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LIST RELEVANT TECH AREA(S).	*LIST RELEVANT ADS NO(S).*	*LIST RELEVANT STRUCTURE NO(S).*	*LIST RELEVANT SWMU NO(S)/PRS.*
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Volume 1 of 1

PHASE REPORT IB

TA-21 OPERABLE UNIT RCRA FACILITY INVESTIGATION

OPERABLE UNIT-WIDE SURFACE SOIL, DEPOSITION LAYER AND FILTER BUILDING INVESTIGATION

28 January 1994

ENVIRONMENTAL RESTORATION PROGRAM
LOS ALAMOS NATIONAL LABORATORY

Los Alamos
NATIONAL LABORATORY

LA-UR-93-4390

EXECUTIVE SUMMARY

Phase Report 1B

This report summarizes results of field work conducted in 1992 at Technical Area (TA)-21 of Los Alamos National Laboratory, also referred to as Operable Unit (OU) 1106. This work is prescribed by the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for this Operable Unit. The investigation included phase 1 surface and near-surface soil sampling intended to establish site-wide background, characterize potential contamination from airborne emissions deposition, and delineate contamination extent at former filter buildings. The investigations described in this report address 18 potential release sites listed as Solid Waste Management Units (SWMUs) in the RFI work plan. Phase Report 1A, issued on 14 June 1993, summarizes TA-21 geologic characterization activities carried out in 1992. Phase Report 1C, to be issued on 28 February 1994, will include an assessment of the results of 1992 RFI sampling of 25 work plan SWMUs related to TA-21 outfalls and septic systems.

The 1992 RFI soil characterization data show that site-wide levels of inorganic, organic, and radiological constituents from 16 work plan SWMUs associated with airborne releases are below levels of concern. Although slightly elevated site-wide radionuclide levels from airborne deposition were confirmed, the levels are far below applicable action levels and cannot be attributed to any specific subset of airborne emission SWMUs. Based on these findings, no further action is warranted for these 16 units.

The 1992 RFI soil characterization data for two work plan SWMUs associated with the locations of two former filter buildings showed that levels of inorganic, organic, and radionuclide constituents are below levels of concern. Although slightly elevated subsurface levels of plutonium, americium, and tritium were detected, the levels are far below applicable action levels and not indicative of source terms of concern. Based on the RFI data, no further RFI investigation is warranted for these two units.

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LIST OF ACRONYMS

AOC	Area of Concern
AES	Atomic Emission Spectroscopy
CRQL	Contract-Required Quantitation Limits
DNA	Delayed Neutron Activation
EPA	(U. S.) Environmental Protection Agency
ER	Environmental Restoration
ETVAA	Electro Thermal Vapor Atomic Absorption
FAA	Flame Atomic Absorption
FIMAD	Facility for Information Management, Analysis, and Display
HSWA	Hazardous and Solid Waste Ammendments
ICPES	Inductively Coupled Plasma Emission Spectrometry
ICPMS	Inductively Coupled Plasma Mass Spectrometry
ID	Identification
KPA	Kinetic Phosphorescence Activation
LANL	Los Alamos National Laboratory (the Laboratory)
MDA	Material Disposal Area
NAA	Neutron Activation Analysis
NFA	No Further Action
OU	Operable Unit
PRS	Potential Release Site
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SAL	Screening Action Level
SWMU	Solid Waste Management Unit
TA	Technical Area
TSTA	Tritium System Test Assembly

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

1.1 Purpose of Report

This document, Phase Report 1B, reports the results of 1992 field investigations conducted under the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for Operable Unit (OU) 1106, which is constituted by Technical Area (TA)-21 (LANL 1991a). This work was conducted as part of the Environmental Restoration (ER) Program of the Los Alamos National Laboratory (the Laboratory). The terms TA-21 OU and OU 1106 are used interchangeably throughout this report.

The TA-21 RFI is being conducted according to the RFI work plan as amended by an addendum and approved by Region 6 of the U. S. Environmental Protection Agency (EPA) (LANL 1991b; EPA 1992). The work plan was prepared to meet the requirements of the Hazardous and Solid Waste Amendment (HSWA) Module VIII of the RCRA Operating Permit for the Laboratory (EPA 1990).

Phase Report 1B is the second of three parts of the initial RFI phase report to be issued for OU 1106. The first part (Phase Report 1A), issued on June 14, 1993, included the results of studies of the TA-21 geology, fractures, stratigraphy, petrography, mineralogy, and geomorphology (LANL 1993a).

Phase Report 1B, constituting the second part of the initial phase report, assesses results from soil sampling activities conducted in 1992 that could not be reported earlier because of delays in receiving analytical results. Included are results from investigations of site-wide background, airborne emissions deposition, and possible contamination of former filter building locations. In all, 18 potential release sites listed as Solid Waste Management Units (SWMUs) in the RFI work plan are addressed in full or in part by the investigations reported in this document. These 18 subunits are referred to throughout this phase report as "SWMUs" or "work plan SWMUs." Of these 18 subunits, two are listed as non-priority SWMUs and none as priority SWMUs in the original HSWA Module VIII.

A third phase report segment, Phase Report 1C, scheduled for submission on 28 February 1994, will address an additional 25 work plan SWMUs related to outfalls and septic systems. Aspects of RFI work at TA-21 continue to be reported in quarterly technical progress reports presented to EPA Region 6 (LANL 1992a-c; LANL 1993b).

1.2 Site Background

1.2.1 Site Description

Figures 1.1 and 1.2 show the location of TA-21 regionally and in relation to other OUs of the Laboratory. TA-21 is located on the northern edge of the Laboratory and has a mesa-top elevation of about 7,000 ft. The site is centrally located on the Pajarito Plateau, roughly midway between the steep flanks of the Jemez Mountains to the west and White Rock Canyon of the Rio Grande to the east. The bedrock throughout the operable unit is the Bandelier Tuff, which consists locally of approximately 800 ft of volcanic ash deposits. Groundwater lies within the underlying Puye Formation at a depth of approximately 1,150 ft below the mesa top. Shallow alluvial and perched aquifers have been identified in Los Alamos Canyon. The RFI work plan, the Installation Work Plan (IWP) (LANL 1992d; LANL 1993c), and Phase Report 1A contain additional details of the geologic setting of TA-21.

TA-21 occupies 311 acres and is centered on DP Mesa, immediately east-southeast of the Los Alamos townsite. The OU extends from the mesa top to the stream channels in the adjacent canyons, DP Canyon to the north and Los Alamos Canyon to the south. Additional information relevant to general site conditions at TA-21 and vicinity is presented in the RFI work plan.

1.2.2 Site History

TA-21 was used primarily for plutonium research and metal production and related activities from 1945 to 1978. Subsequent unrelated office and small scale research activities have continued at the site to the present time. Primarily as a result of the former activities, the OU contains 29 potential release sites identified in the RFI work plan as SWMUs. The work plan further subdivides these units into 112 SWMU subunits, 18 of which are addressed in this phase report. Figure 1.3 indicates the locations of these subunits and Table 1.1 contains brief descriptions.

Because the major industrial activities at TA-21 were related to plutonium production, the major waste disposal activities also were plutonium related. Hazardous and radioactive constituents are likely to have been present in most waste streams as a result of the process chemistry.

The RFI work plan aggregates TA-21 SWMUs into four conceptual categories, as follows:

- deep liquid release sites, such as seepage pits and absorption beds into which plutonium-bearing liquids were discharged (these sites include Material Disposal Areas (MDAs) T, U and V);
- near-surface liquid release sites, which received discharges from septic systems that may have contained liquid industrial wastes;
- subsurface solid waste disposal areas, such as MDAs A and B, where contaminated equipment, industrial materials, stabilized process residues, and solid radioactive or hazardous wastes were buried in shallow trenches or isolated shafts; and
- surface contamination areas, where limited quantities of contaminants were released to the land surface by sources such as outfalls, stack emissions fallout, building operations, and surface spills.

Detailed historical data regarding TA-21 are presented in the RFI work plan in Chapter 3, TA-21 Operable Unit Background Information. Knowledge of the environmental setting, geology, and surface and groundwater hydrology for the Pajarito Plateau and TA-21 was summarized in the RFI work plan in Chapter 4, Environmental Setting. Additional relevant information is contained in the IWP. The grouping of TA-21 SWMUs into conceptual categories, and a discussion of potential migration pathways for each type of SWMU, is presented in the RFI work plan in Chapter 5, Potential Contaminant Migration Pathways.

1.2.3 Previous Investigations

The geologic studies described in Phase Report 1A were the first TA-21 RFI field activities formally reported (other than in quarterly technical progress reports). The results presented in Phase Report 1B are the first contaminant assessment results to be reported for the TA-21 RFI. However, extensive environmental and operational monitoring has been conducted at TA-21 in the past. These studies are

highly relevant to the RFI and are summarized in the RFI work plan in Chapter 4, Environmental Setting, and Chapters 13 through 20 that detail the current knowledge for each SWMU. In addition, preliminary information related to the results presented in this phase report continues to be reported in ER quarterly technical progress reports submitted to EPA Region 6. Relevant information from previous investigations is drawn upon in assessing the RFI investigations reported herein.

1.3 Content of Phase Report 1B

The three major components of Phase Report 1B investigations are summarized below and in Table 1.1. Chapters 2 through 4 of this phase report summarize the background, investigations, data assessments, conclusions, and recommendations resulting from 1992 RFI field activities at TA-21. These investigations are discussed in depth in Appendices A-D. Appendix E tabulates analytes which exceeded the 95.5 percentile of their respective baseline. Appendix F provides details of statistical assessments of the filter buildings investigation data. Complete analytical results will be accessible on the ER Program's Facility for Information Management and Display (FIMAD) database.

OU-wide surface soil background. Surface soil samples (0 to 6 in. sampling interval) were collected from all areas of the OU, as indicated by Map 1 at the end of this phase report. Analyses of these samples serve as the basis for distinguishing contaminant releases from isolated sources from low-level airborne emissions deposition across the OU. The results of this investigation are summarized in Chapter 2 and discussed in detail in Appendix A.

Airborne emissions deposition. Deposition-layer surface soil samples (0 to 1 in. sampling interval) were collected from all areas of the OU, as indicated by Map 1. Sampling of this thin top layer of soil is used to detect deposition of airborne particulate contaminants from the 16 atmospheric release SWMUs listed in Table 1.1. Evaluation of these data relative to the 0 to 6 in. OU-wide surface soil background data is used to identify airborne deposition patterns resulting from historic atmospheric release points at TA-21. The results of this investigation are summarized in Chapter 3 and discussed in detail in Appendix B.

Filter buildings. Two air filter buildings at TA-21 were demolished in the 1970's. In addition to contributing to airborne particulate deposition across TA-21 while they were operational, the air filtering

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TABLE 1.2 PROPOSED STATUS OF EACH TA-21 SWMU OR AREA OF CONCERN

Work Plan NFA	Investigation-Based NFA	Proposed Status Awaiting Investigation	Additional Action Needed	Work Plan Section	Description
		21-001		16.5	Radioactive Waste Container Storage Area
		21-002(a,b)		18.4,14.6,14.1	Container Storage
		21-003		14.2	PCB Storage Area
		21-004(a-c)		14.3	Aboveground Tanks
			21-004(d)	14.3,15.8	Surface Drainge of TA-21-155
		21-005		17.6	Acid Pit
		21-006(a)		18.2	Underground Seepage Pits
			21-006(b)	15.9,17.2	Underground Seepage Pits
		21-006(c-f)		18.2	Underground Seepage Pits
	21-007			13.1	Salamanders
	21-008			13.1	Incinerator
		21-009		17.3	Waste Treatment Laboratory
		21-010(a-h)		16.4	Industrial Liquid Waste Treatment Facility
		21-011(a,b,d-j)		16.4	New Industrial Waste Treatment Plant
		21-011(c)		16.5	Acid Tank & Pump
			21-011(k)	15.4	Direct Discharge Outfall
21-012(a)				17.4	Dry Wells
		21-012(b)		20.4	Dry Wells
		21-013(a)		14.8	Surface Disposal
		21-013(b-g)		14.7	Surface Disposal
		21-014		16.8	Material Disposal Area A
		21-015		16.2	Material Disposal Area B
		21-016(a-c)		16.3	Material Disposal Area T
		21-017(a-c)		16.6	Material Disposal Area U
		21-018(a,b)		16.7	Material Disposal Area V
	21-019(a-m)			13.1	Filter Houses
	21-020(a,b)			13.1	Decommissioned Filter Houses
	21-021			13.1	Stack Emissions
		21-022(a,f)		17.5	Acid Waste Lines & Sump
		21-022(b-e,g)		4,15,18.5,18.8	Acid Waste Lines & Sump
				18.9	
			21-022(h)	18.9	Direct Discharge Outfall
		21-022(i,j)		4,15,18.5,18.8	Acid Waste Lines & Sump
				18.9,18.9	
		21-023(a,b,d)		18.3	Decommissioned Septic Systems
			21-023(c)	15.2	Decommissioned Septic Systems
	21-024(a)			15.2	Septic Systems Outfall
			21-024(b-e)	15.2,15.3	Septic Systems Outfall
	21-024(f-h)			15.8,15.9	Septic Systems Outfall
			21-024(i-k)	15.6	Septic Systems Outfall
	21-024(l-o)			15.4	Septic Systems Outfall
21-025(a,b)				20.1	Off-gas System
		21-026(a-c)		14.8	Treatment Plant Outfall
	21-026(d)			15.4	Treatment Plant Outfall
			21-027(a)	15.5	Surface Discharge
	21-027(b-d)			15.7,15.2	Surface Discharge
		21-028(a)		16.3	Active Container Storage Area
21-028(b)				18.4	Active Container Storage Area
		21-028(c,d)		20.2,14.4	Active Container Storage Area
21-0228(e)				14.4	Active Container Storage Area
		21-029		14.5	DP Tank Farm
		C-21-001		19.1-3	
C-21-002-004				19.1-3	
		C-21-005-007		19.1-3	
C-21-008				19.1-3	
		C-21-009		19.1-3	
C-21-010-011				19.1-3	
		C-21-012		19.1-3	
C-21-013-026				19.1-3	
		C-21-027		19.1-3	
C-21-028-032				19.1-3	
		C-21-033-37		19.1-3	

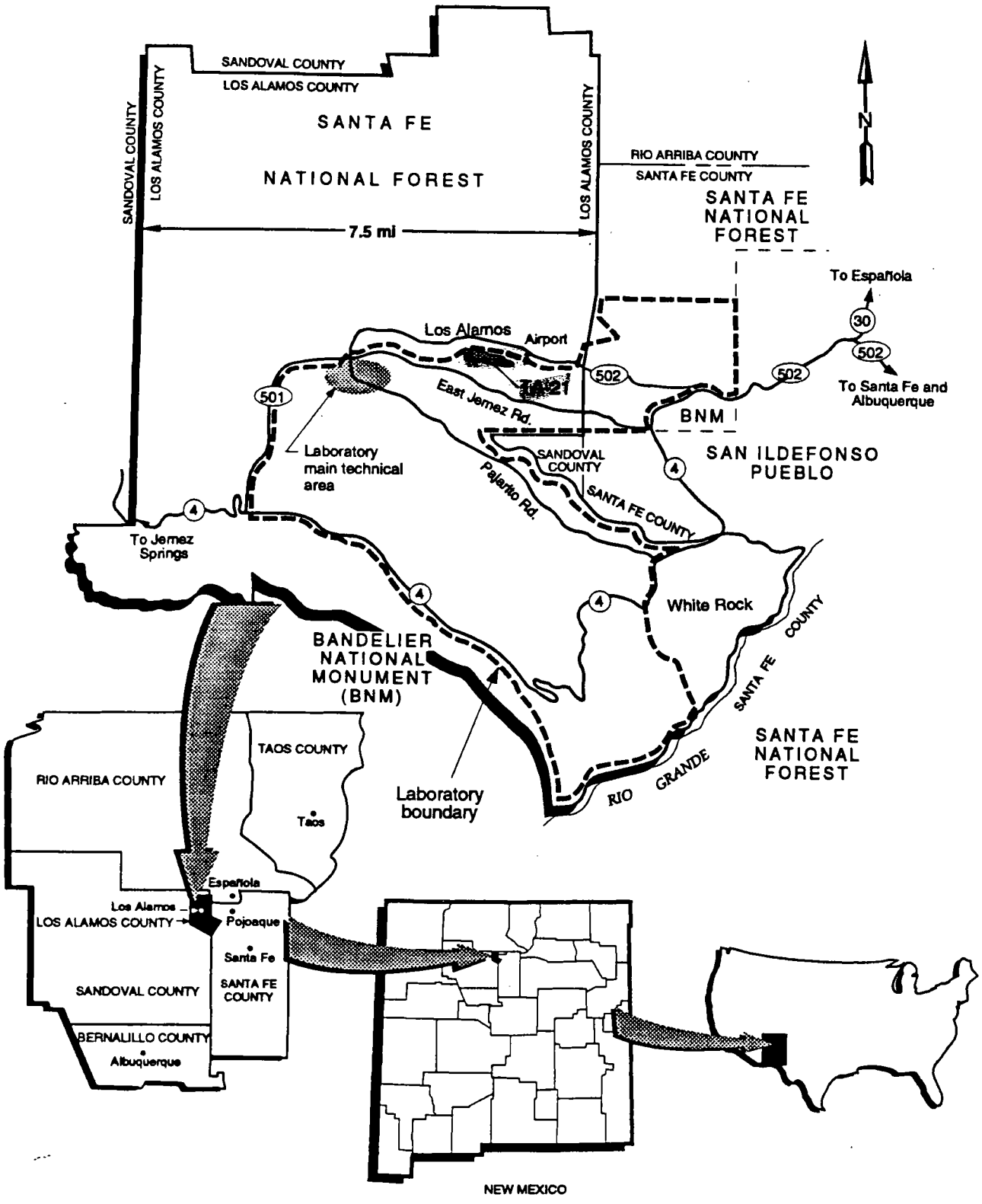

Figure 1.1 Regional location of the TA-21 Operable Unit.

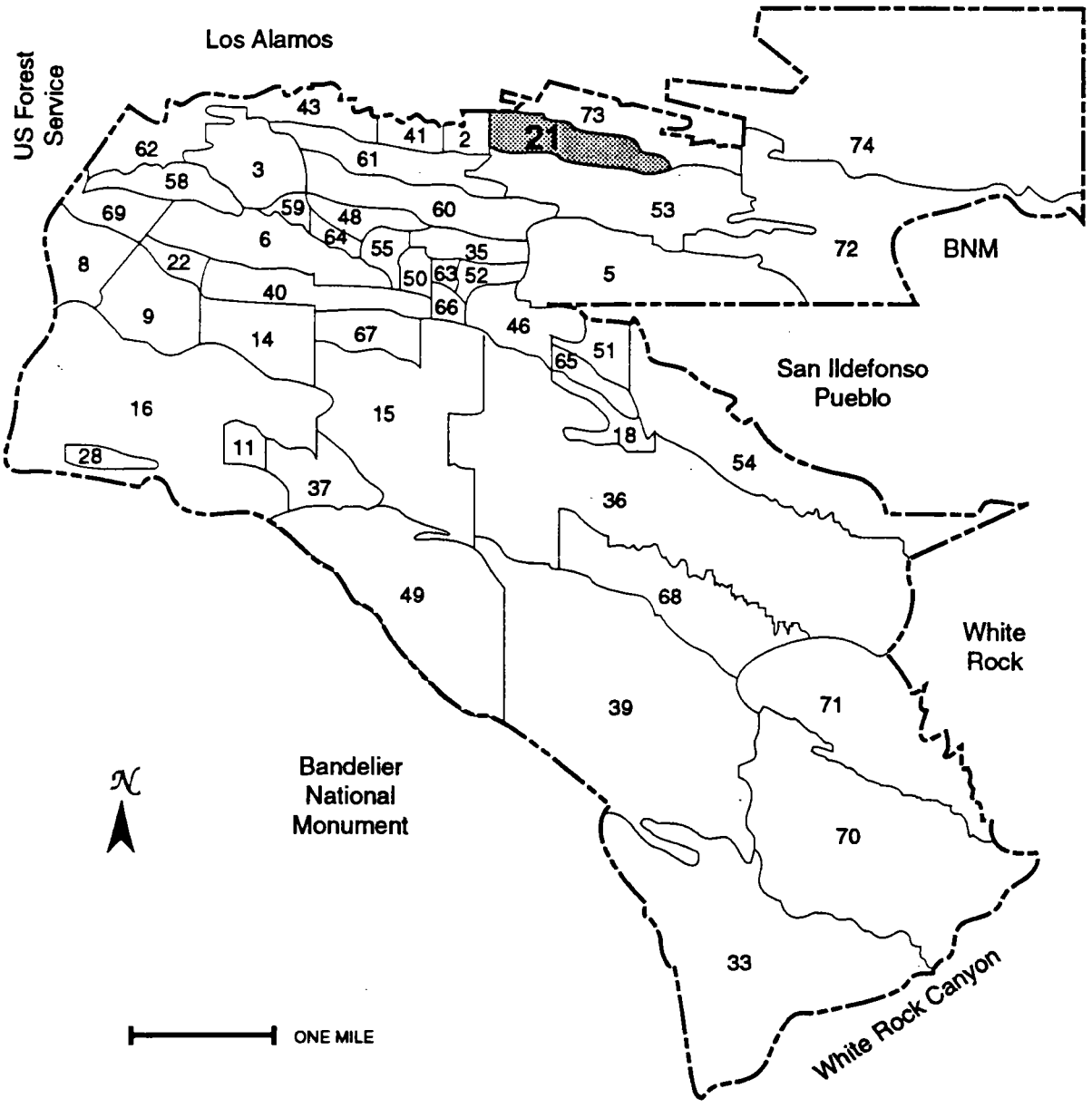

Figure 1.2 Relation of Technical Area (TA)-21 and other TAs of Los Alamos National Laboratory in relation to surrounding landholdings.

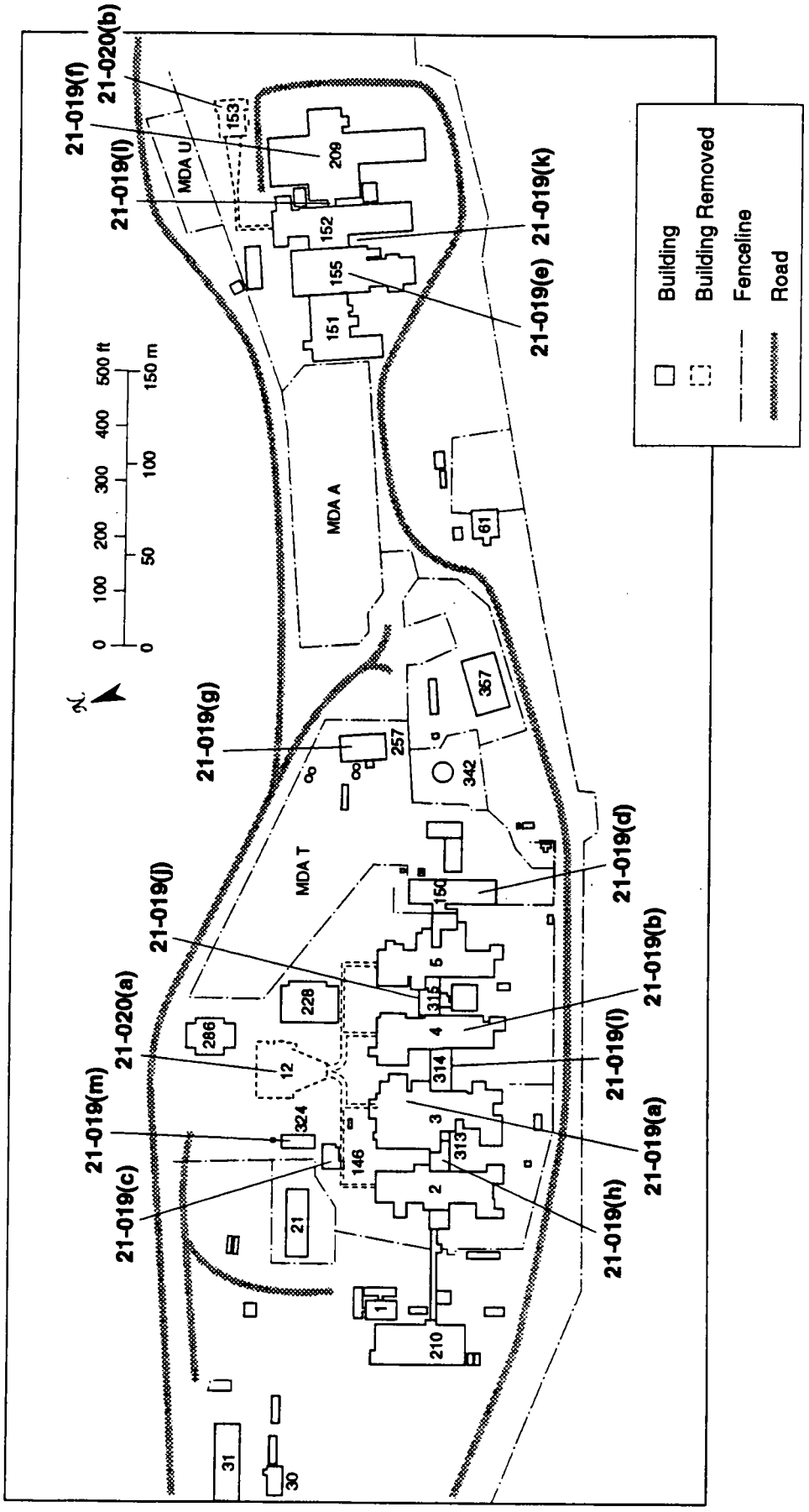

Figure 1.3 Location of SWMUs associated with airborne emissions at TA-21. Not shown are SWMUs 21-007 (salamander incinerators, not all locations known), 21-008 (former incinerators in Buildings 2 and 3), and 21-021 (general stack emissions throughout the OU).

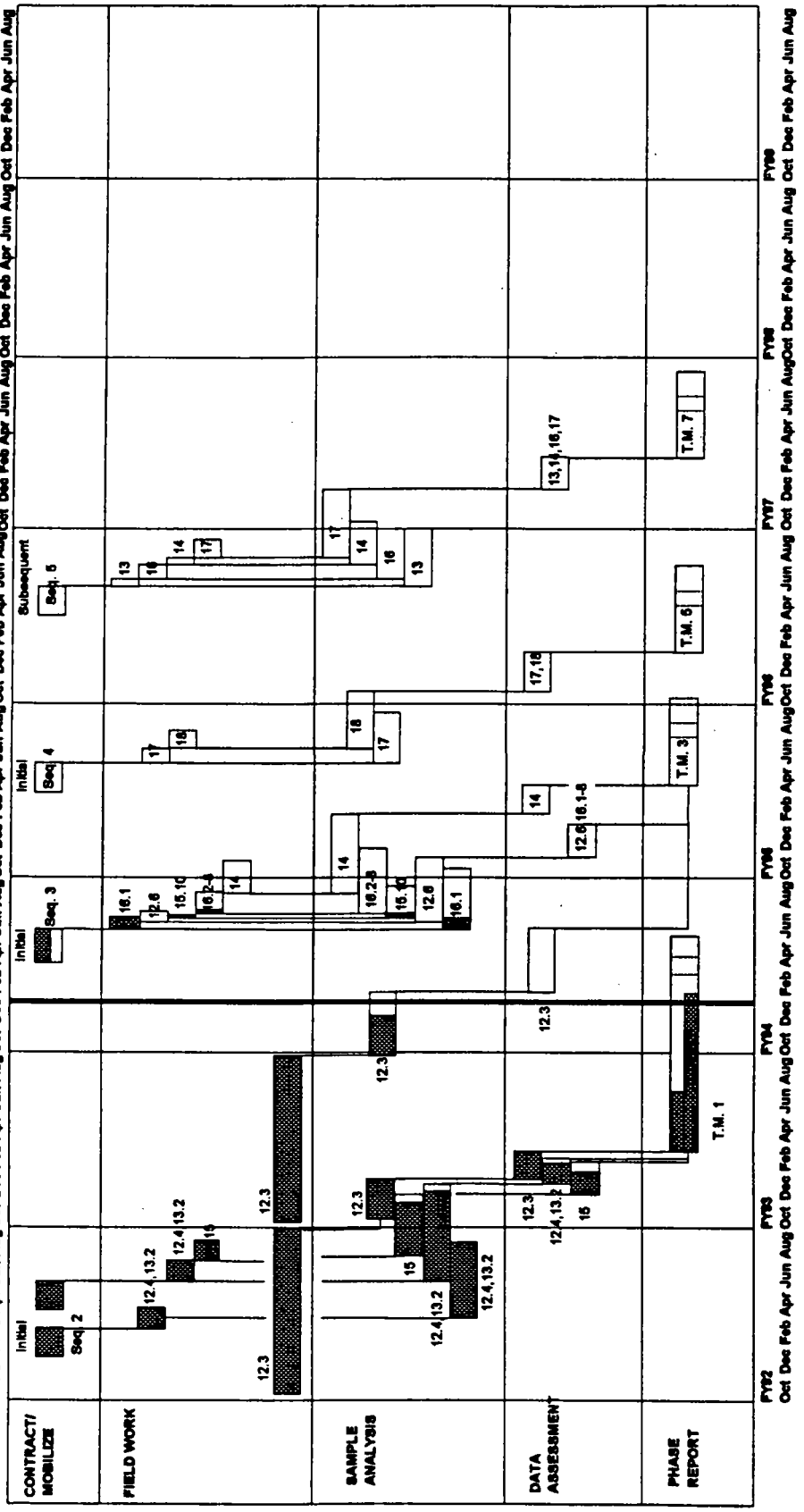

Figure 1.4 TA-21 OU RFI Progress: near-surface investigations (1/14/94). Numbers XX.Y denote RFI work plan sections. "T.M." denotes "tech memo", now referred to as "phase report".

Notes: Sample analysis tasks 12.4, 13.2 and 15 are not on schedule due to slow return of laboratory results.

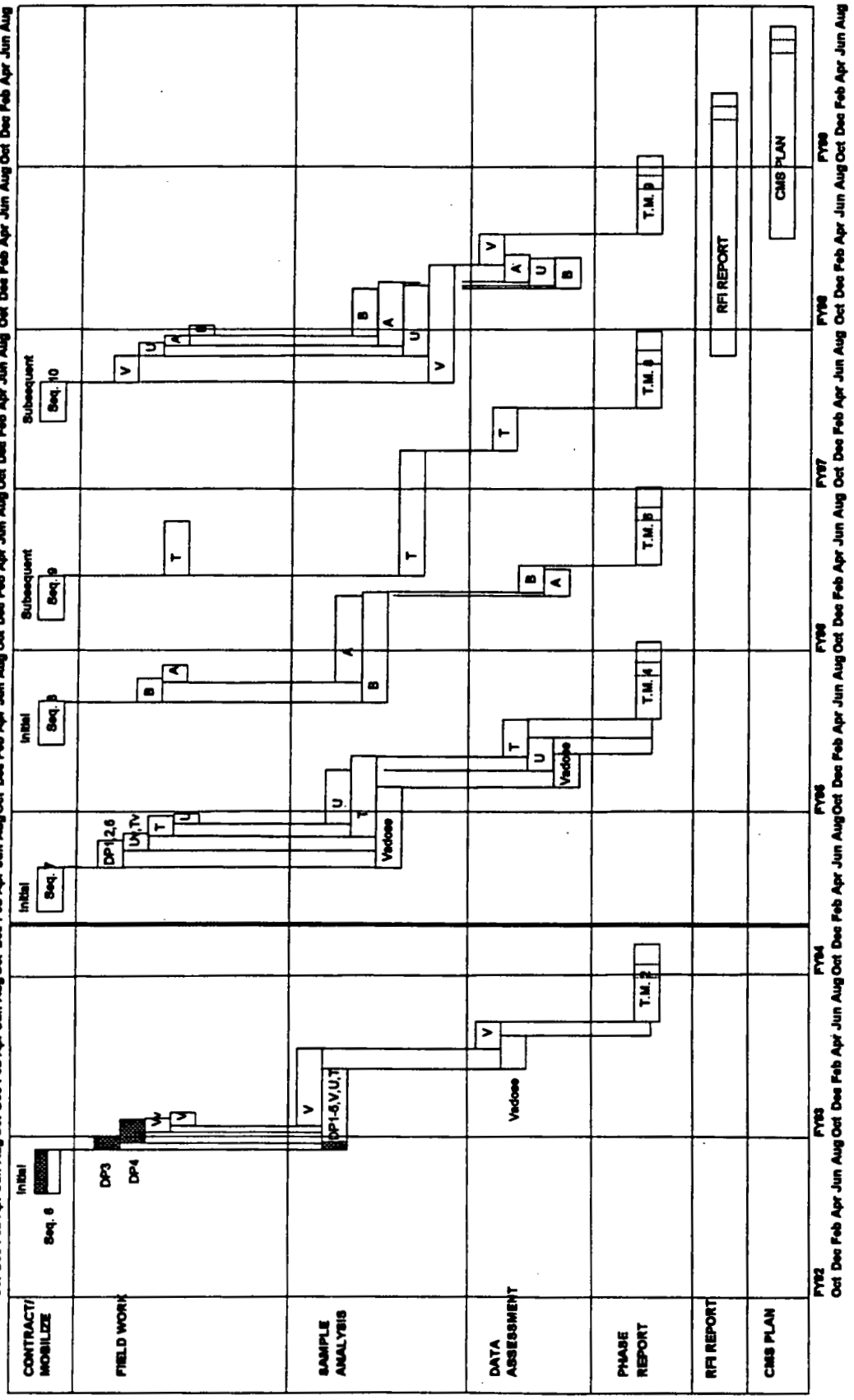

Figure 1.5 TA-21 OU RFI Progress: subsurface investigations (1/14/94). Numbers XX.Y denote RFI work plan sections. "T.M." denotes "tech memo", now referred to as "phase report".

CHAPTER TWO

SUMMARY OF OU-WIDE SURFACE SOIL INVESTIGATION

2.0 SUMMARY OF OU-WIDE SURFACE SOIL INVESTIGATION

2.1 Background

The OU-wide surface soil investigation is described in the RFI work plan in Section 12.4, Surface Grid Sampling Plan. The purpose of this investigation was to document the concentrations of target analytes in surface soils (0 to 6 in. sampling interval) across the OU. These results are used as a baseline for comparison with soil concentrations measured at discrete potential release sites within the OU. The 0 to 6 in. sampling interval is consistent with the typical RFI surface soil sampling interval at TA-21 SWMUs and other Laboratory OUs. These data are used to conclude with reasonable confidence whether any contaminants detected in SWMU-specific investigations represent localized SWMU releases rather than low-level airborne emissions deposition across the OU.

In the RFI work plan, the OU-wide surface soil constituent levels were referred to as "local contaminant levels," but this terminology has been found to be confusing. In this phase report, the OU-wide surface soil levels are referred to interchangeably as "baseline analyte concentrations" or "local background levels."

2.2 Summary of Investigation

A detailed review of the RFI sampling plan and the actual conduct of the field investigation is presented in Appendix A of this phase report. The investigation was conducted in two phases, March-May, 1992 and June-July, 1992. These sampling events are referred to as "Grid 1" and "Grid 2," respectively.

As illustrated by Map 1, 155 locations were sampled on a 40 by 40 meter grid across the OU. Concurrently, OU-wide depositional layer sampling (0 to 1 in.) was carried out on the same grid, as described in Chapter 3 and Appendix B.

The OU-wide surface soil investigation produced a total of 181 samples which were submitted to analytical laboratories, as summarized in Table 2.1. This number includes 18 spatial

variability samples (off-grid points) and 26 associated field QA samples. The laboratory sample analysis plan is summarized in Table 2.2.

2.3 Data Assessment Overview

Appendix A of this phase report provides a detailed discussion of several area categories into which specific radionuclide, inorganic, and organic constituents fall. Some radionuclide and all inorganic constituents are globally present due either to natural occurrence or atmospheric nuclear testing. Taken together, regional levels of these constituents are referred to in this phase report as "regional background." In addition, slightly elevated levels of certain constituents may be present across TA-21 due to releases either from within TA-21 or from adjacent OUs. Such OU-wide levels, together with natural variations within TA-21, are referred to as "local background." The OU-wide surface soil investigation has quantified analytes of interest so that concentrations in specific areas of TA-21 can be compared to local and regional background levels.

From assessment of the 0 to 6 in. surface soil data, the following key points can be made:

1. Semivolatile organic compounds are confirmed to be generally absent OU-wide. At only four of the 155 surface soil sampling locations were semivolatile organics detected, and the detects were limited in number and far below screening action levels. These four locations will be addressed separately in future phase reports in conjunction with investigations of specific SWMUs in their vicinity.

2. For almost all of TA-21 outside the main industrial area, analyte concentrations are similar to regional background for almost all analytes. This area of local background is identified as the "Non-Process Area" on Map 2 of this report. Table 2.3 and Figures 2.1 and 2.2 compare the concentrations of target analytes measured in the non-process area to regional background. The only two inorganic analyte means outside the regional background range are cadmium (means within one standard deviation) and

molybdenum (means within two standard deviations). Except for plutonium-239/240, which is well above the regional mean, all non-process area means for radiological constituents are within about one standard deviation of regional means. The OU-wide non-process area levels of all target constituents are far below action levels specified in the IWP.

3. For that portion of TA-21 centered on the industrial area (identified as "Process Area" on Map 2), americium-241, plutonium-238, and plutonium-239/240 mean concentrations are slightly higher than regional background, but well below action levels. Table 2.4 and Figures 2.1 and 2.2 compare the concentrations measured in the process area to both regional background and the non-process area levels.

4. An area in proximity to the Tritium Systems Test Assembly (TSTA) facility has tritium concentrations that are generally elevated relative to background, but far below action levels. This area is identified as area SI-2 on Map 2 and is referred to as the "TSTA Area." Table 2.5 compares the target analyte concentrations measured in the vicinity of TSTA to both regional background and the non-process area levels.

5. In the vicinity of MDA T and MDA A, americium-241, plutonium-238, and plutonium-239/240 are elevated compared to process area levels, but well below action levels. This area is identified as SI-1 on Map 2 and is referred to as the "MDA A/MDA T Area." Table 2.6 tabulates mean analyte concentrations for the MDA T/MDA A area and compares them to regional background and non-process area levels.

6. In assessing the OU-wide surface soil data, results for a few analytes at a few specific locations within the non-process area did not fit the overall distribution for this area. These special cases, referred to as "outliers," are attributable to specific SWMU releases and were removed from the data set intended to represent OU-wide background levels. These outliers are treated with SWMU-specific investigations and are discussed further in Appendix A and are summarized in Table 2.7.

2.4 Conclusions and Recommendations

OU-wide grid surface soil sampling over a 0 to 6 in. sampling interval indicated analyte levels consistent with regional background, except for slightly elevated plutonium-239/240 levels, which are well below the action level. The investigation identified four areas within TA-21 for which local background analyte levels were derived. These four data sets are used to evaluate analyte concentrations at specific release sites within the four areas. The four areas are identified as the non-process area, comprising most of TA-21 outside the industrial area; the process area, comprising the industrialized portion of TA-21; the TSTA area in the immediate vicinity of the TSTA facility; and the MDA A//MDA T area encompassing MDAs A and T and their immediate drainages.

Table 2.1. Summary of 0-6 in. Surface Soil Grid and Field QA Samples Submitted to Analytical Laborator

Invest.	No. of Loc.	Soil Samples			Field QA Samples		
		Grid Pts.	Bldg. Area	Off grid Pts.*	Dups	Rinsate Bl.	Field Bl.
Grid 1	85	76	***	9	6	5	5
Grid 2	70	51	10	9	4	3	3
Total	155	127	10	18	10	8	8

Grand Total of Samples 181

* Spatial variability samples

Table 2.2. Sample Analysis Plan for 0 to 6 in. Surface Soil Grid Samples

Radionuclide	% of Samples Analysed	Analytical Method
americium-241	50	alpha spectroscopy
gamma emitters	100	gamma spectrometry
plutonium-238, 239/240	100	alpha spectroscopy
strontium-90	100	gas proportional counting
thorium-228, 230, 232	25	alpha spectroscopy
tritum	100	liquid scintillation counting
uranium (total)	100	delayed neutron activation
uranium-234, 235, 238	25	alpha spectroscopy
Inorganics	100	SW 846-6010
Semivolatile organics	100	SW 846-8270

Table 2.3 Non-Process Area Analyte Concentrations vs Regional Background Surface Soil Investigation

Inorganics	Non-Process Area Mean (µg/g)	Non-Process Area Std. Dev. (µg/g)	Regional Background Mean (µg/g)	Regional Background Range (µg/g)	Screening Action Level (µg/g)
Arsenic	2.1	1.3	5	1.4-9.8	0.4
Barium	225	155	510	230-750	5,500
Beryllium	1.9	1.2	2.3	1.0-3.8	0.16
Cadmium	0.75	0.38	0.17	0.03-0.52	80
Cobalt	4	1.7	8	1.7-22.5	
Chromium	9.6	5.8	38.3	10.9-61.9	400
Copper	7.3	6.1	10	2.0-18	3,000
Molybdenum	4	1.7	0.59	N/A	
Nickel	6.2	6	8.9	1.6-19	1,600
* Lead	21	13	27	<14-44	500
Selenium	0.16	0.1	0.26	N/A	400
Strontium	88	72	120	N/A	
Uranium	4.7	1.3	3.4	2.2-4.9	240
Vanadium	20	12	52	19-97	560
Zinc	43	19	34	<7-76	24,000
Silver	1.7	0.1	N/A	N/A	400

Radionuclides	Non-Process Area Mean	Non-Process Area Std. Dev.	Background Mean	Background Std Dev.	Screening Action Level (pCi/g)
* Americium-241	0.029	0.022	N/A	N/A	22
* Plutonium-238	0.007	0.006	0.001	0.002	27
* Plutonium-239/240	0.56	0.66	0.007	0.009	24
Strontium-90	0.22	0.27	0.34	0.27	8.9
* Tritium	1.81	1.53	2.6	2.3	1.5 x 10 7
Thorium-228	1.5	0.2	N/A	N/A	
Thorium-230	1.4	0.2	N/A	N/A	10
Thorium-232	1.5	0.2	1	0.4	
* Uranium (Total)	4.7	1.3	2.4	0.5	66.3
Uranium-234	1.5	0.2	N/A	N/A	86
Uranium-235	0.08	0.03	N/A	N/A	18.9
Uranium-238	1.5	0.2	1.1	0.5	59

*Indicates TA-21 Analytes of potential concern based on historical information outlined in the RFI Workplan.
Radionuclide units are (pCi/g) except for tritium (mCi/L) and total uranium (µg/g).
Regional background levels are taken from Longmire et al., 1993 and Purtymun et al., 1987.

Table 2.4 Process Area Analyte Concentrations vs Regional Background Surface Soil Investigation

Inorganics	Process Area Mean (µg/g)	Process Area Std Dev. (µg/g)	Non-Process Area Mean (µg/g)	Non-Process Area Std. Dev. (µg/g)	Regional Background Mean (µg/g)	Regional Background Range (µg/g)
Arsenic	2	0.72	1.93	0.87	5	1.4-9.8
Beryllium	1.99	1.03	1.73	1.25	2.3	1.0-3.8
Cadmium	0.96	0.59	0.69	0.24	0.17	0.03-0.52
Chromium	8.73	4.65	8.73	6.11	38.3	10.9-61.9
Lead	25.9	15.3	18.9	11.1	27	<14-44
Nickel	7.1	3.26	5.87	2.99	8.9	1.6-19
Molybdenum	4	1.7	4	1.7	0.59	N/A
Selenium	0.15	0.059	0.15	0.11	0.26	N/A
Zinc	70.8	69.8	39	15	34	<7-76

Radionuclides	Process Area Mean	Process Area Std Dev	Non-Process Area Mean	Non-Process Area Std. Dev.	Background Mean	Background Std. Dev.
Americium-241	0.15	0.188	0.031	0.049	N/A	N/A
Plutonium-238	0.53	2.84	0.019	0.11	0.001	0.002
Plutonium-239/240	2.33	3.54	0.58	0.73	0.007	0.009
Uranium (Total)	4.67	1.42	4.66	1.38	2.4	0.5
Strontium-90	0.21	0.239	0.23	0.25	0.34	0.27
Tritium	2.87	2.49	1.63	1.48	2.6	2.3

Radionuclide units are pCi/g except for tritium (mCi/L) and total uranium (µg/g).
N/A indicates data not available.
Regional background levels are taken from Longmire et al., 1993, Purtymun et al., 1987, and Schaldette et al., 1984.

Table 2.5 TSTA Area Analyte Concentrations vs Regional background, Surface Soil Investigation

Inorganics	TSTA Area Mean (µg/g)	TSTA Std. Dev (µg/g)	Non-Process Area Mean (µg/g)	Non-Process Area Std. Dev. (µg/g)	Regional Background Mean (µg/g)	Regional Background Range (µg/g)
Arsenic	2.1	1.3	2.1	1.3	5	1.4-9.8
Beryllium	1.9	1.2	1.9	1.2	2.3	1.0-3.8
Cadmium	0.75	0.38	0.75	0.38	0.17	0.03-0.52
Chromium	9.6	5.8	9.6	5.8	38.3	10.9-61.9
Lead	21	13	21	13	27	<14-44
Nickel	6.2	6	6.2	6	8.9	1.6-19
Molybdenum	4	1.7	4	1.7	0.59	N/A
Selenium	0.16	0.1	0.16	0.1	0.26	N/A
Zinc	43	19	43	19	34	<7-76

Radionuclides	TSTA Area Mean	TSTA Area Std Dev.	Non-Process Area Mean	Non-Process Area Std. Dev.	Background Mean	Background Std. Dev.
Americium-241	0.029	0.022	0.029	0.022	N/A	N/A
Plutonium-238	0.007	0.006	0.007	0.006	0.001	0.002
Plutonium-239/240	0.56	0.66	0.56	0.66	0.007	0.009
Uranium (Total)	4.7	1.3	4.7	1.3	2.4	0.5
Strontium-90	0.22	0.27	0.22	0.27	0.34	0.27
Tritium	4.63	3.19	1.81	1.53	2.6	2.3

Radionuclide units are pCi/g except for tritium (mCi/L) and total uranium (µg/g).
N/A indicates data not available.
Regional background levels are taken from Longmire et al., 1993, Purtymun et al., 1987, and Schaklette et al., 1984.

Table 2.6 MDA T/MDA A Area Analyte Concentrations vs Regional Background, Surface Soil Investigation

Inorganics	MDA T/ MDA A Area Mean (µg/g)	MDA T/MDA A Area Std. Dev. (µg/g)	Non-Process Area Mean (µg/g)	Non-Process Area Std. Dev. (µg/g)	Background Mean (µg/g)	Background Range (µg/g)
Arsenic	2.1	1.3	2.1	1.3	5	1.4-9.8
Beryllium	1.9	1.2	1.9	1.2	2.3	1.0-3.8
Cadmium	0.75	0.38	0.75	0.38	0.17	0.03-0.52
Chromium	9.6	5.8	9.6	5.8	38.3	10.9-61.9
Lead	21	13	21	13	27	<14-44
Molybdenum	4	1.7	4	1.7	* 0.59	N/A
Nickel	6.2	6	6.2	6	8.9	1.6-19
Selenium	0.16	0.1	0.16	0.1	* 0.26	N/A
Zinc	43	19	43	19	34	<7-76

Radionuclides	MDA T/MDA A Area Mean	MDA T/MDA A Area Std. Dev.	Non-Process Area Mean	Non-Process Area Std. Dev.	Regional Background Mean	Regional Background Std Dev.
Americium-241	0.2	0.24	0.029	0.022	N/A	N/A
Plutonium-238	0.044	0.056	0.007	0.006	0.001	0.002
Plutonium-239/240	3.3	4.6	0.56	0.66	0.007	0.009
Uranium (Total)	4.7	1.3	4.7	1.3	2.4	0.5
Strontium-90	0.22	0.27	0.22	0.27	0.34	0.27
Tritium	1.81	1.53	1.81	1.53	2.6	2.3

Radionuclide units are pCi/g except for tritium (mCi/L) and total uranium (µg/g).
N/A indicates data not available.
Regional background levels are taken from Longmire et al., 1993, Purtymun et al., 1987, and Schaldette et al., 1984.

Table 2.7 Outliers Removed from the OU Wide Surface Soil Investigation Data Set

Location ID	Analytes Removed	SWMU or Area
21-1079	Am-241, Pu-239/240, U Total, U-234, U-235, U-238, arsenic, chromium, lead	21-024(e)
21-1173	Am-241, cobalt	21-024(k)
21-1168	Am-241, U (total), chromium, lead	21-024(k)
21-1061	Am-241	21-013(d)
21-1125	Pu-238, zinc	21-022(h)
21-1176	U (total)	21-024(k)
21-1190	tritium	DP Canyon
21-1180	tritium	LA Canyon
21-1145	tritium	LA Canyon
21-1126	tritium	LA Canyon
21-1195	tritium	LA Canyon
21-1209	tritium	LA Canyon
21-1030	silver	MDA B
21-1055	arsenic	21-024(c)
21-1144	copper, lead	21-024(a) 21-012(d)
21-1054	cobalt	21-023(c)
21-1172	molybdenum	21-024(k)
21-1284	nickel	21-024(k)
21-1084	lead	21-002(b)
21-1077	lead	21-024(f)
21-1099	lead	21-002(b)

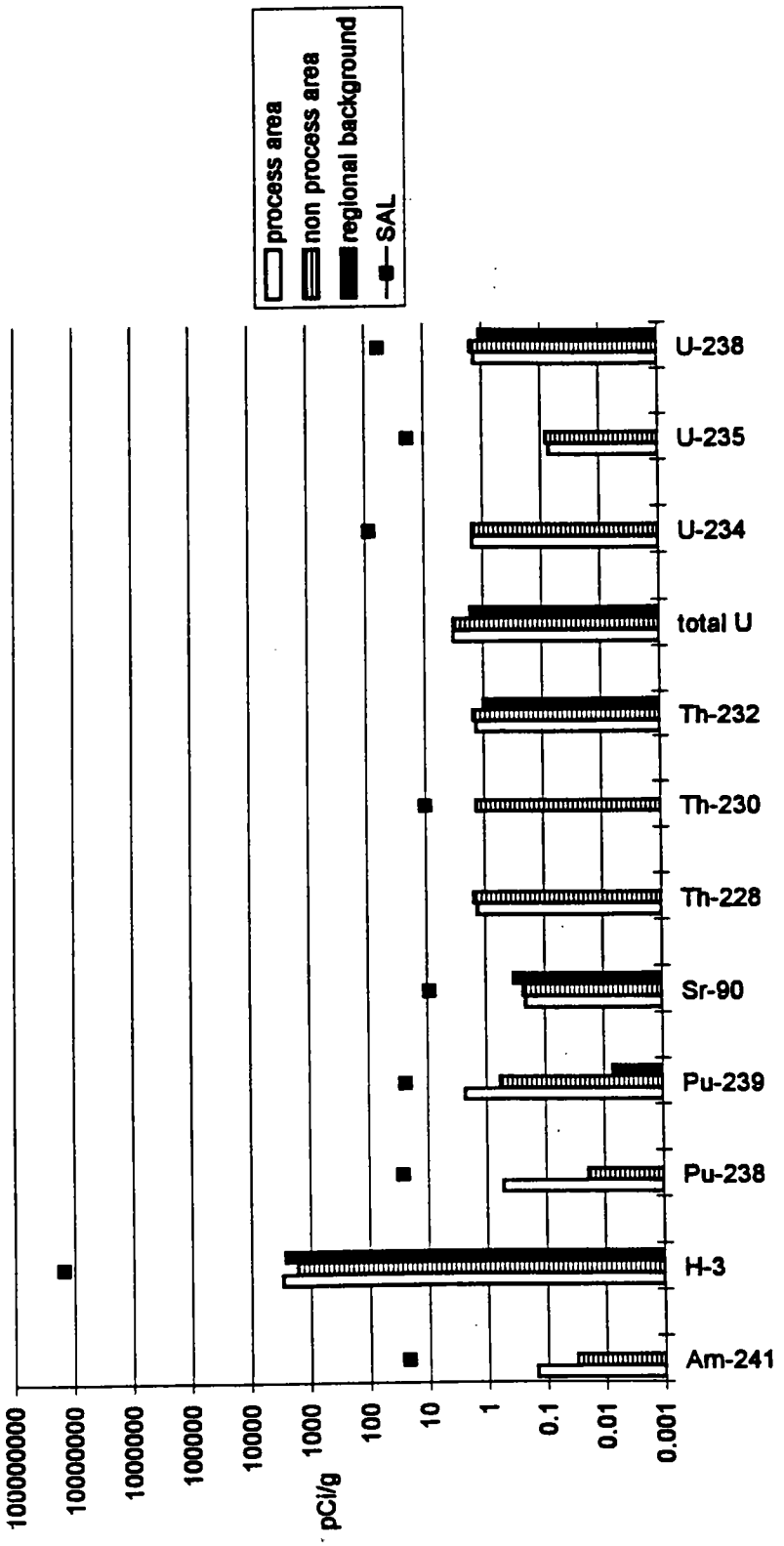

Figure 2.1. Comparison of mean radiological levels for process area, non process area, and regional background. Regional background levels are from Purtyman et al., 1987. SALs are from IWP Appendix J. Tritium units are in pCi/l.

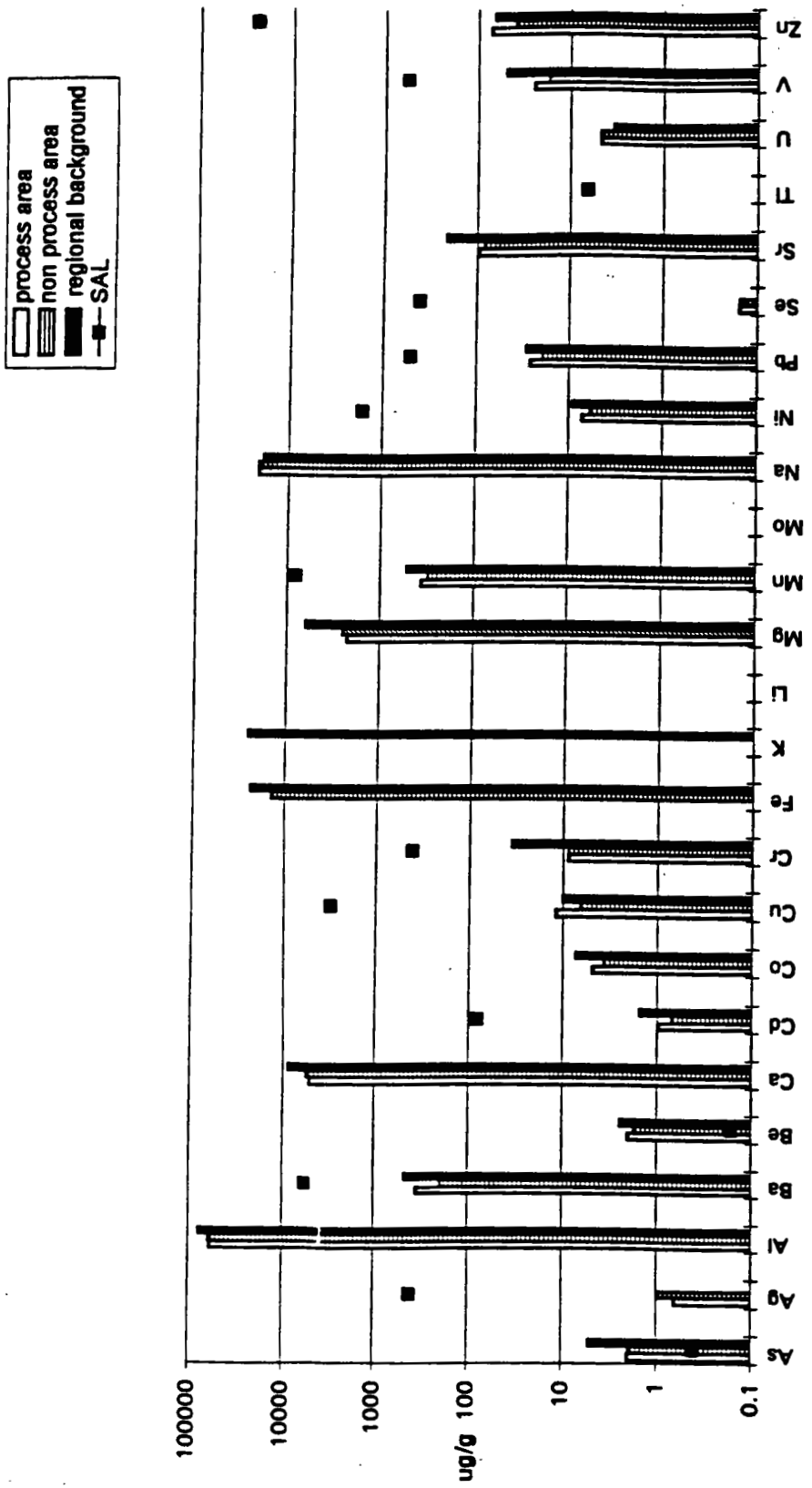

Figure 2.2 Comparison of mean inorganic levels for process area, non process area and regional background. Regional background levels for Cu and Ni are from Ferenbaugh et al., 1990. All other regional background levels are from Longmire et al., 1993.
SALs are from IWP, Appendix J.

CHAPTER THREE

SUMMARY OF OU-WIDE INVESTIGATION OF AIRBORNE EMMISSIONS DEPOSITION

3.0 SUMMARY OF OU-WIDE INVESTIGATION OF AIRBORNE EMISSIONS DEPOSITION

3.1 Background

The plan for investigating OU-wide airborne emissions deposition at TA-21 is described in the RFI work plan in Section 13.2, Airborne Emissions. The purpose of this investigation was to evaluate the presence or absence of contaminants in the surficial soil layer due to airborne contaminant emissions. The RFI work plan gives a description, site history, and summary of existing information about airborne contaminant releases and source terms for each of the 18 work plan SWMUs which may have contributed to these releases at TA-21 (see Figure 1.3 and Table 1.2 of this phase report).

The airborne emissions deposition sampling plan calls for "deposition-layer" sampling across the OU on a 40 m by 40 m grid. "Deposition-layer" is the term used in the RFI work plan to distinguish the 0 to 1 in. sampling interval from the 0 to 6 in. interval used for the "surface soil" investigation, as discussed in Chapter 2, the surface soil and deposition layer investigations shared a common grid and were conducted concurrently. The grid size was determined statistically to ensure high probability identification of airborne depositional areas of minimum size 3,000 m^2.

3.2 Summary of Investigation

A detailed review of the depositional layer sampling plan and the conduct of the field investigation is presented in Appendix B, Section B.1 of this phase report. The investigation was conducted in two phases, March-May 1992 (Grid 1) and June-July, 1992 (Grid 2), in conjunction with the OU-wide surface soil investigation described in Chapter 2. A total of 363 locations were sampled across the OU, as illustrated by Map 1. The investigation generated analytical samples which were submitted to analytical laboratories, as summarized in Tables 3.1 and 3.2.

3.3 Data Assessment Overview

Possible outcomes of this investigation included the following:

- One or more spatial depositional patterns would be identified. The pattern(s) would be attributable to a single SWMU or subset of SWMUs.
- One or more airborne depositional patterns would be clearly identifiable but not directly attributable to a specific set of SWMUs.
- No airborne depositional pattern would be clearly identifiable.

Data assessment consisted of several steps to identify depositional patterns:

- Depositional layer data were evaluated for each location and analyte to identify measurements outside the statistical distribution. Any such outliers then were assessed to determine if they were associated with a release other than from one of the 18 airborne release SWMUs.
- The 0 to 1 in. data were compared to the 0 to 6 in. surface soil data to identify areas of the OU where elevated deposition-layer concentrations exist.
- Data were evaluated for spatial patterns of analyte concentrations which would correspond to expected deposition trends based on prevailing local wind and drainage patterns.
- Analyte concentrations were compared to screening action levels to evaluate whether surficial soil analyte levels are of concern.

3.4 Conclusions and Recommendations

Assessment of the depositional layer data led to the following conclusions for the sampled grid area of TA-21:

1. Discernible airborne depositional patterns of surface soil contamination exist at TA-21, but these cannot be attributed to any specific set of SWMUs.
2. Deposition layer concentrations of americium-241, plutonium-239/240, and plutonium-238 are slightly elevated near the industrial area of TA-21. However, the levels are below applicable screening action levels. No hazardous organic constituents were detected and levels of inorganic constituents are within the range of regional background across the grid.

3. Interpretation of airborne depositional patterns near the industrial area is complicated by the presence of numerous discrete potential release sites and the probable dispersion of contaminants from these sources.

Figures 2.1 and 2.2 and Tables 2.3 to 2.6 compare regional means for target analytes with levels measured in the TA-21 RFI for the OU-wide surface soil investigation. Figures 3.1 and 3.2 provide an OU-wide comparison of the 0 to 6 in. OU-wide data with the OU-wide 0 to 1 in. deposition layer data for tritium and plutonium 239/240, two key contaminants at TA-21. In both cases, it can be seen that contamination generally is most concentrated in the surficial layer, suggesting strong retardation of transport downward through the soil profile.

Because elevated hazardous constituent levels were not found in the depositional samples and because radioactive contaminants generally were not detected above screening action levels and were not attributable to specific SWMUs, it is recommended that no further action is warranted for the 16 airborne emission SWMUs 21-007, 21-008, 21-019(a-m), and 21-021. SWMUs 21-020(a) and 21-020(b) are addressed further in Chapter 4 and Appendix C of this phase report.

