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Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Sandia National Laboratories, Albuquerque, New Mexico

Jerry L. Peace, Timothy J. Goering, and Michael D. McVey

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

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Jerry L. Peace, Timothy J. Goering, and Michael D. McVey
Site Closures Department
Sandia National Laboratories
P.O. Box 5800
Albuquerque, New Mexico 87185-1089

Abstract

In 1987, the Comprehensive Environmental Assessment and Response Program Installation Assessment determined a positive finding for Resource Conservation and Recovery Act-regulated wastes at the Mixed Waste Landfill. In 1990, a Phase 1 Resource Conservation and Recovery Act (RCRA) facility investigation determined that tritium had been released to the environment.

From 1992 to 1995, a Phase 2 RCRA facility investigation was conducted to investigate environmental impacts associated with disposal activities at the Mixed Waste Landfill. The facility investigation included surface radiological surveys; ambient air sampling; soil sampling for background metals and radionuclides; soil sampling for volatile organic compounds, semivolatile organic compounds, TAL metals, and radionuclides; nonintrusive geophysical surveys; passive and active soil gas sampling; borehole drilling; installation of groundwater monitoring wells; groundwater sampling; vadose zone tests; aquifer tests; and risk assessment. Tritium was confirmed as the primary contaminant of concern. Tritium levels range from 1100 picocuries/gram in surface soils to 206 picocuries/gram in subsurface soils. The highest tritium levels are found within 30 feet of the surface in soils adjacent to and directly below classified area disposal pits. Tritium also occurs as a diffuse air emission from the landfill releasing 0.294 Curies/year to the atmosphere.

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Executive Summary

[The Mixed Waste Landfill Phase 2 Resource Conservation and Recovery Act (RCRA) facility investigation report was submitted to the New Mexico Environment Department in September 1996 for technical review and comment. The report went through numerous review and comment response actions. The original report was revised based upon these review and comment response actions. The report was approved by the New Mexico Environment Department in 2002 and is published herein in its final technical format.]

The Mixed Waste Landfill is located approximately 5 miles southeast of Albuquerque International Sunport and 4 miles south of Sandia National Laboratories' central facilities. The landfill is a fenced, 2.6-acre compound in the north-central portion of Technical Area 3. Mean elevation is 5381 feet.

The Mixed Waste Landfill was established in 1959 as a disposal area for low-level radioactive and mixed waste that was generated at Sandia National Laboratories' research facilities. Originally, the landfill was opened as the "Area 3 Low-level Radioactive Dump," when the low-level radioactive dump in Technical Area 2 was closed in March 1959. The Area 3 dump accepted low-level radioactive waste and minor amounts of mixed waste from March 1959 through December 1988. Approximately 100,000 cubic ft of low-level radioactive waste containing approximately 6300 curies of activity was disposed of at the landfill.

The Mixed Waste Landfill consists of two distinct disposal areas: the classified area, occupying 0.6 acres, and the unclassified area, occupying 2.0 acres. Low-level radioactive and mixed waste has been disposed of in each area. Wastes in the classified area were buried in unlined, vertical pits. Wastes in the unclassified area were buried in unlined, shallow trenches.

A Phase 1 RCRA facility investigation was conducted in 1989 and 1990 to determine if a release of RCRA contaminants had occurred at the Mixed Waste Landfill and to begin characterizing the nature and extent of any such release. The Phase 1 facility investigation indicated that tritium was the primary contaminant of concern. No organic contaminants were identified. A Phase 2 RCRA facility investigation was initiated in 1992 to determine contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and recommend remedial action, if warranted, for the landfill.

The Phase 2 RCRA facility investigation incorporated the streamlining approach, combining data quality objectives and the observational approach. Nonintrusive field activities were conducted first to facilitate the efficiency and cost-effectiveness of intrusive field activities. Data collected during the Phase 2 RCRA facility investigation were evaluated using U.S. Environmental Protection Agency-approved methods. Initially, a constituent population was statistically compared to natural background. Any constituent failing the statistical comparison was further analyzed for spatial distribution. Constituents that failed the statistical comparison to background and showed a strong spatial correlation were identified as potential contaminants of concern.

After a constituent was identified as a potential contaminant of concern, the sample population was compared to RCRA-proposed Subpart S action levels and studied in a transport and risk assessment. Reasonable Maximum Exposure was used to assess risk. The basic risk assessment methodology defined by the U.S. Environmental Protection Agency was modified to include a quantitative uncertainty analysis technique.

The Phase 2 RCRA facility investigation was completed in 1995. The Phase 2 RCRA facility investigation consisted of surface radiological surveys; ambient air sampling; soil sampling for background metals and radionuclides; soil sampling for volatile organic compounds, semivolatile organic compounds, target analyte list metals, and radionuclides; nonintrusive geophysical surveys; passive and active soil gas sampling; borehole drilling; installation of groundwater monitoring wells; groundwater sampling; vadose zone tests; aquifer tests; and risk assessment. The Phase 2 RCRA facility investigation confirmed the findings of the Phase 1 RCRA facility investigation. Tritium is the primary contaminant of concern.

Tritium levels range from 1100 picocuries/gram in surface soils to 206 picocuries/gram in subsurface soils in the classified area of the landfill. The highest tritium levels are found within 30 feet of the surface in soils adjacent to and directly below classified area disposal pits. Below 30 feet below ground surface, tritium levels fall off rapidly to a few picocuries/gram of soil.

Tritium also occurs as a diffuse air emission from the landfill. A total of 0.294 curies/year is released from the landfill surface. The maximum radiological dose to an off-site receptor is 2.3×10^{-5} millirem/year due to vapor exposure to tritium. The maximum radiological dose to an on-site receptor due to combined soil and vapor exposure to tritium is 0.29 millirem/year.

A detailed risk assessment was conducted for the Mixed Waste Landfill, and the results indicate that the landfill will not affect human health or the environment under an industrial land-use scenario. Mixed Waste Landfill constituents present little risk either to groundwater or as air emissions to potential receptors. Due to its relatively short half-life of 12.3 years, tritium activities at the Mixed Waste Landfill will decrease steadily with time. Tritium activity at the landfill will decrease to approximately 10 percent of its original activity within 4 half-lives. The risk to human health and the environment due to natural radiological sources in the Albuquerque area is much greater than the risk posed by the Mixed Waste Landfill.

Based upon the results of the Mixed Waste Landfill Phase 1 and Phase 2 RCRA facility investigations, risk assessment, and the results of Mixed Waste Landfill groundwater monitoring, the Mixed Waste Landfill is recommended for no further action. The landfill should remain under institutional control with access restricted. Future groundwater monitoring at the Mixed Waste Landfill should focus on specific parameters for detection monitoring for contamination. Groundwater monitoring parameters should include volatile organic compounds, tritium, gross alpha/beta activity, and major ion chemistry.

Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
bgs	below ground surface
BH	Borehole
CFR	Code of Federal Register
Ci	curie(s)
CLP	Contract Laboratory Program
cm	centimeter(s)
cm^3	cubic centimeter(s)
COC	contaminant of concern
EDE	effective dose equivalent
EIFC	emission isolation flux chambers
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
°F	Fahrenheit
FID	flame ionization detector
FR	Federal Register
ft	foot (feet)
ft^2	square foot (feet)
ft^3	cubic foot (feet)
g	gram(s)
GC/MS	gas chromatography/mass spectrometry
gpm	gallon(s) per minute
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
hr	hour(s)
HSWA	Hazardous and Solid Waste Amendments
ID	identification
in.	inch(es)
IP	instantaneous profile
IRIS	Integrated Risk Information System
KAFB	Kirtland Air Force Base
K_{sat}	saturated hydraulic conductivity
KUMSC	Kirtland Underground Munitions Storage Complex
L	liter(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
MCLs	maximum contaminant levels
μg	microgram(s)
MDA	minimum detectable activity
min	minute(s)
mL	milliliter(s)
mm	millimeter(s)

mph	mile(s) per hour
mrem	millirem(s)
mS	milliSiemen(s)
mV	millivolt(s)
MWL	Mixed Waste Landfill
NESHAP	National Emission Standards for Hazardous Air Pollutants
ng	nanogram(s)
NMED	New Mexico Environment Department
OPs	Operating Procedures
PCE	Tetrachloroethene
pCi	picocurie(s)
PID	photoionization detector
PM_{10}	particulate monitor (10 micron)
ppb	part(s) per billion
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RETC	Retention Curve Code
RFI	RCRA facility investigation
RME	Reasonable Maximum Exposure
s	second(s)
SNL/NM	Sandia National Laboratories, New Mexico
SVOC	semivolatile organic compounds
SWMU	Solid Waste Management Unit
TA	Technical Area
TAL	target analyte list
TCA	1,1,1-trichloroethane
TCE	trichloroethene
UTL	upper tolerance limit
VOC	volatile organic compounds
WRS	Wilcoxon Rank Sum
yr	year(s)

Conversion Factors For Selected SI (Metric) Units

Multiply U.S. Customary Unit	By	To Obtain SI (Metric) Unit
Inches (in.)	2.54	Centimeters (cm)
Feet (ft)	0.304	Meters (m)
Miles (mi)	1.6	Kilometers (km)
Square feet (ft^2)	0.093	Square meters (m^2)
Acres	0.4	Hectares (ha)
Cubic feet (ft^3)	0.028	Cubic Meters (m^3)
Gallons (gal)	3.8	Liters (L)
Ounces (oz)	28.6	Grams (g)
Pounds (lbs)	0.45	Kilograms (kg)
Parts per billion (ppb)	1	Micrograms per kilogram (µg/kg)
Parts per million (ppm)	1	Milligrams per kilogram (mg/kg)
Fahrenheit (°F)	-32 x 5/9	Celsius (°C)

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1. Introduction

1.1 Background

Sandia National Laboratories, New Mexico (SNL/NM) is located within the boundaries of Kirtland Air Force Base (KAFB), immediately south of the city of Albuquerque in Bernalillo County, New Mexico (Figure 1.1-1). The Mixed Waste Landfill (MWL) is located 3.5 miles south of SNL/NM's central facilities and 5 miles southeast of Albuquerque International Sunport. The landfill is a fenced, 2.6-acre compound in the north-central portion of Technical Area (TA)-3 (Figure 1.1-2).

The MWL was first opened as the "Area 3 Low-level Radioactive Dump," when the existing low-level radioactive dump in TA-2 was closed in March 1959. The MWL was operated from March 1959 to December 1988 as the primary disposal site for SNL/NM technical and remote test areas involved in nuclear weapons research and development. Approximately 100,000 cubic feet (ft^3) of low-level radioactive waste and minor amounts of mixed waste containing approximately 6300 curies (Ci) of activity (at the time of disposal) were disposed of in the MWL. From 1989 to 1996, the southern unclassified area of the landfill was used for temporary, aboveground storage of containerized, low-level radioactive and mixed waste.

The MWL consists of two distinct disposal areas: the classified area, occupying 0.6 acres, and the unclassified area, occupying 2.0 acres (Figure 1.1-3). Wastes in the classified area were disposed of in unlined, vertical pits. Historical records indicate that early pits were 3 to 5 feet (ft) in diameter and 15 ft deep. Later pits were 10 ft in diameter and 25 ft deep. Once pits were filled with waste, they were backfilled with soil, allowed to settle, then capped with concrete. Wastes in the unclassified area were disposed of in shallow, unlined trenches. Records indicate that trenches were 15 to 25 ft wide, 150 to 180 ft long, and 15 to 20 ft deep. Trenches were partially backfilled with soil on a quarterly basis and, once filled with waste, capped with the excavated soils that had been stockpiled locally.

A detailed MWL waste inventory, by pit and trench, is provided in Appendix A. The inventory is based upon SNL/NM employee interviews and historical records. Containment and disposal of waste commonly occurred in tied, double polyethylene bags, sealed A/N cans (military ordnance metal containers of various sizes), fiberboard drums, wooden crates, cardboard boxes, 55-gallon drums, and 55-gallon polyethylene drums. Larger items, such as glove boxes, construction debris, and spent-fuel shipping casks, were disposed of in bulk without containment. Disposal of free liquids was not allowed at the MWL. Liquids, such as acids, bases, and solvents, were solidified with commercially available agents, such as Aquaset, Safe-T-Set, Petroset, vermiculite, marble chips, or yellow powder, before containerization and disposal.

Most pits and trenches contain routine operational and miscellaneous decontamination waste. Routine operational and decontamination waste included: gloves, paper, mop heads, brushes, rags, tape, wire, metal and polyvinyl chloride (PVC) piping, cables, towels, quartz cloth, swipes, disposable labcoats, shoes covers, coveralls, high-efficiency particulate air filters, prefilters, tygon tubing, watch glasses, polyethylene bottles, beakers, balances, pH meters, screws, bolts, saw blades, Kleenex, petri dishes, scouring pads, metal scrap and shavings, foam, plastic, glass, rubber scrap, electrical connectors, ground cloth, wooden shipping crates and pallets, wooden and lucite dosimetry holders, and expended or obsolete experimental equipment.

A Phase 1 Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) was conducted in 1989 and 1990 to determine if a release of RCRA contaminants had occurred at the MWL. The Phase 1 RFI indicated that tritium had been released to the environment. A Phase 2 RFI was conducted from 1992 to 1995 to determine contaminant source, define the nature and extent of contamination, identify potential contaminant transport pathways, evaluate potential risks posed by the levels of contamination identified, and provide remedial action alternatives for the landfill.

The Phase 2 RFI confirmed tritium as the primary contaminant of concern (COC). Tritium has been a consistent finding at the MWL since environmental studies were initiated at SNL/NM in 1969. Tritium occurs in surface and near-surface soils in and around the classified area of the landfill. Tritium levels range from 1100 picocuries (pCi) per gram (g) in surface soils to 206 pCi/g in subsurface soils. The highest tritium levels are found within 30 ft of the surface in soils adjacent to and directly below classified area disposal pits. Below 30 ft from the ground surface, tritium levels fall off rapidly to a few pCi/g of soil. Tritium also occurs as a diffuse air emission from the landfill, releasing 0.294 Ci/year (yr) to the atmosphere.

The MWL is designated as a Soils Contamination Area, a Radioactive Materials Management Area, and a Hazardous and Solid Waste Amendments (HSWA) Solid Waste Management Unit (SWMU), subject to final closure under state and federal regulations. The New Mexico Environment Department (NMED), the lead regulatory agency, will oversee formal closure of the MWL.

1.2 Resource Conservation and Recovery Act Facility Investigation Work Plan Overview and Objectives

MWL Phase 2 RFI field work was conducted in accordance with both the *Mixed Waste Landfill Phase 2 RCRA Facility Investigation Work Plan* approved in May 1995 (SNL/NM 1993) and the *Comment Responses to U.S. Environmental Protection Agency Notice of Deficiency* approved by the U.S. Environmental Protection Agency (EPA) in May 1995 (SNL/NM 1994a). The MWL Phase 2 RFI work plan incorporated a streamlining approach and an investigation strategy that included surface radiological surveys; ambient air monitoring; soil sampling for background metals and radionuclides; nonintrusive geophysical surveys; active and passive soil gas surveys; surface soil sampling for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), target analyte list (TAL) metals, and tritium; borehole drilling and subsurface soil sampling for VOCs, SVOCs, TAL metals, and radionuclides; vadose zone tests; aquifer tests; and risk assessment. The overall goal of the Phase 2 RFI Work Plan was to thoroughly investigate the environmental impacts associated with disposal activities at the MWL.

2. Environmental Setting

2.1 Climate

The climate of Albuquerque and vicinity, including SNL/NM, is one of high-altitude, dry continental-type weather. The normal daily temperature ranges from 23 degrees Fahrenheit (°F) to 52°F during winter months and from 57°F to 91°F during summer months. The average annual relative humidity is 46 percent. The relative humidity, however, can range from a low of 5 percent to a high of 70 percent.

The average annual precipitation for the Albuquerque area is 8.5 inches (in.). Monthly precipitation can range from a minimum of less than 0.5 in. during winter months to 1.5 in. during summer months. Average annual snowfall in the Albuquerque area is 11 in. Summer precipitation, particularly July through August, is usually in the form of heavy thundershowers that typically last less than 1 hour (hr) at any given location. Average annual pan evaporation at Albuquerque International Airport station 224 is 89 in. (U.S. National Weather Service 1982). Under normal conditions, wind speeds seldom exceed 32 miles per hr (mph) and are generally less than 8 mph. Strong winds, often accompanied by blowing dust, occur mostly in late winter and early spring. During these months, the prevailing surface winds are from the southwest. Rapid night-time ground-cooling produces strong temperature inversions and strong winds through mountain canyons.

2.2 Surface Features

There are no permanent structures at the MWL. All disposal pits and trenches were excavated below grade. The only visible surface features are the earthen berms above the unclassified area trenches and the security fences that surround the 2.6-acre compound. The MWL rests on an expansive, relatively featureless, arid mesa. Elevations at the MWL range from 5385 ft on the east to 5375 ft on the west. Mean elevation is 5381 ft.

2.3 Surface Water

Surface water at the MWL is rare. Surface run-off is regionally controlled and to the west. There are no natural run-off features or man-made surface run-off controls. Surface run-off flows from the landfill surface to dirt roads that surround the compound.

2.4 Geology

2.4.1 Regional Geology

The Albuquerque basin is one of the largest north-south trending basins comprising the Rio Grande rift. The basin is a complex trough measuring 90 miles long and 30 miles wide, bordered by major uplifted fault blocks to the east and minor uplifted fault blocks to the west. The eastern boundary is marked by the Sandia, Manzanita, and Manzano mountains. The western boundary is marked by the Lucero uplift, with the Ladron Mountains to the south and Nacimiento Mountains to the northwest.

Erosion and sediment transport from the surrounding uplifts has filled the Albuquerque basin with up to 14,000 ft of deposits that comprise the Santa Fe Group. The Santa Fe Group thins toward the basin edges and is truncated by the bounding uplifts. The Santa Fe Group is a diverse suite of alluvial gravel, sands, and silts, as well as fluvial sands, silts, and clays. As Santa Fe Group deposition ceased, probably within the last 1 million years, the current Rio Grande began incising its present fluvial channel.

2.4.2 Site-Specific Geology

The MWL is underlain by approximately 50 ft of post-Santa Fe Group alluvial gravel, sand, and silt followed by Santa Fe Group deposits at depth. These collective deposits are characterized by great internal variability. Detailed correlations of individual lithologic units between monitoring wells and boreholes is difficult. In general, Santa Fe Group deposits decrease in average grain size with depth.

2.5 Groundwater Hydrology

2.5.1 Regional Hydrology

The Rio Grande is the major surface hydrologic feature in the Albuquerque basin. The Rio Grande lies approximately 8 miles west of the MWL. The regional groundwater table occurs in the unconsolidated gravels, sands, silts, and clays of the Santa Fe Group. The water table is generally unconfined, although semiconfined conditions may exist locally because of discontinuous silt and clay deposits.

At KAFB, regional groundwater flows westward toward the Rio Grande at an average gradient of approximately 0.002. Local perturbations in the water table occur due to pumping wells and lithologic and structural controls. Before development of the regional aquifer by the City of Albuquerque and KAFB occurred, the predominant groundwater flow direction in the KAFB area was southwest (Bjorklund and Maxwell 1961). Subsequent pumping by the City of Albuquerque and KAFB profoundly modified the natural groundwater flow regime (Reeder et al. 1967, Kues 1987) creating a trough in the water table in the western and northeastern portion of KAFB.

2.5.2 Local Hydrology

Groundwater at the MWL lies approximately 500 ft below ground surface (bgs) in unconsolidated Santa Fe Group deposits. Groundwater recharge occurs by infiltration of precipitation from the mountains to the east. Recharge from infiltration of precipitation at the MWL is negligible due to high evapotranspiration, low precipitation, and dry Santa Fe group deposits. MWL groundwater monitoring records indicate that groundwater is declining an average 0.81 ft/yr. Additional information on the groundwater hydrology at the MWL is presented in Section 5, Groundwater Monitoring.

3. Sampling and Analysis

MWL Phase 2 RFI sampling and analysis followed standard EPA procedures for sample collection (EPA 1987a), quality assurance (QA)/quality control (QC) (EPA 1980, 1987b), and statistical analysis (EPA 1992). Each is discussed in detail in the following sections.

3.1 Field Methods

MWL assessment and characterization followed the phased approaches proposed in the MWL Phase 2 RFI Work Plan (SNL/NM 1993). Protocols for sampling and analysis followed the procedures outlined in the Environmental Restoration (ER) Project Quality Assurance Project Plan and Operating Procedures (OPs) developed specifically for the ER Project Implementation Plan (SNL/NM 1995 and subsequent revisions). A complete list of OPs implemented during the Phase 2 RFI is provided in Table 3.1-1. Although much of the field work was conducted prior to formal issuance of SNL/NM ER Project OPs, activities were conducted in accordance with generally accepted practices and professional experience and judgment, which formed the basis of ER Project OPs. All field work followed task-specific Health and Safety Plans.

3.2 Analytical Data Evaluation

MWL Phase 2 RFI analytical data were reviewed to determine whether an analyte was present as a contaminant. This involved a statistical comparison to local background coupled with an examination of the analyte's spatial distribution (Section 3.4). Initially, an analyte's distribution type was determined and then, using the distribution results, data indicating contamination was compared to local background using EPA-approved methods. Any analyte failing the statistical comparison to background was further examined for spatial distribution. Analytes that failed the statistical comparison to background and showed a strong spatial correlation were identified as a potential COC. Once an analyte was identified as a potential COC, the sample population was compared to EPA RCRA-proposed Subpart S (55 Federal Register [FR] 30865) action levels and evaluated for potential transport mechanism and risk assessment (Section 7).

3.3 Quality Assurance/Quality Control

All MWL Phase 2 RFI assessment and characterization activities followed strict QA/QC protocols. These protocols governed the collection of appropriate field QC samples, including equipment blanks, method blanks, duplicate samples, matrix and matrix spike duplicate samples, and trip blanks. QA/QC samples accounted for no less than 5 percent of all samples collected during the MWL Phase 2 RFI.

QA/QC samples proved invaluable in the evaluation of VOC and SVOC analytical results. Common laboratory contaminants, such as methylene chloride, acetone, 2-butanone, and bis-2(ethylhexyl) phthalate, were frequently identified in both field and QC samples. The occurrence of these compounds in method blanks, trip blanks, and equipment blanks is attributed to laboratory contamination.

QA/QC procedures employed during the Phase 2 RFI also included verification and validation of the analytical results according to guidelines from Administrative Operating Procedure 94-27 (SNL/NM 1994b). Verification and validation procedures are employed to ensure contract compliance and to meet standards of conduct that exist throughout the environmental industry. These procedures include the review of chain-of-custody, extraction and sample holding times, equipment rinsate, method and trip blank results, comparison of duplicate samples, use of data qualifiers, and data defensibility and usability.

3.4 Statistical Analysis of MWL Background

As part of the Phase 2 RFI, a statistical analysis of MWL background values for metals and radionuclides was performed. The methodology and analysis of results are summarized in the following sections. The purpose of the MWL background analysis was to determine the concentrations of metals and radionuclides that occur naturally in the MWL area. In June 1994, 10 holes were drilled with a 5-in.-diameter, solid-stem auger in undisturbed surface soils 600 ft west of the MWL (Figure 3.4-1). Two soil samples were obtained from each hole: one at 6 ft bgs and one at 12 ft bgs. Analyses were conducted on each sample for TAL metals, gross alpha/beta activity, gamma spec, strontium-90, isotopic uranium, isotopic thorium, isotopic plutonium, and tritium.

3.4.1 Background Concentration Determinations

To determine the upper range of expected background concentrations, the 95th upper tolerance limit (UTL) and 95th percentile were calculated for parametric and nonparametric data sets, respectively. The sequential steps used to determine MWL background concentrations were as follows: 1) *a priori* screening of the data; 2) determination of the percentage of nondetects in the data sets, with a cut-off level of 15 percent nondetects; 3) distribution analysis of the portion of the data set that exhibited less than 15 percent nondetects, including coefficients of skewness, histograms, and Shapiro-Wilk probability plots; 4) a second screening of the data performed by the calculation of the T_n statistic for parametric data; and finally 5) calculation of the UTL for parametric data sets or the 95th percentile for nonparametric data sets.

3.4.1.1 *A Priori* Screening

The *a priori* test involved a visual inspection of the data to eliminate outliers. The data were ranked numerically from highest to lowest. Maximum values that were three times greater than their nearest neighbor were removed from the data set before the next test in the sequence was applied.

3.4.1.2 Determination of Parametric Versus Nonparametric Data

The percentage of nondetect data in each data set was determined. Data sets with fewer than 15 percent nondetect values qualify for parametric distribution analysis. Data sets with greater than 15 percent nondetect values were identified as nonparametric.

Parametric and nonparametric data sets were then transformed, or "coded," according to EPA (1992). Data that were "ND" or nondetect, were not assigned "zero" values. Rather, they were assigned values of one-half the laboratory practical quantitation limit. Coded data sets tend to be skewed left, decreasing the effectiveness of determining the mean. Therefore, the median is reported as a more accurate measure of central tendency when greater than 15 percent of the data are nondetects.

3.4.1.3 Distribution Analyses

Distribution analyses were conducted on qualified data sets to determine whether the data were parametric (normal, lognormal) or nonparametric. The distribution analyses were performed by computing coefficients of skewness, conducting Shapiro-Wilk tests, and analyzing histograms and probability plots for each analyte for normal and lognormal coded data.

3.4.1.4 Calculation of T_n Statistic

Once the distribution analysis was completed, the T_n statistic test was performed on data sets determined to be parametric (normal or lognormal) to verify that no statistical outliers exist. The T_n test was run iteratively until the largest value in the data set passed the T_n statistic test. New mean and standard deviations were calculated for the data sets that had outliers removed in the T_n statistic analysis before the test was run again. The maximum data point, or datum, in the data set is considered an outlier if the T_n statistic exceeds the critical number (C_n) identified in the 1992 EPA guidance for a given sample size.

3.4.1.5 Calculation of Upper Tolerance Limit and 95th Percentile

Basic statistical parameters, including the mean, standard deviation, and UTL, were calculated for each parametric (normal or lognormal) population data set. The UTL establishes the upper concentration range that contains a specified proportion of the population with a specified confidence. The proportion of the population included is referred to as "the coverage," and the probability with which the tolerance interval includes the proportion is referred to as the "tolerance coefficient." The EPA-recommended coverage value of 95 percent and tolerance coefficient value of 95 percent were used to calculate the UTLs (EPA 1992).

Nonparametric statistics were used when data sets did not exhibit normal or lognormal distributions, or when the percentage of nondetects exceeded 15 percent. The median was used to describe central tendency for data sets with greater than 15 percent nondetects and the 95th percentile was used to predict the upper range of concentrations for comparison to background. It should be noted that 5 percent of the data will probably exceed the upper range of concentration for both the UTL and the 95th percentile.

3.4.2 Statistical Tests

A priori test results for MWL background soil data are presented in Table 3.4-1. The "X factor" is the ratio of the maximum value to the next highest value. If the ratio is ≥ 3, it indicates the maximum value is anomalously high. None of the analytes examined were determined *a priori* as outliers, with the exception of strontium-90.

Distribution analyses for the MWL are presented in Table 3.4-2, and T_n statistic test results are presented in Table 3.4-3. Only the barium data set was censored for calculating MWL background values.

Background values for selected parameters and their corresponding UTL or 95th percentile are presented in Table 3.4-4. RCRA-proposed Subpart S action levels for analytes of interest are provided in Table 3.4-5.

3.4.3 Comparison Tests

Parametric, nonparametric, and combined parametric/nonparametric tests were used to compare MWL background data to Phase 2 RFI data. Nonparametric tests included the Wilcoxon Rank Sum (WRS) test and the Quantile test. Parametric tests included the Student's t-test using assumptions of both equal and unequal variance. The Hot-Measurement Comparison test uses either the 95th UTL calculation (for parametric data) or the 95th percentile calculation (for nonparametric data) as recommended by EPA (1992). Nonparametric tests were applied to all soil data regardless of distribution. Parametric tests were not applied to nonparametric data.

The WRS test is performed by ordering all values from background and a potentially-contaminated area according to their magnitude, then ranking these values from lowest to highest. The ranks in the potentially-contaminated area are summed and compared to a table of critical values to determine whether the area is contaminated. The WRS test is more powerful than the Quantile test for determining whether the potentially-contaminated area has values uniformly higher than background (EPA 1992). The WRS test, however, allows for fewer nondetects than the Quantile test. As a general rule, the WRS test should be avoided if more than 40 percent of the values in the potentially-contaminated area or background data are nondetects. All soil analytical data were subject to the WRS test in this analysis, although the power of the test was known to be greatly reduced when nondetects are greater than 40 percent.

The Quantile test is performed by comparing background data with data from a potentially-contaminated area. The two sets of data are then ordered from highest to lowest. The rank of background and potentially-contaminated area data points are determined. The number of data points for background and the potentially-contaminated area are then compared to a table that identifies how many of the highest measurements come from the potentially-contaminated area versus background to indicate contamination. The Quantile test is more accurate than the WRS test in determining when only a small portion of the site is contaminated. The Quantile test also can be used when a fairly large proportion of the data are nondetects (EPA 1992).

The t-test is a parametric test that compares sample means from background and potentially-contaminated areas. To use the t-test statistic procedure, both sample populations must have approximately normal (or lognormal) distributions with approximately equal population variances, and the random samples must be selected independent of one other.

The Hot-Measurement Comparison test compares each value from a potentially-contaminated area with an upper-limit concentration value (UTL or 95th percentile). Any value from the potentially-contaminated area that is equal to or greater than the upper-limit concentration value indicates an area of relatively high concentrations that must be further investigated (EPA 1992). Concentrations exceeding the upper-limit value also may indicate inappropriate sample collection, handling, or errors in analytical procedures. The upper-limit concentration value was calculated as previously described, based upon the 95th percentile for nonparametric data and the 95th UTL for parametric data.

3.4.4 MWL Phase 2 Resource Conservation and Recovery Act Facility Investigation Comparison Tests

Comparison tests between MWL background data and the maximum concentrations for Phase 2 RFI data were performed for metals and radionuclides in accordance with the Phase 2 RFI Work Plan (SNL/NM 1993). Discussions of the significance of the statistical tests on MWL background data and comparisons to the relevant RCRA-proposed Subpart S action levels for each analyte are found in Sections 4.6 and 4.7. RCRA-proposed Subpart S action levels are provided in Table 3.4-5.

3.5 Contaminant Fate, Transport, and Risk Assessment

MWL COCs were evaluated in a site-specific risk assessment to determine the potential impacts to human health and the environment. This approach is consistent with EPA guidance (EPA 1989) and with discussions between SNL/NM, the EPA, and the NMED. MWL risk assessment is based upon a future, industrial land-use scenario.

MWL assessment and characterization has provided representative concentrations of contaminants in surface and subsurface soils. Models were employed to supplement site characterization data to estimate contaminant concentrations in the air above the landfill and to predict future concentrations in groundwater below the landfill. The models employed use methods and mathematical models from published literature. Maximum concentrations were used in identifying potential exposure pathways to calculate potential contaminant intakes and subsequent noncarcinogenic and carcinogenic risk values. As prescribed by EPA (1989), a Reasonable Maximum Exposure (RME) approach was used.

The results and uncertainties in the risk assessment analysis are described in Section 7. The risk values estimated will be used to support decisions for further actions regarding the MWL.

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4. MWL Phase 2 RCRA Field Investigation Activities

4.1 Radiation Survey

A surface radiation survey of the MWL was performed in 1992 prior to the initiation of field activities to identify areas of potential radiation exposure and to assist in establishing radiation health and safety protocols. A Bicron micro-R-meter, an Eberline ESP-2 NaI detector, and an Automess 6150AD2 Teletecter were used for the survey. Radiation readings were obtained along a predetermined grid in both the classified and unclassified areas, as well as outside the fenced perimeter of the landfill.

Three areas of elevated radiation were detected in the classified area. Pits SP-4, 35, and 36 had surface readings of 0.5 millirem (mrem)/hr, 50 mrem/hr, and 6 mrem/hr, respectively (Figure 4.1-1). Pits SP-4 and 36 have permanent in-place concrete caps. Pit 35 has a diamond-steel cap with an operable, hinged door. No other areas of elevated radiation were detected at the landfill. Background radiation at the MWL is 10 to 15 microrem/hr.

4.2 Air Emissions

In 1992, air monitoring was conducted at the MWL to measure radioactive ambient air emissions from the landfill. The MWL is designated as a diffuse radiological source due to known tritium surface contamination. Through wind action, fugitive dust can be suspended and transported downwind, causing an exposure to persons breathing air containing contaminated dust.

Air samples were collected at the MWL and analyzed for beryllium, uranium, and plutonium. Samples were collected using Wedding & Associates high-volume particulate monitor (10 micron) (PM_{10}) air samplers. The air inlet is factory-calibrated to yield a particle cut-off of 10 micrometers for unit density particles when sampled at 40 ft^3/minute (min).

More than 130 PM_{10} samples were collected at three locations at the MWL (Figure 4.2-1). Results are summarized in Table 4.2-1. Analysis of these samples showed that PM_{10} concentrations averaged less than 10 micrograms (μg) per cubic meter (m^3). Beryllium was not detected in any sample. None of the radionuclides were present in the environment at levels above background nor were any of the measured values above applicable DOE, federal, or state ambient air standards (Radian Corporation 1992a).

As part of the 1992 study, measurements were made of the rate at which tritiated water was being emitted from the landfill. Flux of tritiated water was measured at fifteen locations using emission isolation flux chambers (EIFC) in conjunction with silica gel sorbent columns (Radian Corporation 1992b). 1992 tritium flux sampling locations are shown in Figure 4.2-2.

An EIFC is designed to make direct flux measurements of gaseous species from an isolated surface area. A schematic of an EIFC is presented in Figure 4.2-3. EIFCs were inserted into the soil at depths of 1 to 2 in. to effectively isolate the desired surface area. The silica gel columns were analyzed for tritium at Radian's radiochemistry lab in Austin, Texas. Condensate was collected and analyzed by liquid scintillation counting.

Results of tritium flux sampling are presented in Table 4.2-2. These data show that the highest measured emission rate occurred at sample location 6. This rate was approximately 6000 pCi/square meter (m^2)/hr. If an emission rate of 6000 pCi/m^2/hr were trapped in a 1.0 m^3 chamber it would take 3333 hrs for an individual to inhale the derived air concentration for tritium (20 microcuries/m^3). This is approximately 21 months of continuous exposure and inhalation in a 1.0 m^3 confined space.

Two EIFC samples were screened for gamma emissions to determine if a radioisotope, other than tritium, was trapped by the silica gel, possibly biasing the tritium determination. Two sorbent columns (from locations 8 and 9) were sealed inside the lead cave of a high-purity germanium detector and counted. The gamma spectrum showed no significant emissions beyond those associated with instrument background. Also, the count rate beyond the tritium region in the liquid scintillation spectrum was constant and showed no correlation with count rate in the tritium region. Therefore, no other radioisotope other than tritium was observed during flux measurements at the MWL.

In another 1992 air monitoring study, PM_{10}s were placed around the MWL while groundwater monitoring well MW-4 was drilled to a depth of 552 ft beneath Trench D. This air monitoring was designed to quantify potential radionuclide release during intrusive environmental characterization activities. Results showed no difference in airborne radionuclide activity between PM_{10}s located immediately adjacent to drilling operations and PM_{10}s located upwind and downwind from the MW-4 drill site.

In 1993, the classified area of the MWL was subject to intensive tritium flux sampling. Sampling strategy was based upon tritium emission rates obtained during the 1992 Radian study. Twenty-seven sampling locations were scoped for the 1993 study. Twenty sample locations were selected within the classified area. Six sample locations were selected outside the classified area to determine the extent of tritium migration from the classified area. One sample location was located west of the landfill to be used as a background station (Radian Corporation 1994). The 1993 tritium flux sampling locations are presented in Figure 4.2-4.

Flux of tritiated water was measured using the same methodology as in the 1992 study. Results of the 1993 study are presented in Table 4.2-3. Tritium flux varied from slightly above 100 pCi/m^2/hr at sample location 10, the background station, to just above 166,000 pCi/m^2/hr at sample location 23. As indicated in the 1992 study, tritium emission rates are greatest in and around the classified area. These data show that the classified area is the primary source of tritium emissions at the landfill. The 1993 tritium flux is presented in Figure 4.2-5.

4.2.1 1993 MWL Radiological Release

A total of eight facilities at SNL/NM release measurable quantities of airborne radionuclides. Seven of the eight sources are point releases. The MWL is the only diffuse source with a measurable release. Table 4.2-4 summarizes the complete radionuclide release inventory for SNL/NM in 1993. Based upon studies at the MWL, 0.294 Ci of tritium was released from the 107,500-square-feet (ft^2) landfill in 1993 (Radian Corporation 1994).

4.2.2 MWL Dose Assessment

Facility dose assessments were calculated using EPA's CAP88-PC computer code. The CAP88-PC computer model is a set of computer programs, databases, and associated utility programs for estimating dose and risk from point and diffuse sources of radionuclide air releases. CAP88-PC consists of modified versions of the AIRDOS-EPA (Moore et al. 1979) and DARTAB (ORNL 1981) computer code.

The radiological dose to the maximally-exposed individual from routine operations at SNL/NM's eight facilities was calculated using the CAP88-PC code. Tables 4.2-5 and 4.2-6 summarize doses to boundary receptors and KAFB receptors, respectively. Individual doses were computed for each of these receptors from each contributing facility. Individual doses were summed to yield the cumulative composite dose (from all facilities) at each receptor. The composite dose analysis yielded a maximum dose impact location for National Emission Standards for Hazardous Air Pollutants (NESHAP) at the Kirtland Underground Munitions Storage Complex (KUMSC) receptor site, located approximately 1 mile northwest of SNL/NM TA-5. The effective dose equivalent (EDE) to the maximally-exposed individual at KUMSC was calculated to be 0.0016 mrem/yr, well below the NESHAP dose standard of 10 mrem/yr. The MWL contributes 0.5 percent of the total EDE due to internal exposure from tritium inhalation.

4.3 Nonintrusive Geophysical Surveys

Nonintrusive geophysical surveys were utilized to determine the location and approximate dimension of disposal trenches before intrusive characterization activities were initiated. The location of unclassified area trenches and unconfirmed reports of burials outside the landfill were of great concern to ER personnel. These concerns were addressed using a combination of complementary, nonintrusive geophysical surveys.

The northern half of the unclassified area was surveyed in October 1992. The outside perimeter of the landfill was surveyed in August 1993, and the southern half of the unclassified area was surveyed in June 1995. Pits in the classified area were marked well enough to preclude the need for geophysical surveys.

4.3.1 Northern Unclassified Area Geophysical Surveys

Engineering design map 91342 shows the location of 4 trenches (A, B, C, and D) in the northern half of the unclassified area of the landfill (Figure 4.3-1). The design map indicates trenches of equal length, width, depth, and spacing on the 1-acre site. Field observations, however, did not support the design configuration. There are three earthen berms within the fenced area, presumably indicating three trenches. Each berm is of different length, width, and spacing. The north and south ends of each observed berm is marked with a steel fence post.

4.3.2 Survey Design

The northern half of the unclassified area covers approximately 43,000 ft^2 and is fenced on all sides. The 1-acre site was grided on 5-ft centers starting with the northwest corner of the landfill (Figure 4.3-2). The northwest cornerpost was designated as the point of origin, (0,0), with 5-ft stations staked to the east along the north fence line as 5E, 10E, 15E, and so forth to 200E and to the south along the west fence line as 5S, 10S, 15S, and so forth to 215S. This 5-ft grid and point of origin was used as a reference for all Phase 2 RFI activities. Each 5-ft grid station was equipped with a Geonics EM-31 and a Geometrics 856AX total field magnetometer for data acquisition. Readings were taken from west to east and then east to west along successive survey lines with spatial control maintained within 6 in. A Geonics EM-61 high-resolution metal detector, which is a wheel-mounted instrument with an encoder that automatically triggers data acquisition during a traverse, was pulled along each grid line acquiring data every 8 in. All data were recorded in the field with data loggers.

4.3.3 Ground Conductivity Survey

The Geonics EM-31 was operated in the vertical dipole mode, and both ground conductivity and the in-phase component of the induced magnetic field were recorded. The EM-31 has an effective depth of penetration to approximately 18 ft. EM-31 ground conductivity and in-phase field data were processed with DAT31 (Geonics 1992), and compiled and plotted with Geosoft Mapping and Processing System, a personal computer–based mapping and processing software package (Geosoft 1994).

4.3.4 Magnetic Gradient Survey

A Geometrics G-856AX proton precession magnetometer, operated in the gradient mode, was used to acquire vertical magnetic gradient data. The vertical magnetic gradient survey utilized two magnetic sensors deployed on the same vertical staff. The top and bottom sensors were positioned 9.2 and 4.6 ft above the ground, respectively. The vertical magnetic gradient was calculated by subtracting the top sensor reading from the bottom sensor reading, then dividing by the sensor separation. The gradient data were reduced using MAGLOC (TerraSense 1993) and compiled and plotted with Geosoft Mapping and Processing System.

4.3.5 Metal Detection Survey

The Geonics EM-61 was utilized to discriminate between soil conductivity and highly conductive ferrous and nonferrous metallic materials. The EM-61 has an effective depth of penetration of approximately 10 ft. EM-61 response data were processed with DAT61 (Geonics 1994), and compiled and plotted with Geosoft Mapping and Processing System.

4.3.6 EM-31 Ground Conductivity Results

EM-31 ground conductivity data from the northern unclassified area are presented in Figure 4.3-3. Areas of low conductivity are shown in blue and areas of high conductivity are shown in red. The contour interval is 5 milliSiemens (mS)/meter (m).

Ground conductivity values vary from 15 mS/m to well over 200 mS/m near the fences. Typical background conductivity values outside the MWL are on the order of 15 mS/m. There is a distinct feature along grid line 155E, between 60S and 100S, marked by high-amplitude, low-conductivity anomalies. The magnitude and limited extent of these anomalies indicate buried metal. There are also two broad areas of low conductivity centered on grid line 100E. These features may indicate areas of undisturbed ground or the burial of low density, nonconductive material.

EM-31 in-phase data from the northern unclassified area are presented in Figure 4.3-4. Negative in-phase data are shown in blue, positive in-phase data are shown in yellow and pink. Contour lines are drawn at 0, 2, 4, 8, 12, 16, 20, and 24 parts per thousand/100. Two distinct lineaments occur along grid lines 100E and 155E. There appear to be two coalescing lineaments along grid lines 20E and 55E. The feature along line 155E is quite pronounced, with closely spaced high- and low-amplitude anomalies, indicating a significant mass of buried metal. The feature along grid line 100E is distinct but of less magnitude, perhaps indicating less buried metal. The coalescing linear features along grid lines 20E and 55E probably represent two very closely-spaced disposal trenches.

4.3.7 Magnetic Gradient Results

Magnetic gradient data from the northern unclassified area are presented in Figure 4.3-5. Negative gradient values trend toward blue and positive gradient values trend toward pink. The contour interval is 100 gamma/m.

Three distinct linear features occur along grid lines 20E, 100E, and 155E. A subtle linear feature occurs along grid line 55E. Spurious dipolar anomalies are prevalent in the magnetic gradient data indicating random orientation of buried metal objects. At least three large metal objects occur along grid line 155E at 85S, 100S and 195S. At least one large metal object occurs along grid line 100E at 140S and one along grid line 20E at 90S.

The location of trenches A, B, C, and D is quite evident when one superimposes EM-31 in-phase data and positive vertical magnetic gradient data. This superimposition is presented in Figure 4.3-6. The exact outline of each trench is difficult to determine, but the general location of the disposal trenches can be inferred to be:

- Trench A: Along grid line 20E between 50S and 200S.
- Trench B: Along grid line 55E between 45S and 175S.
- Trench C: Along grid line 100E between 70S and 185S.
- Trench D: Along grid line 155E between 50S and 205S.

4.3.8 Metal Detection Results

EM-61 response data from the northern unclassified area are presented in Figure 4.3-7. Increasing response trends toward pink. Contours are drawn at 5, 25, 50, 100, 200 and 500 millivolt (mV). EM-61 response data ranges from a few mV (background) to several hundred mV.

The location and outline of each disposal trench is intuitive. Disposal trenches occur along grid line 20E between 50S and 200S; along grid line 55E between 30S and 170S; along grid line 100E between 70S and 180S; and along grid line 155E between 50S and 200S. The "as-built" configuration was quite different, as suspected, from engineering design map 91342 (compare Figure 4.3-1 with Figures 4.3-7 and 4.3-8). The actual disposal trenches are not of equal length, width, and spacing on the 1-acre site.

4.3.9 Southern Unclassified Area Geophysical Surveys

The Geonics EM-61 and a Geometrics G-858 cesium-vapor magnetometer were used for trench delineation in the southern half of the unclassified area.

EM-61 response data from the southern unclassified area are presented in Figure 4.3-8. Increasing response trends toward pink. Contours are drawn at 5, 50, 100, 300, and 500 mV. EM-61 response data range from a few mV (background) to several hundred mV.

Magnetic gradient data from the southern unclassified area are presented in Figure 4.3-9. Negative gradient values trend toward blue and positive gradient values trend toward pink. The contour interval is 100 gamma/m.

The location and outline of Trench E and F is obvious. The "as-built" configuration is similar to the engineered design, as shown on engineering design map 91342 (compare Figures 4.3-1 and 4.3-8). Numerous, individual metal objects are visible in each trench. The geophysical signature for Trench G, however, is quite limited compared to what is shown on Figure 4.3-1. Trench G was open and active at the time the landfill was closed in December 1988. Apparently, Trench G was only partially filled with waste before it was backfilled and the landfill closed.

4.3.10 MWL Perimeter Geophysical Surveys

Reports of burials outside the fenced perimeter of the landfill were investigated with the EM-31 and a Schonstedt 52B fluxgate magnetometer. The results were negative, indicating that there are no undocumented burials within 100 ft of the MWL fence.

4.4 Surface Soil Sampling for Tritium

In July 1993, 92 surface soil samples (6 to 12 in. bgs) were collected at the MWL for tritium analysis. Sampling density and location were based upon MWL historical records and 1982 tritium sampling results (Millard et al. 1983). Sampling was expanded to include the southern half of the unclassified area that was not sampled in 1982. The 1993 sample locations are presented in Figure 4.4-1.

The 1982 and 1993 sampling results are presented in Figure 4.4-2 and 4.4-3, respectively. Tritium activities are greatest within the classified area of the landfill. The maximum tritium activity, observed during the 1993 program (1103 pCi/g), occurred south of Pit 33.

Historical records reveal that a total of 1861 Ci of tritium was disposed of at the MWL from March 1959 to January 1983. Of this total, 1451 Ci were disposed of in the classified area of the landfill. Of this amount disposed of in the classified area, 822 Ci were disposed of in Pit 33 between May 1979 and January 1983. The remaining 410 Ci of the tritium was probably disposed of in unclassified area Trenches A through D. Figure 4.4-4 depicts the amount of tritium disposed of in specific pits in the classified area of the landfill from 1959 to 1983. No information has been found on specific tritium disposal in Trenches A through D.

The distribution of tritium in surface soils in and around the MWL is attributed to historical tritium disposal practices at the MWL. The 1982 and 1993 tritium activity and distribution in surface soils corroborate MWL disposal records. Tritium distribution is restricted primarily to the northern half of the MWL, with the greatest concentration of tritium occurring in the classified area.

4.5 Soil Gas Surveys

Active and passive soil gas surveys were used to assess the nature and extent of VOCs in subsurface soils at the MWL. Passive soil gas surveys were employed as a reconnaissance tool since large areas of the landfill could be sampled over a short period of time at a relatively low cost. Passive soil gas surveys identified surface areas with anomalous VOC emissions. Active soil gas surveys were employed to obtain more quantitative soil gas information at depth. Passive and active soil gas sample locations were based upon the grid established for geophysical surveys described in Section 4.3-2.

4.5.1 Passive Soil Gas Surveys

Quadrel Services, Inc., Ijamsville, Maryland, was selected to perform passive soil gas surveys at the MWL because of their surface-based, nonintrusive sampling technology. Quadrel developed a proprietary soil gas sampling method, EMFLUX^R, which employs a hemispherical flux chamber containing a proprietary adsorbent cartridge. EMFLUX^R sampling equipment is illustrated in Figure 4.5-1. Samples are typically collected over a 72-hr period and analyzed by gas chromatography/mass spectrometry (GC/MS) using EPA Contract Laboratory Program (CLP) procedures. Transfer of the adsorbed gases from the cartridge into a GC/MS system is accomplished through the standard purge and trap sampling system (NETAC 1989).

Two passive soil gas surveys were conducted at the MWL in 1993. A total of 93 EMFLUX^R flux chambers were deployed during the sampling events. Analysis of the EMFLUX^R adsorbent cartridges was performed by Quadrel's contract laboratory, Maryland Spectral Services, Inc., Baltimore, Maryland. Maryland Spectral Services analyzed all EMFLUX^R sample cartridges with GC/MS equipment, using a modified EPA Method 8240 (Table 4.5-1). Each cartridge was analyzed for VOCs specified on EPA's standard Target Compound List. Laboratory results, reported in nanograms (ng) of a specific contaminant recovered per cartridge, were then converted by Quadrel to average flux reported in ng/m^2/min using the subtended area of the collector shell and the period of exposure for each sample. In addition to the 93 field samples collected, nine control samples and two trip blanks were incorporated into the two surveys for QA/QC.

4.5.1.1 First-Round EMFLUX^R Sampling

First-round passive soil gas sampling was conducted by Quadrel and SNL/NM personnel in July and August 1993. Seventy-one EMFLUX^R flux chambers were deployed at the MWL. Sampling locations are shown in Figure 4.5-2. Of the 71 flux chambers deployed, 51 were placed in and around the classified area. The remaining 20 flux chambers were placed in the unclassified area.

First-round passive soil gas sampling results are presented in Table 4.5-2. This table provides the coordinates for each sample, the sample location number, and VOC flux. VOCs detected in surface soil gas at the MWL are discussed in the following sections.

Tetrachloroethene (PCE)

PCE was detected at 48 of the 71 sample locations (Figure 4.5-3). The highest flux occurred in the northern unclassified area.

Trichloroethene (TCE)

TCE was detected at 36 of the 71 locations sampled (Figure 4.5-4). The highest flux occurred in the classified area at sample locations 18, 47, and 48.

1,1,1-Trichloroethane (TCA)

1,1,1-TCA was detected at 24 of the 71 locations sampled (Figure 4.5-5). The highest flux occurred at sample location 35.

Toluene

Toluene was detected at 17 of the 71 locations sampled (Figure 4.5-6). The highest flux occurred at sample location 35.

1,1,2-Trichloro-trifluoroethane

1,1,2-trichloro-trifluoroethane was detected at 9 of the 71 locations sampled (Figure 4.5-7). The highest flux occurred at sample locations 16, 18, and 46.

Dichloroethene

Dichloroethene was tentatively identified by mass spec comparison with the National Bureau of Standards Library at 12 of the 71 locations sampled (Figure 4.5-8). The highest flux occurred at sample location 48.

Acetone

Acetone was detected at 8 of the 71 locations sampled (Figure 4.5-9). The highest flux occurred in the southern unclassified area at sample locations 62 and 63.

Other Compounds

Isopropyl ether was detected at sample locations 39 and 40. 1,1-dichloroethene, a by-product of 1,1,1-TCA, was detected at sample location 35. Styrene, a minor component of many petroleum products, was detected at sample location 59.

4.5.1.2 Second-Round EMFLUX^R Sampling

Second-round passive soil gas sampling was conducted in September 1993. Second-round sampling was conducted for three reasons: 1) to resample 5 first-round sample locations for EMFLUX^R repeatability; 2) to determine VOC flux west of the landfill; and 3) to determine background VOC flux. To accomplish this, 22 EMFLUX^R flux chambers were deployed at sampling locations shown in Figure 4.5-10. Sample locations 18, 19, 20, 21, and 22 were repeated first-round sample locations (Figure 4.5-2). Background sample locations are represented by second-round sample locations 13, 14, 15, 16, and 17.

Second-round passive soil gas sampling results are presented in Table 4.5-3. This table provides the coordinates for each sample, the sample location number, and VOC flux. No VOCs were detected in background samples from locations west and south of the landfill. VOCs detected in surface soil gas at the MWL are discussed in the following sections. Results from sample location 10 were lost due to laboratory instrument failure.

PCE

PCE was detected at 15 of the 22 locations sampled (Figure 4.5-11). The highest flux occurred at sample locations 20 and 21.

TCE

TCE was detected at 11 of the 21 locations sampled (Figure 4.5-12). The highest flux occurred at sample locations 18 and 19.

TCA

1,1,1-TCA was detected at 4 of the 21 locations sampled (Figure 4.5-13). The highest flux occurred at sample location 21.

1,1-Dichloroethene

1,1-dichloroethene was detected at sample location 21. This compound was detected at the same sample location (location 35) during first-round sampling.

4.5.2 Active Soil Gas Sampling

The 1993 EMFLUX^R passive soil gas sampling identified 12 VOCs in surface soils at the MWL. This reconnaissance tool was effective as a qualitative "yes-no" screening for VOCs, but provided an accumulation of VOCs over time only. Active soil gas sampling was conducted at the MWL as a quantitative follow-up to EMFLUX^R passive soil gas sampling. Three rounds of active soil gas sampling were conducted. First-round sampling was performed in June 1994; second-round sampling in August 1994; and third-round sampling in October 1994.

4.5.2.1 Active Soil Gas Sampling Methodology

Active soil gas sampling was based upon EMFLUX^R sampling results. Sample locations were selected at or within close proximity to anomalous passive soil gas locations. The classified area was not sampled due to security and Environmental Safety and Health concerns. The southern unclassified area was not sampled due to aboveground storage of low-level radioactive and mixed waste. Although active soil gas sampling was not conducted in these two areas, samples were obtained outside the fenced perimeters of each.

Nineteen locations were sampled during first-round sampling; 12 during second-round sampling; and 12 during third-round sampling. Two samples were obtained at each location: one at 10 ft bgs and one at 30 ft bgs. Sample locations for each round of sampling are shown in Figure 4.5-14.

4.5.2.2 Active Soil Gas Sample Collection Equipment

Active soil gas samples were collected using a modified version of a soil gas collection system manufactured by GeoProbe Inc. The basic system consists of a truck-mounted hydraulic hammer, 3-ft lengths of steel drive-pipe, reusable hardened steel drive-points, disposable polyethylene tubing, and a constant-discharge air pump (Figure 4.5-15). The GeoProbe was modified by substituting a low-flow air pump for the GeoProbe-supplied vacuum pump. This modification allowed insertion of a photoionization detector (PID) and a flame ionization detector (FID) into the gas stream to monitor exhaust gas prior to and during sample collection. Monitoring exhaust gas helped define the appropriate time to pull a sample.

Active soil gas samples were collected in two types of containers: 500 milliliter (mL) glass septum-port gas sampling bulbs with Teflon stopcocks; and 6-liter (L) Summa canisters. First-round samples, taken at 10 ft bgs, were collected in glass bulbs only. First-round samples, taken at 30 ft bgs, were collected in both glass bulbs and Summa canisters. Second- and third-round soil gas samples at 10 ft bgs and 30 ft bgs were collected in Summa canisters only.

4.5.2.3 Active Soil Gas Sample Collection Procedures

Active soil gas sampling was conducted by driving steel pipe with a reusable drive-point to the desired sample depth using the GeoProbe hydraulic hammer. At the desired sample depth, the drive-pipe was retracted approximately 3 in. to create a sampling void between the drive-pipe and the drive-point. A polyethylene sample tube was then inserted down the drive-pipe and threaded onto the drive-point.

The upper end of the polyethylene sample tube was then connected to the influent port of a gas-sampling box. Air is drawn by the air pump into the back of the gas-sampling box via 1/4-in. polyethylene tubing. Air enters through the air inlet port, interacts with the flow regulator and the gauges, and exits through the air exhaust port. The two three-way valves can be used to isolate part of the tubing within the gas-sampling box to allow either purging or sampling from either the upper Summa port or the lower glass bulb port. The tee fitting at the exhaust port allows PID and FID monitoring of the VOC exhaust stream without impeding gas flow.

All field equipment for soil gas sampling was decontaminated prior to sampling at each location and depth. GeoProbe drive-pipe and drive-points were washed with a solution of Alconox and distilled water, rinsed with distilled water, and allowed to air-dry. Polyethylene sample tubing was purged with nitrogen gas for approximately 20 min after each soil gas sample was collected. After purging, the tube was checked with the PID and FID to ensure that it was completely evacuated of VOCs. The steel drive-pipe was sealed at the ground surface with a mud paste to prevent preferential flow along the annulus.

4.5.2.4 Active Soil Gas Sample Analysis

First-round soil gas samples, collected in 500 mL glass bulbs, were analyzed by SNL/NM personnel with an on-site Viking Spectra Trak 600 GC/MS. Soil gas samples collected in Summa canisters were submitted to Encotec, Ann Arbor, Michigan, for EPA Method TO-14 analysis.

Five equipment blanks were collected during the three rounds of active soil gas sampling. Trace levels of several target analytes were detected in the equipment blanks. The concentrations of contaminants detected in the equipment blanks were below laboratory quantitation limits and did not affect the quality of the data. A duplicate soil gas sample was collected approximately once per day or once per ten samples. These duplicate samples were collected using the same procedures as the primary soil gas samples.

4.5.2.5 Active Soil Gas Sampling Results

First-, second-, and third-round active soil gas sampling results are presented in Tables 4.5-4, 4.5-5, and 4.5-6, respectively. In all, 43 locations were sampled. Each table provides the coordinates for each sample collected, the sample number, the sample depth, and VOC concentrations detected. VOCs at 10 ft bgs and 30 ft bgs are discussed in the following sections.

4.5.2.6 Volatile Organic Compounds in Soil Gas at 10 Feet

VOCs in soil gas at 10 ft bgs are presented in Figures 4.5-16 through 4.5-21. Sampling shows that dichloro-difluoromethane, trichloro-fluoromethane, 1,1,2-trichloro-1,2,2-trifluoroethane, TCE, 1,1,1-TCA, and PCE are present in soil gas at 10 ft bgs.

Dichloro-difluoromethane

Dichloro-difluoromethane was detected at 6 sample locations in the northern unclassified area at concentrations ranging from 170 parts per billion (ppb) to 29,000 ppb (Figure 4.5-16).

Trichloro-fluoromethane

Trichloro-fluoromethane was detected at 12 sample locations outside the fenced perimeter of the southern unclassified area at concentrations ranging from 12 ppb to 190 ppb (Figure 4.5-17).

1,1,2-trichloro-1,2,2-trifluoroethane

1,1,2-trichloro-1,2,2-trifluoroethane was detected at 8 sample locations along the southern fence line of the southern unclassified area at concentrations ranging from 19 ppb to 120 ppb (Figure 4.5-18).

TCE

TCE was detected at 38 sample locations. Concentrations ranged from 13 ppb to 540 ppb (Figure 4.5-19). The highest concentrations occurred at sample locations along the west and north fence lines of the northern unclassified area. Elevated TCE concentrations were also observed along the southern fence line of the classified area.

1,1,1-TCA

1,1,1-TCA was detected at 29 sample locations ranging from 9 ppb to 280 ppb (Figure 4.5-20). Elevated 1,1,1-TCA concentrations were also observed along the western fence line of the northern unclassified area and in the southwest corner of the classified area.

PCE

PCE was detected at 40 sample locations ranging from 19 ppb to 5,200 ppb (Figure 4.5-21). The highest concentrations occurred in the northern unclassified area.

4.5.2.7 Volatile Organic Compounds in Soil Gas at 30 Feet

VOCs observed in soil gas at 30 ft bgs are shown in Figures 4.5-22 through 4.5-27. Figures 4.5-25, 4.5-26, and 4.5-27 show two VOC concentrations at 19 locations. The dual numbers represent concentrations obtained by on-site analysis of the 500-mL glass bulb sample and by off-site analysis of the 6-L Summa canister sample.

Sampling shows that dichloro-difluoromethane, trichloro-fluoromethane, 1,1,2-trichloro-1,2,2-trifluoroethane, TCE, 1,1,1-TCA, and PCE all are present in soil gas at 30 ft bgs. Methylene chloride was detected at two locations and chloroform was detected at one location.

Dichloro-difluoromethane

Dichloro-difluoromethane was detected at 24 sample locations, ranging from 50 ppb to 21,500 ppb (Figure 4.5-22). Concentrations of dichloro-difluoromethane, observed at five of the eight sample locations in the northern unclassified area, ranged from 1,200 ppb to 21,500 ppb. Elevated concentrations also were present along the west fence line of the northern unclassified area.

Trichloro-fluoromethane

Trichloro-fluoromethane was detected at 17 sample locations, primarily around the perimeter of the southern unclassified area and in the northern unclassified area. Concentrations ranged from 16 ppb to 740 ppb (Figure 4.5-23). The highest concentrations occurred along the fence line in the northeast corner of the southern unclassified area. Elevated concentrations also were found at three sample locations in the northern unclassified area.

1,1,2-trichloro-1,2,2-trifluoroethane

1,1,2-trichloro-1,2,2-trifluoroethane was detected at 34 sample locations, ranging from 25 ppb to 330 ppb (Figure 4.5-24). The highest concentrations were observed along the north and west fence lines of the northern unclassified area. Elevated concentrations also occurred both at the southwest corner of the classified area and along the west and east fence lines of the southern and classified areas, respectively.

TCE

TCE was detected at 42 of the 43 locations sampled (Figure 4.5-25). Concentrations obtained from glass bulb analyses ranged from 163 ppb to 776 ppb. Concentrations obtained from Summa canisters ranged from 120 ppb to 630 ppb. The highest TCE concentrations occurred along the west fence line of the northern unclassified area and along the south fence line of the classified area.

1,1,1-TCA

1,1,1-TCA was detected at all sampling locations (Figure 4.5-26). Concentrations obtained from glass bulb analysis ranged from 21 ppb to 337 ppb. Concentrations obtained from Summa canisters ranged from 26 ppb to 750 ppb. The highest concentrations occurred along the west fence line in the northern unclassified area and in the southwest corner of the classified area. 1,1,1-TCA also was detected around the entire perimeter of the southern unclassified area.

PCE

PCE was detected at all sampling locations (Figure 4.5-27). Concentrations from glass bulb analyses ranged from 63 ppb to 1,666 ppb. Concentrations from Summa canister analysis ranged from 19 ppb to 5,900 ppb. The highest PCE concentrations were found in the northern unclassified area. Elevated PCE concentrations also were detected along the north and west fence lines of the northern unclassified area, and around the entire perimeter of the southern unclassified area.

Methylene chloride

Methylene chloride was detected at two sample locations: 100 ppb at sample location 3 (a duplicate sample taken at the same location showed no measurable concentration) and 14 ppb at sample location 6. No other measurable concentrations of methylene chloride were observed during active soil gas sampling. Trace levels of methylene chloride were present in each equipment blank taken during second-round sampling, and in one of two equipment blanks taken during third-round sampling.

Chloroform was detected at sample location 10 at 14 ppb. No other measurable concentrations of chloroform were observed during active soil gas sampling.

4.5.2.8 Total Volatile Organic Compounds

Total VOCs in soil gas at 10 ft bgs and 30 ft bgs are presented in Figures 4.5-28 and 4.5-29, respectively. Total VOC concentrations at 10 ft bgs and 30 ft bgs correspond very well, generally increasing with depth. Sample locations showing the highest concentrations of total VOCs at 10 ft bgs were typically the same sample locations that showed the highest concentrations at 30 ft bgs. There are three areas where total VOC concentration at 10 and 30 ft bgs are higher than in other areas of the landfill. The highest concentration of total VOCs occurs in the northern unclassified area. Elevated concentrations also occur both along the west fence line of the northern unclassified area and in the northeast corner of the southern unclassified area.

4.6 Borehole Drilling

4.6.1 Borehole Drilling Objectives

The objectives of borehole drilling were to obtain representative subsurface soil samples from beneath MWL disposal pits and trenches for VOCs, SVOCs, TAL metals, isotopic uranium, isotopic thorium, isotopic plutonium, gross alpha/beta activity, strontium-90, and tritium analysis. Previous studies at the MWL indicate that tritium is the primary COC (Brewer 1973, Simmons 1979, Millard et al. 1983, SNL/NM 1990, Radian Corporation 1992a and 1992b). Phase 2 RFI borehole drilling was designed to further investigate this finding and to evaluate the potential for hazardous waste release to the environment. A total of 15 boreholes were used to accomplish these objectives.

4.6.2 Borehole Locations

The locations of Boreholes (BH)-1 through BH-15 were based upon MWL Phase 1 RFI results, completed Phase 2 RFI characterization results, and consultations with the NMED. BH-1 through BH-13 are holes drilled at an angle of 30 degrees adjacent and perpendicular to the landfill fence, in order to obtain samples directly below disposal pits and trenches. BH-14 and BH-15 are vertical holes drilled 60 ft east of the classified area fence to evaluate potential eastward migration of tritium from the classified area. Figure 4.6-1 presents the location, surface projection, and sample depths for VOCs, SVOCs, TAL metals, and radiological analyses in BH-1 through BH-15. Figure 4.6-2 presents the location, surface projection, and sample depths for tritium in BH-1 through BH-15. Lithologic logs for BH-1 through BH-15 are provided in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II.

4.6.3 Sampling Frequency

Borehole drilling and sampling were accomplished using resonant sonic drilling. Each borehole was cased as the hole was advanced to prevent sloughing. Samples were obtained using a California-modified, 18-in.-long, 2.5-in.-diameter split-spoon core sampler hammered into undisturbed soil ahead of the bit-face. VOC, SVOC, TAL metals, and isotopic samples were obtained at 10 ft, 30 ft, 50 ft, 70 ft, 90 ft, and total depth. Tritium samples were obtained every 20 ft beginning at 10 ft to total depth. Boreholes were advanced to a minimum-targeted depth of 120 linear ft. Boreholes were advanced further if on-site screening warranted and drilling conditions were favorable.

4.6.4 Borehole Drilling Analytical Procedures

Borehole drilling analytical procedures were designed to address COCs suspected or previously documented at the MWL. Analytical procedures consisted of analyses for VOCs, SVOCs, TAL metals, isotopic uranium, isotopic thorium, isotopic plutonium, gross alpha/beta activity, strontium-90, and tritium. All samples were analyzed using EPA CLP and SW-846 methods. Table 4.6-1 summarizes the analytical methods used during borehole drilling.

VOC, SVOC, and TAL metals analyses were performed by General Engineering Laboratories, Inc., Charleston, South Carolina. Radiological analyses were performed by Lockheed Analytical Services, Las Vegas, Nevada. A total of 532 samples, including duplicates, were collected from the 15 boreholes. Samples were collected from 88 different depths for VOC, SVOC, TAL metals and radiological analyses. Samples were collected from 105 different depths for tritium analyses. Table 4.6-2 summarizes the total number of samples, including duplicates, collected from each borehole.

4.6.4.1 Volatile Organic Compound, Semivolatile Organic Compound, and Target Analyte List Metals Results

VOC, SVOC, and TAL metals results for all borehole soil samples collected during borehole drilling are available in SNL/NM, June 1998, *Responses to NMED Technical Comments on the*

Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996, Volumes I and II. VOC and SVOC analytical results for borehole soil samples are discussed in detail in Sections 4.6.4.2 and 4.6.4.3. TAL metals analytical results are discussed in detail in Section 4.6.4.4.

VOC, SVOC, and TAL metals results were compared to RCRA-proposed Subpart S action levels for soils. Where no proposed Subpart S action level was available for a specific VOC, SVOC, or TAL metal, an action level was calculated using toxicity information contained in either EPA's Integrated Risk Information System (IRIS) database (EPA 1995a) or the Health Effects Assessment Summary Tables (HEAST) (EPA 1995b). Proposed Subpart S (55 FR 30870) soil ingestion equations were used to calculate unavailable action levels.

In evaluating VOC and SVOC data, EPA guidance was used to discount specific VOCs and SVOCs that were present in the borehole soil sample and the associated laboratory or field blanks. The EPA states: "The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks). If problems with any blank exist, all associated data must be carefully evaluated to determine whether or not there is an inherent variability in the data, or if the problem is an isolated occurrence not affecting other data" (EPA 1991a). Further guidance from EPA states that: "In reality, it is not unusual to find low levels of common laboratory solvents (i.e., acetone, 2-butanone, methylene chloride), phthalates (i.e., di-n-butyl phthalate, bis [2-ethylhexyl] phthalate), and other ubiquitous compounds in laboratory blanks" (EPA 1993). Specific EPA guidance states that an analytical result may be discounted if either of the following criteria are met: 1) the compound is identified in a sample at a concentration that is less than 10 times the concentration that was identified in a blank sample; or 2) the compound is identified in a sample at a concentration that is less than 5 times the detection limit (EPA 1993).

A number of VOCs and SVOCs were present in laboratory and field blanks associated with borehole soil samples. Acetone, PCE, methylene chloride, 2-butanone, 2-hexanone, 4-methyl-2-pentanone, and toluene were detected in laboratory and/or field blanks. Acetone was present in laboratory and field blanks associated with all borehole soil samples. PCE was present in a field blank associated with BH-2. Methylene chloride was present in laboratory and field blanks associated with BH-8 through BH-14. 2-butanone was present in laboratory and field blanks associated with BH-2, BH-3, BH-5, BH-6, and BH-10 through BH-13. 2-hexanone, 4-methyl-2-pentanone, and toluene were present in a field blank associated with BH-11.

Two SVOCs were present in laboratory and field blanks associated with borehole samples. Bis(2-ethylhexyl) phthalate was found in laboratory and field blanks associated with soil samples from BH-4, BH-5, and BH-10. Isophorone was detected in the laboratory blank associated with BH-10.

Using EPA guidance, all but six occurrences of acetone (97 total), 20 occurrences of 2-butanone, and 40 occurrences of methylene chloride were attributed to laboratory contamination and discounted. Four occurrences of bis(2-ethylhexyl) phthalate, out of 15 total occurrences, were similarly discounted.

4.6.4.2 Volatile Organic Compounds

Table 4.6-3 summarizes VOCs detected in borehole soil samples, excluding those discounted based upon EPA guidance. The table provides the borehole number, the analyte, the highest concentration for that specific analyte, and the action level for each analyte listed. VOCs were not detected in BH-9, BH-11, BH-12, and BH-14.

None of the VOCs detected in borehole soil samples exceeded their corresponding Subpart S action level for soils or action levels generated from toxicity information contained in IRIS or the HEAST.

4.6.4.3 Semivolatile Organic Compounds

Table 4.6-4 summarizes SVOCs detected in borehole soil samples, excluding those discounted based upon EPA guidance. The table provides the borehole number, the analyte, the highest concentration for that specific analyte, and the action level for each analyte listed.

SVOCs were not detected in BH-5, BH-6, and BH-12 through BH-15. None of the SVOCs detected in borehole soil samples exceeded either proposed Subpart S action levels for soil or action levels generated from toxicity information contained in IRIS or the HEAST.

4.6.4.4 Target Analyte List Metals

Table 4.6-5 summarizes TAL metals detected in borehole soil samples. The table provides the borehole number, the analyte, the highest concentration for that specific analyte, the action level for each analyte listed, and the statistically-determined UTL.

Calcium, iron, potassium, magnesium, and sodium are considered essential nutrients according to Risk Assessment Guidance for Superfund (RAGS) (EPA 1989), and have no action levels. Aluminum, cobalt, copper, manganese, vanadium, and zinc are not listed as RCRA metals in 40 Code of Federal Register (CFR) 261 Appendix VIII. Therefore, they were not considered as COCs.

The TAL metals analysis (Method 6010 for inductively coupled plasma metals) includes analysis for total chromium. Total chromium includes chromium III and chromium VI. Since chromium VI was not analyzed for, but may represent a portion of the total chromium concentration reported, the more conservative action level for chromium VI was used.

Only beryllium was observed in concentrations exceeding proposed Subpart S action levels. Table 4.6-6 shows the range of beryllium concentrations in borehole soil samples. Of the 103 soil samples analyzed for beryllium, only four exhibited concentrations below the Subpart S action level of 0.2 mg/kg. Using data generated from background soil sampling (Section 3.4), a

UTL was statistically calculated to compare background beryllium concentrations to beryllium concentrations in borehole soil samples.

The UTL for beryllium is 0.82 mg/kg. All 103 beryllium concentrations fall below the UTL. The UTL is greater than beryllium concentrations in borehole soil samples because natural beryllium concentrations in soil at the MWL are greater than the proposed Subpart S action level.

4.6.4.5 Radiological

Radiological results for borehole soil samples are provided in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II. Two anomalous values were identified during validation of the radiochemical analytical data. Plutonium-238 and Plutonium-239/240 were detected at 50 ft in BH-8 at levels exceeding the minimum detectable activity (MDA), and Strontium-90 was detected at 130 ft in BH-10 at a level exceeding the MDA. SNL/NM requested reanalysis of the two soil samples. Results of the reanalysis showed levels of both radionuclides to be below the MDAs. All other analyses performed on borehole soil samples for isotopic uranium, isotopic thorium, and isotopic plutonium, total strontium, and gross alpha/beta activity were below MDAs. The only other radionuclide detected in borehole soil samples was tritium.

4.6.4.6 Tritium

The range of tritium activities in borehole soil samples is presented in Table 4.6-7. Tritium was detected in all 15 boreholes. Tritium activities with depth are presented in Table 4.6-8. The table provides the borehole number, the borehole depth (linear ft) true depth (ft bgs), and tritium activity with depth. These activities are projected into two cross sections, A-A' and B-B', in Figures 4.6-3 and 4.6-4, respectively. Figure 4.6-5 shows the bearing of cross sections A-A' and B-B'. The highest tritium activities were detected in BH-12.

There are no RCRA-proposed Subpart S action levels for radionuclides in soil. As a result, tritium activities from borehole drilling were compared to local background tritium levels. Local background tritium results are presented in Table 4.6-9.

4.6.5 Borehole Drilling Results Summary

VOCs and SVOCs detected in borehole soil samples were below RCRA-proposed Subpart S action levels or action levels generated from toxicity information contained in EPA's IRIS database (EPA 1995a) or the HEAST (EPA 1995b).

TAL metals were below RCRA-proposed Subpart S action levels, with the exception of beryllium. Beryllium concentrations exceeded the proposed Subpart S action level in all but four soil samples; however, those concentrations were all below the statistically-determined UTL. The results of the statistical tests performed on MWL borehole soil sampling data are presented in Table 4.6-10.

All borehole soil samples analyzed for isotopic uranium, isotopic thorium, isotopic plutonium, gross alpha/beta activity, and strontium-90 were below their respective MDAs. The only radionuclide detected in borehole soil samples was tritium. Tritium is present at levels exceeding local background. Tritium was detected to a depth of 120 ft bgs. The highest tritium activities occurred in the upper 26 ft, with maximum tritium activities in the upper 9 ft.

4.7 Groundwater Monitoring Well MW-4

MWL groundwater monitoring well MW-4 was installed using resonant sonic drilling between December 1992 and February 1993. MW-4 was installed directly beneath Trench D at an angle of 6 degrees from vertical in the north-south plane (Figure 4.7-1). In May and June 1967, approximately 204,000 gallons of coolant wastewater from the Sandia Engineering Reactor Facility were disposed of in Trench D. Approximately 1 Ci of total radioactivity, mainly short-lived radionuclides, was discharged into the trench with the coolant wastewater. Trench D was an active disposal trench at the time of this wastewater discharge and represents the most likely source for contaminant release and migration from disposal cells at the landfill.

4.7.1 Sampling Methodology

MW-4 was continuously cored to 552 ft bgs and cased as the hole was advanced to prevent sloughing. Soil samples were collected ahead of the bit-face using a California-modified, 18-in.-long, 2.5-in.-diameter split-spoon sampler. Soil gas samples were obtained with a stainless steel soil gas probe. Water-bath headspace analyses for VOCs were performed on all split-spoon soil samples. These soil samples were subsequently screened with a SNL/NM GC/MS. Field screening for VOCs and high-energy beta/gamma activity was conducted on all core as it was removed from the sonic core barrel before sampling and logging.

Split-spoon soil samples were collected every 20 ft from the surface to 200 ft and every 50 ft from 200 ft to total depth. Soil gas samples were collected at the same interval to a depth of 160 ft. Soil gas sampling was discontinued below 160 ft because all previous screening had indicated no VOCs were present. When split-spoon recovery was poor, soil samples were collected directly from the sonic core barrel.

4.7.2 MW-4 Analytical Procedures

MW-4 soil samples were analyzed for VOCs, SVOCs, TAL metals, chromium VI, gross alpha/beta activity, isotopic uranium, isotopic thorium, isotopic plutonium, tritium, and gravimetric moisture content. A summary of MW-4 soil samples and analyses is provided in Table 4.7-1. All samples were analyzed using EPA CLP and SW-846 methods. The laboratory analytical methods are provided in Table 4.7-2. All analyses, chemical and radiological, were performed by Enseco Rocky Mountain Analytical Laboratory. A total of 212 samples were collected for analysis. A summary of the sample number and depth is provided in Table 4.7-3.

4.7.2.1 Volatile Organic Compound, Semivolatile Organic Compound, and Target Analyte List Metals Results

VOC, SVOC, and TAL metals analytical results for soil samples collected from MW-4 are presented in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II. VOC and SVOC results for MW-4 soil samples are discussed in detail in Sections 4.7.2.2 and 4.7.2.3. TAL metals results are discussed in detail in Section 4.7.2.4.

VOC, SVOC, and TAL metals results were compared to RCRA-proposed Subpart S action levels for soils. Where no proposed Subpart S action level was available for a particular VOC, SVOC, or TAL metal, an action level was calculated using toxicity information contained in either EPA's IRIS database (EPA 1995a) or the HEAST (EPA 1995b). Proposed Subpart S (55 FR 30870) soil ingestion equations were used to calculate unavailable action levels. In evaluating VOC and SVOC data, EPA guidance was used to discount particular VOCs and SVOCs present in MW-4 soil samples and the associated laboratory or field blanks.

Six VOCs, acetone, 2-butanone, methylene chloride, total xylenes, carbon disulfide, and ethylbenzene, were detected in laboratory and/or field blanks associated with MW-4 soil samples. Table 4.7-4 provides soil sample depths at which VOCs were detected in associated blanks. VOC concentrations detected in MW-4 soil samples, the associated Subpart S action level, whether they were discounted based upon EPA guidance, and VOC concentrations present in the blanks associated with the soil samples are provided in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II. Using EPA guidance, 23 of 24 acetone occurrences, 15 of 21 methylene chloride occurrences, and 5 of 11 2-butanone occurrences were attributed to laboratory contamination and discounted.

Three SVOCs, diethyl phthalate, N-nitrosodiphenylamine, and di-n-butyl phthalate were detected in laboratory and/or field blanks associated with MW-4 soil samples. Table 4.7-4 provides soil sample depths at which SVOCs were detected in associated blanks. SVOC concentrations detected in MW-4 soil samples, the associated Subpart S action level, whether they were discounted based upon EPA guidance, and the SVOC concentrations present in the blanks associated with the soil samples are provided in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II. Using EPA guidance, one di-n-butyl phthalate occurrence was attributed to laboratory contamination and discounted.

4.7.2.2 Volatile Organic Compounds

Table 4.7-5 summarizes VOCs detected in MW-4 soil samples, excluding those discounted based upon EPA guidance. The table provides the analyte, the sample depth (linear ft and total ft bgs), the highest measured concentration of that specific analyte, and the action level for each listed analyte. Six VOCs were detected in MW-4 soil samples. All VOCs were detected at concentrations below their corresponding Subpart S action levels.

4.7.2.3 Semivolatile Organic Compounds

Table 4.7-5 summarizes SVOCs detected in MW-4 soil samples, excluding those discounted based upon EPA guidance. The table provides the analyte, the sample depth (linear ft and total ft bgs), the highest measured concentration of that specific analyte, and the action level for each listed analyte. Six SVOCs were detected in MW-4 soil samples. All six SVOCs detected in MW-4 soil samples were present in concentrations below their corresponding Subpart S action levels.

4.7.2.4 Target Analyte List Metals

Table 4.7-6 summarizes TAL metals in MW-4 soil samples. The table provides the metal, the sample depth (linear ft and total ft bgs), the highest measured concentration of that specific metal, the action level for each listed metal, and the statistically-determined UTL. Calcium, iron, potassium, magnesium, and sodium are considered essential nutrients (EPA 1989) and; therefore, have no associated action levels.

Analysis for total chromium and chromium VI were performed on MW-4 soil samples. Total chromium includes chromium III and chromium VI. Table 4.7-7 provides the concentrations of total chromium and chromium VI reported from laboratory analysis. The chromium III concentration shown in the table is the difference between the chromium VI concentration and the total chromium concentration. All reported concentrations of chromium III and chromium VI are below the specified Subpart S action levels.

Aluminum, cobalt, copper, manganese, vanadium, and zinc are not listed as RCRA metals in 40 CFR 261 Appendix VIII; therefore, they were not considered to be COCs. Although none of the metals discussed above exceeded action levels, the UTLs calculated for those metals are shown in Table 4.7-6.

Beryllium was the only metal observed in MW-4 soil samples that exceeded Subpart S action levels. Table 4.7-8 provides beryllium concentrations with depth. Only three samples had concentrations below the RCRA-proposed Subpart S action level of 0.2 mg/kg. A UTL was statistically calculated to compare background beryllium concentrations to the beryllium concentrations obtained in MW-4 soil samples.

The UTL for beryllium is 0.82 mg/kg. Of the 26 soil samples, 21 had concentrations below the UTL. To verify the beryllium concentrations, archived core from MW-4 was resampled at appropriate depths and submitted to General Engineering Laboratories Inc. for reanalysis. Reanalysis results are presented in Table 4.7-9. Two of the five soil samples (250 ft and 499 ft) contained beryllium concentrations below the UTL. The other three samples (353 ft, 447 ft, and 546 ft) still contained concentrations that exceeded the UTL.

Figure 4.7-2 provides both beryllium concentrations with depth in MW-4 soil samples and beryllium concentrations in BH-1 through BH-15 (Section 4.6). Two distinct populations of beryllium are evident: one from 0 ft to 200 ft bgs and one from 250 ft to 543 ft. Concentrations of beryllium in the first population ranged from 0.05 mg/kg to 0.605 mg/kg. Concentrations of beryllium in the second population ranged from 0.55 mg/kg to 1.43 mg/kg.

Particle-size analyses of both MW-4 soil samples and BH-1 through BH-15 are presented in Section 6.3.3. In general, the percentage of silt and clay increases with depth. Silt and clay predominates below 300 ft bgs. Figure 4.7-2 indicates that beryllium is more abundant in the finer-grained sediments below 300 ft bgs. The bimodal beryllium distribution depicted in Figure 4.7-2 represents two distinct sources of origin for the sediments. The finer-grained sediments below 250 ft bgs represent ancestral Rio Grande deposits, whereas the coarser-grained alluvial sediments above 250 ft represent alluvial fan deposits from uplifted areas to the east.

4.7.2.5 Radiological

Radiological analytical results for MW-4 soil samples are presented in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II. The only radionuclide detected was tritium.

4.7.2.6 Tritium

Tritium activity with depth in MW-4 soil samples is presented in Table 4.7-10. The table provides sample depth, activity, 2-sigma error (analytical uncertainty), and gravimetric moisture content.

There are no RCRA-proposed Subpart S action levels for radionuclides in soil. As a result, tritium levels from MW-4 were compared to MWL background tritium levels. Local background tritium results are presented in Table 4.6-9. Background tritium activities ranged from 0.004 pCi/g to 0.042 pCi/g, well below tritium activity observed in MW-4 soil samples.

4.7.2.7 Plutonium-238 and Plutonium-239/240

Twenty-six soil samples, including four duplicate samples, were collected from MW-4 for isotopic plutonium analysis. The radiological analytical results from these samples are presented in Table 4.7-11. The table presents the ER sample identification (ID), the laboratory sample ID, the sample depth, the activity detected for Plutonium-238 and Plutonium-239/240, and the 2-sigma error associated with each sample result. No plutonium was detected above the 2-sigma error (analytical uncertainty) in any of the samples collected.

4.7.3 MW-4 Drilling Results Summary

VOC and SVOC concentrations detected during installation of MW-4 all were below either RCRA-proposed Subpart S action levels or action levels generated from toxicity information contained in both EPA's IRIS (EPA 1995a) database and the HEAST (EPA 1995b).

The concentrations of all metals detected were below Subpart S action levels, with the exception of beryllium. Beryllium is considered a natural artifact associated with ancestral Rio Grande deposits. The results of the statistical tests performed on the MW-4 soil data are presented in Table 4.7-12.

Soil samples analyzed for isotopic uranium, isotopic thorium, isotopic plutonium, and gross alpha/beta activity are within the range of normal background for SNL/NM. Tritium was detected in MW-4 soil samples to a depth of 15 ft bgs. The highest tritium activity was 1.1 pCi/g at 5 ft bgs.

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5. Groundwater Monitoring

Groundwater monitoring at the MWL was initiated in September 1990. Groundwater monitoring was conducted quarterly from September 1990 through January 1992, and semiannually from January 1992 to December 1995.

Groundwater monitoring at the MWL is conducted in accordance with the requirements set forth in Section R3d(1) of SNL/NM's HSWA Part B Operating Permit. Section R3d(1) states that, at a minimum, the RFI should determine the horizontal and vertical extent of any contaminant plumes originating from the MWL; the horizontal and vertical direction and velocity of contaminant migration; the factors influencing contaminant migration; and extrapolation of future contaminant movement. Groundwater sampling and analysis is conducted in accordance with the MWL site-specific sampling and analysis plan (SNL/NM 1994c) for major anions and cations, VOCs, SVOCs, TAL metals, and radionuclides.

The MWL monitoring well network was installed to detect potential contaminant releases to groundwater. The network was originally intended to comply with 40 CFR 265, Subpart F of RCRA and Section 206 of the Interim State Groundwater Monitoring Requirements of the New Mexico Hazardous Waste Regulations (HWMR-4). These requirements pertain to detecting releases of regulated, hazardous wastes to groundwater.

The MWL is regulated as a SWMU, and groundwater monitoring at the MWL must comply with 40 CFR 264.101, Corrective Action for SWMUs. The MWL is not a "regulated unit" under 40 CFR 264.90 9a(2) and the groundwater monitoring requirements of 40 CFR 264.91-264.100 do not apply (Davis 1994).

5.1 Monitoring Well Network

In 1995, the MWL monitoring well network consisted of five wells. The locations of these wells are shown in Figure 5.1-1. Background monitoring well BW-1 and MW-1, MW-2, and MW-3 were installed in a one-up, three-down configuration, respectively, based upon the regional groundwater gradient in 1988. MW-1 was installed in October 1988. BW-1, MW-2, and MW-3 were installed between June and September 1989 (Ecology and Environment 1989). MW-4 was installed between December 1992 and February 1993. MW-4 was installed in the northern unclassified area of the landfill to sample soils and groundwater directly beneath Trench D. Between May and June 1967, approximately 204,000 gallons of coolant wastewater from the Sandia Engineering Reactor Facility were disposed of in Trench D (Section 4.7).

5.2 Monitoring Well Completion

MW-1 was drilled using an air-rotary casing hammer, and BW-1, MW-2, and MW-3 were drilled using mud-rotary techniques. MW-1 is screened between 456 and 476 ft bgs. BW-1 and MW-2 are screened between 452 and 472 ft bgs. MW-3 is screened between 451 and 471 ft bgs. Well completion diagrams for these monitoring wells are presented in Figures 5.2-1 through 5.2-4.

MW-4 was installed using resonant sonic drilling at a 6-degree angle from vertical. MW-4 was completed in two zones to evaluate both vertical anisotropy and the changes in aquifer parameters with depth. The zones are screened between 482.5 and 502.5 ft bgs and between 522.5 and 542.5 ft bgs and separated by a Baski inflatable packer. The well completion diagram for MW-4 is presented in Figure 5.2-5.

5.3 Regional Groundwater

Depth to groundwater at KAFB varies from less than 50 ft bgs east of Hubbell Spring and the Tijeras and Sandia faults to greater than 500 ft bgs west of the faults. Figure 5.3-1 presents the regional water table map for KAFB in October 1995.

The regional water table map indicates that groundwater flow at KAFB is presently west/northwest. In 1961, Bjorklund and Maxwell reported that groundwater flow was to the west/southwest. This marked change in flow direction over the past 35 years is due to pumping of KAFB and City of Albuquerque production wells. Pumping of these wells has created a north-trending trough in the water table northwest of KAFB.

5.3.1 Drawdown of Regional Groundwater

Pumping of KAFB and City of Albuquerque production wells has caused regional groundwater at KAFB to decline. Figure 5.3-2 shows the annual groundwater level decline in the regional aquifer at KAFB in 1995. Groundwater level decline is greatest in the northwest portion of KAFB. Figure 5.3-3 presents a hydrograph for regional wells in TA-3, including NWTA-3, SWTA-3, and KAFB-10. Water levels in NWTA-3 and SWTA-3 are declining at a rate of approximately 2 ft/yr. The water level in KAFB-10, a recently abandoned production well, is declining at a rate of 1 ft/yr. The rate of decline in these wells varies due to aquifer lithologic heterogeneity, proximity to production wells, and differences in well depth and screen length.

5.3.2 MWL Groundwater

Figure 5.3-4 presents a hydrograph for MW-1, MW-2, MW-3, and BW-1. The average rate of water level decline for these monitoring wells between 1989 and 1995 is 0.81 ft/yr. Automated hourly readings of water levels in these monitoring wells were obtained from September 1991 through August 1995 using pressure transducers. A subset of these data is presented in Figure 5.3-5. These data show the steady decline in MWL monitoring well water levels in 1995. Semiannual sampling events are visible as sharp negative fluctuations in the data.

Automated water level readings were discontinued in August 1995 for all MWL monitoring wells except MW-4. Water levels in MW-4 continue to be monitored using pressure transducers because manual readings cannot be obtained due to the physical obstruction of the packer in the well.

Changes in barometric pressure have been observed to cause temporal fluctuations in water levels in MWL monitoring wells. In general, increasing barometric pressures result in decreasing water levels, and vice versa. The barometric responses of MWL monitoring wells provide additional evidence that groundwater at the site is semiconfined, rather than unconfined. Water levels in wells completed in semiconfined aquifers typically respond to fluctuations in barometric pressure, whereas water levels in wells completed in unconfined aquifers do not (Freeze and Cherry 1979). Figure 5.3-6 depicts temporal fluctuations in water levels in MW-4 due to barometric pressure changes.

5.3.2.1 Horizontal Hydraulic Gradient

The horizontal gradient of the aquifer beneath TA-3 ranges from 0.006 and 0.009 to the west. The horizontal gradient beneath the MWL is approximately 0.007 to the west, based upon the water table map presented in Figure 5.3-1.

5.3.2.2 Vertical Hydraulic Gradient

The vertical gradient beneath the MWL was calculated using differences in water levels between individual well screens within the aquifer. Table 5.3-1 summarizes the vertical gradient data for the aquifer at the MWL. Vertical gradients are downward, ranging from 0.11 to 0.93.

5.4 Groundwater Quality

This section summarizes groundwater quality at the MWL. The complete MWL groundwater quality data set is provided in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II. These results are further discussed below.

5.4.1 Major Ion Chemistry

Major ion chemistry data can reveal distinct characteristics useful for interpreting aquifer flow characteristics and identifying zones of mixing between contaminated and noncontaminated groundwater (Freeze and Cherry 1979). Table 5.4-1 summarizes the major ion chemistry of groundwater at the MWL. The complete major ion chemistry data-set for MWL groundwater is presented in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II. Major ion chemistry data are presented graphically using Piper trilinear and Stiff diagrams (Figures 5.4-1 through 5.4-20).

5.4.1.1 Piper Trilinear Diagrams

Figures 5.4-1 through 5.4-5 present Piper trilinear diagrams showing major ion concentrations in groundwater samples collected from the five MWL monitoring wells during April 1993, November 1993, October 1994, April 1995, and October 1995. The figures show consistent cation/anion chemistry over time. Groundwater at the MWL is a bicarbonate-type water.

Piper trilinear diagrams for samples from individual monitoring wells are presented in Figures 5.4-6 through 5.4-10. These figures show the consistency of groundwater quality in MW-1, MW-2, MW-3, MW-4 and BW-1 during the period April 1993 through October 1995.

Figure 5.4-9 shows a subtle, but distinct, shift in major-ion chemistry in groundwater collected from MW-4 during the same period. This shift occurred in June 1994 when the upper and lower screened zones of MW-4 were isolated with a Baski packer (see Section 5.2). Samples collected prior to June 1994 represent commingled upper and lower zone groundwater, while the samples collected after June 1994 represent upper zone groundwater only.

5.4.1.2 Stiff Diagrams

Stiff diagrams also show MWL groundwater quality has been stable over time. Stiff diagrams for groundwater samples collected from all five MWL wells during April 1993, November 1993, October 1994, April 1995, and October 1995 are presented in Figures 5.4-11 through 5.4-15. Stiff diagrams for individual monitoring wells are presented in Figures 5.4-16 through 5.4-20.

Subtle differences in major-ion chemistry between the upper and lower zones of MW-4 are observed in Figure 5.4-19. Major-ion chemistry for groundwater from MW-4 varies slightly between November 1993 and October 1994, reflecting installation of the inflatable packer in June 1994. The Stiff diagrams prior to June 1994 show the major-ion chemistry of commingled groundwater from the upper and lower zones, while the Stiff diagrams after June 1994 show the major ion chemistry from the upper zone only.

These Piper trilinear and Stiff diagrams demonstrate conclusively that MWL groundwater chemistry has remained consistent over time, and does not vary significantly from well to well.

5.4.2 Resource Conservation and Recovery Act Metals

Concentrations of RCRA metals in groundwater at the MWL were compared to EPA maximum contaminant levels (MCLs) and proposed Subpart S action levels (Tables 5.4-2 through 5.4-6). Cadmium, lead, and nickel were detected in groundwater in concentrations at or slightly above the MCLs or action levels specified in the 1995 EPA drinking water standards (EPA July 1995). No other analytes exceeded the MCLs or Subpart S action levels. The complete groundwater quality data set for TAL metals is provided in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II.

Cadmium was detected in MW-1, MW-2, MW-3, and BW-1 in January 1993 at concentrations exceeding the MCL of 0.005 mg/L. The matrix spike recovery and the relative percent difference for cadmium were out of QC limits for cadmium in the January 1993 samples. These results are attributed to laboratory error, since no cadmium has been detected in any of the monitoring wells in concentrations exceeding the MCL since 1993.

Lead was detected in MW-1 in November 1993 at 0.018 mg/L, slightly above the EPA Action Level of 0.015 mg/L. No lead concentrations have exceeded the EPA Action Level in any MWL monitoring wells since November 1993.

Nickel was detected in MW-1 in 1992, 1994, and 1995 at concentrations exceeding the MCL of 0.1 mg/L. Elevated nickel concentrations in this well are attributed to corrosion of the stainless steel screen used in its construction.

5.4.3 Nitrate

Nitrate concentrations for MWL groundwater are presented in Table 5.4-7, with all concentrations presented in mg/L (as nitrogen). Nitrate concentrations are below the EPA MCL of 10 mg/L and range from 0.14 mg/L to 5.9 mg/L. The highest nitrate concentrations were measured in BW-1, and the lowest nitrate concentrations were measured in MW-4. The source of nitrate in MWL groundwater is attributed to off-site natural- and man-made sources.

5.4.4 Radionuclides

Groundwater at the MWL has been analyzed for various radionuclides, including tritium, isotopic uranium, total uranium, isotopic thorium, isotopic plutonium, strontium-90, cobalt-60, and cesium-137. Sampling for radionuclides includes screening for gamma-emitters and gross alpha/beta activity. The radionuclide data set is provided in SNL/NM, June 1998, *Responses to NMED Technical Comments on the Report of the Mixed Waste Landfill Phase 2 RCRA Facility Investigation Dated September 1996*, Volumes I and II.

5.4.4.1 Gross Alpha/Gross Beta Activities

Gross alpha activities in groundwater are indicator parameters of possible radionuclide contamination. MWL groundwater has been screened for gross alpha activity since September 1990. Gross alpha activities are shown in Table 5.4-8.

The EPA MCL for gross alpha activity is 15 pCi/L, excluding the component of gross alpha activity attributable to uranium. Gross alpha activities in Table 5.4-8 are not corrected for the average uranium activity in MWL groundwater. Gross alpha activities in MWL groundwater do not exceed the EPA MCL.

Gross beta activities in MWL groundwater are shown in Table 5.4-9. The maximum gross beta activity, 72.8 pCi/L, was measured on a sample from BW-1 in January 1993. The 72.8 pCi/L activity is attributed to laboratory error.

The EPA MCL for gross beta activity is site-specific and is determined by the activity that would result in an annual dose of 4 mrem/yr to a potential receptor from a man-made source. Because no man-made sources are present in MWL groundwater, the MCL for gross beta activity is not applicable to the MWL.

5.4.4.2 Uranium

Uranium occurs naturally in groundwater both at KAFB and within the Middle Rio Grande Basin. At KAFB, a background study showed total uranium concentrations ranging from 0.5 to 14.9 µg/L in background wells across KAFB (IT 1996).

MWL groundwater samples are routinely analyzed for total and isotopic uranium. Total uranium concentrations in MWL groundwater range from 1.34 to 7.84 µg/L, and average 5.49 µg/L (Table 5.4-10.). An anomalous total uranium value of 2690 µg/L was measured in a sample from MWL-MW4 in October 1994. The sum of this sample's isotopic constituents yields a total uranium value of 8.85 µg/L. The 2690 µg/L value is attributed to laboratory error.

Total uranium concentrations in MWL groundwater (Table 5.4-10) are well within the total uranium ranges established in the KAFB background study (IT 1996). Uranium concentrations in MWL groundwater are significantly lower than the proposed EPA MCL of 20 µg/L.

Table 5.4-11 presents isotopic uranium analyses for MWL groundwater. Isotopic uranium activities are within background ranges measured during the KAFB background study (IT 1996).

The MWL isotopic uranium data were obtained using standard radiometric methods (gamma spectroscopy and alpha spectrometry). Although these data are adequate for evaluating the order of magnitude activities of the various isotopes in groundwater, they are not sufficiently accurate for isotopic ratio analysis.

5.4.4.3 Tritium

Tritium is the primary COC at the MWL. Tritium has been a consistent finding at the MWL since environmental studies at SNL/NM were initiated in 1969. Tritium is present in surface and near-surface soils at the landfill. Tritium activities range from 1100 pCi/g in surface soils to 206 pCi/g in subsurface soils. The highest tritium activities are found within 30 ft of the surface in soils adjacent to and directly below MWL disposal pits. Below 30 ft, tritium activity falls off rapidly to a few pCi/g of soil.

Tritium results for MWL groundwater are presented in Table 5.4-12. Tritium was detected in MW-3 in October 1991 at 906 ± 276 pCi/L but was not detected in the duplicate sample. Tritium was also detected at low activities in BW-1 and MW-1 in October 1991, and in MW-4 in May 1994. Tritium has not been detected in MWL groundwater since 1994.

5.4.4.4 Plutonium

Plutonium results for MWL groundwater are presented in Table 5.4-13. Plutonium 239 was detected in a sample from MWL-MW2 in October 1995 at 0.028 ± 0.024 pCi/L. The 2-sigma error in this sample is nearly equal to the given value. Subsequent sampling of MWL-MW2 has not indicated the presence of plutonium, and the October 1995 MWL-MW2 detection is considered a false positive.

5.4.4.5 Strontium-90

Strontium-90 results for MWL groundwater are presented in Table 5.4-14. Strontium-90 has been detected five times at activities ranging from 1.8 to 5.7 pCi/L. None of the detections exceed the EPA drinking water standard for beta-gamma emitting radionuclides of 8 pCi/L. The strontium-90 detections in MWL groundwater are considered false positives.

5.4.4.6 Cobalt-60

Cobalt-60 results for MWL groundwater are presented in Table 5.4-15. Cobalt-60 is readily detected using gamma spectroscopy, which is conducted routinely on all MWL groundwater samples. Results show no evidence of cobalt-60 contamination in MWL groundwater.

5.4.4.7 Cesium-137

Cesium-137 results for MWL groundwater are presented in Table 5.4-16. Cesium-137 was detected in BW-1 in September 1990 at 3.75 pCi/L. Cesium-137 was detected in MW-1 in May 1991 at 3.01 ± 2.81 pCi/L. Subsequent sampling of BW-1 and MW-1 has not indicated the presence of cesium-137, and the 1990 and 1991 detections are considered false positives.

Cesium-137, like cobalt-60, is readily detected using gamma spectroscopy. Results show no evidence of cesium-137 contamination in MWL groundwater.

5.4.4.8 Thorium

Isotopic thorium results for MWL groundwater are presented in Table 5.4-17. In October 1994, activities of thorium-228, thorium-230, and thorium-232 exceeding the Derived Concentration Guides were measured in samples from several MWL monitoring wells. These data are considered suspect for the following reasons: 1) isotopic thorium analyses performed in triplicate for the samples in question showed a high degree of variability, raising questions about the validity of the data; 2) concurrent gamma spectral analyses did not indicate the presence of measurable concentrations of thorium-228, whereas the laboratory reported thorium-228 concentrations in excess of 20 pCi/L; and 3) subsequent groundwater sampling has not shown elevated levels of isotopic thorium.

5.4.5 Organic Compounds

Groundwater sampling for organic compounds has included RCRA Appendix IX VOCs, SVOCs, dioxins, furans, chlorinated pesticides, PCBs, herbicides, total organic carbon, total organic halogen, and phenolics. MWL groundwater is currently sampled annually for VOCs and SVOCs.

5.4.5.1 Volatile Organic Compounds

The VOCs detected in MWL groundwater and the corresponding EPA MCLs are presented in Table 5.4-18. In general, VOCs detected in MWL groundwater are above the MDL but below the laboratory RL or PQL. Detections below the laboratory RL or PQL are estimated, and designated as "J" values.

Most of the VOCs detected in MWL groundwater are among the common laboratory contaminants, including acetone, methylene chloride, and 2-butanone. According to the EPA "Rule of Ten" (EPA 1993), detections should be reported unless the concentration in the sample is less than or equal to 10 times the concentration in the blank for the common laboratory contaminant, or 5 times the concentration in the blank for other VOCs. The "Rule of Ten" was applied to Table 5.4-18, and the VOCs listed in Table 5.4-18 do not include results where common laboratory contaminants were detected in the associated laboratory or method blanks.

Acetone has been detected in BW-1, MW-2, and MW-4. All results were qualified as J values except for results from MW-4 in October 1995.

Methylene chloride (the most common volatile laboratory contaminant) is often detected in MWL samples and associated trip or laboratory blanks. All of the methylene chloride detects in Table 5.4-18 were J qualified. The EPA drinking water standard for methylene chloride is 5 μg/L. No values have exceeded the EPA standard.

Toluene was detected in MW-4 in May 1994 at 0.54 J μg/L. The EPA drinking water standard for toluene is 1000 μg/L. No values have exceeded the EPA standard.

5.4.5.2 Semivolatile Organic Compounds

SVOCs detected in MWL groundwater are presented in Table 5.4-19. Bis(2-ethylhexyl) phthalate, a plastic additive and common laboratory contaminant, was detected in BW-1, MW-1, MW-2, and MW-4. SVOCs detected in MWL groundwater are attributed to laboratory contamination.

5.4.6 Nature and Extent of Contamination in MWL Groundwater

Between September 1990 and October 1995, fifteen rounds of quarterly and semiannual groundwater sampling have been conducted at the MWL. Extensive analyses for VOCs, SVOCs, TAL metals, and radionuclides have demonstrated that there is no groundwater contamination at the MWL.

5.5 MWL Aquifer Testing

In 1994, pumping tests were conducted on the upper- and lower-screened intervals of MW-4 to measure the hydraulic conductivity of the aquifer at each screened interval. During each test, an inflatable packer was used to hydraulically isolate the upper- and lower-screened intervals. The water level in each interval was monitored using pressure transducers. A 52-hr pumping test was conducted on the lower-screened interval at flow rates ranging from 2.94 gallons per minute (gpm) to 3.68 gpm. No drawdown was observed in the upper-screened interval of MW-4 or in adjacent observation wells, although 12,000 gallons of water were pumped from the aquifer.

A subsequent aquifer test was conducted on the upper-screened interval, again using the inflatable packer to isolate the upper- and lower-screened intervals. A 13.3-hr pumping test was conducted on the upper-screened interval at flow rates ranging from 0.12 gpm to 1.06 gpm.

Again, water levels were monitored using pressure transducers. No drawdown was observed in the lower-screened interval of MW-4, or in adjacent observation wells.

The results from both aquifer tests are presented in Table 5.5-1. Storativity was not determined because no drawdown was measured in adjacent observation wells.

During April and May 1994, wells MW-1, MW-2, MW-3, and BW-1 were sampled for water quality as part of the ongoing MWL groundwater monitoring program. Water levels were monitored with pressure transducers during the purging and sampling of the wells, and hydraulic conductivity values were calculated from the drawdown and recovery data (SNL/NM June 1998).

5.5.1 Results of MWL Aquifer Testing

Analysis of MW-4 aquifer test data and MWL monitoring well recovery data indicate that the hydraulic conductivities of MWL geologic strata are typical of conductivities observed in silt and silty sand (Freeze and Cherry 1979). A summary of the aquifer test results is presented in Table 5.5-1.

Aquifer test data indicate that MW-4's lower screen is completed in a more conductive zone of the aquifer. The average (geometric mean) hydraulic conductivity of the shallower portion of the aquifer (based upon tests conducted on MW-1, MW-2, MW-3, and BW-1) is $1.09\text{x}10^{-2}$ ft/day. The hydraulic conductivity of the deeper, more conductive zone in which the lower screen of MW-4 is completed is 1.48 ft/day.

MW-4 aquifer test results indicate that aquifer vertical anisotropy is significant. During testing, no potentiometric responses were observed in adjoining MW-4 zones or in adjacent MWL observation wells. These data indicate that the aquifer horizontal hydraulic conductivity is several orders of magnitude greater than the vertical hydraulic conductivity.

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6. Vadose Zone Characterization

6.1 Introduction

The MWL is underlain by a thick vadose zone extending approximately 500 ft bgs to groundwater. Consequently, meteoric water movement (and potential contaminant migration) at the landfill is likely to occur as unsaturated flow in the vadose zone. To adequately assess the potential for contaminant migration from the MWL to groundwater, extensive vadose zone characterization was conducted, including:

- Analyzing geochemical soil parameters
- Measuring unsaturated hydrologic flow parameters in the laboratory and in the field
- Assessing recharge at the MWL
- Evaluating contaminant migration mechanisms in the vadose zone

6.2 Geochemical Analysis of Soils

Persaud and Wierenga (1982) conducted a detailed geochemical study of solute interactions and transport in soils at the MWL. The excavation of Pit 33 (Figure 4.4-4) in the classified area was used for this study. Pit 33 was excavated to a depth of 29 ft bgs. Soil core samples were collected from soil horizons within and below Pit 33 for geochemical and physical analysis. A detailed description of the soil profile from Pit 33 is presented in Table 6.2-1.

6.2.1 Geochemical Sampling

Saturation extracts from the soil core samples were prepared and analyzed for key geochemical parameters, and the core samples were analyzed for particle size distribution. Table 6.2-2 presents the results of these analyses. The analyses include the electrical conductivity and pH of the saturation extracts, the percent $CaCO_3$ and organic matter, the cation exchange capacity of the samples, and the particle size fraction. Additional particle size data are presented in Section 6.3.3.

Composite samples were collected from the bottom of Pit 33 between 28.0 and 29.5 ft bgs, and between 30.2 and 32.2 ft bgs. These samples were sieved to determine particle size distribution. The < 2 millimeter (mm) size fractions comprised more than 90 percent by weight of each sample. Because this size fraction often exerts the greatest influence on geochemical adsorption processes, these fractions were further analyzed for specific geochemical properties, such as free iron oxide content, and organic carbon content, which are likely to play a major role in solute mobility. The results are summarized in Table 6.2-3.

6.2.2 Adsorption Studies

The < 2 mm fraction from the composite sample taken from the 28.0 to 29.5 ft bgs interval was analyzed to determine the adsorption properties of various metals in Pit 33 soils (Persaud and

Wierenga 1982). The metals studied were cesium, strontium, chromium, lead, mercury, nickel, and cadmium. Several types of adsorption experiments were conducted on these samples, and the Freundlich and Langmuir equations were fitted to yield empirical relationships between the contaminant concentrations adsorbed and the resulting concentrations of the equilibrium solutions. The studies indicate relatively strong adsorption of all elements studied, with the exception of chromium, which was not appreciably adsorbed (Persaud and Wierenga 1982).

6.2.3 Column Leaching Studies

Column leaching studies were conducted on composite soil samples from Pit 33. These studies were conducted under unsaturated flow conditions for tritium, chromium, cesium, and strontium. Solutions containing these analytes were leached through soil columns, and the effluents were analyzed. The results from the column leaching studies were consistent with the results from Persaud and Wierenga (1982) adsorption studies.

6.3 Hydrologic Properties of Subsurface Soils

The hydrologic properties of subsurface soils at the MWL were analyzed in both the laboratory and the field. Laboratory analyses of physical and hydrologic parameters were conducted on both subsurface soil samples collected during Phase 2 RFI borehole drilling and MW-4 core samples. Field measurements of the hydrologic properties of MWL soils were obtained during an instantaneous profile (IP) test conducted west of the MWL (Goering et al. 1995).

Subsurface soil properties measured on core samples in the laboratory included gravimetric and volumetric moisture contents, bulk density and porosity, saturated and unsaturated hydraulic conductivity, soil moisture characteristics, and particle size analyses. Atterberg limits were determined for several samples that appeared high in clay content. Laboratory data (with the exception of moisture content data) are presented in Table 6.3-1. Subsurface soil properties measured in the field during the IP test included soil moisture characteristics and the relationships between unsaturated hydraulic conductivity and volumetric moisture content. These data are discussed in Sections 6.3.1 through 6.3.6.

6.3.1 Soil Moisture

Understanding the range and variations of soil moisture conditions at a site is important in understanding unsaturated flow and contaminant transport. Soil moisture contents were measured according to American Society for Testing and Materials (ASTM) Method D-2216-90. Soil samples were weighed, oven-dried, and weighed again. Gravimetric moisture contents are reported as a percent value, based upon the mass of water per mass of dry soil. Where samples were relatively undisturbed, gravimetric moisture contents were converted to volumetric moisture contents (i.e., the volume of water per bulk volume of soil).

A total of 486 samples from MWL borehole drilling (Section 4.6) were analyzed for gravimetric moisture content. Eighteen samples were analyzed for volumetric moisture content. Gravimetric moisture content profiles in soils at the MWL are shown in Figure 6.3-1. In general, higher moisture contents are observed in the upper 20 ft of the soil profile. Gravimetric moisture contents in subsurface soils range from 0.2 percent to 13.0 percent by weight, averaging 3.0 percent. Volumetric moisture contents range from 0.9 percent to 10.6 percent, averaging 4.6 percent.

6.3.2 Bulk Density and Porosity

Soil bulk density is the mass of dry soil per total volume of soil. Bulk density and porosity were determined using procedures described in Methods of Soil Analysis (1987). Fourteen subsurface soil samples were analyzed for bulk density and porosity. The bulk density values of MWL subsurface soils range from 1.38 to 2.07 g/cubic centimeter (cm^3), averaging 1.92 g/cm^3. Bulk density and porosity data are presented in Table 6.3-1.

Soil porosity values are estimated as a function of bulk density and, therefore, show a consistent inverse relationship to bulk density. Porosity values for MWL subsurface soils range from 21.9 percent to 47.9 percent, averaging 27.4 percent.

6.3.3 Particle Size Analysis

Nineteen samples from the MWL boreholes were analyzed for particle size distribution. The samples were weighed and sieved, and the weight that remained on each screen was measured and used to calculate the percentage of soil retained for each particle size. Many MWL soil samples were fine-grained, requiring hydrometer analyses to adequately determine the silt and clay fraction. The grain size divisions used are based upon the Unified Soil Classification System.

The results of the particle size analysis are presented in Figures 6.3-2 and 6.3-3. The particle size distributions shown on these figures represent samples collected from linear depths of 30 to 120 ft. Table 6.3-1 presents the weight percentage of each sample that is silt/clay-sized (i.e., < 0.075 mm).

Core samples from MW-4 were analyzed for particle size distribution, and the results are shown in Figures 6.3-4 and 6.3-5. Figure 6.3-6 shows the relationship between percentage of silt and clay and the MW-4 sample depth. In general, silt and clay percentages increase with depth. High percentages of silt and clay predominate below 250 ft bgs. This predominance of fine-grained materials, particularly in samples collected from the saturated zone, is reflected in the low hydraulic conductivity measured in the MWL aquifer (Section 5.5).

6.3.4 Saturated Hydraulic Conductivity

Saturated hydraulic conductivity (K_{sat}) is a measure of a saturated soil's capacity to transmit water. The K_{sat} of 18 soil samples from MWL boreholes and 9 soil samples from MW-4 were measured. Hydraulic conductivity data from MWL boreholes are presented in Table 6.3-1. Hydraulic conductivity data from MW-4 are presented in Figure 6.3-7.

The K_{sat} tests were conducted using a rigid-wall permeameter in accordance with ASTM Method D 2325-68. The tests utilized a 0.1 N CaSO4 solution as the primary fluid with either a constant-head or a falling-head permeameter. The constant-head permeameter was used when the K_{sat} was relatively high (greater than 10^{-3} or 10^{-4} centimeters [cm]/second [s]). The falling-head permeameter was used when the K_{sat} was less than 10^{-3} or 10^{-4} cm/s.

The K_{sat} observed from MWL borehole and MW-4 samples varied by up to 3 orders of magnitude. In general, samples with a higher percentage of sand and gravel had a higher K_{sat} than samples with a higher percentage of silt and clay. Figure 6.3-7 shows the relationship between the K_{sat}, the percentage of silt and clay, and sample depth.

6.3.5 Soil Moisture Characteristics

Soil moisture characteristics refer to the relationship between soil moisture content and soil water tension. Soil moisture characteristics reflect the lithologic characteristics of the soils and provide useful information about pore-size distribution. Sandy soils tend to release water at small tension values, rapidly desaturating, whereas clayey soils release water only at great tension, remaining saturated for longer periods of time. The pressure at which the soil becomes unsaturated is called the air-entry pressure. This pressure is close to atmospheric pressure for sands and highly negative for clays.

An IP test was conducted in a clean area approximately 500 ft west of the MWL from 1993 to 1995. The purpose of the test was to measure the unsaturated hydraulic properties of soils near the MWL, including the relationship between hydraulic conductivity, moisture content, and soil water tension. Results of the IP test are presented in SAND96-0813, SAND95-1637, and SAND96-2090 (Bayliss et al. 1995, Goering et al. August 1995, and Roepke et al. August 1996).

Soil moisture characteristics for subsurface soil samples from the IP test plot were measured in the laboratory using the pressure plate extractor method found in Methods of Soil Analysis (1987). These characteristics are shown in Figures 6.3-8 and 6.3-9. The soil moisture characteristics were also measured in the field during the IP test. These results are shown in Figure 6.3-10. The soil moisture characteristic curves in these figures were fitted to the laboratory and field data points using the computer code Retention Curve Code (RETC) (Van Genuchten et al. 1992).

6.3.6 Unsaturated Hydraulic Conductivity

Hydraulic conductivity is a function of lithology, soil moisture characteristics, and soil moisture content. The relationship between hydraulic conductivity and volumetric moisture content was determined in both the laboratory and the field.

The relationship between hydraulic conductivity and volumetric moisture content is difficult to measure directly in the laboratory. Consequently, this relationship was determined indirectly using RETC. RETC uses the laboratory-measured soil moisture characteristic and K_{sat} data to calculate the unsaturated hydraulic conductivity. Hydraulic conductivity as a function of volumetric moisture content for IP test plot core samples is shown in Figures 6.3-11 and 6.3-12.

Hydraulic conductivity as a function of volumetric moisture content was measured *in situ* during the IP test. These data are shown in Figure 6.3-13 and compare quite favorably with the laboratory results. The curves on this figure were fitted to the field data points using RETC.

The relationship between unsaturated hydraulic conductivity and moisture content can be used to estimate recharge based upon the moisture content of subsurface soils. Section 6.4.1 discusses how the MWL unsaturated hydraulic conductivity data were used to estimate recharge at the landfill.

6.4 Recharge at the MWL

Determining recharge through the vadose zone at the MWL is important in understanding the MWL conceptual model and the potential contaminant pathways to groundwater. Estimates of recharge at the MWL were obtained using three independent approaches. These approaches included the

- Soil-physics method
- Chloride mass balance method
- Stable-isotope method

The commonly-applied bomb-pulse tritium method was not used because of existing tritium contamination in surface and subsurface soils at the MWL. Recharge was estimated using multiple methods because of the importance of this parameter to the MWL conceptual model and because of the uncertainty involved with estimating recharge. The results are presented in the following sections.

