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DOCUMENT DATE: 11/01/86

ORIGINATOR NAME: LANL

ORGANIZATION: LANL

SYMBOL: —

PAGE COUNT: 37

SUBJECT/TITLE: Surface Geophysical Investigation Utilizing Magnetometry & Ground Penetrating Radar at Area F, Tech Area 6

RECORD TYPE (Circle relevant type for primary record; type of attachments should be selected on *Keywords List*):

Analytical Data	Excerpt	Map	Plan	Study
Article	FAX	Memo	Procedure	Summary
Chain-of-Custody	Figure	Microform	Purchase Request	Telephone Record
Chart	Form	Notebook	Receipt Acknowledgment	TOC
Computer Output	Interview	Outline	(Report)	Transcription
Contract	Letter	Personal Notes	Review	Video
Controlled Distribution	List	Photo	SOW	Work Plan
Drawing	Logbook			Other____

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Buried	Containment		Glass Beaker	Leak Legal

ER Record Index Form Keyword List-8/14/92

ER Record Index Form Keyword List
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Letter
Limit
Lines
Liquid
List
Log
Logbook

Magazine
Management
Manhole
Map
Material
MDA (Material Disposal Area)
Media
Meeting
Memo
Mercury
Metal
Microform
Minimization
Minutes
MIS (Management Information System)
Mixed Waste
MOA (Memo of Agreement)
Model
Modification
Money (Allocation, Appropriation, Budget, Cost, Funding, etc.)
Monitoring
Monthly Report
Mortar Impact Area
MOU (Memo of Understanding)
MSA (Major System Acquisition)

NEPA (National Environmental Policy Act)
NFA (No Further Action)
Nitrate
NMED (New Mexico Environment Department)
NMEID (New Mexico Environmental Improvement Division)
NOD (Notice of Deficiency)
Nonexplosive
Notebook
Notification
NPDES (National Pollutant Discharge Elimination System)
NRC (Nuclear Regulatory Commission)
Nuclear

Observation
Off-gas
Oil
Open
Open Burning
Operation
Order
Organic
Organization
OSHA (Occupational Safety & Health Administration)
OU (Operable Unit)
Outfall
Outline

Pad
PA/RFA (Preliminary Assessment /RCRA Facility Assessment)
PCB (Polychlorinated Biphenyl)
Permit
Personal Notes
Personnel
Personnel Qualification
Photo
Pilot Study
Pipe
Pit
Plan
Plant
Plutonium
Pollution
Polonium
Polaroid
Potential
Presentation
Prevention
Priority
Procedure
Program
Programmatic
Project
Project Leader
Propellant
Property
Proposal
Protection
Protocol
PRS (Potential Release Site)
Public
Pump
Purchase Request

Quality
QA (Quality Assurance)
QP (Quality Procedure)
Quarterly Report

Radioactive
Radiochemistry
Radionuclide
Radium
Rationale
RCRA (Resource, Conservation, and Recovery Act)
Reactor
Receipt
Acknowledgment
Recommendation
Reconnaissance
Records
Recovery
Recycle
Reduction
Reference
Regulation
Release
Remediation
Removal
Report
Request
Requirements
Research
Resin Bed
Resolution
Resource
Respirator
Response
Restoration
Restriction
Results
Review
Revision
RFI/RI (RCRA Facility Investigation/Remedial Investigation)
Risk
RPF (Records-Processing Facility)

Safety
Salamander
Salvage
Sample
Sampling Plan
Sanitary
Satellite
Schedule
Scope
Scrap
Scrap Detonation Site
Screening
Scrubber
Search
Security
Seep
Seminar
Semivolatile
Septic
Sewer
Shaft
Sheet
Shell
Shot
Silver
Site
Sludge
Soil
Solid
Solvent
SOP (Standard Operating Procedure)
SOW (Statement of Scope of Work)
Specific
Spill
Stack
Standard
Statistics
Steamline
Steel
Storage
Strontium
Structure
Study
Subcontractor
Subsurface
Summary
Sump
Support
Surface
Surveillance
Survey
Swipe
SWMU (Solid Waste Management Unit)
System

Table
Tank
Task
TCLP (Toxicity Characteristic Leaching Procedure)
TDD (Technical Document Description)
Technical
Technical Team
Technology
Telephone Record
Test Area
Testing
TLD (Thermoluminescent Dosimeter)
TOC (Table of Contents)
Townsite
Toxic
Tracking
Training
Transcription
Transfer
Transformer
Transport
Treatment
Trench
Trip Report
Tritium
TRU (Transuranic)
TSCA (Toxic Substances Control Act)
Tubalioy
Tuff

Underground
Uranium
Urine
USGS (United States Geological Survey)
UST (Underground Storage Tank)
Utility

Validation
Variance
VE (Value Engineering)
Ventilation
Verification
Video
Volatile
Volume

Warehouse
Waste
Water
WBS (Work Breakdown Structure)
Weapon
Well
Work
Working Group

Zinc

Attachment List con't ER ID# 0015243

E) Form Title: Special Work Permit For Potentially Hazardous Activities, Area F, TA-6 Date: 06/11/86

F) List Ground Survey Crew

G) Personal Notes Handwritten List of Names

H) Procedure Title: Preparation, Review, and Approval Instructions

I) Memo To: Roger Ferenbaugh, Marjorie Martz From: Naomi M. Becker Symbol: HSE8-86-594 Subject: Preliminary FY86 Work Plan For Los Alamos CEARP - Geophysics Date: 05/23/86

J) Figure Title: Structure Location Plan, TA-6, Two Mile Mesa Symbol: ENG-R120

K) Form Official Laboratory Visitor Request From: Alan K. Stoker Date: 06/10/86

L) Form Shipping Request Form From: Roy F. Weston, Inc. Date: 06/25/86 Symbol: 48541D

M) Figure Title: Figure 3 - Countour Plot of Magnetic Townsites

SURFACE GEOPHYSICAL INVESTIGATION

UTILIZING

MAGNETOMETRY & GROUND PENETRATING RADAR

AT

AREA F

TECH AREA 6

LOS ALAMOS NATIONAL LABORATORY

LOS ALAMOS, NEW MEXICO

NOVEMBER, 1986

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1. INTRODUCTION

1.1 BACKGROUND

The scope of this preliminary investigation is focused on the characterization of present conditions at a land disposal containing construction/equipment debris, located in Area F, Tech Area (TA) 6, shown on Figure 1. These materials may be contaminated with high explosive (HE) and with radioactivity including depleted uranium, Strontium-90 and Cesium-137.

The Area F Site is about 2.5 acres in areal extent. The disposal area was used in 1940s and 1950's. The disposal area is comprised of pits of various shapes and sizes containing the types of wastes previously mentioned. The number, size and location of these pits are unknown as are their exact contents.

1.2 PURPOSE

The purpose of this work is to establish a basis for a future characterization of this site. Presently, Area F is being prepared to protect the surface from erosional effects.

1.3 STATEMENT OF WORK

LANL has, in conjunction with erosional protection and closure, requested a geophysical survey be conducted to estimate the location of buried excavations and objects to optimize the design of the present surface work, and to map underground anomalies for future considerations. The reconnaissance is to include the use of magnetometry and ground penetrating radar.

1.4 HEALTH AND SAFETY

A Health and Safety Plan was developed which defines the level of protection that is required at Area F site while work is being performed. The Health and Safety Plan is shown in Appendix A.

2. RECORDS REVIEW AND WASTE INVENTORY

2.1 GENERAL

The records containing waste management procedures are very limited and are contained in documents filed by LANL. Generally waste materials identified for disposal were buried in trenches and covered with natural soils. For those areas requiring personal and livestock protection, the disposal areas were roped, fenced (3-4 string barb-wire or cyclone fence material) and identified with appropriate flagging or warning signs.

2.2 WASTE CHARACTERISTICS

The waste characteristics of the buried materials are vaguely known, and only a general description of the debris is known. The Area F disposal site was established on or about 1946 and functioned as a disposal site through 1954. The disposal debris included HE materials including shapes, squibs, detonators, spark gaps, and blocks of HE. There are also depleted uranium contaminated materials which can be described as construction and equipment debris. Some debris may also be contaminated with Sr-90 and Cs-137. The site has been determined as not containing any materials which could be a hazard to human health or containing materials which might constitute an explosion (detonation) hazard while conducting surface surveys utilizing low energy, high frequency radio waves.

2.3 PREVIOUS SITE INVESTIGATIONS

There are no known prior investigations performed to identify the location, shape and/or contents of the waste disposal areas within Area F, TA-6.

3. GEOPHYSICAL SURVEYS

3.1 GENERAL

A preliminary geophysical field investigation was conducted by WESTON at the LANL Area F Waste Disposal site during the week of June 17, 1986. The surface geophysical survey covered the entire disposal site, including areas within perimeter fences. WESTON performed two complementary geophysical surveys:

- o Magnetometry, and
- o Ground Penetrating Radar (GPR).

The use of multiple complementary techniques increases the confidence level of the data, providing quality assurance between results, and a comprehensive evaluation of the site.

The results of the investigations will be used to delineate subsurface anomalies (buried slit trenches and basins), locate subsurface targets (buried fill material, scrap, metal debris, drums, etc.), and estimate the approximate depths to subsurface anomalies.

Tables and figures with overlays are included as a separate attachment to this report.

3.2 METHODOLOGY

Geophysical mapping at Area F Waste Disposal Area provided a direct comparison of results obtained from the application of two different geophysical techniques: (1) Magnetrometry, and (2) Ground Penetrating Radar (GPR). The two types of data were used in a complementary manner to locate disturbed areas and metal objects which are indicators of where disposal has occurred. The survey was conducted in grid fashion to identify possible disposal trenches, debris, and containers. Prior to the field investigation the site was subdivided into grids consisting of 5, 10, 20 and 25 foot spacings based on locations of buried trenches. The resulting cartesian grid was oriented with the X axis traversing west to east and the Y axis traversing south to north, as shown on Figure 1. The magnetometer survey was conducted on a grid established at 25-foot nodals and is shown as a composite to the magnetometer contour data on Figure 4. No magnetometer data was recorded within fenced areas or north of the large fenced area (northeast part in Figure 1). The variable GPR grid used in the survey was used to complement the actual conditions of the site and is shown on Figure 2.

The magnetic data were used to provide a semiquantitative measure of the distribution of magnetic anomalies produced by subsurface metallic sources. The GPR provided qualitative information characteristic of the substructure and its components. Utilizing both geophysical techniques in an integrated approach allowed a rapid convergence of information necessary for assessing subsurface conditions within the site. The methodology for each of the two survey techniques is described in the following subsections. A correlation between data acquired by these techniques is reported Subsection 3.3.

3.2.1 Magnetometer Survey

A magnetometry survey was performed using Scintrex Model MF-2-100 vertical field flux gate magnetometer. Prior to conducting the survey, a permanent base station was established outside the site for the purposes of establishing background conditions and quality control. By filtering out the ambient geomagnetic field, the instrument was calibrated to a relative zero at the base station. The diurnal (daily) variation of the earth's magnetic field was then monitored during the survey by measuring the magnetic intensities at the base station periodically throughout the day. The diurnal variation was negligible, and thus the application of correction factors to the data was unnecessary. Measurements were obtained at 25 foot grid intervals across the site, see Figure 4. Additionally, closer-spaced measurements were taken in areas showing anomalous magnetic intensities. A total of 207 measurements were collected (Fig. 4).

3.2.2 Ground Penetrating Radar

The GPR survey at Area F commenced on June 17, 1986 utilizing a GSSI System 8 GPR unit. The GPR system was field calibrated for specific site soil and moisture conditions and traverses were conducted across the site at 5, 10, 20 and 25 foot intervals. The grid was altered to conform to areas within fences and local obstructions. A map of Area F, depicting the survey grid, is shown in Figure 2. The GPR Survey was conducted by traversing the survey grid with the GPR transmitter/receiver antenna in both the east to west and north to south directions. The identification number of each traverse and the direction in which it was run was labeled and recorded. GPR was conducted within the small fence enclosure at 5 foot grid intervals to provide a more comprehensive coverage, (Figure 1 and 2). The GPR survey produced a series of 62 graphic cross-section profiles. The profiles include transects varying in length from 20 to 500 feet. A typical example of a graphic radar profile is shown in Figure 3. The data were standardized by fixing location marks on each profile at grid intersections and other surficial reference points. The GPR graphic cross-section profiles in raw form were submitted to LANL as a separate document to this report. Only the results of the GPR survey are contained herein.

3.3 SUMMARY OF GEOPHYSICAL SURVEY RESULTS

WESTON used a VAX 11-785 computer and Contour Plotting System -1 (CPS-1) graphic software package to construct a contour map of the magnetometry data. The contour map and raw magnetic intensities are shown on Figure 4. These data are the basis for analysis and interpretation.

Data analysis of GPR survey data consisted of the interpretation of each profile individually and comparing the results collectively. The interpretation process had two objectives:

- o Correlating signature densities and geometric configurations towards the identification of pipes, drums, trenches, soil structures, discontinuities and subsurface disturbances.
- o Identifying trends and conditions by comparing standard profiles one to another to identify soil interfaces, buried utilities and stratigraphic units.

The GPR profiles produced by this survey exhibited good resolution, clearly defining disturbed subsoils and highlighting characteristic signatures of discrete objects beneath the site. A total of 62 profiles were analyzed for the interpretation shown on Figure 5.

3.3.1 Magnetometer Results

In addition to ferrous materials, strong positive magnetic (ferromagnetic) responses may be indicators of associated metals such as nickel and chrome. The intensities of the magnetic responses depend largely upon the composition, size, depth and orientation of the subsurface materials. Small objects such as iron bolts and very small pieces of scrap metal may produce anomalies ranging between 25+ gamma to 200+ gamma, while larger objects such as metal structures or steel drums may generate magnetic intensities on the order of 100+ gamma to 5000+ gamma. Strong negative magnetic (diamagnetic) responses are produced naturally by quartz, marble, graphite and rock salt; and by the proximity of contrasting metallic surface objects such as metal fences and antennae. Localized magnetic intensities across Area F varied from between 7100- gamma(diamagnetic) to 2350+ gamma (ferromagnetic).

