenyls (PCBs), solvents, and ion exchange resins. Disposal of mixed wastes (i.e., radioactive hazardous chemical compounds) is a likely future use for CAI technology. Low-level wastes such as scintillation vials and slightly contaminated oils are also candidates for combustion treatment. In addition to providing a far more acceptable disposal form for these wastes, substantial volume reduction would be obtained. As of this time, however, no funding is available for operating the CAI facility for any waste treatment.

II.4 Plans and Budget Projections

II.4.1 Interim Storage of High-Level Liquid Wastes

Not applicable.

II.4.2 Long-Term Storage of High-Level Liquid Waste

Not applicable.

II.4.3 Management of Low- and Intermediate-Level Liquid Waste

II.4.3.1 Summary and Milestones

During the next 10 years, the emphasis will continue to be on reduction of liquid discharges and improvement of radionuclide removals from waste streams (Fig. 15). A study of ways to improve the entire liquid waste management system at the Laboratory was completed in 1975. The study considered pretreating wastes at TA-3, TA-43, TA-48, and TA-53, as well as upgrading the existing plants, an improvement of the waste collection and transmission pipelines, and removal of all abandoned sewers and structures in the liquid waste management system. During FY 1982, the funding for the radioactive liquid waste collection system improvements and D&D of the old collection system (FY 1978 Line Item, $12.5M) was reduced by $3.5M. Although construction of the doubly contained, fully monitored collection system has been completed, only those abandoned radioactive waste lines in the vicinity of the Jemez-Diamond intersection and along Pajarito Road were removed. Removal of other abandoned radioactive waste lines would resume if the $3.5M were restored.

Construction has started for the treatment plant upgrading. This is an FY 1981 project with a total estimated cost of $8M. which will provide additions to the TA-50-1 treatment plant including process improvements and additional storage capacity for influent liquid waste. Emphasis on treatment process improvements at TA-50 and DP-257 is directed toward minimum release of radioactivity to the environment and compliance with effluent guidelines established by the Environmental Protection Agency (EPA) under the Water Pollution Control Act, Amendments of 1972 (PL 92-500) and of 1977 (PL 95-217) (now cited as the Clean Water Act). Treatment process improvements will result in much higher

	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	FY 1988-1991
TA-50	1					7
DP-257	2					
Sigma Mesa Evap. Ponds	3	3	3	4	5	6

1. Complete contruction of plant improvements at TA-50.
2. Construct the pipeline from DP-257 to TA-50.
3. Continue operating pilot evaporation pond.
4. Design full-scale evaporation ponds on Sigma Mesa.*
5. Construct full-scale evaporation ponds on Sigma Mesa.*
6. Begin operating evaporation ponds.*
7. Construct new liquid waste treatment facilities in support of a major expansion at TA-55.

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* Accomplishment depends on availability of line-item funding.

Fig. 15. Planning guide for management of radioactive liquid wastes.

quality liquid discharges at a minimum cost in energy consumed. The following processes are included:

- upgrading of the chemical treatment plants including prefiltration, addition of powdered activated carbon, weak cation exchange, and solar heated wiped-film evaporation of high-solids process wastes at TA-50.
- transfer of treated or low-radioactivity wastes from TA-21-257 to TA-50.

A third project, solar evaporation of all treated wastes, is planned for the purpose of eliminating all discharge of any liquid radioactive waste to the environment. Installation of evaporation ponds for elimination of effluent now depends on FY 1986 line-item funding.

Tritiated water is being generated from the meson physics accelerator operation. Management methods were developed to handle these wastes at the site and the plans were implemented with MP-Division funding. However, the cooling systems have leaked so badly that the large volumes of waste have been routed to the sanitary lagoons at TA-53. Releases of both liquid and airborne contaminants have been well below DOE guidelines.

In accordance with retrievability requirements through FY 1983, the cement paste at TA-21-257 is being placed in burial shafts if TRU activity is below 10 nCi/g, and in 0.76-m (2.5-ft)-diameter by 6.1-m (20-ft)-long corrugated metal pipe lengths if TRU activity exceeds 10 nCi/g. Plutonium processing has been transferred to TA-55 and ^{241}Am, ^{239}Pu wastes are no longer generated at TA-21. Cement paste with TRU activity >10 nCi/g in FY 1982 has been the result only of cleanup operations and the inventory of waste remaining in tanks at TA-21-257. With the new 100-nCi/g definition of TRU, it is expected that no more retrievable cement paste will be generated at TA-21-257.

II.4.3.2 Expected Accomplishments in FY 1983

The treatment plant improvement line-item project will be completed in FY 1983. This project will result in improvements at TA-50 and DP-257 so that pollutants in liquid discharges

to the environment can be reduced. The pipeline from TA-21-257 to TA-50 also will be completed furing FY 1983 so treated liquid waste discharge to Los Alamos Canyon can be discontinued. A Safety Analysis Review (SAR) will be completed before the newly installed processes begin operation.

The liquid process streams from TA-55 have far exceeded both the volume of waste and the concentrations of ^{239}Pu and ^{241}-Am that were originally predicted by plutonium processing personnel. Most of these wastes were to be evaporated to dryness at TA-55 and discarded there as solid waste. It has been necessary to treat these process wastes at TA-50-1 by blending them with the main stream of incoming liquid waste, thus waste (chemical precipitate or sludge) from the TA-50-1 plant has become TRU waste. Over 900 210-L (55-gal) drums were generated in FY 1982.

A small pretreatment plant was constructed in TA-50-1, Room 60, to isolate these TA-55 process streams. Waste Management GPP funds were used for heating and ventilating modifications and Group MST-11 funds are being used for equipment and piping procurement and installation. Construction of this pretreatment plant is complete with start-up expected as soon as operational procedures are approved. Operation of this pretreatment plant is projected to reduce the TRU waste generated at TA-50-1 to less than 100 drums/year. Some decontamination operations may be necessary on the TA-50-1 main plant and tanks to enable the chemical precipitate to once again become nonretrievable; the solid chemical precipitate from TA-50-1 is now averaging in excess of 10 000 nCi/g.

II.4.3.3 Expected Accomplishments in FY 1984

The processes added to the TA-50 treatment plant will be in full operation during FY 1984. Improvements in both chemical and radiochemical quality are expected for the TA-50 treatment plant effluents in FY 1984. There should be no discharge to Los Alamos Canyon from the TA-21-257 treatment plant during FY 1984.

II.4.3.4 Proposed Program and Expected Accomplishments for FY 1985 Through FY 1989

Construction that may begin on a major line-item project

FY 1987 would eliminate liquid discharges from TA-50 and TA-21 by on-site evaporation in engineered solar ponds.

II.4.3.5 **Annual Budget Projections**

Budget projections for management of low- and intermediate-level liquid wastes follow (in thousands of dollars):

Year	Operating Costs[a]	Capital Equipment	Construction
FY 1983	1700	55	5000
FY 1984	1900	10	50
FY 1985	2100	10	50

[a] Operating costs for liquid waste management are estimated to average about 45% for direct waste treatment costs, 32% for analytical support, and 23% for compliance with various State and Federal regulations.

Much of the funding indicated for capital equipment and construction for FY 1983-85 is related to finishing major modifications and improvements in liquid waste management at TA-50.

II.4.4 **Management of Solid Waste Contaminated with Radioactivity**

II.4.4.1 **Summary and Milestones**

The primary effort of the Los Alamos solid radioactive waste management program will continue to be efficient and effective operation of all radioactive waste disposal or storage areas at the Laboratory. Included in these operations is the controlled burial of Laboratory-generated low-level radioactive wastes, retrievable storage of TRU waste, volume reduction of waste, generation of waste disposal records, preparation of reports, maintenance of current and past disposal or storage areas, burial-site monitoring, and implementation of improved waste packaging, handling, and disposal or storage technologies. Waste management operations will continue to be managed so as to meet all Federal Government criteria and regulations for burial and storage sites.

A continuing waste volume reduction effort will play an ever-increasing role in the program. Major emphasis is placed on control of waste generation by direct interaction with generators to implement documented policies and procedures, improve segregation, and overall, reduce the volume generated. Waste treatment technologies, including compaction and size reduction, are continuing development and expansion of operations to further reduce waste volumes buried and stored. Detail on the volume-reduction program is contained in Sec. I.3.3.

DOE planning documents require that Defense TRU wastes generated at Los Alamos be sent to the Waste Isolation Pilot Plant (WIPP) for permanent disposal. Before shipment to the WIPP, however, all TRU wastes must be certified as meeting the WIPP Waste Acceptance Criteria. Plans and procedures will be developed and implemented beginning in FY 1983 with the goal of having all newly generated TRU wastes certified as meeting the WIPP acceptance requirements.

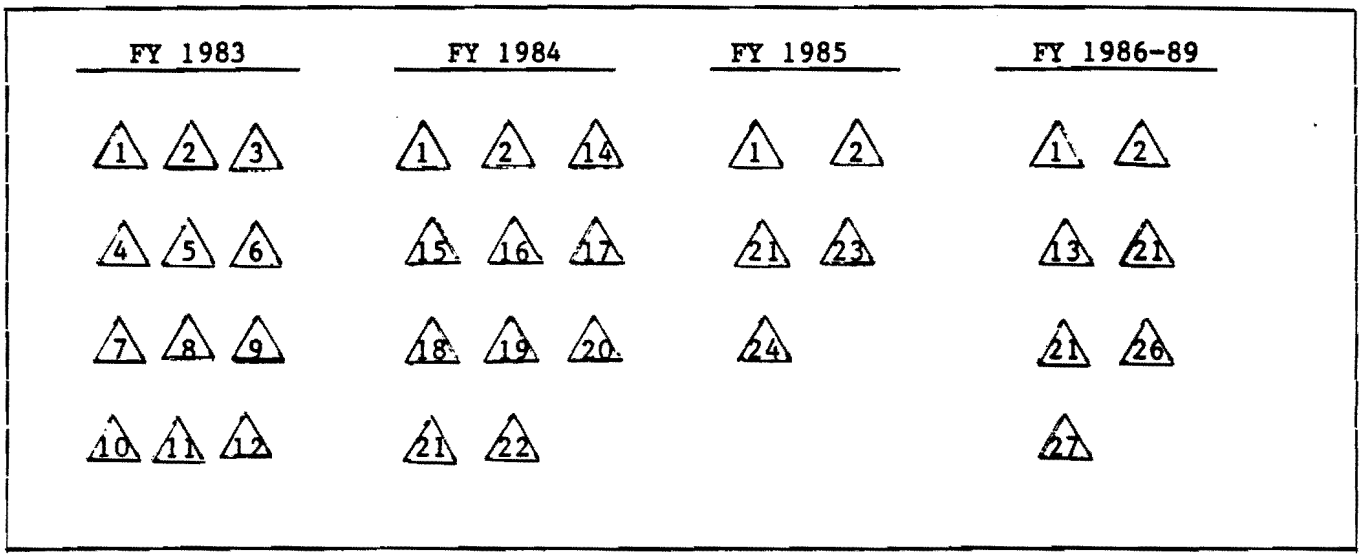
Specific major program milestones to be reached in attaining these overall program goals are identified in Fig. 16.

