FILE LANL HSWA Fu-3 OU 1122 TA-33-008(c)

Environmental Restoration
University of California
Environmental Restoration Project, MS M992
Los Alamos, New Mexico 87545
505-667-0808/FAX 505-665-4747

U. S. Department of Energy
Los Alamos Area Office, MS A316
Environmental Restoration Program
Los Alamos, New Mexico 87544
505-667-7203/FAX 505-665-4504

AUG 1996 RECEIVED

Date: July 23, 1996
Refer to: EM/ER:96-410

Mr. Benito Garcia
NMED-HRMB
P.O. Box 26110
Santa Fe, NM 87502

SUBJECT: SAMPLING AND ANALYSIS PLAN FOR PRS 33-008(c)

Dear Mr. Garcia:

Enclosed please find two copies of a sampling plan that is submitted as an addition to the Resource Conservation and Recovery Act Facility Investigation Report for Operable Unit 1122. This plan is for new Solid Waste Management Unit 33-008(c).

If you have any questions, please call Roy Michelotti at (505) 665-7444 or Joe Mose at (505) 667-5808.

Sincerely,

Jorg Jansen, Program Manager
LANL/ER Project

Sincerely,

for Theodore J. Taylor, Program Manager
DOE/LAAO

JJ/TT/bp

Enclosure: Sampling And Analysis Plan For PRS 33-008(c)

Cy (w/ enc.):
D. Griswold, AL-ERD, MS A906
J. Harry, EES-5, MS M992
B. Hoditschek, NMED-HRMB
R. Michelotti, CST-18, MS E525
J. Mose, LAAO, MS A316
N. Naraine, DOE-HQ, EM-453
D. Neleigh, EPA, R.6, 6PD-N (2 copies)
T. Taylor, LAAO, MS A316
N. Weber, NMED-AIP, MS J993
J. White, ESH-19, MS K490
S. Yanicak, NMED-AIP, MS J993
RPF, MS M707

4743

TV

Cy (w/o enc.):
T. Baca, EM, MS J591
D. Bradbury, EM/ER, MS M992
T. Glatzmaier, DDEES/ER, MS M992
D. McInroy, EM/ER, MS M992
G. Rael, AL-ERD, MS A906
W. Spurgeon, DOE-HQ, EM-453
J. Vozella, LAAO, MS A316
EM/ER File, MS M992

SAMPLING AND ANALYSIS PLAN
PRS 33-008(c)

In 1996, debris was found eroding from the face of the fill surrounding the culvert that drains Main Site at Technical Area (TA) 33. The debris included intact chemical bottles, metal turnings, broken glass, battery cores, lead security ties, and general debris. Further inspection revealed a trench north of the culvert and a second area of debris southeast of the culvert. Archival aerial photos indicate that the suspected disposal areas were established, and possibly covered, prior to 1958 when LANL operating group W-3 occupied Main Site (LANL 1992, 0784).

The site was identified as new potential release site (PRS) 33-008(c) in May 1996 in accordance with the Hazardous and Solid Waste Amendments Module permit requirements under the Resource Conservation and Recovery Act Facility Investigation at Los Alamos National Laboratory (LANL). This document presents a Phase I sampling and analysis plan to investigate the nature and extent of the newly-discovered PRS.

1.0 Problem Definition

In order to plan a voluntary corrective action for PRS 33-008(c), more information about the nature, volume, and location of buried material is required, as well as determining if contaminants have migrated from the unit. Specific objectives of Phase I sampling at PRS 33-008(c) are formulated as the following questions.

- What are the lateral and vertical boundaries and volume of the fill in the area adjacent to the Main Site drainage? If removal is the remedial alternative selected, volume estimates must be accurate within ±25%.

- Does an isolated trench to the north of the drainage contain buried debris? What is the volume of the trench?

- Have hazardous chemicals been released to the environment at PRS 33-008(c)? Are potential risks to human health or the environment associated with the materials buried in the disposal areas? Preliminary estimates of the level and extent of contamination in these disposal areas are required to compare the potential remedial alternatives.

- What potential waste characterization issues should be considered during remedial planning? Is uranium present at levels that would indicate the possible presence of mixed waste?

Phase I sampling of PRS 33-008(c) is designed to provide data to evaluate remedial alternatives for this disposal area. The remedial alternatives to be considered are

- stabilizing the disposal areas in place, which could include techniques ranging from simple erosion control measures to capping the disposal areas and diverting Main Site runoff, or
- removing buried material for disposal elsewhere.

If hazardous chemicals have been released to the environment at this site, they can potentially migrate via contaminant transport pathways. The transport pathways of primary concern for this site include:

- infiltration into near-surface or subsurface soils;
- soil erosion and/or excavation exposing subsurface contamination;
- surface water runoff resulting in the contamination of sediments in drainage channels; and
- wind entrainment of contaminated dusts and particulates with deposition onto surface soils.

Exposure to hazardous chemicals present at this site is predicated on the current and future land use for the site and the activity of potentially exposed receptors. Current and future land use for this site is considered industrial and continued Laboratory operations. Because Bandelier National Monument is adjacent to TA-33 and open land surrounds the site, recreational land use is also considered. Potential routes of exposure to workers or recreational users at this site include incidental ingestion of soil/sediments, dermal contact with soil/sediments, and inhalation of suspended dust. Because of arid conditions at this site and the absence of surface water features, water pathways are not considered complete for drinking water supply and ingestion/contact of surface water.

Based on current information, a recommendation for no further action is not considered a viable alternative at this PRS. Recommendation for the preferred alternative will be based on the characterization of risk associated with the landfill in its current condition. Decision rules have been developed, as follows.