The contour plot of magnetic intensities for Area F is shown on Figure 4. Magnetic intensities were contoured at 500 gamma intervals from -3000 to -500 gamma and from 500 to 2000 gamma. Contour intervals from -100 to 100 gamma is 100. Intensities in excess of the range limits were measured in areas of cultural interferences (i.e., cyclone fences and metal stand pipes). Since these values are not indicative of subsurface features, they were filtered out in the computer program to enhance the resolution of the contours. The zero gamma contour in Figure 4 operationally defines the areas of background (presumably undisturbed) subsurface conditions. Several high positive (ferromagnetic) anomalies and high negative (diamagnetic) anomalies are shown across the site. Three diamagnetic responses encompassing grid nodes 265 E by 80 N (1000- gamma) and 330 E by 180 N (3100-gamma) and 400 E by 190 N (2600- gamma) are attributed to cultural interferences produced by the cyclone fence enclosures. A high positive magnetic intensity of 2350 gamma was detected at grid node 75 E by 90 N which occurs near he site of an old homestead, however, it may indicate buried debris other than homestead materials. Artifacts around the homestead are probably depicted by the three diamagnetic responses ranging from 100- to 400-gamma.

There are several dominant features on Figure 4 which depict ferromagnetic anomalies with corresponding diamagnetic reversals paired next to each anomaly. The first is located between 150 E by 250 E and 150 N by 250 N and trends NE-SW. This area is located in the vicinity of sunken areas and a circular sinkhole. Another is located within 370 E by 450 E and 50 N by 150 N and trends NW-SE. Such paired ferro- and diamagnetic reversals are typically associated with relatively large masses of metallic objects. The trending ferromagnetic anomalies could indicate buried trenches used for disposal of metallic and other wastes. Metallic standpipes throughout the site are of unknown usage or origin and may be influencing the shape and/or the trend of the anomaly.

Only two magnetic anomalies of 615 gamma (50 E by 300 N) and 500 gamma (675 E by 300 N) could not be associated with any known sources or surface perturbations. The latter anomaly was surveyed but is not shown in Figure 4.

3.3.2 Ground Penetrating Radar Results

Areas of intermittent shallow discontinuities are shown in Figure 5 as the shaded areas. These delineate the lateral boundaries of disturbed, discontinuous soil. Two major soil discontinuities were detected in the central portion of the site and general adjoining areas. These soil discontinuities were defined from broken zones within the stratified subsoils as indicated in the radar profiles. Discontinuities may occur naturally through various geologic processes but are a result of "cut and fill" operations in cultural and landfill areas. Based on the geologic setting of the site, its past history as a possible waste depository, and the characteristics of the radar profiles, the two major discontinuities appear to be a result of shallow excavation and fill activities. These fill areas range in depth from 3 to 5 feet and extend across the site in irregular patterns as seen in Figure 5. A smaller suspected fill area was detected, northeast of the elongated enfencement at about grid node 500 E x 280 N, and extending outside of the survey area to the east. This anomaly was detected based on a single GPR and Magnetometry Traverse across the site.

The discontinuity observed in the old homestead area along traverse 75 E from 75 N to 185 N is very shallow and regular. Based on the radar signatures, the soils in this area appear to be more disturbed than discontinuous representing a possible swale or mound covering buried objects. Subsurface targets identified during the scan of GPR profile area also identified on Figure 5. Targets are shallow and generally all located within the disturbed areas. A few are outside the fenced areas. Based on radar profile signatures, the most suspect targets are located within the surface rockpile (160 E x 140 N), the sinkhole (200 E x 175 N), within the small fenced area (250 E x 100 N) and at 300 E x 125 N.

A continuous, well defined signature was found consistently on radar profiles traversing the drainage ditch immediately north of Two Mile Mesa Road. This linear feature is probably a response from a subsurface utility and is located on Figure 5.

3.4 SUMMARY OF RESULTS

The magnetometer and GPR surveys produce results which require individual interpretations. The interpretations of the data are enhanced by comparing the results of each method. The inherent limitations of any single technique of remote sensing can be lessened by cross-referencing two or more geophysical techniques and the sensitivity enhanced by dense grid spacing.

Magnetometer data were processed on WESTON's VAX 11-785 computer and CPS-1 contouring program. Magnetometer contour intervals were chosen to show trends in areas of subtle changes while maintaining distinction in areas of large contrasts as shown on Figure 4.

The CPS-1 contouring program interpolates raw data by dividing each grid cell into intermediate subcells. An intermediate grid value is computed as the average of the four corner values and located at the center of the subcell with diagonals extending to each corner. The intersections of the contour locus with the sides and temporarily computed diagonals are determined using inverse linear interpolation. The process continues until each chosen contour interval is completed.

Data analysis of GPR survey data involved the interpretation of each profile individually and then comparing the results collectively. The interpretation process had two objectives:

- o Applying specific knowledge of signature densities and configurations to the identification of pipes, drums, trenches, soil structures, discontinuities and surface disturbances.
- o Identifying trends and conditions by comparing standard profiles one to another. This process identified soil interfaces and buried utilities.

The GPR profiles produced as a result of this survey exhibited good resolution, defining disturbed subsoils and highlighting individual drum-like targets beneath landfills and trenches. An example of a GPR profile is shown in Figure 2.

Magnetic highs and lows are exhibited by mounds and depressions in the contoured surface. These anomalies represent the general shapes of local magnetic force fields generated by subsurface magnetic sources. Magnetic anomalies may also represent changes in magnetic properties of the earth below, caused by filled material versus natural undisturbed soil. Magnetic anomalies shown in Figure 4 are explained in Section 3.3.1. No corrections to the data were required due to the minimal diurnal variation of the earth's magnetic field during the survey.

Until excavation begins, it is uncertain what is the cause of these magnetic contour gradients. The changes in magnetic readings may indicate boundaries between waste pits, or buried drums or other metal objects. The anomaly areas found using the magnetometer correlate fairly well with the results obtained using the GPR, however the grid intensities for both surveys was not dense enough to produce quantitative results.

Figure 5 is an interpretive map of subsurface conditions based upon the GPR data. This figure identifies all detected targets , however only five are considered as priority targets based upon the density and geometric configuration of the profile signature, Section 3.3.2.

High priority targets were extremely good signal reflectors exhibiting a dense, parabolic signature. This type of signature is characteristic of rounded objects such as pipes, boulders, or drums. In contrast, the signatures produced by the low-priority targets were characteristically less dense and more variable in geometric configuration. Occasionally, this signature difference is a result of the orientation of the buried object with respect to the antenna traverse, (i.e., a buried drum in a vertical plane with the ground surface typically exhibits a hyperbolic signature).

Numerous shallow trench-like features were detected throughout the site, particularly near 200 E x 200 N and 450 E x 130 N. Figure 5 shows the areas of disturbed subsoils and suspected trench locations. The plots of these phenomena are a product of the collective analysis of the radar profiles.

Drum-like targets and disturbed soil areas were detected throughout the disposal site as shown in the GPR plot map (Fig. 5). When the magnetometer contour map is superimposed upon the GPR plot, similar subsurface trends are reflected. Most of the former trench areas are characterized by magnetically high contours.

Some of the major anomalies identified as a result of the geophysical surveys are listed below:

- o Magnetometer anomalies at:
  - 75 E x 100 N
  - 225 E x 225 N
  - 275 E x 100 N
  - 350 E x 200 N
  - 425 E x 125 N.
- o GPR anomalies:
  - Figure 5

The results of these surveys were limited by the coarse grid spacing as evidenced by the non-correlative nature of buried objects, magnetic highs and disturbed soils. These discrepancies are especially noted in the vicinity of the small fenced area (250 E x 190 N) and within the magnetic anomaly at 425 E x 125 N.

4. CONCLUSIONS AND RECOMMENDATIONS

The records, waste inventory, and disposal practices review performed for LANL shows that potentially hazardous wastes have been disposed of in designated pits and trenches at Area F, TA-6, Los Alamos National Laboratory. Documentation and personal interviews obtained from LANL personnel connected with the disposal site clearly indicate that it is impossible to estimate the volume or type of waste; however, it may be contaminated with HE and depleted uranium.

Table 1 summarizes the results of the geophysical surveys. Suspect areas occur where identified anomalies cannot be explained by known site subsurface features such as foundations or buried utilities. Areas showing correlation between magnetic anomalies and the location by GPR of disturbed soils or buried objects include the sink hole area and the metal standpipe area (Figures 4 and 5). These areas should be considered of special interest because they may contain metal objects. Two strong subsurface anomalies were identified by GPR with no magnetic anomalies. These are 150E by 130N and 170E by 140N (Figure 5).

The results of this survey indicate that surface geophysics is a useful technology for investigating sites similar to Area F where waste may be been buried in the past and where surface indicators and background information are lacking. Geophysical data is most useful when dense grid patterns are used, the data is correlated to historical records and aerial photographs, and direct physical data obtained by selective test pits or soil borings.

Should a remedial investigation be implemented, WESTON recommends that the following technical activities be included.

- o Conduct a preliminary analysis of historical aerial photographs, in stereo pair to correlate past surface features and disturbances with existing geophysical data.
- o Conduct a shallow subsurface metal detection survey using an antenna capable of deep penetration (4-6 feet).
- o Conduct a comprehensive geophysical survey within the suspected fill area, which was detected by single GPR and Magnetometry traverses outside of the principal survey boundary, from grid node 500E by 275N to 675E by 295N.
- o Investigate the locations identified as high priority or special consideration areas in Table 1.
- o Conduct detailed subsurface characterization to include drilling/soil sampling and construction of test pits at selected locations.

TABLE 1

Area F, TA 6
Summary of Priority Subsurface Anomalies

Coordinate Location	Suspected Source	Magnetic Response	GPR Response	Recommended Action
75E x 100N	Associated with Old Homestead Site	+2350 Gamma	Yes	None, Archeological Considerations
80E x 150N	Associated with Old Homestead Site	-445 Gamma	Yes	None Archeological Considerations
200E x 180N	Subsurface Waste Materials (Sink Hole)	+500 Gamma	Yes	Backhoe Test-Pit
190E x 200N	Undetermined	+1050 Gamma	Yes	Backhoe Test-Pit
170E x 140N	Undetermined	None	Targets	Backhoe Test-Pit
150E x 130N	Undetermined	None	Targets	Backhoe Test-Pit
250E x 110N	Subsurface Waste (Berm Area)	-1000 Gamma	Targets	Backhoe Test-Pit
300E x 135N	Section of Pipe	None	Targets	Backhoe Test-Pit

TABLE 1
(Continued)

225E x 225N	Waste Trench	Variable Gamma	Targets	Shallow Soil Borings
325E x 200N	Waste Trench	-3100 Gamma	Yes	Shallow Soil Borings
400E x 200N	Waste Trench	-2600 Gamma	Yes	Shallow Soil Borings
400E x 115N	Waste Pit	+2000 Gamma	Yes	Backhoe Test-Pit
425E x 125N	Undetermined	+700 Gamma	No	Shallow Soil Borings

<u>Note</u>: All recommended actions should use extreme precautionary measures because of the likely presence of HE.

APPENDIX A Health & Safety Plan

CEARP Health and Safety Plan

Los Alamos National Laboratory

Area F
Site Characterization Study

June 12, 1986

LANL CERRO - AREA F
GEOPHYSICAL SURVEY
2744-01-04

HEALTH AND SAFETY PLAN
APPROVAL/SIGN OFF FORMAT

I have read, understood, and agreed with the information set forth in this Health and Safety Plan (and attachments) and discussed in the Personnel Health and Safety briefing.

Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
William C Mason Site Safety & Project Co-ordinator MGR.	[signature]	6-12-86
George M Crawford Director, Corporate Health and Safety	[signature]	6/12/86
Kelly Peel ~~Project~~ DEPT Manager	[signature]	6/15/86
[signature] Project Director/ Department Manager	[signature]	6/16/86

Personnel Health and Safety Briefing Conducted By:

Name	Signature	Date

5433A

Table of Contents

1.0 Introduction

This Health and Safety Plan pertains to the Surface Characterization activities at Area F of the Los Alamos National Lab (LANL), Los Alamos, New Mexico. Guidance provided in the Comprehensive Environmental Assessment and Response Program (CEARP) Generic Health and Safety Plan will be adhered to during all site characterization activities.

The surface characterization of the site will consist of performing Ground Penetrating Radar (GPR) and Magnetometer Surveys on the approximately four acre site. The radar used will be of a frequency of 120 to 300 MHz. The survey will be conducted by traversing the 4-acre area in a regular gridded pattern and spaced at 20 foot intervals.

No invasive activities are to take place at Area F at this time. No direct contact with the waste forms will be made.

The records for disposal of waste at Area F are incomplete. Four pits were dug and filled with scrap as follows:

September	1949	40ft x 20ft x 10ft deep
February	1950	6ft x 6ft x 6ft deep
June	1951	2ft x 2ft x 4ft deep
August	1951	2ft x 2ft x 4ft deep

The LANL employee records report that the waste may consist of:

- o Large metal pieces (tube alloy)
- o Large blocks of high explosives (H.E.), primacord, etc.
- o Small amounts of radioactive materials (U,Pu)
- o Small detonators with squibs
- o Firing unit gaps
- o Classified shapes

The materials in these pits are buried under approximately 3 to 4 feet of soil

2.0 Risk Assessment

2.1 Chemical Hazards: No chemical constituents which could provide a risk to human health or the environment are anticipated at the LANL Area F site.

2.2 Radiological Hazard: Only very low levels of gamma emitting radionuclides are expected at the Area F site. Since all radioactive materials are buried no hazard from contaminated air particulates or surface contamination is likely.

2.3 Biological Hazards: No Bacterialotogoical hazards exist.

2.4 Physical Hazards: Over-exposure to sun is possible since the altitude of Los Alamos, New Mexico is greater than 7000 feet. Temperature and pulse should be checked frequently to avoid Heat Stress. Poisonous snakes may be present On-Site, and should be watched for. Ticks are also expected.

It has been determined that GPR does not pose a threat of detonating the possibly buried HE materials due to the low energy imparted (DAF, 1983). No invasive activities is planned within this area. LANL believes that the possibility of buried, HE is very slim (Mason, 1986). Therefore, explosion or fire is not expected due to GPR or magnetromety surveys. In the unlikely event a fire is started, workers shall be instructed to only attempt to extinguish it if it is small and controlled, and in all other cases, call the 9911 emergency telephone number.

3.0 Site Entry

The following sections describe the procedures to be followed by site workers to ensure safety and protection from hazards.

3.1 Worker Training

Prior to commencing field work at the Area F site, all personnel shall be formally trained by the WESTON Health and Safety coordinator on the anticipated work hazards. At a minimum, training sessions shall include discussion of anticipated hazards, site layout, protective equipment, requirements, safety practices and use of emergency procedures.