II.4.4.2 Expected Accomplishments in FY 1983

Radioactive waste burial and storage operations will continue to meet all applicable criteria. One major activity will be the development and implementation of procedures to begin certification of currently generated contact-handled TRU waste as meeting the WIPP acceptance criteria. A second significant milestone will be the completion of the SAR for the SRF, and the subsequent full-scale operation of the facility.

Shallow land burial of Los Alamos-generated low-level solid waste will continue. Burial will be in compliance with the "Initial Disposal Criteria for DOE Low-Level Solid Waste," Laboratory guidelines, and other applicable standards. A waste management operations QA/QC program will be maintained for all appropriate waste burial activities. One new burial pit will be required and appropriate burial shafts will be provided.

Compaction of nonretrievable trash-type waste before burial will continue to be a major volume reduction technique.



1. Excavate new burial pits and shafts.
2. Place of historical waste burial records into computer system.
3. Develop and implement plans and procedures to certify newly generated TRU wastes to WIPP requirements; begin storing WIPP-certified waste.
4. Complete stored TRU waste work-off plan.
5. Complete construction on TA-54 Waterline Project.
6. Initiate fencing project for old burial sites.
7. Initiate design and construction on TA-54 Trailer Replacement Project.
8. Initiate design and construction on TDF Filtration Project.
9. Initiate surface decontamination and stabilization work at Area C.
10. Complete SAR for SRF and begin multigram operations in facility.
11. Establish SRF operating goal and conduct initial assessment of meeting goal.
12. Develop overall plan for stabilization of Los Alamos burial areas.
13. Provide status report on meeting 20-year retrievability requirement.
14. Continue certification development work; implement process changes required.*
15. Complete burial sites fencing.
16. Complete trailer replacement facility.
17. Complete TDF filtration project.
18. Complete Area C surface stabilization.*
19. Initiate design and construction on Area G decontamination facility and TDF egress bay modifications.*
20. Initiate new waste volume-reduction program.
21. Continue SRF treatment of previously stored wastes
22. Establish work-off plan for stored wastes requiring SRF treatment.
23. Complete implementation of certification plans and procedures; essentially all newly generated waste will be WIPP-certified.*
24. Complete decontamination facility and egress bay projects.*
25. Certify previously stored TRU wastes other than SRF-treated wastes; develop plans and procedures; provide equipment and facilities; initiate operations.*
26. Complete work on historical waste burial records.
27. Complete long-term stabilization of Los Alamos burial grounds.*

* Accomplishment depends on receipt of requested Waste Management operations funding.

Fig. 16. Planning guide for management of solid wastes contaminated with radioactivity.

At current annual waste generation rates, an estimated 870 m^3 (30 700 ft^3) of waste will be reduced to a burial volume of about 180 m^3 (6355 ft^3), for a projected overall volume reduction of about 4.8:1.

Facilities for retrievable storage of TRU waste also will be provided as necessary. Storage of WIPP-certified TRU waste will be initiated on the new (third) above-ground waste storage pad. Although additional storage facilities for remote-handled (RH) β/γ-TRU waste will be required, the extent to which these new facilities are needed will depend on the effectiveness of alternative packaging methods for some potential RH wastes, and on whether any Sandia National Laboratory-generated TRU hot-cell wastes are received. An evaluation will be completed late this FY on the condition of previously stored TRU waste packages. Based upon studies completed to date, all drums and FRP boxes are expected to be in excellent condition.

A major program effort in FY 1983 will be the development and implementation of plans and procedures to certify newly generated contact-handled (CH) TRU wastes as meeting the WIPP acceptance criteria. Needed modifications to waste segregation and handling procedures, waste form, packaging and documentation will be determined, appropriate test procedures will be identified, and quality assurance measures will be incorporated. All certified TRU waste packages will be placed into completely separate storage from noncertified wastes. Several years of effort will be required before essentially all of the newly generated TRU wastes are certified as acceptable for eventual shipment to the WIPP. As a related activity during this FY, records of previously stored TRU wastes will be reviewed and evaluated to assess the adequacy of these records for WIPP certification, and to determine the needs for the overall certification of these already-stored wastes. As a separately funded project, a stored-waste inventory work-off plan that will contain this information will be completed this year. Considerable interaction with other DOE contractors is anticipated with regard to the development of WIPP-acceptable packagings, transportation overpacks (TRUPACT), and in the application of WIPP/WAC compliance requirements.

Waste management personnel will continue to interact closely with Laboratory waste generators, including both operations and decontamination/decommissioning personnel, to assure proper waste handling and disposal procedures, to reduce waste volumes where possible, and to resolve any special waste disposal problems. This interaction is a vital part of maintaining and upgrading the overall waste management effort.

Los Alamos Waste Management Guidelines and the Initial DOE Criteria require maintenance of a burial site, facilities, and equipment, and restoration of a site after completion of waste disposal activities. Maintenance and restoration at the Laboratory disposal sites will combine safety considerations with essential disposal functions, and will assure adequate containment within the burial or storage environment. After completion of burial or storage in a portion of the disposal site, the area is revegetated and disposal facility markers (monuments) are installed. Site revegetation includes reestablishing proper surface drainage patterns and spreading topsoil over the area, followed by applications of seed and fertilizer.

Surveillance at two old Laboratory burial sites, Areas B and C, identified the presence of low levels of residual surface contamination left from the previous operations. Surface erosion over the past 20 to 30 years caused some slow movement of this contamination to near or just beyond the disposal site fences. Also, inadequate surface cover was placed over some wastes in these sites, and slumping of the pit covers occurred in many locations. A program was initiated in FY 1982 to correct this situation and to stabilize the surface by adding new cover, compacting, proper contouring, and reseeding of these areas. In FY 1982, approximately $90K was spent for this work at Area B; in FY 1983 approximately $100K will be spent to begin work at Area C.

Environmental monitoring tasks include annual surveillance of the radiological and physical condition of retired and active waste management areas. Where surface contamination is encountered, more detailed surface and subsurface studies will be necessary. In addition, field monitoring will be necessary to

support the above described work at Area C. During and after corrective measures have been taken, the radiological conditions will be examined to be certain any surface contamination is removed or covered. This effort will provide the necessary monitoring to assure compliance with the DOE Criteria.

Detailed computer records will continue to be maintained for all buried and stored radioactive waste. In addition, as time permits, pre-1971 historic written records of waste disposal activities will be entered into the computer system to provide a readily accessible waste disposal data base for Los Alamos. Data will be assessed in order to meet all applicable DOE reporting requirements (e.g., SWIMS). A modified computer data base will be developed to produce the data package required for certified TRU wastes.

The FY 1982 GPP-funded project to construct a water line to Area G will be completed. A 15-cm (6-in.) line is planned to provide water for improved fire protection, decontamination, dust control, assistance with revegetation, and personnel uses. One FY 1983 project involves replacing an old inadequate trailer at the disposal site with a larger, more permanent building for personnel. A second project will be to fence at least two old Laboratory waste disposal areas. This work is part of the continuing effort to meet the FY 1987 milestone to complete the long-term stabilization of Los Alamos burial grounds. The third FY 1983 project is to provide HEPA filtration to the second high bay, added in 1981, to the Treatment Development Facility. This modification will allow that work area to be used for waste certification support studies. A total expenditure of $300K is anticipated for these projects in FY 1983.

Volume reduction of bulky TRU-contaminated wastes, for example, gloveboxes, ductwork, and process equipment, is an essential step in the eventual disposal of these wastes at the WIPP. WIPP acceptance criteria specify maximum package size and weight, and transportation requirements apply further restrictions. In addition, significant cost savings from waste size reduction may result from lower interim storage, packaging, transport, and repository disposal volume requirements. Planning and

design work was initiated in FY 1977 for a prototype facility at Los Alamos in which bulky TRU wastes can be reduced in volume by remote cutting and disassembly operations. This work will continue in FY 1983 with completion of the SAR for the SRF process, followed by the routine operations of the facility with processing TRU contaminated wastes.

DOE Program Guidance calls for continuing emphasis on improving all operations, extending burial ground life, reducing waste volumes, affirmation of 20-year retrievability of stored TRU-wastes, and other tasks. To meet these goals, technical evaluation of current practices and conditions will be necessary so that Los Alamos waste management operations can be upgraded.

II.4.4.3 Proposed Program and Expected Accomplishments in FY 1984

II.4.4.3.1 Reference Budget Level

At reference level funding of $2560K, all ongoing aspects of the program as described above for FY 1983 will be continued. In addition, 1/2 staff (scientific) personnel will be added for special burial site monitoring, and significant funding will be provided for WIPP certification development work. The waste volume reduction program described earlier in this document will be fully implemented.

The volume of nonretrievable waste to be buried this year is estimated at 5000 m^3 (176 500 ft^3); the volume of TRU waste to be stored is estimated at 380 m^3 (13 400 ft^3). Use of the SRF to process any currently generated bulky TRU wastes, as well as to work on the backlog of wastes generated in the decontamination of the old Plutonium Facility, will continue. By the end of FY 1984, Los Alamos will have in excess of 6200 m^3 (218 860 ft^3) of TRU waste in various modes of storage. Studies to affirm the retrievability of this waste will continue, and storage mode and/or waste packaging modifications will be implemented as required. Waste certified as being in compliance with WIPP acceptance criteria will be stored in a separate facility from noncertified TRU wastes. Continuing operations to properly dispose of nonretrievable wastes will require excavation of one new

burial pit and numerous shafts. Additional lined shafts for high-activity tritium waste will be provided, as will additional storage facilities for $^{238}Pu/^{233}U$ wastes and β/γ TRU-wastes.