- If data from the Phase I RFI investigation indicates that risk to human health and the environment is within an acceptable range, stabilization in place will be recommended as a best management practice to prevent debris from entering the watercourse.
- If sampling and analysis indicate an unacceptable risk due to exposure to RCRA constituents and/or radionuclides regulated by the Department of Energy, the landfill(s) will be recommended for partial or complete removal. Any fill remaining at the PRS will be stabilized.

1.1 Site Description

Recent erosion around the culvert's exit has exposed what appears to be empty and partially filled chemical bottles. Machine turnings, cable, and general trash lie in the area and in the channel downstream of the culvert.

The 2-ft culvert is approximately 30 ft long and 3 ft below grade. The downgrade end of the culvert drains directly into a small tributary of Chaquehui Canyon (Fig. 1). The fill over the culvert may have been placed to raise the grade to the bottom of a fence that once crossed the channel, but this fill material appears to cover debris as well. The fill extends 20–30 ft to the north, thinning as the slope rises. The southern extent of fill is harder to determine because the natural surface appears to be loose pumice. While the fill forms an abrupt bank near the east end of the culvert, it is not clear how far the fill extends to the west. A north-south swath approximately 30 ft wide has been cleared for a power line. West of this clearing the vegetation appears mature, including several juniper and pinyon trees.

The main channel carries most of the runoff from Main Site. Enough moisture is delivered to support dense vegetation in the channel for about 70 ft east of the culvert, as well as a grassy plain to the west of the culvert. Except during runoff events, however, the channel bed is dry.

The second feature in PRS 33-008(c) is a long, narrow (approximately 3-ft wide) trench approximately 250 ft north of the main channel, separated from the disposal area at the main channel by undisturbed ground. A linear feature corresponding to this trench is visible in a 1958 aerial photograph of TA-33. At the west end of the trench is a small asphalt pad; at the east end, a pile of concrete. Debris present at the surface includes a brown bottle containing some liquid. There is no evidence of active erosion at this site.

1.2 Historical Data

As part of the investigation of PRS 33-017, RFI Phase I samples collected in 1993 near this disposal area included surface samples AAA2060, AAA2061, AAA2195, AAA2062, and AAA2063 from the main channel, sample AAA2086 from a point 50 ft southwest of the drainage, and sample AAA2080 from a point north of the trench (Environmental Restoration Project 1995, 1265). Table 1.2-1 lists results reported above LANL background upper tolerance limits (UTLs). Screening action levels (SALs) were not exceeded in any sample. For analyses of organic compounds, only tentatively-identified compounds were reported in any of these samples. Sample locations are shown in Fig. 1.

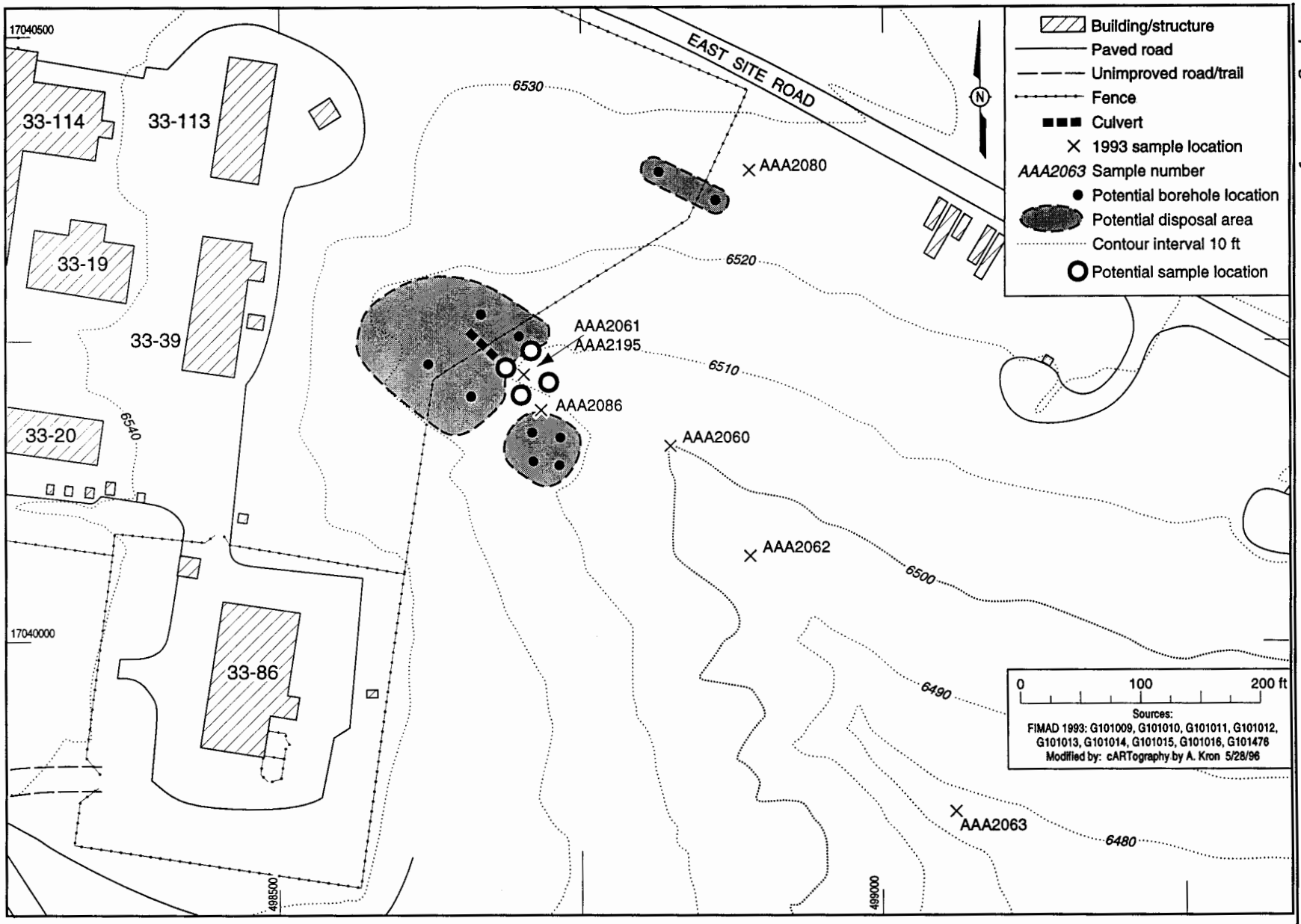

Fig. 1. Sampling points at PRS 33-008(c).