Table 3.1 Summary of OU-Wide 0 to 1 in. Grid Surface Soil Samples Submitted to Analytical Laboratories

Investigation	Number of Locations	Soil Samples		Spatial Variation	*QA Samples		
		OU-Wide	Bldg. Area		Dups	Rinsate B	Field B
Grid 1		123		10	12	12	14
Grid 2		125	30	10	13	13	14
Total		248	30	20	25	25	28

* Dups = field duplicate. B = blank

Table 3.2 Sample Analysis Plan for 0 to 1 in. Grid Surface Soil Samples

	% of Total Samples	Analytical Method
americium-241	52	alpha spectroscopy
gamma emitter	100	gamma spectrometry
plutonium-238, 239/240	100	alpha spectroscopy
strontium-90	100	gas proportional counting
tritium	100	liquid scintillation counting
uranium (total)	100	delayed neutron activation
inorganics	100	SW 846-6010

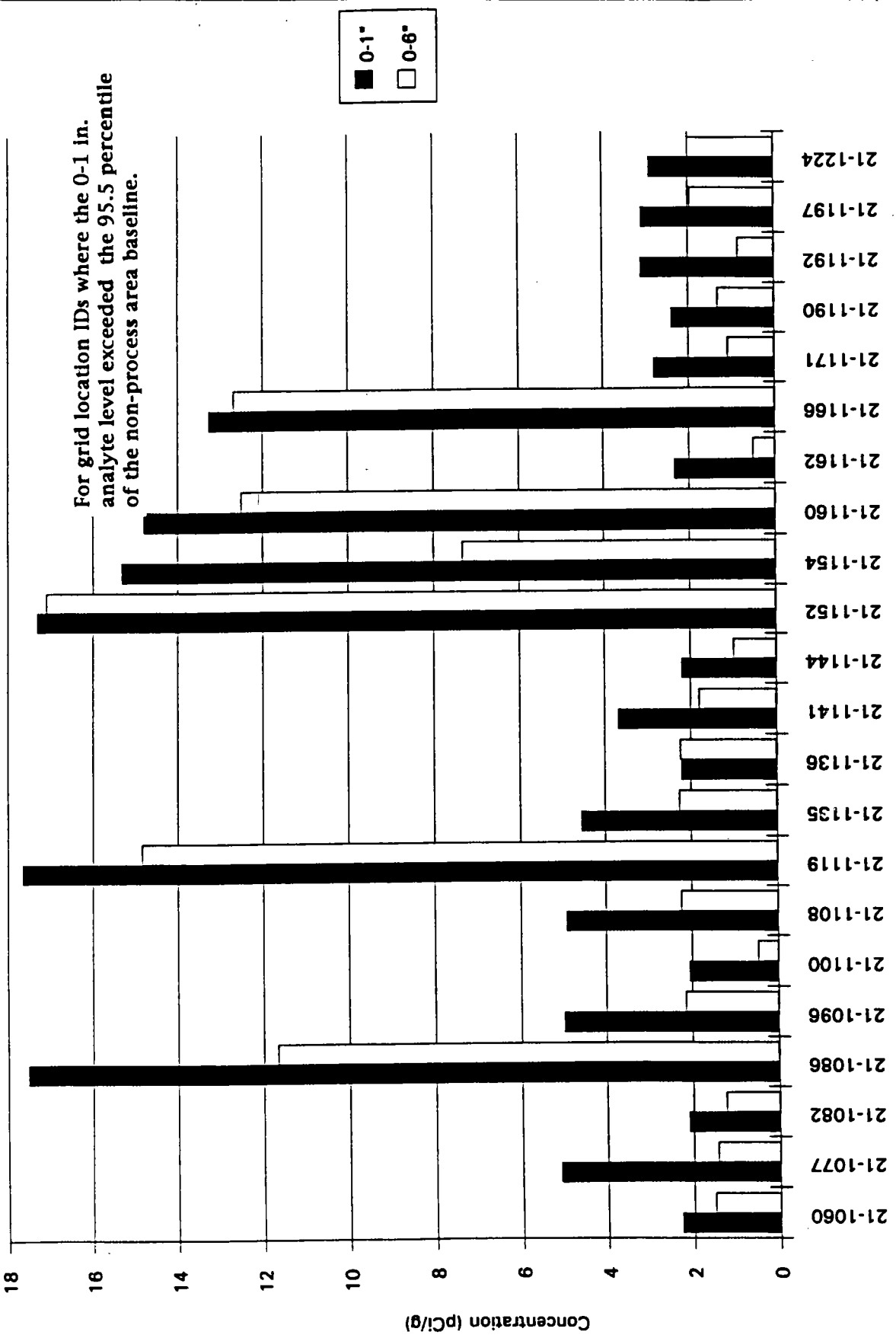

Figure 3.1 Comparison of Plutonium-239/240 levels in 0 to 1 in. deposition layer and 0 to 6 in. surface grid samples.

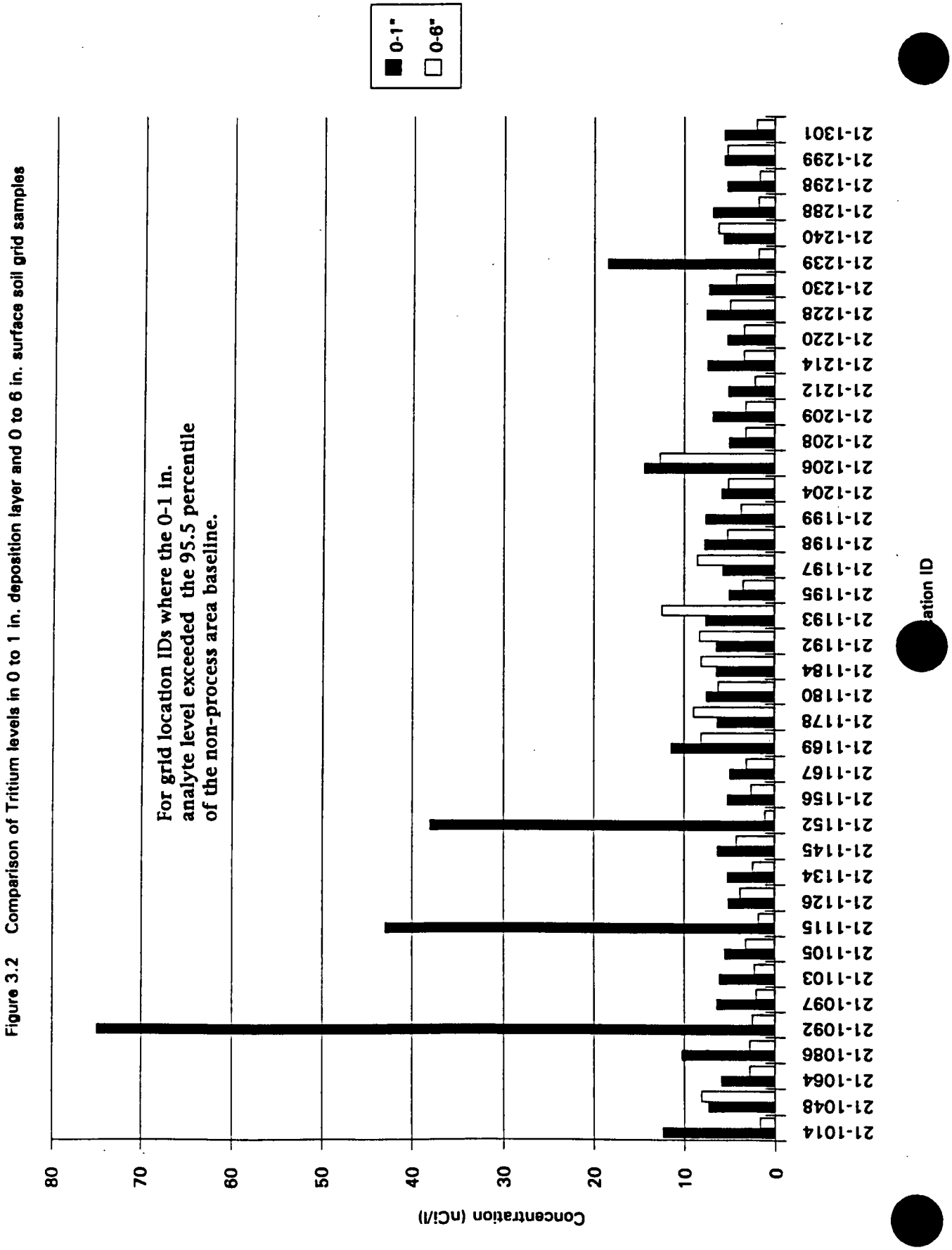

Figure 3.2 Comparison of Tritium levels in 0 to 1 in. deposition layer and 0 to 6 in. surface soil grid samples

CHAPTER 4

SUMMARY OF FILTER BUILDINGS INVESTIGATION

4.0 SUMMARY OF FILTER BUILDINGS INVESTIGATION

4.1 Background

The investigation reported in this chapter is described in the TA-21 OU RFI work plan in Chapter 13, *Surface Contamination from Airborne Emissions, Description and Sampling Plan*. This work plan chapter describes the two filter buildings which filtered particulates from glove box and laboratory room air from the radiological facilities at TA-21. Building TA-21-12 [work plan SWMU 21-020(a)] began operation in 1949 and was removed in 1973. Building TA-21-153 [work plan SWMU 21-020(b)] began operation in 1949 and was removed in 1978.

The filter buildings investigation addresses the sites (referred to in this phase report as "footprints") where the buildings were located. Records documenting the demolition of the buildings indicate that residual radioactive contamination (primarily plutonium-239/240) remains at low levels in the building footprints.

The primary objectives of this investigation were to confirm the presence or absence of residual contamination in the filter building footprints, identify specific contaminants of concern, and assess the depth of contaminant dispersal into the footprint soil.

4.2 Summary of Investigation

A detailed review of the sampling plan, revisions to it, and the conduct of the field investigation is presented in Appendix C of this phase report. Surface and near-surface soil sampling to a depth of 30 in. was conducted in July 1992. Hand-auger sampling to a 7 ft depth was conducted in October 1992.

A total of 36 locations was sampled. Seventy-eight soil samples were collected at 21 locations in or near the footprint of Building TA-21-12. Fifteen locations are in or near the footprint of Building TA-21-153, at which an additional 62 soil samples were collected. Figures 4.1 and 4.2 of this chapter identify the building footprints and sample locations.

The filter building samples were submitted to analytical laboratories, as summarized in Table 4.1. The sample analysis plan is summarized in Table 4.2.

4.3 Data Assessment Overview

The investigation employed field screening and field laboratory data to identify a subset of samples for submission to an analytical laboratory. The suite of analytes for the subset is listed in Table 4.2. The sample selection criteria included three components:

- Determine with reasonable confidence whether contaminants of concern are sufficiently identified for some of the samples with the highest field screening and field laboratory results.
- Assess concentrations at the deepest points sampled.
- Assess contaminant levels and distribution at intermediate depth using field screening and field laboratory results.

The data assessment process consisted of three major components:

- The data were checked to identify calculational errors, reporting mistakes, and related problems. One strontium-90 result was excluded based on this evaluation.
- Contaminants of concern were identified. Detected analytes were americium-241, plutonium-239/240, plutonium-238, and tritium, all at levels below screening action levels. No hazardous constituents were identified at levels of concern.
- Contaminant distributions over the sampled depth profiles were evaluated. Radionuclide contaminants did not show a clear pattern of change, but were detectable at low levels throughout the soil profile.

Appendix F contains figures illustrating the results of statistical assessment of the filter buildings data.

4.4 Conclusions and Recommendations

Tritium, americium, and plutonium contaminants are present at very low levels in the soil profile beneath the former filter building locations. Although americium and plutonium are known to have been associated with the filter building operations, these radionuclides generally exist at similar levels in the industrial area of TA-21 due to other releases. Based on the RFI data and process knowledge, It is unlikely that the filter building operations significantly impacted contaminant levels in the building footprints.

Also based on the RFI data and process knowledge, it is unlikely that the marginally elevated tritium levels are related to filter building operations. The tritium depth profile is consistent with soil contamination from atmospheric releases of tritium which are known to have occurred elsewhere at TA-21. The observed tritium depth profile may reflect the movement of a tritiated-water front into the soil profile, or the depletion of tritium from the upper portions of the soil profile by vapor phase exchange with the atmosphere.

Concentrations of all detected contaminants are below screening action levels and no RCRA hazardous constituents were detected in the filter buildings investigation.

Since hazardous constituents were not detected and detected radiological constituents were present well below action levels at SWMUs 21-020(a) and 21-020(b) associated with the two filter building footprints and not indicative, it is recommended that no further action is required for these two SWMUs.

Table 4.1 Filter Building and QA Samples Submitted for Analysis in Field Laboratory and Offsite Analytical Laboratories

SWMU	Number of Locations Near-Surface	Number of Locations Auger Hole	Samples for:	Near Surface Soil Samples	Hand-Auger Samples	*QA Samples
Building TA-21-12, SWMU 21-020(a)	16	5	Field Analyses	48	10	0
			Laboratory Analyses	15	5	17
Building TA-21-153, SWMU 21-020(b)	10	5	Field Analyses	40	8	0
			Laboratory Analyses	10	4	14
Total	26	10				

* Indicates field duplicate, field blanks, rinsate blanks, and trip blanks.

Table 4.2 Sample Analysis Plan for Filter Building Investigations

Field Laboratory Analyses Suite (All Samples)	Analytical Method
gamma emitter	gamma spectroscopy
gross gamma	NaI gamma counting
gross beta	gas proportional counting
gross alpha	gas proportional counting
tritium	liquid scintillation counting
volatile organics	gas chromatography
Analytical Laboratory Analysis Suite (30 % of Samples)	
gamma spectrometry	gamma spectrometry
tritium	liquid scintillation counting
americium-241	alpha spectroscopy
uranium (total)	delayed nueutron activation
plutonium-238, 239/240	alpha spectroscopy
strontium-90	gas proportional counting
volatile organics	SW 846-8240
semivolatile organics	SW 846-8770
inorganics	SW 846-6010

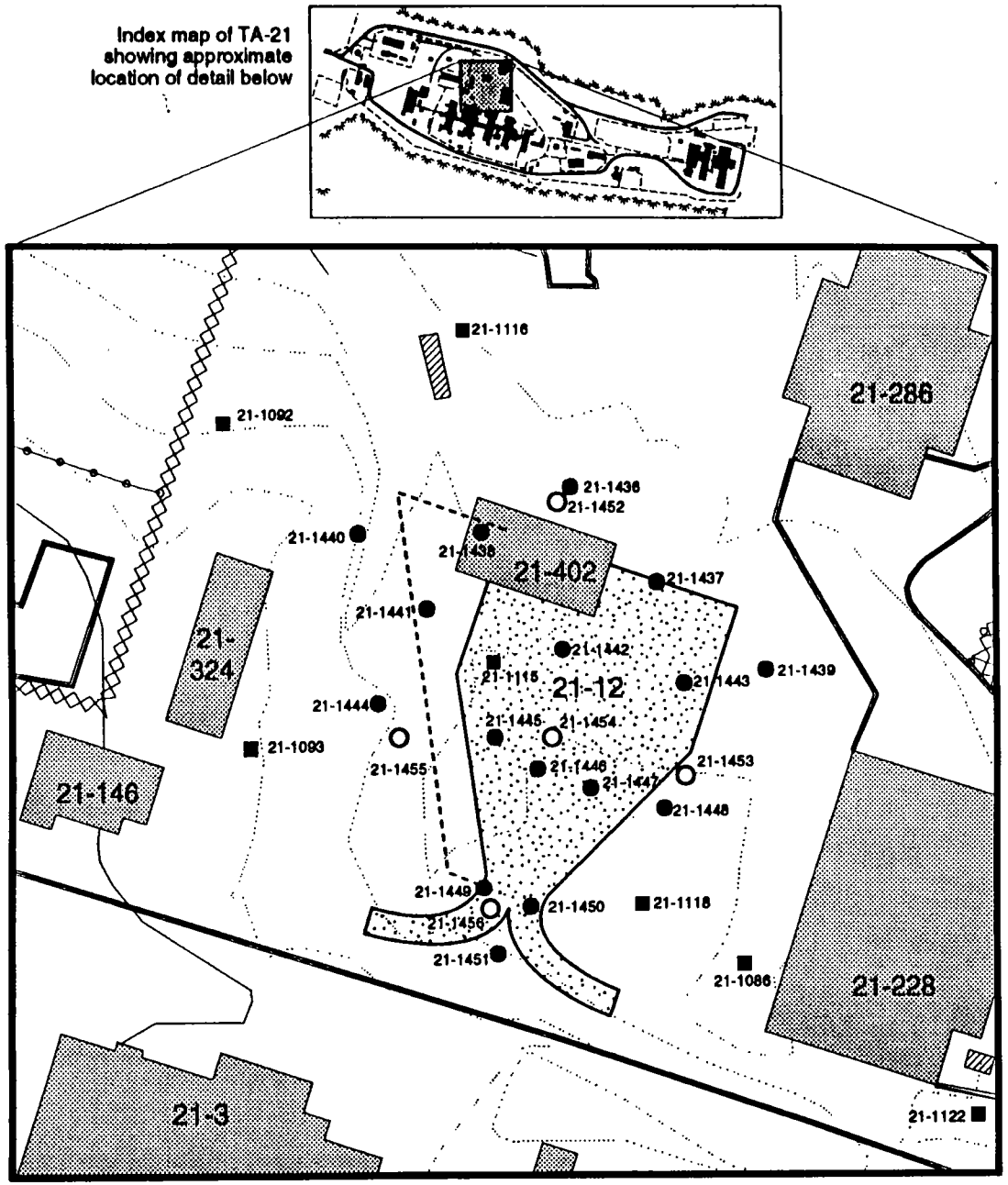

Figure 4.1 Sampling locations for filter building TA-21-12, SWMU 21-020(a).

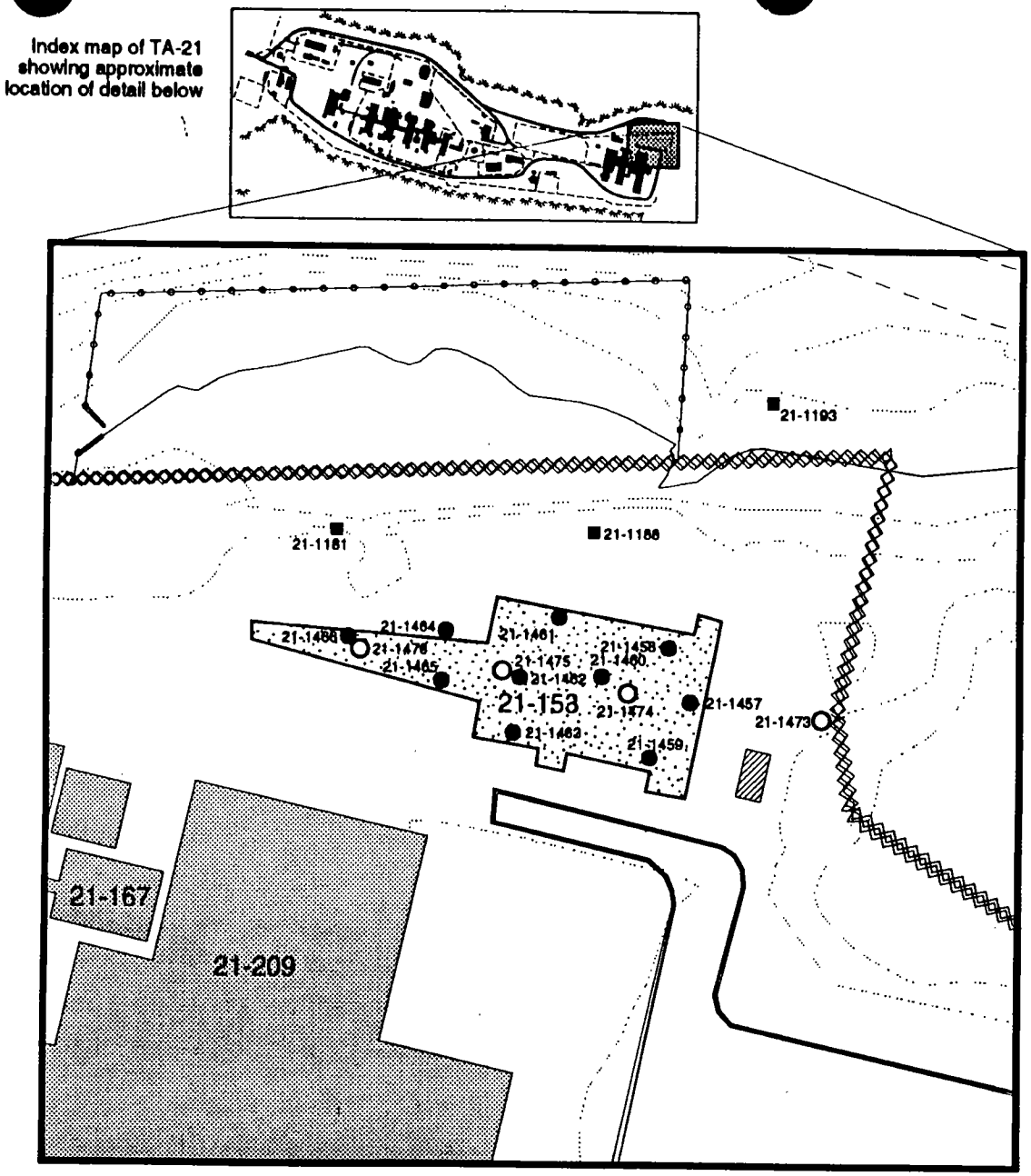

Figure 4.2 Sampling locations for filter building TA-21-153, SWMU 21-020(b).

CHAPTER REFERENCES/APPENDICES REFERENCES

Cressie, 1991. Cressie, Noel A. C. Statistics for Spatial Data,"A Wiley-Interscience publication." QA278.2C75, 1991.

DOE 1993a. Letter from Joseph C. Vozella, Environmental Restoration Program, Environment, Safety, and Health Branch, U. S. Department of Energy, Los Alamos Area Office, to Guanita Reiter, RCRA Permits Branch, U. S. Environmental Protection Agency, Dallas, Texas. May 14, 1993.

DOE 1993b. Letter from Theodore J. Taylor, Environmental Restoration Program, Environment, Safety, and Health Branch, to Barbara Driscoll, RCRA Permits Branch, U. S. Environmental Protection Agency, Dallas, TX 75202-2733. January 6, 1994.

EPA 1989. Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual (Part A)," U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, EPA540/1-89/002. 1989.

EPA 1990. (U. S. Environmental Protection Agency). Module VIII of RCRA Permit No. NM-890010515, EPA Region VI, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, EPA Region VI, Hazardous Waste Management Division, Dallas, Texas. April 10, 1990.

EPA 1992. Letter from Allyn M. Davis, Director, Hazardous Waste Management Division, Region 6, U. S. Environmental Protection Agency, Dallas, TX to Mr. Jerry Bellows, Area Manager, Los Alamos Area Office, U. S. Department of Energy, Los Alamos, New Mexico. January 9, 1992.

Ferenbaugh et al., 1990. Ferenbaugh, R.W., Gladney, E.S., Brooks, G.H., Sigma Mesa: Background Elemental Concentrations in Soil and Vegetation, Los Alamos National Laboratory Report No. LA-UR-11941-MS, Los Alamos, New Mexico. 1990.

Gilbert 1987. Gilbert, R.O., Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold Company, New York. 1987.

LANL 1991a. TA-21 Operable Unit RFI Work Plan for Environmental Restoration, LA-UR-91-962, Los Alamos National Laboratory, Los Alamos, New Mexico. May 1991.

LANL 1991b. Addendum to TA-21 Operable Unit RFI Work Plan for Environmental Restoration, Los Alamos National Laboratory, Los Alamos New Mexico. December 1991.

LANL 1992a. Quarterly Technical Progress Report, TA-21 Operable Unit, RCRA Facility Investigations, Second Quarter FY92. Environmental Restoration Group, Los Alamos National Laboratory, Los Alamos, New Mexico. May 15, 1992.

LANL 1992b. Quarterly Technical Progress Report, TA-21 Operable Unit, RCRA Facility Investigation, Third Quarter FY92. Environmental Restoration Group, Los Alamos National Laboratory, Los Alamos, New Mexico. August 15, 1992.

LANL 1992c. Quarterly Technical Progress Report, TA-21 Operable Unit, RCRA Facility Investigation, Fourth Quarter FY92. Environmental Restoration Group, Los Alamos National Laboratory, Los Alamos, New Mexico. November 2, 1992.

LANL 1992d. (Los Alamos National Laboratory). "Installation Work Plan for Environmental Restoration," Revision 2, Los Alamos National Laboratory Report LA-UR-92-3795, Los Alamos, New Mexico. November 1992.

LANL 1992e. "Environmental Restoration Standard Operating Procedures," Vols. I and II, Los Alamos, New Mexico. March 16, 1992.

LANL 1993a. Phase Report 1A, TA-21 Operable Unit, RCRA Facility Investigation, LA-UR-93-2028 , Los Alamos National Laboratory, Los Alamos, New Mexico. June 14, 1993.

LANL 1993b. Quarterly Technical Progress Report, TA-21 Operable Unit, RCRA Facility Investigation, First Quarter FY93. Environmental Restoration Group, Los Alamos National Laboratory, Los ALamos, New Mexico. February 15, 1993.

LANL 1993c. Installation Work Plan for Environmental Restoration - Volume II, LA-UR-93-3987, Los Alamos National Laboratory, Los Alamos, New Mexico. 1993

Lehmann and D'Abrera, 1975. Lehmann, E. L. and H. J. M. D'Abrera 1975. Nonparametrics, Statistical Methods Based on Ranks, University of California. Berkeley. Library of Congress Catalog Card Number: 73-94384. 1975.

Longmire, et al., 1993. P. Longmire, C. Duffy, and S. Reneau. Preliminary Background Elemental Concentrations in Bandelier Tuff and Selected Soil Series, 1993. Appendix D of the 1993 IWP.

Myririck et al., 1981. Myrick, T.E., Berven, B.A., Haywood, F.F., State Background Radiation Levels: Results of Measurements Taken During 1975-1979, Oak Ridge National Laboratory Report, ORNL/TM-7343, Oak Ridge, Tennessee. 1981.

Purtymun et al., 1987. Purtymun, W.D., Maes, M, Survey of Sediments in Major Stream Channels for Toxic and Hazardous Waste in Environmental Surveillance at Los Alamos During 1986, Los Alamos National Laboratory Report LA-UR-10992-ENV, Los Alamos, New Mexico. 1987.

Schaklette and Boerngen, 1984. Schaklette, H.T. and Boerngen, J.G., Element Concentrations in Soils and Other Surficial Materials of the Coterminous United States, U.S. Geological Survey Professional Paper 1270, Alexander Virginia. 1984.

APPENDIX A

OU-WIDE SURFACE SOIL INVESTIGATION

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OU-WIDE SURFACE SOIL INVESTIGATION

A.1 Description of Investigation

The OU-wide surface soil investigation is described in the TA-21 RFI work plan in Section 12.4, Surface Grid Sampling Plan. The purpose of this investigation was to document background concentrations of target analytes in surface soils in all areas of the OU. For this purpose, surface soils were sampled over a depth interval of 0 to 6 in., consistent with the soil surface sampling interval used at most TA-21 SWMUs and other Laboratory OUs.

In the RFI work plan, OU-wide surface soil levels were referred to as "local contaminant levels," but this terminology has been found to be confusing. In this phase report, these levels are described as non-process area "baseline analyte concentrations" or "local background levels."

The surface soil investigation serves several purposes:

- It provides data on target analytes to establish a baseline for comparison to published regional background data. This baseline is used to determine whether individual measurements resemble regional background or differ due to localized releases.
- It provides a basis for comparison for observations relevant to potential release sites, including OU-wide 0 to 1 in. surface soil data to investigate airborne emission deposition and 0 to 6 in. and deeper samples collected at filter buildings and other SWMUs.
- It provides preliminary OU-wide information for baseline risk assessment which could be required in the future.

A.1.1 Revision of Sampling Plan

As described in the RFI work plan, it was intended that the OU-wide surface soil sampling would utilize a 40-m by 40-m grid. As described in a quarterly technical progress report, a revision to that plan was necessary, because an error was found in the scale of the drawing used for laying out the proposed grid (LANL 1992a). Specifically, the official TA-21 site drawing had a factor of two error in scale, indicating 500 ft where the actual distance is 1000 ft. This error was propagated through much of the RFI work plan and affects all work plan drawings similar to Figure 1.1-1 of the work plan. The error was

discovered when grid maps were generated from the FIMAD graphical information system. Use of the original sampling plan on a 40-m by 40-m grid over the OU at the correct scale would have resulted in approximately four times as many sampling locations as were originally planned (770 rather than about 230).

As described in the RFI work plan, the surface soil investigation shared the same grid as the OU-wide deposition-layer soil investigation. Because the budget and schedule for the OU-wide surface soil sampling plan was based on approximately 230 sampling points for each of the two investigations, a program requiring four times as many points could not be conducted.

Because the goals of the two investigations are different, sampling to determine surface soil concentrations is not necessarily tied precisely to the deposition layer sampling to accomplish the objectives of both investigations.

Accordingly, a revised sampling strategy was devised which allowed both objectives to be achieved while maintaining the same total number of samples for the two original sampling plans. In the revision, the number of 0 to 6 in. surface soil samples was reduced while the number of 0 to 1 in. deposition layer samples was increased. The new strategy has the following attributes:

- Inaccessible terrain on the walls of DP Canyon and Los Alamos Canyon is taken into account, deleting grid points where sampling is not feasible.
- Sampling was deleted at grid points near potential release sites that will be addressed in SWMU-specific sampling plans, eliminating duplication and bias due to potential contaminant releases.
- The 40-m by 40-m grid for deposition-layer sampling was maintained, retaining the focus on identifying all depositional areas of area 3000m^2 or greater.
- The original number of deposition-layer sampling points in building areas was retained (30 locations).

- The total number of local background surface soil samples was focused more acutely on specific areas of greatest need, which allowed a reduction in the number of samples both OU-wide and near buildings. The 40 by 40 meter grid was still utilized to define the sampling locations, but not all grid points had to be sampled to establish local background.
- The number of samples originally planned for estimating spatial variability was maintained (20 deposition-layer samples and 20 local background surface soil samples).
- As in the original plan, the revised sampling covers the top of DP Mesa from west of MDA B to east of the sewage treatment plant. The grid extends southwards to the channel of Los Alamos Canyon and northwards to the channel of DP Canyon.

The new strategy was completely consistent with the original investigation goals of both the deposition layer and surface soil investigations, while conforming to the number of samples originally used to develop the RFI budget and schedule, as presented in the work plan addendum.

Table A.1 shows the number of samples used in the revised sampling strategy for the surface soil and depositional layer investigations. The sampling locations resulting from the implementation of the revised sampling plan are illustrated by Map 1 in this phase report.

A.1.2 Field and Laboratory Procedures

RFI surface soil grid sampling at TA-21 was conducted in two rounds of field work, herein referred to as Grid 1 and Grid 2. Grid 1 field work was conducted from March through May, 1992 and included mesa-top areas near but outside the fenced industrial area. Grid 1 surface soil sampling locations are indicated by green dots on Map 1. Grid 2 sampling was conducted in June and July, 1992 and included the fenced industrial area, mesa-top grid points at the west and east ends of the grid, and locations in DP and Los Alamos Canyons. Grid 2 surface soil sampling locations are indicated by black dots on Map 1.

Prior to sampling, grid points were marked in the field by land surveyors. The sampling team then assessed the suitability of each sampling location. If soil was available within 3 ft of the survey marker, the sample was collected and the distance from the marker was noted in the field notes, but the sample

site was not resurveyed. Thus, the precision of the land survey (+/- 0.5 ft) exceeds the accuracy in the reported sampling location in some cases. If no suitable soil was available within 3 ft of the survey marker, the nearest suitable location was identified and marked. The distance and direction from the survey marker were recorded and the actual sampling point was resurveyed. Sampling points were moved most commonly because survey markers fell on exposed bedrock, but also because they coincided with trees or inaccessible locations (among boulders or on a cliff).

When a grid location was used for both surface soil and deposition layer sampling, the two sample types were taken separately from excavations placed as close to each other as possible (typically within a few inches). If necessary, the sampling site was prepared by removing pine needle or leaf debris, with due notation in the field records. Samples then were collected with stainless steel scoops and placed in a stainless steel mixing bowl. Holes for 0 to 6 in. samples were dug with vertical sides to avoid biasing the sample with depth and the hole depths were measured. Each soil sample was thoroughly mixed in the bowl and rocks and large pieces of organic matter (pine cones, root balls, etc.) were removed. The soil samples were described in the field notes and placed into sample containers appropriate for the required analyses. Sample containers were labeled and sealed and each sampling location was photographed for future reference.

Field sampling and field measurements, quality assurance sample preparation and equipment decontamination were conducted as required by the Quality Assurance Project Plan (Appendix A) of the RFI work plan and in accordance with appropriate Laboratory ER program Standard Operating Procedures (LANL 1992e). Copies of all field records, notes, and procedures are archived in the Records Processing Facility of the Laboratory's ER program.

For this investigation, the original sampling plan estimated that 230 locations were to be sampled to generate 230 soil samples. In addition, 37 field QA samples would be generated (13 duplicate soil samples, 12 rinsate blanks, and 12 field blanks). When the revised plan was executed, the sampling exercise generated 155 soil samples and 26 field QA samples (10 duplicate soil samples, 8 rinsate blanks, and 8 field blanks) were generated.

The sample analysis plan originally specified in the RFI work plan was followed, except for the addition of Am-241 analysis on approximately half of the samples. All samples were field-screened with hand-

held instruments at the time of collection, assessed for gross alpha, beta, and gamma contamination in a field laboratory, and submitted to a laboratory for radionuclide, semivolatile, and inorganic analyses. The analytical laboratory sample analysis plan is summarized in Table A.2. Table A.3 summarizes samples submitted for laboratory analysis.

As part of the field activities, all sampling locations and samples were surveyed with several field radiation instruments. The data from these field measurements were tabulated and presented in the Quarterly Technical Progress Report for the third quarter of FY92 (LANL 1992b). Complete tabulations of laboratory data will be available on the FIMAD database.

A.2 Data Assessment Rationale

Some target radionuclides and all target inorganic constituents occur naturally in TA-21 soils, as listed in Table A.4. Some man-made radioisotopes have been dispersed globally in soils, water and biota as a result of atmospheric nuclear testing. For the latter, observations above detection limits are not necessarily indicative of a release attributable to operations at TA-21 or elsewhere at the Laboratory. By contrast, semivolatile organics are assumed to have zero background and any observation above detection limits indicates either a release or inadvertent contamination of the sample.

It was anticipated that statistically significant spatial variability might be observed for some constituents across the OU as a result of area releases such as stack emissions. When significant spatial variation was noted for target analytes during data assessment, backgrounds specific to localized areas of the OU were established. An additional factor complicating the data assessment was the fact that analyses for some inorganic constituents were performed by different analytical procedures, as discussed in Appendix D.

The following considerations were used to guide assessment of the 0 to 6 in. surface soil grid data:

- For constituents exhibiting large spatial variability within the OU, local background distributions were developed for comparison with data from SWMUs located in the respective areas (see Map 2).

- An observation is identified as an outlier if the measured concentration lies substantially outside the local background distribution for the sampled area. Outliers are the subject of further assessment, but they are excluded for the purpose of developing local background distributions.
- Spatial trends may result from natural geologic features or processes, or be due to patterns of wide-spread contaminant dispersal (i.e., airborne emissions deposition).
- Variations in analytical procedures which affect data comparability (0.9, sample dissolution procedure) had to be considered.

Where elevated levels of hazardous or radioactive constituents are observed, a preliminary assessment of the associated risk will be carried out following the screening assessment procedure described in the IWP. Specifically, observations that exceed baseline concentrations will be compared with non site-specific screening action levels (SALs) listed in the IWP and in tables of this appendix. These SALS have been computed following the methods proposed in Subpart S of RCRA for nonradioactive constituents, or using comparable intake assumptions and a dose-based criterion in the case of radioactive constituents. The following screening assessment criterion is used:

> It is assumed that there is risk potential if the measured concentration of a constituent exceeds the soil screening action level for that constituent. In this case, the risk potential may be evaluated further by means of baseline risk assessment.

When site data are compared to SALs, the presence of multiple contaminants must be considered. In general, the contaminant to SAL ratios are summed for all contaminants. If the sum of the ratios is less than one, target doses and risks are assumed not to be exceeded. Table contains a tabulation of applicable SALs.

To initiate data assessment, three subareas at TA-21 were assumed:

1. Non-Process Area: This term refers to a perimeter area extending from the vicinity of the fenced industrial area to the OU boundary. This category may have "local background levels" which are similar to regional background, or slightly in excess of regional background for some analytes, but clearly different from levels for the other two categories discussed below.

2. Process Area: This term refers to the industrial area of TA-21, which is expected to have elevated local background levels for some analytes due to releases associated with past operations.
3. Special Impact Areas: This term refers to localized areas of TA-21 where elevated concentrations of particular analytes are expected to be associated with specific TA-21 operations.

These three categories of areas are in addition to highly localized areas which have been impacted by discrete SWMU releases.

A.3 Analytes Reviewed in Baseline Development

A.3.1 Potential Contaminants of Concern

In the surface soil investigation, the development of baseline concentrations included the analytes indicated in Table A.6. Surface soil grid samples have been analyzed for semivolatile organics, inorganics, and radionuclides. Table A.6 also lists potential contaminants of concern, based on process knowledge and past environmental data summarized in the RFI work plan. Elevated concentrations detected near a SWMU are assumed to be associated with waste material at the SWMU, unless other information indicates a more probable source.

A.3.2 Regional Background Concentrations

Table A.7 summarizes available regional background data. Concentrations of selected fallout radionuclides are measured annually by the Laboratory's Environmental Surveillance Group at five to seven regional locations between 1974 and 1986 with values reported in Table A.7 (Purtymun et al., 1987).

The primary source of regional background for inorganic constituents is the recent study by Longmire et al., (1993), in which soil and tuff samples were collected from sites near Los Alamos that are unlikely to have been impacted by the Laboratory operations. In this study, most analytes were measured using

neutron activation and thus represent total analyte levels. Reported values in Table A.7 are based on soil samples from various depths, excluding soil samples consisting of the fine fraction only, or of fracture fill material.

The inorganic results from the study by Longmire et al. are supplemented by those of an earlier Los Alamos study (Ferenbaugh et al., 1990) and by a national study (Shacklette and Boerngen, 1984). The earlier Los Alamos measurements were on 0 to 2 in. samples from Sigma Mesa about one mile southwest of TA-21, collected prior to development of that area. The Sigma Mesa study sampled an area that is geologically less diverse than the range of settings covered by Longmire's study, but where both studies report results, the levels are comparable. The more than 1000 sampling locations from the conterminous United States measured by Shacklette and Boerngen represent far more variable environments than that of the Pajarito Plateau.

A.3.3 Screening Action Levels

Screening action levels (SALs) are decision levels for comparison to soil concentration data. SALs are listed in Table A.5 of this appendix and Appendix J of the IWP for chemical class A, B, and C carcinogens, non-carcinogenic toxicants and radionuclides. SALs were developed by the Laboratory based on exposure pathways and the assumption that the contaminant in question is the only contaminant present. The upper target risk or dose for each of these categories is:

Class A and B carcinogens	10^{-6} risk
Class C carcinogens	10^{-5} risk
Non-carcinogenic toxicants	RfD (reference dose)
Radionuclides	10 mrem annual incrementa dose

When soil concentration levels are compared to SALs, the presence of multiple contaminants must be considered. In general, the contaminant to SAL ratios at a sampling site are summed for all contaminants. If the sum of the ratios is less than one, target doses and risks are assumed not to be exceeded.

A.4 Determination of Baseline Concentrations

A.4.1 Preliminary Data Review

This preliminary data assessment involved the plotting of 0 to 6 in. surface soil grid data in four regions: north - DP Canyon, south - Los Alamos Canyon, east - Tritium Systems Test Assembly (TSTA) area, and west - mesa top. Concentrations at each grid point were represented in graphical bubble plot format, in which relative concentrations were plotted as circles of varying sizes as a visual means of identifying relative contaminant concentration across the grid. This analysis revealed sets of radionuclides that were elevated in these regions. At some grid points, relative concentrations appeared to be elevated due to process impact (for example, elevated tritium concentrations near TSTA). Other relationships, such as slightly elevated levels of plutonium and americium in DP Canyon, also were clearly evident in the bubble plots. These bubble plots were used as a starting point in refining baseline area selections, as described below.

A.4.2 Definition of Baseline Areas

Further evaluation of the surface soil grid data indicated that the RFI data could be interpreted adequately for the purpose of the RFI by partitioning TA-21 into four baseline areas, defined as the non-process area, process area, and special impact areas MDA A/MDA T and TSTA. As discussed in Appendices B and C, maximum analyte concentrations at SWMUs are compared first to the 95.5 percentile of the non-process area baseline and sequentially to process area and special impact area baselines. Analyte concentrations exceeding the 95.5 percentile of the process or special impact area baselines are potentially impacted by one or more release sites. Map 2 shows the locations of the four baseline areas, which are discussed in the following sections.

A.4.3 Non-Process Area

The non-process baseline area largely comprises the portion of TA-21 outside the fenced industrial area, as shown by Map 2. Surface soil grid data judged to have been impacted by SWMUs or within the process or special impact areas were excluded from the non-process area baseline data set. The non-process area baseline is the most conservative of the four baselines and, as discussed below, is very

similar to regional background. Other baseline data and all SWMU-specific data were compared to this data set as a first basis of comparison.

A.4.4 Process Area

The process baseline area is defined by the fenced industrial area of TA-21, as shown by Map 2. Process area grid data judged to have been impacted by specific SWMUs were excluded from the process area baseline data set. The process area baseline is used to evaluate data for SWMUs located within the process area. Process area grid sampling locations are summarized in Table A.8.

The process area baseline is less conservative than the non-process area baseline and generally more conservative than the special impact area baseline. Process area inorganic baseline analytes of particular interest are arsenic, beryllium, cadmium, chromium, lead, nickel, selenium, and zinc. Radionuclide baseline analytes of interest are americium-241, plutonium-238, plutonium-239/240, strontium-90, and tritium. These analytes were selected for particular attention due to their above-background detection at SWMUs located in or near the process area.

A.4.5 Special Impact Areas

The two special impact areas are the TSTA area in the vicinity of TSTA (labeled as SI2 on Map 2) and the MDA A/MDA T area in the vicinity of MDAs A and T (labeled as SI1 on Map 2). These special impact areas have been impacted by airborne deposition, surface releases, and other mechanisms. Special impact area baselines are used for comparison with data from SWMUs that are co-located in the special impact areas. Elevated analyte concentrations associated with these SWMUs then can be attributed to specific SWMU releases or to generally elevated levels across the area. The special impact baselines obviously are less conservative than the non-process or process baselines.

Special impact baselines were developed only for analytes exhibiting elevated concentrations within the impact areas. These analytes are tritium, americium-241, plutonium-238, and plutonium-239/240. The TSTA special impact area, characterized by slightly elevated tritium levels, is a rectangular area containing twenty-six 0 to 6 in. grid sampling locations around and extending to the east of TSTA. Plutonium-238, plutonium-239/240, and americium-241 characterize the MDA/MDA T special impact

baseline area, which includes nineteen 0 to 6 in. grid sampling locations in the area north and east of MDAs T and A, extending into DP Canyon, as can be seen on Map 1, the two special impact areas overlap. The special impact area baseline distributions and are intended for comparison with data from SWMUs within these areas.

A.4.6 Data Preparation

The 0 to 6 in. surface soil grid data were downloaded from the FIMAD database for use with personal computer software packages. Non-process area, process area, and special impact area data were separated and sorted by location ID grouping and analyte. QA/QC and field duplicate samples then were identified for each baseline data set. Per EPA guidance, concentrations for duplicate samples were averaged (EPA 1989). If one sample of a duplicate set indicated a detect and the other did not, the detected value was used.

The resulting modified data set was then sorted by detect versus non-detect. A proxy concentration of one-half the detection limit was used for non-detects (EPA 1989). The data set then was ordered numerically for each analyte. Outliers were tentatively identified by their analyte levels and proximity to SWMUs or other contamination indications as revealed by bubble plots. If identified as having been impacted by a SWMU, the grid data point was excluded from the final baseline data set and assessed separately with the respective SWMU-specific data.

A.4.7 Data Analyses

The following statistical tests were applied to determine whether the baseline distributions were better described as normal or log-normal: the Shapiro-Wilks Test (valid for number of data points less than or equal to 50); the Lilliefors Test; and the Coefficient of Variation Test. The Shapiro-Wilks Test and Lilliefors Test are used to compute two-tailed test significance levels. The significance level of a statistical test is defined as the probability of falsely rejecting a null hypothesis (i.e., data set distribution is normal or lognormal). If the significance level is found to be below a defined level, the distribution type being tested is rejected. For the determination of distribution type, the significance level was set at 5% (0.05), which is a common value used in environmental statistical analyses (Gilbert 1987).

The coefficient of variation was computed for each analyte data set using the following equations:

Normal Distribution : CV =

Lognormal Distribution:

$$CV = \exp(s^2_y)-1$$

Where:

CV = coefficient of variation

μ = mean

s = standard deviation

μ_y = lognormally transformed mean

sy = lognormally transformed standard deviation

t = distribution shift factor (set equal to 0 for no distribution shift)

If the computed coefficient of variation for an analyte data set was less than one, it was assumed that the data set approximated the distribution type that was being tested.

A data set was assumed to be normally or log-normally distributed if so indicated by any of the three statistical tests. If a baseline distribution data set contained a high percentage of non-detects, it was unlikely to fit either a normal or log-normal distribution due to the large number of proxy concentrations. For all baseline categories, SWMU data are compared to the 95.5 percentile limit of the normal distribution. Log-normal means and percentiles are listed in this appendix to provide general information only.

A.5 Non-Process Area Radionuclide Baseline Distributions

Summaries of non-process area baseline parameters for inorganic and radionuclide analyte are presented in Tables A.9 and A.10. Table A.9 also presents SALs for comparison. In most cases, the SALs exceed the mean non-process area baseline means and 95.5 percentiles by one to four orders of magnitude. Only for thorium-232 does the baseline mean exceed the SAL, and in this case the baseline mean (1.47 pCi/g) is lower than the regional background mean (1.81 pCi/g) with the exclusion of thorium-232, the sum of individual SAL ratios is much less than one for all non-process area baseline sample locations. Therefore, the 0 to 6 in. grid surface soil data indicate acceptable health-based risk levels of analytes across the non-process area grid.

The following discussion assesses the 0 to 6 in. non-process area surface soil data by analyte.

Americium-241 - Americium-241 concentrations associated with 61 non-process area grid samples ranged from 0.001 to 0.37 pCi/g, compared to a SAL of 22.0 pCi/g. Regional background data are not available for americium-241. Americium-241 non-process area concentrations are highest north and east of MDA T and MDA A, as also observed for plutonium-239/240 as discussed below. This distribution pattern suggests past surface erosion transport from these sources and/or airborne deposition from TA-21 stacks along the prevailing wind direction.

Plutonium-239/240 - Plutonium-239/240 concentrations associated with 103 non-process area grid samples ranged from 0.002 to 40.8 pCi/g across the grid. When the 40.8 pCi/g outlier associated with outfall SWMU 21-024(c) was removed, the resulting range was 0.002 to 3.26 pCi/g and the mean was 0.58 pCi/g, far below the SAL of 24 pCi/g. The reported regional background range and mean for plutonium 239/240 are 0.00 to 0.05 and 0.009 pCi/g, respectively. The final baseline also excluded plutonium-239 data associated with seven location IDs from special impact areas. The distribution pattern of plutonium-239/240 in the non-process area is similar to that for americium-241.

Plutonium-238 - Concentrations associated with 104 plutonium-238 non-process area grid locations ranged from 0.001 to 1.05 pCi/g, compared to the SAL of 28 pCi/g. The reported regional background range and mean for plutonium 238 are 0.00 to 0.010 and 0.001 pCi/g, respectively. For location IDs 21-1468, 21-1469, and 21-1470, reported values of "0" were replaced with a default value of 0.001 pCi/g. The distribution pattern for plutonium-238 in the non-process area is less systematic than for either americium-241 or plutonium-239.

Uranium - Total uranium concentrations associated with 113 non-process area grid surface soil samples ranged from 2.5 to 14.2 ppm across the grid, in reasonable agreement with the regional background data range of 1.5 - 6.7 ppm and far below the SAL of 66 ppm. No distinct distribution patterns were noted over the grid. Uranium-234, 235, and 238 levels are in reasonable agreement with regional background.

Tritium - Tritium soil moisture concentrations associated with 97 non-process area surface soil grid location ranged from the detection limit to a maximum of 8.10 nCi/l with a mean of 1.63 nCi/l,

compared to the SAL of 1.5 x 10^4 nCi/l. The reported regional range and mean for tritium are <0.3 to 8.8 and 2.6 nCi/l, respectively. All tritium sample locations associated with the TSTA special impact area were excluded from the non-process area baseline due to systematically elevated tritium concentrations near TSTA.

Five grid sampling points in Los Alamos Canyon (location IDs 21-1180, 21-1145, 21-1126, 21-1195, 21-1209) exhibited tritium concentrations ranging from 3.20 to 6.20 nCi/l. Data from these site locations were excluded from the non-process area baseline because of probable impact by upgradient discharges from TA-21 outfalls and the Omega West Reactor.

Thorium - The thorium isotope data is consistent with regional background. No outlier concentrations were identified and the entire data set was used in the baseline. A total of 24 thorium-228 grid samples were included in the non-process area baseline, with a resulting concentration range of 1.1 to 2.3 pCi/g, compared to the reported regional range of 1.2 to 2.6 pCi/g. No SAL is available for thorium-228. Twenty-four thorium-230 grid analyses were included in the non-process area baseline, with a resulting concentration range of 0.96 to 1.9 pCi/g, compared to a reported regional range of 0.7 to 1.7 pCi/g and a SAL of 10.0 pCi/g. A total of 24 thorium-232 grid analyses were included in the non-process area baseline, with a resulting concentration range of 1.1 to 2.1 pCi/g, and mean of 1.5 pCi/g. While the thorium-232 mean exceeds the SAL of 0.88 pCi/g, the levels are consistent with the reported regional background range of 1.2 to 2.6 pCi/g and mean of 1.8 pCi/g.

Strontium-90 - Strontium-90 concentrations in the non-process area follow no distinct distribution pattern, except that levels in DP Canyon and on the eastern part of the mesa appear to be systematically slightly elevated relative to regional background. No outliers were identified, and all 114 grid samples were used in the non-process area baseline. Strontium-90 concentrations ranged from 0.02 to 3.26 pCi/g with a mean of 0.23 pCi/g compared to a regional mean of 0.34 pCi/g and a SAL of 8.9 pCi/g.

A.6 Non-Process Area Inorganics Baseline

Table A.10 summarizes inorganic baseline parameters for the non-process area. Individual analyses are treated in the following discussion. Figure A.1 graphically compares regional background with the process area and non-process area baselines.

Aluminum - All Grid 1 and 2 aluminum analyses were performed using ICPES, but two distinct ranges of concentrations were reported since different laboratory digestion procedures were used. Consequently, Grid 2 aluminum analyses (which utilized HNO_3 digestion) were reported approximately one order of magnitude lower than Grid 1 analyses (which utilized more effective HF digestion) or Longmire et al.'s regional background analyses (total analysis by neutron activation. Grid 1 data ranged from 37100 to 83500 ppm, consistent with regional aluminum background levels. The final data set contained all 56 data points from Grid 1. No SAL has been defined for aluminum.

Arsenic - Arsenic data were grouped into two sets based on laboratory detection limits associated with different analytical methods. Inductively coupled plasma emission spectroscopy (ICPES) analyses reported Grid 2 detection limits of approximately 53-65 ppm and all results were non-detects. Atomic emission spectroscopy (AES) detection limits associated with Grid 1 analyses were not specified, but are much lower than for ICPES, with reported detects ranging from 0.8 to 9.9 ppm. Therefore, the more sensitive Grid 1 data were used to calculate the arsenic baseline. The two highest analytical results, 9.9 ppm at location ID 21-1055 and 6.2 ppm at location ID 21-1079, were excluded because they were near outfalls 21-023(c) and 21-024(e), respectively. The final baseline range of 0 to 4.9 ppm was slightly higher than the respective SAL of 0.4 ppm, but within the regional background concentration range of 1.2-10.8 ppm.

Barium - Grid 1 barium analyses ranged from 99 to 618 ppm, in agreement with the regional background range of 164 to 899 ppm. In contrast, the Grid 2 range (<1.2 to 205 ppm) was much lower due to use of a different digestion procedure. Therefore, Grid 2 data were excluded from the barium baseline. All 66 Grid 1 data were used in the assessment of the barium baseline since no outliers were identified. Review of the Grid 2 data also revealed no outliers. The final barium baseline range was 99 to 618 ppm, compared to the SAL of 5600 ppm.

Beryllium - All 110 Grid 1 and Grid 2 beryllium analyses were performed using ICPES, but the two data sets had distinctly different ranges and percentages of non-detects due to the use of different digestion procedures. Most Grid 1 data were reported as non-detects with a reported detection limit ranging from 1-1.3 ppm, while Grid 2 detects ranged from 1.68 to 5.1 ppm. Both Grid 1 and 2 samples were used in the development of the 1 beryllium baseline, with non-detects included at a proxy concentration of one-half the reported detection limit. The inclusion of non-detects probably tends to overestimate the baseline mean.

The beryllium baseline mean of 1.91 ppm and the associated range of 0.14 to 5.1 ppm is in agreement with the published regional background range of 1.0 to 4.40 ppm. No notable concentration trends were evident across the grid system. Although levels exceed the SAL of 0.16 ppm, the beryllium data were assessed no further because the levels are consistent with regional background and process knowledge indicates no reason to suspect beryllium to be of concern at TA-21.

Cadmium - Of the 109 Grid 1 and Grid 2 cadmium results reviewed, only 10 were reported as detects, all of which were associated with Grid 2. The reported detection limits associated with the non-detects ranged from 0.6 - 2.0 ppm. The cadmium baseline was calculated using both Grid 1 and Grid 2 data sets and proxy concentrations of one-half the reported detection limits for non-detects. This approach probably tends to overestimate the baseline mean. The final baseline concentration range was 0.3 - 1.0 ppm. No regional background cadmium levels have been reported which can be compared with the grid data. No specific concentration trends were noted across the grid system and all reported concentrations are at least an order of magnitude less than the SAL of 80 ppm.

Calcium - Calcium data associated with Grids 1 and 2 exhibited significantly different concentration ranges due to digestion procedure differences. Grid 2 data exhibited a range of 655 to 11600 ppm. Only the 56 Grid 1 data (range 2000 to 31700 ppm) were included in the baseline calculation. The Grid 1 data range is within the published regional background range of 1911 to 80380 ppm, and no specific concentration trends were noted across the grid system. No SAL has been defined for calcium.

Chromium - The range of chromium concentrations was similar for Grid 2 (3.0 - 27.5 ppm) and Grid 1 (<2 - 21.4 ppm). A proxy concentration of one-half the detection limit was used for non-detects, which

probably overestimates the mean chromium concentration. The final data set included 110 points with a range of 1.0 to 28.1 ppm, uniformly distributed over the grid and consistent with the published regional background range of 2.0 to 71 ppm. All baseline concentrations are at least one order of magnitude lower than the SAL of 400 ppm.

Cobalt - Cobalt concentration ranges were 1.7 - 8.1 ppm for Grid 2 and 2-14 ppm for Grid 1. Two outliers were identified at location ID 21-0154 near outfall 21-023(c) (14 ppm) and ID 21-1080 near outfall 21-024(o) (11 ppm). These outliers were excluded from the baseline. The final cobalt data set included 109 points with a range of 1.05 to 11.0 ppm, uniformly distributed over TA-21 and consistent with the published background data range of 9.41-23 ppm. No SAL has been defined for cobalt.

Copper - Grid 1 and 2 concentrations for copper were consistently distributed over the grid system. The final copper data set included 109 data points in the range 1.0-57.4 ppm, consistent with the published background data range of 2-300 ppm. All reported concentrations are at least two orders of magnitude less than the SAL of 3000 ppm.

Iron - Significantly different iron concentration ranges were reported for Grid 1 and Grid 2 data due to digestion procedure inconsistencies. The ranges were 5.9 - 19100 ppm for Grid 2 samples and 4200 - 27900 for Grid 1. The Grid 1 range is at the lower end of the regional background range of 10000 to 49000 ppm. The final baseline included only the 56 data points for Grid 1. No SAL has been defined for iron.

Lead - Lead analyses exhibited similar ranges for Grid 1 (7 to 82 ppm) and Grid 2 (6.6 to 49.9 ppm), and all sample results were reported as detects. No readily discernible distribution patterns were noted over the grid. The final lead data set included 136 points with a range of 5.3 to 61 ppm, consistent with the regional background range of 18 to 56 ppm. Location ID 21-099 [near SWMU 21-0026(b)], with a reported concentration of 42 ppm, was excluded from the baseline. The maximum reported lead concentration is nearly one order of magnitude lower than the SAL of 500 ppm. Based on these data and process knowledge, lead is not of concern over the TA-21 grid.

Lithium - Significantly different lithium ranges were reported for Grids 1 and 2 due to digestion procedure differences. Of 67 Grid 2 analyses, 53 were reported at or below reported detection limits of 20.5 to 26.1 ppm, while 14 detects were in the range 5.7 to 23.7 ppm. Grid 1 analyses were all reported above detection limits in

the range 18.9 to 58.6 ppm. No baseline was developed for lithium. Although not of interest from a risk perspective, it was noted that five of the seven highest lithium concentrations (location IDs 21-1230, 21-1259, 21-1241, 21-1222, and 21-1251), ranging from 37 to 58.6 ppm, were located along the southern "finger mesa" in the southwest portion of TA-21. No SAL has been defined for lithium.

Magnesium - Magnesium levels associated with Grid 1 and Grid 2 exhibited significantly different concentration ranges due to digestion procedure differences. Grid 2 data ranged from < 11.5 to 3860 ppm and Grid 1 data were in the range 1000 to 6200 ppm. The reported regional background range is 1300 to 17000 ppm. The baseline data set included 56 data points. Five of the six highest magnesium concentrations (location IDs 21-1230, 21-1233, 21-1193, 21-1168, and 21-1199) are located on the mesa top to the east of the TSTA. The concentration range associated with these points (3900 to 6200 ppm) is well within the regional background range. No SAL has been defined for magnesium.

Manganese - Grid 1 and 2 manganese levels ranged from 193 to 696 ppm for Grid 1 and from 111 to 625 ppm for Grid 2. All 111 data points were included in the baseline calculation with the exception of location ID 1208, which was associated with outfall 21-024(k). The higher manganese concentrations are located in the vicinity of the TSTA and MDA U. All baseline concentrations are at least one order of magnitude lower than the SAL of 8000 ppm.

Molybdenum - Of the 141 Grid 1 and 2 molybdenum analyses reported, 121 were non-detects. Reported detection limits ranged from <2.2 to <6.5 ppm for Grid 2 and from <1 to <4 ppm for Grid 1. Grid 1 detects were reported in the range 1.3 to 2.7 ppm, with the exception of one outlier (7 ppm) associated with location ID 21-1172 [21-024(k)]. Due to the high percentage of non-detects, no baseline was calculated. No SAL has been defined for molybdenum.

Nickel - The range of nickel levels is comparable for Grid 2 (2.8 to 13.9 ppm) and Grid 1 data (< 3 to 19 ppm). Nickel concentrations are consistently distributed over the TA-21 grid and within the regional background range of 1.6 to 19 ppm. The final nickel data set included all 110 points including 55 non-detects included at a proxy concentration of one-half the reported detection limit. The maximum observed concentration is nearly two orders of magnitude lower than the SAL of 1600 ppm.

Potassium - Significantly different Grid 1 and Grid 2 potassium ranges were reported due to digestion procedure differences. Grid 1 data were reported about one order of magnitude higher than the Grid 2 range of < 512 - 3020 ppm. No baseline parameters were calculated with the grid data and the reported regional background of 1000 - 4200 ppm was used as the baseline range. No SAL has been reported for potassium.

Selenium - Grid 1 and 2 selenium grid data were reported in different concentration ranges and detection limits due to digestion procedure differences. Grid 1 concentrations ranged from < 0.1 to 0.6 ppm. Most Grid 2 levels ranged from < 51.2 to < 65.4 ppm, with eleven samples in the range < 0.3 to < 0.38 ppm. The baseline development included all Grid 1 samples and the group of lower detection limit samples from Grid 2. No outliers or unusual distributions were noted. Non detects were included at half the reported detection limits, which probably leads to overestimation of the mean. The large number of proxy concentrations input for selenium yielded a statistical distribution that was non-parametric. The final selenium data set included 58 data points with a range of .050 to 0.60 ppm. All concentrations were lower than the SAL of 400 ppm. No source of regional background data was available for comparison.

Silver - Of the 109 silver laboratory analyses, only 16 were reported as detects of these 16, all were 2.3 ppm or lower, far below the SAL of 400 ppm. The reported detection limits associated with non-detects ranged from 0.61 to 2.6 ppm, while detect concentrations ranged from 1.1 to 10.8 ppm. The silver baseline mean was calculated using both Grid 1 and 2 data sets, with standard proxy concentrations of one half the detection limits inserted for non-detects. The highest concentration, associated with location ID 21-1030 near MDA B was not used. The large number of non-detects probably causes the mean to be overestimated. The final data set range was 0.32 to 5.0 ppm. Because available regional background data for silver are near detection limits, no comparison to background was performed.

Sodium - Sodium data associated with Grids 1 and 2 exhibited significantly different data ranges due to digestion procedure differences. Grid 2 concentrations ranged from 70.3 to 643 ppm. Only the 85 Grid 1 data (range 10700 to 31200 ppm) were included in the baseline, which falls within the regional background range of 2700 to 32560 ppm. No SAL has been defined for sodium.

Strontium - Grid 1 and Grid 2 strontium analyses were reported at significantly different ranges due to digestion procedure differences. Grid 2 concentrations ranged from < 5.2 to 47.2 ppm and were excluded from the strontium baseline. Grid 1 concentrations ranged from 25 to 184 ppm, consistent with the regional background range of 170.4 to 242.2 ppm. The final baseline data set included all 52 Grid 1 data points. No SAL has been defined for strontium.

Vanadium - The concentration ranges reported for Grid 1 and Grid 2 vanadium analyses were similar and both data sets were used in baseline development. Of 110 analyses, two were non-detects. The range of concentrations was 1.2 - 58.6 ppm, consistent with the reported regional background range of 0 to 97 ppm. All baseline vanadium concentrations were at least one order of magnitude lower than the SAL of 560 ppm.