3.2 Safety Equipment

The following equipment will be available at the LANL Area F site in case of emergencies and for routine monitoring of contamination.

- o Fire extinguisher
- o Personal TLD's
- o MicroR meter
- o Water supply and soap for decontamination
- o Paper towels
- o Paper cups and drinking water supply
- o Trash bag for contaminated refuse
- o Thermometers: (1)Ambient and (2)Oral with alcohol or H_2O_2 and cotton for sterilization

3.3 Designation of Work Zones

The entirety of Area F will be designated as a Control Area, in which access will be controlled for people and vehicles. An access control point shall be designated by the WESTON Health and Safety Representative. This point shall be the control point for monitoring access and egress at the site. In order to prevent any accidental ingestion of hazardous materials, all personnel working within the controlled areas will be prohibited from eating, drinking, smoking or chewing gum or tobacco.

3.4 Personnel and Equipment Contamination

Although surface contamination is not anticipated at the Area F site, precautions will be taken until this is confirmed. Until levels of surface contaminants are determined to be below MDA, all personnel and equipment shall be monitored prior to exiting the site and before eating, drinking, or smoking (excepting emergencies). Monitoring will be done using an alpha scintillation probe capable of detecting 20 dpm/100 cm^2. For workers, boots, knees, hands and any other areas potentially in contact with contaminated materials will be surveyed. All equipment in contact with contaminated materials will also be surveyed. Any equipment which have levels of activity exceeding ANST N13.12 limits will be decontaminated. All activity measured on personnel will be removed.

3.5 Decontamination

Decontamination shall be done with caution to reduce airborne suspension of contaminated dust particles. Decontamination will be conducted at a centralized spot within the controlled area as designated by the WESTON Health and Safety representative. Water, brushes and paper towels will be provided to remove contaminants.

3.6 Dosimetry and Bioassay

All site workers shall have thermoluminescent dosimeters (TLD's) assigned and in use while at the site.

Bioassay (urinalysis) will not be required of workers unless surface contamination is found and monitoring indicates personnel contamination.

4.0 Key Personnel

The following individuals will be present during site characterization activities at the LANL Area F site.

William C. Mason - WESTON Health and Safety Representative
John A. Williams - Lead Geophysist
John B. Price - Assistant Geophysist

These individuals will be accompanied by a LANL representative at all times during the site characterization.

5.0 Emergency Procedures

The telephone number to be used in case of an emergency situation during work at the Area F site is:

Fire, Police, Ambulance: 9911

Directions and a map to the nearest medical facility are attached.

REFERENCES

Mason, William, June 12, 1986, personal communication with LANL.

Dept. of the Air Force, 1983. Explosives Safety Standards Fig. 6.4 AF Reg 127-100.

ATTACHMENT A

HAZARD REVIEW AND WORKER SAFETY SUPPLEMENT
FOR THE LANL AREA E SITE

JUNE 12, 1986

Date

Manager, Health and Safety

Site Manager,
Technical Representative

A.1 Introduction

The purpose of this site-specific health and safety supplement is to:

- o Review some of the more important items discussed in the CHARP Project Health and Safety Plan
- o Point out some of the more relevant OSHA regulations regarding equipment and excavation safety requirements
- o Provide information on hazards or potential hazards that are unique to the AREA E site
- o Provide telephone numbers and locations of emergency medical, fire, and police services.

Rather than being all inclusive, it is intended to be a supplement to the existing Health and Safety Plan.

A.2 Radiological Hazards

The AREA E site ~~is~~ may be contaminated with ~~chemical and~~ radioactive waste. The external exposure of personnel to penetrating radiation shall be monitored for all persons who will be working in a controlled area. All personnel are expected to have whole body exposures that are well below the 5 rem/yr limit imposed by DOE Order 5480.1. A more serious concern is the potential ingestion and inhalation hazard from hazardous materials. To minimize airborne contamination hazards, the resuspension of dust by equipment should be reduced as much as possible. When work activities or weather conditions result in visible airborne contamination, it may become necessary to require personnel to use respirators, or to prevent work at, and downwind from, contaminated areas. The site safety officer shall be informed of any changes in site conditions or work activities that may affect the potential for worker exposure.

<u>External Exposure</u> - Site workers may be assigned a thermoluminescent dosimeter (TLD) to measure individual gamma radiation doses.

<u>Internal Exposure</u> - The two primary internal exposure pathways result from inhalation and/or ingestion of contaminated material. At the AREA E site, contaminated materials may be present. To assess the potential for personnel exposure, airborne dust concentrations will be measured. This sampling will be conducted by a Site Safety

NOTE: NO AIR MONITORING WILL BE NECESSARY; NO SURFACE CONTAMINATION officer concurrently with drilling, surveying, or other site activities when site conditions need to be evaluated.

Personnel Contamination - All personnel who have been in contact with contaminated material in the controlled area are required to be surveyed for contamination before leaving the job site for any reason, ~~including emergencies.~~ excluding emergencies. Coveralls will be used to prevent contamination of personal clothing. It is recommended that workers wash or shower at the end of each work day, in order to eliminate trace levels of contamination. NOTE: COVERALLS NOT REQUIRED

Eating, drinking, chewing gum, smoking, or chewing tobacco shall be prohibited while working on or around the waste sites. This requirement is designed to minimize the ingestion of contaminated materials and thus minimize risk.

Equipment Contamination - All potentially-contaminated vehicles and equipment in use on the site shall be surveyed by the Site Safety Officer for contamination prior to release or removal from the site.

A.3 Protective Equipment

The following protective equipment shall be provided by the subcontractor, as necessary:

- Head and foot protection - employees working around drilling equipment or overhead hazard sites shall wear hard hats and steel toed shoes. HARD HATS NOT REQUIRED
- Eye and face protection - employees shall be provided and shall wear eye or face protection while working with equipment or during other activities which may result in a potential eye or face injuries from flying debris. EYE PROTECTION NOT REQUIRED
- Noise - exposure to potentially damaging noise may be expected while heavy equipment, such as drill rigs, are in operation. Hearing protection will be available for personnel working on or around equipment when alternate methods or noise exposure control are not feasible, such as barriers or distance form noise source.

A.4 Excavation and Equipment Requirements

Trenching - OSHA requires all trenches more than 5 feet deep to have shored or appropriately sloped walls if they pose a cave-in danger to workers.

Equipment - All bi-directional machines shall be equipped with a reverse signal alarm distinguishable from the surrounding noise level, or an employee shall be used as a signal person to ensure safe movement. Rollover protective structures (ROPS) are and OSHA requirement for all rubber tired self propelled scrapers, rubber tired front end loaders, rubber tired dozers, wheel-type industrial and agricultural tractors, crawler tractors, crawler type loaders and motor graders. Unless designed for standup operation, vehicles equipped with ROPS shall also be equipped with seat belts. Compacters, sideboom pipelaying tractors and all equipment manufactured before July 1, 1969 are not required to have ROPS.

A.5 <u>Site Description and Potential Hazards</u>

At the site there are:

X a. no buildings present

___ b. abandoned buildings. Since they may be structurally unsound, or contain hazardous materials, employees should stay clear of them as much as possible.

Ponded water or rivers:

X a. are not present on the site

___ b. are present on the site. Appropriate safety precautions shall be observed when a drowning hazard exists.

There are: *

___ a. no electrical power lines crossing the site

* b. electric power lines crossing the site. While in use the minimum distance of a crane or drilling rig to the power line shall be:

___ 1. 10 feet (50 kv)
___ 2. 20 feet (345 kv)
___ 3. 34 feet (750 kv)

In transit, with the boom or derrick lowered, the closest approach to a powerline shall be:

___ 1. 4 feet (50 kv)
___ 2. 10 feet (50 - 345 kv)
___ 3. 16 feet (345 - 750 kv)

___ c. buried electric power lines

___ d. buried utilities have not been searched and marked. This must precede any drilling off-pile, particularly in the former mill area.

* NOT REVEVENT TO THIS SURVEY

The local gas utility, * _______________:

X a. indicates that gas pipelines do not cross the site

___ b. indicates that gas pipelines are present on the site. Their locations are marked as follows: _______________

___ c. must be consulted before drilling at the site.

Hazardous materials on site may include:

X a. radioactive materials - very low concentrations - none at the surface

___ b. acids

___ c. bases

___ d. solvents

___ e. petroleum products

X f. reactive materials

Buried fuel tanks:

X a. have not been reported to be on-site, but could be present.

___ b. are present on the site. The approximate locations of those that are known to exist are given on the accompanying map.

Other potential hazards include: Buried High Explosives MAY BE PRESENT, HOWEVER, THEY ARE BURIED IN PITS WITH 3 TO 4 FT OF COVER. GROUND PENETRATING RADAR SURVEY (120-300 MHz) WILL NOT DETONATE EXPLOSIVES.

* not relevent to this survey

EMERGENCY INFORMATION FOR Los Alamos Area F

Fire: 9911
Ambulance: 9911
Police/Sheriff: 9911

Nearest Available Telephones: At ~~[illegible]~~ Site House

Nearest Hospital with Emergency Room: in Los Alamos, Escort (Guide) will be with team all of the time.

WESTON OFFICE: 5301 Central Avenue, NE
Albuquerque, NM 87108
505-255-1445

LANL
~~DOE/AL~~ Representative: [illegible] Work: 667-6950 or 67[illegible]
Home:

Site Manager: WILLIAM C MASON Work: 505.255.1445
Home: [illegible]

Technical
Representative: John H Williams Work: 215-692-3030
Home:

Health and Safety Representatives:

W. C. Mason Work: [illegible]
Home: [illegible]
Robert P. [illegible] Work: 215-1445
Regional Safety Officer Home:

ATTACHMENT B

WESTON

inter-office memorandum

TO: Don Diego Gonzalez, Albuquerque Ops DATE: 10 June 1986

FROM: J. A. Williams, Geosciences

SUBJECT: Geophysical Investigation at Los Alamos Facility, Albuquerque, New Mexico

W. O. No.:

As per your request, I am forwarding a Field Operations Plan to conduct a subsurface Geophysical Investigation within the high explosives (HE) disposal area at the Los Alamos Facility in Albuquerque, New Mexico. This Field Operation Plan is inclusive of the following activities:

- Conduct a Ground Penetrating Radar (GPR) Survey to locate and identify subsurface trenches containing unknown quantities of high explosives materials, and to delineate trench dimensions and identify any individual buried objects.
- Conduct a Magnetometry Survey to map magnetic anomalies, associated with subsurface materials.

INTRODUCTION

It is suspected that specific areas within the Los Alamos Facility are underlain by subsurface trenches containing, among other waste materials, high explosives (HE). It is the desire of Los Alamos to identify these zones and map them for follow-up site activities. Due to the possible hazards and liabilities associated with these sites, the following special conditions must be addressed.

It must be unequivocally determined that:

- any radiological contaminants present at any of the sites being investigated are within the safety limits for Personal exposure.

- the site surface is deemed free and clear of any unexploded ordinance which may be either pressure shock sensitive to physical activities at the site.

- the high explosive (HE) material underlying the site is not sensitive to (cannot be detonated by) the low energy high frequency (HF) waves transmitted into the ground by the Ground Penetrating Radar.

I have discussed these conditions with you and with Bill Mason, and these conditions are planned to be dealt with in detail in the Site Safety Operations Procedures (SOP). This SOP is being written by Donna Wooding of the Albuquerque, NM office, and will be forwarded to George Crawford and Martin O'Neil (Corporate Safety Officers) for their review and approval prior to arranging field activities.

I have had conversations with (GSSI) the manufactures of the GPR, and others knowledgeable in the field of explosives, and have been given a "limited" assurance that the sensitivity of H.E. to the low energy, High Frequency Radar waves is "probably very low". This "limited" reassurance is really not reassuring at all, and Geosciences has severe reservations concerning the work in an H.E. area. For the use of Los Alamos in ascertaining the potential susceptibility of their H.E. to radar waves the following output power specification for the 120 and 3000 MHG intensive are as provided below.

<u>100 MHz Antenna</u>

100 V. Trigger Pulse - (Fiser Transmitter)

20.4 Watts	Applied Peak
1.7 M Watts	Average Applied Peak
5.1 Watts	Radiated Peak
.42 M Watt	Average Radiated Peak - Spread out over the broad band spectrum of Frequencies.

Over all 4 Watt output at @ 20% peak efficiency resulting in a few MW.

<u>120 MHz Antenna</u>

41.7 Watts	Applied Peak
7.5 M Watts	Average Applied Peak
12.5 Watts	Radiated Peak
1.88 M Watts	Average Radiated Peak

MAGNETOMETER SURVEY

Magnetic measurements are commonly used to map regional geologic structure and to explore for minerals. They are also used to locate pipes and survey stakes or to map archeological sites. They are commonly used to locate buried drums and trenches.

A magnetometer is a passive instrument which measures the intensity of the earth's magnetic field. The presence of ferrous metals creates variations in the local strength of that field, permitting their detection. A magnetometer's response is proportional to the mass of the ferrous target. Typically, a single drum can be detected at distances up to 6 meters, while massive piles of drums can be detected at distances up to 20 meters or more.

The effectiveness of a magnetometer can be reduced or totally inhibited by noise or interference from time-variable changes in the earth's field and spatial variations caused by magnetic minerals in the soil, or iron and steel debris, ferrous pipes, fences, buildings, and vehicles. Many of these problems can be avoided by careful selection of instruments and field techniques.

GROUND PENETRATING RADAR

GPR is a non-destructive method of profiling the earth by means of reflected radar impulses. It utilizes a downward-directed thin line pulsed radar beam to transmit an electromagnetic signal into the earth. Subsurface interfaces, including trenches, soil discontinuities, buries materials, etc., reflect the signal back to a receiver and printer where return pulses are analyzed and recorded. The result is an accurate, continuous, linear plot of subsurface features.

At present, GPR is utilized by WESTON for soil and bedrock surveys, shallow underground mapping, location of buried objects such as waste trenches and drums, and for mapping ground-water seepage plumes and pipe leaks. GPR records spacial data rapidly and provides excellent detail.

TECHNICAL APPROACH

The subsurface trench locations at Los Alamos are expected to be dividing lines between two subsurface materials with different conductivities, and such subsurface interfaces would be detected on the basis of differences between natural and trench zones and the different dielectric constants of the two media. In the case of trenched areas, most of these changes are indicated on the printout by attenuated signal returns, indicating the lateral and vertical changes in conductivity between soils and the subsurface trenches.