TABLE 1.2-1
INORGANICS AND TRITIUM ABOVE LANL BACKGROUND LEVELS IN SURFACE SAMPLES NEAR THE DISPOSAL AREA

SAMPLE ID	CADMIUM (mg/kg)	LEAD (mg/kg)	NICKEL (mg/kg)	SILVER (mg/kg)	ZINC (mg/kg)	TRITIUM (pCi/g)
SAL [a]	*38*	*400*	*1500*	*380*	*23 000*	*260*
UTL [b]	*2.7*	*23.3*	*15.2*	*ND* [c]	*50.8*	*ND*
AAA2061	3.3	98	46	<1	750	9.9
AAA2195	2.2	100	13	3	350	6.7
AAA2062	0.8	11	4.9	<1	49	3.8
AAA2063	1	15	7	<1	85	42.5
AAA2080	<0.4	15	<2	<1	34	20
AAA2086	<0.4	12	<2	<1	17	27

[a] SAL = Screening action level.
[b] UTL = LANL (95%, 0.95) upper tolerance limit.
[c] ND = Not determined.

2.0 Sampling and Analysis Design

The design for this sampling and analysis plan includes survey activities, field screening, sample collection, and analysis. Surface and shallow subsurface soil and sediment samples will be collected for fixed laboratory analysis for uranium, inorganics, SVOCs, and VOCs. Chemical bottles will be reported to LANL Emergency Management and Response for pickup and disposal.

2.1 Survey Activities

Investigation of PRS 33-008(c) will include mapping and geomorphic/geophysical surveys. These data will be used to estimate the extent and volume of the fill. Geophysical data will indicate the location of any large objects that may be buried in the fill.

2.2 Sampling and Analysis

Samples will be collected from a minimum of four boreholes located within the disposal areas. The locations of these boreholes will be biased by geophysical survey results toward fill areas containing buried debris. If no basis for biasing samples is found, one borehole will be located within each quadrant of the landfill area(s) using standard randomizing techniques.

All results from samples collected for laboratory analysis will be summarized to characterize actual and potential releases from buried debris in the disposal areas. These data will be used to determine if it is appropriate to contain rather than excavate the types of materials present, to estimate risks associated with the material if it is left in place (possibly with some stabilization) and to estimate risks associated with any contaminants mobilized in channel sediments.

Individual observations will be compared with LANL soil and tuff inorganic background UTLs and with SALs. Preliminary remediation goals will be developed for chemicals of potential concern if any are identified.

Samples will include soil and fill from the boreholes in each disposal area and sediments from the drainage below the culvert. All samples will be analyzed for inorganics, total uranium (except liquids), and semivolatile organic compounds (SVOCs). Subsurface samples will be analyzed for volatile organic compounds (VOCs) (Table 2.2-1).

TABLE 2.2-1
SAMPLES AND ANALYSES FOR PRS 33-008(c)

AREA	MEDIUM	NO.	ANALYTE SUITES
Culvert	Biased fill samples	4 - 6	Inorganics, total uranium, SVOCs [a], VOCs [b]
	Soil-tuff interface	4	Inorganics, total uranium, SVOCs, VOCs
	Channel sediments	6	Inorganics, total uranium, SVOCs, VOCs
South Area	Biased fill samples	4 - 6	Inorganics, total uranium, SVOCs, VOCs
	Soil-tuff interface	4	Inorganics, total uranium, SVOCs, VOCs
North trench	Biased fill sample	1	Inorganics, total uranium, SVOCs, VOCs

[a] SVOCs = Semivolatile organic compounds.

[b] VOCs = Volatile organic compounds; VOCs will be analyzed only in subsurface sediment samples.

Tritium is not considered a chemical of potential concern at this PRS. Tritium concentrations in the 1993 samples are listed in Table 1.2-1 of this sampling and analysis plan. Tritium at Main Site is discussed in detail in the RCRA Facility Investigation Report for MDA K (Environmental Restoration Project 1995, 1263).

Two duplicate samples will be collected with the samples described above. One duplicate sample should be collocated with a biased fill sample, and the second will be collocated with either the bank cut sample or the sample from the toe of the disposal area. These samples will be used to estimate local heterogeneity of areas affected by buried debris. Local estimates will be compared with the expected overall level of heterogeneity derived from borehole sampling.

2.3 Assumptions

The following assumptions underlie the design of this sampling plan.

- The fill lies on bedrock and its volume can be estimated within ±25%.
- At least a portion of the fill contains material similar to that eroding from the face.
- The samples specified in Table 2.2-1 are adequate to calculate risk associated with the maximum volume of fill expected. Risk assessments at this PRS will be based on continued institutional control.
- Should risk at the site prove acceptable, current capping technologies are adequate to stabilize the landfill sufficiently.

2.4 Data Quality

The contract laboratories will provide standard quality control measurements (surrogates, blanks, check standards, matrix spikes, etc., as specified by the analytical procedures requested) and will supply complete analytical data packages supporting the reported results. Estimates of data quality will be developed in accordance with the Environmental Restoration Project's Quality Assurance Project Plan (LANL 1996, 1292). No special handling is required beyond good laboratory practices and standard field procedures.