Zinc - Comparable concentration ranges were reported for Grid 1 and Grid 2 zinc analyses and all 110 data points were included in the baseline. The baseline range (14.3 to 130 ppm) is consistent with the regional background range of 11.5 to 113 ppm. All baseline concentrations were at least one order of magnitude lower than the SAL of 24000 ppm.

A.7 Process Area Radionuclide and Inorganics Baseline

The process area lies within and near the fenced industrial area of TA-21, as shown on Map 2 and summarized in Table A.7. Analytical data associated with location IDs in this area are the basis for the process area baseline. Process area baseline parameters are tabulated in Tables A.11 for selected radionuclide and inorganic analytes, together with associated SALS and non-process area baseline means. While some analyte levels are higher for the process area than for the non-process area, all are significantly lower than the associated SALs. Only those analytes detected above non-process area concentrations were assessed in detail and are discussed in this section.

Americium-241. Americium-241 concentrations associated with 21 process area grid samples ranged from 0.015 to 0.912 pCi/g with a mean of 0.15 pCi/g. The mean process area concentration was higher than the mean non-process mean of 0.031 pCi/g. Both of these levels are well below the SAL of 22.0 pCi/g.

Plutonium-239/240. Plutonium-239/240 concentrations associated with 40 process grid samples ranged from 0.034 to 14.7 pCi/g within a mean of 2.33 pCi/g. The mean process area concentration is approximately four times the non-process area mean of 0.58 pCi/g. These levels are well below the SAL of 24.0 pCi/g.

Plutonium-238. Plutonium-238 concentrations associated with 43 process grid samples ranged from 0.002 to 18.7 pCi/g. The mean process area concentration of 0.53 pCi/g is approximately thirty times the mean non-process area mean of 0.019 pCi/g. These levels are well below the plutonium-238 SAL of 27 pCi/g.

Total Uranium. Total uranium concentrations associated with 42 process area grid samples ranged from 2.5 to 10.7 ppm. The mean process area concentration of 4.67 ppm is essentially identical to the mean non-process concentration of 4.66 ppm and far below the SAL of 66 ppm

Uranium-234. Uranium-234 concentrations associated with 11 process area grid samples ranged from 1.19 to 1.8 pCi/g. The mean process area concentration of 1.49 pCi/g is essentially identical to the mean non-process mean concentration of 1.5 pCi/g.

Uranium-235. Uranium-235 concentrations associated with 11 process area grid samples ranged from 0.50 to .095 0.5 pCi/g. The mean process area concentration of 0.073 pCi/g is very similar to the mean non-process area concentration of 0.081 pCi/g.

Uranium-238. Uranium-238 concentrations associated with 11 process area grid samples ranged from 0.79 to 1.77 pCi/g. The mean process area concentration of 1.38 pCi/g is very similar to the non-process area mean of 1.59 pCi/g.

Thorium-228. Thorium-228 concentrations associated with 12 process area grid samples ranged from 0.86 to 1.62 pCi/g. The mean process area concentration of 1.34 pCi/g is within 20% of the mean non-process area concentration of 1.55 pCi/g. No SAL has been determined for this analyte.

Thorium-232. Thorium-232 concentrations associated with 12 process area grid samples ranged from 0.89 to 1.52 pCi/g. The mean process area concentration of 1.33 pCi/g is within 20% of the mean non-process area concentration of 1.5 pCi/g.

Tritium. Soil moisture tritium concentrations associated with 41 process area grid samples ranged from 0.300 to 12.5 nCi/l, compared to a SAL of 1.5 by 10^4 nCi/l. The mean process area concentration of 2.871 nCi/l is about 50% greater than the non-process area concentration of 1.63 nCi/l. This difference is attributable to atmospheric releases within the industrial area and subsequent airborne deposition across the OU.

Strontium-90. Strontium-90 concentrations associated with 41 process area grid samples ranged from 0 to 1 pCi/g. The mean process area concentration of 0.21 pCi/g is nearly identical to the mean non-process area concentration of 0.23 pCi/g.

All other baseline means are similar to the non-process area baseline means and range from 1-4 orders of magnitude below applicable SALs. Because inorganics are not elevated across the non-process area grid relative to regional background, they were investigated no further.

A.8 Special Impact Areas Discussion

Assessment of the 0 to 6 in. surface soil grid data led to definition of two special impact areas with generally elevated levels of specific radionuclides. The first area, labeled as SI1 on Map 2, is immediately downgradient (north) of MDAs A and T and is referred to as the MDA A/MDA T special impact area. The initial grid data assessment indicated that the only analyte levels warranting further assessment for this area are americium-241, plutonium-238, and plutonium-239/240. The impacted area includes mesa top, bench, and canyon terrain.

The second special impact area, referred to as the TSTA special area and labeled as SI2 on Map 2, is associated with elevated tritium. This area covers much of the area immediately surrounding TSTA and extending eastward along the mesa top. The TSTA and MDA A/MDA T areas overlap.

The location IDs associated with these two special impact areas are summarized in Table A.7. Table A.11 summarizes special impact area radionuclide baselines, together with SALs and non-process area baseline means.

Americium-241. Americium-241 concentrations associated with 14 special impact area 1 samples ranged from 0.031 to 3.56 pCi/g. The mean special impact area 1 concentration of 2.02 pCi/g was significantly higher than the process area mean of 0.15 pCi/g and the non-process area mean of 0.031 pCi/g. All of these levels are well below the SAL of 22.0 pCi/g.

Plutonium-238. Plutonium-238 concentrations associated with 28 special impact area 1 samples ranged from 0.004 to 0.268 pCi/g. The mean special impact area 1 concentration of 0.044 pCi/g was lower than the process area mean of 0.53 pCi/g but higher than the non-process area mean of 0.019 pCi/g. All of these levels are well below the SAL of 27.0 pCi/g.

Plutonium-239/240. Plutonium-239/240 concentrations associated with 28 special impact area 1 samples ranged from 0.084 to 16.5 pCi/g. The mean special impact area 1 concentration of 3.32 pCi/g was higher than the process area mean of 2.33 pCi/g and the non-process area mean of 0.58 pCi/g. These levels are well below the SAL of 24 pCi/g.

Tritium. Tritium soil moisture concentrations associated with 26 special impact area 2 samples ranged from 1.30 to 12.7 nCi/l. The mean special impact area 2 concentration of 4.63 nCi/l was higher than the process area mean of 2.87 nCi/l and the non-process area mean of 1.63 nCi/l. These levels are well below the SAL of 1.5 by 10^4 nCi/g.

A.9 Organics - All Locations

Volatile organic analysis was not part of the 0 to 6 in. surface soil grid investigation. Semivolatile organic compounds were detected at only four grid locations, location IDs 21-1056, 21-1122, 21-1198, and 21-1300, as listed in Table A.13. All of these levels are very low and well below SALs and possibly associated with paving materials. Further characterization will be performed when investigations of SWMUs near these locations are performed.

Location 21-1056 is downgradient of SWMU 21-013(b), which consists of surface debris from building TA-21-33 and possibly other sources.

Location 21-1198 is adjacent to SWMU 21-013(c), which contains surface building debris. Location 21-1198 also is in the area of the former high temperature chemistry building.

Very low semivolatile levels (below 790 µg/kg) were detected at locations 21-1122 and 21-1300 within the extensively paved process area.

A baseline was not developed for semivolatile organic compounds for the following reasons:

- semivolatiles are not naturally occurring,
- semivolatiles were detected in only four grid locations, and
- all detected levels at the four locations were very low and likely to be associated with the process area or surface SWMUs which will be assessed in subsequent investigations.

A.10 RADIOLOGICAL FIELD SCREENING AND SURVEYS

All grid surface soil samples were screened in a field laboratory for gross alpha, beta, and gamma radiation. Most samples analyzed were found to have gross alpha, beta, and gamma concentrations below the minimum detectable activity. Exceptions are discussed below.

Grid samples from locations 21-1045, 21-1052, 21-1198, 21-1218, 21-1228, and 21-1239 exhibited gross alpha concentrations slightly above the detection limit. Locations 21-1228 and 21-1239, located on the mesa top east of TSTA, exhibited the highest gross alpha levels (18.2 pCi/g and 10.4 pCi/g, respectively). Gross alpha levels at locations 21-1045 (6.9 pCi/g) and 21-1052 (8.6 pCi/g) may be related to SWMUs 21-013(d) and 21-013(e). Gross alpha levels at location 21-1218 sample (8.6 pCi/g) may be associated with SWMU 21-013(c).

Gross beta was detected by the field laboratory in only three grid soil samples. The detection limit was only slightly exceeded. These samples are from locations 21-1228 (27.8 pCi/g), 21-1239 (22.9 pCi/g), and 21-1240 (25.5 pCi/g), which are east of TSTA. As discussed above, locations 21-1228 and 12-1239 also reported slightly detectable gross alpha levels.

No gamma concentrations were detected in any soil grid samples above the field laboratory detection limit of 5 pCi/g.

An alpha surface survey was performed at each grid sampling location using alpha radiation detectors, and no significant trends were observed. Only one location, 21-1017, exhibited an activity level (102.5 dpm) which could be construed as slightly elevated. This location is on the finger mesa in the western portion of TA-21.

A beta/gamma survey was performed at each of the 0 to 6 in. soil grid sampling locations using Geiger-Mueller radiation detectors, and elevated activity was not observed.

External radiation levels were measured at each grid sampling location. Only three locations exhibited external radiation levels which could be construed as slightly elevated: 26 μR/hr (surface and 3 ft above

the ground) at location 21-1097; 30 μR/hr (surface) and 36 μR/hr (3 ft above the ground) at location 21-1141; and 26 μR/hr (3 ft above ground) and 25 μR/hr (surface) at location 21-1260. Locations 21-1097 and 21-1260 are within Los Alamos Canyon and location 21-1141 is immediately downgradient of MDA-T and outfall SWMU 21-011(k) No other trends were observed in the external radiation survey data.

Table A.3. Summary of 0-6 in. Grid Surface Soil Investigation Samples Submitted to Analytical Laboratories

		Soil Samples			Field QA Samples		
Invest.	No. of Loc.	Grid Pts.	Bldg. Area	Off grid Pts.*	Dups	Rinsate Bl.	Field Bl.
Grid 1	85	76	***	9	6	5	5
Grid 2	70	51	10	9	4	3	3
Total	155	127	10	18	10	8	8

Grand Total of Samples 181

TABLE A.4. Globally Occurring Radionuclide and Inorganic Constituents

RADIOISOTOPES

Naturally Occurring

Thorium-228, 230, 232
Uranium-234, 235, 238

Worldwide Fallout

Tritium
Strontium-90
Cesium-137
Plutonium-238, 239/240
Americium-241

INORGANICS

Major Elements (>1000 ppm)

Aluminum
Iron
Potassium

Minor Elements (100-1000 ppm)

Barium
Calcium
Magnesium
Manganese
Sodium
Strontium

Minor Elements (<100 ppm)

Antimony
Arsenic
Beryllium
Cadmium
Chromium
Cobalt
Copper
Lead
Lithium
Molybdenum
Nickel
Selenium
Silver
Thallium
Uranium
Vanadium
Zinc

Table A.5 Soil Screening Action Levels (SALs) for Baseline Inorganic and Radionuclide Analytes (SALs are from IWP Appendix J)

Radionuclides	(pCi/g)
Americium-241	22.0
Cesium-137	4.0
Plutonium-238	27.0
Plutonium-239	24.0
Strontium-90	8.90
Thorium-230	10.0
Thorium-232	0.88
Tritium	1.5×10^4 (nCi/L soil moisture)
Uranium-234	86.0
Uranium-235	18.9
Uranium-238	59.0
Natural Uranium	66.3

Inorganics	SAL (µg/g)
Aluminum	*
Antimony	32
Arsenic	0.40
Barium	5,500
Beryllium	0.16
Cadmium	80
Calcium	*
Chromium	400
Cobalt	*
Copper	3,000
Iron	*
Lead	500
Magnesium	*
Manganese	8,000
Mercury	24
Nickel	1,600
Potassium*	*
Selenium	400
Silver	400
Sodium	*
Thallium	6.4
Uranium	240
Vanadium	560
Zinc	24,000

*Not defined.

Table A.6 Baseline Inorganic and Radionuclide Analytes

INORGANIC		RADIONUCLIDE
aluminum	magnesium	americium-241*
arsenic	manganese	cesium-137*
barium	molybdenum	plutonium-238*, 239/240 *
beryllium	nickel	strontium-90*
calcium	potassium	thorium-228, 230, 232
cadmium	selenium	total uranium*
cobalt	sodium	tritium*
chromium	strontium	uranium-234, 235*, 238*
copper	thallium	
iron	vanadium	
lead*	zinc	
lithium	silver	

*Potential contaminants of concern at TA-21, based on process knowledge and historical environmental data, as described in the RFI work plan.

Table A.7 Background Information for TA-21 Radioisotope and Inorganic Analytes

Analyte	Min.	Max.	Mean	Units	Source
Total Thorium	10.46	23.23	16.37	ppm	b
Th-228	1.16	2.58	1.81	pCi/g	
Th-230	0.74	1.65	1.16	pCi/g	
Th-232	1.16	2.58	1.81	pCi/g	
Total Uranium	2.182	6.728	3.522	µg/g	b
U-234	0.72	2.22	1.16	pCi/g	
U-235	0.033	0.103	0.054	pCi/g	
U-238	0.72	2.22	1.16	pCi/g	
Tritium	<0.3	8.8	2.6	nCi/L	c
Sr-90	0.03	1	0.34	pCi/g	c
Cs-137	<0.1	1.4	0.43	pCi/g	c
Pu-238	<0.001	0.010	0.001	pCi/g	c
Pu-239/240	<0.002	0.052	0.009	pCi/g	c
Am-241	ND	ND	ND		
Aluminum	<1524	111100	75305	µg/g	b
Iron	11370	40310	23910	µg/g	b
Potassium	15090	42000	24884	µg/g	b
Sodium	8500	28160	17191	µg/g	b
Calcium	<1114	80380	8404	µg/g	b
Magnesium	1331	12310	5101	µg/g	b
Manganese	186	1329	478	µg/g	b
Barium	163.9	898.9	494.0	µg/g	b
Strontium	<5	3000	240	µg/g	e
Vanadium	<6.41	96.99	49.48	µg/g	b
Chromium	9.26	61.94	36.37	µg/g	b
Zinc	<6.95	79.4	35	µg/g	b
Nickel	7	55	26	µg/g	d
Lead	<14	56	27.6	µg/g	b
Lithium	19	39	24	µg/g	d
Copper	2	18	10	µg/g	d
Cobalt	1.718	22.53	7.61	µg/g	b
Arsenic	1.195	9.799	4.877	µg/g	b
Beryllium	1	4.4	2.353	µg/g	b
Molybdenum	<3	15	0.97	µg/g	e
Antimony	<.246	1.146	0.602	µg/g	b
Cadmium	0.03	1.7	0.17	µg/g	a
Selenium	<0.1	4.3	0.39	µg/g	e
Thallium	ND	ND	ND		
Silver	ND	ND	ND		

(a) Maxima based on Longmire et al., 1993, minima and means from Ferenbaugh et al., 1990
(b) Longmire et al., 1993
(c) Purtymun et al., 1987
(d) Ferenbaugh et al., 1990
(e) Schacklette and Boerngen, 1984

Table A.8. Process Area and Special Impact Area Baseline Sample Location IDs.

Process Area	Special Impact Area TSTA[2]	Special Impact Area MDA A/MDA T[3]
21-1078[1]		
21-1079[1]		
21-1084[1]		
21-1087[1]		
21-1091[1]		
21-1095[1]		
21-1096	21-1166	21-1123[1]
21-1099	21-1167	21-1119
21-1100[1]		
21-1300	21-1301	21-1124
21-1094	21-1168	21-1128
21-1106	21-1172	21-1131[1]
21-1107[1]		
21-1269[1]		
21-1111	21-1173	21-1135
21-1092	21-1175	21-1140[1]
21-1093	21-1178	21-1141
21-1113[1]		
21-1115	21-1179	21-1142[1]
21-1116	21-1184	21-1143
21-1086		
21-1122	21-1188[1]	21-1139
21-1119	21-1189	21-1146[1]
21-1124	21-1185[1]	21-1147
21-1125		
21-1121	21-1186	21-1148
21-1127	21-1192	21-1149
21-1130	21-1193	21-1152
21-1085		
21-1103		
21-1132		
21-1133	21-1194[1]	21-1153[1]
21-1136		
21-1139	21-1197	21-1154
21-1143		
21-1144		
21-1149		
21-1150		
21-1154	21-1198	21-1158[1]
21-1155[1]		
21-1157[1]		
21-1160	21-1199	21-1159[1]
21-1161[1]		
21-1162[1]		
21-1166	21-1200[1]	21-1160
21-1167[1]		
21-1301[1]		
21-1168	21-12031	21-1164

Table A.8 (continued)

Process Area	TSTA[2]	Special Impact Area MDA A/MDA T[3]
21-1172[1]		
21-1173[1]		
21-1175	21-1204	21-1165[1]
21-1178[1]		
21-1179[1]		
21-1184	21-12051	21-1166
21-1185[1]		
21-1186[1]		
21-1188	21-1206	21-1170[1]
21-1189	21-1207[1]	21-1171
21-1192	21-1208	21-1172
21-1193	21-1211[1]	21-1176
21-1194[1]	21-1211[1]	21-1176
21-1198[1]	21-1212	21-1177[1]
21-1199[1]	21-1288	21-1178
21-1187[1]	21-1213[1]	21-1182[1]
	21-1214	21-1183[1]
	21-1215[1]	21-1184
	21-1218	21-1144
	21-1219[1]	21-1136
	21-1220	21-1138
	21-1221[1]	21-1133
	21-1287	21-1162
	21-1222	21-1168
		21-1173
		21-1179
		21-1186
		21-1155

[1] Both 0 to 1 and in. as 0-6 in. grid samples collected.
[2] Applies to tritium.
[3] Applies to americium-241, plutonium-238, and plutonium-239/240.

Location IDs Removed from the Non-Process Americium-241 Baseline

Location ID	Am-241 Concentration (pCi/g)	Associated SWMU
21-1079	1.24	21-024(e)
21-1173	0.156	21-024(k)
21-1168	0.131	21-024(k)
21-1061	0.071	21-013(d)

Table A.9. Radionuclide Baseline Parameters for Non-Process Areas (0 to 6 in. Sample Depth).

		Normal Distribution		Log-Normal Distribution					
Radionuclide	SAL	Mean	95.5%	Mean	95.5%	No. of Samples	Min.	Max.	Dist. Type
Am-241	22	0.031	0.129	0.0194	0.13	61	0.001	0.37	LN
H-3	1.50E+04	1630	4590	1100	7790	97	50	8100	LN
Pu-238	27	0.019	0.239	0.00499	0.05	104	0.001	1.05	LN
Pu-239	24	0.58	2.04	0.247	4.31	103	0.002	3.26	LN
Sr-90	8.9	0.23	0.73	0.135	1.22	114	0.02	1.8	X
Th-228	NA	1.55	2.05	1.52	2.05	24	1.1	2.3	LN
Th-230	10	1.38	1.82	1.36	1.84	24	0.96	1.9	LN,N
Th-232	0.88	1.5	1.98	1.48	1.99	24	1.05	2.1	X
U total	66.3	4.66	7.42	4.53	7.46	113	2.48	14.2	X
U-234	86	1.51	2.03	1.49	2.05	24	1.2	2.29	LN,N
U-235	18	0.081	0.153	0.0742	0.18	24	0.038	0.19	LN,N
U-238	59	1.59	2.19	1.57	2.25	24	1.18	2.45	N,LN

NOTE: All values in pCi/g except for U (ug/g) and H-3 (nci/l)
LN = Log normal distribution
N = Normal distribution
X = Does not fit either distribution

Table A.10 Non-Process Area Inorganic Baseline Parameters

		Normal Distribution		Log-Normal Distribution					
Analyte	SAL (UG/G)	Mean	95.5%	Mean	95.5%	No. of Samples	Min.	Max.	Dist. Type
As	0.4	1.93	3.67	1.79	3.90	56	0	4.9	X
Ag	400	0.97	2.33	0.835	2.32	109	0.32	5	X
Al	NA	60300	74900	59300	75900	56	37100	83500	N,LN
Ba	5600	192	498	126	934	109	18.9	618	X
Be	0.16	1.73	4.23	1.26	6.75	110	0.14	5.1	X
Ca	NA	5320	13880	4580	11700	56	2000	31700	LN
Cd	80	0.69	1.17	0.657	1.32	109	0.3	1	X
Co	NA	3.67	7.99	3.03	10.9	109	1.05	11	X
Cu	3000	6.52	18.9	5.1	20.3	109	1	57.4	LN
Cr	400	8.73	21	6.55	34.5	110	1	28.1	X
Fe	NA	14000	23200	13200	26100	56	4200	27900	N,LN
K	NA	ND	ND	ND	ND	ND	ND	ND	ND
Li	NA	ND	ND	ND	ND	ND	ND	ND	ND
Mg	NA	2480	4760	2230	6060	56	430	6200	LN
Mn	8000	301	485	287	534	108	123	639	N,LN
Mo	NA	ND	ND	ND	ND	ND	ND	ND	ND
Na	NA	20600	29600	20100	31900	56	10700	31200	N,LN
Ni	1600	5.87	11.9	5.31	13.1	110	1.5	18	X
Pb	500	18.9	41.1	16.1	50.4	108	5.5	61	LN
Se	400	0.15	0.37	0.129	0.41	58	0.05	0.60	LN
Sr	NA	83	151	75.9	179	52	25	184	N,LN
Tl	6.4	ND	ND	ND	ND	ND	ND	ND	ND
V	560	17	41	13.5	60.3	110	1.2	58.6	X
Zn	24000	39	69	36.6	73.7	108	14.3	130	X

N = Normal distribution
LN = Log normal distribution
X = Does not fit either distribution
ND = Not determined
NA = Not available

Table A.11 Process Area Baseline Parameters

		Normal Distribution		Log-Normal Distribution				
Analyte	SAL	Mean	95.5%	Mean	95.5%	No. of Samples	Min.	Max.
As	0.4	2	3.44	1.89	3.75	42	0.8	4.4
Ag	400	0.63	1.55	0.532	1.56	41	0.305	2.2
Al	NA	59300	68700	59900	69500	29	49700	70000
Ba	5600	347	513	337	565	29	190	527
Be	0.16	1.99	4.05	1.56	8.38	41	0.14	3.8
Ca	NA	4880	7500	4720	7680	29	2000	31700
Cd	80	0.96	2.14	0.799	2.91	41	0.3	3
Co	NA	4.82	8.5	4.44	10.6	42	1.1	9
Cu	3000	11.8	50.8	8.67	29.3	41	3.2	131
Cr	400	8.73	18	11.7	26.4	41	3.7	24
Fe	NA	12.6	9210	13200	26100	56	4200	27900
K	NA	ND	ND	ND	ND	ND	ND	ND
Li	NA	ND	ND	ND	ND	ND	ND	ND
Mg	NA	2200	3990	2000	5200	43	460	4200
Mn	8000	358	592	340	687	41	129	696
Mo	NA	ND	ND	1.00	ND	ND	ND	ND
Na	NA	20400	27300	20100	28300	29	14300	28000
Ni	1600	7.1	13.6	6.42	16.4	41	1.5	19
Pb	500	25.9	56.5	22.2	68	41	7.5	82
Se	400	0.15	0.268	0.141	0.289	42	0.1	0.33
Sr	NA	95	146	90.9	166	29	43	151
Tl	6.4	ND	ND	1.00	ND	ND	ND	ND
V	560	24.4	43.4	22.4	53.4	41	7.5	48
Zn	24000	70.8	210	58.6	169	42	26.1	466

		Normal Distribution		Log-Normal Distribution				
Radionuclide	SAL	Mean	95.5%	Mean	95.5%	No. of Samples	Min.	Max.
Am-241	22	0.15	0.526	0.103	0.56	21	0.015	0.912
H-3	1.50E+04	2870	7850	2160	9920	41	300	12500
Pu-238	27	0.53	6.21	0.0282	1.03	43	0.002	18.7
Pu-239	24	2.33	9.41	0.835	20.1	40	0.034	14.7
Sr-90	8.9	0.21	0.688	0.149	0.934	41	0	1
Th-228	NA	1.34	1.78	1.32	1.91	12	0.86	1.62
Th-230	10	1.38	1.82	1.36	1.84	42	0.96	1.9
Th-232	0.88	1.33	1.71	1.31	1.8	12	0.89	1.52
U total	66.3	4.67	7.51	4.53	7.6	12	2.5	10.7
U-234	86	1.49	1.95	1.47	2.00	11	1.19	1.8
U-235	18	0.073	0.1	0.0714	0.105	11	0.095	0.5
U-238	59	1.38	1.94	1.35	2.14	11	0.785	1.77

Table A.12 Radionuclide and inorganic baseline parameters for special impact areas.

			Normal Distribution		Log-Normal Distribution	
Radionuclide	Special Impact area	SAL (UG/G)	Mean	95.5% Percentile	Mean	95.5% Percentile
Am-241 (pCi/g)	1	22	0.202	0.673	0.136	0.759
Pu-238 (pCi/g)	1	27	0.0435	0.155	0.0257	0.192
Pu-239 (pCi/g)	1	24	3.32	12.5	1.5	21.6
H-3 (nci/l)	2	1.5E+04	4.63	11	3.84	12.8

Table A.13 Semi-Volatile Organics Detected in 0 to 6 in. Grid Surface Soil Samples.

Location ID	Analyte	Concentration(ppm)	Associated SWMU or Area
21-1056	Acenaphthene	1700	21-013(b)
21-1056	Chloro-3-methylphenol [4-]	2900	
21-1056	Chlorophenol [o-]	2500	
21-1056	Dinitrotoluene [2,4-]	1700	
21-1056	Nitrophenol [4-]	3100	
21-1056	Nitrosodi-n-propylamine [N-]	1500	
21-1056	Pentachlorophenol	3900	
21-1056	Phenol	12600	
21-1056	Pyrene	1600	
21-1056	Trichlorobenzene [1,2,4-]	1500	
21-1122	Fluoranthene	400	process area
21-1198	Benzo[b]fluoranthene	400	21-013(c)
21-1198	Fluoranthene	410	
21-1198	Pyrene	470	
21-1300	Benzo[b]fluoranthene	440	process area
21-1300	Fluoranthene	790	
21-1300	Phenanthrene	630	
21-1300	Pyrene	720	

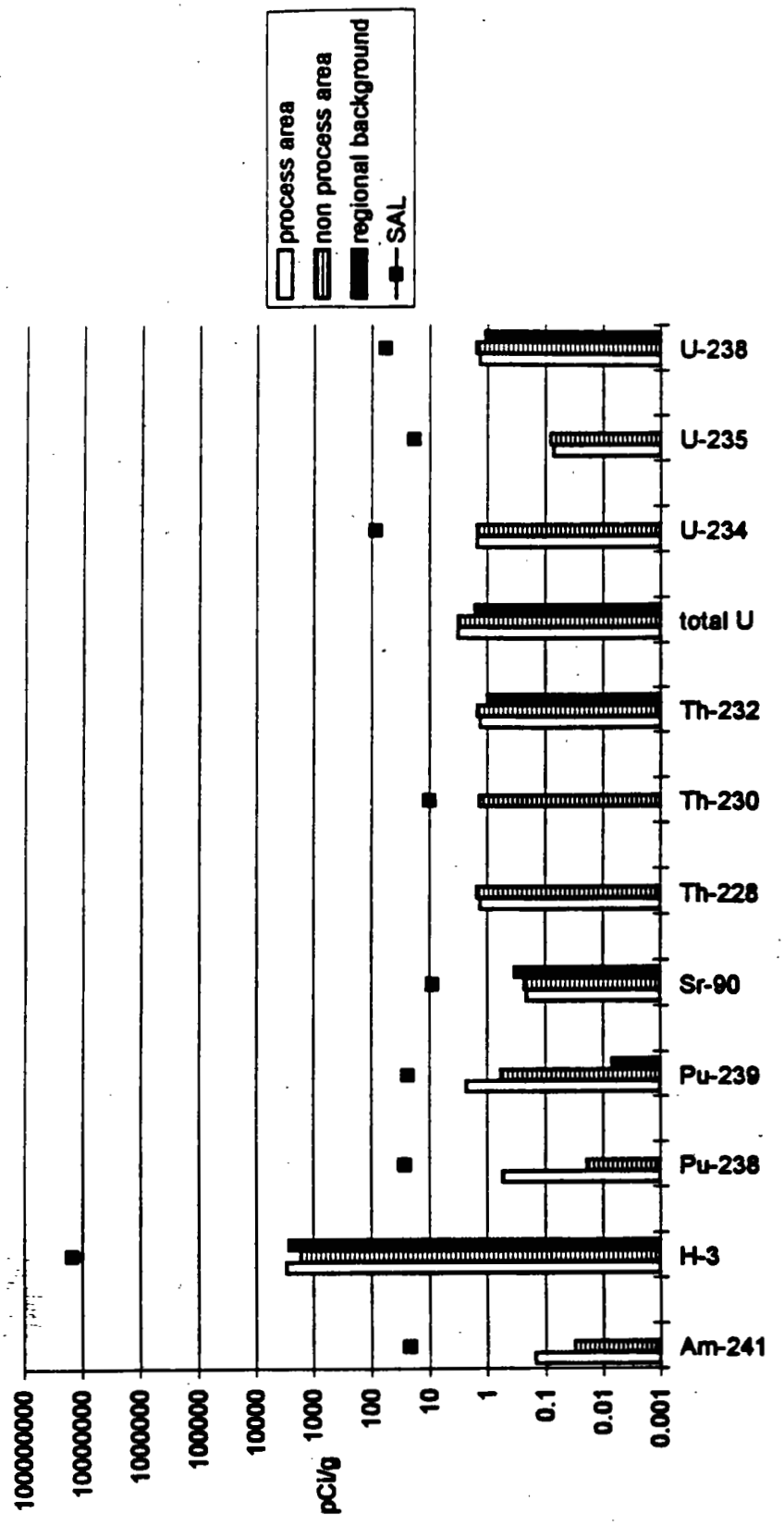

Figure A.1. Comparison of mean radiological levels for process area, non process area, and regional background. Regional background levels are from Purtyman et al., 1987. SALs are from IWP Appendix J. Tritium units are in pCi/l.

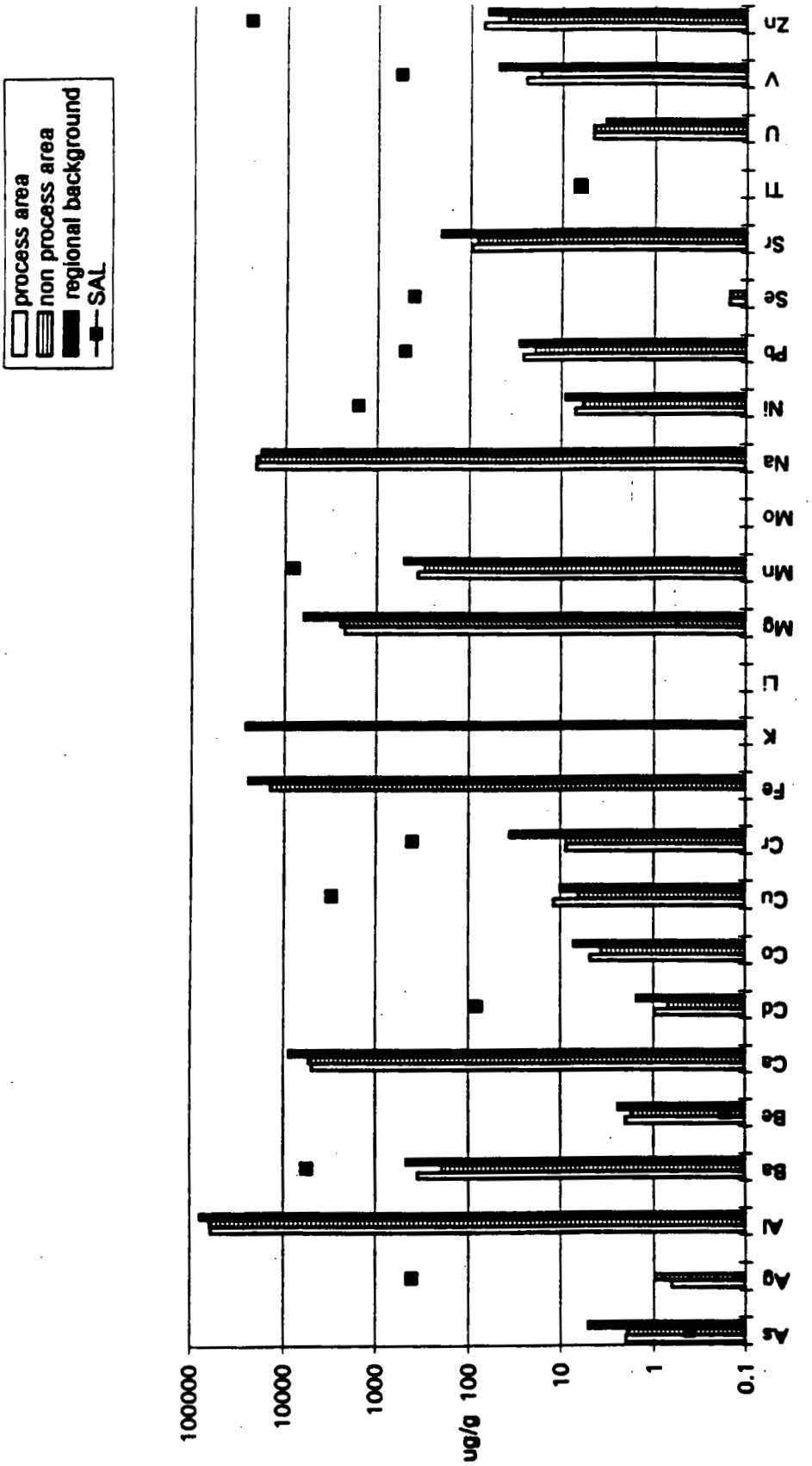

Figure A.2 Comparison of mean inorganic levels for process area, non process area and regional background. Regional background levels for Cu and Ni are from Ferenbaugh et al., 1990. All other regional background levels are from Longmire et al., 1993. SALs are from IWP, Appendix J.

APPENDIX B

INVESTIGATION OF AIRBORNE EMISSIONS DEPOSITION

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B.1 Background

This appendix provides an assessment of analyses of OU-wide 0 to 1 in. grid soil samples, as per the sampling plan presented in Chapter 13.2 of the RFI work plan. Appendix A of this phase report provides details on the sampling grid design, amended as described in Appendix A. Deposition layer sampling (0 to 1 in. sampling interval) was performed on a 40 meter by 40 meter grid covering DP Mesa from west of MDA B to the east end of the mesa, as indicated by Map 1 at the end of this phase report. Additional grid samples were collected in Los Alamos and DP Canyon. Locations that occurred on steep canyon sides or within paved areas, structures, MDAs, or other SWMUs were avoided. Additional samples were collected at some grid locations to provide spatial variability data and some field duplicates were collected.

Sampling occurred in 1992 in two rounds. The Grid 1 sampling event, from March to May 1992, sampled mesa-top areas outside the industrial area and Grid 2 sampling, from June to July 1992, included points inside the fence, mesa top points at the west and east ends of the grid, and grid locations in DP and Los Alamos Canyons. In July and August of 1993, the grid was extended by fifteen points westward up DP Canyon. Grid extension analyses were not available at the time of submission of this phase report and will be assessed in a future report.

Table B.1 summarizes the grid samples planned and actually collected and Table B.2 lists target analytes. Field quality assurance samples associated with the grid sampling are listed in Table A.1. Complete deposition layer data tabulations will be available on the FIMAD database.

The primary objective of this investigation was to characterize surface soil contamination resulting from 18 airborne deposition emission units listed as SWMUs in the RFI work plan. In addition to airborne deposition from these primary sources, environmental data discussed in the RFI work plan suggest that contamination has been redistributed by resuspension and runoff. Neighboring potential sources, such as the Omega West Reactor in Los Alamos Canyon immediately southwest of TA-21, also are considered.

Based on windrose information (see Figure 4.1-3 in the RFI work plan), airborne contamination from TA-21 stacks probably was deposited preferentially to the northeast of the industrialized area. It was

anticipated that the 18 SWMU sources of airborne contamination listed above might not be distinguished by the deposition layer investigation, and this expectation was borne out by the investigation described in this appendix. The sampling grid was set up to detect all localized contamination areas of minimum size 3000 m^2 in all directions from the point-sources.

Soil sampling in the 0 to 1 in. interval is referred to as "deposition layer sampling." In relatively undisturbed parts of the OU, it was anticipated that relatively immobile contaminants deposited by airborne deposition would be most concentrated in surficial material. However, this hypothesis does not necessarily apply either to highly mobile contaminants (e.g., tritium) or to disturbed soils (as in much of the fenced industrial part of the site). Data from the 0 to 6 in. grid samples, collected at about one-third of the deposition layer grid sites as described in Appendix A, are used to supplement the 0 to 1 in. grid data.

The following two criteria were used to evaluate airborne deposition contamination:

- Deposition layer contaminant concentrations should decrease with distance from the known point sources and be highest along the prevailing northeast wind direction.
- At any grid location, concentrations in the 0 to 1 in. surface layer should exceed concentrations found in the 0 to 6 in. interval.

Where elevated levels of hazardous or radioactive constituents are observed, a preliminary assessment of the associated risk will be carried out as described in Appendix A of this phase report.

In addition to assessing airborne contaminant deposition, the deposition layer data also are used to identify areas of elevated contaminant concentrations for further assessment.

Except for the omission of uranium and thorium isotopes, deposition layer target analytes are the same as those identified in Appendix A for the 0 to 6 in. surface soil grid samples (see Table B.2). The results of the two investigations are assessed jointly in this chapter to characterize the surface of the mesa top (also see Chapters 12 and 13 of the RFI Work Plan).

An expected consequence of the deposition layer investigation was aggregation of the 18 SWMUs associated with airborne emissions, because historical data indicated the unlikelihood that contamination due to these emissions can be assigned to individual point sources. The data assessment described in this appendix confirms this expectation.

Deposition layer data are compared in this appendix to non-process area baseline concentrations (see Appendix A) and SALs. Sample concentrations exceeding the 95.5 percentile of the non-process area baseline were evaluated for impact by other source terms.

B.2 Deposition Layer Target Analytes

Deposition layer grid samples were analyzed for inorganics and radionuclides identified in Table B.2. Because process knowledge indicates that organic compounds were not released from the airborne emissions SWMUs, organics were not included in the analytical suite.

B.3 Technical Approach

Deposition layer data were assessed by a multi-step process to discriminate contamination patterns due to air emissions from other types of releases and from natural geologic variations. Data were sorted by analyte concentration and compared to the upper 95.5 percentile of the process area baseline to identify sample locations that might require further assessment. Hand-plotted maps were used to initially identify locations with possible contamination not derived from airborne deposition.

This exercise was complicated by the fact that no individual TA-21 target analyte can be linked solely to airborne releases. Therefore, a comparison to 0 to 6 in. grid data was made to determine if contaminants were increasing or decreasing with depth. Contamination derived from airborne deposition (with the exception of tritium) should decrease rapidly with depth because strong retardation of downward migration into subsurface soils is expected.

Three additional assumptions from Section 13.2 of the work plan were used to assess the deposition layer data. The first assumption is that the predominant wind direction at TA-21 is from the southwest

and therefore contaminant levels due to airborne deposition should be most enhanced to the northeast and decrease radially from the industrial area. The second assumption is that, other than the impact of the Omega West Reactor in Los Alamos Canyon, other Laboratory OUs have made no significant contribution to TA-21 contamination. Lastly, it is assumed that contamination associated with other types of TA-21 releases will be discernible from airborne deposition.

A two-phase analysis next was performed to determinewhether airborne emissions contributed to the elevated contamination levels detected in some deposition layer samples. First, SWMUs with known or suspected surface contamination (e.g., Area T) which potentially affect an area extending outward from the process area were identified. Sample locations near these SWMUs usually were excluded from the deposition layer assessment and are assessed with SWMU-specific investigations.

Next, factors influencing airborne emissions, such as predominant wind direction, distance from the individual area, surface drainage patterns, and vertical concentrations of contaminants, were taken into account. For example, elevated contaminant concentrations that occur in drainage features from the downgradient process area are not likely to be due only to airborne deposition.

Also, at any single grid location, the observation of higher concentrations in a 0 to 1 in. sample compared to the corresponding 0 to 6 in. sample generally is taken as an indication of airborne deposition. Exceptions may include areas where soils have been mechanically disturbed or where mechanical disturbance may have caused dust generation and subsequent deposition.

B.4 Deposition Layer Radionuclides

Assessment of airborne deposition patterns at TA-21 is complicated by other types of releases which are known to have occurred at the site. For example, americium and plutonium contamination in DP Canyon has resulted in part from surface releases from MDA T and vicinity outfalls as well as from TA-21 stacks.

The deposition layer data were compared to SALs to determine if surface layer contamination is of concern at any grid point. Further assessment of those sample locations falling above the 95.5 percentile of the non-process area baseline also was performed. Table B.3 lists all location IDs where

cumulative radiological SAL percentages exceed a value of 10%. The highest sum of SAL percentages exceeds 100% at only one deposition layer grid location. This location, ID 21-1086, is adjacent to a number of SWMUs which will be addressed in a future SWMU-specific phase report. The next highest cumulative SALs were as follows: one location in the 80% range, three locations in the 70% range, and three locations in the 60% range. Cumulative SALs for all other locations fell well below 50%.

Although slightly elevated radionuclide contamination clearly exists, the SAL comparison demonstrates that risk levels are acceptable for any use scenario over the grid area which was sampled. Therefore, the deposition layer grid area requires neither further investigation nor baseline risk assessment, with the exception of location ID 21-1086 as discussed above.

In the remainder of this section, selected deposition layer target analytes are discussed individually.

Americium-241 Americium analysis was obtained on approximately 50% of the deposition layer samples. Concentrations ranged from 0.002 to 1.42 pCi/g. Approximately 4.3% of the analytical results were above the upper 95.5 percentile (0.129 pCi/g) of the non-process area baseline and all values were far below the SAL of 22.0 pCi/g. The most elevated levels were within the process area and the area immediately downgradient and northwest of MDA-T, a known source of americium-241. However, some samples with marginally elevated americium-241 levels do not lie in obvious drainages from known sources and thus are not likely due to surface water transport. For such locations it is likely to be that both aeolian and runoff transport have occurred.

Two location (IDs 21-1119 and 21-10279) were excluded from the data set because higher americium concentrations occurred in the corresponding 0 to 6 in. samples. Two additional locations (IDs 21-1047 and 21-1168) were excluded because of obvious association with contaminated outfalls (SWMUs 21-023(c) and 21-024(k), respectively).

Table B.4 identifies samples with americium levels exceeding the 95.5 percentile of the non-process area baseline. Table B.4 also identifies the sample locations removed from the evaluation deposition layer due to close proximity to outfalls. Figure B.1 graphically compares americium levels in 0 to 1 in. and 0 to 6 in. grid samples, showing that the surficial layer generally has the higher levels.

Plutonium-238 - Plutonium-238 concentrations ranged from below the detection limit to a maximum of 50.2 pCi/g over the 0 to 1 in. sampling grid. An outlier from location ID 21-1086, near outfall 21-024(d), is the only datum which exceeds the plutonium-238 SAL of 27.0 pCi/g. About 5.1% of the plutonium-238 concentrations were above the 95.5 percentile of the non-process baseline (0.239 pCi/g). As for americium-241, the grid sampling indicates that surficial plutonium-238 contamination is concentrated in the process area and in DP canyon. Onet locations was excluded from the data set because higher concentrations of plutonium-238 were observed in the corresponding 0 to 6 in. sample. An additional two locations near contaminated outfalls were excluded.

Locations where plutonium-238 levels exceed the 95.5 percentile of the non-process area baseline (0.239 pCi/g) are presented in Table B.5. Figure B.2 graphically compares Pu-238 levels in 0 to 1 in. and 0 to 6 in. grid samples. As for americium-241, the surficial layer locations generally contain the higher contamination levels.

Plutonium-239/240 - Plutonium-239/240 concentrations ranged from 0.005 to 22.5 pCi/g, with about 7% of the analyses esceeding the 95.5 percentile of the non-process area baseline (2.04 pCi/g). The maximum plutonium-239/240 level used in the analysis was 17.6 pCi/g, compared to the SAL of 24.0 pCi/g. Plutonium-239/240 and plutonium-238 patterns are similar over the grid, but plutonium-239/240 is relatively more concentrated in the section of DP Canyon northwest of MDA-T. A few outliers were identified from an area also exhibiting slightly elevated plutonium 239/240, indicating contamination from sources in addition to airborne emissions. One consistent outlier with respect to many of the analytes is location ID 21-1079 near outfall SWMU 21-024(e).

Three locations were removed from the data set because higher plutonium concentrations were observed in the corresponding 0 to 6 in. sample. Three other locations were removed due to obvious association with contaminated outfalls.

Deposition layer samples with plutonium-239/240 levels above the 95.5 percentile of non-process area baseline are presented in Table B.6. Figure B.3 graphically compares levels in 0 to 1 in. and 0 to 6 in. samples.

Total Uranium - Total uranium concentrations across the grid ranged from 2 to 24 ppm. Only about 7% of the 287 samples exceeded the 95.5 percentile of the non-process area baseline (7.4 ppm). The highest total uranium level used in the analysis was 16.0 ppm, well below the total uranium SAL of 66.3 ppm. The uranium distribution across the grid differed from the plutonium and americium distributions, with 14 of the 22 elevated levels occurring within the southwestern portion of the mesa.

Three locations were excluded from the data set because higher concentrations of uranium were observed in the corresponding 0 to 6 in. sample. One additional location was excluded because of proximity to outfall SWMU 21-024(k).

Total uranium samples exceeding the 95.5 percentile of Category 1 baseline are presented in Table B.7. Figure B.4 graphically compares total uranium level in 0 to 1 in. and 0 to 6 in. grid samples.

Tritium - Tritium levels exceed the 95.5 percentile of the non-process area baseline (4590 pCi/1) at 82 of the 287 grid locations. At the location with the highest result (ID 21-1107, at the southwest corner of building TA-21-3), the level was 2.3×10^3 nCi/l soil moisture, compared to the SAL of 1.5×10^4 nCi/l. As expected, tritium levels were systematically elevated in the vicinity of TSTA. Also as expected, elevated tritium levels were observed in Los Alamos Canyon, likely due to known releases from the Omega West Reactor located upgradient of the grid points. One marginal tritium outlier (7.20 nCi/l) is situated at location ID 21-1007 on the far southwestern boundary of DP mesa, where total uranium also was found to be marginally elevated.

Because tritium is mobile through the soil column, no locations were excluded because higher concentrations were observed in the corresponding 0 to 6 in. sample. One location (ID 21-1194) was removed because of obvious association with outfall SWMU 21-024(i).

Tritium analytes exceeding the 95.5 percentile of the non-process baseline are presented in Table B.8. Figure B.5 graphically compares tritium levels in 0 to 1 in. and 0 to 6 in. grid samples. It is evident that concentrations are generally higher in the deposition layer. However, some exceptions occur around TSTA.

Strontium-90 - Thirty-four of the 287 strontium-90 analyses exceeded the 95.5 percentile of the non-process area baseline. The maximum observed strontium-90 concentration (2.0 pCi/g) was well below the

SAL of 8.90 pCi/g. No distinct distribution pattern was observed across the grid except that levels were generally elevated in the MDA-T drainage. Levels within the process area did not exceed the 95.5 percentile. These data indicate that strontium-90 levels of concern from airborne deposition do not exist over the sampled grid area.

In lower DP canyon, five locations were identified with strontium-90 levels above the 95.5 percentile of the non-process area baseline. Although locations fell within the drainage channel of outfall SWMU 21-026(b), strontium-90 was not detected in sampling of that outfall. Therefore, these locations were left in the assessment even though they may have been influenced by sources other than airborne deposition. Two locations (21-1088 and 21-1173) were removed from the assessment because of higher levels in the 0 to 6 in. samples.

Strontium-90 analytes above the 95.5 percentile of the non-process area baseline are presented in Table B.9. Figure B.6 graphically compares strontium-90 levels in the 0 to 1 in. and 0 to 6 in. grid samples, showing that levels generally are higher in the deposition layer.

B.5 Deposition Layer Inorganics

Although process knowledge indicates that detectable airborne releases of inorganic contaminants is unlikely to have occurred at TA-21, inorganic analysis was performed on all 0 to 1 in. Grid 2 samples. Data assessment was performed as with radiological analytes, including a comparison to the 95.5 percentile of the non-process area baseline and to SALs. Table B.10 tabulates inorganic data exceeding the 95.5 percentile of the non-process area baseline. The maximum cumulative SAL percentage was 62% with all others below 31%, showing that surficial inorganic contamination is not of concern over the sampled grid area. Therefore, no further investigation of site-wide inorganic levels is warranted. The remainder of this appendix assesses the inorganic data analyte by analyte.

Aluminum - All samples were analyzed for aluminum by ICPES, but Grid 1 samples were extracted with hydrofluoric acid while Grid 2 samples were extracted with nitric acid. Grid 1 results agreed with regional background as determined by neutron activation analysis. Grid 2 results were lower by about an order of magnitude and were not used for assessment. No Grid 1 aluminum values exceeded the 95.5 percentile (60300 ppm) of the non-process baseline.

Arsenic -Grid 1 deposition layer samples were analyzed for arsenic by (ETVAA) with an unspecified detection limit. Grid 2 analyses used ICPES with a reported detection limit between 50 and 65 ppm and all results were reported as non-detects. Only Grid 1 data were used for further assessment.

Only 5 of the 198 Grid 1 deposition layer samples had arsenic levels exceeding the 95.5 percentile of the non-process area baseline (3.67 ppm). The overall range was 0 to 25 ppm with only one location (ID 21-1173) being above 6.5 ppm, above the SAL of 0.40 ppm but consistent with regional background. One of the four outlier locations (ID 21-1079) is at the discharge point of outfall SWMU 21-24(e), which also had elevated radionuclide levels. This location will be addressed in Phase Report 1C with SWMU 21-024(e) data. The four remaining arsenic outliers are near TSTA. Is is highly unlikely that airborne arsenic was released from TSTA, based on process knowledge and the fact that the three outlier locations are fairly localized.

Barium - Grid 1 and Grid 2 barium analyses were not comparable due to differences in sample dissolution procedures. All barium values were below the 95.5 percentile (192 ppm) of the non-process area baseline and far below the SAL of 5600 ppm.

Beryllium - Grid 1 and Grid 2 beryllium results were not comparable due to differences in sample dissolution procedure. Because all Grid 2 beryllium values were below regional background and the SAL of 0.16 ppm, the data were assessed no further.

Cadmium - Sixteen grid locations exhibited cadmium levels above the 95.5 percentile of the non-process area baseline (1.17 ppm). No obvious airborne deposition pattern was noted. Sample location ID 21-1079 was excluded because of association with SWMU 21-024(e) and will be addressed in Phase Report 1C. Of the remaining four locations, the highest value was only 1.5 times the upper range of regional background. Since no cadmium data exceeded the SAL of 80 ppm, the data were assessed no further.

Cobalt - Cobalt analyses were in agreement with the regional background range (0.44 - 23.3 ppm). Eighteen analyses exceeded the 95.5 percentile of the non-process area baseline (7.99 ppm). The highest cobalt concentration was 25 ppm, compared to the baseline mean of 4.1 ppm and the regional background mean of 7.14. No SAL has been defined for cobalt. Cobalt data were assessed no

further. Table B.11 tabulates locations where cobalt levels exceeded the 95.5 percentile of the non-process area baseline.

Chromium - Seventeen samples exhibited a chromium level exceeding the 95.5 percentile of the non-process area baseline (20.95 ppm). This sample from location ID 21-1185 near the southeast corner of the TSTA building, had a chromium level of 111 ppm, compared to the 95.5 percentile baseline value of 20.95 ppm and a SAL of 400 ppm. Since the highest concentration was 111 ppm, and that level is well below the SAL, the chromium data will be assessed no further.

Copper and Iron - All copper and iron analyses were below the 95.5 percentile of Category 1 baseline and far below the SAL of 3000 ppm. No SAL for iron has been defined.

Lead - The non-process area baseline range for lead is 6.6 to 61 ppm. Lead levels for 37 samples fell above the baseline 95.5 percentile of 4.1.8 ppm. The highest level (location ID 21-1005 at the westernmost portion of the grid, 300 ppm) is well below the SAL of 500 ppm. The locations of these 37 samples were spread across the grid. There is no indication or pattern to suggest that the lead in these soils was impacted by airborne deposition. These data indicate that surficial lead levels are not of concern over the sampled grid area. Table B.12 lists deposition layer samples for which lead levels exceed the 95.5 percentile (41.1 ppm) of the non-process area baseline.

Lithium and Potassium - Due to analytical procedural problems, potassium and lithium data were not usable for comparison to 0 to 6 in. grid data or for developing a baseline. Since potassium and lithium are not of concern at TA-21, no attempt was made to assess the data further.

Magnesium - Due to differences in sample dissolution procedure, only Grid 1 data were used to assess deposition layer magnesium concentrations. Only two sample locations had concentrations exceeding the 95.5 percentile of the non-process area baseline (4760 ppm). Concentrations for locations 21-1203 and 21-1034, located on opposite sides of DP Mesa, were 22000 and 17000 ppm, respectively, both near the upper range of regional background. No SAL has been defined for magnesium.

Manganese - Manganese levels were comparable for Grid 1 and Grid 2 data and ranged between 111 and 827 ppm at three sample locations. The 95.5 percentile of the non-process baseline (485 ppm) was

slightly exceed at location IDs 21-1173, 21-1192, and 21-1039 (concentrations of 827, 734, and 730 ppm respectively). The SAL for manganese is 8000 ppm and one order of magnitude above the highest level detected.

Molybdenum - A non-process area baseline was not developed for molybdenum due the high number of non-detects in the 0 to 6 in. grid data. Molybdenum levels in 0 to 1 in. samples were slightly elevated above regional background at two well separated locations (IDs 21-1172 and 21-1221, 5 and 21 ppm, respectively). No SAL has been developed for molybdenum.

Nickel - The non-process area baseline range for nickel is 1.6 to 19 ppm. All deposition layer nickel data fall within this range and well below the SAL of 1600 ppm.

Sodium - Grid 2 analyses for sodium for 0 to 1 in. samples were not used due to differences in sample dissolution procedure. The sodium range Grid 1 data was 10700-31200 ppm, consistent with the non-process area baseline.

Selenium - Selenium analyses were reported with very different detection limits for Grid 1 and Grid 2 deposition layer samples due to the use of ETVAA for Grid 1 sample and ICPES for most Grid 2 samples. The Grid 1 data and those Grid 2 data obtained by ETVAA were assessed. No selenium analyses exceeded the 95.5 percentile of the non-process area baseline (0.36 ppm) or the SAL of 400 ppm.

Strontium - Only three strontium analyses exceed the 95.5 percentile (151 ppm) of the non-process area baseline (location IDs 21-1250 189 ppm; 21-1290 153 ppm; and 21-1052 152 ppm).

Thallium - No non-process area baseline was established for thallium. Due to analytical data deficiencies were encountered with depositional layer thallium analyses, thallium data were not assessed in detail. Process knowledge indicates thallium is not a contaminant of concern at TA-21.

Vanadium - All vanadium deposition layer results were far below the SAL of 560 ppm and consistent with the non-process area baseline. Only seven locations exceeded the 95.5 percentile of the non-process area baseline (41 ppm).

Zinc - Nine deposition layer zinc analyses fell outside the non-process area baseline range of 1.2 to 130 ppm, but all were well below the SAL of 24000 ppm.

A description of 18 incinerators, stacks, and filter houses is given in Table B.13.

Table B.1 Sampling Summary for 0 to 1 inch Deposition Layer Grid Soil Samples

Sampling Event	Dates	Surface Soil Samples		QA Samples*	
		Planned	Collected	Planned	Collected
Grid 1	March-May 1992	115	133	18	22
Grid 2	June-July 1992	115	165	19	43

*Denotes rinsate blanks, field blanks, and duplicate samples associated specifically with 0 to 1 in. samples.

Table B.2 Deposition Layer Target Analytes

Radionuclides	Inorganics	
* Americium-241	Arsenic	Lithium
* Plutonium-238	Aluminum	Manganese
* Plutonium-239	Barium	Molybdenum
* Tritium	Beryllium	Sodium
* Strontium-90	Cadmium	Nickel
* Uranium-total	Cobalt	*Lead
*Cesium-137	Chromium	Selenium
	Copper	Strontium
	Iron	Thallium
	Potassium	Vanadium
		Zinc

*Potential TA-21 Contaminants of Concern, based on process knowledge and available environmental data as outlined in the RFI work plan.