6.4.1 Soil-Physics-Based Method

The soil-physics method is an indirect means of estimating recharge using Darcy's Law. It is based upon the relationship between unsaturated hydraulic conductivity and volumetric moisture content of subsurface soils at the site in question (Stephens and Knowlton 1986). This method presupposes that the downward flux of water below the root zone will eventually reach groundwater. This method assumes

- One-dimensional, steady-state flow
- No preferential flow
- Insignificant diffusion
- Negligible runoff

Using the soil-physics method, the downward flux at a particular depth in the vadose zone is calculated, based upon Darcy's Law,

$$q = K(\theta) \times I$$

where

q = Darcian flux [L/T]
$K(\theta)$ = Vertical unsaturated hydraulic conductivity as a function of moisture content [L/T]
I = The unsaturated vertical hydraulic gradient beneath the root zone [L/L].

The unsaturated vertical hydraulic gradient below the root zone was assumed to be unity, based upon the results from the MWL IP test. Gee and Hillel (1988) indicate that this assumption of unit vertical hydraulic gradient is reasonable for uniform soil conditions in the vadose zone.

The unsaturated hydraulic conductivity of subsurface MWL soils at ambient moisture content is estimated to be 1×10^{-10} cm/s. This estimate is based upon the results of the IP test and laboratory testing of core samples and assumes a conservatively-high volumetric moisture content of 0.10. Field evidence indicates that actual volumetric moisture contents of subsurface soils are considerably lower (Section 6.3.1). As a result, the actual unsaturated hydraulic conductivity of subsurface soils at the MWL may be much less than 1×10^{-10} cm/s.

Assuming a vertical hydraulic gradient of unity and an unsaturated hydraulic conductivity of 1×10^{-10} cm/s, recharge at the MWL is estimated to be 1×10^{-10} cm/s using the soil-physics method of estimating recharge.

6.4.2 Chloride Mass Balance Method

The chloride mass balance method is commonly used to estimate recharge through the vadose zone (Allison and Hughes 1978, Sharma and Hughes 1985, Phillips et al. 1988). This method assumes

- One-dimensional, steady-state flow
- That chloride is added to the soil at a constant rate through precipitation and dryfall
- That chloride is conservative and moves downward through piston displacement
- No preferential flow
- Insignificant diffusion
- Negligible runoff

In this approach, the average chloride flux from precipitation is equal to the average chloride flux below the root zone. The recharge, R, is calculated using

$$R = C_p \cdot P / C_r$$

where

P = The average annual precipitation rate [L/T]
C_p = The average chloride concentration in precipitation [M/L^3]
C_r = The chloride concentration in soil water beneath the root zone [M/L^3].

Chloride profiles with depth were obtained from MW-4, BH-1, and BH-7. Thirteen samples for chloride analysis were collected from depths of 50 to 499 ft bgs during the installation of MW-4.

A total of 148 samples for chloride analysis from BH-1 and BH-7 were collected at 1-ft intervals to a depth of 30 ft, and at 2-ft intervals from 30 to 118 ft bgs. Figure 6.4-1 presents the chloride profiles with depth for BH-1 and BH-7. The MW-4 chloride data are not included in the figure because so few samples were collected.

Recharge was estimated based upon the average chloride concentration in the soil profile between linear depths of 71 to 118 ft in BH-1 and from 66 to 118 ft in BH-7. These depth intervals were used because chloride concentrations are relatively constant in these intervals.

Using the chloride mass balance approach, the average recharge at the MWL was estimated to be 1×10^{-9} cm/s, or approximately 0.2 percent of annual precipitation in the area. This is based upon

$P = 6.3 \times 10^{-7}$ cm/s
$C_p = 0.35$ mg/L (from Phillips 1994)
$C_r = 220$ mg/L (the average chloride concentration in soil water beneath the root zone).

6.4.3 Stable-Isotope Method

The stable-isotope method may be used to estimate recharge in arid regions (Allison et al. 1983). This method utilizes the stable isotopes (oxygen-18 and deuterium) and is based upon isotopic enrichment that occurs as a result of evaporation. Isotopic enrichment yields unique isotope concentration profiles that reflect the combined effect of precipitation timing and evaporative losses at a given site. The isotopic concentration profiles are determined by sampling soil water with depth for oxygen-18 and deuterium.

The stable-isotope method assumes

- One-dimensional, steady-state flow;
- No preferential flow;
- Negligible runoff;
- Direct evaporation from soil significant enough to enrich the isotopic composition of infiltration;
- Fairly constant temperatures throughout the period of accumulation of the soil water sampled; and
- That the isotopic composition of rainwater has been constant (climate has not significantly changed) throughout the period of accumulation of the soil water analyzed.

The stable-isotope method involves plotting the deuterium values against the oxygen-18 values for each sample and calculating the difference between the deuterium values and the meteoric water line (Craig 1961). The average difference between deuterium values and the meteoric water line (the average $\Delta\delta D$) is proportional to the reciprocal of the square root of the recharge.

Rearranging to solve for recharge yields

$$R = k\,(\Delta\delta D)^{-2}$$

where

R = Recharge [mm/yr]
k = The proportionality constant equal to approximately 400 [mm/yr] (Allison et al. 1983)
$\Delta\delta D$ = The average difference in deuterium values from the meteoric water line.

Thirteen subsurface soil samples from MW-4 were collected for analyses of stable isotopes. The samples were obtained from depths of between 50 and 499 ft bgs. The stable isotope data from these samples were analyzed using the method discussed above. Assuming a value of 400 for the proportionality constant, k, and a value of approximately 23 permil for $\Delta\delta D$, recharge was estimated to be 2×10^{-9} cm/s.

6.4.4 Summary of Recharge Calculations

Recharge based upon the analytical methods ranges from 1×10^{-10} cm/s to 2×10^{-9} cm/s. These values are summarized in Table 6.4-1. Assuming an average depth to groundwater of 500 ft bgs and an average volumetric moisture content of 4.6 percent, the ambient downward seepage velocity at the MWL ranges from 2×10^{-9} cm/s to 4×10^{-8} cm/s.

Using the most conservative seepage velocity of 4×10^{-8} cm/s, it would take approximately 10,000 years for aqueous-phase contaminants to reach groundwater at current groundwater levels (500 ft bgs) under ambient recharge conditions. However, groundwater levels beneath the MWL are declining at a rate of 0.81 ft/yr, which is orders of magnitude greater than the maximum predicted seepage velocity. Hence, aqueous-phase contaminants may never reach groundwater beneath the MWL at the current rate of water level decline in the regional aquifer.

6.5 Vadose Zone Monitoring

To better understand the transient effects of precipitation on recharge, subsurface moisture contents in the vadose zone were monitored at the MWL using a CPN 503 DR neutron moisture probe. In July 1995, BH-15 (Figure 4.6-1) was cased to 120 ft bgs with 2-in.-diameter Schedule 80 PVC pipe for neutron moisture monitoring. Soil moisture profiles in BH-15 were obtained monthly since July 1995 to observe the effects of precipitation on moisture contents in subsurface soils at the landfill.

Figure 6.5-1 presents soil moisture profiles with depth in the upper 100 ft of BH-15 from July 1995 through April 1996. Figure 6.5-2 presents soil moisture profiles in the upper 10 ft of BH-15 during this same period. Figure 6.5-2 shows that meteoric stresses influence moisture content in the upper 2 ft of soils, but moisture contents below 2 ft are fairly stable and not significantly affected by meteoric stresses. Thus, although precipitation temporarily increases the quantity of water stored in near surface soils, most of this water is subsequently removed from the soil profile by evapotranspiration rather than percolating below the root zone to groundwater.

6.6 Conclusions

The data from the Phase 2 RFI and previous MWL investigations demonstrate that the vadose zone has intrinsic, favorable properties that limit subsurface contaminant migration and potential contaminant migration to groundwater. These properties include the following:

- The vadose zone is thick, extending approximately 500 ft from ground surface to groundwater.

- Vadose zone geochemical properties favorably mitigate the migration of heavy metals and radionuclides from the MWL. Tritium is the only contaminant that has migrated from landfill disposal cells.

- The relative percentage of silt and clay increases with depth, predominating below 250 ft bgs. This soil size fraction exerts the greatest influence on geochemical adsorption processes that act as a geochemical barrier, protecting groundwater from the migration of heavy metals and radionuclides. This silt/clay-rich strata also acts as a hydrogeological barrier providing extremely low unsaturated hydraulic conductivity.

- The vadose zone is quite dry, with average volumetric moisture contents of 4.6 percent. As a result, the unsaturated hydraulic conductivity of these soils is on the order of 10^{-10} cm/s, further protecting groundwater from potential contaminants.

- Low hydraulic conductivity, coupled with the low precipitation and high evapotranspiration in the Albuquerque area, results in negligible recharge to groundwater at the MWL. Recharge is on the order of 1×10^{-10} cm/s to 2×10^{-9} cm/s.

- Neutron moisture-meter monitoring of the vadose zone indicates that precipitation infiltrates less than 2 ft of soil and is removed rapidly via evapotranspiration.

- The vadose zone conceptual model is substantiated by the fact that there is no groundwater contamination at the MWL. The thick vadose zone, coupled with favorable geochemical and hydrologic properties, negligible recharge, and high evapotranspiration, have prevented potential COCs from migrating into groundwater. These favorable physical and chemical features will continue to protect groundwater well into the future.

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7. Risk Assessment

7.1 MWL Land-Use Scenario

An industrial land-use scenario has been designated for the MWL due to its location, disposal history, and projected future use. The landfill is currently fenced to prevent unrestricted access. The most likely receptors are site workers. These individuals provide maintenance and environmental surveillance of the landfill. Trespassers may also be receptors, although the potential for trespass at this remote, controlled site is not considered significant; the potential exposure routes for trespassers is the same as for site workers but the exposure frequency and duration would be significantly less. Therefore, a potential receptor is considered to be a site worker in an industrial land-use scenario.

7.2 MWL Exposure Routes

Contaminant transport mechanisms have been identified that result in three primary exposure routes. Contaminants may be transported from disposal pits and trenches downward through the vadose zone to groundwater and potentially laterally into water-supply wells. The nearest production well, KAFB-8, is 3 miles north of the MWL. To be conservative, a production well was assumed to be located directly below the MWL for use in calculating potential intakes from ingestion of drinking water. Contaminants may be volatilized and move through the vadose zone to the surface. Contaminants may exist in surface soils and these may be ingested or inhaled as respirable particles. No human intrusion scenarios are included in the MWL risk assessment. Institutional controls are presumed to mitigate these potential intrusion scenarios.

The conceptual model of chemical contamination and potential transport includes three exposure routes for risk assessment: (1) ingestion of chemicals in drinking water, (2) ingestion of chemicals in soil, and (3) inhalation of soil-derived particulates and vapor-phase contaminants. No potential for swimming in surface water is present due to high-desert environmental conditions. Because of these considerations and the projected industrial land-use scenario, SNL/NM does not consider ingestion routes related to consumption of fish, shellfish, fruits, vegetables, meat, eggs, or dairy products to be significant. These routes, therefore, are not considered in the risk assessment. Additionally, dermal exposure routes are not considered significant because of the lack of surface water.

For radionuclides, the conceptual model for potential transport includes the same three exposure routes for chemicals, with the additional potential exposure route of external gamma radiation. The inhalation exposure route includes both particulates and vapor-phase radon and tritium.

7.3 Risk Assessment Analysis

Risk assessment includes a number of steps that culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at a site. The steps, discussed in this section, include:

Step 1. Site data are obtained that provide information on potential COCs, as well as the relevant physical characteristics and properties of the site.

Step 2. Potential pathways by which humans might be exposed to potential COCs are identified.

Step 3. The potential intake of these COCs by humans is calculated using a tiered approach. The tiered approach includes screening steps, followed by potential intake calculations and a discussion or evaluation of the uncertainty in those calculations.

Step 4. Data are obtained on the potential toxicity and cancer effects from exposure to potential COCs and subsequent intake.

Step 5. Potential toxicity effects (specified as a Hazard Index [HI]), cancer risks, and radiation doses are calculated.

Step 6. These values are compared with standards established by the EPA and DOE to determine if further evaluation and/or potential site remediation, are required.

Step 7. Discussion of uncertainties in the previous steps.

7.3.1 Step 1. Site Data

The ID of potential COCs and the sampling to determine the concentration of each COC at the MWL are described in Chapters 4 and 5. In order to provide conservatism in this risk assessment, only the maximum concentration of each potential COC is used.

Section 7.3.2 describes the exposure pathways selected for this risk assessment. This section summarizes the data that are required to support those analyses. The types of data that are required include the concentrations of potential COCs in drinking water, the concentrations of potential COCs in surface soils, and the concentrations of the dust or vapors that may be inhaled.

Table 7.3-1 summarizes the maximum concentrations of analytes in surface soils at the MWL. The table consists of potential metal COCs only. These values are used to calculate the corresponding concentration of respirable particles (PM_{10}) in air for each of the analytes. The concentrations of dust in air were calculated using an EPA-documented model (EPA 1991b).

For the vapor inhalation pathway, data on the vapor concentration in air are required. VOC flux was measured during two separate passive soil gas surveys in 1993 (Section 4.5). Tritium flux was measured in 1993 (Section 4.2). Table 7.3-2 presents maximum VOC and tritium flux and the corresponding modeled air concentration at the landfill. For tritium, the maximum flux was 166,000 pCi/m^3/hr corresponding to a modeled air concentration of 608 pCi/m^3. The modeled air concentration was estimated from the flux measurements using methodology described in *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0* (Yu et al. 1993).

Active soil gas surveys at the MWL detected VOCs at 10 and 30 ft bgs (Section 4.5). Because VOCs in the vapor phase may migrate through the vadose zone to groundwater, the migration of VOCs in soil gas is an important exposure pathway. Maximum VOC concentrations in soil gas are shown in Table 7.3-3. None of these VOCs have been detected in MWL groundwater. These maximum VOC concentrations were used to calculate maximum anticipated groundwater concentrations, based upon flow and transport calculations using the BOSS computer code (Klavetter 1995). These predicted groundwater concentrations are summarized in Table 7.3-3.

7.3.2 Step 2. Pathway Identification

A future industrial land-use scenario has been designated for the MWL. Soil ingestion and inhalation from dust and vapors are considered potential pathways. VOCs have been detected in soil gas, and therefore a pathway to groundwater and subsequently to human receptors via drinking water is considered significant. Because of the lack of surface water and other mechanisms for dermal contact, the dermal exposure pathway is considered insignificant. Direct gamma exposure is included in the radioactive contamination risk assessment. No intake routes through plant, meat, or milk ingestion are considered appropriate.

Pathway Identification

Chemical Constituents	Radionuclide Constituents
Soil Ingestion	Soil Ingestion
Inhalation (Dust)	Inhalation (Dust)
Inhalation (Vapor)	Inhalation (Vapor)
Drinking Water	Direct Gamma

7.3.3 Steps 3 through 5. Calculation of Hazard Indices and Cancer Risks

These steps include discussion of the tiered approach to calculating intakes, toxicity information, and calculation of the HIs and cancer risks. The risks from potential COCs at the MWL were evaluated using this approach.

- The maximum concentrations of potential COCs were compared to background levels using 95th UTLs or percentile values. Maximum concentrations of potential COCs were used to provide a conservative estimate of the associated risk. Those potential COCs that were below background were not considered further in risk assessment.

- The remaining maximum concentrations were compared with action levels calculated according to methods and equations promulgated in the proposed RCRA Subpart S (40 CFR 1990) and RAGS (EPA 1989) documentation. Accordingly, all calculations were based upon the assumption that receptor doses from both toxic and potentially carcinogenic compounds result most significantly from ingestion of contaminated soil. Because the samples were all taken from the surface or near-surface, this assumption is considered valid. If there are 10 or fewer potential COCs and each has a maximum concentration less than one-tenth of the action level, then the site would be judged to pose no significant health hazard to humans.

- HIs and risk due to carcinogenic effects were calculated using RME methods and equations promulgated in RAGS (EPA 1989). The combined effects of all potential COCs in soils that were above background were calculated. For toxic compounds, this was accomplished by summing the individual hazard quotients for each metal into a total HI. This HI is compared to the recommended standard of 1. For potentially carcinogenic compounds, the individual risks were summed. Total risk was compared to the recommended risk range of 10^{-4} to 10^{-6}. For potential radioactive COCs, the cumulative dose was calculated and the corresponding excess cancer risk estimated.

7.3.4 Comparison to Background and Action Levels

Potential COCs are listed in Table 7.3-4, along with the 95th percentile or UTL background levels. Surface soil sampling for radionuclides showed all values to be below the 95th percentile or UTL background level, with the exception of tritium. Because tritium does not produce gamma radiation, the direct gamma pathway was excluded. Therefore, tritium is included only in Table 7.3-4. Background levels for tritium are the result of a comprehensive study at KAFB and SNL/NM (IT 1996). The last column in Table 7.3-4 compares the maximum contaminant concentration to the background level. Several compounds have maximum measured values greater than background levels. Those compounds are retained for further analysis.

As part of the tiered risk assessment, only those contaminants that have values above background are included in the next tier of risk assessment. Table 7.3-5 shows the inorganic contaminants from the soil sample analyses that were greater than background. All of the organic contaminants are included in the next tier of analyses. For the soil samples only, Table 7.3-5 also shows the Subpart S action level for the contaminants. Table 7.3-5 compares the maximum concentration to 1/10 of the Subpart S action level. This is the second screening process in the tiered risk assessment. Only one nonradioactive compound, thallium, has a concentration value greater than 1/10 of the Subpart S action level. Because of this single analyte, the site fails the Subpart S screening criteria and HI and cancer risk values are calculated for the contaminants.

Radioactive contamination does not have pre-determined action levels analogous to Subpart S. Therefore, this step in the screening process is not performed for radionuclides.

None of the potential COCs from the surface soil samples can be eliminated in this screening step. These potential COCs are retained for the next level of risk assessment. Table 7.3-6 shows all of the contaminants and their concentrations that are used in the RME calculations performed in the next tier of the analysis.

7.4 Toxicological Parameters

Table 7.3-7 shows potential COCs that have been retained in the risk assessment and the values for the toxicological information available for those COCs.

7.4.1 Risk Characterization

The equations and parameters used in the calculation of HI and excess cancer risk are based upon RAGS (EPA 1989), as well as other EPA guidance documents, and reflect the RME approach advocated in RAGS (EPA 1989).

Table 7.3-8 shows the risk assessment values due to contamination from the surface. The values are based upon an industrial land-use scenario with ingestion and dust inhalation exposure pathways. The HI calculated for these exposure pathways is 0.0. The excess cancer risk is calculated as 5×10^{-8}.

Table 7.3-9 shows the risk assessment values calculated for an industrial land-use scenario for the vapor-inhalation pathway resulting from vaporization of surface or subsurface VOCs. The HI for this exposure pathway is 0.0. The excess cancer risk is calculated as 7×10^{-7}.

The final exposure pathway considered is the potential for ingestion of drinking water that has been contaminated at the groundwater level and brought into contact with a worker at the surface via an on-site well. Table 7.3-10 shows the calculated risk assessment values. The calculated HI is 0.0. The calculated excess cancer risk is 2×10^{-7}. The table also notes that the Applicable or Relevant and Appropriate Requirements for PCE, TCA, and TCE are significantly higher than the estimated groundwater concentration.

Consistent with guidance provided in RAGS (EPA 1989), nonradioactive and radioactive excess cancer risks are not additive. The excess cancer risk due to tritium vapor exposure is estimated to be 6×10^{-6} corresponding to a dose of 0.29 mrem/yr.

7.4.2 Total Risk Assessment Values

The risk assessment values for the MWL are the summation of the risk values for the individual exposure pathways considered and are shown in Table 7.3-11. The total calculated HI for the MWL is 0.0. The total calculated excess cancer risk for the MWL is 6×10^{-7}.

7.4.3 Comparison of Risk Values to Numerical Standards

For potential nonradioactive COCs, the calculated HI is 0.0 which is much lower than the numerical standard suggested in RAGS (EPA 1989) of 1. The excess cancer risk is estimated at 9×10^{-7}. For potential radioactive contaminants, the excess cancer risk is estimated at 6×10^{-6}, corresponding to a dose of 0.29 mrem/yr. In RAGS, the EPA suggests that a range of values (10^{-4} to 10^{-6}) be used as the numerical standard; the value calculated for the MWL is lower than even the low end of the suggested range. Therefore, for an industrial land-use scenario, the risk assessment values are significantly lower than the established numerical standards.

7.4.4 Uncertainty in Risk Assessment

This section describes uncertainties in the formulation of the risk assessment for the MWL. The conclusion from risk assessment is that the potential affects to human health are low compared to established numerical standards. MWL historical records regarding volume disposal of VOCs are not quantitative. However, substantial site characterization has been performed to mitigate these uncertainties. Surface and subsurface measurements have been made, investigating potential contamination in the soil as well as the soil gas. These investigations have resulted in measurements that quantify the current contamination of the soil and the soil gas.

Groundwater monitoring wells are sampled regularly for detection of contaminants. No contamination has been detected to date. MWL characterization is considered adequate to address the uncertainty associated with MWL historical records.

To further address the uncertainties in potential MWL contamination, only maximum values of contaminant concentrations were used in risk assessment. When possible, direct concentration measurements were used. When such data were not available, documented models were used to estimate the concentrations used in the analyses (e.g., for particulate and vapor concentrations in the air and groundwater concentrations). Calculation of groundwater concentrations were performed to determine the estimated maximum level of contamination in groundwater in the near future. Those calculations show that, because of the extremely low level of VOCs in the vadose zone at present, concentrations of all of the contaminants in groundwater will remain low for the foreseeable future. Consistent with MWL monitoring well sampling, the calculated concentrations of potential COCs (e.g., TCE, TCA, and PCE) are not only below detection levels, but also significantly below the EPA MCLs.

There are also uncertainties associated with the calculation of risk assessment values. The intake calculations use maximum concentrations and recommended values of other input parameters to provide the RME value. These RME values are recognized, generally, as very conservative compared to the mean or expected value. Additionally, uncertainties exist in the toxicological values used in determining the HI and excess cancer risk values. SNL/NM used the best available information from the IRIS and HEAST documents, supplementing those values with information from the EPA. The toxicological values already have factors that have been included to address uncertainty.

Because an RME approach was used, along with maximum concentration values of potential COCs considered in the assessment, a sensitivity analysis to quantify the conservative nature of the analysis is not considered necessary. RME calculations have been shown to generally provide estimates of the risk to human health in excess of the 99th percentile of the cumulative distribution of risks. The calculated RME risk values are low compared to the established standards. Based upon risk assessment, the MWL will not affect human health under a future industrial land-use scenario.

8. Conclusions and Recommendations

The Phase 2 RFI Report presents the cumulative results of five years of assessment and characterization at the MWL. The MWL Phase 2 RFI incorporated the streamlining approach, combining data quality objectives and the observational approach. The streamlining approach provided a consistent, logical, common-sense approach that optimized planning, assessment, and implementation of the RFI in a framework that was compatible with existing DOE and EPA regulations and guidance.

The field work for the Phase 2 RFI was completed in 1995. Field work consisted of surface radiological surveys; ambient air sampling; soil sampling for background metals and radionuclides; soil sampling for VOCs, SVOCs, TAL metals, and radionuclides; nonintrusive geophysical surveys; passive and active soil gas sampling; borehole drilling; installation of groundwater monitoring wells; groundwater sampling; vadose zone tests; aquifer tests; and risk assessment.

A number of contaminants were identified at the MWL during the Phase 2 RFI, including VOCs, SVOCs, metals, and tritium. VOCs in soil gas were detected to depths of 30 ft bgs. Vapor-phase profiles with depth were calculated for VOCs in soil gas, and in all cases initial soil gas concentrations dropped to less than 10 percent within 200 ft bgs. None of the VOCs in soil gas were predicted to reach groundwater in concentrations exceeding Proposed Subpart S action levels.

VOCs, SVOCs, and metals were detected in subsurface soils at the MWL. VOCs and SVOCs were all below proposed Subpart S action levels or action levels generated from toxicity information. Metals, with the exception of beryllium, were also below proposed Subpart S action levels. Background concentrations of beryllium in subsurface soils range from 0.1 to 1.6 mg/kg in background soils at KAFB/SNL/NM (IT 1996). Radionuclides were all below their respective MDAs, with the exception of tritium.

Tritium was identified as the primary COC at the MWL. Tritium has been a consistent finding at the MWL since environmental studies were initiated at SNL/NM in 1969. Tritium occurs in both surface and near-surface soils in and around the classified area of the landfill. Tritium levels range from 1100 pCi/g in surface soils around Pit 33 to 207 pCi/g in subsurface soils. The highest tritium levels are found within 30 ft of the surface in soils adjacent to and directly below classified area disposal pits. Below 30 ft bgs, tritium levels fall off rapidly to a few pCi/g of soil.

Tritium also occurs as a diffuse air emission from the landfill. A total of 0.294 Ci/yr is released from the landfill surface. The maximum radiological dose to the maximally-exposed off-site receptor is 2.3×10^{-5} mrem/yr due to vapor exposure to tritium. The maximum radiological dose to the maximally-exposed on-site receptor due to combined tritium soil and vapor exposure is 0.29 mrem/yr.

For comparison, the average radiation exposure due to natural sources (radon, internal radiation, cosmic radiation, and terrestrial radiation) in the U.S. is approximately 295 mrem/yr

(NCRP 1987). In Albuquerque, the background radiation level is 300 to 500 mrem/yr (Brookins 1992). The calculated MWL doses for the industrial land-use scenario are well below the proposed EPA dose limit of 15 mrem/yr (40 CFR 196 1994).

Risk assessment was conducted for the MWL, and the results indicate that the MWL will not affect human health or the environment under a future industrial land-use scenario. MWL constituents present little risk to either groundwater or as air emissions to potential receptors. The risk to human health and the environment due to naturally occurring radiological sources is much greater than that posed by the MWL.

Based upon the results of the MWL Phase 1 and Phase 2 RCRA facility investigations, risk assessment, and the results of MWL groundwater monitoring, the MWL is recommended for no further action. The landfill should remain under institutional control with access restricted. Future groundwater monitoring at the MWL should focus on specific parameters for detection monitoring for contamination. Groundwater monitoring parameters should include VOCs, tritium, gross alpha/beta activity, and major ion chemistry.

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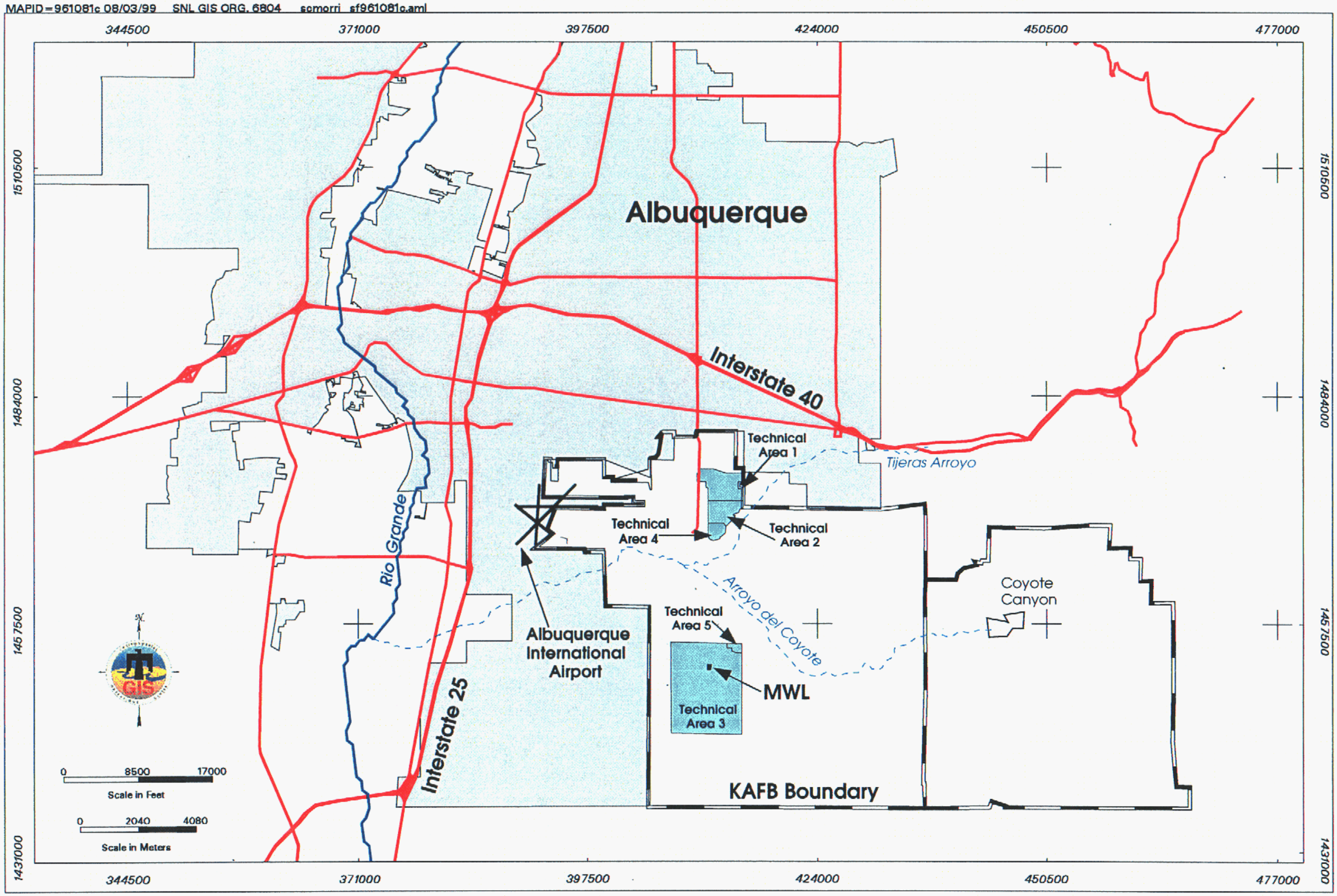

Figure 1.1-1 Location of Kirtland Air Force Base and Sandia National Laboratories, New Mexico

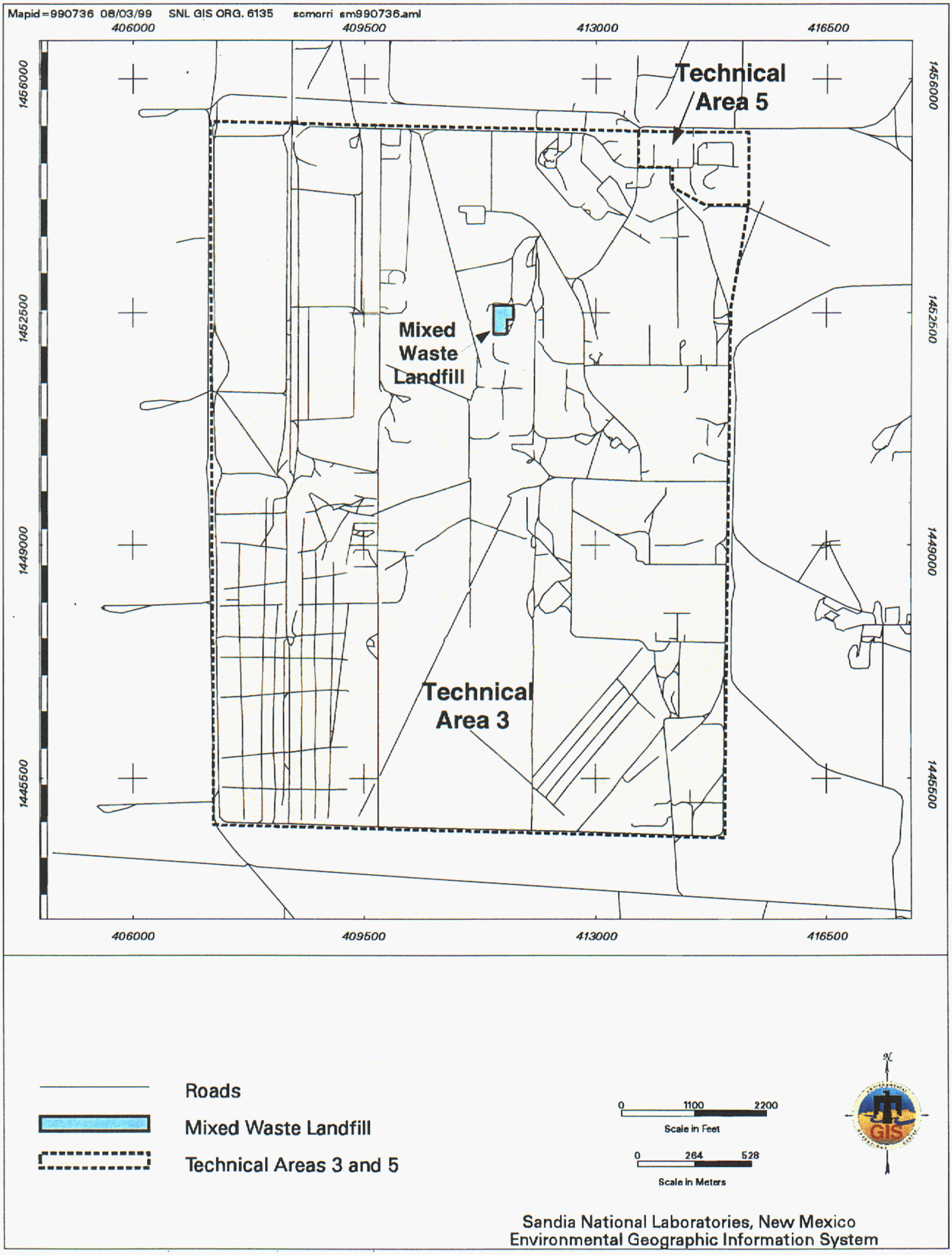

Figure 1.1-2 Location of Technical Areas 3 and 5 and the Mixed Waste Landfill

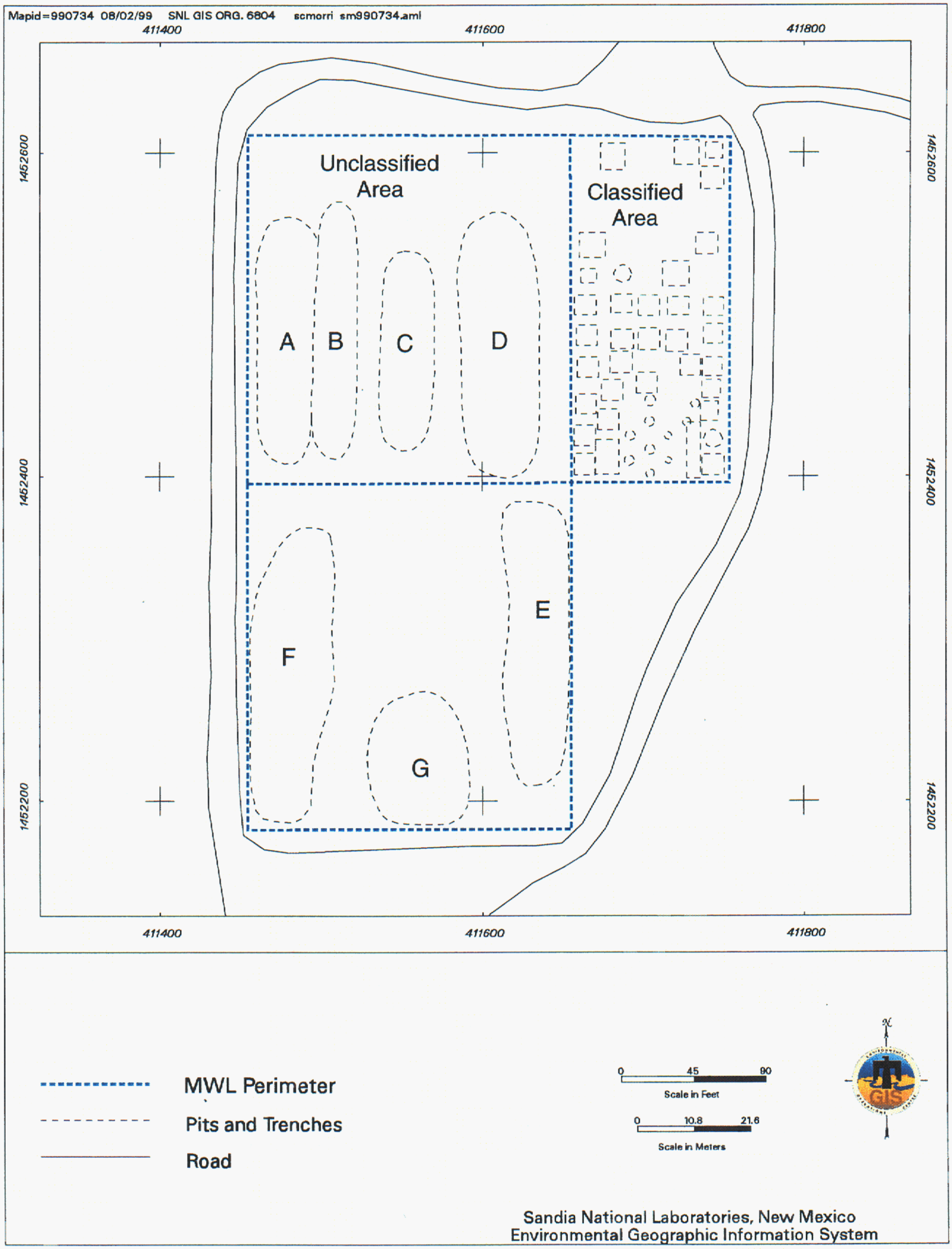

Figure 1.1-3 Map of the Mixed Waste Landfill

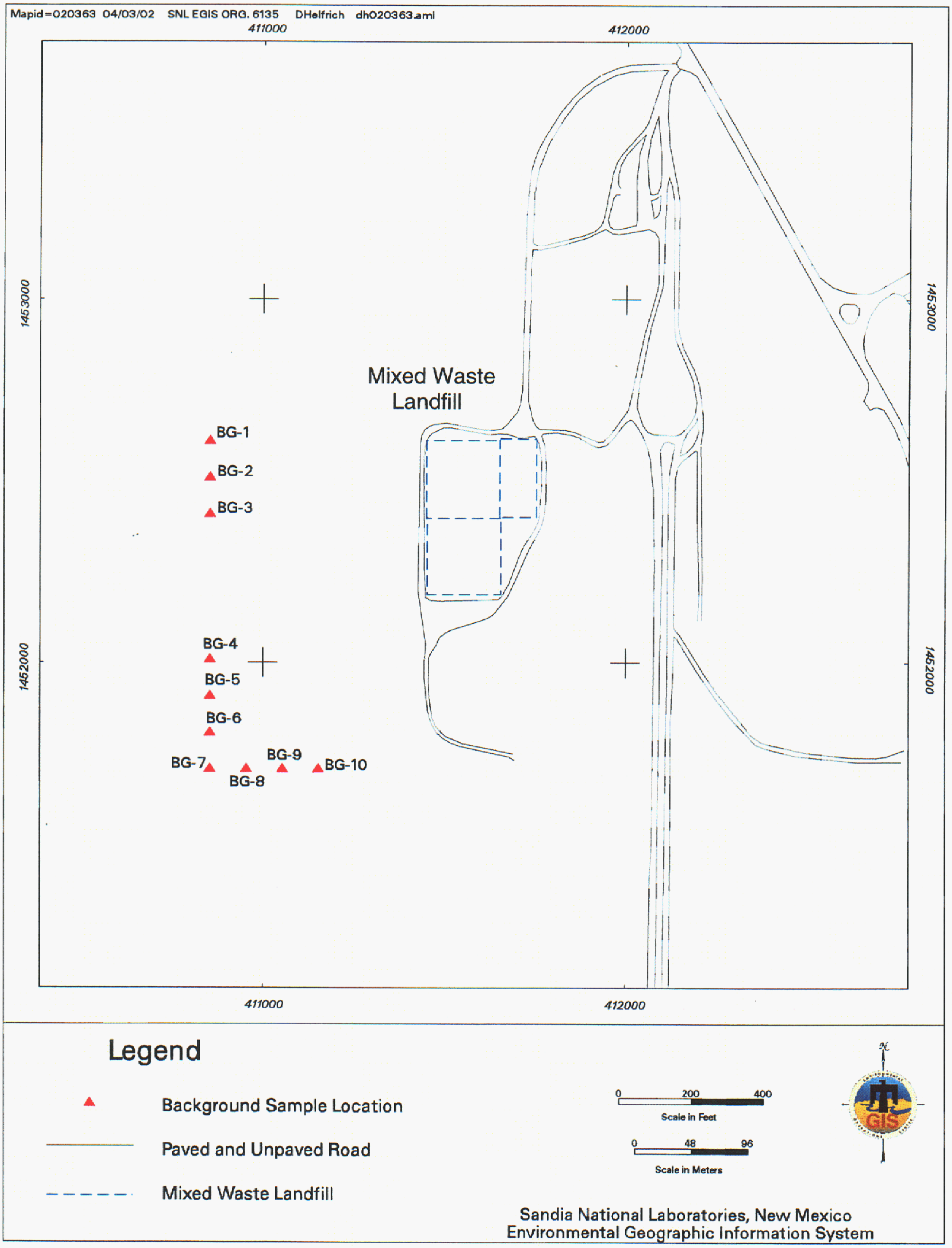

Figure 3.4-1 Background Soil Sample Locations

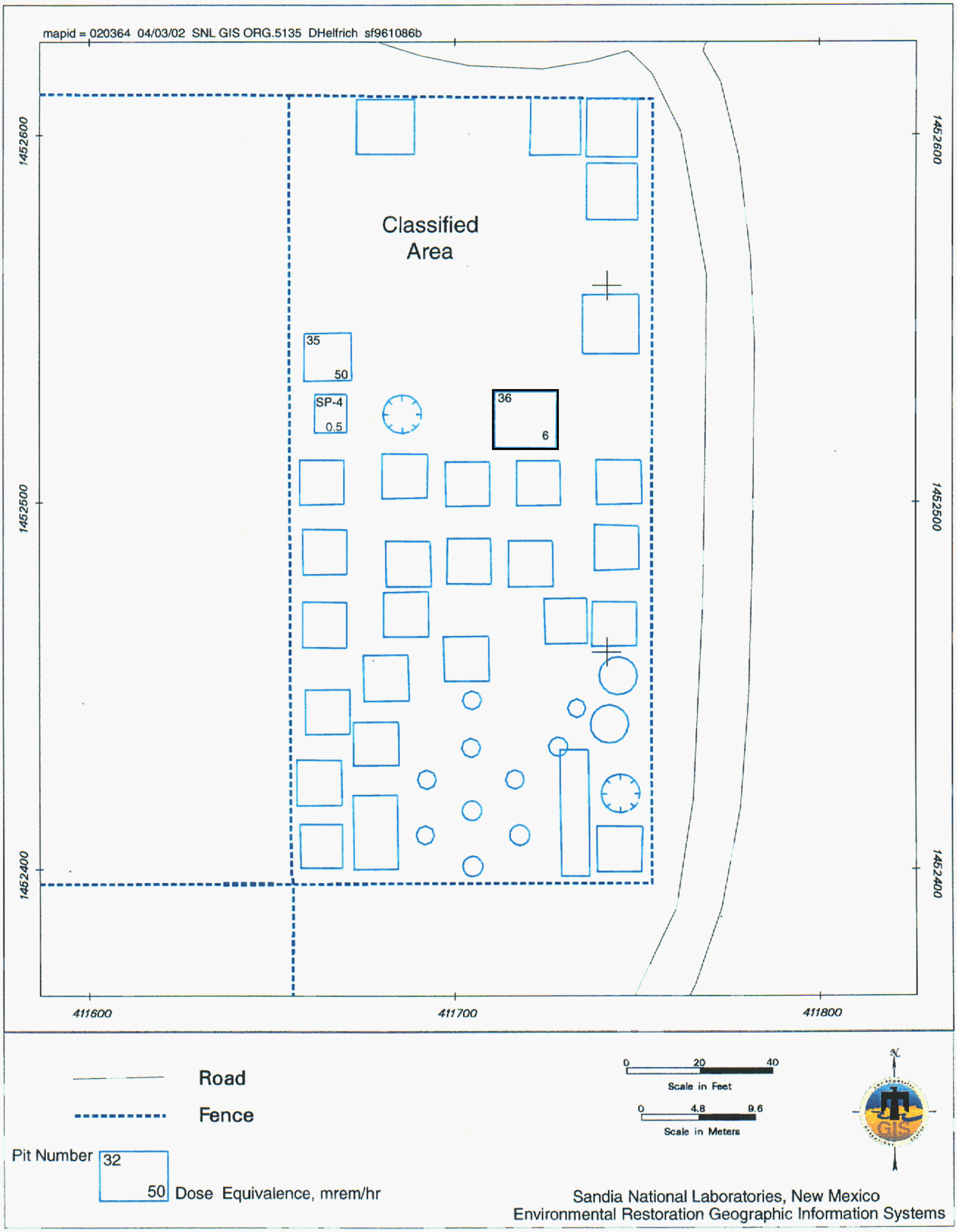

Figure 4.1-1 MWL Radiation Survey

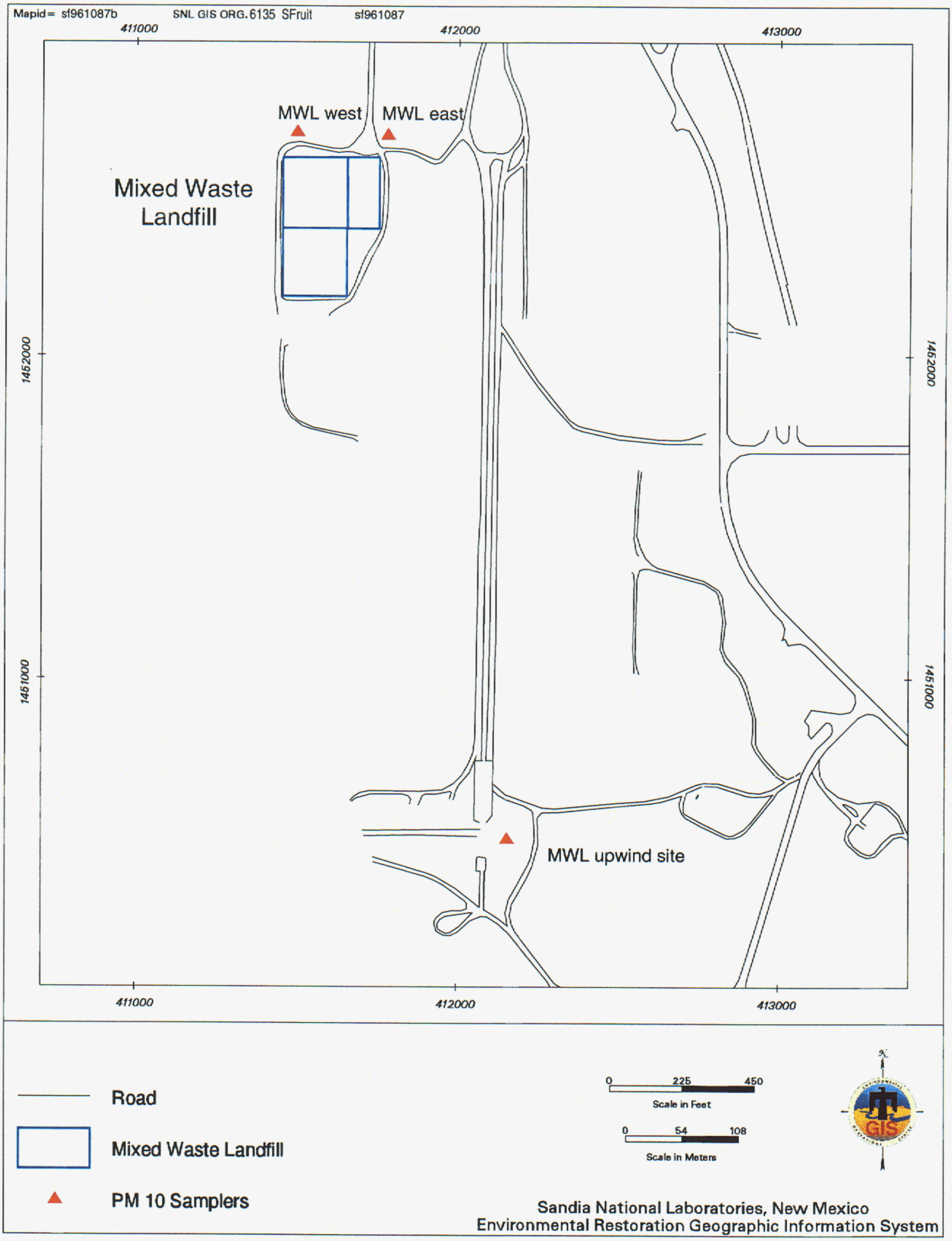

Figure 4.2-1 PM_{10} Sample Locations

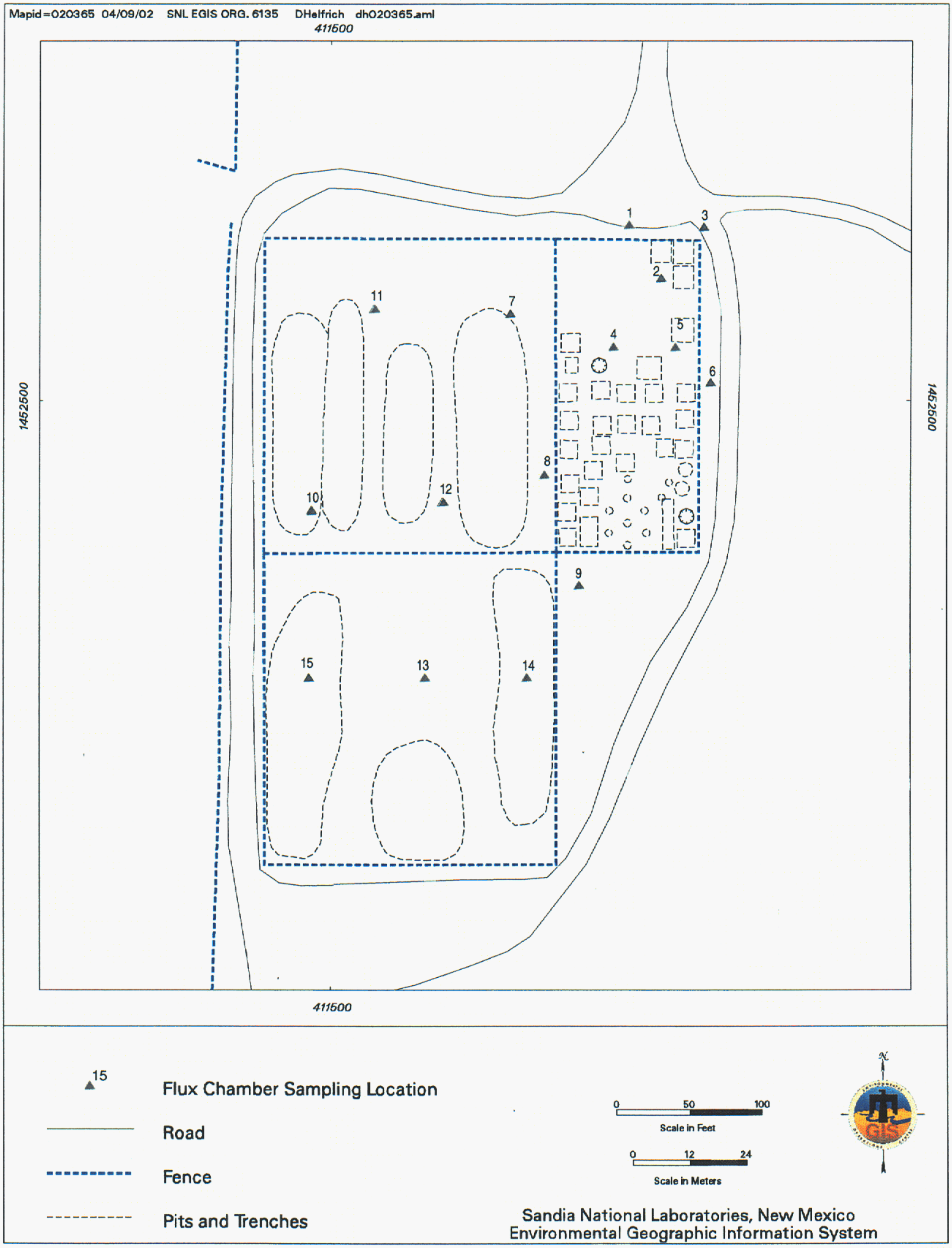

Figure 4.2-2 1992 Tritium Flux Sampling Locations

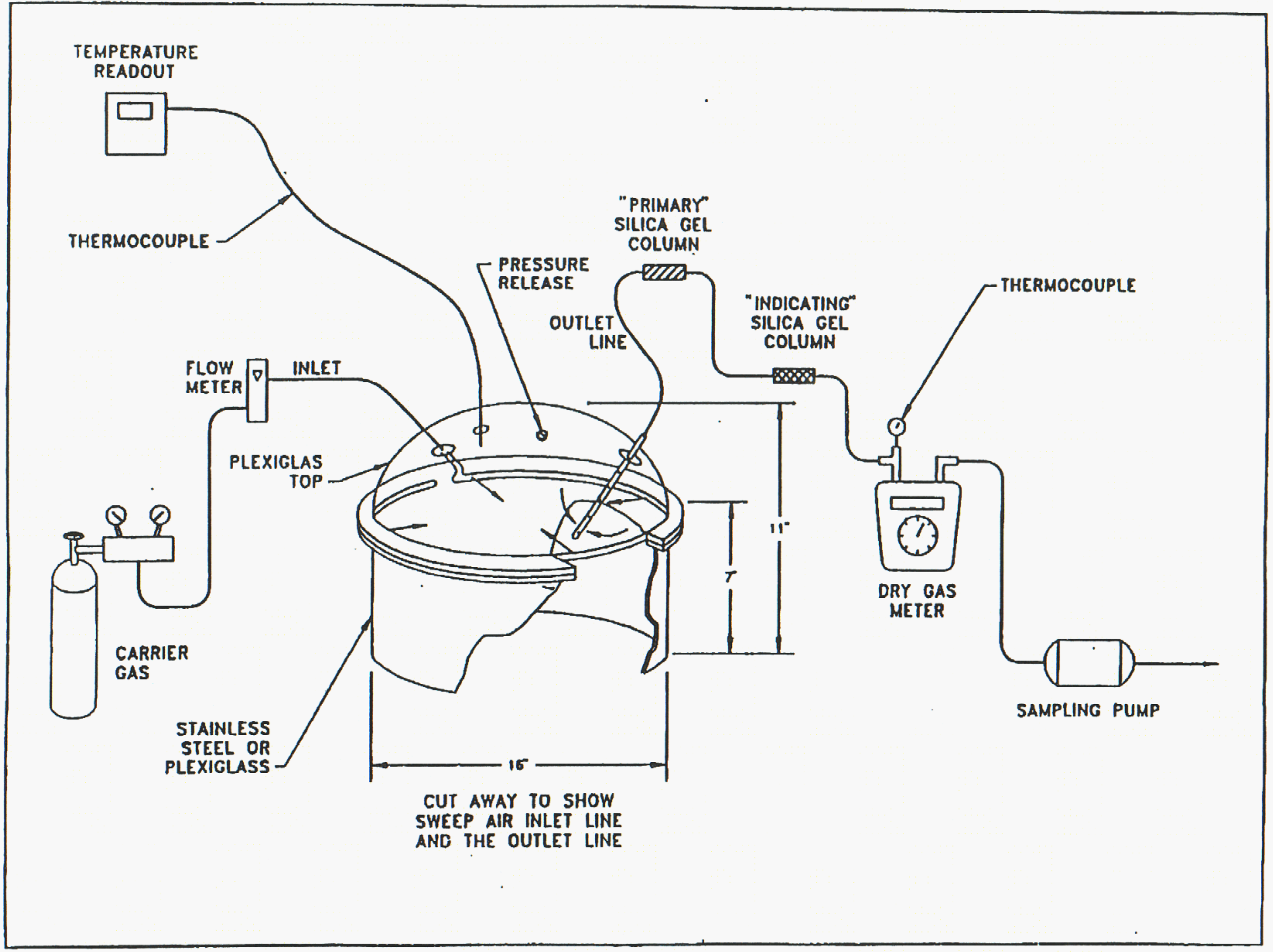

Figure 4.2-3 EIFC Schematic

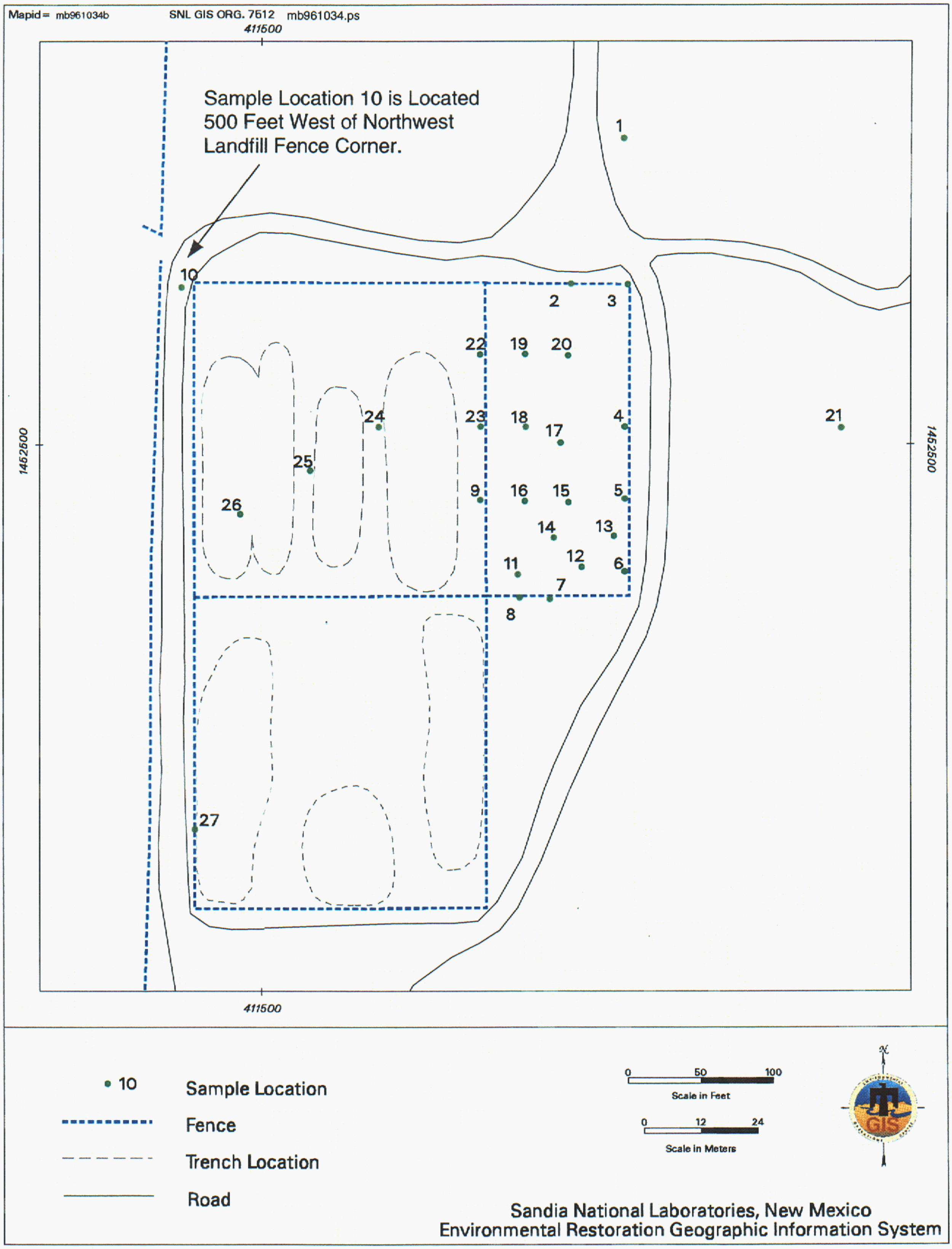

Figure 4.2-4 1993 Tritium Flux Sampling Locations

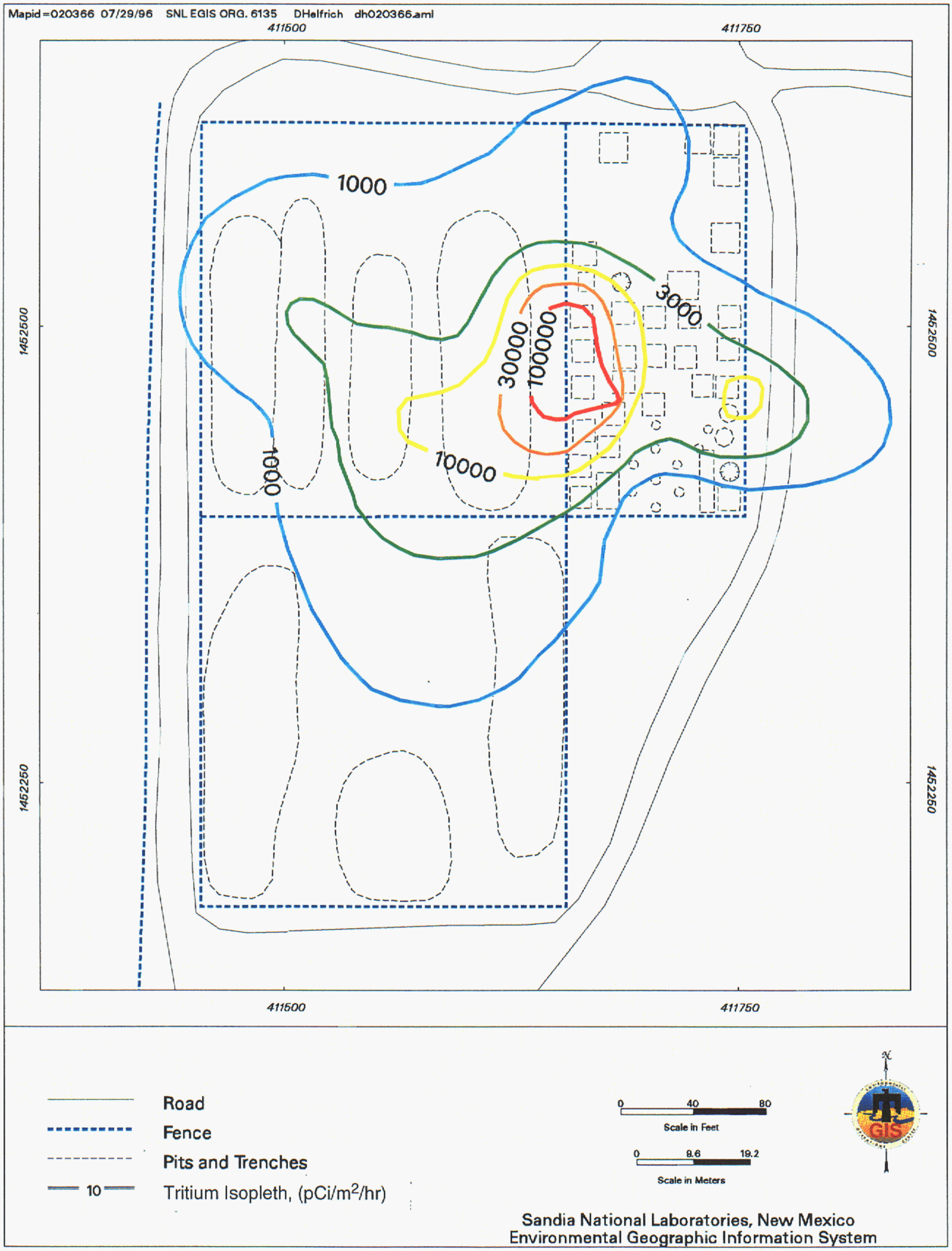

Figure 4.2-5 1993 Tritium Flux

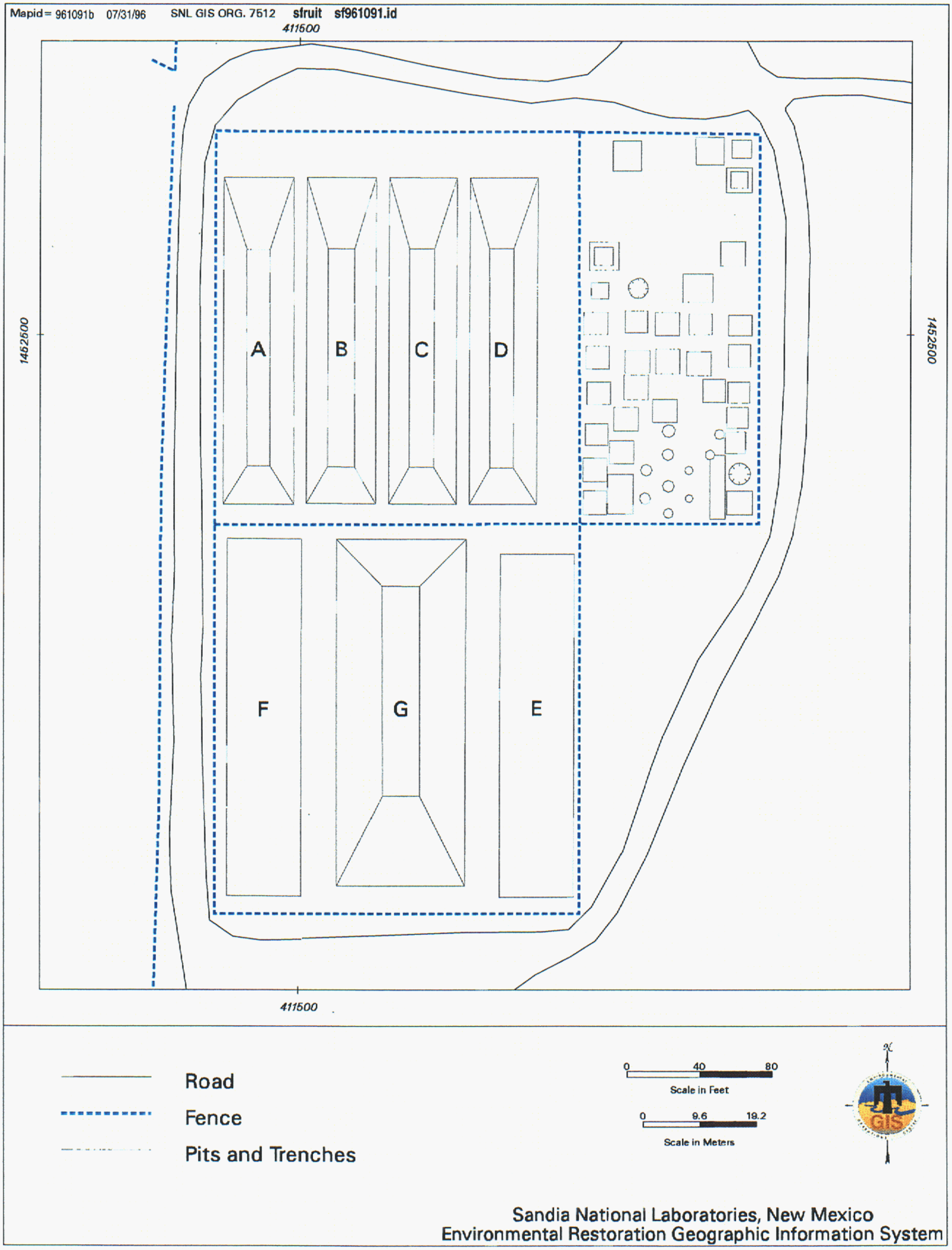

Figure 4.3-1 MWL Engineering Design Map 91342

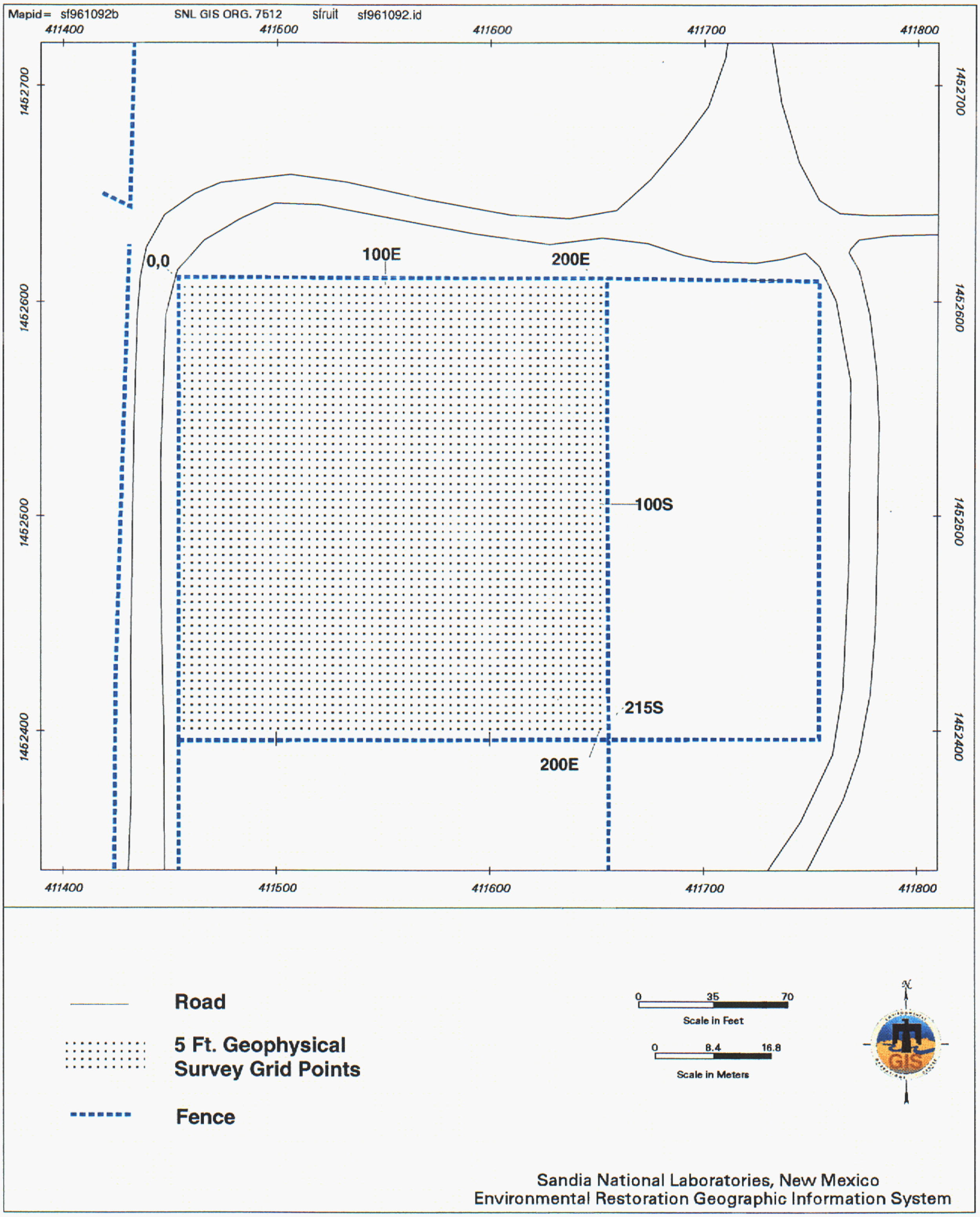

Figure 4.3-2 MWL Survey Grid, Northern Unclassified Area

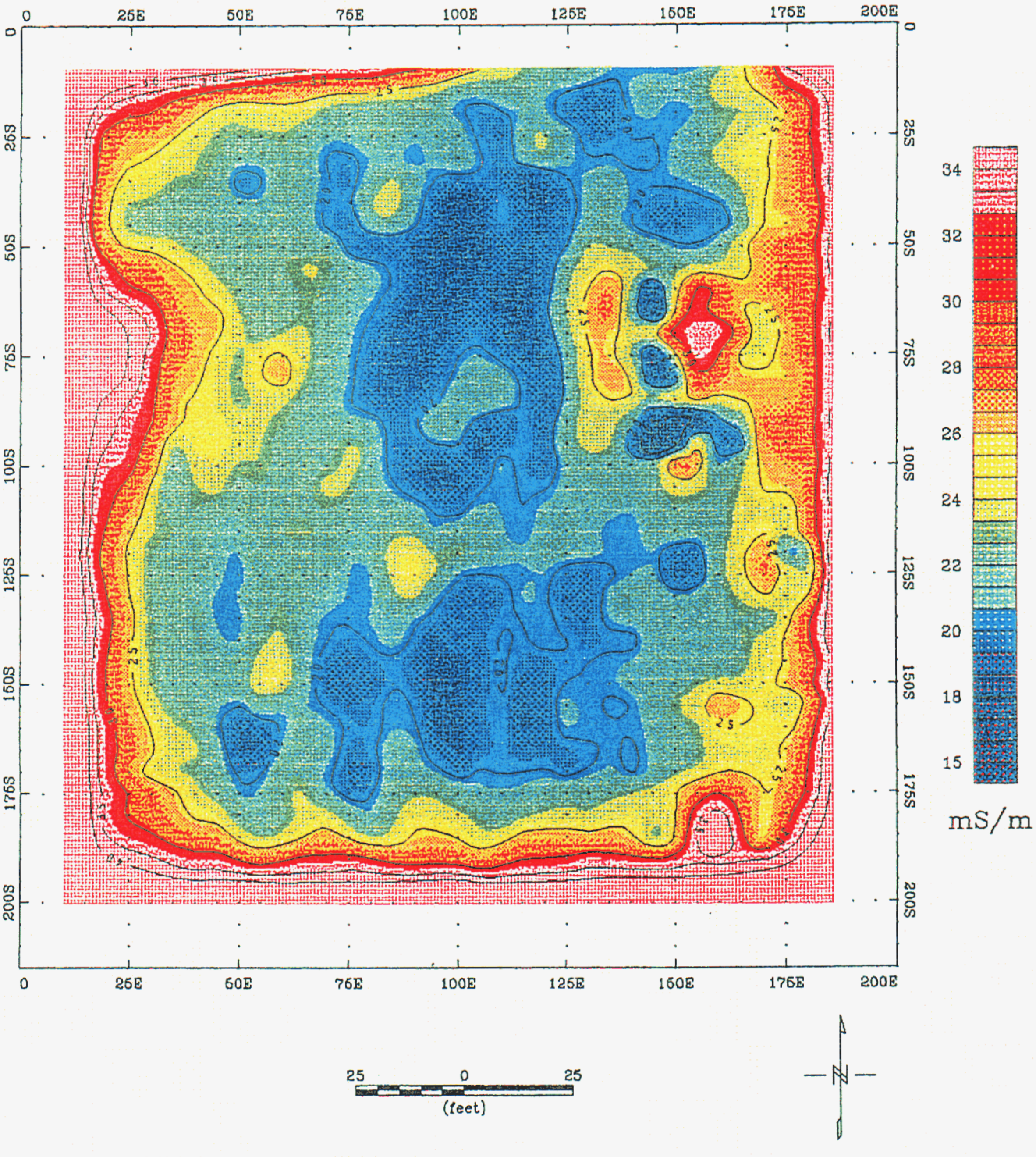

Figure 4.3-3 EM-31 Ground Conductivity, Northern Unclassified Area

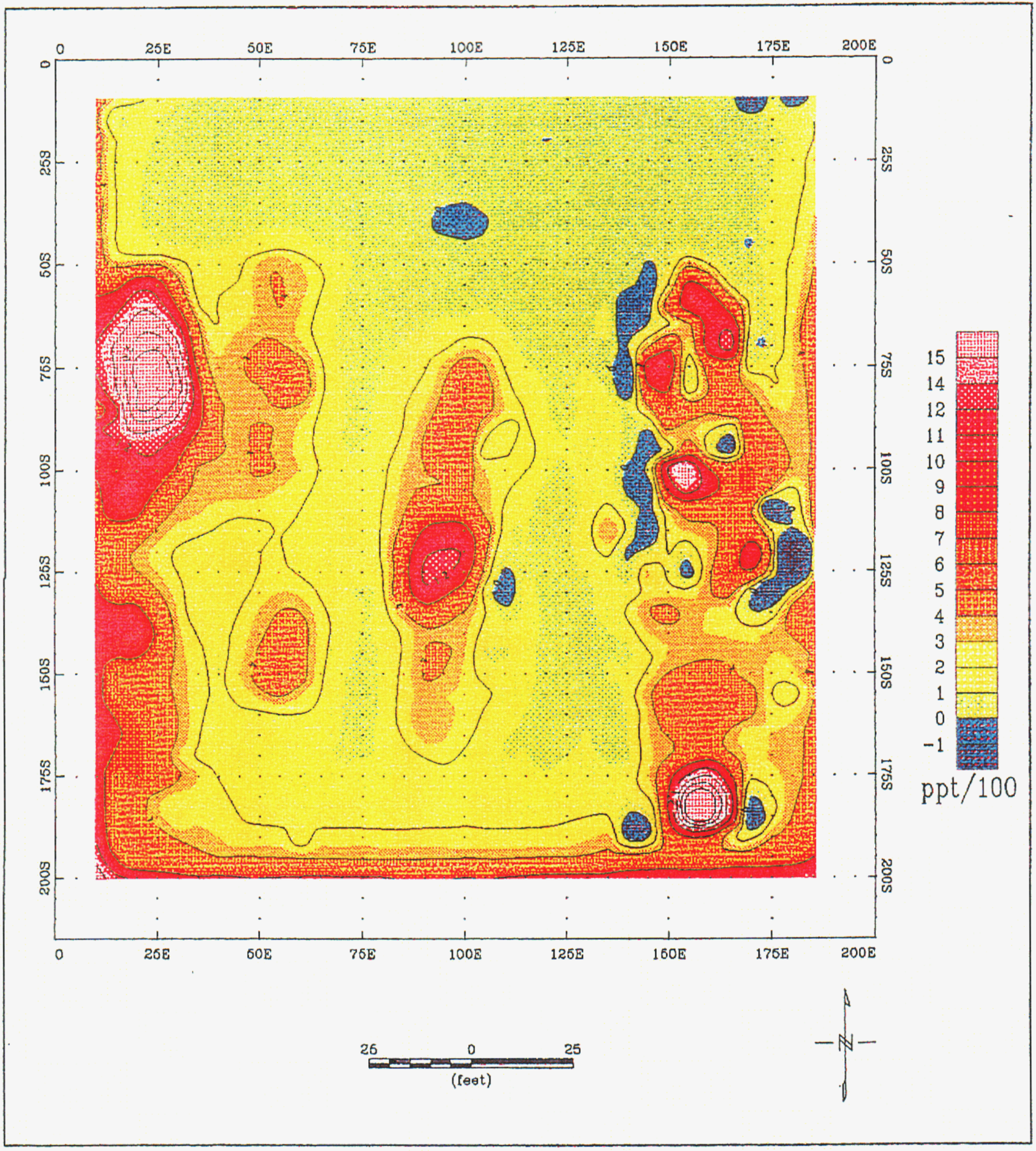

Figure 4.3-4 EM-31 In-Phase, Northern Unclassified Area

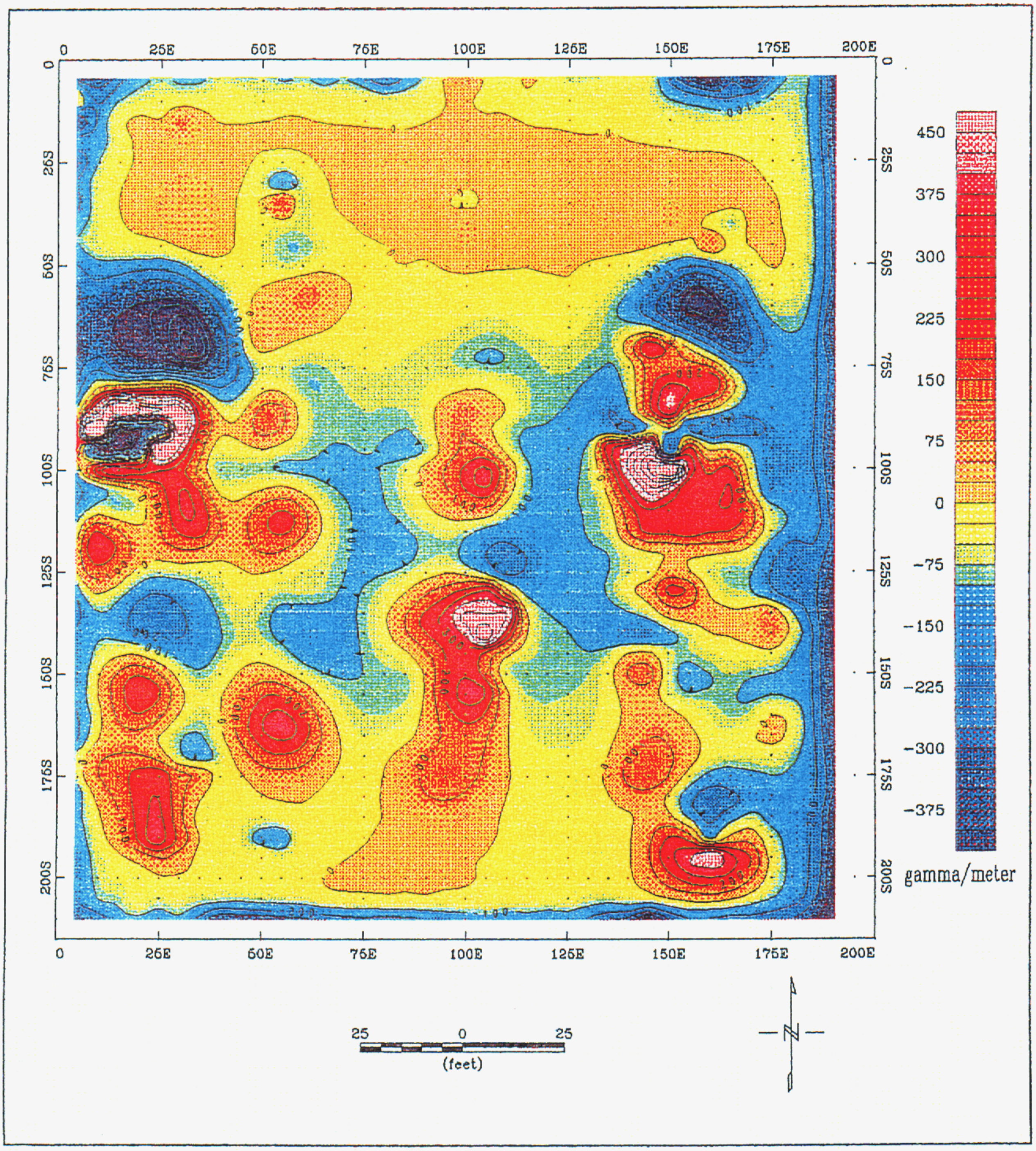

Figure 4.3-5 Vertical Magnetic Gradient, Northern Unclassified Area

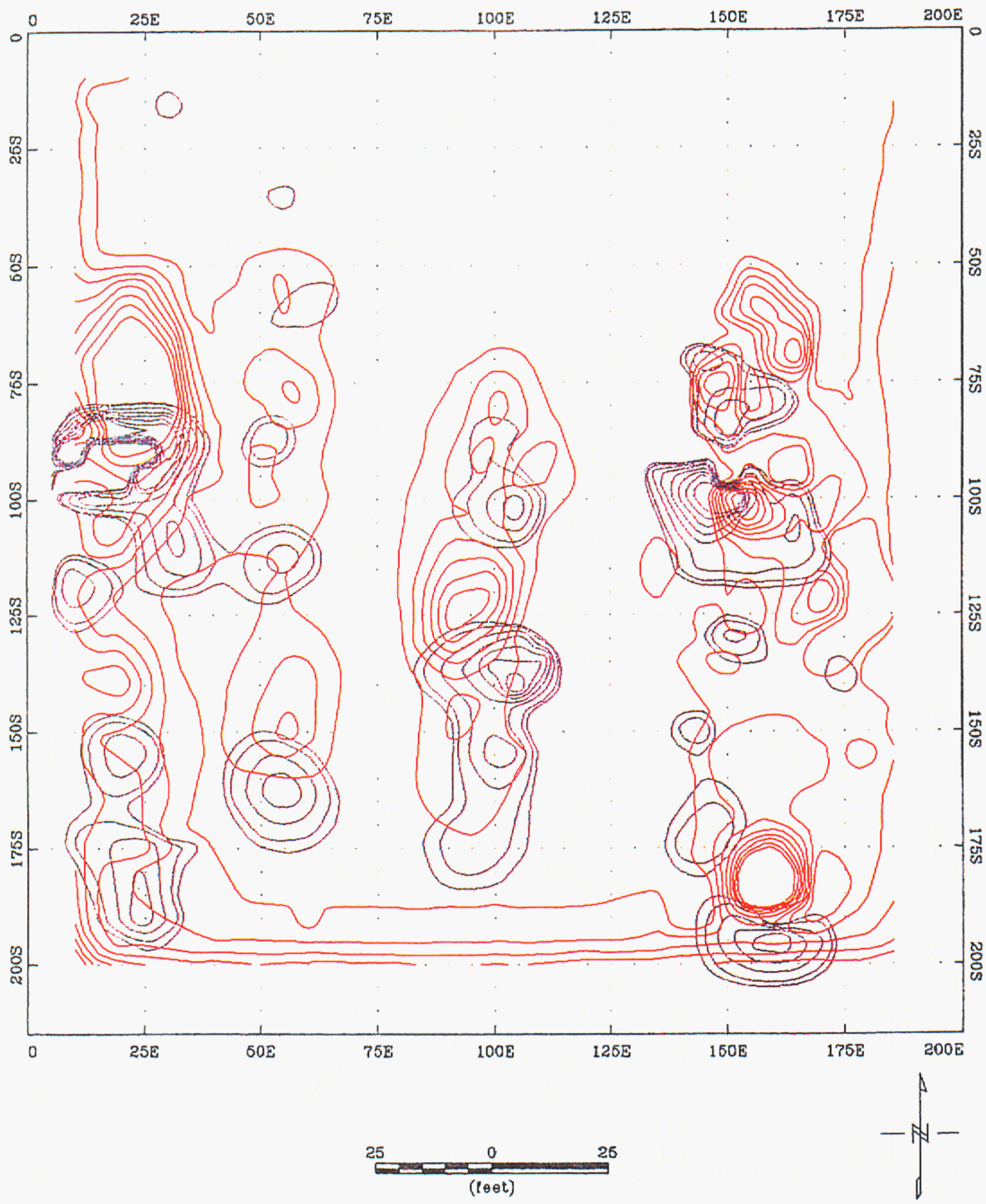

Figure 4.3-6 Superposition of EM-31 In-Phase and Vertical Magnetic Gradient, Northern Unclassified Area

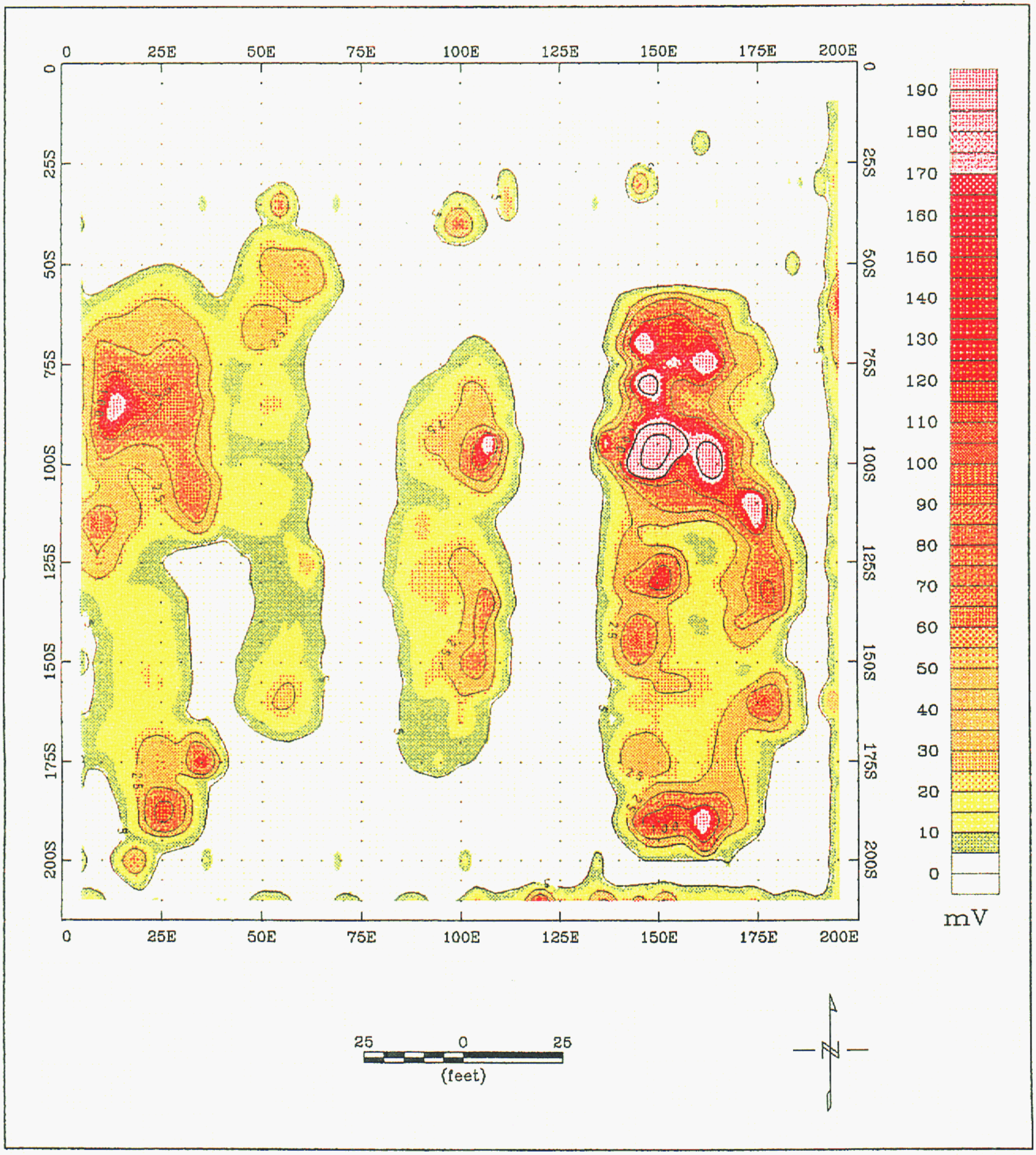

Figure 4.3-7 EM-61 Response, Northern Unclassified Area

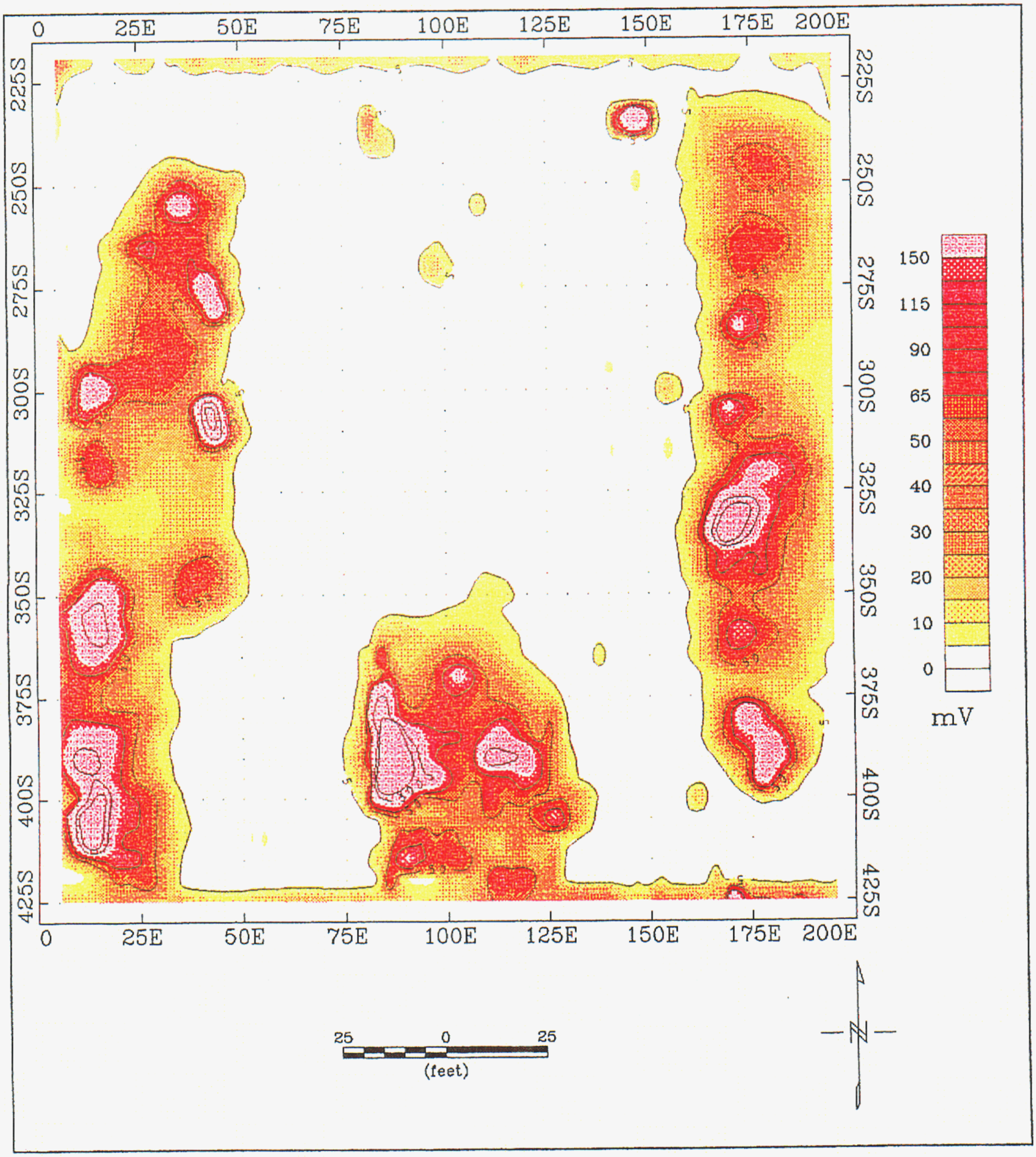

Figure 4.3-8 EM-61 Response, Southern Unclassified Area

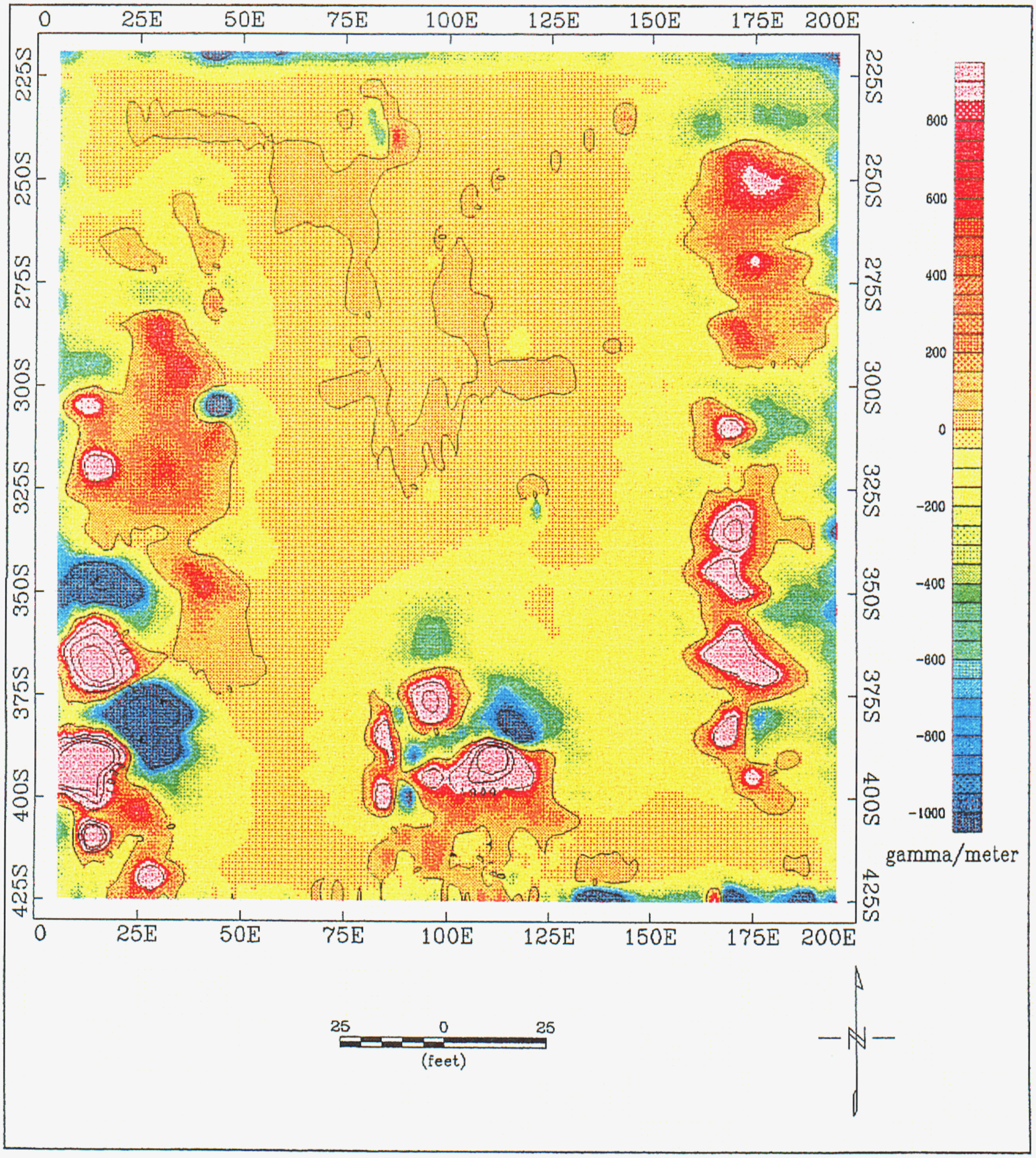

Figure 4.3-9 Vertical Magnetic Gradient, Southern Unclassified Area

Figure 4.4-1 1993 Tritium Surface Soil Sampling Locations

Figure 4.4-2 1982 Tritium Surface Soil Sampling Results

Figure 4.4-3 1993 Tritium Surface Soil Sampling Results

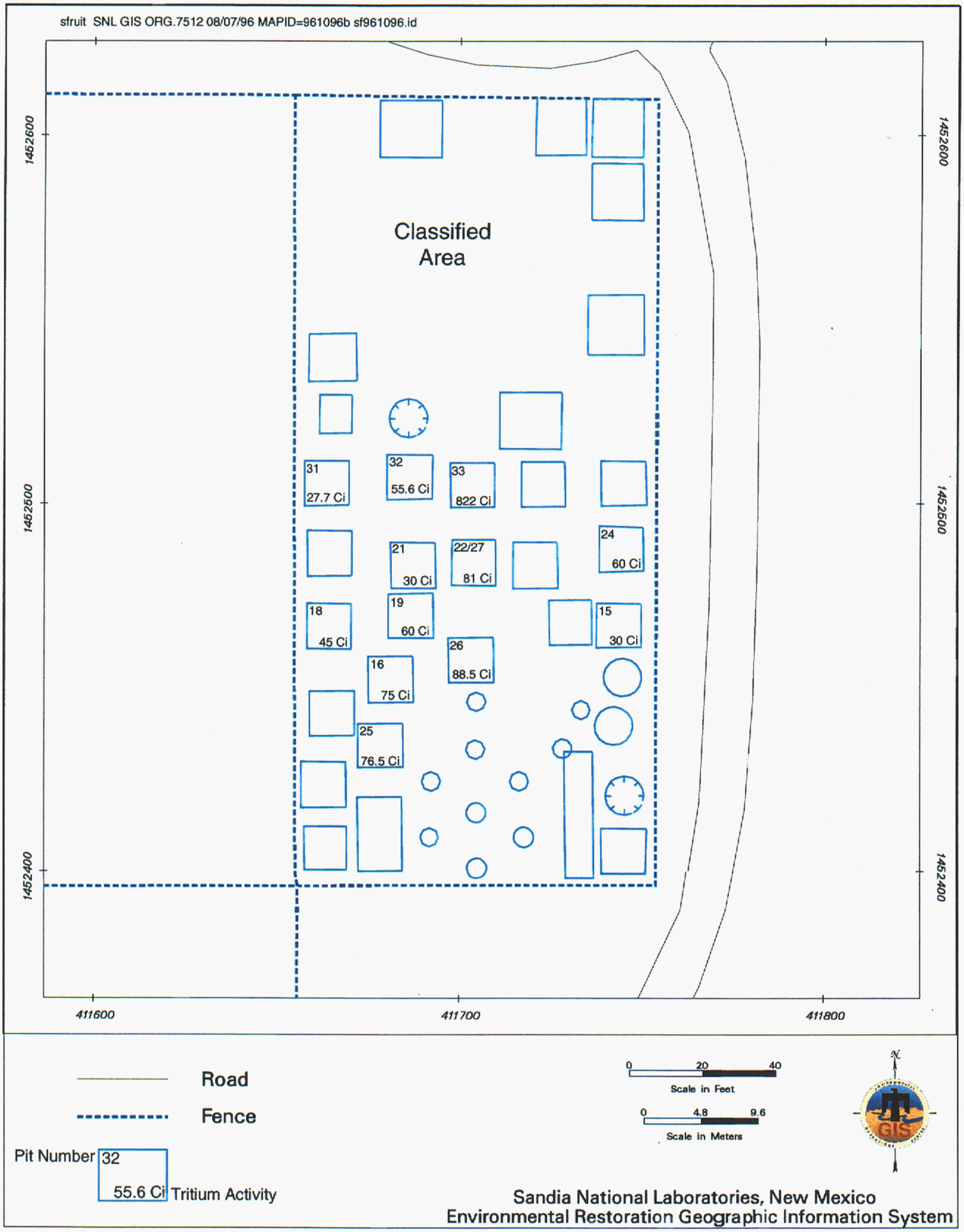

Figure 4.4-4 Classified Area Tritium Disposal, 1959-1983

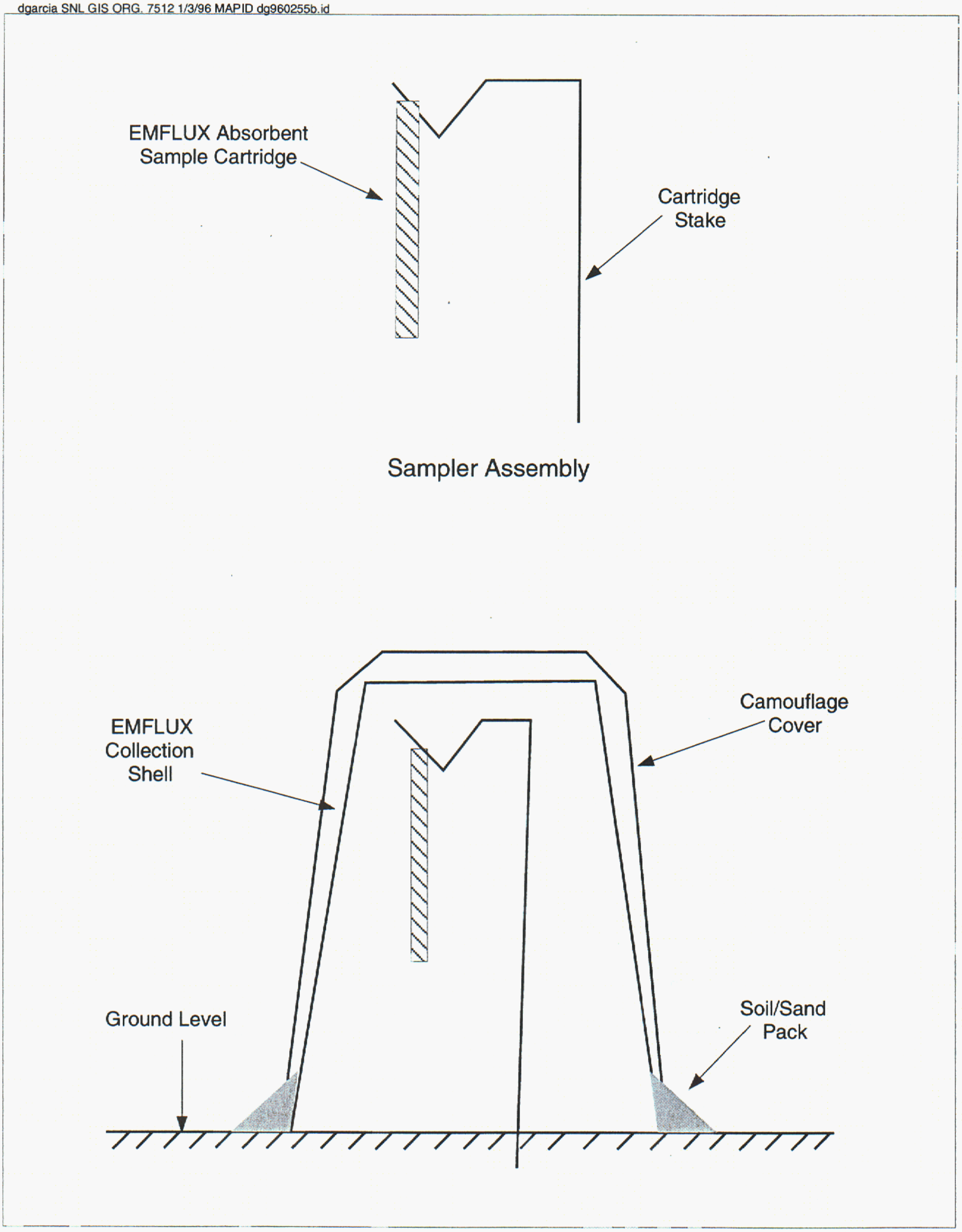

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Figure 4.5-1 EMFLUX Sampling Equipment Schematic