Concentration ranges, precision, and bias of analytical techniques specified under the current LANL ER statement of work are adequate to meet the critical ranges of interest at this PRS. In addition, contract laboratories will provide standard quality control measurements: surrogates, blanks, check standards, matrix spikes, etc., as specified by the analytical procedures requested and will supply complete analytical data packages supporting the reported results, as specified in the current LANL ER statement of work for contract laboratories (LANL 1995, 1278).

3.0 Implementation

Field implementation is detailed in the TA-33 field implementation plan for 1996 (ICF Kaiser 1995, 02-138). All work will be conducted using ER Project standard operating procedures (SOPs) (LANL 1993, 0875).

3.1 Field Methods

3.1.1 Field Surveys

Geophysical survey Geophysical surveys were performed using a magnetometer/gradiometer investigation for shallowly-buried (less than 20 ft) material exhibiting magnetic properties. Ground-penetrating radar was used to detect nonmagnetic material. Surveys were in accordance with LANL-ER-SOP-03.02, R1, General Surface Geophysics. The surveys concluded that a significant landfill does not occur in the area near the culvert, but buried debris is present. The survey also determined that a second disposal area lies a few yards to the south. The geophysical survey is attached as Appendix A.

Geomorphic survey A geomorphic survey will delineate the area around the culvert that may be fill. The survey will be conducted using shallow borehole drilling in accordance with LANL-ER-SOP-04.01, R0, Drilling Methods and Drill Site Management.

The undisturbed surface soils adjacent to the disposal areas will be characterized. Sediment traps in the drainage that could provide material representing releases over the past 30 years will be identified in the main channel below the fill, for a distance of approximately 70 ft from the fence. The types and location of debris observed on the surface will be recorded, including field identification of metallic debris. Location of stained soil, if any, will be recorded.

These survey results will be recorded on a base map including 2-ft elevation contours. The current power lines and any other features that might provide future reference points will be marked. The results of these surveys will provide preliminary estimates of fill boundaries and volume. They may also indicate which areas contain the most buried debris and the presence of large items. This information will be used to bias the selection of samples as described in Section 2.2.

Land surveys Engineering geodetic mapping will be used to record borehole points. The engineering survey will locate, stake, and document the locations of these points in the field. These data will be recorded on the base map. If repositioning a sample location becomes necessary during sample collection, this new position will be resurveyed and the revised location will be indicated on the base map. The engineering will be performed by licensed professionals working to minimum standards for land surveying in New Mexico with oversight by the field team leader in accordance with LANL-ER-SOP-03.01, R1, interim change notice (ICN) 6, Land Surveying Procedures.

3.2 Sampling

Prior to sampling, all sample locations will be field screened for radioactivity in accordance with LANL-ER-SOP-10.10, R0, Radiation Scoping Surveys and for VOCs to identify gross concentrations of contaminants in accordance with the ER health and safety manual for direct reading monitoring methods. Other appropriate health and safety precautions will be undertaken under the site-specific health and safety plan for TA-33 in accordance with 29 CFR 1910.120, the LANL radiological control manual, and the LANL generic health and safety plan.

Sample collection A minimum of four boreholes will be located in the primary disposal area near the culvert. The locations of these boreholes will be biased by geophysical survey results toward areas where buried debris has been found. If the boundaries of the fill have not been adequately delineated by the surveys described in Section 2.1, additional boreholes may be required to determine the extent of the fill. In this case, the four boreholes selected for sampling should be located where fill material and buried debris have been encountered. A fifth borehole will be located in an area that is not fill to verify the validity of the geophysical techniques, but this borehole will not be one of the four boreholes selected for sampling.

Borehole cores will be screened for beta/gamma radioactivity, VOCs, and at 1-ft intervals in the fill for metals detectable by laser-induced breakdown spectroscopy or x-ray fluorescence. If elevated radioactivity or organics are detected in core from the bottom of the hole, then the hole will be continued up to 10 ft to bound the extent of the apparent release.

A surface sample will be taken at two of the four borehole locations, preferably at a borehole biased by the discovery of debris. If no such borehole is found, the surface samples will be collected at those borehole locations nearest to the inlet and outlet of the culvert. At least one fill sample will be collected above the fill/tuff interface in each hole. This sample will be biased by elevated field measurements or by being adjacent to debris, if such indicators are available. A second fill sample may be collected if there is more than one such indicator. A sample will be collected at the soil/tuff interface.

The sampling plan described above that includes a minimum of four boreholes will be replicated in the area south of the culvert.

Surface (0–6 in.) and subsurface (12–18 in. or at sediment/tuff interface, whichever is shallower) channel sediment samples will be collected approximately 2–10 ft and 10–40 ft downstream from the culvert. Actual locations will be determined based on the presence of sediment traps containing historical sediments identified by the geomorphic survey. Two additional sediment samples will be collected, one from the bank cut in this channel within 10 ft of the culvert and one from the eroding toe of the fill on the east-facing slope adjacent to the culvert. Both of these samples will be biased to areas containing debris.

One sample will be taken from the north trench near the lower (east) end. Core will be field screened as described above, and sampled at total depth and at the tuff/fill interface. Additional samples (0–4 per core) will be taken in the fill above the interface only if positive field screening indicators or buried debris are encountered.

All samples will be collected using the applicable LANL-ER SOPs for the collection, preservation, identification, storage, transport, and documentation of environmental samples, as described in the ER Quality Assurance Project Plan requirements for sampling and analysis (LANL 1996, 1292). Decontamination of sampling equipment will be performed in accordance with LANL-ER-SOP-01.08, R0, Field Decontamination of Drilling and Sampling Equipment. Wash water and other wastes generated during the sampling operation will be managed and disposed of in accordance with LANL-ER-AP-05.3, R0, Management of ER Program Waste.