As you had indicated in your telephone conversation, two subsurface trenches 20 feet wide x 40 feet long x 20 feet deep are known to exist somewhere within a 4-acre area. In addition, numerous smaller trenches are suspected to exist within the same area. To identify the subsurface trenches, we have made an estimate that most of the trenches are no less than twenty feet in smallest lateral dimension. With this assumption, the grid spacing which we recommend for the survey would be 20 feet in each direction. The survey would be conducted by trenching each anomalous area detected by the magnetometer in grid fashion at 20 foot intervals with the GPR transmitter/receiver antennae.

The product of the GPR survey would be a series of real time graphic profiles exhibiting both lateral and vertical variations in the subsurface media. Trenches detected during the grid survey would be surveyed in a "random walk" pattern to enhance the definition of trench boundaries. Prior to surveying the instrument will be depth calibrated to a theoretical dielectric value of the site specific materials or to a reflector of a known depth, if present, such as a buried utilities conduit or storm drain. Data will be presented in a graphic of each area surveyed, showing the grid survey accomplished, the locations of any trenches detected, and the locations of any "hard" contacts detected in the subsurface.

ATTACHMENT C

AREA F

I. GENERAL INFORMATION

Area F is located on Two-Mile Mesa Road 2.1 km (1.3 miles) east of the intersection of Two-Mile Mesa Road and West Road (see Fig. F-1). It is north of Two-Mile Mesa Road within LASL coordinates N.33+00 and N.30+00, and E.12+50 and E.7+50. The boundaries of Area F are not strictly defined. There are two burial sites. The small one, closest to the road, has coordinates (beginning with the northeast corner and moving in a clockwise direction) of N.31+68, E.9+54; N.31+25, E.9+46; N.31+30, E.9+00; and N.31+82, E.9+13. The larger site, to the east and north of the smaller one, has coordinates of N.32+70, E.11+94; N.32+37, E.11+96; N.32+31, E.10+26; and N.32+86, E.10+23. Location by township and range is described as near the center of sec. 20, T. 19 N., R. 6 E. The approximate acreage for Area F is 0.18.[illegible]

II. GEOLOGY AND HYDROLOGY

Two-Mile Mesa is formed by tributaries of the northern branch of Pajarito Canyon. Area F is centered between the tributary canyons. It is at a distance of approximately 457 m (1500 ft) from either canyon and lies about 24 m (80 ft) above the canyon floors. Soil cover for the smaller site is approximately 0.6 to 0.9 m (2 to 3 ft) thick. For the larger area it is approximately 0.3 to 0.6 m (1 to 2 ft) thick.[illegible] The surface of the smaller site is level while the surface of the larger pit slopes gently north. Excavations at both sites are in the Tshirege Member of the Bandelier Tuff. A 1963 USGS report[illegible] notes that there is little indication of erosion over the smaller site; however, sheet erosion is evident near the larger site and a small wash has been cut at the west end of the site. *"Blocky tuff with no apparent joint pattern and a northward slope of less than 3 percent crops out between the fenced area* [larger site] *and the south fork of Two-Mile Canyon a few hundred feet north."*[illegible]

III. PIT DESCRIPTIONS

A. Background

May 13, 1946,[illegible] the Director of LASL wrote a memo to division and group leaders concerning a disposal pit at TD-site (see Fig. F-2). TD-site on the memo is crossed out, and Two-Mile Mesa is penciled in. Another penciled note says the pit was completed May 7, 1946.

B. Type of Waste.

No reliable information on the waste materials has been found to date. In 1952, J. Bolton, Assistant Director for Engineering, reported *"Dump F contains some alpha contamination but is essentially used for disposal of toxic compounds."*[illegible] The USGS reported in 1963[illegible] that there were beta-gamma emitters buried in Area F. In January 1973, D. Meyer of H-1 stated[illegible] that the burial pits contain a very small burial of equipment contaminated by ^{90}Sr and ^{137}Cs. In March 1974, R. Reider of H-3 said his sources of information indicate that the sites contain no radioactively contaminated material but that the smaller site does contain HE contaminated material and that the larger site may contain HE contaminated material.

C. Mode of Disposal

On Engineering Drawing ENG-R-4462, Area F is shown as two distinct sites. The smaller site is considered to have several pits within it. It approximates a square of 13.4 m (44 ft). The larger site is rectangular, approximately 10.7 m (35 ft) by 52.4 m (172 ft). After visiting Area F, the larger site appears to be 9.1 m (30 ft) by 118.3 m (385 ft).

IV. STUDIES AND MONITORING

None known. Area F was described in the 1963 USGS report "Geologic and Hydrologic Environment of Radioactive Waste Disposal Sites at Los Alamos, New Mexico."[30]

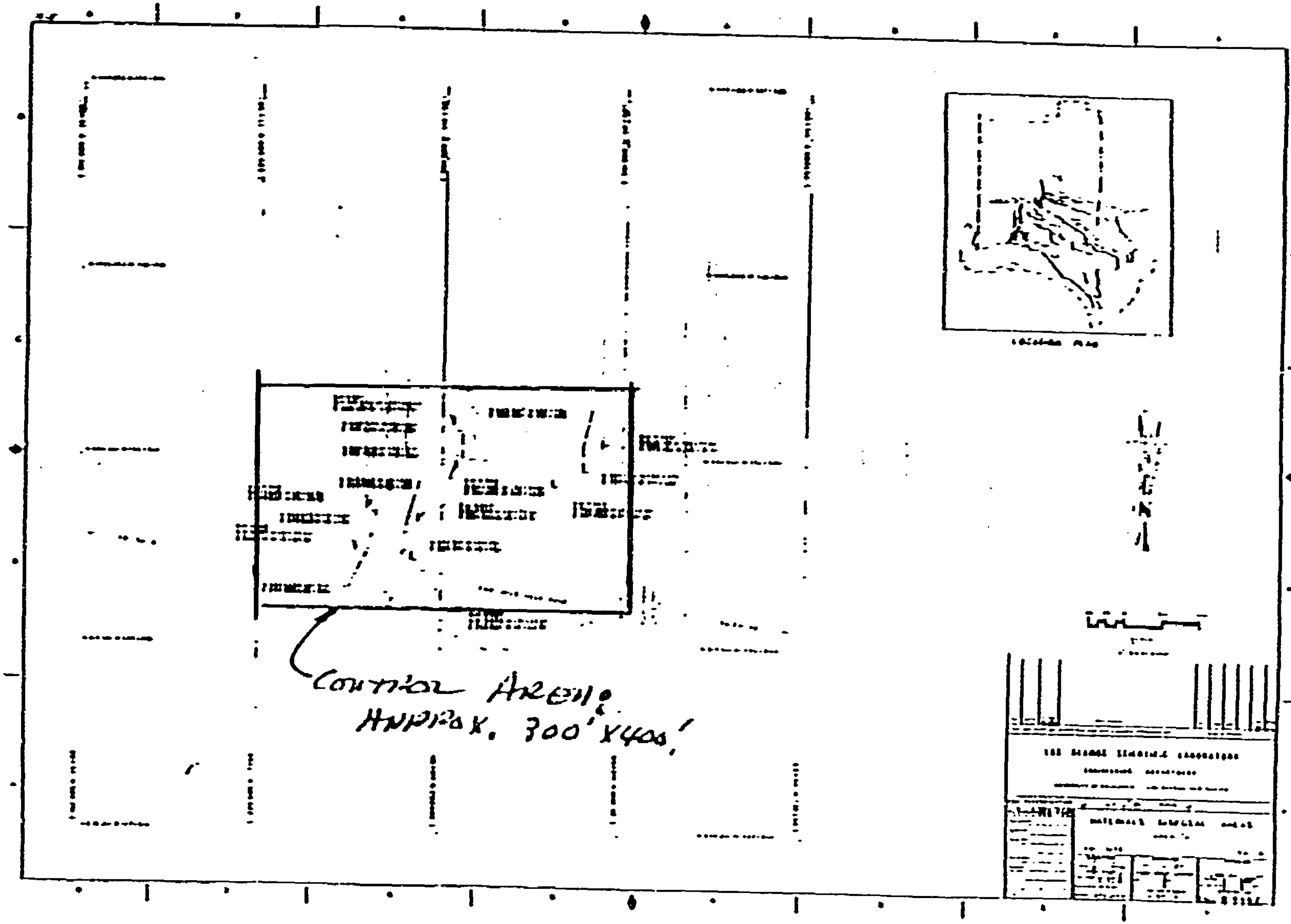
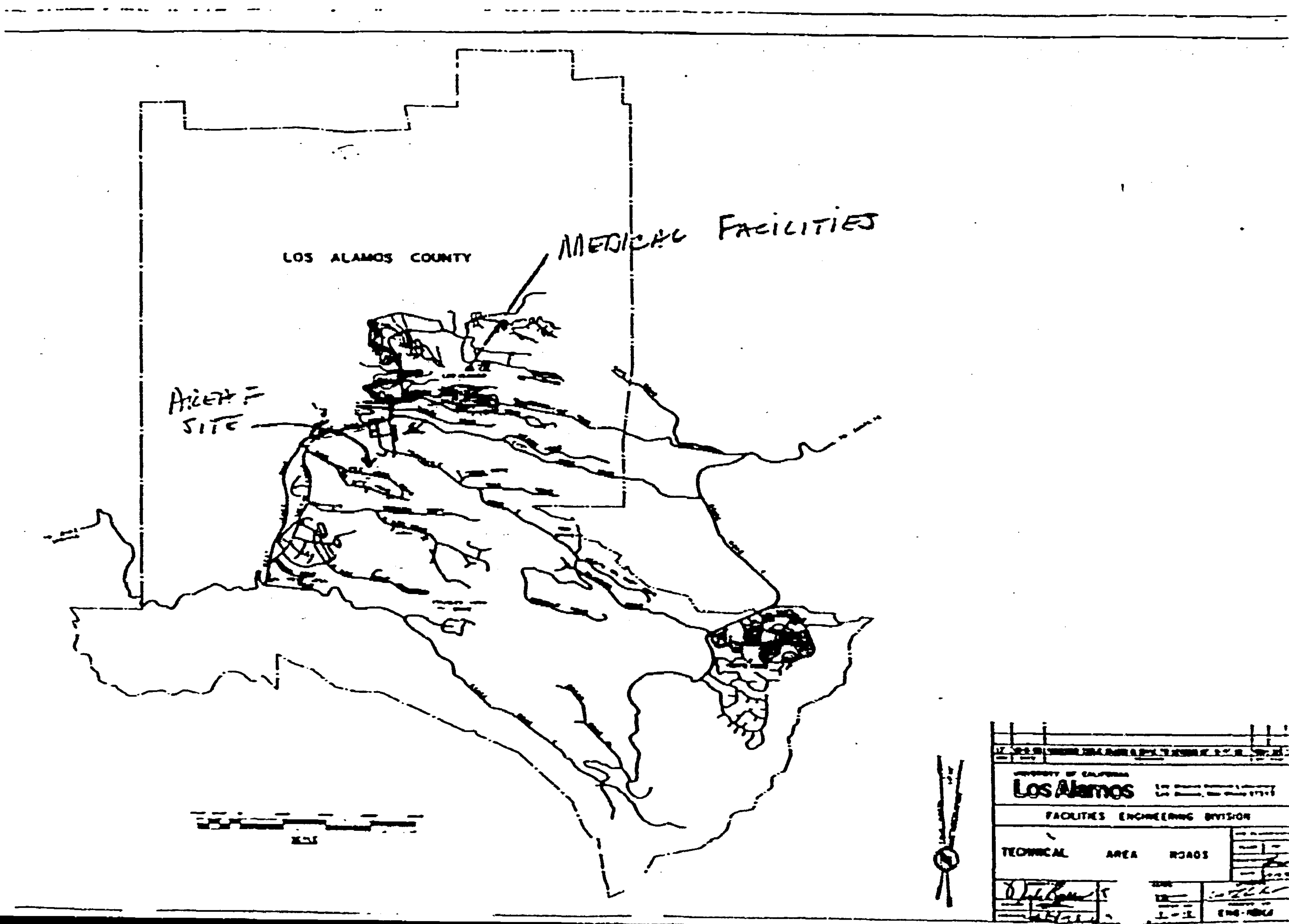


Fig. F-1.
Materials Disposal Area F, TM Site, TA-6.


LOS ALAMOS COUNTY
MEDICAL FACILITIES
AIRPORT SITE
UNIVERSITY OF CALIFORNIA
Los Alamos
FACILITIES ENGINEERING DIVISION
TECHNICAL AREA ROADS

APPENDIX B Data

B-1 Site Survey Data
Site Survey data is depicted as Figure 1, attached to this report.

B-2 Magnetometry Data

B-3 Ground Penetrating Radar Data
The Magnetometry Ground Penetrating Radar data have been transmitted under separate cover to LANL.