Table B.3 Comparison of deposition layer radiological data to screening action levels (SALs). Only values with cumulative SAL percentages above 10.0% are listed. SALs are taken from IWP Appendix J. U denotes total uranium (ppm). Other analyte units are pCi/g except for H-3 (nCi/l)

Location	Analyte	Result	SAL	% of Individual SAL	Cumulative SAL %
21-1018	Sr-90	1.00	8.9	11.24	
	U	6.95	66.3	10.48	21.72
21-1019	Sr-90	0.9	8.9	10.11	10.11
21-1031	U	7.44	66.3	11.2	
	Sr-90	0.80	8.9	8.99	20.21
21-1039	Sr-90	1.3	8.9	14.61	
	U	6.24	66.3	9.41	24.02
21-1040	U	8.48	66.3	12.8	12.8
21-1043	U	11.09	66.3	16.72	16.72
21-1060	Sr-90	0.90	8.9	10.11	
	Pu-239	2.27	24	9.48	19.59
21-1066	Pu-239/240	3.32	24	13.85	
	Pu-238	0.03	27	0.10	13.95
21-1070	Pu-239/240	3.37	24	14.02	14.02
21-1077	Pu-239/240	5.08	24	21.18	
	Sr-90	0.90	8.9	10.11	
	U	5.35	66.30	8.07	
	Am-241	0.45	22	2.04	
	Pu-238	0.06	27	0.23	41.63
21-1081	Sr-90	1.7	8.9	19.10	19.10
21-1085	Pu-238	6.97	27	25.81	
	Am-241	0.60	22	2.73	28.55
21-1086	Pu-238	50.15	27	185.74	
	Pu-239/240	17.51	24	72.96	
	Am-241	0.99	22	4.51	
	H3	10.2	1.5×10^4	0.07	263.28
21-1093	Pu-239/240	4.28	24	17.83	
	Am-241	0.20	22	0.89	
	Pu-238	0.16	27	0.59	19.30

21-1094	Pu-239/240	2.87	24	11.96	
	Pu-238	0.12	27	0.46	
	H3	10.1	1.5×10^4	0.07	12.48
21-1096	Pu-239/240	4.98	24	20.75	
	Pu-238	0.03	27	0.11	20.86
21-1102	Pu-239/240	3.47	24	14.44	
	Sr-90	1.00	8.9	11.24	
	Pu-238	0.04	27	0.16	25.84
21-1107	U	10.22	66.30	15.41	
	H3	2300	1.5×10^4	15.33	
	Pu-239/240	2.83	24	11.79	
	Am-241	0.30	22	1.38	
	Pu-238	0.11	27	0.41	44.33
21-1108	Pu-239/240	4.92	24	20.48	
	Pu-238	0.04	27	0.14	20.62
21-1110	Pu-239/240	4.41	24	18.38	
	Pu-238	0.25	27	0.91	
	H3	22.4	1.5×10^4	0.15	19.43
21-1112	Pu-239/240	5.10	24	21.26	
	Am-241	0.31	22	1.39	
	Pu-238	0.04	27	0.16	22.81
21-1113	U	7.30	66.30	11.01	11.01
21-1116	Pu-239/240	5.62	24	23.42	
	Am-241	0.60	22	2.74	
	H3	136	1.5×10^4	0.91	
	Pu-238	0.16	27	0.59	27.65
21-1118	Pu-238	9.26	27	34.3	
	Pu-239/240	7.91	24	32.96	
	H3	16.0	1.5×10^4	0.11	67.36
21-1119	Pu-239/240	17.65	24	73.52	
	Am-241	0.96	22	4.35	
	Pu-238	0.13	27	0.48	78.36
21-1123	Pu-239/240	3.30	24	13.77	
	Am-241	0.25	22	1.14	
	Pu-238	0.03	27	0.12	15.03
21-1131	Pu-239/240	3.90	24	16.25	
	Pu-238	0.10	27	0.36	16.61
21-1135	Pu-239/240	4.553	24	18.97	
	Pu-238	0.06	27	0.20	19.17

21-1137	Sr-90	0.90	8.9	10.11	
	Am-241	0.19	22	0.84	
	Pu-238	0.11	27	0.40	11.35
21-1141	Sr-90	2.00	8.9	22.47	
	Pu-239/240	3.68	24	15.31	
	Pu-238	0.10	27	0.36	38.14
21-1142	Pu-239/240	9.16	24	38.16	
	U	5.49	66.3	8.28	
	Pu-238	0.24	27	0.88	47.32
21-1147	Sr-90	0.80	8.9	8.99	
	Am-241	0.23	22	1.05	
	Pu-238	0.03	27	0.13	10.17
21-1152	Pu-239/240	17.30	24	72.08	
	Am-241	0.58	22	2.62	
	H3	38.1	1.5×10^4	0.25	74.96
21-1153	Pu-239/240	3.27	24	13.64	
	Pu-238	0.04	27	0.14	13.77
21-1154	Pu-239/240	15.31	24	63.79	
	Pu-238	0.13	27	0.49	64.28
21-1158	Pu-239/240	2.42	24	10.10	
	Am-241	0.20	22	0.92	
	Pu-238	0.07	27	0.27	11.30
21-1160	Pu-239/240	14.78	24	61.58	
	Am-241	0.53	22	2.42	
	Pu-238	0.09	27	0.33	64.33
21-1165	Pu-239/240	12.50	24	52.08	
	Sr-90	1.20	8.9	13.48	
	U	5.63	66.3	8.49	
	Am-241	0.76	22	3.45	
	Pu-238	0.16	27	0.59	78.09
21-1166	Pu-239/240	13.26	24	55.25	
	Sr-90	1.20	8.9	13.48	
	U	5.60	66.3	8.45	
	Am-241	1.42	22	6.47	
	Pu-238	0.19	27	0.69	84.35
21-1173	Sr-90	0.90	8.9	10.11	
	U	5.35	66.3	8.07	
	Am-241	0.40	22	1.81	
	Pu-238	0.07	27	0.25	20.25

21-1182	Sr-90	1.30	8.9	14.61	
	Pu-238	0.12	27	0.43	15.03
21-1183	Pu-239/240	2.69	24	11.19	
	Am-241	0.13	22	0.60	
	Pu-238	0.02	27	0.09	11.88
21-1190	Pu-239/240	2.38	24	9.92	
	Am-241	0.49	22	2.23	
	Pu-238	0.04	27	0.13	12.28
21-1192	Pu-239/240	3.10			
	Sr-90	0.80	8.9	8.99	
	Am-241	0.27	22	1.21	
	Pu-238	0.04	27	0.14	
	H3	6.40	1.5×10^4	0.04	23.28
21-1197	Pu-239/240	3.09	24	12.88	
	Pu-238	0.02	27	0.09	
	H3	5.70	1.5×10^4	0.04	13.00
21-1202	Pu-239/240	2.51	24	10.48	
	Pu-238	0.02	27	0.09	10.56
21-1224	Sr-90	1.30	8.9	14.61	
	Pu-239/240	2.90	24	12.09	
	U	5.35	66.30	8.07	
	Pu-238	0.03	27	0.11	34.88
21-1248	Sr-90	1.50	8.9	16.85	
	Pu-239/240	2.51	24	10.45	
	U	5.21	66.3	7.86	
	Pu-238	0.04	27	0.14	35.31
21-1249	Sr-90	1.00	8.9	11.24	11.24
21-1250	Sr-90	1.80	8.9	20.22	
	Am-241	0.13	22	0.59	20.82
21-1262	Sr-90	1.30	8.9	14.61	14.61
21-1267	Sr-90	1.30	8.9	14.61	14.61
21-1269	U	7.16	66.3	10.80	10.80
21-1270	Sr-90	1.70	8.9	19.10	
	Am-241	0.07	22	0.34	19.44
21-1271	Sr-90	1.20	8.9	13.48	13.48
21-1277	Sr-90	1.20	8.9	13.48	
	Am-241	0.10	22	0.46	13.94
21-1283	Sr-90	0.90	8.9	10.11	10.11

Table B.4 Deposition Layer Samples for which Americium-241 Levels Exceed the 95.5 Percentile (0.129 pCi/g) of the Non-Process Area Baseline

Location ID	Sample Number	Concentration (pCi/g)
21-1166	AAA0187	1.42
21-1290	AAA0181	1.31
21-1255	AAA0373	1.05
21-1079	AAA0239	1.02
21-1130	AAA0594	1.00
21-1086	AAA0565	0.992
21-1119	AAA0135	0.958
21-1165	AAA0403	0.759
21-1116	AAA0588	0.603
21-1085	AAA0564	0.601
21-1152	AAA0413	0.576
21-1125	AAA0139	0.549
21-1160	AAA0185	0.532
21-1190	AAA0392	0.491
21-1149	AAA0179	0.487
21-1077	AAA0110	0.449
21-1148	AAA0177	0.411
21-1173	AAA0159	0.399
21-1172	AAA0189	0.343
21-1300	AAA0573	0.343
21-1112	AAA0429	0.305
21-1107	AAA0580	0.304
21-1192	AAA0195	0.267
21-1123	AAA0425	0.251
21-1147	AAA0415	0.232
21-1128	AAA0423	0.231
21-1150	AAA0599	0.229
21-1158	AAA0410	0.203
21-1093	AAA0569	0.195
21-1155	AAA0147	0.190
21-1082	AAA0438	0.189
21-1111	AAA0578	0.189
21-1137	AAA0529	0.185
21-1144	AAA0145	0.173
21-1301	AAA0605	0.167
21-1196	AAA0389	0.156
21-1045	AAA0092	0.140
21-1103	AAA0571	0.133
21-1183	AAA0395	0.131
21-1250	AAA0066	0.130

Locations excluded because concentrations were higher in the 0 to 6 in. samples

Location ID	Sample Number	Concentration (pCi/g)
21-1079	AAA0239	1.02
21-1119	AAA0135	0.958

Locations Eliminated due to Outfall Proximity

Location ID	Sample Number	Concentration (pCi/g)	Outfalls
21-1047	AAA0211	0.197	21-023(c)
21-1168	AAA0152	0.228	21-024(k)

Table B.5 Deposition Layer Samples for which Plutonium-238 Levels Exceed the 95.5 Percentile (0.239 pCi/g) of the Non-Process Area Baseline

Location ID	Sample Number	Concentration (pCi/g)
21-1086	AAA0565	50.2
21-1118	AAA0589	9.26
21-1085	AAA0564	6.97
21-1092	AAA0567	1.75
21-1130	AAA0594	0.625
21-1127	AAA0593	0.522
21-1115	AAA0586	0.494
21-1125	AAA0139	0.339
21-1290	AAA0181	0.284
21-1110	AAA0577	0.245

Locations Excluded Because Plutonium-238 Concentrations were Greater than the 0 to 6 in. Samples

Location ID	Sample Number	Concentration (pCi/g)
21-1122	AAA0591	0.474

Table B.6 Deposition Layer Samples for which Plutonium-239/240 Levels Exceed the 95.5 Percentile (2.04 pCi/g) of the Non-Process Area Baseline

Location ID	Sample Number	Concentration (pCi/g)
21-1119	AAA0135	17.6
21-1086	AAA0565	17.5
21-1152	AAA0413	17.3
21-1154	AAA0183	15.3
21-1160	AAA0185	14.8
21-1166	AAA0187	13.3
21-1165	AAA0403	12.5
21-1142	AAA0172	9.16
21-1118	AAA0589	7.91
21-1116	AAA0588	5.62
21-1112	AAA0429	5.10
21-1077	AAA0110	5.08
21-1096	AAA0127	4.98
21-1108	AAA0430	4.92
21-1135	AAA0420	4.55
21-1110	AAA0577	4.41
21-1093	AAA0569	4.28
21-1131	AAA0422	3.90
21-1141	AAA0418	3.68
21-1102	AAA0432	3.47
21-1070	AAA0502	3.37
21-1066	AAA0103	3.32
21-1123	AAA0425	3.30
21-1153	AAA0412	3.27
21-1102	AAA0432	3.14
21-1192	AAA0195	3.10
21-1197	AAA0200	3.09
21-1224	AAA0383	2.90
21-1094	AAA0570	2.87
21-1107	AAA0580	2.83
21-1171	AAA0401	2.81
21-1183	AAA0395	2.69
21-1202	AAA0388	2.51
21-1248	AAA0374	2.51
21-1158	AAA0410	2.42
21-1190	AAA0392	2.38
21-1191	AAA0391	2.35
21-1162	AAA0149	2.33
21-1060	AAA0101	2.27
21-1170	AAA0399	2.27
21-1144	AAA0145	2.20
21-1174	AAA0538	2.11

Location ID	Sample Number	Concentration (pCi/g)
21-1082	AAA0438	2.09
21-1100	AAA0129	2.04

Locations Excluded Because Plutonium-239/240 Concentrations were Greater in the 0 to 6 in. Samples

Location ID	Sample Number	Concentration (pCi/g)
21-1128	AAA0423	3.31
21-1136	AAA0143	2.21
21-1290	AAA0181	2.35

Locations Eliminated due to Outfall Proximity

Location ID	Sample Number	Concentration (pCi/g)	Outfalls
21-1043	AAA0210	4.46	21-023(c)
21-1047	AAA0211	3.09	21-024(k)
21-1079	AAA0239	22.5	21-024(e)

Table B.7 Deposition Layer Samples for which Uranium Levels Exceed the 95.5 Percentile (7.42 ug/g) of the Non-Process Area Baseline

Location ID	Sample Number	Concentration (ug/g)
21-1043	AAA0210	16.0
21-1107	AAA0580	14.7
21-1040	AAA0252	12.2
21-1176	AAA0397	11.0
21-1031	AAA0247	10.7
21-1113	AAA0581	10.5
21-1269	AAA0267	10.3
21-1018	AAA0481	10.0
21-1013	AAA0469	9.30
21-1022	AAA0487	9.23
21-1025	AAA0492	9.06
21-1039	AAA0208	8.98
21-1016	AAA0478	8.90
21-1291	AAA0254	8.30
21-1165	AAA0403	8.10
21-1166	AAA0187	8.06
21-1050	AAA0219	8.00
21-1142	AAA0172	7.90
21-1063	AAA0235	7.70
21-1077	AAA0110	7.70
21-1173	AAA0159	7.70
21-1224	AAA0383	7.70
21-1026	AAA0496	7.60
21-1075	AAA0503	7.50
21-1248	AAA0374	7.50

Locations Excluded Because Plutonium-239/240 Concentrations were Greater in the 0 to 6 in. Samples

Location ID	Sample Number	Concentration (ug/g)
21-1024	AAA0488	10.2
21-1079	AAA0239	24.0
21-1125	AAA0139	7.90

Locations Eliminated due to Outfall Proximity

Location ID	Sample Number	Concentration (ug/g)	Outfalls
21-1168	AAA0152	11.0	21-024(k)

Table B.8 Deposition Layer Samples for which Tritium Levels Exceed the 95.5 Percentile (4590 pCi/l) of the Non-Process Area Baseline

Location ID	Sample Number	Concentration (pCi/l)
21-1107	AAA0580	2.3E+06
21-1116	AAA0588	136300
21-1157	AAA0601	97700
21-1092	AAA0567	75000
21-1181	AAA0608	60400
21-1175	AAA0607	54500
21-1115	AAA0586	43000
21-1152	AAA0413	38100
21-1132	AAA0595	32700
21-1127	AAA0593	22900
21-1110	AAA0577	22400
21-1188	AAA0612	21700
21-1239	AAA0063	18500
21-1118	AAA0589	16000
21-1129	AAA0522	14600
21-1205	AAA0052	14550
21-1206	AAA0045	14400
21-1121	AAA0590	14200
21-1014	AAA0475	12400
21-1169	AAA0536	11400
21-1150	AAA0599	10800
21-1086	AAA0565	10200
21-1094	AAA0570	10100
21-1130	AAA0594	9900
21-1151	AAA0532	8500
21-1203	AAA0081	8325
21-1198	AAA0050	7700
21-1025	AAA0492	7700
21-1193	AAA0197	7600
21-1199	AAA0047	7600
21-1180	AAA0539	7500
21-1228	AAA0033	7500
21-1214	AAA0042	7400
21-1048	AAA0216	7300
21-1007	AAA0464	7200
21-1230	AAA0016	7200
21-1187	AAA0541	7000
21-1209	AAA0545	6800
21-1288	AAA0055	6800
21-1163	AAA0535	6700
21-1097	AAA0507	6400
21-1184	AAA0193	6400
21-1192	AAA0195	6400
21-1145	AAA0530	6300
21-1178	AAA0191	6300

Location ID	Sample Number	Concentration (pCi/l)
21-1161	AAA0602	6200
21-1207	AAA0044	6200
21-1213	AAA0041	6200
21-1103	AAA0571	6100
21-1050	AAA0219	6100
21-1064	AAA0498	5900
21-1211	AAA0078	5900
21-1204	AAA0079	5800
21-1197	AAA0200	5700
21-1240	AAA0031	5600
21-1105	AAA0510	5500
21-1231	AAA0551	5500
21-1299	AAA0555	5500
21-1301	AAA0605	5500
21-1201	AAA0544	5400
21-1221	AAA0040	5300
21-1134	AAA0525	5200
21-1156	AAA0533	5200
21-1215	AAA0026	5200
21-1220	AAA0036	5200
21-1298	AAA0513	5200
21-1015	AAA0477	5200
21-1126	AAA0520	5100
21-1212	AAA0053	5100
21-1195	AAA0542	5000
21-1208	AAA0027	5000
21-1167	AAA0603	4900

Locations Eliminated due to Outfall Proximity

Location ID	Sample Number	Concentration (pCi/l)	Outfalls
21-1194	AAA0030	6500	21-024(i)

Table B.9 Deposition Layer Samples for which Strontium-90 Levels Exceed the 95.5 Percentile (0.73 pCi/g) of the Non-Process Area Baseline

Location ID	Sample Number	Concentration (pCi/g)
21-1141	AAA0418	2.0
21-1250	AAA0066	1.8
21-1081	AAA0504	1.7
21-1270	AAA0368	1.7
21-1248	AAA0374	1.5
21-1039	AAA0208	1.3
21-1182	AAA0394	1.3
21-1224	AAA0383	1.3
21-1262	AAA0363	1.3
21-1267	AAA0362	1.3
21-1165	AAA0403	1.2
21-1166	AAA0187	1.2
21-1271	AAA0367	1.2
21-1277	AAA0357	1.2
21-1018	AAA0481	1.0
21-1102	AAA0432	1.0
21-1173	AAA0161	1.0
21-1249	AAA0069	1.0
21-1019	AAA0482	0.9
21-1060	AAA0101	0.9
21-1077	AAA0110	0.9
21-1102	AAA0433	0.9
21-1137	AAA0529	0.9
21-1283	AAA0274	0.9
21-1031	AAA0247	0.8
21-1146	AAA0416	0.8
21-1147	AAA0415	0.8
21-1171	AAA0401	0.8
21-1192	AAA0195	0.8
21-1221	AAA0040	0.8
21-1257	AAA0365	0.8
21-1296	AAA0467	0.8

Locations Excluded Because Plutonium-239/240 Concentrations were Greater in the 0 to 6 in. Samples

Location ID	Sample Number	Concentration (pCi/g)
21-1173	AAA0159	0.8
21-1088	AAA0123	0.8

Table B.10. Inorganic analytes exceeding the 95.5 percentile of non-process area baseline for deposition layer samples

Location	Analyte	Result ppm	% of Individual SAL	Cummulative % of SAL	ID
21-1005	Pb	300	500	60.0	
	Zn	473	24000	1.97	62.0
21-1018	Pb	134	500	26.8	26.8
21-1022	Pb	71.9	500	14.4	14.4
21-1034	Mg	17000	NA	NA	0.00
21-1039	Mn	730	8000	9.13	9.13
21-1043	Pb	83	500	16.6	
	Zn	210	24000	0.88	17.5
21-1077	Pb	87	500	17.4	17.4
21-1078	Pb	154	500	30.8	30.8
21-1079	Cd	3	80	3.75	
21-1079	Zn	200	24000	0.83	4.58
21-1083	Pb	87	500	17.4	17.4
21-1084	Pb	66	500	13.2	13.2
21-1094	Cd	3.3	80	4.13	4.13
21-1103	Pb	70.8	500	14.2	14.12
21-1107	Zn	390	24000	1.63	1.63
21-1113	Zn	186	24000	0.78	0.78
21-1125	Zn	574	24000	2.39	2.39
21-1132	Pb	90.4	500	18.1	18.1
21-1144	Pb	67	500	13.4	
	Zn	187	24000	0.78	14.2
21-1167	Cd	2	80	2.5	2.5
21-1168	Zn	186	24000	0.78	0.78
21-1173	Mn	826.5	8000	10.3	10.3
21-1185	Cd	2.1	80	2.63	
21-1185	Cr	111	400	27.8	30.4
21-1192	Mn	734	8000	9.18	9.18
21-1203	Mg	22000	NA	NA	0.00
21-1221	Zn	142	24000	0.59	0.59
21-1235	Cd	2	80	2.50	2.50
21-1250	Sr	189	NA	NA	0.00
21-1252	Pb	82	500	16.4	16.4
21-1266	Co	25	NA	NA	0.00
21-1300	Pb	77.9	500	15.6	15.6

Table B.11 Deposition Layer Samples for which Cobalt Levels exceed the 95.5 Percentile (7.99 ug/g) of the Non-Process Area Baseline

Location ID	Sample Number	Concentration (ug/g)
21-1266	AAA0370	25
21-1031	AAA0247	16
21-1178	AAA0191	11
21-1046	AAA0094	9
21-1060	AAA0101	9
21-1068	AAA0106	9
21-1166	AAA0187	9
21-1168	AAA0152	9
21-1204	AAA0079	9
21-1207	AAA0044	9
21-1052	AAA0096	8.9
21-1045	AAA0092	8.4
21-1053	AAA0095	8
21-1054	AAA0230	8
21-1061	AAA0099	8
21-1066	AAA0103	8
21-1067	AAA0104	8
21-1206	AAA0045	8

Table B.12 Deposition Layer Samples for which Lead Levels exceed the 95.5 Percentile (41.1 ug/g) of the Non-Process Area Baseline

Location ID	Sample Number	Concentration (ug/g)
21-1005	AAA0460	300
21-1127	AAA0593	297
21-1078	AAA0114	154
21-1018	AAA0481	134
21-1132	AAA0595	90.4
21-1077	AAA0110	87
21-1083	AAA0117	87
21-1043	AAA0210	83
21-1252	AAA0005	82
21-1300	AAA0573	77.9
21-1022	AAA0487	71.9
21-1103	AAA0571	70.8
21-1144	AAA0145	67
21-1084	AAA0116	66
21-1073	AAA0107	61
21-1099	AAA0120	60
21-1045	AAA0092	59
21-1079	AAA0239	59
21-1190	AAA0392	57.1
21-1185	AAA0609	55.3
21-1168	AAA0152	53
21-1066	AAA0103	52
21-1060	AAA0101	51
21-1248	AAA0374	48.7
21-1091	AAA0118	47
21-1224	AAA0383	46.4
21-1096	AAA0127	46
21-1136	AAA0143	46
21-1046	AAA0094	45
21-1088	AAA0123	45
21-1044	AAA0089	44
21-1003	AAA0457	43.2
21-1072	AAA0108	43
21-1208	AAA0027	43
21-1121	AAA0590	42.9
21-1271	AAA0367	42.8
21-1173	AAA0159	42

Table B.13 DESCRIPTION OF 18 INCINERATORS, STACKS AND FILTER HOUSES

SWMU	SHORT DESCRIPTION	PERIOD OF USE*	AVAILABLE INFORMATION ON EMISSIONS THAT MAY BE PRESENT IN SURFACE SOIL CONTAMINATION
21-007	Salamander incinerators at TA-21 used to burn oils and fats; three located within MDA T, other locations unknown.	1964-1972	Material incinerated was tricresylphosphate contaminated with Pu-239 (approximately 10000 dpm/m) and diluted with one-half part kerosene.
21-008	Scrap incinerator in TA-21-2 Rag incinerator in TA-21-3, Room 313, hood 2	1945-1962 1945-1970	plutonium waste rags for recovery of U-235 oxide
21-019(a)	Exhaust stack at TA-21-3	1945-Present	U-235, U-238, Am-241
21-019(b)	Exhaust stack at TA-21-4	1945-Present	U-235, U-238, Pu-239
21-019(c)	Filter house TA-21-146 immediately north of TA-21-3	1960-Present	Unknown
21-019(d)	Exhaust stack at TA-21-150	1962-Present	Pu-239
21-019(e)	Exhaust stack at TA-21-155 (TSTA: formerly Building 55)	1949-Present	Tritium
21-019(f)	Exhaust stack at TA-21-209	1965-Present	Tritium (gas)
21-019(g)	Exhaust stack at TA-21-257	1967-Present	Pu-239

21-019(h)	Exhaust stack at TA-21-313	1945-Present	Pu-239, Pu-238
21-019(i)	Exhaust stack at TA-21-314	1945-Present	Pu-239
21-019(j)	Exhaust stack at TA-21-315	1945-Present	Pu
21-019(k)	Exhaust stack at TA-21-322	1971-Present	radionuclides
21-019(l)	Exhaust stack at TA-21-323	1971-Present	radionuclides
21-019(m)	Filter house TA-21-324	1974-Present	Pu-239, Pu-235, Pu-238
21-020(a)	Filter house TA-21-12 for DP west rooms and processes; was immediately north of TA-21-4	1945-1972	radionuclides; Pu-239/240 present at 30-cm depthwhen building was decommissioned in 1973
TA-020(b)	Filter house TA-21-153 for DP east operations; was immediately south of MDA U	1945-1970	radionuclides, Ac-227 present in building when it was decommissioned
21-021	Stack emissions throughout TA-21 to the airport (300,000 m2 area)	1945-Present	

*Although some stacks are still active, only the potential surface soil contamination resulting from past stack emissions is of concern herein. Present stack emissions are monitored as part of the Laboratory's routine environmental surveillance program.

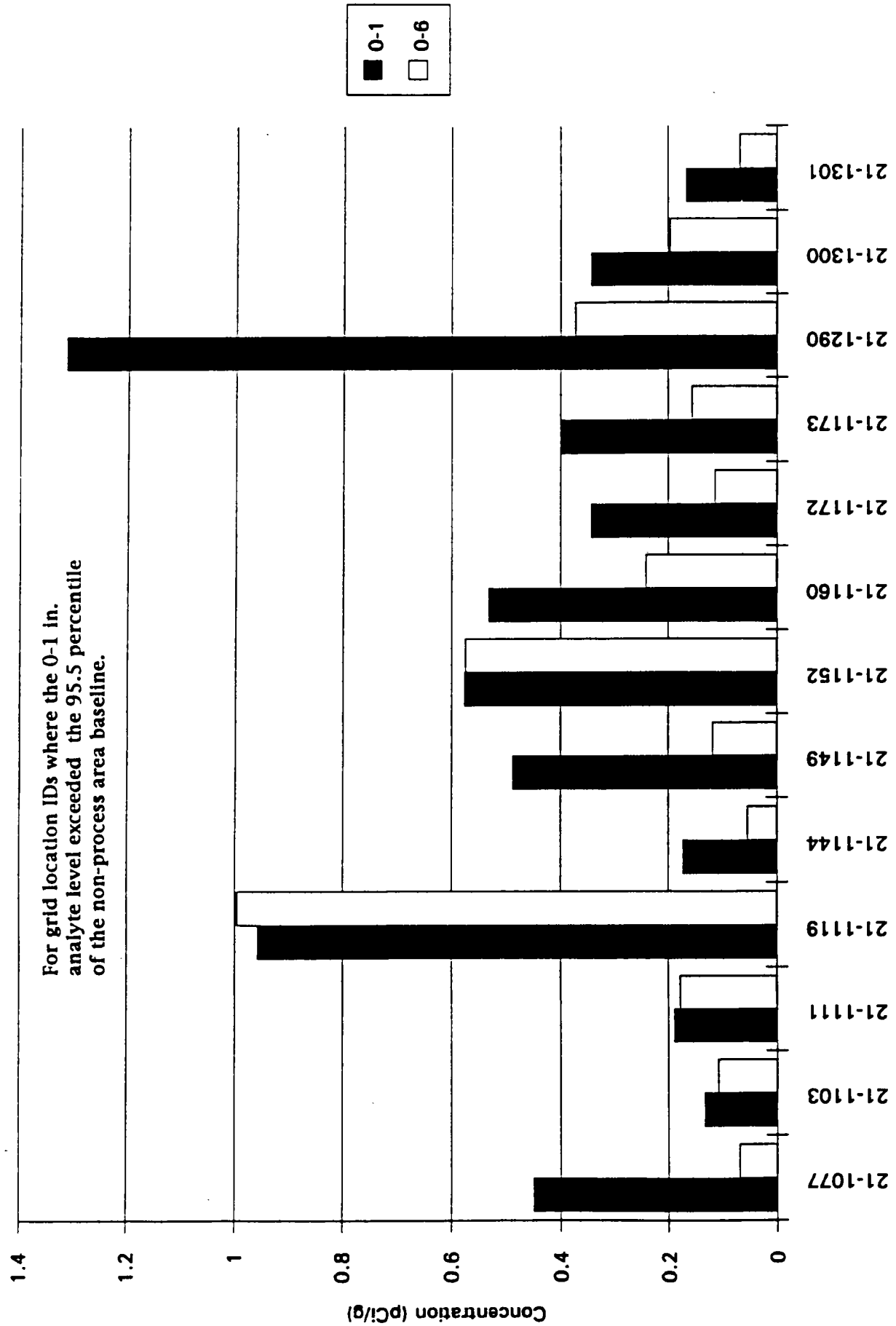
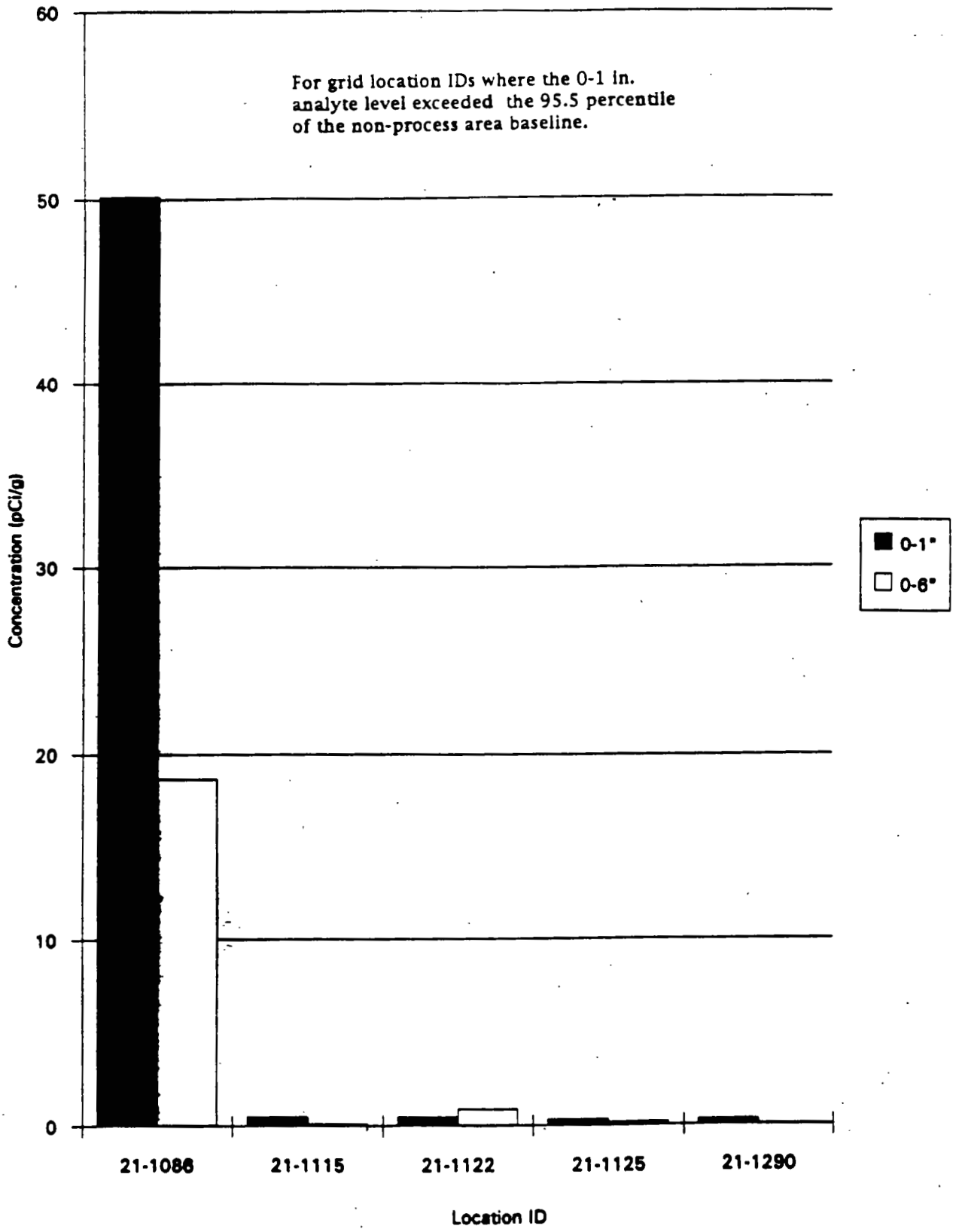


Figure B.1. Comparison of Americium-241 Levels in 0 to 1 in. Deposition Layer and 0 to 6 in. Surface Grid Samples.

Figure B.2. Comparison of Plutonium-238 Levels in 0 to 1 in. Deposition Layer and 0 to 6 in. Surface Grid Samples.



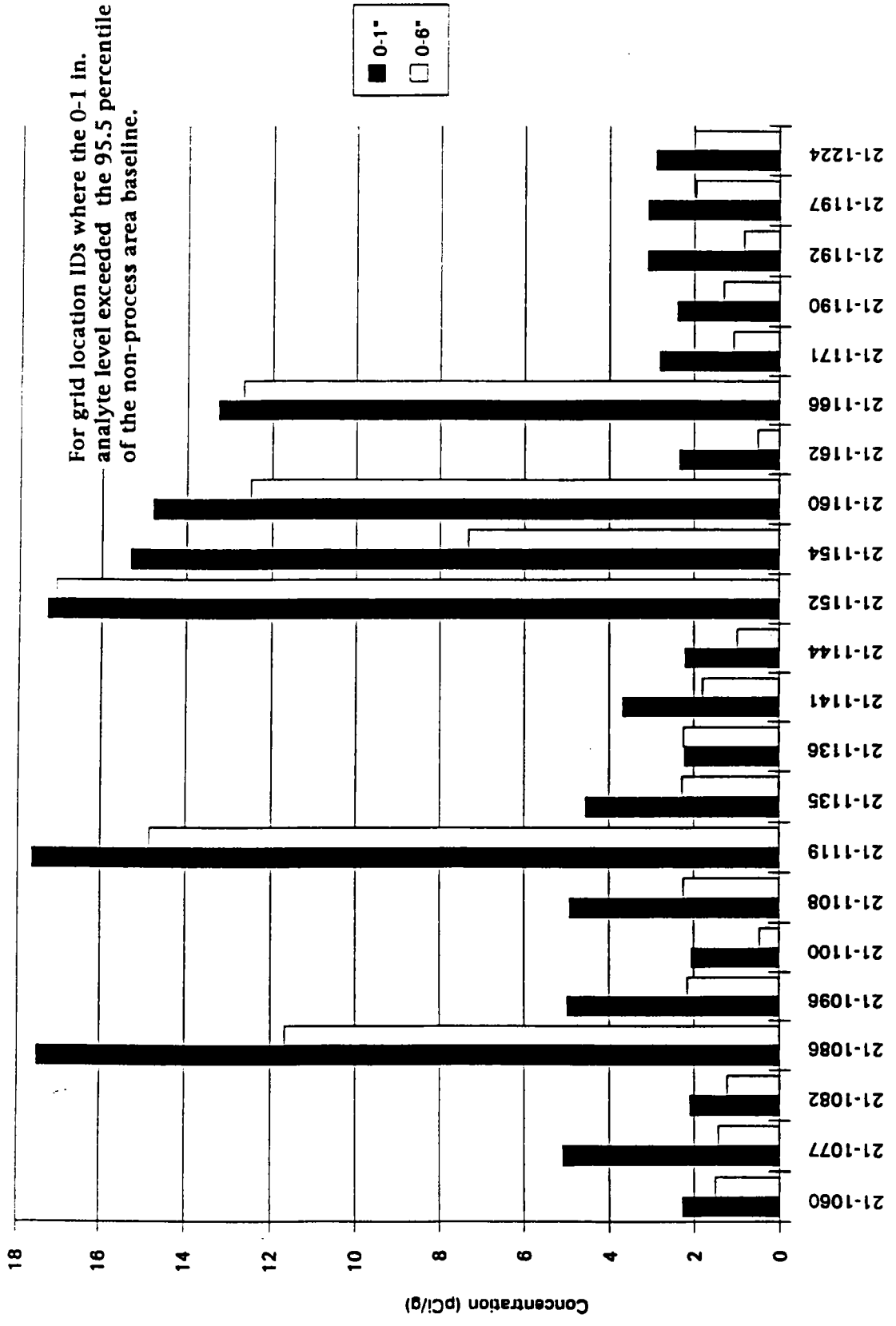


Figure B.3. Comparison of Plutonium-239/240 Levels in 0 to 1 in. Deposition Layer and 0 to 6 in. Surface Grid Samples.

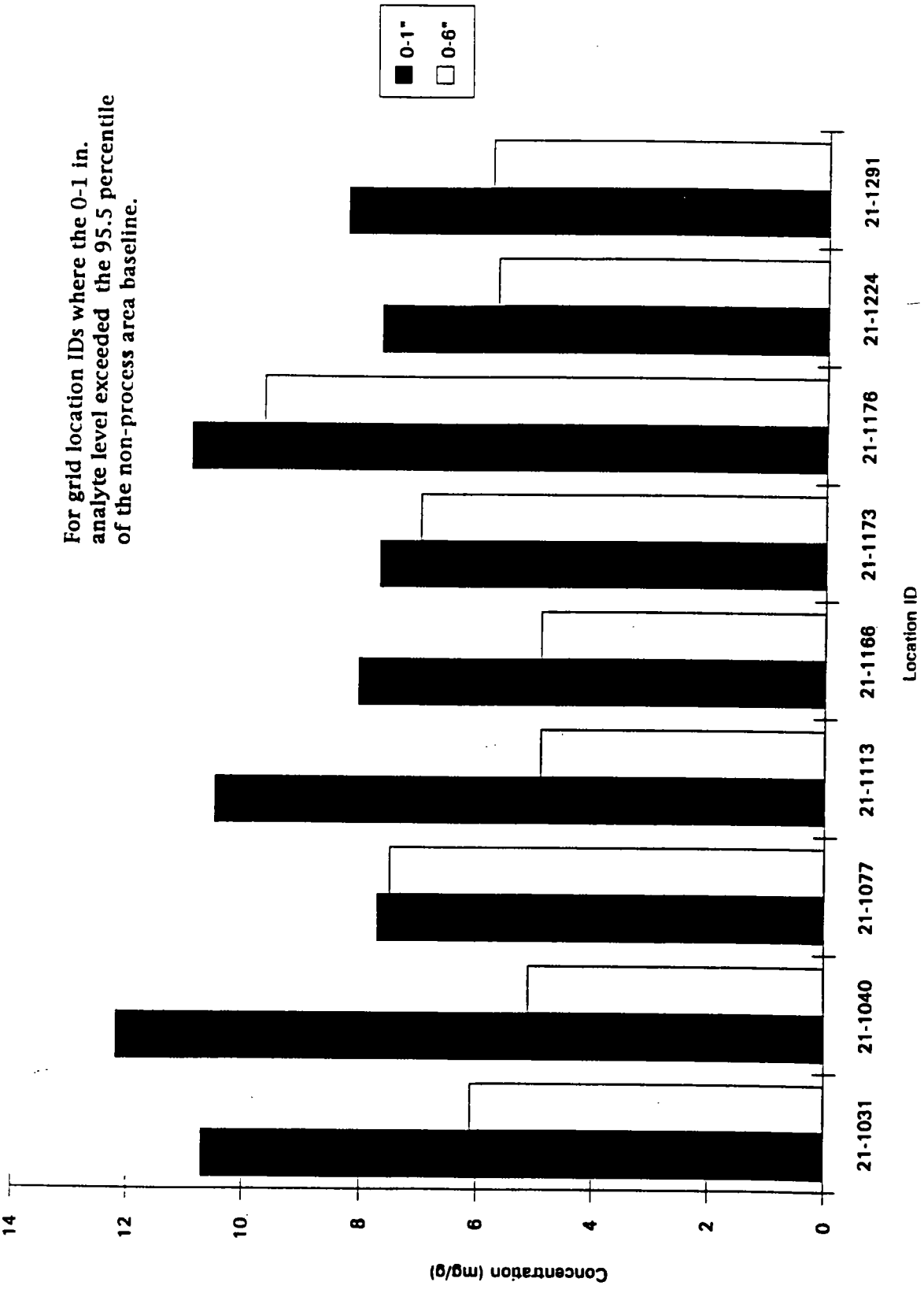


Figure B.4. Comparison of U-Total Levels in 0 to 1 in. Deposition Layer and 0 to 6 in. Surface Grid Samples.

For grid location IDs where the 0-1 in. analyte level exceeded the 95.5 percentile of the non-process area baseline.

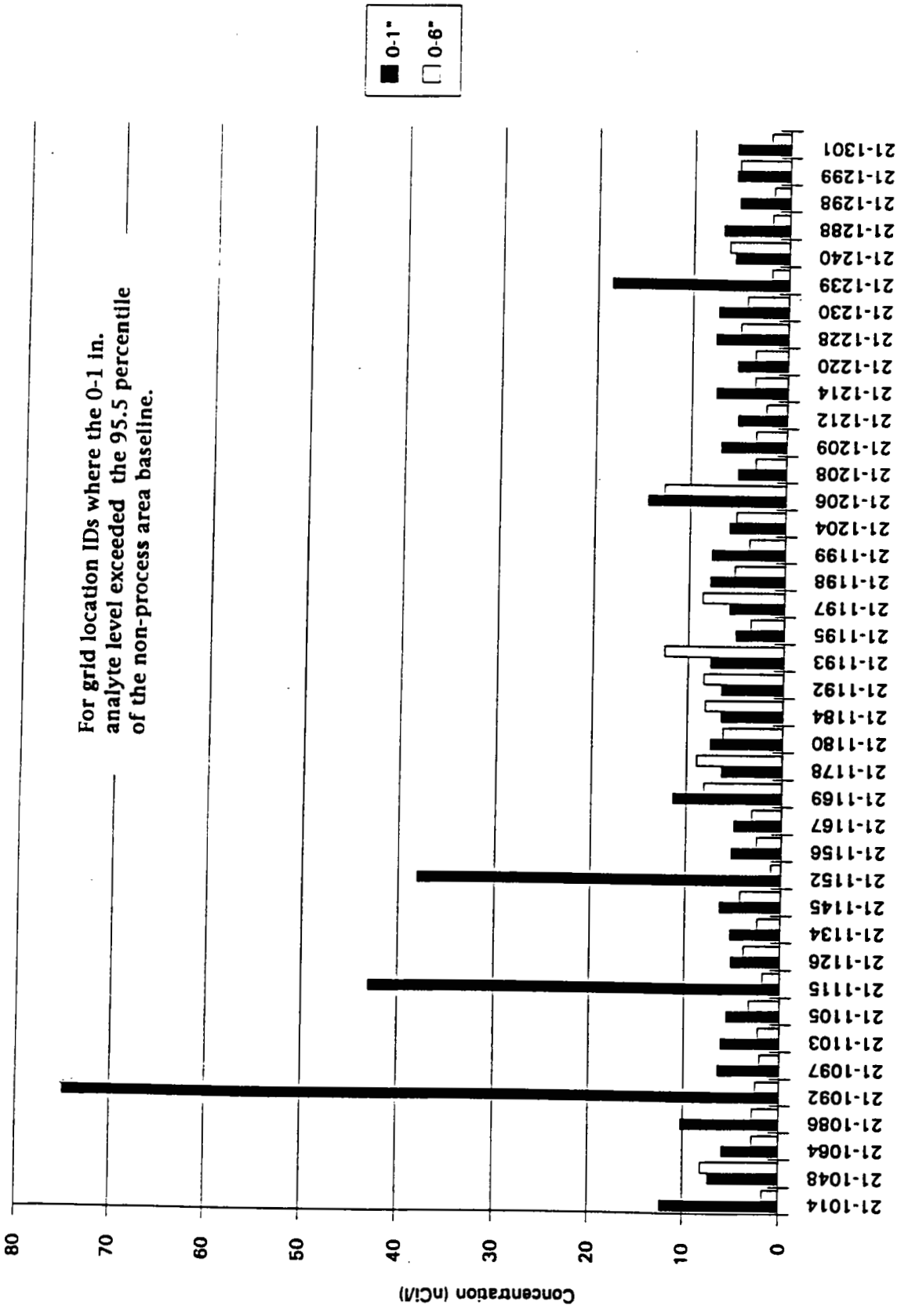


Figure B.5. Comparison of Tritium Levels in 0 to 1 in. Deposition Layer and 0 to 6 in. Surface Grid Samples.

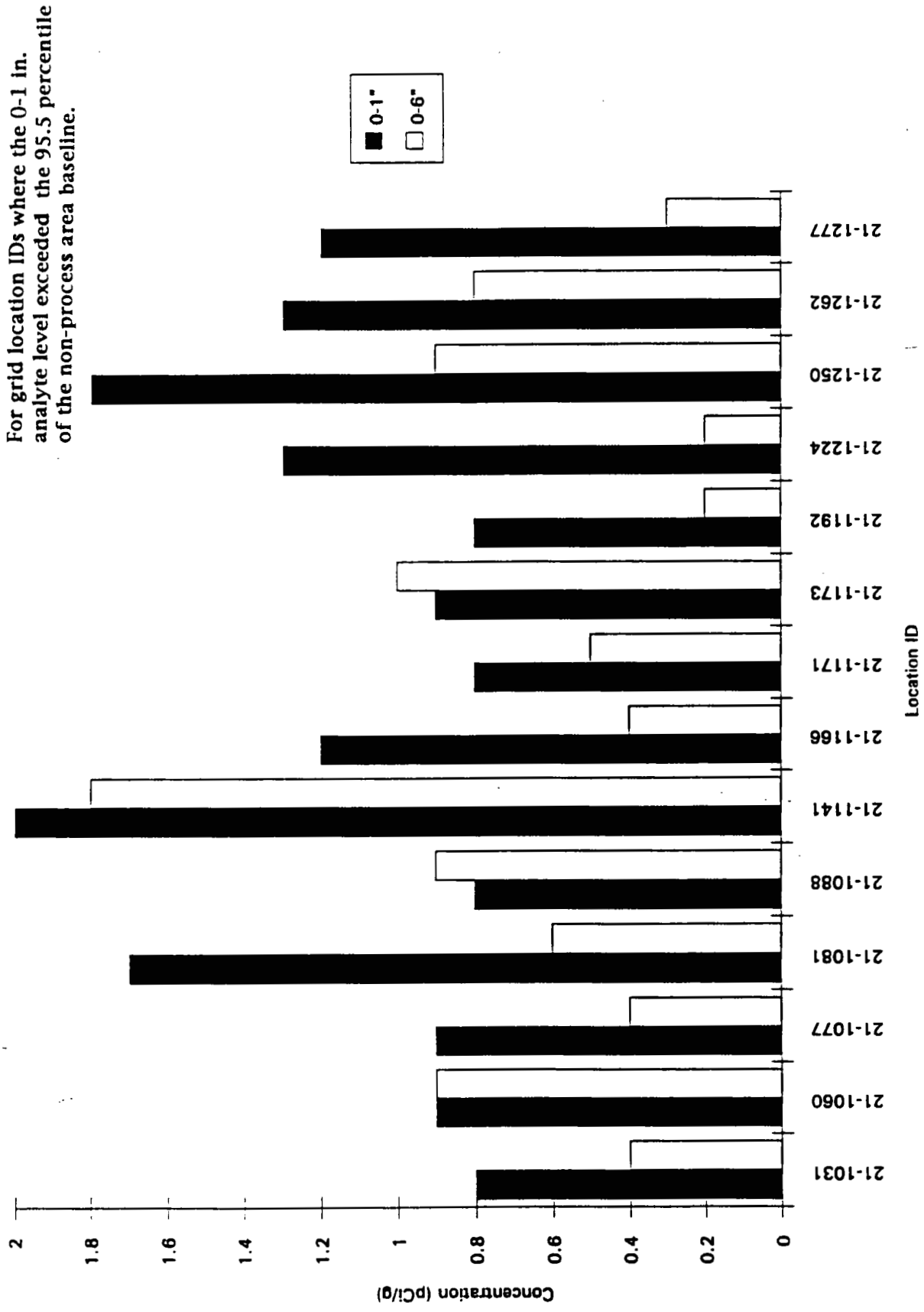


Figure B.6. Comparison of Strontium-90 Levels in 0 to 1 in. Deposition Layer and 0 to 6 in. Surface Grid Samples.

APPENDIX C

FILTER BUILDINGS INVESTIGATION

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FILTER BUILDINGS INVESTIGATION

C.1 Description of Investigation

The investigation reported in this appendix is described in the RFI work plan in Chapter 13, Surface Contamination from Airborne Emissions, Description and Sampling Plan, in the subsections on filter buildings. Two buildings formerly filtered glove box and room air from the TA-21 process facilities. Building TA-21-12 (SWMU 21-020(a)) served DP West from 1949 until it was removed in 1973. Building TA-21-153 (SWMU 21-020(b)) served DP East from 1949 until it was removed in 1978. This investigation addresses the soil and rock beneath the areas where the buildings once stood. A summary of this appendix is provided in Chapter 4 of this phase report. The investigation addressing the stack emissions from these buildings over their operational life is not included here. That investigation is separate and is included in the OU-wide deposition-layer investigation described in Chapter 3 and Appendix B of this phase report.

The potential release mechanism which defines these SWMUs is the loss of contaminants to underlying soils through cracks and joints in the building floor. It is the potential for residual contamination beneath the buildings, left after demolition and removal, which is addressed by the filter buildings investigation.

Records documenting the demolition of building TA-21-12 indicate that residual radioactive contamination (primarily plutonium-239) remained at low levels (up to 70 pCi/g) in isolated locations in the soil and rock beneath the building after it had been removed. That area, referred to in this report as the building "footprint," was backfilled with about a foot of soil.

Documentation on the demolition of building TA-21-153 does not identify any residual contamination (potentially actinium-227 and its progeny) above a gross alpha instrument detection limit (approximately 30 pCi/g) in the soil beneath the building. The area was not backfilled, but was graded and recontoured.

The purpose of the filter buildings investigation is to define the nature and extent of contaminants in the building footprints. For SWMU 21-020(a) some contaminants are known. For SWMU 21-020(b) the presence of contaminants is unknown at gross alpha levels below 30 pCi/g. Three components to the investigation were defined in the RFI work plan:

- Determine the location of the former filter buildings. Survey and mark their perimeters in the field, based on measurements from old engineering drawings.

- Collect surface and subsurface soil samples and identify residual contaminants using field screening and field laboratory measurements.

- Assess the lateral and vertical extent of contamination. Identify the contaminants present and quantify their concentrations in subsurface soil using field laboratory measurements on most samples and analytical laboratory measurements on a subset.

The filter building investigation was conducted in two periods during the summer and autumn of 1992. The near-surface portion was conducted in July 1992 and the subsurface sampling was in October 1992. The delay between the two portions of the investigation was the result of NESHAP compliance issues related to the potential for generating airborne radioactive emissions from drilling operations. The need for the delay was reported to EPA in the Quarterly Technical Progress Report for the fourth quarter of FY92 (LANL 1992c). The completion of the field activities during October 1992 was reported to EPA in the Quarterly Technical Progress Report for the first quarter of FY93 (LANL 1993b).

C.1.1 Revision of Sampling Plan

The filter building investigation was conducted largely as proposed in the RFI work plan, with only a few minor changes consistent with the intent of the original plan. The investigation is described as conducted in this section.

Investigation of SWMU 21-020(a). As described in work plan Section 12.2.4.1, Initial Investigations, the investigation within and near the perimeter of the building was to use near-surface soil samples and shallow boreholes to confirm the presence of residual contamination.

Sixteen locations for near-surface sampling to a 30 in. depth were planned. Near-surface samples were defined as 6-in. sampling intervals collected by spade and scoop or hand auger. Field laboratory analysis was planned for all samples deeper than 12 in., with confirmatory laboratory analysis on 30 percent of those samples. The focus was on depths greater than 12 in. because the area had been backfilled following removal of the building.

Five locations for shallow borings to a 7.5 ft depth were planned within the perimeter of the building. The locations were to be biased to areas where the near-surface samples identified contamination (based on field screening and field laboratory results). Samples were to be prepared from each 2.5 ft interval, with field laboratory analysis on all samples below 2.5 ft and confirmatory laboratory analysis on 50 percent of the samples.

Figure C-1 shows the sampling locations as placed for this investigation. The investigation was conducted as planned with the following minor changes:

- As described in the work plan, the shallow borings were to be done by hollowstem coring using a small drilling rig. Due to a Laboratory restriction on drilling activities, the shallow borings were conducted with a manual "bucket" auger.
- A shallow boring could not be augered to the planned 7.5 ft depth at location ID 21-1454 because the auger was refused at 7.0 ft.
- One additional near-surface sample beyond the number planned was submitted for laboratory analysis.
- The field laboratory analytical suite was supplemented by the addition of gravimetric soil moisture measurements. Americium-241 was added to the analytical laboratory suite.
- An error in the marking of the building perimeter led to the placing of fewer sampling locations within the building perimeter than were planned (see Figure C-1).

Based on the data assessment discussion below, the investigation as conducted satisfied the full intent of the RFI work plan.

Investigation of SWMU 21-020(b). As described in work plan Section 12.2.4.1, Initial Investigations, the investigation within and near the perimeter of the building was to use near-surface soil samples to identify the presence of residual contamination. No shallow borings were planned.

Ten locations for near-surface sampling to a 30 in. depth were planned. Field laboratory analysis was planned for all samples deeper than 6 in., with confirmatory laboratory analysis on 30 percent of the samples. The focus was on depths greater than 6 in. because the surficial soils were recontoured following removal of the building.

Figure C-2 shows the sampling locations as placed for this investigation. The investigation was conducted as planned with the following minor changes:

- Two fewer near-surface samples than planned were submitted for laboratory analysis. The number was reduced to allow some additional shallow boring samples, which had not been planned, to be submitted without jeopardizing the investigation budget.

- Based on field laboratory results, which showed elevated tritium in deeper near-surface samples, four locations were selected for shallow borings to be sampled to a 7.5 ft depth. These were conducted in the same fashion as the shallow borings for SWMU 21-020(a). This investigation added 4 additional samples to the number submitted to the analytical laboratory.

- A shallow boring at location ID 21-1476 could not be augered to the planned 7.5 ft depth because the auger was refused at 6.2 ft.

- The field laboratory analytical suite was supplemented by the addition of gravimetric soil moisture measurements. Americium-241 was added to the analytical laboratory suite.

C.1.2 Summary of Investigation

Prior to sampling, the perimeter of each building was marked in the field by surveyors working from engineering drawings of the building locations. For both buildings the calculated perimeters for marking in the field agreed with the locations displayed in the FIMAD graphical information system. The calculated perimeters were properly translated to markings in the field, except for the west side of building TA-21-12 which was marked incorrectly because of a surveying error. This error led to several sampling locations not being placed precisely as planned for building TA-21-12.

Near-surface sampling locations and boring locations were marked according to the scheme identified in the work plan. Additional locations were selected for shallow borings to 7.5 ft at building TA-21-153, where the deeper investigations were not originally planned. As each location was occupied by the sampling team, an assessment of the suitability of the sampling location was made. In the filter building areas sampling locations were moved only to avoid surface obstructions such as rocks, or to avoid blocking a roadway. When necessary, the sampling location was moved to the nearest suitable location. The final location for each sampling point was marked and surveyed after sampling was completed, as displayed in Figures C-1 and C-2.

Each 6-in. near-surface sample interval or 2.5-ft shallow-boring sample interval was collected and processed individually prior to collecting the next deeper sample. Samples were collected with a manually operated "bucket" auger and placed in a stainless steel mixing bowl. When volatile organic samples were to be collected, soil for these was collected immediately from the bowl and sealed in the sample container. After volatile organic samples were taken, the soil in the bowl was thoroughly mixed with hand scoops and rocks and large pieces of organic matter (root balls, etc.) were removed. The soils were described and placed into sample containers as appropriate for the required analyses. Sample containers were labeled and sealed as required by applicable procedures. Each sampling location was photographed as a record of the exact location.

For this investigation, the selection of samples for submission to the analytical laboratory was to be based on the results of field laboratory analyses. All samples collected were held in the custody of the field team pending the field laboratory results and the decision on which samples to submit for further analysis. These decisions were made within 24 hr of sample collection and did not impact any sample holding times. Samples for volatile and semivolatile organic analyses were labeled and sealed in the final sample container and were held in coolers at preservation temperature. Samples for metals and radiological determinations were held in covered, labeled sampling bowls. Upon the selection of samples to be submitted for analysis, the unneeded samples were returned to the sampling point and emptied. Used containers were properly disposed as waste.

Sampling, field measurements, preparation of quality assurance samples, and decontamination of equipment were conducted as required by the TA-21 Quality Assurance Project Plan and Appendix A of the RFI work plan, and in accordance with appropriate Laboratory ER Program SOPs. Copies of all field records generated and SOPs used have been archived at the Laboratory ER Program Records Processing Facility.

For this investigation, 35 locations were sampled. Of these, 21 locations were within or near the perimeter of Building TA-21-12 (SWMU 21-020(a)) and generated 95 soil samples. The remaining 14 locations were within or near the perimeter of building TA-21-153 (SWMU 21-020(b)) and generated 62 soil samples. Of these 157 samples, 107 were submitted for field laboratory analyses and 34 of the latter were submitted to the analytical laboratory. In addition, 26 QA samples were prepared and submitted to the analytical laboratory. The number of QA samples prepared was based on the number of samples submitted to the laboratory for analysis, according to the percentages required by the QA Project Plan (e.g., one field duplicate was required for each 20 sample analyses, thus two duplicates were prepared for the 34 samples submitted for analysis).

Table C.1 summarizes the numbers of samples planned, collected, and submitted for each filter building investigation. Table C.2 identifies the analytical suite to which samples were subjected, for both the field laboratory and the analytical laboratories. Table C.3 summarizes the numbers of analyses of each type reported for the investigation. Complete data tables of analytical results are maintained on the FIMAD database. Results for analytes exceeding the 95.5 percentile of the non-process area baseline are tabulated in Appendix F (see Appendix A for derivation of baseline). Supporting statistical information using the data from the filter buildings investigation is presented in Appendix E.

As part of the field activities, all sampling locations were surveyed with several field instruments and screened in the field laboratory. With the exception of tritium in soil moisture, field instrument and field laboratory measurement results were non-detects. The field-generated data were tabulated and presented in the Quarterly Technical Progress Report for the fourth quarter of FY92 (LANL 1992c) and the first quarter of FY93 (LANL 1993b).

C.2 Data Assessment: TA-21-12, SWMU 21-020(a)

C.2.1 Investigation Assessment

All data acquired for assessment of SWMU 21-020(a) were judged to be usable. The execution of the sampling plan in the field was judged to be sufficient for the full intent of the plan, although a surveying error resulted in the placement of fewer sampling locations within the building footprint than were planned. As planned, 16 of the 21 sampling locations were to be placed within or immediately adjacent to the building perimeter. As conducted, 12 of the 21 locations fell within or immediately adjacent to the perimeter. As discussed below, however, there is no discernible difference in the results obtained within or outside the perimeter. Sixteen near-surface sampling locations and five shallow boring locations were investigated. In one boring, the hand auger was refused at 7.0 ft, slightly short of the 7.5 ft target depth.

Field laboratory analysis results were provided to the field crew on a rapid turn-around basis to allow selection of samples to be submitted to the analytical laboratory for analysis. Sample selection was biased to maximize the probability of identifying of contaminant species and contamination extent. Due to the low levels of most radionuclides, the only field laboratory measurement which provided information usable for this purpose was the measurement of tritium in soil moisture. The detection limits for the field laboratory techniques were: 4 pCi/g gross gamma, 24 pCi/g gross beta, 63 pCi/g

gross alpha, and 2 pCi/ml tritium in soil moisture. All field laboratory measurements except for tritium were reported as less than detection limit for all samples, except one sample for which a gross gamma result of 5.1 pCi/g was obtained. In lieu of other biasing factors, the samples selected for further analysis were biased to high tritium values and chosen to represent all depth intervals sampled. Table C-4 identifies the sample numbers assigned to each sample collected.

Results were reported by the analytical laboratories for all samples submitted except for three subsurface americium-241 samples, and one plutonium-238 and one plutonium-239/240 analysis on an equipment rinse quality assurance sample. The loss of these sample analyses is judged not to affect the quality of the investigation or the derived recommendations and conclusions.

C.2.2 Organics and Inorganics

No semivolatile organic constituents were identified in any field samples. No volatile organic constituents were identified except for common laboratory contaminants (acetone, methylene chloride) at near-detection limit concentrations in a few samples. These detects are judged not to be indicative of site contamination. No inorganic constituents were found in concentrations above the non process area concentration range (see Chapter 2 and Appendix A of this phase report). These findings confirm the process knowledge information which indicated that only radiological contaminants were of concern at SWMU 21-020(a).

C.2.3 Radionuclides

Seven measurements of radioactivity in soils were made on samples submitted to the analytical laboratory, as discussed below.

C.2.3.1 Strontium-90, uranium (total), and gamma spectroscopy

These measurements were indistinguishable from the local background levels or analytical detection limits at all locations and depths that were sampled (deeper than 12 inches, down to 7.5 ft) within or near the perimeter of building TA-21-12. The strontium-90 results are presented in Table C-5, which identifies the sampling location, indicates the depth interval, and shows the calculated mean of the results for each depth interval.

The total uranium results are presented in Table C-6. The analytical laboratory switched the analytical technique used for total uranium between the July 1992 field event (delayed neutron activation analysis, DNA) and the October 1992 event (kinetic phosphorescence activation, KPA). The KPA results appear to be biased about a factor of two less than the DNA results, based on the following assessment. When a conversion between DNA data in mass units (ug/g) to activity units (pCi/g) is calculated, there is good agreement between the DNA technique and radiochemical separation and alpha spectrometric methods. This comparison allows the two techniques to confirm each other. In all of the samples in the building TA-21-12 area, the DNA uranium concentrations are uniform and representative of the typically uniform uranium background found in the Bandelier tuff. The KPA results are likewise uniform, but have values consistently about half of that expected from the other techniques. On this basis it is judged that the KPA total uranium data appear to be biased low by about 50%.

Laboratory results for gamma spectroscopy were not reported by the laboratory as estimates of radionuclide concentrations in soil, as is customary. To interpret the gamma spectroscopy results, a manual spectral peak assessment was done. First, the spectral data were reviewed to identify any peaks that were not normally found in background soil spectra. Second, for the normal peaks of a background spectrum, peak size was reviewed to identify any that were disproportionately larger than for background soils. No anomalous peak energies or sizes were identified. The reported detection limit of about 4 pCi/g (based on cesium-137) places an upper limit on gamma emitting radionuclides in the filter building samples.

C.2.3.2 Plutonium-238, and plutonium-239/240

For plutonium-238 and plutonium-239/240 measurements, the concentrations in all samples were well below the SALs. The maximum plutonium-238 result was 1.96 pCi/g, compared to the SAL, 27.0 pCi/g. The maximum plutonium-239/240 result was 13.4 pCi/g, compared to the SAL, 24.0 pCi/g. The shallower samples, in the 12 to 18 in. and 18 to 24 in. intervals, were in the range expected for the MDA T/MDA A special impact area (see Appendix A of this phase report). The concentrations decreased with depth so that the deepest intervals sampled (5.0 to 7.5 ft) had average concentrations within or close to the non process area levels. There was no noticeable difference in the plutonium analysis results for sample locations falling within or adjacent to the building perimeter versus those outside the perimeter. Plutonium analyses are summarized in Tables C-7 and C-8.

C.2.3.3 Americium-241

Americium-241 measurements also were slightly elevated in the shallow samples, but well below SALs. The maximum americium-241 result was 0.696 pCi/g, compared to the SAL, 22.0 pCi/g. Samples in the three intervals sampled from 12 in. to 30 in. exhibited concentrations in the range expected for the MDA T/MDA A special impact area. No concentration trend with depth was evident in the top 30 inches. Because americium-241 analyses for the greater depths have not yet been received from the analytical laboratory, the deeper intervals cannot presently be assessed for americium. However, based on the gamma spectra discussed above (in which americium-241 would have been detected), the americium data on the shallow samples, and the full depth of plutonium data, americium levels of concern are highly unlikely in the deeper samples. There was no noticeable difference in the analysis results for sample locations falling within or adjacent to the building perimeter versus those outside the perimeter. Americium data are presented in Table C-9.

C.2.3.4 Tritium

Tritium differed from the other radionuclides in showing a possible trend for increasing concentration with depth, as shown in Table C-10. Tritium levels at all depth intervals were elevated above local background levels, and were at or above the range expected for surface soils in the TSTA special impact area (see Appendix A of this phase report). There was no noticeable difference in the analysis results for sample locations falling within or adjacent to the building perimeter versus those outside the perimeter. Tritium is not a contaminant that was expected to be of concern for building TA-21-12. The observed tritium in the footprint almost certainly originated elsewhere (e.g., releases from TSTA or other sources).

C.3 Data Assessment: TA-21-153, SWMU 21-020(b)

C.3.1 Investigation Assessment

All data acquired for assessment of SWMU 21-020(b) were judged to be usable. The execution of the sampling plan in the field was in full agreement with the RFI sampling plan. Four additional shallow borings were placed to address elevated tritium concentrations identified in field laboratory analyses. In one boring the hand auger was refused at 6.2 ft, short of the 7.5 ft target depth.

As for the SWMU 21-020(a) investigation described in Section C.2.1, above, field laboratory analyses did not provide information useful in selecting samples for further analysis, except for the tritium soil moisture measurements. Table C-11 identifies the sample numbers assigned to each sample collected.

Results were reported by the analytical laboratories for all samples submitted except for two subsurface americium-241 samples, plus one plutonium-238 analysis and one plutonium-239/240 analysis on an equipment rinse quality assurance sample. The loss of these sample analyses is judged not to affect the quality of the investigation or the derived recommendations and conclusions.

C.3.2 Organics and Inorganics

No semivolatile organic constituents were identified in the field samples. No volatile organic constituents were identified, except for two common laboratory contaminants (acetone, methylene chloride) at near-detection limit concentrations in a few samples. These detects are judged not to be indicative of site contamination. No inorganic constituents were found in concentrations above non process area levels. These findings confirm the process knowledge information which indicated that only radiological contaminants were of concern at SWMU 21-020(b).

C.3.3 Radionuclides

Seven measurements of radioactivity in soils were made on samples submitted to the analytical laboratory, as discussed below.

C.3.3.1 Strontium-90, total uranium, gamma spectroscopy, and plutonium-239/240

The results of these four measurement techniques were indistinguishable from local background. There is no indication of elevated levels from these measurements at any location or any depth sampled (deeper than 6 inches, down to 7.5 ft) within or near the footprint of building TA-21-153.