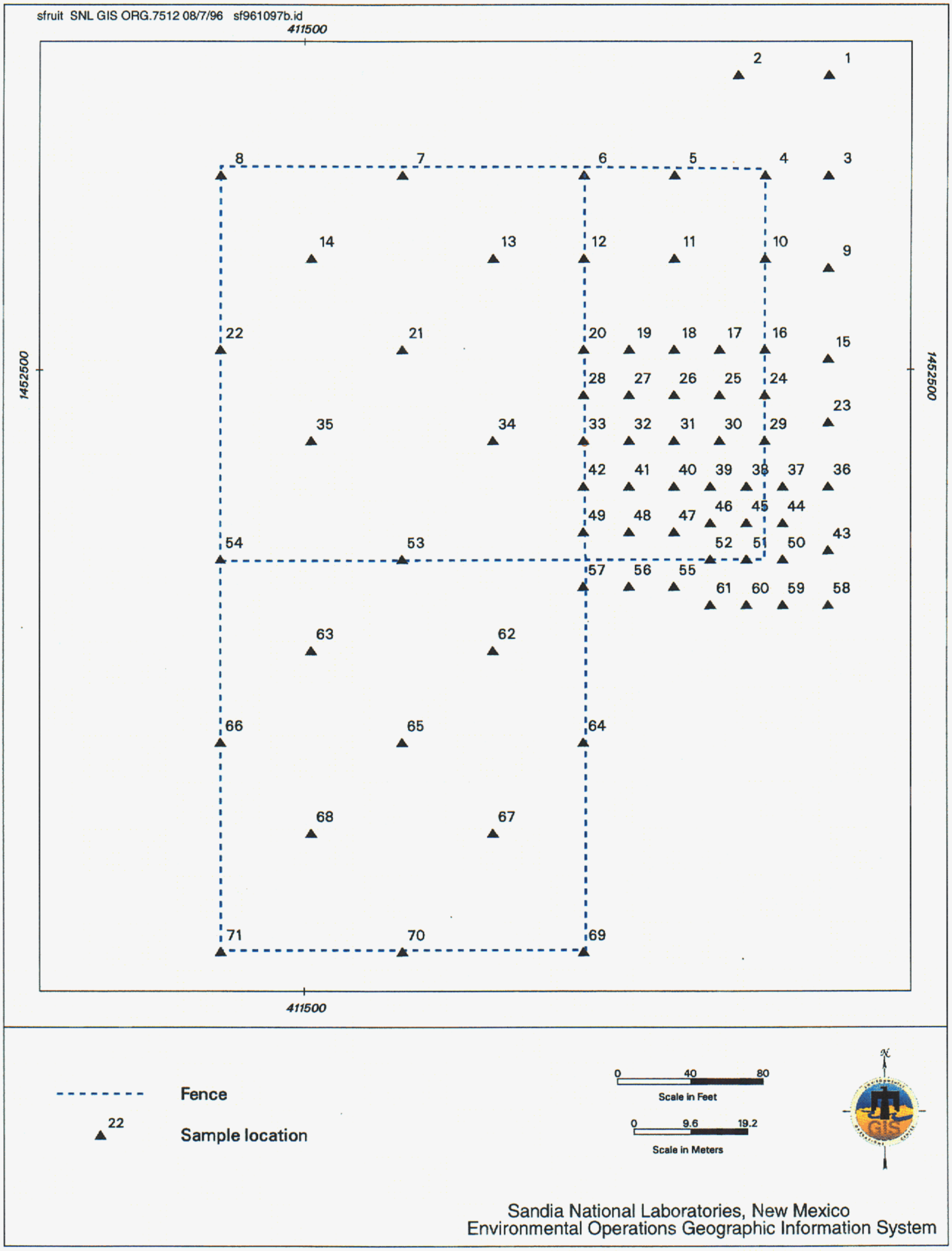

Figure 4.5-2 First-Round Passive Soil Gas Sampling Locations

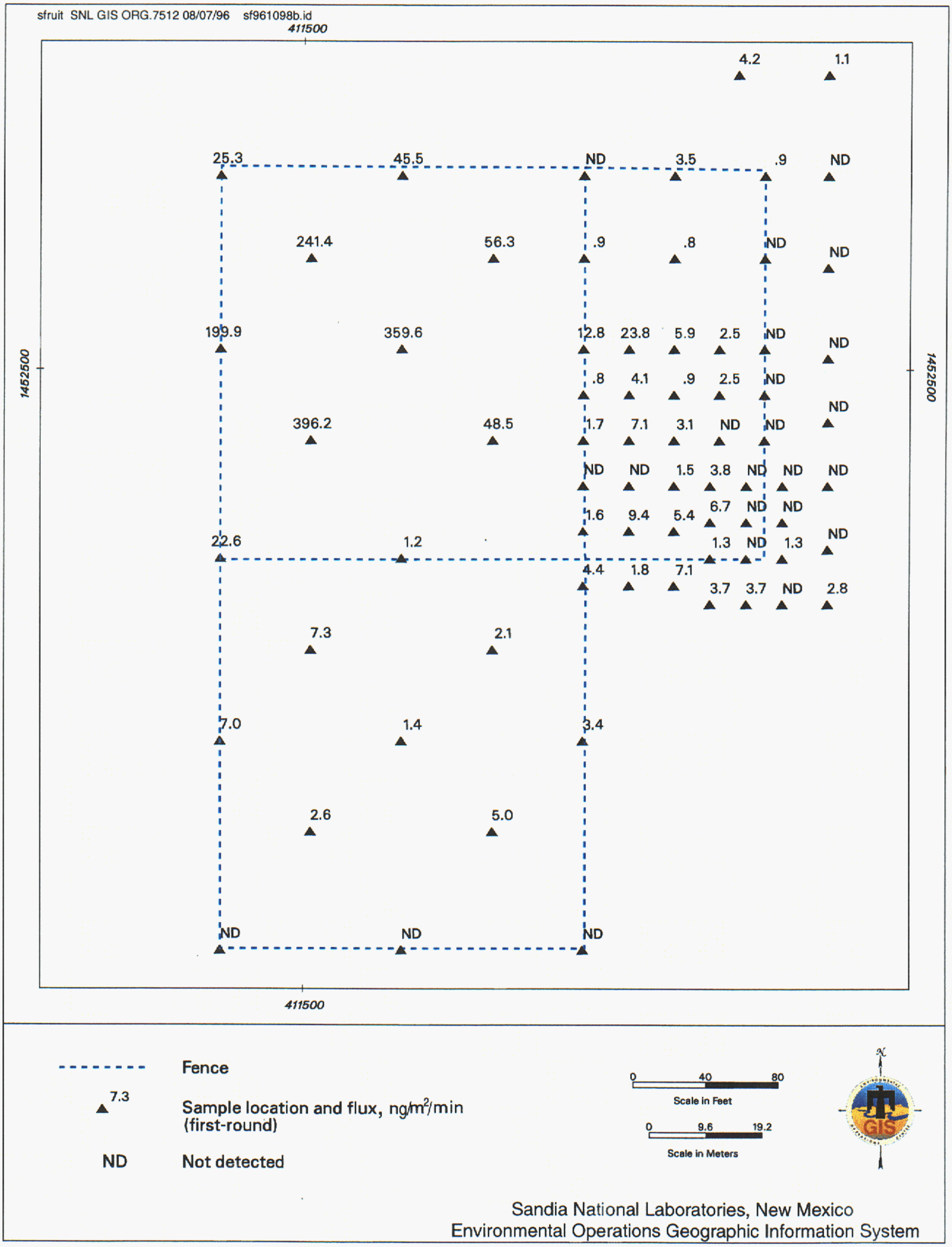

Figure 4.5-3 PCE Flux, First-Round Passive Soil Gas Sampling

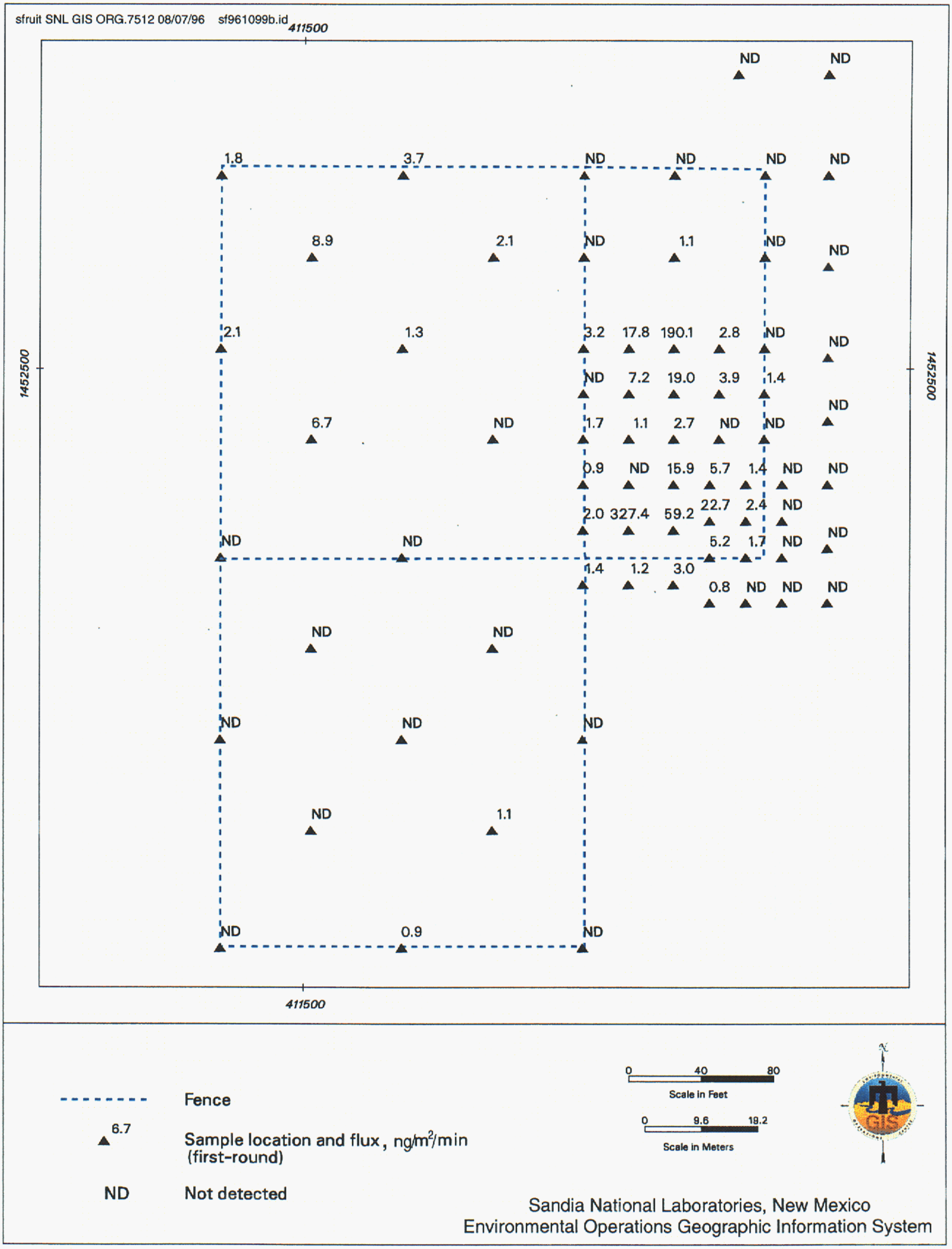

Figure 4.5-4 TCE Flux, First-Round Passive Soil Gas Sampling

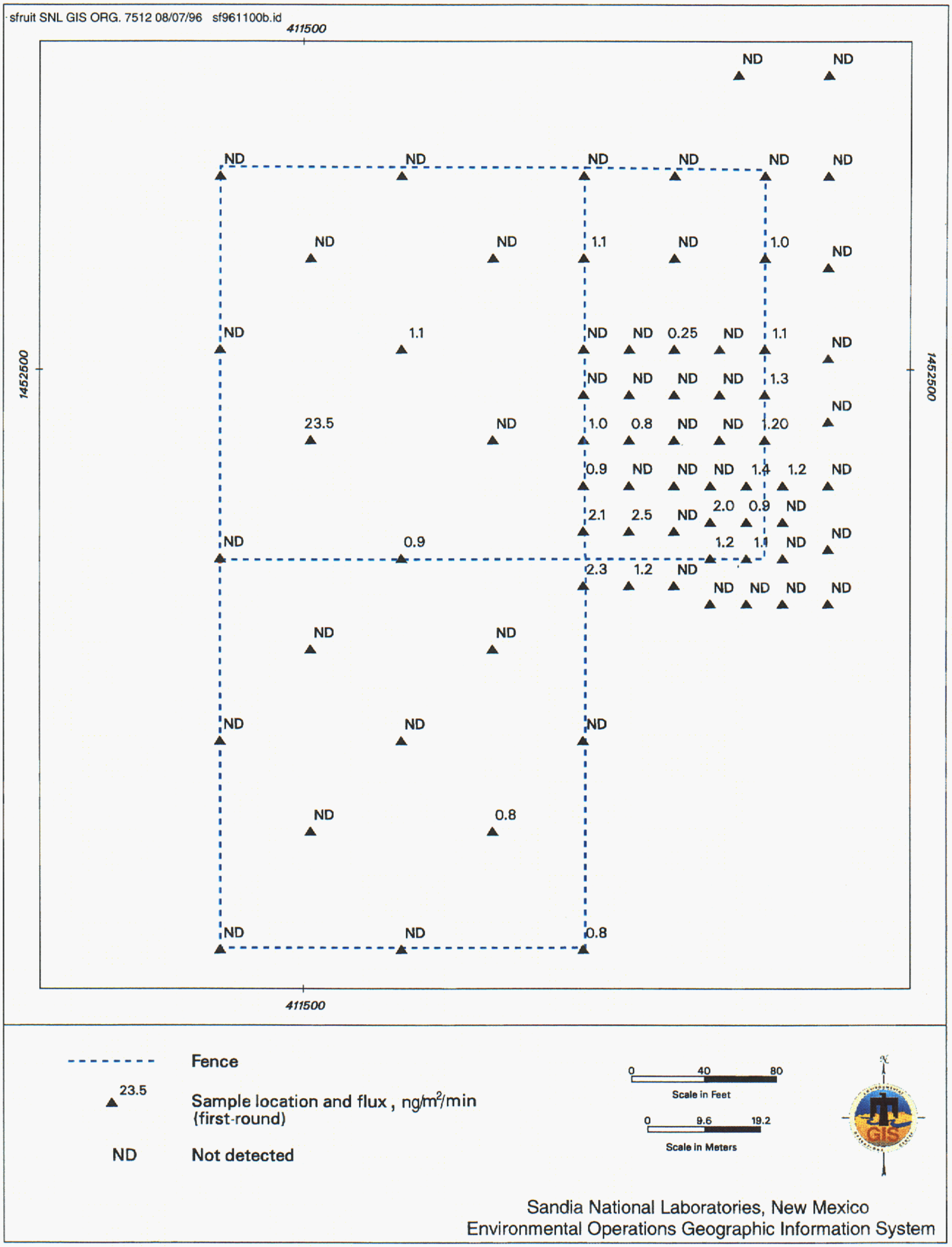

Figure 4.5-5 1,1,1-TCA Flux, First-Round Passive Soil Gas Sampling

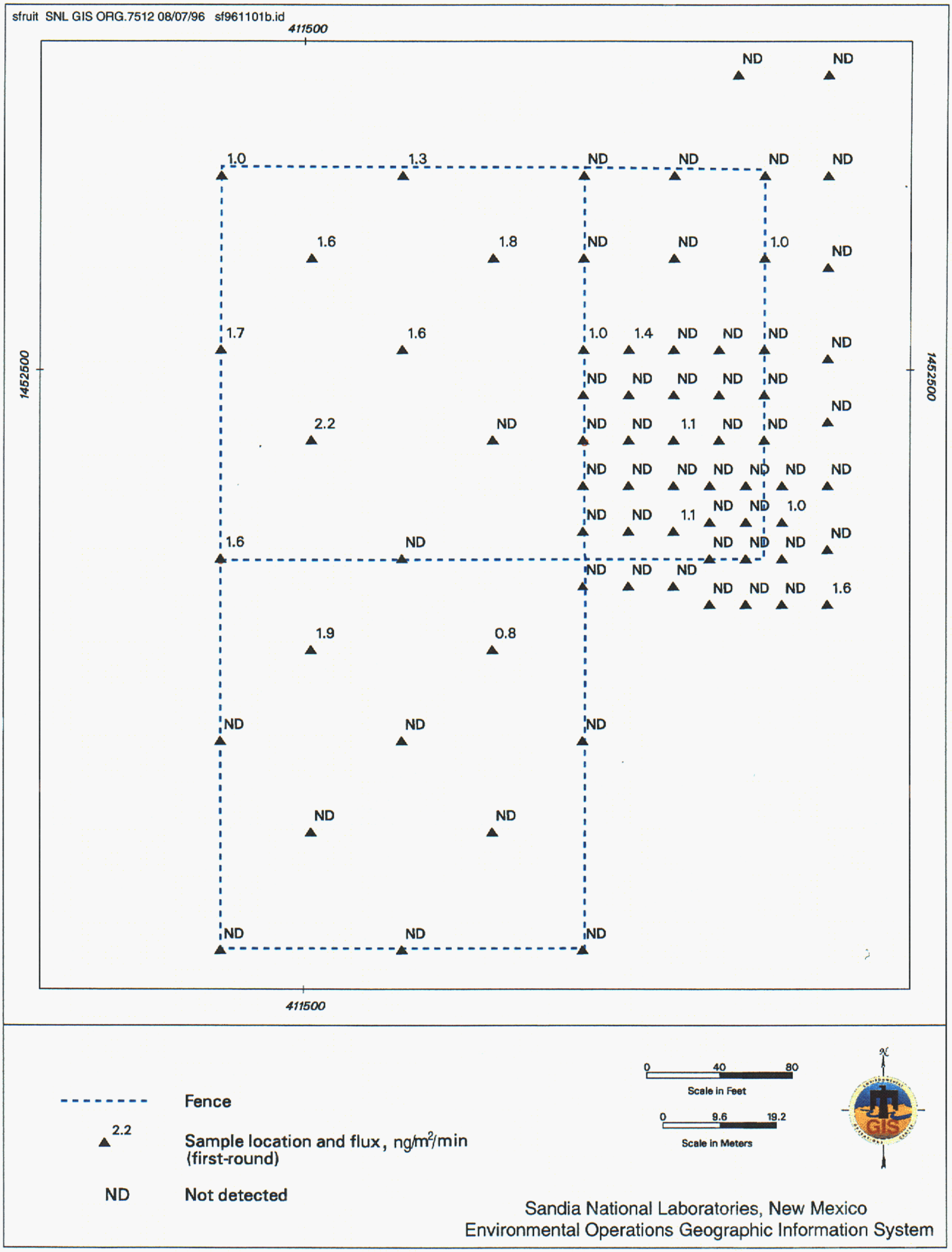

Figure 4.5-6 Toluene Flux, First-Round Passive Soil Gas Sampling

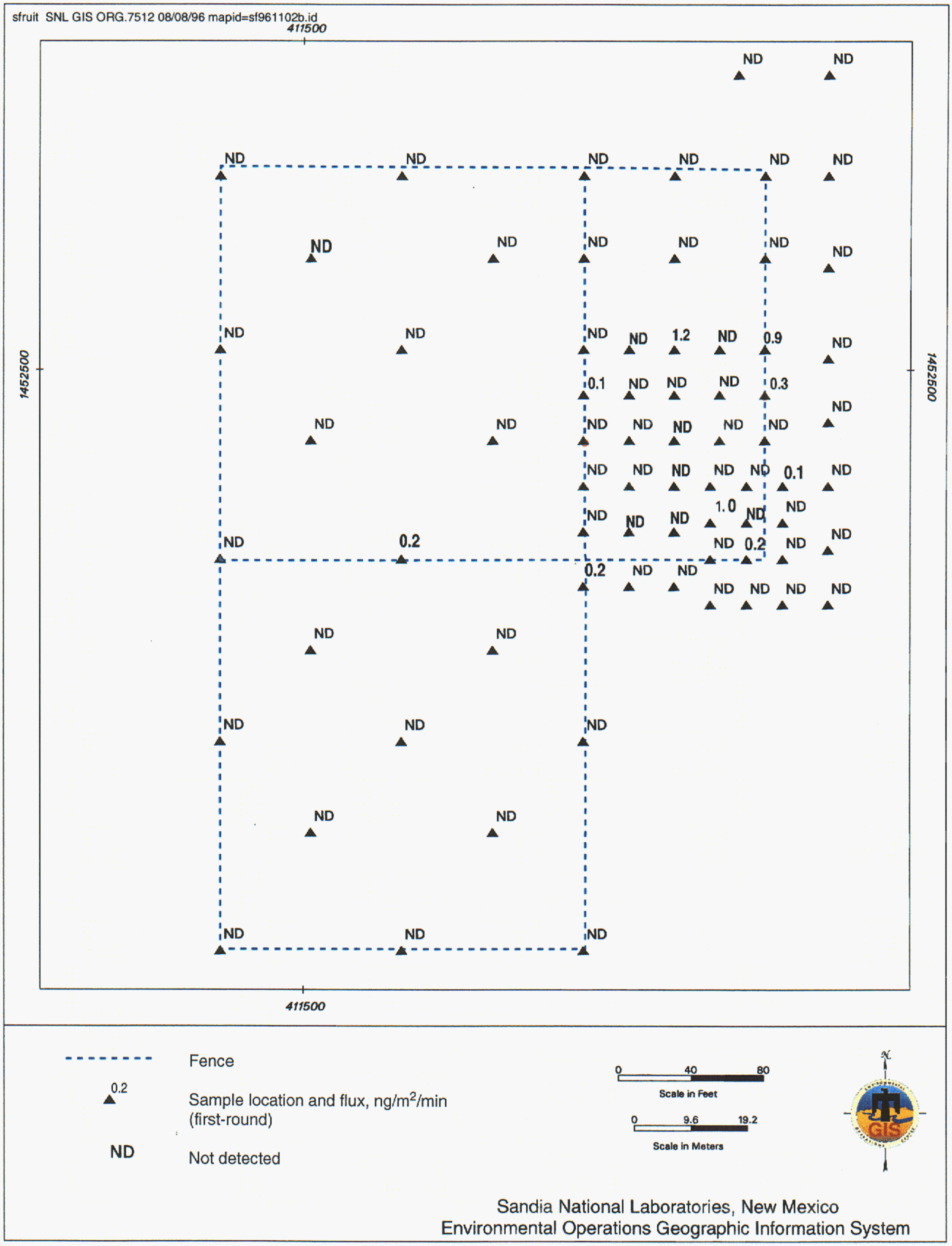

Figure 4.5-7 1,1,2-Trichloro-trifluoroethane Flux, First-Round Passive Soil Gas Sampling

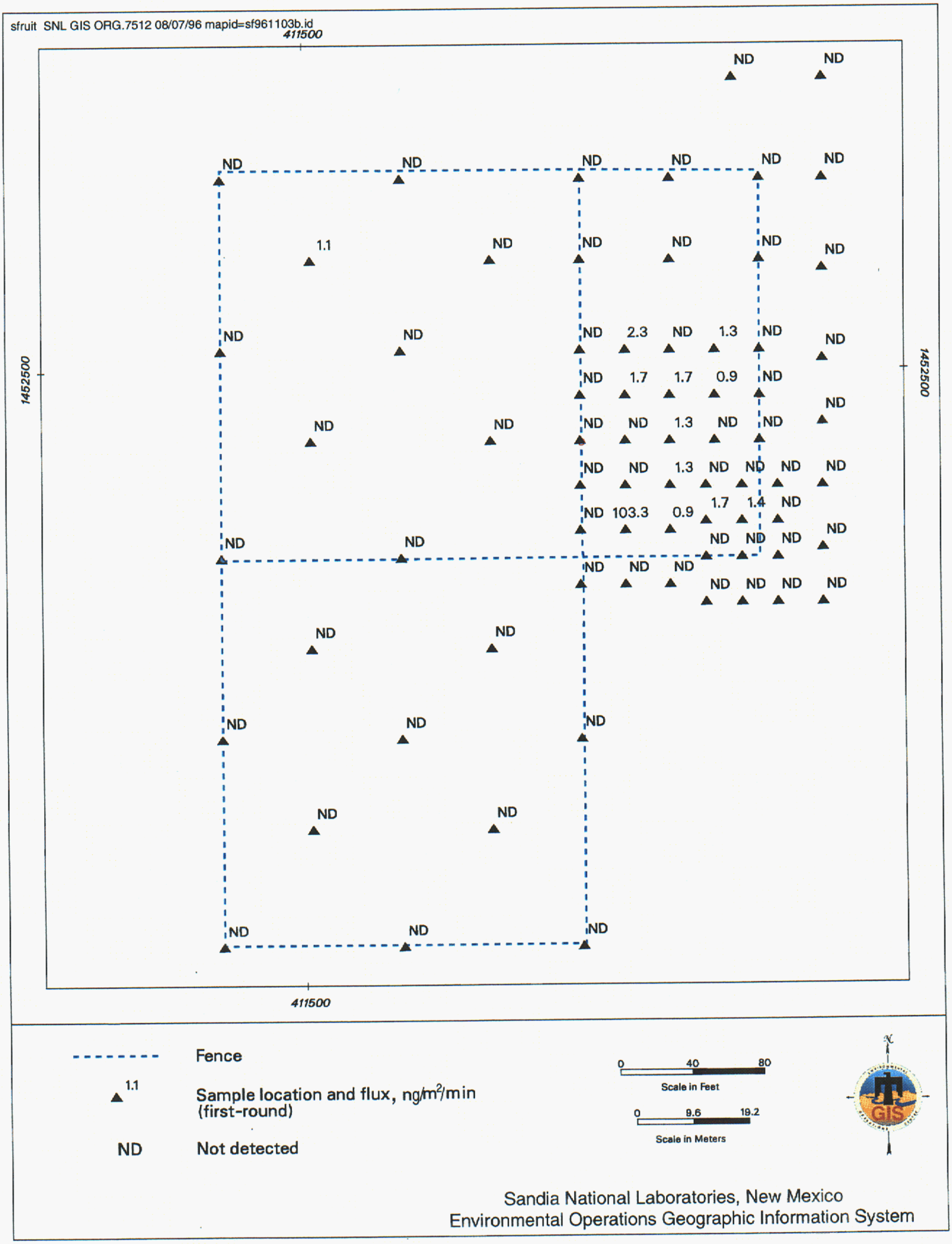

Figure 4.5-8 Dichloroethene Flux, First-Round Passive Soil Gas Sampling

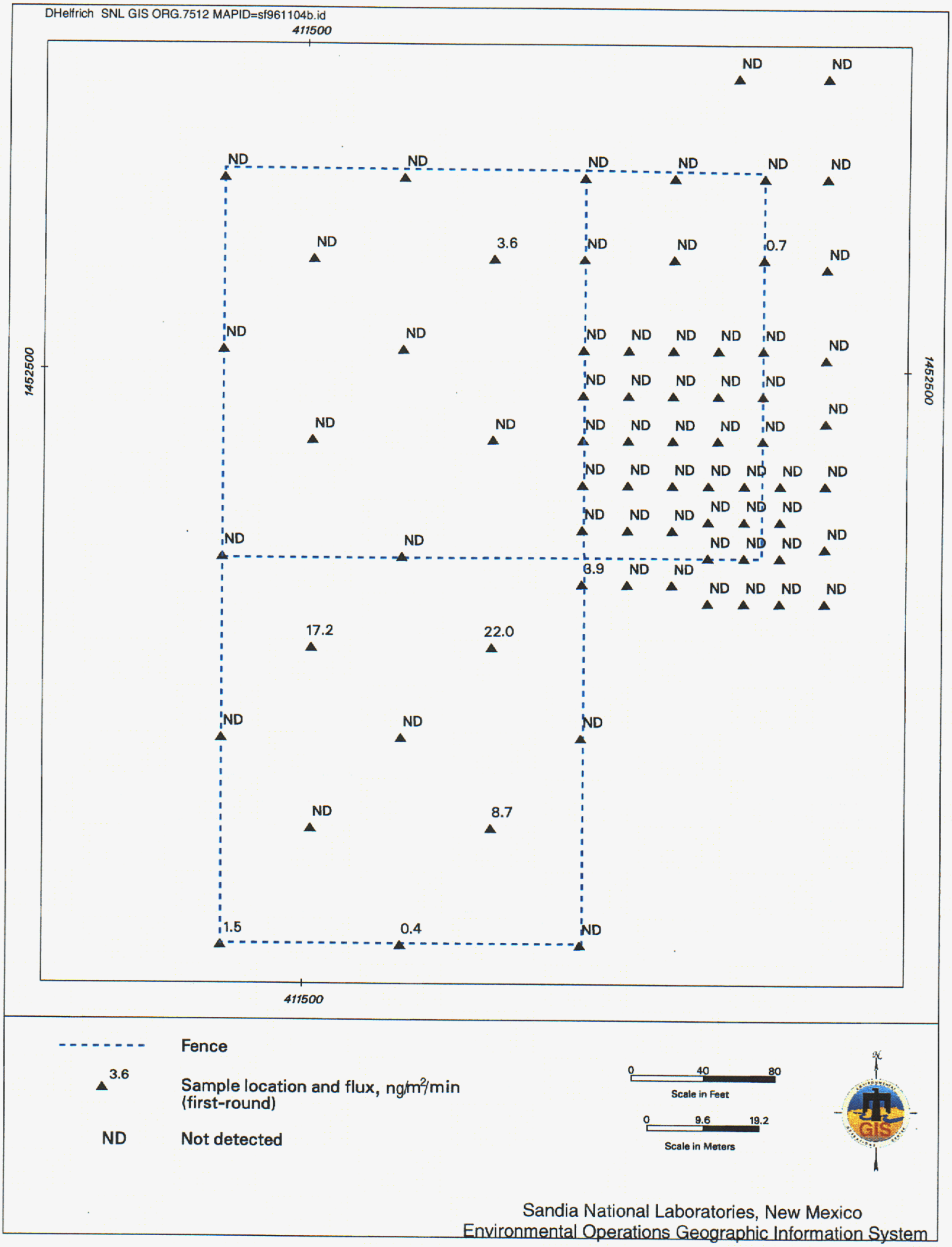

Figure 4.5-9 Acetone Flux, First-Round Passive Soil Gas Sampling

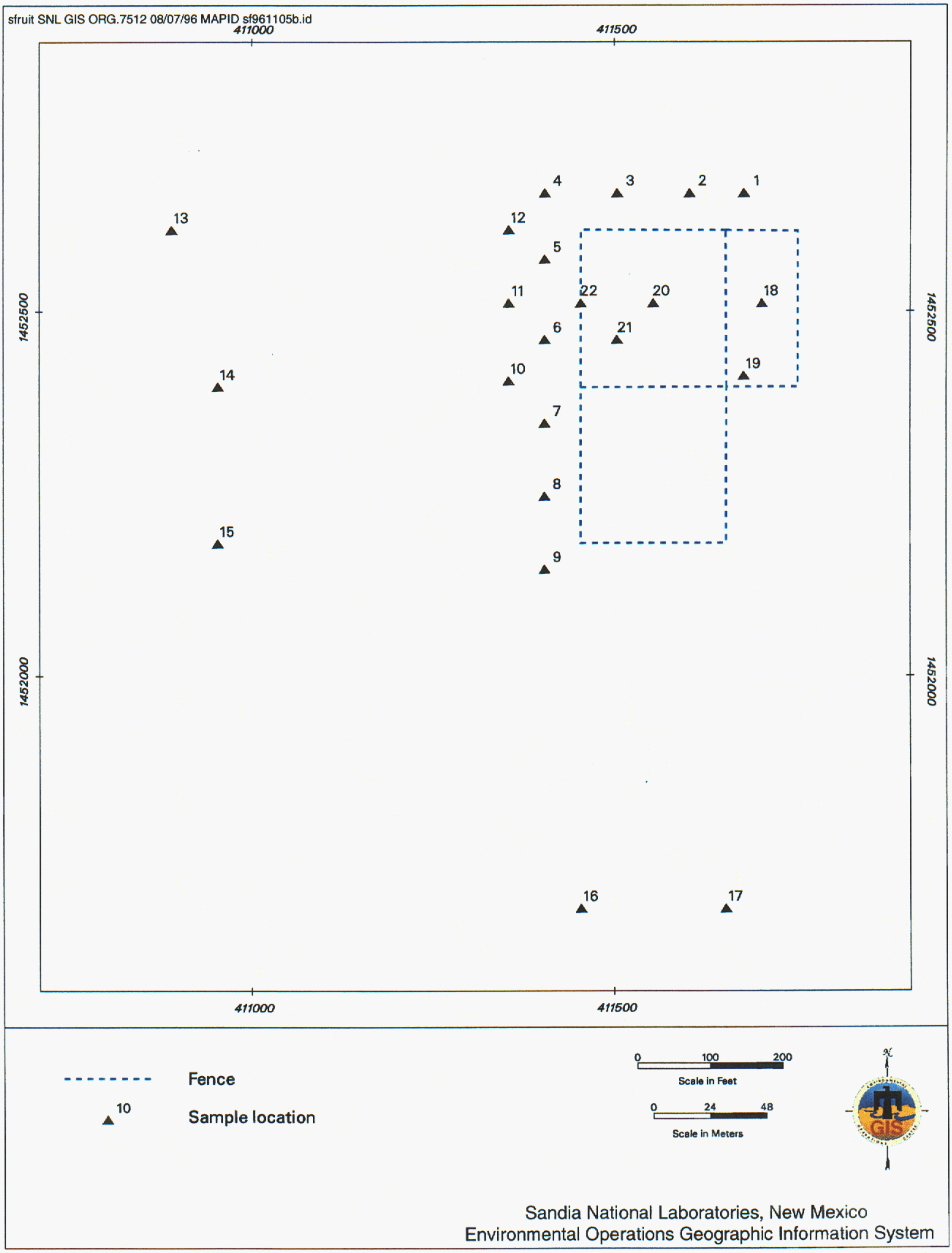

Figure 4.5-10 Second-Round Passive Soil Gas Sampling Locations

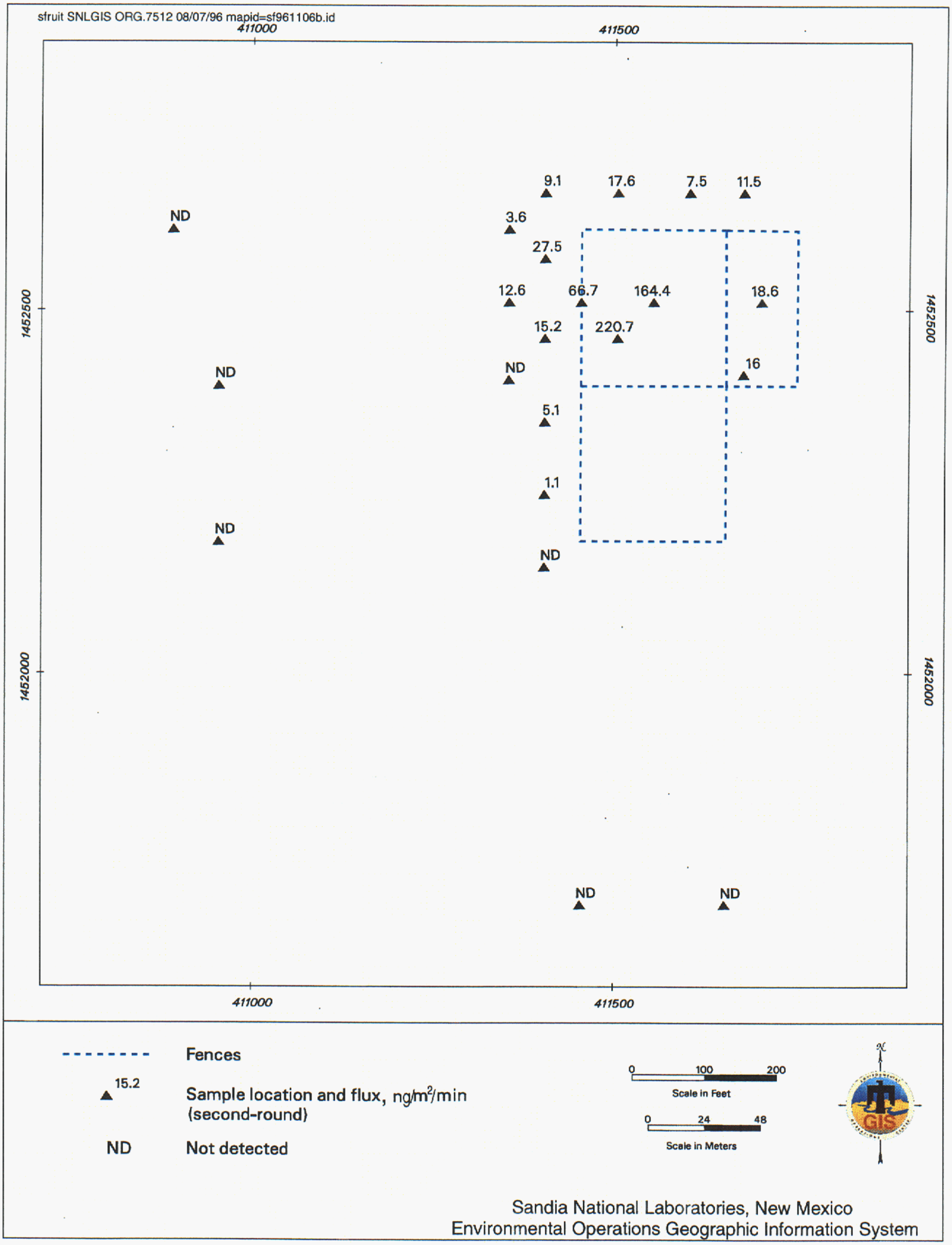

Figure 4.5-11 PCE Flux, Second-Round Passive Soil Gas Sampling

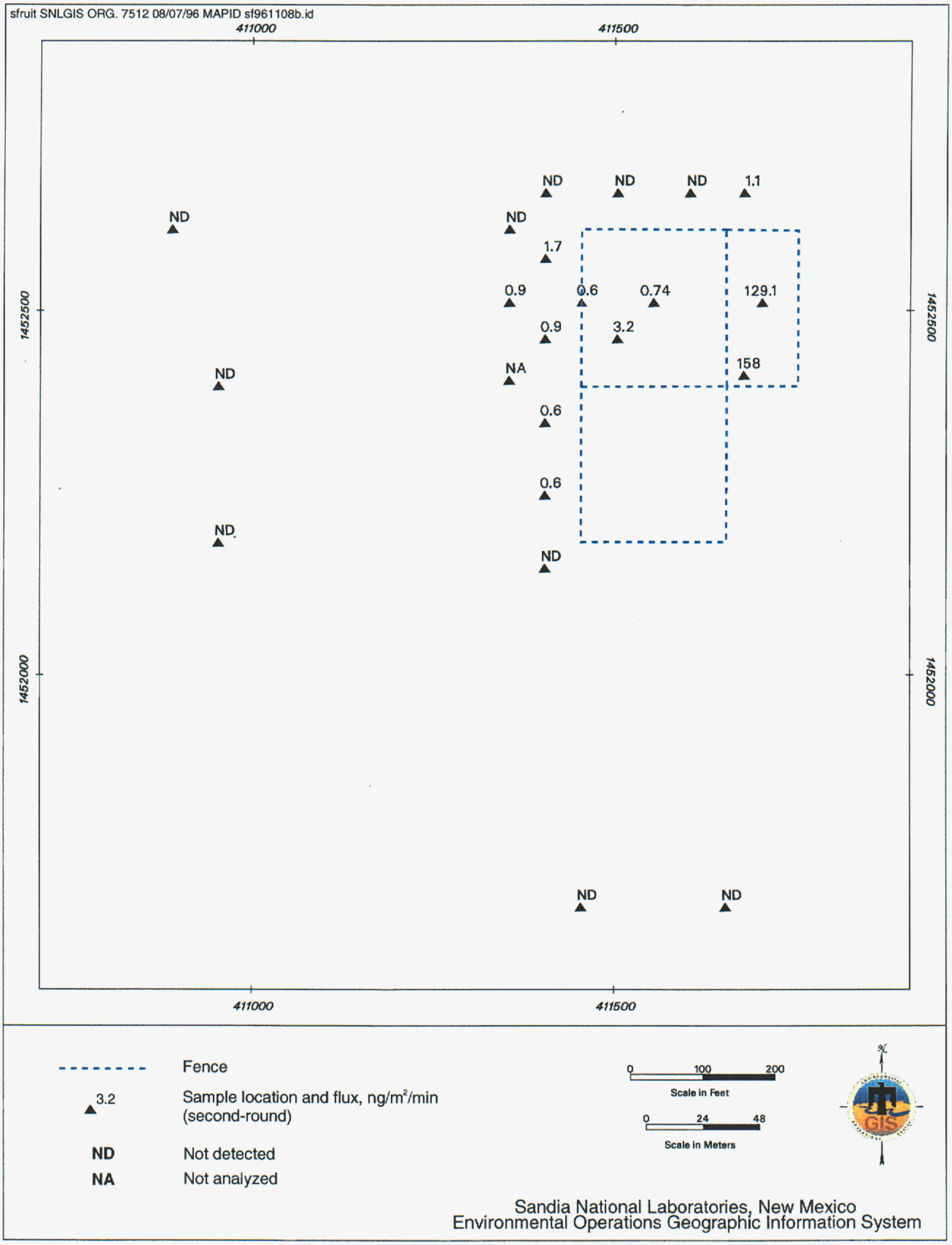

Figure 4.5-12 TCE Flux, Second-Round Passive Soil Gas Sampling

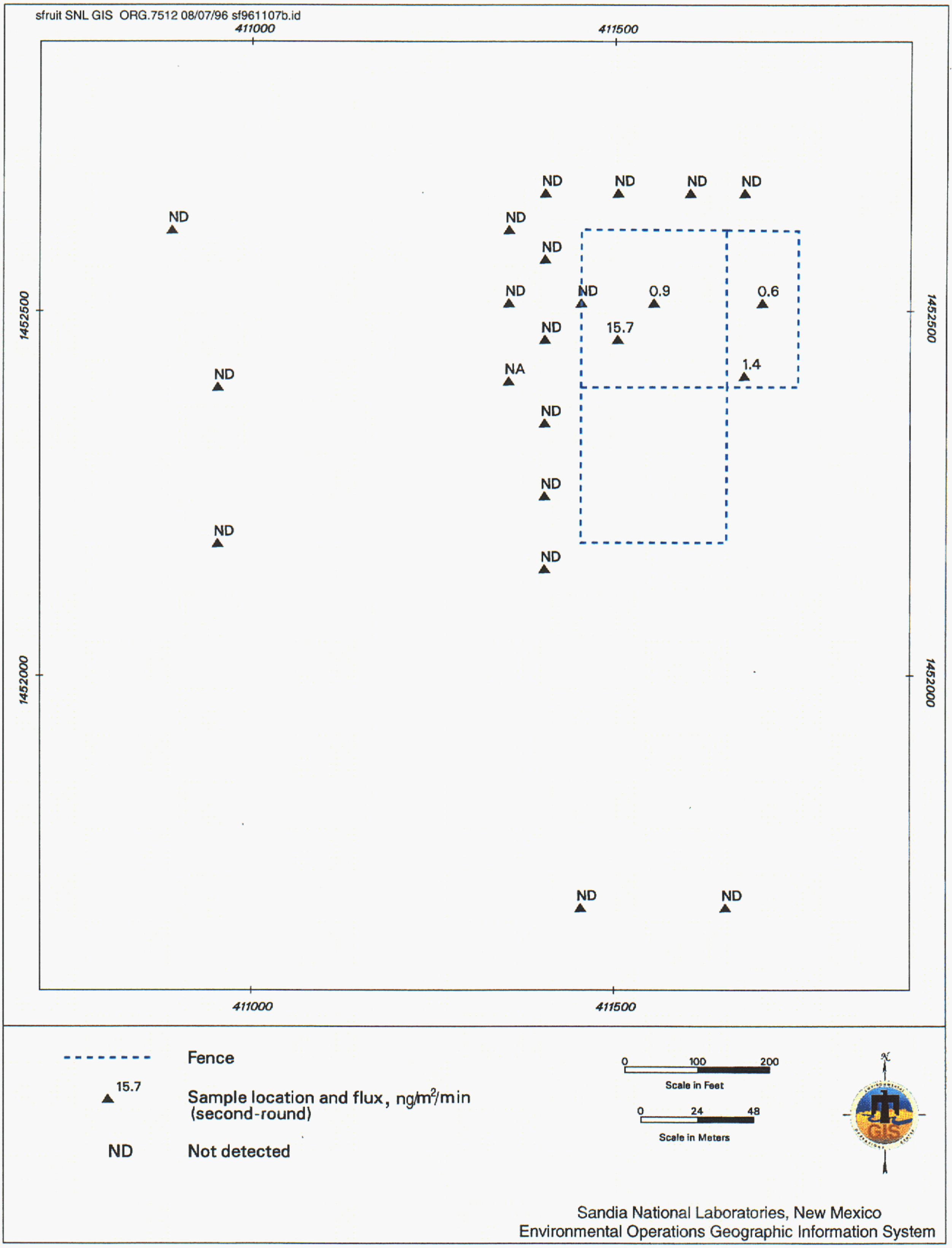

Figure 4.5-13 1,1,1-TCA Flux, Second-Round Passive Soil Gas Sampling

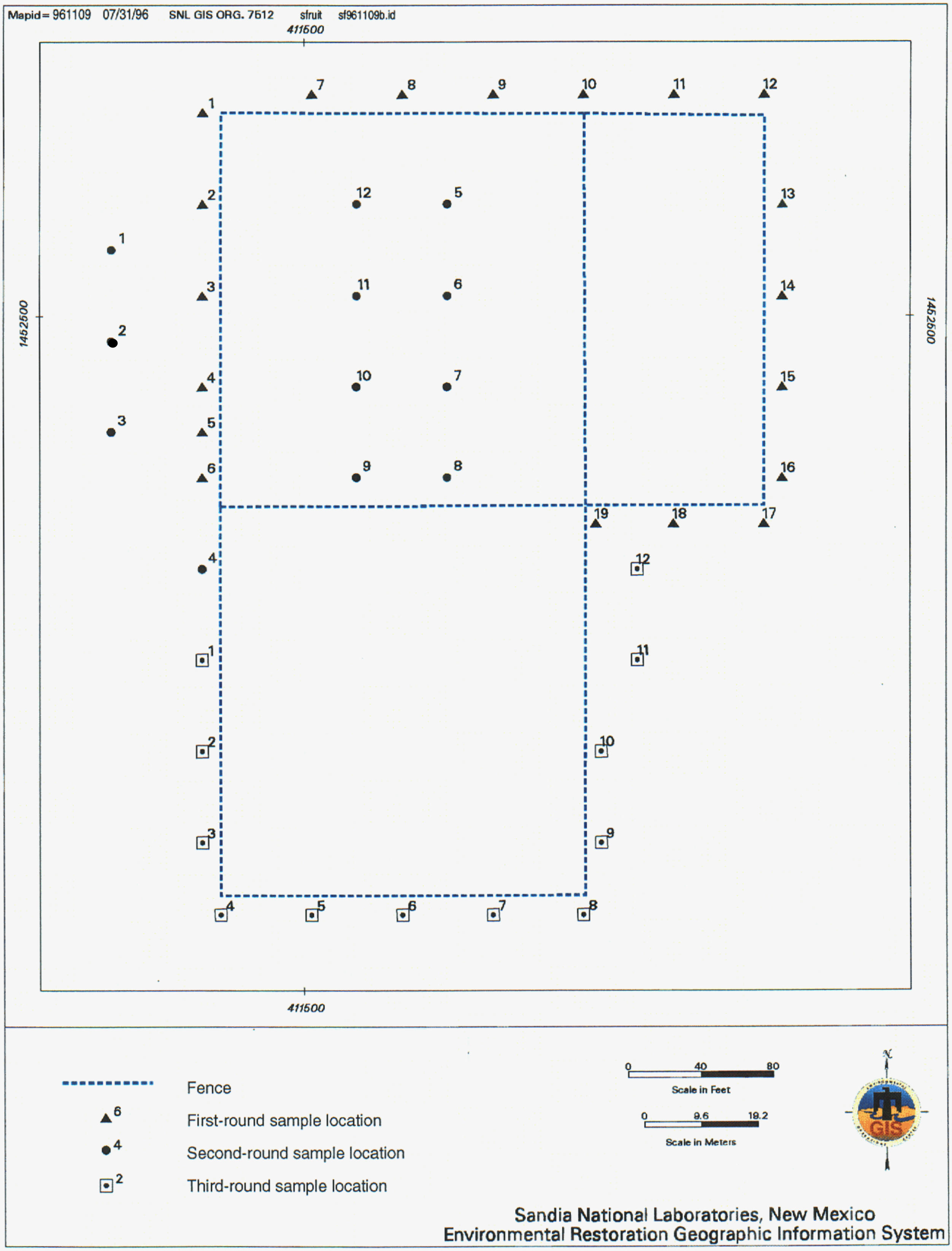

Figure 4.5-14 Active Soil Gas Sampling Locations

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Figure 4.5-15 Active Soil Gas Sampling Schematic

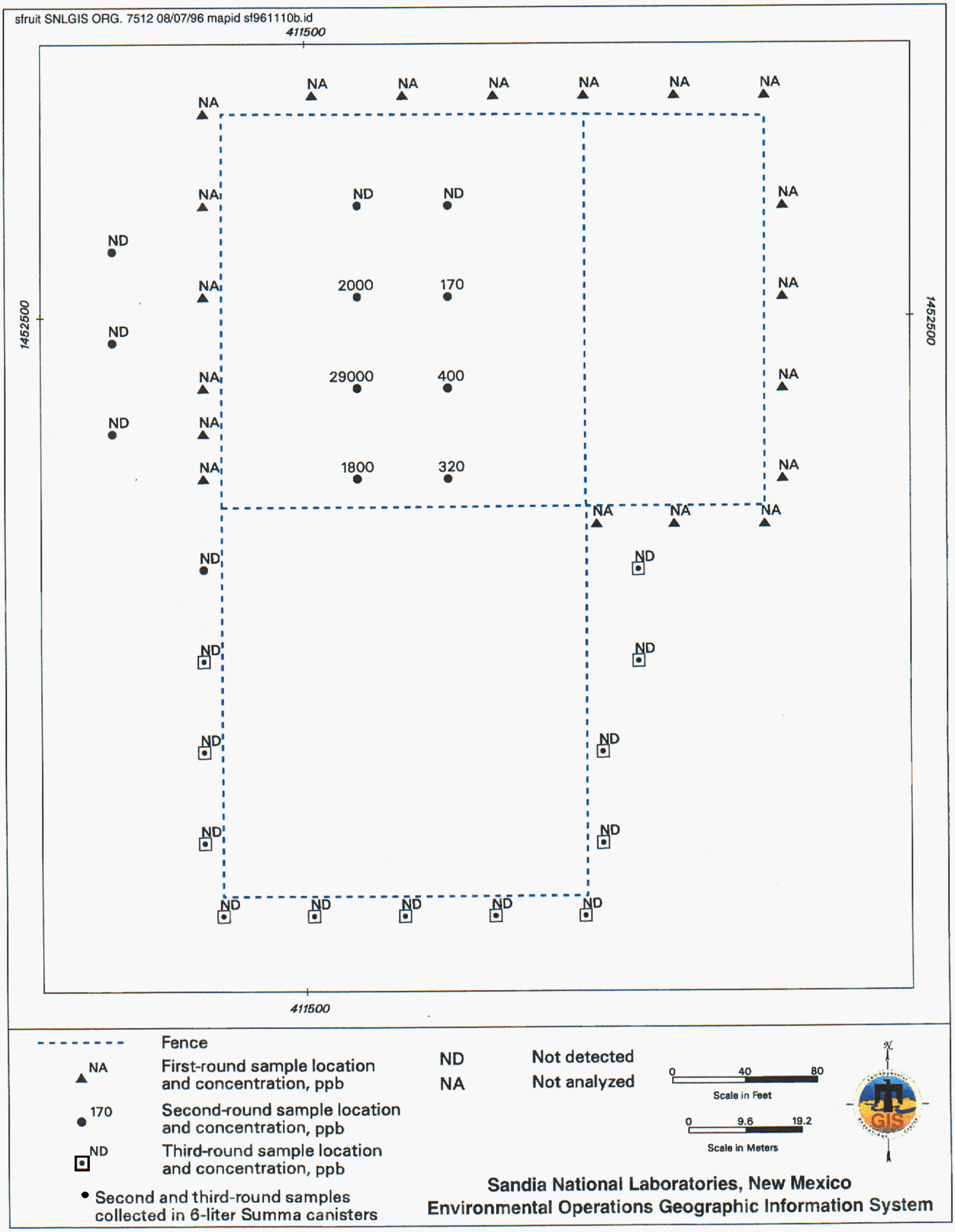

Figure 4.5-16 Dichloro-difluoromethane in Soil Gas at 10 Feet

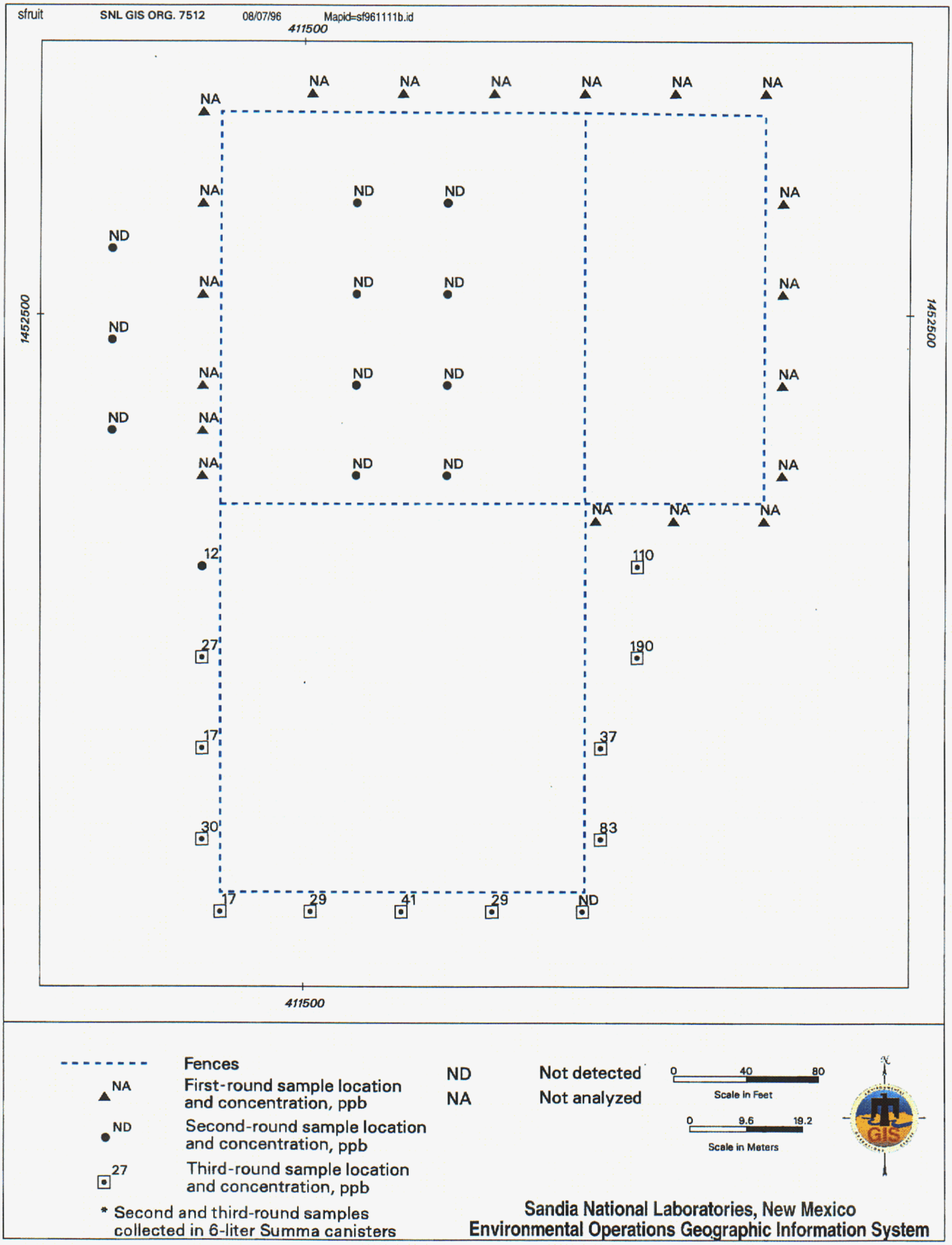

Figure 4.5-17 Trichloro-fluoromethane in Soil Gas at 10 Feet

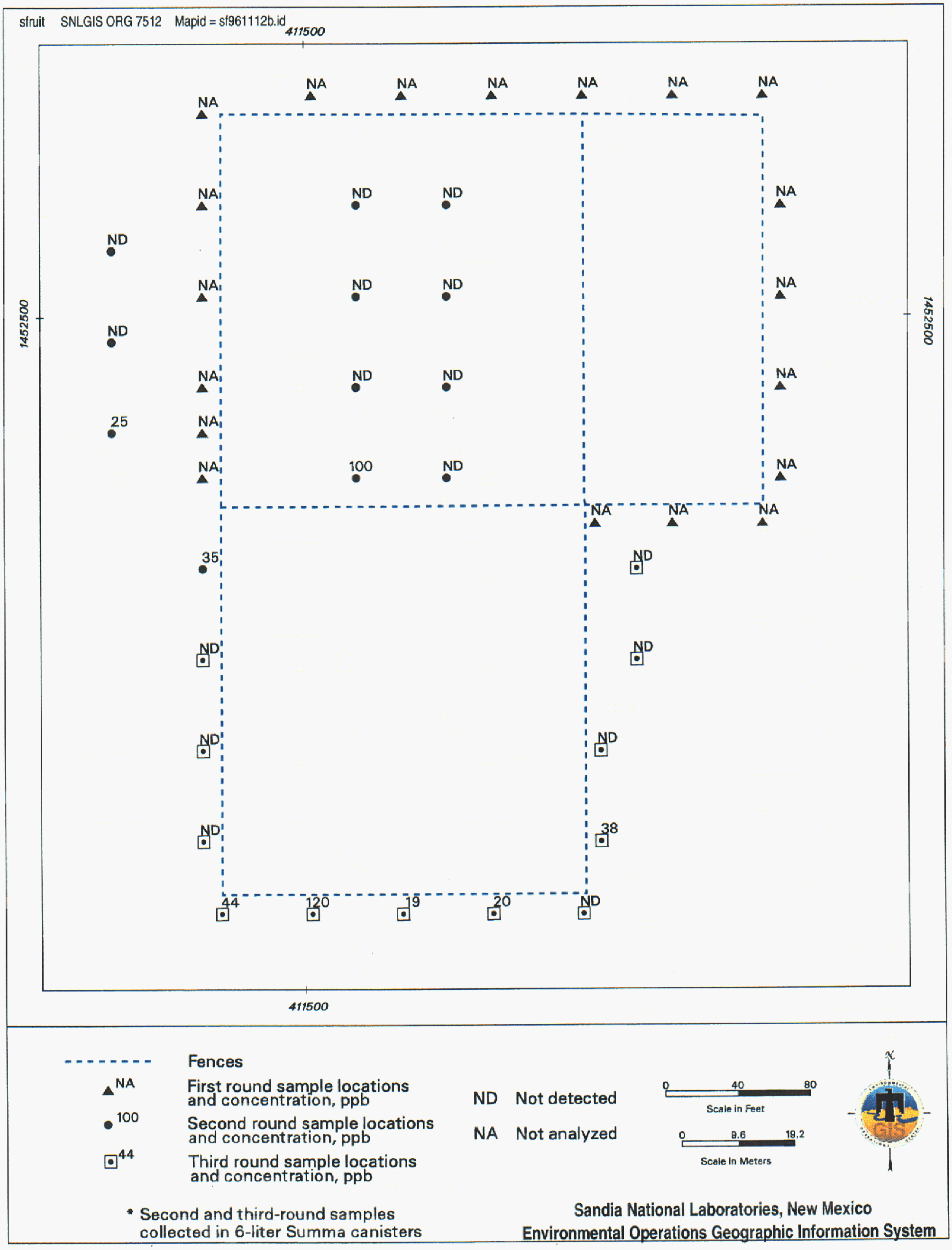

Figure 4.5-18 1,1,2-trichloro-1,2,2-trifluoroethane in Soil Gas at 10 Feet

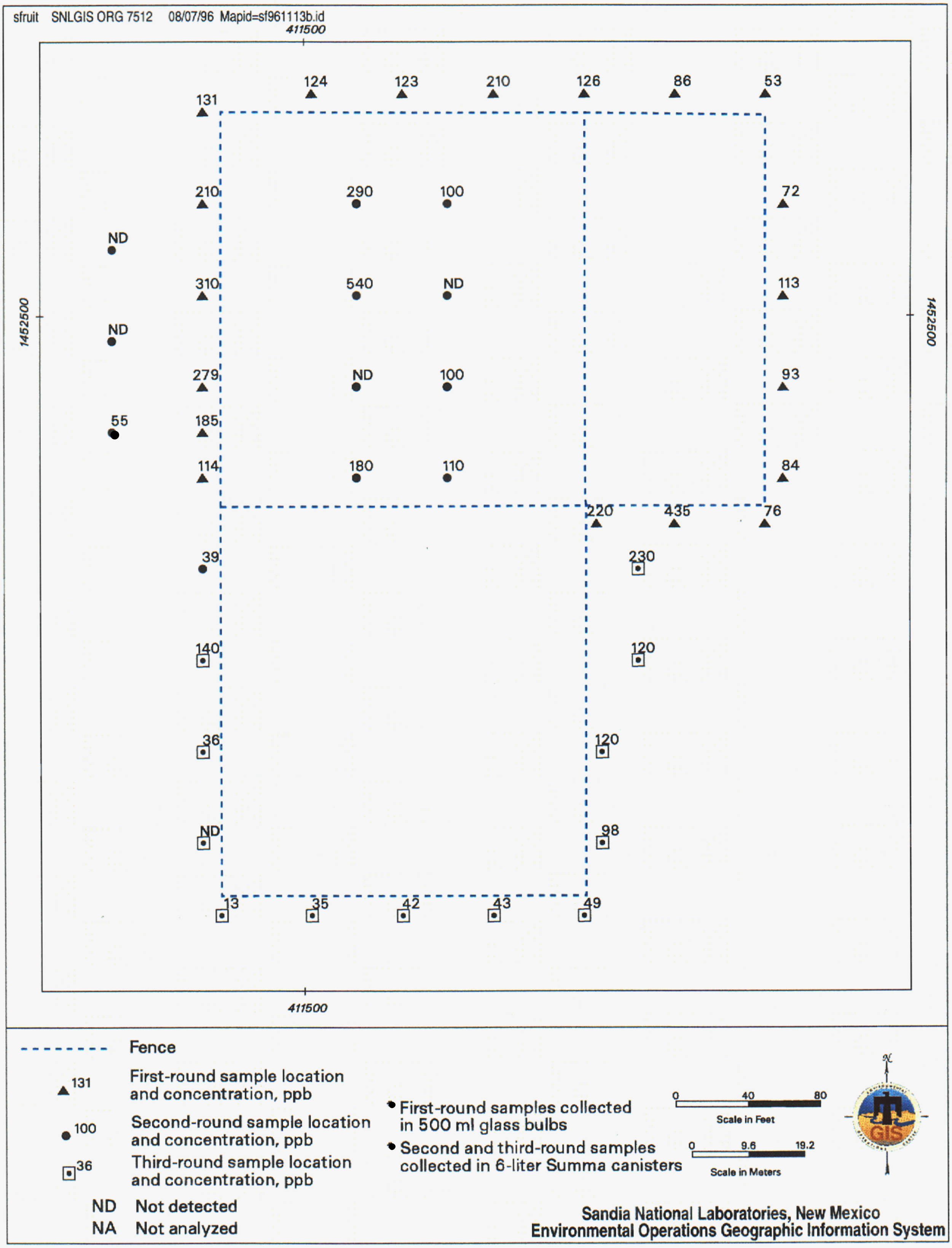

Figure 4.5-19 TCE in Soil Gas at 10 Feet

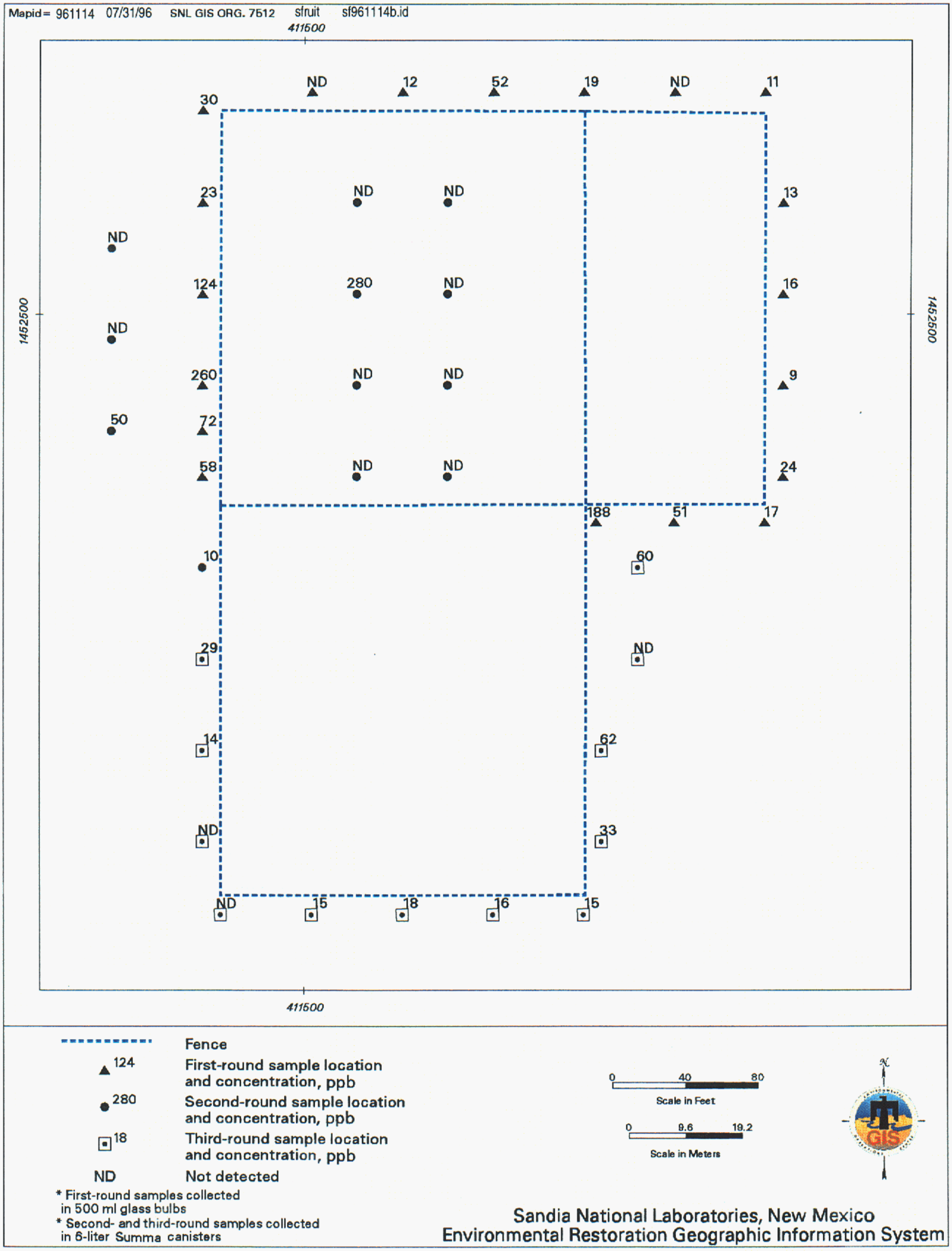

Figure 4.5-20 1,1,1-TCA in Soil Gas at 10 Feet

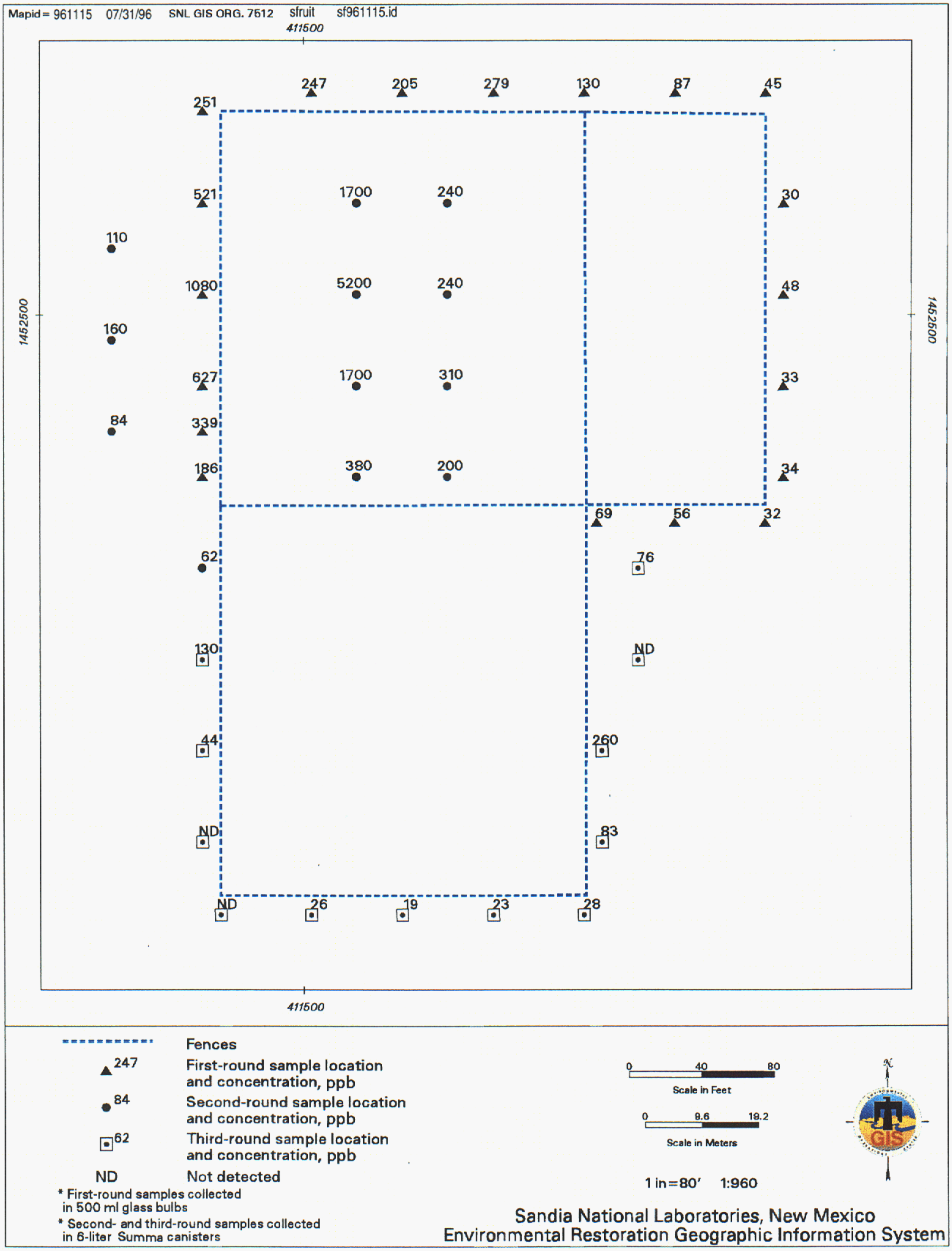

Figure 4.5-21 PCE in Soil Gas at 10 Feet

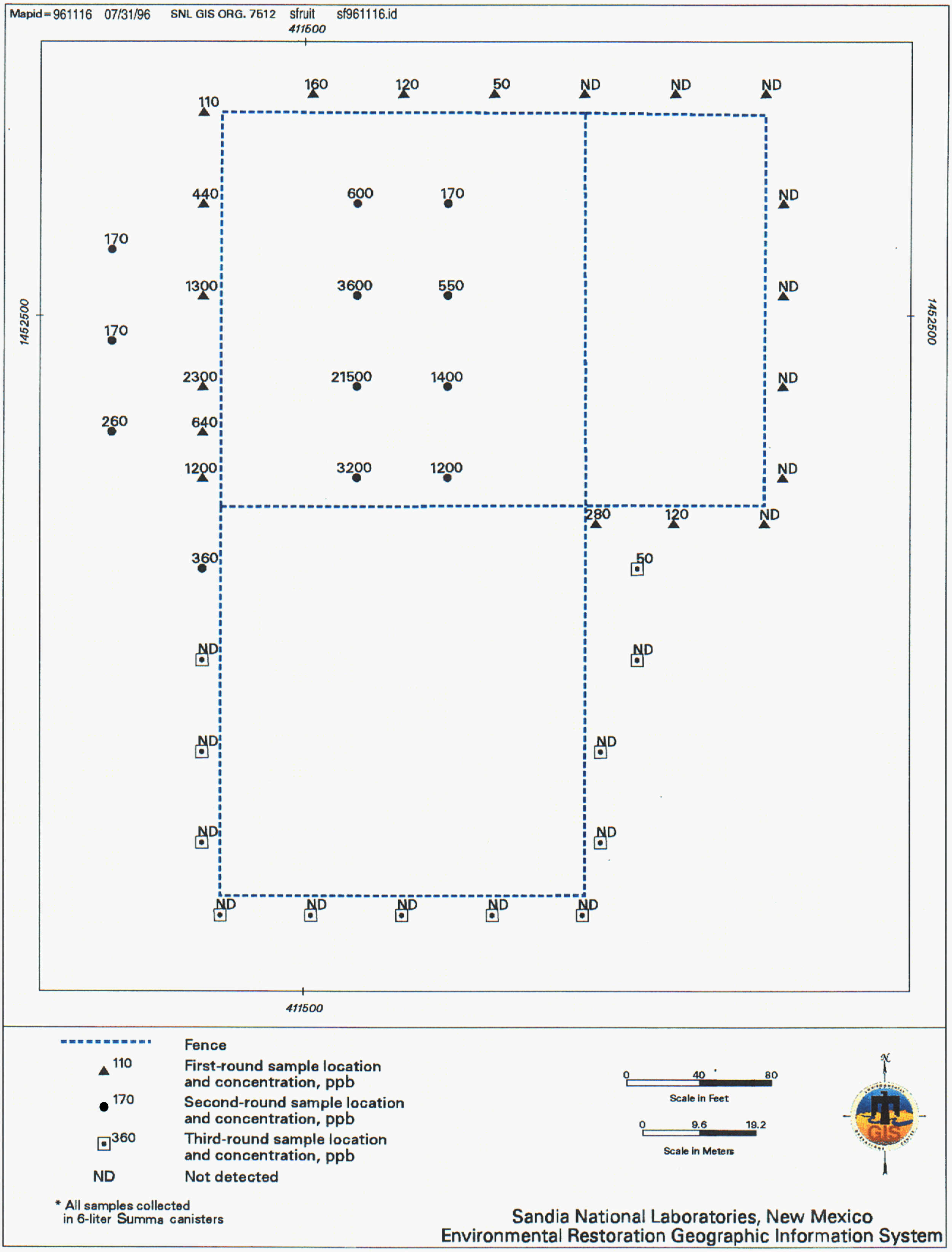

Figure 4.5-22 Dichloro-difluoromethane in Soil Gas at 30 Feet

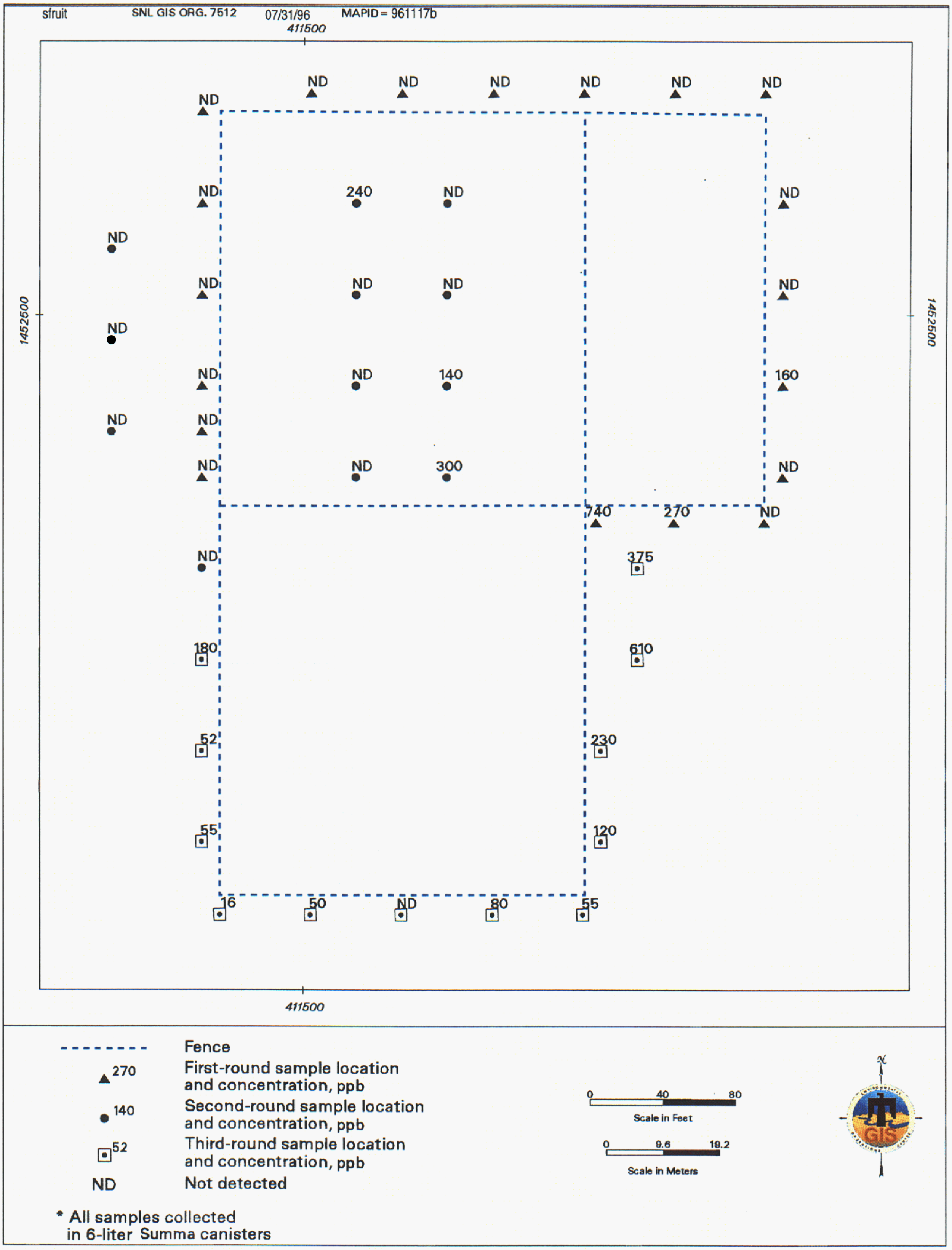

Figure 4.5-23 Trichloro-fluoromethane in Soil Gas at 30 Feet

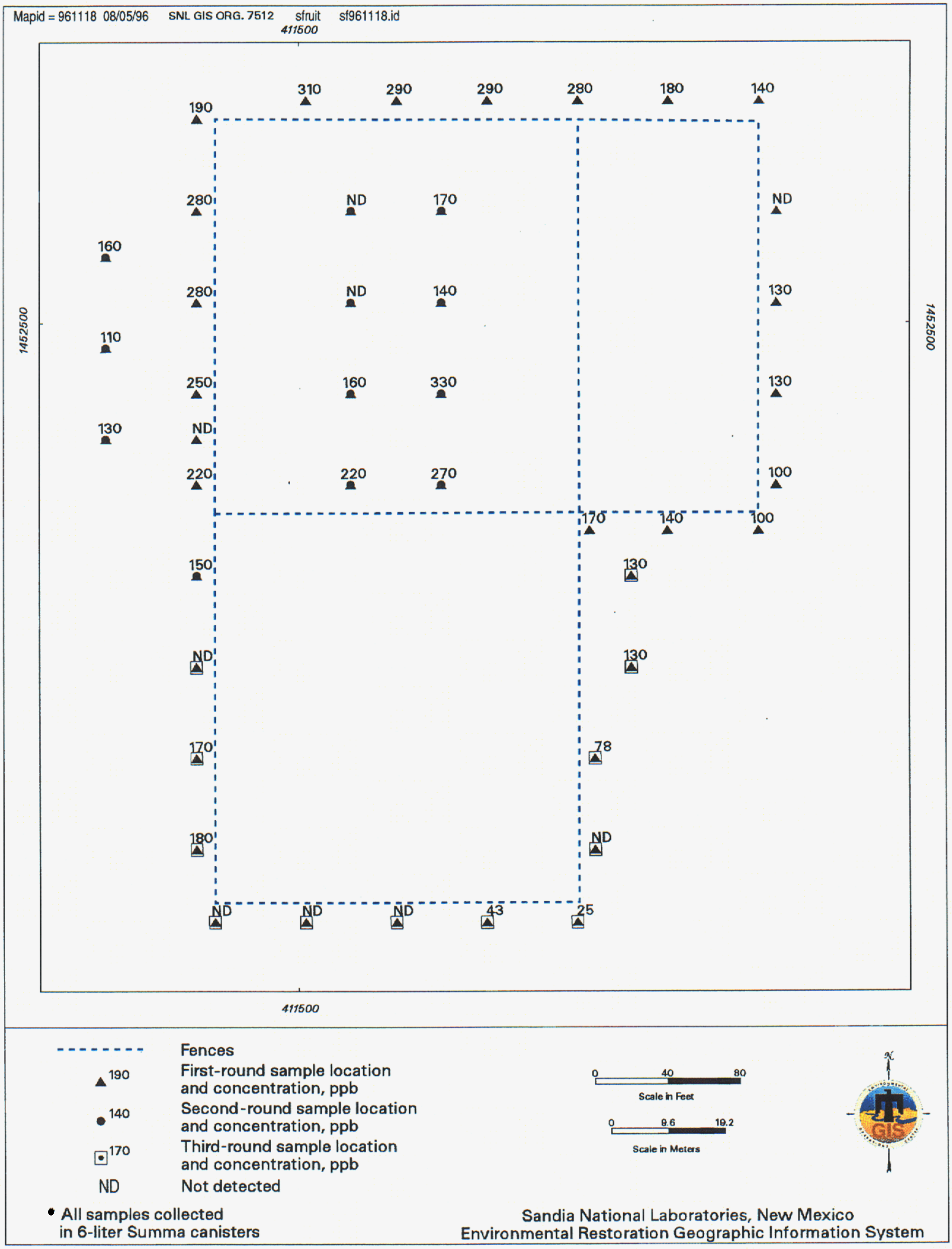

Figure 4.5-24 1,1,2-trichloro-1,2,2-trifluoroethane in Soil Gas at 30 Feet

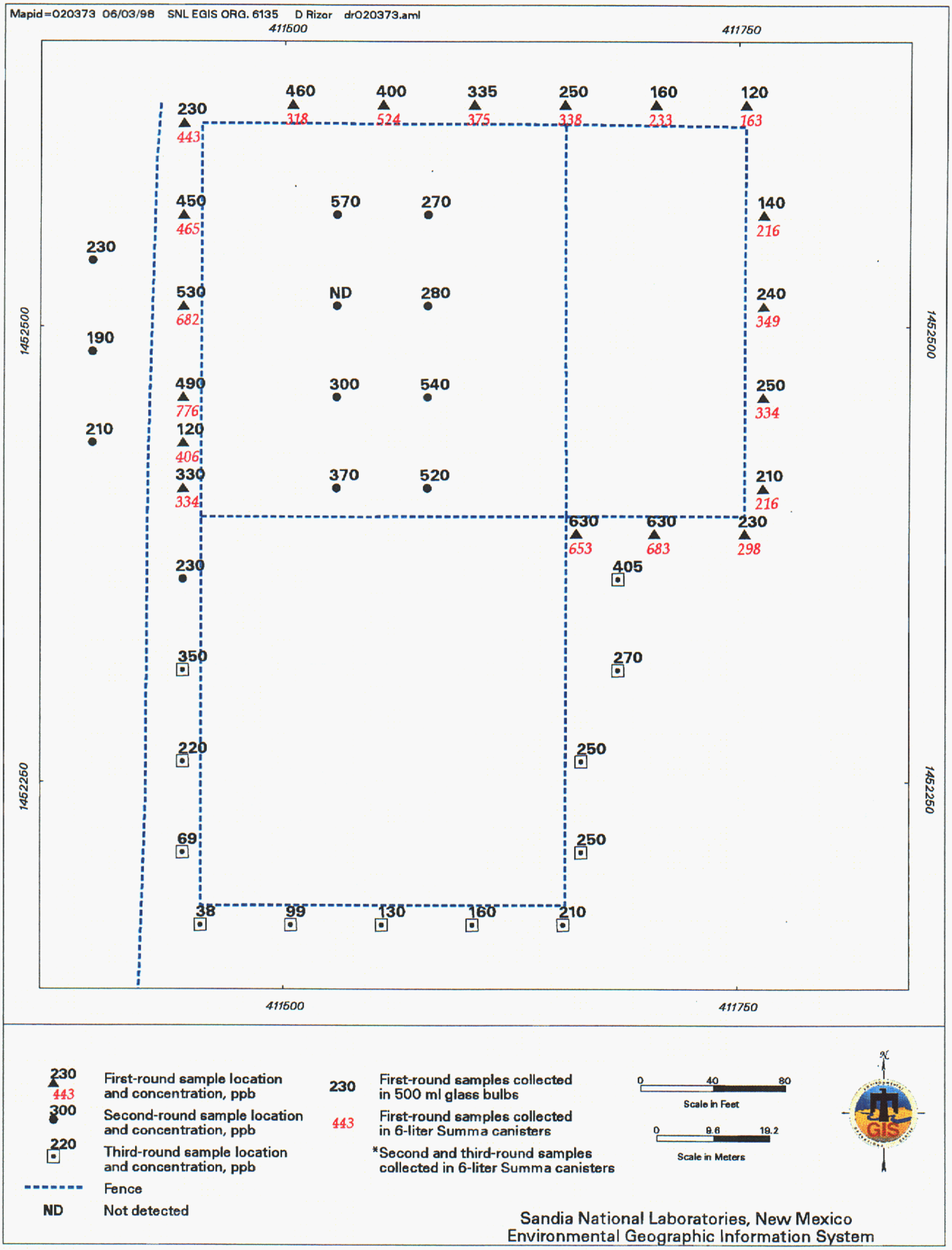

Figure 4.5-25 TCE in Soil Gas at 30 Feet

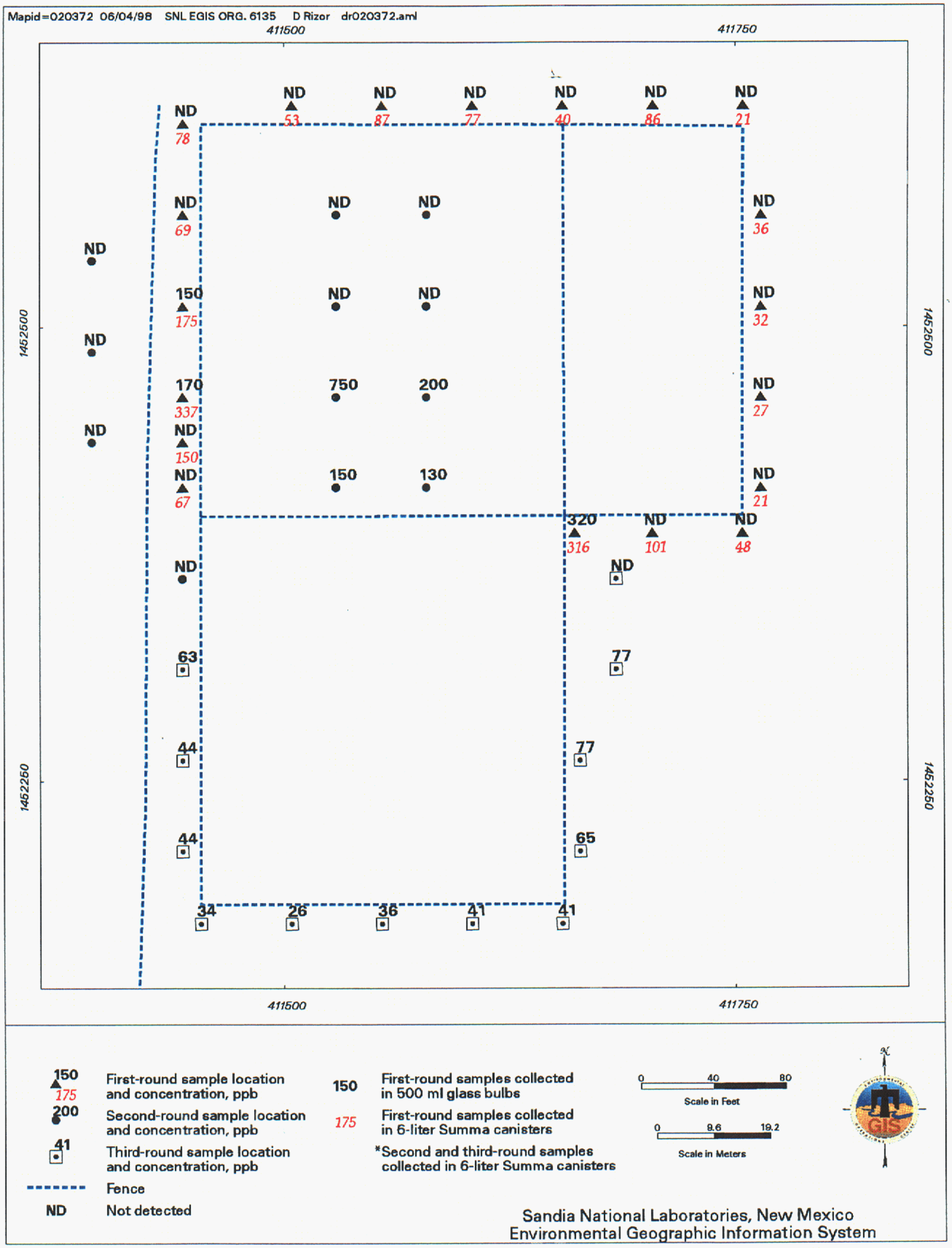

Figure 4.5-26 1,1,1-TCA in Soil Gas at 30 Feet

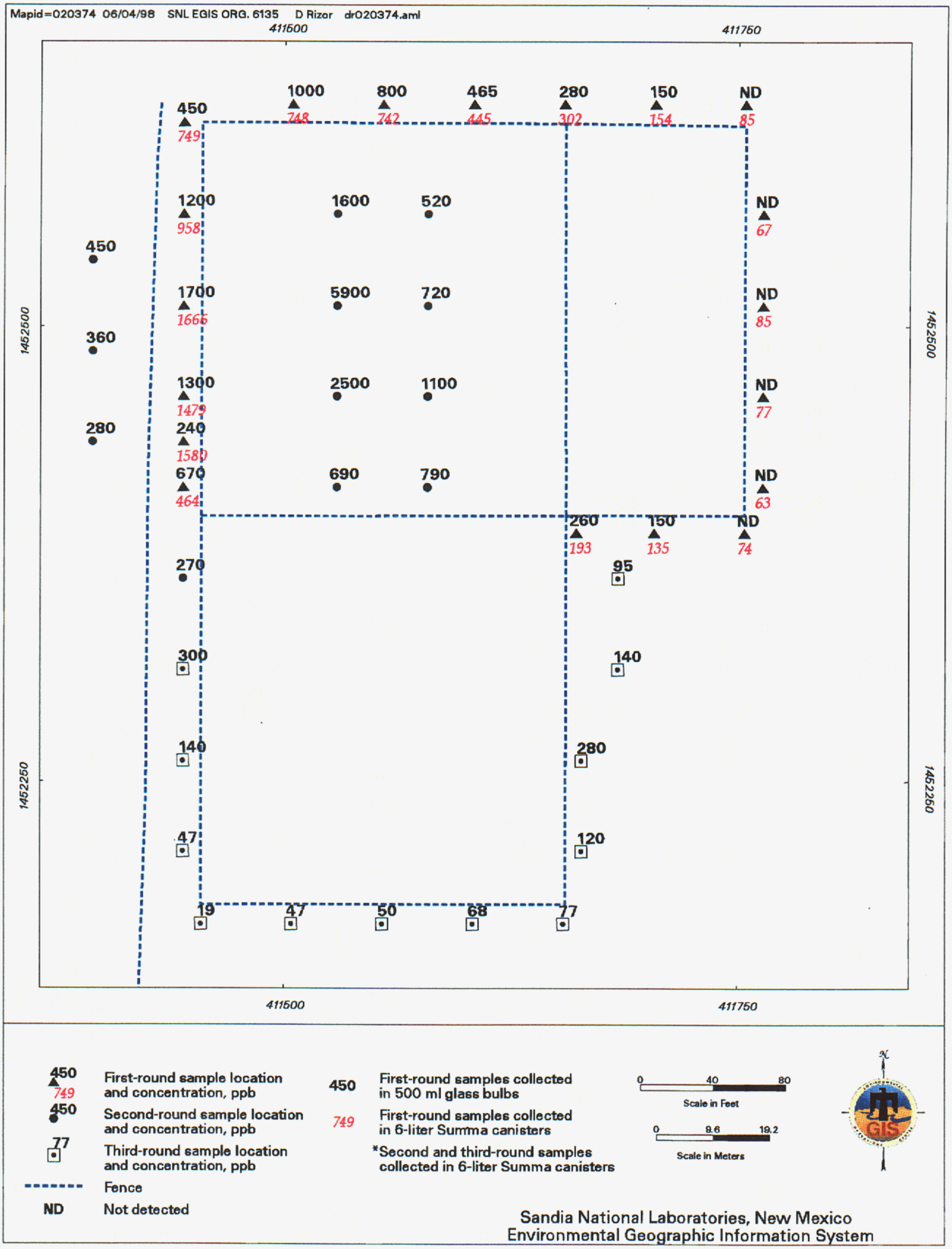

Figure 4.5-27 PCE in Soil Gas at 30 Feet

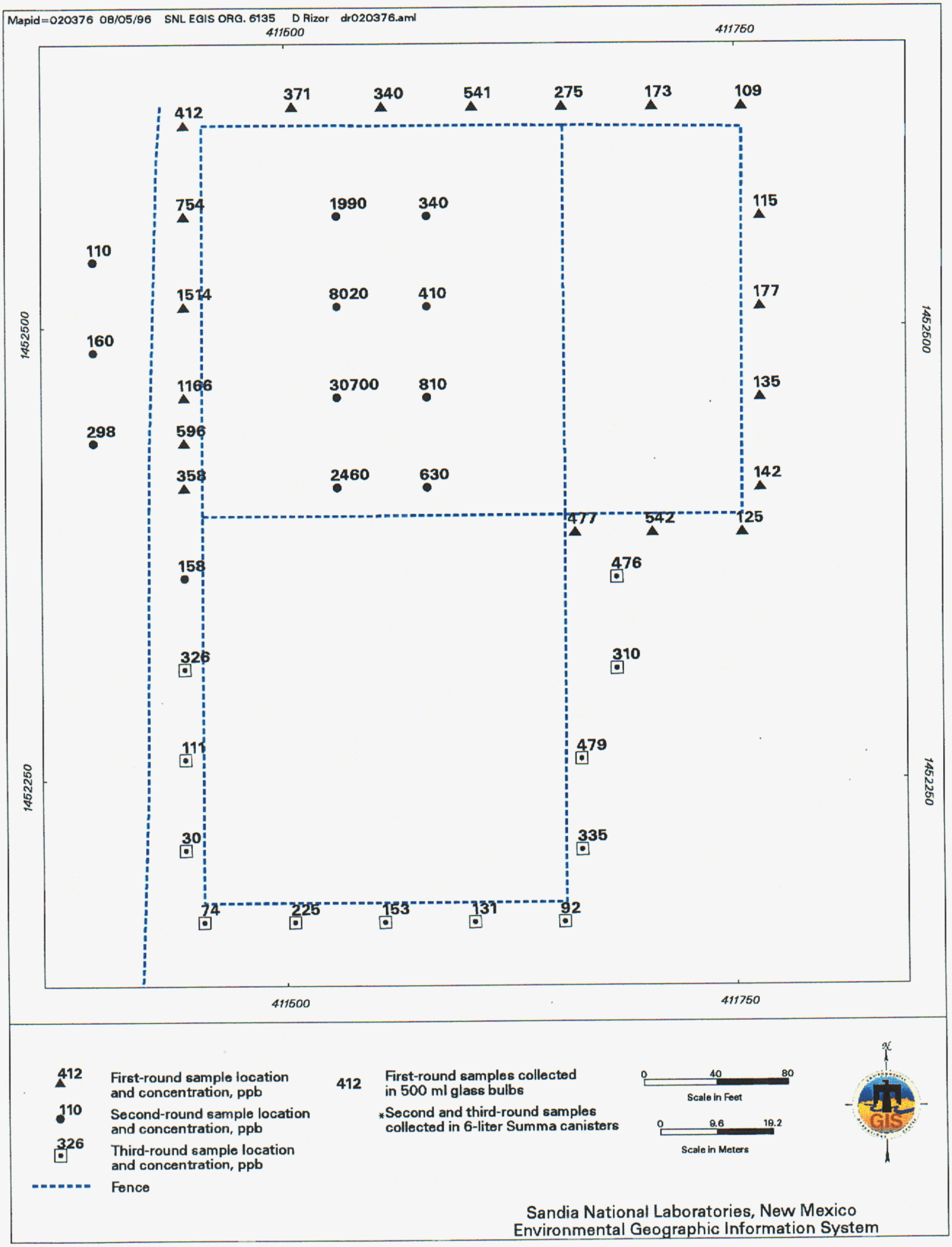

Figure 4.5-28 Total Volatile Organic Compounds in Soil Gas at 10 Feet

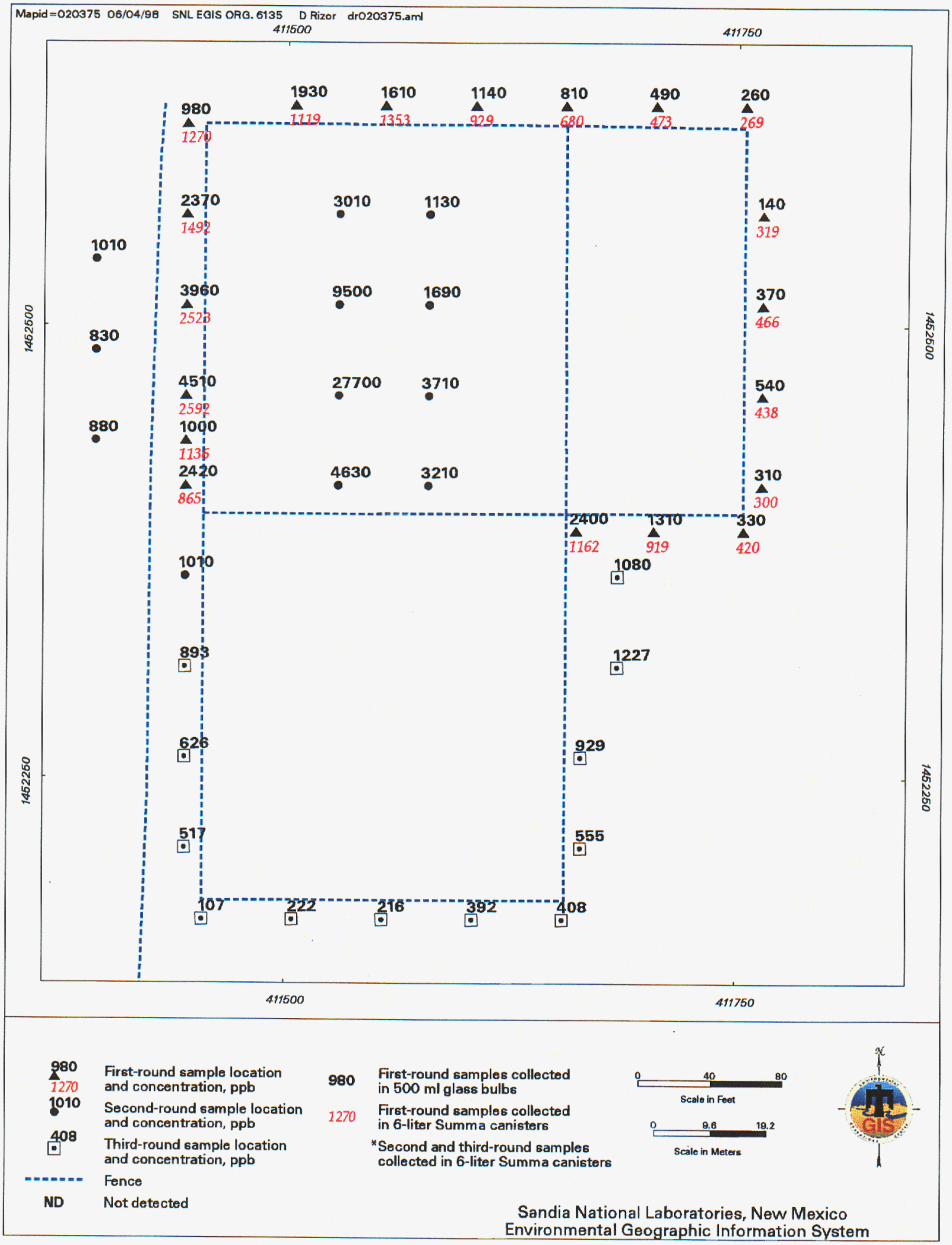

Figure 4.5-29 Total Volatile Organic Compounds in Soil Gas at 30 Feet

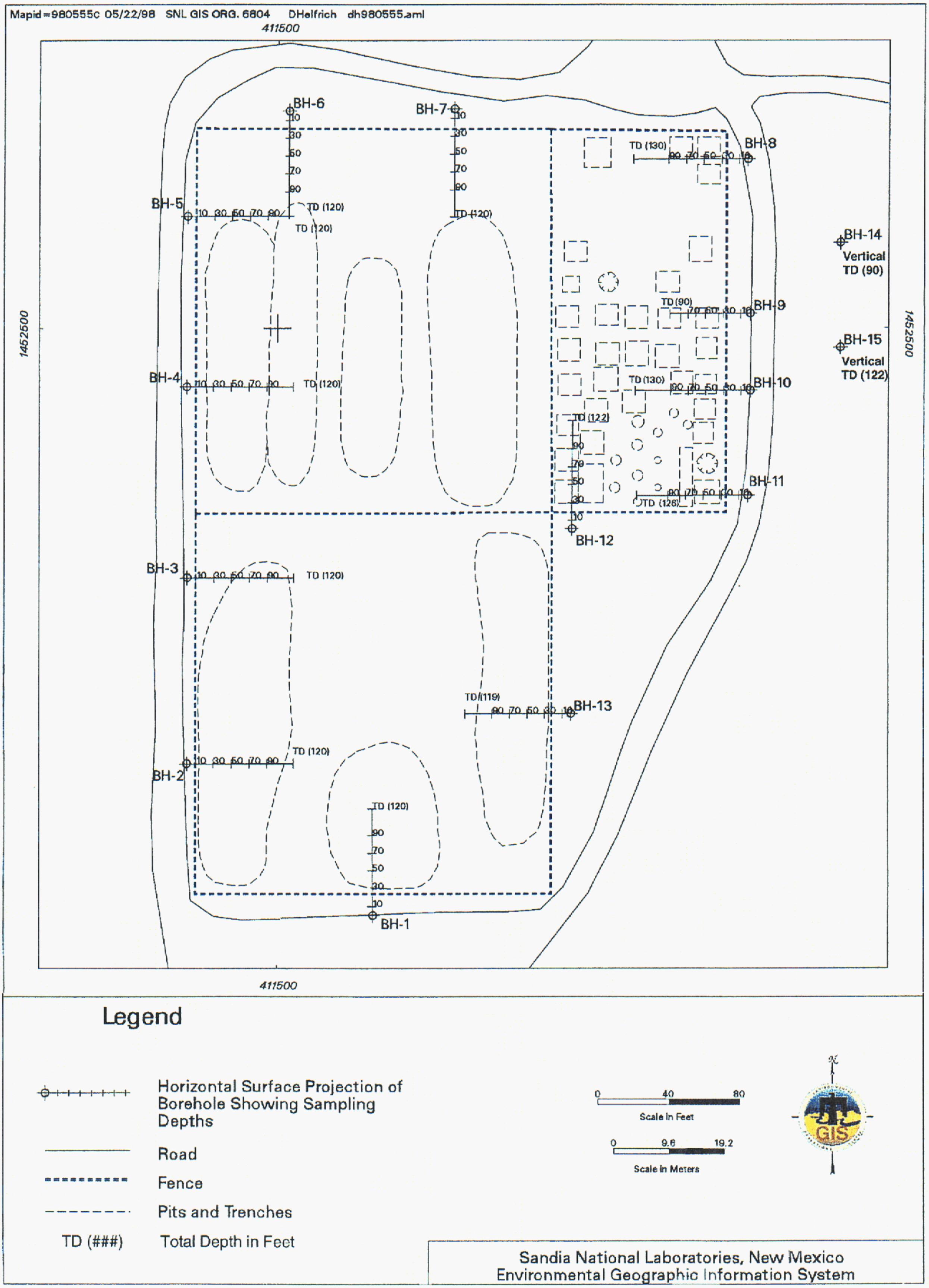

Figure 4.6-1 Location, Surface Projection, and Sampling Depths for Volatile Organic Compounds, Semivolatile Organic Compounds, Target Analyte List Metals, and Radiochemical Analyses in Boreholes 1 through 15

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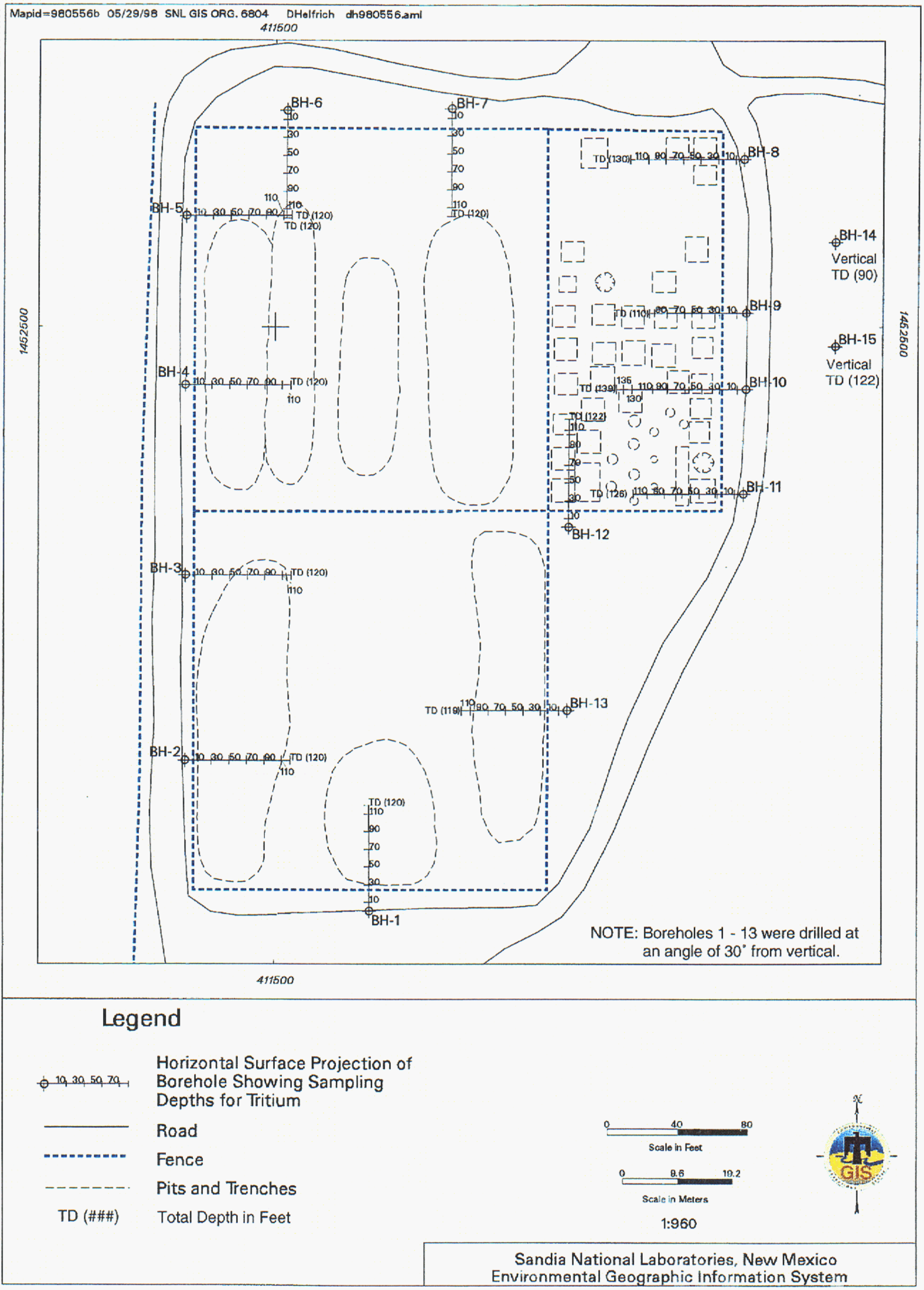


NOTE: Boreholes 1 - 13 were drilled at an angle of 30° from vertical.

Figure 4.6-2 Location, Surface Projection, and Sampling Depths for Tritium in Boreholes 1 through 15

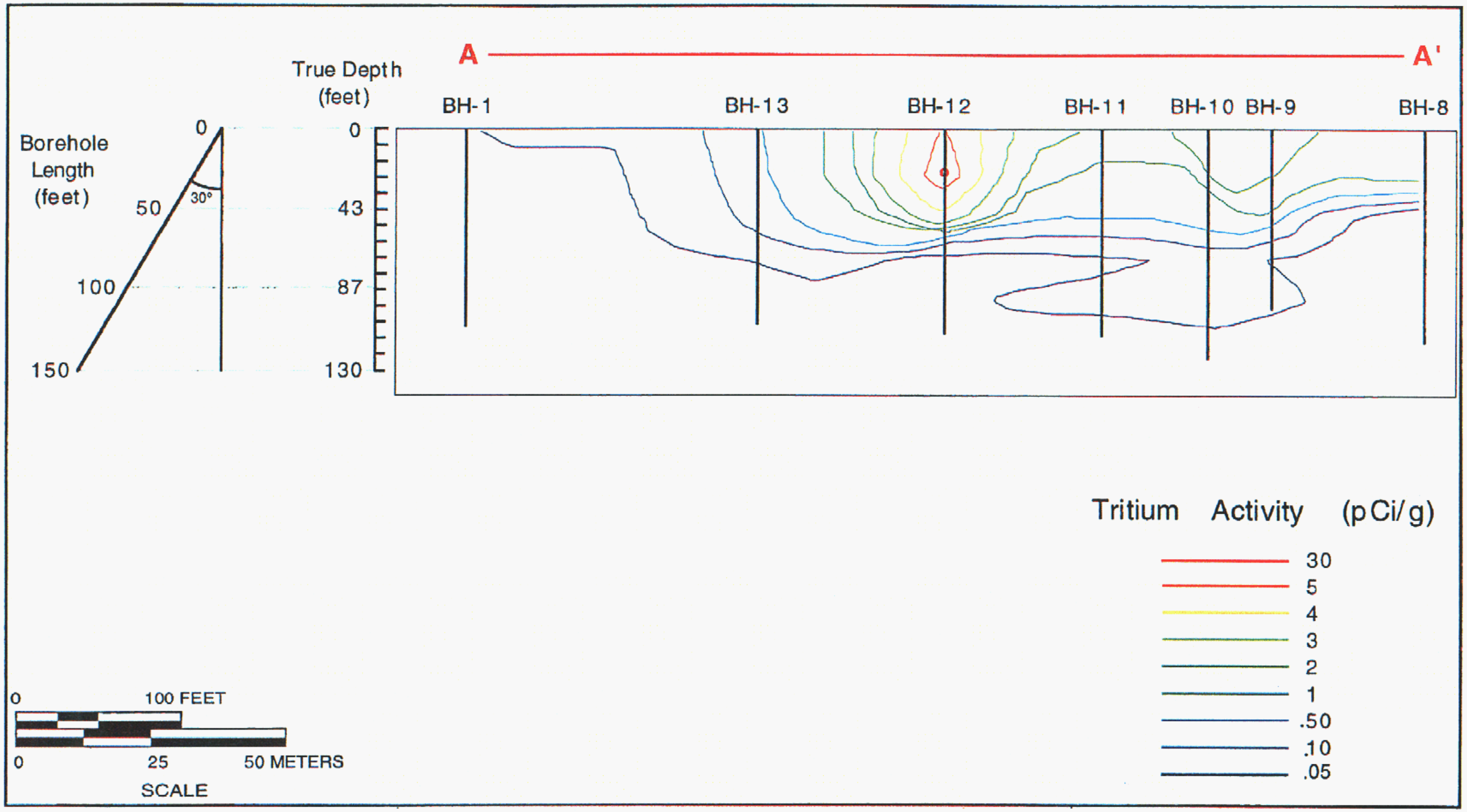


Figure 4.6-3 Tritium Activity in Soil Beneath the MWL, Cross-Section A-A'

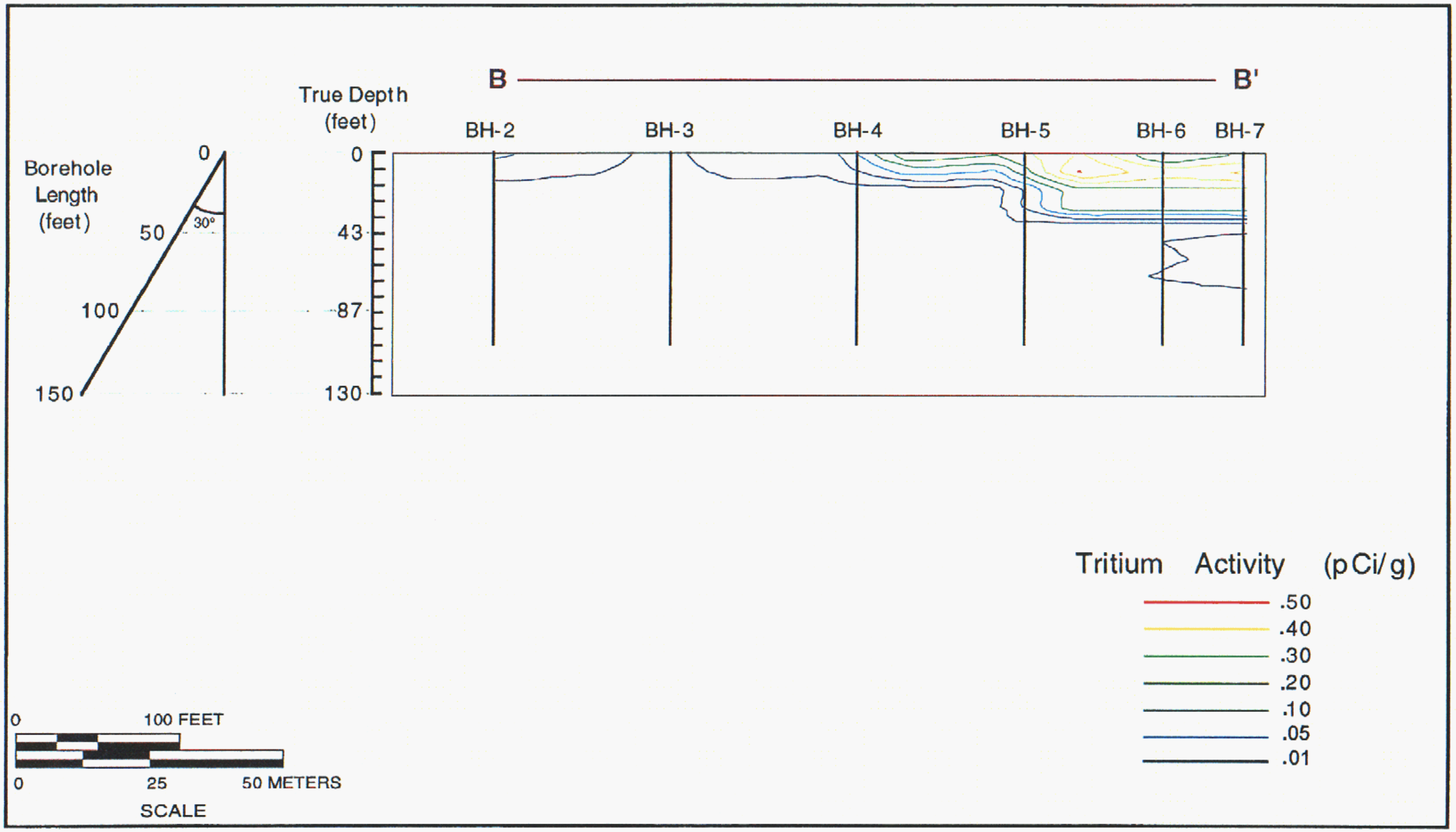


Figure 4.6-4 Tritium Activity in Soil Beneath the MWL, Cross-Section B-B'

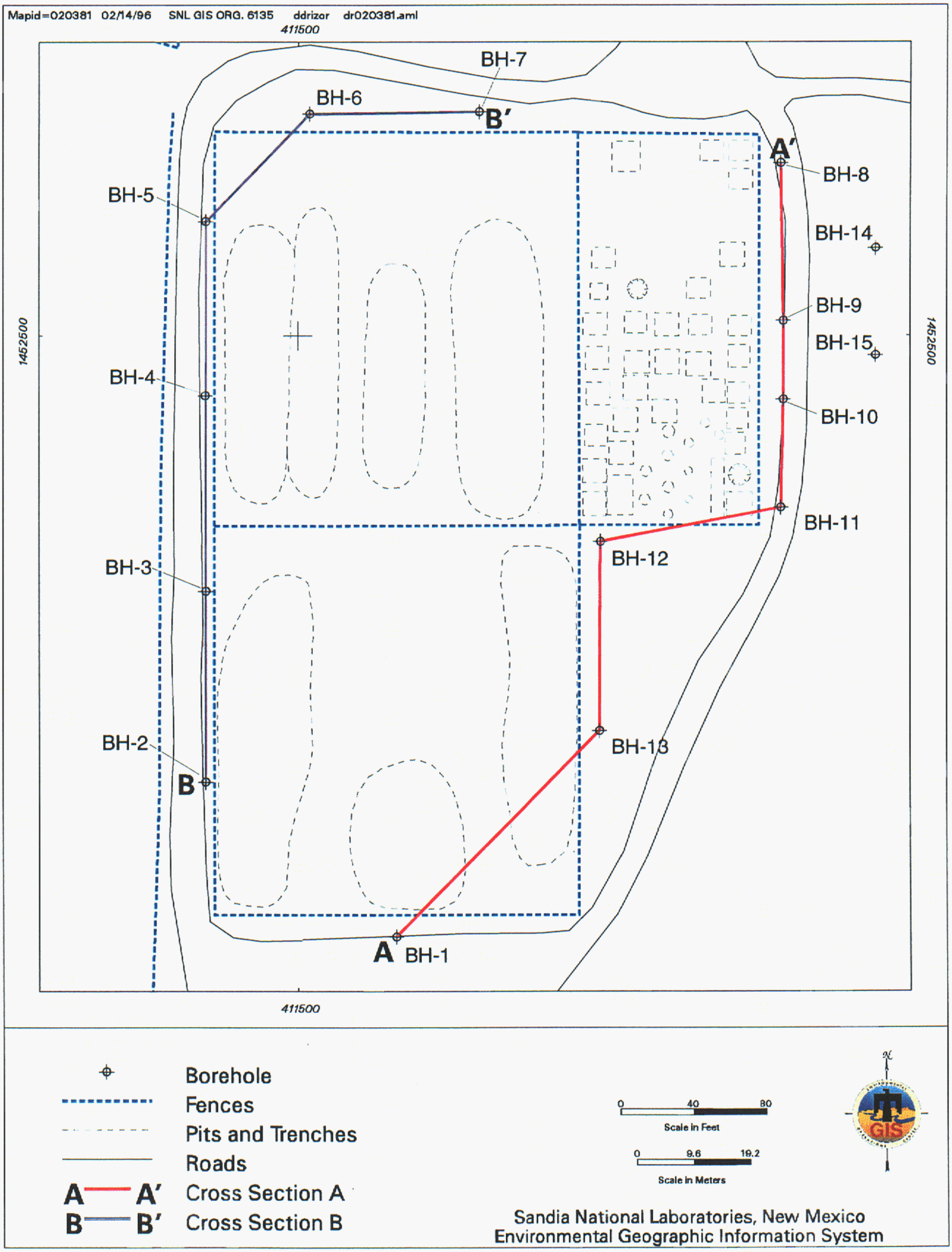


Figure 4.6-5 Bearing of Tritium Activity Cross-Sections A-A' and B-B'

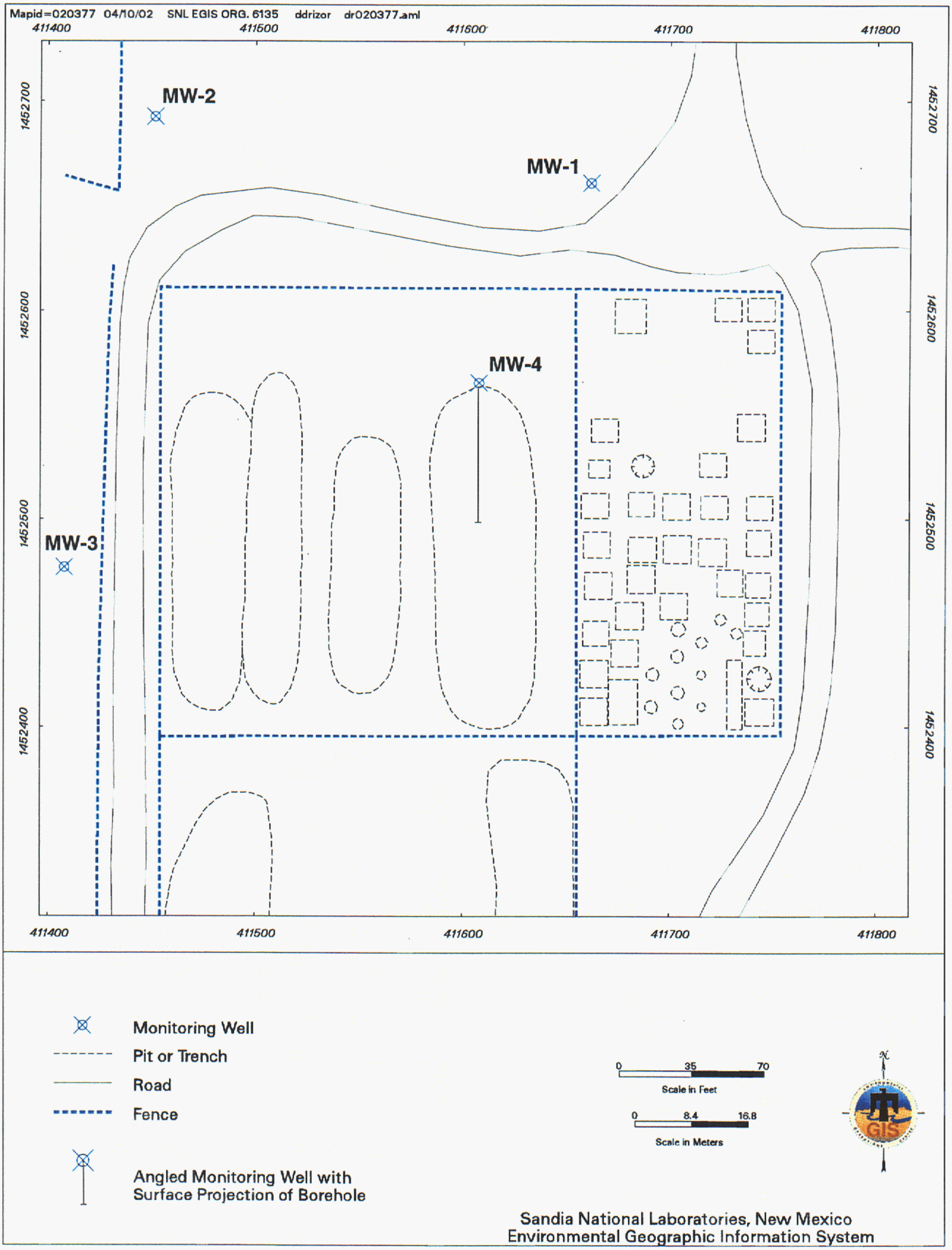


Figure 4.7-1 Location and Surface Projection of MW-4

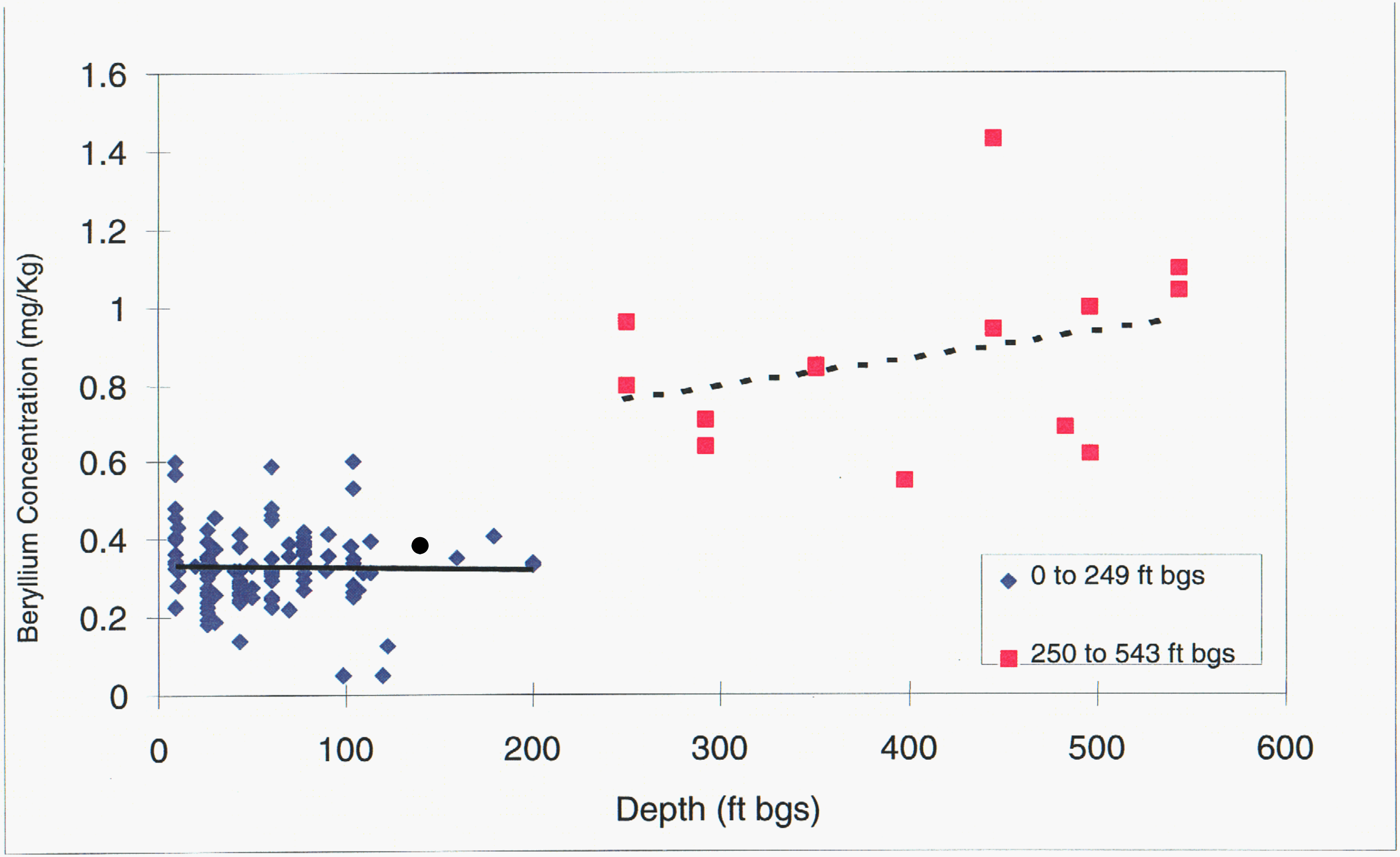
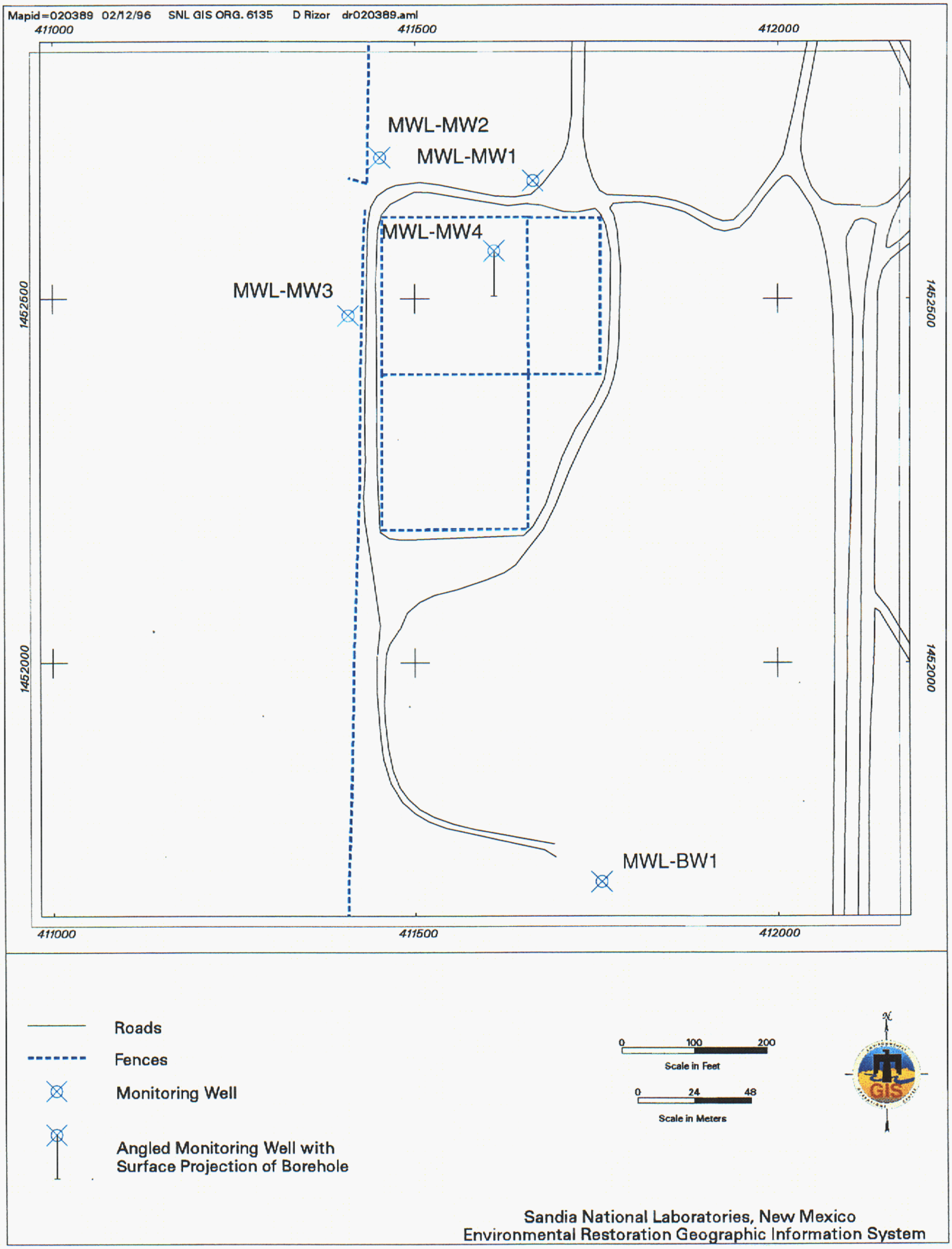