Work to certify Los Alamos TRU wastes will progress with the highest priority; the goal during this FY is to certify and separately store most of the currently generated contact-handled wastes. A significant aspect of this certification work will be to implement waste/materials processing changes needed to generate WIPP acceptable waste forms.

Work involving removal of surface contamination followed by surface restabilization at the old burial Area C should be completed by mid-FY 1984. At that time, any required upgrading for other old disposal sites will be initiated. A significant part of the environmental monitoring effort this FY will be in direct support of this work. Routine burial site monitoring and special studies initiated in FY 1983 will continue. The addition of 1/2 scientific staff is required this FY for direction and interpretation of the special studies.

Waste Management GPP funding need and projects have been identified in a Schedule 44 submittal. These projects are listed here.

1. Decontamination Facility - $200K

Vehicles and equipment used at Area G must be routinely decontaminated for continued use, travel over public roads, or use at other Laboratory facilities. A disposal site decontamination facility is required for such situations to contain contamination and minimize adverse effects of contamination incidents at the disposal site.

2. Egress Bay (Zone 3) Addition to Treatment Development Facility - $200K

An addition to provide for the movement of equipment into and out of the Zone 2 process bays at the TDF will significantly improve ventilation and contamination control in these areas. This will allow the much more extensive use of these areas for TRU certification development and support studies.

II.4.4.3.2 **Increment Level**

No increment level above the Reference is identified based upon the already much expanded scope of effort identified in the Reference Level program.

II.4.4.3.3 **Decrement Level**

At this lower funding level, increased efforts identified at the Reference Level for environmental monitoring and TRU waste certification will not be possible. For the environmental monitoring work, the additional 1/2 scientific staff will not be added for direction and evaluation of the results of planned special burial site studies. This will require deferment of the work to later years. TRU waste certification also will be slowed in implementing process changes needed to certify some of the newly generated wastes. This delay will result in a greater volume of uncertified waste being placed into storage. Later efforts to certify this material will be much more costly.

II.4.4.4 **Proposed Program and Expected Accomplishments for FY 1985 Through FY 1989**

Waste burial/storage operations will be continued in the most efficient manner possible. Annual volumes of buried and stored waste during this period are projected in Table IV. The volume for waste burial in each of these years is difficult to predict because of uncertainty in planning D&D projects during this period. Waste compaction-baling operations will continue throughout the period with annual reduction of about 1000 m^3 (35 300 ft^3) of waste to a burial volume of about 200 m^3 (7060 ft^3). Operations of the SRF will continue with the volume reduction of any appropriate currently generated TRU wastes along with the work-off of previously generated wastes.

Development work toward certifying all Los Alamos TRU wastes will continue. By the end of FY 1985, essentially all of the Laboratory-generated TRU wastes will be certified. Certification of previously generated (stored) TRU wastes also will be initiated during this period, with this effort beginning in FY 1986. In accordance with the TRU Work-Off Plan to be developed in FY 1983, facilities will be required for retrieval of stored

waste, nondestructive examination/evaluation of waste packages for WIPP compliance, sorting and repackaging, treatment of some wastes, and for TRUPACT handling and loading.

All programs initiated in previous years will continue as required, particularly in areas of general site and operations upgrading, waste volume reduction, and the conversion of historical disposal records into the computer-based system. With continued funding, this latter program should be completed during this period.

A DOE Headquarters milestone scheduled for FY 1987 completion is long-term stabilization of Los Alamos burial grounds. Current needs for this work are being identified through a Burial Grounds Evaluation Program, and an overall plan for site stabilization will be developed in FY 1983. However, some Los Alamos burial grounds contain only low-level waste, but others contain a mixture of previously buried low-level and TRU waste. In these latter sites, a decision must be made regarding exhumation (retrieval). It is not known when this decision will be made. Actual exhumation operations, if necessary, could take 15 or more years to complete. Work began in FY 1983, however, to upgrade several old burial areas by removing surface contamination, filling some slumps, revegetating, installing pit/shaft markers, etc. This work at Area C will be completed in FY 1984.

II.4.4.5 Budget Projections

Budget projections for the management of radioactively contaminated solid wastes are listed in Table IV. Note that these are operating costs only, and are also only those costs borne by the DOE-funded Interim Waste Operations Program. As such, these costs are primarily for operation of the storage/burial area and do not include costs borne by waste generators, such as packaging, handling, and on-site transportation, or the costs of waste management R&D programs. Funding for developing and implementing TRU waste certification work for newly generated wastes is being received in FY 1983 through Interim Waste Operations. It is anticipated that funding for this work will be required at least through FY 1985.

TABLE IV
ESTIMATED PROGRAM OPERATING COSTS
INTERIM WASTE OPERATIONS

Operating Costs ($K)

Task	FY 1983	FY 1983			FY 1985
		Dec	Ref	Inc	
1.1 Burial Operations	420	460	460	460	525
1.2 TRU-Waste Storage	190	210	210	210	240
1.3 Facilities Maintenance, Restoration, Site Stabilization	175	200	200	200	300
1.4 Environmental Monitoring	210	210	240	240	300
1.5 Records Management	110	120	120	120	150
1.6 Compaction	35	40	40	40	45
1.7 Generation Control	210	240	240	240	300
1.8 Size Reduction	265	290	290	290	340
1.9 TRU Waste Certification Development	275	380	760	760	900
TOTAL	1890	2150	2560	2560	3100

Capital equipment funding in the amount of $60K per year is required for this program to assure that Los Alamos waste handling and disposal needs can be met. Equipment needed include replacement items and new equipment to modify operations to meet DOE criteria and to satisfy new waste handling requirements. Specific items include new and replacement equipment for waste handling, facilities maintenance, site/waste security, environmental monitoring, personnel safety, waste treatment, and records keeping. Capital equipment funding in excess of this amount is required in FY 1983 and beyond to support TRU certification.

For FY 1983, Waste Management GPP-funded projects totaling $300K include the fencing of old burial sites, construction of a personnel facility at Area G to replace an old and inadequate trailer, and the installation of a HEPA filtration system on the second high bay in the Treatment Development Facility (TDF) to permit use for certification support work. In FY 1984, $400K is required for a decontamination facility at Area G and an egress bay for the TDF. Over the period FY 1986-1990, a total of $21M (FY 1982 dollars) is estimated to provide facilities to retrieve, evaluate, certify, process, and eventually ship stored wastes to the WIPP. Projected solid waste management costs (in thousands of dollars) through FY 1985 are summarized below.

Year	Operating Costs	Capital Equipment	Construction
FY 1983	1890	90	300
FY 1984	2570	260	400
FY 1985	3100	110	300

II.4.5 Management of Airborne Radioactive Waste

II.4.5.1 Summary and Milestones

The principal sources of airborne radioactive emissions at the Laboratory in CY 1981 were the accelerator operations at TA-53 (activated gases of carbon, nitrogen, and oxygen), the reactor research operation at TA-2 (radioactive argon), the various tritium handling operations at TA-3, -21, -33, -35, -41, and -53

(tritiated water vapor), and the chemistry and metallurgy operations at TA-3-29 (plutonium oxide). Other potential sources are the radiochemistry operations at TA-48, the decontamination operations at TA-50, and decommissioning at other sites. Only a few stacks at Los Alamos ever exceed the Radioactive Concentration Guide for air (RCG_a) on an annual average at the point of release. This very conservative criterion sometimes used by DOE ensures that concentrations at locations where people are actually present remain orders of magnitude less than RCG_a. During CY 1981, radionuclide concentrations exceeded RCG_a at the point of release at the Omega Reactor(TA-2-9) and at tritium operations and facilities at TA-3-16, TA-33-86, and TA-41-4. Radionuclide concentration levels from the accelerator operations at TA-53 also exceeded RCG_a at the point of release. All other annual concentrations were below applicable RCG_a guides for uncontrolled areas at the point of discharge. Milestones in the airborne radioactive effluent program are shown in Fig. 17.

II.4.5.1.1. **TA-2-9, Omega Reactor**

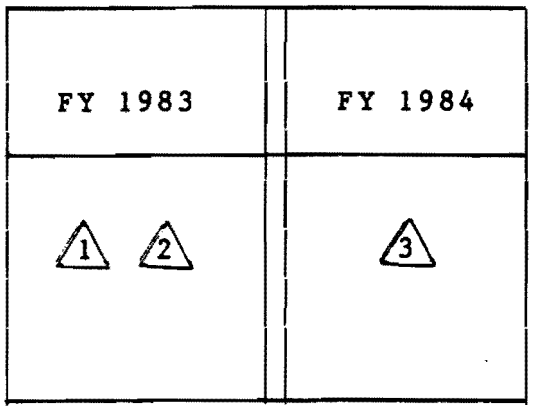
The quantity of ^{41}Ar generated and released depends on the amount of air passed through the high neutron flux of the thermal column. A certain minimum air flow is necessary to reduce potential occupational exposures. Operational procedures keep the volume of exposed air to a minimum. No additional effluent treatment system is feasible or planned at this time.

II.4.5.1.2 **TA-33-86, Tritium Facility**

Funding has been requested to build a new tritium facility to replace TA-33-86. The new facility will provide triple containment and will be capable of cleaning up accidental spills into the two outer containments. The cost is estimated to be $5M. Construction began in FY 1982, startup will be in FY 1984.

II.4.5.1.3 **TA-3-16, Van de Graaff Facility**

Occasionally, tritium targets are used at this facility, hence, the facility has a tritium collection and gas handling system. The exhaust air flow rate from the systems is extremely low, which means that the concentration at the point of discharge is high even for small releases. Releases were reduced from 100



1. Sealing of shield blocks at LAMPF will continue to reduce required ventilation rate.
2. Construction of the new tritium facility at TA-16 to replace TA-33-86 continues.
3. New tritium facility startup in 1984.

Fig. 17. Planning guide for management of airborne radioactive wastes.