The strontium-90 data are given in Table C-12. One strontium-90 result was judged to be a laboratory error and was excluded from the assessment. This value was reported as 35.3 pCi/g, which is two orders of magnitude greater than any other strontium-90 value found. This value exceeds the SAL of 8.9 pCi/g for strontium-90, and this outlier is considered explicitly in the interpretation, conclusions and recommendations discussed below.

Total uranium data are given in Table C-13. A change in analytical technique for total uranium between the July 1992 and the October 1992 field episodes introduced a bias in the uranium results between the two periods. This change is discussed in detail in the data assessment section for SWMU 21-020(a) (see Section C.2.3.1).

The interpretation of the gamma spectroscopy data was discussed in detail in the data assessment for SWMU 21-020(a) (see Section C.2.3.1). No anomalous peaks or unusual peak sizes were identified in the spectra for SWMU 21-020(b) samples.

Results of plutonium-239/240 analyses, presented in Table C-14, and are indistinguishable from the non process area levels. There is no indication of elevated concentrations at any location or any depth that was sampled (deeper than 6 inches, down to 7.5 ft) within or near the perimeter of building TA-21-153.

C.3.3.2 Plutonium-238

Plutonium-238 concentrations (see Table C-15) were well below the SAL in all samples. The highest result was 0.149 pCi/g, compared to the SAL, 27.0 pCi/g. Soil samples from the 6 to 12 in. interval had values in the range expected for the MDA T/MDA special impact area (see Appendix A of this phase report). Samples in the depth intervals between 12 in. and 30 in. gave values in the range expected for Process Area soils (see Appendix A of this phase report). The concentrations decreased with depth and intervals below 2.5 ft were in the range of non process area levels in surface soils, or lower. There was no noticeable trend in the analysis results for sample locations falling within the building perimeter versus those outside the perimeter.

C.3.3.3 Americium-241

Americium-241 levels were slightly elevated, but well below the SAL in the shallow samples (see Table C-16). The maximum americium-241 result was 1.09 pCi/g, compared to the SAL, 22.0 pCi/g. Samples in the three intervals sampled from 12 in. to 30 in. exhibited concentrations in the range expected for the MDA T/MDA A special impact area. No concentration trend was evident in the top 30 inches. Because americium-241 analyses for the greater depths have not yet been received from the analytical laboratory, the deeper intervals cannot presently be assessed for americium. However, based on the gamma spectra discussed above (in which americium-241 would have been detected), the americium data on the shallow samples, and the full depth of plutonium data, americium levels of

concern are highly unlikely in the deeper samples. There was no noticeable difference in the analysis results for sample locations falling within the building perimeter versus those outside.

C.3.3.4 Tritium

Tritium differed from the other radionuclides in showing a possible slight concentration increase with depth. The results are displayed in Table C-17. Tritium levels in all depth intervals were elevated above local background levels, and were at or above the range expected for the TSTA special impact area. There was no noticeable difference in the analysis results for sample locations falling within the building perimeter versus those outside the perimeter. Tritium is not an expected contaminant of concern for building TA-21-153, and is thought to be indicative of contamination originating elsewhere.

C.4 Interpretation, Conclusions, and Recommendations

C.4.1 Interpretation

For filter buildings TA-21-12 (SWMU 21-020(a)) and TA-21-153 (SWMU 21-020(b)), above background concentrations of radionuclides exist in the soil profile to a depth as great as 7.5 ft. At both SWMUs, concentrations of tritium, americium-241, and plutonium-238 in some samples are clearly elevated above non process area levels, process area levels, and in some cases MDA T/MDA A or TSTA special impact area levels. At SWMU 21-020(a) this is also true for plutonium-239/240. However, in all cases the levels are well below SALs.

C.4.1.1 Tritium

Tritium is the only radionuclide generally showing elevated concentrations at the deepest depth sampled. However, the tritium is believed to have originated from releases elsewhere at TA-21 and the levels are well below the SAL for all samples. The subsurface tritium concentrations identified in the filter building areas are indicative of pervasive tritium presence in soil moisture in the central portion of the TA-21 operable unit, as discussed in earlier appendices. The observed concentrations are no different within or outside the building footprints. The increasing concentrations with depth are thought to be the result of percolation of tritiated water into the soil profile, with dilution of the concentration near the surface by infiltration of precipitation, or loss of tritium from surface soils through water vapor exchange with the atmosphere. Observed tritium concentrations are considered

to be unrelated to the specific SWMUs under investigation and are not used for SWMU related decisions in this report.

C.4.1.2 Plutonium-238, plutonium-239/240, americium-241

Plutonium-238 levels (at both SWMUs) and plutonium-239/240 levels (at SWMU 21-020(a) only) decrease with depth in the soil profile. A similar decrease in concentration with depth is not observed for americium-241, although data from the deeper samples have not been received from the laboratory and remain to be assessed. It is clear that concentrations are similar inside and outside the building perimeter, implying that the observed concentrations are not related to residual contamination left in the area following building demolition and removal. The observed contamination may be pervasive over the central area of the TA-21 operable unit and is probably related to the historic atmospheric releases at TA-21 and other nearby source terms, such as MDA T near building TA-21-12 and MDA U near building TA-21-153. In no case do the results for these radionuclides exceed SALs in any samples from these investigations, as noted in the specific discussions above.

C.4.1.3 Strontium-90

Although the data assessment presented above for SWMU 21-020(b) (see Section C.3.3.1) indicated that strontium-90 concentrations were no different from the local background range, one sample analysis was excluded from that assessment. Sample AAA1387, a 24 to 30 in. sample at location 21-1458 within the building footprint, was reported as 35.3 pCi/g of strontium-90. This value was excluded from assessment as a probable laboratory error, a hypothesis which is being checked by further examination of laboratory records. If the analysis is correct, it is significantly elevated above any other strontium-90 result obtained (all of which were in the background range), and exceeds the SAL of 8.9 pCi/g. Even so, since the result is an isolated one found at depth, it is judged that it should not alter a recommendation for no further action at SWMU 21-020(b).

C.4.1.4 Other potential contaminants of concern.

No other contaminants were identified. No organic compounds were detected and no inorganic constituents or other radionuclides in excess of local background concentrations were identified.

C.4.2 Conclusions

Contaminants identified in the vicinity of SWMUs 21-020(a,b) were very low levels of tritium, plutonium-238, and americium-241. Plutonium-239/240 also was identified in the vicinity of building TA-21-12. The tritium almost certainly originated elsewhere at TA-21. The other radionuclides were expected at these levels based on process knowledge. There is no difference in contaminant concentrations inside and outside of the building perimeters. In no case do the residual radionuclide concentrations exceed SALs. On this basis, it is concluded that the contaminants observed are not indicative of residual radioactivity left beneath the buildings following their demolition and removal.

C.4.3 Recommendation

It is recommended that no further action is warranted for SWMUs 21-020(a) and 21-020(b).

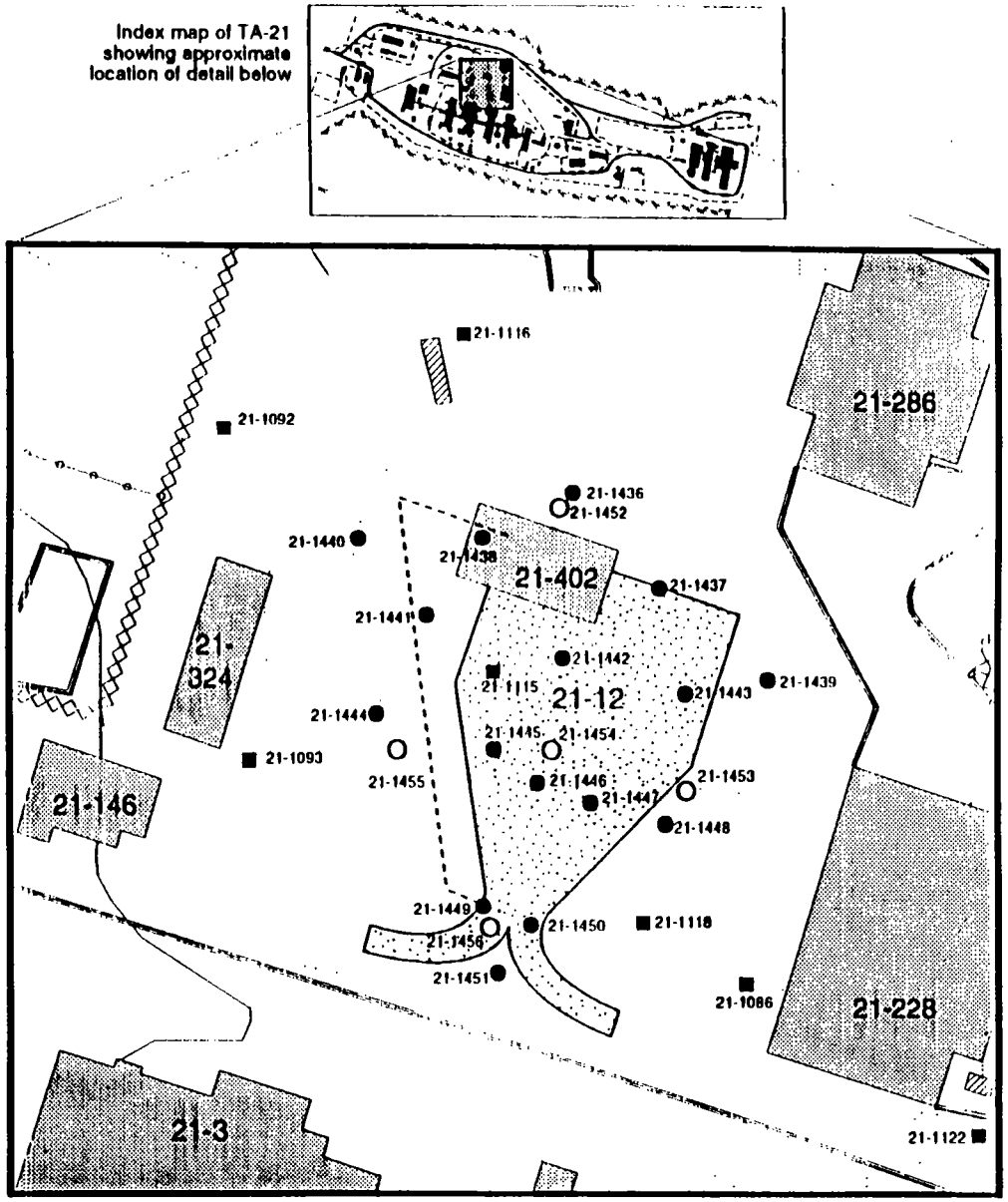

Figure C-1 Sampling locations for filter building TA-21-12, SWMU 21-020(a).

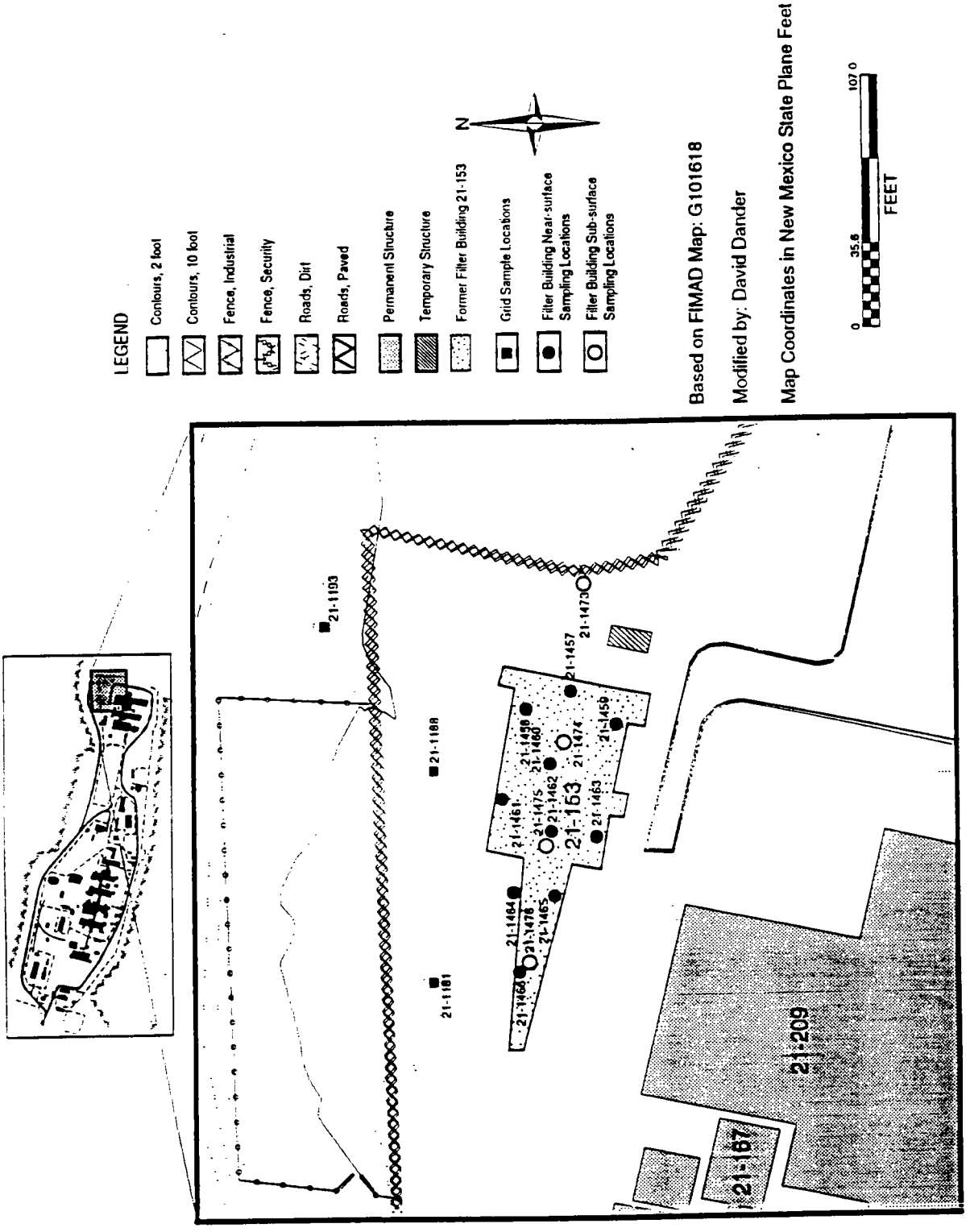

Figure C-2 Sampling locations for filter building TA-21-153, SWMU 21-020(b).

Table C.1 Sumary of Numbers of Filter Buildings Investigation Samples Collected and Analyzed

Near-Surface Soil Sampling

PRS Identification	Sampling Locations	Samples: Planned	Samples: Collected	Samples Submitted to: Field Screening	Samples Submitted to: Field Laboratory	Analytical Laboratory: Planned	Analytical Laboratory: Actual	Field QA Samples: Planned Total	Field QA Samples: Actual Total	Trip	Reagent	Equipment	Duplicate
Building TA-21-12 SWMU 21-020(a)	16	80	80	80	48	14	15	13	13	4	4	4	1
Building TA-21-153 SWMU 21-020(b)	10	50	50	50	41	12	10	8	8	1	3	3	1
Total (Near-Surface)	26	130	130	130	89	26	25	21	21	5	7	7	2

Subsurface Soil Sampling

PRS Identification	Sampling Locations	Samples: Planned	Samples: Collected	Samples Submitted to: Field Screening	Samples Submitted to: Field Laboratory	Analytical Laboratory: Planned	Analytical Laboratory: Actual	Field QA Samples: Planned Total	Field QA Samples: Actual Total	Trip	Reagent	Equipment	Duplicate
Building TA-21-12 SWMU 21-020(a)	5	15	15	15	10	5	5	3	3	1	1	1	0
Building TA-21-153 SWMU 21-020(b)	4	0	12	12	8	0	4	3	3	1	1	1	0
Total (Subsurface)	9	15	27	27	18	5	9	6	6	2	2	2	0
Grand Total	35	145	157	157	107	31	34	27	27	7	9	9	2

Table C.2 Analytical Suite for Filter Building Samples

Field Laboratory Suite (all samples)

- Gamma spectroscopy
- Gross gamma
- Gross beta
- Gross alpha
- Tritium (in soil moisture)
- Volatile organic compounds
- Soil moisture

Analytical Laboratory Suite (30% near-surface samples; 50% subsurface samples)

- Gamma spectroscopy
- Tritium (in soil moisture)
- Americium-241 (on half the samples submitted)
- Uranium (total)
- Plutonium-238, 239/240
- Strontium-90
- Volatile organic compounds
- Semivolatile organic compounds
- Inorganics

Table C.3 Summary of Number Filter Buildings Investigation Analysis Results Reported versus Number of Samples Submitted for Analysis

Near-Surface Samples

Analysis Requested	Building TA-21-12, SWMU 21-020(a) Reported:Submitted						Building TA-21-153, SWMU 21-020(b) Reported:Submitted					
	Samples	Trip Blank	Reagent Blank	Equipment Rinsate	Field Duplicates	Total	Samples	Trip Blank	Reagent Blank	Equipment Rinsate	Field Duplicates	Total
Americium-241	7 : 7	0 : 0	0 : 0	3 : 3	0 : 0	10 : 10	6 : 6	0 : 0	0 : 0	3 : 3	1 : 1	10 : 10
Gamma Spectroscopy	15 : 15	0 : 0	0 : 0	0 : 0	1 : 1	16 : 16	10 : 10	0 : 0	0 : 0	3 : 3	1 : 1	14 : 14
Plutonium-238	15 : 15	0 : 0	0 : 0	4 : 4	1 : 1	20 : 20	10 : 10	0 : 0	0 : 0	3 : 3	1 : 1	14 : 14
Plutonium-239	15 : 15	0 : 0	0 : 0	4 : 4	1 : 1	20 : 20	10 : 10	0 : 0	0 : 0	3 : 3	1 : 1	14 : 14
Strontium-90	15 : 15	0 : 0	0 : 0	4 : 4	1 : 1	20 : 20	10 : 10	0 : 0	0 : 0	3 : 3	1 : 1	14 : 14
Tritium	15 : 15	0 : 0	0 : 0	4 : 4	1 : 1	20 : 20	10 : 10	0 : 0	0 : 0	3 : 3	1 : 1	14 : 14
Uranium (total)	15 : 15	0 : 0	0 : 0	4 : 4	1 : 1	20 : 20	10 : 10	0 : 0	0 : 0	3 : 3	1 : 1	14 : 14
Inorganics (SW-6010)	15 : 15	0 : 0	4 : 4	4 : 4	1 : 1	24 : 24	10 : 10	0 : 0	3 : 3	3 : 3	1 : 1	17 : 17
Semivolatiles (SW-8270)	15 : 15	0 : 0	4 : 4	4 : 4	1 : 1	24 : 24	10 : 10	0 : 0	3 : 3	3 : 3	1 : 1	17 : 17
Volatiles (SW 8240)	15 : 15	4 : 4	4 : 4	4 : 4	1 : 1	28 : 28	10 : 10	1 : 1	3 : 3	3 : 3	1 : 1	18 : 18

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Subsurface Samples

Analysis Requested	Building TA-21-12, SWMU 21-020(a) Reported:Submitted						Building TA-21-153, SWMU 21-020(b) Reported:Submitted					
	Samples	Trip Blank	Reagent Blank	Equipment Rinsate	Field Duplicates	Total	Samples	Trip Blank	Reagent Blank	Equipment Rinsate	Field Duplicates	Total
Americium-241	0 : 3	0 : 0	0 : 0	1 : 1	0 : 0	1 : 4	0 : 2	0 : 0	0 : 0	1 : 1	0 : 0	1 : 3
Gamma Spectroscopy	5 : 5	0 : 0	0 : 0	0 : 0	0 : 0	5 : 5	4 : 4	0 : 0	0 : 0	0 : 0	0 : 0	4 : 4
Plutonium-238	5 : 5	0 : 0	0 : 0	0 : 1	0 : 0	5 : 6	4 : 4	0 : 0	0 : 0	0 : 1	0 : 0	4 : 5
Plutonium-239	5 : 5	0 : 0	0 : 0	0 : 1	0 : 0	5 : 6	4 : 4	0 : 0	0 : 0	0 : 1	0 : 0	4 : 5
Strontium-90	5 : 5	0 : 0	0 : 0	1 : 1	0 : 0	6 : 6	4 : 4	0 : 0	0 : 0	1 : 1	0 : 0	5 : 5
Tritium	5 : 5	0 : 0	0 : 0	1 : 1	0 : 0	6 : 6	4 : 4	0 : 0	0 : 0	1 : 1	0 : 0	5 : 5
Uranium (total)	5 : 5	0 : 0	0 : 0	1 : 1	0 : 0	6 : 6	4 : 4	0 : 0	0 : 0	1 : 1	0 : 0	5 : 5
Inorganics (SW-6010)	5 : 5	0 : 0	1 : 1	1 : 1	0 : 0	7 : 7	4 : 4	0 : 0	1 : 1	1 : 1	0 : 0	6 : 6
Semivolatiles (SW-8270)	5 : 5	0 : 0	1 : 1	1 : 1	0 : 0	7 : 7	4 : 4	0 : 0	1 : 1	1 : 1	0 : 0	6 : 6
Volatiles (SW 8240)	5 : 5	1 : 1	1 : 1	1 : 1	0 : 0	8 : 8	4 : 4	1 : 1	1 : 1	1 : 1	0 : 0	7 : 7

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Table C.4 Building TA-21-12 Sample Numbers

Near-Surface Sample Numbers:

	SAMPLE LOCATION ID															
	Sample Locations Outside Building Footprint							Sample Locations Inside Building Footprint								
DEPTH	21-1436	21-1439	21-1440	21-1441	21-1444	21-1448	21-1451	21-1437	21-1438	21-1442	21-1443	21-1445	21-1446	21-1447	21-1449	21-1450
0-6"																
6-12"																
12-18"	AAA1305	AAA1317	AAA1320	AAA1323	AAA1335	AAA1352	AAA1364	AAA1308	AAA1313	AAA1329	AAA1332	AAA1339	AAA1344	AAA1347	AAA1355	AAA1360
18-24"	AAA1306	AAA1318	AAA1321	AAA1324	AAA1336	AAA1353	AAA1365	AAA1309	AAA1314	AAA1330	AAA1333	AAA1340	AAA1345	AAA1348	AAA1356	AAA1361
24-30"	AAA1307	AAA1319	AAA1322	AAA1327	AAA1337	AAA1354	AAA1366	AAA1312	AAA1315	AAA1331	AAA1334	AAA1343	AAA1346	AAA1350	AAA1359	AAA1362

Subsurface Sample Numbers:

	SAMPLE LOCATION ID				
	OS	IS			
DEPTH	21-1455	21-1452	21-1453	21-1454	21-1456
0-2.5'					
2.5-5.0'		AAA1367	AAA1369		
5.0-7.5'	AAA1376			AAA1372	AAA1378

NOTES:

OS indicates sample locations outside the building footprint.

IS indicates sample locations inside or adjacent to the building footprint.

Location ID 21-1454 had a terminal depth of 7.0 feet.

Location ID 21-1447 had an associated field duplicate.

Table C.5 Building TA-21-12 Strontium-90 Concentrations, pCi/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID																	
	Sample Locations Outside Building Footprint							Sample Locations Inside or Adjacent to Building Footprint										
DEPTH	21-1436	21-1439	21-1440	21-1441	21-1444	21-1448	21-1451	21-1437	21-1438	21-1442	21-1443	21-1445	21-1446	21-1447	21-1449	21-1450	Mean	(n)
0-6"																		
6-12"																		
12-18"			0.288	0.245	0.065		0.734		0.221	0.160	0.215	0.198	0.206	0.273			0.261	10
18-24"	0.252					0.400		0.338									0.330	3
24-30"															0.397	0.231	0.314	2

Subsurface Analysis Results:

	SAMPLE LOCATION ID						
	OS	IS					
DEPTH	21-1455	21-1452	21-1453	21-1454	21-1456	mean	(n)
0-2.5'							
2.5-5.0'		0.300	0.100			0.200	2
5.0-7.5'	0.100			0.100	0.200	0.133	3

NOTES:

OS indicates sample locations outside the building footprint.
IS indicates sample locations inside or adjacent to the building footprint.
Location ID 21-1454 had a terminal depth of 7.0 feet.
Location ID 21-1447 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

Table C.6 Building TA-21-12 Total Uranium Concentrations, ug/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID																
	Sample Locations Outside Building Footprint							Sample Locations Inside or Adjacent to Building Footprint									
DEPTH	21-1436	21-1439	21-1440	21-1441	21-1444	21-1448	21-1451	21-1437	21-1438	21-1442	21-1443	21-1445	21-1446	21-1447	21-1449	21-1450	Mean	(n)
0-6"																		
6-12"																		
12-18"			3.6	3.4	3.2		3.2		3.5	3.2	3.5	3.4	3.3	3.6			3.390	10
18-24"	2.9					3.5		3.6									3.333	3
24-30"															3.5	3.2	3.350	2

Subsurface Analysis Results:

	SAMPLE LOCATION ID						
	OS	IS					
DEPTH	21-1455	21-1452	21-1453	21-1454	21-1456	mean	(n)
0-2.5'							
2.5-5.0'		1.58	2.07			1.825	2
5.0-7.5'	1.43			1.92	2.47	1.940	3

NOTES:

OS indicates sample locations outside the building footprint.
IS indicates sample locations inside or adjacent to the building footprint.
Location ID 21-1454 had a terminal depth of 7.0 feet.
Location ID 21-1447 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

Table C.7 Building TA-21-12 Plutonium-239/240 Concentrations, pCi/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID																	
	Sample Locations Outside Building Footprint							Sample Locations Inside or Adjacent to Building Footprint										
DEPTH	21-1436	21-1439	21-1440	21-1441	21-1444	21-1448	21-1451	21-1437	21-1438	21-1442	21-1443	21-1445	21-1446	21-1447	21-1449	21-1450	Mean	(n)
0-6"																		
6-12"																		
12-18"			0.832	10.200	13.400		3.620		1.170	1.130	0.842	0.170	0.477	4.880			3.672	10
18-24"	0.152					5.660		0.156									1.989	3
24-30"															1.710	1.180	1.445	2

Subsurface Analysis Results:

	SAMPLE LOCATION ID						
	OS	IS					
DEPTH	21-1455	21-1452	21-1453	21-1454	21-1456	mean	(n)
0-2.5'							
2.5-5.0'		0.033	2.64			1.337	2
5.0-7.5'	0.051			0.744	0.131	0.309	3

NOTES:

OS indicates sample locations outside the building footprint.
IS indicates sample locations inside or adjacent to the building footprint.
Location ID 21-1454 had a terminal depth of 7.0 feet.
Location ID 21-1447 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

Table C.8 Building TA-21-12 Plutonium-238 Concentrations, pCi/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID																	
	Sample Locations Outside Building Footprint							Sample Locations Inside or Adjacent to Building Footprint										
DEPTH	21-1436	21-1439	21-1440	21-1441	21-1444	21-1448	21-1451	21-1437	21-1438	21-1442	21-1443	21-1445	21-1446	21-1447	21-1449	21-1450	Mean	(n)
0-6"																		
6-12"																		
12-18"			1.420	0.444	0.114		0.067		0.143	0.123	0.079	0.152	1.960	0.470			0.497	10
18-24"	0.152					0.327		0.195									0.225	3
24-30"															0.067	0.092	0.080	2

Subsurface Analysis Results:

	SAMPLE LOCATION ID						
	OS	IS					
DEPTH	21-1455	21-1452	21-1453	21-1454	21-1456	mean	(n)
0-2.5'							
2.5-5.0'		0.001	0.186			0.094	2
5.0-7.5'	0.001			0.087	0.015	0.034	3

NOTES:

OS indicates sample locations outside the building footprint.
IS indicates sample locations inside or adjacent to the building footprint.
Location ID 21-1454 had a terminal depth of 7.0 feet.
Location ID 21-1447 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

Table C.9 Building TA-21-12 Americium-241 Concentrations, pCi/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID																	
	Sample Locations Outside Building Footprint							Sample Locations Inside or Adjacent to Building Footprint										
DEPTH	21-1436	21-1439	21-1440	21-1441	21-1444	21-1448	21-1451	21-1437	21-1438	21-1442	21-1443	21-1445	21-1446	21-1447	21-1449	21-1450	Mean	(n)
0-6"																		
6-12"																		
12-18"				0.696					0.408		0.086	0.097					0.322	4
18-24"	0.082					0.605											0.344	2
24-30"																0.907	0.907	1

Subsurface Analysis Results:

	SAMPLE LOCATION ID						
	OS	IS					
DEPTH	21-1455	21-1452	21-1453	21-1454	21-1456	mean	(n)
0-2.5'							
2.5-5.0'							
5.0-7.5'							

NOTES:

OS indicates sample locations outside the building footprint.
IS indicates sample locations inside or adjacent to the building footprint.
Location ID 21-1454 had a terminal depth of 7.0 feet.
Location ID 21-1447 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.
To date, no analytical results have been reported from the laboratory for the subsurface samples.

Table C.10 Building TA-21-12 Tritium Concentrations, pCi/L

Near-Surface Analysis Results:

	SAMPLE LOCATION ID																
	Sample Locations Outside Building Footprint							Sample Locations Inside or Adjacent to Building Footprint									
DEPTH	21-1436	21-1439	21-1440	21-1441	21-1444	21-1448	21-1451	21-1437	21-1438	21-1442	21-1443	21-1445	21-1446	21-1447	21-1449	21-1450	Mean	(n)
0-6"																		
6-12"																		
12-18"			1,300	2,400	2,000		14,100		600	1,400	1,000	4,200	600	1,800			2,940	10
18-24"	2,600					1,500		1,900									2,000	3
24-30"															5,500	24,000	14,750	2

Subsurface Analysis Results:

	SAMPLE LOCATION ID						
	OS	IS					
DEPTH	21-1455	21-1452	21-1453	21-1454	21-1456	mean	(n)
0-2.5'							
2.5-5.0'		1,000	3,100			2,050	2
5.0-7.5'	9,000			69,200	6,300	28,167	3

NOTES:

OS indicates sample locations outside the building footprint.
IS indicates sample locations inside or adjacent to the building footprint.
Location ID 21-1454 had a terminal depth of 7.0 feet.
Location ID 21-1447 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

Table C.11 Building TA-21-153 Sample Numbers

Near-Surface Sample Numbers:

	SAMPLE LOCATION ID									
	OS			IS						
DEPTH	21-1457	21-1461	21-1464	21-1458	21-1459	21-1460	21-1462	21-1463	21-1465	21-1466
0-6"										
6-12"		AAA1399	AAA1414							
12-18"										AAA1424
18-24"						AAA1397	AAA1406			
24-30"	AAA1383			AAA1387	AAA1393			AAA1413	AAA1421	

Subsurface Sample Numbers:

	SAMPLE LOCATION ID			
	OS	IS		
DEPTH	21-1473	21-1474	21-1475	21-1476
0-2.5'				
2.5-5.0'				AAA1721
5.0-7.5'	AAA1712	AAA1717	AAA1719	

NOTES:

OS indicates sample locations outside the building footprint.

IS indicates sample locations inside the building footprint.

Location ID 21-1476 had a terminal depth of 6.2 feet.

Location ID 21-1466 had an associated field duplicate.

Table C.12 Building TA-21-153 Strontium-90 Concentrations, pCi/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID											
	OS			IS								
DEPTH	21-1457	21-1461	21-1464	21-1458	21-1459	21-1460	21-1462	21-1463	21-1465	21-1466	Mean	(n)
0-6"												
6-12"		0.332	0.393								0.363	2
12-18"										0.316	0.316	1
18-24"						0.287	0.404				0.346	2
24-30"	0.392			35.300	0.216			0.555	0.210		7.335	5

Subsurface Analysis Results:

	SAMPLE LOCATION ID					
	OS	IS				
DEPTH	21-1473	21-1474	21-1475	21-1476	mean	(n)
0-2.5'						
2.5-5.0'				<.001	<.001	1
5.0-7.5'	0.300	0.200	0.200		0.233	3

NOTES:

OS indicates sample locations outside the building footprint.

IS indicates sample locations inside the building footprint.

Location ID 21-1476 had a terminal depth of 6.2 feet.

Location ID 21-1466 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

The 24-30" value at location 21-1458, 35.3 pCi/g is not included in the calculated mean

Table C.13 Building TA-21-153 Total Uranium Concentrations, ug/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID											
	OS			IS								
DEPTH	21-1457	21-1461	21-1464	21-1458	21-1459	21-1460	21-1462	21-1463	21-1465	21-1466	Mean	(n)
0-6"												
6-12"		3.6	3.2								3.400	2
12-18"										3.5	3.500	1
18-24"						3.7	3.5				3.600	2
24-30"	4			3.7	3.6			3.6	4.2		3.820	5

Subsurface Analysis Results:

	SAMPLE LOCATION ID					
	OS	IS				
DEPTH	21-1473	21-1474	21-1475	21-1476	mean	(n)
0-2.5'						
2.5-5.0'				1.57	1.570	1
5.0-7.5'	1.5	1.97	1.67		1.713	3

NOTES:

OS indicates sample locations outside the building footprint.

IS indicates sample locations inside the building footprint.

Location ID 21-1476 had a terminal depth of 6.2 feet.

Location ID 21-1466 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

Table C.14 Building TA-21-153 Plutonium-239/240 Concentrations, pCi/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID											
	OS			IS								
DEPTH	21-1457	21-1461	21-1464	21-1458	21-1459	21-1460	21-1462	21-1463	21-1465	21-1466	Mean	(n)
0-6"												
6-12"		<.001	0.044								0.023	2
12-18"										0.011	0.011	1
18-24"						0.004	0.160				0.082	2
24-30"	0.055			0.853	0.014			0.012	0.021		0.191	5

Subsurface Analysis Results:

	SAMPLE LOCATION ID					
	OS	IS				
DEPTH	21-1473	21-1474	21-1475	21-1476	mean	(n)
0-2.5'						
2.5-5.0'				0.001	0.001	1
5.0-7.5'	0.011	0.003	0.001		0.005	3

NOTES:

OS indicates sample locations outside the building footprint.

IS indicates sample locations inside the building footprint.

Location ID 21-1476 had a terminal depth of 6.2 feet.

Location ID 21-1466 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

Table C.15 Building TA-21-153 Plutonium-238 Concentrations, pCi/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID											
	OS			IS								
DEPTH	21-1457	21-1461	21-1464	21-1458	21-1459	21-1460	21-1462	21-1463	21-1465	21-1466	Mean	(n)
0-6"												
6-12"		0.149	0.142								0.146	2
12-18"										0.030	0.030	1
18-24"						0.011	0.160				0.086	2
24-30"	0.082			<.001	0.015			0.182	0.105		0.077	5

Subsurface Analysis Results:

	SAMPLE LOCATION ID					
	OS	IS				
DEPTH	21-1473	21-1474	21-1475	21-1476	mean	(n)
0-2.5'						
2.5-5.0'				0.001	0.001	1
5.0-7.5'	0.007	<.001	0.001		0.003	3

NOTES:

OS indicates sample locations outside the building footprint.

IS indicates sample locations inside the building footprint.

Location ID 21-1476 had a terminal depth of 6.2 feet.

Location ID 21-1466 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

Table C.16 Building TA-21-153 Americium-241 Concentrations, pCi/g

Near-Surface Analysis Results:

	SAMPLE LOCATION ID											
	OS			IS								
DEPTH	21-1457	21-1461	21-1464	21-1458	21-1459	21-1460	21-1462	21-1463	21-1465	21-1466	Mean	(n)
0-6"												
6-12"			0.515								0.515	1
12-18"										1.086	1.086	1
18-24"						0.642	0.518				0.580	2
24-30"				0.592	0.478						0.535	2

Subsurface Analysis Results:

	SAMPLE LOCATION ID					
	OS	IS				
DEPTH	21-1473	21-1474	21-1475	21-1476	mean	(n)
0-2.5'						
2.5-5.0'						
5.0-7.5'						

NOTES:

OS indicates sample locations outside the building footprint.

IS indicates sample locations inside the building footprint.

Location ID 21-1476 had a terminal depth of 6.2 feet.

Location ID 21-1466 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

To date, no analytical results have been reported from the laboratory for the subsurface samples.

Table C.17 Building TA-21-153 Tritium Concentrations, pCi/L

Near-Surface Analysis Results:

	SAMPLE LOCATION ID											
	OS			IS								
DEPTH	21-1457	21-1461	21-1464	21-1458	21-1459	21-1460	21-1462	21-1463	21-1465	21-1466	Mean	(n)
0-6"												
6-12"		18,100	24,600								21,350	2
12-18"										222,650	222,650	1
18-24"						20,400	16,000				18,200	2
24-30"	15,200			12,300	13,000			43,300	53,400		27,440	5

Subsurface Analysis Results:

	SAMPLE LOCATION ID					
	OS	IS				
DEPTH	21-1473	21-1474	21-1475	21-1476	mean	(n)
0-2.5'						
2.5-5.0'				46,700	46,700	1
5.0-7.5'	7,500	19,500	23,900		16,967	3

NOTES:

OS indicates sample locations outside the building footprint.

IS indicates sample locations inside the building footprint.

Location ID 21-1476 had a terminal depth of 6.2 feet.

Location ID 21-1466 had an associated field duplicate. The value reported is the average of the sample value and the field duplicate value.

APPENDIX D

DATA QUALITY ASSESSMENT

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DATA QUALITY ASSESSMENT

D.1 Data Quality

This appendix summarizes data quality assessments for the data resulting from the investigations reported in this phase report: OU-wide surface soil investigation, airborne emissions deposition investigation, and filter buildings investigation. The overall requirements for data quality assurance were specified in the Laboratory's Generic Quality Assurance Project Plan (QAPjP), as presented in the Installation Work Plan (LANL 1993c). The QAPjP specifies quality assurance requirements for field sampling, field measurements, and analytical laboratory data. Quality assurance objectives for precision, accuracy, analytical sensitivity, representativeness, completeness, and comparability (PARCC) are defined in the QAPjP. Appendix A of the TA-21 RFI Work Plan summarizes the specific objectives for the TA-21 operable unit.

Analytical data assessed in this phase report are accessible on the Facility for Information Management and Display (FIMAD) data management system. Appendix E of this phase report provides summary data tables for sample analyses exceeding the 95.5 percentile of the applicable baseline.

For ease in presentation, the data quality summary is organized around the PARCC parameters. Within that organization, the data from each investigation are discussed as appropriate. Some problems were encountered in completing the data quality assessment. The primary issues were related to the consistency of analytical methods, the batching of QA samples with field samples, and the ability to relate samples to batches and QA results within the data management system. The issues are explained and evaluated further in appropriate sections of this appendix. In general the more severe issues were related to the inorganic analyses, with less concern for the radiological and organic analyses.

In summary, it is judged that the data acquired in the FY92 investigations and presented in this phase report are acceptable and usable for the purposes intended, even though not all measures of quality can be assessed at this time and some care must be taken to ensure comparisons are made between comparable sets of data, primarily with regard to inorganic analysis results.

D.2 Overview of Data Management

The data management system, from collection of samples through reporting of results, is reviewed in this section. The purpose is to identify the important stages in the process and the

problematic parts of the process which may impact data quality or the ability to assess data quality.

D.2.1 Data Management Process Description

The data collection and management process used for the TA-21 RFI is briefly summarized below.

D.2.1.1 Collection

The collection of field samples is accompanied by the collection or creation of field QA samples: trip blanks, equipment rinsate blanks, field reagent blanks, field duplicates, and in some cases performance assessment spiked samples are added in the field. The number of QA samples added is a percentage of the number of field samples, typically 5% to 10%. Each day of sampling, the field team delivered its samples to the ER Program's Sample Coordination Facility (SCF). For the TA-21 RFI, the daily production of field and QA samples was not intended to be a stand-alone batch of samples containing a full set of QA samples. It was recognized that some day's productions would contain some of the QA sample types, on other days other QA sample types, and on some days perhaps no QA samples. However, it was intended that the QA samples submitted with a day's production would be batched for analysis with the other samples from that day.

D.2.1.2 Distribution

Upon delivery to the SCF, field sample sets sometimes were combined and usually were supplemented with additional performance assessment QA samples, but were always maintained intact and submitted to the appropriate analytical laboratory as a batch. The batches were documented by a uniquely numbered analytical request form which noted the sample numbers assigned by the field team, sample numbers assigned by the SCF, and the analyses to be performed. This document also included any quality assurance samples associated with the request and identified the analyses to be performed on these samples. The request number was intended to uniquely identify each laboratory batch, and generally is used to track and retrieve sample information. Table D.1 summarizes laboratory request numbers associated with each suite of analytes requested for each investigation.

D.2.1.3 Analysis

Sample batches were submitted to analytical laboratories based on laboratory capabilities and capacity. The several different types of analyses (e.g., radiological versus inorganic) for an individual sample were often conducted by different laboratories. Sample aliquots were collected in the field in separate sample containers for each type of analysis. The analytical methods employed by the laboratories are detailed in the QAPjP.

D.2.1.4 Reporting

Upon completion of sample analyses, analytical reports were prepared by the SCF. Each report was assigned a unique report number and referenced the original request number. The analytical reports identify the analytical results for field samples and associated QA samples, the analytical methods, the analyst, and the laboratory performing the analyses. Data review is documented by the reviewer's initials on the final page of the report.

D.2.1.5 Data management

Analytical results were entered into the FIMAD data management system to provide a means for reviewing the large volume of data and for accessing the results for data assessment including statistical analysis. Each of the approximately 618 individual samples addressed in this phase report was analyzed for one or more of the following categories of analytes: radiological, inorganics, semi-volatiles, and volatiles. Each category includes from five to thirty individual analytes, resulting in a large data set to be managed.

D.2.2 Data Management Issues

Issues impacting data quality or the ability to assess data quality are identified below for each stage in the data collection and management process.

D.2.2.1 Collection issues

Field collection of samples and submission of QA samples was conducted as planned for the TA-21 RFI.

D.2.2.2 Distribution issues

Distribution of samples to analytical laboratories was conducted as planned for the TA-21 RFI.

D.2.2.3 Analysis issues

Several issues that have created data quality issues for TA-21 RFI data are related to the performance or control of the analytical laboratories. The issues of laboratory rebatching and inconsistency in extraction and analytical methods are discussed below.

Rebatching. In some cases, sample batches sent to an analytical laboratory were split (i.e., rebatched) at the laboratory to facilitate through-put. Rebatching was not realized by the operable unit team until after much of the data had been received and entered into FIMAD. In some cases, quality assurance samples were batched separately from the corresponding field samples.

Each laboratory batch was addressed in one analytical report. Thus, a single request number (indicating the intended batch) may have resulted in more than one report number (indicating actual batches) if the laboratory split a batch. This problem did not become evident to the operable unit team until most data had been entered into FIMAD without inclusion of the report number as a separate field. Subsequently, new data have been entered into FIMAD with inclusion of the report number. At present, some records in FIMAD include the report number and others do not. This inconsistency currently makes it impossible to efficiently correlate field samples with their associated quality assurance samples. Manual review of hard copy reports is ongoing.

Inconsistent extraction techniques. During initial Grid 1 and Grid 2 data assessment, unexpectedly large variations were observed for several inorganic analytes. In some cases, these variations were an order of magnitude or greater. The differences were determined to be due to the use of two different extraction techniques by the analytical laboratories doing the inorganic analyses. For the Grid 1 sample submissions (March through May, 1992), an extraction technique employing hydrofluoric acid was used to enhance sample dissolution. For Grid 2 and subsequent sample submissions (June 1992 and later), this deviation from the QAPjP was rectified and the standard SW-846 extraction using nitric acid was employed.

The use of two different extraction techniques is strongly reflected in the reported concentrations of the elements that are major constituents of the minerals comprising the soil and rock matrix (i.e., sodium, potassium, magnesium, calcium, aluminum, iron, and silicon). Reported concentrations of other elements associated with accessory minerals or with mineral surfaces (notably, added contaminants) would be expected to be impacted minimally by the different methods. The data comparison presented in Section D.3.3, Comparability confirmed this expectation. However, since no samples were extracted by both methods and analyzed, a quantitative comparison of the effect of the different extraction methods cannot be made with the

available data. The impact of the use of the two different extraction techniques is that for a certain set of elements, the data acquired by one method are not comparable to those acquired by the other method.

Inconsistent analytical techniques. A second problem that complicated the assessment of inorganic analyses for grid samples was the inadvertent use of two different analytical methods. Most analyses were conducted using Inductively Coupled Plasma-Emission Spectrometry (ICPES) (as specified in the (QAPjP), but a substantial number also were conducted using Inductively Coupled Plasma Mass Spectrometry (ICPMS) which has lower detection limits. Since the two methods have different detection limits, comparability between the two data sets is affected for analytes which are generally present in the soil in concentrations below the higher of the two detection limits. In a few instances, the detection limit differences resulted in incompatible data sets that could not be combined for statistical analyses.

D.2.2.4 Reporting issues

Multiple reporting. When errors were detected in data reports, a new analytical report was issued by the SCF. Depending on the severity of the error and the amount of data that changed, the new report sometimes carried a new report number. This created a situation where two reports with different report numbers provided sometimes different results for the same sample analysis. Whether or not a new report number was issued, all revised data were entered into FIMAD. To avoid loss of older data in the database, no data were overwritten, and multiple data records for individual samples have resulted. During use of the information in the FIMAD database, care must be taken to ensure the correct value is chosen from multiple entries.

D.2.2.5 Data management issues

Incomplete information in the database. Early on, most data were entered into FIMAD without inclusion of the report number as a separate field, as discussed above in Section D.2.2.3, Analysis. More recent data have been entered into FIMAD with the report number included. At present some records in FIMAD include the report number and others do not. This inconsistency currently makes it impossible to efficiently correlate field samples with their associated quality assurance samples. For specific assessments, manual access to hard copy data reports must be employed.

At present, data qualifiers are not uploaded to FIMAD, resulting in the lack of that information within the electronic database. The result is a need to refer to hard copy analytical reports to complete some data assessment activities.

Currently, the association of QA samples with analytical samples cannot be performed readily using the information in the FIMAD data management system because sample numbers cannot be associated with report numbers or with results from relevant QA/QC samples. Most data records appear to involve multiple reports per request. It has been determined that insufficient information is available at this time to verify the intactness of the batches of samples and assess their association with QA/QC samples. This assessment should be possible when the FIMAD database is revised.

In the near future, the FIMAD database will be purged and all analytical data will be resubmitted to eliminate duplicate reporting and to supply report numbers for all data. The new data will be verified prior to release to other users and should allow a complete assessment of data quality, especially measures of precision and accuracy. Due to the difficulties described above, full evaluation of data precision, accuracy (and to a lesser degree completeness) could not be performed in time for submission in this phase report.

D.3 Data Quality Summary

For ease in presentation, the data quality summary is organized around the PARCC parameters. Within that organization, the data from each investigation are discussed as appropriate.

D.3.1 Representativeness

The RFI work plan provides the primary guidance to ensure that collected samples were representative of the environment being assessed. If the samples were collected as specified in the work plan, and if conditions at the sampling locations were as expected, the samples are judged to be suitably representative. These conditions clearly were met for the OU-wide surface soil sampling (Chapter 2 and Appendix A) and the related deposition-layer sampling to address airborne emissions (Chapter 3 and Appendix B). In these investigations, the samples were collected as specified in the revised sampling plan and are representative of surface soils in all areas of the OU.

For the filter buildings investigation (Chapter 4 and Appendix C), two conditions need consideration.

- At building TA-21-12 (SWMU 21-020(a)) the sample locations were not placed precisely as planned for assessing the area within the footprint of the building. As discussed in Appendix C, the inadvertent displacement of a few locations to the west of the building footprint did not seriously impact the results of the investigation. In fact, having a few extra samples outside the footprint provided useful information on the lack of a distinct difference between contaminant concentrations inside and outside the footprint.

- The subsurface samples at both SWMUs were obtained by hand auger rather than by hollowstem coring as planned. Core samples would have been less subject to potential sample cross-contamination within the soil/rock profile and would have been of intact tuff. However, intact core samples were not an investigation requirement. Further, based on the contaminant concentrations presented in Appendix C, no scenario is envisioned where low-level cross-contamination would impact the conclusions reached.

The representativeness requirements are judged to have been met fully for all three investigations reported in this phase report.

D.3.2 Completeness

Completeness will be assessed in this phase report as the percentage of usable analytical results reported, based on the number planned for the investigation. This is a less stringent definition of completeness than for some investigations. The decision to use this definition is explained in the following paragraphs.

For all three investigations reported in this phase report, the number of samples submitted to the laboratory for analysis and reported to the operable unit team was in excellent agreement with the sampling plan. For the OU-wide and deposition-layer investigations, the revised plan described in Appendix A is used as the basis for assessing completeness. For the filter buildings, the plan in Appendix C is used as the basis. In all three investigations, the percentage of results reported is very high as shown in Tables D.2 through D.4.

Other aspects of the assessment of completeness include:

- The processing of matrix spike and matrix spike duplicate QA samples with each analytical batch by the analytical laboratory to document analytical recovery and provide a measure of analytical precision. This requirement was fulfilled without exception.

- The submission for analysis of field QA samples to document inadvertent contamination of samples and to provide a measure of sample variability. The frequency specification and the actual frequency achieved is summarized in Table D.5 for all investigations combined.

These measures of completeness are less rigorous than in other assessments which include analytical laboratory compliance with the exact analytical technique specified in the QAPjP or assessment every sample batch with its associated quality assurance samples.

There are two facets to acceptance of a less stringent definition for completeness. First, the data management capabilities of the FIMAD do not currently include all of the information needed to relate samples to their analytical batches and associated quality assurance samples. In addition, it is known that in a number of cases the submitted batches were split and that many sample analysis results cannot be assessed at present against some of the QA samples. However, in all cases where the assessments have been made, the judgment is that the sample analysis results are acceptable and usable for all intended purposes of this investigation. This position is reasonable for investigations such as these where the purpose is to determine whether contaminants are present, prepare statistical assessments of concentration ranges, or determine whether any contaminant release occurred.

Second, several inconsistencies in analytical techniques occurred (see D.2.2.3, Analysis). If use of the prescribed analytical technique is a strict criterion for judging acceptability, many analyses for these investigations would be unusable and the completeness measure would be much lower. In reviewing the data and analysis information, however, it has been judged that the analyses done by the various techniques are usable, even if they differ from those specified in the QAPjP. The impact, however, is incompatibility between certain sets of data (discussed below in D.3.3, Comparability). For the purposes of these investigations, the comparability issues were judged not to affect the usability of the data.

D.3.3 Comparability

As discussed in Section D.2.2.3, Analysis Issues, two inconsistencies in laboratory procedure affected the inorganic analyses.

Inconsistent Extraction Techniques. Two different extraction techniques were used by the analytical laboratories for sample preparation for inorganic analysis. In the Grid 1 sample submissions (March through May, 1992), an extraction technique employing hydrofluoric acid was used to enhance sample dissolution. For Grid 2 and subsequent rounds of sample submissions (June 1992 and later), this deviation from the QAPjP was rectified and the standard SW-846 extraction using nitric acid was employed. For certain elements, the reported results for soils derived from Bandelier tuff differed by an order of magnitude or more between the two extraction methods. Table D.6 identifies the analysis request numbers for which each extraction procedure was used.

The non-standard hydrofluoric acid extraction technique greatly increases the dissolution of the elements that are major constituents of the minerals comprising the soil or rock matrix (i.e., sodium, potassium, magnesium, calcium, aluminum, iron, and silicon). Samples are less completely dissolved by the SW846 nitric acid dissolution method. Analytes associated with accessory minerals or with mineral surfaces (notably, added contaminants) are expected to be impacted minimally since either extraction method should be sufficient. However, since no samples were analyzed by both methods, a quantitative comparison of the effect of the different extraction methods cannot be made with the available data. The major effect is that soil matrix analytes are reported at greater concentrations when samples are extracted with hydrofluoric acid compared with nitric acid due to the greater degree of sample dissolution.

Hydrofluoric acid extraction leads to analytical results which are more comparable with the neutron activation method (NAA) used for recent Laboratory regional background investigations, which gives the total element concentrations in the soil or rock matrix. On the other hand, nitric acid extraction analyses are more comparable to typical RCRA or CERCLA investigation data, and to data from RFI studies currently being performed at other Laboratory operable units.

Table D.7 presents a comparison of inorganic data for adjacent grid points, one each from Grid 1 (hydrofluoric extraction) and Grid 2 (nitric extraction), both analyzed by ICPES. The major soil matrix elements are listed at the top of the table. The major differences between methods are associated with these elements. The next several analytes in the table are not major elements in

the soil matrix, but they also show strong differences between the two locations. The remaining analytes in the table exhibit little apparent bias between the two methods.

Also shown in the table are the mean and range for most elements as determined by NAA on comparable soils in a regional background study. Underlined values in the table are those which are below the range of background as determined by NAA. These are primarily found in the Grid 2 (nitric extraction) sample, although sodium, lead, and strontium from the Grid 1 (hydrofluoric extraction) sample are also low compared to the NAA data.

Since Grid 1 results were intended to be used in conjunction with Grid 2 results, the use of two different extraction methods creates a data comparability problem for the major elements comprising the soil matrix. Fortunately, these analytes are not contaminants of concern at TA-21. To minimize the comparability problem, the following constraints were imposed for inorganic data assessment:

- General comparisons of the RFI data to other RCRA/CERCLA data using SW846 procedures will be restricted to Grid 2 data, except as noted below.
- General comparisons of the RFI data to other mineralogical or geochemical data utilizing total analyses (i.e., NAA) will be restricted to Grid 1 data.
- Comparisons between the Grid 1 and the Grid 2 data, or of Grid 1 data with other RCRA/CERCLA methodology data, will exclude detailed comparisons of the major elements sodium, potassium, magnesium, calcium, aluminum, iron, and silicon. Comparisons involving other elements will be evaluated statistically to determine comparability prior to further use. Combinations of the two data sets for any use also will be subject to confirmation that the data are acceptably comparable.

Inconsistent Analytical Techniques. A second problem that complicated the assessment of inorganic analyses for grid samples was the inadvertent use of two different analytical methods. Most analyses were conducted using Inductively Coupled Plasma-Emission Spectrometry (ICPES) (as specified in the (QAPjP), but a substantial number also were conducted using Inductively Coupled Plasma Mass Spectrometry (ICPMS) which has lower detection limits. Since the two methods have different detection limits, the overall comparability of the two data sets is affected for analytes which are generally present in the soil in concentrations below the higher of the two detection limits. In a few instances, the detection limit differences resulted in incompatible data sets that could not be combined for statistical analyses.

In general, for establishing site baseline concentrations, the more sensitive ICPMS data were used for comparison to other values obtained by that technique. Where possible the higher detection limit ICPES method, results and detection limits were compared to ICPMS data. This approach is consistent with the original intent of the RFI Work Plan (which specified the higher detection limit technique) to identify contaminant releases.

D.3.4 Analytical Sensitivity

A review of the 1992 RFI analytical data available on FIMAD was conducted to determine consistency of reported instrument detection limits with practical quantitative limits (PQLs) prescribed in the QAPjP. Reported detection limits for sample are displayed in FIMAD data records as a value preceded by the symbol "< or "-".

All detection limits for radiological analyses complied with the PQLs in the QAPjP, with the exception of americium-241 analyses performed by gamma spectrometry. The gamma spectrometry americium-241 detection limit (0.2 pCi/g) exceeded the PQL, but remains far below any decision level for these investigations. This departure from the QAPjP was judged to have no practical impact on the RFI objectives or data useability.

The QAPjP did not provide inorganic PQLs for soil samples. For this reason, detection limits for the PQLs were those associated with rinsate blanks. A large portion of the inorganic soil sample results were reported as µg/L. The percentage of data reported in µg/L varied from 4% for antimony to 82% for iron, and most frequently were between 25% and 45%. Reported sample detection limits for beryllium and magnesium (between 1 and 10 µg/L for beryllium and between 1 and 100 µg/L for magnesium) always exceeded the PQLs. Aluminum and arsenic complied with the PQL requirement 4% and 9% of the time respectively. All other analyte detection limits fell below the PQLs from 20-66% of the time. Ranges of values varied widely from 1-10 µg/L to 2-10 mg/L. Because the range of detection limits were far below decision levels for target analytes of the investigation, data useability was judged to be unaffected by deviations from the PQLs.

Except for one sample where the reported detection limit for each volatile organic analyte exceeded the PQL by a factor of 1000, all reported detection limits for volatile organic compounds were very near the PQLs. Reported detection limits for semi-volatile organic compounds ranged from 330-3300 ug/kg for all analytes. These detection limits met or were better than PQL requirements for 37% of the analytes. Detection limits for the remaining analytes were above the PQL. Again, deviations from the PQLs are judged to be of no significance regarding data useability for the purposes of these investigations.

D.3.5 Precision

Assessment of the compliance of 1992 RFI data with PARCC precision objectives is not possible at this time due to the inability to electronically relate all QA/QC data with corresponding laboratory batch numbers.

D.3.6 Accuracy

Assessment of the compliance of 1992 RFI data with PARCC accuracy objectives is not possible at this time due to the inability to electronically relate all QA/QC data with corresponding laboratory batch numbers.

D.4 Special Concerns and Issues

The following issues are not directly related to PARCC requirements, but do represent deviations from the planned analytical program, and potentially impact data quality.

D.4.1 Gamma Spectroscopy

Gamma spectroscopy was performed on all samples collected in the investigations described in this phase report. A preliminary gamma scan was performed in the field laboratory. These data were used primarily as screening information prior to sample shipping. In the filter buildings investigation, these data also were used to select samples to be submitted for laboratory analysis. A more sensitive gamma spectroscopy was also performed in an analytical laboratory on all samples submitted for laboratory analysis. In a deviation from the QAPjP, the performing laboratory reported non-quantitative gamma spectroscopy data, where the intent was quantitative analyses.

The gamma spectrometry data were intended primarily to address the presence of cesium-137 in the OU-wide surface soil investigation and the deposition-layer investigation. In addition, it was intended to address the potential presence of gamma emitting progeny in the actinium-227 decay series at SWMU 21-020(b) in the filter buildings investigation. These needs can be fulfilled in a qualitative sense using the reported gamma spectroscopy data as discussed in Appendix C. A further check which reduces the need for quantitative gamma spectral analysis is provided by the gross gamma measurements made on all samples in the field laboratory. For cesium-137, this technique has a detection limit of approximately 4 pCi/g. Because gamma levels were not observed above 4 pCi/g in any filter buildings data, cesium-137 and other gamma emitters are

assumed to be below that level. For OU-wide grid investigations, gross gamma levels were rarely reported above the detection limit, and then only marginally so.

More extensive evaluation of gamma spectroscopy data for the other investigations reported in this phase report (deposition layer and OU-wide surface soil investigations) is ongoing.

D.4.2 Total uranium analyses

The analytical technique used for total uranium was changed between the summer 1992 field events (delayed neutron activation analysis (DNA) was used then) and the October 1992 event (kinetic phosphorescence activation (KPA) began to be used). The KPA results appear to be biased about a factor of two less than the DNA results, based on the following assessment.

A calculational check can be done by converting DNA data in mass units (ug/g) to activity units (pCi/g). In general, there is good agreement between the DNA technique and radiochemical separation and alpha spectrometric methods which report concentrations of specific uranium isotopes in activity units (pCi/g). In all of the samples in the building TA-21-12 area, the DNA uranium concentrations indicate a uniform uranium background in the Bandelier tuff.

The KPA results for the several samples on which the technique has been used are likewise uniform, but have values consistently about half of that expected from the other techniques. On this basis, it is judged that the KPA total uranium data are biased low by about 50%. This observation has no impact on the one affected investigation reported in this phase report, the October 1992 subsurface component of the filter buildings investigation. The origin of the apparent bias will be investigated and the impact if any on subsequent investigations will be assessed at an appropriate time.

D.5 Geodetic Survey Data

Specific attention has been given to verifying the accuracy of the coordinate data representing the locations of sampling points, as determined by geodetic surveys and reported in a final survey report. The geodetic survey coordinates were checked for validity prior to final entry into FIMAD. A total of 340 sampling locations were surveyed for the investigations reported in this phase report. There were 305 locations for the deposition-layer investigation and OU-wide surface soil investigation grid. In addition, there were 35 locations for the filter buildings investigations.

Survey coordinates initially provided in a draft survey report were loaded into a temporary FIMAD file and plotted on a base map for review to screen for major discrepancies. The planned

locations for sampling were also displayed on the base map for ease of comparison. Errors resulting primarily from data entry were corrected and revised coordinates were entered into a temporary FIMAD file.

Subsequently, a point by point comparison was made to identify points which deviated from the planned locations, and to identify the group of points which were placed based on field information (for which no planned location was available). Based on field notes, the plotted location of each of these points was verified, to confirm that the deviations from planned locations were appropriate and that the field-placed locations were correct. In some cases, locations were revisited in the field to confirm field documentation which had been carefully recorded to identify the point at which each sample had been collected. This documentation was done with the intent of being able to reoccupy a sampling point even in the event of the loss of the geodetic survey information. For the erroneous locations, the survey data were recalculated and replotted. In a few cases when a discrepancy still remained between the plotted location and the known location in the field, sampling locations were re-surveyed, plotted, and confirmed.

Following the validity check described above, the temporary FIMAD data file was plotted and rechecked prior to approval for the permanent download into FIMAD.

D.6 Conclusions

Difficulties in accessing data through the FIMAD data management system have prevented a complete data quality assessment at this time. Quality related issues include: the use of alternative extraction and analysis techniques for inorganic analyses, the breaking of analytical batches by the analytical laboratories resulting in the separation of field samples from their associated QA samples, a general inability to efficiently relate samples to their analytical batches and QA samples within the electronic data management system, gamma spectroscopy results which can be used only qualitatively, and an unexpected change in the total uranium analytical technique with an apparent bias between the two techniques.

This assessment of data quality for the TA-21 RFI is specific to the intended purposes of the three investigations reported in this phase report. The purposes of those investigations focus on identifying whether contaminants are present, preparing statistical assessments of concentration ranges, and determining whether contaminants were released. With consideration of those investigation objectives, it is judged that the data acquired in the FY92 investigations and presented in this phase report are acceptable and usable for all intended purposes, even though not all measures of quality can be assessed at this time.