Figure 4.7-2 Beryllium Concentrations with Depth



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Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System

Figure 5.1-1 Location of MWL Monitoring Wells, 1995

WELL DATABASE SUMMARY SHEET

Project Name: MIXED WASTE LANDFILL
ER ADS #: 1289
Well Name: MWL-BW1
Owner Name: SNL/NM
Date Drilling Started: 24-JUN-89
Drilling Contractor: STEWART BROTHERS
Drilling Method: MUD ROTARY
Borehole Depth: 519
Casing Depth: 477.17

Geo Location: TA III
Well Completion Date: 01-JUL-89
Completion Zone: SAND AND GRAVEL
Formation of Completion: SANTA FE
Well Comment: WATER LEVEL MEASURED ON 5/14/90

Survey Data

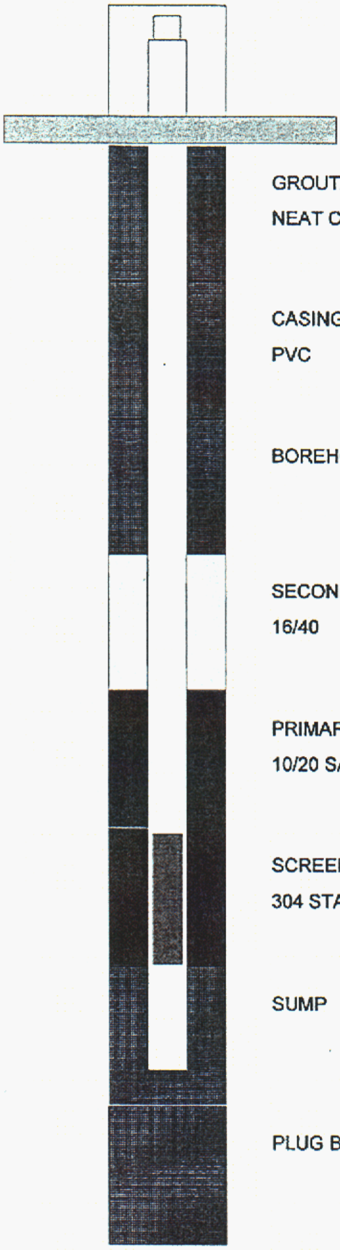
Survey Date: 12-APR-90
Surveyed By: SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting: 411756.001
(Y) Northing: 1451698.73

Surveyed Elevations (FAMSL)

Protective Casing: 5385.05
Top of Inner Well Casing: 5384.51
Concrete Pad: 5383.35
Ground Surface: 5382.7



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.16

Interval	Start	Stop
GROUT/BACKFILL NEAT CEMENT	0'	433'
CASING PVC I.D. 5"	0'	477.17'
BOREHOLE O.D. 12.25"	0'	519'
SECONDARY PACK 16/40	441'	443'
PRIMARY PACK 10/20 SAND	443'	478'
SCREEN 304 STAINLESS STEEL Slot Size .01"	452.17'	472.17'
SUMP	472.17'	477.17'
PLUG BACK	477.17'	519'

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL) 4923.3
Initial Depth To Water: (FBGS) 461.21

Last measured water level was 4918.54 FASL **measured on** 06-AUG-96

Date Updated: 14-MAR-00
Date Printed: 01-APR-02

Figure 5.2-1 Well Completion Diagram for BW-1

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL
ER ADS #:	1289
Well Name:	MWL-MW1
Owner Name:	SNL
Date Drilling Started:	28-SEP-88
Drilling Contractor:	WATER DEVELOPMENT
Drilling Method:	AIR ROTARY
Borehole Depth:	478.67
Casing Depth:	478

Geo Location:	MIXED WASTE LANDFILL
Well Completion Date:	01-OCT-88
Completion Zone:	SILTY SAND
Formation of Completion:	SANTA FE GROUP
Well Comment:	BOREHOLE DIAM IS 14" TO 200' - 10" TO 478.67 - WATER LEV ELEV 8/16/90

Survey Data

Survey Date:	01-JAN-90
Surveyed By:	SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting:	411661.747
(Y) Northing:	1452661.099

Surveyed Elevations (FAMSL)

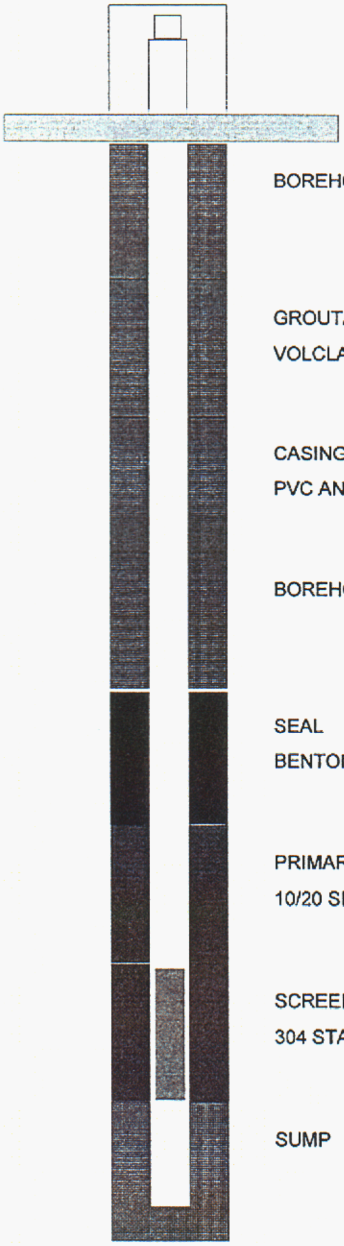
Protective Casing:	5382.2
Top of Inner Well Casing:	5381.54
Concrete Pad:	5379.56
Ground Surface:	5379.12

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.36
Initial Depth To Water: (FBGS)	458.18

Last measured water level was 4918.82 **FASL**
measured on 06-AUG-96

Date Updated:	**Date Printed:**
14-MAR-00	01-APR-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.98

Interval		**Start**	**Stop**
BOREHOLE		0'	200'
		O.D.	14"
GROUT/BACKFILL VOLCLAY		0'	434.9'
CASING PVC AND STEEL	I.D. 5"	0'	478'
BOREHOLE		200'	478.67'
		O.D.	10"
SEAL BENTONITE PELLETS		434.9'	445.5'
PRIMARY PACK 10/20 SILICA SAND		445.5'	478.67'
SCREEN 304 STAINLESS STEEL		456'	476'
		Slot Size	.01"
SUMP		476'	478'

Figure 5.2-2 Well Completion Diagram for MW-1

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	01-AUG-89
Well Name:	MWL-MW2	**Completion Zone:**	SAND
Owner Name:	SNL	**Formation of Completion:**	SANTA FE
Date Drilling Started:	21-JUL-89	**Well Comment:**	WATER LEVEL MEASURED ON 5/14/90
Drilling Contractor:	STEWART BROTHERS		
Drilling Method:	MUD ROTARY		
Borehole Depth:	521		
Casing Depth:	477		

Survey Data

Survey Date:	12-APR-90
Surveyed By:	SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting:	411451.366
(Y) Northing:	1452692.592

Surveyed Elevations (FAMSL)

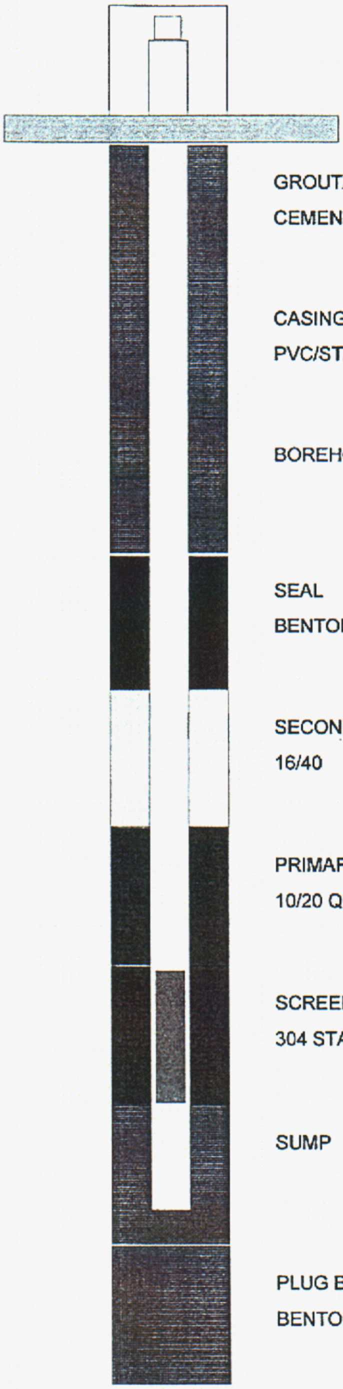
Protective Casing:	5378.18
Top of Inner Well Casing:	5377.26
Concrete Pad:	5376.49
Ground Surface:	5375.71

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4923.27
Initial Depth To Water: (FBGS)	453.99

Last measured water level was 4918.78 **FASL**
measured on 06-AUG-96

Date Updated:	**Date Printed:**
14-MAR-00	01-APR-02



Completion Data Measured Depths (FBGS)

Casing Stickup: .77

Interval		**Start**	**Stop**
GROUT/BACKFILL		0'	430'
CEMENT/BENTONITE			
Interval		**Start**	**Stop**
CASING		0'	477'
PVC/STAINLESS STEEL	I.D.	5"	
Interval		**Start**	**Stop**
BOREHOLE		0'	521'
		O.D.	12.25"
Interval		**Start**	**Stop**
SEAL		431'	442'
BENTONITE			
Interval		**Start**	**Stop**
SECONDARY PACK		442'	444'
16/40			
Interval		**Start**	**Stop**
PRIMARY PACK		444'	477'
10/20 QUARTZ SAND			
Interval		**Start**	**Stop**
SCREEN		452'	472'
304 STAINLESS STEEL			
		Slot Size	.01"
Interval		**Start**	**Stop**
SUMP		472'	477'
Interval		**Start**	**Stop**
PLUG BACK		477'	521'
BENTONITE			

Figure 5.2-3 Well Completion Diagram for MW-2

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL
ER ADS #:	1289
Well Name:	MWL-MW3
Owner Name:	SNL
Date Drilling Started:	20-AUG-89
Drilling Contractor:	STEWART BROTHERS
Drilling Method:	MUD ROTARY
Borehole Depth:	501
Casing Depth:	476.3

Geo Location:	TA-III
Well Completion Date:	22-AUG-89
Completion Zone:	SAND
Formation of Completion:	SANTA FE
Well Comment:	BOREHOLE TD AT 501', BACKFILL WITH .4 BENTONITE/CEMENT PLUG TO 478' ABOUT 1' OF 16/40 FN SIL SAND AT TOP OF FILTER PACK

Survey Data

Survey Date:	16-AUG-90
Surveyed By:	SANTIAGO ROMERO AND ASSOCIATES

State Plane Coordinates

(X) Easting:	411407.995
(Y) Northing:	1452476.617

Surveyed Elevations (FAMSL)

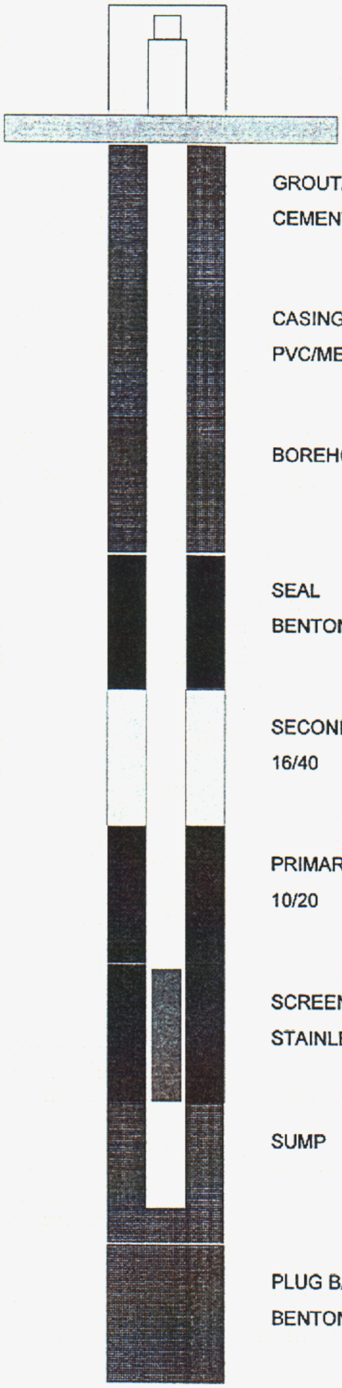
Protective Casing:	5381.78
Top of Inner Well Casing:	5381.32
Concrete Pad:	5379.41
Ground Surface:	5378.97

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4921.1
Initial Depth To Water: (FBGS)	460.22

Last measured water level was 4917.35 **FASL**
measured on 06-AUG-96

Date Updated:	**Date Printed:**
14-MAR-00	01-APR-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.91

Interval	Start	Stop	O.D.	Slot Size
GROUT/BACKFILL CEMENT/BENTONITE	0'	429'		
CASING PVC/METAL	0'	478.8'	5"	
BOREHOLE	0'	501'	12.25"	
SEAL BENTONITE	429'	444'		
SECONDARY PACK 16/40	444'	446'		
PRIMARY PACK 10/20	446'	476'		
SCREEN STAINLESS STEEL	451.3'	471.3'		.01"
SUMP	471.3'	476.3'		
PLUG BACK BENTONITE	479'	501'		

Figure 5.2-4 Well Completion Diagram for MW-3

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	TA III
ER ADS #:	1289	**Well Completion Date:**	10-FEB-93
Well Name:	MWL-MW4	**Completion Zone:**	FINE MEDIUM SAND/GRAVELLY SAND
Owner Name:	SNL/NM	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	16-DEC-92	**Well Comment:**	2 SCREENED INTERVALS
Drilling Contractor:	WATER DEVELOPMENT CORPOR		
Drilling Method:	SONIC/DRY		
Borehole Depth:	552.5		
Casing Depth:	548		

Survey Data

Survey Date:	15-MAY-94
Surveyed By:	GREINER,INC.

State Plane Coordinates

(X) Easting:	411608.044
(Y) Northing:	1452565.255

Surveyed Elevations (FAMSL)

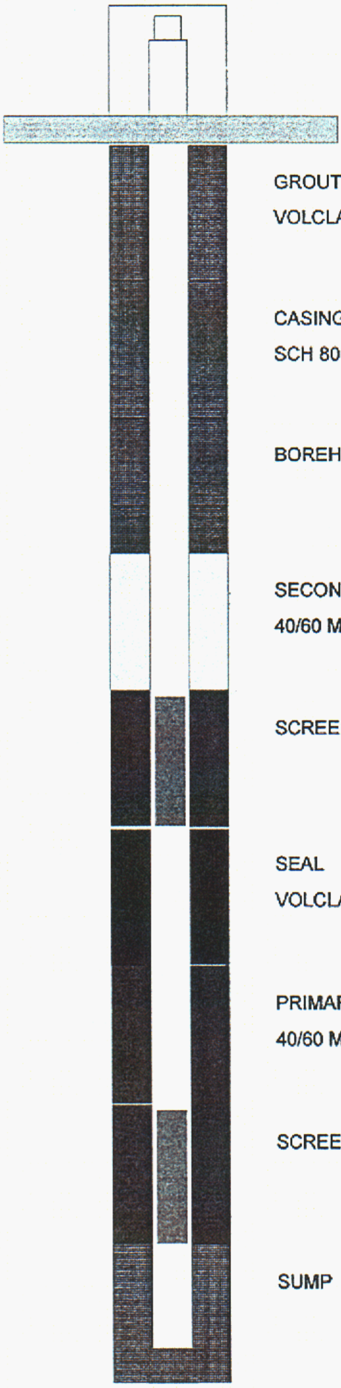
Protective Casing:	5384.05
Top of Inner Well Casing:	5383.46
Concrete Pad:	5381.35
Ground Surface:	5381.61

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4896.46
Initial Depth To Water: (FBGS)	487

Last measured water level was FASL **measured on**

Date Updated:	**Date Printed:**
14-MAR-00	01-APR-02



Completion Data Measured Depths (FBGS)

Casing Stickup: 2.11

Interval	**Start**	**Stop**
GROUT/BACKFILL VOLCLAY	0'	473'
CASING SCH 80 PVC	0' I.D. 4.768"	548' O.D. 5.563"
BOREHOLE	0'	552.5' O.D. 11"
SECONDARY PACK 40/60 MESH	473'	508'
SCREEN	482.5'	502.5' Slot Size .01"
SEAL VOLCLAY/BENTONITE	503'	520'
PRIMARY PACK 40/60 MESH	520'	552.5'
SCREEN	522.5'	542.5' Slot Size .01"
SUMP	542.5'	548'

Figure 5.2-5 Well Completion Diagram for MW-4

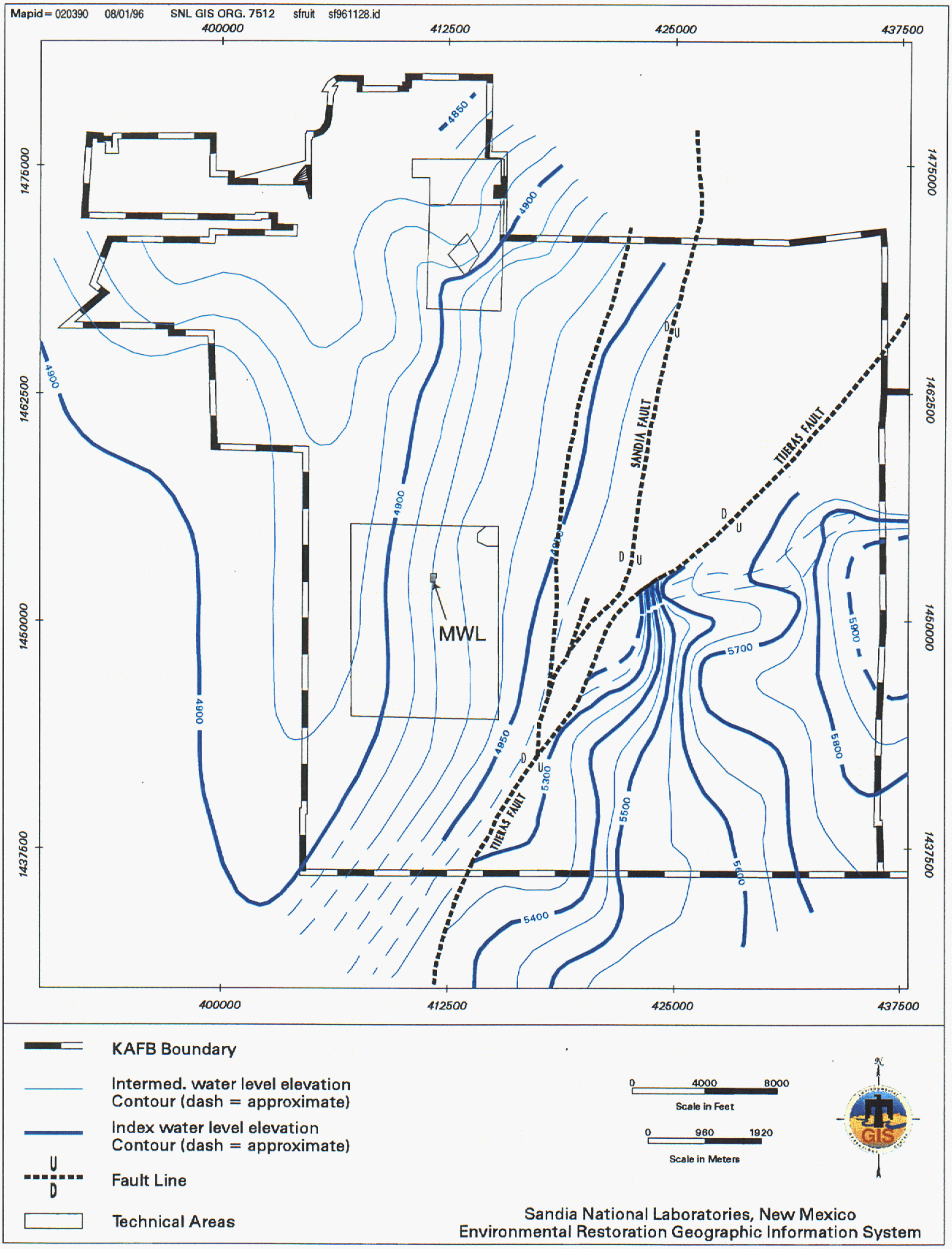


Figure 5.3-1 Regional Water Table Map for Kirtland Air Force Base, October 1995

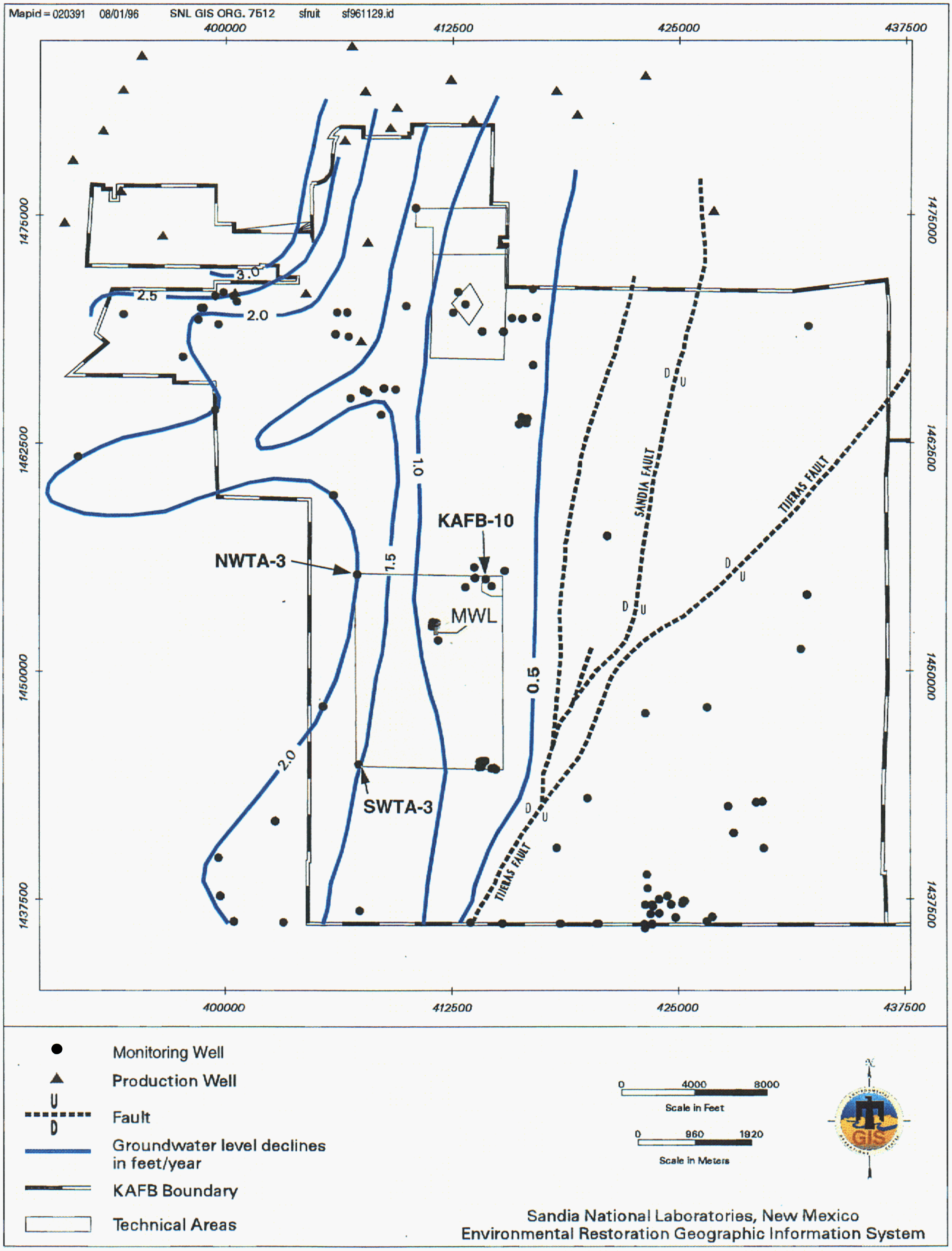


Figure 5.3-2 Groundwater Level Decline in the Regional Aquifer in 1995

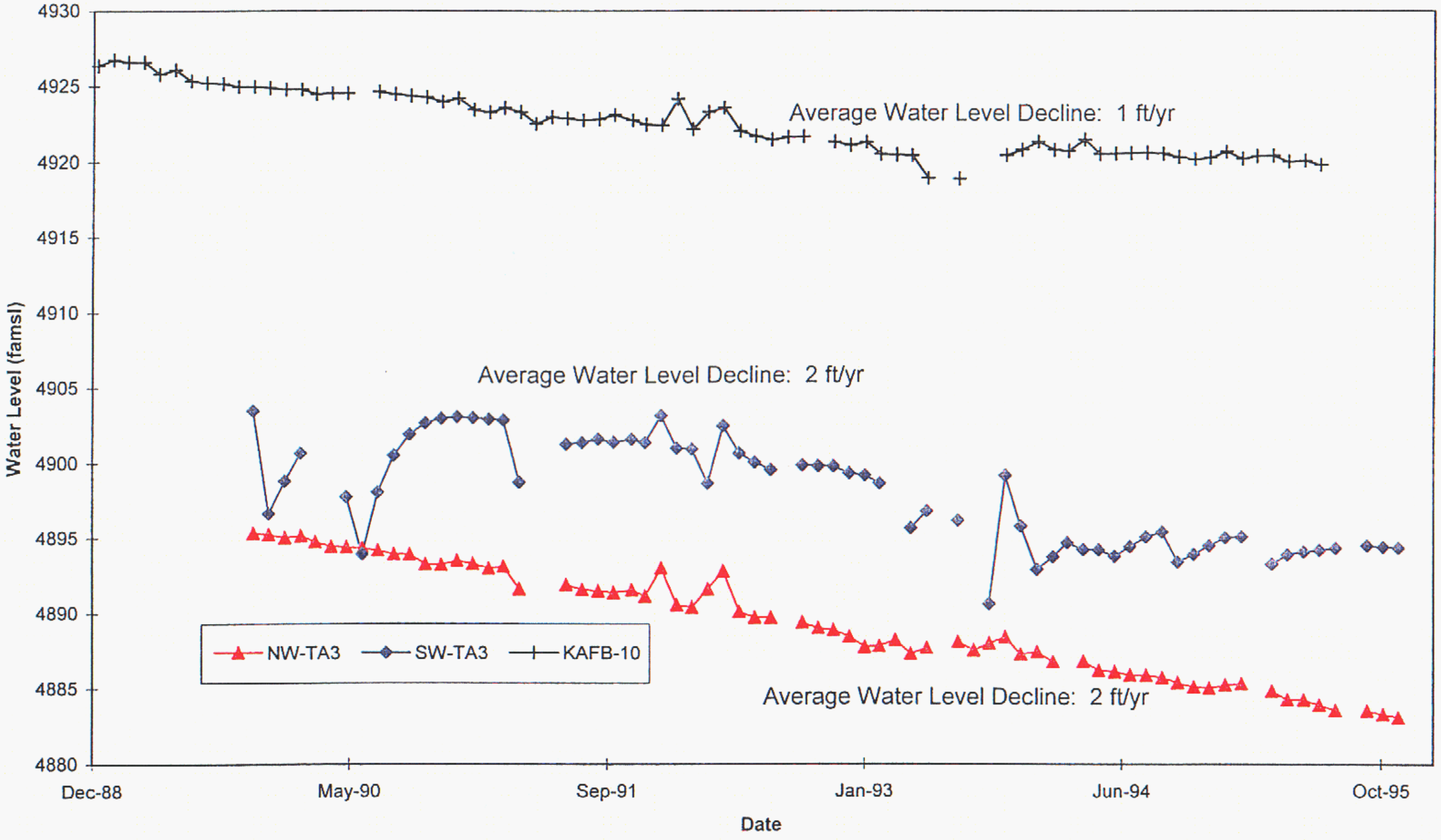
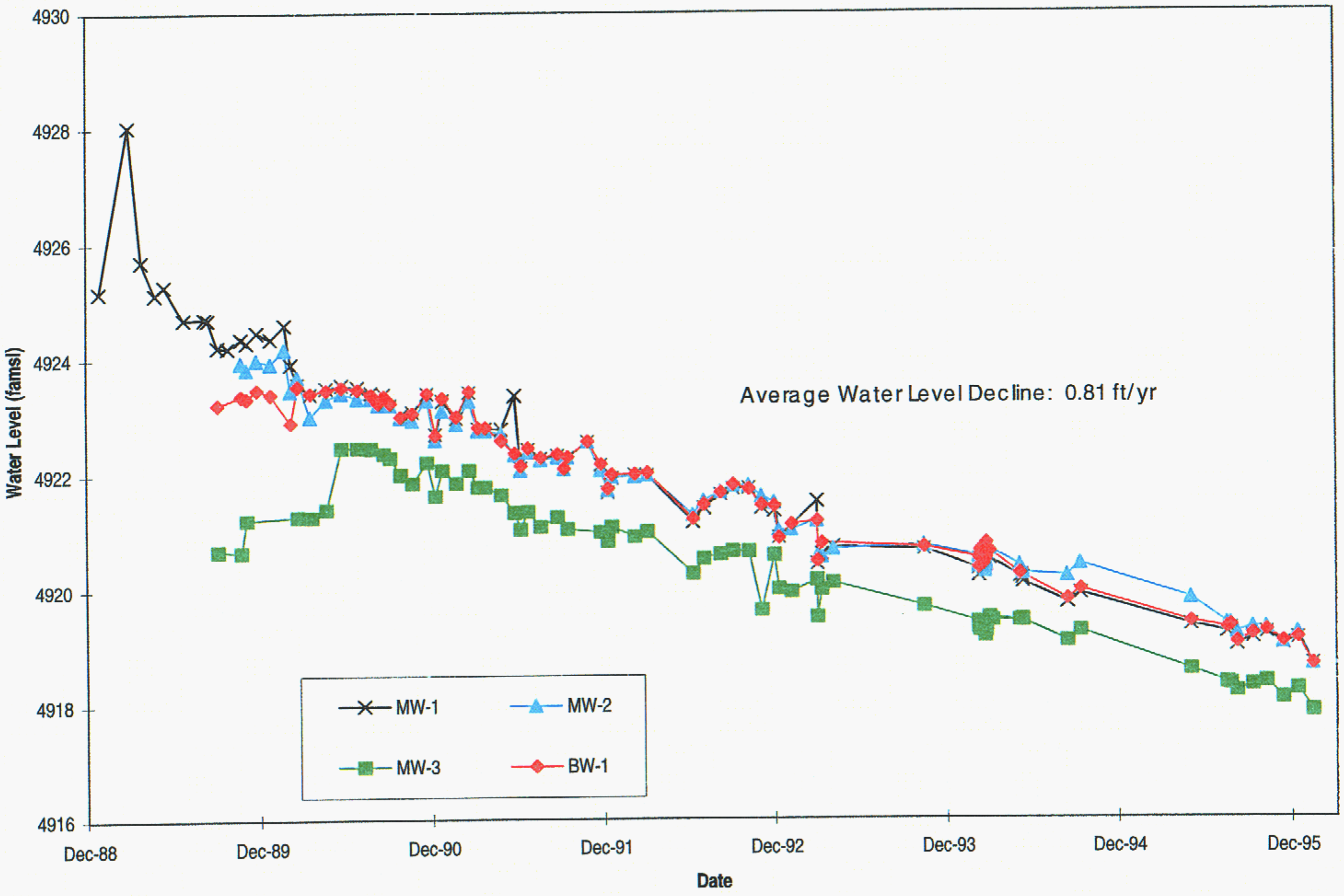


Figure 5.3-3 Six-Year Hydrograph for Regional Monitoring Wells NW TA3, SW TA3, and KAFB-10



Average Water Level Decline: 0.81 ft/yr

Figure 5.3-4 Six-Year Hydrograph for MWL MW-1, MW-2, MW-3, and BW-1

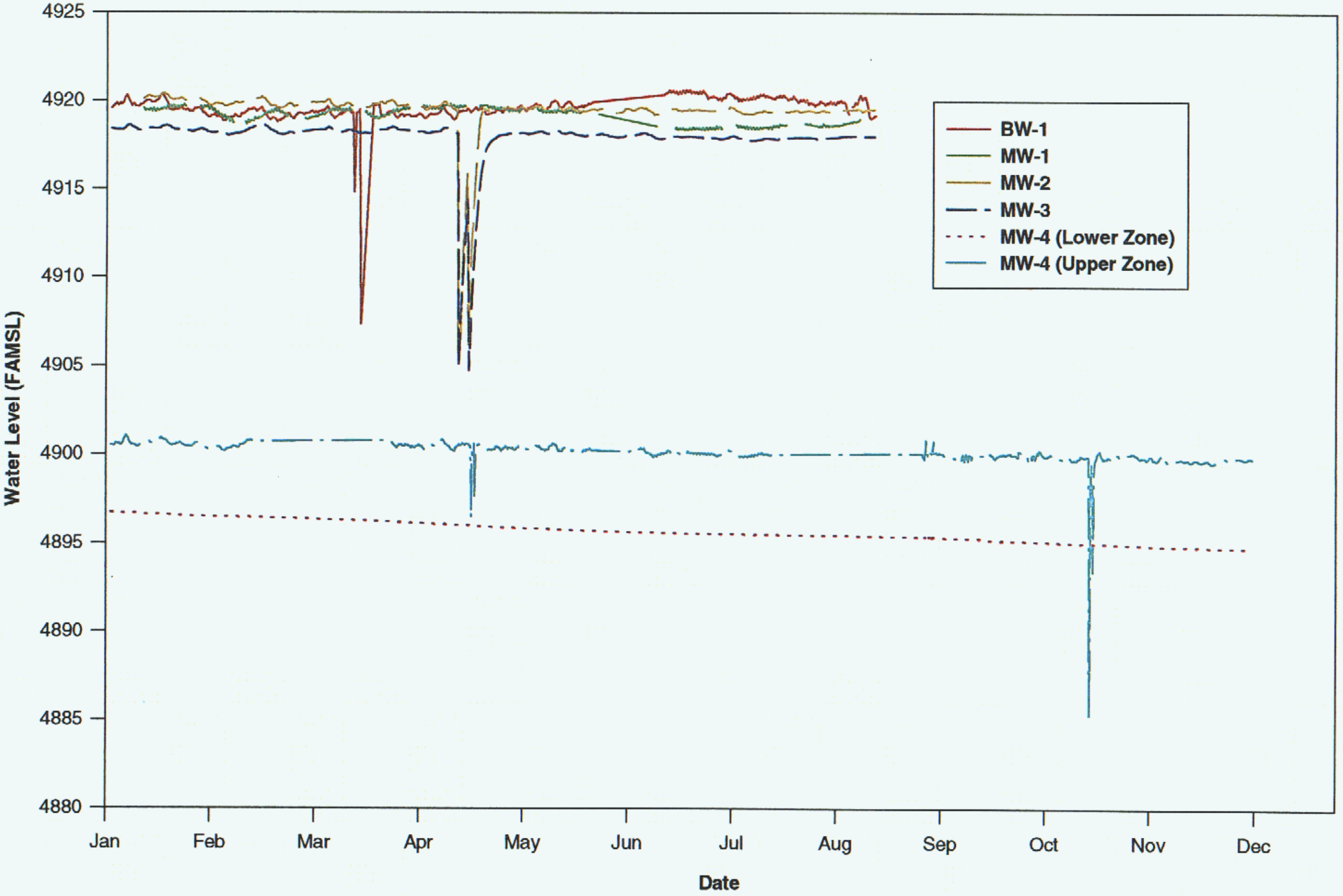


Figure 5.3-5 1995 Water Levels in MWL Monitoring Wells Based on Pressure Transducer Data

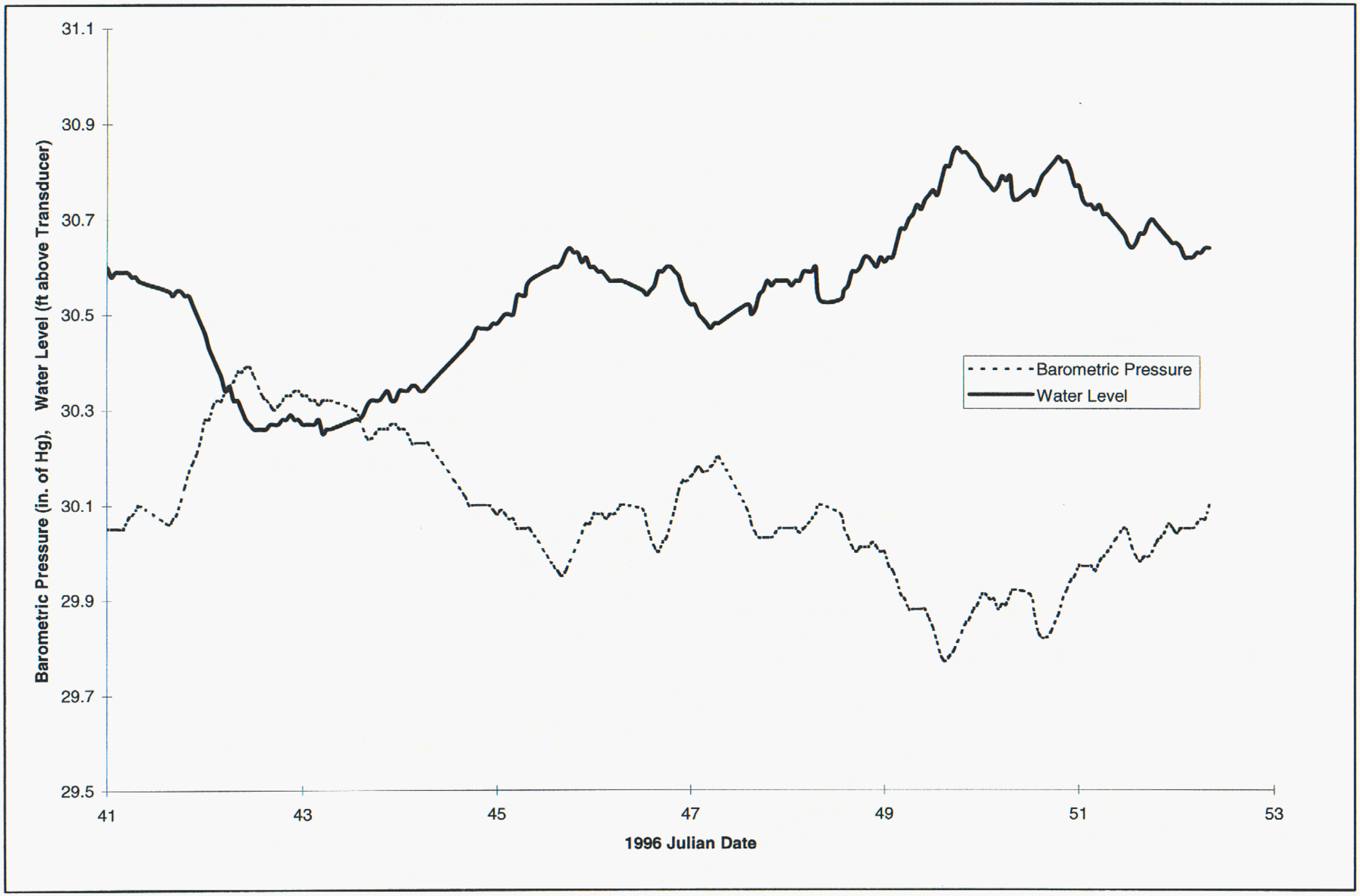


Figure 5.3-6 Temporal Fluctuations in MW-4 Water Level

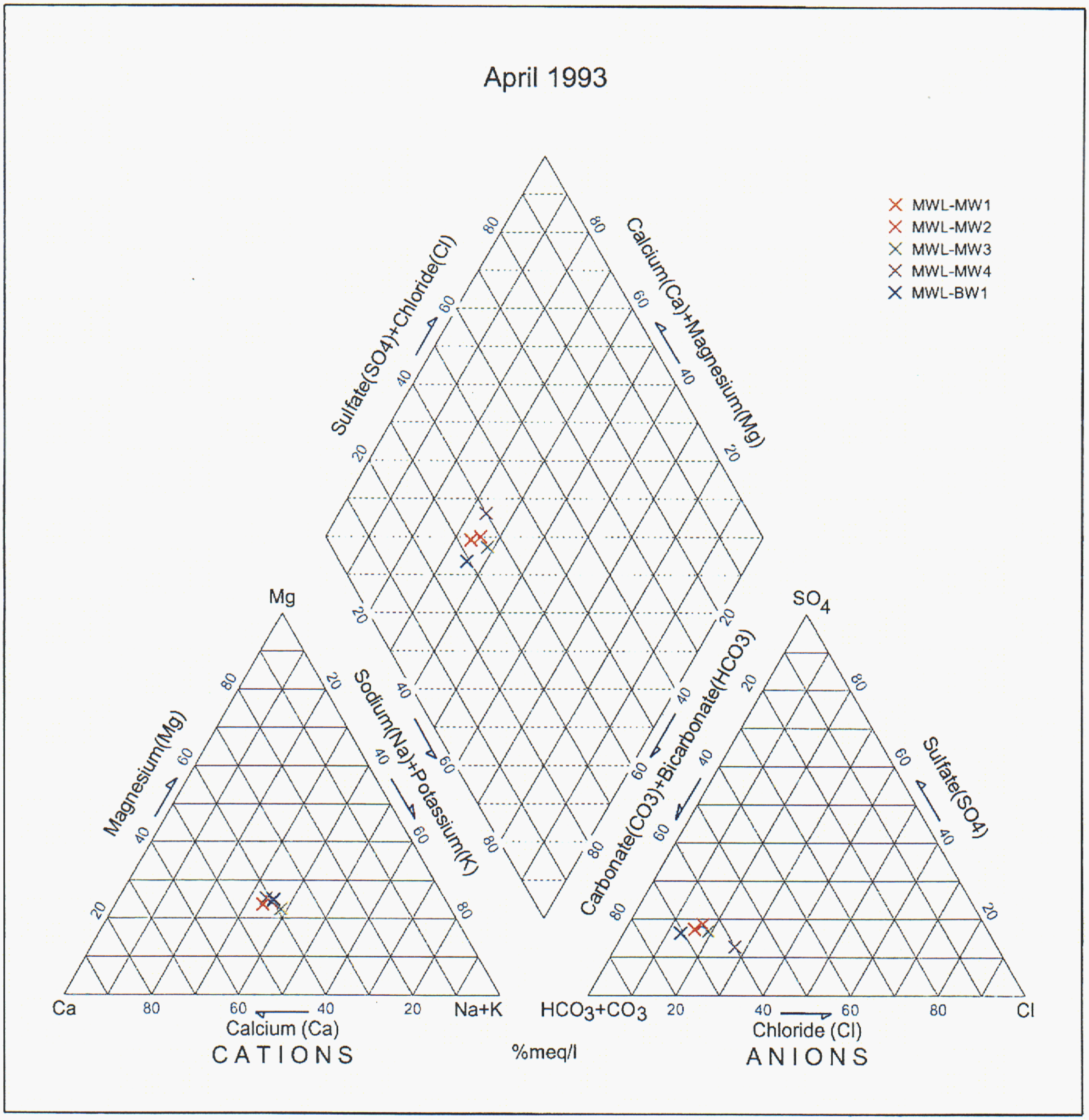


Figure 5.4-1 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells April 1993

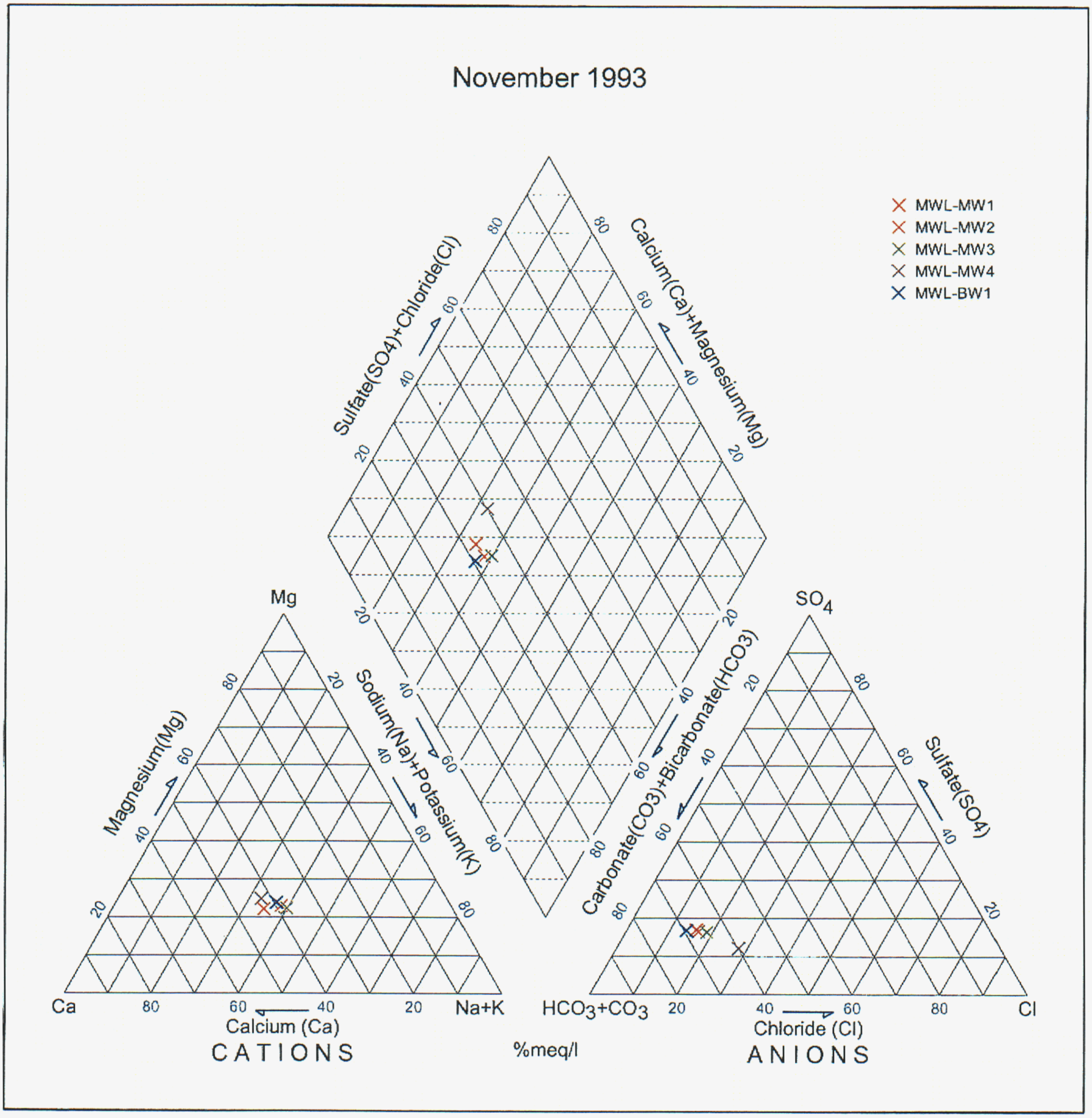


Figure 5.4-2 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells
November 1993

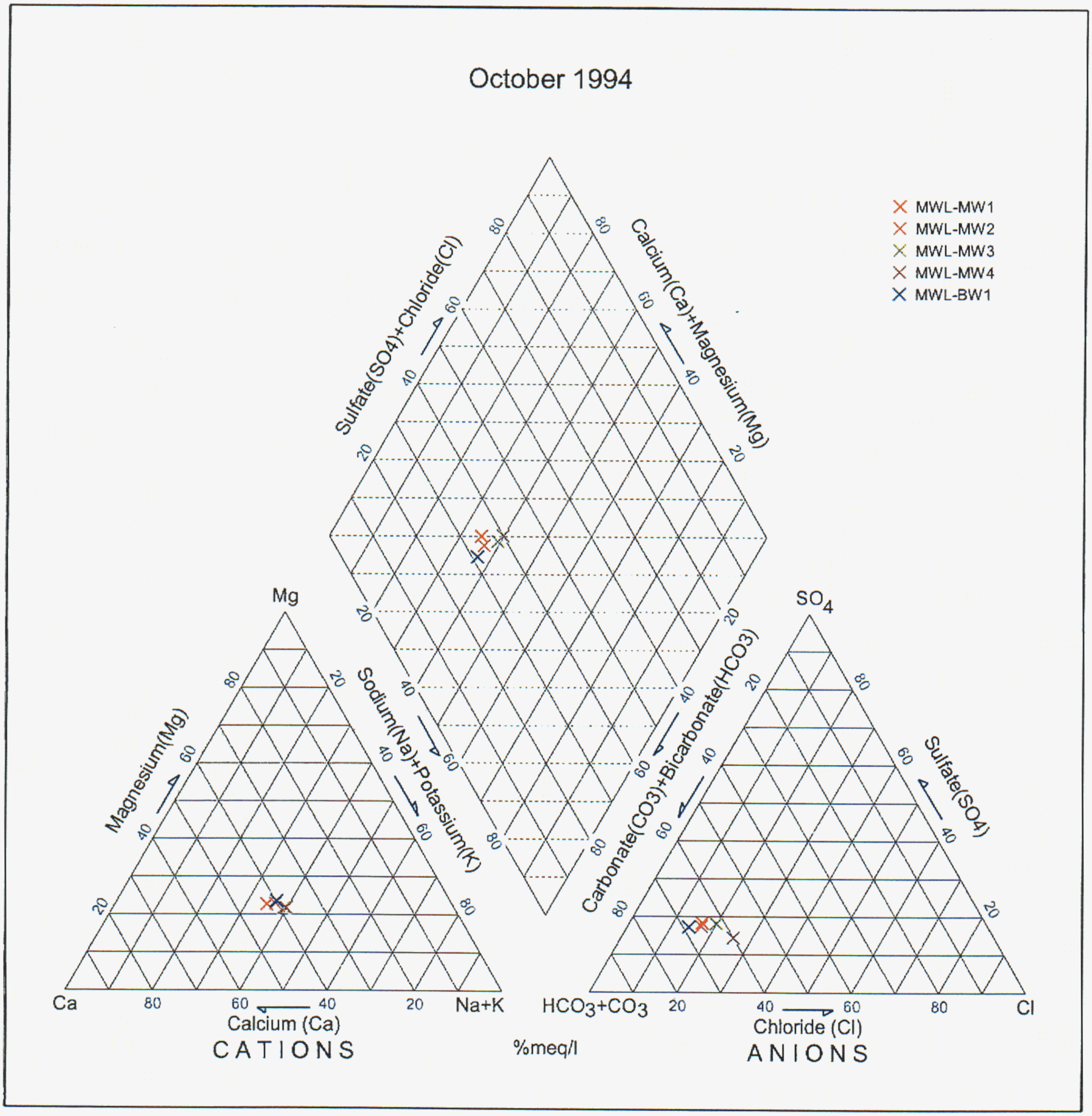


Figure 5.4-3 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells October 1994

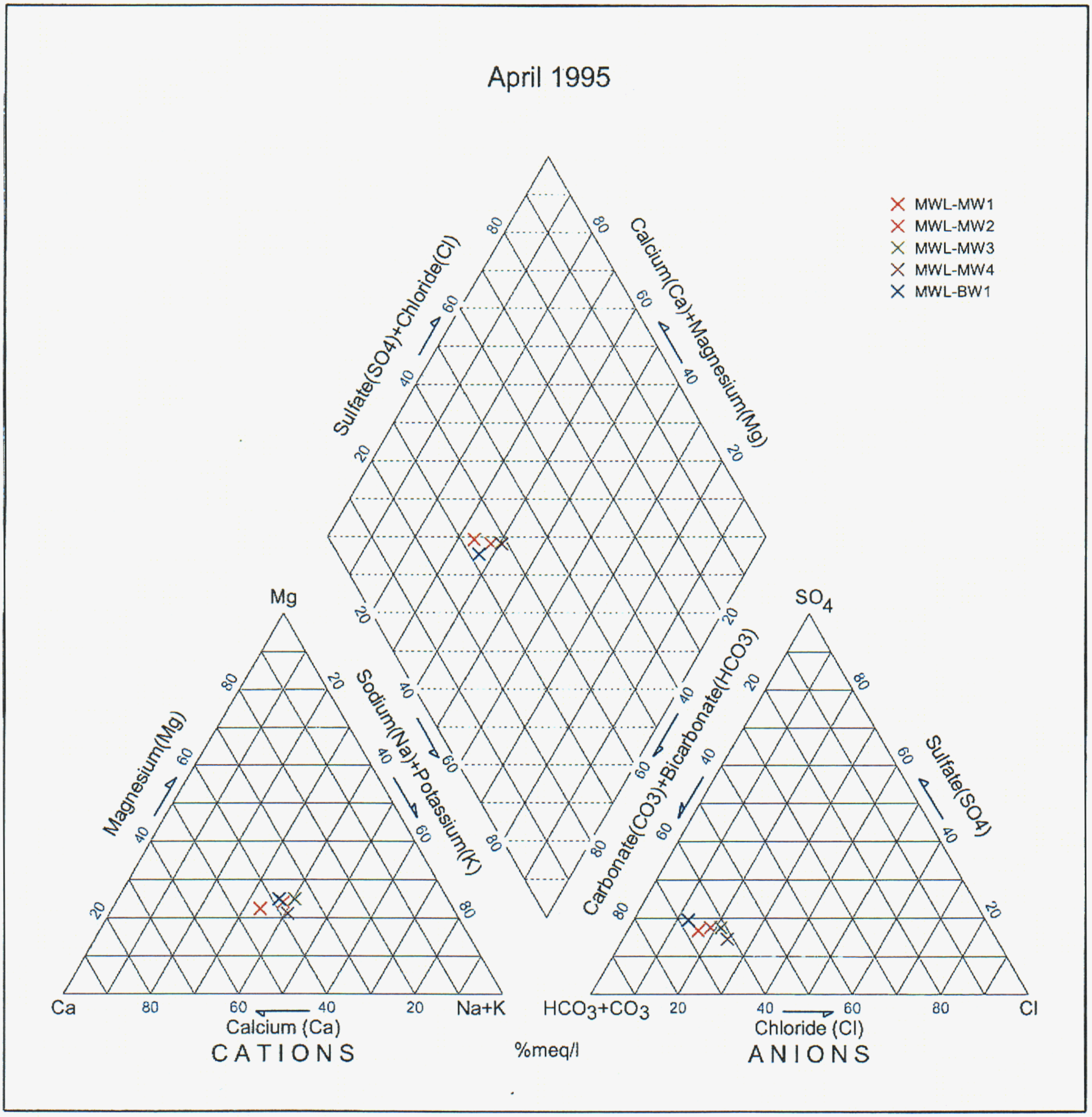


**Figure 5.4-4 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells
April 1995**

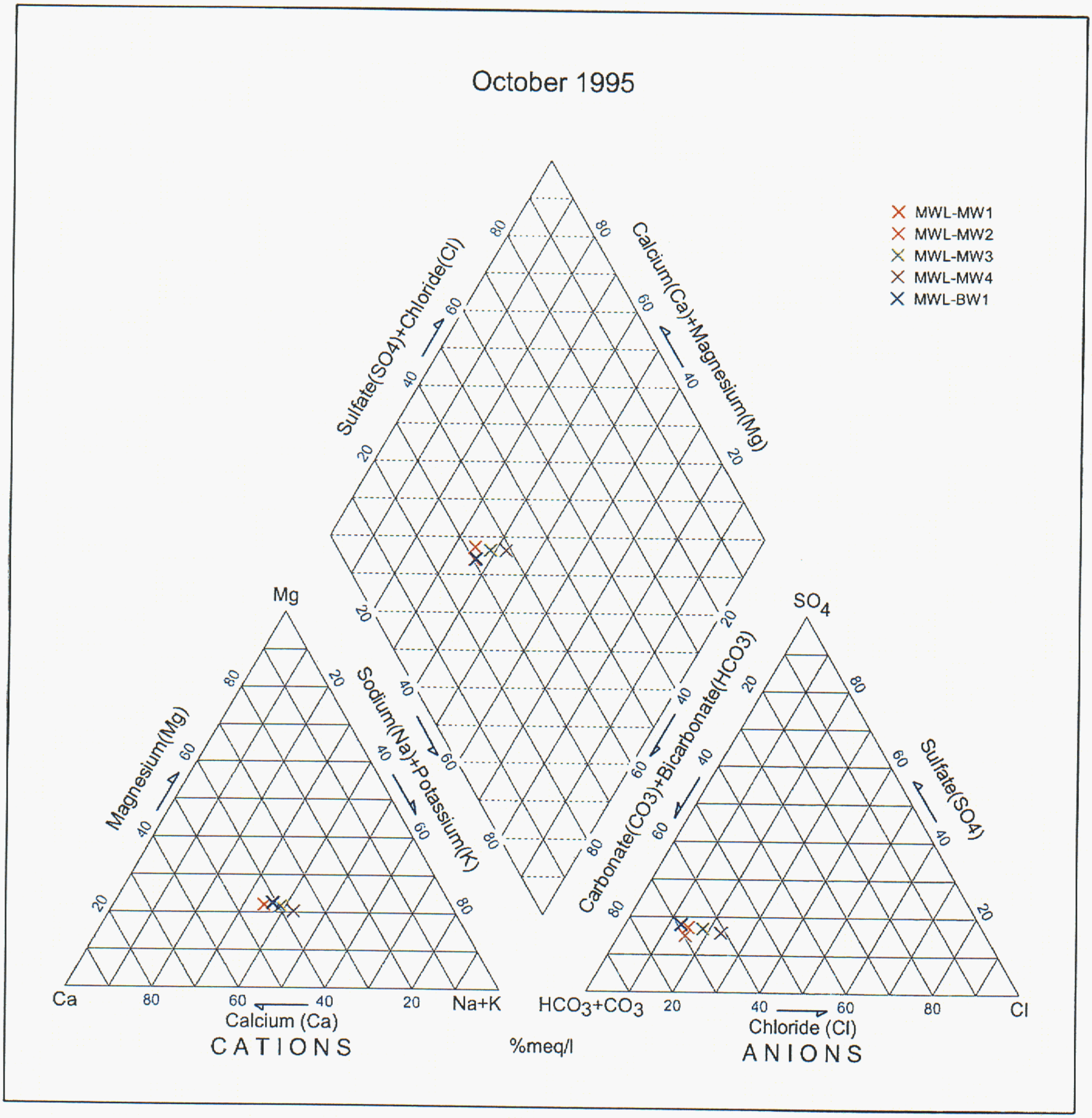


Figure 5.4-5 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells October 1995

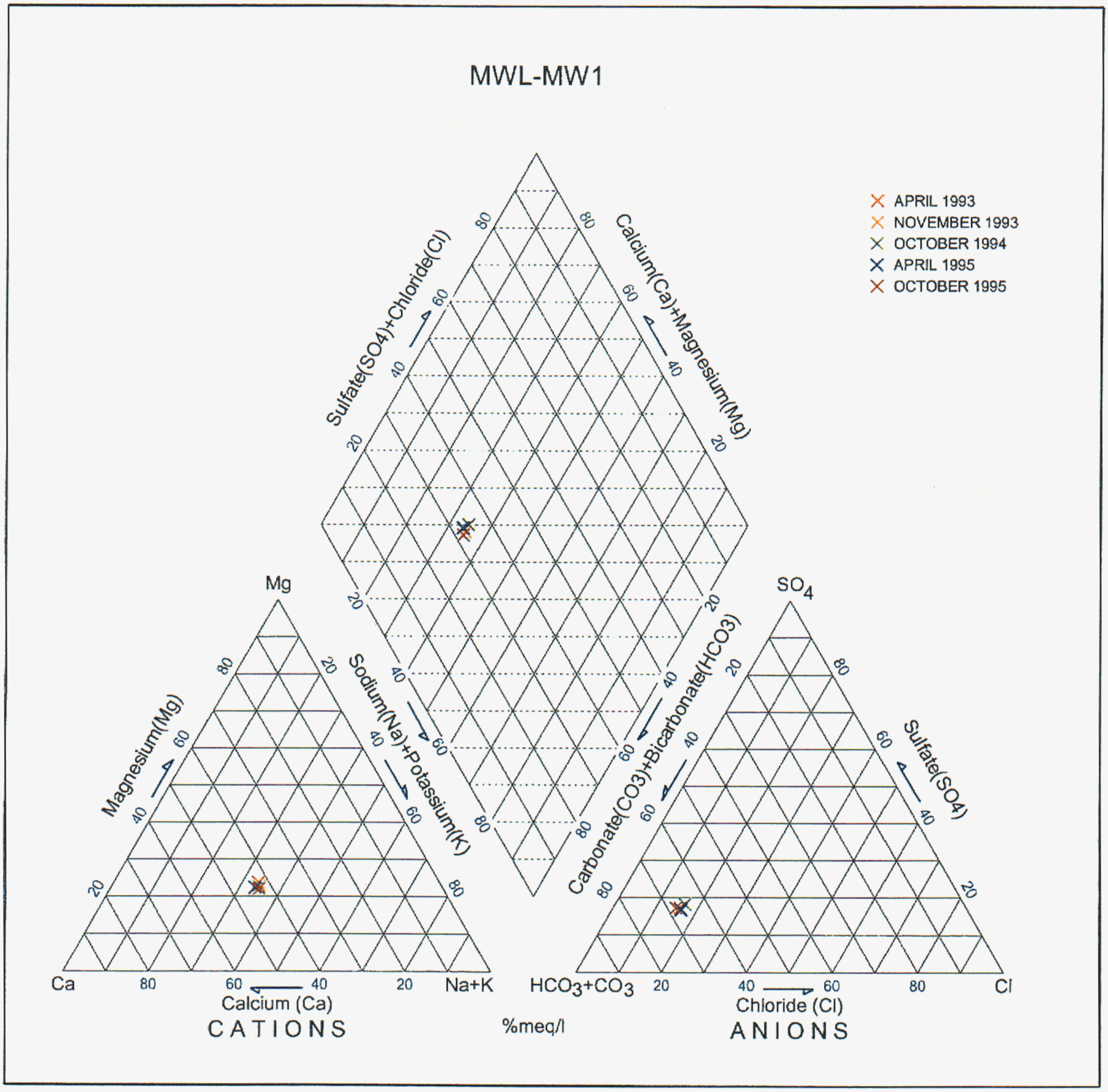


Figure 5.4-6 Piper Trilinear Diagram of Major Ion Chemistry for MW-1 1993 through 1995

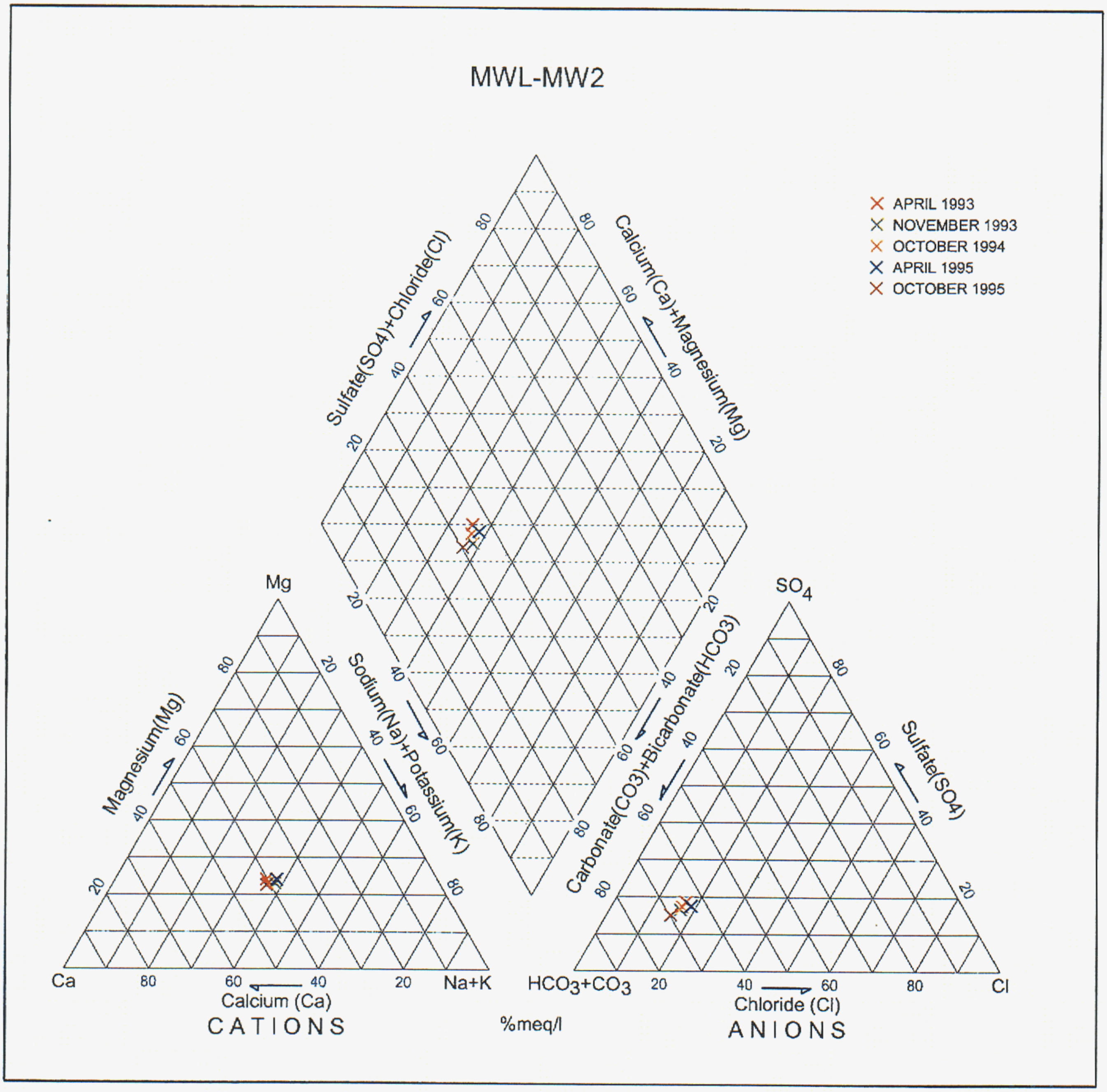


Figure 5.4-7 Piper Trilinear Diagram of Major Ion Chemistry for MW-2 1993 through 1995

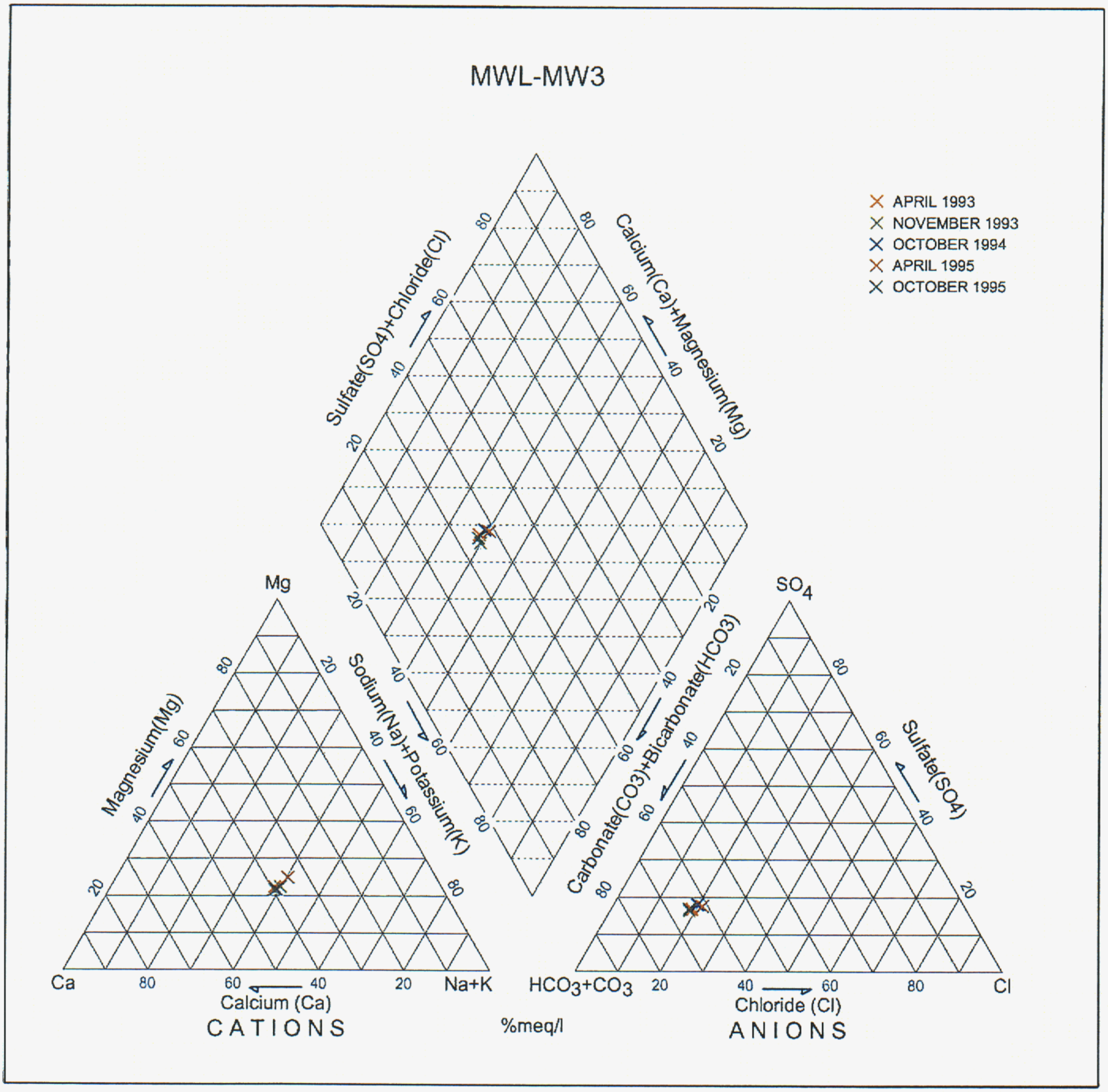


Figure 5.4-8 Piper Trilinear Diagram of Major Ion Chemistry for MW-3 1993 through 1995

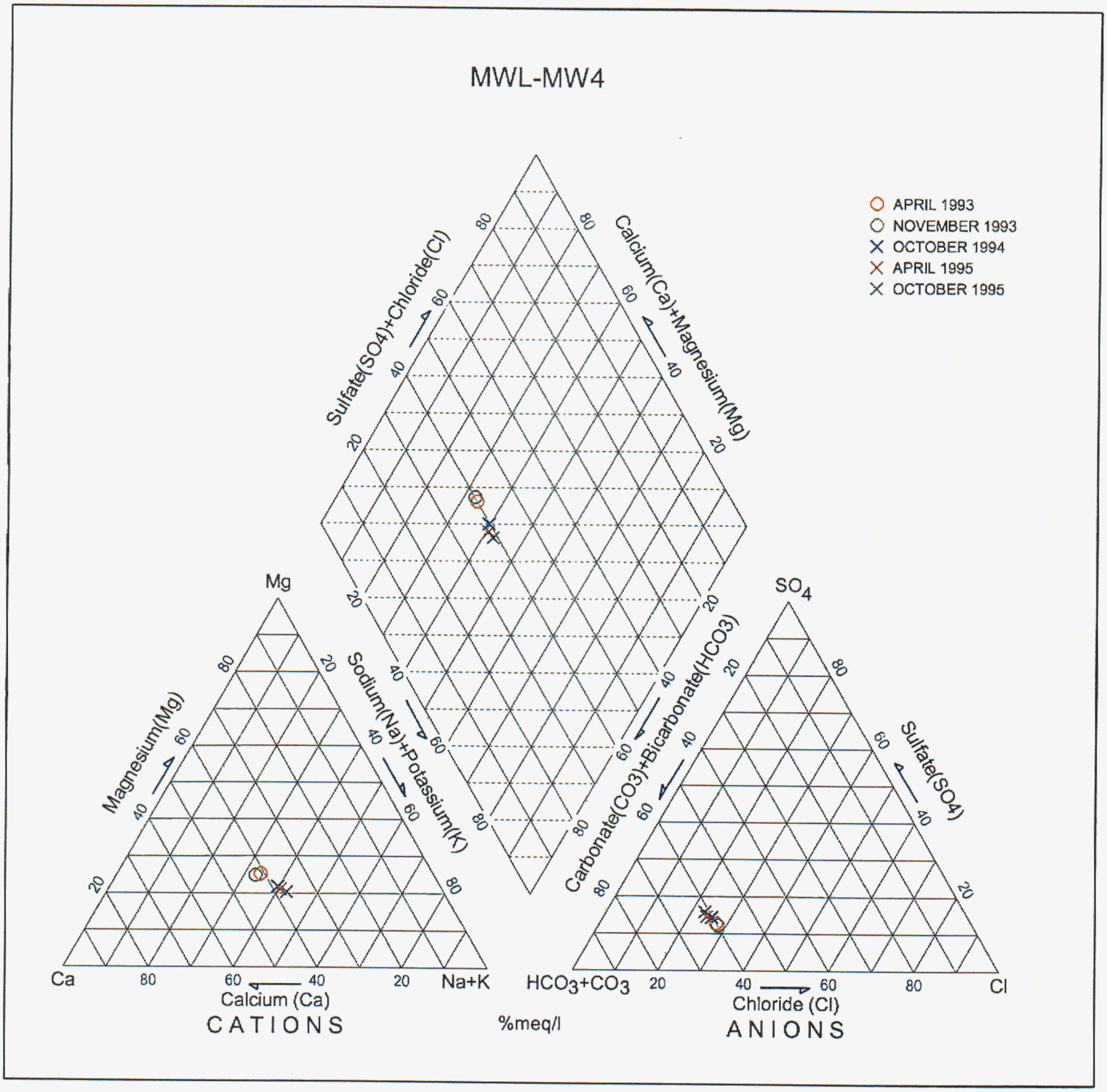


Figure 5.4-9 Piper Trilinear Diagram of Major Ion Chemistry for MW-4 1993 through 1995

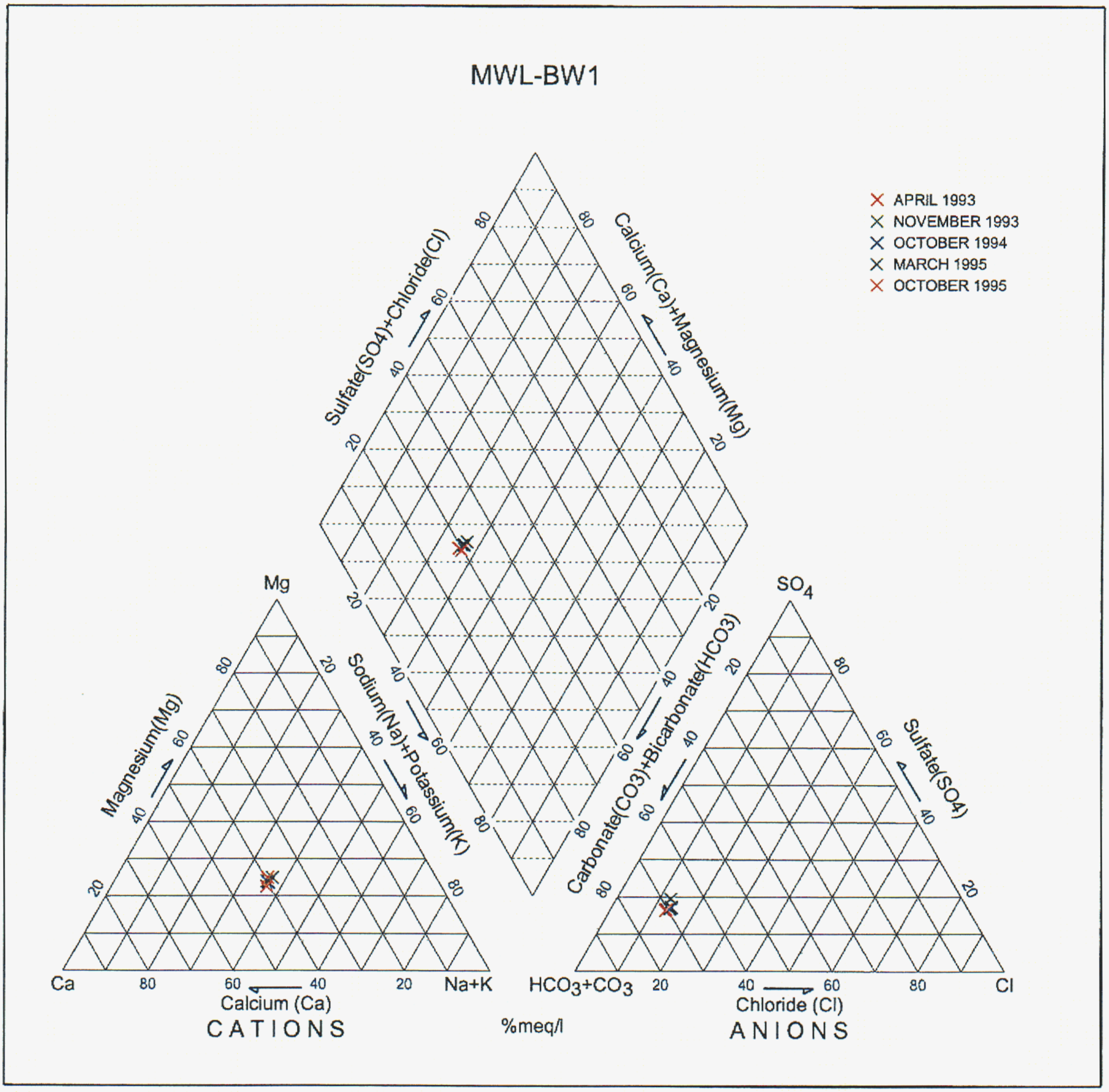


Figure 5.4-10 Piper Trilinear Diagram of Major Ion Chemistry for BW-1 1993 through 1995

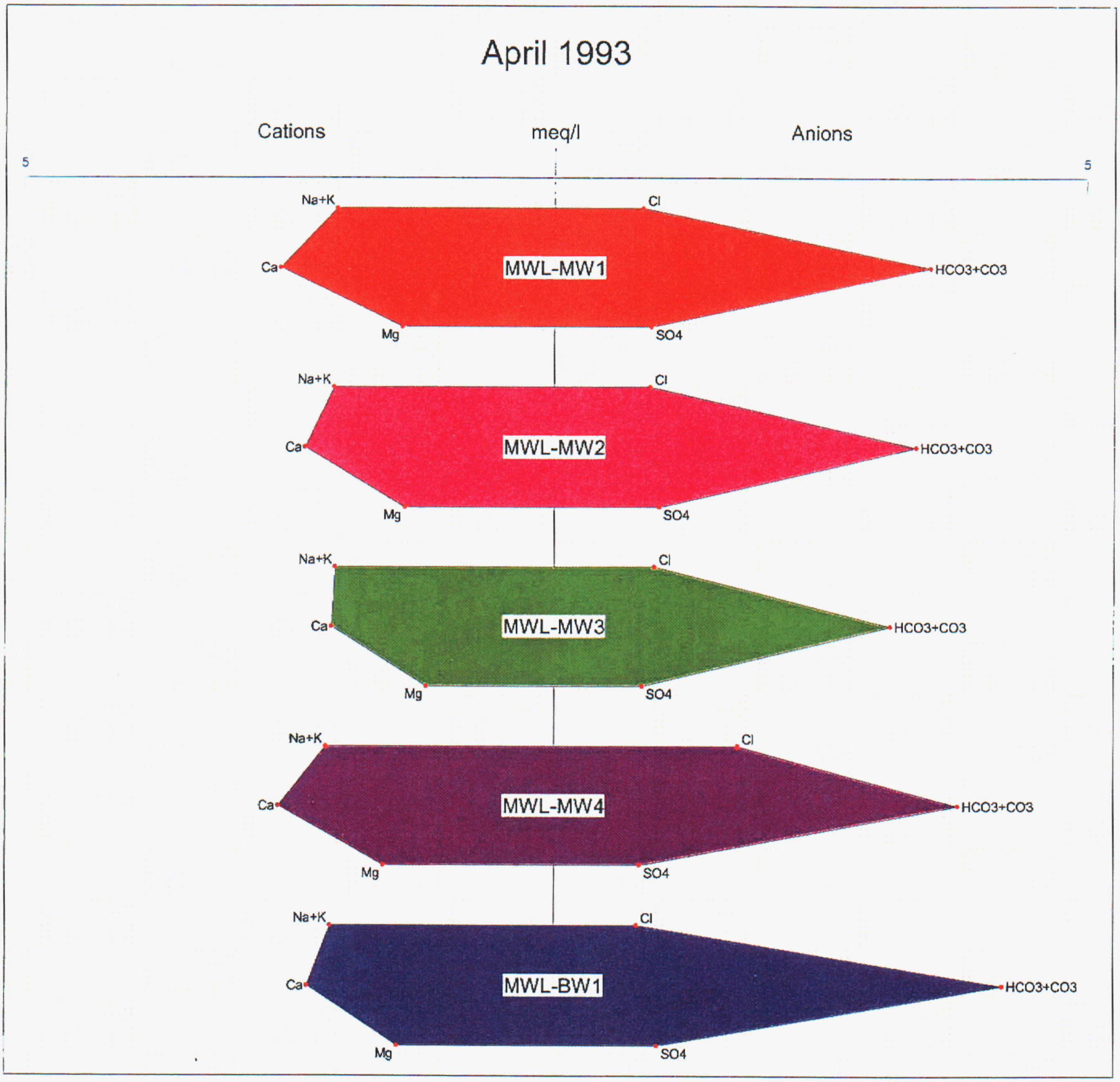


Figure 5.4-11 Stiff Diagrams of Major Ion Chemistry for All MWL Wells April 1993

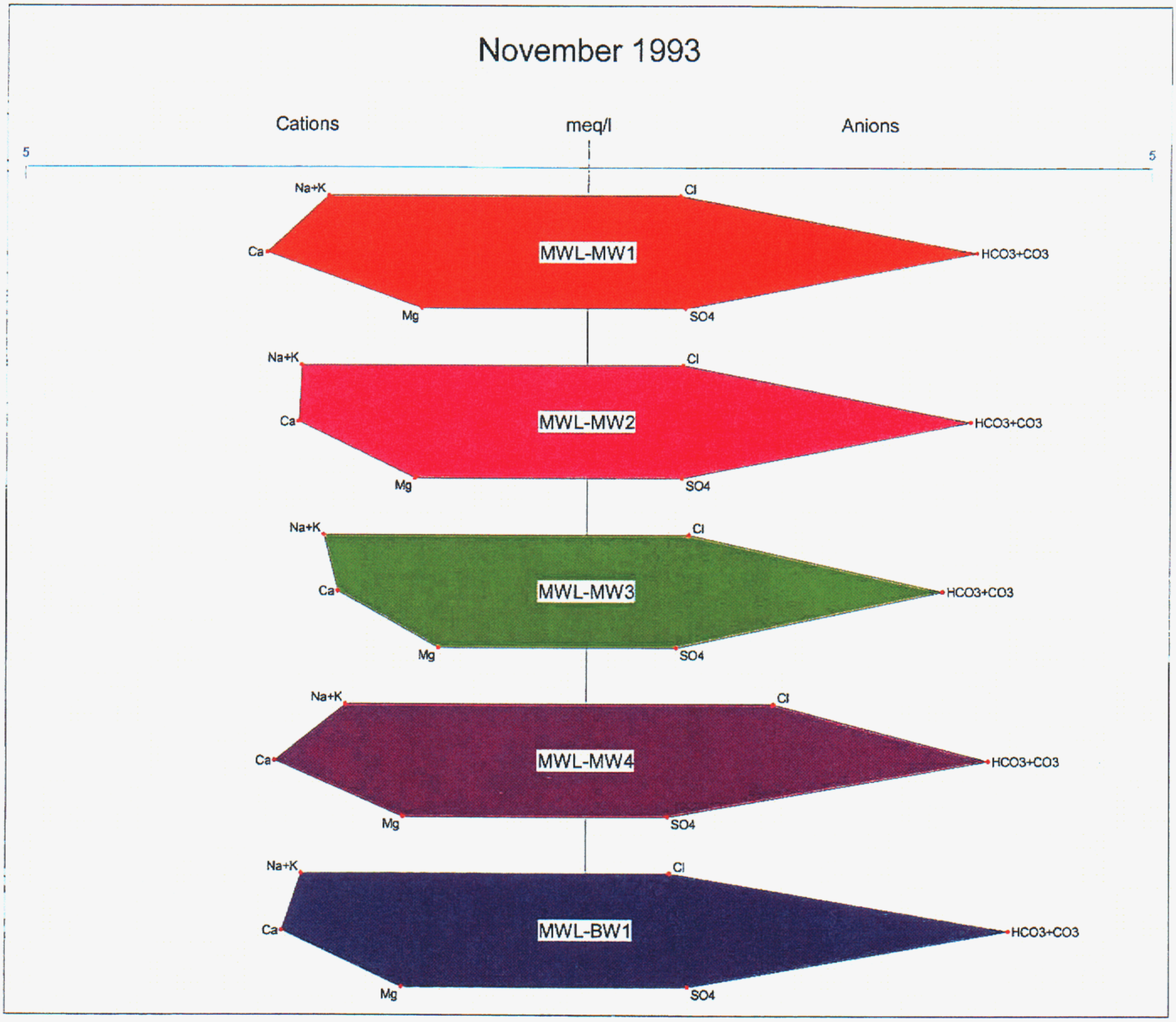


Figure 5.4-12 Stiff Diagrams of Major Ion Chemistry for All MWL Wells November 1993

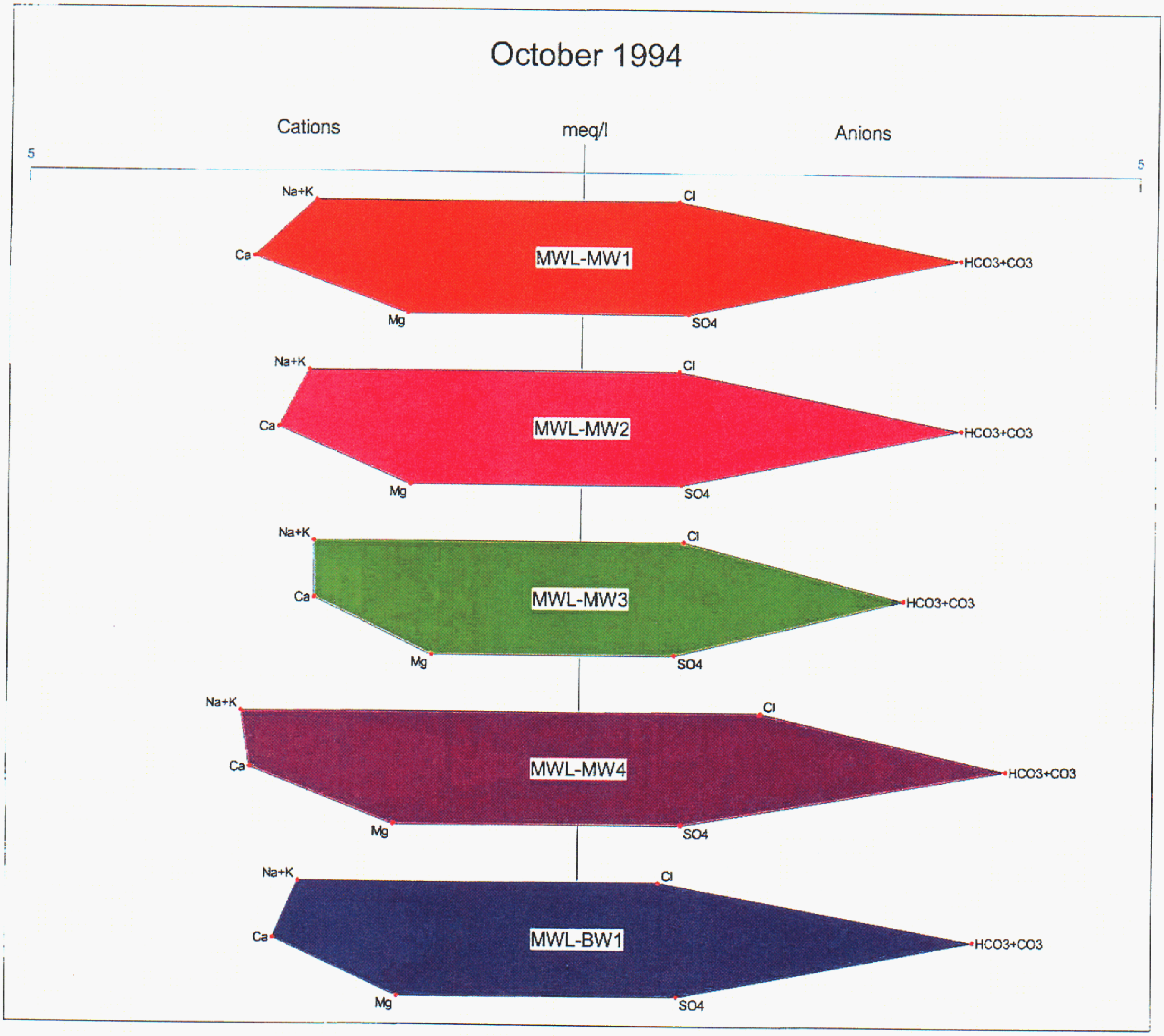


Figure 5.4-13 Stiff Diagrams of Major Ion Chemistry for All MWL Wells
October 1994

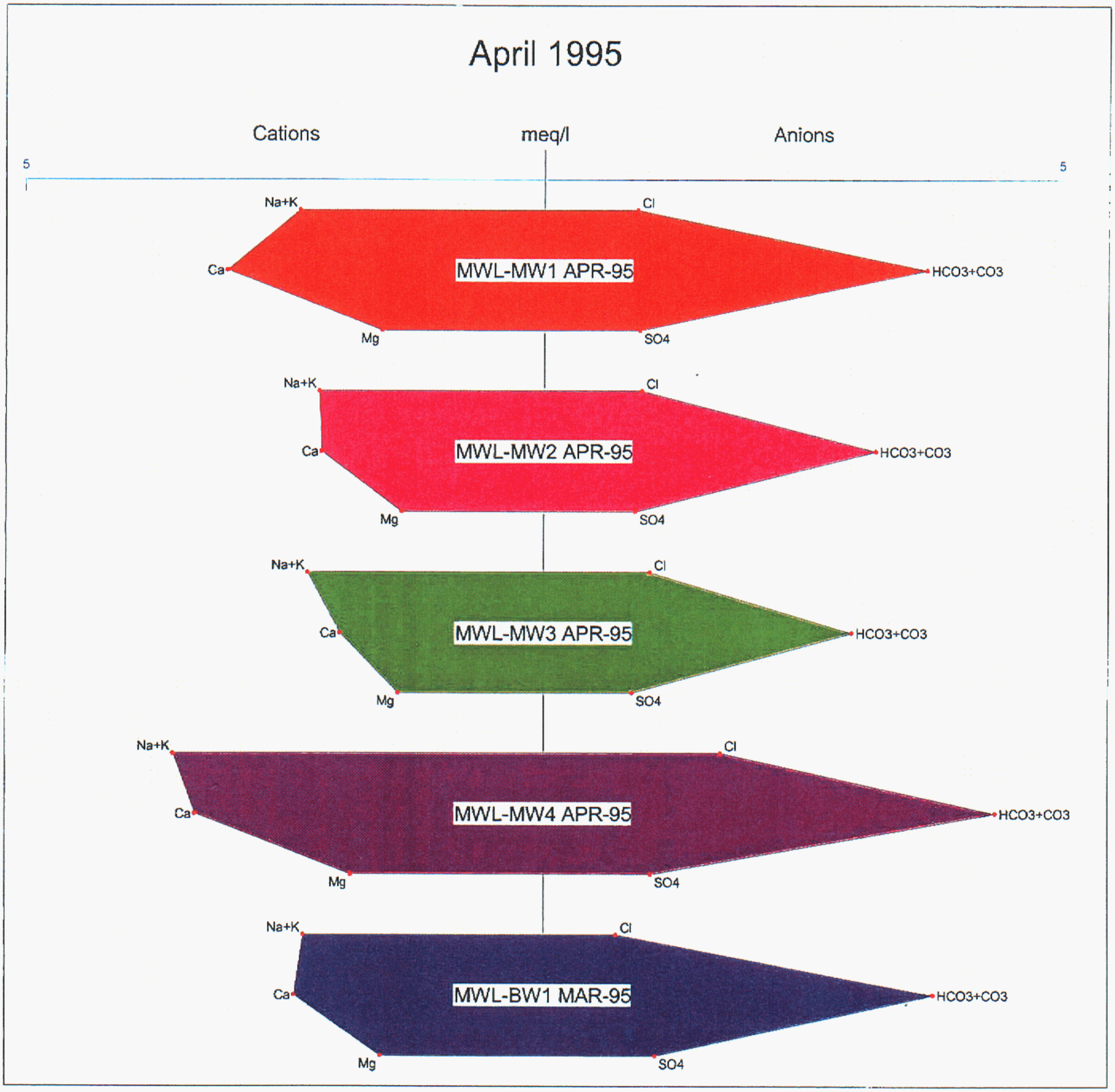


Figure 5.4-14 Stiff Diagrams of Major Ion Chemistry for All MWL Wells April 1995

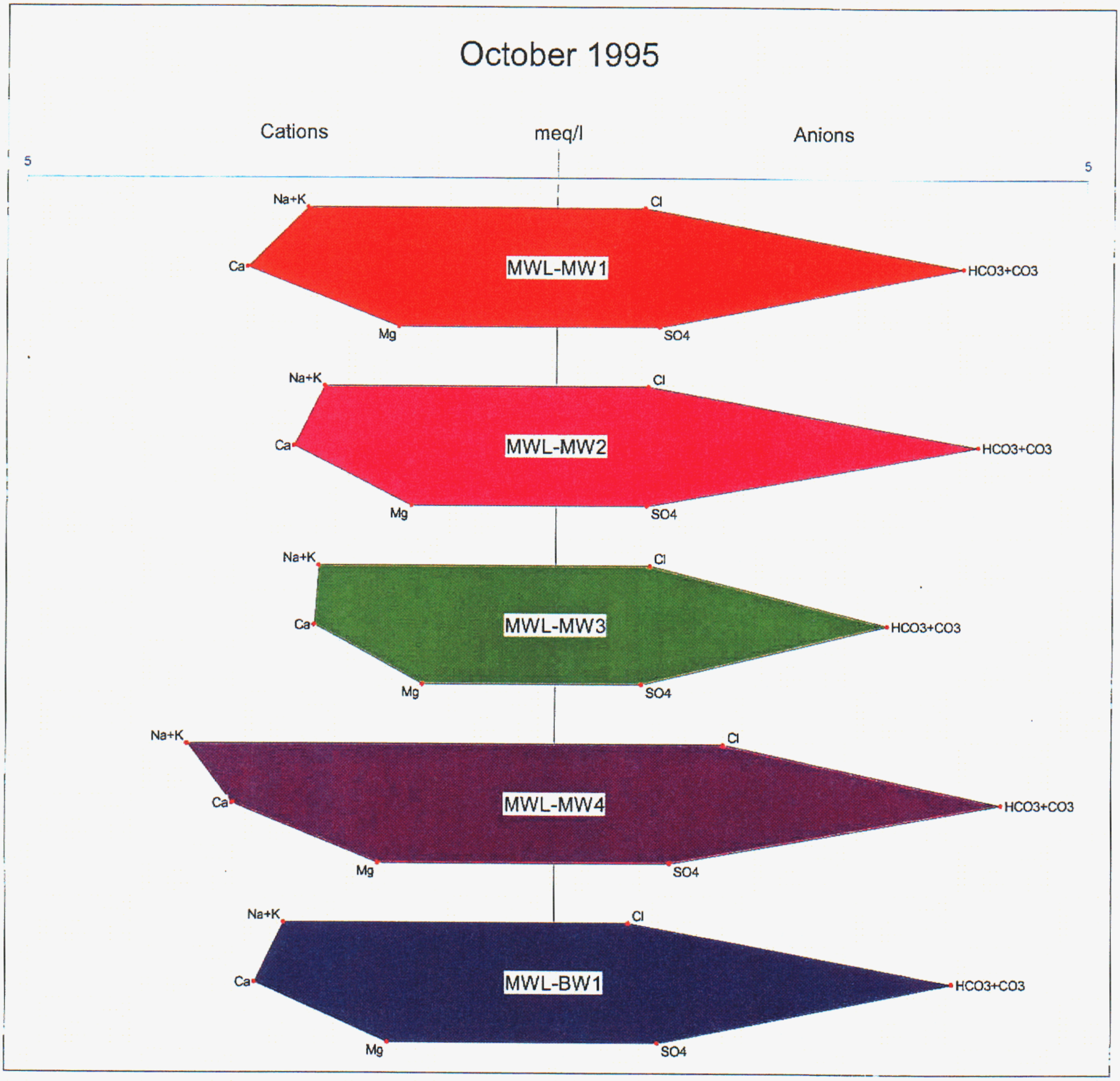


Figure 5.4-15 Stiff Diagrams of Major Ion Chemistry for All MWL Wells October 1995

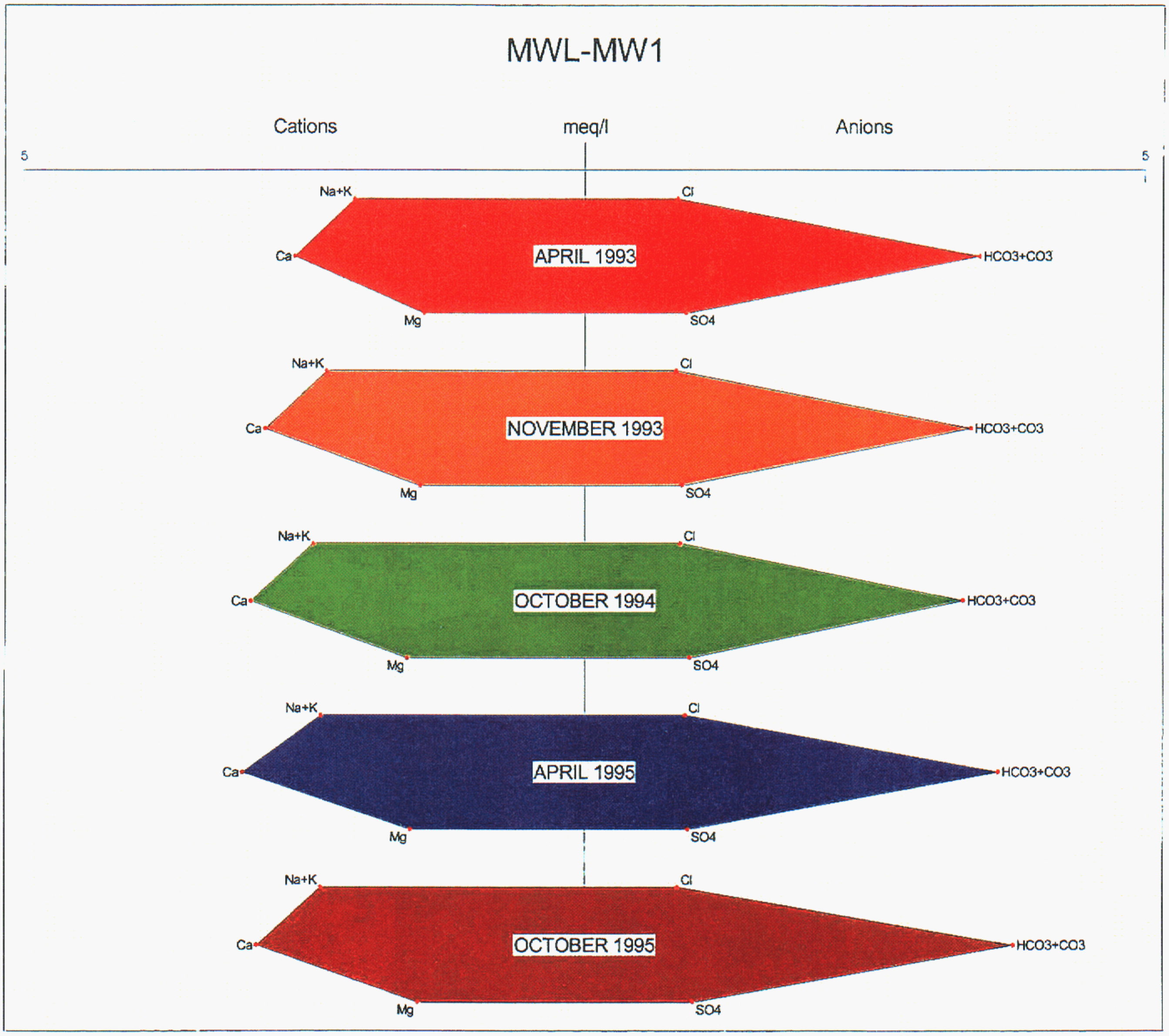


Figure 5.4-16 Stiff Diagrams of Major Ion Chemistry for MW-1 1993 through 1995

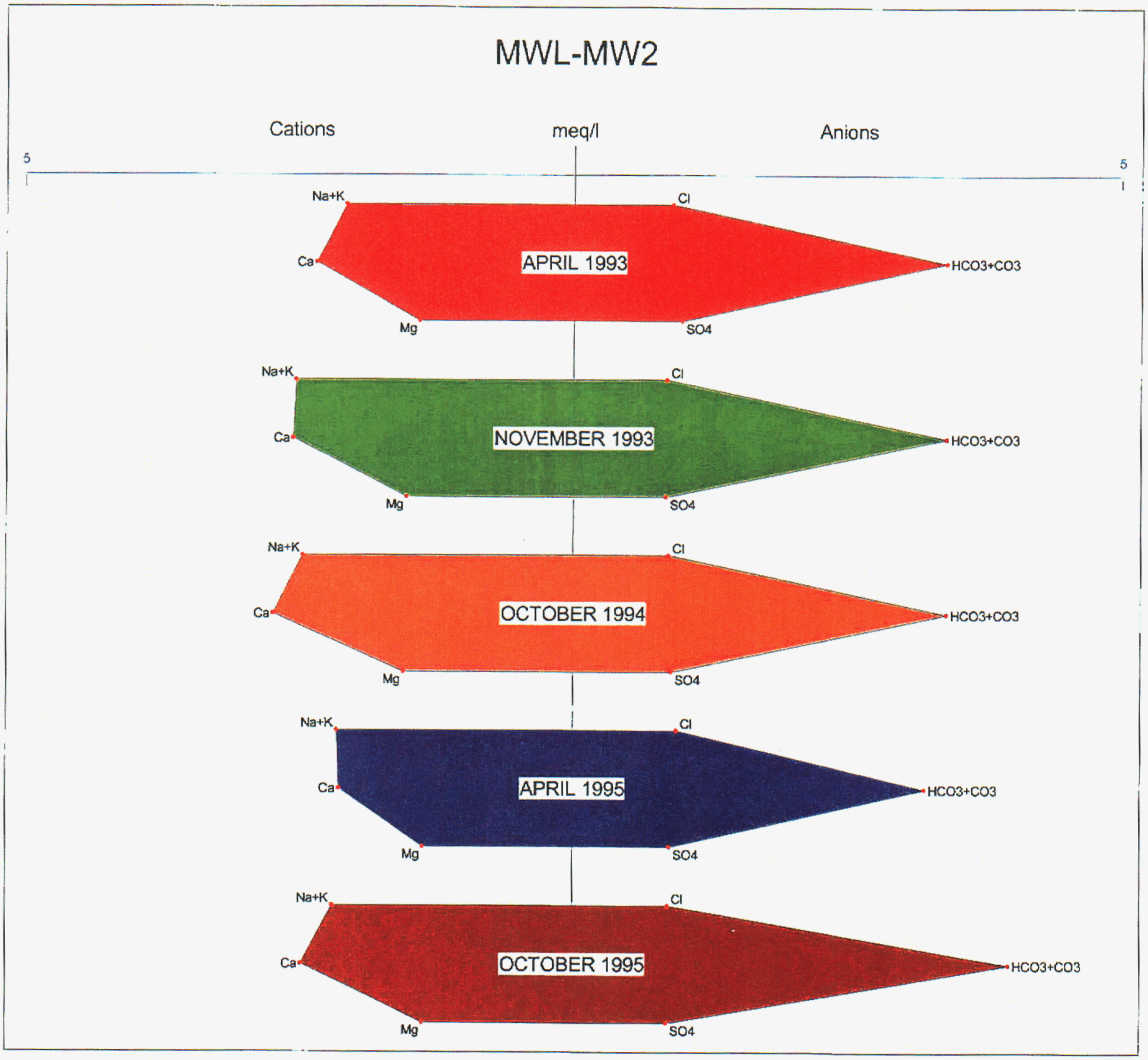


Figure 5.4-17 Stiff Diagrams of Major Ion Chemistry for MW-2 1993 through 1995

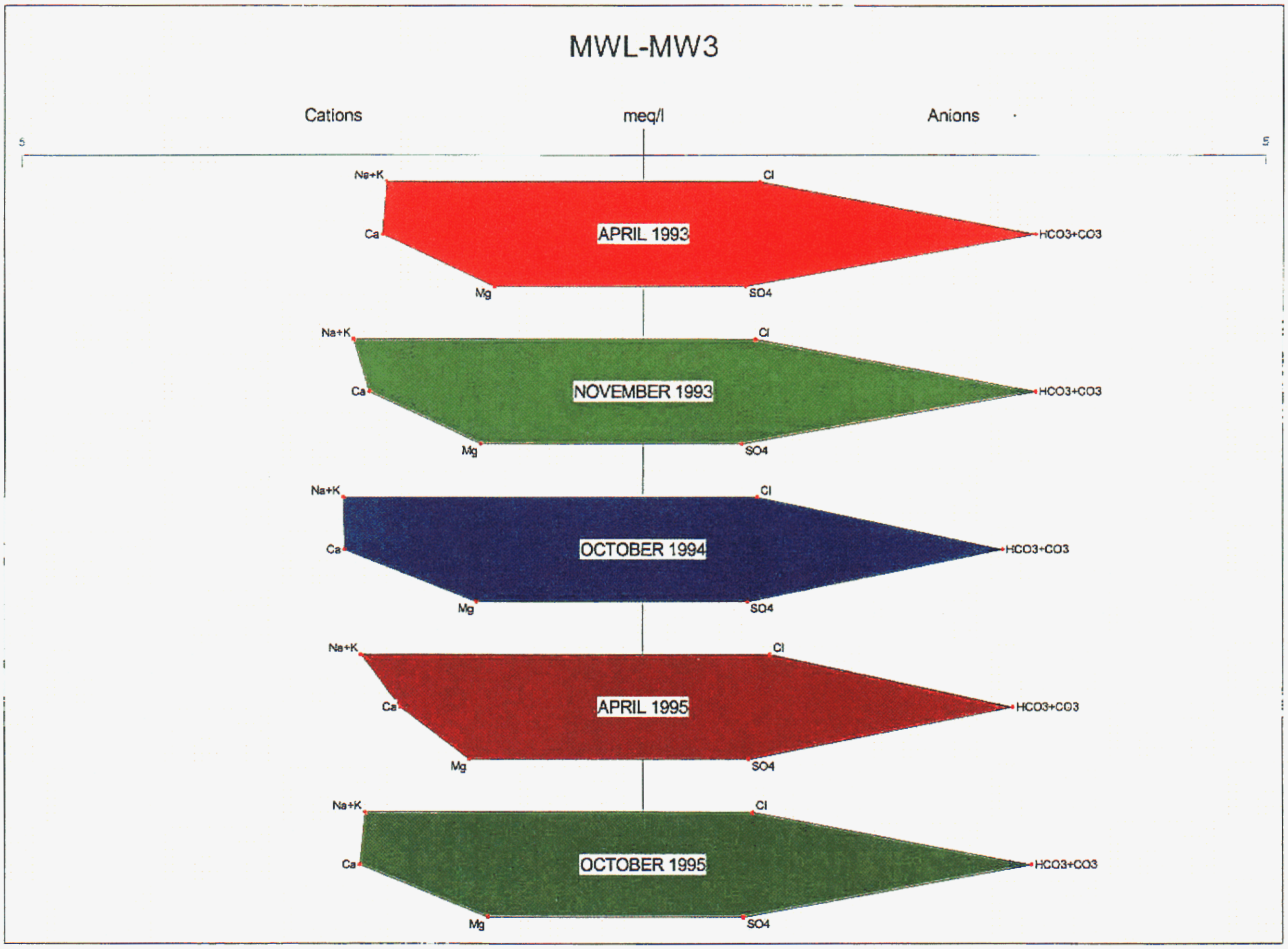


Figure 5.4-18 Stiff Diagrams of Major Ion Chemistry for MW-3 1993 through 1995

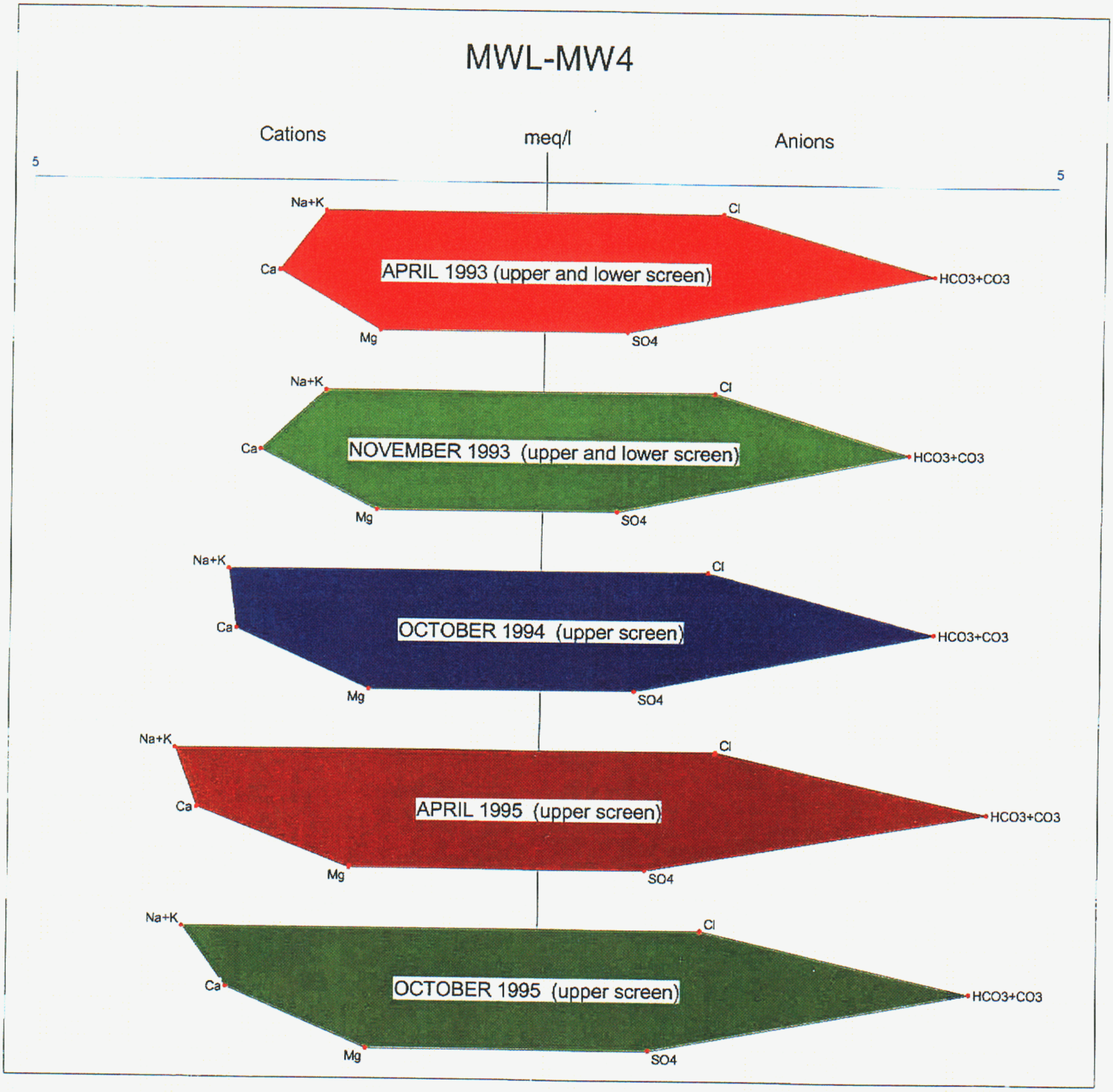


Figure 5.4-19 Stiff Diagrams of Major Ion Chemistry for MW-4 1993 through 1995

Figure 5.4-20 Stiff Diagrams of Major Ion Chemistry for BW-1 1993 through 1995

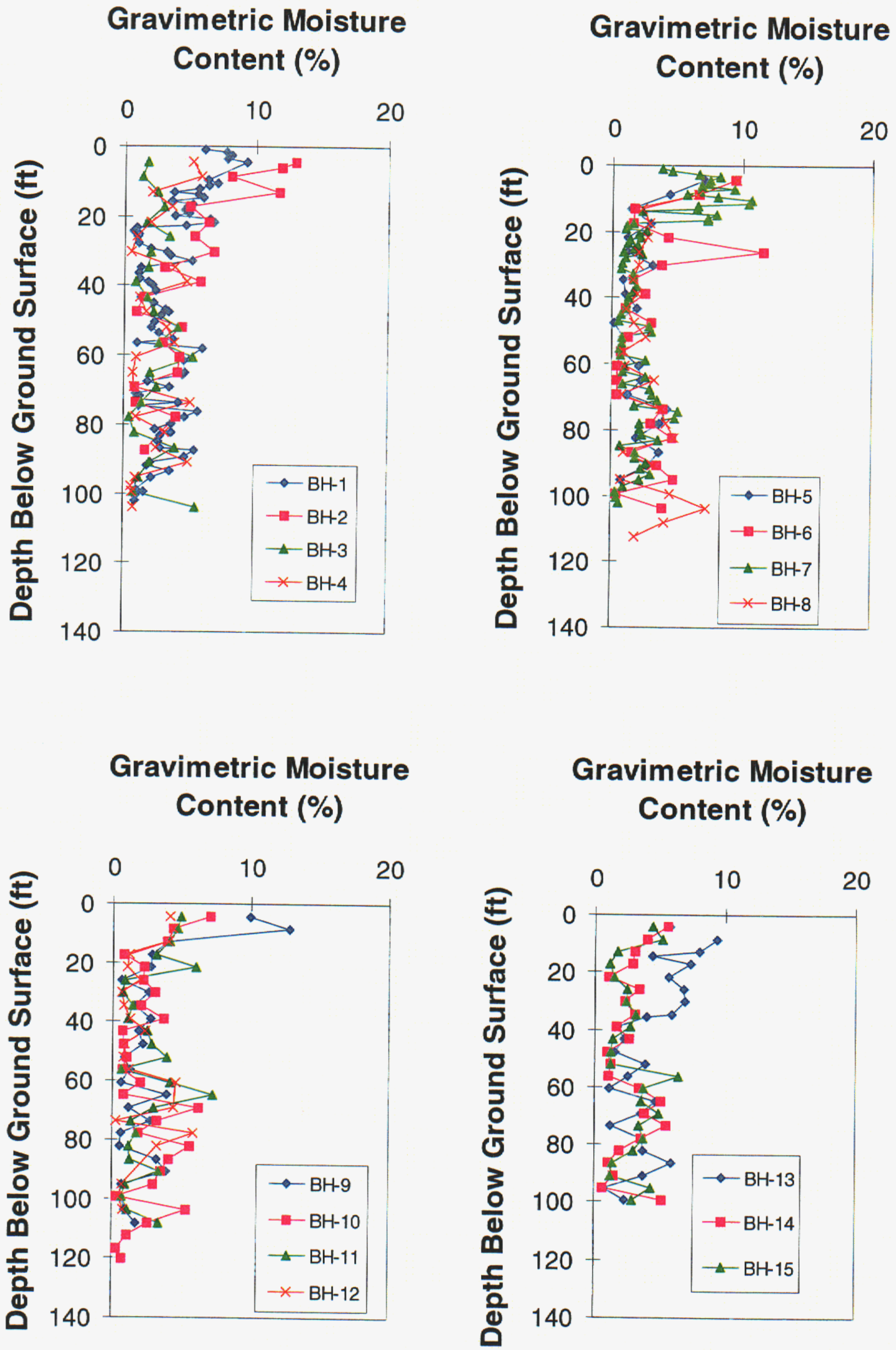


Figure 6.3-1 Gravimetric Moisture Content Profiles for MWL Borehole Soils

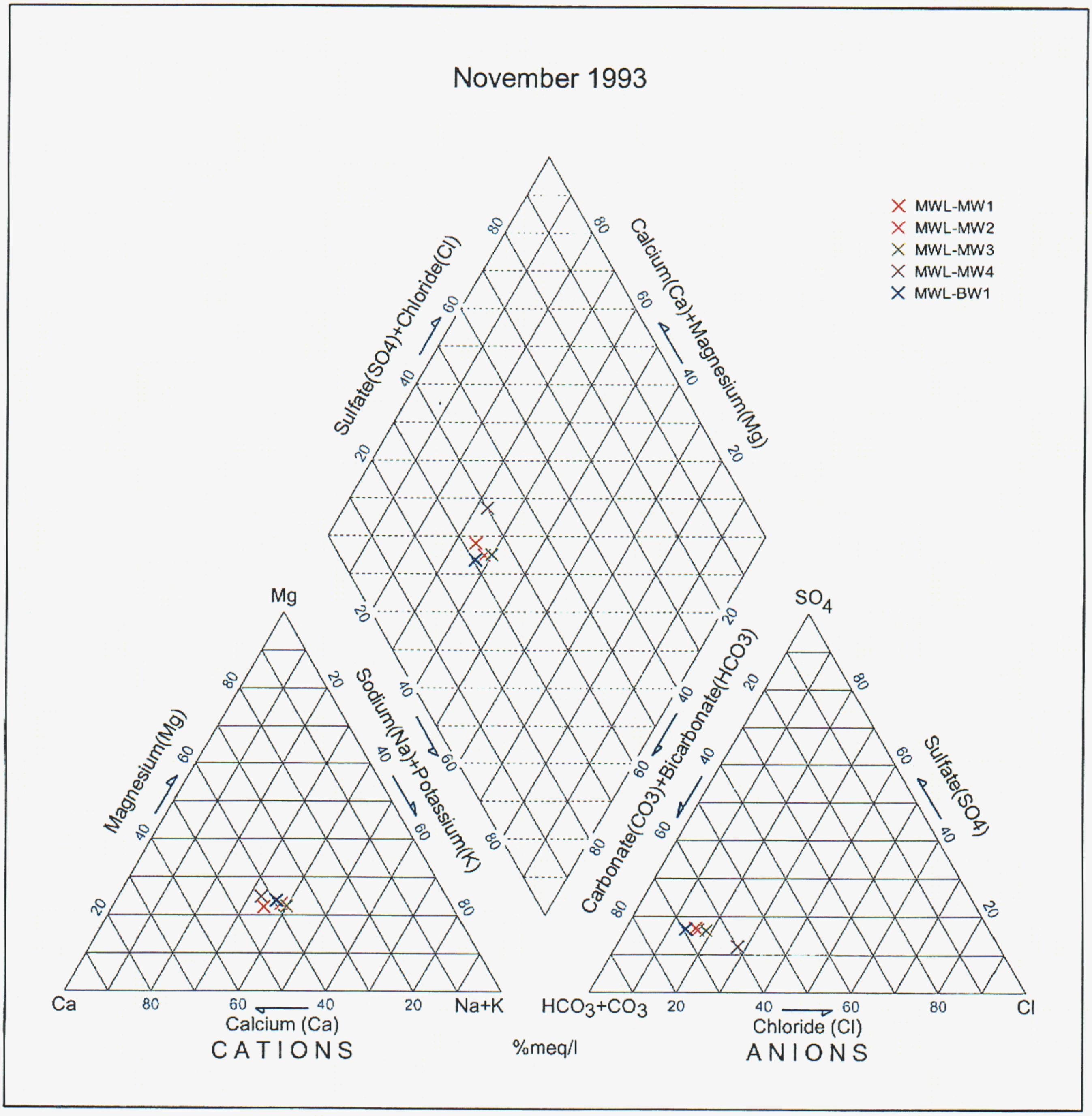


Figure 5.4-2 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells November 1993