Ci in CY 1978 to 14 Ci in CY 1979 and increased to 70 Ci in CY 1980. In 1981, the release totaled 320 Ci. No major changes are planned beyond improved collection and retention of the tritium.

II.4.5.1.4 TA-3-34 (FE-52) Cryogenics Laboratory

The cryogenics laboratory does not normally release tritium from any of its operations. In CY 1979 a single release of 3000 Ci occurred on May 4, when a uranium tritide furnace overheated during preparation for a tritium gas experiment. Tritium gas was released into the laboratory experimental area and vented to the atmosphere. Improvements made after this release have prevented any further problem. In CY 1980 the tritium release from the facility was at nondetectable levels, nominally zero. In CY 1981, a single release of 4 Ci occurred.

II.4.5.1.5 TA-21-209, Tritium Facility

This facility is equipped with a state-of-the-art effluent treatment system and no further reduction appears possible. During CY 1981 the facility released a total of 108 Ci, which resulted in an average concentration of 5.4×10^{-7} Ci/ml at the point of release.

II.4.5.1.6 TA-35-2, Main Laboratory

In FY 1981, there was a one time release of about 25 Ci of tritium. This amount represented less than 1% of the average annual tritium released at Los Alamos, and was calculated to average an annual concentration of 9.4×10^{-7} Ci/ml at the release point. This laboratory uses tritium to fill laser fusion targets. It is being replaced by a new Target Fabrication Facility, scheduled for completion in FY 1983, which will have improved effluent treatment capabilities.

II.4.5.1.7 TA-41 (FE-4), Tritium Handling Laboratory

Tritium releases at TA-41 are erratic because they occur three or four times per year; little is released between the major spikes. This is mostly because the group is divided between operations at TA-41 and TA-33, which increases the number of handling steps and allows only periodic experiments. The construction of a new facility at TA-16 is a step toward consolidating this work, thereby reducing the chance of a release.

II.4.5.1.8 **TA-50, Decontamination Facility**

This facility is part of the larger liquid waste treatment facility at TA-50. On occasion, highly contaminated gloveboxes or equipment items are decontaminated for reuse. The exhaust system that serves these operations was improved by installing an improved HEPA filtration unit in FY 1979. The release from this source during CY 1981 was 60 nCi.

II.4.5.1.9 **TA-53, LAMPF Accelerator Facility**

Short-lived activation products of air and spallation products are produced in proportion to the accelerator beam intensity. Oxygen-15, carbon-11, nitrogen-13 and argon-41 are the primary radionuclides. The task force formed to accomplish reduction of airborne radioactivity to ALARA continues its involvement. Ongoing efforts consist of attempts to reduce leakage of activated air into the normal ventilation system and to reduce the volume of air intercepted by the beam.

II.4.5.1.10 **TA-3-29, Chemistry Laboratory**

Analytical chemistry operations in the south side of wing 3 generate airborne plutonium. This wing is not equipped with a double-HEPA filter system like other wings in the facility, but individual glovebox systems have HEPA-filtered exhaust. During FY 1980, an engineering study was made to determine the feasibility and cost of installing a central double-HEPA filter system. A proposal to install this filter system was considered in FY 1981 but no action is planned.

II.4.5.2 **Proposed Program and Expected Accomplishments in FY 1983**

Relocation of certain tritium high-temperature and pressure operations at TA-41 to a more suitable facility within the Laboratory, probably at TA-16, is proposed. The new facility would be similar to that at TA-21.

II.4.5.3 **Budget Projections**

The only clearly identifiable operational cost associated with the Laboratory's airborne waste management program is for the routine monitoring of exhaust stacks. In FY 1982, this cost totaled approximately $160K. This level is expected to

remain relatively constant through the forseeable future, with cost increases resulting only from inflation.

II.4.5.4 Summary of Budget Projections

Projected radioactive waste management costs (in thousands of dollars) for the Los Alamos National Laboratory are summarized below.

Year	Operating Costs	Capital Equipment	Construction
FY 1983	3765	145	5300
FY 1984	4660	270	450
FY 1985	5410	120	350

II.5 Description of Decontamination and Decommissioning

II.5.1 Identification and Description of Contaminated Facilities

II.5.1.1 Excess to Present Needs

A 10-year Decontamination/Decommissioning Site Plan was prepared for the Laboratory during 1977. From FY 1978 through 1981, the following D&D work was accomplished.

TA-42	Plutonium Incinerator Facility	- Decommissioned
TA-21-153	Filter Building	- Decommissioned
TA-35-2	Room 12A Tritium Gloveboxes	- Decontaminated
TA-35-7	Filter Building	- Decontaminated
TA-35-43	Contaminated Sodium Tanks	- Entombed
TA-35-2	LAMPRE Reactor Vessel	- Decontaminated
TA-21-2, -3, -4, -5, and -150	Plutonium Facilities	- Decontaminated

II.5.1.1.1 TA-35, LAPRE Reactor

The vessel that housed the LAPRE Reactor is buried under a paved area south of TA-35-2. It is activated and contains small amounts of uranium. It is excess and should be removed and buried at the Laboratory radioactive waste disposal site when office trailers now in the area are relocated. The location has been marked and no detectable radiation levels exist at the pavement surface.

II.5.1.1.2 TA-2, Water Boiler Reactor Facilities

This experimental water boiling reactor was defueled in CY 1974, making the reactor and associated liquid and gaseous waste systems available for decommissioning. The reactor fuel form was enriched uranium-uranyl-nitrate solution, and the reactor vessel is highly contaminated with uranium, induced activity, and long-lived fission products. Gaseous waste transfer systems are moderately contaminated with fission products and the massive concrete biological radiation shields have low levels of induced activity.

II.5.1.1.3 TA-52, UHTREX Reactor Facility

The Ultra-High-Temperature Reactor Experiment (UHTREX) is located at TA-52. The site is in limited use by the Energy

Division, and also houses a classified document disposal operation in one of the support buildings.

There are two main buildings. Building RD-1 is a composite, rectangular building with maximum dimensions of 40.25 m (132 ft) x 26.0 m (85.3 ft). It consists of the containment area and the areas outside the containment, which are the ground floor level, the operations level and the basement level. The reactor was defueled around 1970 and there are no plans for reactivation. The building has hot-water heating, evaporative cooling and ventilation, electric, water, and sewer services, sanitary facilities, a fire detection system, a telephone conduit system, and a paging system. A vacuum cleaning system, breathing-air system, compressed-air system, and air sampling system are also provided in certain areas. Portions of the reactor (fuel has been removed) are highly contaminated with fission products and induced radioactivity.

Building RD-11, the Mechanical Assembly Building, is a prefabricated, rigid-frame metal building set on reinforced concrete foundations. The outside dimensions are 10.1 m (33.1 ft) x 18.8 m (61.7 ft). The wall height is 8.4 m (27.5 ft); the gable height is 9.8 m (32.3 ft). The building has toilet and washroom facilities, heat, power, lightning protection, and a fire detection system.

II.5.1.2 Considered to be Standby

There are no facilities considered standby.

II.5.1.3 In Use

Radioactively contaminated facilities currently in use at Los Alamos are given in Table V. Other Los Alamos land areas contaminated with radioactivity are listed in Table VI.

II.5.2 Projection of Waste Volumes from D&D Activities

Wastes buried from D&D projects in recent years have amounted to about $^{2}/_{3}$ of the total buried radioactive waste during this period, as indicated in Table VII.

Volumes of D&D wastes through the next several years are anticipated to be reduced since no major projects are planned until FY 1984 at the earliest, as indicated in Table VIII.

TABLE V

CONTAMINATED FACILITIES CURRENTLY IN USE

Tech Area (Fig. 2)	Description	Location Bldg #	Location Dwg.#	Contamination Category[a]	Radioactive Contaminant(s)
TA-2	Omega Reactors	1	ENG-R 2409	M	FP, IA
TA-2	Stack Gas Valve	19	" " "	M	FP, IA
TA-2	Equipment Building	44	" " "	M	FP, IA
TA-2	Cooling Tower	49	" " "	M	FP, IA
TA-3	Van de Graaff Lab	16	ENG-R 2414	L	T, IA
TA-3	CMR Building	29	" " "	M	TRU, U, FP, IA, T
TA-3	Cryogenics Building "B"	34	" " "	L	T
TA-3	Press Building	35	" " "	M	U
TA-3	Tech Shop, Rm 42	39	" " "	L	U
TA-3	Physics Laboratories	40	" " "	L	T, TRU, FP, IA
TA-3	Source Storage Building	65	" " "	L	Ra
TA-3	Sigma Building	66	" " "	L	U
TA-3	Tech Shops	102	" " "	L	U
TA-3	Rolling Mill Building	141	" " "	L	U
TA-3	Liquid Waste Storage Facility	154	" " "	M	TRU, U, FP, IA
TA-3	Shop Storage Building	164	" " "	S	TRU, U
TA-8	Betatron Building	23	ENG-R 2422	M	IA, FP, TRU, U
TA-8	Isotope Building	24	" " "	S	IA
TA-8	Radiation Laboratory	26	" " "	S	IA
TA-8	Nondestruct. Test Facil.	70	" " "	L	U
TA-9	Lab.Bldg. (Rms 119 & 120)	21	ENG-R 2424	L	T
TA-16	Assembly Building	410	ENG-R 2441	S	TRU, U, T
TA-16	Rest House	411	" " "	S	TRU, U, T
TA-18	Assembly Bldg. (Kiva 1)	23	ENG-R 2446	M	U, IA
TA-18	Vault	26	" " "	M	U, TRU
TA-18	Assembly Bldg. (Kiva 2)	32	" " "	M	TRU, U, IA
TA-18	Assembly Bldg. (Kiva 3)	116	" " "	M	TRU, U, IA
TA-18	Reactor Subassembly Bldg	129	" " "	L	U
TA-18	Dynam. Crit. Assay Facil.	168	" " "	M	U, FP, IA
TA-21	All Laboratory Buildings	-	ENG-R 5113	S-H	U, Pu, T, FP
TA-35	Laboratory Buildings	2	ENG-R 2462	S-H	FP, Pu, T
TA-46	Lab Bldg. (Ducts & Drains)	1	ENG-R 2480	M	U
TA-46	Test Cell No. 1 & 2	16	" " "	M	U
TA-48	Laboratory Building	1	ENG-R 2483	H	TRU, U, FP, IA, T
TA-50	Waste Management Facilities	-	ENG-R 2493	M	TRU, U, FP, IA, T
TA-53	Accelerator Building	3	ENG-R 2500	L	IA
TA-54	Waste Disposal Site	-	ENG-R 5131	M	All
TA-55	Plutonium Facility	4		M	TRU
TA-59	Occupational Health	1		L	All

[a] DOE recommended classification criteria applied with addition of Suspect (S) category for facilities where health physics surveys do not indicate contamination; however, a more intensive survey is advisable if facility is removed or used fo other purposes. H, M, L indicates high, medium, low levels of contamination.