Table D.1. Laboratory request numbers for OU-wide grid and filter building samples.

	Radiological Request No.	Organics Request No.	Inorganics Request No.
Grid 1	12649	12648	12647
	12662	12662	12661
	12665	12672	12664
	12668	12679	12667
	12681	12692	12678
	12692	12701	12691
	12696	12702	12695
	12702	12714	12700
	12722	12722	12721
	12726	12725	12724
	12740	12729	12728
	12742	12742	12741
	12754	12752	12752
	12759		12758
Grid 2	12994	12995	12996
	12002	12008	12002
	12009	12014	12007
	12015	12019	12012
	12022	12021	12020
	12041	12046	12040
	12045	12059	12047
	12054	12071	12052
	12060	12081	12058
	12068	12092	12070
	12077	12095	12076
	12079	12126	12080
	12090	12149	12091
	12094	12157	12092
	12127		12125
	12150		12148
	12158		12156
	12165		12162
Filter Buidlings	12247	12246	12245
	12267	12266	12265
	12272	12271	12270
	12295	12294	12292
	12202	12201	12200

Table D.2 Percentage of OU-Wide Surface Soil Sample Results Returned from Laboratory

	Grid 1 Samples			Grid 2 Samples		
Analysis Requested	Number of Samples Submitted	Number of Sample Analyses Received	Percentage of Data Received	Number of Samples Submitted	Number of Sample Analyses Received	Percentage of Data Received
Americium-241	50	50	100%	45	45	100%
Gamma Spectroscopy	96	96	100%	77	77	100%
Plutonium-238	96	96	100%	77	77	100%
Plutonium-239	96	96	100%	77	77	100%
Strontium-90	96	96	100%	77	77	100%
Thorium-228	27	27	100%	20	20	100%
Thorium-230	27	27	100%	20	20	100%
Thorium-232	27	27	100%	20	20	100%
Tritium (in soil moisture)	96	96	100%	77	77	100%
Uranium-234	27	27	100%	20	19	95%
Uranium-235	27	27	100%	20	19	95%
Uranium-238	27	27	100%	20	19	95%
Uranium (total)	96	96	100%	77	77	100%
Metals (SW-6010)	101	101	100%	81	81	100%
Semivolatiles (SW-8270)	101	100	99%	81	81	100%

Table D.3 Percentage of Deposition-Layer Soil Sample Results Returned from Laboratory

	Grid 1 Samples			Grid 2 Samples		
Analysis Requested	Number of Samples Submitted	Number of Sample Analyses Received	Percentage of Data Received	Number of Samples Submitted	Number of Sample Analyses Received	Percentage of Data Received
Americium-241	76	76	100%	100	100	100%
Gamma Spectroscopy	148	148	100%	192	192	100%
Plutonium-238	148	148	100%	192	192	100%
Plutonium-239	148	148	100%	192	192	100%
Strontium-90	148	148	100%	192	192	100%
Tritium (in soil moisture)	148	148	100%	192	192	100%
Uranium (total)	148	148	100%	192	192	100%
Metals (SW-6010)	155	155	100%	201	201	100%

Table D.4 Percentage of Filter Building Sample Results Returned from Laboratory

	Filter Building Samples -- Near-Surface			Filter Building Samples -- Sub-Surface		
Analysis Requested	Number of Samples Submitted	Number of Sample Analyses Received	Percentage of Data Received	Number of Samples Submitted	Number of Sample Analyses Received	Percentage of Data Received
Americium-241	20	0	0%	7	2	29%
Gamma Spectroscopy	30	30	100%	9	9	100%
Plutonium-238	34	34	100%	11	9	82%
Plutonium-239	34	34	100%	11	9	82%
Strontium-90	34	34	100%	11	11	100%
Tritium (in soil moisture)	34	34	100%	11	11	100%
Uranium (total)	34	34	100%	11	11	100%
Metals (SW-6010)	41	41	100%	13	13	100%
Semivolatiles (SW-8270)	41	41	100%	13	13	100%
Volatiles (SW-8240)	46	46	100%	15	15	100%

Table D.5 QAPjP Field QA Frequency Requirements versus Actual Frequency

QA type	QAPjP requirement	Actual QA sampling
Field blanks	1 per 20 field samples	1 per 16 samples
Rinsate blanks	1 per 20 field samples	1 per 16 samples
Field replicate	1 per 20 field samples	1 per 18 samples (duplicates)
Trip blank	None for soil samples	1 per shipping container (VOA analysis only)

Table D.6 Identification of Extraction Technique Used for Each Request Number

Method: ICPES
Extraction: Nitric
No. Samples Affected: 576

Request Numbers:							
	12664	13013	13070	13103	13176	13265	14693
	12695	13030	13076	13125	13185	13270	14908
	12752	13040	13080	13148	13194	13293	
	12996	13047	13091	13156	13211	13300	
	13002	13053	13093	13163	13219	13764	
	13007	13058	13101	13174	13245	13761	

Method: ICPES
Extraction: Hydrofluoric
No. Samples Affected: 230

Request Numbers:		
	12647	12721
	12661	12724
	12667	12738
	12678	12741
	12691	12758
	12700	

Table D.7 Comparison of Reported Inorganic Concentrations for Adjacent Grid 1 and Gri

ANALYTE	GRID 1 #AAA0001 21-1258 Hydrofluoric	GRID 2 #AAA0270 21-1263 Nitric	REGIONAL BACKGROUND (1) MIN-MAX	REGIONAL BACKGROUND (1) MEAN
Aluminum	58300 b	5810 a	50000 - 114000	7700 b
Calcium	3400 b	1430	2000 - 80000	9000 b
Iron	13500 b	7840	10000 - 49000	24000 b
Potassium	3010 b	829	1000 - 4200	2500 b
Magnesium	1900 b	1000	1300 - 17000	6000 b
Sodium	2170 b	137	3000 - 33000	18000 b
Barium	298	59.7	125 - 829	459
Beryllium	2.6	< 1.2 BD	1.0 - 4.4	2.4
Chromium	12	4.6	2.0 - 71	34
Strontium	81	11.9	170 - 242	206
Vanadium	23	10.3	11.5 - 113	49
Cobalt	3	2.6	0.44 - 23.3	7.14
Copper	5	4.4	-----	
Manganese	342	264	-----	
Uranium	4.63	3.9	1.5 - 6.7	3.4
Zinc	42	27.7	20 - 146	65
Arsenic	1.16	< 57.6 BD	1.2 - 10.8	5
Lithium	33	< 23 BD	-----	
Nickel	4	< 8.6 BD	1.6 - 19	8.9
Lead	16	< 11.5 BD	18 - 56	28
Cadmium	< 2 BD	< 1.2 BD	-----	
Silver	< 1 BD	< 2.3 BD	-----	
Molybdenum	< 4 BD	< 5.8 BD	-----	
Antimony	< 6 BD	< 23 BD	-----	
Selenium	< 0.1 BD	< 57.6 BD	-----	
Thallium	< 20 BD	< 57.6 BD	-----	

(1) Neutron activation analysis data taken from Longmire et al., 1993, except for nickel which was taken from Ferenbaugh, et al., 1990. Only selected background values are listed.

BD = Below detection limit.

a = Underlined values are below the range of regional background.

b = Measurements originally reported as percentages (%) were converted to ppm for comparison to Grid 2 data.

APPENDIX E

DATA TABLES FOR ANALYTES EXCEEDING THE 95.5 PERCENTILE OF THEIR RESPECTIVE BASELINE

The data in this appendix represent only detectable levels of organics and analyte values exceeding the 95.5 percentile of the applicable baseline for inorganic and radiological constituents. Complete data will be available on the Facility for Information and Display database.

The following table lists definitions for acronyms used in this appendix:

FE	rinsate blank
FB	trip blank
FR	field blank
NS	near-surface soil sample
SU	surface soil sample
FD	field duplicate
ETVAA	electro thermal vapor atomic absorbtion
PTCG	photothermal gas chromotography
FAA	flame atomic absorbtion
RAS	radio analytical alpha spectroscopy
PC	gas proportional counting
DNA	delayed neutron activation
GCMS	gas chromatography mass spectrometry
ICPES	inductively-coupled plasma emissions spectroscopy

Non Process Area
Laboratory Inorganic Data

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1002	AAA0453	0-6 in.	PB	13053	SU	ICPES	49.9	MG/KG
21-1003	AAA0457	0-1 in.	PB	13053	SU	ICPES	43.2	MG/KG
	AAA0457	0-1 in.	ZN	13053	SU	ICPES	75.5	MG/KG
21-1005	AAA0460	0-1 in.	PB	13053	SU	ICPES	300	MG/KG
	AAA0460	0-1 in.	ZN	13053	SU	ICPES	473	MG/KG
21-1006	AAA0461	0-1 in.	ZN	13053	SU	ICPES	79.1	MG/KG
	AAA0462	0-6 in.	CU	13053	SU	ICPES	57.4	MG/KG
	AAA0462	0-6 in.	ZN	13053	SU	ICPES	83	MG/KG
	AAA0463	0-1 in.	ZN	13053	FD	ICPES	70.4	MG/KG
21-1017	AAA0480	0-4 in.	NI	13047	SU	ICPES	13.9	MG/KG
21-1018	AAA0481	0-1 in.	PB	13047	SU	ICPES	134	MG/KG
	AAA0481	0-1 in.	ZN	13047	SU	ICPES	110	MG/KG
21-1022	AAA0487	0-1 in.	NI	13040	SU	ICPES	12.6	MG/KG
	AAA0487	0-1 in.	PB	13040	SU	ICPES	71.9	MG/KG
	AAA0487	0-1 in.	SE	13040	SU	ICPES	54.4	MG/KG
21-1028	AAA0493	0-1 in.	NI	13040	SU	ICPES	14	MG/KG
	AAA0493	0-1 in.	SE	13040	SU	ICPES	70	MG/KG
21-1030	AAA0203	0-1 in.	ZN	12741	SU	ICPES	80	UG/G
	AAA0204	0-6 in.	AG	12741	SU	FAA	10.8	UG/G
	AAA0204	0-6 in.	CU	12741	SU	ICPES	25	UG/G
	AAA0204	0-6 in.	MN	12741	SU	ICPES	580	UG/G
	AAA0204	0-6 in.	ZN	12741	SU	ICPES	130	UG/G
21-1031	AAA0247	0-1 in.	CO	12758	SU	ICPES	16	UG/G
21-1034	AAA0250	0-1 in.	MG	12758	SU	ICPES	1.7	%
21-1038	AAA0206	0-1 in.	ZN	12741	SU	ICPES	76	UG/G
	AAA0207	0-5 in.	BE	12741	SU	ICPES	4.6	UG/G
	AAA0207	0-5 in.	NA	12741	SU	ICPES	3.12	%
21-1039	AAA0208	0-1 in.	MN	12741	SU	ICPES	730	UG/G
	AAA0208	0-1 in.	ZN	12741	SU	ICPES	85	UG/G
21-1043	AAA0210	0-1 in.	AG	12741	SU	FAA	65.8	UG/G
	AAA0210	0-1 in.	BA	12741	SU	ICPES	570	UG/G
	AAA0210	0-1 in.	CR	12741	SU	ICPES	42	UG/G
	AAA0210	0-1 in.	CU	12741	SU	ICPES	59	UG/G
	AAA0210	0-1 in.	PB	12741	SU	ICPES	83	UG/G
	AAA0210	0-1 in.	ZN	12741	SU	ICPES	210	UG/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1044	AAA0089	0-1 in.	PB	12691	SU	ICPES	44	UG/G
21-1045	AAA0092	0-1 in.	CO	12691	SU	ICPES	8.4	UG/G
	AAA0092	0-1 in.	PB	12691	SU	ICPES	59	UG/G
	AAA0093	0-6 in.	BA	12691	SU	ICPES	618	UG/G
	AAA0093	0-6 in.	CO	12691	SU	ICPES	8.4	UG/G
	AAA0093	0-6 in.	PB	12691	SU	ICPES	57	UG/G
	AAA0093	0-6 in.	SR	12691	SU	ICPES	166	UG/G
21-1046	AAA0094	0-1 in.	BA	12691	SU	ICPES	525	UG/G
	AAA0094	0-1 in.	CO	12691	SU	ICPES	9	UG/G
	AAA0094	0-1 in.	CR	12691	SU	ICPES	21	UG/G
	AAA0094	0-1 in.	PB	12691	SU	ICPES	45	UG/G
	AAA0094	0-1 in.	V	12691	SU	ICPES	43.1	UG/G
21-1048	AAA0217	0-6 in.	MN	12741	SU	ICPES	639	UG/G
	AAA0217	0-6 in.	ZN	12741	SU	ICPES	78	UG/G
21-1050	AAA0219	0-1 in.	NA	12758	SU	ICPES	2.98	%
21-1052	AAA0096	0-1 in.	BA	12691	SU	ICPES	551	UG/G
	AAA0096	0-1 in.	CO	12691	SU	ICPES	8.9	UG/G
	AAA0096	0-1 in.	SR	12691	SU	ICPES	152	UG/G
21-1053	AAA0095	0-1 in.	BA	12691	SU	ICPES	536	UG/G
	AAA0095	0-1 in.	CO	12691	SU	ICPES	8	UG/G
21-1054	AAA0230	0-1 in.	CO	12758	SU	ICPES	9	UG/G
	AAA0231	0-6 in.	CO	12758	SU	ICPES	14	UG/G
21-1055	AAA0224	0-6 in.	AS	12741	SU	ETVAA	9.9	UG/G
21-1056	AAA0225	0-1 in.	AG	12741	SU	FAA	2.8	UG/G
	AAA0225	0-1 in.	ZN	12741	SU	ICPES	84	UG/G
21-1060	AAA0101	0-1 in.	CO	12691	SU	ICPES	9	UG/G
	AAA0101	0-1 in.	PB	12691	SU	ICPES	51	UG/G
	AAA0101	0-1 in.	ZN	12691	SU	ICPES	69	UG/G
	AAA0102	0-6 in.	AS	12691	SU	ETVAA	3.7	UG/G
	AAA0102	0-6 in.	PB	12691	SU	ICPES	42	UG/G
21-1061	AAA0099	0-1 in.	CO	12691	SU	ICPES	8	UG/G
	AAA0100	0-6 in.	CO	12691	SU	ICPES	8.7	UG/G
21-1062	AAA0233	0-1 in.	BE	12758	SU	ICPES	4.4	UG/G
21-1066	AAA0103	0-1 in.	CO	12691	SU	ICPES	8	UG/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
	AAA0103	0-1 in.	PB	12691	SU	ICPES	52	UG/G
21-1067	AAA0104	0-1 in.	CO	12691	SU	ICPES	8	UG/G
	AAA0105	0-6 in.	BA	12691	SU	ICPES	530	UG/G
	AAA0105	0-6 in.	CO	12691	SU	ICPES	8	UG/G
21-1068	AAA0106	0-1 in.	BA	12691	SU	ICPES	518	UG/G
	AAA0106	0-1 in.	CO	12691	SU	ICPES	9	UG/G
21-1069	AAA0236	0-1 in.	BE	12758	SU	ICPES	4.6	UG/G
	AAA0237	0-6 in.	BE	12758	SU	ICPES	5.1	UG/G
21-1072	AAA0108	0-1 in.	PB	12700	SU	ICPES	43	UG/G
21-1073	AAA0107	0-1 in.	PB	12691	SU	ICPES	61	UG/G
21-1077	AAA0110	0-1 in.	PB	12700	SU	ICPES	87	UG/G
	AAA0111	0-6 in.	PB	12700	SU	ICPES	42	UG/G
21-1080	AAA0246	0-6 in.	CO	12758	SU	ICPES	11	UG/G
21-1083	AAA0117	0-1 in.	PB	12700	SU	ICPES	87	UG/G
21-1088	AAA0123	0-1 in.	PB	12700	SU	ICPES	45	UG/G
21-1104	AAA0132	0-6 in.	NI	12721	SU	ICPES	2.64	%
21-1110	AAA0577	0-1 in.	CD	13125	SU	ICPES	1.4	MG/KG
	AAA0577	0-1 in.	ZN	13125	SU	ICPES	97.1	MG/KG
21-1118	AAA0589	0-1 in.	CD	13125	SU	ICPES	1.2	MG/KG
21-1138	AAA0596	0-1 in.	CD	13148	SU	ICPES	1.3	MG/KG
21-1174	AAA0538	0-1 in.	SE	13076	SU	ICPES	25.5	MG/KG
21-1176	AAA0397	0-1 in.	CU	13013	SU	ICPES	20.7	MG/KG
	AAA0397	0-1 in.	CU	13013	SU	ICPES	20.7	MG/KG
	AAA0398	0-6 in.	CU	13013	SU	ICPES	19.4	MG/KG
	AAA0398	0-6 in.	CU	13013	SU	ICPES	19.4	MG/KG
21-1190	AAA0392	0-1 in.	PB	13013	SU	ICPES	57.1	MG/KG
	AAA0392	0-1 in.	PB	13013	SU	ICPES	57.1	MG/KG
	AAA0393	0-6 in.	PB	13013	SU	ICPES	48.7	MG/KG
	AAA0393	0-6 in.	PB	13013	SU	ICPES	48.7	MG/KG
21-1203	AAA0081	0-1 in.	CO	12691	SU	ICPES	8	UG/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1204	AAA0079	0-1 in.	CO	12691	SU	ICPES	9	UG/G
	AAA0080	0-6 in.	CO	12691	SU	ICPES	8.73	UG/G
21-1206	AAA0045	0-1 in.	BA	12678	SU	ICPES	534	UG/G
	AAA0045	0-1 in.	CO	12678	SU	ICPES	8	UG/G
	AAA0045	0-1 in.	V	12678	SU	ICPES	41	UG/G
	AAA0046	0-6 in.	BA	12678	SU	ICPES	508	UG/G
21-1207	AAA0044	0-1 in.	BA	12667	SU	ICPES	501	UG/G
	AAA0044	0-1 in.	CO	12667	SU	ICPES	9	UG/G
	AAA0044	0-1 in.	MN	12667	SU	ICPES	560	UG/G
	AAA0044	0-1 in.	V	12667	SU	ICPES	44	UG/G
21-1208	AAA0027	0-1 in.	BA	12661	SU	ICPES	510	UG/G
	AAA0027	0-1 in.	MN	12661	SU	ICPES	580	UG/G
	AAA0027	0-1 in.	PB	12661	SU	ICPES	43	UG/G
	AAA0027	0-1 in.	V	12661	SU	ICPES	44	UG/G
	AAA0028	0-6 in.	CR	12661	SU	ICPES	21.2	UG/G
	AAA0028	0-6 in.	MN	12661	SU	ICPES	530	UG/G
	AAA0028	0-6 in.	V	12661	SU	ICPES	45	UG/G
21-1211	AAA0078	0-1 in.	V	12678	SU	ICPES	45	UG/G
21-1215	AAA0026	0-1 in.	MN	12661	SU	ICPES	486	UG/G
21-1221	AAA0040	0-1 in.	ZN	12667	SU	ICPES	142	UG/G
21-1224	AAA0383	0-1 in.	MN	13013	SU	ICPES	609	MG/KG
	AAA0383	0-1 in.	PB	13013	SU	ICPES	46.4	MG/KG
	AAA0384	0-6 in.	SE	13013	SU	ICPES	59.2	MG/KG
	AAA0384	0-6 in.	SE	13013	SU	ICPES	59.2	MG/KG
21-1226	AAA0058	0-1 in.	MN	12678	SU	ICPES	576	UG/G
21-1230	AAA0016	0-1 in.	AS	12661	SU	ETVAA	5	UG/G
	AAA0016	0-1 in.	ZN	12661	SU	ICPES	70	UG/G
	AAA0017	0-6 in.	AL	12661	SU	ICPES	8.35	%
	AAA0017	0-6 in.	CR	12661	SU	ICPES	28.1	UG/G
	AAA0017	0-6 in.	FE	12661	SU	ICPES	2.79	%
	AAA0017	0-6 in.	MG	12661	SU	ICPES	0.56	%
	AAA0017	0-6 in.	NI	12661	SU	ICPES	16	UG/G
	AAA0017	0-6 in.	V	12661	SU	ICPES	58.6	UG/G
	AAA0018	0-6 in.	AL	12661	SU	ICPES	8	%
	AAA0018	0-6 in.	CR	12661	SU	ICPES	26.9	UG/G
	AAA0018	0-6 in.	FE	12661	SU	ICPES	2.7	%
	AAA0018	0-6 in.	MG	12661	SU	ICPES	0.52	%
	AAA0018	0-6 in.	NI	12661	SU	ICPES	16	UG/G
	AAA0018	0-6 in.	V	12661	SU	ICPES	56.9	UG/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1233	AAA0074	0-6 in.	AS	12678	SU	ETVAA	4.9	UG/G
	AAA0074	0-6 in.	BE	12678	SU	ICPES	4.4	UG/G
	AAA0074	0-6 in.	CA	12678	SU	ICPES	1.6	%
	AAA0074	0-6 in.	NI	12678	SU	ICPES	18	UG/G
	AAA0074	0-6 in.	SE	12678	SU	ETVAA	0.6	UG/G
21-1235	AAA0015	0-1 in.	CD	12647	SU	ICPES	2	UG/G
	AAA0015	0-1 in.	NI	12647	SU	ICPES	13	UG/G
21-1241	AAA0013	0-1 in.	CR	12647	SU	ICPES	21	UG/G
	AAA0013	0-1 in.	NI	12647	SU	ICPES	13	UG/G
21-1246	AAA0010	0-1 in.	ZN	12647	SU	ICPES	70	UG/G
21-1248	AAA0374	0-1 in.	PB	13013	SU	ICPES	48.7	MG/KG
21-1250	AAA0066	0-1 in.	CA	12678	SU	ICPES	3.12	%
	AAA0066	0-1 in.	SE	12678	SU	ETVAA	0.4	UG/G
	AAA0066	0-1 in.	SR	12678	SU	ICPES	189	UG/G
	AAA0067	0-6 in.	CA	12678	SU	ICPES	3.17	%
	AAA0067	0-6 in.	SE	12678	SU	ETVAA	0.4	UG/G
	AAA0067	0-6 in.	SR	12678	SU	ICPES	184	UG/G
21-1252	AAA0005	0-1 in.	PB	12647	SU	ICPES	82	UG/G
	AAA0006	0-6 in.	PB	12647	SU	ICPES	61	UG/G
21-1266	AAA0370	0-1 in.	SE	13007	SU	ICPES	12.6	MG/KG
21-1271	AAA0367	0-1 in.	PB	13007	SU	ICPES	42.8	MG/KG
21-1282	AAA0275	0-1 in.	AG	12996	SU	ICPES	5.9	MG/KG
21-1288	AAA0056	0-6 in.	AS	12678	SU	ETVAA	4.5	UG/G
	AAA0056	0-6 in.	CR	12678	SU	ICPES	26	UG/G
	AAA0056	0-6 in.	FE	12678	SU	ICPES	2.57	%
	AAA0056	0-6 in.	MG	12678	SU	ICPES	0.62	%
	AAA0056	0-6 in.	NI	12678	SU	ICPES	13	UG/G
	AAA0056	0-6 in.	SE	12678	SU	ETVAA	0.4	UG/G
	AAA0056	0-6 in.	V	12678	SU	ICPES	50	UG/G
21-1290	AAA0181	0-1 in.	AG	12738	SU	FAA	2.6	UG/G
	AAA0181	0-1 in.	SR	12738	SU	ICPES	153	UG/G
21-1468	AAA0359	0-1 in.	CU	13007	SU	ICPES	25.9	MG/KG

Non Process Area
Laboratory Radiological Data

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1010	AAA0466	0-6 in.	PU-239	13045	SU	RAS	3.245	PCI/G
21-1013	AAA0469	0-1 in.	U	13045	SU	DNA	9.3	UG/G
21-1016	AAA0478	0-1 in.	U	13045	SU	DNA	8.9	UG/G
21-1017	AAA0480	0-4 in.	TH-228	13045	SU	RAS	2.3	PCI/G
	AAA0480	0-4 in.	TH-230	13045	SU	RAS	1.9	PCI/G
	AAA0480	0-4 in.	TH-232	13045	SU	RAS	2.1	PCI/G
21-1018	AAA0481	0-1 in.	SR-90	13045	SU	PC	1	PCI/G
	AAA0481	0-1 in.	U	13045	SU	DNA	10	UG/G
21-1019	AAA0482	0-1 in.	SR-90	13041	SU	PC	0.9	PCI/G
21-1022	AAA0487	0-1 in.	U	13041	SU	DNA	9.23	UG/G
21-1023	AAA0495	0-6 in.	PU-239	13054	SU	RAS	4.132	PCI/G
21-1024	AAA0488	0-1 in.	U	13041	SU	DNA	10.24	UG/G
	AAA0489	0-3 in.	U	13041	SU	DNA	14.2	UG/G
21-1025	AAA0492	0-1 in.	U	13041	SU	DNA	9.06	UG/G
21-1026	AAA0496	0-1 in.	U	13054	SU	DNA	7.6	UG/G
21-1030	AAA0204	0-6 in.	U	12743	SU	DNA	8.39	UG/G
21-1031	AAA0247	0-1 in.	SR-90	12759	SU	PC	0.8	PCI/G
	AAA0247	0-1 in.	U	12759	SU	DNA	10.7	UG/G
21-1039	AAA0208	0-1 in.	SR-90	12743	SU	PC	1.3	PCI/G
	AAA0208	0-1 in.	U	12743	SU	DNA	8.98	UG/G
21-1040	AAA0252	0-1 in.	U	12759	SU	DNA	12.2	UG/G
21-1043	AAA0210	0-1 in.	PU-239	12743	SU	RAS	4.458	PCI/G
	AAA0210	0-1 in.	U	12743	SU	DNA	15.95	UG/G
21-1047	AAA0211	0-1 in.	PU-239	12743	SU	RAS	3.093	PCI/G
21-1050	AAA0219	0-1 in.	U	12759	SU	DNA	8	UG/G
21-1054	AAA0231	0-6 in.	PU-239	12759	SU	RAS	2.099	PCI/G
21-1060	AAA0101	0-1 in.	PU-239	12693	SU	RAS	2.274	PCI/G
	AAA0101	0-1 in.	SR-90	12693	SU	PC	0.9	PCI/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value
	AAA0102	0-6 in.	SR-90	12693	SU	PC	0.9 PCI/G
21-1063	AAA0235	0-1 in.	U	12759	SU	DNA	7.7 UG/G
21-1066	AAA0103	0-1 in.	PU-239	12693	SU	RAS	3.324 PCI/G
21-1070	AAA0502	0-1 in.	PU-239	13068	SU	RAS	3.365 PCI/G
21-1075	AAA0503	0-1 in.	U	13068	SU	DNA	7.5 UG/G
21-1077	AAA0110	0-1 in.	PU-239	12702	SU	RAS	5.082 PCI/G
	AAA0110	0-1 in.	SR-90	12702	SU	PC	0.9 PCI/G
	AAA0110	0-1 in.	U	12702	SU	DNA	7.7 UG/G
	AAA0111	0-6 in.	U	12702	SU	DNA	7.5 UG/G
21-1081	AAA0504	0-1 in.	SR-90	13068	SU	PC	1.7 PCI/G
21-1082	AAA0438	0-1 in.	PU-239	13041	SU	RAS	2.094 PCI/G
21-1088	AAA0123	0-1 in.	SR-90	12702	SU	PC	0.8 PCI/G
	AAA0124	0-6 in.	SR-90	12702	SU	PC	0.9 PCI/G
21-1102	AAA0432	0-1 in.	PU-239	13041	SU	RAS	3.139 PCI/G
	AAA0432	0-1 in.	SR-90	13041	SU	PC	1 PCI/G
	AAA0433	0-1 in.	PU-239	13041	FD	RAS	3.79 PCI/G
	AAA0433	0-1 in.	SR-90	13041	FD	PC	0.9 PCI/G
21-1105	AAA0511	0-6 in.	U-234	13077	SU	RAS	2.29 PCI/G
	AAA0511	0-6 in.	U-238	13077	SU	RAS	2.45 PCI/G
	AAA0512	0-6 in.	U-234	13077	FD	RAS	2.07 PCI/G
21-1108	AAA0430	0-1 in.	PU-239	13032	SU	RAS	4.915 PCI/G
	AAA0431	0-6 in.	PU-239	13032	SU	RAS	2.139 PCI/G
21-1110	AAA0577	0-1 in.	PU-238	13127	SU	RAS	0.245 PCI/G
	AAA0577	0-1 in.	PU-239	13127	SU	RAS	4.41 PCI/G
21-1112	AAA0429	0-1 in.	PU-239	13032	SU	RAS	5.103 PCI/G
21-1118	AAA0589	0-1 in.	PU-238	13127	SU	RAS	9.26 PCI/G
	AAA0589	0-1 in.	PU-239	13127	SU	RAS	7.91 PCI/G
21-1123	AAA0425	0-1 in.	PU-239	13032	SU	RAS	3.304 PCI/G
21-1128	AAA0423	0-1 in.	PU-239	13032	SU	RAS	3.308 PCI/G
	AAA0424	0-6 in.	PU-239	13032	SU	RAS	3.688 PCI/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value
21-1131	AAA0422	0-1 in.	PU-239	13032	SU	RAS	3.9 PCI/G
21-1135	AAA0420	0-1 in.	PU-239	13032	SU	RAS	4.553 PCI/G
	AAA0421	0-6 in.	PU-239	13032	SU	RAS	2.24 PCI/G
21-1137	AAA0529	0-1 in.	SR-90	13077	SU	PC	0.9 PCI/G
21-1138	AAA0597	0-6 in.	PU-238	13150	SU	RAS	0.268 PCI/G
21-1141	AAA0418	0-1 in.	PU-239	13015	SU	RAS	3.675 PCI/G
	AAA0418	0-1 in.	SR-90	13015	SU	PC	2 PCI/G
	AAA0419	0-6 in.	SR-90	13015	SU	PC	1.8 PCI/G
21-1142	AAA0172	0-1 in.	PU-239	12726	SU	RAS	9.158 PCI/G
	AAA0172	0-1 in.	U	12726	SU	DNA	7.9 UG/G
21-1146	AAA0416	0-1 in.	SR-90	13015	SU	PC	0.8 PCI/G
21-1147	AAA0415	0-1 in.	SR-90	13015	SU	PC	0.8 PCI/G
21-1148	AAA0178	0-6 in.	PU-239	12740	SU	RAS	4.207 PCI/G
21-1152	AAA0413	0-1 in.	PU-239	13015	SU	RAS	17.3 PCI/G
	AAA0414	0-6 in.	PU-239	13015	SU	RAS	20.4 PCI/G
21-1153	AAA0412	0-1 in.	PU-239	13015	SU	RAS	3.273 PCI/G
21-1158	AAA0410	0-1 in.	PU-239	13015	SU	RAS	2.424 PCI/G
21-1164	AAA0405	0-6 in.	SR-90	13015	SU	RAS	0.8 PCI/G
21-1165	AAA0403	0-1 in.	PU-239	13015	SU	RAS	12.5 PCI/G
	AAA0403	0-1 in.	SR-90	13015	SU	PC	1.2 PCI/G
	AAA0403	0-1 in.	U	13015	SU	DNA	8.1 UG/G
21-1170	AAA0399	0-1 in.	PU-239	13015	SU	RAS	2.269 PCI/G
21-1171	AAA0401	0-1 in.	PU-239	13015	SU	RAS	2.808 PCI/G
	AAA0401	0-1 in.	SR-90	13015	SU	PC	0.8 PCI/G
21-1174	AAA0538	0-1 in.	PU-239	13077	SU	RAS	2.114 PCI/G
21-1176	AAA0397	0-1 in.	U	13015	SU	DNA	10.96 UG/G
	AAA0398	0-6 in.	U	13015	SU	DNA	9.7 UG/G
21-1182	AAA0394	0-1 in.	SR-90	13015	SU	PC	1.3 PCI/G

Location ID	Sample ID	Depth		Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1183	AAA0395	0-1	in.	PU-239	13015	SU	RAS	2.686	PCI/G
21-1190	AAA0392	0-1	in.	PU-239	13015	SU	RAS	2.381	PCI/G
21-1191	AAA0391	0-1	in.	PU-239	13015	SU	RAS	2.348	PCI/G
21-1197	AAA0200	0-1	in.	PU-239	12740	SU	RAS	3.09	PCI/G
21-1202	AAA0388	0-1	in.	PU-239	13015	SU	RAS	2.514	PCI/G
21-1221	AAA0040	0-1	in.	SR-90	12668	SU	RAS	0.8	PCI/G
21-1224	AAA0383	0-1	in.	PU-239	13015	SU	RAS	2.902	PCI/G
	AAA0383	0-1	in.	SR-90	13015	SU	PC	1.3	PCI/G
	AAA0383	0-1	in.	U	13015	SU	DNA	7.7	UG/G
21-1233	AAA0074	0-6	in.	TH-228	12681	SU	RAS	2.1	PCI/G
21-1242	AAA0554	0-6	in.	U-235	13090	SU	RAS	0.19	PCI/G
21-1248	AAA0374	0-1	in.	PU-239	13015	SU	RAS	2.509	PCI/G
	AAA0374	0-1	in.	SR-90	13015	SU	PC	1.5	PCI/G
	AAA0374	0-1	in.	U	13015	SU	DNA	7.5	UG/G
21-1249	AAA0069	0-1	in.	SR-90	12681	SU	PC	1	PCI/G
21-1250	AAA0066	0-1	in.	SR-90	12681	SU	PC	1.8	PCI/G
	AAA0067	0-6	in.	SR-90	12681	SU	PC	0.9	PCI/G
21-1257	AAA0365	0-1	in.	SR-90	13009	SU	PC	0.8	PCI/G
21-1262	AAA0363	0-1	in.	SR-90	13009	SU	PC	1.3	PCI/G
	AAA0364	0-6	in.	SR-90	13009	SU	PC	0.8	PCI/G
21-1267	AAA0362	0-1	in.	SR-90	13009	SU	PC	1.3	PCI/G
21-1270	AAA0368	0-1	in.	SR-90	13009	SU	PC	1.7	PCI/G
	AAA0369	0-1	in.	SR-90	13009	FD	PC	1.6	PCI/G
21-1271	AAA0367	0-1	in.	SR-90	13009	SU	PC	1.2	PCI/G
21-1277	AAA0357	0-1	in.	SR-90	13009	SU	PC	1.2	PCI/G
21-1283	AAA0274	0-1	in.	SR-90	12994	SU	PC	0.9	PCI/G
21-1290	AAA0181	0-1	in.	PU-238	12740	SU	RAS	0.284	PCI/G
	AAA0181	0-1	in.	PU-239	12740	SU	RAS	2.354	PCI/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value
	AAA0182	0-6 in.	PU-239	12740	SU	RAS	2.894 PCI/G
21-1291	AAA0254	0-1 in.	U	12759	SU	DNA	8.3 UG/G
21-1294	AAA0171	0-6 in.	PU-238	12726	SU	RAS	1.05 PCI/G
21-1296	AAA0467	0-1 in.	SR-90	13045	SU	PC	0.8 PCI/G
	AAA0468	0-2 in.	SR-90	13045	SU	PC	0.8 PCI/G
21-1468	AAA0360	0-6 in.	PU-239	13009	SU	RAS	3.256 PCI/G

Non Process Area
Laboratory Semivolatile Data

ID	Sample ID	Depth	Analyte	Number	Type	Technique	Sample Value
21-1056	AAA0226	0-6 in.	Acenaphthene	12742	SU	GCMS	1700 UG/KG
	AAA0226	0-6 in.	Chloro-3-methylphenol [4-]	12742	SU	GCMS	2900 UG/KG
	AAA0226	0-6 in.	Chlorophenol [o-]	12742	SU	GCMS	2500 UG/KG
	AAA0226	0-6 in.	Dinitrotoluene [2,4-]	12742	SU	GCMS	1700 UG/KG
	AAA0226	0-6 in.	Nitrophenol [4-]	12742	SU	GCMS	3100 UG/KG
	AAA0226	0-6 in.	Nitrosodi-n-propylamine [N-]	12742	SU	GCMS	1500 UG/KG
	AAA0226	0-6 in.	Pentachlorophenol	12742	SU	GCMS	3900 UG/KG
	AAA0226	0-6 in.	Phenol	12742	SU	GCMS	2600 UG/KG
	AAA0226	0-6 in.	Pyrene	12742	SU	GCMS	1600 UG/KG
	AAA0226	0-6 in.	Trichlorobenzene [1,2,4-]	12742	SU	GCMS	1500 UG/KG
21-1077	AAA0113	-	Bis(2-ethylhexyl)phthalate	12703	FR	GCMS	21 UG/L
21-1471	AAA0256	-	Isophorone	12753	WA	GCMS	63 UG/L

Process Area
Laboratory Inorganic Data

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1078	AAA0114	0-1 in.	PB	12700	SU	ICPES	154	UG/G
21-1079	AAA0239	0-1 in.	AS	12758	SU	ETVAA	6	UG/G
	AAA0239	0-1 in.	CD	12758	SU	ICPES	3	UG/G
	AAA0239	0-1 in.	CR	12758	SU	ICPES	27	UG/G
	AAA0239	0-1 in.	CU	12758	SU	ICPES	27	UG/G
	AAA0239	0-1 in.	MN	12758	SU	ICPES	532	UG/G
	AAA0239	0-1 in.	PB	12758	SU	ICPES	59	UG/G
	AAA0239	0-1 in.	SE	12758	SU	ETVAA	0.6	UG/G
	AAA0239	0-1 in.	V	12758	SU	ICPES	47	UG/G
	AAA0239	0-1 in.	ZN	12758	SU	ICPES	200	UG/G
	AAA0240	0-6 in.	AS	12758	SU	ETVAA	6.2	UG/G
	AAA0240	0-6 in.	CD	12758	SU	ICPES	3	UG/G
	AAA0240	0-6 in.	CR	12758	SU	ICPES	24	UG/G
	AAA0240	0-6 in.	CU	12758	SU	ICPES	28	UG/G
	AAA0240	0-6 in.	PB	12758	SU	ICPES	59	UG/G
	AAA0240	0-6 in.	SE	12758	SU	ETVAA	0.5	UG/G
	AAA0240	0-6 in.	V	12758	SU	ICPES	43	UG/G
	AAA0240	0-6 in.	ZN	12758	SU	ICPES	208	UG/G
21-1084	AAA0115	0-6 in.	PB	12700	SU	ICPES	82	UG/G
	AAA0115	0-6 in.	ZN	12700	SU	ICPES	86.1	UG/G
	AAA0116	0-1 in.	PB	12700	SU	ICPES	66	UG/G
	AAA0116	0-1 in.	ZN	12700	SU	ICPES	87.9	UG/G
21-1091	AAA0118	0-1 in.	PB	12700	SU	ICPES	47	UG/G
	AAA0119	0-1 in.	PB	12700	FD	ICPES	43	UG/G
21-1092	AAA0568	0-6 in.	CD	13125	SU	ICPES	1.2	MG/KG
21-1093	AAA0569	0-1 in.	ZN	13125	SU	ICPES	82.1	MG/KG
21-1094	AAA0570	0-1 in.	CD	13125	SU	ICPES	3.3	MG/KG
	AAA0570	0-1 in.	ZN	13125	SU	ICPES	76.4	MG/KG
21-1095	AAA0125	0-1 in.	ZN	12700	SU	ICPES	74.1	UG/G
	AAA0126	0-6 in.	ZN	12700	SU	ICPES	71.1	UG/G
21-1096	AAA0127	0-1 in.	PB	12721	SU	ICPES	46	UG/G
	AAA0128	0-6 in.	PB	12721	SU	ICPES	44	UG/G
21-1099	AAA0120	0-1 in.	PB	12700	SU	ICPES	60	UG/G
	AAA0120	0-1 in.	ZN	12700	SU	ICPES	111	UG/G
	AAA0121	0-6 in.	PB	12700	SU	ICPES	42	UG/G
	AAA0121	0-6 in.	ZN	12700	SU	ICPES	107	UG/G
21-1103	AAA0571	0-1 in.	CD	13125	SU	ICPES	1.2	MG/KG

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
	AAA0571	0-1 in.	PB	13125	SU	ETVAA	70.8	MG/KG
	AAA0571	0-1 in.	ZN	13125	SU	ICPES	90.2	MG/KG
	AAA0572	0-6 in.	CD	13125	SU	ICPES	1.2	MG/KG
21-1106	AAA0575	0-1 in.	CD	13156	SU	ICPES	1.6	MG/KG
	AAA0576	0-1 in.	CD	13156	FD	ICPES	2.2	MG/KG
21-1107	AAA0580	0-1 in.	CD	13125	SU	ICPES	1.3	MG/KG
	AAA0580	0-1 in.	ZN	13125	SU	ICPES	390	MG/KG
21-1111	AAA0578	0-1 in.	CD	13156	SU	ICPES	1.8	MG/KG
	AAA0578	0-1 in.	ZN	13156	SU	ICPES	104	MG/KG
	AAA0579	0-6 in.	CD	13156	SU	ICPES	2.5	MG/KG
	AAA0579	0-6 in.	ZN	13156	SU	ICPES	153	MG/KG
21-1113	AAA0581	0-1 in.	NI	13148	SU	ICPES	12.1	MG/KG
	AAA0581	0-1 in.	ZN	13148	SU	ICPES	186	MG/KG
	AAA0582	0-6 in.	CD	13148	SU	ICPES	1.3	MG/KG
21-1116	AAA0588	0-1 in.	CD	13125	SU	ICPES	1.5	MG/KG
21-1119	AAA0135	0-1 in.	CD	12721	SU	ICPES	1.3	UG/G
	AAA0135	0-1 in.	ZN	12721	SU	ICPES	96	UG/G
	AAA0136	0-6 in.	NI	12721	SU	ICPES	4.92	%
	AAA0136	0-6 in.	ZN	12721	SU	ICPES	88	UG/G
21-1121	AAA0590	0-1 in.	PB	13125	SU	ETVAA	42.9	MG/KG
21-1122	AAA0592	0-6 in.	CD	13125	SU	ICPES	1.5	MG/KG
21-1124	AAA0169	0-6 in.	ZN	12724	SU	ICPES	70	UG/G
21-1125	AAA0139	0-1 in.	NI	12721	SU	ICPES	6	%
	AAA0139	0-1 in.	ZN	12721	SU	ICPES	574	UG/G
	AAA0140	0-6 in.	ZN	12721	SU	ICPES	466	UG/G
21-1127	AAA0593	0-1 in.	PB	13125	SU	ETVAA	297	MG/KG
21-1132	AAA0595	0-1 in.	PB	13148	SU	ETVAA	90.4	MG/KG
21-1136	AAA0143	0-1 in.	PB	12721	SU	ICPES	46	UG/G
	AAA0143	0-1 in.	ZN	12721	SU	ICPES	74	UG/G
21-1144	AAA0145	0-1 in.	CU	12721	SU	ICPES	223	UG/G
	AAA0145	0-1 in.	PB	12721	SU	ICPES	67	UG/G
	AAA0145	0-1 in.	ZN	12721	SU	ICPES	187	UG/G
	AAA0146	0-6 in.	CU	12721	SU	ICPES	131	UG/G
	AAA0146	0-6 in.	PB	12721	SU	ICPES	43	UG/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
	AAA0146	0-6 in.	ZN	12721	SU	ICPES	116	UG/G
21-1149	AAA0179	0-1 in.	ZN	12724	SU	ICPES	70	UG/G
21-1155	AAA0147	0-1 in.	ZN	12724	SU	ICPES	74.3	UG/G
	AAA0148	0-6 in.	ZN	12724	SU	ICPES	78	UG/G
21-1166	AAA0187	0-1 in.	CO	12738	SU	ICPES	9	UG/G
21-1167	AAA0603	0-1 in.	CD	13148	SU	ICPES	2	MG/KG
	AAA0603	0-1 in.	MN	13148	SU	ICPES	492	MG/KG
	AAA0604	0-6 in.	CD	13148	SU	ICPES	1.9	MG/KG
	AAA0604	0-6 in.	MN	13148	SU	ICPES	504	MG/KG
21-1168	AAA0152	0-1 in.	CO	12724	SU	ICPES	9	UG/G
	AAA0152	0-1 in.	CR	12724	SU	ICPES	22	UG/G
	AAA0152	0-1 in.	CU	12724	SU	ICPES	26	UG/G
	AAA0152	0-1 in.	MN	12724	SU	ICPES	510	UG/G
	AAA0152	0-1 in.	NI	12724	SU	ICPES	18	UG/G
	AAA0152	0-1 in.	PB	12724	SU	ICPES	53	UG/G
	AAA0152	0-1 in.	ZN	12724	SU	ICPES	186	UG/G
	AAA0153	0-6 in.	AS	12724	SU	ETVAA	4.4	UG/G
	AAA0153	0-6 in.	CD	12724	SU	ICPES	3	UG/G
	AAA0153	0-6 in.	CO	12724	SU	ICPES	8	UG/G
	AAA0153	0-6 in.	CR	12724	SU	ICPES	21	UG/G
	AAA0153	0-6 in.	CU	12724	SU	ICPES	24	UG/G
	AAA0153	0-6 in.	MN	12724	SU	ICPES	498	UG/G
	AAA0153	0-6 in.	NI	12724	SU	ICPES	19	UG/G
	AAA0153	0-6 in.	PB	12724	SU	ICPES	50	UG/G
	AAA0153	0-6 in.	V	12724	SU	ICPES	41	UG/G
	AAA0153	0-6 in.	ZN	12724	SU	ICPES	181	UG/G
21-1173	AAA0159	0-1 in.	MN	12724	SU	ICPES	920	UG/G
	AAA0159	0-1 in.	PB	12724	SU	ICPES	42	UG/G
	AAA0160	0-6 in.	CO	12724	SU	ICPES	9	UG/G
	AAA0160	0-6 in.	MN	12724	SU	ICPES	696	UG/G
	AAA0161	0-1 in.	MN	12724	FD	ICPES	805	UG/G
21-1178	AAA0191	0-1 in.	CO	12738	SU	ICPES	11	UG/G
21-1179	AAA0162	0-1 in.	MN	12724	SU	ICPES	560	UG/G
	AAA0162	0-1 in.	ZN	12724	SU	ICPES	84	UG/G
	AAA0163	0-6 in.	ZN	12724	SU	ICPES	75	UG/G
21-1185	AAA0609	0-1 in.	AS	13148	SU	ETVAA	6.5	MG/KG
	AAA0609	0-1 in.	CD	13148	SU	ICPES	2.1	MG/KG
	AAA0609	0-1 in.	CR	13148	SU	ICPES	111	MG/KG

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
	AAA0609	0-1 in.	PB	13148	SU	ETVAA	55.3	MG/KG
	AAA0609	0-1 in.	ZN	13148	SU	ICPES	101	MG/KG
21-1188	AAA0612	0-1 in.	CD	13148	SU	ICPES	1.2	MG/KG
21-1189	AAA0610	0-1 in.	AS	13148	SU	ETVAA	5.2	MG/KG
	AAA0610	0-1 in.	CD	13148	SU	ICPES	1.3	MG/KG
	AAA0610	0-1 in.	CR	13148	SU	ICPES	34.3	MG/KG
	AAA0610	0-1 in.	MN	13148	SU	ICPES	526	MG/KG
	AAA0611	0-6 in.	CD	13148	SU	ICPES	1.8	MG/KG
	AAA0611	0-6 in.	CO	13148	SU	ICPES	8.1	MG/KG
	AAA0611	0-6 in.	CR	13148	SU	ICPES	21.4	MG/KG
	AAA0611	0-6 in.	MN	13148	SU	ICPES	625	MG/KG
21-1192	AAA0195	0-1 in.	MN	12738	SU	ICPES	734	UG/G
21-1193	AAA0197	0-1 in.	MN	12738	SU	ICPES	506	UG/G
	AAA0197	0-1 in.	V	12738	SU	ICPES	45	UG/G
	AAA0198	0-6 in.	BA	12738	SU	ICPES	527	UG/G
	AAA0198	0-6 in.	CR	12738	SU	ICPES	22	UG/G
	AAA0198	0-6 in.	MN	12738	SU	ICPES	502	UG/G
	AAA0198	0-6 in.	NI	12738	SU	ICPES	15	UG/G
	AAA0198	0-6 in.	SR	12738	SU	ICPES	151	UG/G
	AAA0198	0-6 in.	V	12738	SU	ICPES	48	UG/G
	AAA0199	0-1 in.	V	12738	FD	ICPES	42	UG/G
21-1194	AAA0030	0-1 in.	MN	12667	SU	ICPES	516	UG/G
	AAA0030	0-1 in.	ZN	12667	SU	ICPES	69.7	UG/G
21-1199	AAA0048	0-6 in.	CO	12678	SU	ICPES	8	UG/G
	AAA0048	0-6 in.	CR	12678	SU	ICPES	24	UG/G
	AAA0048	0-6 in.	V	12678	SU	ICPES	43	UG/G
21-1300	AAA0573	0-1 in.	PB	13125	SU	ETVAA	77.9	MG/KG
	AAA0574	0-6 in.	PB	13125	SU	ETVAA	53	MG/KG
21-1301	AAA0605	0-1 in.	CD	13148	SU	ICPES	1.8	MG/KG
	AAA0605	0-1 in.	ZN	13148	SU	ICPES	90.5	MG/KG
	AAA0606	0-6 in.	CD	13148	SU	ICPES	1.5	MG/KG

Process Area
Laboratory Radiological Data

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1079	AAA0239	0-1 in.	PU-239	12759	SU	RAS	22.54	PCI/G
	AAA0239	0-1 in.	U	12759	SU	DNA	24	UG/G
	AAA0240	0-6 in.	PU-238	12759	SU	RAS	0.35	PCI/G
	AAA0240	0-6 in.	PU-239	12759	SU	RAS	47.74	PCI/G
	AAA0240	0-6 in.	U	12759	SU	DNA	27	UG/G
	AAA0240	0-6 in.	U-234	12759	SU	RAS	11.1	PCI/G
	AAA0240	0-6 in.	U-235	12759	SU	RAS	0.443	PCI/G
	AAA0240	0-6 in.	U-238	12759	SU	RAS	8.26	PCI/G
21-1085	AAA0564	0-1 in.	PU-238	13127	SU	RAS	6.97	PCI/G
21-1086	AAA0565	0-1 in.	PU-238	13127	SU	RAS	50.15	PCI/G
	AAA0565	0-1 in.	PU-239	13127	SU	RAS	17.51	PCI/G
	AAA0566	0-6 in.	PU-238	13127	SU	RAS	18.66	PCI/G
	AAA0566	0-6 in.	PU-239	13127	SU	RAS	7.51	PCI/G
21-1092	AAA0567	0-1 in.	PU-238	13127	SU	RAS	1.75	PCI/G
	AAA0568	0-6 in.	PU-238	13127	SU	RAS	0.731	PCI/G
	AAA0568	0-6 in.	PU-239	13127	SU	RAS	3.63	PCI/G
21-1093	AAA0569	0-1 in.	PU-239	13127	SU	RAS	4.28	PCI/G
21-1094	AAA0570	0-1 in.	PU-239	13127	SU	RAS	2.87	PCI/G
21-1095	AAA0126	0-6 in.	PU-239	12702	SU	RAS	2.271	PCI/G
21-1096	AAA0127	0-1 in.	PU-239	12723	SU	RAS	4.98	PCI/G
	AAA0128	0-6 in.	PU-239	12723	SU	RAS	2.129	PCI/G
21-1094	AAA0570	0-1 in.	PU-239	13127	SU	RAS	2.87	PCI/G
21-1100	AAA0129	0-1 in.	PU-239	12723	SU	RAS	2.044	PCI/G
21-1103	AAA0572	0-6 in.	PU-238	13127	SU	RAS	0.932	PCI/G
21-1107	AAA0580	0-1 in.	PU-239	13127	SU	RAS	2.83	PCI/G
	AAA0580	0-1 in.	U	13127	SU	DNA	14.7	UG/G
21-1113	AAA0581	0-1 in.	U	13150	SU	DNA	10.5	UG/G
21-1115	AAA0586	0-1 in.	PU-238	13127	SU	RAS	0.494	PCI/G
21-1116	AAA0588	0-1 in.	PU-239	13127	SU	RAS	5.62	PCI/G
21-1119	AAA0135	0-1 in.	PU-239	12723	SU	RAS	17.645	PCI/G
	AAA0136	0-6 in.	PU-239	12723	SU	RAS	13.814	PCI/G
21-1122	AAA0591	0-1 in.	PU-238	13127	SU	RAS	0.474	PCI/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
	AAA0592	0-6 in.	PU-238	13127	SU	RAS	0.878	PCI/G
	AAA0592	0-6 in.	PU-239	13127	SU	RAS	7.32	PCI/G
21-1125	AAA0139	0-1 in.	PU-238	12723	SU	RAS	0.339	PCI/G
	AAA0139	0-1 in.	U	12723	SU	DNA	7.9	UG/G
	AAA0140	0-6 in.	U	12723	SU	DNA	8.1	UG/G
21-1127	AAA0593	0-1 in.	PU-238	13127	SU	RAS	0.522	PCI/G
21-1130	AAA0594	0-1 in.	PU-238	13127	SU	RAS	0.625	PCI/G
21-1136	AAA0143	0-1 in.	PU-239	12723	SU	RAS	2.205	PCI/G
	AAA0144	0-6 in.	PU-239	12723	SU	RAS	2.235	PCI/G
	AAA0144	0-6 in.	SR-90	12723	SU	PC	0.9	PCI/G
21-1144	AAA0145	0-1 in.	PU-239	12723	SU	RAS	2.196	PCI/G
21-1154	AAA0183	0-1 in.	PU-239	12740	SU	RAS	15.31	PCI/G
	AAA0184	0-6 in.	PU-239	12740	SU	RAS	6.837	PCI/G
21-1155	AAA0148	0-6 in.	PU-239	12726	SU	RAS	2.119	PCI/G
	AAA0148	0-6 in.	SR-90	12726	SU	PC	0.8	PCI/G
21-1160	AAA0185	0-1 in.	PU-239	12740	SU	RAS	14.78	PCI/G
	AAA0186	0-6 in.	PU-239	12740	SU	RAS	11.66	PCI/G
21-1162	AAA0149	0-1 in.	PU-239	12726	SU	RAS	2.333	PCI/G
21-1166	AAA0187	0-1 in.	PU-239	12740	SU	RAS	13.26	PCI/G
	AAA0187	0-1 in.	SR-90	12740	SU	PC	1.2	PCI/G
	AAA0187	0-1 in.	U	12740	SU	DNA	8.06	UG/G
	AAA0188	0-6 in.	PU-239	12740	SU	RAS	11.96	PCI/G
21-1168	AAA0152	0-1 in.	U	12726	SU	DNA	11	UG/G
	AAA0153	0-6 in.	U	12726	SU	DNA	10.7	UG/G
21-1173	AAA0159	0-1 in.	SR-90	12726	SU	PC	0.8	PCI/G
	AAA0160	0-6 in.	SR-90	12726	SU	PC	1	PCI/G
	AAA0161	0-1 in.	SR-90	12726	FD	PC	1	PCI/G
	AAA0161	0-1 in.	U	12726	FD	DNA	8	UG/G
21-1192	AAA0195	0-1 in.	PU-239	12740	SU	RAS	3.095	PCI/G
	AAA0195	0-1 in.	SR-90	12740	SU	PC	0.8	PCI/G
21-1269	AAA0267	0-1 in.	U	12994	SU	DNA	10.3	UG/G

Process Area
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Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1122	AAA0592	0-6 in.	Fluoranthene	13126	SU	GCMS	400	UG/KG
21-1198	AAA0051	0-6 in.	Benzo[b]fluoranthene	12679	SU	GCMS	400	UG/KG
	AAA0051	0-6 in.	Fluoranthene	12679	SU	GCMS	410	UG/KG
	AAA0051	0-6 in.	Pyrene	12679	SU	GCMS	470	UG/KG
21-1300	AAA0574	0-6 in.	Benzo[b]fluoranthene	13126	SU	GCMS	440	UG/KG
	AAA0574	0-6 in.	Fluoranthene	13126	SU	GCMS	790	UG/KG
	AAA0574	0-6 in.	Phenanthrene	13126	SU	GCMS	630	UG/KG
	AAA0574	0-6 in.	Pyrene	13126	SU	GCMS	720	UG/KG

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Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1166	AAA0187	0-1 in.	CO	12738	SU	ICPES	9	UG/G
21-1167	AAA0603	0-1 in.	CD	13148	SU	ICPES	2	MG/KG
	AAA0603	0-1 in.	MN	13148	SU	ICPES	492	MG/KG
	AAA0604	0-6 in.	CD	13148	SU	ICPES	1.9	MG/KG
	AAA0604	0-6 in.	MN	13148	SU	ICPES	504	MG/KG
21-1168	AAA0152	0-1 in.	CO	12724	SU	ICPES	9	UG/G
	AAA0152	0-1 in.	CR	12724	SU	ICPES	22	UG/G
	AAA0152	0-1 in.	CU	12724	SU	ICPES	26	UG/G
	AAA0152	0-1 in.	MN	12724	SU	ICPES	510	UG/G
	AAA0152	0-1 in.	NI	12724	SU	ICPES	18	UG/G
	AAA0152	0-1 in.	PB	12724	SU	ICPES	53	UG/G
	AAA0152	0-1 in.	ZN	12724	SU	ICPES	186	UG/G
	AAA0153	0-6 in.	AS	12724	SU	ETVAA	4.4	UG/G
	AAA0153	0-6 in.	CD	12724	SU	ICPES	3	UG/G
	AAA0153	0-6 in.	CO	12724	SU	ICPES	8	UG/G
	AAA0153	0-6 in.	CR	12724	SU	ICPES	21	UG/G
	AAA0153	0-6 in.	CU	12724	SU	ICPES	24	UG/G
	AAA0153	0-6 in.	MN	12724	SU	ICPES	498	UG/G
	AAA0153	0-6 in.	NI	12724	SU	ICPES	19	UG/G
	AAA0153	0-6 in.	PB	12724	SU	ICPES	50	UG/G
	AAA0153	0-6 in.	V	12724	SU	ICPES	41	UG/G
	AAA0153	0-6 in.	ZN	12724	SU	ICPES	181	UG/G
21-1173	AAA0159	0-1 in.	MN	12724	SU	ICPES	920	UG/G
	AAA0159	0-1 in.	PB	12724	SU	ICPES	42	UG/G
	AAA0160	0-6 in.	CO	12724	SU	ICPES	9	UG/G
	AAA0160	0-6 in.	MN	12724	SU	ICPES	696	UG/G
	AAA0161	0-1 in.	MN	12724	FD	ICPES	805	UG/G
21-1175	AAA0607	0-1 in.	CU	13148	SU	ICPES	32.6	MG/KG
21-1178	AAA0191	0-1 in.	CO	12738	SU	ICPES	11	UG/G
21-1179	AAA0162	0-1 in.	MN	12724	SU	ICPES	560	UG/G
	AAA0162	0-1 in.	ZN	12724	SU	ICPES	84	UG/G
	AAA0163	0-6 in.	ZN	12724	SU	ICPES	75	UG/G
21-1185	AAA0609	0-1 in.	AS	13148	SU	ETVAA	6.5	MG/KG
	AAA0609	0-1 in.	CD	13148	SU	ICPES	2.1	MG/KG
	AAA0609	0-1 in.	CR	13148	SU	ICPES	111	MG/KG
	AAA0609	0-1 in.	PB	13148	SU	ETVAA	55.3	MG/KG
	AAA0609	0-1 in.	ZN	13148	SU	ICPES	101	MG/KG
21-1188	AAA0612	0-1 in.	CD	13148	SU	ICPES	1.2	MG/KG

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1189	AAA0610	0-1 in.	AS	13148	SU	ETVAA	5.2	MG/KG
	AAA0610	0-1 in.	CD	13148	SU	ICPES	1.3	MG/KG
	AAA0610	0-1 in.	CR	13148	SU	ICPES	34.3	MG/KG
	AAA0610	0-1 in.	MN	13148	SU	ICPES	526	MG/KG
	AAA0611	0-6 in.	CD	13148	SU	ICPES	1.8	MG/KG
	AAA0611	0-6 in.	CO	13148	SU	ICPES	8.1	MG/KG
	AAA0611	0-6 in.	CR	13148	SU	ICPES	21.4	MG/KG
	AAA0611	0-6 in.	MN	13148	SU	ICPES	625	MG/KG
21-1192	AAA0195	0-1 in.	MN	12738	SU	ICPES	734	UG/G
21-1193	AAA0197	0-1 in.	MN	12738	SU	ICPES	506	UG/G
	AAA0197	0-1 in.	V	12738	SU	ICPES	45	UG/G
	AAA0198	0-6 in.	BA	12738	SU	ICPES	527	UG/G
	AAA0198	0-6 in.	CR	12738	SU	ICPES	22	UG/G
	AAA0198	0-6 in.	MN	12738	SU	ICPES	502	UG/G
	AAA0198	0-6 in.	NI	12738	SU	ICPES	15	UG/G
	AAA0198	0-6 in.	SR	12738	SU	ICPES	151	UG/G
	AAA0198	0-6 in.	V	12738	SU	ICPES	48	UG/G
	AAA0199	0-1 in.	V	12738	FD	ICPES	42	UG/G
21-1194	AAA0030	0-1 in.	MN	12667	SU	ICPES	516	UG/G
	AAA0030	0-1 in.	ZN	12667	SU	ICPES	69.7	UG/G
21-1199	AAA0048	0-6 in.	CO	12678	SU	ICPES	8	UG/G
	AAA0048	0-6 in.	CR	12678	SU	ICPES	24	UG/G
	AAA0048	0-6 in.	V	12678	SU	ICPES	43	UG/G
21-1203	AAA0081	0-1 in.	CO	12691	SU	ICPES	8	UG/G
21-1204	AAA0079	0-1 in.	CO	12691	SU	ICPES	9	UG/G
	AAA0080	0-6 in.	CO	12691	SU	ICPES	8.73	UG/G
21-1206	AAA0045	0-1 in.	BA	12678	SU	ICPES	534	UG/G
	AAA0045	0-1 in.	CO	12678	SU	ICPES	8	UG/G
	AAA0045	0-1 in.	V	12678	SU	ICPES	41	UG/G
	AAA0046	0-6 in.	BA	12678	SU	ICPES	508	UG/G
21-1207	AAA0044	0-1 in.	BA	12667	SU	ICPES	501	UG/G
	AAA0044	0-1 in.	CO	12667	SU	ICPES	9	UG/G
	AAA0044	0-1 in.	MN	12667	SU	ICPES	560	UG/G
	AAA0044	0-1 in.	V	12667	SU	ICPES	44	UG/G
21-1208	AAA0027	0-1 in.	BA	12661	SU	ICPES	510	UG/G
	AAA0027	0-1 in.	MN	12661	SU	ICPES	580	UG/G
	AAA0027	0-1 in.	PB	12661	SU	ICPES	43	UG/G
	AAA0027	0-1 in.	V	12661	SU	ICPES	44	UG/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
	AAA0028	0-6 in.	CR	12661	SU	ICPES	21.2	UG/G
	AAA0028	0-6 in.	MN	12661	SU	ICPES	530	UG/G
	AAA0028	0-6 in.	V	12661	SU	ICPES	45	UG/G
21-1211	AAA0078	0-1 in.	V	12678	SU	ICPES	45	UG/G
21-1215	AAA0026	0-1 in.	MN	12661	SU	ICPES	486	UG/G
21-1221	AAA0040	0-1 in.	ZN	12667	SU	ICPES	142	UG/G
21-1301	AAA0605	0-1 in.	CD	13148	SU	ICPES	1.8	MG/KG
	AAA0605	0-1 in.	ZN	13148	SU	ICPES	90.5	MG/KG
	AAA0606	0-6 in.	CD	13148	SU	ICPES	1.5	MG/KG