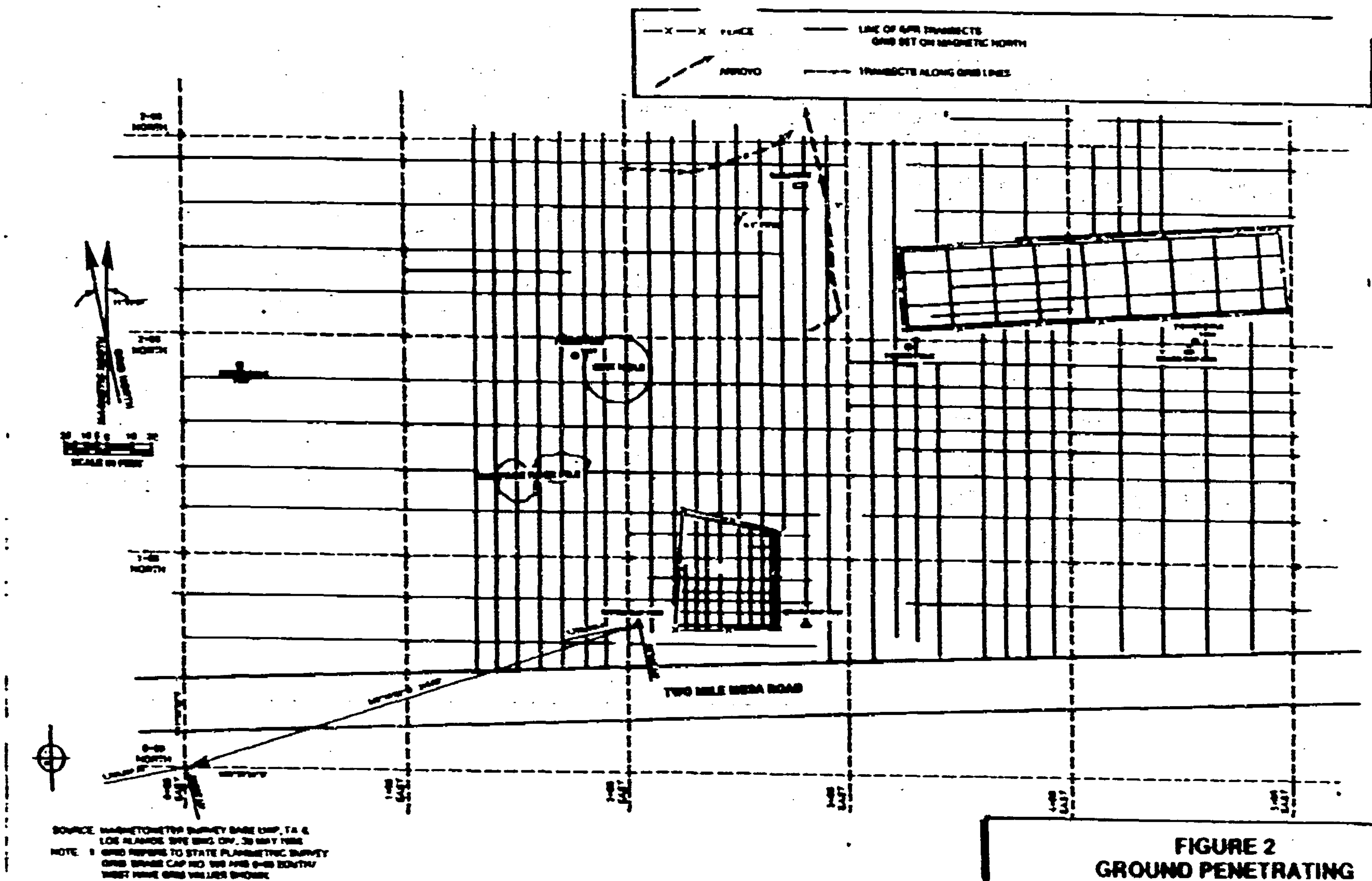
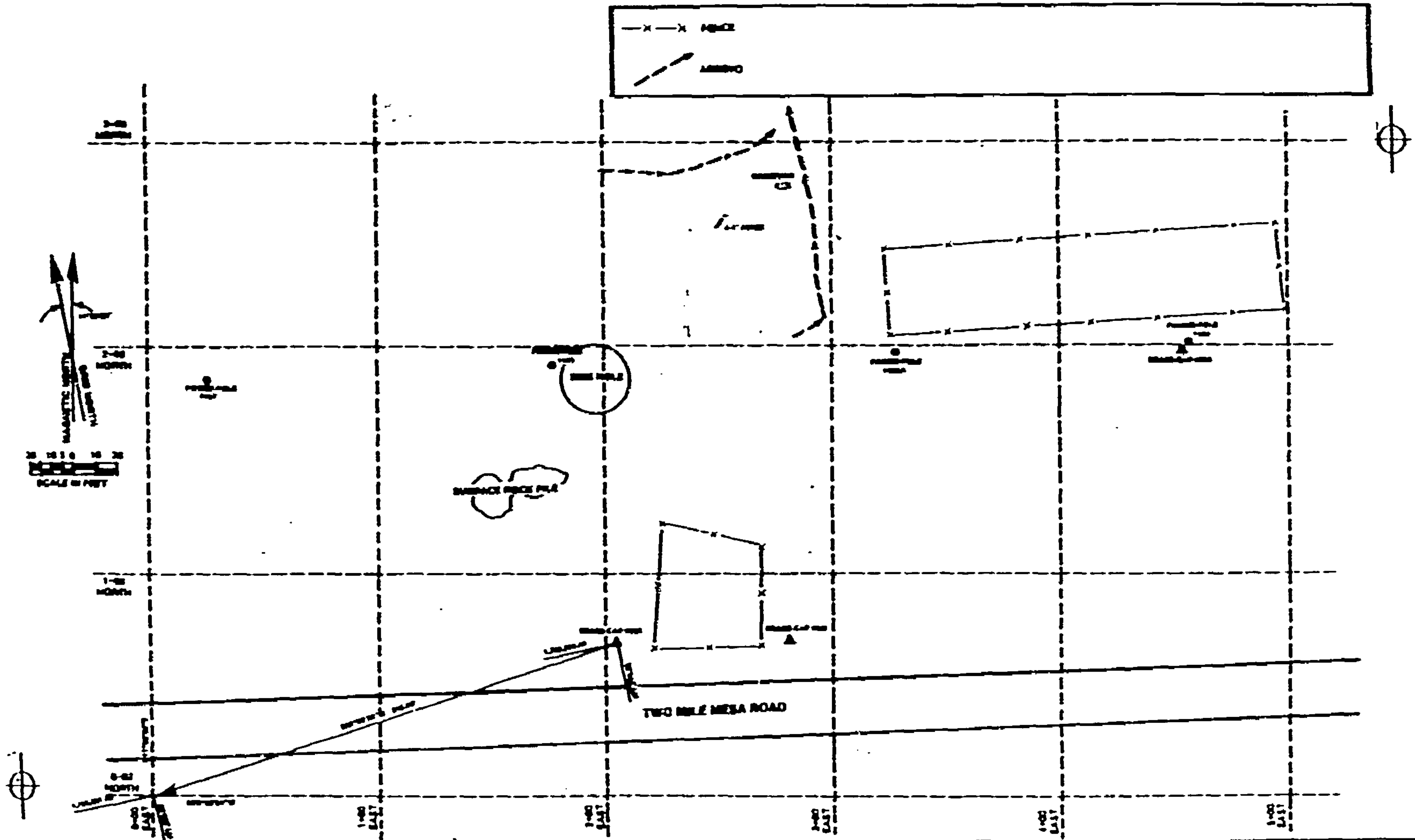


FIGURE 2
GROUND PENETRATING
RADAR GRID TRANSECTS



SOURCE: MAGNETOMETER SURVEY BASE MAP, TA 6, LOS ALAMOS SITE ENG. DIV., 30 MAY [illegible]

NOTE: 1. GRID REFERS TO STATE PLANIMETRIC SURVEY GRID. BRASS CAP NO. [illegible] AND 0+00 SOUTH/WEST HAVE GRID VALUES SHOWN.