TABLE VI

OTHER CONTAMINATED AREAS

Identification/Description (Fig. 2)	Surface Area (acres)	Estimated Radio-activity[a]	Principle Radio-nuclides
A. Underground pits used for liquid disposal:			
1. Near TA-21-164 (Area U)	0.3	H	Po, Ac, Ra
2. TA-21-20 (dismantled laundry) between TA-21-14 and Waste Disposal Area B (Area V)	1.0	M	Pu, U
3. Near TA-33-86 (Area K)	0.003	L	T
4. At TA-49	1.0	M	Pu
B. Outfall and disposal areas for liquid effluent:			
1. TA-45 (dismantled) and Acid-Pueblo Canyon	3.7 (est.)	L	Pu
2. TA-21 and DP-Los Alamos Canyon	11.1 (est.)	L	Pu
3. TA-50, Mortandad Canyon, and Ten Site Canyon	2.2 (est.)	L	Pu
4. TA-53 Lagoons	2.0	L	H-3
C. Septic tanks:			
TA-2, TA-21, TA-33, TA-41, TA-42, TA-46	Unknown	L	Pu, U, T
D. Underground contaminated drainlines: (Ref: Dwg. ENG-R 2404 and others in Ref. 12)			
1. TA-3-700 to ULR-33 manhole	Unknown	M	Pu, U, FP
2. ULR-33 to north top edge of Los Alamos Canyon.	Unknown	M	Pu, U, FP
3. HRL to ULR-60	Unknown	L	Pu, FP
4. Under Canyon Rd. near Diamond Dr.	Unknown	M	Pu, U, FP
5. ULR-62 to north side Central Ave.	Unknown	M	Pu, U
6. Under Rose St. near Central Ave.	Unknown	M	Pu, U
7. Under Canyon Rd. near Central Ave.	Unknown	M	Pu, U
8. TA-48-1 to ULR-149	Unknown	L	Pu, U, FP
9. Miscellaneous lines at TA-21	Unknown	H	Pu, Am, U
E. Miscellaneous			
1. Dirt bunkers (4) at TA-15-44, 45, E, and I-J firing points	Unknown	L	U
2. Underground chamber TA-33-29	0.7	L	Po

[a] H, M, L indicate high, medium, low levels of contamination.

TABLE VII

LOS ALAMOS WASTE VOLUMES BURIED

(Volume - m^3)

Year (CY)	Routine	D & D	Total Volume
1975	2337	10270	12607
1976	2830	5990	8820
1977	2358	1352	3710
1978	2003	5501	7504
1979	2214	2656	4870
1980	2588	2167	4755
1981	2883	2656	5539
TOTAL	17210 (36.0%)	30590 (64.0%)	47800

TABLE VIII

PRESENT AND FUTURE LOS ALAMOS D&D WASTES

Tech Area	Project	FY	Estimated Waste Volume (m^3) Retrievable	Nonretrievable	Type
TA-2-1	Decommissioning of water boiler reactor	84-86	0	500-1000	Steel bldg. material and piping
TA-33-86	Decontamination of the High Pressure Tritium Facility	85-86	0	100-200	Line removal, septic tank, and room equipment
TA-52	Decontamination of UHTREX Reactor Area	85-86	0	200-400	Steel vessels and piping
TA-35	LAPRE Reactor	1987	0	100-200	Steel vessels, piping, soil

II.5.3 D&D Plans and Priorities

Los Alamos has prepared a comprehensive 10-year D&D plan for the period from FY 1980 through FY 1989, which describes facilities that are either surplus or expected to become programmatically inactive. It identifies, describes, and justifies these as projects, addresses project alternatives, estimates D&D costs, and ranks projects according to priority. Entire surplus buildings with or without surplus equipment items, on-site land areas and building portions are considered as facilities. In FY 1982, the present underground industrial liquid waste collection system became excess, and parts of this system and SM-700 were removed as part of the new radioactive liquid waste system improvement construction project.

III. HAZARDOUS WASTE MANAGEMENT

III.1 Description of Nonradioactive Hazardous Waste Generating Processes

Various types of nonradioactive hazardous waste are generated in Laboratory operations. Because of the R&D nature of the Laboratory's work and the varied origin of these wastes, it is not considered practical to provide process flow sheets. Descriptions of the types and origins of these wastes follow.

III.1.1 Basic and Applied Chemistry Research and Development Programs

Primary Laboratory sites for basic and applied chemistry R&D include the Chemistry and Metallurgy Research (CMR) Building (TA-3-29), Radiochemistry Laboratory (TA48), Sigma Building (TA-3-66), and the Health Research Laboratory (TA-43). Typical nonradioactive chemical wastes consist primarily of large quantities of partly empty small containers of laboratory reagent chemicals, pump oil, solvents, test samples, and miscellaneous laboratory wastes. Overall, up to several hundred relatively small quantities of different acids, bases, organics, inorganics, reactive metals, and other chemicals require disposal.

Small volumes of waste chemicals are placed by the waste generator into special storage cabinets at most of these sites. Periodically, Waste Management personnel sort, package, and transport to the chemical disposal site all such collected wastes. Occasionally, an entire laboratory or research area will require cleanup and disposal of reagent chemicals. In these instances, Waste Management personnel go to the laboratory and sort, package, and prepare for disposal all waste materials. Generally, the wastes in small bottles, jars, and cans are packaged with vermiculite for disposal into metal drums. Wastes are sorted to assure that incompatible chemicals are not packaged in the same disposal container. Liquids greater than 3.8 L (1 gal) in volume are absorbed on vermiculite before disposal. All nonradioactive chemicals are disposed of at Area L (TA-54).

III.1.2 Waste Chemicals from Laser Research Programs

Laser research is conducted primarily at TA-35 and TA-46. Nonradioactive chemical wastes include large quantities of waste oils, solvents, dyes, and some laboratory chemicals. Larger quantities of oils and solvents are absorbed and packaged in 210-L (55-gal) metal drums for handling, transport, and disposal.

III.1.3 Electrochemistry Wastes

The Electrochemistry Section of the MST-6 Materials Technology Group, located at TA-3-66, generates significant quantities of plating solutions containing chromates and cyanides. Quantities of these wastes ranging from 380 to 760 L (100 to 200 gal) at a time are collected in lined metal drums and are transferred to TA-50 for chemical treatment before disposal at Area L.

III.1.4 Carcinogenic Wastes

Research on carcinogens is conducted by Group H-5 in a laboratory in the CMR-Building, and by Life Sciences (LS) Division groups in the HRL facility (TA-43). All solid wastes known or suspected of being contaminated with known or suspected carcinogens are handled as hazardous wastes and require disposal at an approved site. Wastes include contaminated paper, plastic, rubber, glassware, and small quantities of known or suspected carcinogens. Contaminated trash-type wastes are packaged in plastic lined cardboard boxes that are placed into special dumpsters for disposal. When filled, these dumpsters are transported to Area G for disposal.

III.1.5 Explosives Wastes

High-explosives (HE) waste is generated by Dynamic Testing (M) and Design Engineering (WX) Division groups in the course of processing and testing various HE materials. Processing embraces pressing, machining, and casting HE. Waste occurs as discrete pieces of HE, as well as chips, machine cuttings, and powder. The chips, cuttings, and powder usually are in the form of waterborne suspensions, collected in specially designed accumulating/settling sump tanks. Wastes also consist of materials contaminated with HE; these may include paper, oils, solvents, wood, etc., as well as contaminated machine tools, fixtures, etc.

Chemically the wastes consist of HMX, RDX, TNT, PETN, amonium nitrate, barium nitrate, boric acid, TATB (triaminotrinitrobenzene), nitrocellulose, tetryl, nitroguanide, and various plastic binders. These are disposed of by burning at S Site or burying at Area J.

III.1.6 Gas Cylinders

Due to the varied research interests of the Laboratory, large quantities of many compressible gases are used annually. Empty gas cylinders, whenever possible, are refitted with good valves, retested hydrostatically, and put back into service. Empty one-time usage and nonreservicable cylinders are transported to Area G or Area L for disposal. Full or partially full cylinders declared unusable are collected and stored at the Compressed Gas Facility at TA-3-170 until arrangements can be made for the safe absorption or conversion of the gas into a nonhazardous form.

III.1.7 Wastes from Laboratory Maintenance and Support Operations

A variety of hazardous wastes originate throughout the Laboratory as a result of routine maintenance and support operations.

III.1.7.1 Asbestos Waste

Asbestos wastes originate from a wide variety of sources including old pipe insulation, transite board, ceiling insulation, welding curtains, and welders' gloves. These and all other asbestos wastes are packaged in plastic bags or plastic-lined cardboard boxes in which they are collected and transported to Area L or Area G for disposal.

III.1.7.2 PCBs: Oil, Transformers and Other Items

Transformers, capacitors, and hydraulic and heat transfer systems containing PCBs are located throughout the Laboratory. Most of these items are either serviced or replaced by Zia craftsmen as necessary. Until March 1981, PCB capacitors were disposed of at Area G. After that date all large PCB capacitors, along with oil with greater than 500 ppm PCB, must be disposed of at an incinerator permitted by the US Environmental Protection

Agency. PCB transformers can be disposed of at Area G as long as they are drained of all free-flowing liquids and are rinsed with kerosene or other appropriate solvent. Capacitors and PCB oil are stored at TA-21-61 until a load can be assembled for transportation to an approved incinerator. Oil-contaminated rags, soil, and debris are disposed of at Area G.