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Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1166	AAA0187	0-1 in.	PU-239	12740	SU	RAS	13.26	PCI/G
	AAA0187	0-1 in.	SR-90	12740	SU	PC	1.2	PCI/G
	AAA0187	0-1 in.	U	12740	SU	DNA	8.06	UG/G
	AAA0188	0-6 in.	PU-239	12740	SU	RAS	11.96	PCI/G
21-1168	AAA0152	0-1 in.	U	12726	SU	DNA	11	UG/G
	AAA0153	0-6 in.	U	12726	SU	DNA	10.7	UG/G
21-1173	AAA0159	0-1 in.	SR-90	12726	SU	PC	0.8	PCI/G
	AAA0160	0-6 in.	SR-90	12726	SU	PC	1	PCI/G
	AAA0161	0-1 in.	SR-90	12726	FD	PC	1	PCI/G
	AAA0161	0-1 in.	U	12726	FD	DNA	8	UG/G
21-1192	AAA0195	0-1 in.	PU-239	12740	SU	RAS	3.095	PCI/G
	AAA0195	0-1 in.	SR-90	12740	SU	PC	0.8	PCI/G
21-1197	AAA0200	0-1 in.	PU-239	12740	SU	RAS	3.09	PCI/G
21-1221	AAA0040	0-1 in.	SR-90	12668	SU	RAS	0.8	PCI/G

Special Impact Area 1
Laboratory Semivolatile Data

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value
21-1198	AAA0051	0-6 in.	Benzo[b]fluoranthene	12679	SU	GCMS	400 UG/KG
	AAA0051	0-6 in.	Fluoranthene	12679	SU	GCMS	410 UG/KG
	AAA0051	0-6 in.	Pyrene	12679	SU	GCMS	470 UG/KG

Special Impact Area 2
Laboratory Inorganic Data

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1119	AAA0135	0-1 in.	CD	12721	SU	ICPES	1.3	UG/G
	AAA0135	0-1 in.	ZN	12721	SU	ICPES	96	UG/G
	AAA0136	0-6 in.	NI	12721	SU	ICPES	4.92	%
	AAA0136	0-6 in.	ZN	12721	SU	ICPES	88	UG/G
21-1124	AAA0169	0-6 in.	ZN	12724	SU	ICPES	70	UG/G
21-1136	AAA0143	0-1 in.	PB	12721	SU	ICPES	46	UG/G
	AAA0143	0-1 in.	ZN	12721	SU	ICPES	74	UG/G
21-1138	AAA0596	0-1 in.	CD	13148	SU	ICPES	1.3	MG/KG
21-1144	AAA0145	0-1 in.	CU	12721	SU	ICPES	223	UG/G
	AAA0145	0-1 in.	PB	12721	SU	ICPES	67	UG/G
	AAA0145	0-1 in.	ZN	12721	SU	ICPES	187	UG/G
	AAA0146	0-6 in.	CU	12721	SU	ICPES	131	UG/G
	AAA0146	0-6 in.	PB	12721	SU	ICPES	43	UG/G
	AAA0146	0-6 in.	ZN	12721	SU	ICPES	116	UG/G
21-1149	AAA0179	0-1 in.	ZN	12724	SU	ICPES	70	UG/G
21-1155	AAA0147	0-1 in.	ZN	12724	SU	ICPES	74.3	UG/G
	AAA0148	0-6 in.	ZN	12724	SU	ICPES	78	UG/G
21-1166	AAA0187	0-1 in.	CO	12738	SU	ICPES	9	UG/G
21-1168	AAA0152	0-1 in.	CO	12724	SU	ICPES	9	UG/G
	AAA0152	0-1 in.	CR	12724	SU	ICPES	22	UG/G
	AAA0152	0-1 in.	CU	12724	SU	ICPES	26	UG/G
	AAA0152	0-1 in.	MN	12724	SU	ICPES	510	UG/G
	AAA0152	0-1 in.	NI	12724	SU	ICPES	18	UG/G
	AAA0152	0-1 in.	PB	12724	SU	ICPES	53	UG/G
	AAA0152	0-1 in.	ZN	12724	SU	ICPES	186	UG/G
	AAA0153	0-6 in.	AS	12724	SU	ETVAA	4.4	UG/G
	AAA0153	0-6 in.	CD	12724	SU	ICPES	3	UG/G
	AAA0153	0-6 in.	CO	12724	SU	ICPES	8	UG/G
	AAA0153	0-6 in.	CR	12724	SU	ICPES	21	UG/G
	AAA0153	0-6 in.	CU	12724	SU	ICPES	24	UG/G
	AAA0153	0-6 in.	MN	12724	SU	ICPES	498	UG/G
	AAA0153	0-6 in.	NI	12724	SU	ICPES	19	UG/G
	AAA0153	0-6 in.	PB	12724	SU	ICPES	50	UG/G
	AAA0153	0-6 in.	V	12724	SU	ICPES	41	UG/G
	AAA0153	0-6 in.	ZN	12724	SU	ICPES	181	UG/G
21-1173	AAA0159	0-1 in.	MN	12724	SU	ICPES	920	UG/G
	AAA0159	0-1 in.	PB	12724	SU	ICPES	42	UG/G
	AAA0160	0-6 in.	CO	12724	SU	ICPES	9	UG/G
	AAA0160	0-6 in.	MN	12724	SU	ICPES	696	UG/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value
	AAA0161	0-1 in.	MN	12724	FD	ICPES	805 UG/G
21-1176	AAA0397	0-1 in.	CU	13013	15064 SU	ICPES	20.7 MG/KG
	AAA0397	0-1 in.	CU	13013	SU	ICPES	20.7 MG/KG
	AAA0398	0-6 in.	CU	13013	15046 SU	ICPES	19.4 MG/KG
	AAA0398	0-6 in.	CU	13013	SU	ICPES	19.4 MG/KG
21-1178	AAA0191	0-1 in.	CO	12738	SU	ICPES	11 UG/G
21-1179	AAA0162	0-1 in.	MN	12724	SU	ICPES	560 UG/G
	AAA0162	0-1 in.	ZN	12724	SU	ICPES	84 UG/G
	AAA0163	0-6 in.	ZN	12724	SU	ICPES	75 UG/G

Special Impact Area 2
Laboratory Radiological Data

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1119	AAA0135	0-1 in.	PU-239	12723	SU	RAS	17.645	PCI/G
21-1123	AAA0425	0-1 in.	PU-239	13032	SU	RAS	3.304	PCI/G
21-1128	AAA0423	0-1 in.	PU-239	13032	SU	RAS	3.308	PCI/G
	AAA0424	0-6 in.	PU-239	13032	SU	RAS	3.688	PCI/G
21-1131	AAA0422	0-1 in.	PU-239	13032	SU	RAS	3.9	PCI/G
21-1135	AAA0420	0-1 in.	PU-239	13032	SU	RAS	4.553	PCI/G
	AAA0421	0-6 in.	PU-239	13032	SU	RAS	2.24	PCI/G
21-1136	AAA0143	0-1 in.	PU-239	12723	SU	RAS	2.205	PCI/G
	AAA0144	0-6 in.	PU-239	12723	SU	RAS	2.235	PCI/G
	AAA0144	0-6 in.	SR-90	12723	SU	PC	0.9	PCI/G
21-1138	AAA0597	0-6 in.	PU-238	13150	SU	RAS	0.268	PCI/G
21-1141	AAA0418	0-1 in.	PU-239	13015	SU	RAS	3.675	PCI/G
	AAA0418	0-1 in.	SR-90	13015	SU	PC	2	PCI/G
	AAA0419	0-6 in.	SR-90	13015	SU	PC	1.8	PCI/G
21-1142	AAA0172	0-1 in.	PU-239	12726	SU	RAS	9.158	PCI/G
	AAA0172	0-1 in.	U	12726	SU	DNA	7.9	UG/G
21-1144	AAA0145	0-1 in.	PU-239	12723	SU	RAS	2.196	PCI/G
21-1146	AAA0416	0-1 in.	SR-90	13015	SU	PC	0.8	PCI/G
21-1147	AAA0415	0-1 in.	SR-90	13015	SU	PC	0.8	PCI/G
21-1148	AAA0178	0-6 in.	PU-239	12740	SU	RAS	4.207	PCI/G
21-1152	AAA0413	0-1 in.	PU-239	13015	SU	RAS	17.3	PCI/G
	AAA0414	0-6 in.	PU-239	13015	SU	RAS	20.4	PCI/G
21-1153	AAA0412	0-1 in.	PU-239	13015	SU	RAS	3.273	PCI/G
21-1154	AAA0183	0-1 in.	PU-239	12740	SU	RAS	15.31	PCI/G
	AAA0184	0-6 in.	PU-239	12740	SU	RAS	6.837	PCI/G
21-1155	AAA0148	0-6 in.	PU-239	12726	SU	RAS	2.119	PCI/G
	AAA0148	0-6 in.	SR-90	12726	SU	PC	0.8	PCI/G
21-1158	AAA0410	0-1 in.	PU-239	13015	SU	RAS	2.424	PCI/G
21-1160	AAA0185	0-1 in.	PU-239	12740	SU	RAS	14.78	PCI/G
	AAA0186	0-6 in.	PU-239	12740	SU	RAS	11.66	PCI/G

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1162	AAA0149	0-1 in.	PU-239	12726	SU	RAS	2.333	PCI/G
21-1164	AAA0405	0-6 in.	SR-90	13015	SU	RAS	0.8	PCI/G
21-1165	AAA0403	0-1 in.	PU-239	13015	SU	RAS	12.5	PCI/G
	AAA0403	0-1 in.	SR-90	13015	SU	PC	1.2	PCI/G
	AAA0403	0-1 in.	U	13015	SU	DNA	8.1	UG/G
21-1166	AAA0187	0-1 in.	PU-239	12740	SU	RAS	13.26	PCI/G
	AAA0187	0-1 in.	SR-90	12740	SU	PC	1.2	PCI/G
	AAA0187	0-1 in.	U	12740	SU	DNA	8.06	UG/G
	AAA0188	0-6 in.	PU-239	12740	SU	RAS	11.96	PCI/G
21-1168	AAA0152	0-1 in.	U	12726	SU	DNA	11	UG/G
	AAA0153	0-6 in.	U	12726	SU	DNA	10.7	UG/G
21-1170	AAA0399	0-1 in.	PU-239	13015	SU	RAS	2.269	PCI/G
21-1171	AAA0401	0-1 in.	PU-239	13015	SU	RAS	2.808	PCI/G
	AAA0401	0-1 in.	SR-90	13015	SU	PC	0.8	PCI/G
21-1173	AAA0159	0-1 in.	SR-90	12726	SU	PC	0.8	PCI/G
	AAA0160	0-6 in.	SR-90	12726	SU	PC	1	PCI/G
	AAA0161	0-1 in.	SR-90	12726	FD	PC	1	PCI/G
	AAA0161	0-1 in.	U	12726	FD	DNA	8	UG/G
21-1176	AAA0397	0-1 in.	U	13015	SU	DNA	10.96	UG/G
	AAA0398	0-6 in.	U	13015	SU	DNA	9.7	UG/G
21-1182	AAA0394	0-1 in.	SR-90	13015	SU	PC	1.3	PCI/G
21-1183	AAA0395	0-1 in.	PU-239	13015	SU	RAS	2.686	PCI/G

Special Impact Area 2
Laboratory Semivolatile Data

Location ID	Sample ID	Depth	Analyte	Request Number	Sample Type	Technique	Sample Value

No semivolatiles were detected in Special Impact Area 2.

Filter Buildings
Laboratory Radiological Data

Location ID	Sample ID	Depth		Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1440	AAA1320	12-18	in.	PU-238	13267	NS	RAS	1.42	PCI/G
21-1441	AAA1323	12-18	in.	PU-238	13267	NS	RAS	0.444	PCI/G
	AAA1323	12-18	in.	PU-239	13267	NS	RAS	10.2	PCI/G
21-1444	AAA1335	12-18	in.	PU-239	13267	NS	RAS	13.4	PCI/G
21-1446	AAA1344	12-18	in.	PU-238	13267	NS	RAS	1.96	PCI/G
21-1447	AAA1347	12-18	in.	PU-238	13267	NS	RAS	0.603	PCI/G
	AAA1347	12-18	in.	PU-239	13267	NS	RAS	5.52	PCI/G
	AAA1349	12-18	in.	PU-238	13267	FD	RAS	0.336	PCI/G
	AAA1349	12-18	in.	PU-239	13267	FD	RAS	4.23	PCI/G
21-1448	AAA1353	12-18	in.	PU-238	13302	NS	RAS	0.327	PCI/G
	AAA1353	12-18	in.	PU-239	13302	NS	RAS	5.66	PCI/G
21-1451	AAA1364	12-18	in.	PU-239	13302	NS	RAS	3.62	PCI/G
	AAA1364	12-18	in.	SR-90	13302	NS	PC	0.734	PCI/G
21-1453	AAA1369	3-5	ft.	PU-239	13763	SS	RAS	2.64	PCI/G
21-1458	AAA1387	24-30	in.	SR-90	13302	NS	PC	35.3	PCI/G

Filter Buildings
Laboratory Inorganic Data

Location ID	Sample ID	Depth		Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1436	AAA1306	18-24 in.	CD	13245	17915	NS	ICPES	1.4	MG/KG
21-1440	AAA1320	12-18 in.	CO	13265		NS	ICPES	8.8	MG/KG
21-1449	AAA1359	24-30 in.	AS	13300		NS	ETVAA	4.9	MG/KG
	AAA1359	24-30 in.	CO	13300		NS	ICPES	8.6	MG/KG
21-1450	AAA1362	24-30 in.	CO	13300		NS	ICPES	12.4	MG/KG
21-1451	AAA1364	12-18 in.	CD	13300		NS	ICPES	3	MG/KG
	AAA1364	12-18 in.	ZN	13300		NS	ICPES	121	MG/KG
21-1453	AAA1369	3-5 ft.	CO	13761	17198	SS	ICPES	10	UG/G
	AAA1369	3-5 ft.	MN	13761	17198	SS	ICPES	539	UG/G
21-1454	AAA1372	5-7 ft.	CO	13761	17198	SS	ICPES	13	UG/G
	AAA1372	5-7 ft.	CR	13761	17198	SS	ICPES	23	UG/G
	AAA1372	5-7 ft.	MG	13761	17198	SS	ICPES	5137	UG/G
	AAA1372	5-7 ft.	NI	13761	17198	SS	ICPES	18	UG/G
	AAA1372	5-7 ft.	V	13761	17198	SS	ICPES	45	UG/G
21-1455	AAA1376	5-8 ft.	NA	13761	17198	SS	ICPES	31047	UG/G
21-1456	AAA1378	5-8 ft.	BA	13761	17198	SS	ICPES	537	UG/G
	AAA1378	5-8 ft.	CO	13761	17198	SS	ICPES	13	UG/G
	AAA1378	5-8 ft.	CR	13761	17198	SS	ICPES	29	UG/G
	AAA1378	5-8 ft.	FE	13761	17198	SS	ICPES	24412	UG/G
	AAA1378	5-8 ft.	MG	13761	17198	SS	ICPES	5924	UG/G
	AAA1378	5-8 ft.	MN	13761	17198	SS	ICPES	583	UG/G
	AAA1378	5-8 ft.	NI	13761	17198	SS	ICPES	17	UG/G
	AAA1378	5-8 ft.	V	13761	17198	SS	ICPES	56	UG/G
21-1464	AAA1414	6-12 in.	CO	13300		NS	ICPES	8	MG/KG
21-1466	AAA1424	12-18 in.	CA	13300		NS	ICPES	20300	MG/KG
	AAA1424	12-18 in.	CO	13300		NS	ICPES	9	MG/KG
	AAA1424	12-18 in.	NI	13300		NS	ICPES	14.8	MG/KG
	AAA1427	12-18 in.	AS	13300		FD	ETVAA	4.3	MG/KG
	AAA1427	12-18 in.	CA	13300		FD	ICPES	16200	MG/KG
	AAA1427	12-18 in.	CD	13300		FD	ICPES	1.3	MG/KG
	AAA1427	12-18 in.	CO	13300		FD	ICPES	8.3	MG/KG
	AAA1427	12-18 in.	NI	13300		FD	ICPES	14.8	MG/KG
21-1473	AAA1712	5-8 ft.	NA	13761	17198	SS	ICPES	30479	UG/G
21-1474	AAA1717	5-8 ft.	NA	13761	17198	SS	ICPES	30454	UG/G

Location ID	Sample ID	Depth		Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1475	AAA1719	5-8 ft.	NA	13761	17198	SS	ICPES	31518	UG/G
21-1476	AAA1721	3-5 ft.	NA	13761	17198	SS	ICPES	32208	UG/G

Filter Buildings
Laboratory Semivolatile Data

No semivolatiles were detected in the area of the filter buildings

Filter Buildings
Laboratory Volatile Data

Location ID	Sample ID	Depth		Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1436	AAA1306	18-24	in.	Acetone	13246	NS	PTGC	15	UG/KG
21-1437	AAA1309	18-24	in.	Acetone	13246	NS	PTGC	16	UG/KG
	AAA1310			Acetone	13271	FE	PTGC	36	UG/L
	AAA1311			Acetone	13271	FR	PTGC	42	UG/L
21-1438	AAA1313	12-18	in.	Acetone	13246	NS	PTGC	24	UG/KG
21-1439	AAA0931			Acetone	13271	FB	PTGC	39	UG/L
21-1440	AAA1320	12-18	in.	Acetone	13266	NS	PTGC	17	UG/KG
	AAA1320	12-18	in.	Methylene chloride	13266	NS	PTGC	15	UG/KG
21-1441	AAA1323	12-18	in.	Methylene chloride	13266	NS	PTGC	9	UG/KG
	AAA1326			Acetone	13271	FR	PTGC	42	UG/L
21-1442	AAA1329	12-18	in.	Acetone	13266	NS	PTGC	19	UG/KG
	AAA1329	12-18	in.	Methylene chloride	13266	NS	PTGC	13	UG/KG
21-1443	AAA1332	12-18	in.	Methylene chloride	13266	NS	PTGC	9	UG/KG
21-1444	AAA1335	12-18	in.	Acetone	13266	NS	PTGC	27	UG/KG
	AAA1335	12-18	in.	Methylene chloride	13266	NS	PTGC	15	UG/KG
	AAA1338			Acetone	13294	FB	PTGC	47	UG/L
21-1445	AAA1339	12-18	in.	Methylene chloride	13266	NS	PTGC	16	UG/KG
	AAA1341			Acetone	13294	FE	PTGC	36	UG/L
	AAA1342			Acetone	13294	FR	PTGC	49	UG/L
21-1446	AAA1344	12-18	in.	Acetone	13266	NS	PTGC	16	UG/KG
	AAA1344	12-18	in.	Methylene chloride	13266	NS	PTGC	7	UG/KG
21-1447	AAA1347	12-18	in.	Acetone	13266	NS	PTGC	14	UG/KG
	AAA1347	12-18	in.	Methylene chloride	13266	NS	PTGC	10	UG/KG
21-1448	AAA1351			Acetone	13294	FB	PTGC	41	UG/L
	AAA1353	18-24	in.	Acetone	13301	NS	PTGC	18	UG/KG
	AAA1353	18-24	in.	Methylene chloride	13301	NS	PTGC	8	UG/KG
21-1449	AAA1358			Acetone	13294	FR	PTGC	66	UG/L
	AAA1359	24-30	in.	Acetone	13301	NS	PTGC	44	UG/KG
	AAA1359	24-30	in.	Methylene chloride	13301	NS	PTGC	11	UG/KG
21-1450	AAA1362	24-30	in.	Acetone	13301	NS	PTGC	22	UG/KG
	AAA1362	24-30	in.	Methylene chloride	13301	NS	PTGC	8	UG/KG

Location ID	Sample ID	Depth		Analyte	Request Number	Sample Type	Technique	Sample Value	
21-1451	AAA1364	12-18	in.	Acetone	13301	NS	PTGC	44	UG/KG
	AAA1364	12-18	in.	Methylene chloride	13301	NS	PTGC	10	UG/KG
21-1454	AAA1373			Acetone	13765	FE	PTGC	26	UG/L
	AAA1374			Acetone	13765	FR	PTGC	28	UG/L
21-1457	AAA1383	24-30	in.	Acetone	13301	NS	PTGC	42	UG/KG
	AAA1383	24-30	in.	Methylene chloride	13301	NS	PTGC	11	UG/KG
21-1458	AAA1387	24-30	in.	Acetone	13301	NS	PTGC	22	UG/KG
21-1459	AAA1392			Acetone	13294	FR	PTGC	37	UG/L
	AAA1393	24-30	in.	Acetone	13301	NS	PTGC	17	UG/KG
	AAA1393	24-30	in.	Methylene chloride	13301	NS	PTGC	7	UG/KG
21-1460	AAA1397	18-24	in.	Acetone	13301	NS	PTGC	30	UG/KG
	AAA1397	18-24	in.	Methylene chloride	13301	NS	PTGC	8	UG/KG
21-1461	AAA1399	6-12	in.	Acetone	13301	NS	PTGC	30	UG/KG
	AAA1399	6-12	in.	Methylene chloride	13301	NS	PTGC	9	UG/KG
21-1462	AAA1363			Acetone	13294	FB	PTGC	35	UG/L
	AAA1405	18-24	in.	Acetone	13301	NS	PTGC	13	UG/KG
	AAA1405	18-24	in.	Methylene chloride	13301	NS	PTGC	9	UG/KG
21-1463	AAA1412			Acetone	13294	FR	PTGC	44	UG/L
	AAA1413	24-30	in.	Acetone	13301	NS	PTGC	28	UG/KG
	AAA1413	24-30	in.	Methylene chloride	13301	NS	PTGC	7	UG/KG
21-1464	AAA1414	6-12	in.	Acetone	13301	NS	PTGC	27	UG/KG
	AAA1414	6-12	in.	Methylene chloride	13301	NS	PTGC	7	UG/KG
21-1465	AAA1421	24-30	in.	Acetone	13301	NS	PTGC	37	UG/KG
	AAA1421	24-30	in.	Methylene chloride	13301	NS	PTGC	9	UG/KG
21-1466	AAA1424	12-18	in.	Acetone	13301	NS	PTGC	18	UG/KG
	AAA1428			Acetone	13294	FE	PTGC	27	UG/L
	AAA1429			Acetone	13294	FR	PTGC	55	UG/L
21-1475	AAA1719	5-8	ft.	Acetone	13762	SS	PTGC	28	UG/KG

APPENDIX F

GRAPHICAL DISPLAYS AND STATISTICAL TESTS FOR FILTER BUILDINGS DATA

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F.1 Graphical displays

The 34 samples submitted for laboratory analysis from the filter buildings [20 from SWMU 21-020(a) and 14 from SWMU 21-020(b)] come from 34 different holes, but cover a range of depths: from 12 in. to 90 in. at SWMU 21-020(a) and from 6 in. to 90 in. at SWMU 21-020(b). The displays in this appendix illustrate the results by SWMU, depth and analytical method, but ignore possible lateral variability.

Shown for comparison on each plot are indicators of

- the middle and upper limit of local background concentrations;
- the middle and upper limit of the distribution of the nearest analytically comparable neighbors from the 0 to 6 in. grid; and
- the screening action level (taken from Appendix J of the Installation Work Plan).

For these comparison purposes, local background has been selected in one of three ways:

1) Regional backgrounds are used only if virtually all 0 to 6 in. grid measurements were below detection limits. This is the case for antimony, molybdenum, and thallium. The middle and upper limit of these distributions are represented by their reported means and maxima, respectively.

2) The OU background distributions developed in Appendix A are used for most elements. The middle and upper limit of these distributions are represented by the median and maximum of 0 to 6 in. grid samples analyzed by comparable methods. For arsenic, selenium and silver, the comparable grid samples come from Round 1, where Atomic Absorption methods were used for these elements. For all other organics except lead, the comparable grid samples come from Round 2, where EPA SW-846 method 6010 was followed. Both Round 1 and Round 2 results are used for lead and for the radionuclides.

   The statistics (median and maximum) are computed after outliers shown in Table F-1 have been eliminated. Grid location 21-1079 is omitted because it is at the outfall SWMU 21-024(e).

3) A local background estimate at the SWMU is estimated by kriging for the four radionuclides that exhibit very large spatial variability across the OU, as discussed in Section F.4 (Cressie, 1991). These radionuclides are Pu238, Pu239/240, Am241 and tritium. In these cases, the middle and upper limit of these distributions are represented by the median and 99.9th percentiles at each SWMU, provided in Table F-2.

For elements where Round 1 data are not used, the nearest neighbors are twelve Round 2 grid points within 600 ft of SWMU 21-020(a) and six Round 2 grid points within 525 ft of SWMU 21-020(b). For elements where Round 1 or both sets of data are used, the neighbors are eight grid points within 300 ft of SWMU 21-020(a) and eleven grid points within 400 ft of SWMU 21-020(b). The middle and upper limits of the distributions of concentrations at these neighbors are represented in the plots by the medians and maxima of the observed values.

F.2 Trends with depth

For four radionuclides (Pu-238, Pu-239/240, uranium, and Sr-90), the decreasing trend with depth that is apparent in the graphical displays is readily confirmed by a statistical test. In this case, the nonparametric Wilcoxon test, comparing the distribution of samples between 12 in. and 30 in. with the distribution of samples between 30 in. and 90 in., was used (Lehmann and D'Abrera, 1975). There are no Am-241 measurements on samples from depths greater than 30 in. Concentrations of tritium as measured in nCi/l of pore water appear to be increasing marginally, but moisture data are required to determine whether concentrations in soil are actually increasing as might appear in the plots.

The effects of depth and analytical method are unfortunately confounded for many inorganics. Samples between 6 in. and 30 in. were collected first and submitted for laboratory analysis, while the deeper samples, from the 30 to 60 in. interval and the 60 to 90 in. interval, were collected later, submitted separately, and in many cases analyzed using a different procedure or analytical technique. Thus, apparent trends with depth must be carefully evaluated to determine whether they reflect not changes in concentration but changes of analytical method. For example, the method used to analyze the deeper samples for beryllium has a different detection limit and relatively large reported errors compared to the 6010 analyses that were used for the shallower samples.

F.3 Statistical comparisons with grid samples

Two tests were performed:

- The nonparametric Wilcoxon test (Lehmann and D'Abrera, 1975) was used to compare the observations from each of the filter building SWMUs with the neighboring grid samples, selected as described above. Results are shown in Table F-3, where a "Y" in the column headed "Neighbors" indicates that the hypothesis that these two sets of observations come from the same distribution was rejected at the 5% level.

- The number of samples above the 95th percentile of the local background was compared with the number that would be expected in a sample of size 20 [in the case of SWMU 21-020(a)] or of size 14 [in the case of SWMU 21-020(b)]. Specifically, given a sample of size 20 from the postulated background distribution, the probability that four or more observations will exceed the 95th percentile is about 0.02, but the chances of three observations exceeding that level is greater than 0.05; thus if four or more observations from SWMU 21-020(a) exceed the 95th percentile, this is an indication that the distribution at that filter building may not be the same as the local background distribution. For a sample of size 14 [i.e., at 21-020(b)], three samples above the 95th percentile provides such an indication (probability under the null hypothesis: 0.03). This test was used only where substantial numbers of observations, at both the filter buildings and on the grid, exceeded detection levels. Results are shown in Table F-3, where a "Y" in the column headed "Local bkgd" indicates that four samples from SWMU 21-020(a) or three from SWMU 21-020(b) exceeded the 95th percentile of local background.

While a number of these tests turn up positive, results for most inorganics share the problems of looking for trends with depth discussed above. Specifically, many positive results appear to

be artifacts of the relatively high detection levels available for most grid samples (particularly for beryllium, lithium and nickel) and of method incomparabilities.

There is one high measurement of Sr-90 (35.3 pCi/g) from the 24-30 in. depth at 21-1458 at SWMU 21-020(b). The SAL for Sr-90 is 8.9 pCi/g. As discussed in Appendix C, laboratory records are being checked to determine whether, as suspected, this apparent outlier is an artifact. No other observations exceed SALs except those for arsenic and beryllium, where the SALs are below regional background values.

F.4 Binomial Tests To Determine Whether Observations at a SWMU Exceed Local Background

In order to compare small samples with a background distribution described only by its upper tail quantiles, we consider whether "too many" of the observations in the sample exceed these quantiles. The null hypothesis is that the sample of size N comes from the background distribution, in which case the probability that n of the N observations will exceed the qth quantile of that background is

$$P_q = \sum_{i=n}^{N} \binom{N}{i} (1-q)^i q^{N-i} \quad \text{Equation 1}$$

Of course, this use of the binomial formula assumes that the N observations are independent, which is probably not the case, as they never come from more than three boreholes, and sometimes as few as one. The effect of this failure of independence is that the actual probability may exceed the calculated probability for n>0. In the application of this test here, the result in conservative; we are more likely to declare that a SWMU is above local background on the basis of this test than perhaps we should be.

Table F-4 shows choices of n for q=.9 or .95 that result in tests with significance levels (P_q's) below 0.05, in most cases, well below, except for the fact that Equation 1 may be too small by an undetermined amount because of correlation. The last column of Table F-4 indicates the number of outfalls with this sample size.

Table F-1. Quantiles of Spatially Varying Local Background Distributions at the Two Filter Buildings

	Quantile			
	0.50	0.90	0.95	0.999
Pu238				
20a	0.1155	0.3308	0.4458	1.4608
20b	0.0055	0.0157	0.0211	0.0690
Pu239/Pu240				
20a	2.4371	9.0084	13.0497	57.0091
20b	0.0763	0.3603	0.5595	3.2222
Am241				
20a	0.1387	0.4120	0.5610	1.9156
20b	0.0342	0.1037	0.1420	0.4963
Tritium				
20a	2.2759	3.8588	4.4818	8.1294
20b	6.2363	11.4093	13.5402	26.7603

Table F-2. 0 to 6 In. Grid Samples Omitted from Local Background Comparisons for Filter Buildings and Outfalls

Analyte	Method	Loc.	Value	Units
Pu-238	RAS	21-1086	18.66	pCi/g
Tritium	LS	21-1190	152.7	nCi/l
Antimony	6010	21-1224	23.7	ppm
Arsenic	ETVAA	21-1055	9.9	ppm
Beryllium	6010	21-1017	2.5	ppm
Copper	6010	21-1006	57.4	ppm
Molybdenum	6010	21-1224	5.9	ppm
Silver	FAA	21-1030	10.8	ppm

Table F-3. Indications of Releases at the Filter Buildings by Two Statistical Tests

	SWMU 21-020(a)		SWMU 21-020(b)	
	Local bkgd	Nbrs	Local bkgd	Nbrs
Pu238	Y			
Pu239/240				
Am241	Y		Y	Y
Tritium	Y		Y	Y
Uranium				
Sr90		Y		Y
Arsenic				
Barium	Y			
Beryllium	Y	Y	Y	
Cadmium				
Chromium				
Cobalt	Y		Y	
Copper				
Lead				
Lithium	Y	Y	Y	
Manganese				
Nickel	Y			
Strontium	Y		Y	
Vanadium	Y			
Zinc				

Table F.4. Binomial Tests

N	n	q	Pq	#PRSs
3	2	0.9	0.028	
4	3	0.9	0.004	2
5	3	0.9	0.009	2
6	3	0.9	0.016	9
7	3	0.9	0.026	
8	3	0.95	0.006	2
9	3	0.95	0.008	3
10	3	0.95	0.012	
11	3	0.95	0.015	
12	3	0.95	0.02	1
13	3	0.95	0.025	
14	3	0.95	0.03	1
15	3	0.95	0.036	1
16	3	0.95	0.043	
17	4	0.95	0.009	
18	4	0.95	0.011	2
19	4	0.95	0.013	
20	4	0.95	0.016	1
21	4	0.95	0.019	

GRAPHICAL DISPLAYS AND STATISTICAL ASSESSMENT FOR FILTER BUILDINGS DATA

DNA denotes the analytical technique (Delayed Neutron Counting).

ETVAA/xxxx denotes the analytical technique (Electo Thermal Vapor Atomic Absorption) and the analytical procedure number.

ICPES/xxxx denotes the analytical technique (Inductively Coupled Plasma Emission Spectrometry) and the analytical procedure number.

ICPMS/xxxx denotes the analytical technique (Inductively Coupled Plasma Mass Spectrometry) and the analytical procedure number.

KPA denotes the analytical technique.

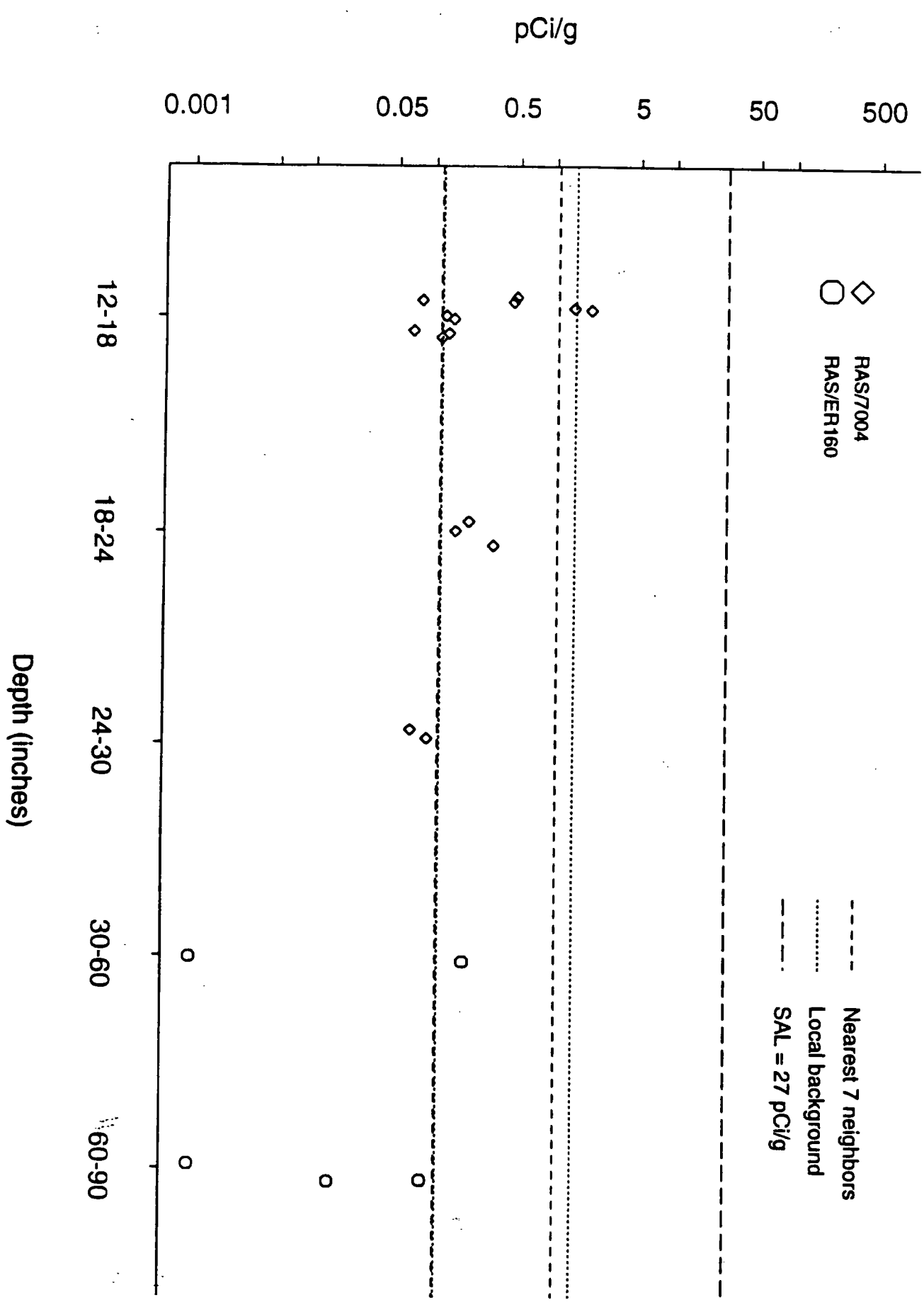
LS denotes the analytical technique (Liquid Scintillation).

RAS/xxxx denotes the analytical technique (Radiochemistry Alpha Spectrometry) and the analytical procedure number.

P<0.02 denotes the significance level of the statistical test for trend with depth (from the Wilcoxon test as referenced in the text).

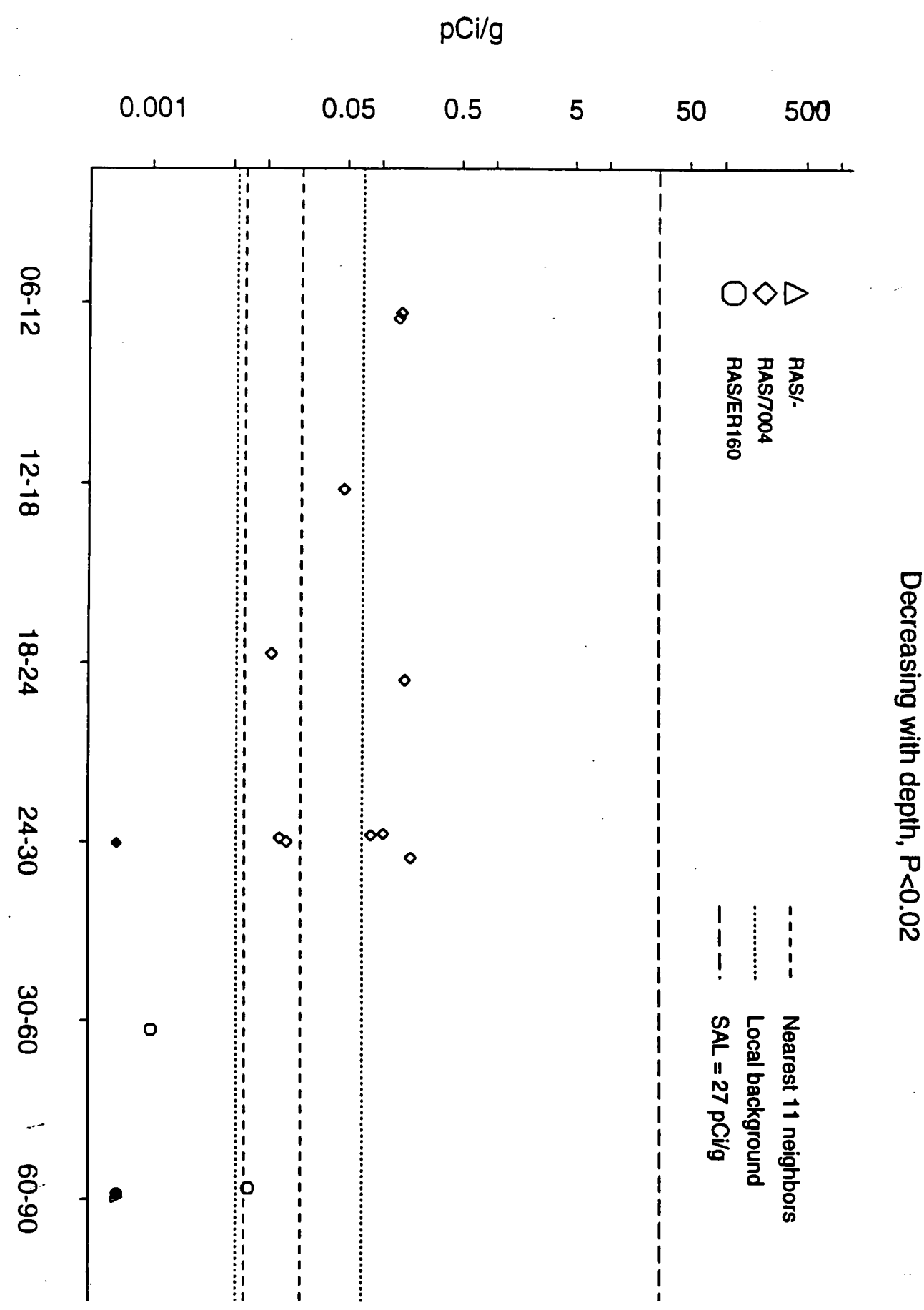
Filter Building 20a denotes SWMU 21-020(a).

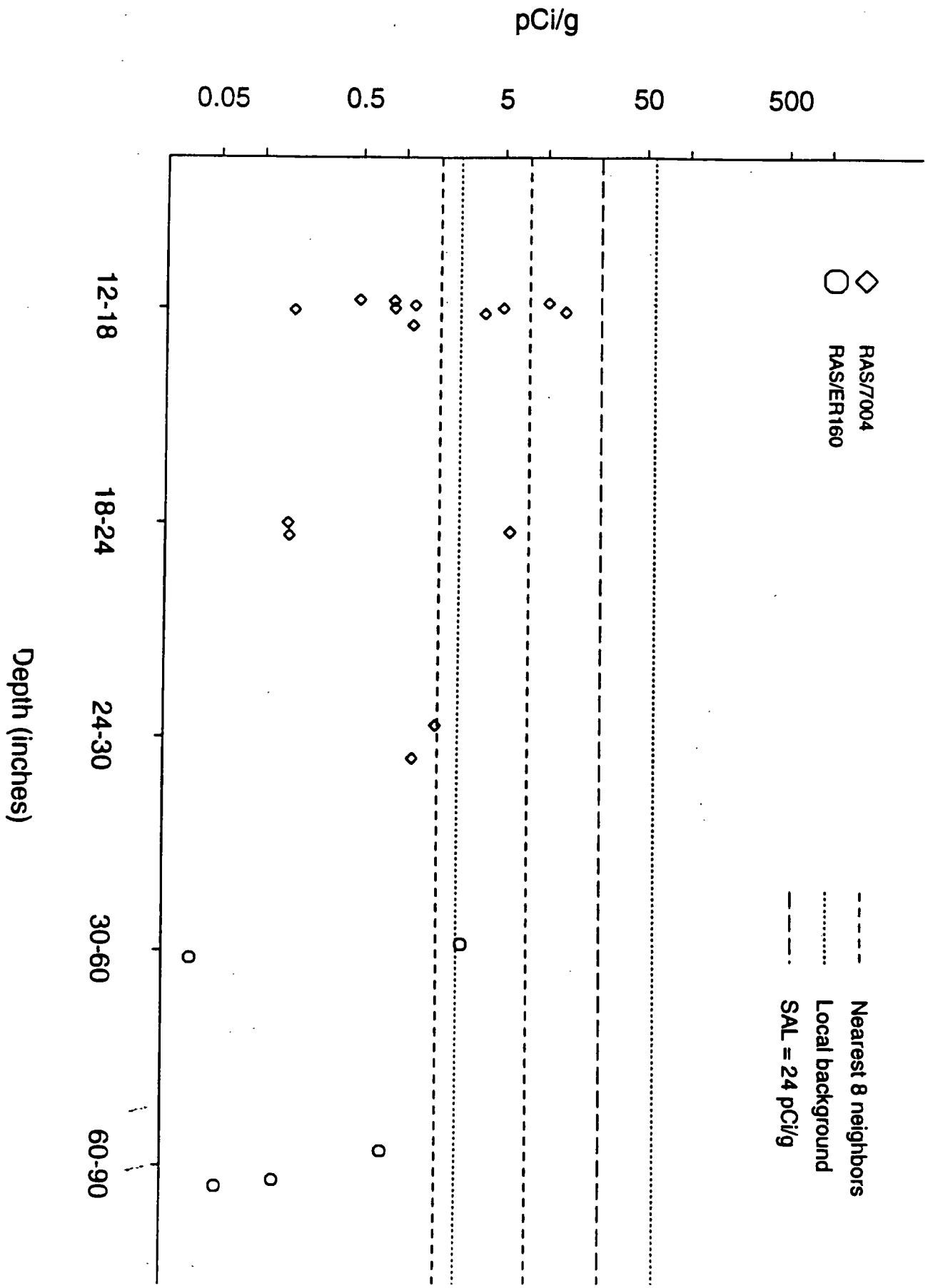
Filter Building 20b denotes SWMU 21-020(b).

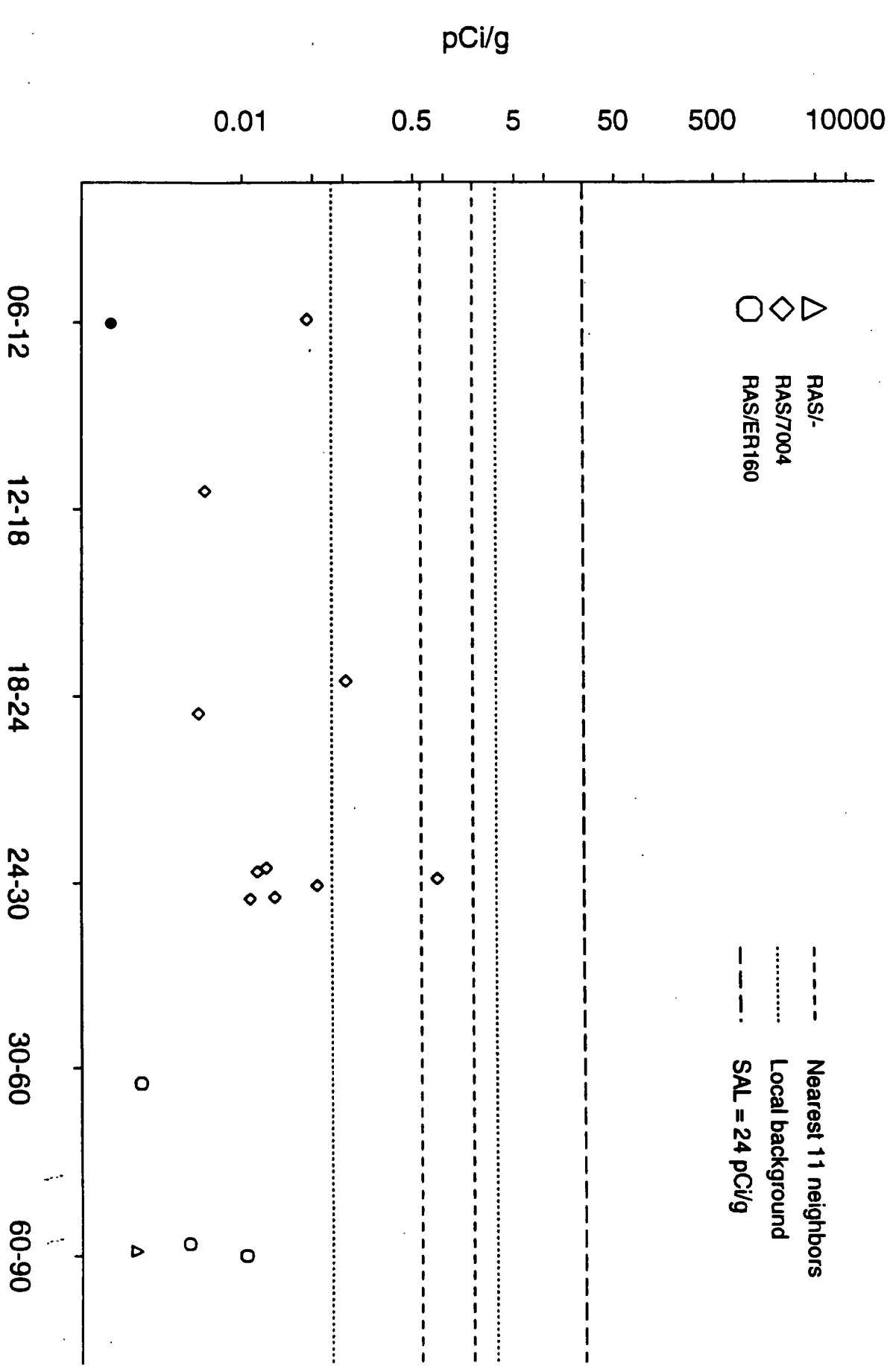


Pu238 in samples from filter building 20a

Decreasing with depth, P<0.02

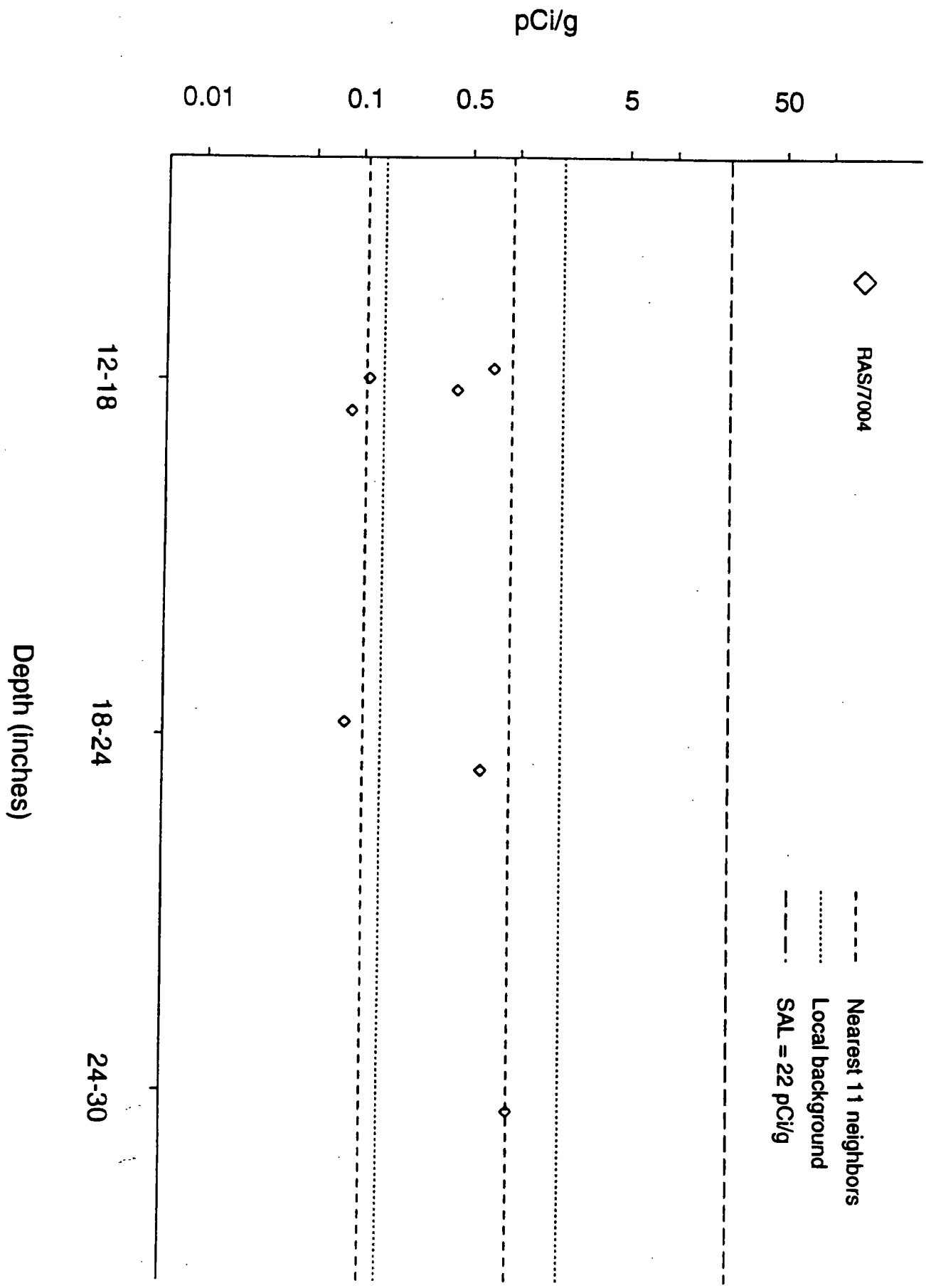

Pu238 in samples from filter building 20b
Decreasing with depth, P<0.02
pCi/g
0.001
0.05
0.5
5
50
500
Depth (inches)
06-12
12-18
18-24
24-30
30-60
60-90
RAS/-
RAS/7004
RAS/ER160
Nearest 11 neighbors
Local background
SAL = 27 pCi/g


Pu239 in samples from filter building 20a
Decreasing with depth, P<0.03
pCi/g
0.05
0.5
5
50
500
RAS/7004
RAS/ER160
Nearest 8 neighbors
Local background
SAL = 24 pCi/g
12-18
18-24
24-30
30-60
60-90
Depth (inches)

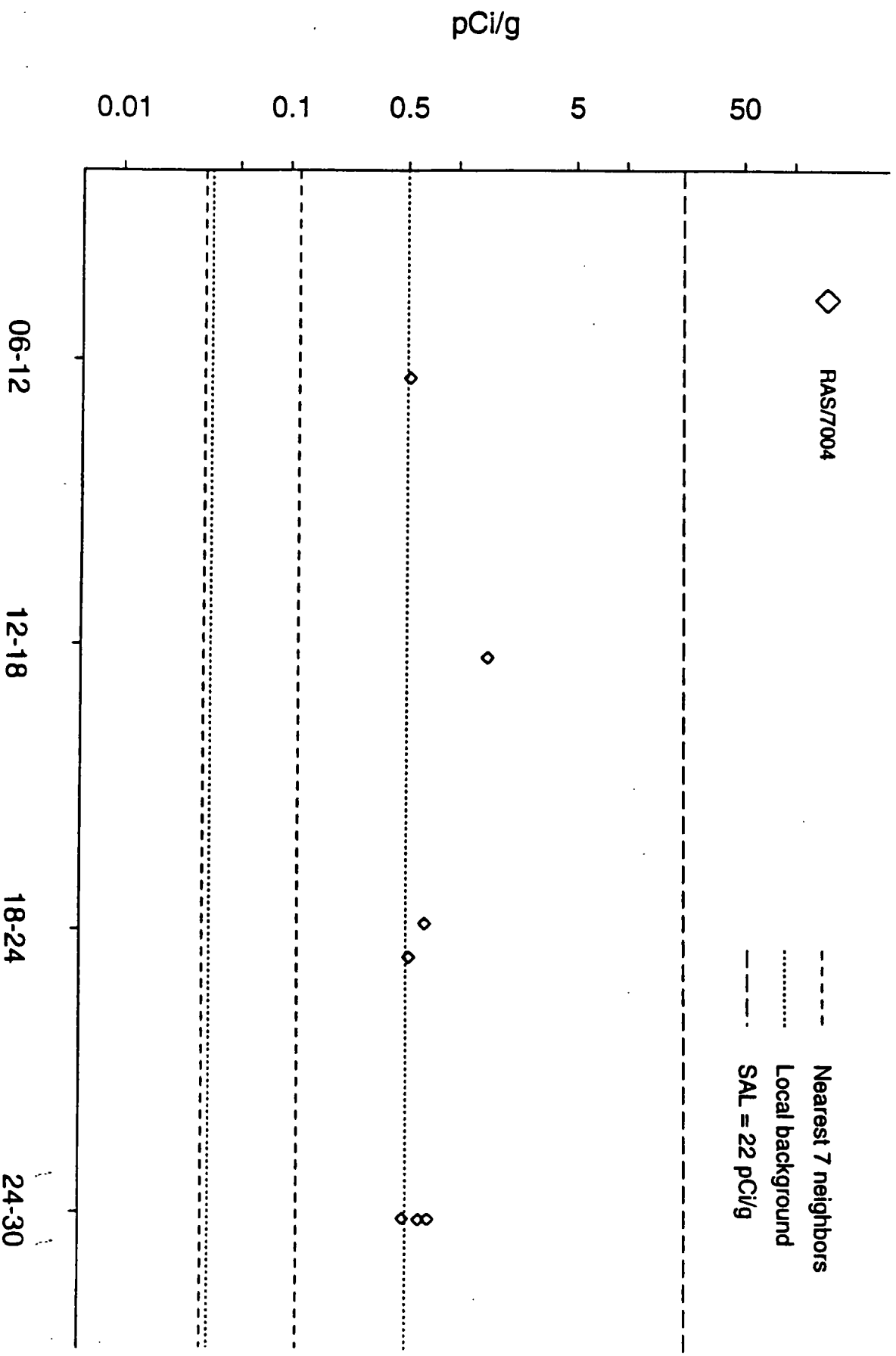


Pu239 in samples from filter building 20b

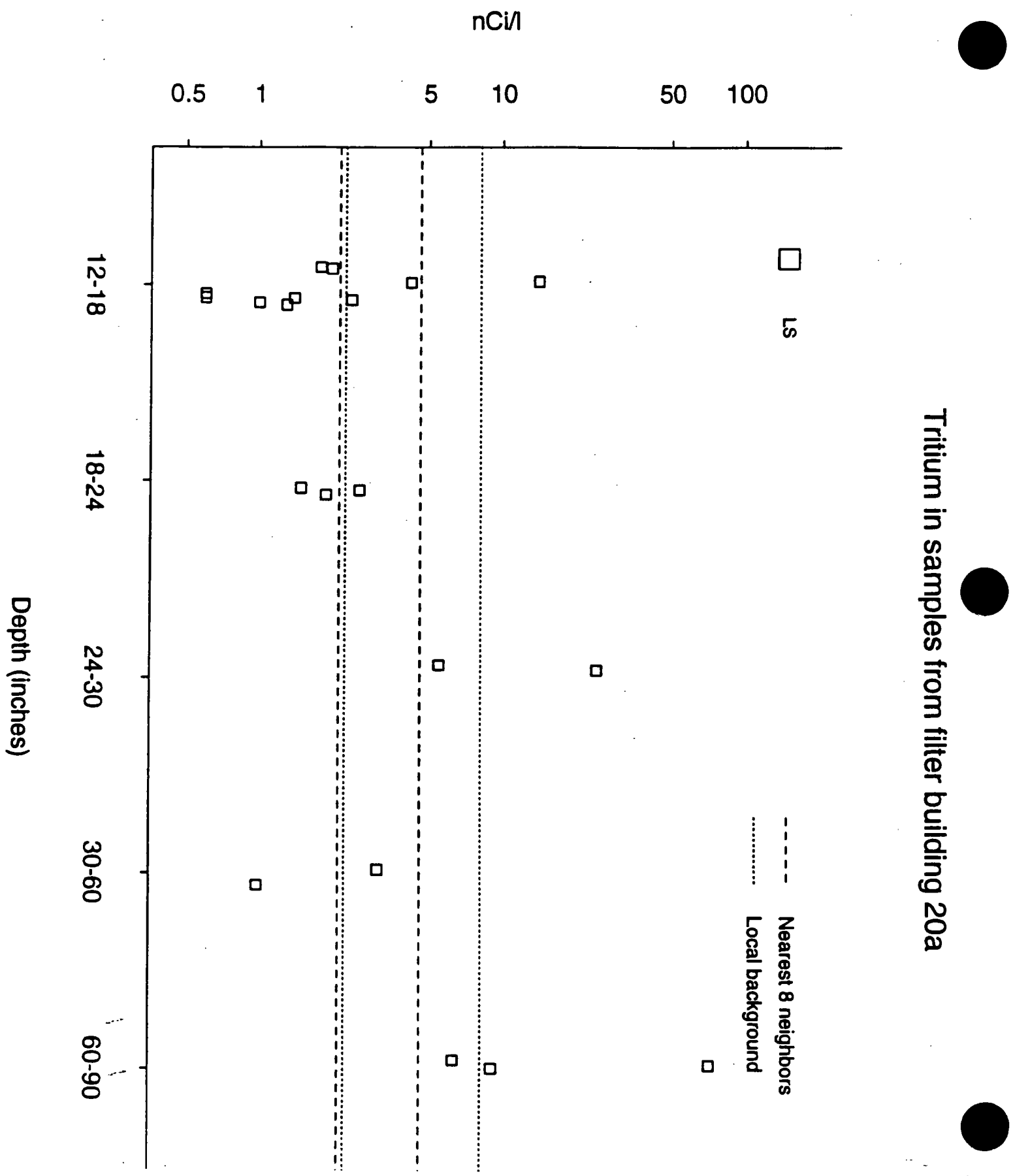
Decreasing with depth, P<0.01

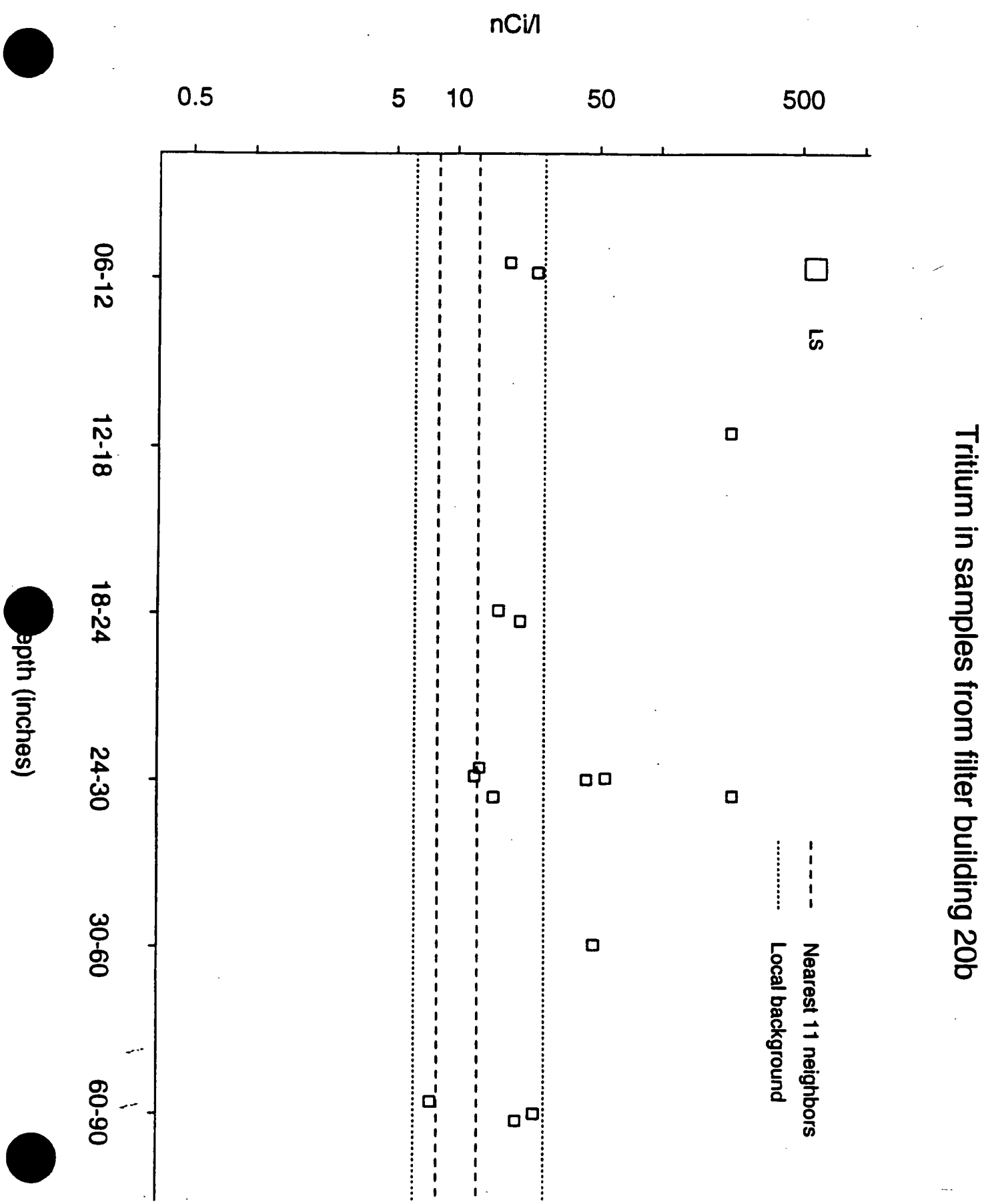


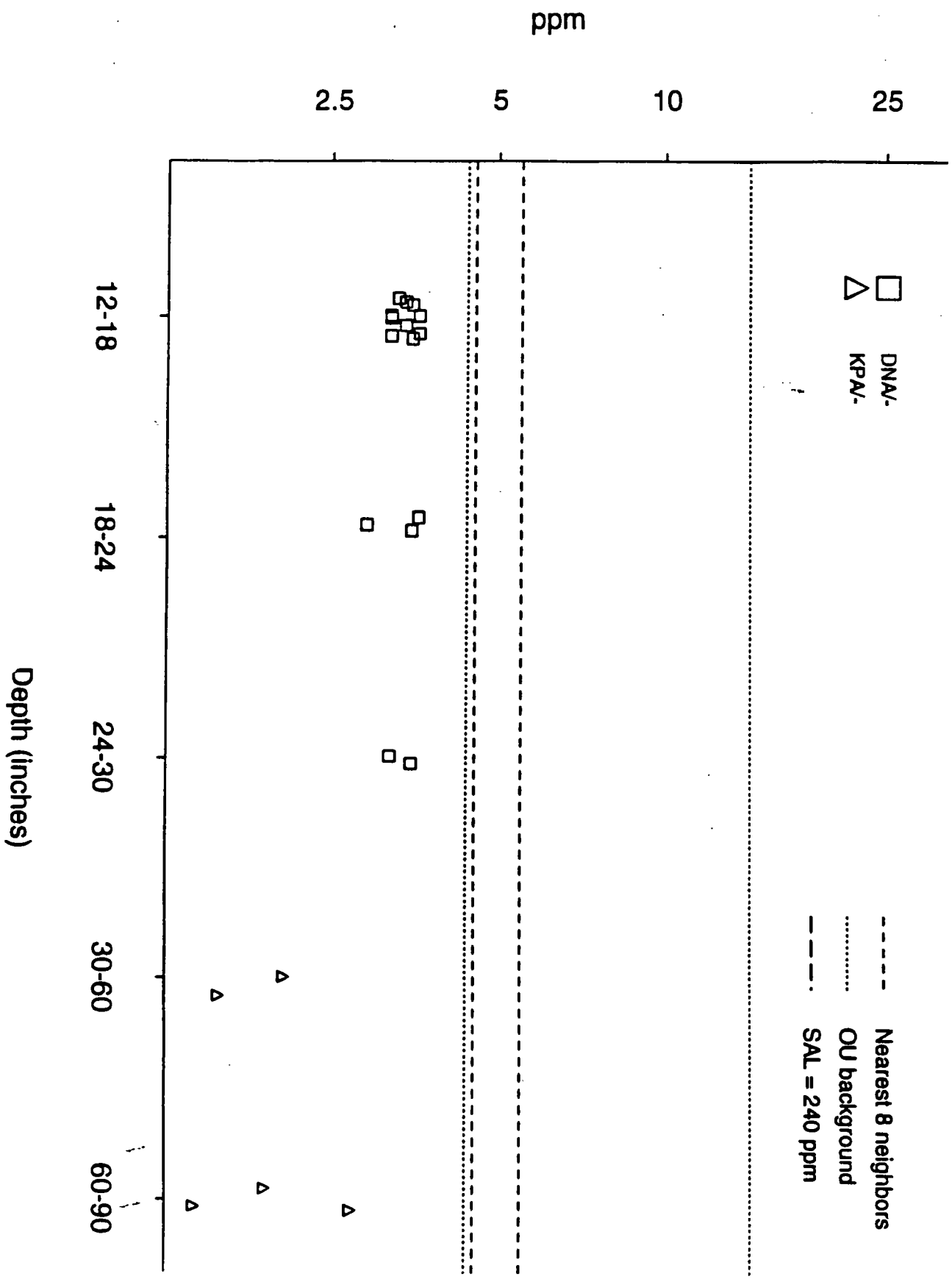
Am241 in samples from filter building 20a