Sampling Techniques Surface samples will be collected according to LANL-ER-SOP-06.09, R0, ICN7, Spade and Scoop Method for Collection of Soil Samples. Subsurface sediment samples will be collected according to LANL-ER-SOP-06.10, R0, Hand Auger and Thin-Wall Tube Sampler. All sediment samples will be a minimum depth interval of 6 in. If the sediment is sufficiently deep, a second analytical sample will be gathered at a depth interval between 6–20 in. Borehole samples will be collected using drilling techniques according to LANL-ER-SOP-04.01, R0.

3.3 Laboratory Analyses

Samples will be analyzed for inorganics, uranium, and SVOCs. Subsurface samples will be additionally analyzed for VOCs. All soil, sediment, and tuff samples submitted for laboratory analyses will be analyzed using routine laboratory contract methods. Inorganic, SVOC, and VOC analyses will be performed by EPA SW-846 methods. Uranium will be analyzed by inductively coupled plasma mass spectrometry.

3.4 Sample Handling, Packaging and Shipping

Samples will be handled, packaged, and shipped in accordance with the latest revisions of the applicable LANL ER Program SOPs: LANL-ER-SOP-01.01, R0, ICN11, General Instructions for Field Investigations, LANL-ER-SOP-01.02, R0, Sample Container and Preservation, LANL-ER-SOP-01.03, R1, Handling, Packaging, and Shipping of Samples, LANL-ER-SOP-01.04, R2, ICN10, Sample Control and Field Documentation, and LANL-ER-SOP-01.05, R0, Field Quality Control Samples. Samples will be submitted to off-site contract analytical laboratories through the ER sample management office (SMO) under the current statement of work.

3.5 Waste management

Waste management and minimization is described in the 1996 field implementation plan for TA-33 (ICF Kaiser 1995, 02-138).

3.6 Schedule

All sampling will be completed by September 30, 1996. The RFI report will be completed within 90 days of receipt of all data.

4.0 Data Assessment

4.1 Verification

Data packages will be checked for completeness and reported deficiencies by routine data verification and validation procedures (LANL 1996, 1292). Focused validation will be performed only if routine validation indicates possible problems with analytes of concern.

4.2 Transmittal of Results

Field data will be collected and documented in field notebooks and field sample collection logs. Additionally, required field data will be entered in the ER 4-D™ electronic field database. This electronic record will be uploaded to the ER Facility for Information Management, Analysis and Display (FIMAD) at the conclusion of the sampling season.

Analytical results will be returned to the SMO from off-site contract analytical laboratories. Complete data packets, adequate to support focused validation if necessary, will be provided. Data will be uploaded into the FIMAD database by the SMO (LANL 1996, 1292).

5.0 Administration

5.1 Task Organization

Task organization, training, records, and oversight are detailed in the field implementation plan (ICF Kaiser 1996, 02-138).

Records Maps will be prepared based on the geodetic surveys discussed in Section 3.1 of this sampling and analysis plan. Copies of field logs and other field information will be supplied, together with information captured in the field database.

Reports A field summary report prepared following the field activities will be submitted to the ER Records Processing Facility. Field data will be preserved in a 4-D™ database and provided to FIMAD. The analytical laboratories will prepare electronic deliverables as well as hard copy reports of the results.

REFERENCES

Environmental Restoration Project, September 29, 1995. "RFI Report for TA-33, PRSs 33-003(a), 33-004(a), 33-007(c), 33-009, 33-011(d), 33-013, 33-016, 33-017 and Revised Sampling Plans for PRSs 33-003(b), 33-004(k), 33-008(a), 33-008(b), C-33-001, C-33-002," Los Alamos National Laboratory Report LA-UR-95-3625, Los Alamos, New Mexico. **(Environmental Restoration Project 1995, 1265)**

ICF Kaiser Engineers, Inc., September 29, 1995. "OU 1122 Field Implementation Plan for Phase I and II and VCA/EC Activities at Technical Area 33 During the FY 1996 Sampling Season" ICF-Kaiser Engineers, Inc., Contract 9-XS2-X5348-1, Los Alamos, New Mexico. **(ICF Kaiser 1995 02-138)**

LANL (Los Alamos National Laboratory), May 1992. "RFI Work Plan for Operable Unit 1122," Los Alamos National Laboratory Report LA-UR-92-925, Los Alamos, New Mexico. **(LANL 1992, 0784)**

LANL (Los Alamos National Laboratory), 1993. "Los Alamos National Laboratory Environmental Restoration Program Standard Operating Procedures," Los Alamos National Laboratory report, Los Alamos, New Mexico. **(LANL 1993, 0875)**

LANL (Los Alamos National Laboratory), July 1995. "Statement of Work–Analytical Support," Revision 2, RFP No. 9-XS1-Q4257, ER ID No. 49738, Los Alamos, New Mexico. **(LANL 1995, 1278)**

LANL (Los Alamos National Laboratory), March 1996. "Quality Assurance Project Plan Requirements for Sampling and Analysis," Los Alamos National Laboratory Report LA-UR-96-441, Los Alamos, New Mexico. **(LANL 1996, 1292)**

APPENDIX A

REPORT of GEOPHYSICAL STUDIES at PRS 33-008(c)

GEOPHYSICAL INVESTIGATION OF PRS 33-008(C), TA-33, LOS ALAMOS NATIONAL LABORATORY LOS ALAMOS, NEW MEXICO

Prepared for:

Los Alamos National Laboratory
Los Alamos, New Mexico

Prepared by:

ICF Kaiser, Inc.

June 1996

Martin J. Miele
Registered Geophysicist, R.Gp.-941, R.G.-6088

REGISTERED GEOPHYSICIST
MARTIN J. MIELE
No. 941
STATE OF CALIFORNIA

REGISTERED GEOLOGIST
MARTIN J. MIELE
NO. 6088
STATE OF CALIFORNIA

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GEOPHYSICAL INVESTIGATION OF PRS 33-008(C), TA-33, LOS ALAMOS NATIONAL LABORATORY, LOS ALAMOS, NEW MEXICO

1.0 INTRODUCTION

This report presents the results of a geophysical investigation conducted by ICF Kaiser for the Environmental Restoration Program at Los Alamos National Laboratory in Los Alamos, New Mexico. The geophysical survey was conducted at PRS 33-008(c) in Technical Area 33 (TA-33) from June 18 to June 21, 1996.