III.1.7.3 Ammonium Bifluorides (ABF)

As part of the preventive maintenance program of group ENG-4, all evaporative cooling coils at various sites are periodically cleaned by flushing with a solution of ammonium bifluoride (ABF). These operations generate significant volumes of ammonium bifluoride solution that are treated at the site of the cleaning operation. Waste Management personnel work with ENG-4 in collecting and treating the used solutions.

III.1.7.4 Shops Department Wastes

The Main Shops Department, Building TA-3-39, houses most of the extremely versatile machine shop capability at the Laboratory. Parts can be machined from almost any metal, alloy, or other materials. These operations generate significant volumes of nonradioactive hazardous wastes including dirty oils and solvents, beryllium, lithium hydride, magnesium turnings, etc. These wastes are placed in suitable containers, such as 210-L (55-gal) drums for oils, for transport to TA-50 or Area L for treatment or disposal.

III.2 Hazardous Nonradioactive Waste Storage/Disposal Facilities

III.2.1 Locations

Laboratory facilities in which nonradioactive hazardous wastes have been or are being treated, stored, or disposed of are shown in Fig. 18.

III.2.2 Treatment Facilities

Batches of cyanide and chromate plating solutions and solutions of acids, bases, and heavy metals are chemically treated in facilities at TA-50 before disposal. Ammonium bifluoride (ABF) waste solutions may be treated at the site where the waste is generated. All treated solutions or slurries are transferred to Area L for disposal.

III.2.2.1 Cyanide Wastes

Batches of up to 570 L (150 gal) of waste cyanide solution are treated at one time. Treatment involves essentially complete destruction of all CN^- to CO_2 and N_2 using chlorine gas and sodium hydroxide. Chemical analysis is performed to assure the absence of cyanide before disposal.

III.2.2.2 Chromate Wastes

Chromate plating solutions are treated to reduce hexavalent chromium to the less toxic trivalent state, followed by precipitation of $Cr(OH)_3$ before disposal. Again, this is a batch treatment process performed in the facilities at TA-50 that are used for cyanide wastes. Sulfur dioxide is used in acid media to reduce the chromium; caustic is added to precipitate the metal hydroxide.

III.2.2.3 Batch Waste Acids, Bases, and Heavy Metals

Large quantities, greater than 210 L (55 gal), of waste acids and bases are neutralized using sodium hydroxide or mineral acids (HCl or H_2SO_4), respectively. Batch wastes containing toxic heavy metals such as antimony, arsenic, lead, copper, nickel, silver, gold, etc. are treated to complex and removethe metals by a variety of chemical means depending on the nature of the specific contaminant(s) and the media. After precipitation of the metals the waste is neutralized.

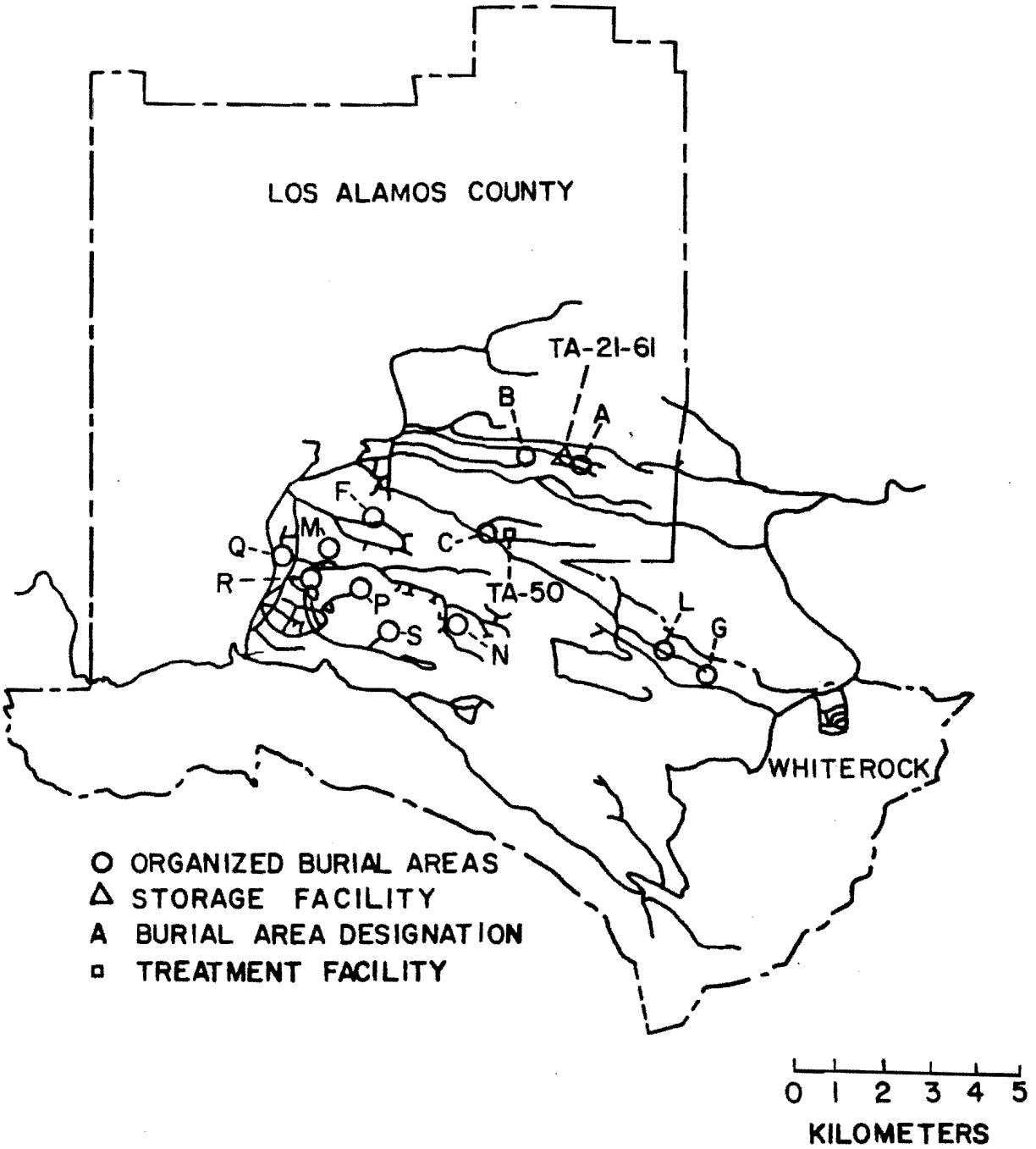


Fig. 18. Locations of hazardous/chemical waste management facilities.

III.2.2.4 Ammonium Bifluoride (ABF) Waste

Batches of up to 3.8×10^3 L (1×10^3 gal) of ABF waste solution may be treated at one time; the treatment is conducted in a portable Dumpster tank. ABF wastes are treated in calcium chloride and calcium hydroxide to convert the ammonia to ammonium chloride, and the fluoride to calcium fluoride precipitate. After treatment, the batch is chemically analyzed to assure that all the fluoride has precipitated.

III.2.3 Storage and Disposal Facilities

III.2.3.1 PCB Storage

Building 61 at TA-21, dedicated to storage of PCB materials generated by the Laboratory, meets the requirements of Annex III of the February 17, 1980, Federal Register (PCB Disposal and Marking) for PCB storage facilities. As of November 1, 1982, items stored in DP-61 are five 210-L (55-gal) drums of contaminated rags, 19 210-L (55-gal) drums of contaminated oil, two 210-L (55-gal) drums of capacitors, and 11 210-L (55-gal) and seven 115-L (30-gal) drums of usable PCB oil belonging to Zia.

A temporary curbed, asphalt holding pad was constructed behind Building 61. This pad serves as a storage area for oil awaiting results from analysis. If the data indicate >500 ppm PCB in the oil, the drum is moved into the building. If <500 ppm are found, it is solidified and transferred for disposal to Area G or L, depending on the concentration.

III.2.3.2 Disposal Facilities

Hazardous chemical wastes are known or suspected to have been disposed of at 13 Los Alamos waste disposal sites. All these sites, whether active or not, are on Laboratory lands and are within security fences. At Areas A, B, C, and G, chemical solid wastes are known to have been interspersed with radioactive solid wastes in the same burial locations. At Area F, a small amount of radioactive waste may be intermixed with some HE-contaminated wastes.

III.2.3.2.1 Area A

Located on the north side of TA-21, Area A was opened in late 1944 or early 1945, and closed in 1947. It covers a 5 x

10^3 -m^2 (1.25-acre) area and originally contained four pits for burial of TA-21-generated polonium- and possibly some plutonium-contaminated wastes, and two buried tanks (designated the "general's tanks") for storage of solution containing ^{239}Pu. Unknown quantities and types of waste chemicals, including pressurized gas cylinders, were buried in these pits along with the radioactive solid wastes at this site.

III.2.3.2.2 **Area B**

Area B, located west of TA-21 and covering 2.44 x 10^4 m^2 (6.03 acres), was used from 1946 through 1948. The waste in these pits is contaminated with all types of radioactive materials used at Los Alamos. In addition, unknown quantities of waste chemicals including pressurized gas cylinders, were buried in these pits along with the radioactive wastes. The fenced area has been divided into two sections. The smaller section (about 1/3 of the total) has not been developed further; the remainder has been covered with asphalt and made available to Los Alamos County for rental spaces for storage of private camper trailers and other types of vehicles.

III.2.3.2.3 **Area C**

Located south of TA-50, Area C occupies 4.8 x 10^4 m^2 (11.8 acres), and contains 7 pits (one of which was designated a hazardous-chemical pit), and 108 disposal shafts. The pits and shafts contain alpha and beta-gamma radioactive wastes. Area C was used from 1948 to 1969. Before 1960, chemical wastes were disposed of in pits and shafts with radioactive solid waste. In 1960 a small pit was excavated in Area C and dedicated to the disposal of nonradioactive waste chemicals. This pit was used until 1964 when Area L at TA-54 was opened. Available records indicate that this pit contains "a variety of chemicals, pyrophoric metals, hydrides and powders, sealed vessels containing sodium-potassium alloy or compressed gases, and equipment ---."[13] No explosives residues are known to be in the pit; however, some radioactive contamination (uranium and plutonium) is known to have been included with some wastes.