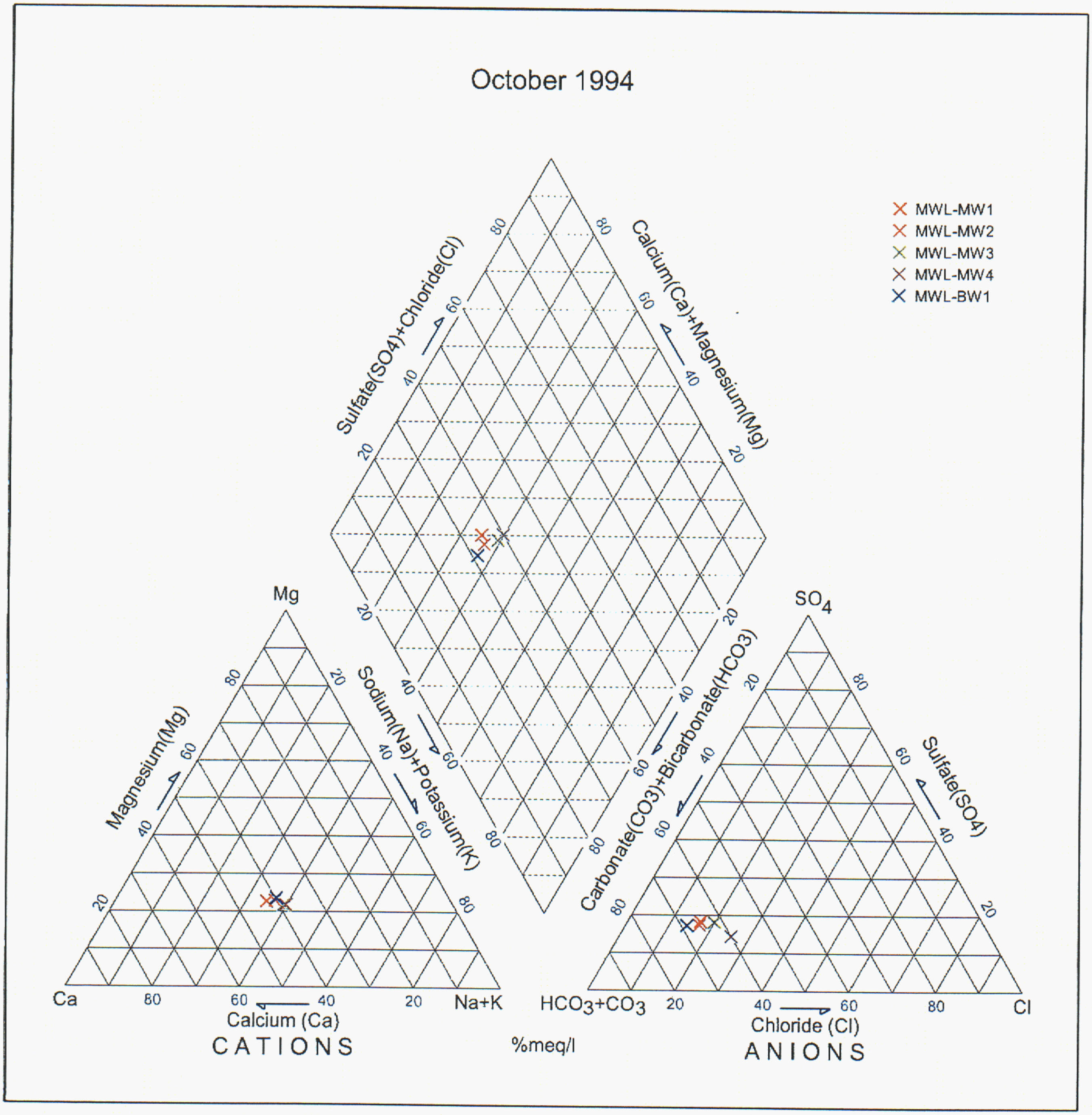


Figure 5.4-3 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells
October 1994

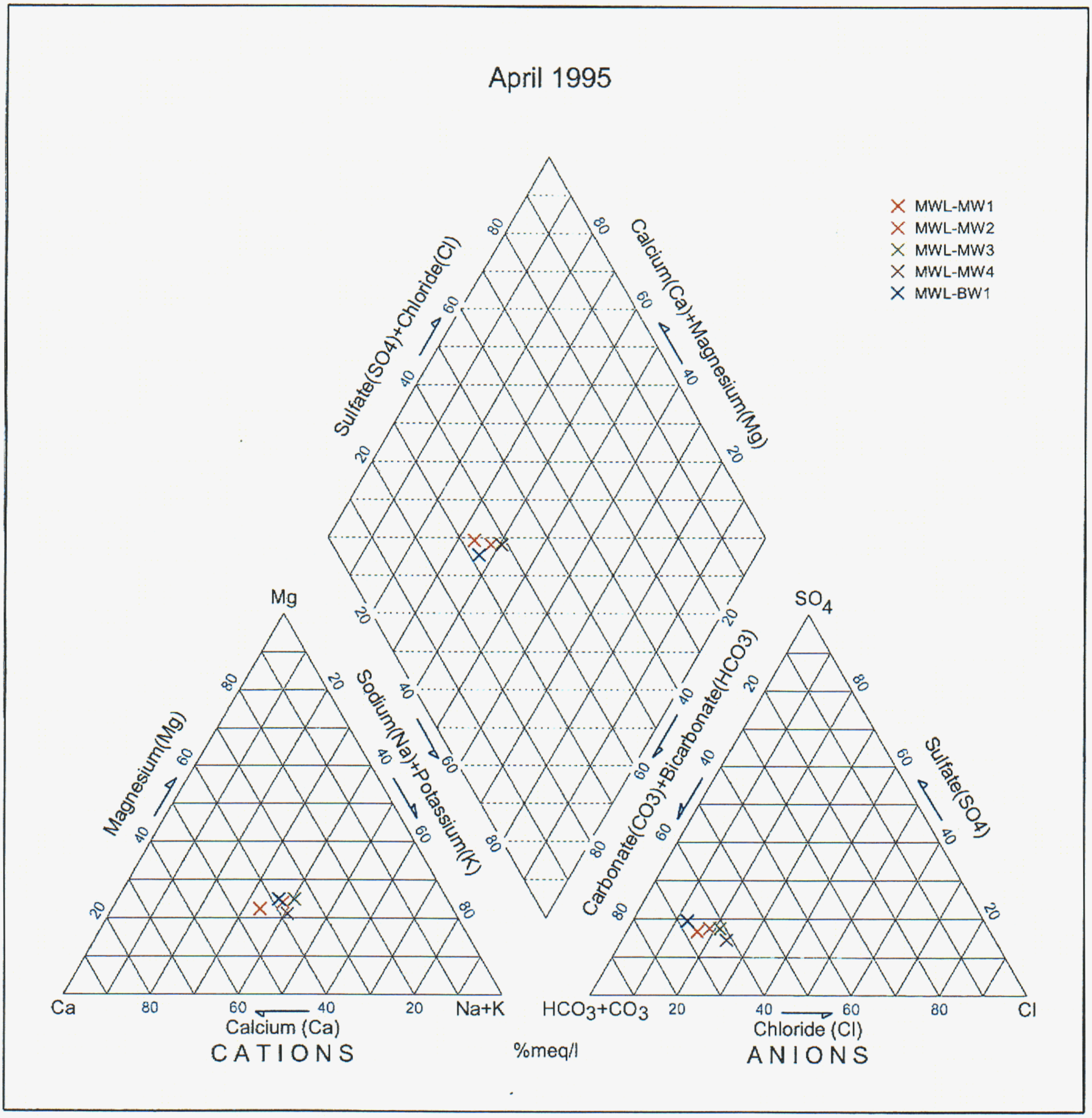


Figure 5.4-4 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells
April 1995

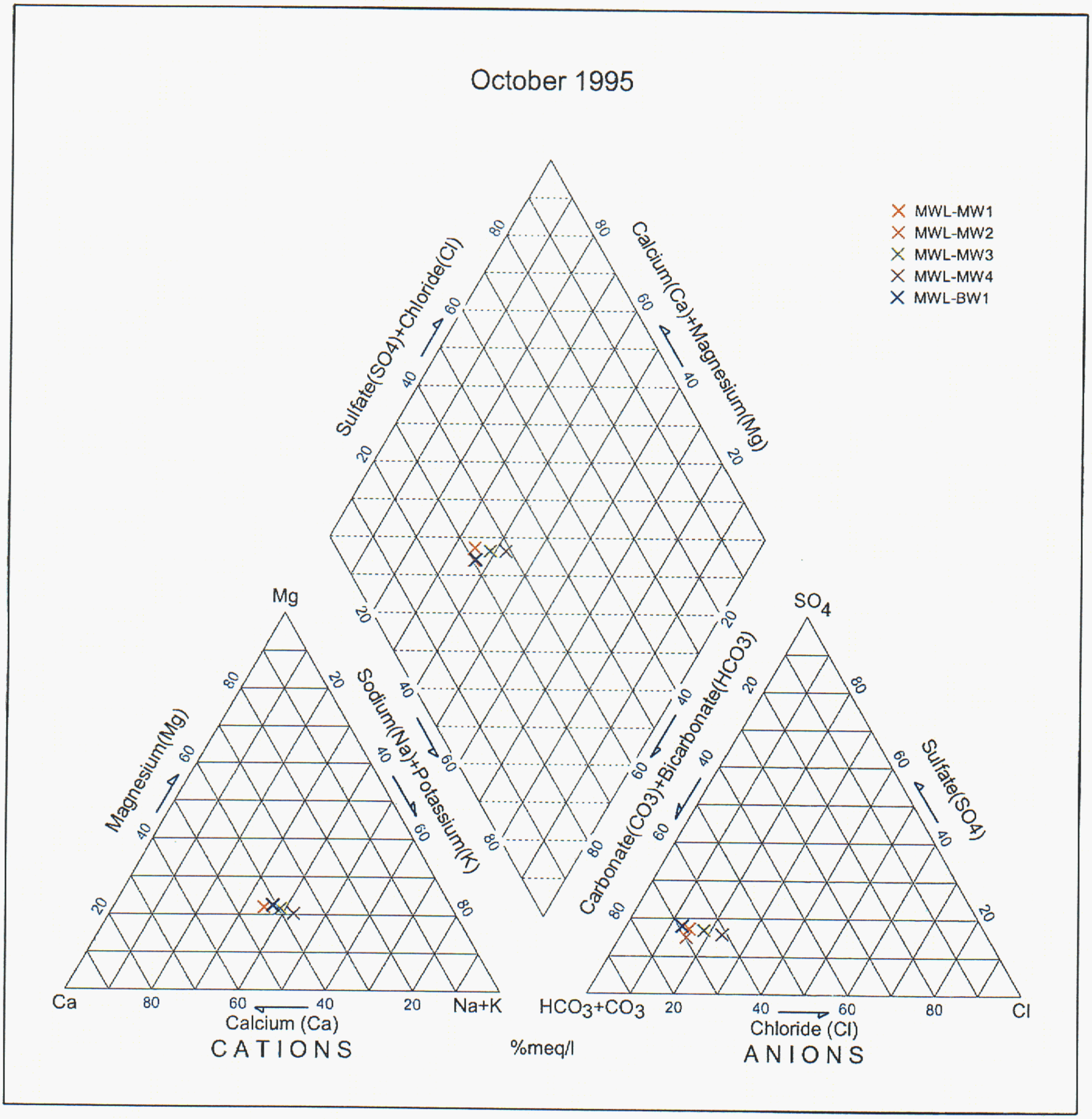


Figure 5.4-5 Piper Trilinear Diagram of Major Ion Chemistry for All MWL Wells October 1995

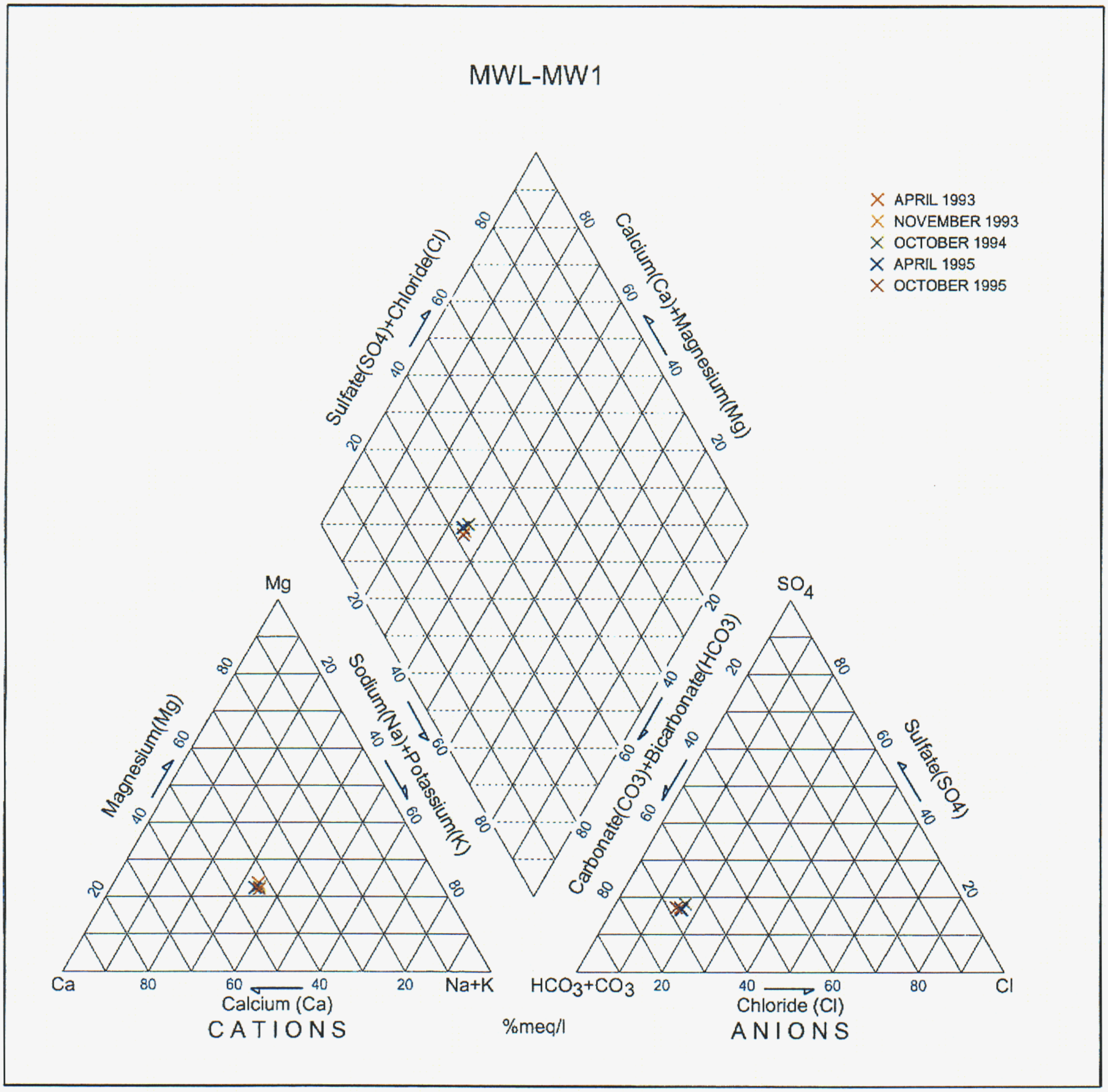


Figure 5.4-6 Piper Trilinear Diagram of Major Ion Chemistry for MW-1 1993 through 1995

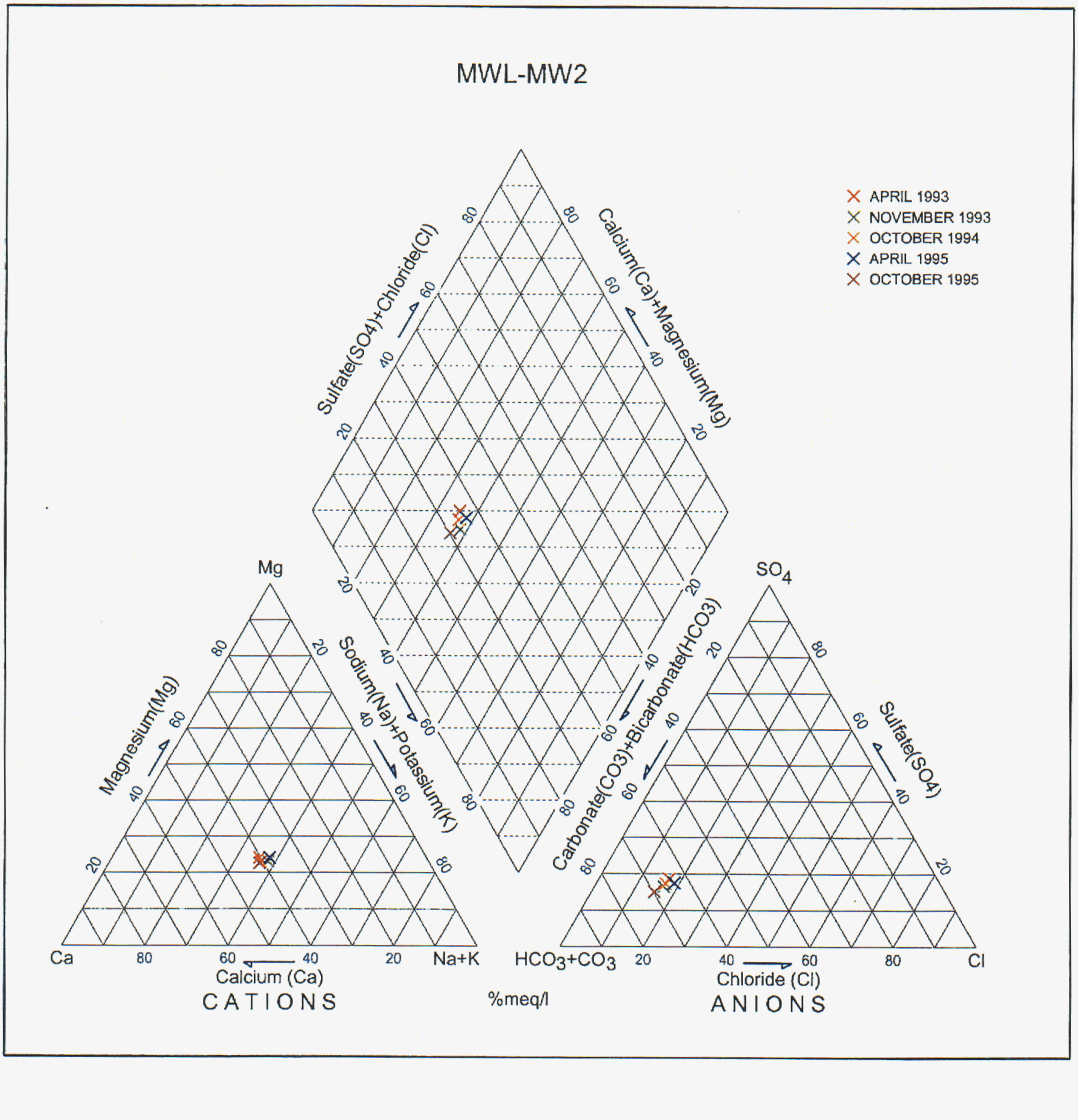


Figure 5.4-7 Piper Trilinear Diagram of Major Ion Chemistry for MW-2 1993 through 1995

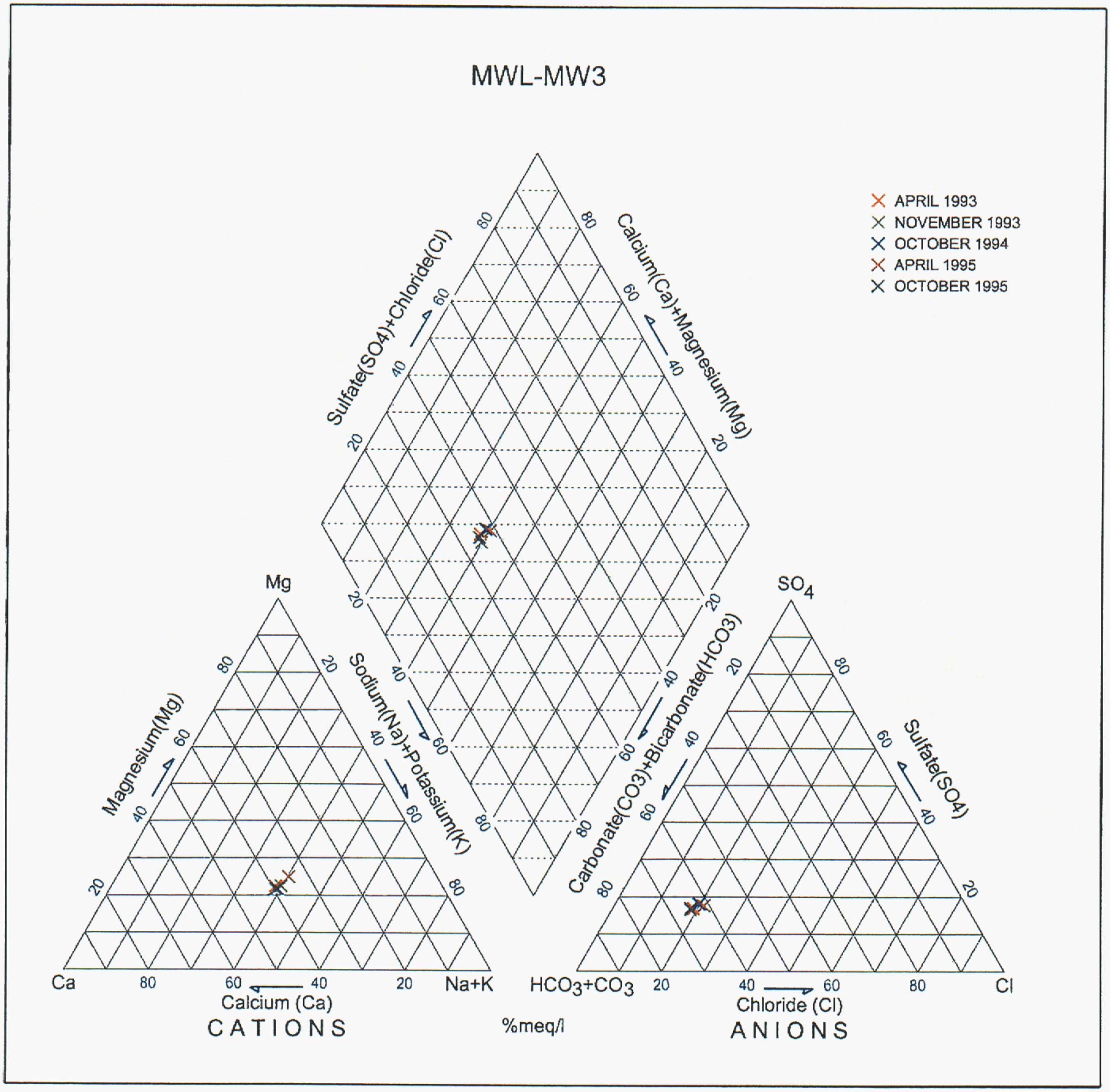


Figure 5.4-8 Piper Trilinear Diagram of Major Ion Chemistry for MW-3
1993 through 1995

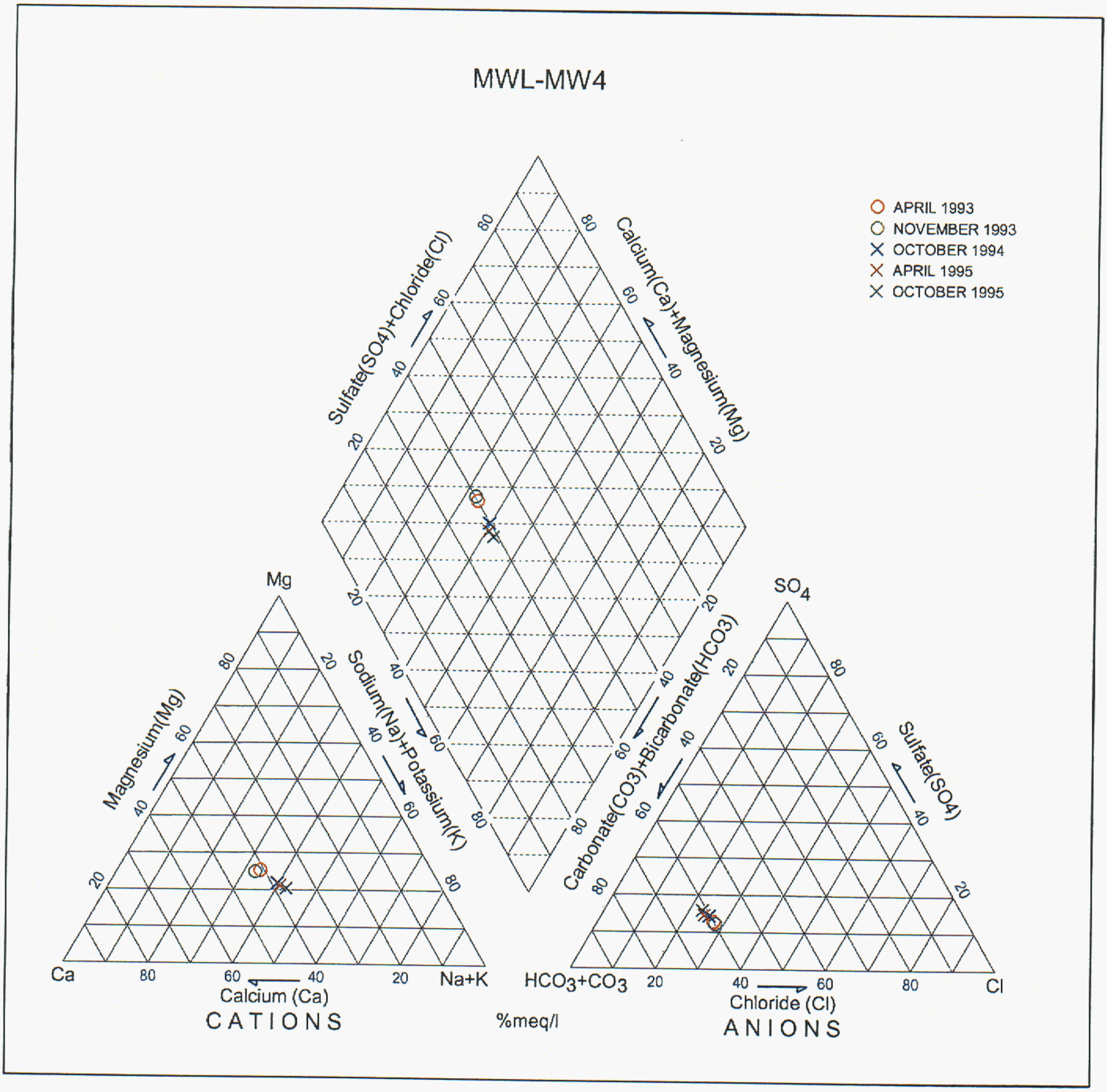


Figure 5.4-9 Piper Trilinear Diagram of Major Ion Chemistry for MW-4
1993 through 1995

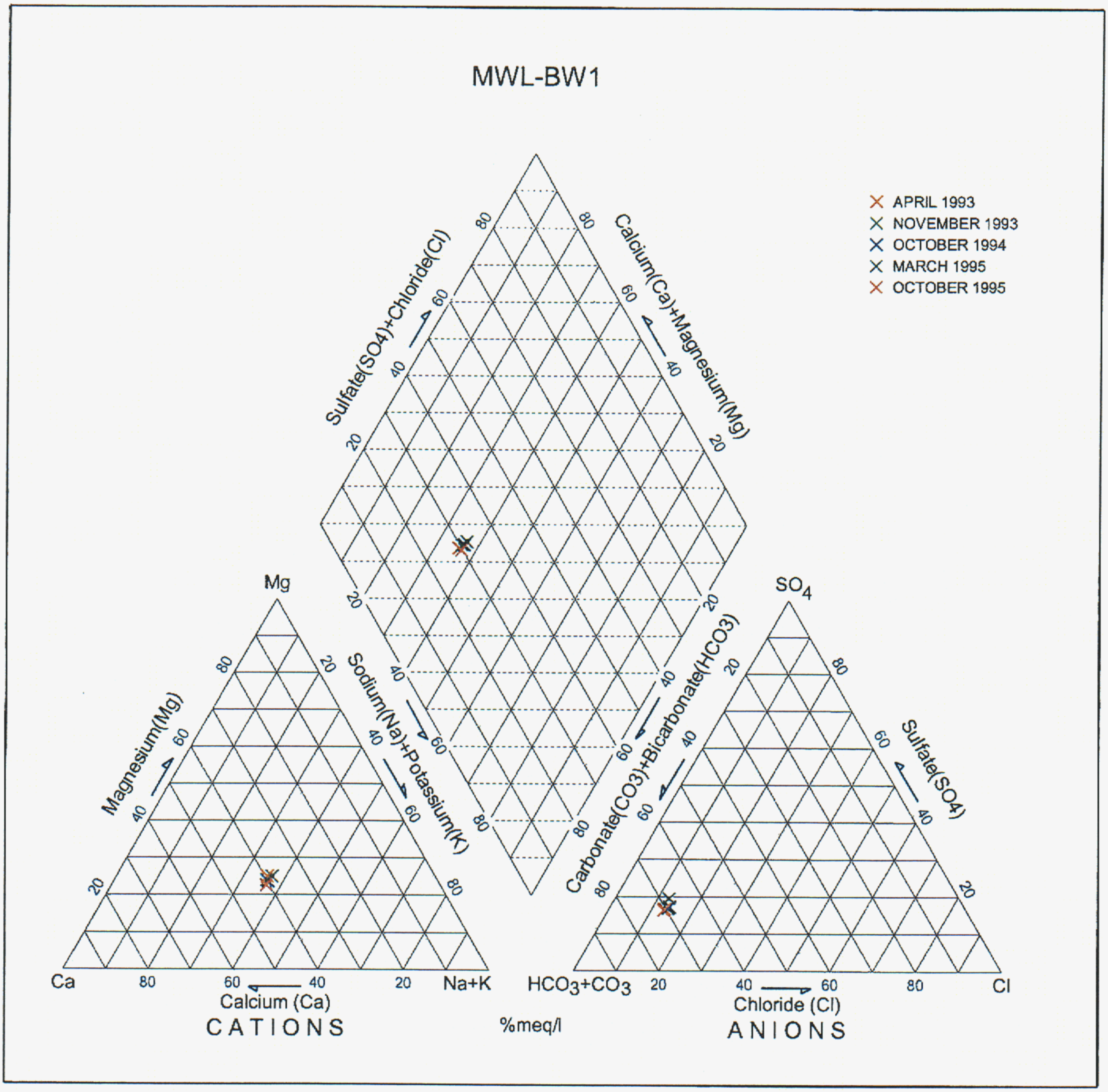


Figure 5.4-10 Piper Trilinear Diagram of Major Ion Chemistry for BW-1 1993 through 1995

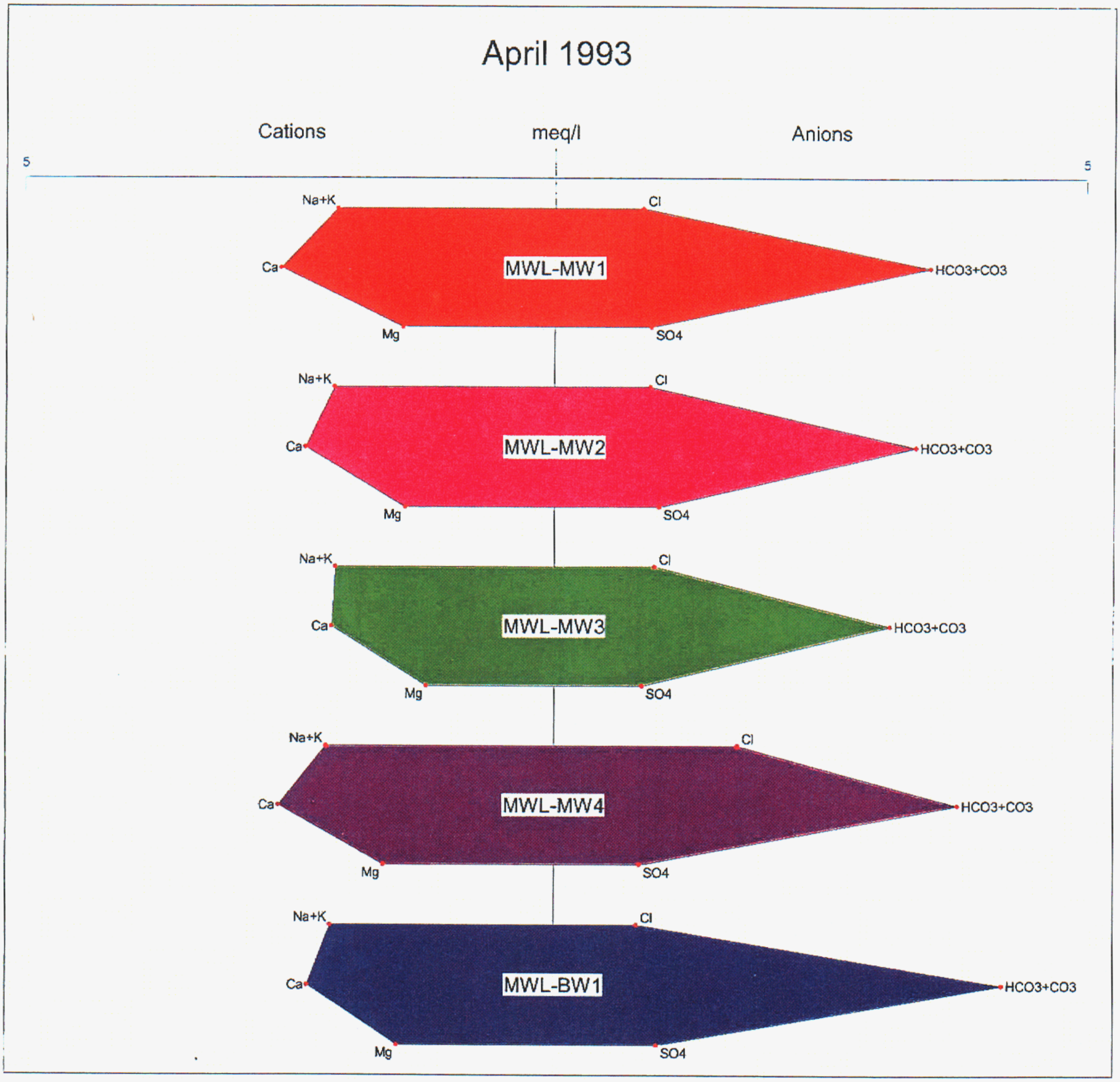


Figure 5.4-11 Stiff Diagrams of Major Ion Chemistry for All MWL Wells April 1993

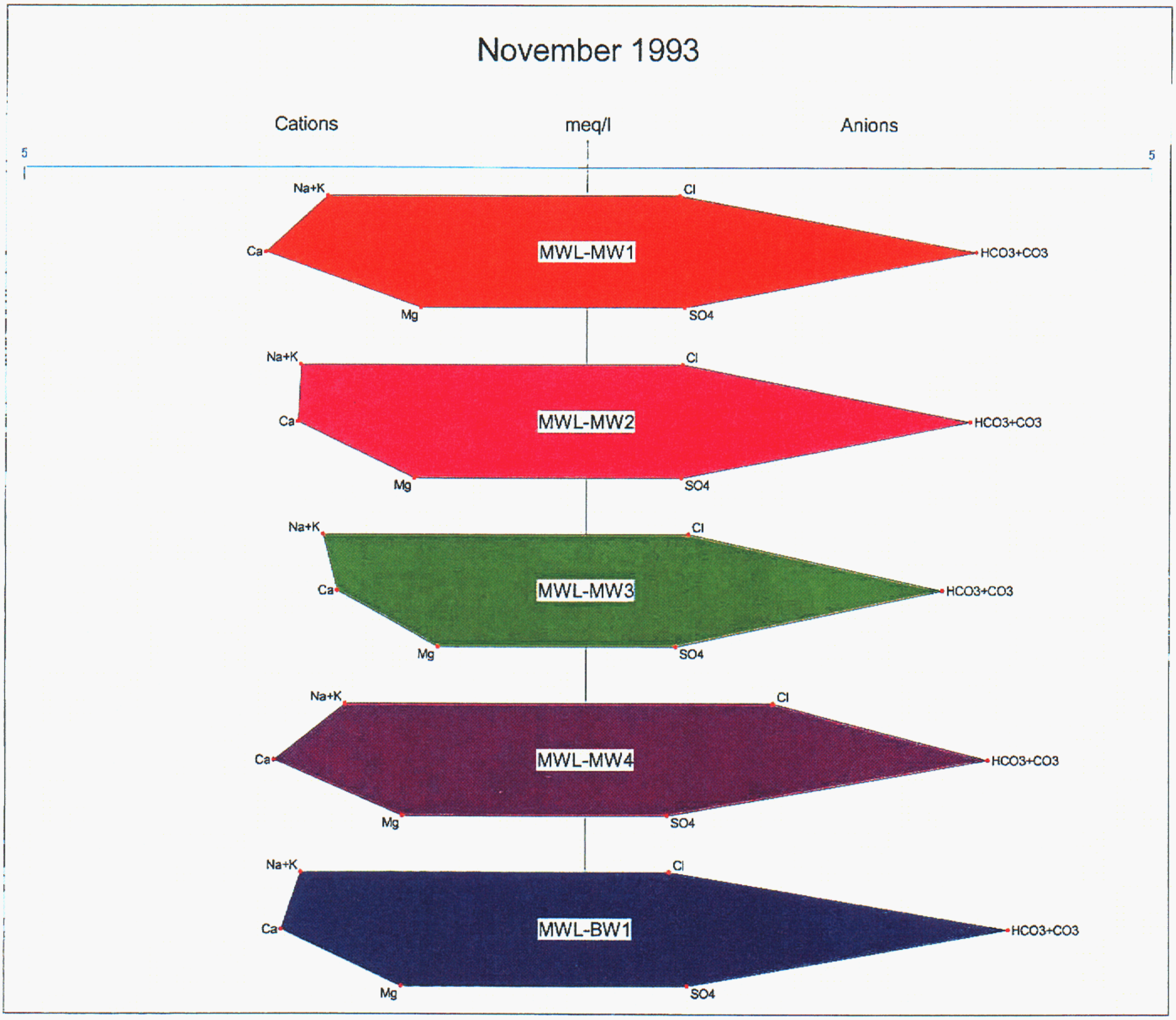


Figure 5.4-12 Stiff Diagrams of Major Ion Chemistry for All MWL Wells November 1993

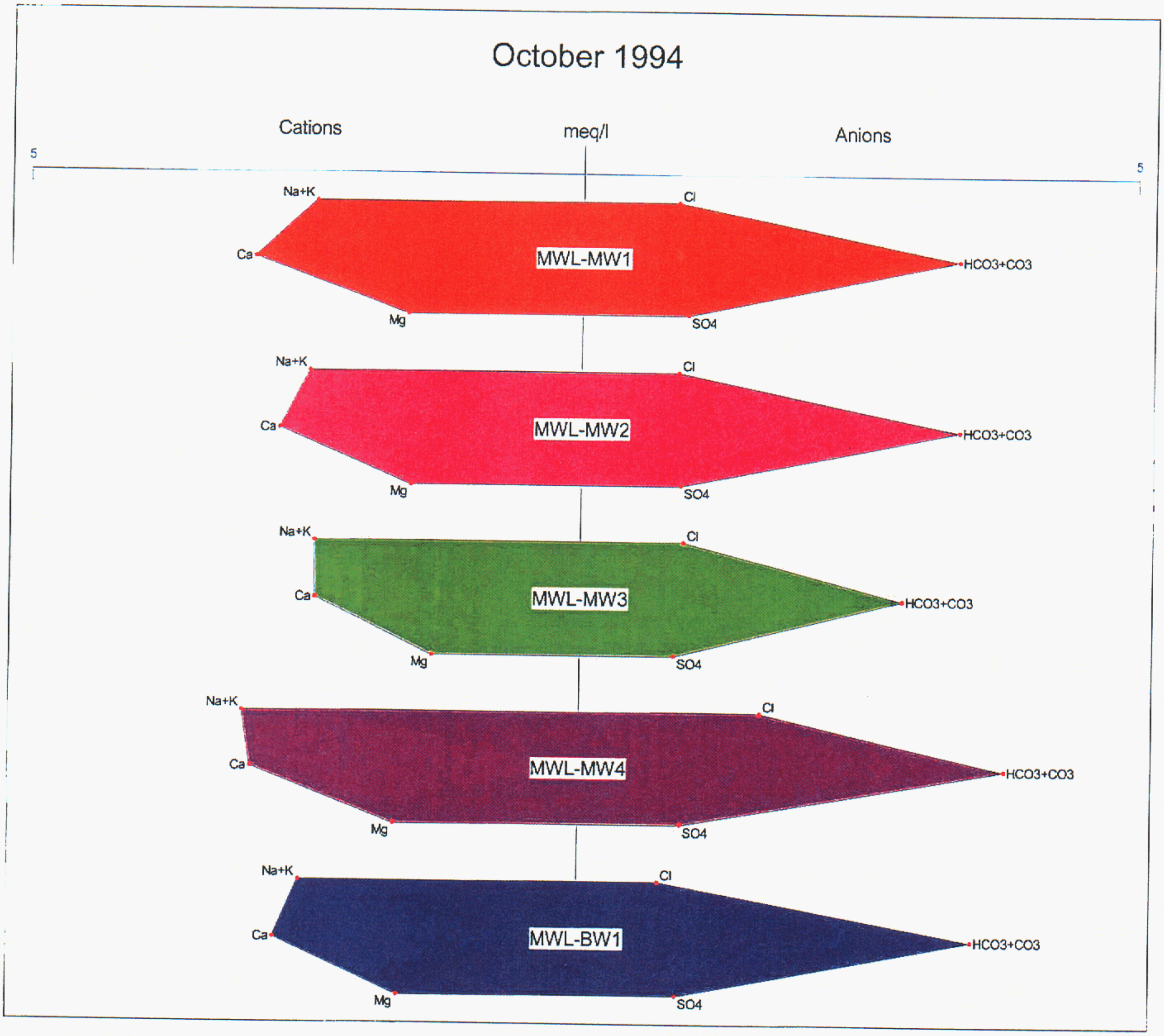


Figure 5.4-13 Stiff Diagrams of Major Ion Chemistry for All MWL Wells October 1994

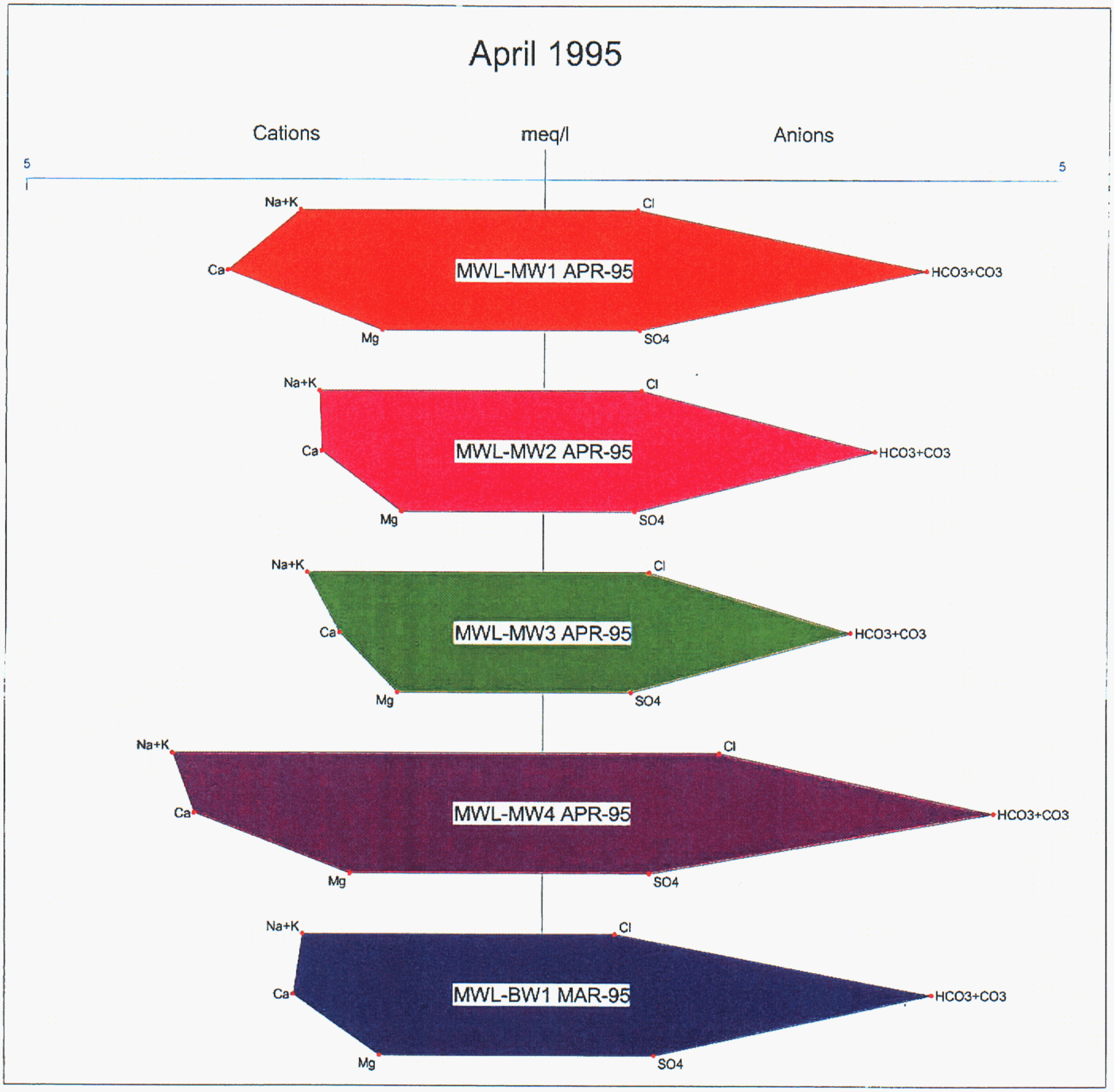


Figure 5.4-14 Stiff Diagrams of Major Ion Chemistry for All MWL Wells April 1995

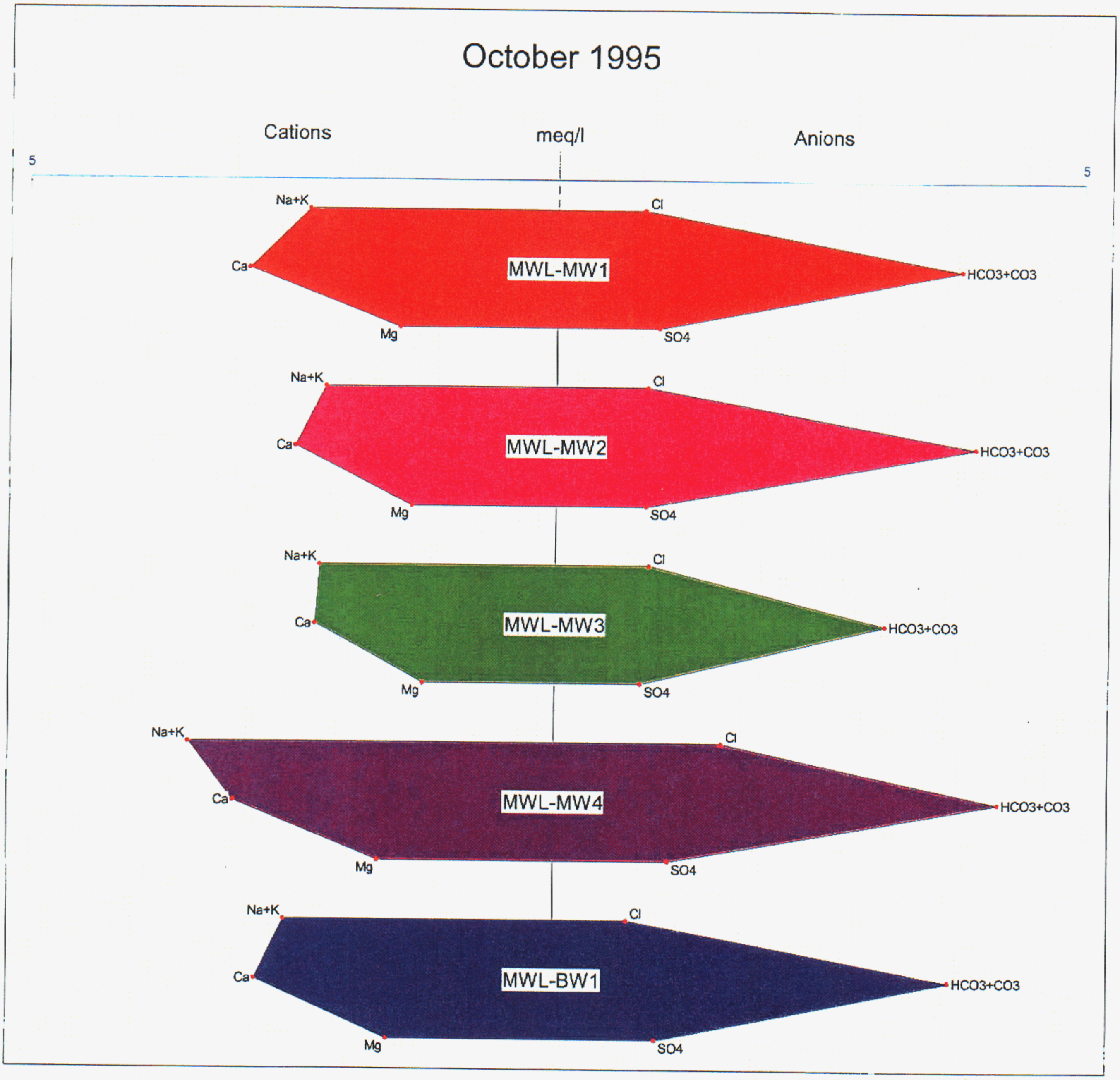


Figure 5.4-15 Stiff Diagrams of Major Ion Chemistry for All MWL Wells October 1995

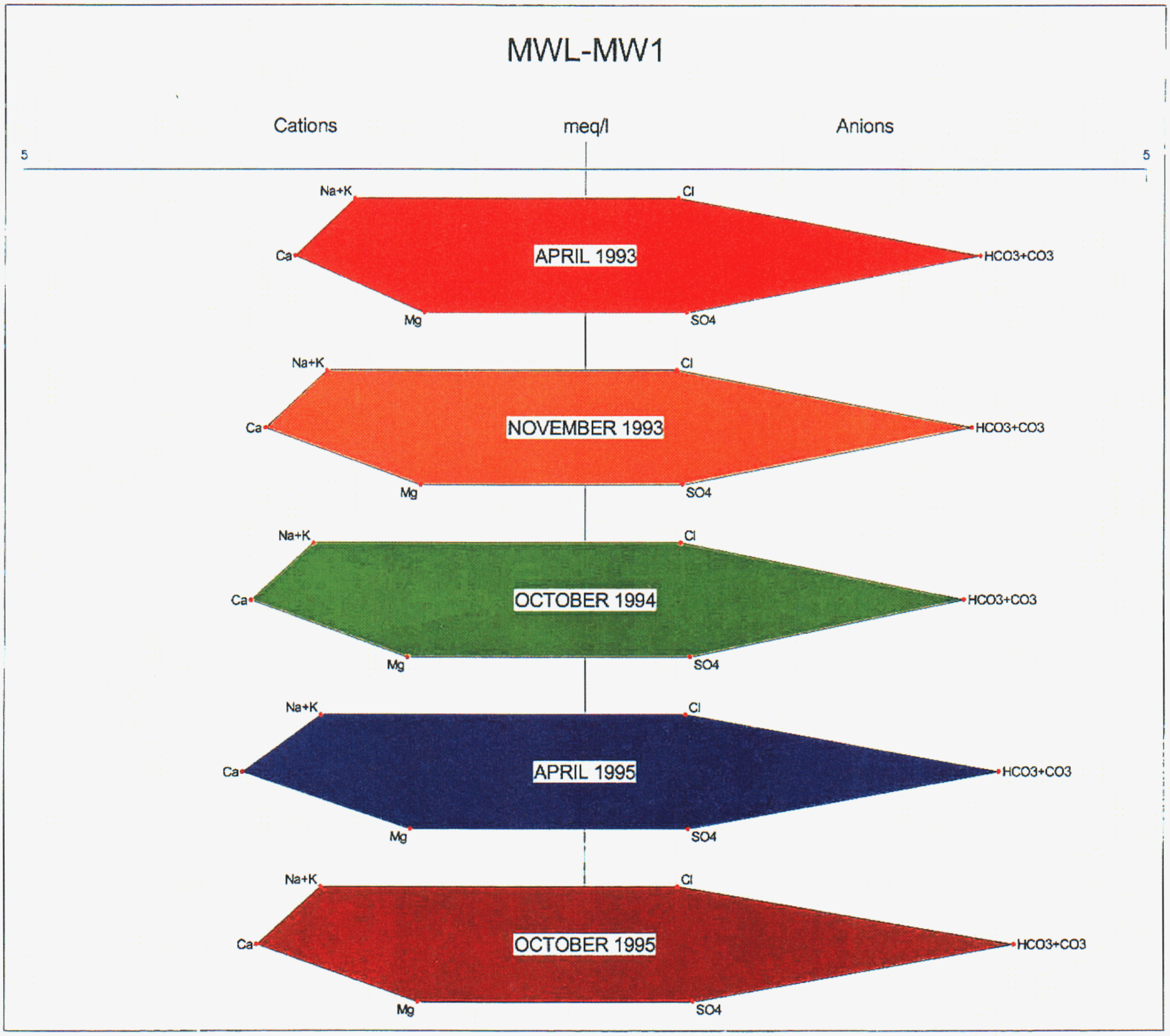


**Figure 5.4-16 Stiff Diagrams of Major Ion Chemistry for MW-1
1993 through 1995**

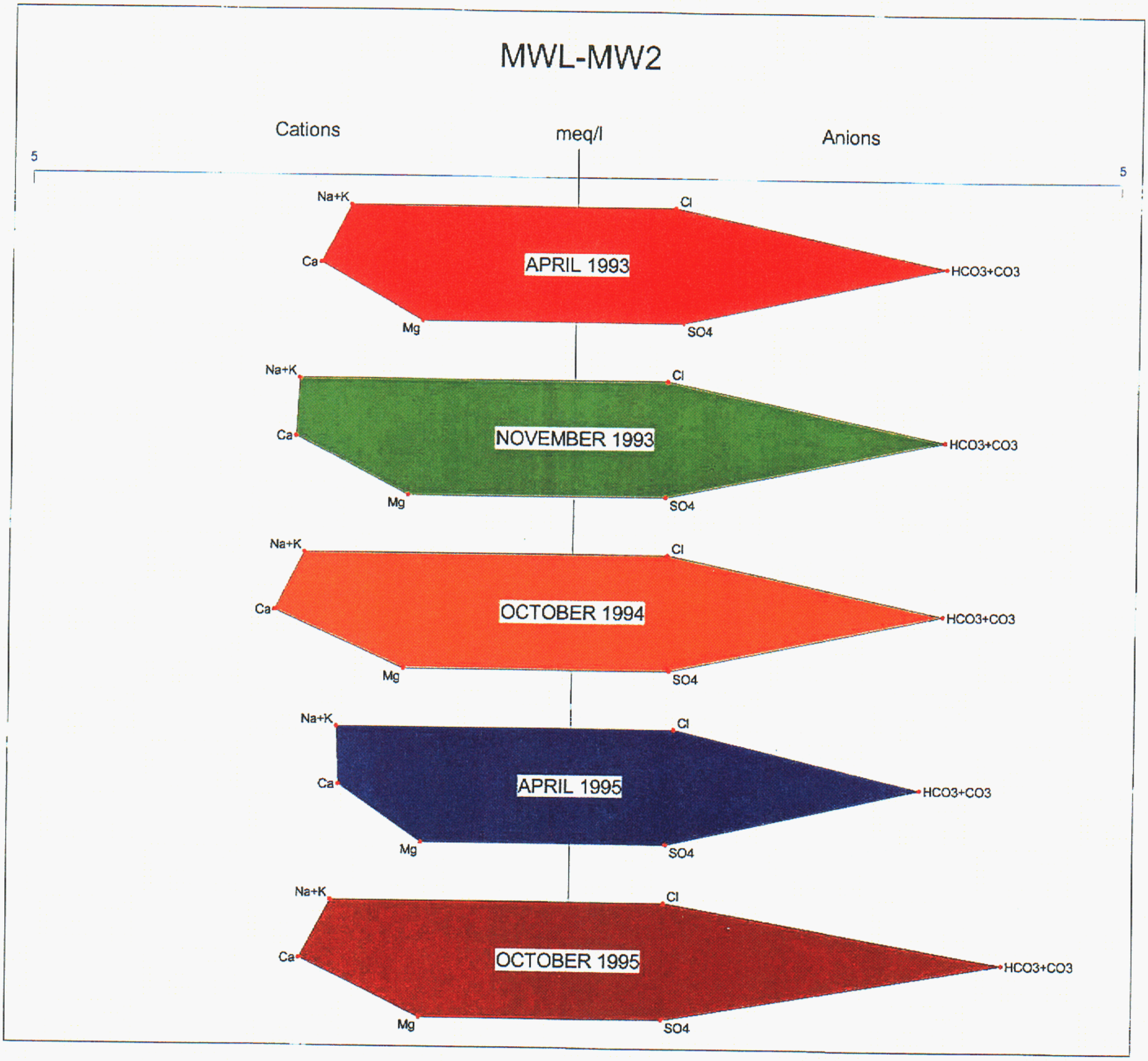


Figure 5.4-17 Stiff Diagrams of Major Ion Chemistry for MW-2 1993 through 1995

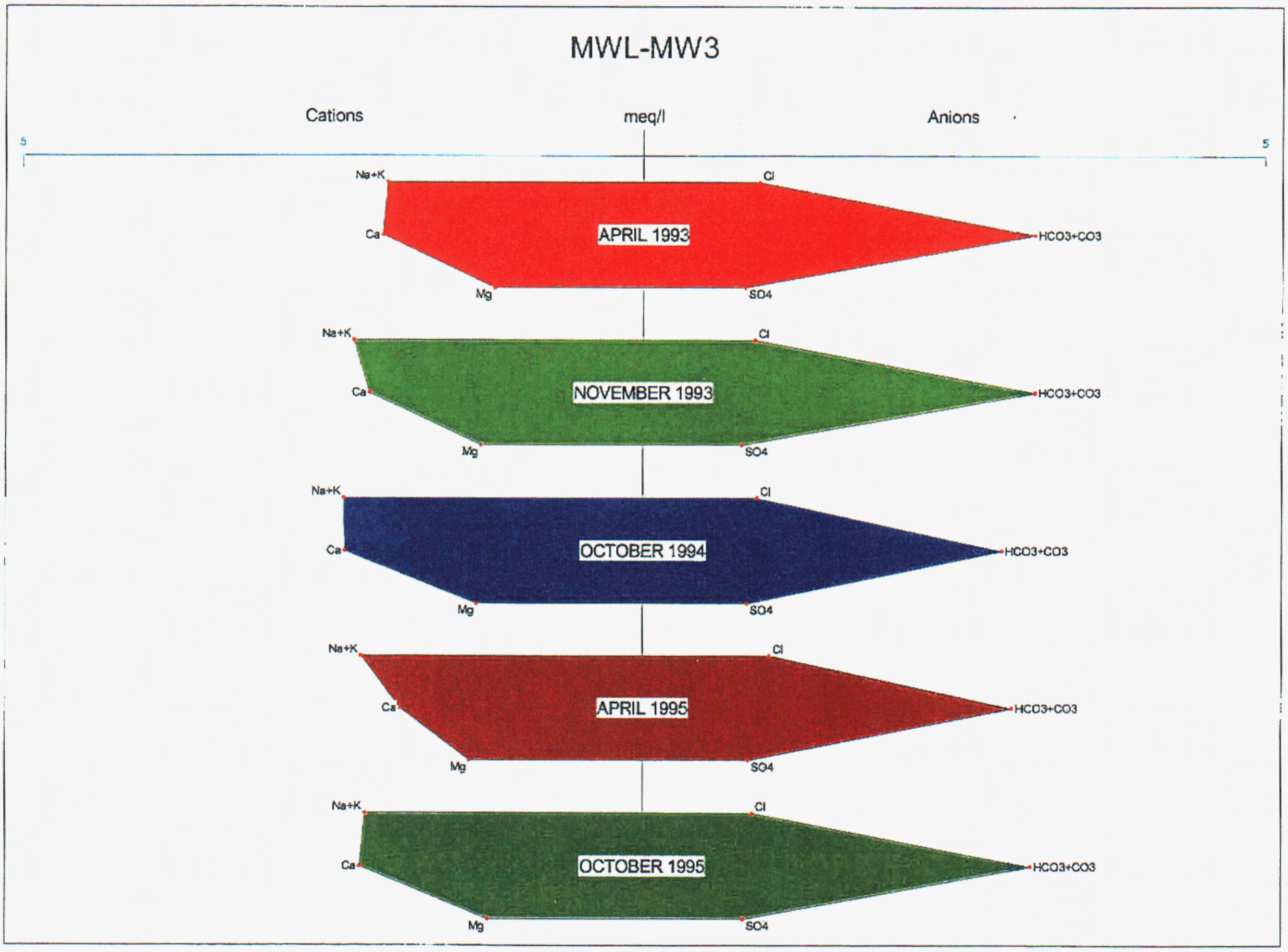


**Figure 5.4-18 Stiff Diagrams of Major Ion Chemistry for MW-3
1993 through 1995**

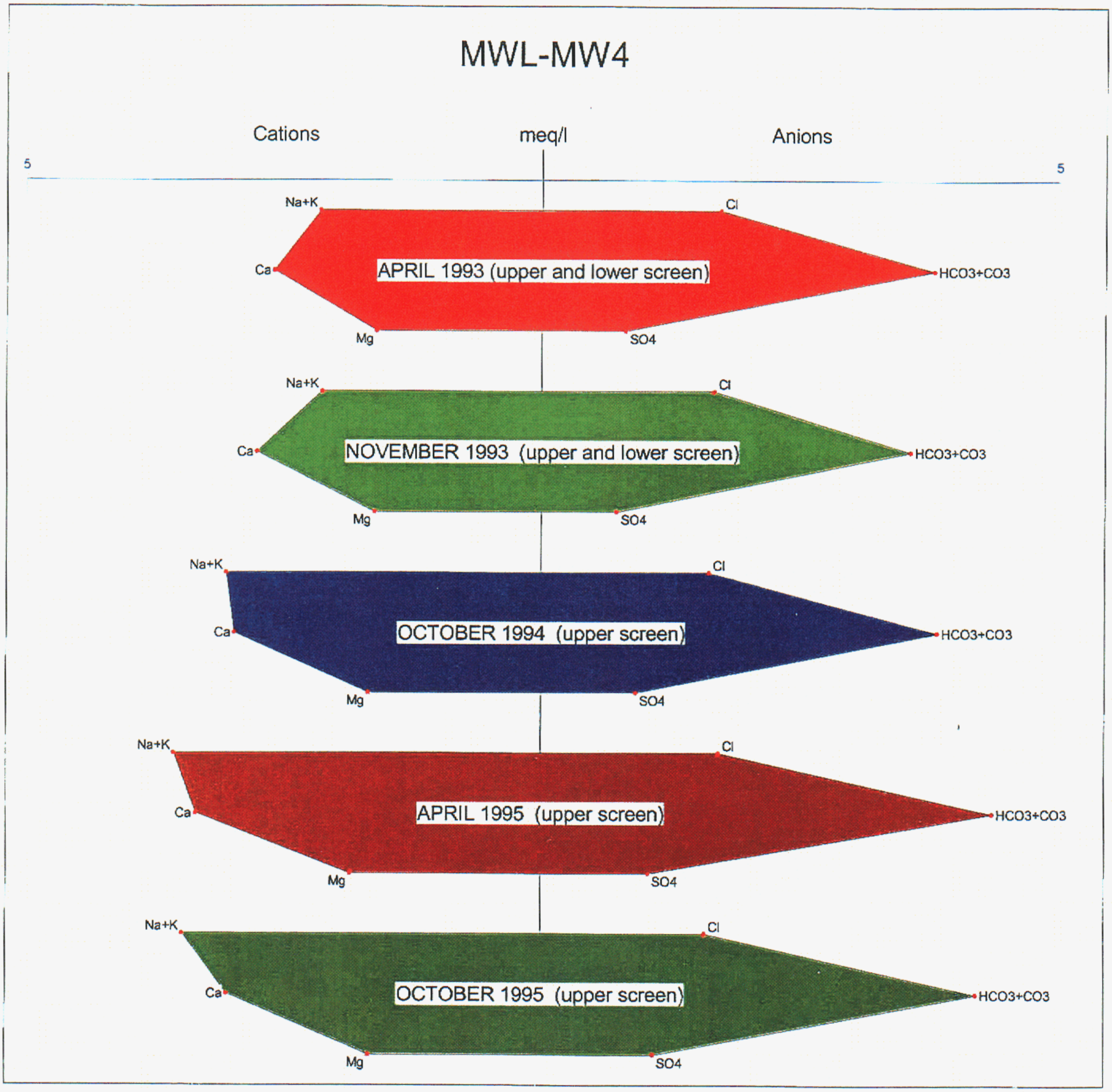


Figure 5.4-19 Stiff Diagrams of Major Ion Chemistry for MW-4 1993 through 1995

Figure 5.4-20 Stiff Diagrams of Major Ion Chemistry for BW-1 1993 through 1995

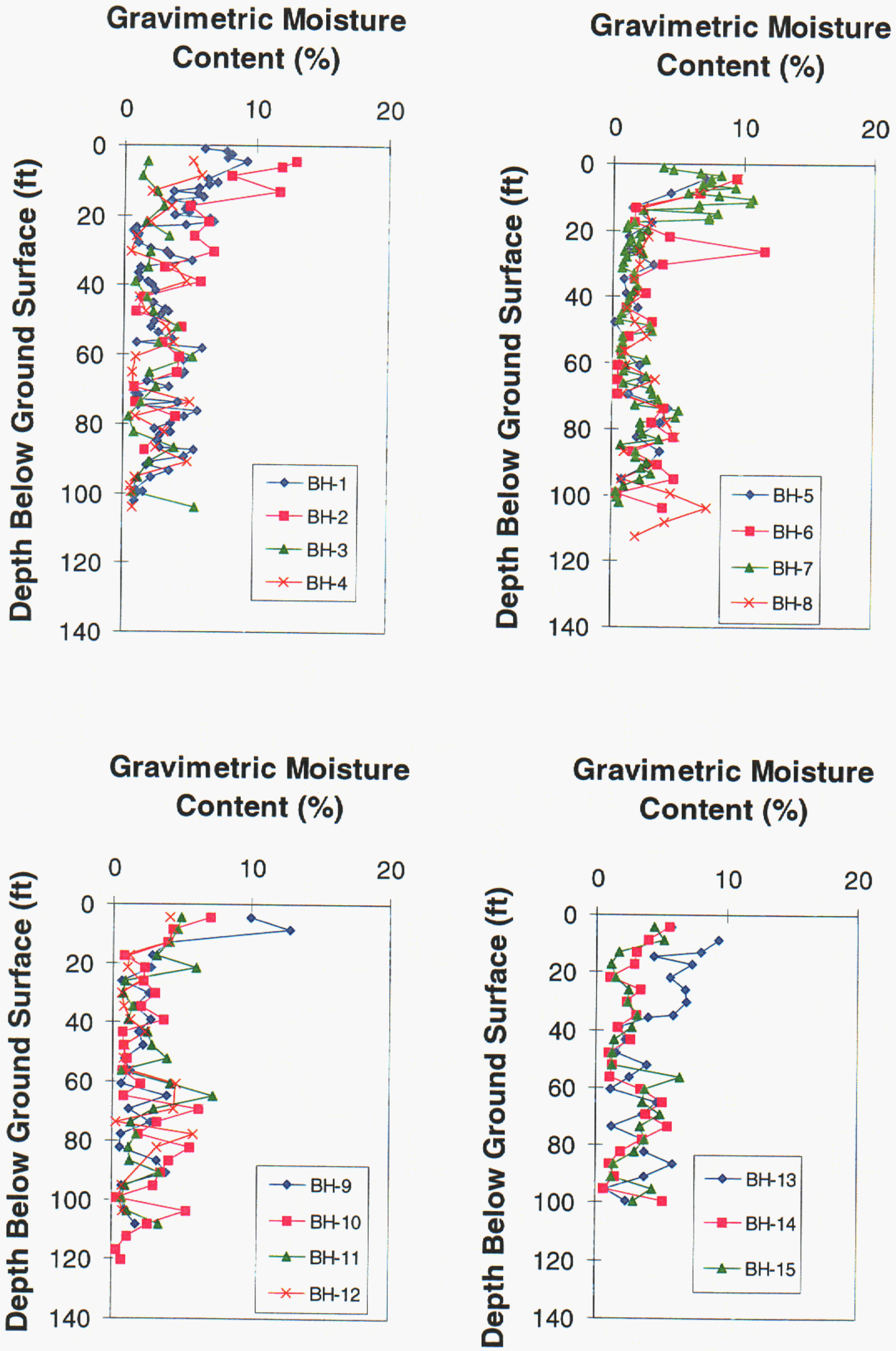


Figure 6.3-1 Gravimetric Moisture Content Profiles for MWL Borehole Soils

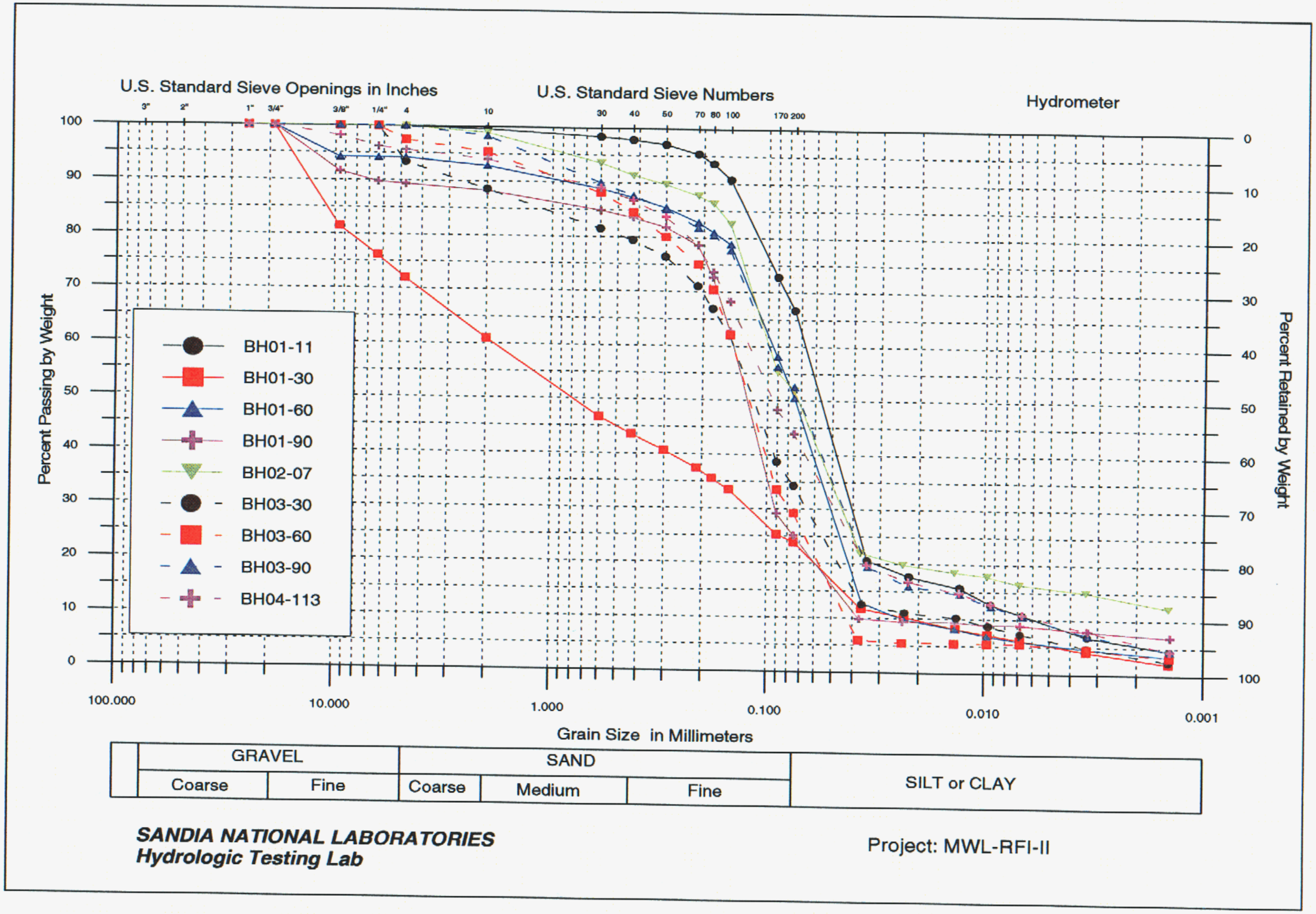


Figure 6.3-2 Particle Size Distribution of Samples Collected From BH-1, BH-2, BH-3, and BH-4

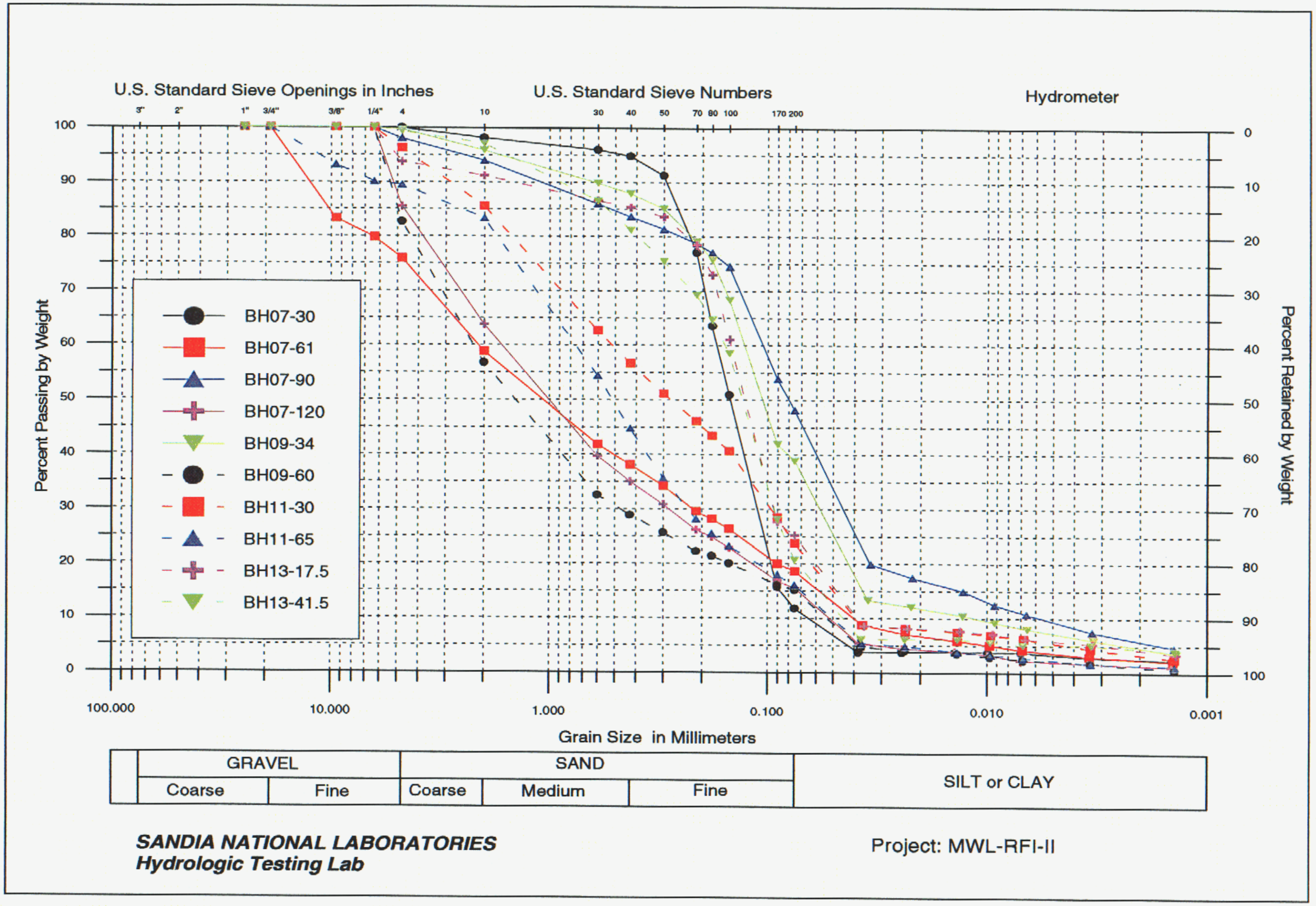


Figure 6.3-3 Particle Size Distribution of Samples Collected From BH-7, BH-9, BH-11, and BH-13

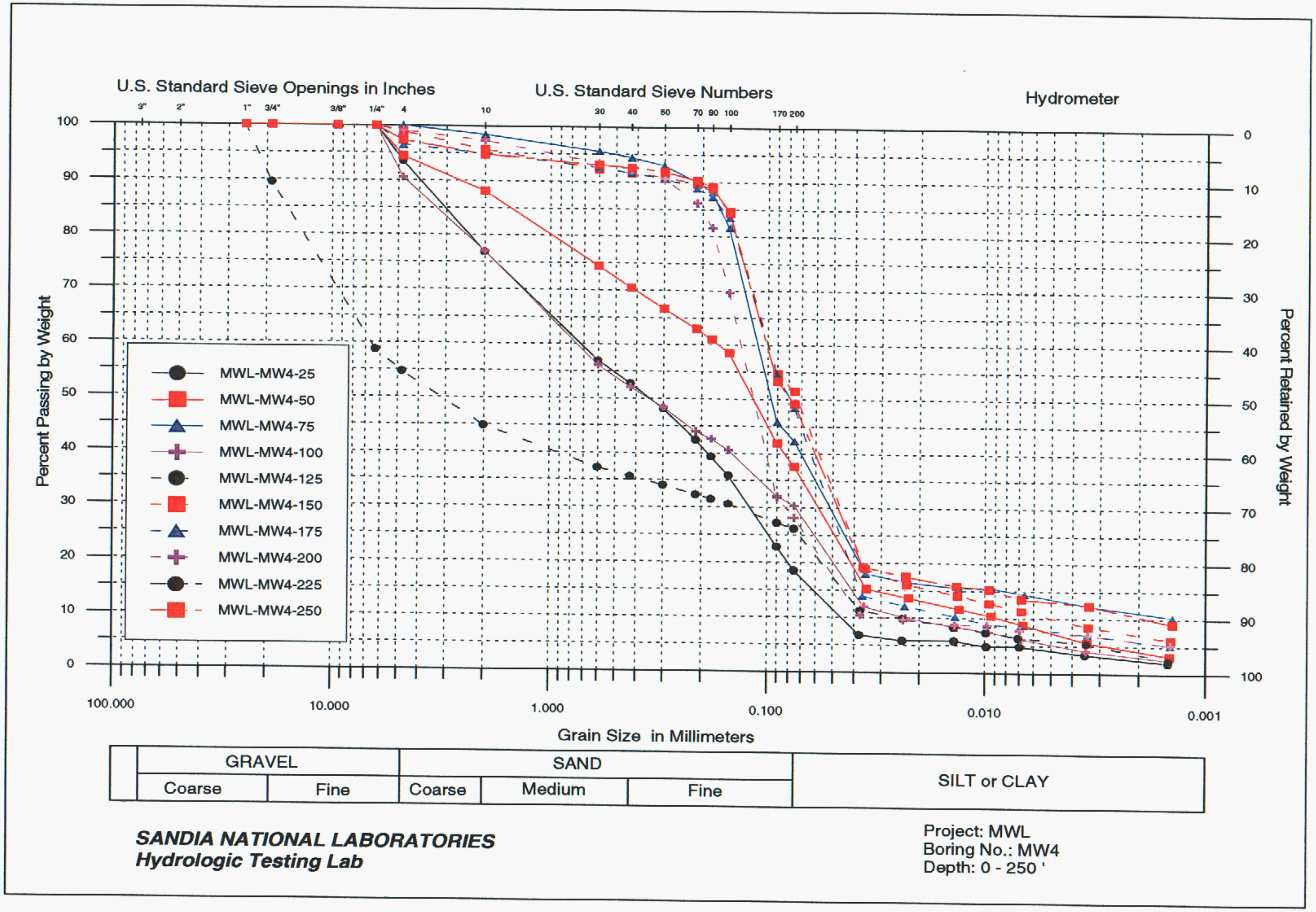
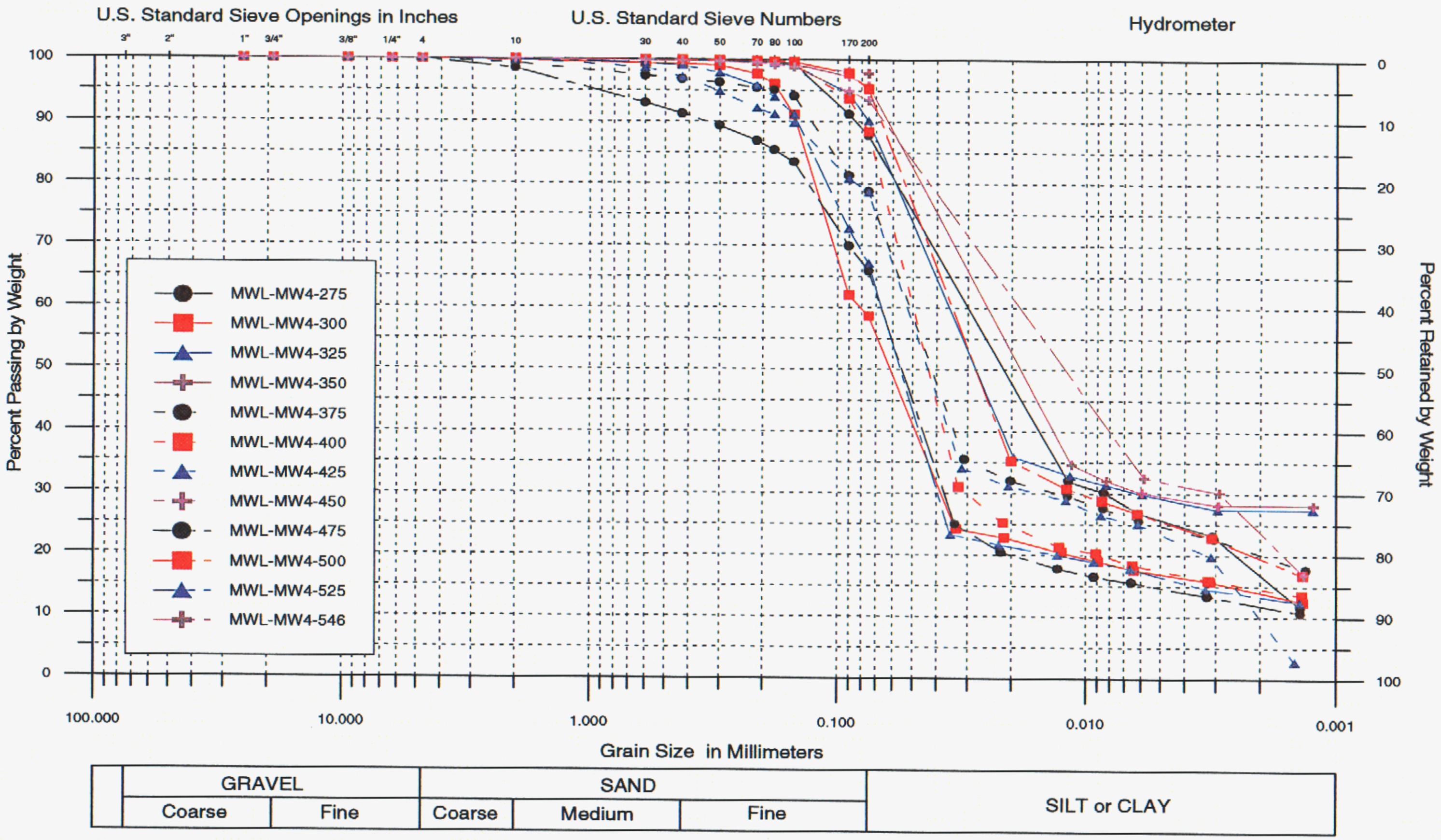


Figure 6.3-4 Particle Size Distribution From MW-4 Core Samples, 0 to 250 Feet Below Ground Surface



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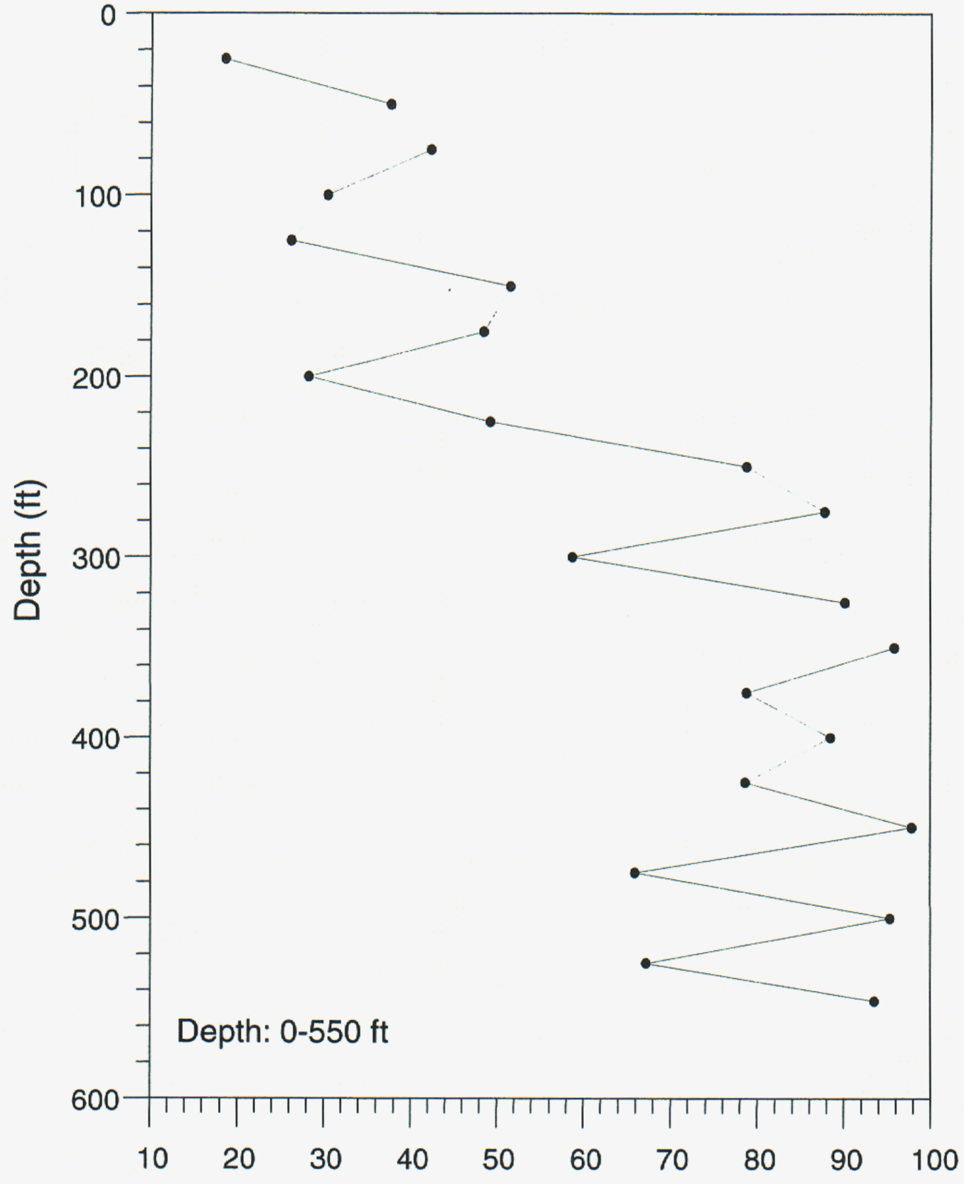
Project: MWL
Boring No.: MW4
Depth: 275 - 550 '

Figure 6.3-5 Particle Size Distribution From MW-4 Core Samples, 250 to 550 Feet Below Ground Surface



SANDIA NATIONAL
Hydrologic Testing

Figure 6.3-6 Relationship Between the Percent Silt and Clay and MW-4 Sample Depth

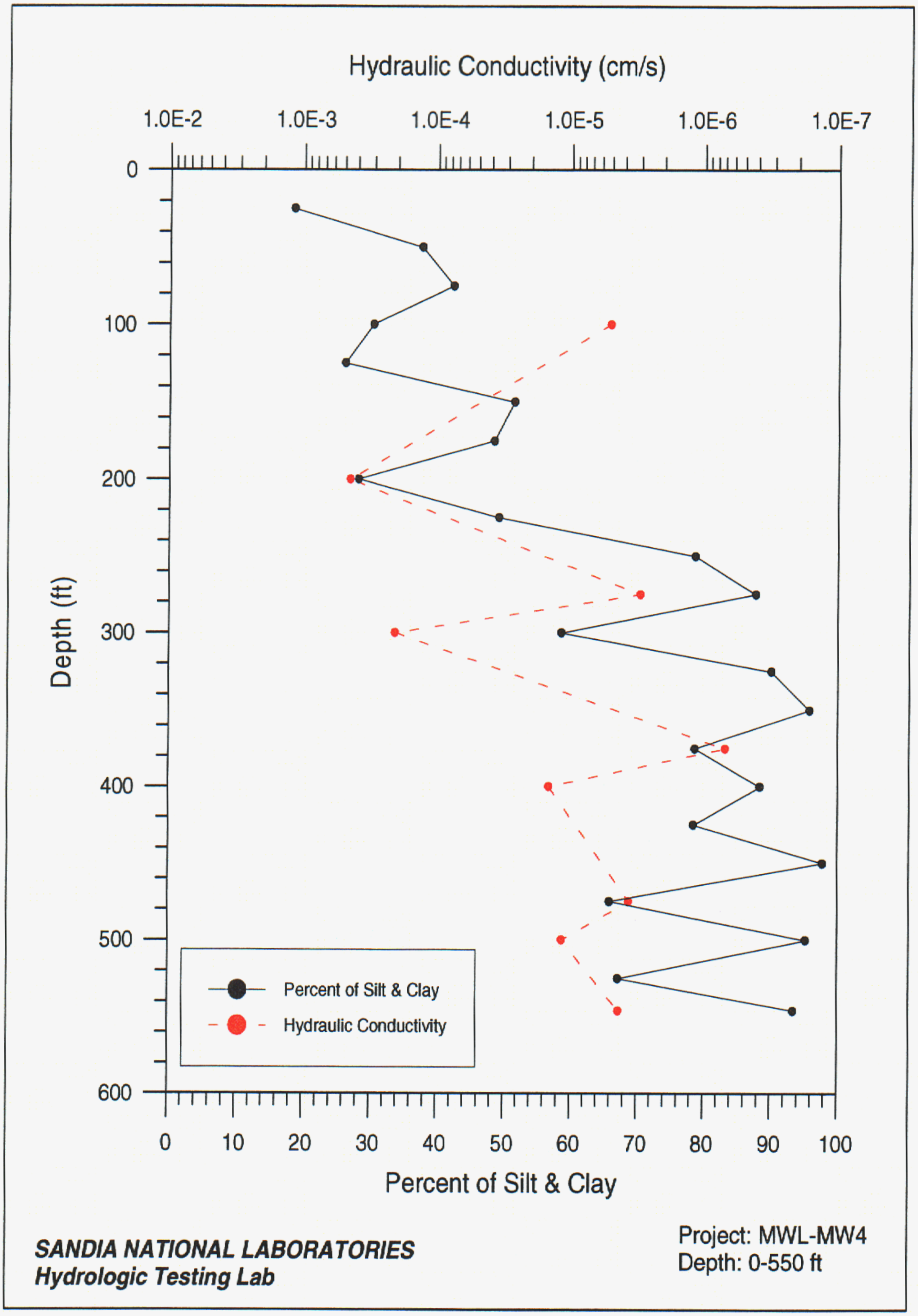


Figure 6.3-7 Relationship Between the Saturated Hydraulic Conductivity and the Percent Silt and Clay in MWL Core Samples

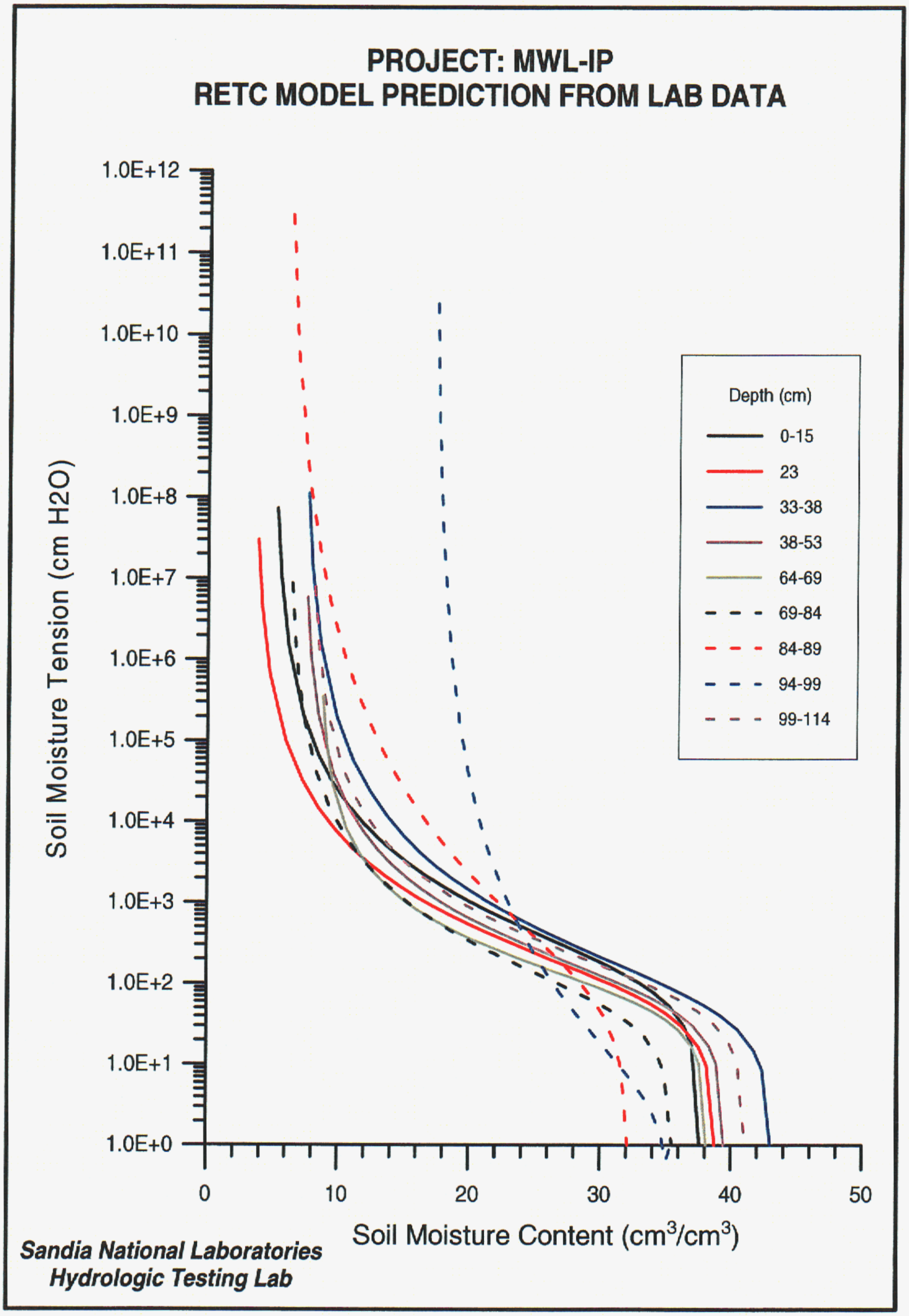


Figure 6.3-8 Soil Moisture Characteristic Curves for Core Samples From the Upper 4 Feet of the IP Test Plot

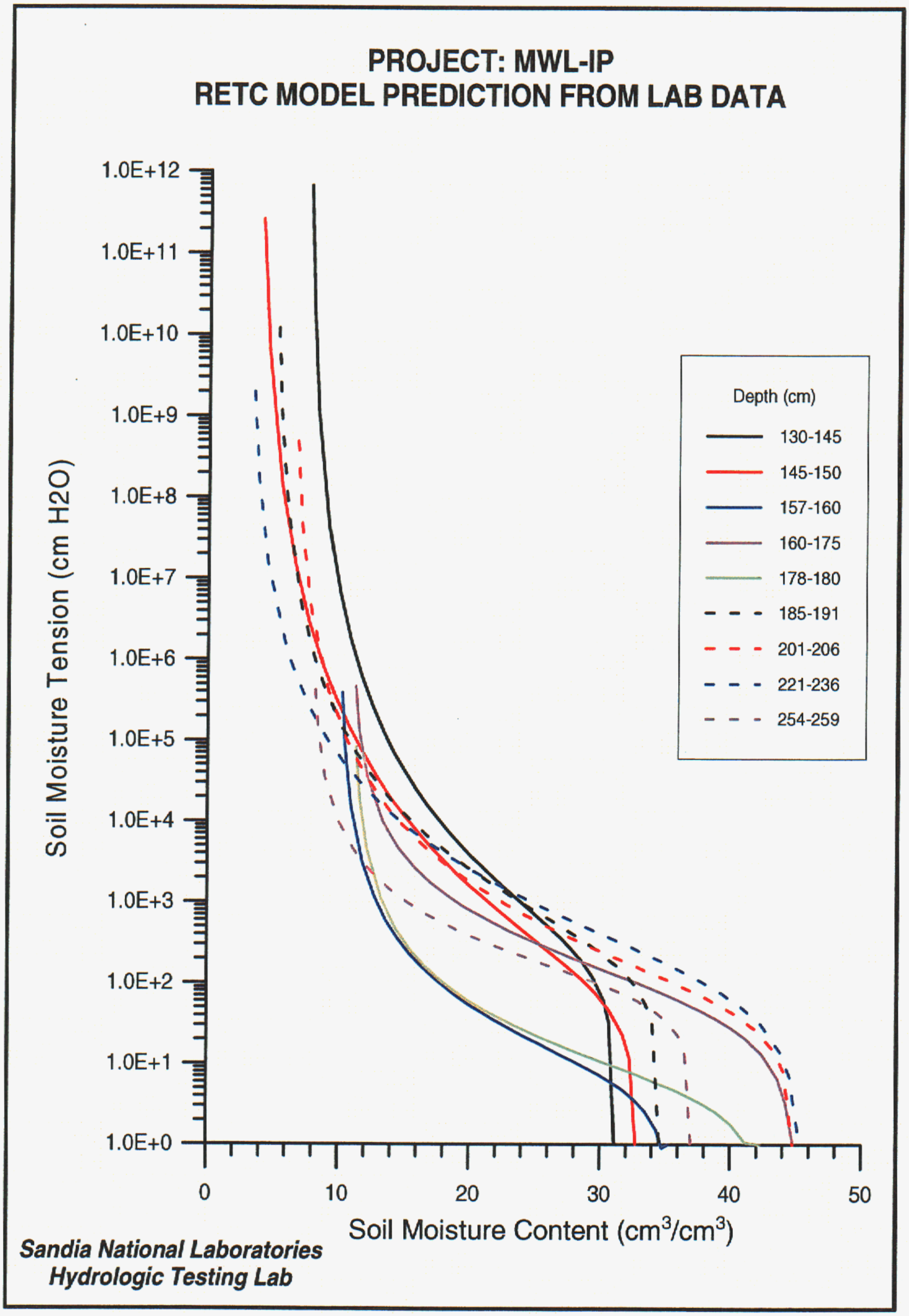


Figure 6.3-9 Soil Moisture Characteristic Curves for Core Samples From the Lower 4 Feet of the IP Test Plot

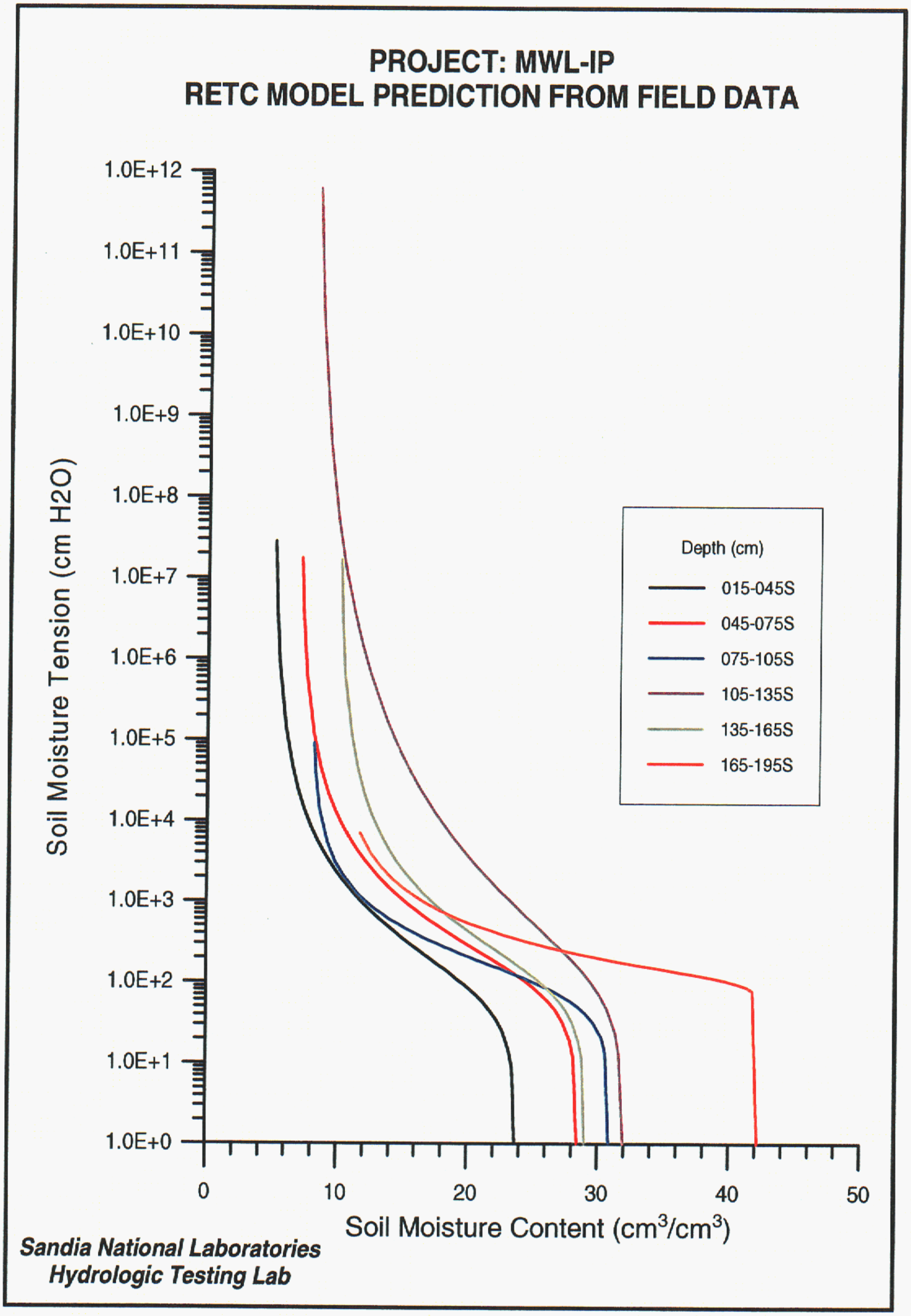


Figure 6.3-10 Field-Measured Moisture Characteristic Curves From the IP Test Plot

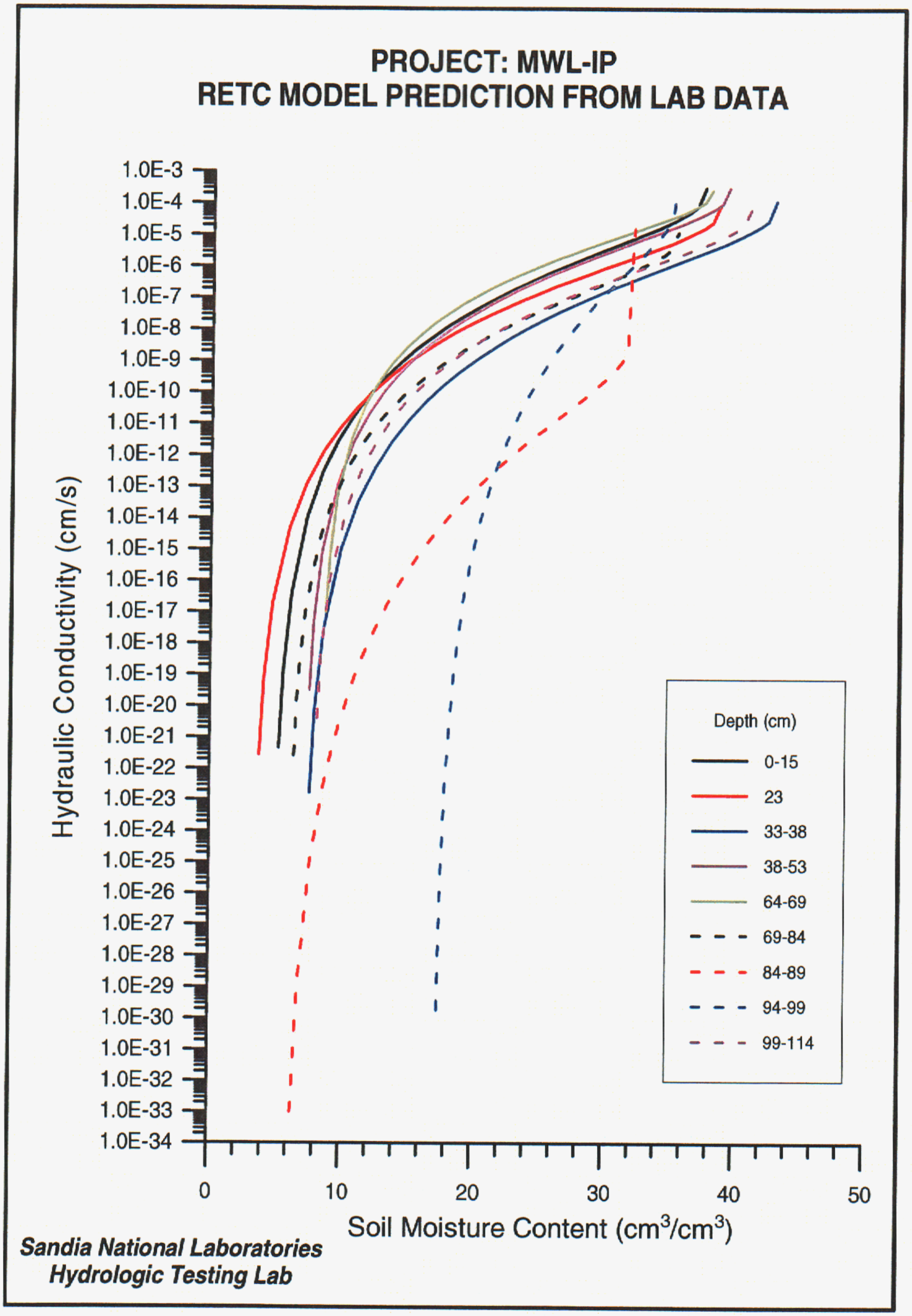


Figure 6.3-11 Hydraulic Conductivity as a Function of Volumetric Moisture Content for Core Samples From the Upper 4 Feet of the IP Test Plot