1.1 Site Description

PRS 33-008(c) is located within TA-33 approximately 200 feet north of Material Disposal Area K. The site is characterized by thick brush and is located outside and east of the security fence surrounding Building 33-086. In the northern section of the site, the security fence changes direction and trends toward the east. The site extends beyond (north of) that portion of the fenceline.

PRS 33-008(c) was discovered during recconnaisance in the area. Several semi-buried objects and surface debris were observed. The materials were observed in an area containing thick brush but no trees. Most of the objects in the area were constructed of metal or had a metallic component. However, empty chemical bottles were also observed on the ground surface. The area was subsequently designated a SWMU and potential release site.

In addition to the landfill area, two trench-like features were observed on the ground surface east of the main PRS 33-008(c) site. The features are approximately 120 long and 15 feet wide. One feature resembles an elongated "low" area. The other appears as an elongated "mounded" area. The features are very subtle in their appearance. Geophysical traverses were also conducted over each of these features.

1.2 Purpose of Geophysical Surveys

The objective of the geophysical investigation is to assess the presence and lateral extent of buried objects and debris. The electromagnetic induction (EM) method was employed to assess the overall amount and lateral extent of buried non-metallic and metallic debris. The EM method is commonly used to assess landfill limits and general magnitude of buried materials. The time-domain metal detection method (TDMD) was employed to assess the location, lateral extent and general depth of buried metallic debris (ferrous and non-ferrous).

2.0 DATA ACQUISITION AND RESULTS

Prior to obtaining data all brush was removed from the PRS 33-008(c) field area. In addition, all surface objects and debris were removed from the area that would cause interference to the geophysical data. Since some areas on both sides of the fence required geophysical surveying, the fencing was removed. However, the fenceposts were still present during the survey.

2.1 Data Acquisition - Landfill Area

Time domain metal detection (TDMD) data were obtained at 2 foot increments along north-south traverses spaced 5 feet apart. Data were obtained from all accessible areas within the field area. Due to the density of the grid, interference from the fenceposts could not be avoided. However the interference is limited and interpretations regarding buried materials could still be made.

TDMD data were stored on a data logger and downloaded to computer disk at the end of the survey. The data were then collated and contoured by computer (Golden Software).

Electromagnetic Induction (EM) data were obtained at 5 foot increments along north-south traverses spaced 10 feet apart. Data were obtained from all accessible areas within the field area. Interference from the fenceposts was avoidable due to the larger traverse spacing.

EM data were stored on a data logger and downloaded to computer disk at the end of the survey. The data were then collated and contoured by computer (Golden Software).

2.1 Data Acquisition - Trenches

TDMD and EM data were obtained along two traverses over the trench-like features east of the landfill site. One traverse was located over the mound area and one was located over the low area. The traverses were approximately 120 feet long and extended from the pea gravel area at the north end of the elongated features to pile of concrete debris at the south end. Data were obtained at 2-foot increments along both traverses.

2.3 Results of Geophysical Surveys - Landfill Area

The results of the geophysical surveys are illustrated on Figures 1 and 2. Figure 1 is a contour map of the TDMD data and Figure 2 is a contour map of the EM data. The maps are discussed separately in the following paragraphs.

On Figure 1, the lineation of high magnitude anomalies extending from approximately -20S, 72E to 30S, 10E are caused by the fence posts in the field area. The fence posts which trend south, after the turn in the fence line, donnot cause interference in the data because they were avoidable during the survey. The survey lines were parallel to that lineation and posts could be effectively avoided.

The linear high magnitude anomaly extending from approximately -10S, 25E to 0S, 55E is caused by a buried culvert. The ends of the culvert are exposed at the approximate ends of the linear anomaly.

The remaining anomalies on Figure 1 are caused by buried and semi-buried metallic debris (ferrous and non-ferrous metal). Most of the buried objects occur between 30S and 80S and between 10E and 40E. The data indicate the buried metal is relatively shallow (within a couple feet deep). This is also supported by the numerous semi-buried objects in thre area such as wire, concrete with metal rebar and chunks of exposed metal. However, the geophysical data indicate that buried metal objects that are not partially exposed do occur within the anomalous zone.

On Figure 2, the lineation of high magnitude anomalies extending from approximately -10S, 25E to 0S, 55E is caused by the buried culvert. The effects of the culvert also occur on Figure 1. The remaining anomalies on Figure 2 are caused by buried and semi-buried metallic debris that were outlined on Figure 2 (TDMD Data). Due to the nature of the geophysical methods resolution of the buried metal is better with the TDMD data than with the EM data.

The EM method is commonly used for the detection and delineation of buried landfills, trenches, and pits containing all types of wastes (metallic and non-metallic). It is an effective recconnaisance technique for assessing the presence and extent of significant buried landfill wastes.

The EM data from PRS 33-008(c) indicate that there is no significant landfilling in the area. The only buried materials that were detected are the shallow buried metal that was detected with the TDMD survey.

2.4 Results of Geophysical Surveys - Trenches

The TDMD and EM data obtained over the mound area and low area indicate no geophysical anomalies. The data were very consistent and low in magnitude, analogous to background data. Therefore, no buried objects or debris are expected to occur below those features.

3.0 DISCUSSION

PRS 33-008(c) consists of an area approximately 50 feet by 30 feet with shallow buried metallic debris or buried debris with metallic components. The geophysical data indicate that no significant landfill occurs in the area. The area in the northeastern section of the field are was originally suspect due to the "fill" appearance of the surface material. However, no geophysical anomalies occur in the area. That area contains scattered surface debris, however, the geophysical data suggest that there are no detectable buried objects.