III.2.3.2.4 **Area F**

In 1946, a 730-m^2 (0.18-acre) tract on Two-Mile Mesa east of TA-6 was set aside for a one-time burial of obsolete materials. The pits contain little, if any, radioactive contaminated material. There may be small amounts of ^{90}Sr, ^{137}Cs, and HE-contaminated wastes.

III.2.3.2.5 **Area G**

Area G is situated on Mesita del Buey in TA-54 and is the main active radioactive solid waste burial/storage site at the Laboratory. The area has been used since 1957 and is expected to remain active through the foreseeable future. In FY 1977, the active portion of the site was expanded to a current total area of 2.55×10^5 m^2 (63 acres); future expansion of this area is planned. Burial/storage facilities within the area include pits, shafts, trenches, and pads of varying dimensions. A more detailed description of the use of these facilities and of current waste management operations is contained in the LASL Final Environmental Impact Statement.[1]

Certain "nonreactive" hazardous chemical wastes have been buried in pits and shafts along with radioactive wastes at Area G. Such wastes include asbestos, beryllium residues, empty pesticide containers, PCB-contaminated solids [transformers, capacitors, solids (before 1978)], and solid trash-type wastes contaminated with known or suspected carcinogens. Between 1976 and 1979 much of this waste was buried in a separate pit (Pit 19) at the site, although there were exceptions due to very large volumes (e.g., PCB-contaminated transformers). In 1980 approval was granted by the EPA for disposal of PCB-solid waste in special facilities at Area G.

III.2.3.2.6 **Area J**

Area J, approximately 1.07×10^4 m^2 (2.65 acres), is located at TA-54 (Mesita del Buey) and has been used since the early 1960s for burial of equipment wastes potentially contaminated with HE. One small pit in this area was filled in 1966, and a second pit has been used since that time. From 1966 through 1977, approximately 970 000 kg (2 134 000 lb) of equipment waste was buried in this pit, which is still in use.

III.2.3.2.7 **Area L**

Area L, 3.6×10^3 m^2 (0.88 acre), is located on Mesita del Buey in TA-54, and since 1964, has been the main active chemical waste disposal site at Los Alamos. From 1964 through May 1975, all chemical wastes were disposed of in one pit at the site. Beginning in June 1975, with the transfer of responsibility for disposal operations to the Waste Management Group, this pit was covered and shafts were used for waste chemical disposal.

Chemical disposal shafts measure 0.6 m (2 ft) to 2.4 m (8 ft) in diameter by up to 20 m (65 ft) deep. Different shafts are used for different categories of waste chemical (e.g., organics, inorganics, oils, etc.) to assure that incompatible chemicals will not mix and react. In addition, one small pit at the site is used for disposal of bulk quantities of treated aqueous waste (sec. III.2.2). The water quickly evaporates from these wastes leaving a "salt cake" in the pit bottom. When this salt cake is within 1 m (3 ft) of the top of the pit, backfill is applied. One such small pit in the area was filled between June 1975 and July 1978.

III.2.3.2.8 **Area M**

Area M is an old disposal site (pre-1960) located east of TA-8, Anchor Site West. It contains miscellaneous metallic objects, conduits, remnants of concrete, and other junk, much of which is suspected of being contaminated with explosives or chemicals. The site covers an area about 1.3×10^4 m^2 (3.2 acres).

III.2.3.2.9 **Area N**

Area N is a burial pit located east of Building R-23, TA-15, which contains remnants of several structures from R Site that had been exposed to explosives or chemical contamination. The area is about 400 m^2 (0.1 acre) in size, and was used before 1960.

III.2.3.2.10 **Area P**

Area P is a canyon (Canyon de Valle), located immediately north of Building 16-387, TA-16. Miscellaneous noncombustible materials have been placed in the canyon, including remnants of structures that were burned in 1960 at TA-6, Two Mile Mesa Site,

and TA-9, Anchor Site East. The materials had been exposed to explosives or chemical contamination. The area covers approximately 2.7×10^4 m^2 (6.7 acres).

III.2.3.2.11 **Area Q**

Area Q was a pit located at the original TA-8, Anchor Site West, where a number of discarded gun barrels and related equipment were buried near the end of World War II. The area, approximately 84 m^2 (0.02 acre) in size, may contain some hazardous waste materials.

III.2.3.2.12 **Area R**

Area R, approximately 9.2×10^3 (2.3 acres), is located at TA-16. The area was used as a burning ground for waste explosives before construction of the 132 Group buildings and the present burning area. During the course of new construction, the ground surface was graded and pushed into the canyon.

III.2.3.2.13 **Area S**

Area S, 9.3 m^2 (100 ft^2), is located approximately 24 m (80 ft) southeast of Magazine K-36, TA-11. It is enclosed by a pipe rail and was used for soil studies in connection with disposing of explosives in several borings within the enclosure. No wastes were ever disposed of at this location.

III.2.4 Description of Effluent Control Systems

III.2.4.1 Liquid Effluent Systems

The Laboratory received a second-round National Pollutant Discharge Elimination System (NPDES) permit from the EPA reauthorizing 116 surface water discharges. Major changes in the new NPDES permit eliminated flow or an effluent limit, removed fecal coliform as an effluent at one location, and increased the maximum value for total suspended solids as an effluent limit to 90 mg/L when the sole source of domestic waste treatment is an oxidation pond.

The NPDES permit groups discharge locations, called outfalls, into generic groups such as Treated Cooling Water/or High Explosive Waste. Table IX lists the groups, number of outfalls in each group, number of outfalls currently not meeting established effluent limits, and the number of outfalls that did not meet established effluent limits when the permit was issued.

TABLE IX

Type	No. of Outfalls	Not in Compliance	Originally Not in Compliance[a]
Power Plant	5	1	6
Boiler Blowdown	1	1	4
Treated Cooling Water	31	0	0
Noncontact Cooling Water	31	0	0
Industrial Waste	2	0	0
High Explosive Waste	20	4	9
Photo Waste	14	0	5
Printed Circuit Board	1	1	0[b]
Domestic Waste	11	2	3
TOTALS	116	9	18

[a] Some outfalls have been eliminated.
[b] Originally met effluent limit but, because of increased production, does not now meet effluent limits.

The Los Alamos Area Office (LAAO) of DOE is currently negotiating a Federal Facility Compliance Agreement (FFCA) with the EPA. The FFCA will establish a statement schedule for reducing the number of outfalls in noncompliance. Funding for improvments at one outfall (TA-53) has not been agreed to. EPA has requested a September 1985 completion date, which would require FY 1985, funding and the Laboratory has proposed a 1987 completion date with funding budgeted as part of the Neutrino Facility.

III.2.4.2 **Airborne Effluent Systems**

Periodic sampling and special studies are used to verify Laboratory compliance with appropriate Federal and State air quality regulations on chemical emissions. Previous investigations have indicated no violations of Federal or State emissions standards or ambient air quality standards.

and all disposals in Area L were maintained for the site operations. This volume of waste in FY 1982 totaled approximately 29.6 m^3 (1045 ft^3).

Detailed records of all aqueous wastes treated at TA-50 or at field locations are maintained by Waste Management personnel. All treated aqueous wastes are disposed of into the seepage pit at Area L. For FY 1982, aqueous chemical wastes treated and disposed of were:

Type	Volume (m^3)
Cyanide	1.0

In summary, during FY 1982 approximately ~~697.9~~ 392.6 m^3 (24 636 ft^3) of nonradioactive hazardous waste was treated and/or disposed of at the Laboratory. The total weight of this waste is estimated to be approximately 151 604 kg (333 939 lb).

III.3.1 Projections of Future Disposal Activities

With several exceptions, disposal activities in future years will not reflect any significant changes. Asbestos waste, because of Laboratory-wide removal of asbestos insulation, will remain a significant volume through FY 1983. The volume of lithium hydride wastes to be disposed of, because of increased machining and a backlog of the material awaiting treatment, also is expected to be much higher in FY 1983.

III.4 Operational Plans and Budget Projections

III.4.1 Summary and Milestones

The primary effort of the Los Alamos nonradioactive hazardous waste treatment/disposal program will be to assure compliance with applicable Federal and State regulations governing the handling and disposal of these wastes. These include regulations promulgated under the Resource Conservation and Recovery Act (RCRA) (1976), Toxic Substances Control Act (TOSCA) (1976), and the New Mexico Hazardous Waste Act (1978). The New Mexico hazardous waste regulations do not now specifically apply to the Los Alamos operations because only Laboratory wastes are treated/disposed at on-site facilities. Moreover, it is anticipated that a DOE order is to be promulgated in FY 1983 that essentially requires the Laboratory Hazardous Waste Management program to meet the RCRA regulations; however, program compliance will be monitored by DOE-ALO rather than EPA. Current program milestones for the nonradioactive hazardous waste program are listed in Fig. 19.

III.4.2 Expected Accomplishments in FY 1983

Program activities this FY will include the continuation of disposal/treatment operations in the safest and most effective manner possible to remain consistent with the applicable regulations. To comply with the anticipated DOE order, an extensive evaluation of the hazardous waste management program will be continued. Current problems, such as the disposal of gas cylinders and reactives, as well as long-term situations, such as the need for utilities at the disposal site, will be resolved under this plan.

It is hoped that treatment capabilities will be expanded during this year. A new chemical batch treatment area within Building 1 at TA-50 is being designed, and, if the funding is appropriated, the facility should be operational by the end of FY 1983. This would improve the treatment of present waste streams, such as the cyanide and chromate electroplating wastes.

The MAT-operated Gas Plant has about 65 partly full and very old HF cylinders containing about 2500 to 3000 pounds of HF, and all are suspected of containing hydrogen due to decomposition

FY 1983	FY 1984	FY 1985 - 90
1 2 3 4 5	1	6 7

1. Continue evaluation of Hazardous Waste Management Program.
2. Design and build gas treatment capabilities.*
3. Design and build chemical batch treatment plant.*
4. Design and construct LiH treatment facility.*
5. Establish a computer program as the record-keeping system for hazardous waste disposal.
6. Obtain major utilities at Area L disposal site.
7. Complete evaluation of Hazardous Waste Management Program.

---

* Depends on availability of funding.