FIGURE 1
SITE LOCATION MAP

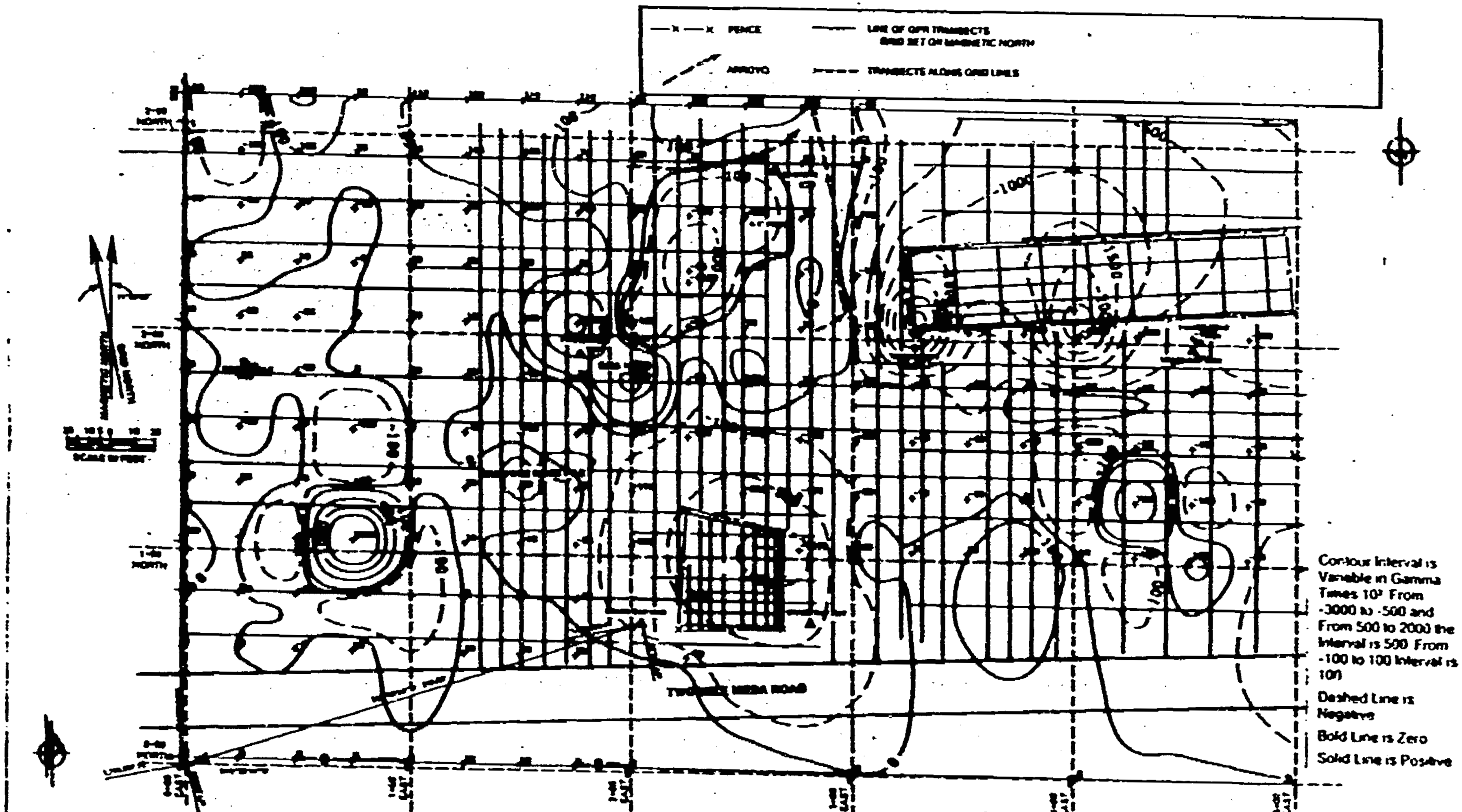


FIGURE 4
RAW MAGNETOMETER INTENSITIES AND CONTOUR PLOT

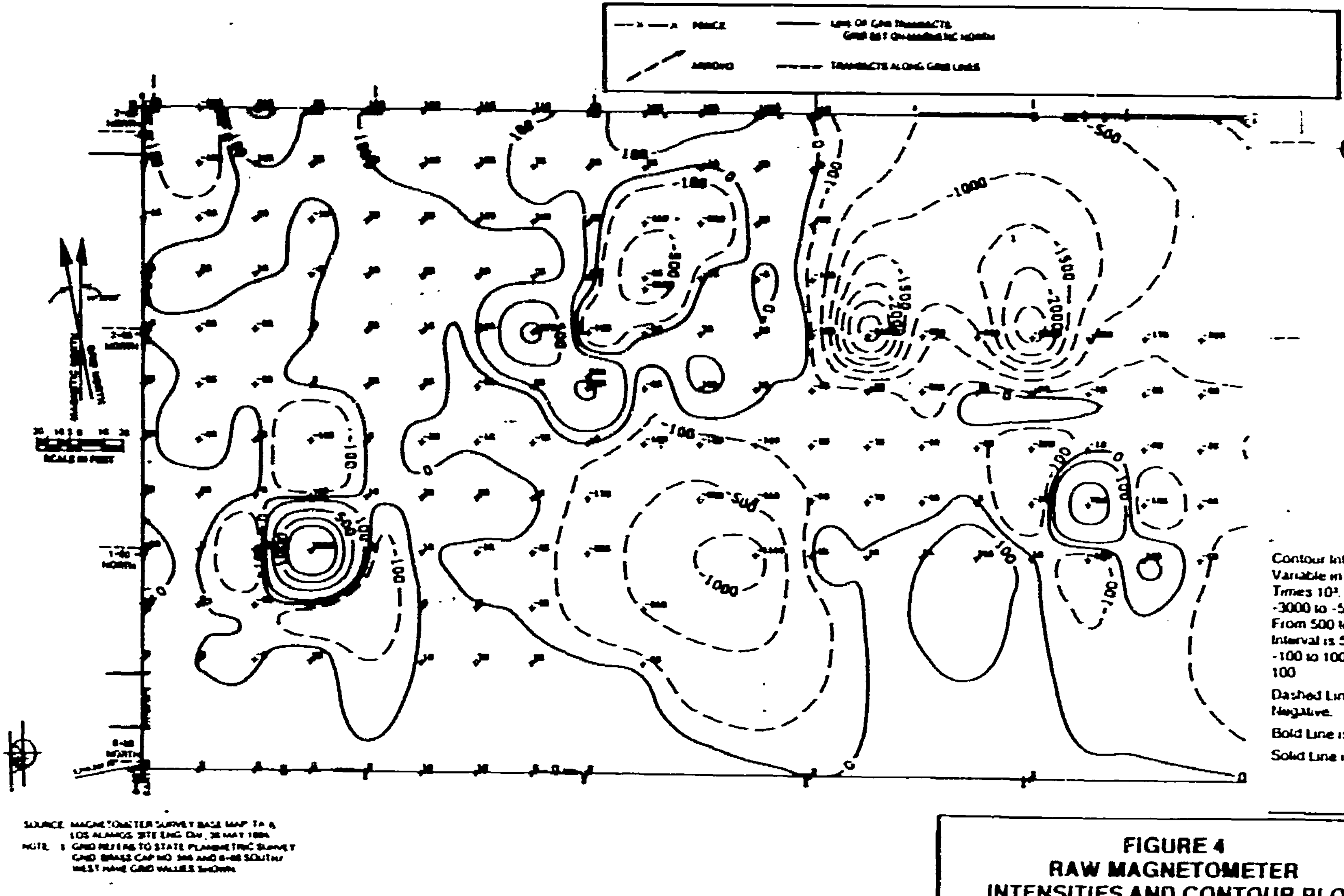


FIGURE 4
RAW MAGNETOMETER INTENSITIES AND CONTOUR PLOT

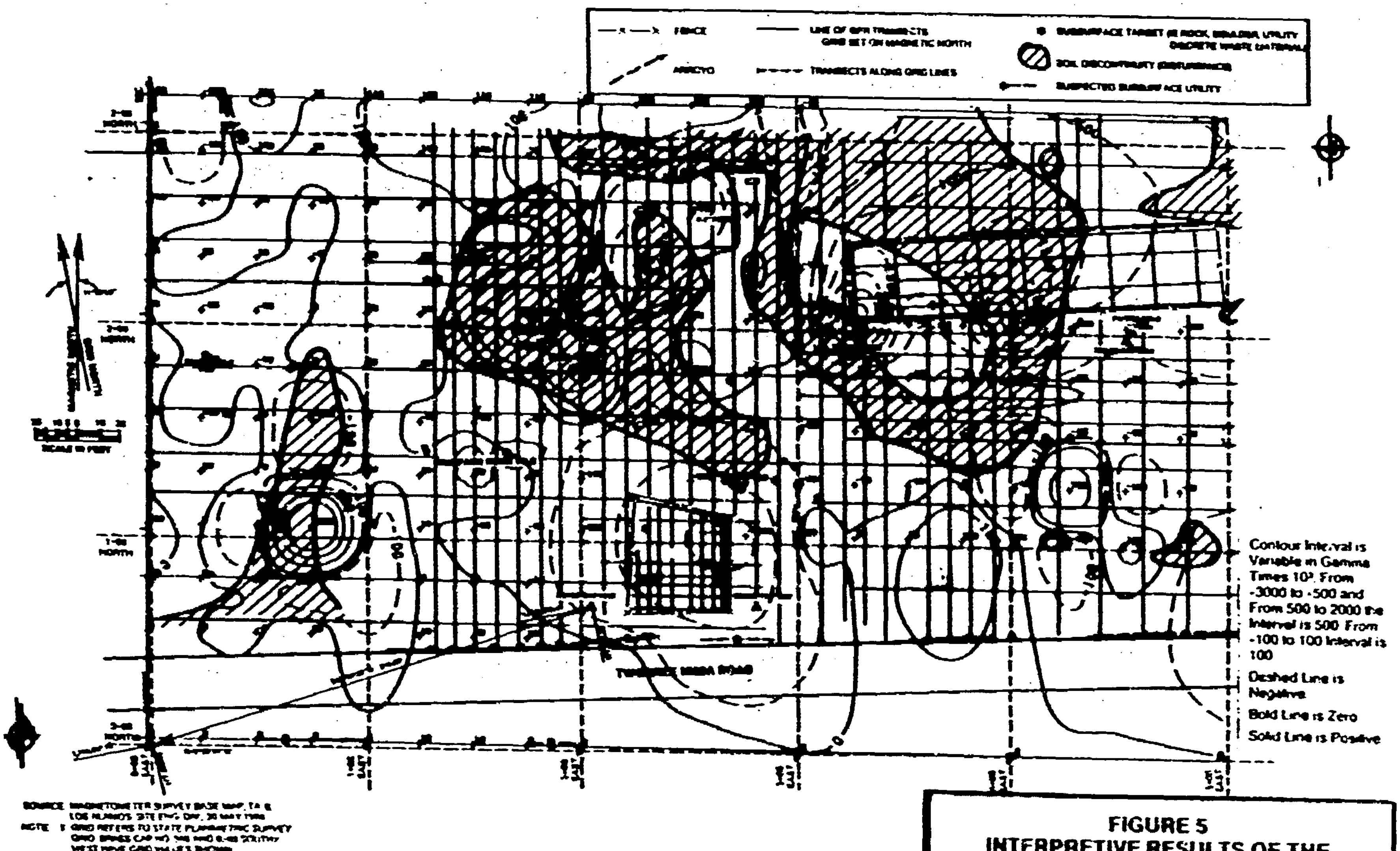


FIGURE 5
INTERPRETIVE RESULTS OF THE GROUND PENETRATING RADAR SURVEY

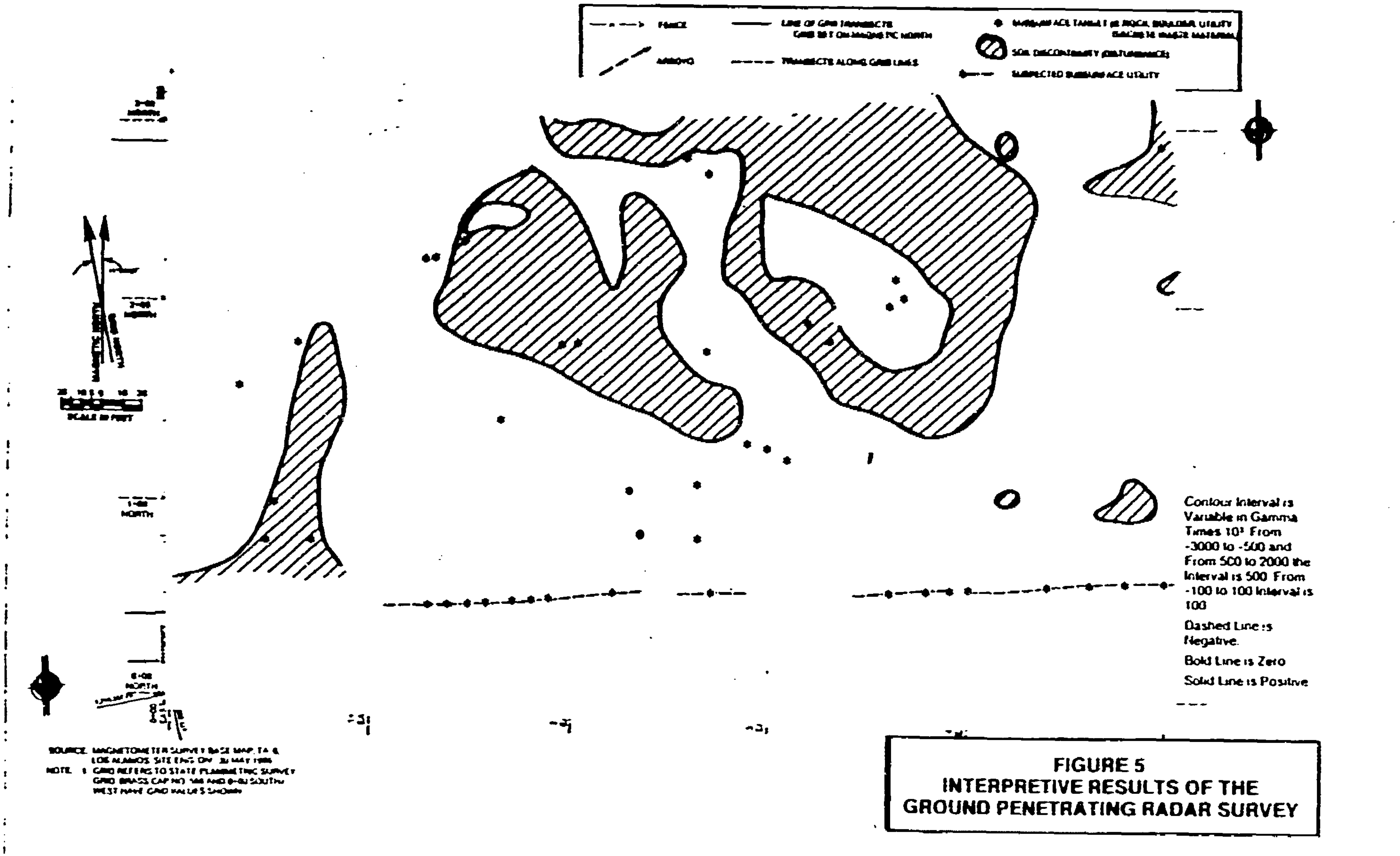


FIGURE 5
INTERPRETIVE RESULTS OF THE GROUND PENETRATING RADAR SURVEY

RECEIVED ...

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509) 375-3808
Telex 15-2874

January 14, 1987

Mr. Robert Voche
Environmental Surveillance
HSE-8, MS K490
Los Alamos National Laboratory
Los Alamos NM 87545

Dear Mr. Voche:

The enclosed document is a copy of a letter in which I comment on a draft report submitted by Roy F. Weston, Incorporated. Naomi asked that I send a copy to you because of her planned absence over the next few months.

Sincerely,

Gerald A. Sandness, Ph.D.
Senior Research Scientist
Electro-Optic Systems Section

GAS:klk

Enclosure

Battelle
Pacific Northwest Laboratories
P O Box 999
Richland, Washington 99352
Telephone (509) 375-3808
Telex 15-2874

January 13, 1987

Naomi Becker
Environmental Surveillance
HSE-8, MS K490
Los Alamos National Laboratory
Los Alamos NM 87545

Dear Naomi:

As you requested, I have reviewed a draft report submitted by Roy F. Weston, Incorporated.* This report describes ground-penetrating radar (GPR) and magnetic surveys performed at the Site F waste disposal area at the Los Alamos National Laboratory. These surveys were intended to detect and map waste burial trenches and other related subsurface features or objects which are believed to be located within the surveyed area. The draft report listed the geophysical survey instruments used in the surveys, briefly described the procedures used for data collection and analysis, and summarized the results of Weston's interpretation of the data as of mid-July, 1986. The draft report discussed the GPR survey but did not include copies of the GPR data. Consequently, my assessment of the GPR survey is based mainly on our brief examination of the original paper-chart data records during my visit to LANL last fall.

Some of the comments presented in the following paragraphs consist of questions that occurred to me as I read the draft report. Others relate to what seem to be possible problems with the survey procedures or with Weston's interpretation of the data.. Because I have not had an opportunity to study the final version of this report, I don't know whether any of these points are addressed there; however, it is my understanding that the final version does not differ greatly from the draft.

1) The GPR data were collected along parallel survey lines oriented in both the north-south and the east-west directions. The spacing of these lines was 10 ft over most of the site and 5 ft within the fenced areas. Given the fact that GPR data collection was essentially continuous along the survey lines, these parameters were consistent with the objective of

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* Draft letter report from J. A. Williams to Don Diego Gonzalez: Results of the Geophysical Investigation Conducted at Los Alamos Labs Facility, Los Alamos, New Mexico

locating relatively large deposits of waste materials. On the other hand, the line spacing was too large to permit reliable detection of moderate-sized individual objects. (The detection of individual objects was listed as an objective in the draft report.) It is not clear that a line spacing of less than 5 ft would be feasible at this site due to the presence of numerous trees.

2) Measurements of the magnetic field (vertical component) were made at 25-ft intervals in both the N-S and E-W directions. I believe that this data spacing is too large to be consistent with the objectives of this study. It would be more appropriate for a reconnaissance survey of a large site where large waste deposits are assumed to be present. In this case, it did not provide enough data to reliably detect individual objects or to adequately define the relatively small waste deposits that one would expect to find at this site. A 5-ft data spacing would have been more effective, particularly in adding needed detail to what turned out to be a rather generalized pattern of magnetic anomalies (see the attached map).

3) The effective (usable) depth penetration achieved by the radar unit at this site appears to be no more than two feet. Strong absorption of the radar signal was apparently caused by a high value of ground conductivity. This result was unfortunate given the low resolution and apparent complexity of the magnetic data. Good radar data at this site would be very helpful in defining trench or pit boundaries. Weston was perhaps a bit over-enthusiastic in describing the radar profiles as exhibiting good resolution and clearly defining subsurface features.

4) As you know, our examination of the radar profiles at your facility last fall resulted in the identification of an apparent problem with some of the radar data. Specifically, the reflection patterns obtained in orthogonal traverses of a given piece of ground were markedly different at locations in and around the larger of the two fenced areas. The differences seemed to be much greater than those which could be attributed to, say, the presence of linear reflectors with a consequent polarization-dependent reflectivity. It looked like there might have been a problem with mis-labeling the profiles.

5) The instrument used to perform the magnetic survey was a vertical-field flux gate magnetometer. The use of this type of magnetometer requires that care be taken in the orientation of the instrument in order to avoid erroneous readings. One assumes that care was taken, but no mention was made of the uncertainties associated with the data due to this factor.

6) The contour interval on the magnetic contour map was 100 gammas in the -100 to +100 gamma range and 500 gammas elsewhere. A smaller contour interval in, say, the -200 to +200 gamma range, might help to define the locations of some relatively small magnetic sources. On the other hand, the wide data spacing and uncertainty in the magnitude of the measurement errors lead one to question the significance of apparent low-amplitude anomalies.

7) Five minor (nit-picking?) comments:

   i) The use of the term "diamagnetic" is inappropriate when referring to negative magnetic anomalies. The term applies to materials which exhibit negative values of magnetic susceptibility, but not to a negative magnetic anomaly. The latter is a natural part of the dipolar field produced by a permanently magnetized object or by the magnetic polarization induced in a paramagnetic or diamagnetic object by an external (or ambient) magnetic field such as that of the earth. Except at the earth's magnetic poles, an induced magnetic dipole field will be tilted and will thus tend to exhibit a measurable negative component.

   ii) The zero magnetic contour level does not necessarily define areas of undisturbed ground (no buried materials) as stated on page 5 of the draft report. A zero contour level can occur as a result of the dipolar nature of a magnetic anomaly and as a result of the superposition of positive and negative components of multiple anomalies.

   iii) I assume that the "sinkhole" referred to in the report is a result of excavation or the collapse of buried materials rather than a sinkhole in the geological sense.

   iv) The linear magnetic anomalies referred to on page 7 do not exist on what I assume is the latest version of the magnetic contour map. (The raw data do not indicate the presence of such anomalies either.)

   v) Three of the (measured?) magnetic anomalies listed on page 7 are not shown on the contour map.

8) The magnetic contour map contains large areas where no data are shown. Were these areas inaccessible or otherwise difficult to survey?

9) The results of this study suggest that buried materials (possibly hazardous wastes) may be present outside the limits of the area surveyed so far, particularly on its west and north sides.

10) The fences enclosing the two areas presumed to be known waste disposal areas seemed to cause serious difficulties in both the radar and magnetic surveys. In the radar survey, the fences caused traverse lines to be truncated and repositioned, may have led to confusion in the labeling of certain traverse lines, and may have produced spurious reflections which could mask the desired signals. In the magnetic survey, the fences again caused problems with the traverse lines, but more importantly, produced large magnetic anomalies which may mask weaker anomalies associated with buried materials.