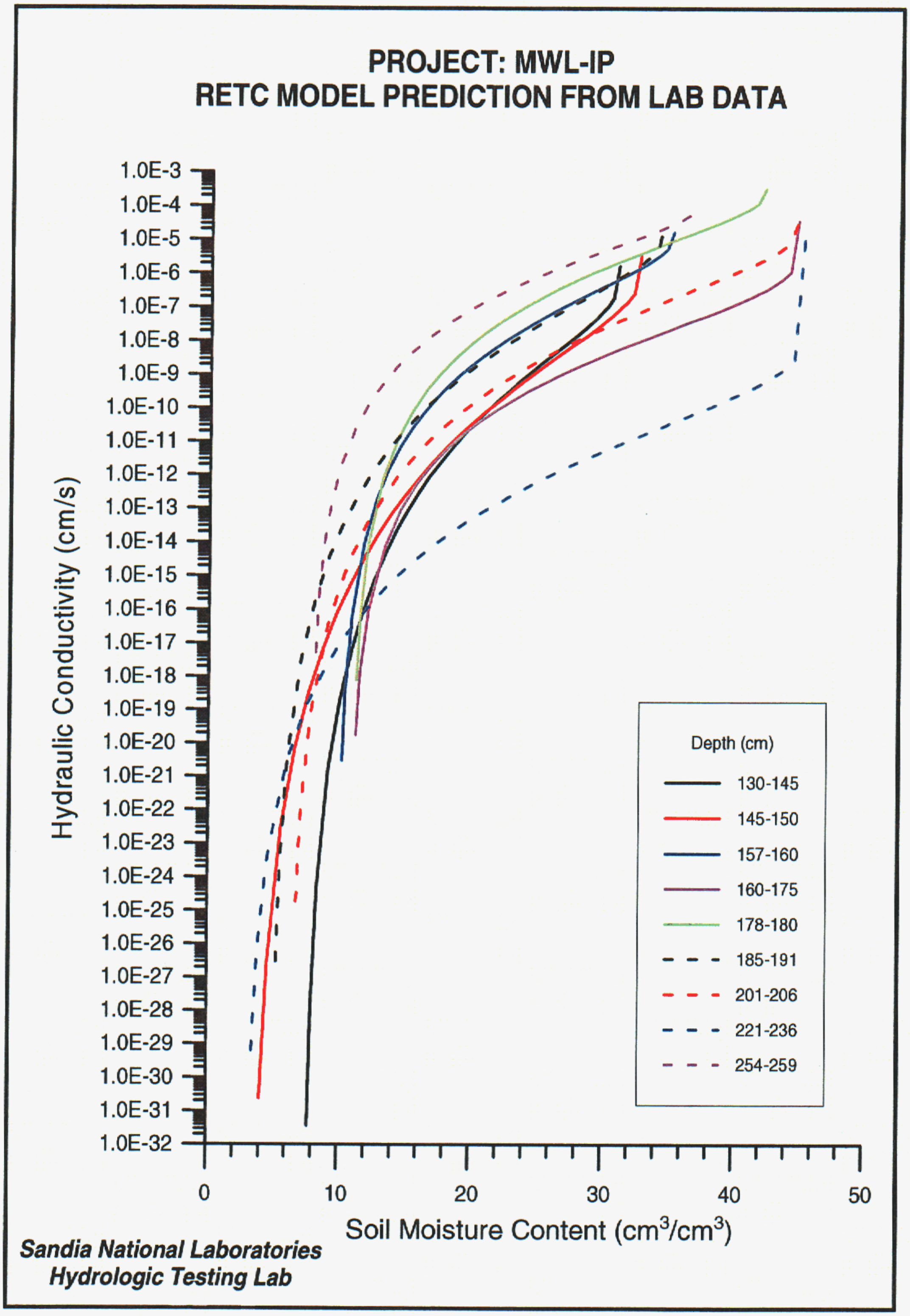


Figure 6.3-12 Hydraulic Conductivity as a Function of Volumetric Moisture Content for Core Samples From the Lower 4 Feet of the IP Test Plot

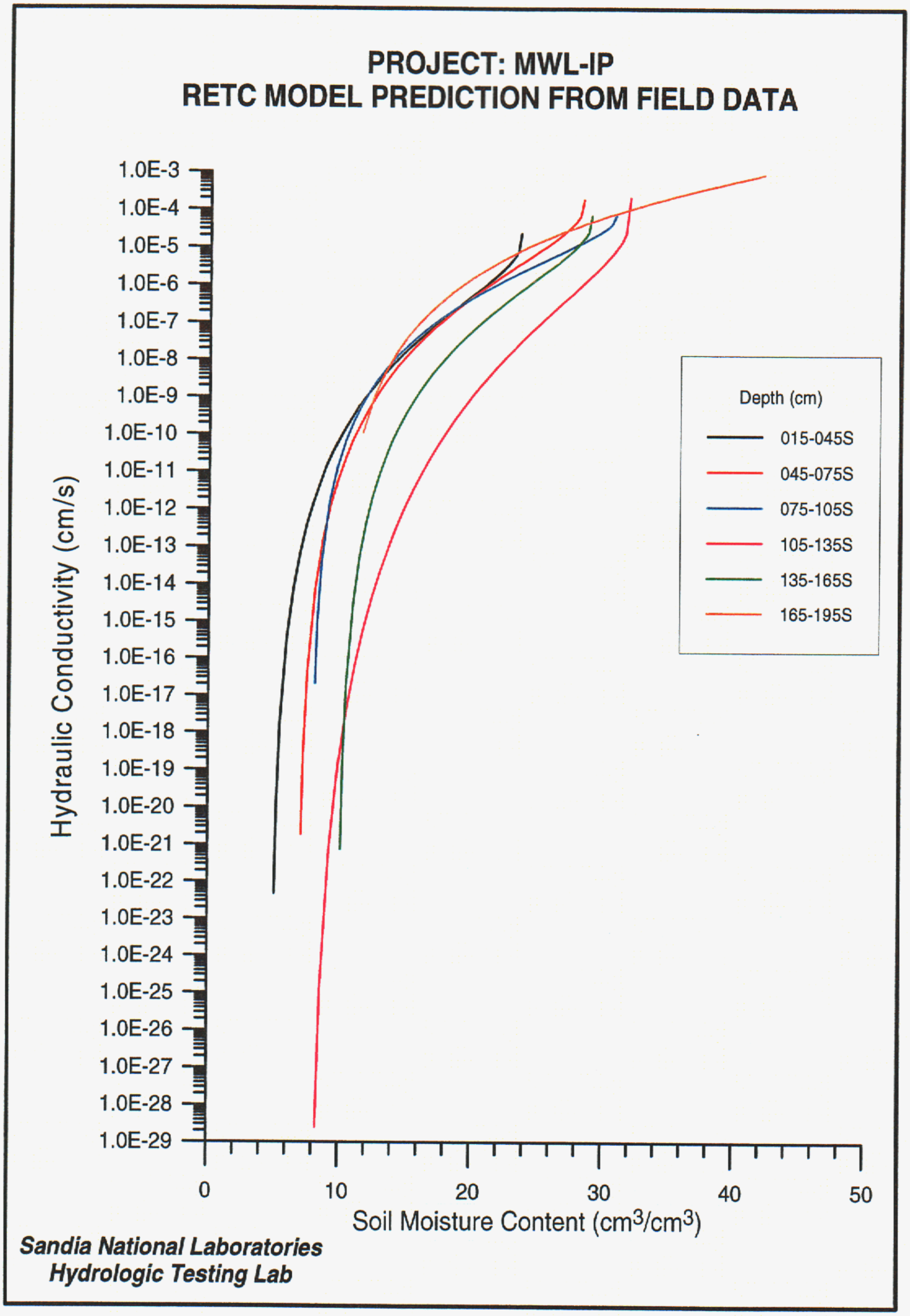


Figure 6.3-13 Field-Measured Hydraulic Conductivity as a Function of Volumetric Moisture Content

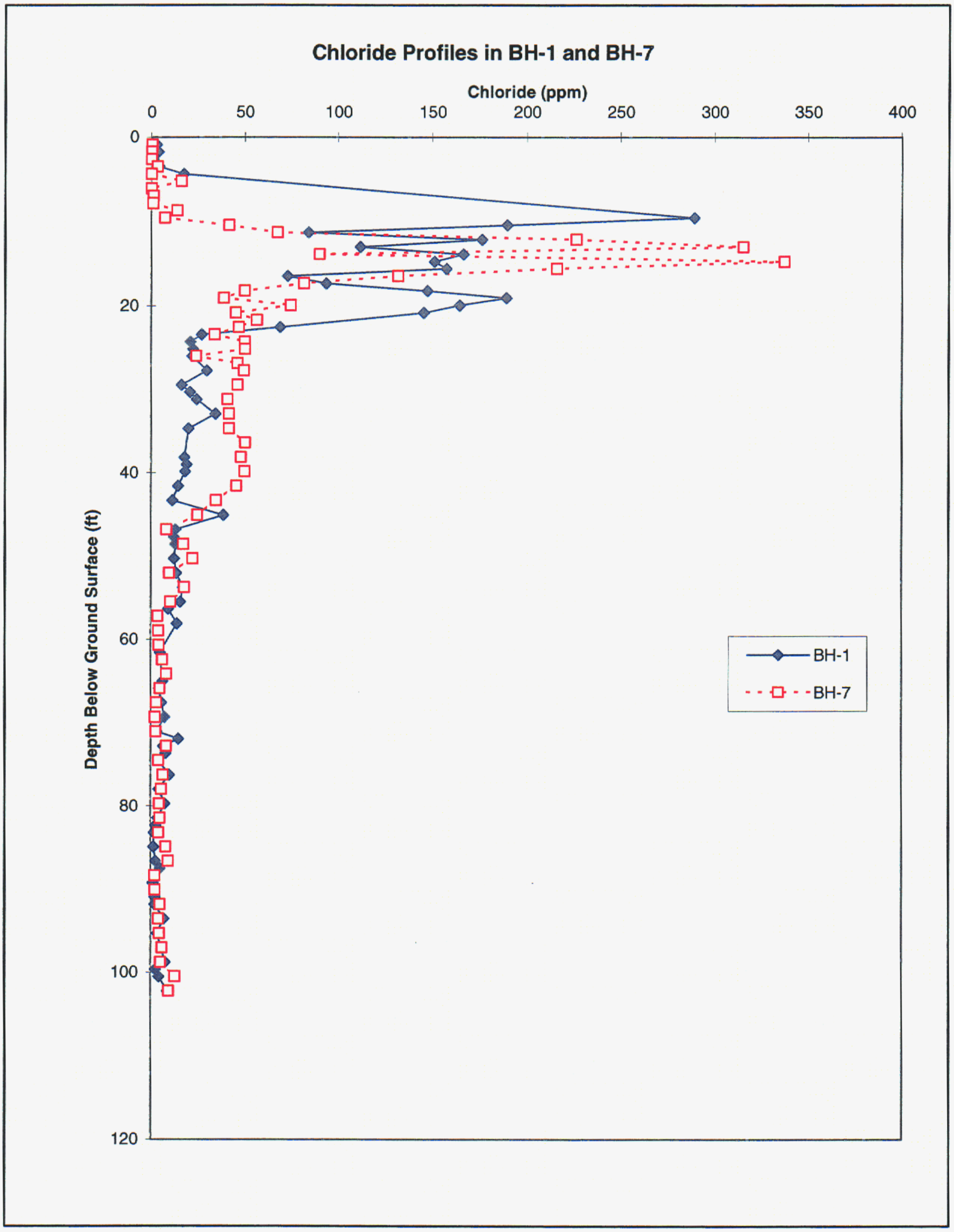


Figure 6.4-1 Chloride Profiles with Depth in BH-1 and BH-7

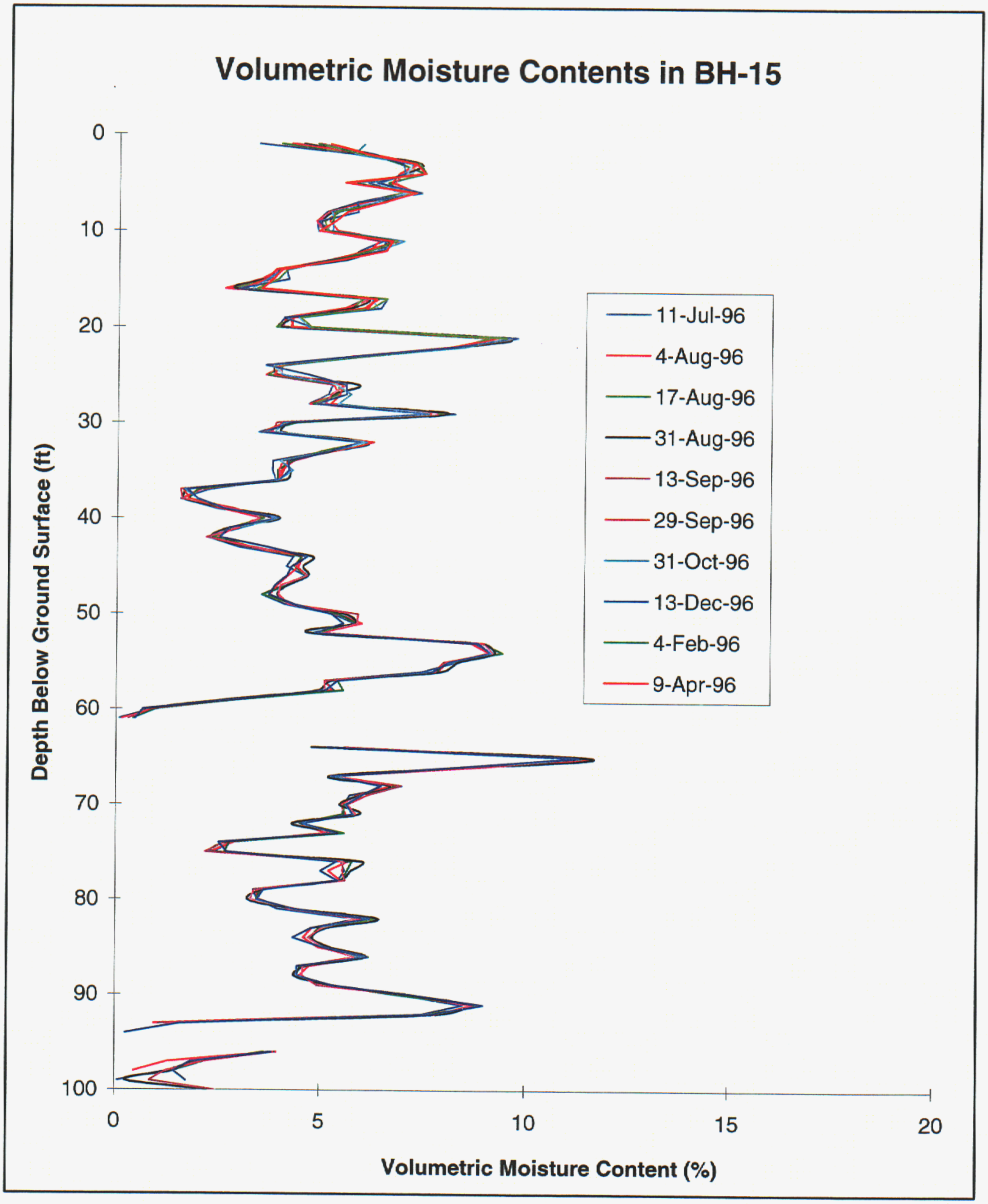


Figure 6.5-1 Soil Moisture Profiles in the Upper 100 Feet of BH-15, July 1995 to April 1996

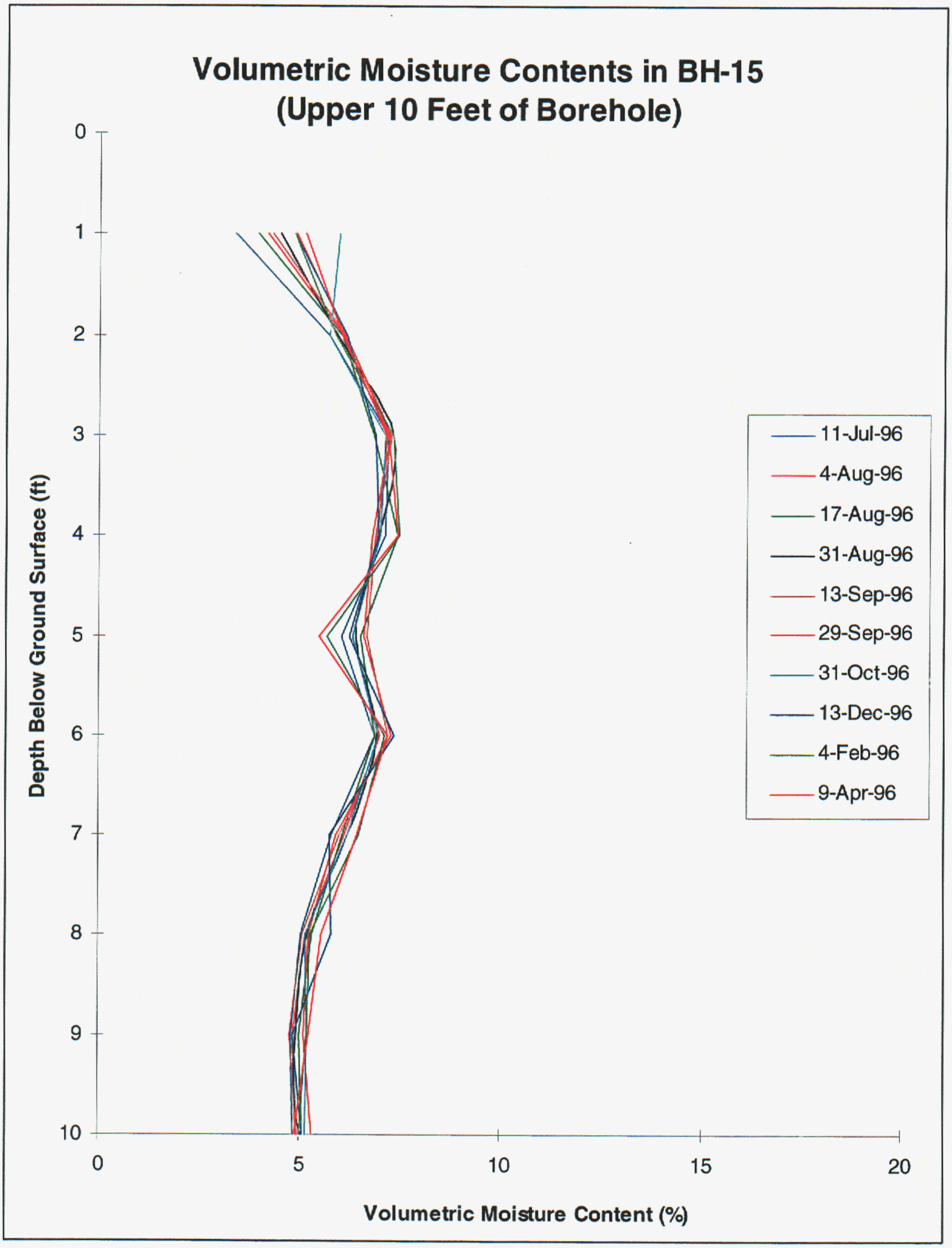


Figure 6.5-2 Soil Moisture Profiles in the Upper 10 Feet of BH-15, July 1995 to April 1996

Table 3.1-1
SNL/NM Environmental Restoration Project Operating Procedures Applicable to the MWL Phase 2 Resource Conservation and Recovery Act Facility Investigation

OP Number	Title
AOP 94-40	ER Project Site Posting and Security
FOP 94-01	Safety Meetings, Inspections, and Pre-Entry Briefings
FOP 94-05	Borehole Lithologic Logging
FOP 94-21	Shallow Soil Gas Sampling
FOP 94-22	Deep Soil Gas Sampling
FOP 94-23	Hand Auger and Thin-Wall Tube Sampler
FOP 94-25	Documentation of Field Activities
FOP 94-26	General Equipment Decontamination
FOP 94-27	Thin-Walled Tube Sampling of Soils
FOP 94-28	Health and Safety Monitoring of Organic Vapors (Flame Ionization Detector and Photoionization Detector)
FOP 94-34	Field Sample Management and Custody
FOP 94-38	Drilling Methods and Drill Site Management
FOP 94-52	Spade and Scoop Method for Collection of Soil Samples
FOP 94-57	Decontaminating Drilling and Other Field Equipment
FOP 94-68	Field Change Control
FOP 94-69	Personnel Decontamination (Level D, C & B Protection)
FOP 94-71	Land Surveying
FOP 94-78	Environmental Restoration Project Waste Management and Characterization Procedure
FOP 94-81	Establishment and Management of Less-Than-90-Day Accumulation Areas for Environmental Restoration Project Sites
FOP 95-23	Shallow Subsurface Drilling and Soil Sampling Using Hydraulic Augers or the Geoprobe® Soil Core Sampler

AOP	administrative operating procedure
ER	Environmental Restoration
FOP	field operating procedure
MWL	Mixed Waste Landfill
SNL/NM	Sandia National Laboratories/New Mexico

Table 3.4-1
MWL Background Soil Samples, a Priori Sampling

Analyte	Maximum Value	Next Maximum	X Factor	Result
Aluminum	6570 mg/kg	6300 mg/kg	1.04	Pass
Antimony	6.6 mg/kg	4.8 mg/kg	1.38	Pass
Arsenic	4.1 mg/kg	3.7 mg/kg	1.11	Pass
Barium	363 mg/kg	213 mg/kg	1.70	Pass
Beryllium	0.8 mg/kg	0.77 mg/kg	1.04	Pass
Cadmium	0.95 mg/kg	0.87 mg/kg	1.09	Pass
Calcium	70600 mg/kg	55800 mg/kg	1.27	Pass
Chromium	8.1 mg/kg	7.9 mg/kg	1.03	Pass
Cobalt	4.7 mg/kg	4.6 mg/kg	1.02	Pass
Copper	7.5 mg/kg	7.1 mg/kg	1.06	Pass
Iron	10900 mg/kg	10600 mg/kg	1.03	Pass
Lead	7.0 mg/kg	6.7 mg/kg	1.04	Pass
Magnesium	4330 mg/kg	4010 mg/kg	1.08	Pass
Manganese	224 mg/kg	209 mg/kg	1.07	Pass
Mercury	ND	ND	NA	NA
Nickel	8.3 mg/kg	8.1 mg/kg	1.02	Pass
Potassium	1370 mg/kg	1330 mg/kg	1.03	Pass
Selenium	ND	ND	NA	NA
Silver	ND	ND	NA	NA
Sodium	537 mg/kg	489 mg/kg	1.10	Pass
Thallium	ND	ND	NA	NA
Vanadium	20.8 mg/kg	20.6 mg/kg	1.01	Pass
Zinc	26.2 mg/kg	26.2 mg/kg	1.00	Pass
Gross Alpha	22 pCi/g	20 pCi/g	1.1	Pass
Gross Beta	28 pCi/g	26 pCi/g	1.08	Pass
Plutonium-238	0.044 pCi/g	0.042 pCi/g	1.05	Pass
Plutonium-239/240	0.044 pCi/g	0.043 pCi/g	1.02	Pass
Strontium-90	1.9 pCi/g	0.6 pCi/g	3.17	Fail
Strontium-90	0.6 pCi/g	0.55 pCi/g	1.09	Pass
Thorium-230	0.78 pCi/g	0.76 pCi/g	1.03	Pass
Thorium-232	1.0 pCi/g	0.91 pCi/g	1.10	Pass
Uranium-233/234	0.82 pCi/g	0.79 pCi/g	1.04	Pass
Uranium-235	0.052 pCi/g	0.042 pCi/g	1.24	Pass
Uranium-238	0.76 pCi/g	0.74 pCi/g	1.03	Pass
Tritium	0.042 pCi/g	0.034 pCi/g	1.24	Pass

mg/kg	milligram per kilogram
MWL	Mixed Waste Landfill
NA	not applicable
ND	not detected
pCi/g	picocuries per gram

$$\text{X Factor} = \frac{\text{maximum value}}{\text{next maximum value}}$$

Table 3.4-2
MWL Distribution Analysis Results

Parameter	Probability Plot	Histogram	Coefficient of Skewness[a]	Shapiro-Wilk[b]	Distribution Type
Aluminum	Normal	Normal	-0.39	0.933	Normal
Antimony	NA	NA	NA	NA	Nonparametric[c]
Arsenic	Normal	Normal	-0.12	0.98	Normal
Barium	Lognormal	Lognormal	1.19	0.90	Lognormal
Beryllium	Lognormal	Lognormal	0.55	0.92	Lognormal
Cadmium	NA	NA	NA	NA	Nonparametric[c]
Calcium	Lognormal	Lognormal	-0.14	0.99	Lognormal
Chromium	Normal	Normal	0.10	0.98	Normal
Cobalt	Lognormal	Lognormal	-0.19	0.94	Lognormal
Copper	Lognormal	Lognormal	-0.21	0.97	Lognormal
Iron	Lognormal	Lognormal	0.21	0.97	Lognormal
Lead	Lognormal	Lognormal	0.43	0.95	Lognormal
Magnesium	Normal	Normal	-0.07	0.97	Normal
Manganese	Lognormal	Lognormal	-0.01	0.98	Lognormal
Mercury	NA	NA	NA	NA	NA[d]
Nickel	Normal	Normal	-0.13	0.98	Normal
Potassium	Lognormal	Lognormal	-0.004	0.98	Lognormal
Selenium	NA	NA	NA	NA	NA[d]
Silver	NA	NA	NA	NA	NA[d]
Sodium	NA	NA	NA	NA	Nonparametric[c]
Thallium	NA	NA	NA	NA	NA[d]
Vanadium	Lognormal	Lognormal	0.26	0.91	Lognormal
Zinc	Lognormal	Lognormal	0.30	0.97	Lognormal
Gross Alpha	Lognormal	Lognormal	0.17	0.95	Lognormal
Gross Beta	Normal	Normal	-0.10	0.97	Normal
Plutonium-238	NA	NA	NA	NA	NA[d]
Plutonium-239/240	NA	NA	NA	NA	NA[d]
Uranium-233/234	Lognormal	Lognormal	0.09	0.96	Lognormal
Uranium-235	Lognormal	Lognormal	0.40	0.98	Lognormal
Uranium-238	Normal	Normal	-0.17	0.98	Normal
Thorium-230	Lognormal	Lognormal	-0.006	0.95	Lognormal
Thorium-232	Lognormal	Lognormal	0.28	0.98	Lognormal
Strontium-90	NA	NA	NA	NA	NA[d]
Tritium	Lognormal	Lognormal	-0.35	0.98	Lognormal

[a] Critical value for Coefficient of Skewness: -1 to 1.

[b] Critical value for Shapiro-Wilk was 0.911 for all parameters except barium, which had a critical value of 0.908.

[c] Distribution type is nonparametric because percentage of nondetects is greater than 15%.

[d] All analytical results were nondetect, therefore no statistics were performed.

MWL Mixed Waste Landfill
NA not applicable

Table 3.4-3
MWL T_n Statistic Analysis

Analyte	Distribution	Observation (mg/kg)	Mean (mg/kg)	Standard Deviation (mg/kg)	T_n Statistic	Number of Samples	Upper 5%	Pass or Fail T_n Statistic
Aluminum	Normal	6570	5432	789	1.44	22	2.60	Pass
Antimony	Nonparametric	NA	NA	NA	NA	22	2.60	NA
Arsenic	Normal	4.1	2.71	0.74	1.88	22	2.60	Pass
Barium	Lognormal[a]	5.89	4.82	0.37	2.87	22	2.60	Fail
Barium	Lognormal[a]	5.36	4.77	0.29	2.01	21	2.58	Pass
Beryllium	Lognormal[a]	-0.22	-0.67	0.20	2.20	22	2.60	Pass
Cadmium	Nonparametric	NA	NA	NA	NA	22	2.60	NA
Calcium	Lognormal[a]	11.16	10.53	0.30	2.11	22	2.60	Pass
Chromium	Normal	8.1	6.03	1.13	1.82	22	2.60	Pass
Cobalt	Lognormal[a]	1.55	1.23	0.16	1.99	22	2.60	Pass
Copper	Lognormal[a]	2.01	1.62	0.22	1.74	22	2.60	Pass
Iron	Lognormal[a]	9.30	8.94	0.19	1.92	22	2.60	Pass
Lead	Lognormal[a]	1.95	1.64	0.16	1.93	22	2.60	Pass
Magnesium	Normal	4330	3284	597	1.75	22	2.60	Pass
Manganese	Lognormal[a]	5.41	4.92	0.27	1.80	22	2.60	Pass
Mercury	NA	NA	NA	NA	NA	22	2.60	NA
Nickel	Normal	8.3	6.00	1.21	1.89	22	2.60	Pass
Potassium	Lognormal[a]	7.22	6.92	0.16	1.89	22	2.60	Pass
Selenium	Nonparametric	NA	NA	NA	NA	22	2.60	NA
Silver	NA	NA	NA	NA	NA	22	2.60	NA
Sodium	Nonparametric	NA	NA	NA	NA	22	2.60	NA
Thallium	NA	NA	NA	NA	NA	22	2.60	NA
Vanadium	Lognormal[a]	3.03	2.69	0.21	1.66	22	2.60	Pass
Zinc	Lognormal[a]	3.27	2.94	0.18	1.85	22	2.60	Pass

Refer to footnotes at end of table.

Table 3.4-3 (Concluded)
MWL T_n Statistic Analysis

Analyte	Distribution	Observation (pCi/g)	Mean (pCi/g)	Standard Deviation (pCi/g)	T_n Statistic	Number of Samples	Upper 5%	Pass or Fail T_n Statistic
Gross Alpha	Lognormal[a]	3.09	2.43	0.36	1.84	22	2.60	Pass
Gross Beta	Normal	28	20.91	3.65	1.94	22	2.60	Pass
Plutonium-238	NA	NA	NA	NA	NA	22	2.60	NA
Plutonium-239/240	NA	NA	NA	NA	NA	22	2.60	NA
Strontium-90	NA	NA	NA	NA	NA	22	2.60	NA
Thorium-230	Lognormal[a]	-0.25	-0.51	0.16	1.60	22	2.60	Pass
Thorium-232	Lognormal[a]	0	-0.37	0.16	2.28	22	2.60	Pass
Uranium-233/234	Lognormal[a]	-0.20	-0.45	0.15	1.76	22	2.60	Pass
Uranium-235	Lognormal[a]	-2.96	-3.83	0.38	2.29	22	2.60	Pass
Uranium-238	Normal	0.76	0.61	0.08	1.77	22	2.60	Pass
Tritium[b]	Lognormal[a]	-3.17	-4.22	0.57	1.83	22	2.60	Pass

[a] Observation, mean, and standard deviation are lognormally transformed.

[b] Site-specific background data for tritium used to calculate the UTL is provided in Table 4.6-9.

mg/kg	milligrams per kilogram
MWL	Mixed Waste Landfill
NA	not applicable
pCi/g	picocuries/gram
UTL	upper tolerance limit

Table 3.4-4
MWL Soil Upper Tolerance Limits

Analyte	Distribution	Censored	Log mean (mg/kg)	Log Standard Deviation (mg/kg)	Mean (mg/kg)	Standard Deviation (mg/kg)	One-sided Tolerance Factor (K)	Log UTL (mg/kg)	95th UTL/ 95th %[a] (mg/kg)	Number of Samples
Aluminum	Normal	No	NA	NA	5432	789	2.35	NA	7287	22
Antimony	Nonparametric	No	NA	NA	NA	NA	NA	NA	4.8	22
Arsenic	Normal	No	NA	NA	2.71	0.74	2.35	NA	4.45	22
Barium	Lognormal	Yes	4.77	0.29	NA	NA	2.35	5.46	235	22
Beryllium	Lognormal	No	-0.67	0.20	NA	NA	2.35	-0.19	0.82	22
Cadmium	Nonparametric	No	NA	NA	NA	NA	NA	NA	0.87	22
Calcium	Lognormal	No	10.53	0.30	NA	NA	2.35	11.24	75830	22
Chromium	Normal	No	NA	NA	6.03	1.13	2.35	NA	8.7	22
Cobalt	Lognormal	No	1.23	0.16	NA	NA	2.35	1.61	4.98	22
Copper	Lognormal	No	1.62	0.22	NA	NA	2.35	2.15	8.61	22
Iron	Lognormal	No	8.94	0.19	NA	NA	2.35	9.38	11812	22
Lead	Lognormal	No	1.64	0.16	NA	NA	2.35	2.01	7.48	22
Magnesium	Normal	No	NA	NA	3284	597	2.35	NA	4687	22
Manganese	Lognormal	No	4.92	0.27	NA	NA	2.35	5.56	260	22
Mercury	NA	No	NA	NA	NA	NA	NA	NA	<0.1	22
Nickel	Normal	No	NA	NA	6.0	1.21	2.35.	NA	8.86	22
Potassium	Lognormal	No	6.92	0.16	NA	NA	2.35	7.30	1473	22
Selenium	NA	No	NA	NA	NA	NA	NA	NA	<1	22
Silver	NA	No	NA	NA	NA	NA	NA	NA	<1	22
Sodium	Nonparametric	No	NA	NA	NA	NA	NA	NA	489	22
Thallium	NA	No	NA	NA	NA	NA	NA	NA	<1.1	22
Vanadium	Lognormal	No	2.69	0.21	NA	NA	2.35	3.18	24.12	22
Zinc	Lognormal	No	2.94	0.18	NA	NA	2.35	3.35	28.6	22

Refer to footnotes at end of table.

Table 3.4-4 (Concluded)
MWL Soil Upper Tolerance Limits

Analyte	Distribution	Censored	Log mean (pCi/g)	Log Standard Deviation (pCi/g)	Mean (pCi/g)	Standard Deviation (pCi/g)	One-sided Tolerance Factor (K)	Log UTL (pCi/g)	95th UTL/ 95th %[a] (pCi/g)	Number of Samples
Gross Alpha	Lognormal	No	2.43	0.36	NA	NA	2.35	3.27	26.2	22
Gross Beta	Normal	No	NA	NA	20.9	3.65	2.35	NA	29.5	22
Plutonium-238	NA	No	NA	NA	NA	NA	NA	NA	0.042	22
Plutonium-239/240	NA	No	NA	NA	NA	NA	NA	NA	0.043	22
Strontium-90	NA	No	NA	NA	NA	NA	NA	NA	0.55	21
Thorium-230	Lognormal	No	-0.51	0.16	NA	NA	2.35	-0.13	0.88	22
Thorium-232	Lognormal	No	-0.37	0.16	NA	NA	2.35	0.01	1.01	22
Uranium-233/234	Lognormal	No	-0.45	0.15	NA	NA	2.35	-0.11	0.89	22
Uranium-235	Lognormal	No	-3.83	0.38	NA	NA	2.35	-2.93	0.05	22
Uranium-238	Normal	No	NA	NA	0.61	0.08	2.35	NA	0.81	22
Tritium[b]	Lognormal	No	-4.22	0.57	NA	NA	2.35	-2.87	0.06	22

[a] 95th percentile used for nonparametric distributions; 95th UTL used for parametric distributions.

[b] Site-specific background data for tritium used to calculate the UTL is provided in Table 4.6-9.

mg/kg	milligrams per kilogram
MWL	Mixed Waste Landfill
NA	not applicable
pCi/g	picocuries/gram
UTL	upper tolerance limit

Table 3.4-5
Resource Conservation and Recovery Act Proposed Subpart S Action Levels

Analyte	mg/kg
Aluminum	--[a]
Antimony	30
Arsenic	20[b]
Barium	6000[b]
Beryllium	0.2
Cadmium	80[b]
Calcium	--[c]
Chromium	400
Cobalt	--[a]
Copper	--[a]
Iron	--[c]
Lead	400[d]
Magnesium	--[c]
Manganese	10,000[a, b]
Mercury	20
Nickel	2000
Potassium	--[c]
Selenium	400[b]
Silver	400[b]
Sodium	--[c]
Thallium	6[e]
Vanadium	600[a, b]
Zinc	20,000[a, b]

[a] Not listed as a RCRA constituent (40 CFR 261 Appendix VIII).

[b] Action level based on toxicity information contained in the IRIS database (EPA 1995a) or the HEAST (EPA 1995b) and an HI of 1.

[c] Metal is considered an essential nutrient as described in RAGS (Risk Assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual (EPA 1989).

[d] Action level provided in "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (EPA 1994).

[e] The IRIS database, for all thallium compounds listed, gives RFDs in the narrow range 8×10^{-5} to 9×10^{-5}. Based on the conservative value of 8×10^{-5}, an action level of 6 mg/kg was calculated.

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
IRIS	Integrated Risk Information System
mg/kg	milligrams per kilogram
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RFD	reference doses

Table 4.2-1
PM$_{10}$ Sampling Results

Species	Average Concentration[a]	Maximum Concentration[a]	Minimum Concentration[a]
MWL East Side PM$_{10}$			
PM$_{10}$	9.5	18.4	3
Beryllium[b]	ND	ND	ND
Uranium[c]	$8.0x10^{-4}$	$1.4x10^{-3}$	$2.6x10^{-4}$
Plutonium-239/240[d]	NA	$2.7x10^{-4} \pm 1.9x10^{-4}$	ND
Plutonium-238[d]	NA	$4.6x10^{-4} \pm 2.7x10^{-4}$	ND
MWL West Side PM$_{10}$			
PM$_{10}$	10.5	68.5	0.9
Beryllium[b]	ND	ND	ND
Uranium[c]	$6.9x10^{-4}$	$1.3x10^{-3}$	$2.4x10^{-4}$
Plutonium-239/240[d]	NA	$2.5x10^{-4} \pm 2.0x10^{-4}$	ND
Plutonium-238[d]	NA	$1.9x10^{-3} \pm 5.7x10^{-5}$	ND
MWL Upwind PM$_{10}$			
PM$_{10}$	9.0	19.4	3
Beryllium[b]	ND	ND	ND
Uranium[c]	$1.0x10^{-3}$	$1.4x10^{-3}$	$2.4x10^{-4}$
Plutonium-239/240[d]	NA	$2.2x10^{-4} \pm 1.6x10^{-4}$	ND
Plutonium-238[d]	NA	$1.2x10^{-4} \pm 9.2x10^{-5}$	ND

[a] All concentrations in µg/m^3 except for plutonium which is pCi/m^3.

[b] Detection limit for beryllium is 0.002 µg/m^3.

[c] Detection limit for uranium is $2.4x10^{-4}$ µg/m^3.

[d] Detection limit for Pu-238 and Pu-239/240 is $1x10^{-5}$ pCi/m^3.

MWL	Mixed Waste Landfill
ND	not detected
NA	not applicable
PM$_{10}$	particulate monitor (10 micron)
pCi/m^3	picocuries per cubic meter
µg/m^3	micrograms per cubic meter

Table 4.2-2
1992 Tritium Flux

Sampling Location	Flux (pCi/m^2/hr)[a]
1	156
2	909
3	3200
4	1970, 2020[b]
5	992, 1080[b]
6	6050, 6170[b], 6110[b], 6120[b]
7	622
8	1990
9	385
10	343, 376[b]
11	323
12	123
13	51, 57[b]
14	345
15	277

[a] Sample area equals 0.13 m^2.

[b] Replicate analytical analyses.

m^2	square meters
pCi/m^2/hr	picocuries per square meter per hour

Table 4.2-3
1993 Tritium Flux

Sampling Location	Flux (pCi/m^2/hr)
1	132
2	1580
3	210
4	1600
5	12,100
6	978
7	498
8	858
9	141,000
10	126
11	1310
12	786
13	1180
14	3810
15	4290
16	107,000
17	6870
18	9460
19	1300
20	1060
21	324
22	1610
23	166,000
24	1670
25	4250
26	1020
27	336

pCi/m^2/hr picocuries per square meter per hour

Table 4.2-4
1993 SNL/NM Radionuclide Releases

Location	Source Type	Release	Ci/yr
ACRR	Point	Ar-41	2.7
		Kr-83m	0.068
		Kr-85	3.7×10^{-6}
		Kr-85m	0.14
		Kr-87	0.17
		Kr-88	0.36
		Rb-86	1.1×10^{-7}
		Rb-87	1.0×10^{-14}
		Rb-88	0.41
		Rb-89	0.0011
		Xe-131m	5.7×10^{-6}
		Xe-133	0.026
		Xe-133m	0.0013
		Xe-135	0.40
		Xe-135m	0.18
		Xe-138	0.0019
SPR	Point	Ar-41	0.48
Hermes III	Point	N-13	0.58
		O-15	0.005
PBFA	Point	N-13	0.042
		O-15	0.005
TOF	Point	H-3	6.0×10^{-5}
Tandem Accelerator	Point	C-11	4.2×10^{-5}
		N-13	9.9×10^{-5}
		O-15	0.0017
		F-18	9.4×10^{-6}
Radiation Lab	Point	H-3	1.0×10^{-5}
		C-14	2.0×10^{-12}
		N-13	1.0×10^{-8}
		Ar-41	1.0×10^{-9}
		Cm-244	7.0×10^{-11}
		Pb-210	4.0×10^{-13}
		U-238	4.0×10^{-12}
		Pu-239	6.0×10^{-12}
		Am-241	1.0×10^{-11}
Mixed Waste Landfill	Diffuse	H-3	0.294

ACRR	Annular Core Research Reactor
Ci/yr	curies per year
PBFA	Particle Beam Fusion Accelerator II
SNL/NM	Sandia National Laboratories/New Mexico
SPR	Sandia Pulse Reactor
TOF	Time-of-Flight Lab

Table 4.2-5
Annual Effective Dose Equivalent (mrem/yr) to Boundary Receptors From SNL/NM Facilities

Receptor	Rad Lab	Tandem	TOF Lab	ACRR	SPR	Hermes	PBFA II	MWL
Tijeras	1.8x10^{-9}	4.1x10^{-10}	4.7x10^{-9}	1.8x10^{-4}	1.5x10^{-5}	6.5x10^{-7}	4.7x10^{-8}	2.3x10^{-5}
City Landfill	1.0x10^{-9}	8.3x10^{-11}	3.7x10^{-9}	3.4x10^{-5}	3.2x10^{-6}	1.2x10^{-7}	8.4x10^{-9}	7.1x10^{-6}
Airport	2.7x10^{-9}	1.6x10^{-9}	5.5x10^{-9}	1.4x10^{-4}	1.2x10^{-5}	5.0x10^{-6}	3.6x10^{-7}	8.8x10^{-6}
SE Corner of NW Base Housing	1.2x10^{-8}	1.2x10^{-8}	1.2x10^{-8}	1.0x10^{-4}	9.0x10^{-6}	4.7x10^{-5}	3.6x10^{-6}	1.2x10^{-5}
Eubank Gate	6.5x10^{-9}	1.0x10^{-7}	1.5x10^{-8}	1.3x10^{-4}	1.1x10^{-5}	1.4x10^{-5}	1.0x10^{-6}	1.1x10^{-5}
NE Resident	1.0x10^{-9}	2.1x10^{-10}	3.7x10^{-9}	3.1x10^{-5}	3.0x10^{-6}	2. 8x10^{-7}	2.1x10^{-8}	5.9x10^{-6}
E Resident	6.8x10^{-10}	1.7x10^{-11}	3.2x10^{-9}	6.3x10^{-6}	6.4x10^{-7}	1.5x10^{-8}	1.1x10^{-9}	4.0x10^{-6}
Isleta Gate	7.3x10^{-10}	1.9x10^{-11}	3.3x10^{-9}	1.0x10^{-5}	1.0x10^{-6}	1.1x10^{-8}	7.8x10^{-10}	5.1x10^{-6}
W Resident	8.7x10^{-10}	3.5x10^{-11}	3.5x10^{-9}	1.7x10^{-5}	1.6x10^{-6}	4.0x10^{-8}	2.8x10^{-9}	5.7x10^{-6}

ACRR	Annular Core Research Reactor
E	east
mrem/yr	millirems per year
MWL	Mixed Waste Landfill
NE	northeast
NW	northwest
PBFA	Particle Beam Fusion Accelerator II MWL
SE	southeast
SNL/NM	Sandia National Laboratories/New Mexico
SPR	Sandia Pulse Reactor
TOF	Time-of-Flight Lab
W	west

Table 4.2-6
Annual Effective Dose Equivalent (mrem/yr) to Kirtland Air Force Base Receptors From SNL/NM Facilities

Receptor	Rad Lab	Tandem	TOF Lab	ACRR	SPR	Hermes	PBFA II	MWL
KUMSC	$2.8x10^{-9}$	$2.7x10^{-9}$	$1.0x10^{-9}$	$1.6x10^{-3}$	$5.9x10^{-5}$	$1.7x10^{-5}$	$1.2x10^{-6}$	$8.5x10^{-6}$
KAFB Landfill	$4.5x10^{-9}$	$1.9x10^{-8}$	$1.5x10^{-9}$	$2.2x10^{-4}$	$1.8x10^{-5}$	$7.1x10^{-5}$	$5.4x10^{-6}$	$2.8x10^{-6}$
Raytheon/ DNA	$2.0x10^{-8}$	$3.1x10^{-8}$	$6.5x10^{-9}$	$1.6x10^{-4}$	$1.3x10^{-5}$	$1.5x10^{-4}$	$1.3x10^{-5}$	$2.6x10^{-6}$
Rinchem	$1.7x10^{-8}$	$2.8x10^{-7}$	$5.4x10^{-9}$	$1.6x10^{-4}$	$1.4x10^{-5}$	$1.1x10^{-4}$	$9.9x10^{-6}$	$2.3x10^{-6}$
Golf Course Lobby	$1.6x10^{-9}$	$2.1x10^{-9}$	$5.6x10^{-10}$	$3.0x10^{-4}$	$2.0x10^{-5}$	$1.0x10^{-5}$	$7.3x10^{-7}$	$2.0x10^{-6}$
Golf Course Maintenance	$1.8x10^{-9}$	$6.9x10^{-9}$	$6.5x10^{-10}$	$5.1x10^{-4}$	$3.2x10^{-5}$	$3.2x10^{-5}$	$2.2x10^{-6}$	$1.7x10^{-6}$
Riding Club	$1.0x10^{-9}$	$9.3x10^{-10}$	$3.8x10^{-10}$	$6.3x10^{-4}$	$3.5x10^{-5}$	$3.9x10^{-6}$	$2.3x10^{-6}$	$3.1x10^{-6}$
CERF	$3.5x1^{-10}$	$1.2x10^{-10}$	$1.5x10^{-10}$	$8.2x10^{-5}$	$7.3x10^{-6}$	$2.9x10^{-7}$	$2.8x10^{-7}$	$1.5x10^{-6}$
Lovelace	$6.8x10^{-10}$	$2.1x10^{-10}$	$2.9x10^{-10}$	$8.3x10^{-5}$	$7.8x10^{-6}$	$2.1x10^{-7}$	$2.1x10^{-8}$	$1.5x10^{-6}$
Manzano	$6.5x10^{-10}$	$5.4x10^{-10}$	$2.5x10^{-10}$	$2.1x10^{-4}$	$1.4x10^{-5}$	$2.2x10^{-6}$	$1.5x10^{-8}$	$2.3x10^{-6}$
Credit Union	$4.5x10^{-6}$	$2.2x10^{-7}$	$1.3x10^{-6}$	$9.8x10^{-5}$	$8.6x10^{-6}$	$2.1x10^{-5}$	$1.6x10^{-7}$	$1.8x10^{-6}$
North Base Housing	$3.1x10^{-8}$	$1.8x10^{-7}$	$9.6x10^{-9}$	$1.0x10^{-4}$	$9.1x10^{-6}$	$1.9x10^{-5}$	$1.4x10^{-6}$	$1.7x10^{-6}$
Building 887	$2.3x10^{-8}$	$6.7x10^{-6}$	$7.1x10^{-9}$	$1.2x10^{-4}$	$1.0x10^{-5}$	$3.1x10^{-5}$	$2.2x10^{-6}$	$1.8x10^{-6}$
Trailer Village	$1.6x10^{-8}$	$9.1x10^{-5}$	$5.1x10^{-9}$	$1.4x10^{-4}$	$1.2x10^{-5}$	$2.9x10^{-5}$	$2.0x10^{-6}$	$2.0x10^{-6}$

ACRR	Annular Core Research Reactor
CERF	Civil Engineering Research Facility
DNA	Defense Nuclear Agency
KAFB	Kirtland Air Force Base
KUMSC	Kirtland Underground Munitions Storage Complex
mrem/yr	millirem per year
MWL	Mixed Waste Landfill
PBFA	Particle Beam Fusion Accelerator II
SNL/NM	Sandia National Laboratories/New Mexico
SPR	Sandia Pulse Reactor
TOF	Time-of-Flight Lab

Table 4.5-1
EMFLUX® Modified Laboratory Procedures

After exposure, EMFLUX® cartridges are analyzed as follows:	
A.	The GC/MS equipment to be used is calibrated in accordance with the EPA Contract Laboratory method for low waters.
B.	The exposed cartridge is placed in a Tekmar Autosampler chamber where it is desorbed at 270 degrees C for 11 minutes at 40 mL/min helium, through a sparging vessel containing five mL of water with internal standards and surrogates into a three-component trap on a Tekmar Liquid Sample Concentrator. The three components in the secondary trap are Tenax, silica gel, and coconut charcoal.
C.	The secondary trap is thermally desorbed at 220 degrees C into a Restek 502.2 capillary column, per the EPA CLP Statement of Work.
D.	Following the Statement of Work, the GC/MS is scanned between 35 and 260 Atomic Mass Units at two seconds per scan.
E.	The internal standard method is used to determine the amounts of analytes found.
F.	The compounds found are measured against five mL of aqueous standard analyzed previously.

C	Celsius
CLP	Contract Laboratory Program
EPA	U.S. Environmental Protection Agency
GC/MS	gas chromatography/mass spectrometry
mL	milliliter
mL/min	milliliter per minute

Table 4.5-2
First-Round Passive Soil Gas Flux (ng/m²/min)

Sample Location		Sample Number	tetrachloroethene (PCE)[c]	trichloroethene (TCE)[c]	1,1,1-trichloroethane (1,1,1-TCA)[c]	1,1,2-trichlorotrifluoroethane[c]	dichloroethene[c,d]	toluene[c]	acetone[c]	isopropyl ether[c]	1,1-dichloroethene[c]	styrene[c]	ethlybenzene[c]	xylene[c]
X Coordinate[a] (feet)	Y Coordinate[b] (feet)													
335	50	1	1.1	U	U	U	U	U	U	U	U	U	U	U
285	50	2	4.2	U	U	U	U	U	U	U	U	U	U	U
335	-5	3	U	U	U	U	U	U	U	U	U	U	U	U
300	-5	4	0.9	U	U	U	U	U	U	U	U	U	U	U
250	-5	5	3.5	U	U	U	U	U	U	U	U	U	U	U
200	-5	6	U	U	U	U	U	U	U	U	U	U	U	U
100	-5	7	45.5	3.7	U	U	U	1.3	U	U	U	U	U	U
0	-5	8	25.3	1.8	U	U	U	1	U	U	U	U	U	U
335	-55	9	U	U	U	U	U	U	U	U	U	U	U	U
300	-50	10	U	U	1	U	U	1	0.7	U	U	U	U	U
250	-50	11	0.8	1.1	U	U	U	U	U	U	U	U	U	U
200	-50	12	0.9	U	1.1	U	U	U	U	U	U	U	U	U
150	-50	13	56.3	2.1	U	U	U	1.8	3.6	U	U	U	U	0.8
50	-50	14	241.4	8.9	U	U	1.1	1.6	U	U	U	U	U	U
335	-105	15	U	U	U	U	U	U	U	U	U	U	U	U
300	-100	16	U	U	1.1	0.9	U	U	U	U	U	U	U	U
275	-100	17	2.5	2.8	U	U	1.3	U	U	U	U	U	U	U
250	-100	18	5.9	190.1	0.25	1.2	U	U	U	U	U	U	U	U
225	-100	19	23.8	17.8	U	U	2.3	1.4	U	U	U	U	U	U
200	-100	20	12.8	3.2	U	U	U	1	U	U	U	U	U	U
100	-100	21	359.6	1.3	1.1	U	U	1.6	U	U	U	U	U	U
0	-100	22	199.9	2.1	U	U	U	1.7	U	U	U	U	U	U
335	-140	23	U	U	U	U	U	U	U	U	U	U	U	U
300	-125	24	U	1.4	1.3	0.3	U	U	U	U	U	U	U	U
275	-125	25	2.5	3.9	U	U	0.9	U	U	U	U	U	U	U
250	-125	26	0.9	19	U	U	1.7	U	U	U	U	U	U	U
225	-125	27	4.1	7.2	U	U	1.7	U	U	U	U	U	U	U
200	-125	28	0.8	U	U	0.1	U	U	U	U	U	U	U	U
300	-150	29	U	U	1.2	U	U	U	U	U	U	U	U	U
275	-150	30	U	U	U	U	U	U	U	U	U	U	U	U
250	-150	31	3.1	2.7	U	U	1.3	1.1	U	U	U	U	U	U
225	-150	32	7.1	1.1	0.8	U	U	U	U	U	U	U	U	U
200	-150	33	1.7	1.7	1	U	U	U	U	U	U	U	U	U
150	-150	34	48.5	U	U	U	U	U	U	U	U	U	U	U

Refer to footnotes at end of table.

Table 4.5-2 (Continued)
First-Round Passive Soil Gas Flux (ng/m²/min)

Sample Location		Sample Number	tetrachloro-ethene (PCE)[c]	trichloro-ethene (TCE)[c]	1,1,1-trichloro-ethane (1,1,1-TCA)[c]	1,1,2-trichloro-trifluoro-ethane[c]	dichloro-ethene[c,d]	toluene[c]	acetone[c]	isopropyl ether[c]	1,1-dichloro-ethene[c]	styrene[c]	ethly-benzene[c]	xylene[c]
X Coordinate[a] (feet)	Y Coordinate[b] (feet)													
50	-150	35	396.2	6.7	23.5	U	U	2.2	U	U	1.3	U	U	U
335	-175	36	U	U	U	U	U	U	U	U	U	U	U	U
310	-175	37	U	U	1.2	0.1	U	U	U	U	U	U	U	U
290	-175	38	U	1.4	1.4	U	U	U	U	U	U	U	U	U
270	-175	39	3.8	5.7	U	U	U	U	U	0.9	U	U	1.2	U
250	-175	40	1.5	15.9	U	U	1.3	U	U	35.7	U	U	U	U
225	-175	41	U	U	U	U	U	U	U	U	U	U	U	U
200	-175	42	U	0.9	0.9	U	U	U	U	U	U	U	U	U
335	-210	43	U	U	U	U	U	U	U	U	U	U	U	U
310	-195	44	U	U	U	U	U	1	U	U	U	U	U	U
290	-195	45	U	2.4	0.9	U	1.4	U	U	U	U	U	U	U
270	-195	46	6.7	22.7	2	1	1.7	U	U	U	U	U	U	U
250	-200	47	5.4	59.2	U	U	0.9	1.1	U	U	U	U	U	U
225	-200	48	9.4	327.4	2.5	U	103.3	U	U	U	U	U	U	U
200	-200	49	1.6	2	2.1	U	U	U	U	U	U	U	U	U
310	-215	50	1.3	U	U	U	U	U	U	U	U	U	U	U
290	-215	51	U	1.7	1.1	0.2	U	U	U	U	U	U	U	U
270	-215	52	1.3	5.2	1.2	U	U	U	U	U	U	U	U	U
100	-215	53	1.2	U	0.9	0.2	U	U	U	U	U	U	U	U
0	-215	54	22.6	U	U	U	U	1.6	U	U	U	U	U	U
250	-230	55	7.1	3	U	U	U	U	U	U	U	U	U	U
225	-230	56	1.8	1.2	1.2	U	U	U	U	U	U	U	U	U
200	-230	57	4.4	1.4	2.3	0.2	U	U	3.9	U	U	U	U	U
335	-240	58	2.8	U	U	U	U	1.6	U	U	U	U	U	U
310	-240	59	U	U	U	U	U	U	U	U	U	1	U	U
290	-240	60	3.7	U	U	U	U	U	U	U	U	U	U	U
270	-240	61	3.7	0.8	U	U	U	U	U	U	U	U	U	U
150	-265	62	2.1	U	U	U	U	0.8	22	U	U	U	U	U
50	-265	63	7.3	U	U	U	U	1.9	17.2	U	U	U	U	U
200	-315	64	3.4	U	U	U	U	U	U	U	U	U	U	U
100	-315	65	1.4	U	U	U	U	U	U	U	U	U	U	U
0	-315	66	7	U	U	U	U	U	U	U	U	U	U	U

Refer to footnotes at end of table.

Table 4.5-2 (Concluded)
First-Round Passive Soil Gas Flux (ng/m²/min)

Sample Location		Sample Number	tetrachloroethene (PCE)[c]	trichloroethene (TCE)[c]	1,1,1-trichloroethane (1,1,1-TCA)[c]	1,1,2-trichlorotrifluoroethane[c]	dichloroethene[c,d]	toluene[c]	acetone[c]	isopropyl ether[c]	1,1-dichloroethene[c]	styrene[c]	ethlybenzene[c]	xylene[c]
X Coordinate[a] (feet)	Y Coordinate[b] (feet)													
150	-365	67	5	1.1	0.8	U	U	U	8.7	U	U	U	U	U
50	-365	68	2.6	U	U	U	U	U	U	U	U	U	U	U
200	-430	69	U	U	0.8	U	U	U	U	U	U	U	U	U
100	-430	70	U	0.9	U	U	U	U	0.4	U	U	U	U	U
0	-430	71	U	U	U	U	U	U	1.5	U	U	U	U	U

[a] East: positive; west: negative.

[b] North: positive; south: negative.

[c] Volatile organics analyzed by EPA GC/MS method 8240 (modified).

[d] Dichloroethene was tentatively identified by mass spectral comparison with the National Bureau of Standards Library.

EPA	U.S. Environmental Protection Agency
GC/MS	gas chromatography/mass spectrometry
ng/m²/min	nanograms per square meter per minute
PCE	tetrachloroethene
TCA	trichloroethane
TCE	trichloroethene
U	Below reported quantitation level.

Table 4.5-3
Second-Round Passive Soil Gas Flux (ng/m²/min)

Sample Location		Sample Number	tetrachloroethene (PCE)[c]	trichloroethene (TCE)[c]	1,1,1-trichloroethane (1,1,1-TCA)[c]	1,1-dichloroethene[c]
X Coordinate[a] (feet)	Y Coordinate[b] (feet)					
225	50	1	11.5	1.1	U	U
150	50	2	7.5	U	U	U
50	50	3	17.6	U	U	U
-50	50	4	9.1	U	U	U
-50	-40	5	27.5	1.7	U	U
-50	-150	6	15.2	0.9	U	U
-50	-265	7	5.1	0.6	U	U
-50	-365	8	1.1	0.6	U	U
-50	-465	9	U	U	U	U
-100	-207	10	NA	NA	NA	NA
-100	-100	11	12.6	0.9	U	U
-100	0	12	3.6	U	U	U
-564	0	13	U	U	U	U
-500	-215	14	U	U	U	U
-500	-430	15	U	U	U	U
0	-930	16	U	U	U	U
200	-930	17	U	U	U	U
250	-100	18[d]	18.6	129.1	0.6	U
225	-200	19[d]	16	158	1.4	U
100	-100	20[d]	164.4	0.74	0.9	U
50	-150	21[d]	220.7	3.2	15.7	1.6
0	-100	22[d]	66.7	0.6	U	U

[a] East: positive; west: negative.

[b] North: positive; south: negative.

[c] Volatile organics analyzed by EPA GC/MS method 8240 (modified).

[d] Sample numbers 18 through 22 were resampled first-round locations for purposes of verification.

EPA	U.S. Environmental Protection Agency
GC/MS	gas chromatography/mass spectrometry
ng/m²/min	nanograms per square meter per minute
NA	not analyzed (Sample number 10 was lost due to laboratory equipment malfunction.)
PCE	tetrachloroethene
TCA	trichloroethane
TCE	trichloroethene
U	Below reported quantitation level.

Table 4.5-4
First-Round Active Soil Gas Sampling Results (ppbv)

Sample Location		Sample Point	Depth (ft bgs)	dichloro-difluoro-methane[c]	PCE[c]	1,1,1-TCA[c]	TCE[c]	trichlorofluoro-methane[c]	1,1,2-trichloro-1,2,2-trifluoro-ethane[c]
X Coordinate[a] (ft)	Y Coordinate[b] (ft)								
-10	0	1	10	NA	251 E	30	131	NA	NA
-10	-50	2	10	NA	521 E	23	210	NA	NA
-10	-100	3	10	NA	1080 E	124	310 E	NA	NA
-10	-150	4	10	NA	627 E	260 E	279 E	NA	NA
-10	-175	5	10	NA	339 E	72	185	NA	NA
-10	-200	6	10	NA	186	58	114	NA	NA
50	10	7	10	NA	247 E	U	124	NA	NA
100	10	8	10	NA	205	12 J	123	NA	NA
150	10	9	13	NA	279 E	52	210	NA	NA
200	10	10	10	NA	130	19 J	126	NA	NA
250	10	11	10	NA	87	U	86	NA	NA
300	10	12	10	NA	45	11 J	53	NA	NA
310	-50	13	10	NA	30	13 J	72	NA	NA
310	-100	14	10	NA	48	16 J	113	NA	NA
310	-150	15	10	NA	33	9 J	93	NA	NA
310	-200	16	10	NA	34	24	84	NA	NA
310	-225	17	10	NA	32	17 J	76	NA	NA
250	-225	18	10	NA	56	51	435 E	NA	NA
207	-225	19	10	NA	69	188	220	NA	NA

Refer to footnotes at end of table.

Table 4.5-4 (Continued)
First-Round Active Soil Gas Sampling Results (ppbv)

Sample Location		Sample Point	Depth (ft bgs)	dichloro-difluoro-methane[c]	PCE[c]	1,1,1-TCA[c]	TCE[c]	trichlorofluoro-methane[c]	1,1,2-trichloro-1,2,2-trifluoro-ethane[c]
X Coordinate[a] (ft)	Y Coordinate[b] (ft)								
-10	0	1	30	NA	749 E	78	443 E	NA	NA
-10	-50	2	30	NA	958 E	69	465 E	NA	NA
-10	-100	3	30	NA	1666 E	175	682 E	NA	NA
-10	-150	4	30	NA	1479 E	337 E	776 E	NA	NA
-10	-175	5	26	NA	580 E	150	406 E	NA	NA
-10	-200	6	26	NA	464 E	67	334 E	NA	NA
50	10	7	30	NA	748 E	53	318 E	NA	NA
100	10	8	30	NA	742 E	87	524 E	NA	NA
150	10	9	30	NA	429 E	58	376 E	NA	NA
150	10	9d	30d	NA	461 E	95	373 E	NA	NA
200	10	10	30	NA	302 E	40	338 E	NA	NA
250	10	11	30	NA	154	86	233 E	NA	NA
300	10	12	30	NA	85	21 J	163	NA	NA
310	-50	13	27	NA	67	36	216	NA	NA
310	-100	14	28	NA	85	32	349 E	NA	NA
310	-150	15	30	NA	77	27	334 E	NA	NA
310	-200	16	28	NA	63	21 J	216	NA	NA
310	-225	17	30	NA	74	48	298 E	NA	NA
250	-225	18	30	NA	135	101	683 E	NA	NA
207	-225	19	30	NA	193	316 E	653 E	NA	NA

Refer to footnotes at end of table.

Table 4.5-4 (Concluded)
First-Round Active Soil Gas Sampling Results (ppbv)

Sample Location		Sample Point	Depth (ft bgs)	dichloro-difluoro-methane[d]	PCE[d]	1,1,1-TCA[d]	TCE[d]	trichlorofluoro-methane[d]	1,1,2-trichloro-1,2,2-trifluoro-ethane[d]
X Coordinate[a] (ft)	Y Coordinate[b] (ft)								
-10	0	1	30	110	450	U	230	U	190
-10	-50	2	30	440	1200	U	450	U	280
-10	-100	3	30	1300	1700	150	530	U	280
-10	-150	4	30	2300	1300	170	490	U	250
-10	-175	5	26	640	240	U	120	U	U
-10	-200	6	26	1200	670	U	330	U	220
50	10	7	30	160	1000	U	460	U	310
100	10	8	30	120	800	U	400	U	290
150	10	9	30	U	480	U	350	U	310
150	10	9d	30d	100	450	U	320	U	270
200	10	10	30	U	280	U	250	U	280
250	10	11	30	U	150	U	160	U	180
300	10	12	30	U	U	U	120	U	140
310	-50	13	27	U	U	U	140	U	U
310	-100	14	28	U	U	U	240	U	130
310	-150	15	30	U	U	U	250	160	130
310	-200	16	28	U	U	U	210	U	100
300	-225	17	30	U	U	U	230	U	100
250	-225	18	30	120	150	U	630	270	140
207	-225	19	30	280	260	320	630	740	170

[a] East: positive; west: negative.

[b] North: positive; south: negative.

[c] Soil gas samples collected in 500 mL glass bulbs and analyzed with the GC/MS at TA-3, Building 6540 by SNL/NM personnel.

[d] Soil gas samples collected in 6-liter Summa canisters and analyzed by EPA Method TO-14 (modified high level) at Encotec, Ann Arbor, MI.

bgs	below ground surface
d	duplicate sample
E	Estimated concentration greater than the ULOQ
EPA	U.S. Environmental Protection Agency
ft	feet
GC/MS	gas chromatography/mass spectrometry
J	Estimated concentration less than the LLOQ (reported down to 1/10th the LLOQ).
LLOQ	Lower limit of quantitation
mL	milliliter
NA	not applicable
PCE	tetrachloroethene
ppbv	parts per billion by volume
SNL/NM	Sandia National Laboratories/New Mexico
TA	technical area
TCA	trichloroethane
TCE	trichloroethene
U	Below reported quantitation level.
ULOQ	upper limit of quantitation

Table 4.5-5
Second-Round Active Soil Gas Sampling Results (ppbv)

Sample Location		Sample Point	Depth (ft bgs)	dichloro-difluoro-methane[c]	PCE[c]	1,1,1-TCA[c]	TCE[c]	trichlorofluoro-methane[c]	1,1,2-trichloro-1,2,2-trifluoro-ethane[c]	methylene chloride[c]
X Coordinate[a] (ft)	Y Coordinate[b] (ft)									
-60	-85	1	10	U	110	U	U	U	U	U
-60	-125	2	10	U	160	U	U	U	U	U
-60	-175	3	10	U	77	50	51	U	20	100
-60	-175	3d	10d	U	91	U	58	U	30	U
-10	-250	4	10	U	62	10	39	12	35	U
125	-50	5	10	U	240	U	100	U	U	U
125	-100	6	10	170	240	U	U	U	U	U
125	-150	7	10	400	310	U	100	U	U	U
125	-200	8	10	320	200	U	110	U	U	U
75	-200	9	10	1800S	380	U	180	U	100	U
75	-150	10	10	29000E	1700	U	U	U	U	U
75	-100	11	10	2000	5200S	280	540	U	U	U
75	-50	12	10	U	1700	U	290	U	U	U
-60	-85	1	30	170	450	U	230	U	160	U
-60	-125	2	30	170	360	U	190	U	110	U
-60	-175	3	28.5	260	280	U	210	U	130	U
-10	-250	4	30	360	270	U	230	U	150	U
125	-50	5	30	170	520	U	270	U	170	U
125	-100	6	30	550	720	U	280	U	140	U
125	-150	7	30	1400S	1100	200	540	140	330	U
125	-200	8	30	1200	790	130	520	300	270	U
75	-200	9	25	3200S	690	150	370	U	220	U
75	-150	10	30	25000E	2700	U	U	U	U	U
75	-150	10d	30d	18000S	2300	750	600	U	320	U
75	-100	11	27	3600	5900	U	U	U	U	U
75	-50	12	30	600	1600	U	570	240	U	U

[a] East: positive; west: negative.

[b] North: positive; south: negative.

[c] Soil gas samples were collected in 6-liter Summa canisters and analyzed by EPA Method TO-14 (low level) at Encotec, Ann Arbor, MI.

bgs	below ground surface
d	duplicate sample
E	Estimated value (concentration was too large to be accurately diluted within the linear range of the calibration curve).
EPA	U.S. Environmental Protection Agency
ft	feet
PCE	tetrachloroethene
ppbv	parts per billion by volume
S	Results due to (secondary) dilution.
TCA	trichloroethane
TCE	trichloroethene
U	Below reported quantitation level.

Table 4.5-6
Third-Round Active Soil Gas Sampling Results (ppbv)

Sample Location		Sample Point	Depth (ft bgs)	dichloro-difluoro-methane[c]	PCE[c]	1,1,1-TCA[c]	TCE[c]	trichloro-fluoro-methane[c]	1,1,2-trichloro-1,2,2-trifluoro-ethane[c]	methylene chloride[c]	chloroform[c]
X Coordinate[a] (ft)	Y Coordinate[b] (ft)										
-10	-300	1	10	U	130E	29	140E	27	U	U	U
-10	-350	2	10	U	44	14	36	17	U	U	U
-10	-400	3	10	U	U	U	U	30	U	U	U
0	-440	4	10	U	U	U	13	17	44	U	U
50	-440	5	10	U	26	15	35	29	120	U	U
100	-440	6	10	U	19	18	42	41	19	14	U
150	-440	7	10	U	23	16	43	29	20	U	U
200	-440	8	10	U	28	15	49	U	U	U	U
210	-400	9	10	U	83	33	98	83	38	U	U
210	-350	10	10	U	260E	62	120	37	U	U	U
225	-300	11	10	U	U	U	120	190	U	U	U
225	-250	12	10	U	76	60	230E	110	U	U	U
-10	-300	1	30	U	300E	63	350E	180E	U	U	U
-10	-350	2	30	U	140E	44	220E	52	170E	U	U
-10	-400	3	30	U	45	68	77	67	260E	U	U
-10	-400	3d	30d	U	50	19	60	43	100	U	U
0	-440	4	30	U	19	34	38	16	U	U	U
50	-440	5	30	U	47	26	99	50	U	U	U
100	-440	6	30	U	50	36	130	U	U	U	U
150	-440	7	30	U	68	41	160	80	43	U	U
200	-440	8	30	U	77	41	210E	55	25	U	U
210	-400	9	30	U	120	65	250E	120	U	U	U
210	-350	10	30	U	280E	77	250E	230E	78	U	14
225	-300	11	30	U	140	77	270	610E	130	U	U
225	-250	12	30	U	140	U	390	370	130	U	U
225	-250	12d	30d	100	50	U	420	380	130	U	U

[a] East: positive; west: negative.

[b] North: positive; south: negative.

[c] Soil gas samples were collected in 6-liter Summa canisters and analyzed by EPA Method TO-14 (low level) at Encotec, Ann Arbor, MI.

bgs	below ground surface
d	duplicate sample
E	Estimated value (concentration was too large to be accurately diluted within the linear range of the calibration curve).
EPA	U.S. Environmental Protection Agency
ft	feet
PCE	tetrachloroethene
ppbv	parts per billion by volume
TCA	trichloroethane
TCE	trichloroethene
U	Below reported quantitation level.

Table 4.6-1
Analytical Methods for Borehole Soil Samples

Analytical Group	Analytical Method
VOCs	SW-846 (8260)
SVOCs	SW-846 (8270)
TAL Metals	SW-846 (6010 for ICP metals and 7471 for mercury)
Isotopic Uranium, Thorium, and Plutonium	LAL-91-SOP-0108[a]
Strontium	LAL-91-SOP-0065[a] and LAL-93-SOP-0196[a]
Gross Alpha/Beta	LAL-91-SOP-0061[a]
Tritium	LAL-91-SOP-0066[a]

[a] Lockheed Analytical Laboratory standard operating procedures for radiochemical analyses.

EPA	U.S. Environmental Protection Agency
ICP	inductively coupled plasma
LAL	Lockheed Analytical Laboratory
SOP	standard operating procedure
SVOC	semivolatile organic compound
SW	southwest
SW846	Analytical laboratory methods presented in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (EPA 1986).
TAL	Target Analyte List
VOC	volatile organic compound

Table 4.6-2
Borehole Soil Sample Collection Summary

Borehole	VOCs	SVOCs	TAL Metals	Isotopic Uranium, Thorium, and Plutonium, Strontium-90, Gross Alpha/Beta	Tritium	Total
BH-1	7	7	7	7	8	36
BH-2	7	7	7	7	8	36
BH-3	7	7	7	7	8	36
BH-4	7	7	7	7	8	36
BH-5	7	7	7	7	8	36
BH-6	7	7	7	7	8	36
BH-7	7	7	7	7	8	36
BH-8	7	7	7	7	8	36
BH-9	6	6	6	6	7	31
BH-10	7	7	7	7	10	38
BH-11	7	7	7	7	8	36
BH-12	7	7	7	7	8	36
BH-13	7	7	7	7	8	36
BH-14	6	6	6	6	7	31
BH-15	7	7	7	7	8	36
Total	103	103	103	103	120	532

SVOCs	semivolatile organic compounds
TAL	Target Analyte List
VOCs	volatile organic compounds

Table 4.6-3
Volatile Organic Compounds Detected in Borehole Soil Samples

Borehole	Analyte	Highest Measured Concentration (μg/kg)	Action Level (μg/kg)
BH-1	2-Butanone	2.07 J	50,000,000[b]
BH-2	Acetone	181	8,000,000[a]
	2-Hexanone	5.81 J	3,000,000[b]
	4-Methyl-2-pentanone	4 J	4,000,000[a]
BH-3	2-Hexanone	4.88 J	3,000,000[b]
	PCE	2.45 J	10,000[a]
	Total Xylenes	3.97 J	200,000,000[a]
BH-4	Acetone	122	8,000,000[a]
	2-Butanone	15 J	50,000,000[b]
	2-Hexanone	8.85 J	3,000,000[b]
	4-Methyl-2-pentanone	7.57 J	4,000,000[a]
BH-5	TCE	1 J	60,000[a]
BH-6	Methylene Chloride	1.48 J	90,000[a]
BH-7	Acetone	126	8,000,000[a]
	2-Butanone	19.1 J	50,000,000[b]
	Methylene Chloride	1.52 J	90,000[a]
	2-Hexanone	5.91 J	3,000,000[b]
	4-Methyl-2-pentanone	5.1 J	4,000,000[a]
	Total Xylenes	4.4 J	200,000,000[a]
BH-8	Acetone	61.8	8,000,000[a]
	2-Butanone	4.38 J	50,000,000[b]
BH-9	ND	NA	NA
BH-10	2-Hexanone	8.46 J	3,000,000[b]
BH-11	ND	NA	NA
BH-12	ND	NA	NA
BH-13	Total Xylenes	17.8 J	200,000,000[a]
	Toluene	20.4 J	20,000,000[a]
BH-14	ND	NA	NA
BH-15	Acetone	225 J	8,000,000[a]
	Methylene Chloride	5.3 J	90,000[a]
	2-Butanone	22.3 J	50,000,000[b]

[a] Proposed RCRA Subpart S action level for soils (55 FR 30865).

[b] Action level based on toxicity information contained in the IRIS database (EPA 1995a) or the HEAST (EPA 1995b) and an HI of 1. Soil ingestion equations provided in Subpart S (55 FR 30870) were used to calculate action levels.

EPA	U.S. Environmental Protection Agency
FR	Federal Register
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
IRIS	Integrated Risk Information System
J	Concentration of the compound in the sample was below the reporting limit but above the detection limit.
NA	Not applicable as result was ND.
ND	No organic compound was detected above instrument detection limits.
PCE	tetrachloroethene
RCRA	Resource Conservation and Recovery Act
TCE	trichloroethene
μg/kg	micrograms per kilogram

Table 4.6-4
Semivolatile Organic Compounds Detected in Borehole Soil Samples

Borehole	Analyte	Highest Measured Concentration (µg/kg)	Action Level (µg/kg)
BH-1	Bis(2-ethylhexyl)phthalate	219 J	50,000[a]
BH-2	Bis(2-ethylhexyl)phthalate	614	50,000[a]
BH-3	Bis(2-ethylhexyl)phthalate	1110	50,000[a]
BH-4	Pyrene	1060	2,000,000[b]
BH-5	ND	NA	NA
BH-6	ND	NA	NA
BH-7	Bis(2-ethylhexyl)phthalate	795	50,000[a]
BH-8	Bis(2-ethylhexyl)phthalate	199 J	50,000[a]
BH-9	Bis(2-ethylhexyl)phthalate	504	50,000[a]
BH-10	Bis(2-ethylhexyl)phthalate	1780	50,000[a]
BH-11	Bis(2-ethylhexyl)phthalate	325 J	50,000[a]
BH-12	ND	NA	NA
BH-13	ND	NA	NA
BH-14	ND	NA	NA
BH-15	ND	NA	NA

[a] Proposed RCRA Subpart S action level for soils (55 FR 30865).

[b] Action level based on toxicity information contained in the IRIS database (EPA 1995a) or the HEAST (EPA 1995b) and an HI of 1. The soil ingestion equations provided in Subpart S (55 FR 30870) were used to calculate the action levels.

EPA	U.S. Environmental Protection Agency
FR	Federal Register
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
IRIS	Integrated Risk Information System
J	Concentration of the compound in the sample was below the Reporting Limit but above the Detection Limit.
NA	Not applicable as result was ND.
ND	No semivolatile organic compound was detected above instrument method detection limits.
RCRA	Resource Conservation and Recovery Act
µg/kg	micrograms per kilogram

Table 4.6-5
Target Analyte List Metals Detected in Borehole Soil Samples

Borehole	Metal	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[a]
BH-1	Mercury	0.0347	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	6950	--[e]	7286.95
	Arsenic	3.6	20[d]	4.45
	Barium	189	6,000[d]	235.51
	Beryllium	0.486	0.2[b]	0.82
	Calcium	64500	--[f]	75830.5
	Cadmium	0.651	80[d]	0.87[g]
	Cobalt	4.9	--[e]	4.98
	Chromium	9.11	400[b]	8.7
	Copper	26.9	--[e]	8.61
	Iron	9500	--[f]	11812
	Potassium	776	--[f]	1473
	Magnesium	3630	--[f]	4687
	Manganese	204	10,000[d,e]	259
	Sodium	358	--[f]	489[g]
	Nickel	9.09	2,000[b]	8.86
	Lead	7.15	400[h]	7.48
	Antimony	0.147	30[b]	4.8[g]
	Selenium	ND	400[b]	--[c]
	Thallium	ND	6[i]	--[c]
	Vanadium	18.4	600[d,e]	24
	Zinc	40.2	20,000[d,e]	28.59
BH-2	Mercury	0.0755	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	8670	--[e]	7286.95
	Arsenic	3.15	20[d]	4.45
	Barium	220	6,000[d]	235.51
	Beryllium	0.451	0.2[b]	0.82
	Calcium	50700	--[f]	75830.5
	Cadmium	1.97	80[d]	0.87[g]
	Cobalt	4.93	--[e]	4.98
	Chromium	17.8	400[b]	8.7
	Copper	25.7	--[e]	8.61
	Iron	13500	--[f]	11812
	Potassium	1240	--[f]	1473
	Magnesium	3450	--[f]	4687
	Manganese	200	10,000[d,e]	259
	Sodium	291	--[f]	489[g]
	Nickel	15.6	2,000[b]	8.86
	Lead	6.96	400[h]	7.48
	Antimony	0.193	30[b]	4.8[g]
	Selenium	ND	400[d]	--[c]
	Thallium	0.385	6[i]	--[c]
	Vanadium	20.4	600[d,e]	24
	Zinc	38.4	20,000[d,e]	28.59

Refer to footnotes at end of table.

Table 4.6-5 (Continued)
Target Analyte List Metals Detected in Borehole Soil Samples

Borehole	Metal	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[a]
BH-3	Mercury	0.041	20[b]	--[c]
	Silver	1.46	400[d]	--[c]
	Aluminum	7990	--[e]	7286.95
	Arsenic	3.05	20[d]	4.45
	Barium	182	6,000[d]	235.51
	Beryllium	0.531	0.2[b]	0.82
	Calcium	56700	--[f]	75830.5
	Cadmium	1.58	80[d]	0.87[g]
	Cobalt	105	--[e]	4.98
	Chromium	14.2	400[b]	8.7
	Copper	645	--[e]	8.61
	Iron	10600	--[f]	11812
	Potassium	1270	--[f]	1473
	Magnesium	3160	--[f]	4687
	Manganese	241	10,000[d,e]	259
	Sodium	206	--[f]	489[g]
	Nickel	97.5	2,000[b]	8.86
	Lead	10.7	400[h]	7.48
	Antimony	0.118	30[b]	4.8[g]
	Selenium	0.374	400[b]	--[c]
	Thallium	ND	6[i]	--[c]
	Vanadium	17	600[d,e]	24
	Zinc	413	20,000[d,e]	28.59
BH-4	Mercury	0.675	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	8250	--[e]	7286.95
	Arsenic	4.01	20[d]	4.45
	Barium	204	6,000[d]	235.51
	Beryllium	0.486	0.2[b]	0.82
	Calcium	66500	--[f]	75830.5
	Cadmium	1.62	80[d]	0.87[g]
	Cobalt	5.08	--[e]	4.98
	Chromium	13.4	400[b]	8.7
	Copper	21.5	--[e]	8.61
	Iron	11100	--[f]	11812
	Potassium	1220	--[f]	1473
	Magnesium	4820	--[f]	4687
	Manganese	207	10,000[d,e]	259
	Sodium	437	--[f]	489[g]
	Nickel	9.18	2,000[b]	8.86
	Lead	10.9	400[h]	7.48
	Antimony	0.119	30[b]	4.8[g]
	Selenium	ND	400[d]	--[c]
	Thallium	ND	6[i]	-[c]
	Vanadium	21.4	600[d,e]	24
	Zinc	29.1	20,000[d,e]	28.59

Refer to footnotes at end of table.

Table 4.6-5 (Continued)
Target Analyte List Metals Detected in Borehole Soil Samples

Borehole	Metal	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[a]
BH-5	Mercury	0.035	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	8500	--[e]	7286.95
	Arsenic	4.17	20[d]	4.45
	Barium	808	6,000[d]	235.51
	Beryllium	0.46	0.2[b]	0.82
	Calcium	49200	--[f]	75830.5
	Cadmium	1.6	80[d]	0.87[g]
	Cobalt	4.55	--[e]	4.98
	Chromium	11.2	400[b]	8.7
	Copper	8.69	--[e]	8.61
	Iron	10600	--[f]	11812
	Potassium	1270	--[f]	1473
	Magnesium	4770	--[f]	4687
	Manganese	189	10,000[d,e]	259
	Sodium	618	--[f]	489[g]
	Nickel	8.67	2,000[b]	8.86
	Lead	7.14	400[h]	7.48
	Antimony	0.213	30[b]	4.8[g]
	Selenium	ND	400[b]	--[c]
	Thallium	ND	6[i]	--[c]
	Vanadium	22.5	600[d,e]	24
	Zinc	28.2	20,000[d,e]	28.59
BH-6	Mercury	0.0307	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	10700	--[e]	7286.95
	Arsenic	3.72	20[d]	4.45
	Barium	185	6,000[d]	235.51
	Beryllium	0.605	0.2[b]	0.82
	Calcium	47800	--[f]	75830.5
	Cadmium	1.19	80[d]	0.87[g]
	Cobalt	4.54	--[e]	4.98
	Chromium	27.5	40[b]0	8.7
	Copper	9.56	--[e]	8.61
	Iron	11300	--[f]	11812
	Potassium	1680	--[f]	1473
	Magnesium	4410	--[f]	4687
	Manganese	194	10,000[d,e]	259
	Sodium	327	--[f]	489[g]
	Nickel	11.6	2,000[b]	8.86
	Lead	13.9	400[h]	7.48
	Antimony	0.237	30[b]	4.8[g]
	Selenium	ND	400[d]	--[c]
	Thallium	ND	6[i]	--[c]
	Vanadium	23.2	600[d,e]	24
	Zinc	31.6	20,000[d,e]	28.59

Refer to footnotes at end of table.

Table 4.6-5 (Continued)
Target Analyte List Metals Detected in Borehole Soil Samples

Borehole	Metal	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[a]
BH-7	Mercury	0.0327	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	8060	--[e]	7286.95
	Arsenic	2.98	20[d]	4.45
	Barium	336	6,000[d]	235.51
	Beryllium	0.419	0.2[b]	0.82
	Calcium	49600	--[f]	75830.5
	Cadmium	0.594	80[d]	0.87[g]
	Cobalt	3.73	--[e]	4.98
	Chromium	19.3	400[b]	8.7
	Copper	9.18	--[e]	8.61
	Iron	11200	--[f]	11812
	Potassium	1340	--[f]	1473
	Magnesium	4360	--[f]	4687
	Manganese	189	10,000[d,e]	259
	Sodium	563	--[f]	489[g]
	Nickel	8.98	2,000[b]	8.86
	Lead	6.33	400[h]	7.48
	Antimony	0.201	30[b]	4.8[g]
	Selenium	ND	400[b]	--[c]
	Thallium	ND	6[i]	--[c]
	Vanadium	18.9	600[d,e]	24
	Zinc	34.8	20,000[d,e]	28.59
BH-8	Mercury	0.0359	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	10300	--[e]	7286.95
	Arsenic	5.12	20[d]	4.45
	Barium	187	6,000[d]	235.51
	Beryllium	0.569	0.2[b]	0.82
	Calcium	64100	--[f]	75830.5
	Cadmium	0.0405	80[d]	0.87[g]
	Cobalt	5.56	--[e]	4.98
	Chromium	33.1	40[b]0	8.7
	Copper	10.7	--[e]	8.61
	Iron	13800	--[f]	11812
	Potassium	1290	--[f]	1473
	Magnesium	6270	--[f]	4687
	Manganese	231	10,000[d,e]	259
	Sodium	523	--[f]	489[g]
	Nickel	11.3	2,000[b]	8.86
	Lead	7.71	400[h]	7.48
	Antimony	0.403	30[b]	4.8[g]
	Selenium	0.152	400[d]	--[c]
	Thallium	1.38	6[i]	--[c]
	Vanadium	27	600[d,e]	24
	Zinc	31.8	20,000[d,e]	28.59

Refer to footnotes at end of table.

Table 4.6-5 (Continued)
Target Analyte List Metals Detected in Borehole Soil Samples

Borehole	Metal	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[a]
BH-9	Mercury	0.0399	20[b]	--[c]
	Silver	0.371	400[d]	--[c]
	Aluminum	6910	--[e]	7286.95
	Arsenic	4.85	20[d]	4.45
	Barium	158	6,000[d]	235.51
	Beryllium	0.418	0.2[b]	0.82
	Calcium	84700	--[f]	75830.5
	Cadmium	0.191	80[d]	0.87[g]
	Cobalt	5.15	--[e]	4.98
	Chromium	16.1	400[b]	8.7
	Copper	12.7	--[e]	8.61
	Iron	10600	--[f]	11812
	Potassium	894	--[f]	1473
	Magnesium	4050	--[f]	4687
	Manganese	282	10,000[d,e]	259
	Sodium	353	--[f]	489[g]
	Nickel	9.19	2,000[b]	8.86
	Lead	5.52	400[h]	7.48
	Antimony	0.475	30[b]	4.8[g]
	Selenium	0.07	400[b]	--[c]
	Thallium	1.14	6[i]	--[c]
	Vanadium	22.2	600[d,e]	24
	Zinc	24.9	20,000[d,e]	28.59
BH-10	Mercury	2.11	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	10500	--[e]	7286.95
	Arsenic	5.63	20[d]	4.45
	Barium	254	6,000[d]	235.51
	Beryllium	0.603	0.2[b]	0.82
	Calcium	82900	--[f]	75830.5
	Cadmium	0.66	80[d]	0.87[g]
	Cobalt	6.23	--[e]	4.98
	Chromium	24.4	400[b]	8.7
	Copper	10.9	--[e]	8.61
	Iron	14200	--[f]	11812
	Potassium	1310	--[f]	1473
	Magnesium	5920	--[f]	4687
	Manganese	262	10,000[d,e]	259
	Sodium	490	--[f]	489[g]
	Nickel	12.1	2,000[b]	8.86
	Lead	8.46	400[h]	7.48
	Antimony	0.375	30[b]	4.8[g]
	Selenium	ND	400[d]	--[c]
	Thallium	1.27	6[i]	--[c]
	Vanadium	30.3	600[d,e]	24
	Zinc	34.4	20,000[d,e]	28.59

Refer to footnotes at end of table.

Table 4.6-5 (Continued)
Target Analyte List Metals Detected in Borehole Soil Samples

Borehole	Metal	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[a]
BH-11	Mercury	0.0302	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	10800	--[e]	7286.95
	Arsenic	4.03	20[d]	4.45
	Barium	281	6,000[d]	235.51
	Beryllium	0.588	0.2[b]	0.82
	Calcium	56100	--[f]	75830.5
	Cadmium	0.587	80[d]	0.87[g]
	Cobalt	5.01	--[e]	4.98
	Chromium	12.5	400[b]	8.7
	Copper	9.46	--[e]	8.61
	Iron	13100	--[f]	11812
	Potassium	1310	--[f]	1473
	Magnesium	4640	--[f]	4687
	Manganese	227	10,000[d,e]	259
	Sodium	441	--[f]	489[g]
	Nickel	10.7	2,000[b]	8.86
	Lead	7.51	400[h]	7.48
	Antimony	0.336	30[b]	4.8[g]
	Selenium	0.34	400[b]	--[c]
	Thallium	1.08	6[i]	--[c]
	Vanadium	24.4	600[d,e]	24
	Zinc	30.8	20,000[d,e]	28.59
BH-12	Mercury	0.0986	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	7390	--[e]	7286.95
	Arsenic	4.65	20[d]	4.45
	Barium	162	6,000[d]	235.51
	Beryllium	0.466	0.2[b]	0.82
	Calcium	53000	--[f]	75830.5
	Cadmium	ND	80[d]	0.87[g]
	Cobalt	4.25	--[e]	4.98
	Chromium	12.3	40[b]0	8.7
	Copper	8.03	--[e]	8.61
	Iron	10200	--[f]	11812
	Potassium	1040	--[f]	1473
	Magnesium	3830	--[f]	4687
	Manganese	201	10,000[d,e]	259
	Sodium	377	--[f]	489[g]
	Nickel	8.83	2,000[b]	8.86
	Lead	6.08	400[h]	7.48
	Antimony	0.389	30[b]	4.8[g]
	Selenium	0.188	400[d]	--[c]
	Thallium	0.966	6[i]	--[c]
	Vanadium	21.5	600[d,e]	24
	Zinc	24.8	20,000[d,e]	28.59

Refer to footnotes at end of table.

Table 4.6-5 (Continued)
Target Analyte List Metals Detected in Borehole Soil Samples

Borehole	Metal	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[a]
BH-13	Mercury	0.00963	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	8290	--[e]	7286.95
	Arsenic	3.26	20[d]	4.45
	Barium	557	6,000[d]	235.51
	Beryllium	0.451	0.2[b]	0.82
	Calcium	67900	--[f]	75830.5
	Cadmium	ND	80[d]	0.87[g]
	Cobalt	4.26	--[e]	4.98
	Chromium	15.6	400[b]	8.7
	Copper	9.62	--[e]	8.61
	Iron	11400	--[f]	11812
	Potassium	1230	--[f]	1473
	Magnesium	3480	--[f]	4687
	Manganese	203	10,000[d,e]	259
	Sodium	296	--[f]	489[g]
	Nickel	8.46	2,000[b]	8.86
	Lead	5.8	400[h]	7.48
	Antimony	0.326	30[b]	4.8[g]
	Selenium	ND	400[b]	--[c]
	Thallium	1.14	6[i]	--[c]
	Vanadium	21.0	600[d,e]	24
	Zinc	75.0	20,000[d,e]	28.59
BH-14	Mercury	0.0249	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	8410	--[e]	7286.95
	Arsenic	4.76	20[d]	4.45
	Barium	266	6,000[d]	235.51
	Beryllium	0.455	0.2[b]	0.82
	Calcium	41400	--[f]	75830.5
	Cadmium	ND	80[d]	0.87[g]
	Cobalt	4.78	--[e]	4.98
	Chromium	14.4	400[b]	8.7
	Copper	9.07	--[e]	8.61
	Iron	12100	--[f]	11812
	Potassium	1240	--[f]	1473
	Magnesium	4780	--[f]	4687
	Manganese	217	10,000[d,e]	259
	Sodium	430	--[f]	489[g]
	Nickel	9.1	2,000[b]	8.86
	Lead	6.45	400[h]	7.48
	Antimony	0.374	30[b]	4.8[g]
	Selenium	0.583	400[d]	--[c]
	Thallium	1.56	6[i]	--[c]
	Vanadium	24.7	600[d,e]	24
	Zinc	28.7	20,000[d,e]	28.59

Refer to footnotes at end of table.

Table 4.6-5 (Concluded)
Target Analyte List Metals Detected in Borehole Soil Samples

Borehole	Metal	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[a]
BH-15	Mercury	0.112	20[b]	--[c]
	Silver	ND	400[d]	--[c]
	Aluminum	8930	--[e]	7286.95
	Arsenic	3.63	20[d]	4.45
	Barium	207	6,000[d]	235.51
	Beryllium	0.411	0.2[b]	0.82
	Calcium	155000	--[f]	75830.5
	Cadmium	ND	80[d]	0.87[g]
	Cobalt	3.97	--[e]	4.98
	Chromium	22.4	400[b]	8.7
	Copper	14.6	--[e]	8.61
	Iron	13000	--[f]	11812
	Potassium	1380	--[f]	1473
	Magnesium	3540	--[f]	4687
	Manganese	183	10,000[d,e]	259
	Sodium	341	--[f]	489[g]
	Nickel	9.99	2,000[b]	8.86
	Lead	5.36	400[h]	7.48
	Antimony	0.316	30[b]	4.8[g]
	Selenium	ND	400[b]	--[c]
	Thallium	1.19	6[i]	--[c]
	Vanadium	20.1	600[d,e]	24
	Zinc	45.4	20,000[d,e]	28.59

[a] The UTL is used to define background if the data set is normal or lognormal. The UTL establishes a concentration range that is constructed to contain a specified proportion of the population with a specified confidence. The EPA-recommended coverage of 95% and tolerance coefficient value of 95% was used to calculate the UTL (EPA 1992).

[b] Proposed RCRA Subpart S action level for soils (55 FR 30865).

[c] No UTL or 95 percentile value was calculated because all background concentrations were nondetect.

[d] Action level based on toxicity information contained in the IRIS database (EPA 1995a) or the HEAST (EPA 1995b) and an HI of 1. Soil ingestion equations provided in Subpart S (55 FR 30870) were used to calculate the action levels.

[e] Metal is not listed as a RCRA constituent (40 CFR 261 Appendix VIII) and therefore does not have to be considered as a contaminant of concern.

[f] Metal is considered an essential nutrient as described in RAGS (EPA 1989).

[g] 95th percentile value is used to define background if the data set is nonparametric. The calculated background value is insensitive to the magnitude of the largest 5% of the data points (EPA 1992).

[h] Action level provided in "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Action Facilities" (EPA 1994).

[i] Particular thallium compound was not identified during analysis. The IRIS database, for all thallium compounds listed, gives RFDs in the narrow range of 8 x 10^{-5} to 9 x 10^{-5} (EPA 1995a). Based on the conservative value of 8 x 10^{-5}, an action level of 6 mg/kg was calculated.

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
FR	Federal Register
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
IRIS	Integrated Risk Information System
mg/kg	milligrams per kilogram
ND	Not detected. Concentration reported below instrument detection limit.
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RFD	reference dose
UTL	upper tolerance limit

Table 4.6-6
Range of Beryllium in Borehole Soil Samples

Borehole	Range of Beryllium Concentrations (mg/kg)
BH-1	0.225–0.486
BH-2	0.136–0.451
BH-3	0.258–0.531
BH-4	0.193–0.486
BH-5	0.293–0.46
BH-6	0.29–0.605
BH-7	0.182–0.419
BH-8	0.258–0.569
BH-9	0.244–0.418
BH-10	0.225–0.603
BH-11	0.311–0.588
BH-12	0.213–0.466
BH-13	0.265–0.451
BH-14	0.279–0.455
BH-15	0.127–0.411

mg/kg milligrams per kilogram

Table 4.6-7
Range of Tritium Activity in Borehole Soil Samples

Borehole	Range of Tritium Activity (pCi/g)
BH-1	0.002–0.04
BH-2	0.064[a]
BH-3	0.008–0.009[b]
BH-4	0.003–0.075
BH-5	0.002–0.395
BH-6	0.003–0.745
BH-7	0.004–0.106
BH-8	0.004–1.043
BH-9	0.112–1.403
BH-10	0.01–13.541
BH-11	0.007–0.295
BH-12	0.017–206.7
BH-13	0.005–0.1
BH-14	0.008–0.07
BH-15	0.001–1.773

[a] Only soil sample in which tritium was detected. All other soil samples from this borehole were nondetect.

[b] Only two samples in which tritium was detected. All other soil samples from this borehole were nondetect.

pCi/g picocuries per gram

Table 4.6-8
Tritium Activity with Depth in Borehole Soil Samples (pCi/g)

Borehole Depth[a] (linear ft)	True Depth[b] (ft bgs)	Borehole				
		BH-1	BH-2	BH-3	BH-4	BH-5
10	9	0.038	0.064	0.009	0.075	0.395
30	26	0.01 (0.011)	ND	ND	0.006 (0.012)	0.003
50	43	ND	ND	ND	0.003	ND (0.014)
70	61	0.04	ND	ND (ND)	ND	0.002
90	78	0.008	ND (ND)	ND	ND	ND
110	95	0.004	ND	ND	0.003	ND
120	104	0.002	ND	0.008	ND	0.009
		BH-6	**BH-7**	**BH-8**	**BH-9**	**BH-10**
10	9	0.187	0.106	0.583	1.403	2.09
30	26	0.742 (0.745)	ND (ND)	0.155 (1.043)	0.557 (0.456)	13.541
50	43	ND	ND	0.005	39.1	0.558 (1.406)
70	61	ND	0.05	0.009	0.112	0.08
90	78	0.003	0.007	0.009	0.135	0.161
110	95	ND	0.004	0.004	ND	0.074
120	104	0.009	0.064	NS	NS	NS
130	113	NS	NS	0.010	NS	0.017
135	117	NS	NS	NS	NS	0.01
139	120	NS	NS	NS	NS	0.029
		BH-11	**BH-12**	**BH-13**	**BH-14[c]**	**BH-15[c]**
10	9	0.295	29.48	0.10	0.07	1.773
30	26	0.014 (0.01)	206.70	ND (0.045)	0.027 (0.017)	0.059 (0.041)
50	43	0.03	5.073 (4.723)	0.008	0.03	0.011
70	61	0.016	0.116	0.01	0.02	0.036
90	78	0.022	0.046	0.008	0.023	0.011
110	95	0.007	0.017	0.005	0.008	0.019
119	103	NS	NS	0.01	NS	NS
122	106	NS	0.017	NS	NS	0.001
126	109	0.012	NS	NS	NS	NS

[a] Depth reported is linear ft for boreholes 1 through 13. These boreholes were drilled at an angle of 30 degrees from vertical.

[b] Depth reported is actual ft bgs.

[c] Boreholes 14 and 15 were drilled vertically, therefore, the depths reported are actual ft bgs.

( )	duplicate sample
bgs	below ground surface
ft	feet
ND	Tritium was not detected above minimum detectable activity.
NS	No sample was collected.
pCi/g	picocuries per gram

Table 4.6-9
Local Background Tritium Activities

Sample Location	Sample Number	Depth (ft)	Tritium (pCi/L)	MDA	% Moisture	Tritium (pCi/g)
BKG BH-1	SNL016570-3	6	490	240	8.5	0.042
	SNL016571-3	12	370	240	5.5	0.02
BKG BH-2	SNL016572-3	6	500	240	5.6	0.028
	SNL016573-3	12	600	240	5.7	0.034
BKG BH-3	SNL016574-3	6	490	240	4.7	0.023
	SNL016575-3	12	310	240	4.7	0.015
BKG BH-4	SNL016576-3	6	410	240	5.1	0.021
	SNL016577-3	12	370	240	4.9	0.018
BKG BH-5	SNL016578-3	6	380	230	5.3	0.02
	SNL016579-3	12	540	230	3.7	0.02
BKG BH-6	SNL016580-3	6	400	240	4.4	0.018
	SNL016581-3	6 dup	220	230	4.3	0.009
	SNL016582-3	12	290	230	4.4	0.013
BKG BH-7	SNL016583-3	6	430	230	4.9	0.021
	SNL016584-3	12	160	230	3.5	0.006
BKG BH-8	SNL016585-3	6	280	240	4.8	0.013
	SNL016587-3	6 dup	290	230	4.1	0.012
	SNL016586-3	12	110	230	3.4	0.004
BKG BH-9	SNL016588-3	6	140	230	5.2	0.007
	SNL016589-3	12	280	230	3.1	0.009
BKG BH-10	SNL016590-3	6	290	230	3.0	0.009
	SNL016591-3	12	430	520	2.7	0.012

BKG	Background
dup	duplicate sample
ft	feet
MDA	Minimum detectable activity
pCi/g	picocuries per gram
pCi/L	picocuries per liter

Table 4.6-10
Summary of Statistical Tests Performed on Borehole Soil Sample Data

Analyte	Comparison	Statistical Tests				Exceeds UTL or 95th %	Exceeds Action Level
		Quantile	Wilcoxon Rank Sum	T-Test Equal Variance	T-Test Nonequal Variance		
Aluminum	BKG vs BH-1	P	P	P	P	No	--[a]
	BKG vs BH-2	P	P	P	P	Yes	--[a]
	BKG vs BH-3	P	P	P	P	Yes	--[a]
	BKG vs BH-4	P	P	P	P	Yes	--[a]
	BKG vs BH-5	P	P	P	P	Yes	--[a]
	BKG vs BH-6	P	P	F	P	Yes	--[a]
	BKG vs BH-7	P	P	P	P	Yes	--[a]
	BKG vs BH-8	P	P	P	P	Yes	--[a]
	BKG vs BH-9	P	P	P	P	No	--[a]
	BKG vs BH-10	P	P	P	P	Yes	--[a]
	BKG vs BH-11	P	P	F	P	Yes	--[a]
	BKG vs BH-12	P	P	P	P	Yes	--[a]
	BKG vs BH-13	F	F	F	F	Yes	--[a]
	BKG vs BH-14	F	F	F	F	Yes	--[a]
	BKG vs BH-15	P	P	P	P	Yes	--[a]
Antimony	BKG vs BH-1	P	P	NA	NA	No[b]	No
	BKG vs BH-2	P	P	NA	NA	No[b]	No
	BKG vs BH-3	P	P	NA	NA	No[b]	No
	BKG vs BH-4	P	P	NA	NA	No[b]	No
	BKG vs BH-5	P	P	NA	NA	No[b]	No
	BKG vs BH-6	P	P	NA	NA	No[b]	No
	BKG vs BH-7	P	P	NA	NA	No[b]	No
	BKG vs BH-8	P	P	NA	NA	No[b]	No
	BKG vs BH-9	P	P	NA	NA	No[b]	No
	BKG vs BH-10	P	P	NA	NA	No[b]	No
	BKG vs BH-11	P	P	NA	NA	No[b]	No
	BKG vs BH-12	P	P	NA	NA	No[b]	No
	BKG vs BH-13	P	P	NA	NA	No[b]	No
	BKG vs BH-14	P	P	NA	NA	No[b]	No
	BKG vs BH-15	P	P	NA	NA	No[b]	No
Arsenic	BKG vs BH-1	P	P	P	P	No	No
	BKG vs BH-2	P	P	P	P	No	No
	BKG vs BH-3	P	P	P	P	No	No
	BKG vs BH-4	P	P	P	P	No	No
	BKG vs BH-5	P	P	P	P	No	No
	BKG vs BH-6	P	P	P	P	No	No
	BKG vs BH-7	P	P	P	P	No	No
	BKG vs BH-8	P	P	P	P	Yes	No
	BKG vs BH-9	P	P	P	P	Yes	No
	BKG vs BH-10	P	P	P	P	Yes	No
	BKG vs BH-11	P	P	P	P	No	No
	BKG vs BH-12	P	P	P	P	Yes	No
	BKG vs BH-13	P	P	P	P	No	No
	BKG vs BH-14	P	P	P	P	Yes	No
	BKG vs BH-15	P	P	P	P	No	No

Refer to footnotes at end of table.

Table 4.6-10 (Continued)
Summary of Statistical Tests Performed on Borehole Soil Sample Data

Analyte	Comparison	Statistical Tests				Exceeds UTL or 95th %	Exceeds Action Level
		Quantile	Wilcoxon Rank Sum	T-Test			
				Equal Variance	Nonequal Variance		
Barium	BKG vs BH-1	P	P	P	P	No	No
	BKG vs BH-2	P	P	P	P	No	No
	BKG vs BH-3	P	P	P	P	No	No
	BKG vs BH-4	P	P	P	P	No	No
	BKG vs BH-5	P	P	P	P	Yes	No
	BKG vs BH-6	P	P	P	P	No	No
	BKG vs BH-7	P	P	P	P	Yes	No
	BKG vs BH-8	P	P	P	P	No	No
	BKG vs BH-9	P	P	P	P	No	No
	BKG vs BH-10	P	P	P	P	Yes	No
	BKG vs BH-11	P	P	P	P	Yes	No
	BKG vs BH-12	P	P	P	P	No	No
	BKG vs BH-13	P	P	P	P	Yes	No
	BKG vs BH-14	P	P	P	P	Yes	No
	BKG vs BH-15	P	P	P	P	No	No
Beryllium	BKG vs BH-1	P	P	P	P	No	Yes
	BKG vs BH-2	P	P	P	P	No	Yes
	BKG vs BH-3	P	P	P	P	No	Yes
	BKG vs BH-4	P	P	P	P	No	Yes
	BKG vs BH-5	P	P	P	P	No	Yes
	BKG vs BH-6	P	P	P	P	No	Yes
	BKG vs BH-7	P	P	P	P	No	Yes
	BKG vs BH-8	P	P	P	P	No	Yes
	BKG vs BH-9	P	P	P	P	No	Yes
	BKG vs BH-10	P	P	P	P	No	Yes
	BKG vs BH-11	P	P	P	P	No	Yes
	BKG vs BH-12	P	P	P	P	No	Yes
	BKG vs BH-13	P	P	P	P	No	Yes
	BKG vs BH-14	P	P	P	P	No	Yes
	BKG vs BH-15	P	P	P	P	No	Yes
Cadmium	BKG vs BH-1	P	F	NA	NA	No[b]	No
	BKG vs BH-2	F	F	NA	NA	Yes[b]	No
	BKG vs BH-3	F	F	NA	NA	Yes[b]	No
	BKG vs BH-4	F	F	NA	NA	Yes[b]	No
	BKG vs BH-5	F	F	NA	NA	Yes[b]	No
	BKG vs BH-6	F	F	NA	NA	Yes[b]	No
	BKG vs BH-7	P	F	NA	NA	No[b]	No
	BKG vs BH-8	P	P	NA	NA	No[b]	No
	BKG vs BH-9	P	P	NA	NA	No[b]	No
	BKG vs BH-10	P	P	NA	NA	No[b]	No
	BKG vs BH-11	P	P	NA	NA	No[b]	No
	BKG vs BH-12	P	P	NA	NA	No[b]	No
	BKG vs BH-13	P	P	NA	NA	No[b]	No
	BKG vs BH-14	P	P	NA	NA	No[b]	No
	BKG vs BH-15	P	P	NA	NA	No[b]	No

Refer to footnotes at end of table.

Table 4.6-10 (Continued)
Summary of Statistical Tests Performed on Borehole Soil Sample Data

Analyte	Comparison	Statistical Tests				Exceeds UTL or 95th %	Exceeds Action Level
		Quantile	Wilcoxon Rank Sum	T-Test			
				Equal Variance	Nonequal Variance		
Calcium	BKG vs BH-1	P	P	P	P	No	--[c]
	BKG vs BH-2	P	P	P	P	No	--[c]
	BKG vs BH-3	P	P	P	P	No	--[c]
	BKG vs BH-4	P	P	P	P	No	--[c]
	BKG vs BH-5	P	P	P	P	No	--[c]
	BKG vs BH-6	P	P	P	P	No	--[c]
	BKG vs BH-7	P	P	P	P	No	--[c]
	BKG vs BH-8	P	F	F	F	No	--[c]
	BKG vs BH-9	F	F	F	P	Yes	--[c]
	BKG vs BH-10	P	P	P	P	Yes	--[c]
	BKG vs BH-11	P	P	P	P	No	--[c]
	BKG vs BH-12	P	P	P	P	No	--[c]
	BKG vs BH-13	P	P	P	P	No	--[c]
	BKG vs BH-14	P	P	P	P	No	--[c]
	BKG vs BH-15	P	P	P	P	Yes	--[c]
Chromium	BKG vs BH-1	P	F	F	F	Yes	No
	BKG vs BH-2	F	P	F	F	Yes	No
	BKG vs BH-3	F	F	F	F	Yes	No
	BKG vs BH-4	F	F	F	F	Yes	No
	BKG vs BH-5	F	F	F	F	Yes	No
	BKG vs BH-6	F	F	F	F	Yes	No
	BKG vs BH-7	F	F	F	F	Yes	No
	BKG vs BH-8	F	F	F	F	Yes	No
	BKG vs BH-9	F	F	F	F	Yes	No
	BKG vs BH-10	F	F	F	F	Yes	No
	BKG vs BH-11	F	F	F	F	Yes	No
	BKG vs BH-12	F	F	F	F	Yes	No
	BKG vs BH-13	F	F	F	F	Yes	No
	BKG vs BH-14	F	F	F	F	Yes	No
	BKG vs BH-15	P	F	F	P	Yes	No
Cobalt	BKG vs BH-1	P	P	P	P	No	--[a]
	BKG vs BH-2	P	P	P	P	No	--[a]
	BKG vs BH-3	P	P	P	P	Yes	--[a]
	BKG vs BH-4	P	P	P	P	Yes	--[a]
	BKG vs BH-5	P	P	P	P	No	--[a]
	BKG vs BH-6	P	P	P	P	No	--[a]
	BKG vs BH-7	P	P	P	P	No	--[a]
	BKG vs BH-8	P	P	P	P	Yes	--[a]
	BKG vs BH-9	P	P	P	P	Yes	--[a]
	BKG vs BH-10	P	P	P	P	Yes	--[a]
	BKG vs BH-11	P	P	P	P	Yes	--[a]
	BKG vs BH-12	P	P	P	P	No	--[a]
	BKG vs BH-13	P	P	P	P	No	--[a]
	BKG vs BH-14	P	P	P	P	No	--[a]
	BKG vs BH-15	P	P	P	P	No	--[a]

Refer to footnotes at end of table.

Table 4.6-10 (Continued)
Summary of Statistical Tests Performed on Borehole Soil Sample Data

Analyte	Comparison	Statistical Tests				Exceeds UTL or 95th %	Exceeds Action Level
				T-Test			
		Quantile	Wilcoxon Rank Sum	Equal Variance	Nonequal Variance		
Copper	BKG vs BH-1	F	F	F	F	Yes	--[a]
	BKG vs BH-2	F	F	F	F	Yes	--[a]
	BKG vs BH-3	F	F	F	F	Yes	--[a]
	BKG vs BH-4	F	F	F	F	Yes	--[a]
	BKG vs BH-5	F	F	F	F	Yes	--[a]
	BKG vs BH-6	F	F	F	F	Yes	--[a]
	BKG vs BH-7	F	F	F	F	Yes	--[a]
	BKG vs BH-8	F	F	F	F	Yes	--[a]
	BKG vs BH-9	F	F	F	F	Yes	--[a]
	BKG vs BH-10	F	F	F	P	Yes	--[a]
	BKG vs BH-11	F	F	F	F	Yes	--[a]
	BKG vs BH-12	P	P	P	P	No	--[a]
	BKG vs BH-13	F	F	F	P	Yes	--[a]
	BKG vs BH-14	P	F	F	P	Yes	--[a]
	BKG vs BH-15	P	P	F	P	Yes	--[a]
Iron	BKG vs BH-1	P	P	P	P	No	--[c]
	BKG vs BH-2	F	P	P	P	Yes	--[c]
	BKG vs BH-3	F	F	F	F	No	--[c]
	BKG vs BH-4	P	P	P	P	No	--[c]
	BKG vs BH-5	P	F	P	F	No	--[c]
	BKG vs BH-6	P	F	F	F	No	--[c]
	BKG vs BH-7	P	P	P	P	No	--[c]
	BKG vs BH-8	P	F	F	F	Yes	--[c]
	BKG vs BH-9	P	F	F	F	No	--[c]
	BKG vs BH-10	P	F	F	P	Yes	--[c]
	BKG vs BH-11	P	F	F	F	Yes	--[c]
	BKG vs BH-12	P	P	P	P	No	--[c]
	BKG vs BH-13	F	F	F	F	No	--[c]
	BKG vs BH-14	P	F	F	F	Yes	--[c]
	BKG vs BH-15	P	P	P	P	Yes	--[c]
Lead	BKG vs BH-1	P	P	P	P	No	No
	BKG vs BH-2	P	P	P	P	No	No
	BKG vs BH-3	P	P	P	P	Yes	No
	BKG vs BH-4	P	P	P	P	Yes	No
	BKG vs BH-5	P	P	P	P	No	No
	BKG vs BH-6	P	F	F	P	Yes	No
	BKG vs BH-7	P	P	P	P	No	No
	BKG vs BH-8	P	P	P	P	Yes	No
	BKG vs BH-9	P	P	P	P	No	No
	BKG vs BH-10	P	P	P	P	Yes	No
	BKG vs BH-11	P	P	P	P	Yes	No
	BKG vs BH-12	P	P	P	P	No	No
	BKG vs BH-13	P	P	P	P	No	No
	BKG vs BH-14	P	P	P	P	No	No
	BKG vs BH-15	P	P	P	P	No	No

Refer to footnotes at end of table.

Table 4.6-10 (Continued)
Summary of Statistical Tests Performed on Borehole Soil Sample Data

Analyte	Comparison	Statistical Tests				Exceeds UTL or 95th %	Exceeds Action Level
		Quantile	Wilcoxon Rank Sum	T-Test			
				Equal Variance	Nonequal Variance		
Magnesium	BKG vs BH-1	P	P	P	P	No	--[c]
	BKG vs BH-2	P	P	P	P	No	--[c]
	BKG vs BH-3	P	P	P	P	No	--[c]
	BKG vs BH-4	P	P	P	P	Yes	--[c]
	BKG vs BH-5	P	P	P	P	Yes	--[c]
	BKG vs BH-6	P	P	P	P	No	--[c]
	BKG vs BH-7	P	P	P	P	No	--[c]
	BKG vs BH-8	P	P	P	P	Yes	--[c]
	BKG vs BH-10	P	P	P	P	No	--[c]
	BKG vs BH-11	P	P	P	P	No	--[c]
	BKG vs BH-12	P	P	P	P	No	--[c]
	BKG vs BH-13	P	P	P	P	No	--[c]
	BKG vs BH-14	P	P	P	P	No	--[c]
	BKG vs BH-15	P	P	P	P	No	--[c]
Selenium[d]	--	--	--	--	--	--	--
Silver[d]	--	--	--	--	--	--	--
Sodium	BKG vs BH-1	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-2	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-3	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-4	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-5	P	P	NA	NA	Yes[b]	--[c]
	BKG vs BH-6	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-7	P	P	NA	NA	Yes[b]	--[c]
	BKG vs BH-8	P	P	NA	NA	Yes[b]	--[c]
	BKG vs BH-9	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-10	P	P	NA	NA	Yes[b]	--[c]
	BKG vs BH-11	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-12	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-13	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-9	P	P	P	P	No	--[c]
	BKG vs BH-10	P	P	P	P	Yes	--[c]
	BKG vs BH-11	P	P	P	P	No	--[c]
	BKG vs BH-12	P	P	P	P	No	--[c]
	BKG vs BH-13	P	P	P	P	No	--[c]
	BKG vs BH-14	P	P	P	P	Yes	--[c]
	BKG vs BH-15	P	P	P	P	No	--[c]

Refer to footnotes at end of table.