Fig. 19. Planning guide for management of nonradioactive hazardous wastes.

of the HF. Many of these cylinders are badly corroded around the valves. In addition, due to ongoing Laboratory operations, Waste Management personnel have regularly been faced with problems associated with leaky and damaged toxic gas cylinders. A considerable study, engineering design, and construction effort is needed to address this situation. To date, however, funding has not been identified for this effort.

Lithium hydride (LiH) wastes are routinely generated in large quantities in the MEC shops from machining operations, and in smaller quantities in other Laboratory operations. This material is highly reactive with water, and consequently requires treatment before disposal. The Laboratory has more than 25 210-L (55-gal) drums of LiH waste and attempts to treat this material have proven to be unacceptable from environmental and safety standpoints. A safe and acceptable treatment means must be developed for this waste as soon as possible because of the large quantity already present. Again, a considerable study, engineering design, construction, and testing program is required, but a funding source has not yet been identified.

Also in FY 1983, a computer record-keeping system will be established for hazardous waste disposal activities. A computer program is being written to allow this capability, and it is anticipated that, by the end of FY 1983, all hazardous waste disposal activities will be computer-posted.

III.4.3 Proposed Program and Expected Accomplishments in FY 1983 Through FY 1990

Evaluation of the Hazardous Waste Management program and facilities needs will be completed. Note that the evaluation assumes there will be no significant regulatory changes once it is finished. Based on the evaluation, needed facilities and/or facility modifications will be determined, designed, and funding requested. It is anticipated that during this time, all major utilities will be obtained at Area L.

III.4.4 Budget Projections

Because the full impact of forthcoming regulations is not now known, no meaningful long-range projections of future

budget requirements can be made at this time. Based on current information regarding the FY 1983 program, it is expected that the budget during this FY will be approximately $125 K for the general handling, treatment, and disposal of laboratory hazardous nonradioactive waste. A breakdown of this amount by subtask is presented below.

Treatment and Disposal Site Operations	$65K
HE Disposal	60K

REFERENCES

1. US Department of Energy, Final Environmental Impact Statement, Los Alamos Scientific Laboratory Site, Los Alamos, New Mexico, DOE/EIS-0018 (December 1979).

2. E. L. Christensen and W. J. Maraman, "Plutonium Processing at the Los Alamos Scientific Laboratory," Los Alamos Scientific Laboratory report LA-3542 (1969).

3. L. J. Mullins, Jr., J. A. Leary, and A. N. Morgan, "Operating Instructions, Procedures, and Equipment for the Los Alamos Plutonium Electrorefining Plant," Los Alamos Scientific Laboratory report LA-2981 (1963).

4. L. J. Mullins, Jr. and J. A. Leary, "Fused Salt Electrorefining of Molten Plutonium and Its Alloys," Los Alamos Scientific Laboratory report LA-3118 (1964).

5. J. A. Leary, A. N. Morgan, and W. J. Maraman, "Plutonium Peroxide Precipitation," Ind. Eng. Chem. 51, 27 (1959).

6. L. A. Emelity, C. W. Christenson, and W. H. Kline, "Operational Practices in the Treatment of Low- and Intermediate-Level Radioactive Wastes: Argonne and Los Alamos Laboratories, United States of America," Proceedings of Symp. on Practices in the Treatment of Low- and Intermediate-Level Radioactive Wastes 187, (IAEA, Vienna, 1966).

7. L. A. Emelity and C. W. Christenson, "Program and Procedures for Control of Radioactive Wastes at Los Alamos," Health Phys. 12, 1170 (1966).

8. L. A. Emelity and C. W. Christenson, "Processing of Plutonium Contaminated Liquid Wastes at Los Alamos," Symp. on Safety in Plutonium Handling Facilities, Rocky Flats Div., Dow Chemical Company Golden, Colorado, 1971.

9. L. A. Emelity, J. R. Buchholz, and P. E. McGinnis, "Review of Radioactive Liquid Waste Management at Los Alamos," Symp. on Management of Low-Level Radioactive Waste, Atlanta, Georgia, 1977.

10. C. W. Christenson and L. A. Emelity, "Chemical Treatment and Cement Fixation of Radioactive Waste," 42nd Annual Conf. of the WPCA, Dallas, Texas, 1969.

11. L. A. Emelity and C. W. Christenson, "Replacement of an Old Treatment Plant, a Design Based on Experience," Symp. on Developments in the Management of Low- and Intermediate-Level Radioactive Wastes, IAEA, Aix en Provence, France, 1970.

12. L. A. Emelity, P.M. Stanley, and J. R. Buchholz, "Liquid Waste Management Systems Improvement Programs at Los Alamos National Laboratory," Int. Symp. on the Management of Alpha Contaminated Wastes (Vienna, Austria, 1981.

13. M. A. Rogers, "History and Environmental Setting of LASL Near-Surface Land Disposal Facilities for Radioactive Wastes (Areas A, B, C, D, E, F, G, and T), A Source Document," Los Alamos Scientific Laboratory report LA-6848-MS, Vol. no. I and II (1977).

14. Environmental Surveillance Group, "Environmental Surveillance at Los Alamos During 1978," Los Alamos Scientific Laboratory Report LA-7800-ENV (1979).

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Attachment 6

Copy of Francis (1997, 76126) Referenced in the Investigation Work Plan for MDA A

Los Alamos
NATIONAL LABORATORY
memorandum
Chemical Science and Technology
Responsible Chemistry for America
Environmental Restoration Project/CST-18
Los Alamos, New Mexico 87545

To/MS: Carl Newton, EES-1, MS E525
From/MS: William C. Francis, CST-18, MS E525 W. C. F.
Phone/FAX: 7-6080/5-4632
Symbol: ER-WFC-97-22
Date: March 21, 1997

HISTORY OF THE GENERAL'S TANKS, SWMU 21-014 AND ACID WASTE SUMP PUMP; STRUCTURE TA-21-223, SWMU 21-011(b).

The General's Tanks were installed in January 1945, by the Robert E. McKee Construction Company. See the attached drawings Eng-C2076 thru Eng-C2078, Attachment No. 1. The tanks are located at the west end of Material Disposal Area-A (MDA-A), SWMU 21-014. The purpose of the tanks was to store solutions that contained plutonium instead of dumping these solutions into disposal pits. The intention was to recover these solutions in the future and reclaim the plutonium. This was never done. The tanks are designated TA-21-107 and TA-21-108.

In March 1974, a decision was made to transfer the liquid radioactive wastes stored in the General's Tanks to the influent holding tanks, TA-21-110 and TA-21-111, at the Waste Disposal Plant, TA-21-257. This waste was them to be treated and released as effluent from the plant. A Standard Operating Procedure to accomplish this was written and implemented later in 1974. Attachment No. 2 is a copy of this procedure.

The following description of how the General's Tanks have been used was obtained from an interview with David Salazar, EM-RLW. Mr. Salazar started working at TA-21-257 in 1970 and was a Plant Operator Assistant in 1974 and helped with the liquid transfer operation. He is now the Facility Operator for TA-21-257.

A shed type of shelter, TA-21-40, was constructed at the south end of the tanks, see Attachment No. 3 for tank and shelter location. 2 1/2" hoses were laid out on the ground from TA-21-40 and connected to the 2 1/2" fill pipes located in the concrete boxes on the surface at the south end of each buried tank. Tank trailers were backed into the shelter and attached to the surface hoses and their radioactive solutions were drained into the tanks. This operation continued on an intermittent basis until 1974.

In 1974, it was decided to drain the General's Tanks to TA-21-257. Holes, with the sides sloped, were dug down to the concrete slab at about the center of each tank. Holes about one yard square were broken through the 8" reinforced concrete slab, the dirt removed from the bottom of the slab to the top of the tanks, and a hole, about 16" in diameter was cut in the top of each tank. Square metal plate covers, rolled to the same dimension as the outside radius of the tank, were fabricated to cover the 16" diameter access holes. There were no gaskets or seals used between the cover plates and the top of the tanks. A submensible pumps was lowered into a tank and the contaminated fluid was pumped from the tank and injected into the 3" force main, that connects TA-21-223 with TA-21-257, through a flushing connection at the northwest corner of the fence around MDA-A. This fluid transfer operation took about five days.

The excavated holes were left open for four or five years. As rainwater collected in the tanks they were pumped, using the same procedure as described above, on an as required basis. At times, when the tanks were being pumped sludge samples were taken using a Bacon Bomb Sampler, see Attachment No. 4. The excavated holes were backfilled about 1979, and the shed structure TA-21-40 removed. The steel plate covers over the 16" diameter openings were not welded to the tanks nor were the one yard square holes in the concrete slab patched and sealed before the backfilling operation started.

Acid waste sump pump TA-21-223 (SWMU 21-011(b)), acid wasted manhole TA-21-222 and acid wasted manhole TA-21-221 were all built on contract AT (29-1)-1785. The contractor was Cillessen Brothers. These structures were started 7/9/64 and completed 5/27/65 on Lab Job 2920. The two manholes and the sump are connected by a 6" drain line and this acid waste sewer system is connected directly to building TA-21-155 at manhole 222, connected to building TA-21-152 at manhole 221 via manhole 173 (SWMU 21-022(f)) and connected directly to building TA-21-209 at manhole 221.. This acid waste sewer system flows by gravity to sump TA-21-223 where the influent is picked up by pumps and injected into a 3" force main that connects to the Waste Disposal Plant, TA-21-257. The sump, TA-21-223, and the two manholes TA-21-222 and 221 are shown on the location plan on drawing Eng-C42985, sheet C-1 (Attachment No. 5).

In 1976, the Acid Sewer Lift Station (sump TA-21-223) was modified by the Zia Company. A 5'-4" X 6'-8" shed type structure was built at ground level over the sump and the two pump motors with their electrical controls were relocated from inside the sump to positions inside the shed. The pumps and floats were left in place and the drive shafts between the pumps and motors and the float rods were extended. The pumps were also repiped to the force main with appropriate gate and check valves installed. See Attachment No. 5, drawings Eng-C42985, sheets 1 and 2. About 1982, the pumps and motors were replaced with submansible type pumps and the new control panels were installed on the walls of the shed.

Attachment No. 6 and No. 7 are included in this report because it was thought that the sampling data that they contain might be of interest.

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