Concluding comments and recommendations:

This study has provided useful information relating to the possible locations of buried materials, some or all of which may be hazardous waste materials. On the other hand, I believe that it should be regarded as only a reconnaissance study because of the low-resolution character of the data and the consequent uncertainties in the identification of waste materials and the locations of those materials. Weston's recommendations for subsequent geophysical work at this site (page 10) are reasonable, but should probably be extended as follows:

i) The magnetic survey should be repeated with a much smaller data spacing. You now have a fast total-field magnetometer and a data recorder capable of rapidly collecting closely spaced magnetic data. This combination of instruments would greatly enhance the interpretability of the data and would eliminate uncertainties due to sensor orientation.

ii) An improved radar survey should be attempted. Better data might be obtained by scheduling the survey at a time when the ground has a minimum moisture content (to minimize absorption of the radar signal) and by utilizing digital data recording and processing techniques to enhance the quality of the data.

iii) Weston's results clearly indicate that the boundaries of the survey area should be extended. The extension should be sufficient to unambiguously enclose the area of possible waste deposition.

iv) The use of a ground conductivity meter such as the Geonics EM31 should be considered. This type of instrument may help to locate trench or pit boundaries.

v) The temporary removal of the fences at this site would substantially facilitate further geophysical measurements and would probably significantly improve the quality and interpretability of the collected data.

I hope that this review will be useful to you. Please feel free to call me if you would like to discuss this matter in greater detail.

Sincerely,

Gerald A. Sandness, Ph.D.
Senior Research Scientist
Electro-Optic Systems Section

GAS:klk

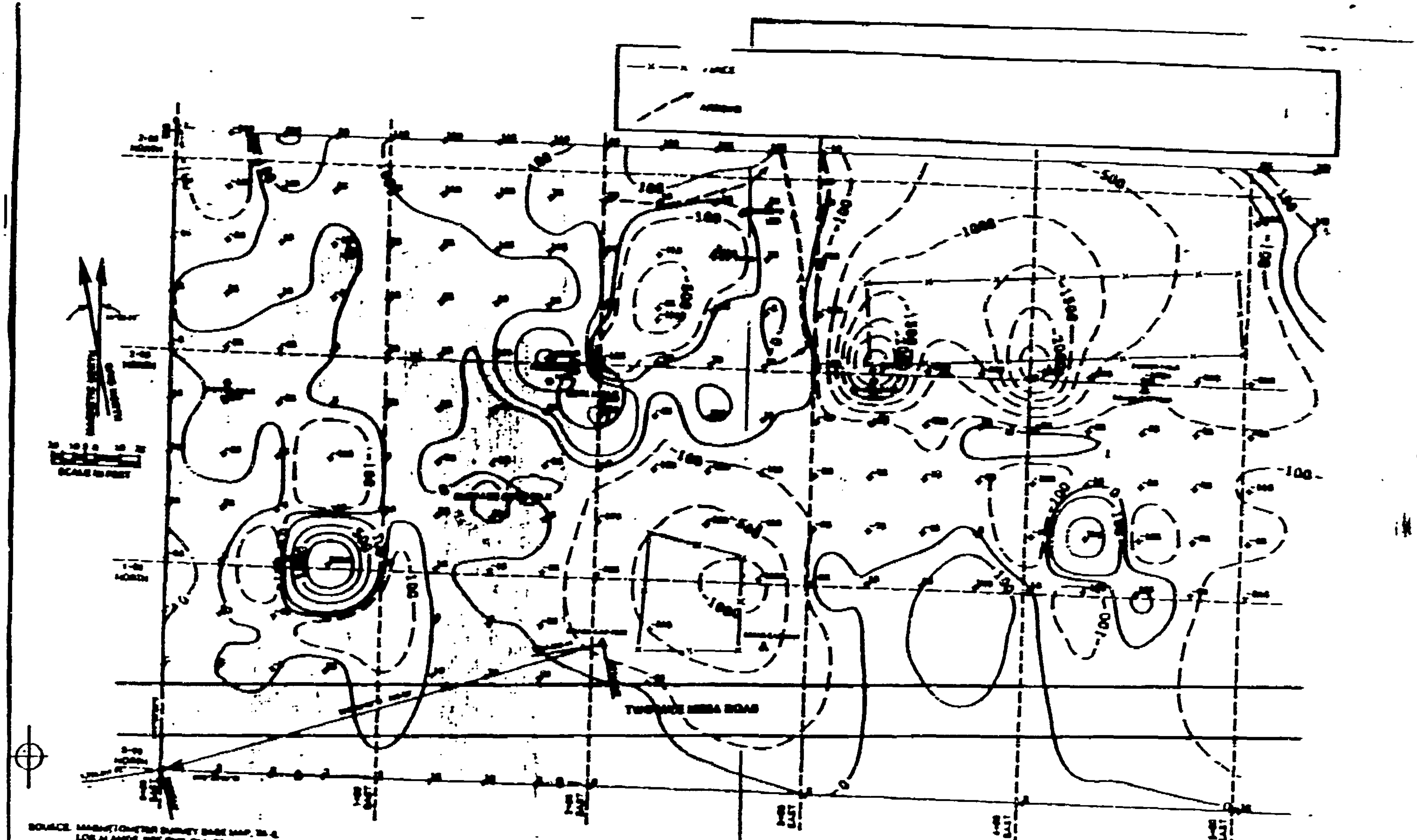


FIGURE 1
LOCATION MAP WITH MAGNETIC NORTH GRID.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

SPECIAL WORK PERMIT FOR POTENTIALLY HAZARDOUS ACTIVITIES

Requested By	Organization	Issue Date	Expiration Date
LYNN SCHOLL-FRITZ	HSE-5	6/11/86	6/16/86

Location of Work (Tech Area, Building, Room Number)
AREA F TA-6

Work to be Performed
SURFACE SURVEY OF GROUND AROUND AREA F TO PICK UP UNUSUAL/UNIDENTIFIED OBJECTS WORK TO BE PERFORMED BEFORE OUTSIDE CONTRACTOR PERFORMS GEOPHYSICAL SURVEYS

Identified Hazards
SCRAP HIGH EXPLOSIVES, UNEXPLODED DETONATORS, UNEXPLODED SQUIBS

PERSONNEL ASSIGNED

Name	Duties
LYNN SCHOLL-FRITZ	GROUND SURVEY
PATTY MAHONEY / ROGER GOLDIE	GROUND SURVEY / IDENTIFICATION
MARJORIE MARTZ	GROUND SURVEY

SEE ATTACHED LIST

SPECIAL CONTROLS

Safety Measures, Precautions, Personal Protective Equipment, Procedures, etc.

APPROVED BY

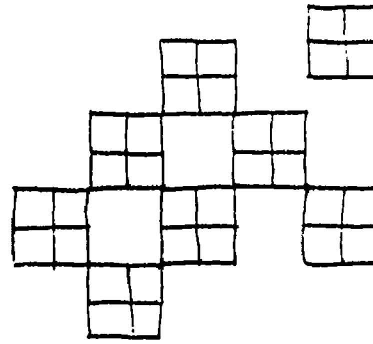
	Organization	Date
Supervisor		
Building Manager		
Others		

HS Form Number 1-38 (6/84)

GROUND SURVEY CREW

KENNETH REA
ROBERT VOCKE
EDDIE LUJAN

GEORGE TRUJILLO
GARY LANGHORST
LEO MARTINEZ
CAROLINE REYNOLDS



12:30

11

- CEARP

Wayne Lamoreaux

Max Roy

Bill [illegible]

Jim Caldwell - ABQ

UCRS - check

Sandia - notebook

Russell E. Duff - Carpenter Shop, 2 miles [illegible], 1956

Knight - Las, then NTS

Liz Marshall

Lynn Schoole - FM

~~Court approval~~ – (6/9/86)

- ~~Goldie~~
  Harry Haugh
  Tom Chandley
  Al Van Vessem
  Weston – statement of work
  Special Work permit

~~Pat — 6/9~~
~~Rogue – [redacted]~~
6/30

- July class – cancel
- Floyd Nichols – August

~~[illegible]~~ Tour

+ Livermore HRS
- Los Alamos HRS.
- Zia motor pool results follow-up.

+ Have painters scheduled 6/23 + bulletin board
✓ phone work also

Patty – 8511

PREPARATION, REVIEW, AND APPROVAL INSTRUCTIONS

1. The assigned operational supervisor of the proposed work shall complete this form.

2. The procedures for the review and approval of SWPs, given in Administrative Requirement 1-3, are as follows.

   - The assigned operational supervisor shall obtain approval of the proposed SWP from a higher level of authority before initiating the work.
   - The assigned operational supervisor also shall obtain approval *from the building manager* who reviews and approves SWPs *for* activities in or within 35 feet of the building.
   - The assigned operational supervisor shall determine (in concurrence with higher level of authority) whether HSE Division approvals are required.
   - When HSE Division approvals are required, the assigned operational supervisor shall submit this form to the appropriate HSE Division groups for review and approval.

3. Once all required approvals have been obtained, this permit shall be posted at the work site and shall be valid only for the dates indicated.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Roger Ferenbaugh, HSE-8, MS K490
Marjorie Martz, HSE-8, MS K490

DATE: May 23, 1986

FROM: Naomi M. Becker, HSE-8 NMB

MAIL STOP/TELEPHONE: K490/7-0818

SYMBOL: HSE8-86-594

SUBJECT: PRELIMINARY FY86 WORK PLAN FOR LOS ALAMOS CEARP - GEOPHYSICS

Per your request in memo HSE8-86-527, the following summarizes a work plan for geophysics for the remainder of FY86.

Purpose: To provide nonevasive techniques at former waste disposal areas to locate burial pits and grounds and buried objects.

Specific Objectives: To provide reconnaissance geophysical surveys in areas of known or suspect former waste burial for location purposes.

Anticipated Methods: Reconnaissance magnetic surveys will be performed.

Site Priorities: Area F at TA-6 is scheduled for A411 site stabilization activities this fiscal year. A magnetic survey on this site is desirable before any disturbance or addition of material. Area E at TA-33, which is also listed on the high priority list, will also be investigated.

Site	Activities	Time Frame
Area F	Grid survey by Zia Special work permit (SWP)	late May
	data collection, interpretation, program development, documentation.	June, July, early August
Area E	Grid Survey by Zia, SWP	early August
	data collection, interprettation, documentation.	Aug., Sept. possibly some FY87

Technical Support Requirements
Zia survey crew at each site
Outside Consultant - Gerald Sandness from PNL
Technician support - One Tech approximately 1/4 time
A Data Analyst intermittently if the data logger isn't ready - see contingencies.

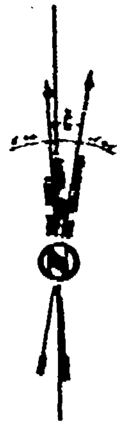
Cost Estimates	$K
Surveying at Area F	5
Surveying at Area E	5
Gerald Sandness 10 days @ $500/day	5
Computing	7
Travel	2

Contingencies
The following program is based on the assumptions that: 1) the control unit for the HSE-8 magnetometer will be ready for use on June 2, 1986 and 2) the data logger for the HSE-8 magnetometer will be ready for use on June 2, 1986. If there is no magnetometer, I will try to borrow one from ESS-3 to use in the interim. If there is no data logger, then all data will need to be hand recorded. In either event, the use of a data analyst will be required to enter all data into the CCF computer system. This will probably increase the time allotted for data collection.

NMB:tp

Cy: R. Vocke, HSE-8, MS K490
A. Stoker, HSE-8, MS K490

OFFICIAL USE ONLY



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[illegible]	[illegible]	LABORATORY
[illegible]	[illegible]	LABORATORY & OFFICE BUILDING
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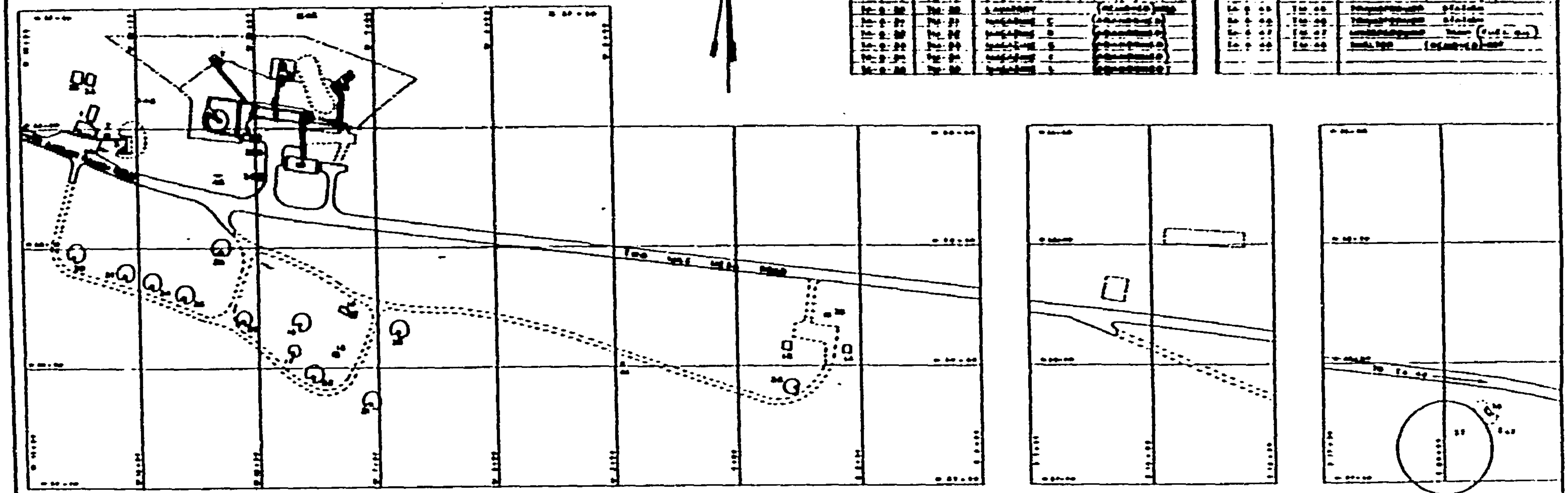


LOS ALAMOS SCIENTIFIC LABORATORY

UNIVERSITY OF CALIFORNIA

STRUCTURE LOCATION PLAN

TA-6 TWO MILE MESA SITE

ENG-R 120

OFFICIAL USE ONLY

OFFICIAL LABORATORY VISITOR REQUEST
(For Security Areas)

Los Alamos
Los Alamos National Laboratory

Date(s) of proposed visit: 6-12-86

TO	VISITOR ASSISTANCE OS - 1 Mail Stop - B236	FROM	Requester Alan K. Stoker Group HSE-8 M/S K490

PART I

A. Full name(s) of visitor(s)	Organization	Citizenship
William C. Mason	Roy F. Weston	U.S. 517-38-5488

B. Locations to be visited

Stations	TA	Building(s)	Room(s)
~~492~~ 502	TA-8	TA-8-~~21~~	Conference Room
JLS 6/12/86		JLS 6/12/86	
per Van Hecke		per Van Hecke	

C. Escorts listed below and members of the Protective Force are the only people authorized to escort visitor(s) listed in A above. Escorts must be fully aware of their responsibilities to prevent access in any manner to classified information, documents, material, or diversion of unclassified SNM.