A number of glass chemical bottles occur on the ground surface in the vicinity of the landfill area. However, buried glass chemical bottles would only be resolved by EM or GPR if a large number of them are buried in a given area (confined trench with only bottles). The EM data from PRS 33-008(c) did not indicate any such anomalies. If the bottles are scattered and buried, there is no practical way to locate each bottle. GPR would have less than a fifty-percent chance of detecting any given bottle. In addition, the field effort would be very large for such an objective that it would be considered impractical. There is no other geophysical method that would resolve each individual bottle.

TDMD and EM data obtained over the trench areas indicate no geophysical anomalies. The GPR method may be succesfull in determining whether the area was disturbed in the past. However, this is dependent upon the specific subsurface conditions in that area. If numerous small fractures occur in the shallow tuff they may obscure the GPR results. There is no other geophysical method that would resolve such features.

APPENDIX A - METHODOLOGY

Time Domain Metal Detection (EM61)

The Geonics EM61 is a high sensitivity high resolution time-domain metal detector which is used to detect both ferrous and non-ferrous metal objects. It consists of a powerful generator that transmits a pulsed primary magnetic field which induces eddy currents in nearby subsurface metallic objects. The decay of these currents is measured by two receiver coils, separated by 40 cm, mounted together on a coil assembly. The responses are recorded and displayed by an integrated data logger as two channel information. The data are downloaded to a PC for further processing.

The EM61 is relatively insensitive to surface interferences from nearby surface metal. Since the measurement is obtained a relatively long time after termination of the primary pulse the response is practically independent of the electrical conductivity of the ground.

Due to its coil arrangement, the response curve is a single well defined positive peak. Therefore, targets can be located accurately and their depth can usually be estimated from the width of the response and/or from relative response of each of the two receiver coils.

The operator can carry the coils on a harness or can pull the coils mounted to a small cart. The EM61 is an excellent metal detector due to its sensitivity, comprehensive detection, depth of investigation, and speed of surveying.

Electromagnetic Induction (EM31)

The EM method consists of a system of two coils. One of these coils transmits a time-varying electromagnetic signal (primary magnetic field) which induces the flow of electrical current in subsurface materials. This current flow produces a secondary magnetic field

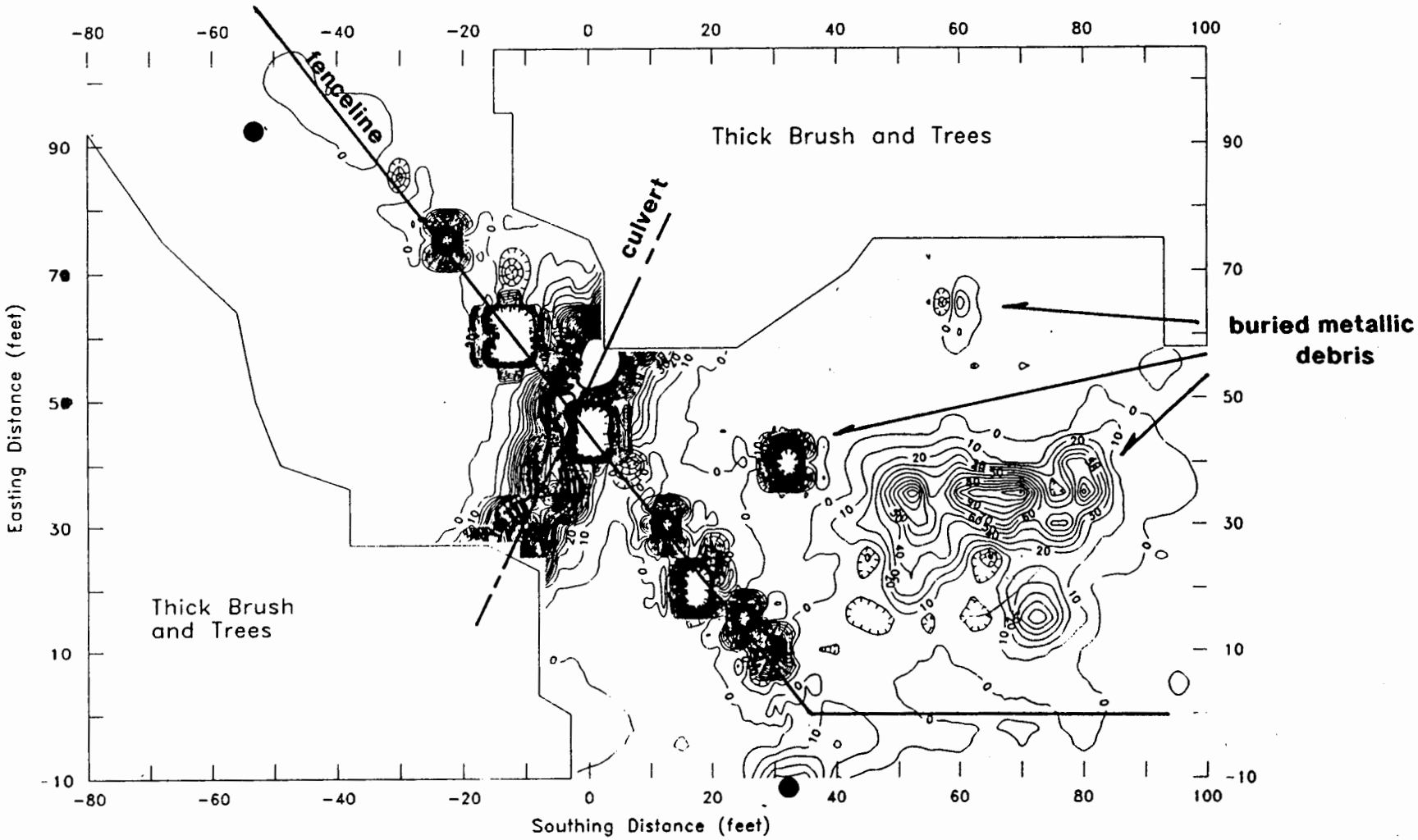
(Lenz's Law) which is detected by the second coil (receiver coil). The received signal provides an estimate of electrical conductivity of the subsurface material it permeates.