Table 4.6-10 (Continued)
Summary of Statistical Tests Performed on Borehole Soil Sample Data

Analyte	Comparison	Statistical Tests				Exceeds UTL or 95th %	Exceeds Action Level
		Quantile	Wilcoxon Rank Sum	T-Test			
				Equal Variance	Nonequal Variance		
Manganese	BKG vs BH-1	P	P	P	P	No	--[a]
	BKG vs BH-2	P	P	P	P	No	--[a]
	BKG vs BH-3	P	P	P	P	No	--[a]
	BKG vs BH-4	P	P	P	P	No	--[a]
	BKG vs BH-5	P	P	P	P	No	--[a]
	BKG vs BH-6	P	P	P	P	No	--[a]
	BKG vs BH-7	P	P	P	P	No	--[a]
	BKG vs BH-8	P	F	F	F	No	--[a]
	BKG vs BH-9	P	F	F	F	Yes	--[a]
	BKG vs BH-10	P	P	P	P	Yes	--[a]
	BKG vs BH-11	P	P	P	P	No	--[a]
	BKG vs BH-12	P	P	P	P	No	--[a]
	BKG vs BH-13	P	P	P	P	No	--[a]
	BKG vs BH-14	P	P	P	F	No	--[a]
	BKG vs BH-15	P	P	P	P	No	--[a]
Mercury[d]	--	--	--	--	--	--	--
Nickel	BKG vs BH-1	P	P	P	P	Yes	No
	BKG vs BH-2	F	P	F	P	Yes	No
	BKG vs BH-3	F	F	F	P	Yes	No
	BKG vs BH-4	P	P	P	P	Yes	No
	BKG vs BH-5	P	P	P	P	No	No
	BKG vs BH-6	F	F	F	F	Yes	No
	BKG vs BH-7	P	P	P	P	Yes	No
	BKG vs BH-8	F	F	F	F	Yes	No
	BKG vs BH-9	F	F	F	F	Yes	No
	BKG vs BH-10	P	P	F	P	Yes	No
	BKG vs BH-11	F	F	F	F	Yes	No
	BKG vs BH-12	P	P	P	P	No	No
	BKG vs BH-13	P	F	F	F	No	No
	BKG vs BH-14	P	F	F	F	Yes	No
	BKG vs BH-15	P	P	P	P	Yes	No
Potassium	BKG vs BH-1	P	P	P	P	No	--[c]
	BKG vs BH-2	P	P	P	P	No	--[c]
	BKG vs BH-3	P	P	P	P	No	--[c]
	BKG vs BH-4	P	P	P	P	No	--[c]
	BKG vs BH-5	P	P	P	P	No	--[c]
	BKG vs BH-6	P	P	P	P	Yes	--[c]
	BKG vs BH-7	P	P	P	P	No	--[c]
	BKG vs BH-8	P	P	P	P	No	--[c]
	BKG vs BH-9	P	P	P	P	No	--[c]
	BKG vs BH-14	P	P	NA	NA	No[b]	--[c]
	BKG vs BH-2	P	P	P	P	No	--[a]
	BKG vs BH-15	P	P	NA	NA	No[b]	--[c]
Thallium[d]	--	--	--	--	--	--	--

Refer to footnotes at end of table.

Table 4.6-10 (Concluded)
Summary of Statistical Tests Performed on Borehole Soil Sample Data

Analyte	Comparison	Statistical Tests				Exceeds UTL or 95th %	Exceeds Action Level
		Quantile	Wilcoxon Rank Sum	T-Test			
				Equal Variance	Nonequal Variance		
Vanadium	BKG vs BH-1	P	P	P	P	No	--[a]
	BKG vs BH-3	P	P	P	P	No	--[a]
	BKG vs BH-4	P	P	P	P	No	--[a]
	BKG vs BH-5	P	P	P	P	No	--[a]
	BKG vs BH-6	P	F	F	F	No	--[a]
	BKG vs BH-7	P	P	P	P	No	--[a]
	BKG vs BH-8	P	F	F	F	Yes	--[a]
	BKG vs BH-9	P	P	F	P	No	--[a]
	BKG vs BH-10	P	P	F	P	Yes	--[a]
	BKG vs BH-11	P	F	F	F	Yes	--[a]
	BKG vs BH-12	P	P	P	P	No	--[a]
	BKG vs BH-13	P	F	F	F	No	--[a]
	BKG vs BH-14	P	F	F	F	Yes	--[a]
	BKG vs BH-15	P	P	P	P	No	--[a]
Zinc	BKG vs BH-1	P	F	F	F	Yes	--[a]
	BKG vs BH-2	P	P	P	P	Yes	--[a]
	BKG vs BH-3	P	F	F	P	Yes	--[a]
	BKG vs BH-4	P	F	F	P	Yes	--[a]
	BKG vs BH-5	P	F	F	F	No	--[a]
	BKG vs BH-6	P	F	F	F	Yes	--[a]
	BKG vs BH-7	P	P	P	P	Yes	--[a]
	BKG vs BH-8	P	F	F	F	Yes	--[a]
	BKG vs BH-9	P	P	P	P	No	--[a]
	BKG vs BH-10	P	P	P	P	Yes	--[a]
	BKG vs BH-11	F	F	F	F	Yes	--[a]
	BKG vs BH-12	P	P	P	P	No	--[a]
	BKG vs BH-13	P	P	F	P	Yes	--[a]
	BKG vs BH-14	P	F	F	P	Yes	--[a]
	BKG vs BH-15	P	P	P	P	Yes	--[a]

[a] Metal is not listed as a RCRA constituent (40 CFR 261 Appendix VIII).

[b] 95th percentile.

[c] Metal is considered an essential nutrient as described in RAGS (EPA 1989).

[d] The number of nondetects in the background soil samples precluded the use of statistical analysis.

BH-1	Borehole analytical data from borehole BH-1.
BKG	Background analytical data.
F	Data set for specified analyte fails statistical test when compared to background.
NA	T-test was not performed because data set is nonparametric.
P	Data set for specified analyte passes statistical test when compared to background.
UTL	upper tolerance limit

Table 4.7-1
Summary of Samples Collected From MW-4

Sample Number	Date Collected	Sample Depth[a] (linear ft)	True Sample Depth[b] (ft bgs)	Sample Matrix	Sample Type	Analyses Requested
ER92003638	12/16/92	5	5	Soil	Routine	Tritium
ER92003639	12/16/92	10	10	Soil	Routine	Full Suite[d]
ER92003639	12/16/92	10	10	Soil	Replicate of 3639	Full Suite[d] except VOCs
ER92003640	12/16/92	10	10	Soil	Duplicate of 3639	GS, VOCs[d]
ER92003641	12/16/92	15	15	Soil	Routine	Tritium
ER92003642	12/16/92	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92003643	12/17/92	20	20	Soil	Routine	Full Suite[d]
ER92003644	12/17/92	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92003645	12/17/92	25	25	Soil	Routine	Tritium
ER92003646	12/17/92	30	30	Soil	Routine	Full Suite[d]
ER92003646	12/17/92	30	30	Soil	Duplicate of 3646	Full Suite[d]
ER92003650	12/18/92	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92003648	12/18/92	35	35	Soil	Routine	Tritium
ER92003649	12/18/92	41	41	Soil	Routine	Full Suite[d]
ER92003651	12/18/92	45	45	Soil	Routine	Tritium
ER92003652	12/18/92	50	50	Soil	Routine	Full Suite[d]
ER92003654	12/19/92	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92003655	12/19/92	70	70	Soil	Routine	Full Suite[d]
ER92004042	12/20/92	78	78	Soil	Routine	Full Suite[d]
ER92004043	12/20/92	89	89	Soil	Routine	Full Suite[d]
ER92004044	12/20/92	100	99	Soil	Routine	GS
ER92004032	12/21/92	NA[c]	NA[c]	Water	Equipment Rinsate	Full Suite[d]
ER92004034	12/21/92	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004031	12/21/92	100	99	Soil	Routine	Full Suite[d]
ER92004033	12/21/92	121	120	Soil	Routine	Full Suite[d]
ER92004038	12/22/92	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004036	12/22/92	140	139	Soil	Routine	Full Suite[d]
ER92004037	12/22/92	160	159	Soil	Routine	Full Suite[d]
ER92004039	1/5/93	180	179	Soil	Routine	GS
ER92004029	1/6/93	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004040	1/6/93	180	179	Soil	Routine	Full Suite[d]
ER92004041	1/6/93	200	199	Soil	Routine	Full Suite[d]
ER92004030	1/6/93	200	199	Soil	Duplicate of 4041	Full Suite[d]
ER92004028	1/8/93	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004027	1/8/93	250	249	Soil	Routine	Full Suite[d]
ER92004026	1/11/93	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004025	1/11/93	294	292	Soil	Routine	Full Suite[d]
ER92004024	1/11/93	294	292	Soil	Duplicate of 4025	Full Suite[d]
ER92004182	1/14/93	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004181	1/14/93	353	351	Soil	Routine	Full Suite[d]

Refer to footnotes at end of table.

Table 4.7-1 (Concluded)
Summary of Samples Collected From MW-4

Sample Number	Date Collected	Sample Depth[a] (linear ft)	True Sample Depth[b] (ft bgs)	Sample Matrix	Sample Type	Analyses Requested
ER92004184	1/20/93	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004183	1/20/93	400	398	Soil	Routine, MS/MSD	Full Suite[d]
ER92004185	1/27/93	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004180	1/27/93	447	445	Soil	Routine	Full Suite[d]
ER92004347	2/4/93	486 water table	483 water table	Soil	Routine	Full Suite[d] no VOCs
ER92004349	2/5/93	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004348	2/5/93	499	496	Soil	Routine	Full Suite[d]
ER92004343	2/8/93	NA[c]	NA[c]	Water	Trip Blank	VOCs
ER92004342	2/8/93	546 total depth	543 total depth	Soil	Routine, MS/MSD	Full Suite[d]
ER92004350	2/8/93	546 total depth	543 total depth	Water	Equipment Rinsate	Full Suite[d]

[a] Depth reported is linear ft. Monitoring well was drilled at an angle of 6 degrees from vertical.

[b] Depth reported is actual ft bgs.

[c] NA - not applicable, aqueous blank not collected from the subsurface.

[d] Full Suite - VOCs (EPA Method 8240); semivolatile organic compounds (EPA Method 8270); Target Analyte List metals (EPA Methods 6000/7000 series); Cr^{6+} (EPA Method 7196); total Pu, Th, U; gross alpha/beta; tritium (EPA Method H-03); isotopic Pu, Th, U (EPA/EMSL); and gamma spectroscopy.

bgs	below ground surface
EMSL	Environmental Measurements and Standards Laboratory
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ft	feet
GS	gamma spectroscopy
MS/MSD	matrix spike/matrix spike duplicate
VOCs	volatile organic compounds

Table 4.7-2
Analytical Methods for MW-4 Soil Sampling

Analytical Group	Analytical Method
VOCs	SW-846 (8240)
SVOCs	SW-846 (8270)
TAL Metals	SW-846 (6010 for ICP metals, 7471 for mercury, 7196 for Cr^{6+}, 7060 for arsenic, 7740 for selenium, 7841 for thallium, and 7421 for lead)
Total Metals	RMAL[a] (3020/3050)
Isotopic Uranium, Thorium, Plutonium	EPA/EMSL[b]
Gross Alpha/Beta	EPA Method 903.1
Tritium in soil	EPA Method H-01

[a] Rocky Mountain Analytical Laboratory method

[b] Environmental Measurements and Standards Laboratory method

EMSL	Environmental Measurements and Standards Laboratory
EPA	U.S. Environmental Protection Agency
ICP	inductively coupled plasma
MW	monitor well
RMAL	Rocky Mountain Analytical Laboratory
SVOC	semivolatile organic compound
SW-846	Analytical laboratory methods presented in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (EPA 1986).
TAL	Target Analyte List
VOC	volatile organic compound

Table 4.7-3
MW-4 Soil Sample Collection Summary

Sample Depth^a (linear ft)	Sample Depth^b (ft bgs)	VOCs	SVOCs	TAL Metals	Hexavalent Chromium (Cr^{6+})	Total U, Pu, Th	Isotopic U, Pu, Th	Gross alpha/ beta	Tritium	Total
5	5	NS	NS	NS	NS	NS	NS	NS	1	1
10	10	1	1	1	1	1	1	1	1	8
10 dup	10 dup	1	1	1	1	1	1	1	1	8
15	15	NS	NS	NS	NS	NS	NS	NS	1	1
20	20	1	1	1	1	1	1	1	1	8
25	25	NS	NS	NS	NS	NS	NS	NS	1	1
30	30	1	1	1	1	1	1	1	1	8
30 dup	30 dup	1	1	1	1	1	1	1	1	8
35	35	NS	NS	NS	NS	NS	NS	NS	1	1
41	41	1	1	1	1	1	1	1	1	8
45	45	NS	NS	NS	NS	NS	NS	NS	1	1
50	50	1	1	1	1	1	1	1	1	8
60	60	NS	NS	NS	NS	NS	NS	NS	NS	NS
70	70	1	1	1	1	1	1	1	1	8
78	78	1	1	1	1	1	1	1	1	8
89	89	1	1	1	1	1	1	1	1	8
100	99	1	1	1	1	1	1	1	1	8
121	120	1	1	1	1	1	1	1	1	8
140	139	1	1	1	1	1	1	1	1	8
160	159	1	1	1	1	1	1	1	1	8
180	179	1	1	1	1	1	1	1	1	8
200	199	1	1	1	1	1	1	1	1	8
200 dup	199 dup	1	1	1	1	1	1	1	1	8
250	249	1	1	1	1	1	1	1	1	8
294	292	1	1	1	1	1	1	1	1	8
294 dup	292 dup	1	1	1	1	1	1	1	1	8
353	351	1	1	1	1	1	1	1	1	8
400	398	1	1	1	1	1	1	1	1	8
447	445	1	1	1	1	1	1	1	1	8
486	483	NS	1	1	1	1	1	1	1	7
499	496	1	1	1	1	1	1	1	1	8
546	543	1	1	1	1	1	1	1	1	8
Total		25	26	26	26	26	26	26	31	212

[a] Depth reported is linear ft. Monitoring well was drilled at an angle of 6 degrees from vertical.

[b] Depth reported is actual ft bgs.

bgs	below ground surface
dup	duplicate sample
ft	feet
MW	monitor well
NS	no sample collected
SVOC	semivolatile organic compound
TAL	target analyte list
VOC	volatile organic compound

Table 4.7-4
Volatile and Semivolatile Organic Compounds Present in Laboratory and/or Field Blanks

Sample Depth[a] (linear ft)	Acetone[b]	2-Butanone[b]	Methylene Chloride[b]	Total Xylenes[b]	Carbon Disulfide[b]	Ethylbenzene[b]	Diethyl Phthalate[c]	N-Nitroso-Diphenylamine[c]	Di-n-butyl Phthalate[c]
10	LMB	LMB	LMB, TB	--	--	--	--	--	--
10 dup	LMB	LMB	LMB, TB	--	--	--	--	--	--
10 dup (RA)	LMB	--	LMB	--	--	--	--	--	--
20	LMB	LMB	LMB, TB	--	--	--	--	--	--
20 (RA)	LMB	--	LMB	--	--	--	--	--	--
30	LMB	LMB	LMB, TB	--	--	--	--	--	--
30 dup	LMB	LMB	LMB	--	--	--	--	--	--
30 (RA)	LMB	--	LMB	--	--	--	--	--	--
41	LMB, TB	--	TB	--	--	--	--	--	--
41 (RA)	LMB	--	LMB	--	--	--	--	--	--
50	TB	--	TB	--	--	--	--	--	--
50 (RA)	LMB	--	LMB	--	--	--	--	--	--
70	LMB	--	LMB, TB	--	--	--	--	--	--
78	LMB	--	LMB, TB	--	--	--	--	--	--
89	LMB	--	LMB, TB	--	--	--	--	--	--
100	EB, TB	--	--	--	--	--	EB	EB	--
121	EB, TB	--	--	--	--	--	--	--	--
140	LMB	--	LMB, TB	--	--	--	--	--	--
160	LMB	--	TB	--	--	--	--	--	--
180	LMB, TB	--	LMB, TB	LMB	--	--	--	--	LMB
200	LMB, TB	--	LMB, TB	LMB	--	--	--	--	--
200 dup	LMB, TB	--	LMB, TB	LMB	--	--	--	--	--
250	LMB	--	LMB	LMB	--	--	--	--	--
294	LMB	--	--	--	TB	--	--	--	--
294 dup	LMB	--	--	--	TB	--	--	--	--
353	LMB, TB	--	TB	--	--	--	--	--	--
400	TB	--	TB	--	--	--	--	--	--
447	LMB, TB	--	LMB, TB	--	--	--	--	--	--

Refer to footnotes at end of table.

Table 4.7-4 (Concluded)
Volatile and Semivolatile Organic Compounds Present in Laboratory and/or Field Blanks

Sample Depth[a] (linear ft)	Acetone[b]	2-Butanone[b]	Methylene Chloride[b]	Total Xylenes[b]	Carbon Disulfide[b]	Ethylbenzene[b]	Diethyl Phthalate[c]	N-Nitroso-Diphenylamine[c]	Di-n-butyl Phthalate[c]
486[d]	--	--	--	--	--	--	--	--	--
499	LMB, TB	--	TB	--	--	--	--	--	--
546	LMB, EB, TB	LMB	TB	--	--	EB	--	--	--

[a] Depth reported is linear ft. Monitoring well was drilled at an angle of 6 degrees from vertical.

[b] Volatile organic compounds.

[c] Semivolatile organic compounds.

[d] No samples were collected for volatile organic compounds analysis at this depth.

dup	duplicate sample
EB	Compound present in equipment rinsate blank.
ft	feet
LMB	Compound present in analytical laboratory method blank.
(RA)	Reanalysis
TB	Compound present in trip blank.
--	not found

Table 4.7-5
Volatile Organic Compounds and Semivolatile Organic Compounds Detected in MW-4 Soil Samples

Analyte	Sample Depth[a] (linear ft)	True Sample Depth[b] (ft bgs)	Highest Measured Concentration (µg/kg)	Action Level (µg/kg)
Volatile Organic Compounds				
2-Butanone	447	445	12	50,000,000[c]
2-Hexanone	447	445	1.7 J	3,000,000[c]
Acetone	447	445	130	8,000,000[d]
Methylene chloride	10	10	3800	90,000[d]
PCE	250	249	5.4	10,000[d]
Toluene	70	70	5.4	20,000,000[d]
Semivolatile Organic Compounds				
Benzoic acid	160	159	68 J	300,000,000[c]
Bis(2-ethylhexyl) phthalate	200 dup	199 dup	2900	50,000[d]
Di-n-butyl phthalate	294	292	80 J	8,000,000[d]
Di-n-octyl phthalate	200 dup	199 dup	130 J	1,600,000[c]
N-nitrosodiphenylamine	160	159	74 J	100,000[d]
Phenol	180	179	460	50,000,000[d]

[a] Depth reported is linear ft. Monitoring well was drilled at an angle of 6 degrees from vertical.

[b] Depth reported is actual ft bgs.

[c] Action level based on toxicity information contained in the IRIS database (EPA 1995a) or the HEAST (EPA 1995b) and an HI of 1. Soil ingestion equations provided in Subpart S (55 FR 30870) were used to calculate action levels.

[d] Proposed RCRA Subpart S action level for soils (55 FR 30865).

bgs	below ground surface
dup	duplicate
EPA	U.S. Environmental Protection Agency
FR	Federal Register
ft	feet
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
IRIS	Integrated Risk Information System
J	Concentration of the compound in the sample was below the Reporting Limit but above the Detection Limit.
MW	monitor well
PCE	tetrachloroethene
RCRA	Resource Conservation and Recovery Act
µg/kg	micrograms per kilogram

Table 4.7-6
Target Analyte List Metals in MW-4 Soil Samples

Metal	Sample Depth (linear ft)	True Sample Depth (ft bgs)	Highest Measured Concentration (mg/kg)	Action Level (mg/kg)	Statistically Determined UTL[g]
Mercury	294	292	0.12	20[a]	--[i]
Silver	30	30	0.73	400[b]	--[i]
Aluminum	546	543	15900	--[d]	7286.95
Arsenic	250	249	4.8	20[b]	4.45
Barium	447	445	225	6,000[b]	235.51
Beryllium	546	543	1.1	0.2[a]	0.82
Calcium	200 dup	199 dup	118000	--[c]	75830.5
Cadmium	10 dup	10 dup	0.81	80[b]	0.87[h]
Cobalt	546	543	8.9	--[d]	4.98
Chromium	10 dup	10 dup	34.3	400[a]	8.7
Copper	546	543	15.9	--[d]	8.61
Iron	546	543	16600	--[c]	11812
Potassium	546	543	3480	--[c]	1473
Magnesium	499	496	7640	--[c]	4687
Manganese	50	50	579	10,000[b, d]	259
Sodium	20	20	413	--[c]	489[h]
Nickel	250	249	15.6	2,000[a]	8.86
Lead	294 dup	292 dup	13.2	400[e]	7.48
Antimony	200 dup	199 dup	5.8	30[a]	4.8[h]
Selenium	70	70	0.61	400[b]	--[i]
Thallium	All depths except 10 dup, 41, 50	All depths except 10 dup, 41, 50	0.0379	6[f]	--[i]
Vanadium	546	543	25.7	600[b, d]	24
Zinc	89	89	69.4	20,000[b, d]	28.59

[a] Proposed RCRA Subpart S action level for soils (55 FR 30865).

[b] Action level based on toxicity information contained in the IRIS database (EPA 1995a) or the HEAST (EPA 1995b) and an HI of 1. Soil ingestion equations provided in Subpart S (55 FR 30870) were used to calculate the action levels.

[c] Metal is considered an essential nutrient as described in RAGS (EPA 1989).

[d] Metal is not listed as a RCRA constituent (40 CFR 261 Appendix VIII) and therefore was not considered as a contaminant of concern.

[e] Action level provided in "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (EPA 1994).

[f] Particular thallium compound was not identified during analysis. The IRIS database, for all thallium compounds listed, gives RFDs in the narrow range of 8×10^{-5} to 9×10^{-5} (EPA 1995a). Based on the conservative value of 8×10^{-5}, an action level of 6 mg/kg was calculated.

[g] The UTL is used to define background if the data set is normal or lognormal. The UTL establishes a concentration range that is constructed to contain a specified proportion of the population with a specified confidence. The EPA-recommended coverage of 95% and tolerance coefficient value of 95% was used to calculate the UTL (EPA 1992).

[h] 95th percentile value is used to define background if the data set is nonparametric. The calculated background value is insensitive to the magnitude of the largest 5% of the data points (EPA 1992).

[i] No UTL or 95 percentile value was calculated because all background concentrations were nondetect.

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
dup	duplicate
EPA	U.S. Environmental Protection Agency
FR	Federal Register
ft	feet
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
IRIS	Integrated Risk Information System
mg/kg	milligrams per kilogram
MW	monitor well
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RFD	reference doses
UTL	upper tolerance limit

Table 4.7-7
Concentrations of Chromium in MW-4 Soil Samples

Sample Number	Sample Depth[a] (linear ft)	True Sample Depth[b] (ft bgs)	Total Chromium Concentration (mg/kg)	Chromium VI Concentration (mg/kg)	Chromium III Concentration (mg/kg)	Below Action Level[c, d]
ER92003639-3	10	10	8.6	ND	8.6	Yes
ER92003639-3	10 dup	10 dup	34.3	ND	34.3	Yes
ER92003643-3	20	20	13.6	ND	13.6	Yes
ER92003646-3	30	30	10.2	ND	10.2	Yes
ER92003646-3	30 dup	30 dup	9.2	ND	9.2	Yes
ER92003649-3	41	41	14.8	ND	14.8	Yes
ER92003652-3	50	50	13.7	ND	13.7	Yes
ER92003655-3	70	70	6.7	ND	6.7	Yes
ER92004042-2	78	78	5.9	ND	5.9	Yes
ER92004043-2	89	89	9.3	ND	9.3	Yes
ER92004031-2	100	99	5.6	0.14	5.46	Yes
ER92004033-2	121	120	5.6	0.12	5.48	Yes
ER92004036-2	140	139	13.2	ND	13.2	Yes
ER92004037-2	160	159	13.6	ND	13.6	Yes
ER92004040-2	180	179	23.5	ND	23.5	Yes
ER92004041-2	200	199	14.1	ND	14.1	Yes
ER92004030-2	200 dup	199 dup	10	0.1	9.9	Yes
ER92004027-2	250	249	11.9	ND	11.9	Yes
ER92004025-2	294	292	25.9	0.13	25.77	Yes
ER92004024-2	294 dup	292 dup	13.8	0.23	13.57	Yes
ER92004181-2	353	351	13.4	ND	13.4	Yes
ER92004183-2	400	398	9.9	ND	9.9	Yes
ER92004180-2	447	445	17.9	ND	17.9	Yes
ER92004347-2	486	483	11.4	ND	11.4	Yes
ER92004348-2	499	496	13.8	ND	13.8	Yes
ER92004342-2	546	543	14.1	0.15	13.95	Yes

[a] Depth reported is linear ft. Monitoring well was drilled at an angle of 6 degrees from vertical.

[b] Depth reported is actual ft bgs.

[c] Action level based on toxicity information contained in the IRIS database (EPA 1995a) and an HI of 1. The soil ingestion equations provided in Subpart S (55 FR 30870) were used to calculate an action level of 80,000 mg/kg for chromium III.

[d] The proposed RCRA Subpart S action level for chromium VI in soils is 400 mg/kg (55 FR 30865).

bgs	below ground surface
dup	duplicate sample
EPA	U.S. Environmental Protection Agency
FR	Federal Register
ft	feet
HI	hazard index
IRIS	Integrated Risk Information System
mg/kg	milligrams per kilogram
MW	monitor well
ND	not detected
RCRA	Resource Conservation and Recovery Act

Table 4.7-8
Concentrations of Beryllium in MW-4 Soil Samples

Sample Number	Sample Depth[a] (linear ft)	True Sample Depth[b] (ft bgs)	Beryllium Concentration (mg/kg)	Below Action Level[c] (0.2 mg/kg)	Below UTL[d] (0.82 mg/kg)
ER92003639-3	10	10	0.28	No	Yes
ER92003639-3	10 dup	10 dup	0.32	No	Yes
ER92003643-3	20	20	0.33	No	Yes
ER92003646-3	30	30	0.26	No	Yes
ER92003646-3	30 dup	30 dup	0.19	Yes	Yes
ER92003649-3	41	41	0.32	No	Yes
ER92003652-3	50	50	0.33	No	Yes
ER92003655-3	70	70	0.22	No	Yes
ER92004042-2	78	78	0.33	No	Yes
ER92004043-2	89	89	0.32	No	Yes
ER92004031-2	100	99	0.05	Yes	Yes
ER92004033-2	121	120	0.05	Yes	Yes
ER92004036-2	140	139	0.38	No	Yes
ER92004037-2	160	159	0.35	No	Yes
ER92004040-2	180	179	0.41	No	Yes
ER92004041-2	200	199	0.33	No	Yes
ER92004030-2	200 dup	199 dup	0.34	No	Yes
ER92004027-2	250	249	0.96	No	No
ER92004025-2	294	292	0.64	No	Yes
ER92004024-2	294 dup	292 dup	0.71	No	Yes
ER92004181-2	353	351	0.85	No	No
ER92004183-2	400	398	0.55	No	Yes
ER92004180-2	447	445	0.94	No	No
ER92004347-2	486	483	0.69	No	Yes
ER92004348-2	499	496	1	No	No
ER92004342-2	546	543	1.1	No	No

[a] Depth reported is linear ft. Monitoring well was drilled at an angle of 6 degrees from vertical.

[b] Depth reported is actual ft bgs.

[c] Proposed RCRA Subpart S action level for soils (55 FR 30865).

[d] The UTL is used to define background if the data set is normal or lognormal. The UTL establishes a concentration range that is constructed to contain a specified proportion of the population with a specified confidence. The EPA-recommended coverage of 95% and tolerance coefficient value of 95% was used to calculate the UTL (EPA 1992).

bgs	below ground surface
dup	duplicate
EPA	U.S. Environmental Protection Agency
ft	feet
FR	Federal Register
mg/kg	milligrams per kilogram
MW	monitor well
RCRA	Resource Conservation and Recovery Act
UTL	upper tolerance limit

Table 4.7-9
Beryllium Reanalysis From Selected MW-4 Soil Samples

Sample Number	Sample Depth[a] (linear ft)	True Sample Depth[b] (ft bgs)	Beryllium Concentration (mg/kg)	Below Action Level[c] (0.2 mg/kg)	Below UTL[d] (0.82 mg/kg)
ER92004027-2	250	249	0.96	No	No
027251-01 (Reanalysis of ER92004027-2)	250	249	0.8	No	Yes
ER92004181-2	353	351	0.85	No	No
027251-02 (Reanalysis of ER92004181-2)	353	351	0.84	No	No
ER92004180-2	447	445	0.94	No	No
027251-03 (Reanalysis of ER92004180-2)	447	445	1.43	No	No
ER92004348-2	499	496	1	No	No
027251-04 (Reanalysis of ER92004348-2)	499	496	0.62	No	Yes
ER92004342-2	546	543	1.1	No	No
027251-05 (Reanalysis of ER92004342-2)	546	543	1.04	No	No

[a] Depth reported is linear ft. Monitoring well was drilled at an angle of 6 degrees from vertical.

[b] Depth reported is actual ft bgs.

[c] Proposed RCRA Subpart S action level for soils (55 FR 30865).

[d] The UTL is used to define background if the data set is normal or lognormal. The UTL establishes a concentration range that is constructed to contain a specified proportion of the population with a specified confidence. The EPA-recommended coverage of 95% and tolerance coefficient value of 95% was used to calculate the UTL (EPA 1992).

bgs	below ground surface
EPA	U.S. Environmental Protection Agency
FR	Federal Register
ft	feet
mg/kg	milligrams per kilogram
MW	monitor well
RCRA	Resource Conservation and Recovery Act
UTL	upper tolerance limit

Table 4.7-10
Tritium Activity with Depth in MW-4 Soil Samples

Sample Depth (ft)[a]	Tritium Activity (pCi/g)	2-sigma Error (pCi/g)	Moisture Content (%)
5	1.1	+/- 0.3	6.1
10	0.3	+/- 0.3	1.2
10 dup	0.3	+/- 0.3	1.2
15	0.7	+/- 0.3	4.9
20	0.1	+/- 0.3	2
25	ND	--	1.2
30	ND	--	13.6
30 dup	ND	--	13.6
35	0.1	+/- 0.3	3.2
41	ND	--	1.1
45	ND	--	2.6
50	ND	--	1
70	ND	--	1.7
78	ND	--	5.3
89	ND	--	1.6
99	ND	--	2.9
120	0.1	+/- 0.3	0.9
139	ND	--	3.6
159	0.1	+/- 0.3	4.5
179	ND	--	2.5
199	ND	--	1.8
199 dup	ND	--	2.2
249	ND	--	15.9
292	ND	--	7.5
292 dup	ND	--	5.9
351	ND	--	10.6
398	0.09	+/- 0.27	11.7
445	ND	--	3.1
483	0.17	+/- 0.37	NS (Water Table)
496	0.23	+/- 0.31	NS
543	ND	--	NS

[a] MW-4 was drilled at an angle of 6 degrees from vertical. The sample depth reported is the true depth below ground surface.

dup	duplicate sample
ft	feet
MDA	minimum detectable activity
MW	monitor well
ND	Tritium was not detected above MDA.
NS	No sample collected for analysis.
pCi/g	picocuries per gram
--	not reported

Table 4.7-11
Plutonium-238 and Plutonium-239/240 Activity in MW-4 Soil Samples

ER Sample ID	Laboratory Sample ID	Sample Depth (ft)[a]	Plutonium-238 (pCi/g)		Plutonium-239/240 (pCi/g)	
			Activity	2-sigma Error	Activity	2-sigma Error
ER92003639-4	026810-0005-SA	10	0.02	0.03	0	0.02
ER92003639-4	026810-0005-DU	10 dup	0.01	0.03	0.02	0.02
ER92003643-4	026842-0004-SA	20	0	0.05	0	0.05
ER92003646-4	026842-0010-SA	30	0	0.07	0	0.07
ER92003646-4	026842-0010-DU	30 dup	0.02	0.04	0.02	0.04
ER92003649-4	026855-0005-SA	41	0.03	0.04	0.04	0.04
ER92003652-3	026855-0010-SA	50	0.04	0.04	0.01	0.02
ER92003655-4	026897-0015-SA	70	0.01	0.03	0	0.009
ER92004042-3	026897-0003-SA	78	0.02	0.04	0	0.03
ER92004043-3	026897-0007-SA	89	0.03	0.04	0.01	0.02
ER92004031-3	026898-0003-SA	99	-0.1	0.1	0.01	0.06
ER92004033-3	026898-0011-SA	120	0	0.05	0.01	0.04
ER92004036-3	026927-0003-SA	139	0.003	0.009	-0.01	0.01
ER92004037-3	026927-0007-SA	159	0	0.05	0.01	0.03
ER92004040-3	027044-0004-SA	179	-0.008	0.076	-0.017	0.05
ER92004041-3	027044-0013-SA	199	0.003	0.014	0.0025	0.0076
ER92004030-3	027044-0010-SA	199 dup	-0.011	0.019	-0.011	0.012
ER92004027-3	027095-0003-SA	249	0.01	0.011	0	0.0095
ER92004025-3	027119-0003-SA	292	-0.005	0.0098	-0.0025	0.0075
ER92004024-3	027119-0007-SA	292 dup	-0.043	0.049	-0.034	0.033
ER92004181-3	027178-0003-SA	351	-0.002	0.018	0.004	0.013
ER92004183-3	027264-0003-SA	398	-0.015	0.02	0.005	0.015
ER92004180-3	027371-0003-SA	445	0.025	0.08	-0.009	0.059
ER92004347-3	027514-0002-SA	483	0.017	0.099	-0.008	0.096
ER92004348-3	027532-0003-SA	496	0.01	0.11	0.06	0.11
ER92004342-3	027548-0003-SA	543	0	0.064	0.064	0.072

[a] MW-4 was drilled at an angle of 6 degrees from vertical. The sample depth reported is the true depth below ground surface.

dup	duplicate sample
ft	feet
ID	identification
MW	monitor well
pCi/g	picocuries per gram

Table 4.7-12
Summary of Statistical Tests Performed on MW-4 Soil Sample Data

Analyte	Comparison	Statistical Tests				Exceeds UTL or 95th %	Exceeds Action Level
		Quantile	Wilcoxon Rank Sum	T-Test			
				Equal Variance	Nonequal Variance		
Aluminum	BKG vs MW-4	F	P	P	P	Yes	--[a]
Antimony	BKG vs MW-4	P	F	NA	NA	Yes	No
Arsenic	BKG vs MW-4	P	P	P	P	Yes	No
Barium	BKG vs MW-4	P	P	P	P	No	No
Beryllium	BKG vs MW-4	F	P	P	P	Yes	Yes
Cadmium	BKG vs MW-4	P	P	NA	NA	No	No
Calcium	BKG vs MW-4	P	P	P	P	Yes	--[b]
Chromium	BKG vs MW-4	F	F	F	F	Yes	No
Cobalt	BKG vs MW-4	F	F	P	P	Yes	--[a]
Copper	BKG vs MW-4	F	F	F	F	Yes	--[a]
Iron	BKG vs MW-4	F	F	F	F	Yes	--[b]
Lead	BKG vs MW-4	F	P	P	P	Yes	No
Magnesium	BKG vs MW-4	F	P	P	P	Yes	--[b]
Manganese	BKG vs MW-4	F	F	F	F	Yes	--[a]
Mercury	BKG vs MW-4	--[c]	--[c]	--[c]	--[c]	--[c]	--[c]
Nickel	BKG vs MW-4	F	F	F	F	Yes	No
Potassium	BKG vs MW-4	F	P	P	P	Yes	--[b]
Selenium	BKG vs MW-4	--[c]	--[c]	--[c]	--[c]	--[c]	--[c]
Silver	BKG vs MW-4	--[c]	--[c]	--[c]	--[c]	--[c]	--[c]
Sodium	BKG vs MW-4	P	P	NA	NA	No	--[b]
Thallium	BKG vs MW-4	--[c]	--[c]	--[c]	--[c]	--[c]	--[c]
Vanadium	BKG vs MW-4	P	F	F	F	Yes	--[a]
Zinc	BKG vs MW-4	F	F	F	F	Yes	--[a]

[a] Metal is not listed as a RCRA constituent (40 CFR 261 Appendix VIII).

[b] Metal is considered an essential nutrient as described in RAGS (EPA 1989).

[c] The number of nondetects in the background soil samples precluded the use of statistical analysis.

BKG	Background analytical data
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
F	Data set for specified analyte fails statistical test when compared to background.
MW-4	Borehole analytical data from MW-4
NA	T-test was not performed because data set is nonparametric.
P	Data set for specified analyte passes statistical test when compared to background.
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
UTL	upper tolerance limit

Table 5.3-1
Vertical Hydraulic Gradients in MWL Groundwater

Date	Well	Groundwater Elevation (famsl)	Center of Saturated Filter Pack (famsl)	Well	Groundwater Elevation (famsl)	Center of Saturated Filter Pack (famsl)	Distance Between Centers of Well 1 and Well 2 (ft)	Difference in Water Levels Between Well 1 and Well 2 (ft)	Vertical Gradient	Direction
04-14-95	MWL-MW1	4921.20	4910.83	MWL-MW4 (lower zone)	4896.00	4848.29	62.53	25.20	0.40	Downward
04-14-95	MWL-MW1	4921.20	4910.83	MWL-MW4 (upper zone)	4900.43	4888.41	22.42	20.77	0.93	Downward
04-14-95	MWL-MW4 (lower zone)	4896.00	4848.29	MWL-MW4 (upper zone)	4900.43	4888.41	40.12	4.43	0.11	Downward

famsl	ft above mean sea level
ft	feet
MWL	Mixed Waste Landfill

Table 5.4-1
Summary of Major Ion Chemistry for MWL Groundwater
1993 through 1995

Sample Attributes		Parameters[a]										
Well	**Sample Date**	**Alkalinity as $CaCO_3$**	**Alkalinity as CO_3**	**Alkalinity as HCO_3**	**Bromide**	**Calcium**	**Chloride**	**Fluoride**	**Magnesium**	**Potassium**	**Sodium**	**Sulfate**
MWL-BW1	04-28-93	257.3	NA	NA	NA	46.6	27.6	NA	17.9	2.7 J (5)	46.9	46.7
MWL-BW1-DU	04-28-93	NA	NA	NA	NA	47.8	27.9	NA	18.3	2.9 J (5)	47.4	46.7
MWL-BW1	11-10-93	229	ND (5)	229	NA	54.1	26.4	0.58	19.1	3.6 J (5)	56	43.5
MWL-BW1	10-27-94	217	ND (5)	217	ND (0.2)	55.8	25.6	0.79	20	3.5 J (5)	56.9	42.5
MWL-BW1	03-14-95	230	NA	NA	NA	48	25	0.8	19	3.4	51	52
MWL-BW1	10-23-95	229	NA	NA	NA	56.8	24.8	0.970	19.1	3.31 B	56.6 B	46.9
MWL-MW1	04-27-93	215.7	NA	NA	NA	51.8	29.5	NA	17.4	2.5 J (5)	45.7	43.7
MWL-MW1	11-09-93	211	ND (5)	211	NA	57.1	29.1	0.72	17.8	3.3 J (5)	50.9	41.9
MWL-MW1	10-25-94	207	ND (5)	207	ND (0.2)	59.6	30	0.8	19	3.3 J (5)	53.6	45.4
MWL-MW1	04-19-95	226	ND (5)	226	NA	61.1	31.9	0.7	18.9	3.2 J (5)	52.1	44.4
MWL-MW1	10-20-95	234	NA	NA	NA	58.6	29.5	0.66	18.1	3.18	52.2	46.6
MWL-MW2	04-26-93	207.7	NA	NA	NA	47.1	31.9	NA	17.1	3.6 J	45.7	47.3
MWL-MW2	11-08-93	208	ND (5)	208	NA	51.3	30.2	1	18.5	4.8 J	55.4	40.5
MWL-MW2	10-24-94	185	ND (5)	185	ND (0.2)	54.9	30.8	1	18.8	4.5 J	53.9	42.9
MWL-MW2	04-17-95	196	ND (5)	196	NA	42.8	33.5	0.7	16.6	4.8 J	46.8	42.4
MWL-MW2	10-16-95	199	NA	NA	NA	49.6	30.8	1.03	16.6	4.25	47.9	41.3
MWL-MW3	04-27-93	193.4	NA	NA	NA	42.1	33.4	NA	14.6	3.1 J (5)	45.7	39.7
MWL-MW3	11-09-93	193	ND (5)	193	NA	44.2	32.2	0.83	15.9	3.6 J (5)	51.5	38.3
MWL-MW3	10-25-94	177	ND (5)	177	ND (0.2)	48.2	32.7	0.94	16.3	3.9 J (5)	53.2	40.5
MWL-MW3	04-17-95	182	ND (5)	182	NA	39.2	36.4	0.68	17	3.9 J (5)	49.9	41
MWL-MW3	10-16-95	191	NA	NA	NA	45.7	31.5	1.04	15.2	3.82	49.2	39.1

Refer to footnotes at end of table.

Table 5.4-1 (Concluded)
Summary of Major Ion Chemistry for MWL Groundwater
1993 through 1995

Sample Attributes		Parameters[a] Units all in mg/L										
Well	**Sample Date**	**Alkalinity as $CaCO_3$**	**Alkalinity as CO_3**	**Alkalinity as HCO_3**	**Bromide**	**Calcium**	**Chloride**	**Fluoride**	**Magnesium**	**Potassium**	**Sodium**	**Sulfate**
MWL-MW4	04-30-93	231.7	NA	NA	NA	52.1	61.2	NA	19.5	4.3 J (5)	46.9	38.7
MWL-MW4	11-11-93	218	ND (5)	218	NA	55.4	59.1	1	19.7	4.8 J (5)	46.2	34.8
MWL-MW4	10-28-94	234	ND (5)	234	ND (0.2)	59.7	57.4	0.85	20.4	5.5	67.1	43.9
MWL-MW4	04-19-95	266	ND (5)	266	NA	68.7	60.7	0.71	23	6.1	80.7	49.8
MWL-MW4-DU	04-19-95	267	ND (5)	267	NA	65.5	61	0.69	22	6	75.9	49.7
MWL-MW4	10-20-95	257	NA	NA	NA	61.1	56.2	0.51	20.3	5.61	76.6	52.2
MWL-MW4-DU	10-20-95	276	NA	NA	NA	62.9	55.6	0.43 J	20.9	5.77	78.5	52

[a] EPA March 1983 and EPA December 1989.

$CaCO_3$	calcium carbonate
CO_3	carbonate
DU	duplicate
HCO_3	bicarbonate
J ( )	estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
mg/L	milligrams per liter
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND ( )	not detected at the method detection limit, shown in parentheses

Table 5.4-2
Summary of Metals Analytical Results for Groundwater Samples From MWL-BW1
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470/7740/3005[a]) (mg/L)			
Subpart S Action Level			NE		NE	
EPA Drinking Water MCL[b]			0.05		2	
AR/COC Number	Date Sampled	Lab	Arsenic		Barium	
			Total	Dissolved	Total	Dissolved
1541	09-27-90	QSTL	ND (0.01)	ND (0.005)	0.12	0.12
1543	09-27-90	QSTL	ND (0.01)	ND (0.005)	0.12	0.13
2314	01-24-91	QSTL	ND (0.005)	ND (0.005)	0.11	0.1
1994	01-24-91	QSTL	ND (0.005)	ND (0.01)	0.11	0.1
2020	05-07-91	QSTL	ND (0.01)	ND (0.005)	0.08	0.1
2415	05-07-91	QSTL	ND (0.005)	ND (0.005)	0.093	0.098
2189	08-06-91	QSTL	ND (0.005)	ND (0.005)	0.09	0.081
2203	08-06-91	QSTL	ND (0.005)	ND (0.005)	0.097	0.082
2719	10-16-91	QSTL	ND (0.005)	ND (0.01)	0.097	0.092
2721	10-16-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
2725	10-16-91	QSTL	ND (0.01)	ND (0.005)	0.095	0.099
4096	07-29-92	QSTL	ND (0.005)	ND (0.005)	0.085	0.078
4133[c]	07-29-92	QSTL	ND (0.005)	ND (0.005)	0.087	0.084
5841	01-20-93	QSTL	ND (0.005)	NA	0.095	NA
5841[c]	01-20-93	QSTL	ND (0.005)	NA	0.092	NA
6316	04-28-93	QSTL	0.0013 J (0.005)	ND (0.005)	0.073	0.077
6316[c]	04-28-93	QSTL	0.0011 J (0.005)	0.001 J (0.005)	0.075	0.075
6997	11-10-93	QSTL	0.0015 J (0.005)	NA	0.078	NA
6997[c]	11-10-93	QSTL	ND (0.005)	NA	0.081	NA
1014	10-27-94	QSTL	ND (0.01)	NA	0.085	NA
1015	10-27-94	QSTL	ND (0.01)	NA	0.085	NA
4397	10-23-95	GEL	0.00219 J (0.01)	NA	0.0882	NA

Refer to footnotes at end of table.

Table 5.4-2 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-BW1
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/ 7470/7740/3005[a]) (mg/L)			
Subpart S Action Level			**8.E-06**		**NE**	
EPA Drinking Water MCL[b]			**0.004**		**0.005**	
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**		**Cadmium**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
1543	09-27-90	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
2314	01-24-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
1994	01-24-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2020	05-07-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2415	05-07-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2189	08-06-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2203	08-06-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2719	10-16-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2721	10-16-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
2725	10-16-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
4096	07-29-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
4133[c]	07-29-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
5841	01-20-93	QSTL	ND (0.002)	NA	**0.031**	NA
5841[c]	01-20-93	QSTL	ND (0.002)	NA	**0.023**	NA
6316	04-28-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6316[c]	04-28-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6997	11-10-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
6997[c]	11-10-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
1014	10-27-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
1015	10-27-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
4397	10-23-95	GEL	0.00009 J,B (0.005)	NA	0.00012 J,B (0.005)	NA

Refer to footnotes at end of table.

Table 5.4-2 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-BW1
1990 through 1995

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740/7470[a]) (mg/L)			
Subpart S Action Level			NE		NE	
EPA Drinking Water MCL[b]			0.1		0.015	
AR/COC Number	**Date Sampled**	**Lab**	**Chromium**		**Lead**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.01)	ND (0.01)	ND (0.02)	ND (0.005)
1543	09-27-90	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.005)
2314	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.005)
1994	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.005)
2020	05-07-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
2415	05-07-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
2189	08-06-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.01)
2203	08-06-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.01)
2719	10-16-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
2721	10-16-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
2725	10-16-91	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
4096	07-29-92	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
4133[c]	07-29-92	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
5841	01-20-93	QSTL	0.017	NA	ND (0.01)	NA
5841[c]	01-20-93	QSTL	0.012	NA	0.0012 J (0.01)	NA
6316	04-28-93	QSTL	ND (0.01)	ND (0.01)	ND (0.02)	ND (0.02)
6316[c]	04-28-93	QSTL	ND (0.01)	ND (0.01)	ND (0.02)	ND (0.02)
6997	11-10-93	QSTL	0.0092 J (0.01)	NA	ND (0.01)	NA
6997[c]	11-10-93	QSTL	0.011	NA	ND (0.01)	NA
1014	10-27-94	QSTL	0.0041 J (0.01)	NA	ND (0.003)	NA
1015	10-27-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
4397	10-23-95	GEL	0.00411 J (0.01)	NA	ND (0.00113)	NA

Refer to footnotes at end of table.

Table 5.4-2 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-BW1
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/ 7470/7740/3005[a]) (mg/L)			
Subpart S Action Level			NE		0.7	
EPA Drinking Water MCL[b]			0.002		0.1	
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**		**Nickel**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
1543	09-27-90	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
2314	01-24-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
1994	01-24-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2020	05-07-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2415	05-07-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2189	08-06-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2203	08-06-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2719	10-16-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2721	10-16-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
2725	10-16-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
4096	07-29-92	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
4133[c]	07-29-92	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
5841	01-20-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
5841[c]	01-20-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
6316	04-28-93	QSTL	ND (0.0002)	ND (0.0002)	0.012 J (0.04)	0.011
6316[c]	04-28-93	QSTL	ND (0.0002)	ND (0.0002)	0.0075	0.016
6997	11-10-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
6997[c]	11-10-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
1014	10-27-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
1015	10-27-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
4397	10-23-95	GEL	0.00003 J,B (0.0002)	NA	0.00196 J (0.01)	NA

Refer to footnotes at end of table.

Table 5.4-2 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples From MWL-BW1
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/ 7470/7740/3005[a]) (mg/L)			
Subpart S Action Level			NE		0.2	
EPA Drinking Water MCL[b]			0.05		0.05	
AR/COC Number	**Date Sampled**	**Lab**	**Selenium**		**Silver**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.01)	ND (0.005)	ND (0.01)	ND (0.01)
1543	09-27-90	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2314	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
1994	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
2020	05-07-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2415	05-07-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2189	08-06-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2203	08-06-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2719	10-16-91	QSTL	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.01)
2721	10-16-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
2725	10-16-91	QSTL	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.01)
4096	07-29-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
4133[c]	07-29-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
5841	01-20-93	QSTL	0.004 J (0.005)	NA	ND (0.01)	NA
5841[c]	01-20-93	QSTL	0.0043 J (0.005)	NA	ND (0.01)	NA
6316	04-28-93	QSTL	ND (5)	ND (5)	ND (0.01)	ND (0.01)
6316[c]	04-28-93	QSTL	ND (5)	ND (5)	ND (0.01)	ND (0.01)
6997	11-10-93	QSTL	0.0017 J (0.005)	NA	ND (0.01)	NA
6997[c]	11-10-93	QSTL	0.0017 J (0.005)	NA	ND (0.01)	NA
1014	10-27-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
1015	10-27-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
4397	10-23-95	GEL	0.0047 J (0.005)	NA	ND (0.00249)	NA

Note: Values right justified and in **bold** indicate concentration above the Subpart S Action Level and/or the EPA drinking water MCL.

[a] EPA November 1986.

[b] EPA July 1995.

[c] Duplicate sample.

AR/COC	analysis request/chain of custody record
B	analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL report)
EPA	U.S. Environmental Protection Agency
GEL	General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( )	estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab	laboratory
MCL	maximum contaminant level
mg/L	milligrams per liter
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
NE	not established
ND ( )	not detected above the method detection limit, shown in parentheses
QSTL	Quanterra Laboratories, St. Louis (off-site laboratory)

Table 5.4-3
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW1 1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)			
Subpart S Action Level			NE		NE	
EPA Drinking Water MCL[b]			0.05		2	
AR/COC Number	Date Sampled	Lab	Arsenic		Barium	
			Total	Dissolved	Total	Dissolved
1541	09-27-90	QSTL	ND (0.005)	ND (0.005)	0.07	0.068
01990	01-24-91	QSTL	ND (0.005)	ND (0.005)	0.07	0.069
02416	05-07-91	QSTL	ND (0.005)	ND (0.01)	0.067	0.065
02187	07-31-91	QSTL	ND (0.005)	ND (0.005)	0.064	0.066
02731	10-15-91	QSTL	ND (0.005)	ND (0.01)	0.068	0.068
4097	07-28-92	QSTL	ND (0.005)	ND (0.005)	0.065	0.063
5839	01-19-93	QSTL	ND (0.005)	NA	0.076	NA
6312	04-27-93	QARV	ND (0.005)	ND (0.005)	0.057	0.056
6994	11-09-93	QSTL	ND (0.005)	NA	0.061	NA
00140	05-03-94	QSTL	ND (0.01)	NA	0.076	NA
00143[c]	05-04-94	QSTL	ND (0.01)	NA	0.076	NA
01010	10-25-94	QSTL	ND (0.01)	NA	0.071	NA
01012[c]	10-25-94	QSTL	ND (0.01)	NA	0.073	NA
03315	04-19-95	QARV	ND (0.003)	NA	0.067	NA
04407	10-20-95	GEL	ND (0.00186)	NA	0.0677	NA

Refer to footnotes at end of table.

Table 5.4-3 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW1
1990 through 1995

Sample Attributes			**Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)**			
Subpart S Action Level			**8.E-06**		**NE**	
EPA Drinking Water MCL[b]			**0.004**		**0.005**	
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**		**Cadmium**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.002)	ND (0.002)	0.046	0.043
01990	01-24-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02416	05-07-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02187	07-31-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02731	10-15-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
4097	07-28-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
5839	01-19-93	QSTL	ND (0.002)	NA	**0.0086**	NA
6312	04-27-93	QARV	0.0016 J (0.002)	ND	ND (0.005)	ND (0.005)
6994	11-09-93	QSTL	ND (0.002)	NA	ND (0.005)	ND (0.005)
00140	05-03-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
00143[c]	05-04-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
01010	10-25-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
01012[c]	10-25-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
03315	04-19-95	QARV	ND (0.002)	NA	ND (0.0049)	NA
04407	10-20-95	GEL	0.00006 J,B (0.005)	NA	0.00013 J,B (0.005)	NA

Refer to footnotes at end of table.

Table 5.4-3 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW1
1990 through 1995

Sample Attributes			**Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)**			
Subpart S Action Level			**NE**		**NE**	
EPA Drinking Water MCL[b]			**0.1**		**0.015**	
AR/COC Number	**Date Sampled**	**Lab**	**Chromium**		**Lead**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
01990	01-24-91	QSTL	ND (0.01)	0.021	ND (0.01)	ND (0.005)
02416	05-07-91	QSTL	ND (0.01)	0.015	ND (0.005)	ND (0.005)
02187	07-31-91	QSTL	ND (0.01)	0.011	ND (0.01)	ND (0.005)
02731	10-15-91	QSTL	ND (0.01)	0.019	ND (0.005)	ND (0.01)
4097	07-28-92	QSTL	0.011	ND (0.01)	ND (0.005)	ND (0.005)
5839	01-19-93	QSTL	0.011	NA	ND (0.005)	NA
6312	04-27-93	QARV	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.05)
6994	11-09-93	QSTL	0.01	NA	**0.018**	NA
00140	05-03-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
00143[c]	05-04-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
01010	10-25-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
01012[c]	10-25-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
03315	04-19-95	QARV	ND (0.003)	NA	ND (0.031)	NA
04407	10-20-95	GEL	0.0428	NA	ND (0.00113)	NA

Refer to footnotes at end of table.

Table 5.4-3 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW1
1990 through 1995

Sample Attributes			**Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)**			
Subpart S Action Level			**NE**		**0.7**	
EPA Drinking Water MCL[b]			**0.002**		**0.1**	
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**		**Nickel**	
			Total	**Dissolved**	**Total**	**Dissolved**
1541	09-27-90	QSTL	ND (0.005)	ND (0.005)	**0.046**	**0.043**
01990	01-24-91	QSTL	ND (0.005)	ND (0.005)	NA	NA
02416	05-07-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02187	07-31-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02731	10-15-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
4097	07-28-92	QSTL	ND (0.0002)	ND (0.0002)	**0.15**	**0.063**
5839	01-19-93	QSTL	ND (0.0002)	NA	**0.078**	**NA**
6312	04-27-93	QARV	ND (0.0002)	ND (0.0002)	**0.097**	**0.094**
6994	11-09-93	QSTL	ND (0.0002)	NA	**0.095**	NA
00140	05-03-94	QSTL	ND (0.0002)	NA	**0.15**	NA
00143[c]	05-04-94	QSTL	ND (0.0002)	NA	**0.13**	NA
01010	10-25-94	QSTL	ND (0.0002)	NA	**0.1**	NA
01012[c]	10-25-94	QSTL	ND (0.0002)	NA	**0.13**	NA
03315	04-19-95	QARV	ND (0.04)	NA	**0.12**	NA
04407	10-20-95	GEL	ND (0.00001)	NA	**0.107**	NA

Refer to footnotes at end of table.

Table 5.4-3 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW1
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010B/6020/7470[a]) (mg/L)			
Subpart S Action Level			NE		0.2	
EPA Drinking Water MCL[b]			0.05		0.05	
AR/COC Number	Date Sampled	Lab	Selenium		Silver	
			Total	Dissolved	Total	Dissolved
1541	09-27-90	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
01990	01-24-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
02416	05-07-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
02187	07-31-91	QSTL	ND (0.01)	ND (0.005)	ND (0.01)	ND (0.01)
02731	10-15-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
4097	07-28-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
5839	01-19-93	QSTL	0.0045 J (0.005)	NA	ND (0.01)	NA
6312	04-27-93	QARV	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
6994	11-09-93	QSTL	0.0023 J (0.005)	NA	ND (0.01)	NA
00140	05-03-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
00143[c]	05-04-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
01010	10-25-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
01012[c]	10-25-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
03315	04-19-95	QARV	ND (0.005)	NA	ND (0.003)	NA
04407	10-20-95	GEL	0.00308 J (0.005)	NA	ND (0.00249)	NA

Note: Values right justified and in **bold** indicate concentration above the Subpart S Action Level and/or the EPA drinking water MCL.

[a] EPA November 1986.

[b] EPA July 1995.

[c] Duplicate sample.

AR/COC	analysis request/chain of custody record
B	analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL report)
EPA	U.S. Environmental Protection Agency
GEL	General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( )	Estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab	laboratory
MCL	maximum contaminant level
mg/L	milligrams per liter
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND ( )	not detected above the method detection limit, shown in parentheses
NE	not established
QARV	Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL	Quanterra Laboratories, St. Louis (off-site laboratory).

Table 5.4-4
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW2 1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/7470/7740[a]) (mg/L)			
Subpart S Action Level			NE		NE	
EPA Drinking Water MCL[b]			0.05		2	
AR/COC Number	**Date Sampled**	**Lab**	**Arsenic**		**Barium**	
			Total	**Dissolved**	**Total**	**Dissolved**
01547	09-28-90	QSTL	ND (0.005)	ND (0.005)	0.099	0.1
01991	01-28-91	QSTL	ND (0.005)	ND (0.005)	0.11	0.11
02351	04-02-91	QSTL	ND (0.005)	ND (0.005)	0.11	0.099
02205	08-01-91	QSTL	ND (0.005)	ND (0.005)	0.098	0.081
02217	10-14-91	QSTL	ND (0.01)	ND (0.005)	0.1	0.095
4098	07-27-92	QSTL	ND (0.005)	ND (0.005)	0.094	0.092
5834	01-18-93	QSTL	0.002 J (0.005)	NA	0.11	NA
6314	04-26-93	QSTL	0.001 J (0.005)	0.0012 J (0.005)	0.074	0.078
6995	11-08-93	QSTL	ND (0.005)	NA	0.11	NA
00138	05-02-94	QSTL	ND (0.01)	NA	0.11	NA
01009	10-24-94	QSTL	ND (0.01)	NA	0.1	NA
03306	04-17-95	QSTL	ND (0.003)	NA	0.091	NA

Refer to footnotes at end of table.

Table 5.4-4 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW2
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/7470/7740[a]) (mg/L)			
Subpart S Action Level			**8.E-06**		**NE**	
EPA Drinking Water MCL[b]			**0.004**		**0.005**	
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**		**Cadmium**	
			Total	**Dissolved**	**Total**	**Dissolved**
01547	09-28-90	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
01991	01-28-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02351	04-02-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02205	08-01-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02217	10-14-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
4098	07-27-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
5834	01-18-93	QSTL	ND (0.002)	NA	**0.016**	NA
6314	04-26-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6995	11-08-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
00138	05-02-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
01009	10-24-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
03306	04-17-95	QSTL	ND (0.002)	NA	ND (0.0049)	NA

Refer to footnotes at end of table.

Table 5.4-4 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW2
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/ 7470/7740^a) (mg/L)			
Subpart S Action Level			**NE**		**NE**	
EPA Drinking Water MCL^b			**0.1**		**0.015**	
AR/COC Number	**Date Sampled**	**Lab**	**Chromium**		**Lead**	
			Total	**Dissolved**	**Total**	**Dissolved**
01547	09-28-90	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
01991	01-28-91	QSTL	0.017	ND (0.01)	ND (0.005)	ND (0.01)
02351	04-02-91	QSTL	0.014	ND (0.01)	ND (0.005)	ND (005)
02205	08-01-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.005)
02217	10-14-91	QSTL	0.02	ND (0.01)	ND (0.005)	ND (0.005)
4098	07-27-92	QSTL	ND (0.01)	ND (0.01)	ND (0.005)	ND (0.005)
5834	01-18-93	QSTL	0.014	NA	ND (0.01)	NA
6314	04-26-93	QSTL	0.016	0.0077 J (0.01)	ND (0.01)	ND (0.01)
6995	11-08-93	QSTL	ND (0.01)	NA	ND (0.005)	NA
00138	05-02-94	QSTL	(0.01)	NA	ND (0.003)	NA
01009	10-24-94	QSTL	0.0085 J (0.01)	NA	ND (0.003)	NA
03306	04-17-95	QSTL	ND (0.003)	NA	ND (0.031)	NA

Refer to footnotes at end of table.

Table 5.4-4 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW2
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/ 7470/7740[a]) (mg/L)			
Subpart S Action Level			NE		0.7	
EPA Drinking Water MCL[b]			0.002		0.1	
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**		**Nickel**	
			Total	**Dissolved**	**Total**	**Dissolved**
01547	09-28-90	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
01991	01-28-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02351	04-02-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02205	08-01-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02217	10-14-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
4098	07-27-92	QSTL	0.0007	ND (0.0002)	ND (0.04)	ND (0.04)
5834	01-18-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
6314	04-26-93	QSTL	ND (0.0002)	ND (0.0002)	0.014 J (0.04)	0.013 J (0.04)
6995	11-08-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
00138	05-02-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
01009	10-24-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
03306	04-17-95	QSTL	ND (0.04)	NA	0.0075 J (0.04)	NA

Refer to footnotes at end of table.

Table 5.4-4 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW2
1990 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/6020/7060/7421/7470/7740[a]) (mg/L)			
Subpart S Action Level			NE		0.2	
EPA Drinking Water MCL[b]			0.05		0.05	
AR/COC Number	**Date Sampled**	**Lab**	**Selenium**		**Silver**	
			Total	**Dissolved**	**Total**	**Dissolved**
01547	09-28-90	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
01991	01-28-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
02351	04-02-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
02205	08-01-91	QSTL	ND (0.01)	ND (0.005)	ND (0.01)	ND (0.01)
02217	10-14-91	QSTL	ND (0.01)	**0.00710 J (0.1)**	ND (0.01)	ND (0.01)
4098	07-27-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
5834	01-18-93	QSTL	0.0038 J (0.005)	NA	ND (0.01)	NA
6314	04-26-93	QSTL	ND (2.5)	ND (5)	ND (0.01)	ND (0.01)
6995	11-08-93	QSTL	0.004 J (0.005)	NA	ND (0.01)	NA
00138	05-02-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
01009	10-24-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
03306	04-17-95	QSTL	ND (0.005)	NA	ND (0.003)	NA

Note: Values right justified and in **bold** indicate concentration above the Subpart S Action Level and/or the EPA drinking water MCL.

[a] EPA November 1986.

[b] EPA July 1995

AR/COC	analysis request/chain of custody record
EPA	U.S. Environmental Protection Agency
J ( )	estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab	laboratory
MCL	maximum contaminant level
mg/L	milligrams per liter
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND ( )	not detected above the method detection limit, shown in parentheses
NE	not established
QSTL	Quanterra Laboratories, St. Louis (off-site laboratory)

Table 5.4-5
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW3 1990 through 1995

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
Subpart S Action Level			NE		NE	
EPA Drinking Water MCL[b]			0.05		2	
AR/COC Number	Date Sampled	Lab	Arsenic		Barium	
			Total	Dissolved	Total	Dissolved
01549	09-28-90	QSTL	ND (0.005)	ND (0.005)	0.1	0.11
01992	01-28-91	QSTL	ND (0.005)	ND (0.005)	0.098	0.1
02352	04-02-91	QSTL	ND (0.005)	ND (0.005)	0.091	0.1
02204	08-05-91	QSTL	ND (0.01)	ND (0.01)	0.089	0.082
02728	10-15-91	QSTL	ND (0.005)	ND (0.005)	0.094	0.088
4099	07-28-92	QSTL	ND (0.005)	ND (0.005)	0.084	0.078
5837	01-19-93	QSTL	0.0021 J (0.005)	NA	0.097	NA
6315	04-27-93	QSTL	0.0016 J (0.005)	0.0019 J (0.005)	0.074	0.07
6994	11-09-93	QSTL	0.0015 J (0.005)	NA	0.085	NA
00141	05-02-94	QSTL	ND (0.01)	NA	0.1	NA
01011	10-25-94	QSTL	ND (0.01)	NA	0.094	NA
03306	04-17-95	QARV	ND (0.003)	NA	0.093	NA
04393	10-16-95	GEL	ND (0.00186)	NA	0.0934	NA

Refer to footnotes at end of table.

Table 5.4-5 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW3
1990 through 1995

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
Subpart S Action Level			**8.E-06**		**NE**	
EPA Drinking Water MCL[b]			**0.004**		**0.005**	
AR/COC Number	**Date Sampled**	**Lab**	**Beryllium**		**Cadmium**	
			Total	**Dissolved**	**Total**	**Dissolved**
01549	09-28-90	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
01992	01-28-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02352	04-02-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02204	08-05-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
02728	10-15-91	QSTL	NA	NA	ND (0.005)	ND (0.005)
4099	07-28-92	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
5837	01-19-93	QSTL	ND (0.002)	NA	**0.029**	NA
6315	04-27-93	QSTL	ND (0.002)	0.0024	ND (0.005)	ND (0.005)
6994	11-09-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
00141	05-02-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
01011	10-25-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
03306	04-17-95	QARV	ND (0.002)	NA	ND (0.0049)	NA
04393	10-16-95	GEL	ND (0.00001)	NA	0.0002 J (0.005)	NA

Refer to footnotes at end of table.

Table 5.4-5 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW3
1990 through 1995

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
Subpart S Action Level			NE		NE	
EPA Drinking Water MCL[b]			0.1		0.015	
AR/COC Number	Date Sampled	Lab	Chromium		Lead	
			Total	Dissolved	Total	Dissolved
01549	09-28-90	QSTL	ND (0.01)	0.013	ND (0.005)	0.0058
01992	01-28-91	QSTL	0.021	0.016	ND (0.005)	ND (0.005)
02352	04-02-91	QSTL	0.017	ND (0.01)	ND (0.005)	ND (0.01)
02204	08-05-91	QSTL	0.027	0.015	ND (0.005)	ND (0.005)
02728	10-15-91	QSTL	0.018	ND (0.01)	ND (0.01)	ND (0.005)
4099	07-28-92	QSTL	0.056	ND (0.01)	ND (0.005)	ND (0.005)
5837	01-19-93	QSTL	0.026	NA	ND (0.01)	NA
6315	04-27-93	QSTL	0.029	0.011	ND (0.05)	ND (0.05)
6994	11-09-93	QSTL	0.01	NA	ND (0.005)	NA
00141	05-02-94	QSTL	0.0092 J (0.01)	NA	ND (0.003)	NA
01011	10-25-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
03306	04-17-95	QARV	ND (0.003)	NA	ND (0.031)	NA
04393	10-16-95	GEL	0.0369	NA	ND (0.00113)	NA

Refer to footnotes at end of table.

Table 5.4-5 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW3
1990 through 1995

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
Subpart S Action Level			**NE**		**0.7**	
EPA Drinking Water MCL[b]			**0.002**		**0.1**	
AR/COC Number	**Date Sampled**	**Lab**	**Mercury**		**Nickel**	
			Total	**Dissolved**	**Total**	**Dissolved**
01549	09-28-90	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	ND (0.04)
01992	01-28-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02352	04-02-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02204	08-05-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
02728	10-15-91	QSTL	ND (0.0002)	ND (0.0002)	NA	NA
4099	07-28-92	QSTL	ND (0.0002)	ND (0.0002)	0.066	**0.043**
5837	01-19-93	QSTL	ND (0.0002)	NA	0.026 J (0.04)	NA
6315	04-27-93	QSTL	ND (0.0002)	ND (0.0002)	**0.037 J (0.04)**	**0.033 J (0.04)**
6994	11-09-93	QSTL	ND (0.0002)	NA	0.014 J (0.04)	NA
00141	05-02-94	QSTL	ND (0.0002)	NA	0.011 J (0.04)	NA
01011	10-25-94	QSTL	ND (0.0002)	NA	0.0098 J (0.04)	NA
03306	04-17-95	QARV	ND (0.04)	NA	0.0093 J (0.04)	NA
04393	10-16-95	GEL	ND (0.00001)	NA	0.00799 J (0.01)	NA

Refer to footnotes at end of table.

Table 5.4-5 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW3
1990 through 1995

Sample Attributes			Metals (EPA Method 6010A/6010B/7060/7421/7470/7740[a]) (mg/L)			
Subpart S Action Level			NE		0.2	
EPA Drinking Water MCL[b]			0.05		0.05	
AR/COC Number	Date Sampled	Lab	Selenium		Silver	
			Total	Dissolved	Total	Dissolved
01549	09-28-90	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
01992	01-28-91	QSTL	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
02352	04-02-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
02204	08-05-91	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
02728	10-15-91	QSTL	ND (0.01)	**0.0054**	ND (0.01)	ND (0.01)
4099	07-28-92	QSTL	ND (0.005)	ND (0.005)	ND (0.01)	ND (0.01)
5837	01-19-93	QSTL	0.004 J (0.005)	NA	ND (0.01)	NA
6315	04-27-93	QSTL	ND (5)	ND (5)	ND (0.01)	ND (0.01)
6994	11-09-93	QSTL	0.0023 J (0.005)	NA	ND (0.01)	NA
00141	05-02-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
01011	10-25-94	QSTL	ND (0.005)	NA	ND (0.01)	NA
03306	04-17-95	QARV	ND (0.005)	NA	ND (0.003)	NA
04393	10-16-95	GEL	0.00144 J (0.005)	NA	ND (0.00249)	NA

Note: Values right justified and in **bold** indicate concentration above the Subpart S Action Level and/or the EPA drinking water MCL.

[a] EPA November 1986.

[b] EPA July 1995.

AR/COC	analysis request/chain of custody record
EPA	U.S. Environmental Protection Agency
GEL	General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( )	estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab	laboratory
MCL	maximum contaminant level
mg/L	milligrams per liter
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND ( )	not detected above the method detection limit, shown in parentheses
NE	not established
QARV	Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL	Quanterra Laboratories, St. Louis (off-site laboratory)

Table 5.4-6
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW4 1993 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
Subpart S Action Level			NE		NE	
EPA Drinking Water MCL[b]			0.05		2	
AR/COC Number	Date Sampled	Lab	Arsenic		Barium	
			Total	Dissolved	Total	Dissolved
6302	04-28-93	QSTL	0.0015 J (0.01)	NA	0.042	NA
6316[c]	04-28-93	QSTL	0.0011 J (0.01)	0.001	0.075	0.075
6317[c]	04-28-93	QSTL	0.004 J (0.01)	0.0045	0.082	0.081
6996	11-10-93	QSTL	0.0047 J (0.01)	NA	0.085	NA
508662	03-14-94	QSTL	0.003 J (0.01)	NA	**0.13**	NA
00144	05-31-94	QSTL	0.0091 J (0.01)	NA	0.1	NA
00319	10-28-94	QSTL	ND (0.01)	NA	0.11	NA
03315	04-19-95	QARV	ND (0.01)	NA	0.11	NA
03315[c]	04-19-95	QARV	0.011	NA	0.1	NA
04407	10-20-95	GEL	0.00864 J (0.01)	NA	0.105	NA

Refer to footnotes at end of table.

Table 5.4-6 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW4
1993 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
Subpart S Action Level			8.E-06		NE	
EPA Drinking Water MCL[b]			0.004		0.005	
AR/COC Number	Date Sampled	Lab	Beryllium		Cadmium	
			Total	Dissolved	Total	Dissolved
6302	04-28-93	QSTL	NA	NA	ND (0.005)	NA
6316[c]	04-28-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6317[c]	04-28-93	QSTL	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)
6996	11-10-93	QSTL	ND (0.002)	NA	ND (0.005)	NA
508662	03-14-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
00144	05-31-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
00319	10-28-94	QSTL	ND (0.002)	NA	ND (0.005)	NA
00319[c]	04-19-95	QSTL	ND (0.002)	NA	ND (0.005)	NA
03315	04-19-95	QARV	ND (0.002)	NA	ND (0.005)	NA
03315[c]	04-19-95	QARV	ND (0.002)	NA	ND (0.005)	NA
04407	10-20-95	GEL	0.00006 J (0.005)	NA	**0.00093 J (0.005)**	NA

Refer to footnotes at end of table.

Table 5.4-6 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW4
1993 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
Subpart S Action Level			NE		NE	
EPA Drinking Water MCL[b]			0.1		0.015	
AR/COC Number	Date Sampled	Lab	Chromium		Lead	
			Total	Dissolved	Total	Dissolved
6302	04-28-93	QSTL	ND (0.01)	NA	0.0019 J (0.0067)	NA
6316[c]	04-28-93	QSTL	ND (0.01)	ND (0.01)	ND (0.02)	ND (0.02)
6317[c]	04-28-93	QSTL	ND (0.01)	ND (0.01)	ND (0.05)	ND (0.05)
6996	11-10-93	QSTL	0.003 J (0.01)	NA	0.0036 J (0.0067)	NA
508662	03-14-94	QSTL	ND (0.01)	NA	0.0056	NA
00144	05-31-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
00319	10-28-94	QSTL	ND (0.01)	NA	ND (0.003)	NA
03315	04-19-95	QARV	ND (0.01)	NA	ND (0.003)	NA
03315[c]	04-19-95	QARV	ND (0.003)	NA	ND (0.003)	NA
04407	10-20-95	GEL	ND (0.0006)	NA	ND (0.00113)	NA

Refer to footnotes at end of table.

Table 5.4-6 (Continued)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW4
1993 through 1995

Sample Attributes			Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)			
Subpart S Action Level			NE		0.7	
EPA Drinking Water MCL[b]			0.002		0.1	
AR/COC Number	Date Sampled	Lab	Mercury		Nickel	
			Total	Dissolved	Total	Dissolved
6302	04-28-93	QSTL	ND (0.0002)	NA	NA	NA
6316[c]	04-28-93	QSTL	ND (0.0002)	ND (0.0002)	0.016 J (0.004)	0.0075
6317[c]	04-28-93	QSTL	ND (0.0002)	ND (0.0002)	ND (0.04)	0.0082
6996	11-10-93	QSTL	ND (0.0002)	NA	ND (0.04)	NA
508662	03-14-94	QSTL	0.00034	NA	ND (0.04)	NA
00144	05-31-94	QSTL	ND (0.0002)	NA	ND (0.04)	NA
00319	10-28-94	QSTL	ND (0.0002)	NA	0.0082 J (0.04)	NA
03315	04-19-95	QARV	ND (0.04)	NA	ND (0.04)	NA
03315[c]	04-19-95	QARV	ND (0.04)	NA	0.0082 J (0.04)	NA
04407	10-20-95	GEL	ND (0.00001)	NA	0.00307 J (0.01)	NA

Refer to footnotes at end of table.

Table 5.4-6 (Concluded)
Summary of Metals Analytical Results for Groundwater Samples From MWL-MW4
1993 through 1995

Sample Attributes			**Metals (EPA Method 6010/6010A/7060/7421/7470[a]) (mg/L)**			
Subpart S Action Level			**NE**		**0.2**	
EPA Drinking Water MCL[b]			**0.05**		**0.05**	
AR/COC Number	**Date Sampled**	**Lab**	**Selenium**		**Silver**	
			Total	**Dissolved**	**Total**	**Dissolved**
6302	04-28-93	QSTL	**0.0071**	NA	ND (0.01)	NA
6316[c]	04-28-93	QSTL	ND (5)	ND (5)	ND (0.01)	ND (0.01)
6317[c]	04-28-93	QSTL	ND (2.5)	ND (5)	ND (0.01)	ND (0.01)
6996	11-10-93	QSTL	0.002 J (0.0067)	NA	ND (0.01)	NA
508662	03-14-94	QSTL	0.0017 J (0.005)	NA	ND (0.01)	NA
00144	05-31-94	QSTL	ND (0.018)	NA	ND (0.01)	NA
00319	10-28-94	QSTL	ND (0.0062)	NA	ND (0.01)	NA
03315	04-19-95	QARV	ND (0.005)	NA	ND (0.003)	NA
03315[c]	04-19-95	QARV	ND (0.005)	NA	ND (0.003)	NA
04407	10-20-95	GEL	0.00191 J (0.005)	NA	ND (0.00249)	NA

Note: Values right justified and in **bold** indicate concentration above the Subpart S Action Level and/or the EPA drinking water MCL.

[a] EPA November 1986.

[b] EPA July 1995.

[c] Duplicate sample.

AR/COC	analysis request/chain of custody record
EPA	U.S. Environmental Protection Agency
GEL	General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( )	estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab	laboratory
MCL	maximum contaminant level
mg/L	milligrams per liter
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND ( )	not detected above the method detection limit, shown in parentheses
NE	not established
QARV	Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL	Quanterra Laboratories, St. Louis (off-site laboratory)

Table 5.4-7
Summary of Nitrate Analytical Results for MWL Groundwater 1991 through 1995

Well	Sample Date	Result (mg/L as N)	Lab	Analytical Method[a]
MWL-BW1	10-16-91	5.6	QSTL	EPA 353.2
	10 16-91	5.6	QSTL	EPA 353.2
	11-10-93	5.9	QSTL	EPA 353.2
	11-10-93	5.8	QSTL	EPA 353.2
	10 27-94	5.6	QSTL	EPA 353.2
	10-27-94	5.7	QSTL	EPA 353.2
	10-31-94	5.7	QSTL	EPA 353.2
MWL-MW1	10-15-91	5.5	QSTL	EPA 353.2
	11-09-93	5.4	QSTL	EPA 353.2
	05-03-94	5	QSTL	EPA 353.2
	05-04-94	5.2	QSTL	EPA 353.2
	10-25-94	5.2	QSTL	EPA 353.2
	10-25-94	5.2	QSTL	EPA 353.2
	04-19-95	5.5	QARV	EPA 353.2
MWL-MW2	10-14-91	5.1	QSTL	EPA 353.2
	11-08-93	4.9	QSTL	EPA 353.2
	05-02-94	4.7	QSTL	EPA 353.2
	10-24-94	4.9	QSTL	EPA 353.2
	04-17-95	5	QARV	EPA 353.2
MWL-MW3	10-15-91	4.3	QSTL	EPA 353.2
	11-09-93	4.2	QSTL	EPA 353.2
	05-03-94	3.9	QSTL	EPA 353.2
	10-25-94	4.3	QSTL	EPA 353.2
	04-17-95	4.7	QARV	EPA 353.2
MWL-MW4	11-11-93	1.9	QSTL	EPA 353.2
	03-14-94	1.5	QSTL	EPA 353.2
	05-31-94	1.2	QSTL	EPA 353.2
	10-28-94	0.6	QSTL	EPA 353.2
	04-19-95	0.14	QARV	EPA 353.2
	04-19-95	0.15	QARV	EPA 353.2

Notes: The NMED background concentration for nitrate is 4 mg/L (measured as N).
The EPA drinking water MCL for nitrate is 10 mg/L (measured as N).
No nitrate concentrations exceeded the EPA MCL.

[a] EPA November 1986.

EPA	U.S. Environmental Protection Agency
Lab	laboratory
MCL	maximum contaminant level
mg/L	milligrams per liter
MWL	Mixed Waste Landfill
N	nitrogen
NMED	New Mexico Environment Department
QARV	Quanterra Arvada, Colorado Laboratory (off-site laboratory)
QSTL	Quanterra St. Louis Laboratory (off-site laboratory)

Table 5.4-8
Summary of Gross Alpha Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-BW1	09-01-90	6.04	3.57	ITAS-O
	09-01-90	7.26	4.08	ITAS-O
	09-01-90	6.93	4.33	ITAS-O
	09-01-90	7.64	3.13	ITAS-O
	01-24-91	3.7±2.5	5	ITAS-O
	01-24-91	5.2±2.8	6	ITAS-O
	01-24-91	3.2±2.4	6	ITAS-O
	01-24-91	5.0±2.6	6	ITAS-O
	01-24-91	4.4 ±2.6	5	ITAS-O
	01-24-91	ND	3	ITAS-O
	01-24-91	ND	5	ITAS-O
	01-24-91	5.4±2.8	5	ITAS-O
	04-07-91	7.4±4.1	NA	QUANTE
	04-07-91	9.7±4.6	NA	QUANTE
	04-07-91	11±5	NA	QUANTE
	04-07-91	14±5	NA	QUANTE
	04-07-91	8.9 ±4.6	NA	QUANTE
	04-07-91	6.5 ±4.2	NA	QUANTE
	04-07-91	8.4 ±4.4	NA	QUANTE
	04-07-91	7.8±4.3	NA	QUANTE
	08-06-91	3.48±2.29	NA	ITAS-O
	08-06-91	5.52±3.14	NA	ITAS-O
	08-06-91	5.08±2.65	NA	ITAS-O
	08-06-91	6.30±2.98	NA	ITAS-O
	08-06-91	9.62±3.99	NA	ITAS-O
	08-06-91	8.05±3.49	NA	ITAS-O
	08-06-91	4.75±2.74	NA	ITAS-O
	08-06-91	6.06±3.23	NA	ITAS-O
	08-06-91	7.64±3.77	NA	ITAS-O
	08-06-91	1.17±0.706	NA	ITAS-O
	08-06-91	10.5±4.34	NA	ITAS-O
	08-06-91	7.61±3.32	NA	ITAS-O
	08-06-91	12.1±4.52	NA	ITAS-O
	08-06-91	4.56±2.61	NA	ITAS-O
	08-06-91	7.61±3.06	NA	ITAS-O
	08-06-91	8.52±3.67	NA	ITAS-O
	01-15-92	4.9±2.61	NA	ITAS-O
	01-15-92	5.92±2.27	NA	ITAS-O
	01-15-92	7.81±2.97	NA	ITAS-O
	01-15-92	7.62±3.93	NA	ITAS-O
	01-15-92	6.73±3.84	NA	ITAS-O
	01-15-92	7.84±3.78	NA	ITAS-O
	01-15-92	4.43±2.45	NA	ITAS-O
	01-15-92	4.47±1.9	NA	ITAS-O
	01-15-92	4.59±2.35	NA	ITAS-O

Refer to footnotes at end of table.

Table 5.4-8 (Continued)
Summary of Gross Alpha Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-BW1 (cont.)	01-15-92	6.25±2.42	NA	ITAS-O
	01-15-92	4.72±2.5	NA	ITAS-O
	01-15-92	13.9±4.15	NA	ITAS-O
	07-29-92	9.87±4.73	NA	ITAS-O
	07-29-92	29.8±8.3	NA	ITAS-O
	07-29-92	11±5	NA	ITAS-O
	07-29-92	6.99±4.05	NA	ITAS-O
	01-20-93	6.2±1.82	1.5	ITRSL
	01-20-93	37.2±5.4	1.3	ITRSL
	01-20-93	7.57±2.05	1.5	ITRSL
	01-20-93	6.84±1.95	1.6	ITRSL
	11-10-93	8.7±3.7	2.5	TMA EB
	04-28-94	7.8±3.2	2.2	TMA EB
	10-27-94	11±1.7	1	QUANTE
	10-23-95	8.9±4.4	6.2	LAS
MWL-MW1	09-01-90	6.01	3.36	ITAS-O
	09-01-90	5.10	3.66	ITAS-O
	01-24-91	5.0±2.7	6	ITAS-O
	01-24-91	4.2±2.3	5	ITAS-O
	01-24-91	ND	5	ITAS-O
	01-24-91	3.0±2.0	5	ITAS-O
	05-07-91	5.6±3.8	NA	QUANTE
	05-07-91	7.2±4.2	NA	QUANTE
	05-07-91	12±5	NA	QUANTE
	05-07-91	7.5±4.3	NA	QUANTE
	07-31-91	6.06±2.82	NA	ITAS-O
	07-31-91	7.56±3.42	NA	ITAS-O
	07-31-91	7.22±3.3	NA	ITAS-O
	07-31-91	6.73±2.93	NA	ITAS-O
	07-31-91	6.6±3.04	NA	ITAS-O
	07-31-91	7.09±3.33	NA	ITAS-O
	07-31-91	8.33±3.8	NA	ITAS-O
	07-31-91	8.06±3.67	NA	ITAS-O
	10-14-91	8.5±5.21	NA	ITAS-O
	01-14-92	5±2.75	NA	ITAS-O
	01-14-92	7.97±3.72	NA	ITAS-O
	01-14-92	4.54±2.48	NA	ITAS-O
	01-14-92	8.26±3.02	NA	ITAS-O
	01-14-92	7.65±3.09	NA	ITAS-O
	01-14-92	6.14±2.87	NA	ITAS-O

Refer to footnotes at end of table.

Table 5.4-8 (Continued)
Summary of Gross Alpha Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW1 (cont.)	01-14-92	5.14±2.85	NA	ITAS-O
	01-14-92	5.41±3.41	NA	ITAS-O
	07-28-92	13.52±-.65	NA	ITAS-O
	07-28-92	4.44±2.84	NA	ITAS-O
	07-28-92	12.3±5.5	NA	ITAS-O
	07-28-92	10.5±4.9	NA	ITAS-O
	07-28-92	5.44±3.44	NA	ITAS-O
	01-19-93	11.7±4	3.5	ITRSL
	01-19-93	10.9±3.8	3.3	ITRSL
	01-19-93	13.9±4.2	2	ITRSL
	01-19-93	10.7±3.8	3.2	ITRSL
	04-27-93	11±4.4	1.9	TMA EB
	04-27-93	7.8±3.5	2.6	TMA EB
	04-27-93	9.6±4.1	2.7	TMA EB
	04-27-93	8.6±3.8	2.5	TMA EB
	11-09-93	11±4.1	2.1	TMA EB
	05-03-94	6.9±3.4	3.1	TMA EB
	05-04-94	10±4.3	3.1	TMA EB
	10-25-94	7.3±1.41	1.19	QUANTE
	10-20-95	4.9±3.5	6.5	LAS
MWL-MW2	09-01-90	13.9	6.03	ITAS-O
	09-01-90	7.42	4.38	ITAS-O
	01-28-91	ND	3	ITAS-O
	01-28-91	4.2±2.2	5	ITAS-O
	01-28-91	3.7±2.2	5	ITAS-O
	01-28-91	ND	5	ITAS-O
	05-02-91	ND	NA	QUANTE
	05-02-91	7.8±4.3	NA	QUANTE
	05-02-91	11±5	NA	QUANTE
	05-02-91	13±5	NA	QUANTE
	08-01-91	9.55±4.02	NA	ITAS-O
	08-01-91	6.21±3.53	NA	ITAS-O
	08-01-91	3.98±2.75	NA	ITAS-O
	08-01-91	5.92±3.16	NA	ITAS-O

Refer to footnotes at end of table.

Table 5.4-8 (Continued)
Summary of Gross Alpha Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW2 (cont.)	08-01-91	3.75±2.36	NA	ITAS-O
	08-01-91	9.08±4.16	NA	ITAS-O
	08-01-91	2±1.85	NA	ITAS-O
	08-01-91	4.42±2.66	NA	ITAS-O
	10-11-91	0.736±0.768	NA	ITAS-O
	01-13-92	5.43±2.72	NA	ITAS-O
	01-13-92	7.87±3.39	NA	ITAS-O
	01-13-92	6.15±3.03	NA	ITAS-O
	01-13-92	9.53±3.61	NA	ITAS-O
	01-13-92	8.16±3.26	NA	ITAS-O
	01-13-92	7.35±2.8	NA	ITAS-O
	01-13-92	9.69±3.86	NA	ITAS-O
	01-13-92	7.11±3.11	NA	ITAS-O
	07-27-92	16.2±6	NA	ITAS-O
	07-27-92	10.8±4.9	NA	ITAS-O
	07-27-92	18.7±6.6	NA	ITAS-O
	07-27-92	11.5±4.8	NA	ITAS-O
	01-18-93	7.34±1.98	1.5	ITRSL
	01-18-93	8.34±2.09	1.5	ITRSL
	01-18-93	13.4±2.8	1.5	ITRSL
	01-18-93	11.6±2.5	1.2	ITRSL
	04-26-93	12±4.7	2.5	TMA EB
	04-26-93	10±4.3	3.1	TMA EB
	04-26-93	13±5.3	4.3	TMA EB
	04-26-93	19±6.8	3.5	TMA EB
	11-08-93	9.7±3.8	2.5	TMA EB
	05-02-94	6.8±3.4	3	TMA EB
	10-19-94	0.26±0.24	0.36	QUANTE
	10-24-94	11.3±1.9	1.3	QUANTE
	04-17-95	3.7±2.4	1.1	LAS
	10-16-95	3.2±2.8	5.7	LAS
MWL-MW3	09-01-90	10.2	5.02	ITAS-O
	09-01-90	5.28	3.54	ITAS-O
	09-01-90	5.68	3.83	ITAS-O
	09-01-90	12.2	5.23	ITAS-O
	01-28-91	ND	3	ITAS-O
	01-28-91	2.9±1.9	5	ITAS-O
	01-28-91	3.3±2.1	5	ITAS-O
	01-28-91	4.7±2.4	5	ITAS-O
	05-02-91	6.9±4.2	NA	QUANTE

Refer to footnotes at end of table.

Table 5.4-8 (Continued)
Summary of Gross Alpha Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW3 (cont.)	05-02-91	10±5	NA	QUANTE
	05-02-91	8.5±4.4	NA	QUANTE
	05-02-91	9.3±4.4	NA	QUANTE
	08-05-91	4.95±2.59	NA	ITAS-O
	08-05-91	4.77±2.57	NA	ITAS-O
	08-05-91	6.58±2.88	NA	ITAS-O
	08-05-91	5.71±2.77	NA	ITAS-O
	08-05-91	9.79±4.01	NA	ITAS-O
	08-05-91	5.91±2.68	NA	ITAS-O
	08-05-91	5.39±2.71	NA	ITAS-O
	08-05-91	9.56±3.97	NA	ITAS-O
	10-11-91	0.881±0.83	NA	ITAS-O
	01-14-92	7.17±3.11	NA	ITAS-O
	01-14-92	6.86±3.27	NA	ITAS-O
	01-14-92	5±2.45	NA	ITAS-O
	01-14-92	1.55±0.878	NA	ITAS-O
	01-14-92	7.6±2.85	NA	ITAS-O
	01-14-92	5.85±2.78	NA	ITAS-O
	01-14-92	6.75±2.85	NA	ITAS-O
	01-14-92	1.19±3.6	NA	ITAS-O
	07-28-92	6.14±3.32	NA	ITAS-O
	07-28-92	8.06±4.08	NA	ITAS-O
	07-28-92	12.1±4.7	NA	ITAS-O
	07-28-92	5.83±3.75	NA	ITAS-O
	01-19-93	8.82±2.09	1.2	ITRSL
	01-19-93	9.92±2.27	1.5	ITRSL
	01-19-93	10.3±2.3	1.3	ITRSL
	01-19-93	9.85±2.24	1.4	ITRSL
	04-27-93	11±4.2	1.6	TMA EB
	04-27-93	7.1±3.3	2.3	TMA EB
	04-27-93	6.3±3.2	2.7	TMA EB
	04-27-93	8.8±3.7	2.3	TMA EB
	11-09-93	12±4.3	2.4	TMA EB
	05-03-94	9.8±3.8	2.1	TMA EB
	10-25-94	5.11±1.55	1.85	QUANTE
	10-25-94	5.3±1.24	1.23	QUANTE
	04-17-95	2.6±2.2	1.1	LAS
	10-16-95	2.2±2.6	5.6	LAS

Refer to footnotes at end of table.

Table 5.4-8 (Concluded)
Summary of Gross Alpha Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW4	02-08-93	1.5±1.2	NA	QUANTE
	04-21-93	17±6.3	2.7	TMA EB
	04-28-93	12±5.2	3.4	TMA EB
	04-28-93	16±6.1	3.3	TMA EB
	04-28-93	12±5.3	4.1	TMA EB
	04-28-93	9.8±4.4	2.3	TMA EB
	04-30-93	8.5±4.4	3.7	TMA EB
	04-30-93	12±5.2	3.5	TMA EB
	04-30-93	7.2±3.8	2.8	TMA EB
	04-30-93	8.7±4.4	3.5	TMA EB
	11-11-93	9.3±3.9	2.4	TMA EB
	03-14-94	11±4.5	2.6	TMA EB
	0531-94	6.5±4.1	5.2	TMA EB
	10-28-94	5.37±1.51	1.74	QUANTE
	04-19-95	7.1±3.9	1.5	LAS
	04-19-95	6.1±3.4	1.3	LAS
	10-20-95	3.5±3.6	7.5	LAS
	10-20-95	2.3±3.6	7.7	LAS

Note: The EPA drinking water MCL for gross alpha activity is 15 pCi/L (excluding activity from uranium).

[a] Analysis by EPA Method 900.0. Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL	IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MCL	maximum contaminant level
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND	not detected at 2 sigma error
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)

Table 5.4-9
Summary of Gross Beta Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-BW1	09-01-90	5.97	2.68	ITAS-O
	09-01-90	6.17	2.69	ITAS-O
	09-01-90	4.73	2.53	ITAS-O
	09-01-90	5.40	2.59	ITAS-O
	01-24-91	ND	5	ITAS-O
	01-24-91	8.2±4.1	6	ITAS-O
	01-24-91	ND	6	ITAS-O
	01-24-91	9.4±3.7	6	ITAS-O
	01-24-91	6.5±3.6	5	ITAS-O
	01-24-91	7.0±3.6	3	ITAS-O
	01-24-91	11±4.0	5	ITAS-O
	01-24-91	6.6±4.0	5	ITAS-O
	04-07-91	3.4±4.1	NA	QUANTE
	04-07-91	4.4±3.3	NA	QUANTE
	04-07-91	4.2±3.4	NA	QUANTE
	04-07-91	3.9±3.3	NA	QUANTE
	04-07-91	8.3±4.1	NA	QUANTE
	04-07-91	5.3±3.7	NA	QUANTE
	04-07-91	3.6±3.5	NA	QUANTE
	04-07-91	ND	NA	QUANTE
	08-06-91	6.92±2.16	NA	ITAS-O
	08-06-91	6.15±1.89	NA	ITAS-O
	08-06-91	5.87±1.91	NA	ITAS-O
	08-06-91	9.02±2.24	NA	ITAS-O
	08-06-91	6.37±2.02	NA	ITAS-O
	08-06-91	9.79±2.38	NA	ITAS-O
	08-06-91	7.22±2.13	NA	ITAS-O
	08-06-91	9.36±2.44	NA	ITAS-O
	08-06-91	4.68±1.97	NA	ITAS-O
	08-06-91	5.72±2.05	NA	ITAS-O
	08-06-91	6.27±2.07	NA	ITAS-O
	08-06-91	7.46±2.27	NA	ITAS-O
	08-06-91	4.88±1.36	NA	ITAS-O
	08-06-91	6.69±2.19	NA	ITAS-O
	08-06-91	6.91±2.17	NA	ITAS-O
	10-11-91	1.61±1.07	NA	ITAS-O
	01-15-92	6.15±2.42	NA	ITAS-O
	01-15-92	5.43±2.3	NA	ITAS-O
	01-15-92	4.42±1.43	NA	ITAS-O
	01-15-92	5.76±1.54	NA	ITAS-O
	01-15-92	5.57±1.73	NA	ITAS-O
	01-15-92	7.83±2.07	NA	ITAS-O
	01-15-92	6.24±2.17	NA	ITAS-O

Refer to footnotes at end of table.

Table 5.4-9 (Continued)
Summary of Gross Beta Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-BW1 (cont.)	01-15-92	6.51±2.23	NA	ITAS-O
	01-15-92	6.96±1.86	NA	ITAS-O
	01-15-92	7.21±1.93	NA	ITAS-O
	01-15-92	6.6±1.74	NA	ITAS-O
	01-15-92	6.6±1.73	NA	ITAS-O
	01-15-92	3.5±1.37	NA	ITAS-O
	01-15-92	4.6±1.43	NA	ITAS-O
	01-15-92	7±1.74	NA	ITAS-O
	01-15-92	5.85±1.59	NA	ITAS-O
	01-15-92	-0.33±.665	NA	ITAS-O
	07-29-92	7.27±2.48	NA	ITAS-O
	07-29-92	5.5±2.39	NA	ITAS-O
	07-29-92	4.08±1.87	NA	ITAS-O
	07-29-92	7.54±1.95	NA	ITAS-O
	07-29-92	6.97±1.96	NA	ITAS-O
	07-29-92	7.02±2.05	NA	ITAS-O
	01-20-93	7.03±2.59	3.6	ITRSL
	01-20-93	4.56±2.25	3.3	ITRSL
	01-20-93	7.45±2.55	3.5	ITRSL
	01-20-93	6.95±2.53	3.5	ITRSL
	01-20-93	5.25±2.53	3.8	ITRSL
	01-20-93	6.06±2.68	3.9	ITRSL
	01-20-93	5±2.4	3.5	ITRSL
	01-20-93	72.8±8.9	4	ITRSL
	04-28-93	6.3±1.9	2.3	TMA EB
	04-28-93	5.9±1.8	2.1	TMA EB
	04-28-93	6.5±2	2.1	TMA EB
	04-28-93	5.3±1.9	2.3	TMA EB
	11-10-93	8±2.1	2	TMA EB
	11-10-93	4.5±1.8	2.5	TMA EB
	04-27-94	ND	2.2	TMA EB
	10-27-94	3.89±0.73	0.98	QUANTE
	10-27-94	5.05±0.8	1.01	QUANTE
	10-23-95	5.4±2.5	3.5	LAS
MWL-MW1	09-01-90	4.75	2.54	ITAS-O
	09-01-90	4.84	2.57	ITAS-O
	01-24-91	ND	6	ITAS-O

Refer to footnotes at end of table.

Table 5.4-9 (Continued)
Summary of Gross Beta Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW1 (cont.)	01-24-91	6.6±3.7	5	ITAS-O
	01-24-91	14±5	5	ITAS-O
	01-24-91	8.0±3.7	5	ITAS-O
	05-07-91	5.7±3.8	NA	QUANTE
	05-07-91	11±5	NA	QUANTE
	05-07-91	7.4±4.3	NA	QUANTE
	05-07-91	7.3±4.1	NA	QUANTE
	07-31-91	4.24±1.83	NA	ITAS-O
	07-31-91	11.4±2.56	NA	ITAS-O
	07-31-91	5.26±2.07	NA	ITAS-O
	07-31-91	4.1±1.96	NA	ITAS-O
	07-31-91	7±2.04	NA	ITAS-O
	07-31-91	6.18±2.06	NA	ITAS-O
	07-31-91	4.66±1.91	NA	ITAS-O
	07-31-91	6.42±2.03	NA	ITAS-O
	10-14-91	14.3±6.75	NA	ITAS-O
	01-14-92	4.58±1.54	NA	ITAS-O
	01-14-92	7.22±1.89	NA	ITAS-O
	01-14-92	6±1.82	NA	ITAS-O
	01-14-92	5.8±1.7	NA	ITAS-O
	01-14-92	6.14±1.75	NA	ITAS-O
	01-14-92	4.12±1.49	NA	ITAS-O
	01-14-92	5.01±2.06	NA	ITAS-O
	01-14-92	5.29±1.95	NA	ITAS-O
	07-28-92	101.54±0.1	NA	ITAS-O
	07-28-92	110.15±1.59	NA	ITAS-O
	07-28-92	4.83±2.65	NA	ITAS-O
	07-28-92	6.96±2.36	NA	ITAS-O
	07-28-92	4.04±2.13	NA	ITAS-O
	07-28-92	4.66±2.57	NA	ITAS-O
	01-19-93	4.24±2.67	4.2	ITRSL
	01-19-93	5.8±2.63	3.9	ITRSL
	01-19-93	6.46±2.98	4.4	ITRSL
	01-19-93	5.53±2.7	4	ITRSL
	04-27-93	4.5±1.8	2.4	TMA EB
	04-27-93	5.3±1.7	2	TMA EB
	04-27-93	4.8±1.8	2.1	TMA EB
	04-27-93	5.2±1.7	2	TMA EB
	11-09-93	5.9±1.8	2.2	TMA EB
	05-03-94	4.4±1.6	2	TMA EB
	05-04-94	5.6±1.8	2.2	TMA EB
	10-25-94	4.92±0.73	0.84	QUANTE

Refer to footnotes at end of table.

Table 5.4-9 (Continued)
Summary of Gross Beta Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW2	09-01-90	7.28	2.82	ITAS-O
	09-01-90	4.97	2.56	ITAS-O
	01-28-91	ND	6	ITAS-O
	01-28-91	7.5±3.6	5	ITAS-O
	01-28-91	9.8±3.8	5	ITAS-O
	01-28-91	10±5	5	ITAS-O
	05-02-91	7.5±4	NA	QUANTE
	05-02-91	8.1±4.5	NA	QUANTE
	05-02-91	9.2±4.3	NA	QUANTE
	05-02-91	7.9±4	NA	QUANTE
	08-01-91	4.23±1.79	NA	ITAS-O
	08-01-91	10.4±2.48	NA	ITAS-O
	08-01-91	10.4±2.65	NA	ITAS-O
	08-01-91	7.98±2.31	NA	ITAS-O
	08-01-91	5.69±2.07	NA	ITAS-O
	08-01-91	6.94±1.96	NA	ITAS-O
	08-01-91	5.64±1.88	NA	ITAS-O
	08-01-91	6.61±1.97	NA	ITAS-O
	10-11-91	0.806±0.874	NA	ITAS-O
	01-13-92	8.17±1.87	NA	ITAS-O
	01-13-92	6.08±1.67	NA	ITAS-O
	01-13-92	6.53±1.68	NA	ITAS-O
	01-13-92	5.5±1.63	NA	ITAS-O
	01-13-92	5.87±1.6	NA	ITAS-O
	01-13-92	7.17±1.71	NA	ITAS-O
	01-13-92	4.88±1.55	NA	ITAS-O
	01-13-92	5.78±1.7	NA	ITAS-O
	07-27-92	9.39±2.32	NA	ITAS-O
	07-27-92	7.73±2.43	NA	ITAS-O
	07-27-92	7.59±2.25	NA	ITAS-O
	07-27-92	7.92±2.4	NA	ITAS-O

Refer to footnotes at end of table.

Table 5.4-9 (Continued)
Summary of Gross Beta Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW2 (cont.)	01-18-93	6.14±2.71	4	ITRSL
	01-18-93	6.16±2.63	3.8	ITRSL
	01-18-93	6.46±2.76	4	ITRSL
	01-18-93	4.77±2.53	3.8	ITRSL
	04-26-93	6.8±2	2.1	TMA EB
	04-26-93	7.6±2	2.1	TMA EB
	04-26-93	7.6±2.1	2.3	TMA EB
	04-26-93	9.9±2.3	2.1	TMA EB
	11-08-93	5.5±1.8	2.1	TMA EB
	05-02-94	6.3±2	2.4	TMA EB
	10-24-94	5.25±0.81	1	QUANTE
	04-17-95	5.5±2.4	1.7	LAS
	10-16-95	6.3±2.6	3.6	LAS
MWL-MW3	09-01-90	4.48	2.49	ITAS-O
	09-01-90	4.81	2.54	ITAS-O
	01-28-91	ND	7	ITAS-O
	01-28-91	8.0±3.6	5	ITAS-O
	01-28-91	8.4±3.6	5	ITAS-O
	01-28-91	6.7±3.6	5	ITAS-O
	05-02-91	4.8±3.7	NA	QUANTE
	05-02-91	8±4.2	NA	QUANTE
	05-02-91	8.4±4.1	NA	QUANTE
	05-02-91	6±3.8	NA	QUANTE
	08-05-91	9.24±2.21	NA	ITAS-O
	08-05-91	5.81±1.86	NA	ITAS-O
	08-05-91	9.17±2.16	NA	ITAS-O
	08-05-91	5.52±1.95	NA	ITAS-O
	08-05-91	7.18±2.03	NA	ITAS-O
	08-05-91	4.64±1.79	NA	ITAS-O
	08-05-91	6.45±2.02	NA	ITAS-O
	08-05-91	5.6±1.91	NA	ITAS-O
	10-11-91	0.954±0.923	NA	ITAS-O
	01-14-92	7.19±1.76	NA	ITAS-O
	01-14-92	4.51±1.44	NA	ITAS-O
	01-14-92	6.58±1.69	NA	ITAS-O
	01-14-92	6.49±1.49	NA	ITAS-O

Refer to footnotes at end of table.

Table 5.4-9 (Continued)
Summary of Gross Beta Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW3 (cont.)	01-14-92	4.35±1.28	NA	ITAS-O
	01-14-92	5.17±1.63	NA	ITAS-O
	01-14-92	5.66±1.42	NA	ITAS-O
	01-14-92	6.59±1.57	NA	ITAS-O
	07-28-92	5.5±1.82	NA	ITAS-O
	07-28-92	7.14±1.88	NA	ITAS-O
	07-28-92	6.18±1.98	NA	ITAS-O
	07-28-92	7.23±1.84	NA	ITAS-O
	01-19-93	7.35±2.6	3.6	ITRSL
	01-19-93	5.49±2.45	3.6	ITRSL
	01-19-93	7.01±2.6	3.7	ITRSL
	01-19-93	4.54±2.27	3.4	ITRSL
	04-27-93	4.5±1.8	2.4	TMA EB
	04-27-93	7.4±2	2	TMA EB
	04-27-93	7.3±2	2	TMA EB
	04-27-93	7.6±2	2.1	TMA EB
	11-09-93	4.3±1.7	2.2	TMA EB
	05-03-94	7±1.9	2.1	TMA EB
	10-25-94	3.84±0.68	0.91	QUANTE
	10-25-94	3.67±0.66	0.88	QUANTE
	04-17-95	6.1±2.7	1.9	LAS
	10-16-95	7±2.6	3.5	LAS
MWL-MW4	04-30-93	8.5±2.1	2	TMA EB
	04-30-93	13±2.6	0.8	TMA EB
	04-30-93	8.9±2.3	2.3	TMA EB
	04-30-93	6.4±2	2.1	TMA EB
	11-11-93	9.7±2.4	2.2	TMA EB
	03-14-94	10±2.5	2.4	TMA EB
	05-31-94	8.3±2.3	2.5	TMA EB

Refer to footnotes at end of table.

Table 5.4-9 (Concluded)
Summary of Gross Beta Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Lab
MWL-MW4 (cont.)	10-28-94	5.69±0.94	1.17	QUANTE
	04-19-95	10.3±3.6	2.5	LAS
	04-19-95	7.9±3.1	2.3	LAS
	10-20-95	6.8±3.2	4.5	LAS
	10-20-95	7.5±3.7	5.2	LAS

Note: The EPA drinking water MCL for beta particles from anthropogenic radionuclides is 4 millirems per year.

[a] Analysis by EPA Method 900.0. Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2-sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL	IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MCL	maximum contaminant level
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND	not detected at 2 sigma error
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)

Table 5.4-10
Summary of Total Uranium Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Total Uranium[a] (µg/L)	MDL (µg/L)	Lab	Analytical Method[b]
MWL-BW1	10-27-94	5.09	1	QUANTE	ASTM D5174
MWL-MW1	10-24-94	1.34	1	QUANTE	ASTM D5174
MWL-MW1	10-25-94	5.48	1	QUANTE	ASTM D5174
MWL-MW2	10-24-94	7.84	1	QUANTE	ASTM D5174
MWL-MW2	04-17-95	6.64	0.14	LAS	LAL-0168
MWL-MW3	10-25-94	4.82	1	QUANTE	ASTM D5174
MWL-MW3	04-17-95	5.49	0.14	LAS	LAL-0168
MWL-MW4	10-28-94	2690	1	QUANTE	ASTM D5174
MWL-MW4	04-19-95	6.17	0.14	LAS	LAL-0168
MWL-MW4	04-19-95	6.5	0.14	LAS	LAL-0168

Notes: The proposed EPA drinking water MCL for total uranium is 20 µg/L.
The background range of total uranium concentrations across KAFB is 0.5 to 14.9 µg/L.

[a] Average Total Uranium Concentration is 5.97 µg/L (7.2 pCi/L, converted) excluding the MWL-MW4 data outlier of October 1994, which is an analytical error.

[b] EPA November 1986 for EPA Method 6020 analyses. ASTM D5174 and LAL-0168 are laboratory specific methods using kinetic phosphorescence analysis.

ASTM	American Society for Testing and Materials
EPA	U.S. Environmental Protection Agency
KAFB	Kirtland Air Force Base
Lab	laboratory
LAL	Lockheed Analytical Laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MCL	maximum contaminant level
MDL	method detection limit
µg/L	micrograms per liter
MWL	Mixed Waste Landfill
pCi/L	picocuries per liter
QUANTE	Quanterra (off-site laboratory)

Table 5.4-11
Summary of Isotopic Uranium Analytical Results for MWL Groundwater
1990 through 1995

Well	Analyte	Sample Date	Activity ±2-sigma[a] pCi/L	MDC pCi/L	Qualifier	Analytical Method	Lab
MWL-BW1	Uranium-234	09-01-90	6.6	0.662	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	6.94	0.703	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	6.38	0.646	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	6.19	0.632	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0629	0.0229	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0782	0.0266	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0833	0.0276	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0909	0.0289	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.38	0.262	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.43	0.272	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.36	0.262	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.28	0.257	--	Radiometric	ITAS-O
	Uranium-235	04-28-93	34	34	ND	Radiometric	TMA EB
	Uranium-238	04-28-93	1100	1100	ND	Radiometric	TMA EB
	Uranium-234	11-10-93	6.8±0.9	0.1	--	Radiometric	TMA EB
	Uranium-234	11-10-93	6.3±0.7	0.056	--	Radiometric	TMA EB
	Uranium-235	11-10-93	0.071±0.064	0.039	--	Radiometric	TMA EB
	Uranium-235	11-10-93	0.11±0.066	0.025	--	Radiometric	TMA EB
	Uranium-238	11-10-93	3±0.5	0.1	--	Radiometric	TMA EB
	Uranium-238	11-10-93	3±0.41	0.025	--	Radiometric	TMA EB
	Uranium-234	04-27-94	0.099±0.062	0.058	B	Radiometric	TMA EB
	Uranium-235	04-27-94	-0.011±0.002	0.067	ND	Radiometric	TMA EB
	Uranium-238	04-27-94	0.041±0.04	0.058	ND	Radiometric	TMA EB
	Uranium-234	10-26-94	0.05±0.076	0.111	ND	Radiometric	QUANTE
	Uranium-235	10-26-94	0.029±0.066	0.137	ND	Radiometric	QUANTE
	Uranium-238	10-26-94	0±0	0.072	ND	Radiometric	QUANTE
	Uranium-234	10-27-94	7.97±1.7	0.19	--	Radiometric	QUANTE
	Uranium-234	10-27-94	7.36±1.57	0.07	--	Radiometric	QUANTE
	Uranium-235	10-27-94	0.43±0.26	0.24	--	Radiometric	QUANTE
	Uranium-235	10-27-94	0.26±0.19	0.14	--	Radiometric	QUANTE
	Uranium-238	10-27-94	3.05±0.8	0.23	--	Radiometric	QUANTE
	Uranium-238	10-27-94	3.18±0.81	0.07	--	Radiometric	QUANTE
	Uranium-234	04-19-95	6.4±1.2	0.28	--	Radiometric	TMA EB
	Uranium-235	04-19-95	0.089±0.13	0.21	ND	Radiometric	TMA EB
	Uranium-238	04-19-95	2.2±0.59	0.24	--	Radiometric	TMA EB
	Uranium-234	10-23-95	5.81±0.42	0.027	--	Radiometric	LAS
	Uranium-235	10-23-95	-13±34	23	ND	Radiometric	LAS
	Uranium-235	10-23-95	0.187±0.055	0.011	--	Radiometric	LAS
	Uranium-238	10-23-95	2.21±0.22	0.021	--	Radiometric	LAS

Refer to footnotes at end of table.

Table 5.4-11 (Continued)
Summary of Isotopic Uranium Analytical Results for MWL Groundwater
1990 through 1995

Well	Analyte	Sample Date	Activity ±2-sigma[a] pCi/L	MDC pCi/L	Qualifier	Analytical Method	Lab
MWL-MW1	Uranium-234	09-01-90	5.69	0.58	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	5.93	0.616	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.963	0.0291	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.105	0.0326	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.10	0.237	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.01	0.239	--	Radiometric	ITAS-O
	Uranium-235	04-27-93	34	34	ND	Radiometric	TMA EB
	Uranium-238	04-27-93	1100	1100	ND	Radiometric	TMA EB
	Uranium-234	11-09-93	6.1±0.82	0.085	--	Radiometric	TMA EB
	Uranium-235	11-09-93	0.064±0.064	0.085	ND	Radiometric	TMA EB
	Uranium-238	11-09-93	3±0.49	0.085	--	Radiometric	TMA EB
	Uranium-234	04-26-94	0.029±0.034	0.026	--	Radiometric	TMA EB
	Uranium-235	04-26-94	0±0	0.026	ND	Radiometric	TMA EB
	Uranium-238	04-26-94	0.034±0.04	0.058	ND	Radiometric	TMA EB
	Uranium-234	05-03-94	5.5±1.1	0.053	B	Radiometric	TMA EB
	Uranium-235	05-03-94	0.094±0.062	0.053	--	Radiometric	TMA EB
	Uranium-238	05-03-94	1.8±0.42	0.053	--	Radiometric	TMA EB
	Uranium-234	05-04-94	5.4±1.1	0.065	--	Radiometric	TMA EB
	Uranium-235	05-04-94	0.1±0.06	0.048	--	Radiometric	TMA EB
	Uranium-238	05-04-94	1.9±0.42	0.078	--	Radiometric	TMA EB
	Uranium-234	10-24-94	0.056±0.08	0.076	ND	Radiometric	QUANTE
	Uranium-235	10-24-94	0±0	0.094	ND	Radiometric	QUANTE
	Uranium-238	10-24-94	-0.002±0.006	0.117	ND	Radiometric	QUANTE
	Uranium-234	10-25-94	7.28±1.51	0.13	--	Radiometric	QUANTE
	Uranium-235	10-25-94	0.38±0.22	0.17	--	Radiometric	QUANTE
	Uranium-238	10-25-94	2.45±0.64	0.12	--	Radiometric	QUANTE
	Uranium-234	04-19-95	5.51±0.41	1.1	--	Radiometric	LAS
	Uranium-235	04-19-95	0.207±0.060	0.014	--	Radiometric	LAS
	Uranium-238	04-19-95	1.85±0.20	0.025	--	Radiometric	LAS
	Uranium-234	10-20-95	5.9±0.46	0.034	--	Radiometric	LAS
	Uranium-235	10-20-95	-15±21	19	ND	Radiometric	LAS
	Uranium-235	10-20-95	0.176±0.065	0.019	--	Radiometric	LAS
	Uranium-238	10-20-95	2.23±0.25	0.027	--	Radiometric	LAS

Refer to footnotes at end of table.

Table 5.4-11 (Continued)
Summary of Isotopic Uranium Analytical Results for MWL Groundwater
1990 through 1995

Well	Analyte	Sample Date	Activity ±2-sigma[a] pCi/L	MDC pCi/L	Qualifier	Analytical Method	Lab
MWL-MW2	Uranium-234	09-01-90	6.98	0.712	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	6.61	0.678	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.129	0.0358	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.101	0.0313	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.84	0.314	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.57	0.289	--	Radiometric	ITAS-O
	Uranium-235	04-26-93	35	35	ND	Radiometric	TMA EB
	Uranium-238	04-26-93	1200	1200	ND	Radiometric	TMA EB
	Uranium-234	11-08-93	5.5±0.74	0.08	--	Radiometric	TMA EB
	Uranium-235	11-08-93	0.12±0.082	0.036	--	Radiometric	TMA EB
	Uranium-238	11-08-93	2.6±0.44	0.095	--	Radiometric	TMA EB
	Uranium-234	04-27-94	1.8±0.41	0.062	--	Radiometric	TMA EB
	Uranium-235	04-27-94	0.079±0.054	0.024	--	Radiometric	TMA EB
	Uranium-238	04-27-94	1.1±0.29	0.062	--	Radiometric	TMA EB
	Uranium-234	05-02-94	6.5±1.3	0.076	--	Radiometric	TMA EB
	Uranium-235	05-02-94	0.23±0.1	0.025	--	Radiometric	TMA EB
	Uranium-238	05-02-94	2.2±0.49	0.025	--	Radiometric	TMA EB
	Uranium-234	10-19-94	0.073±0.105	0.1	ND	Radiometric	QUANTE
	Uranium-235	10-19-94	0.041±0.091	0.19	ND	Radiometric	QUANTE
	Uranium-238	10-19-94	0.033±0.074	0.153	ND	Radiometric	QUANTE
	Uranium-234	10-24-94	7.34±1.66	0.09	--	Radiometric	QUANTE
	Uranium-235	10-24-94	0.2±0.18	0.11	--	Radiometric	QUANTE
	Uranium-238	10-24-94	2.33±0.7	0.09	--	Radiometric	QUANTE
	Uranium-234	04-17-95	6.28±0.48	0.035	--	Radiometric	LAS
	Uranium-235	04-17-95	0.184±0.062	0.015	--	Radiometric	LAS
	Uranium-238	04-17-95	2.41±0.25	0.029	--	Radiometric	LAS
	Uranium-234	10-16-95	6.61±0.47	0.025	--	Radiometric	LAS
	Uranium-235	10-16-95	7±15	10	ND	Radiometric	LAS
	Uranium-235	10-16-95	0.169±0.054	0.013	--	Radiometric	LAS
	Uranium-238	10-16-95	2.26±0.22	0.021	--	Radiometric	LAS

Refer to footnotes at end of table.