Name of escorts	Group	Name of escorts	Group
Lynn Scholl-Fritz	HSE-8		

D. Purpose of visit
To attend a briefing on explosive safety hazards in the field

E. Indicate (x) type(s) of security interests in the building(s) to be visited
☐ Classified Documents ☐ Classified Material ☐ Unclassified SNM

F. If visit involves access to areas under the jurisdiction of others, are they aware and concur?
☐ Yes ☐ No Frank Jackson M-DO

OS-4 signature (if CCF access is needed)

Typed or printed name and signature of individual giving approval
Frank Jackson

PART II I certify that the visit is required for official purposes, is necessary to the performance of Laboratory programs and that the visit will be accomplished without unauthorized access. (Signature of Assistant Group Leader or above)

Signature of requesting official	Telephone	Group	Date
[signature] Assoc. G.L.	7-5021	HSE-8	6/10/86

PART III I certify that the visit can be accomplished without access to classified or other unauthorized information.

OS authorized signature	Date
Kenneth Van Hecke	6/10/86

Form No. 884 (8/82) ST - 2725

FORWARD ALL COPIES OF COMPLETED FORM TO THE LABORATORY'S OS OFFICE. DISTRIBUTION WILL BE MADE BY THE SECURITY OFFICE AFTER APPROVAL.

COPY 1 - REQUESTING OFFICIAL

[illegible] REQUEST

SR 48541 D

(No. P.O. Box for Address) (Entire Form To be Completed By Author, Except Where Indicated)

DATE June [illegible]

Consignee: Roy F. Weston, Inc. Attn: John A. Williams

Telephone: (215) 692-[illegible]

Street Address: One Weston Way

City / State: [illegible], Pennsylvania

Zip Code: [illegible]

ITEM	QUAN.	DESCRIPTION	PROPERTY NO. OR STOCK NO.	UNIT COST	TOTAL COST
		FEDERAL EXPRESS			
		Structure Location Plans			
		Utility Location Plans			
		aerial photographs (with copies),			
		a topographic map, and			
		a copy of an Environmental Surveillance Group			
		internal memo with an oblique aerial photograph.			
		REQUESTED ROUTING / SPECIAL INSTRUCTIONS: FEDERAL EXPRESS			
				TOTAL	

REASON FOR SHIPMENT: mutual interest [illegible] W9545-1

WARNING: It is a Federal offense to [illegible] shipping regulations.

IF [illegible] PUT A "?" [illegible] FOLLOWING, IF ANSWER IS YES.

U. OF C. [illegible]

CONSIGNED [illegible] COMPRESSED GASES

PREPAID X [illegible] FLAMMABLE

LOAN [illegible] AGENTS

REPAIR [illegible] MATERIAL

[illegible] MATERIAL

[illegible] PEROXIDE

[illegible] CLASSIFICATION

PICK UP [illegible] CLASSIFICATION

HSE-8 will [illegible]

[illegible]

GROUP MAT - 2

GROUP [illegible]	[illegible]
HSE-8	5706

S.M. NO.	DATE	NO. [illegible]	[illegible]	[illegible]	PACKED BY

FORM 796 (11/81)

COPY NO.1 SHIPPING OFFICE FILE

SHIPPING REQUEST

SR 48541D

(No. P.O. Box for Address)

(Entire Form To be Completed By Author, Except Where Indicated)

DATE June 25, 1986

Consignee Roy F. Weston' Inc. Attn: John A. Williams Telephone: (215) 692-3030 Ext. 389

Street Address One Weston Way

City / State Westchester, Pennsylvania Zip Code 19360

ITEM	QUAN.	FEDERAL EXPRESS DESCRIPTION	PROPERTY NO. OR STOCK NO.	UNIT COST	TOTAL COST
		Structure Location Plans			
		Utility Location- Plans			
		aerial photographs (with copies),			
		a topographic map, and			
		a copy of an Environmental Surveillance Group internal memo with an oblique aerial photograph.			
		REQUESTED ROUTING FEDERAL EXPRESS SPECIAL INSTRUCTIONS			
				TOTAL	

REASON FOR SHIPMENT

WARNING: It is a Federal offense to knowingly or unknowingly violate hazardous materials shipping regulations.

IF SHIPMENT IS COLLECT, PLEASE CALL VENDOR FOR SHIPPING INSTRUCTIONS.

U. OF C. LABORATORY P.O. No.

CONSIGNEE'S P.O. #

PREPAID ____ COLLECT ____ FOLLOW UP ____

LOAN ____ HOW LONG ____ RETURN OF LOAN ____

REPAIR ____ OTHER ____ PERMANENT TRANSFER ____

IF NOT SURE, PUT A "?"
COMPLETE ALL OF THE FOLLOWING, IF ANSWER IS YES, DESCRIBE ABOVE

RADIOACTIVITY ____
EXPLOSIVES A ____ B ____ C ____
COMBUSTIBLE LIQUID ____
BLASTING AGENT ____
POISON A ____ B ____
FLAMMABLE LIQUID ____
FLAMMABLE SOLID ____
OXIDIZER ____
CORROSIVE LIQUID ____
COMPRESSED GASES ____
FLAMMABLE ____

COMPRESSED GASES -
NON-FLAMMABLE ____
ETIOLOGICAL AGENTS ____
MAGNETIZED MATERIAL ____
IRRITATING MATERIAL ____
ORGANIC PEROXIDE ____

SECURITY CLASSIFICATION OF MATERIAL ____
SECURITY CLASSIFICATION OF THIS SR ____

COMPLETE THE FOLLOWING:

PICK UP ABOVE MATERIAL FROM: HSE-8 will deliver to SM-30

PERSON ____ PHONE ____

GROUP OR STOCKROOM ____

SITE ____ BLDG. ____ ROOM NO. ____

PICK UP DATE ____ TIME ____

DELIVERY DATE REQUIRED Federal Express Overnite Del.

VALUE ____

CREDIT

GROUP NAME	ACCOUNT CODE

APPROVED [signature]

AUTHORIZED GROUP SIGNATURE [signature] X

PROPERTY REPRESENTATIVE ____

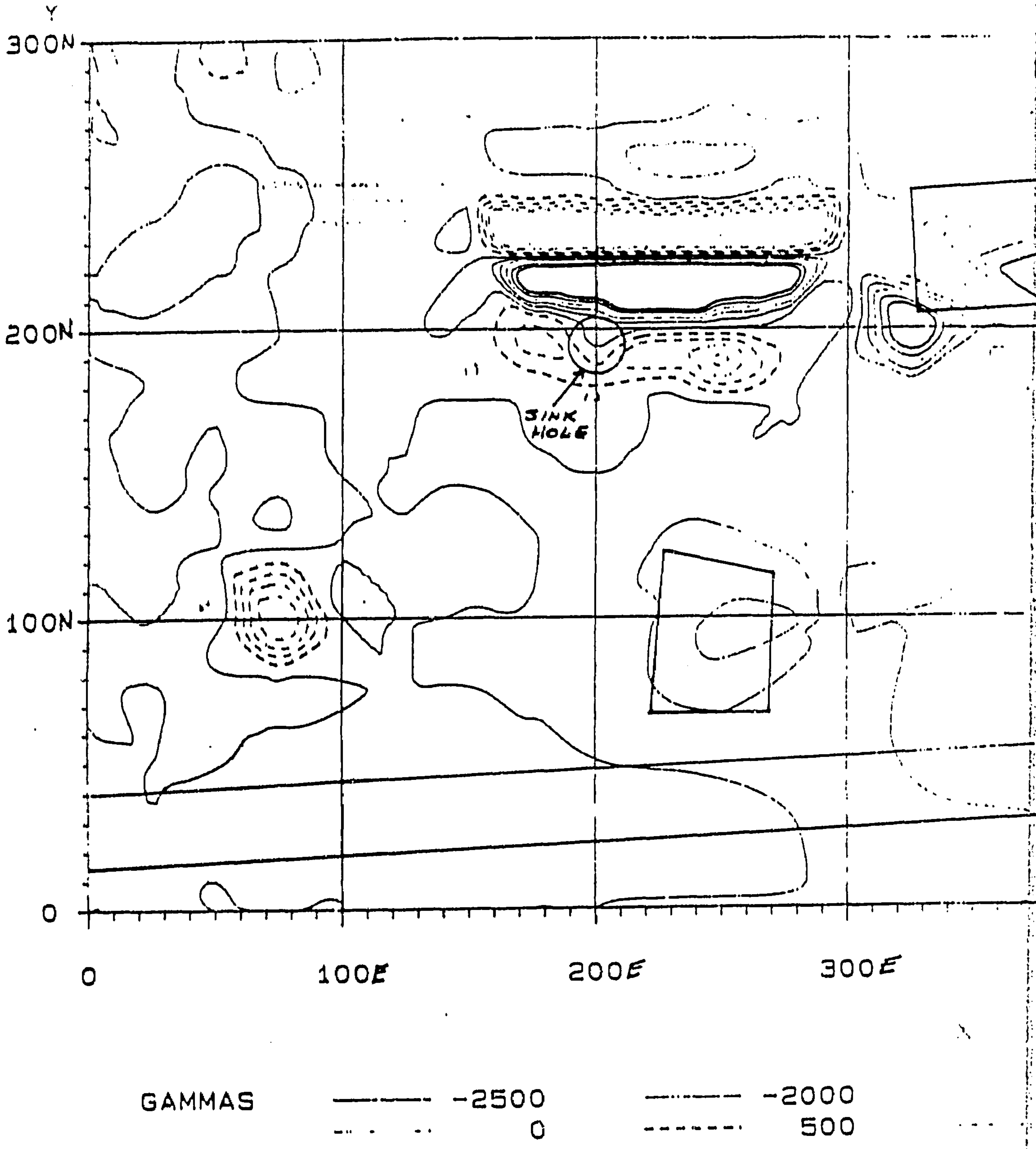
PROPERTY MANAGEMENT GROUP MAT - 2 ____

PROCUREMENT ____

INFORMATION BELOW TO BE COMPLETED BY GROUP MAT-14 ONLY

S.M. NO.	DATE	NO. PKGS.	WT.	DIMENSIONS	PACKED BY

LOS ALAMO



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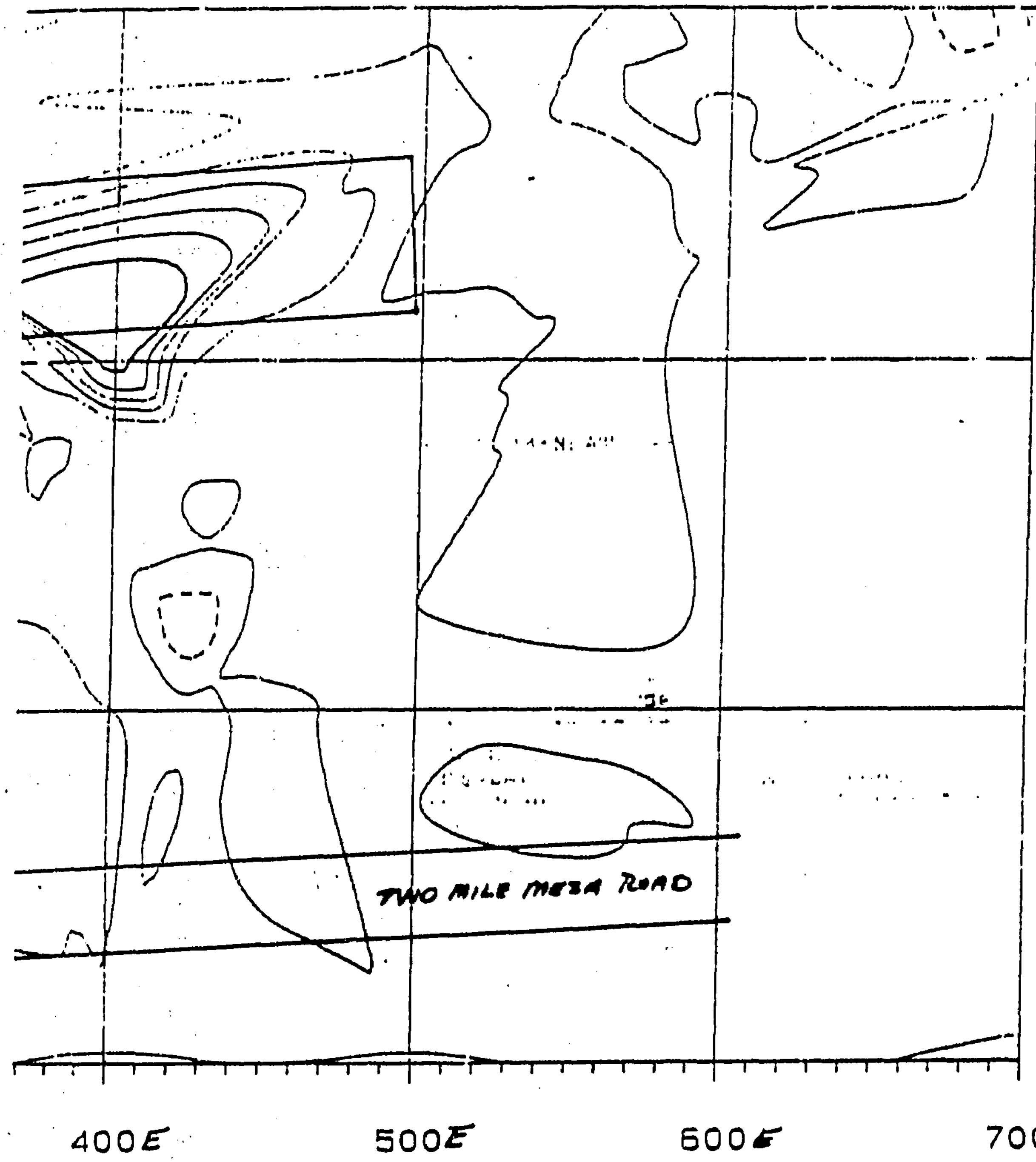

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Figure 3: Contour Plot of Magnetic