The conductivity measured by the instrument is a resultant conductivity, referred to as "terrain conductivity". It represents the overall conductivity of material that the electromagnetic field permeates below the instrument. In other words, the volume of the material sampled by the electromagnetic field may include a number of different materials, with different conductivity values, all of which contribute to the resultant conductivity value (terrain conductivity).

Terrain conductivity values are effected by the physical characteristics of subsurface materials, the presence of buried metallic and non-metallic debris, differences in moisture content, and the composition/lithologic character of subsurface materials. Terrain conductivity measurements are commonly used in areas where rapid data acquisition is required and measurements can be used to delineate landfills/trench fill material, determine the presence of buried objects, map contaminant plumes and many other applications.

Our instrumentation consists of a Geonics EM31-DL ground conductivity meter and an Omnidata data logger. The data logger stores the EM data as well as horizontal grid control data and field notes. These data are then downloaded to a computer for further processing. The EM-31 system has a fixed coil separation of 12 feet which results in a depth of investigation of approximately 18 feet under optimum conditions. The actual investigation depth is dependent upon the conductivity of shallow subsurface materials. For example, the presence of a highly conductive clay layer can reduce the depth of investigation.

Los Alamos National Lab – TA33 Landfill – EM61 Data (mV)



● power pole

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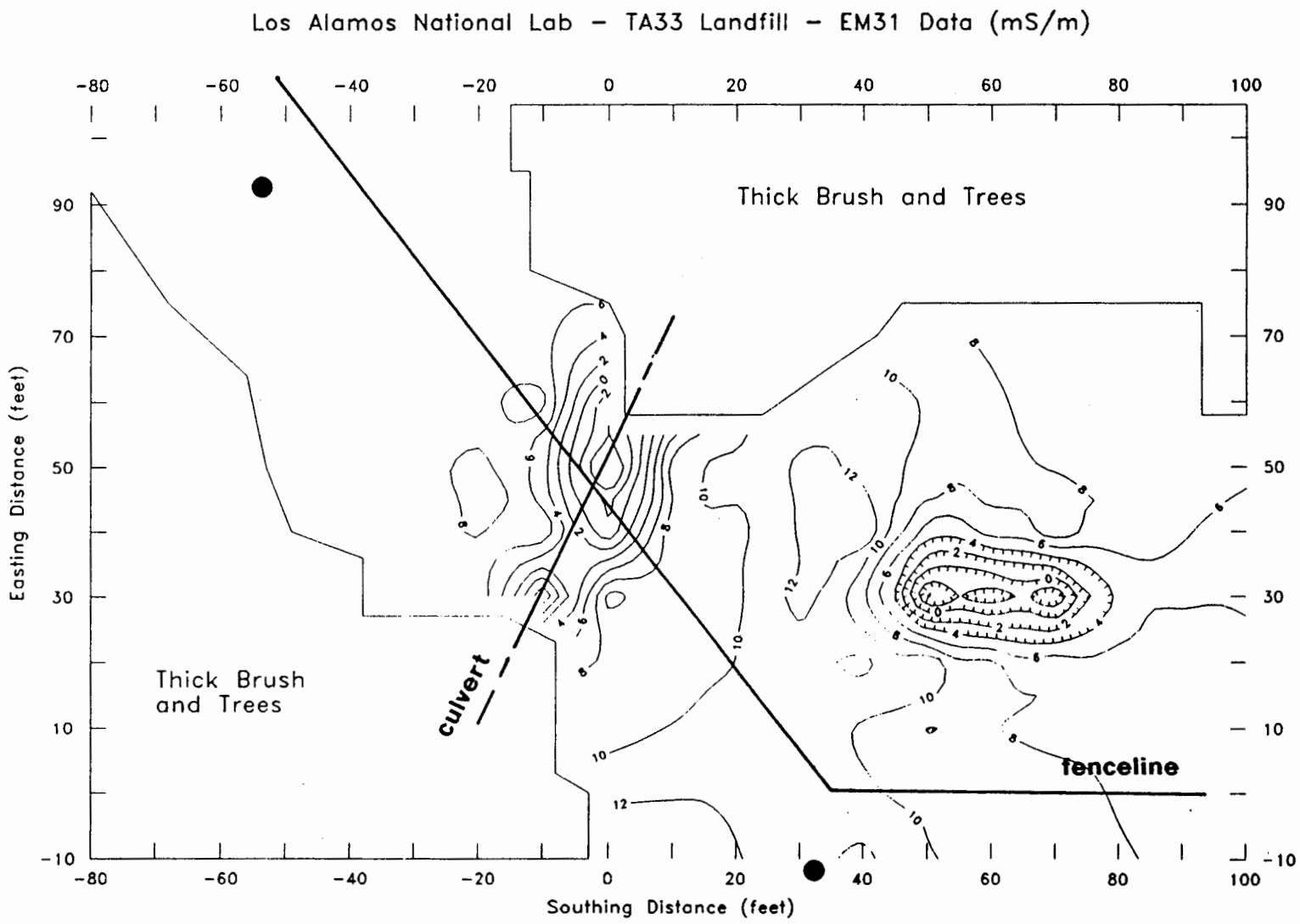
EM61 Results
PRS 33-008(c)
Los Alamos National Lab



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EM31 Results
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Figure 2