Table 5.4-11 (Continued)
Summary of Isotopic Uranium Analytical Results for MWL Groundwater
1990 through 1995

Well	Analyte	Sample Date	Activity ±2-sigma[a] pCi/L	MDC pCi/L	Qualifier	Analytical Method	Lab
MWL-MW3	Uranium-234	09-01-90	5.49	0.569	--	Radiometric	ITAS-O
	Uranium-234	09-01-90	5.63	0.587	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0779	0.0271	--	Radiometric	ITAS-O
	Uranium-235	09-01-90	0.0483	0.0226	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.07	0.239	--	Radiometric	ITAS-O
	Uranium-238	09-01-90	2.27	0.261	--	Radiometric	ITAS-O
	Uranium-235	04-27-93	34	34	ND	Radiometric	TMA EB
	Uranium-238	04-27-93	1200	1200	ND	Radiometric	TMA EB
	Uranium-234	11-09-93	5.2±0.65	0.079	--	Radiometric	TMA EB
	Uranium-235	11-09-93	0.099±0.066	0.03	--	Radiometric	TMA EB
	Uranium-238	11-09-93	2.5±0.39	0.079	--	Radiometric	TMA EB
	Uranium-234	04-27-94	0.55±0.16	0.021	B	Radiometric	TMA EB
	Uranium-235	04-27-94	0±0	0.021	ND	Radiometric	TMA EB
	Uranium-238	04-27-94	0.17±0.08	0.046	--	Radiometric	TMA EB
	Uranium-234	05-03-94	5.2±1.1	0.074	--	Radiometric	TMA EB
	Uranium-235	05-03-94	0.089±0.064	0.062	--	Radiometric	TMA EB
	Uranium-238	05-03-94	2±0.46	0.095	--	Radiometric	TMA EB
	Uranium-234	10-17-94	0.15±0.3	0.41	ND	Radiometric	QUANTE
	Uranium-235	10-17-94	0±0	0.5	ND	Radiometric	QUANTE
	Uranium-238	10-17-94	0±0	0.41	ND	Radiometric	QUANTE
	Uranium-234	10-25-94	6.19±1.51	0.25	--	Radiometric	QUANTE
	Uranium-235	10-25-94	0.32±0.25	0.19	--	Radiometric	QUANTE
	Uranium-238	10-25-94	2.2±0.71	0.21	--	Radiometric	QUANTE
	Uranium-234	04-17-95	5.29±0.41	0.032	--	Radiometric	LAS
	Uranium-235	04-17-95	0.163±0.058	0.017	--	Radiometric	LAS
	Uranium-238	04-17-95	2.02±0.22	0.028	--	Radiometric	LAS
	Uranium-234	10-16-95	4.85±0.37	0.028	--	Radiometric	LAS
	Uranium-235	10-16-95	-11±28	19	ND	Radiometric	LAS
	Uranium-235	10-16-95	0.146±0.05	0.012	--	Radiometric	LAS
	Uranium-238	10-16-95	1.86±0.2	0.019	--	Radiometric	LAS

Refer to footnotes at end of table.

Table 5.4-11 (Continued)
Summary of Isotopic Uranium Analytical Results for MWL Groundwater
1990 through 1995

Well	Analyte	Sample Date	Activity ±2-sigma[a] pCi/L	MDC pCi/L	Qualifier	Analytical Method	Lab
MWL-MW4	Uranium-234	02-08-93	0.12±0.1	NA	--	Radiometric	QUANTE
	Uranium-235	02-08-93	-0.004±0.05	NA	ND	Radiometric	QUANTE
	Uranium-235	02-08-93	13.6	13.6	ND	Radiometric	QUANTE
	Uranium-238	02-08-93	0.108±0.095	NA	--	Radiometric	QUANTE
	Uranium-235	04-28-93	33	33	ND	Radiometric	TMA EB
	Uranium-238	04-28-93	1200	1200	ND	Radiometric	TMA EB
	Uranium-235	04-30-93	35	35	ND	Radiometric	TMA EB
	Uranium-238	04-30-93	1100	1100	ND	Radiometric	TMA EB
	Uranium-234	11-11-93	5.4±0.39	0.021	--	Radiometric	TMA EB
	Uranium-235	11-11-93	0.13±0.042	0.021	--	Radiometric	TMA EB
	Uranium-238	11-11-93	2.4±0.21	0.008	--	Radiometric	TMA EB
	Uranium-234	03-14-94	7.7±1.2	0.019	B	Radiometric	TMA EB
	Uranium-235	03-14-94	0.21±0.082	0.019	--	Radiometric	TMA EB
	Uranium-238	03-14-94	2.8±0.49	0.056	B	Radiometric	TMA EB
	Uranium-234	05-31-94	5.1±1	0.023	B	Radiometric	TMA EB
	Uranium-235	05-31-94	0.061±0.048	0.023	--	Radiometric	TMA EB
	Uranium-238	05-31-94	2.1±0.48	0.023	--	Radiometric	TMA EB
	Uranium-234	10-28-94	5.24±1.3	0.17	--	Radiometric	QUANTE
	Uranium-235	10-28-94	0.22±0.2	0.19	--	Radiometric	QUANTE
	Uranium-238	10-28-94	2.94±0.85	0.1	--	Radiometric	QUANTE
	Uranium-234	04-19-95	4.21±0.35	0.034	--	Radiometric	LAS
	Uranium-234	04-19-95	3.92±0.35	0.035	--	Radiometric	LAS
	Uranium-235	04-19-95	0.142±0.056	0.021	--	Radiometric	LAS
	Uranium-235	04-19-95	0.171±0.062	0.016	--	Radiometric	LAS
	Uranium-238	04-19-95	1.81±0.22	0.031	--	Radiometric	LAS
	Uranium-238	04-19-95	1.81±0.21	0.029	--	Radiometric	LAS
	Uranium-234	10-20-95	3.95±0.32	0.025	--	Radiometric	LAS
	Uranium-234	10-20-95	3.34±0.3	0.029	--	Radiometric	LAS
	Uranium-235	10-20-95	15±27	16	ND	Radiometric	LAS
	Uranium-235	10-20-95	0.116±0.048	0.017	--	Radiometric	LAS
	Uranium-235	10-20-95	1±15	10	ND	Radiometric	LAS
	Uranium-235	10-20-95	0.139±0.051	0.012	--	Radiometric	LAS
	Uranium-238	10-20-95	1.72±0.2	0.02	--	Radiometric	LAS
	Uranium-238	10-20-95	1.76±0.19	0.02	--	Radiometric	LAS

Refer to footnotes at end of table.

Table 5.4-11 (Concluded)
Summary of Isotopic Uranium Analytical Results for MWL Groundwater
1990 through 1995

Notes: The NMED background activity for uranium-234 is 7 pCi/L, for uranium-235 is 0.41 pCi/L, and for uranium-238 is 3.0 pCi/L. Radiometric analytical methods primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a] Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

B	Analyte detected in the associated equipment blank sample, initial calibrating blank, or continuing calibration blank (see associated MWL report).
EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
ND	not detected
NMED	New Mexico Environment Department
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
--	isotope detected above MDC or 2-sigma error

Table 5.4-12
Summary of Tritium Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-BW1	09-01-90	<206	206	ND	ITAS-O
	09-01-90	<202	202	ND	ITAS-O
	09-01-90	<202	202	ND	ITAS-O
	09-01-90	<203	203	ND	ITAS-O
	05-07-91	86.8±188	NA	ND	ITAS-O
	05-07-91	66.2±187	NA	ND	ITAS-O
	05-07-91	180±193	NA	ND	ITAS-O
	05-07-91	127±190	NA	ND	ITAS-O
	08-06-91	61.6±207	NA	ND	ITAS-O
	08-06-91	27.4±205	NA	ND	ITAS-O
	08-06-91	-59.7±200	NA	ND	ITAS-O
	08-06-91	-160±196	NA	ND	ITAS-O
	10-16-91	404±244	NA	--	ITAS-O
	10-16-91	207±233	NA	ND	ITAS-O
	10-16-91	120±228	NA	ND	ITAS-O
	10-16-91	386±243	NA	--	ITAS-O
	01-15-92	23.1±228	NA	ND	ITAS-O
	01-15-92	-16.6±226	NA	ND	ITAS-O
	01-15-92	-146±229	NA	ND	ITAS-O
	01-15-92	-135±220	NA	ND	ITAS-O
	07-29-92	-88±116	NA	ND	ITAS-O
	07-29-92	-146±114	NA	ND	ITAS-O
	07-29-92	-100±115	NA	ND	ITAS-O
	07-29-92	-159±113	NA	ND	ITAS-O
	07-29-92	-143±114	NA	ND	ITAS-O
	07-29-92	-164±113	NA	ND	ITAS-O
	07-29-92	-109±115	NA	ND	ITAS-O
	07-29-92	-163±113	NA	ND	ITAS-O
	01-20-93	-126±111	200	ND	ITRSL
	01-20-93	-180±108	200	ND	ITRSL
	01-20-93	-125±112	200	ND	ITRSL
	01-20-93	-80±112	200	ND	ITRSL
	01-20-93	-33±183	310	ND	ITRSL
	01-20-93	-378±177	310	ND	ITRSL
	01-20-93	-370±178	310	ND	ITRSL
	01-20-93	-268±176	310	ND	ITRSL
	04-28-93	58±220	370	ND	TMA EB
	04-28-93	150±230	370	ND	TMA EB
	04-28-93	-20±220	370	ND	TMA EB
	04-28-93	-150±210	370	ND	TMA EB
	04-28-93	160±230	370	ND	TMA EB
	04-28-93	140±210	330	ND	TMA EB
	04-28-93	290±220	330	ND	TMA EB
	04-28-93	300±240	370	ND	TMA EB
	11-10-93	13±220	360	ND	TMA EB
	11-10-93	78±220	360	ND	TMA EB
	04-27-94	210±160	260	ND	TMA EB
	10-26-94	-20±104	180	ND	QUANTE
	10-27-94	-27±104	180	ND	QUANTE

Refer to footnotes at end of table.

Table 5.4-12 (Continued)
Summary of Tritium Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-BW1 (cont.)	10-27-94	-32±104	180	ND	QUANTE
	10-27-94	-103±102	180	ND	QUANTE
	08-31-95	60±220	290	ND	LAS
	10-23-95	70±200	110	ND	LAS
MWL-MW1	05-07-91	72.8±107	NA	ND	ITAS-O
	05-07-91	50.4±186	NA	ND	ITAS-O
	07-31-91	108±209	NA	ND	ITAS-O
	07-31-91	76.4±207	NA	ND	ITAS-O
	10-15-91	122±228	NA	ND	ITAS-O
	10-15-91	410±246	NA	--	ITAS-O
	01-14-92	0.967±189	NA	ND	ITAS-O
	01-14-92	-82.2±222	NA	ND	ITAS-O
	07-28-92	-41±113	NA	ND	ITAS-O
	07-28-92	-1±115	NA	ND	ITAS-O
	07-28-92	-79±112	NA	ND	ITAS-O
	07-28-92	-65±113	NA	ND	ITAS-O
	01-19-93	-45±109	190	ND	ITRSL
	01-19-93	42±111	190	ND	ITRSL
	04-27-93	160±230	370	ND	TMA EB
	04-27-93	370±240	370	ND	TMA EB
	04-27-93	270±240	370	ND	TMA EB
	04-27-93	35±220	370	ND	TMA EB
	11-09-93	-9±220	360	ND	TMA EB
	04-26-94	160±160	260	ND	TMA EB
	05-03-94	230±160	260	ND	TMA EB
	05-04-94	230±160	260	ND	TMA EB
	10-24-94	-14±157	274	ND	QUANTE
	10-25-94	-37±103	180	ND	QUANTE
	10-20-95	20±190	110	ND	LAS
	04-19-95	-40±160	97	ND	LAS

Refer to footnotes at end of table.

Table 5.4-12 (Continued)
Summary of Tritium Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-MW2	05-02-91	49.5±186	NA	ND	ITAS-O
	05-02-91	87.8±188	NA	ND	ITAS-O
	08-01-91	2.94±204	NA	ND	ITAS-O
	08-01-91	-54.8±201	NA	ND	ITAS-O
	10-14-91	127±229	NA	ND	ITAS-O
	10-14-91	151±230	NA	ND	ITAS-O
	01-13-92	-12±226	NA	ND	ITAS-O
	01-13-92	3.69±227	NA	ND	ITAS-O
	07-27-92	-165±113	NA	ND	ITAS-O
	07-27-92	-209±112	NA	ND	ITAS-O
	07-27-92	-160±114	NA	ND	ITAS-O
	07-27-92	-145±114	NA	ND	ITAS-O
	01-18-93	-89±177	310	ND	ITRSL
	01-18-93	-159±172	300	ND	ITRSL
	01-18-93	-183±176	310	ND	ITRSL
	01-18-93	-130±175	300	ND	ITRSL
	04-26-93	270±240	370	ND	TMA EB
	04-26-93	98±220	370	ND	TMA EB
	04-26-93	130±230	370	ND	TMA EB
	04-26-93	240±230	370	ND	TMA EB
	11-08-93	120±230	360	ND	TMA EB
	04-27-94	210±160	260	ND	TMA EB
	05-02-94	170±160	260	ND	TMA EB
	10-19-94	11±158	274	ND	QUANTE
	10-24-94	105±163	274	ND	QUANTE
	10-24-94	124±163	274	ND	QUANTE
	04-17-95	40±170	95	ND	LAS
	10-16-95	-40±190	110	ND	LAS
MWL-MW3	05-02-91	87.8±188	NA	ND	ITAS-O
	05-02-91	85.9±188	NA	ND	ITAS-O

Refer to footnotes at end of table.

Table 5.4-12 (Continued)
Summary of Tritium Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-MW3 (cont.)	08-05-91	-68.5±200	NA	ND	ITAS-O
	08-05-91	46±206	NA	ND	ITAS-O
	10-15-91	906±276	NA	--	ITAS-O
	10-15-91	5.81±222	NA	ND	ITAS-O
	01-14-92	70.2±230	NA	ND	ITAS-O
	01-14-92	41.6±228	NA	ND	ITAS-O
	07-28-92	-165±113	NA	ND	ITAS-O
	07-28-92	-136±114	NA	ND	ITAS-O
	07-28-92	-106±115	NA	ND	ITAS-O
	07-28-92	-109±115	NA	ND	ITAS-O
	01-19-93	-74±107	190	ND	ITRSL
	01-19-93	1±113	210	ND	ITRSL
	01-19-93	-216±188	330	ND	ITRSL
	01-19-93	-268±187	330	ND	ITRSL
	01-19-93	-354±184	320	ND	ITRSL
	01-19-93	-380±183	320	ND	ITRSL
	04-27-93	280±240	370	ND	TMA EB
	04-27-93	58±220	370	ND	TMA EB
	04-27-93	77±220	370	ND	TMA EB
	04-27-93	-14±220	370	ND	TMA EB
	11-09-93	4.9±220	360	ND	TMA EB
	05-03-94	110±150	260	ND	TMA EB
	10-25-94	-48±103	180	ND	QUANTE
	04-17-95	-60±160	95	ND	LAS
	10-16-95	70±200	110	ND	LAS
	10-17-94	153±165	274	ND	QUANTE
	10-25-94	-90±102	180	ND	QUANTE
	04-27-94	130±160	260	ND	TMA EB
	10-17-94	105±163	274	ND	QUANTE
MWL-MW4	02-08-93	110±240	NA	ND	QUANTE
	04-30-93	280±220	330	ND	TMA EB
	04-30-93	160±230	370	ND	TMA EB
	04-30-93	180±230	370	ND	TMA EB
	04-30-93	88±220	370	ND	TMA EB

Refer to footnotes at end of table.

Table 5.4-12 (Concluded)
Summary of Tritium Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-MW4 (cont.)	03-04-94	230±150	240	ND	TMA EB
	05-31-94	270±160	260	--	TMA EB
	10-28-94	-80±102	180	ND	QUANTE
	04-19-95	-50±160	96	ND	LAS
	04-19-95	-60±160	96	ND	LAS
	10-20-95	-10±190	110	ND	LAS
	10-20-95	10±190	110	ND	LAS

Notes: The SNL/NM background activity for tritium is 420 pCi/L.
The radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a] Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL	IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND	not detected
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
SNL/NM	Sandia National Laboratories/New Mexico
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
--	isotope detected above MDC or 2-sigma error

Table 5.4-13
Summary of Plutonium Analytical Results for MWL Groundwater 1990 through 1995

Well	Radionuclide	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-BW1	Plutonium-238	09-01-90	<0.0153	0.0153	ND	ITAS-O
		09-01-90	<0.017	0.017	ND	ITAS-O
		09-01-90	<0.00248	0.00248	ND	ITAS-O
		09-01-90	<0.0019	0.0019	ND	ITAS-O
		11-10-93	0.012±0.014	0.011	ND	TMA EB
		11-10-93	0±0.001	0.026	ND	TMA EB
		10-26-94	0.008±0.017	0.031	ND	QUANTE
		10-27-94	0.019±0.056	0.147	ND	QUANTE
		10-27-94	0.057±0.074	0.117	ND	QUANTE
		03-14-95	<0.001±0.041	0.11	ND	TMA EB
		10-23-95	0.0028±0.01	0.0052	ND	LAS
	Plutonium-239	09-01-90	<0.018	0.018	ND	ITAS-O
		09-01-90	<0.0122	0.0122	ND	ITAS-O
		09-01-90	<0.0103	0.0103	ND	ITAS-O
		09-01-90	<0.0157	0.0157	ND	ITAS-O
		11-10-93	0±0.001	0.01	ND	TMA EB
		11-10-93	-0.008±0.011	0.036	ND	TMA EB
		10-26-94	-0.013±0.011	0.031	ND	QUANTE
		10-27-94	0.006±0.04	0.132	ND	QUANTE
		10-27-94	-0.008±0.009	0.125	ND	QUANTE
		03-14-95	-0.014±0.028	0.11	ND	TMA EB
		10-23-95	0.01±0.014	0	ND	LAS
MWL-MW1	Plutonium-238	09-01-90	<0.017	0.017	ND	ITAS-O
		09-01-90	<0.00248	0.00248	ND	ITAS-O
		11-09-93	0.011±0.012	0.01	ND	TMA EB
		04-26-94	0.004±0.02	0.059	ND	TMA EB
		05-03-94	-0.005±0.012	0.054	ND	TMA EB
		05-04-94	<0.007±0.022	0.06	ND	TMA EB
		10-24-94	0.016±0.021	0.035	ND	QUANTE
		10-25-94	0.004±0.026	0.052	ND	QUANTE
		10-20-95	0.001±0.012	0.0078	ND	LAS
	Plutonium-239	11-09-93	-0.007±0.01	0.033	ND	TMA EB
		04-26-94	-0.002±0.02	0.068	ND	TMA EB
		05-03-94	-0.008±0.012	0.058	ND	TMA EB
		05-04-94	-0.006±0.013	0.06	ND	TMA EB
		10-24-94	-0.01±0.011	0.035	ND	QUANTE
		10-25-94	0.013±0.015	0.013	ND	QUANTE
		10-20-95	0±0	0	ND	LAS

Refer to footnotes at end of table.

Table 5.4-13 (Continued)
Summary of Plutonium Analytical Results for MWL Groundwater
1990 through 1995

Well	Radionuclide	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-MW2	Plutonium-238	11-08-93	-0.004±0.007	0.026	ND	TMA EB
		04-27-94	<0.002±0.026	0.081	ND	TMA EB
		05-02-94	<0.024±0.026	0.042	ND	TMA EB
		10-19-94	0.004±0.012	0.024	ND	QUANTE
		10-24-94	0.008±0.013	0.022	ND	QUANTE
		04-17-95	-0.015±0.021	0.031	ND	LAS
		10-16-95	0.003±0.012	0.0059	ND	LAS
	Plutonium-239	11-08-93	-0.007±0.01	0.033	ND	TMA EB
		04-27-94	<0.008±0.016	0.021	ND	TMA EB
		05-02-94	-0.006±0.001	0.042	ND	TMA EB
		10-19-94	0±0.009	0.021	ND	QUANTE
		10-24-94	0.006±0.009	0.015	ND	QUANTE
		04-17-95	-0.008±0.015	0.058	ND	LAS
		10-16-95	0.028±0.024	0	--	LAS
MWL-MW3	Plutonium-238	11-09-93	0.003±0.01	0.022	ND	TMA EB
		04-27-94	<0.009±0.024	0.06	ND	TMA EB
		05-03-94	-0.006±0.001	0.048	ND	TMA EB
		10-17-94	0.003±0.02	0.039	ND	QUANTE
		10-25-94	-0.017±0.017	0.039	ND	QUANTE
		04-17-95	-0.009±0.013	0.018	ND	LAS
		10-16-95	0.002±0.017	0.011	ND	LAS
	Plutonium-239	11-09-93	0.006±0.012	0.022	ND	TMA EB
		04-27-94	-0.023±0.002	0.088	ND	TMA EB
		05-03-94	-0.025±0.002	0.078	ND	TMA EB
		10-17-94	-0.005±0.017	0.039	ND	QUANTE
		10-25-94	-0.011±0.015	0.035	ND	QUANTE
		04-17-95	-0.0045±0.0089	0.034	ND	LAS
		10-16-95	-0.0044±0.0061	0.008	ND	LAS
MWL-MW4	Plutonium-238	11-11-93	0.016±0.022	0.036	ND	TMA EB
		03-14-94	-0.034±0.056	0.11	ND	TMA EB
		05-31-94	-0.016±0.001	0.067	ND	TMA EB
		10-28-94	-0.001±0.003	0.06	ND	QUANTE
		04-19-95	-0.0037±0.0073	0.011	ND	LAS
		04-19-95	-0.006±0.011	0.016	ND	LAS
		10-20-95	-0.0022±0.0042	0.0055	ND	LAS
		10-20-95	-0.0023±0.0044	0.0058	ND	LAS
	Plutonium-239	11-11-93	0.016±0.022	0.036	ND	TMA EB
		03-14-94	-0.011±0.017	0.046	ND	TMA EB
		05-31-94	<0±0.014	0.049	ND	TMA EB
		10-28-94	0±0	0.04	ND	QUANTE
		04-19-95	0.007±0.023	0.028	ND	LAS
		04-19-95	0.052±0.059	0.04	--	LAS
		10-20-95	-0.0022±0.0042	0.0055	ND	LAS

Refer to footnotes at end of table.

Table 5.4-13 (Concluded)
Summary of Plutonium Analytical Results for MWL Groundwater
1990 through 1995

Well	Radionuclide	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-MW4 (cont.)	Plutonium-239 (cont.)	10-20-95	0.003±0.012	0.0058	ND	LAS

Note: The radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a] Alpha spectrometry after chemical separation. Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
ND	not detected
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
--	isotope detected above MDC or 2-sigma error

Table 5.4-14
Summary of Strontium-90 Analytical Results for MWL Groundwater 1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-BW1	09-01-90	<0.228	0.228	ND	ITAS-O
	09-01-90	<0.214	0.214	ND	ITAS-O
	09-01-90	<0.249	0.249	ND	ITAS-O
	09-01-90	<0.228	0.228	ND	ITAS-O
	01-20-93	0.446±0.95	1.69	ND	ITRSL
	04-28-93	4±1.6	1.8	--	TMA EB
	04-27-94	1.8±0.87	1.3	--	TMA EB
	10-26-94	0.44±0.48	0.81	ND	QUANTE
	10-27-94	0.5±0.5	0.85	ND	QUANTE
	10-27-94	0.02±0.4	0.77	ND	QUANTE
	10-23-95	0.3±0.32	0.26	ND	LAS
MWL-MW1	04-27-93	5.7±2.7	3.2	--	TMA EB
	04-26-94	-0.54±0.78	1.4	ND	TMA EB
	05-03-94	-0.58±0.79	1.4	ND	TMA EB
	05-04-94	-0.3±0.82	1.5	ND	TMA EB
	10-24-94	0.69±0.55	0.88	ND	QUANTE
	10-25-94	0.43±0.48	0.81	ND	QUANTE
	10-20-95	0.15±0.3	0.25	ND	LAS
MWL-MW2	04-26-93	2.2±1.2	1.6	--	TMA EB
	04-27-94	<0.12±0.91	1.6	ND	TMA EB
	05-02-94	-0.57±0.82	1.5	ND	TMA EB
	10-19-94	0.11±0.48	0.94	ND	QUANTE
	10-24-94	0.36±0.43	0.73	ND	QUANTE

Refer to footnotes at end of table.

Table 5.4-14 (Concluded)
Summary of Strontium-90 Analytical Results for MWL Groundwater 1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-MW2 (cont.)	04-17-95	-0.01±0.14	0.12	ND	LAS
	10-16-95	-0.09±0.29	0.25	ND	LAS
MWL-MW3	04-27-93	2.5±1.2	1.5	--	TMA EB
	04-27-94	<0.49±0.74	1.2	ND	TMA EB
	05-03-94	-0.47±0.73	1.3	ND	TMA EB
	10-17-94	0.27±0.35	0.56	ND	QUANTE
	10-25-94	0.36±0.41	0.72	ND	QUANTE
	04-17-95	-0.04±0.12	0.1	ND	LAS
	10-16-95	0.03±0.31	0.26	ND	LAS
MWL-MW4	04-28-93	<0.83±1.2	1.9	ND	TMA EB
	04-30-93	<1.9±1.4	2	ND	TMA EB
	05-31-94	-0.66±0.76	1.4	ND	TMA EB
	10-28-94	0.06±0.49	0.92	ND	QUANTE
	04-19-95	0.05±0.13	0.11	ND	LAS
	04-19-95	0.01±0.12	0.1	ND	LAS
	10-20-95	-0.15±0.3	0.27	ND	LAS
	10-20-95	0.16±0.31	0.26	ND	LAS

Notes: The NMED background activity for strontium-90 is <1.6 pCi/L.
The radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a] Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL	IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
ND	not detected
NMED	New Mexico Environment Department
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
--	isotope detected above MDC or 2-sigma error

Table 5.4-15
Summary of Cobalt-60 Analytical Results for MWL Groundwater 1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-BW1	09-01-90	4.55	4.55	ND	ITAS-O
	09-01-90	3.17	3.17	ND	ITAS-O
	09-01-90	3.83	3.83	ND	ITAS-O
	09-01-90	3.63	3.63	ND	ITAS-O
	04-28-93	29	29	ND	TMA EB
	10-23-95	-1.9±2.2	7.4	ND	LAS
MWL-MW1	04-27-93	32	32	ND	TMA EB
	10-20-95	-2.7±3.1	4.6	ND	LAS
MWL-MW2	04-26-93	26	26	ND	TMA EB
	10-16-95	-0.7±1	1.7	ND	LAS
MWL-MW3	04-27-93	27	27	ND	TMA EB
	10-16-95	-1.5±2.5	4	ND	LAS
MWL-MW4	02-08-93	5.57	5.57	ND	QUANTE
	04-21-93	19	19	ND	TMA EB
	04-28-93	24	24	ND	TMA EB
	04-30-93	33	33	ND	TMA EB
	10-20-95	1.2±1.3	1.3	ND	LAS
	10-20-95	0.6±4.2	3.4	ND	LAS

Note: Radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a] Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
ND	not detected
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
--	isotope detected above MDC or 2-sigma error

Table 5.4-16
Summary of Cesium-137 Analytical Results for MWL Groundwater 1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-BW1	09-01-90	4.86	4.86	ND	ITAS-O
	09-01-90	3.75	3.48	--	ITAS-O
	09-01-90	4.72	4.72	ND	ITAS-O
	09-01-90	5.42	5.42	ND	ITAS-O
	01-24-91	12	12	ND	ITAS-O
	01-24-91	14	14	ND	ITAS-O
	01-24-91	14	14	ND	ITAS-O
	01-24-91	16	16	ND	ITAS-O
	05-07-91	-1.26±3.41	NA	ND	ITAS-O
	05-07-91	-1.56±3.73	NA	ND	ITAS-O
	05-07-91	0.0932±3.7	NA	ND	ITAS-O
	05-07-91	2±2.89	NA	ND	ITAS-O
	08-06-91	27	27	ND	TMA EB
	01-15-92	-0.0435±2.77	NA	ND	ITAS-O
	01-15-92	0.606±3.51	NA	ND	ITAS-O
	01-15-92	1.52±3.05	NA	ND	ITAS-O
	01-15-92	-2.68±3.15	NA	ND	ITAS-O
	07-29-92	17.6	17.6	ND	ITAS-O
	07-29-92	15	15	ND	ITAS-O
	01-20-93	13.446	13.446	ND	ITRSL
	01-20-93	13.317±5.3	13.317	ND	ITRSL
	04-28-93	31	31	ND	TMA EB
	10-23-95	1.4±6.8	5.5	ND	LAS
MWL-MW1	01-24-91	12	12	ND	ITAS-O
	01-24-91	13	13	ND	ITAS-O
	05-07-91	3.01±2.81	NA	--	ITAS-O
	05-07-91	-2.48±3.38	NA	ND	ITAS-O
	08-01-91	0±24	NA	ND	TMA EB
	01-14-92	0.504±2.47	NA	ND	ITAS-O
	01-14-92	0±0.0001	NA	ND	ITAS-O
	07-28-92	16	16	ND	ITAS-O
	07-28-92	16	16	ND	ITAS-O
	01-19-93	17.619	17.619	ND	ITRSL
	04-27-93	29	29	ND	TMA EB
	10-20-95	-1.7±3.3	4.1	ND	LAS

Refer to footnotes at end of table.

Table 5.4-16 (Concluded)
Summary of Cesium-137 Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Activity ±2-sigma[a] (pCi/L)	MDC (pCi/L)	Qualifier	Lab
MWL-MW2	01-28-91	15	15	ND	ITAS-O
	01-28-91	13	13	ND	ITAS-O
	05-02-91	-2.22±3.42	NA	ND	ITAS-O
	05-02-91	-2.83±2.82	NA	ND	ITAS-O
	08-01-91	0±26	NA	ND	TMA EB
	01-13-92	0.478±2.87	NA	ND	ITAS-O
	01-13-92	0.544±2.45	NA	ND	ITAS-O
	07-27-92	13.7	13.7	ND	ITAS-O
	01-18-93	19.5	19.5	ND	ITRSL
	04-26-93	27	27	ND	TMA EB
	10-16-95	0.7±2.4	1.3	ND	LAS
MWL-MW3	01-28-91	12	12	ND	ITAS-O
	01-28-91	13	13	ND	ITAS-O
	05-02-91	2.8±3.26	NA	ND	ITAS-O
	05-02-91	-1.61±3.57	NA	ND	ITAS-O
	08-05-91	33	33	ND	TMA EB
	01-14-92	-0.311±3.27	NA	ND	ITAS-O
	01-14-92	0.466±2.95	NA	ND	ITAS-O
	07-28-92	14	14	ND	ITAS-O
	01-19-93	13.889	13.889	ND	ITRSL
	04-27-93	29	29	ND	TMA EB
	10-16-95	-0.7±4.3	3.6	ND	LAS
MWL-MW4	02-08-93	8.74	8.74	ND	QUANTE
	04-21-93	24	24	ND	TMA EB
	04-28-93	31	31	ND	TMA EB
	04-30-93	28	28	ND	TMA EB
	10-20-95	-1.4±1.1	1.5	ND	LAS
	10-20-95	1.2±4.9	3.9	ND	LAS

Notes: The NMED background activity for cesium-137 is 9.3 pCi/L.
Radiometric analytical methods primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a] Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
ITRSL	IT Analytical Services, St. Louis, Missouri (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
NA	not analyzed or not reported
ND	not detected
NMED	New Mexico Environment Department
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
--	isotope detected above MDC or 2-sigma error

Table 5.4-17
Summary of Thorium Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Analyte	Activity ±2-sigma[a] pCi/L	Qualifier	MDC pCi/L	Lab
MWL-BW1	01-Sep-90	Thorium-232	0.104	ND	0.104	ITAS-O
			0.0666	ND	0.0666	ITAS-O
			0.102	ND	0.102	ITAS-O
			0.0718	ND	0.0718	ITAS-O
	28-Apr-93	Thorium-232	160	ND	160	TMA EB
	10-Nov-93	Thorium-232	0.003±0.012	ND	0.036	TMA EB
			0.006±0.012	ND	0.016	TMA EB
	27-Apr-94	Thorium-232	-0.004±0	ND	0.048	TMA EB
	27-Oct-94	Thorium-232	37.2±22.5	--	6.7	QUANTE
			6.3±12.5	ND	26	QUANTE
			0.35±0.15	--	0.03	QUANTE
			0.71±1.22	ND	2.2	QUANTE
			6.06±7.81	ND	8.73	QUANTE
			0.012±0.028	ND	0.058	QUANTE
	23-Oct-95	Thorium-232	0.012±0.025	ND	0.014	LAS
MWL-MW1	01-Sep-90	Thorium-232	0.130	ND	0.130	ITAS-O
	27-Apr-93	Thorium-232	160	ND	160	TMA EB
	09-Nov-93	Thorium-232	0.013±0.024	ND	0.054	TMA EB
	26-Apr-94	Thorium-232	-0.01±0	ND	0.061	TMA EB
	03-May-94	Thorium-232	0±0.014	ND	0.051	TMA EB
	04-May-94	Thorium-232	-0.01±0	ND	0.057	TMA EB
	25-Oct-94	Thorium-232	0.32±1.31	ND	3.82	QUANTE
			7.9±7.73	--	7.29	QUANTE
	20-Oct-95	Thorium-232	-0.0103±0.01	ND	0.013	LAS
MWL-MW2	01-Sep-90	Thorium-232	0.240	--	0.172	ITAS-O
	26-Apr-93	Thorium-232	170	ND	170	TMA EB
	08-Nov-93	Thorium-232	0.001±0.026	ND	0.09	TMA EB
	02-May-94	Thorium-232	-0.003±0.016	ND	0.06	TMA EB
	24-Oct-94	Thorium-232	0.043±0.054	ND	0.074	QUANTE
			0.53±0.64	ND	0.76	QUANTE
			0.64±1.3	ND	1.73	QUANTE
	17-Apr-95	Thorium-232	0.03±0.023	--	0.02	LAS
	16-Oct-95	Thorium-232	0.004±0.025	ND	0.017	LAS
MWL-MW3	01-Sep-90	Thorium-232	>0.149	ND	0.149	TMA EB
	27-Apr-93	Thorium-232	>160	ND	160	TMA EB
	09-Nov-93	Thorium-232	0.013±0.022	ND	0.043	TMA EB
	03-May-94	Thorium-232	-0.016±0	ND	0.066	TMA EB
	25-Oct-94	Thorium-232	0.78±1.6	ND	2.12	QUANTE
			4.91±4.82	ND	4.96	QUANTE
	17-Apr-95	Thorium-232	-0.002±0.013	ND	0.02	LAS
	16-Oct-95	Thorium-232	0.0045±0.0088	--	0	LAS
MWL-MW4	08-Feb-93	Thorium-232	0.52±0.59	--	--	QUANTE
		Thorium-232	0.02	0.00005	--	QUANTE
	28-Apr-93	Thorium-232	160	160	ND	TMA EB

Refer to footnotes at the end of the table.

Table 5.4-17 (Concluded)
Summary of Thorium Analytical Results for MWL Groundwater
1990 through 1995

Well	Sample Date	Analyte	Activity ±2-sigma[a] pCi/L	Qualifier	MDC pCi/L	Lab
MWL-MW4 (cont.)	30-Apr-93	Thorium-232	130	130	ND	TMA EB
	11-Nov-93	Thorium-232	130	130	ND	TMA EB
	14-Mar-94	Thorium-232	-0.004±0	0.055	ND	TMA EB
	31-May-94	Thorium-232	0.034±0.034	0.045	ND	TMA EB
	28-Oct-94	Thorium-232	0.024±0.038	0.063	ND	QUANTE
			0±0	0.66	ND	QUANTE
			17.2±6.6	2	--	QUANTE
	19-Apr-95	Thorium-232	0.02±0.019	0.02	--	LAS
			0.021±0.019	0.02	--	LAS
	20-Oct-95	Thorium-232	0.008±0.015	0.0056	--	LAS
			-0.004±0.02	0.016	ND	LAS

Note: The radiometric analytical methods are primarily gamma spectroscopy (EPA 901.1), and alpha spectrometry after chemical separation.

[a] Alpha spectrometry after chemical separation. Laboratory results have an uncertainty of ±2 sigma error (equivalent to the 95% confidence interval); if the 2 sigma value equals or exceeds the count value, the isotope is considered not to be present.

EPA	U.S. Environmental Protection Agency
ITAS-O	IT Analytical Services, Oak Ridge, Tennessee (off-site laboratory)
Lab	laboratory
LAS	Lockheed Analytical Services, Las Vegas, Nevada (off-site laboratory)
MDC	minimum detectable concentration
MWL	Mixed Waste Landfill
ND	not detected
pCi/L	picocuries per liter
QUANTE	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
TMA EB	Thermo Analytical Laboratories/Eberline, Albuquerque, New Mexico (off-site laboratory)
--	isotope detected above MDC or 2-sigma error

Table 5.4-18
Summary of VOCs Detected in MWL Groundwater
1990 through 1995

Well	Analyte	Sample Date	Result (µg/L)	MCL[a] (µg/L)	Analytical Method[b]	Lab
MWL-BW1	Acetone	10-27-94	2.5 J (10)	NE	8240	QSTL
	Methylene chloride	10-27-94	1.7 J (5)	5	8240	QSTL
		10-27-94	1.8 J (5)	5	8240	QSTL
		10-27-94	2 J (5)	5	8240	QSTL
MWL-MW2	Acetone	10-24-94	3.2 J (10)	NE	8240	QSTL
	Bromomethane	05-02-94	1.9 J (10)	NE	8240	QSTL
	Methylene chloride	10-24-94	1.3 J (5)	5	8240	QSTL
MWL-MW4	Acetone	10-20-95	7.83	NE	8260	GEL
	Methylene Chloride	04-19-95	1.1 J (5)	5	8240	QARV
		04-19-95	1.0 J (5)	5	8240	QARV
	Toluene	05-31-94	0.54 J (5)	1000	8260	QSTL
	Trichloroethene	05-31-94	0.28 J (5)	5	8260	QSTL

[a] EPA July 1995.

[b] EPA November 1986.

CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
GEL	General Engineering Laboratories, Charleston, South Carolina (off-site laboratory)
J ( )	estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab	Laboratory
MCL	Maximum contaminant level, EPA Drinking Water Standards, 40 CFR 141, Subparts B and G
µg/L	micrograms per liter
MWL	Mixed Waste Landfill
NE	not established
QARV	Quanterra Arvada Colorado Laboratory (off-site laboratory)
QSTL	Quanterra, St. Louis Laboratory (off-site laboratory)
VOC	volatile organic compound

Table 5.4-19
Summary of SVOCs Detected in MWL Groundwater
1990 through 1995

Well	Analyte EPA Method 8270[a]	Sample Date	Result (µg/L)	Lab
MWL-BW1	bis(2-Ethylhexyl)phthalate	09-27-90	13	QSTL
MWL-MW1	bis(2-Ethylhexyl)phthalate	05-04-94	160	QSTL
MWL-MW2	bis(2-Ethylhexyl)phthalate	04-17-95	89	QARV
	bis(2-Ethylhexyl)phthalate	04-17-95	89	QARV
MWL-MW4	bis(2-Ethylhexyl)phthalate	04-19-95	6.9 J (10)	QARV

Note: No EPA MCLs are established for the SVOCs listed on this table.

[a] EPA November 1986.

EPA	U.S. Environmental Protection Agency
J ( )	estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab	laboratory
µg/L	micrograms per liter
MCL	maximum contaminant level
MWL	Mixed Waste Landfill
QARV	Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL	Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
SVOC	semivolatile organic compound

Table 5.5-1
MWL Aquifer Parameters

Monitoring Well	Transmissivity (ft^2/day)	Storativity	Hydraulic Conductivity (ft/day)	Completion Interval (ft bgs)
MW-1	1.09	NA	5.48×10^{-2}	445.5–478.7
MW-2	2.08×10^{-2}	NA	1.02×10^{-3}	441.8–478
MW-3	9.23×10^{-2}	NA	5.10×10^{-3}	446–478
BW-1	0.80	NA	5.03×10^{-2}	443–478
MW-4 upper	0.315 - 1.83	NA	7.23×10^{-2}	473–508
MW-4 lower	48.0	NA	1.48	520–552.5

bgs	below ground surface
ft	feet
ft^2	square feet
MWL	Mixed Waste Landfill
NA	not analyzed

Table 6.2-1
Soil Profile Description From MWL Pit 33 (Persaud and Wierenga 1982)

Horizon	Depth (cm)	Description
B21t	0-28	Yellowish red (5YR5/8) loamy fine sand, yellowish red (5YR4/6) moist; weak, coarse prismatic structure; hard, friable, slightly sticky and slightly plastic; few thin discontinuous clay films on ped faces; clear wavy boundary.
B22tca	28-46	Reddish yellow (7.5YR6/6) loamy find sand, yellowish red (5YR5/8) moist; weak coarse prismatic structure; very hard, firm slightly sticky and nonplastic; few thin discontinuous clay films on ped faces; violently effervescent with disseminated lime; clear wavy boundary.
B3ca	46-66	Reddish yellow (7.5YR7/6) loamy fine sand, light brown (7.5YR6/4) moist; weak coarse subangular blocky structure; slightly hard, firm, slightly sticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.
B21tcab	66-97	Pink (7.5YR8/4) loamy fine sand, light brown (7.5YR6/4) moist; weak coarse subangular blocky structure; hard, firm, slightly sticky and nonplastic; few thin discontinuous clay films on ped faces; violently effervescent with disseminated lime, clear wavy boundary.
B22tcab	97-157	Pink (7.5YR7/4) very fine sandy loam, light brown (7.5YR6/4) moist; weak coarse prismatic structure; hard, firm, slightly sticky and nonplastic; violently effervescent with disseminated lime; five percent gravel; clear wavy boundary.
B3cab	157-180	Pink (7.5YR7/4) very fine sandy loam, brown (7.5YR5/4) moist; weak coarse prismatic structure; slightly hard, firm, slightly sticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.
C1	180-201	Light brown (7.5YR6/4) loamy fine sand, brown (7.5YR5/4) moist; massive; soft, friable, nonsticky and nonplastic; violently effervescent with disseminated lime and common medium irregular soft masses of lime; clear wavy boundary.
IIC2	201-211	Light brown (7.5YR6/4) loamy fine sand, brown (7.5YR5/4) moist; massive; soft, friable, nonsticky and nonplastic; violent effervescent with disseminated lime and common medium irregular soft masses of lime and lime on the gravel; 10 percent gravel; clear wavy boundary.
IIIC3	211-226	Brown (7.5YR6/4) loamy fine sand, brown (7.5YR5/4) moist; massive; soft, very friable, nonsticky and nonplastic; violently effervescent with disseminated carbonates; five percent gravel; clear wavy boundary.
IIIC4ca	226-251	Pink (7.5YR7/4) very fine sandy loam, brown (7.5YR5/4) moist; weak coarse prismatic structure grading to massive; slightly hard; friable, slightly sticky and nonplastic; violently effervescent with disseminated carbonates; few gravels; clear wavy boundary.
IVB21tcab	251-297	Pink (7.5YR7/4) fine sandy loam, brown (7.5YR5/4) moist; weak coarse prismatic structure; hard, firm, sticky and slightly plastic; violently effervescent with disseminated carbonates and common medium irregular soft masses of lime; clear wavy boundary.
IVB22tcab	297-330	Light brown (7.5YR6/4) very fine sandy loam, brown (7.5YR5/4) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.
VCca	330-348	Light brown (7.5YR6/4) very fine sandy loam, brown (7.5YR5/4) moist; massive; slightly hard, friable, slightly sticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.

Refer to footnotes at end of table.

Table 6.2-1 (Concluded)
Soil Profile Description From MWL Pit 33 (Persaud and Wierenga 1982)

Horizon	Depth (cm)	Description
VICca	348-384	Pink (7.5YR7/4) very fine sandy loam, dark brown to brown (7.5YR4/4) moist, massive; slightly hard to hard, friable, slightly sticky and nonplastic; violently effervescent with disseminated lime; 10 percent gravel; clear wavy boundary.
VIICca	384-432	Pink (7.5YR7/4) loam, dark brown to brown (7.5YR4/4) moist; massive; slightly hard, friable, sticky and slightly plastic; violently effervescent with disseminated lime; clear wavy boundary.
VIIICca	432-467	Light brown (7.5YR6/4) very fine sandy loam, brown (7.5YR5/4) moist; massive; slightly hard; friable, slightly sticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.
IXCca	467-493	Reddish yellow (5YR6/6) loamy fine sand, yellowish red (5YR5/6) moist; massive; hard, friable, slightly sticky and nonplastic; violently effervescent with disseminated lime; less than five percent gravel; clear wavy boundary.
XCxa	493-549	Reddish yellow (5YR6/6) fine sand, strong brown (7.5YR5/6) moist; massive; slightly hard, very friable, nonsticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.
XICca	549-592	Pinkish white (5YR8/2) loamy fine sand, pink (7.5YR7/4) moist; massive; hard, friable, slightly sticky, nonplastic; violently effervescent with disseminated lime; stone line at the surface of the horizon; clear wavy boundary.
XIICca	592-643	Light reddish brown (5YR6/4) loamy fine sand, light brown (7.5YR6/4) moist; massive; hard, very friable, slightly sticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.
XIIICca	643-683	Light reddish brown (5YR6/4) fine sand, light brown (7.5YR6/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.
XIVCca	683-716	Light reddish brown (5YR6/4) fine sand, brown (7.5YR5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; violently effervescent with disseminated lime; less than five percent gravel; abrupt wavy boundary.
XVCca	716-767	Pink (5YR7/4) very gravelly fine sand, light reddish brown (5YR6/4) moist; massive; hard, very friable, nonsticky and nonplastic; violently effervescent with disseminated lime and with lime on the gravel; approximately 60 percent gravel and 10 percent cobbles; clear wavy boundary.
XVICca	767-808	Light reddish brown (5YR6/4) very gravelly coarse sand, brown (7.5YR5/4) moist; massive; hard, very friable, nonsticky and nonplastic; violently effervescent with disseminated lime and with lime on the gravel; approximately 50 percent gravel; abrupt wavy boundary.
XVIICca	808-881	Reddish yellow (5YR6/6) loamy fine sand, strong brown (7.5YR5/6) moist; massive; slightly hard, very friable, nonsticky and nonplastic; violently effervescent with disseminated lime; clear wavy boundary.
XVIIICca	880 +	Pinkish white (7.5YR8/2) fine sand, light brown (7.5YR6/4) moist; massive; very hard, friable, slightly sticky and nonplastic; violently effervescent with disseminated lime.

cm	centimeters
MWL	Mixed Waste Landfill

Table 6.2-2

Geochemical Properties and Textural Parameters for Soil Core Samples From MWL Pit 33 (Persaud and Wierenga 1982)

Depth (cm)	EC (mmhos/cm)	pH	CaCO$_3$ (%)	Organic Matter(%)	CEC (meq/100g)	Sand (%)	Silt (%)	Clay (%)
0-28	3.45	8.27	.5	0.20	6.51	82.58	8.95	8.47
28-46	15.53	7.86	3.9	0.20	8.18	83.28	7.13	9.59
46-66	13.79	7.76	5.5	0.10	7.27	85.90	6.17	7.93
66-97	19.70	7.63	11.3	0.27	5.76	86.69	8.43	4.88
97-157	27.81	7.48	21.4	0.07	7.36	76.28	14.15	9.57
157-180	9.26	7.95	17.1	0.07	6.52	69.49	25.05	5.46
180-201	6.37	7.99	8.8	0.00	6.67	85.52	8.16	6.32
201-211	4.60	8.25	8.3	0.00	5.88	86.97	9.91	3.12
211-226	4.31	8.17	6.3	0.00	6.80	84.23	9.57	6.20
226-251	5.43	7.93	10.8	0.00	9.15	75.19	14.59	10.22
251-297	6.34	7.96	16.8	0.00	10.10	76.75	9.22	14.03
297-330	5.47	7.99	10.9	0.07	9.17	62.42	26.65	10.93
330-348	3.46	8.10	8.3	0.00	7.41	70.39	23.18	6.43
348-384	4.31	8.04	8.6	0.03	7.66	71.14	19.28	9.58
384-432	5.78	7.94	11.8	0.00	10.93	49.58	40.99	9.43
432-467	5.43	7.93	9.1	0.03	7.57	59.22	27.16	13.62
467-493	3.31	8.08	4.2	0.00	7.88	86.06	4.20	9.74
493-549	1.91	8.31	4.4	0.00	5.34	91.51	2.17	6.32
549-592	3.81	8.02	18.9	0.00	4.24	85.20	12.18	2.62
592-643	3.71	8.00	7.9	0.00	5.31	85.11	6.31	8.58
643-683	2.84	8.13	5.3	0.00	4.35	91.95	2.39	5.66
683-716	1.96	8.45	3.5	0.00	2.83	92.56	3.22	4.22
716-767	2.28	8.20	7.4	0.00	3.59	91.47	3.97	4.56
767-808	1.27	8.18	9.9	0.00	3.38	89.51	5.67	4.82
808-881	1.35	8.36	3.5	0.03	5.60	86.93	4.92	8.15
881 +	1.74	8.33	6.5	0.03	3.68	92.91	1.98	5.11

CEC	cation exchange capacity
cm	centimeter
EC	electrical conductivity
meq/100g	milliequivalents per 100 grams
mmhos/cm	millimhos per centimeter
MWL	Mixed Waste Landfill
pH	potential of hydrogen

Table 6.2-3

Textural Parameters and Geochemical Properties of the <2 mm Size Fraction From MWL Pit 33 (Persaud and Wierenga 1982))

Sample Depth (ft)	Particle Size Analysis[a]			$CaCO_3$ Equiv.[a] % $CaCO_3$	Organic Carbon[a] % C	Free Fe Oxides % Fe_20_3	Free Mn Oxides % Mn	CEC[b] meq/100g	Sum of Exch. Cations[c] meq/100g	Sum of Extractable Cations[c] meq/100g	Properties of a 1:1 (water:soil) extract[d]			
	% Sand	% Silt	% Clay								pH	Sum of Soluble Cations meq/L	Elect. Conduct. mmhos/cm	Air-Dry Moisture %
28.0 - 29.5	90.0	2.4	7.7	1.8	0.037	0.21	0.005	8.1	11.4	12.0	7.9	4.6	0.44	0.68
30.2 - 32.2	92.6	1.9	5.6	8.0	0.039	0.10	0.003	7.8	10.8	11.3	8.4	4.6	0.47	0.51

[a] Methods of Soil Analysis (MOSA) 1965.

[b] Polemio and Rhoades 1977.

[c] U.S. Salinity Laboratory Staff 1954a.

[d] U.S. Salinity Laboratory Staff 1954b.

CEC	cation exchange capacity
ft	feet
g	gram
L	liter
meq	milliequivalents
mm	millimeter
mmhos/cm	millimhos per centimeter
MOSA	Methods of Soil Analysis
MWL	Mixed Waste Landfill
pH	potential of hydrogen

Table 6.3-1
Physical Parameters for Soil Samples Collected During Phase 2 Resource Conservation and Recovery Act Facility Investigation Borehole Drilling

Borehole	Linear Depth (ft)	Bulk Density (g/cm^3)	Porosity (%)	% <#200 Sieve (0.075 mm)	Hydraulic Conductivity (cm/s)	Atterberg Limits		
						LL (%)	PL (%)	PI (%)
BH-01	11	1.68	36.60	66.73	3.77 E-5	NA	NA	NA
BH-01	30	1.74	34.34	23.87	1.08 E-5	NA	NA	NA
BH-01	60	1.90	28.30	50.53	9.26 E-5	NA	NA	NA
BH-01	90	2.07	21.89	25.09	3.01 E-4	NA	NA	NA
BH-02	7	NA	NA	51.84	NA	25	16	9
BH-03	30	1.85	30.19	43.28	8.33 E-5	NA	NA	NA
BH-03	60	2.03	23.40	29.20	4.96 E-4	NA	NA	NA
BH-03	90	2.06	22.26	52.56	4.38 E-6	NA	NA	NA
BH-04	113	NA	NA	43.88	2.63 E-4	NA	NA	NA
BH-07	30	1.97	25.66	11.78	1.13 E-3	NA	NA	NA
BH-07	60	NA	NA	18.65	1.66 E-5	NA	NA	NA
BH-07	90	2.06	22.26	48.13	7.47 E-5	NA	NA	NA
BH-07	120	NA	NA	15.47	9.17 E-6	NA	NA	NA
BH-08	8	NA	NA	NA	NA	32	15	17
BH-09	35	1.38	47.92	38.82	2.07 E-4	NA	NA	NA
BH-09	60	NA	NA	15.18	8.42 E-4	NA	NA	NA
BH-11	2	NA	NA	NA	NA	21	NPL	21
BH-11	30	2.06	22.26	23.77	6.78 E-4	NA	NA	NA
BH-11	65	2.06	22.26	16.06	1.02 E-5	NA	NA	NA
BH-12	7	NA	NA	NA	NA	11	NPL	11
BH-13	7	NA	NA	NA	NA	19	NPL	19
BH-13	17	2.01	24.15	25.17	4.84 E-5	NA	NA	NA
BH-13	41	2.05	22.64	20.72	1.64 E-4	NA	NA	NA

BH	borehole
cm/s	centimeters per second
ft	feet
g/cm^3	grams per cubic centimeter
LL	liquid limit
mm	millimeter
NA	not analyzed
NPL	no plasticity
PI	plasticity index
PL	plastic limit

Table 6.4-1
Ambient Recharge at the MWL

Analytical Method	Recharge (cm/s)	Recharge (in/yr)	% of Precipitation
Soil Physics Approach	1×10^{-10}	1×10^{-3}	0.02
Chloride Mass Balance	1×10^{-9}	1×10^{-2}	0.16
Stable Isotope Method	2×10^{-9}	2×10^{-2}	0.3

cm/s	centimeters per second
in/yr	inches per year
MWL	Mixed Waste Landfill

Table 7.3-1
Maximum Concentrations of Analytes in Surface Soil Samples

Potential COC	Maximum concentration (mg/kg)	Maximum Concentration of Respirable Particles in Air (mg/m^3)
Aluminum	12300	1.8×10^{-5}
Arsenic	3.7	5.4×10^{-9}
Barium	168	2.5×10^{-7}
Beryllium	0.65	9.6×10^{-10}
Cadmium	0.4	5.9×10^{-10}
Chromium (VI)	11.5	1.7×10^{-8}
Cobalt	8.6	1.3×10^{-8}
Copper	6.4	9.4×10^{-9}
Lead	7.5	1.1×10^{-8}
Manganese	174	2.6×10^{-7}
Nickel	7.6	1.1×10^{-8}
Selenium	0.57	8.4×10^{-10}
Silver	0.96	1.4×10^{-9}
Thallium	1.9	2.8×10^{-9}
Vanadium	21.1	3.1×10^{-8}
Zinc	28.5	4.2×10^{-8}

COC	contaminant of concern
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter

Table 7.3-2
Maximum MWL Volatile Organic Compound Flux and Modeled Air Concentration

VOC	Maximum Flux (ng/m^2/min)	Modeled Air Concentration (mg/m^3)
Acetone	17	3.5×10^{-6}
Benzene	30	6.2×10^{-5}
1,1-Dichloroethene	1.3	2.7×10^{-7}
Methylene chloride	4800	1.0×10^{-3}
Dichloroethene	100	2.1×10^{-5}
Ethyl benzene	1.2	2.5×10^{-7}
Isopropyl ether	36	7.5×10^{-6}
Styrene	1	2.1×10^{-7}
Tetrachloroethene	1000	2.1×10^{-4}
Toluene	52	1.1×10^{-5}
1,1,1-Trichloroethane	100	2.1×10^{-5}
Trichloroethene	330	6.9×10^{-5}
1,1,2-Trichloro-1,2,2-trifluoroethane	1.2	2.5×10^{-7}
Tritium	166,000 pCi/m^3/hr	608 pCi/m^3
Xylene	0.8	1.7×10^{-7}

mg/m^3	milligrams per cubic meter
MWL	Mixed Waste Landfill
ng/m^2/min	nanograms per square meter per minute
pCi/m^3	picocuries per cubic meter
pCi/m^3/hr	picocuries per cubic meter per hour
VOC	volatile organic compound

Table 7.3-3
Maximum Volatile Organic Compound Concentrations and Modeled Groundwater Concentration

VOC	Maximum Soil Gas Concentration (ppbv)	Modeled Max. Groundwater Concentration time = present (ppb)	Modeled Max. Groundwater Concentration (ppb) (time=30 yrs from present)
Dichloro-difluoromethane	29,000	1.0	4.0
Tetrachloroethene (PCE)	5900	0.4	0.6
1,1,1-Trichloroethane (1,1,1-TCA)	750	0.05	0.1
Trichloroethene (TCE)	800	0.07	0.1
Trichloro-fluoromethane	740	0.05	0.1
1,1,2-Trichloro-1,2,2-trifluoroethane	300	0.005	0.01

PCE	tetrachloroethene
ppb	parts per billion
ppbv	parts per billion by volume
TCA	trichloroethane
TCE	trichloroethene
VOC	volatile organic compound

Table 7.3-4
Potential Contaminants of Concern at the MWL and Comparison to Background Screening Values

Potential COC	Maximum Concentration	95th % or UTL (mg/kg)	Is maximum COC concentration < background screening value?
Surface Soil Samples			
Aluminum	12300 mg/kg	70,000[a]	Yes
Arsenic	3.7 mg/kg	5.6	Yes
Barium	168 mg/kg	130	**No**
Beryllium	0.65 mg/kg	0.65	Yes
Cadmium	0.4 mg/kg	1.6	Yes
Chromium (VI)	11.5 mg/kg	17	Yes
Cobalt	8.6 mg/kg	7.1	**No**
Copper	6.4 mg/kg	25.5	Yes
Lead	7.5 mg/kg	21.4	Yes
Manganese	174 mg/kg	830[a]	Yes
Nickel	7.6 mg/kg	11.5	Yes
Selenium	0.57 mg/kg	<1	**No**
Silver	0.96 mg/kg	2.0	Yes
Thallium	1.9 mg/kg	<1	**No**
Tritium	1101 pCi/g	NA	**No**
Vanadium	21.1 mg/kg	20.4	**No**
Zinc	28.5 mg/kg	62	Yes
Modeled Vapor Concentration			
Acetone	3.5×10^{-6} mg/m^3	NA	NA
Benzene	6.2×10^{-5} mg/m^3	NA	NA
1,1-Dichloroethene	2.7×10^{-7} mg/m^3	NA	NA
Methylene chloride	1.0×10^{-3} mg/m^3	NA	NA
Dichloroethene	2.1×10^{-5} mg/m^3	NA	NA
Ethyl benzene	2.5×10^{-7} mg/m^3	NA	NA
Isopropyl ether	7.5×10^{-6} mg/m^3	NA	NA
Styrene	2.1×10^{-7} mg/m^3	NA	NA
Tetrachloroethene	2.1×10^{-4} mg/m^3	NA	NA
Toluene	1.1×10^{-5} mg/m^3	NA	NA
1,1,1-Trichloroethane	2.1×10^{-5} mg/m^3	NA	NA
Trichloroethene	6.9×10^{-5} mg/m^3	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	2.5×10^{-7} mg/m^3	NA	NA
Tritium	608 pCi/m^3	NA	NA
Xylene	1.7×10^{-7} mg/m^3	NA	NA
Modeled Groundwater Concentration			
Dichloro-difluoromethane	1.0 ppb	NA	NA
Tetrachloroethene (PCE)	0.4 ppb	NA	NA
1,1,1-Trichloroethane (1,1,1-TCA)	0.05 ppb	NA	NA
Trichloroethene (TCE)	0.07 ppb	NA	NA
Trichloro-fluoromethane	0.05 ppb	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	0.005 ppb	NA	NA

[a] Background screening value for the Albuquerque 1° by 2° quadrangle from the National Uranium Resource Evaluation program (USGS 1994).

COC	contaminant of concern	PCE	tetrachloroethene	TCE	trichloroethene
mg/kg	milligrams per kilogram	pCi/g	picocuries per gram	USGS	U.S. Geological Survey
mg/m^3	milligrams per cubic meter	pCi/m^3	picocuries per cubic meter	UTL	upper tolerance limit
MWL	Mixed Waste Landfill	ppb	parts per billion		
NA	not applicable	TCA	trichloroethane		

Table 7.3-5
Comparison of Potential Contaminant of Concern Concentrations to Subpart S Action Levels

Potential COC	Maximum concentration (mg/kg)	Subpart S Action Level	Is individual contaminant less than 0.1 x Action Level?
Barium	168	6000	**Yes**
Cobalt	8.6	5000	**Yes**
Selenium	0.57	400	**Yes**
Thallium	1.9	5.5	**No**
Vanadium	21.1	600	**Yes**

COC	contaminant of concern
mg/kg	milligrams per kilogram

Table 7.3-6
Potential Contaminants of Concern at the MWL Used in the Reasonable Maximum Exposure Analysis

Potential COC	Maximum concentration
Soil Ingestion Pathway	
Barium	168 mg/kg
Cobalt	8.6 mg/kg
Selenium	0.57 mg/kg
Thallium	1.9 mg/kg
Tritium	1101 pCi/g
Vanadium	21.1 mg/kg
Dust Inhalation Pathway	
Barium	2.5×10^{-7} mg/m^3
Cobalt	1.3×10^{-8} mg/m^3
Selenium	8.4×10^{-10} mg/m^3
Thallium	2.8×10^{-9} mg/m^3
Tritium	2.0×10^{-3} pCi/m^3
Vanadium	3.1×10^{-8} mg/m^3
Vapor Inhalation Pathway	
Acetone	3.5×10^{-6} mg/m^3
Benzene	6.2×10^{-5} mg/m^3
1,1-Dichloroethene	2.7×10^{-7} mg/m^3
Methylene chloride	1.0×10^{-3} mg/m^3
Dichloroethene	2.1×10^{-5} mg/m^3
Ethyl benzene	2.5×10^{-7} mg/m^3
Isopropyl ether	7.5×10^{-6} mg/m^3
Styrene	2.1×10^{-7} mg/m^3
Tetrachloroethene	2.1×10^{-4} mg/m^3
Toluene	1.1×10^{-5} mg/m^3
1,1,1-Trichloroethane	2.1×10^{-5} mg/m^3
Trichloroethene	6.9×10^{-5} mg/m^3
1,1,2-Trichloro-1,2,2-trifluoroethane	2.5×10^{-7} mg/m^3
Tritium	608 pCi/m^3
Xylene	1.7×10^{-7} mg/m^3
Drinking Water Ingestion Pathway	
Dichloro-difluoromethane	1.0 ppb
Tetrachloroethene (PCE)	0.4 ppb
1,1,1-Trichloroethane (1,1,1-TCA)	0.05 ppb
Trichloroethene (TCE)	0.07 ppb
Trichloro-fluoromethane	0.05 ppb
1,1,2-Trichloro-1,2,2-trifluoroethane	0.005 ppb

COC	contaminant of concern
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
MWL	Mixed Waste Landfill
pCi/g	picocuries per gram
pCi/m^3	picocuries per cubic meter
ppb	parts per billion

Table 7.3-7
Toxicological Parameters

Potential COC	RfD_o (mg/kg/d)	RfD_{inh} (mg/kg/d)	Confidence	SF_o (kg-d/mg)	SF_{inh} (kg-d/mg)	Cancer Class	ARARs
Soil Ingestion and Dust Inhalation Pathway							
Barium	NA	0.07	M	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA
Selenium	0.005	NA	H	NA	NA	D	NA
Thallium	NA	NA	NA	NA	NA	D	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA
Vapor Inhalation Pathway							
Acetone	0.1	NA	L	NA	NA	NA	NA
Benzene	NA	NA	NA	0.029	0.029	A	NA
1,1-Dichloroethene	0.009	NA	M	0.6	0.18	C	NA
Methylene chloride	0.06	0.86	NA	0.0075	0.0016	B2	NA
Dichloroethene	NA	NA	NA	NA	NA	NA	NA
Ethyl benzene	0.1	0.29	L	NA	NA	D	NA
Isopropyl ether	NA	NA	NA	NA	NA	NA	NA
Styrene	0.2	0.29	M	NA	NA	NA	NA
Tetrachloroethene	0.01	M	NA	NA	NA	NA	NA
Toluene	0.2	0.11	M	NA	NA	D	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	D	NA
Trichloroethene	NA	NA	NA	0.011	0.006	(est.) B2	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	NA	NA	NA	NA	NA
Tritium	NA	NA	NA	7.2×10^{-14} 1/pCi	9.6×10^{-14} 1/pCi	A	NA
Xylene	2.0	NA	M	NA	NA	NA	NA
Drinking Water Ingestion Pathway							
Dichloro-difluoromethane	0.2	0.057	NA	NA	NA	NA	NA
Tetrachloroethene (PCE)	0.01	NA	NA	0.052	0.002	B2	0.005
1,1,1-Trichloroethane (1,1,1-TCA)	NA	NA	NA	NA	NA	NA	0.2
Trichloroethene (TCE)	NA	NA	NA	0.011	0.006	(est.) B2	0.005
Trichloro-fluoromethane	0.3	NA	NA	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	NA	NA	NA	NA	NA

ARAR	applicable or relevant and appropriate requirements
COC	contaminant of concern
H	high
kg-d/mg	kilogram day per milligram
L	low
M	medium
mg/kg/d	milligrams per kilograms per day
NA	not available
PCE	tetrachloroethene

pCi	picocuries
RfD_{inh}	inhalation chronic reference dose in mg/kg-day
RfD_o	oral chronic reference dose in mg/kg-day
SF_{inh}	inhalation slope factor in $(mg/kg\text{-}day)^{-1}$
SF_o	oral slope factor in $(mg/kg\text{-}day)^{-1}$
TCA	trichloroethane
TCE	trichloroethene

Table 7.3-8
Risk Assessment Values From Surface Contamination

Potential COC	Maximum concentration (mg/kg)	Industrial Land Use Scenario		
		HI	Cancer Risk	Dose (mrem/yr)
Barium	168	0.0	NA	NA
Cobalt	8.6	NA	NA	NA
Selenium	0.57	0.0	NA	NA
Thallium	1.9	NA	NA	NA
Tritium	NA	NA	5×10^{-8}	.002
Vanadium	21.1	NA	NA	NA
Total		**0.0**	**5×10^{-8}**	**.002**

COC	contaminant of concern
HI	hazard index
mg/kg	milligrams per kilogram
mrem/yr	millirems per year
NA	not available

Table 7.3-9
Risk Assessment Values Due to Vapor Exposure

Potential COC	Maximum Modeled Vapor Concentration (mg/m^3)	Industrial Land Use Scenario	
		HI	Cancer Risk
Acetone	3.5×10^{-6}	NA	NA
Benzene	6.2×10^{-5}	NA	1.5×10^{-7}
1,1-Dichloroethene	2.7×10^{-7}	NA	4.1×10^{-9}
Methylene chloride	1.0×10^{-3}	0.00	1.3×10^{-7}
Dichloroethene	2.1×10^{-5}	NA	NA
Ethyl benzene	2.5×10^{-7}	0.00	NA
Isopropyl ether	7.5×10^{-6}	NA	NA
Styrene	2.1×10^{-7}	0.00	NA
Tetrachloroethene	2.1×10^{-4}	NA	3.5×10^{-8}
Toluene	1.1×10^{-5}	0.00	NA
1,1,1-Trichloroethane	2.1×10^{-5}	NA	NA
Trichloroethene	6.9×10^{-5}	NA	3.5×10^{-7}
1,1,2-Trichloro-1,2,2-trifluoroethane	2.5×10^{-7}	NA	NA
Xylene	1.7×10^{-7}	NA	NA
Total		**0.0**	**7×10^{-7}**

COC	contaminant of concern
HI	hazard index
mg/m^3	milligrams per cubic meter
NA	not available

Table 7.3-10
Risk Assessment Values Due to Ingestion of Drinking Water

Potential COC	Maximum Modeled Vapor Concentration (ppb)	Industrial Land Use Scenario		
		ARAR (MCL)	HI	Cancer Risk
Dichloro-difluoromethane	1.0	NA	0.00	NA
Tetrachloroethene (PCE)	0.4	5 ppb	NA	2×10^{-7}
1,1,1-Trichloroethane (1,1,1-TCA)	0.05	200 ppb	0.00	3×10^{-8}
Trichloroethene (TCE)	0.07	5 ppb	NA	9×10^{-9}
Trichloro-fluoromethane	0.05	NA	0.00	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	0.005	NA	0.00	NA
TOTAL			**0.0**	2×10^{-7}

ARAR	applicable or relevant and appropriate requirements
COC	contaminant of concern
HI	hazard index
MCL	maximum contaminant level
NA	not available
ppb	parts per billion

Table 7.3-11
Total of Risk Assessment Values Due to all Considered Exposure Pathways

Exposure Pathways	Hazard Index	Nonradioactive Excess Cancer Risk	Radioactive Excess Cancer Risk
Soil Ingestion + Dust Inhalation	0.0	0.0	5×10^{-8}
Inhalation (Vapor)	0.0	7×10^{-7}	6×10^{-6}
Drinking Water	0.0	2×10^{-7}	0.0
Total	**0.0**	**9×10^{-7}**	**6×10^{-6}**

Appendix A
Mixed Waste Landfill Inventory

The following inventory by pit and trench was compiled from classified and unclassified disposal records, interviews with current and retired employees, solid waste information sheets, and nuclear material management records. Considerable effort was made to maintain consistency in nomenclature and units. Commonly used acronyms are as follows:

1) *MFP—multiple fission products: the nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragment's radioactive decay.*

2) *DU—depleted uranium*

3) *Activation—the process of making a material radioactive by bombardment with neutron, protons or other nuclear radiation.*

4) *Induced activity—radioactivity that is created when stable substances are bombarded by neutron e.g., the stable isotope Co-59 becomes the radioactive isotope Co-60 under neutron bombardment.*

Trench A

Differential amplifiers; thermocouples; compressors; MFP- and tritium-contaminated fume hoods, ducting, motors, fans, and plenums; TV cameras, tripods, and telemetry components; MFP-contaminated cooling systems, coils, surge tanks (5 ft diameter X 11 ft long), piping, pumps, couplings, and valves; experimental stainless steel canisters; 17 each 55-gallon drums containing MFP-contaminated demineralizer resin; 2 each 55-gallon drums of MFP-contaminated concrete; empty oxygen cylinders; boxes of fluorescent light bulbs; roll-up door and associated equipment from TA-5 KIVA; shield door from reactor pit; voltage-controlled oscillators, calibrators, and gyros; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; tritium luminary dials; military radium altimeters and gauges; Ni-63 tube; parachute; Sr-90 nuclear cells; flash heating equipment and associated parts; MFP-contaminated L-shaped aluminum chassis; DU in graphite matrix; stainless steel ducting; 61 each spark gap tubes (100 mrem/hr on contact); aluminum sleeve with lead ballast; tritium beds and valves; shock jigs with tubes; 31 each 0.5 Ci Kr-85 tubes and cells; one each 20 ft long X 2 ft diameter heat exchanger, coolant pumps, piping, and valving; air conditioners; tritium targets (10 Ci each) and tubes (100 mCi each); wooden ladder; MFP-, DU-, and tritium-contaminated vacuum cleaners; vacuum pumps and skids; stainless steel sample tubes; irradiated metal samples (5 rem/hr on contact); ion generators; 5-gallons of oil absorbed on vermiculite in sealed A/N can; 128 ft^2 of sheet metal; skid loaded with 300 lbs. of paraffin; 12 each skids of MFP-contaminated concrete blocks, MFP-contaminated lead bricks; 2,600 kg DU.

943 ft^3 of TA-5 routine operational and miscellaneous decontamination waste.

Trench B

HEPA filters, fiberglass filters, final and prefilters; MFP-, DU-, and tritium-contaminated vacuum cleaners; cables; ultra-sonic air samplers; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; MFP- and tritium-contaminated fume hoods, ducting, motors, fans, and plenums; boxes of fluorescent light bulbs; sanding disks; neutron generator tubes; backing plates from TA-5 experimental apparatus; packing materials and wooden shipping crates; metal drums from Nevada Test Site containing DU; alpha-contaminated gas bottles; empty liquid scintillation vials; Ta-182 contaminated platinum-tungsten scrap; heater elements; 10 Ci tritium targets; neutron generator magnets; 14 each empty steel gas cylinders contaminated with DU; 9 each MFP-contaminated ceramic tubes; 1.5-gallons of solvents absorbed on vermiculite in sealed A/N cans; 6 each small storage cabinets; vacuum system components including water circulators, valves, diffusion pumps, fittings, gas analyzers, and vacuum pumps; gas sample bottles from Nevada Test Site; tritium-contaminated tools; DU metal shavings and cuttings; Victoreen Sr-90 ion chambers; glove box and work bench; demineralizer vessel from reactor; neutron radiograph equipment; thermal reflecting rings; micro scales; Kr-85 light sources; 11 kg deuterium containing 0.25 Ci of tritium; 1-gallon toluene absorbed on vermiculite in sealed A/N can; static meter; Ta-182 pellets; demineralization and radiography tubes.

1326 ft^3 of TA-5 routine operational and miscellaneous decontamination waste.

Trench C

Nuclear fuel shipping cask cleanup debris; tritium and C-14 labeled amino acids and tritium labeled uridine; scrap metal contaminated with DU from burn test; 7.1 Ci tritium pellets; uranyl nitrate; dining car test hardware; MFP-, DU-, and tritium-contaminated vacuum cleaners; vacuum hose contaminated during cleaning of thorium cloth and thorium cloth debris; concrete crucibles used in reactor safety studies; Kr-85 particle size analyzer; 1,000 lead bricks contaminated with tritium and Na-22; 43 MFP-contaminated lead bricks; 73 each integrated circuits; Ba-133 reactor bolts; flexible glove box ducting; 2 each mechanical vacuum pumps; Sr-90 contaminated carpet; Cs-137 spark gaps; Na-22 cleanup materials, source holders, and shield (1.5 rem/hr on contact); DU-contaminated waste containers; tritium-contaminated vacuum system and power supply; DU billet, hemisphere, and sphere; Pu-238 contaminated hood exhaust hose; Co-60 debris from trailer used to support nuclear fuel shipping cask; MFP-contaminated hot exhaust system prefilters, HEPA filters, and absolute pressure filters; containerized DU residue, turnings, metal workings, and cuttings; surge voltage arrester; tritium-contaminated pump; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; wooden shipping crates; 13 each Po-210 contaminated static eliminators; one each 62 mCi Se-75 source and one each 1.0 mCi Ta-182 source in sealed A/N can; tritium-contaminated fume hood and exhaust plenum; 2.0 kg deuterium absorbed on vermiculite in sealed A/N can; 12 each 55-gallon drums of MFP-contaminated spent demineralizer resin; DU-contaminated lucite table; 4 each TV cameras; tritium-contaminated ion pump; 1-gallon tritium-contaminated acetone solidified with Safe-T-Set; 24 kg lithium-6 fluoride; 4 each irradiated high speed cameras, lenses, and one telescope; one each 0.1 mCi Ra-226/Be source encapsulated in concrete-filled A/N can; 2 each DU-contaminated glove boxes; 32.1 Ci tritium; 377 kg DU.

Trace Eu-152, Ba-133, I-129, Na-22, Sr-90, Ni-63, Tc-99, Gd-153, Ag-110m, Pm-147, Sr-85, Sb-125, Ta-182, Ge-68, Mn-54, and Fe-55.

1,159 ft^3 of TA-5 routine operational and miscellaneous decontamination waste.

Trench D

Compensator and cables from TA-1; tritium-contaminated water and erbium tritide powder; DU-contaminated rocket motors; broken Ra-226 source in plastic holder; corroded and broken 6-ft aluminum step ladder; 13 each 55-gallon drums containing MFP-contaminated spent demineralizer resin; DU residue, turnings, metal workings, and cuttings; MFP-contaminated tape recorders, transmitters, and video cameras; MFP-contaminated compensated ion chamber; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; 4 each aluminum TA-5 KIVA doors from reactor; PEG housing and lid from Nevada Test Site; MFP-contaminated fuel holsters; ultra filters and ultra filter plenums; MFP-contaminated hot exhaust system prefilters, absolute pressure filters, and plenums; HEPA filters; MFP-contaminated conduit and sheet metal; 2 each sealed Cr-57 sources; TA-1 bldg. 802 construction materials and scrap; MFP-, DU-, and tritium-contaminated vacuum cleaners; TA-5 liquid waste disposal system drain pipes; Cypress packaging material from Nevada Test Site; Ming Vaso rad test debris from Nevada Test Site; Snap 27 test debris; Hudson Moon cleanup and packaging materials from Nevada Test Site; Mint Leaf packaging and cleanup materials from Nevada Test Site; Diana Mist packaging and cleanup materials from Nevada Test Site; Thoria cleanup and packaging materials from Nevada Test Site; old KIVA floor including sheet-rock, wood, and miscellaneous waste from installation of new KIVA floor; MFP-contaminated spent demineralizer columns and cartridges; thoria crucibles and tubing; old reactor boiler with associated radiators, piping, and valves; activated reactor stainless steel support tower, cryostat tube and head; empty thorium impact capsules; empty wooden shipping crates for fuel elements; tritium-contaminated power supply, balance, volt meter, ammeter, bridge, vacuum pump, microscope mount, plug-in units, and glass tubes; neutron radiography tube and beam catcher; ultra-sonic bath and power unit; obsolete Bell Labs experimental core tube (10 rem/hr on contact).

2,315 ft^3 of TA-5 routine operational and miscellaneous decontamination waste.

Trench E

38 each 55-gallon drums of MFP-contaminated spent demineralizer resin; 7 each 55-gallon drums from Three Mile Island containing MFP-contaminated cables, instruments, and electronic components; 11 each Po-210 contaminated static eliminators; 10-gallons Cs-137 solution solidified with Safe-T-Set in sealed A/N can; oil from lapidary shop solidified with soil in sealed A/N can; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; 6 each irradiated 9 ft 10 in. long X 9 in. dia. stainless steel storage tubes and holding rings; activated top and bottom reactor vessel sections;

motor assembly; gattling gun cask; hydraulic pumps; ion pumps; steel frame and motor assembly from TA-5 KIVA door; burned wood from weapons experiment; 2 each burned empty 55-gallon drums; MFP-contaminated vacuum pumps; obsolete and old test equipment and materials used in reactor fuel tests; DU-contaminated glove box; HEPA filters from hot exhaust plenum; DU-contaminated vacuum and filtering system bracket and assembly; DU-contaminated machine shop cabinets, work tables, filters, and ground cloths; 4 each TV cameras; 45 Ci neutron generator tubes; DU-contaminated crucibles; janitorial barrels; vacuum pumps; file cabinets; 70 lbs. thoria-contaminated soil; tritium-contaminated ion pump; one damaged DU-contaminated shake table or vibrator for sieving powdered DU; 10,000 lbs. of decommissioned reactor debris from extensive modifications to the reactor including ventilation ducts, conduit, PVC, nuts and bolts, hot water radiators, metal support parts, concrete, insulation, cable, air blowers, camera equipment, light bulbs, metal stands, electronic equipment, vacuum cleaners, pumps, coveralls, lumber, scaffolding, tables, chairs, gauges, regulators, valves, glove boxes, and stainless steel; 2,500 ft^3 of DU-contaminated soil; plywood ventilation duct; Mettler balance; Sartorius balance; fume hood; Magniwhirl bath; lab furnace; obsolete fire alarm system and associated electrical equipment; scrap wire; 11 each 55-gallon drums numbered 1 through 11: drums 1 through 3 contain 18 nanocuries/gram alpha emitters, drums 4 through 11 contain 8 nanocuries/gram alpha emitters; 2 kg thorium; 8 kg DU; 122 Ci tritium.

Trace amounts of Ce-144, K-40, Zr-95, Nb-95, Sr-85, Eu-152, Eu-155, Ni-63, and Po-210.

Radioactive waste from the Inhalation Toxicology Research Institute (ITRI): ITRI typically disposed of their radioactive waste at the commercial radioactive waste disposal site in Beatty, Nevada. The state of Nevada closed this radioactive disposal site in 1979. SNL/NM accepted a shipment of 119 each 55-gallon drums and 13 plywood boxes of radioactive waste from ITRI in October 1979. A copy of the ITRI radioactive shipment record dated 4/28/80 is provided herein.

1,093 ft^3 of routine operational waste and miscellaneous decontamination waste.

Trench F

Tritium- and DU-contaminated glove boxes; 11 concrete blocks from U-238 melt; U-contaminated concrete blocks and large steel plates used in penetrator test; ducting; stainless steel; steel plates from penetration tests; 6 each 55-gallon poly drums containing MFP-contaminated spent demineralizer resin; aircraft engine; weapons components; MFP-contaminated electronics components; 4 each drums from White Sands Missle Range; soil from cask site; DU-contaminated crushed gravel; lathe; wooden shipping crates; steel cladding and zirconium insulation; dilute nitric acid neutralized with $CaCO_3$, Na_2CO_3, and $NaHCO_3$ and solidified with yellow powder material; Electro-glo electropolishing agent solution with concentrated phosphoric acid neutralized with Na_2CO_3 and NaOH and solidified with yellow powder material; lab benches; metal table; two each glove boxes; resin beds; oscillatron scope cameras with thorium lenses; HEPA and prefilters.

There are 5 nuclear fuel-shipping casks of various sizes in Trench F. They include the Hallam cask, the Helicopter cask, the IF-100 cask, the IF-200 cask, and the Yankee cask. These casks were subject to various destructive tests in the mid-1970's to meet Nuclear Waste Policy Act certification requirements for shipping spent nuclear fuel assemblies. These casks, soon to be retired, were removed from active service for destructive testing. The casks were equipped with fuel mock-ups for destructive testing.

The Hallum Nuclear Power Facility provided the Hallum cask to SNL/NM for torch fire tests. The Hallum cask is 19 ft long x 3 ft in diameter and weighs 40 tons. The cask consists of two stainless steel cylinders separated by 8.5 inches of lead shielding in the annulus.

Pratt and Whitney provided the Helicopter cask for drop tests from 2,000 ft above ground surface. The Helicopter cask is a pot-type cask weighing 3 tons. The interior cavity is 4 inches in diameter and 17.5 inches high surrounded by 10 inches of lead.

The Yankee cask and its Atlas railcar were provided by Westinghouse for sled-track impact tests. The Yankee cask is 13 ft long x 5 ft in diameter and weighs 37 tons. The cask consists of two stainless steel cylinders separated by 8.5 inches of lead shielding in the annulus.

The IF-100 and IF-200 casks were provided by General Electric for sled-track impact tests. The IF-100 cask is 13 ft long x 32 inches in diameter and weighs 22 tons. The cask consists of two stainless steel cylinders separated by 8.5 inches of lead shielding in the annulus. The IF-200 cask is 13 ft long x 3 ft in diameter weighing 25 tons. The cask consists of two stainless steel cylinders separated by 8.5 inches of lead shielding in the annulus.

A semi-tractor trailer or "carriage" used for transporting nuclear fuel shipping casks is buried in Trench F. The trailer was contaminated with Cs-137. The trailer was contaminated due to a leaking shipping cask that contained a spent nuclear fuel assembly destined for SNL/NM. The cask that contained the spent fuel assembly leaked water during shipment. The cask was decontaminated and returned to Savannah River via another trailer, however, the contaminated trailer was designated non-recoverable and buried. A color picture of the trailer buried in Trench F is provided herein.

792 ft^3 of routine operational and miscellaneous decontamination waste.

Trench G

Trench G was the last operational disposal trench. It contained very little waste, as shown by the geophysical survey in the MWL Phase 2 RFI Report, when the MWL was closed in December 1988.

GAP II disassembly room including uni-strut, filter housings, filters; one vacuum cleaner; DF I, II, III, and IV experimental packages without fuel sections; thorium and uranium alloyed aluminum Polaris missile sections; aircraft engine; 1 kg Th-232 as Mg-Th from crash test at small sled track; 3 each glove boxes; one Mettler balance and fume hood contaminated with fission products; MFP-contaminated concrete; 2 each 55-gallon poly drums containing MFP-contaminated spent demineralizer resin; 3 each resin beds with trace Co-60; fluorescent light bulbs; HEPA and prefilters; MFP-contaminated TV camera; 25 each 55-gallon 17H drums with

Ir-192 tracer in sand; 3 each 54 inch diameter cylinders in (2 in wooden crates and 1 in cardboard) with HK-31 skin material; 1,000 cubic yards of dirt from the reactor berm removal.

581 ft^3 of routine operational wastes and miscellaneous decontamination waste.

Pit SP-1

Two each depleted tritium beds; 3-gallons NaOH; 3-gallons acid waste; 1 poly bottle uranium solution; out-dated standard solutions; 30-gallons tritium water; miscellaneous chemicals with beta/gamma contamination; 4 kg enriched lithium; 4 kg Li-6; 408 grams U-235.

Pit SP-2

A plutonium arc tunnel is buried in SP-2. The plutonium arc tunnel was used to simulate ballistic missile re-entry into the earth's atmosphere. Pu-238 microspheres, ranging from 2 to 20 micrometers in diameter, were injected into the arc tunnel under the influence of plasma to determine temperature and pressure effects on nuclear weapon components. The apparatus is 4 ft x 4 ft x 10 ft long with a 2 ft x 2 ft x 5 ft central section. Glove boxes are attached at each end. Approximately 20 microspheres remained in the tunnel when it was buried in 1968.

Pit SP-3

A beryllium catcher is buried in SP-3. The Be-catcher was used to "catch" projectiles fired from various guns and howitzers. Experimental projectiles containing Be and DU were retrieved and studied in tests. The BE-catcher contained fine particles of Be and DU when buried in 1968.

Pit SP-4

Nuclear reactor vessel plates from a decommissioned nuclear reactor are buried in SP-4. The vessel plates came from a nuclear reactor in the San Fernando Valley. The reactor, when decommissioned in 1978, was cut to pieces and shipped to Beatty, Nevada for disposal. Six-foot sections of the outer vessel were salvaged and shipped to Sandia for fission product and Co-60 activation studies. The sections were stored in SP-4 and never tested and remain there to this day. The vessel plates, at the time of burial, measured 2 rem/hour on contact. SP-4 is lined with concrete culvert and concrete bottom-cap making it the only lined pit at the MWL.

Pit SP-5

A 10,000 Ci Co-60 source is buried in SP-5. The 10,000 Ci Co-60 source was manufactured by Oak Ridge National Laboratories in 1960 and delivered to SNL/NM for deployment in the gamma irradiation facility. The source consists of 12 stainless steel rods, 12 inches long x 0.5 inches in diameter, each containing 8 cobalt metal pellets. Each cobalt pellet is 0.5 inches long. The cobalt metal pellets are located in the center of each rod with 4 inches of lead as shielding filling each end. Each cobalt rod contained approximately 840 Ci in September 1961. The Co-60 source was removed from service and transferred to SP-5 in June 1987. The Co-60 source was buried in a 6.7 ft^3 lead burial cask, which was in turn encased in a 24 yd^3 concrete burial cask. The original 10,000 Ci source will have decayed to 76 Ci as of September 1998, or 6.4 Ci per rod.

Pit 1

DU-contaminated weapons components; mass of DU unknown.

Pit 2

DU-contaminated debris bed; DU-contaminated weapons components; mass of DU unknown.

Pit 3A

DU-contaminated weapons components; 22 kg DU.

Pit 3B

DU-contaminated Mark III missile sections; mass of DU unknown.

Pit 4

DU-contaminated weapons components; mass of DU unknown.

Pit 5

DU-contaminated weapons components; mass of DU unknown.

Pit 6

DU-contaminated weapons components; mass of DU unknown.

Pit 7

DU-contaminated weapons components; 846 kg DU.

Pit 8

DU-contaminated weapons components; mass of DU unknown.

Pit 9

DU-contaminated weapons components; mass of DU unknown.

Pit 10

DU-contaminated weapons components; 178 kg DU.

Pit 11

7 Nevada Test Site test shapes; 42 kg DU.

Pit 12

Neutron generator tubes; 1 kg thorium; 103 kg DU.

Pit 13

One each 1,800 Ci Co-60 source sealed in a lead and steel burial cask encapsulated in two truckloads of concrete; one each 98 microCi Ra-226 source, one each 1.3 microCi Ra-226 source, two each 5.0 microCi Ra-226 sources, and one each 1.0 microCi Ra-226 source encapsulated in concrete-filled A/N can.

Pit 14

One each sealed 5.0 microCi Po-210 source and source holder; one each sealed 1.0 microCi Po-210 source; miscellaneous uranium and beryllium waste; Cypress test debris from Nevada Test Site; DU-contaminated vacuum cleaner; 3 Ci tritium water; 100 mCi tritium oxide; Pu-238, Po-210, and tritium-contaminated miscellaneous operational and lab waste; tritium-contaminated pumps and valves; Pu-238 contaminated air sampler; neutron generator tubes; a large weapon shell (18 megaton WWII vintage); DU-contaminated weapons components; 178 kg DU.

Pit 15

One each 102.1 microCi Ra-226/Be source and one each 5.5 microCi source in a encapsulated in concrete-filled 55-gallon drum; fume hood filters and filter housings; reactor fuel element ends (5 rem/hr on contact); Cypress test debris from Nevada Test Site; neutron generator tubes and targets; DU-contaminated weapons components; Pershing missile debris; 167 kg DU; 49 grams U-235; 30 Ci tritium.

Pit 16

One each sealed 2.5 Ci Co-60 source encapsulated in a concrete-filled lead cask; two each non-functional 1.5 mCi Ra-226 ionization alphatron gauges encapsulated in a concrete-filled A/N can; nine each Ba-133 reactor bolts; 2 each 52 Ci Co-60 pencils encapsulated in a lead-lined concrete-filled 55-gallon drum; 2 each 10.0 microCi Ra-226/Be sources in lead container encapsulated in a concrete-filled 5-gallon A/N can; one each 1,000 Ci Co-60 source encapsulated in a lead-lined, concrete-filled 55-gallon drum; ionization chambers and current regulators; one each 0.8 mCi Kr-85 source encapsulated in a concrete-filled A/N can; one each 40 mCi Am-241 source encapsulated in a concrete-filled A/N can; one each 18.9 Ci Kr-85 nuclear battery in a steel tube encapsulated in concrete-filled A/N can; SER control rod guides encapsulated in a lead-lined, concrete-filled A/N can (50 rem/hr on contact); thorium metal scrap; one each Sb-124 source projectile (10 rem/hr on contact); 20 each 5.0 microCi Ra-226/Be sources in lead container encapsulated in concrete-filled A/N can; 2 kg thorium oxide; 2,390 kg DU; 75 Ci tritium.

Pit 17

Casseto and Triga parts from Nevada Test Site; one each 0.5 mCi Ra-226/Be source, one each 36 Ci Co-60 source, and one each 6.0 Ci Sr-90 source each in a lead container encapsulated in concrete-filled 55-gallon drum; 11 each Kr-85 cells (8.1 mCi total); 2 each uranium carbide nose cones; uranium and zirconium scrap in a 55-gallon drum; 30 Ci tritium lab waste in brass tube; neutron generator tubes; dummy DU reservoir; DU scrap and machine parts; test specimens; brazed to aluminum; fusing and firing assemblies; DU-contaminated weapon components; 3 kg thorium oxide; 457 kg DU.

Pit 18

Pu-238 contaminated paper, gloves, small equipment, components, wire, and sockets; 12 each spark gap tubes; 7 each 10 microCi Ra-226/Be sources in a lead container encapsulated in concrete-filled 55-gallon drum; Pu-238 contaminated vacuum pump; radioactive rock; electrical cables from junction box; reactor fuel element ends (5 rem/hr on contact); neutron generator tubes; Pershing missile test debris; DU-contaminated weapons components; 155 mm gun projectile with a Sb-124 source; 762 kg DU; 45 Ci tritium.

Pit 19

Tritium-contaminated buckets, clothing, swipes, rags, paper, work gloves, vacuum cleaner, and decontamination materials; reactor fuel element ends (5 rem/hr on contact); one each Sb-124 source projectile (10 rem/hr on contact); neutron generator tubes; scrap metal, DU-contaminated muffle furnace; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; one each 3.5 microCi Co-60 source and one each 4.1 microCi Co-60 source in a lead container encapsulated in concrete-filled 55-gallon drum; Pershing missile test debris; tritium bed; scrap iron; Pu-238/239 contaminated filters; 621 kg DU; 60 Ci tritium.

Pit 21

Two each 3.4 microCi Co-60 sources, one each 31.8 microCi Sr-90 source, one each 100 microCi Co-60 source, one each leaking Sb-124 source, and one each spent Cs-137 source in a lead container encapsulated in concrete-filled 55-gallon drum; Nevada Test Site irradiated material; DU-contaminated paper, towels, and poly bottles; plutonium oxide-contaminated filters, towels, tape, paper, cleaning and decontamination materials; 4 each irradiated thermal batteries; oil diffusion pump and baffle; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; neutron generator tubes; Pershing missile test debris; DU-contaminated weapons components; 16 kg thorium; 1,731 kg DU; 0.1 grams Pu-238; 30 Ci tritium.

Pit 24

Hudson Moon and Mint Leaf test debris from Nevada Test Site; 3 each 500 microCi Ra-226 ionization alphatron gauges encapsulated in a concrete-filled A/N can; one each 45 Ci Co-60 source in a lead shield housing; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; reactor fuel element ends (5-rem/hr on contact); tritium-contaminated General Electric vacuum system, trigger gauge, transducers, hoods, vacuum pump, and panels; Pu-238, Pu-239, U-235, and U-238 contaminated glove box, gamma probe, and stereo microscope; neutron generator tubes; Pershing missile test debris; DU-contaminated weapons debris; 140 kg DU; 60 Ci tritium.

Pit 25

Stainless steel sample cylinders; tritium-contaminated flexible vent; Pu-239 contaminated microscope slide and slide clamps; Hudson Moon test debris from Nevada Test Site; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; one each 3.5 Ci Ir-192 source encapsulated in concrete-filled 5-gallon A/N can; Ta-182 wire, needles, and foil in lead pigs; 4 each 10 microCi Ra-226/Be sources in a lead container encapsulated in concrete-filled 55-gallon drum; one each 30 Ci Ir-192 source encapsulated in concrete-filled 10-gallon A/N can; Ba-133 reactor bolts; DU ballast, machine chips, cuttings, and turnings; head filters and prefilters; DU-contaminated penetration vehicles; one each Pu-238 contaminated stereo microscope, glove box, balance, and manipulator arm; reactor fuel element ends (5 rem/hr on contact); DU-contaminated ceramic base plates and electric furnace; irradiated scrap nickel and reactor material; DU-contaminated sputtering shield, O-rings, and steel wool; 15 each irradiated fission chambers; Be-contaminated glove box and balance; irradiated floor and exhaust hood coverings; tritium-contaminated ion pump; MFP-contaminated transistors, diodes, resistors, circuits, paper, and plastic; one each iridium iriditron, one each 11.6 microCi Ra-226 dew pointer in brass cylinder, one each DU aft simulator; neutron generator tubes; SRAM missile test debris; DU-contaminated weapons components; 1,431 kg DU; 76.5 Ci tritium.

Pit 26

Co-57 contaminated cleanup debris; DU machine chips, turnings, and cuttings; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; 5 each carbon rings; DU-contaminated cloth, towels, and paper; MFP-contaminated machining wastes; 4 each 4.0 Ci Co-60 sources in a lead container encapsulated in concrete-filled 55-gallon drum; 100 microCi Na-22; DU-contaminated Pershing missile debris; DU-contaminated Sierra Army Depot debris; 18 each 1.8 microCi Ra-226 ionization alphatron gauges encapsulated in concrete-filled 32-gallon A/N can; Ta-182 wires in a lead pig; 3 each Victoreen Sr-90 ion chambers; DU-contaminated penetration ballast, noses, and aft simulators; 5 each sealed 389 microCi Ba-133 sources; 5 each sealed 160 microCi Ra-226 sources; 2 each sealed 10 microCi Ra-226 check sources; 2 each sealed 2.2 microCi Cs-137 check sources;

3 each sealed 4.6 microCi Co-60 solution in glass ampules; one each sealed 1.0 microCi Sr-90 solution in a glass ampule; and one each sealed 0.6 microCi Kr-85 gas in a glass ampule; firing and fusing sets; DU-contaminated weapons components; 5,525 kg DU; 88.5 Ci tritium.

Pit 27

One each DU nose ballast; one each tritium-contaminated shipping container; DU plates; 3 each empty steel gas cylinders; tritium targets; 2 each DU penetrators; enriched uranium tensile bars alloyed with Fe-50; 1 kg thorium oxide; neutron generator tubes; 155 mm gun debris; 3,246 kg DU; 81 Ci tritium.

Pit 28

6 each 55-gallon drums containing DU debris; Cs-137 contaminated debris in sealed A/N can; one each 100 microCi Victoreen Sr-90 ion chamber; 10 each irradiated headers; DU-contaminated tapered cantilever and double cantilever; neutron generator tubes.

Pit 30

20 each 0.4 Ci neutron activated aluminum reflector plates encapsulated in concrete; 4 each 187 Ci Co-60 neutron activated stainless steel tubes encapsulated in concrete; activated stainless steel pipe containing reactor instrumentation (1,000 rem/hr on contact); thoria capsules and fragments.

Pit 31

Cs-137 contaminated reactor waste in sealed A/N can; 8 each DU ballast plugs; DU machine chips, turnings, and cuttings; 19 each highly oxidized DU plates; miscellaneous operational and cleanup wastes including towels, paper, packing material, wire, gloves, and tape; one each 10 microCi Ra-226 ionostat; one each 45 mCi Kr-85 ion generator; prefilters from exhaust systems; one each 4 mCi Ra-226/Be source, 4 each DU plates; 3 each uranium/zirconium samples; one each 16 mCi Se-75 source in steel block; 2 each 55-gallon drums contaminated with DU oxide; quartz cloth contaminated with thorium; 1-gallon toluene absorbed on vermiculite in sealed A/N can; neutron generator tubes and targets; DU-contaminated weapons test debris; Pershing missile test debris; 2,460 kg DU; 27.7 Ci tritium.

Pit 32

Two pints deuterium water absorbed on vermiculite in sealed 2-gallon A/N can; one each 150 mCi Ta-182 source in lead pig; 2 each Ta-182 plugs removed from a rain erosion rocket in sealed A/N can; neutron generator tubes and targets; DU-contaminated inner shield assembly; Ra-226, Na-22, Ba-133, Co-60, Co-57, Mo-54, mixed isotopes (1.0 mCi) in lead pig; 6 each 1.0 mCi Se-75 sources in lead pig; 6 kg DU-contaminated lithium tetra-borate; 10 each Po-210 static eliminators; 25 each obsolete 240 mCi Po-210 static eliminators; one each 300 mCi Ba-226 source in sealed A/N can; one each 1.0 microCi Sm-151 source in sealed A/N can; one each

0.1 mCi Pm-147 source in a sealed A/N can; tritium-contaminated glove box; 549 kg DU; 55.6 Ci tritium.

Trace Gd-153, Eu-152, Ce-144, Sr-85, Ba-133, Ag-110m, Tc-199, Ni-63, Na-22, and Pm-147.

Pit 33

One each 24 kg DU sphere; one each 86 Ci Co-60 source in 4,000 lb. lead cask; 15 each 70 mCi Co-60 sources, one each 1.0 mCi Pm-147 source, one each 350 mCi Se-75 source, 15 each 85 mCi Cs-137 sources, and 10 each 25 mCi Ra-226 sources encapsulated in concrete-filled 55-gallon drums; thorium-contaminated quartz cloth; 200 grams uranium hydride; one each 50 Ci Kr-85 source encapsulated in a concrete-filled A/N can; activated stainless steel roller plate; TA-5 hot cell decontamination debris; one each irradiated balance; fuel element cladding and associated parts from reactor instrumented fuel elements, vacuum system, filters, and tools (2 rem/hr on contact); irradiated, disassembled pressure vessel and crucible; tritium targets and tubes; Three Mile Island radiation detector; 1.6 kg Be; 2,125 kg DU; 822 Ci tritium; 1kg thorium.

Pit 34

One each 110 Ci Co-60 radiography source encapsulated in concrete-filled A/N can; one each ultra-sonic thermometer consisting of a stainless steel tube loaded with copper, cobalt, tantalum, thoria, nickel, and iron (15 rem/hr on contact); activated stainless steel tubing (2 rem/hr on contact); obsolete experimental equipment and parts (3 rem/hr on contact); one each Cs-137 contaminated WESF capsule; neutron generator tubes and targets; U-238 contaminated soil from burn test; 200 grams activated silver; firing sets; uranyl nitrate coatings of foil; trough assembly used in fuel element cleanup; 1,676 kg DU; 328 Ci tritium.

Pit 35

Neutron generator tubes and targets; neutron activated brass; 4 each 55-gallon drums DU from White Sands Missile Range; one each activated stainless steel containment canister; Be-contaminated weapon components; 3 each sources for Beta scope; crucible; stainless steel ion sources and tubes; 686 kg DU; 203 Ci tritium.

Pit 36

Neutron generator tubes and targets; STI experiment package; GAP II upper can; DF 4 outer can; 1 each 55-gallon drum containing ST-2 hardware without fuel section; one each microcomputer; irradiated diodes, transistors, capacitors, resistors, circuit boards, voltage regulators, and other miscellaneous electrical components; thermocouple wire from the ACRR core; 3 each activated stainless steel containment canisters wrapped in polyethylene sheeting; one each weapon shipping and handling container; thorium-contaminated Polaris missile sections; rings from reactor fuel elements (1.7 rem/hr on contact); 4 each 55-gallon drums containing wastes contaminated with fission products; 2 each large wooden boxes; 673 kg DU; 13.1 kg lithium.

Pit 37

Empty, no contents.

Pit U-1

1,589 kg DU in chips, machine turnings, shavings, cuttings, residue, and scrap.

Pit U-2

5,119 kg DU in chips, machine turnings, shavings, cuttings, residue, and scrap; one each irradiated melt chamber; one each copper crucible containing DU scrap.

Pit U-3

1,114 kg DU in chips, machine turnings, shavings, cuttings, residue, and scrap; 1,000 lbs. of Burn Site DU-contaminated soil and debris; one each DU-contaminated 300 lb. crucible.

INHALATION TOXICOLOGY RESEARCH INSTITUTE

LOVELACE BIOMEDICAL AND ENVIRONMENTAL RESEARCH INSTITUTE, INC.

RADIOACTIVE SHIPMENT RECORD FORM

From

Date 4/28/80

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Item No.	Rad. Level (mr/hr)		External Contamination Survey (CPM)	Isotope(s)	Container Type	Radioactive Millicuries	Physical State	Contents	Container Cubic Feet
	Surface	at 3 feet							
1	BKG.	BKG.	<100	^{238}Pu ^{239}Pu	55 Gal. Drum	.5	Solid	Plastic, glass, Paper	7.5
2	"	"	"	^{238}Pu ^{144}Ce	"	"	"	"	"
3	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
4	"	"	"	^{238}Pu	"	"	"	"	"
5	"	"	"	^{238}Pu	"	"	"	"	"
6	"	"	"	^{238}Pu	"	"	"	"	"
7	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
8	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
9	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
11	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
12	"	"	"	^{238}Pu ^{241}Am	"	"	"	"	"
13	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
14	"	"	"	^{144}Ce ^{239}Pu	"	"	"	"	"
15	"	"	"	^{144}Ce ^{239}Pu	"	"	"	"	"
16	"	"	"	^{144}Ce ^{238}Pu	"	"	"	"	"
17	"	"	"	^{144}Ce ^{238}Pu	"	"	"	"	"
18	50	5	"	^{144}Ce	"	100	"	"	"
19	BKG.	BKG.	"	^{144}Ce ^{238}Pu	"	.5	"	"	"
25	"	"	"	^{134}Cs ^{239}Pu	"	"	"	"	"
26	"	"	"	^{134}Cs ^{239}Pu	"	"	"	"	"
27	"	"	"	^{134}Cs ^{241}Am	"	"	"	"	"
28	"	"	"	^{144}Ce ^{239}Pu	"	"	"	"	"
29	"	"	"	^{134}Cs ^{239}Pu	"	"	"	"	"
30	"	"	"	^{134}Cs ^{241}Am	"	"	"	"	"
31	"	"	"	^{134}Cs ^{239}Pu	"	"	"	"	"
32	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
33	"	"	"	^{144}Ce ^{239}Pu	"	"	"	"	"
34	"	"	"	^{144}Ce ^{239}Pu	"	"	"	"	"
35	"	"	"	^{239}Pu ^{241}Am	"	"	"	"	"
36	10.	0.4	"	^{238}Pu ^{169}Yb	"	50 (Yb^{169})	"	"	"
37	BKG.	BKG.	"	^{144}Ce ^{238}Pu	"	.5	"	"	"
38	"	"	"	^{144}Ce ^{239}Pu	"	"	"	"	"
39	"	"	"	^{134}Cs ^{239}Pu	"	"	"	"	"
40	"	"	"	^{238}Pu ^{241}Am	"	"	"	"	"
TOTALS						166			255

All of the waste described above contains no free liquids and no transuranic elements with a radioactivity concentration greater than 10 nanocuries per gram.

J. J. Thompson 4/30/80

Date

Carrier's Signature

Date

INHALATION TOXICOLOGY RESEARCH INSTITUTE

LOVELACE BIOMEDICAL AND ENVIRONMENTAL RESEARCH INSTITUTE, INC.

RADIOACTIVE SHIPMENT RECORD FORM

From

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Item No.	Rad. Level (mr/hr)		External Contamination Survey (CPM)	Isotope(s)	Container Type	Radioactive Millicuries	Physical State	Contents	Container Cubic Feet
	Surface	at 3 feet							
41	BKG.	BKG.	<100	^{144}Ce^{239}Pu	55 Gal.drum	.5	Solid	Glass,paper,plastic	7.5
42	"	"	"	^{147}Pm^{238}Pu	"	"	"	"	"
44	22	2	"	^{134}Cs^{144}Ce	"	50	"	"	"
45	190	10	"	^{144}Ce^{137}Cs	"	500	"	"	"
46	BKG.	BKG.	"	^{144}Ce^{238}Pu	"	.5	"	"	"
47	15	1	"	^{147}Pm	"	15,000	"	"	"
48	BKG.	BKG.	"	^{144}Ce^{239}Pu	"	.5	"	"	"
49	"	"	"	^{144}Ce^{241}Am	"	"	"	"	"
50	"	"	"	^{144}Ce^{239}Pu	"	"	"	"	"
51	"	"	"	^{144}Ce^{239}Pu	"	"	"	"	"
54	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
55	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
56	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
57	"	"	"	^{144}Ce^{239}Pu	"	"	"	"	"
58	"	"	"	^{144}Ce^{239}Pu	"	"	"	"	"
59	5	.5	"	^{144}Ce^{238}Pu	"	10(^{144}Ce)	"	"	"
60	BKG.	BKG.	"	^{238}Pu^{239}Pu	"	.5	"	"	"
61	"	"	"	^{239}Pu^{241}Am	"	"	"	"	"
62	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
63	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
64	"	"	"	^{144}Ce^{239}Pu	"	"	"	"	"
65	"	"	"	^{169}Yb^{238}Pu	"	"	"	"	"
66	"	"	"	^{239}Pu^{241}Am	"	"	"	"	"
67	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
68	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
69	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
70	"	"	"	^{144}Ce^{239}Pu	"	"	"	"	"
71	"	"	"	^{144}Ce^{239}Pu	"	"	"	"	"
72	"	"	"	^{238}Pu^{239}Pu	"	"	"	"	"
73	50	6	"	^{134}Cs^{144}Ce	"	50	"	"	"
74	60	7	"	^{134}Cs^{144}Ce	"	50	"	"	"
75	40	5	"	^{134}Cs^{144}Ce	"	50	"	"	"
76	BKG.	BKG.	"	^{144}Ce	"	.5	"	"	"
77	"	"	"	^{144}Ce^{238}Pu	"	"	"	"	" RD
TOTALS						15724			255

All of the waste described above contains no free liquids and no transuranic elements with a radioactivity concentration greater than 10 nanocuries per gram.

G. J. [illegible] 4/30/80

Consignor's Signature — Date

Carrier's Signature — Date

INHALATION TOXICOLOGY RESEARCH INSTITUTE

LOVELACE BIOMEDICAL AND ENVIRONMENTAL RESEARCH INSTITUTE, INC.

RADIOACTIVE SHIPMENT RECORD FORM

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Date 4/28/80

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Item No.	Rad. Level (mr/hr)		External Contamination Survey (CPM)	Isotope(s)	Container Type	Radioactive Millicuries	Physical State	Contents	Container Cubic Feet
	Surface	at 3 feet							
78	BKG.	BKG.	< 100	^{144}Ce ^{238}Pu	55Gal.drum	.5	Solid	Glass,paper,plastic	7.5
79	"	"	"	^{144}Ce ^{238}Pu	"	"	"	"	"
81	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
82	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
83	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
84	"	"	"	^{239}Pu ^{241}Am	"	"	"	"	"
85	"	"	"	^{137}Cs ^{239}Pu	"	"	"	"	"
86	20	.5	"	^{144}Ce ^{238}Pu	"	50(^{144}Ce)	"	"	"
87	BKG.	BKG.	"	^{169}Yb ^{238}Pu	"	.5	"	"	"
88	"	"	"	^{134}Cs ^{238}Pu	"	"	"	"	"
91	"	"	"	^{134}Cs ^{238}Pu	"	"	"	"	"
92	"	"	"	^{134}Cs ^{238}Pu	"	"	"	"	"
93	"	"	"	^{134}Cs ^{238}Pu	"	"	"	"	"
94	40	5	"	^{106}Ru	"	20	"	"	"
95	110	7	"	^{106}Ru	"	60	"	"	"
96	BKG.	BKG.	"	^{238}Pu ^{239}Pu	"	.5	"	"	"
97	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
98	"	"	"	^{238}Pu ^{241}Am	"	"	"	"	"
99	"	"	"	^{144}Ce ^{239}Pu	"	"	"	"	"
100	"	"	"	^{14}C ^{134}Cs	"	"	"	"	"
101	"	"	"	^{239}Pu ^{241}Am	"	"	"	"	"
102	25	1	"	^{169}Yb ^{238}Pu	"	50 (^{169}Yb)	"	"	"
103	BKG.	BKG.	"	^{169}Yb ^{238}Pu	"	.5	"	"	"
104	"	"	"	^{169}Yb ^{238}Pu	"	"	"	"	"
107	3	0	"	^{169}Yb ^{238}Pu	"	10 (^{169}Yb)	"	"	"
108	BKG.	BKG.	"	^{144}Ce ^{238}Pu	"	.5	"	"	"
109	"	"	"	^{144}Ce ^{238}Pu	"	"	"	"	"
110	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
111	"	"	"	^{106}Ru ^{238}Pu	"	"	"	"	"
112	"	"	"	^{106}Ru ^{238}Pu	"	"	"	"	"
113	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
114	7	1	"	^{134}Cs ^{238}Pu	"	10 (^{134}Cs)	"	"	"
115	BKG.	BKG.	"	^{238}Pu ^{239}Pu	"	.5	"	"	"
117	"	"	"	^{238}Pu ^{239}Pu	"	"	"	"	"
TOTALS						214			255

All of the waste described above contains no free liquids and no transuranic elements with a radioactivity concentration greater than 10 nanocuries per gram.

J. J. Thompson 4/30/80

Customer Signature Date

Carrier's Signature Date

INHALATION TOXICOLOGY RESEARCH INSTITUTE
LOVELACE BIOMEDICAL AND ENVIRONMENTAL RESEARCH INSTITUTE, INC.

RADIOACTIVE SHIPMENT RECORD FORM

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Item No.	Rad. Level (mr/hr) Surface	Rad. Level (mr/hr) at 3 feet	External Contamination Survey (CPM)	Isotope(s)	Container Type	Radioactive Millicuries	Physical State	Contents	Container Cubic Feet
118	BKG.	BKG.	< 100	$^{106}\mathrm{Ru}\,^{238}\mathrm{Pu}$	55 Gal.drum	.5	Solid	Glass,plastic,paper	7.5
119	"	"	"	$^{106}\mathrm{Ru}\,^{238}\mathrm{Pu}$	"	"	"	"	"
120	"	"	"	$^{90}\mathrm{Sr}\,^{144}\mathrm{Ce}$	"	"	"	"	"
121	"	"	"	$^{238}\mathrm{Pu}\,^{239}\mathrm{Pu}$	"	"	"	"	"
122	"	"	"	$^{238}\mathrm{Pu}\,^{239}\mathrm{Pu}$	"	"	"	"	"
123	"	"	"	$^{238}\mathrm{Pu}\,^{239}\mathrm{Pu}$	"	"	"	"	"
124	"	"	"	$^{238}\mathrm{Pu}\,^{239}\mathrm{Pu}$	"	"	"	"	"
125	"	"	"	$^{169}\mathrm{Yb}\,^{238}\mathrm{Pu}$	"	"	"	"	"
128	"	"	"	$^{169}\mathrm{Yb}\,^{238}\mathrm{Pu}$	"	"	"	"	"
131	"	"	"	$^{239}\mathrm{Pu}\,^{241}\mathrm{Am}$	"	"	"	"	"
132	"	"	"	$^{238}\mathrm{Pu}\,^{239}\mathrm{Pu}$	"	"	"	"	"
134	"	"	"	$^{238}\mathrm{Pu}\,^{239}\mathrm{Pu}$	"	"	"	"	"
135	"	"	"	$^{238}\mathrm{Pu}\,^{239}\mathrm{Pu}$	"	"	"	"	"
136	"	"	"	$^{238}\mathrm{Pu}\,^{241}\mathrm{Am}$	"	"	"	"	"
137	"	"	"	$^{238}\mathrm{Pu}\,^{241}\mathrm{Am}$	"	"	"	"	"
242	"	"	"	$^{238}\mathrm{Pu}\,^{241}\mathrm{Am}$	"	"	"	"	"
247	"	"	"	$^{144}\mathrm{Ce}\,^{239}\mathrm{Pu}$	"	"	"	"	"
D	BKG.	BKG.	<100	$^{137}\mathrm{Cs}\,^{238}\mathrm{Pu}$	Plywood Box	.5	Solid	Glass,paper,plastic,	121
G	"	"	"	$^{134}\mathrm{Cs}\,^{144}\mathrm{Ce}$	"	"	"	metal	91
B	"	"	"	$^{144}\mathrm{Ce}\,^{238}\mathrm{Pu}$	"	"	"	"	154
H	"	"	"	$^{90}\mathrm{Sr}\,^{137}\mathrm{Cs}$	"	"	"	Manipulatör cell	411
J	"	"	"	$^{137}\mathrm{Cs}\,^{144}\mathrm{Ce}$	"	"	"	Metal,paper,glass,	121
K	"	"	"	$^{137}\mathrm{Cs}\,^{144}\mathrm{Ce}$	"	"	"	" plastic	91
M	"	"	"	$^{137}\mathrm{Cs}\,^{144}\mathrm{Ce}$	"	"	"	"	91
L	"	"	"	$^{137}\mathrm{Cs}\,144\mathrm{Ce}$	"	"	"	"	121
F	"	"	"	$^{144}\mathrm{Ce}\,^{238}\mathrm{Pu}$	"	"	"	"	91
N	"	"	"	$^{137}\mathrm{Cs}\,^{144}\mathrm{Ce}$	"	"	"	"	121
A	"	"	"	$^{144}\mathrm{Ce}\,^{238}\mathrm{Pu}$	"	"	"	"	121
E	"	"	"	$^{144}\mathrm{Ce}\,^{238}\mathrm{Pu}$	"	"	"	"	91
I	"	"	"	$^{169}\mathrm{Yb}\,^{238}\mathrm{Pu}$	"	5.0	"	Glove Box, paper, glass and plastic	441
TOTALS						19.5			2193.5

All of the waste described above contains no free liquids and no transuranic elements with a radioactivity concentration greater than 10 nanocuries per gram.

J. J. Thompson 4/30/80
Date

____________________ Carrier's Signature Date

Cs-137-Contaminated Shipping Cask and Semitractor Trailer (Trench F)
(only the trailer was buried)

DISTRIBUTION:

1 Krishan Wahi
8500 Menaul Blvd. NE, Suite B-335
Albuquerque, New Mexico 87112

1	MS	0184	J.E. Gould, DOE/OKSO
1		1087	W.P. Moats, NMED
1		1087	F.B. Nimick, 6132
1		1089	R.E. Fate, 6135
1		1089	J.L. Peace, 6135
1		1089	T.J. Goering, 6135
1		0651	ISS Records Center, 9612
1		9018	Central Technical Files, 8945-1
2		0899	Technical Library, 9616
1		0612	Review and Approval Desk, 9612 For DOE/OSTI