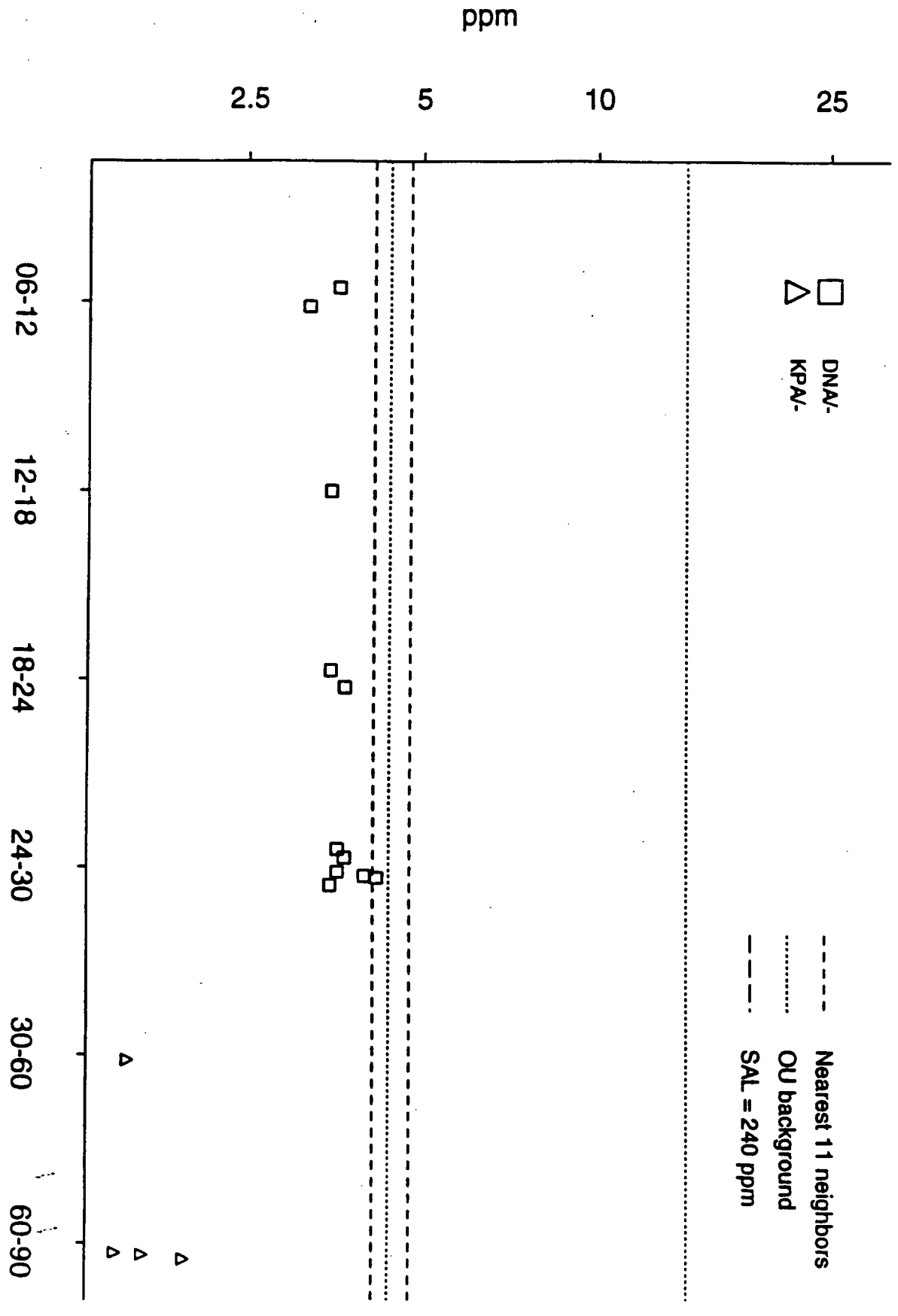


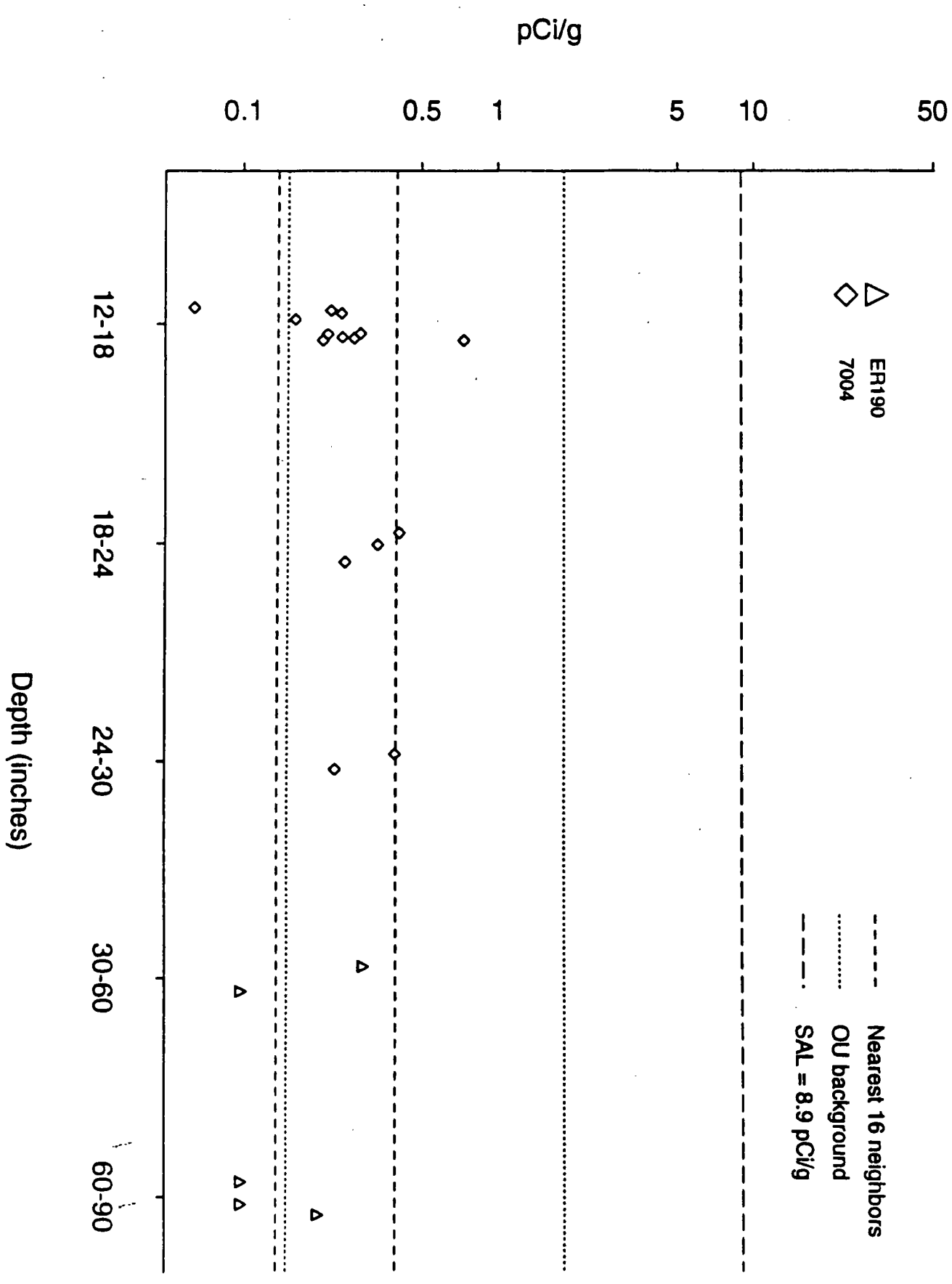
Am241 in samples from filter building 20b

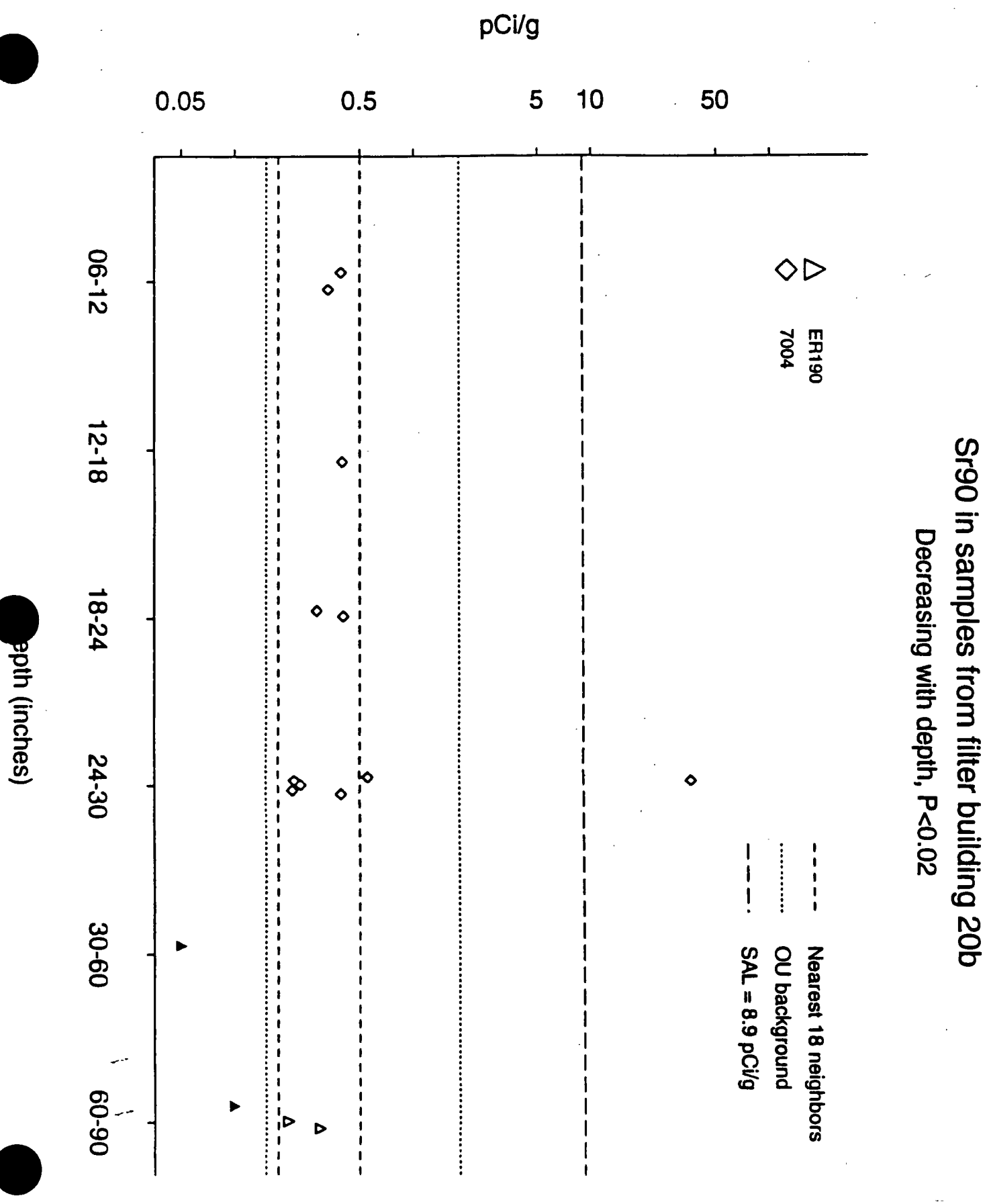

nCi/l
0.5
1
5
10
50
100
12-18
18-24
24-30
30-60
60-90
Depth (inches)
LS
Nearest 8 neighbors
Local background
Tritium in samples from filter building 20a


nCi/l
0.5
5
10
50
500
06-12
12-18
18-24
24-30
30-60
60-90
Depth (inches)
LS
Nearest 11 neighbors
Local background
Tritium in samples from filter building 20b


Uranium in samples from filter building 20a
Decreasing with depth, P<0.01
ppm
2.5
5
10
25
DNAV-
KPAV-
Nearest 8 neighbors
OU background
SAL = 240 ppm
12-18
18-24
24-30
30-60
60-90
Depth (inches)

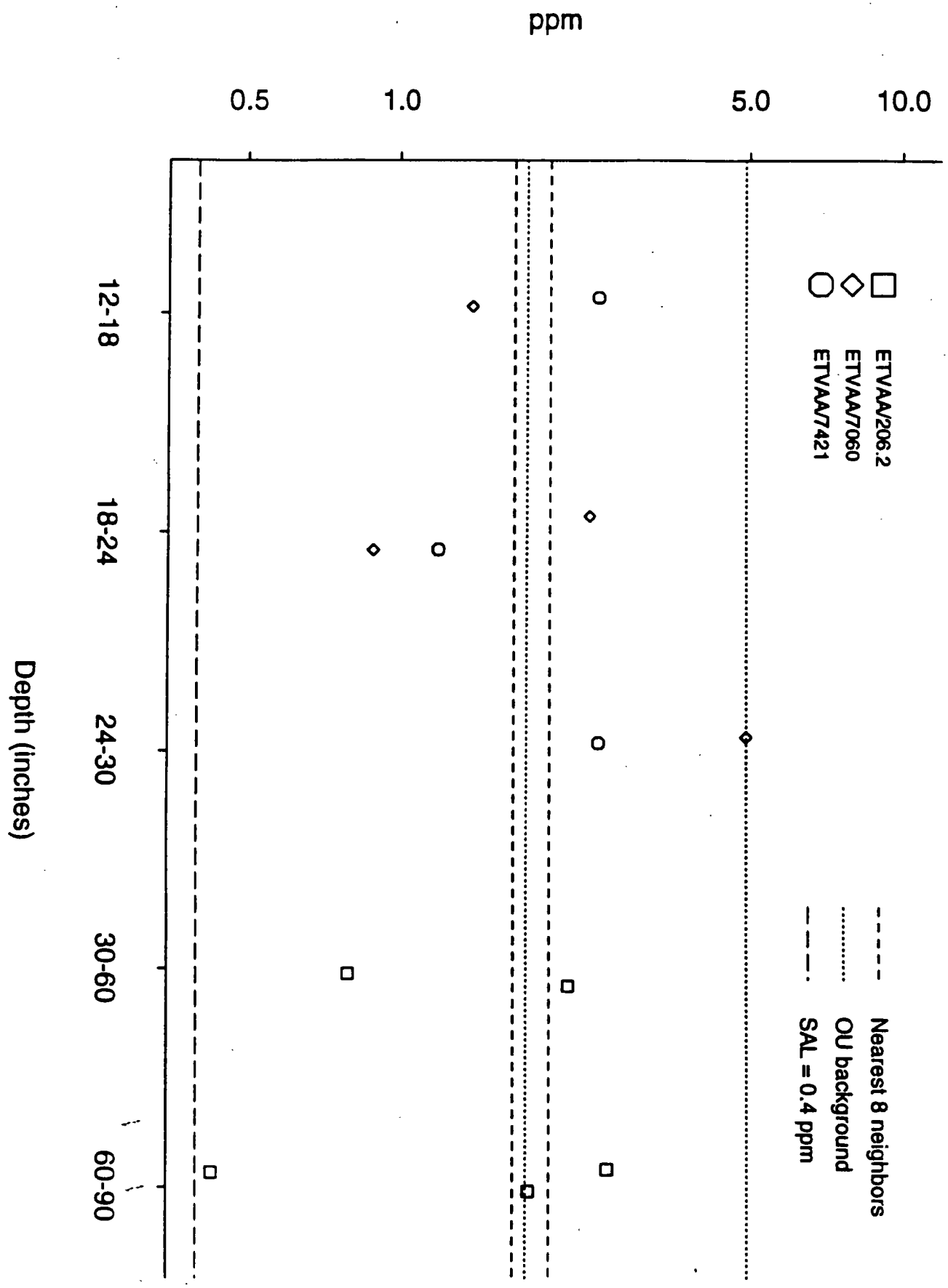

Uranium in samples from filter building 20b
Decreasing with depth, P<0.01
ppm
2.5
5
10
25
06-12
12-18
18-24
24-30
30-60
60-90
epth (inches)
DNAV-
KPAV-
Nearest 11 neighbors
OU background
SAL = 240 ppm

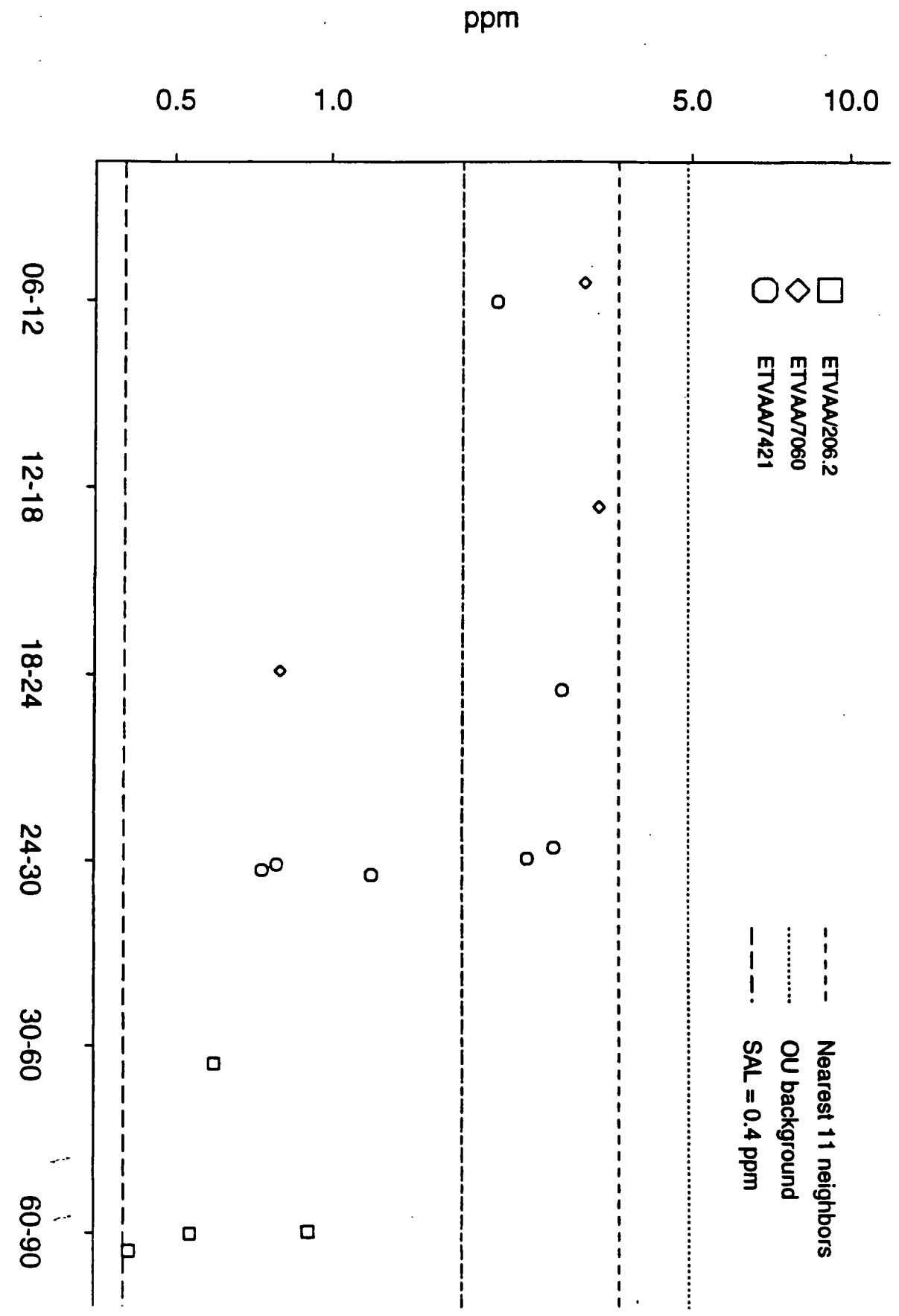

Sr90 in samples from filter building 20a
Decreasing with depth, P<0.04
pCi/g
0.1
0.5
1
5
10
50
12-18
18-24
24-30
30-60
60-90
Depth (inches)
ER190
7004
Nearest 16 neighbors
OU background
SAL = 8.9 pCi/g

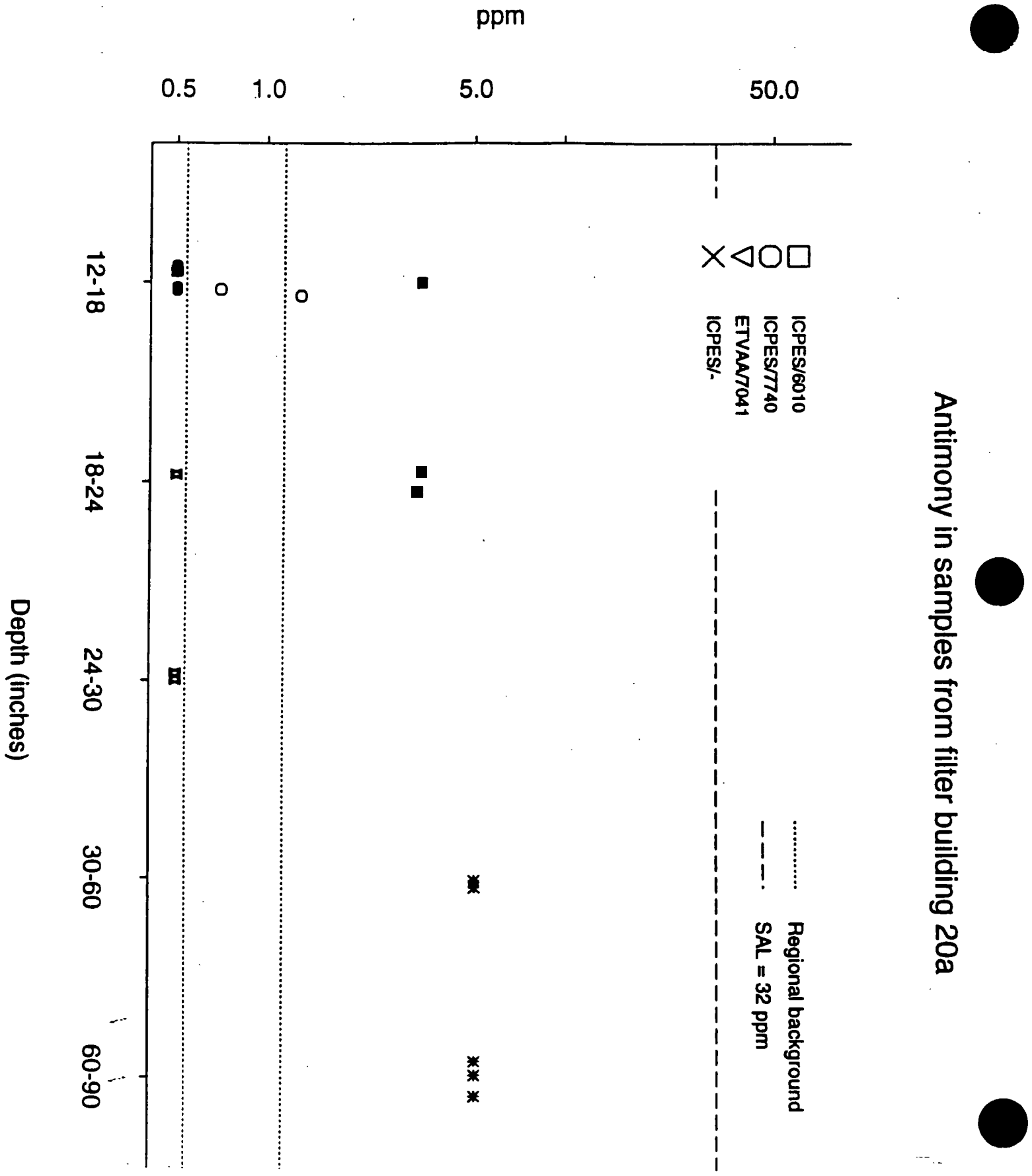


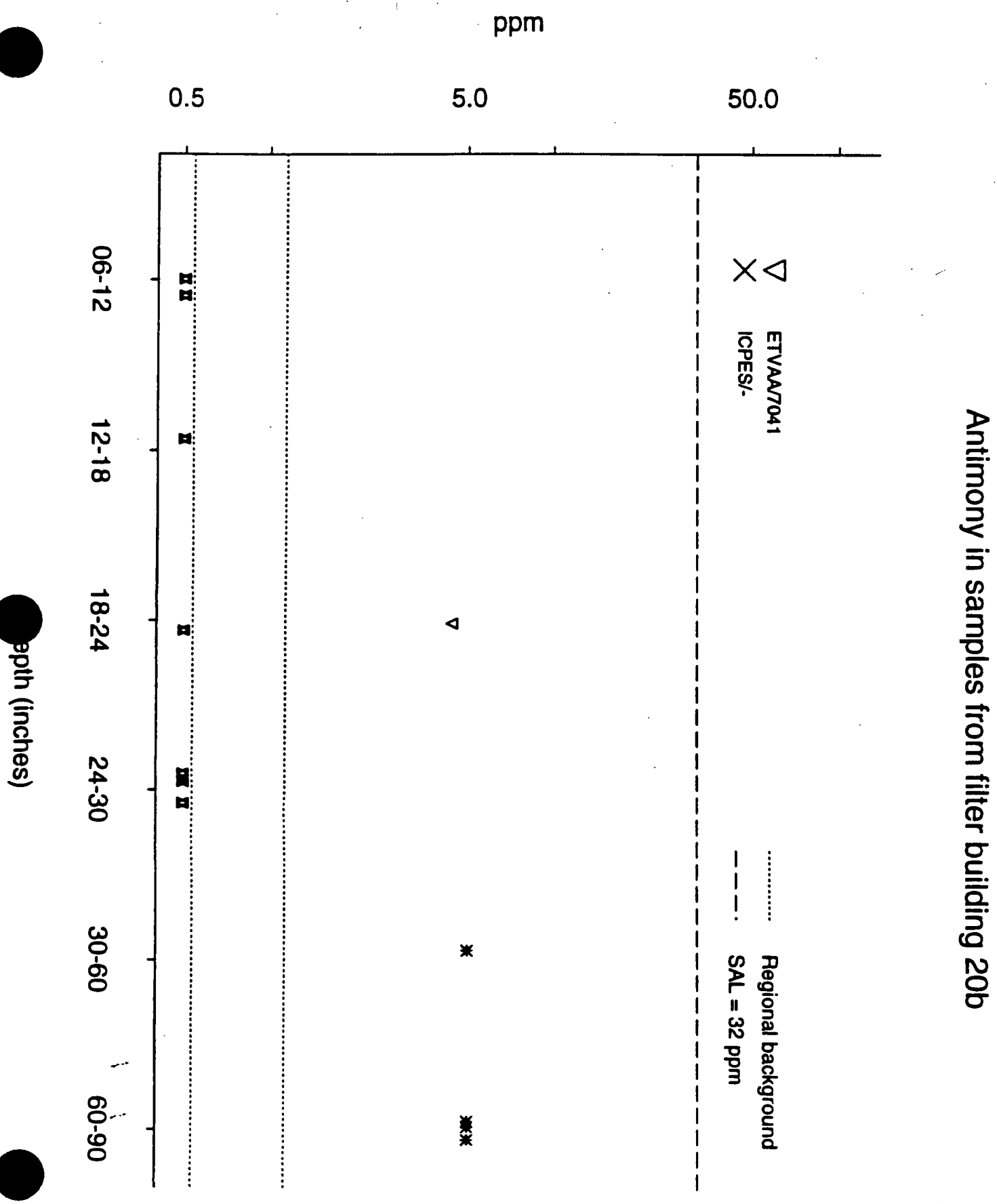
Sr90 in samples from filter building 20b

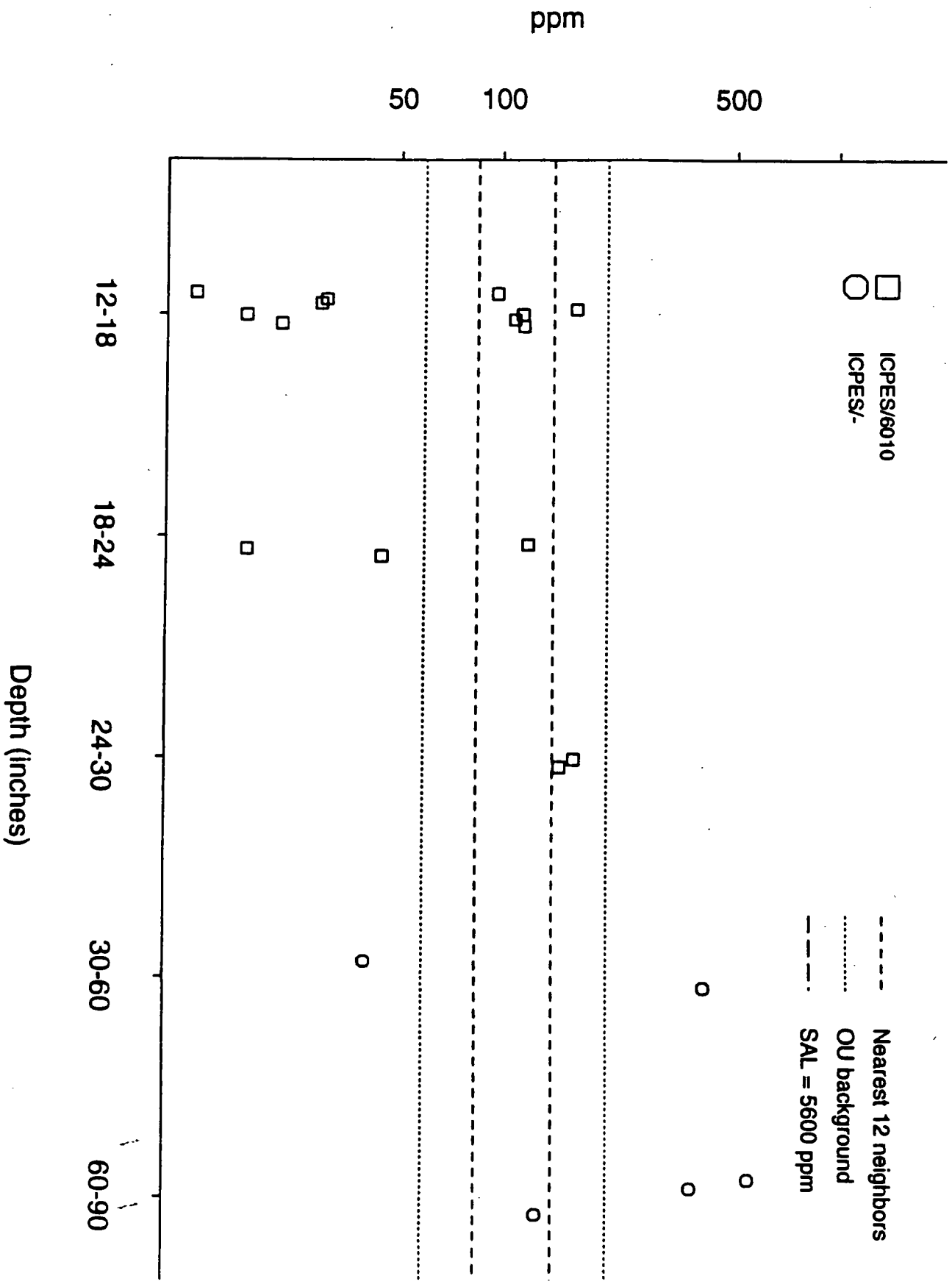
Decreasing with depth, P<0.02

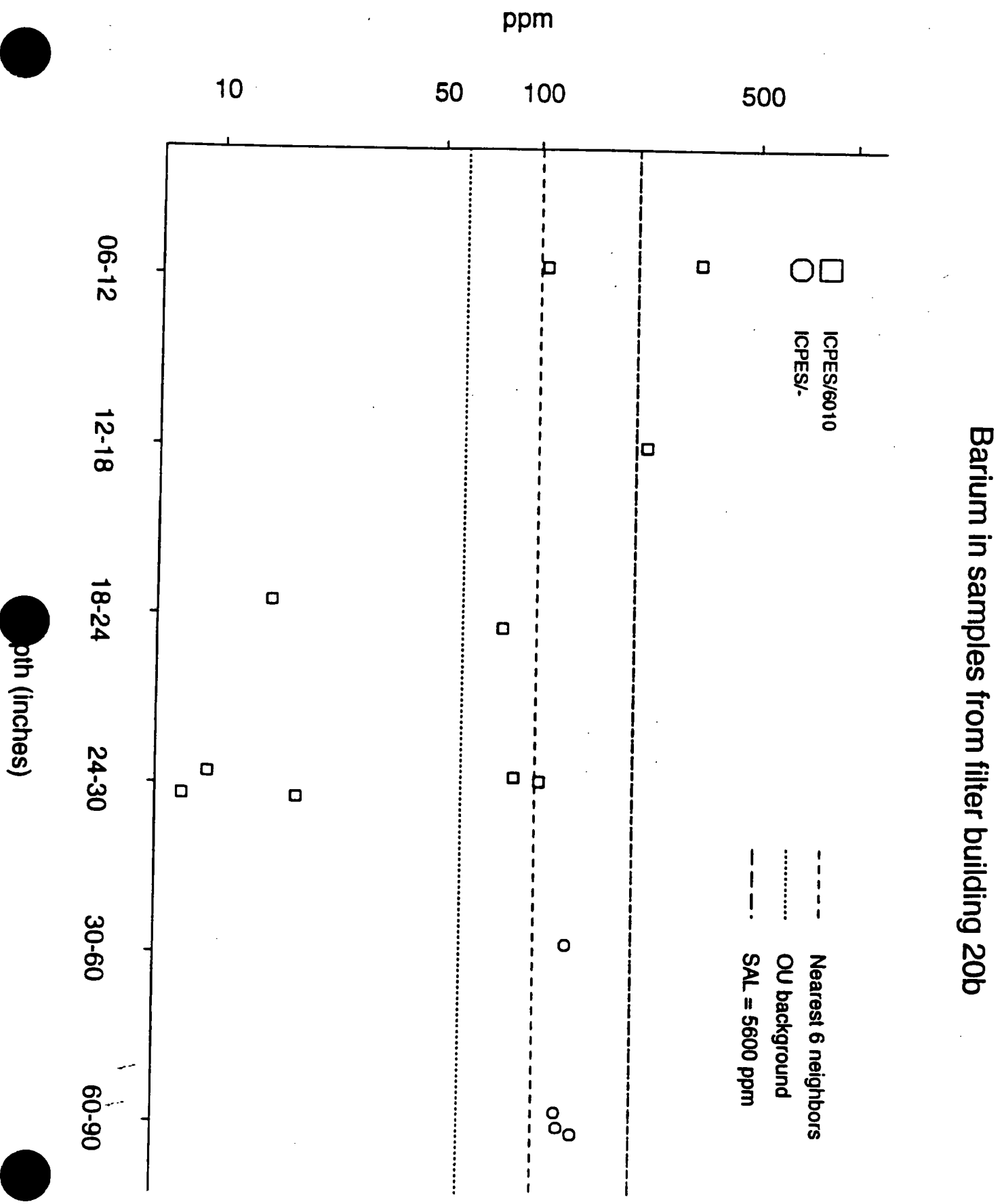

Arsenic in samples from filter building 20a
Decrease with depth not significant
ppm
0.5
1.0
5.0
10.0
ETVAA/206.2
ETVAA/7060
ETVAA/7421
Nearest 8 neighbors
OU background
SAL = 0.4 ppm
12-18
18-24
24-30
30-60
60-90
Depth (inches)


Arsenic in samples from filter building 20b
Decreasing with depth, P<0.02
ppm
0.5
1.0
5.0
10.0
ETVAA/206.2
ETVAA/7060
ETVAA/7421
Nearest 11 neighbors
OU background
SAL = 0.4 ppm
06-12
12-18
18-24
24-30
30-60
60-90
epth (inches)

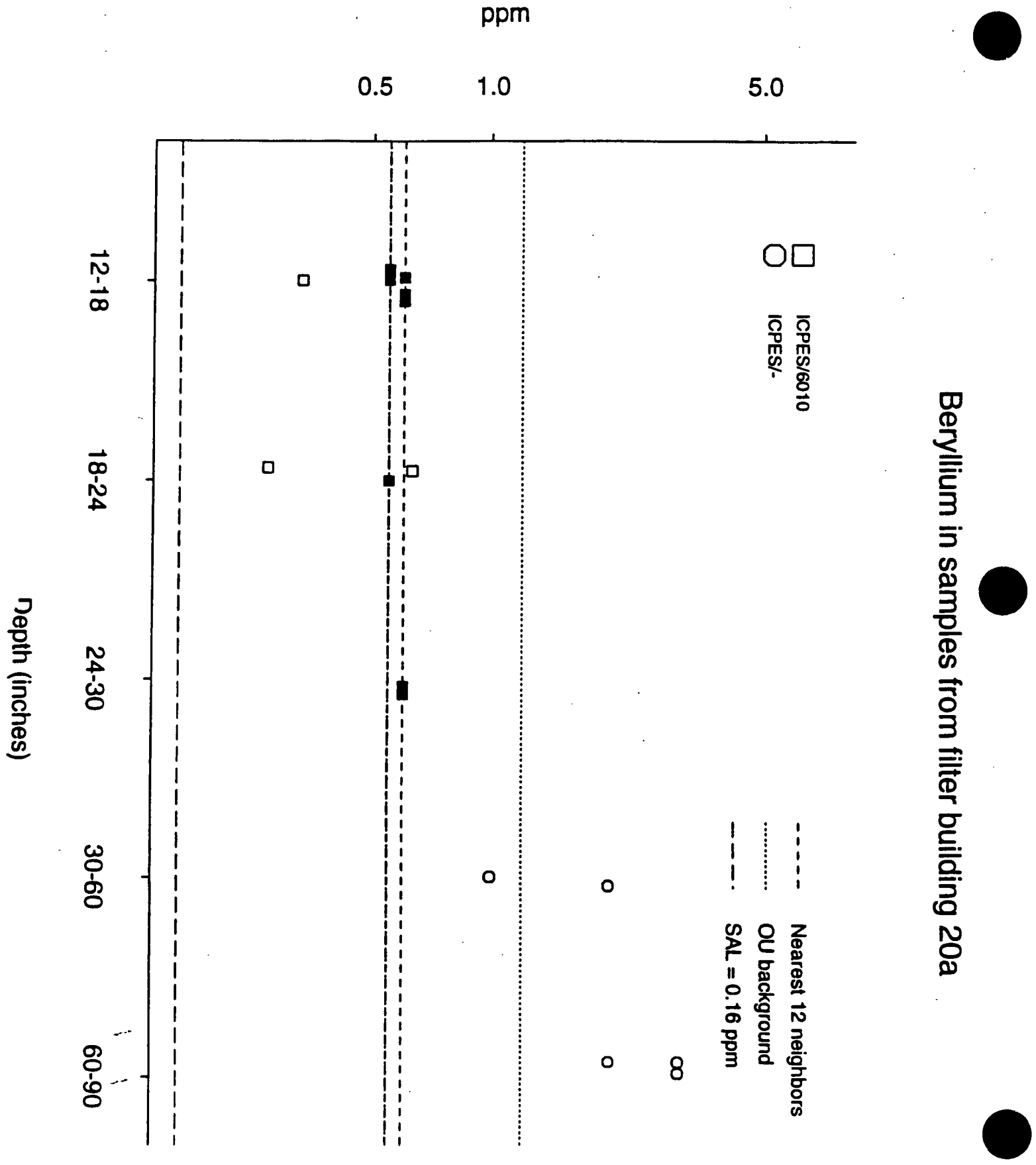

Antimony in samples from filter building 20a
ppm
0.5
1.0
5.0
50.0
Depth (inches)
12-18
18-24
24-30
30-60
60-90
ICPES/6010
ICPES/7740
ETVAA/7041
ICPES/-
Regional background
SAL = 32 ppm

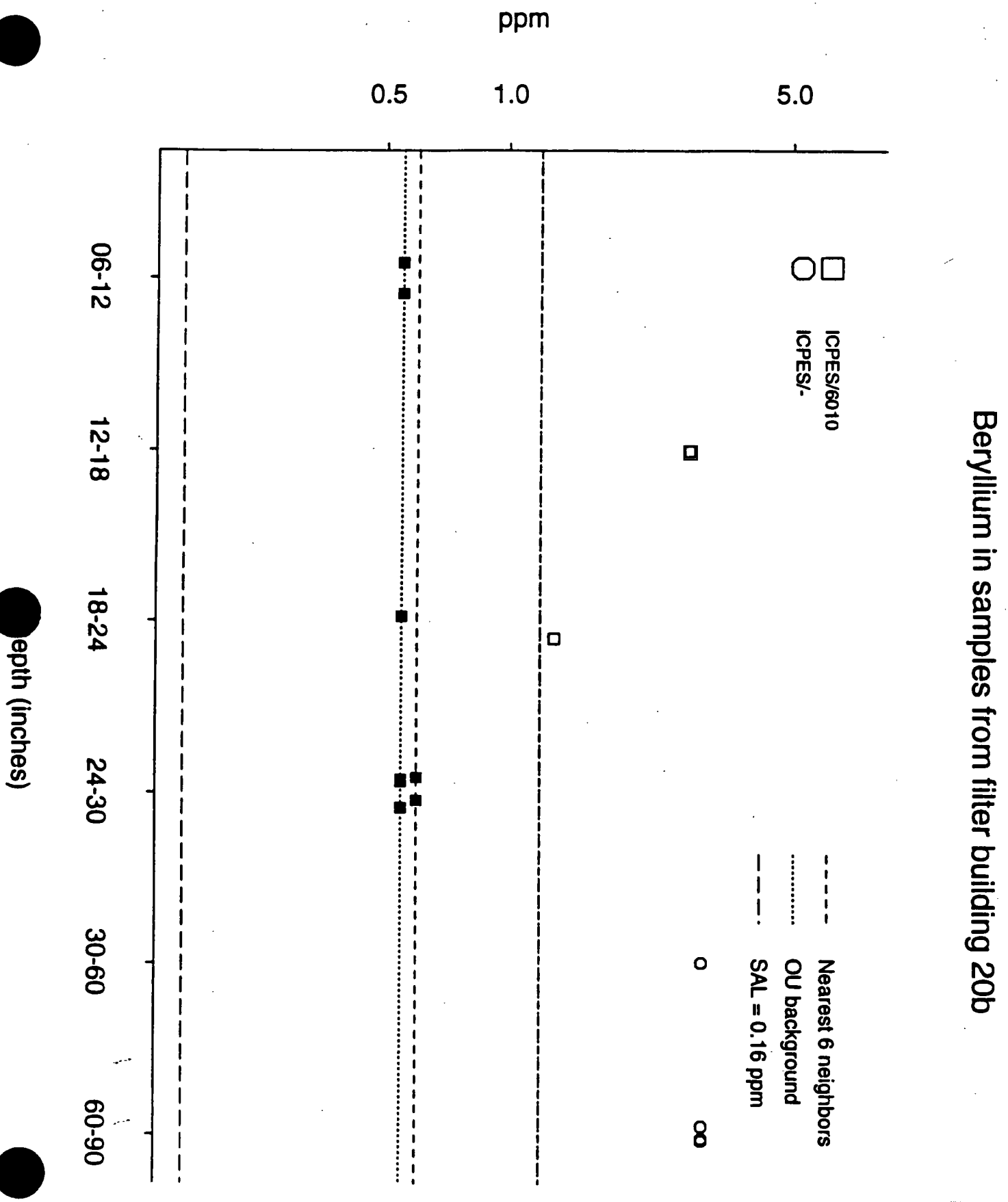

Antimony in samples from filter building 20b
ppm
0.5
5.0
50.0
ETVAA/7041
ICPES/-
Regional background
SAL = 32 ppm
06-12
12-18
18-24
24-30
30-60
60-90
epth (inches)

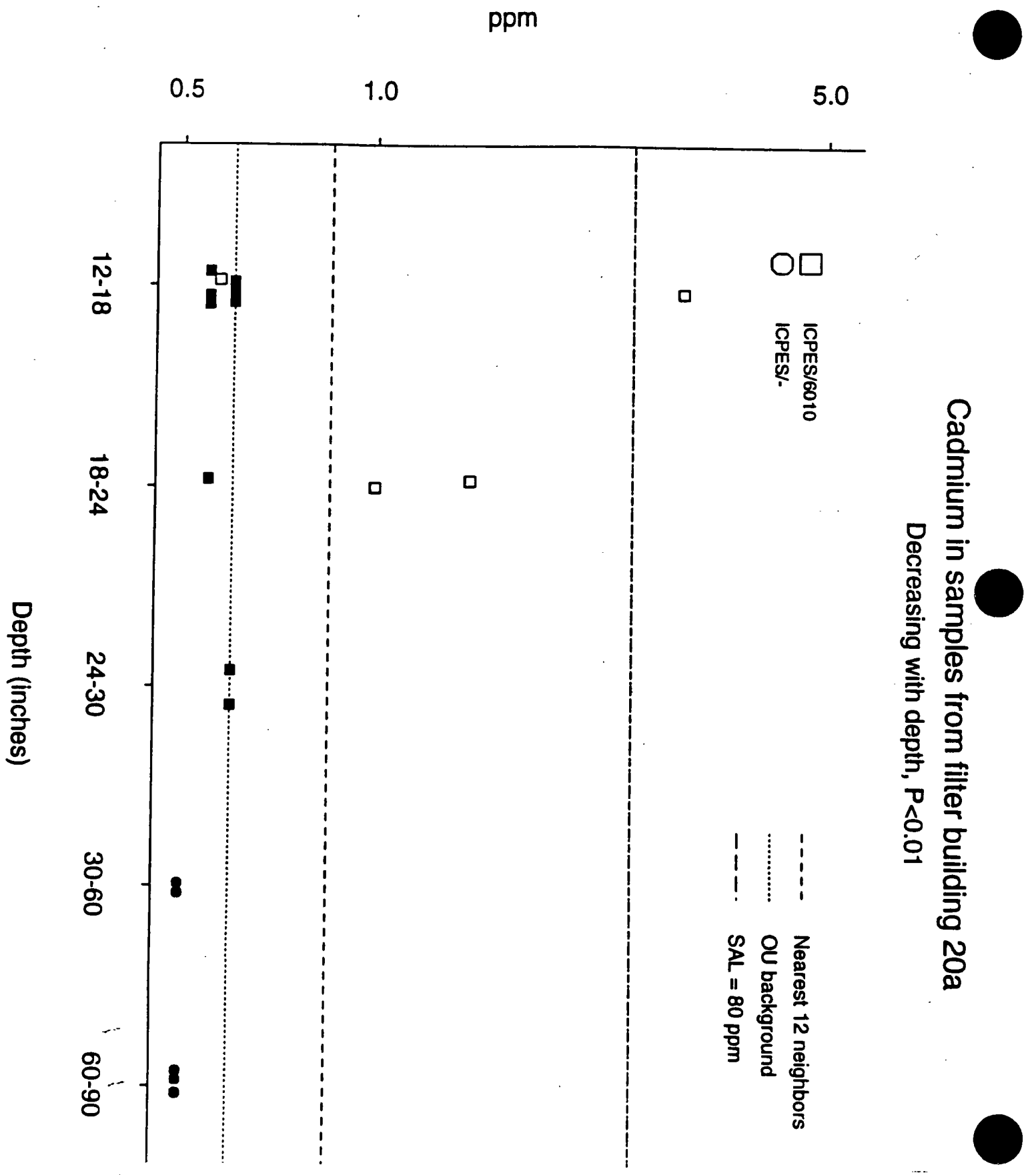

Barium in samples from filter building 20a
ppm
50
100
500
12-18
18-24
24-30
30-60
60-90
Depth (inches)
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 5600 ppm



Barium in samples from filter building 20b

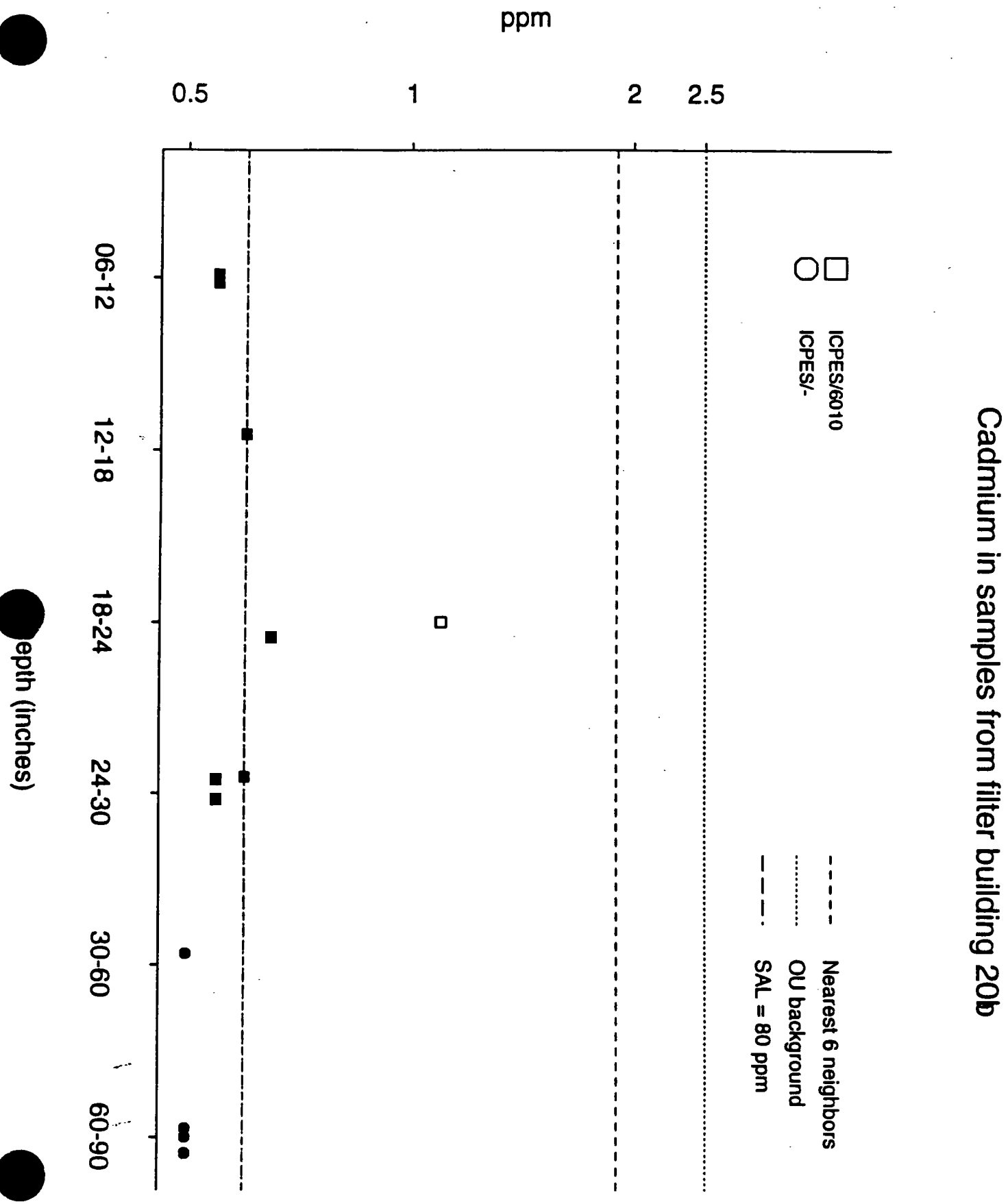

Beryllium in samples from filter building 20a
ppm
0.5
1.0
5.0
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 0.16 ppm
12-18
18-24
24-30
30-60
60-90
Depth (inches)


Beryllium in samples from filter building 20b
ppm
0.5
1.0
5.0
06-12
12-18
18-24
24-30
30-60
60-90
epth (inches)
ICPES/6010
ICPES/-
Nearest 6 neighbors
OU background
SAL = 0.16 ppm

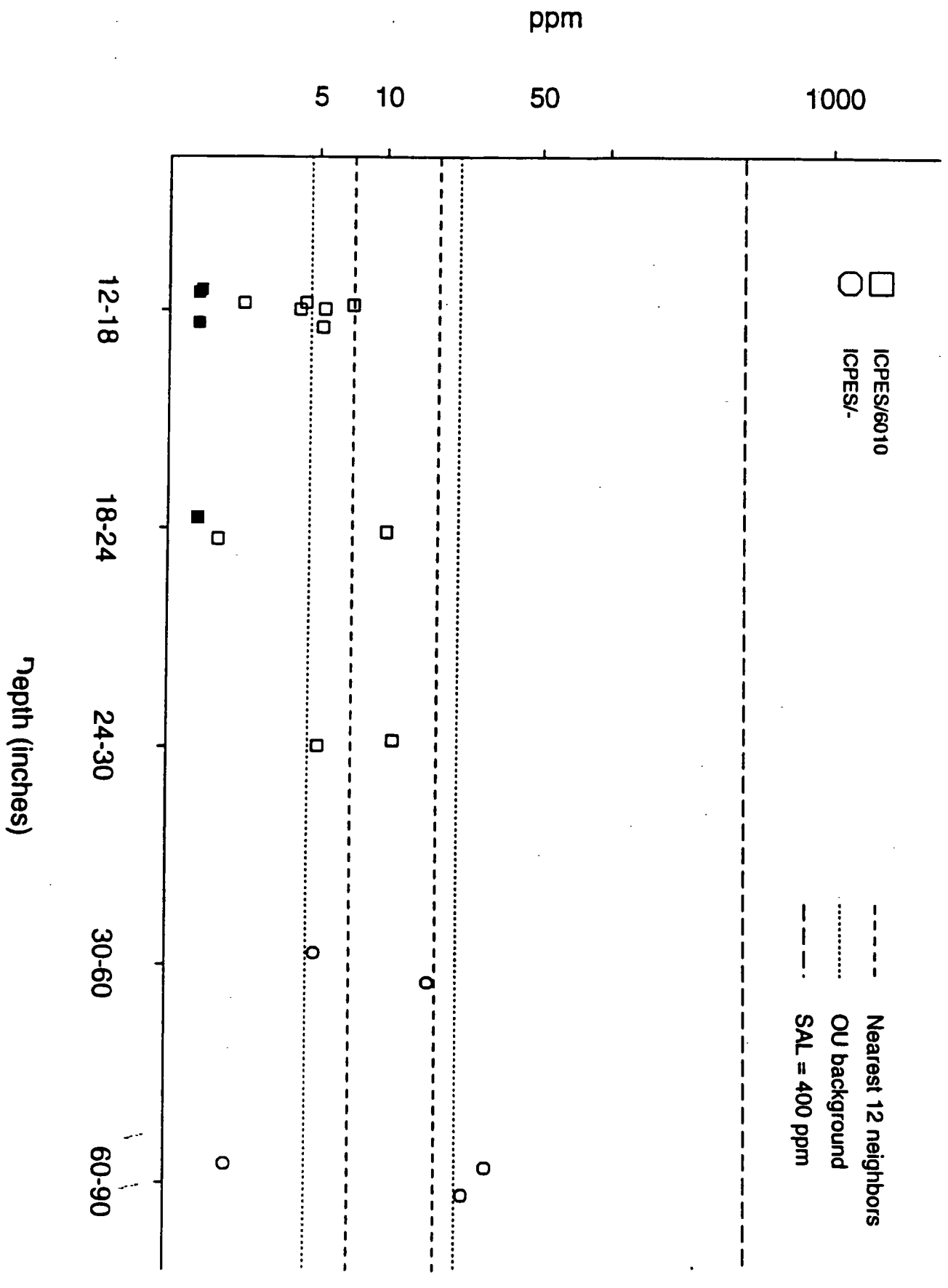


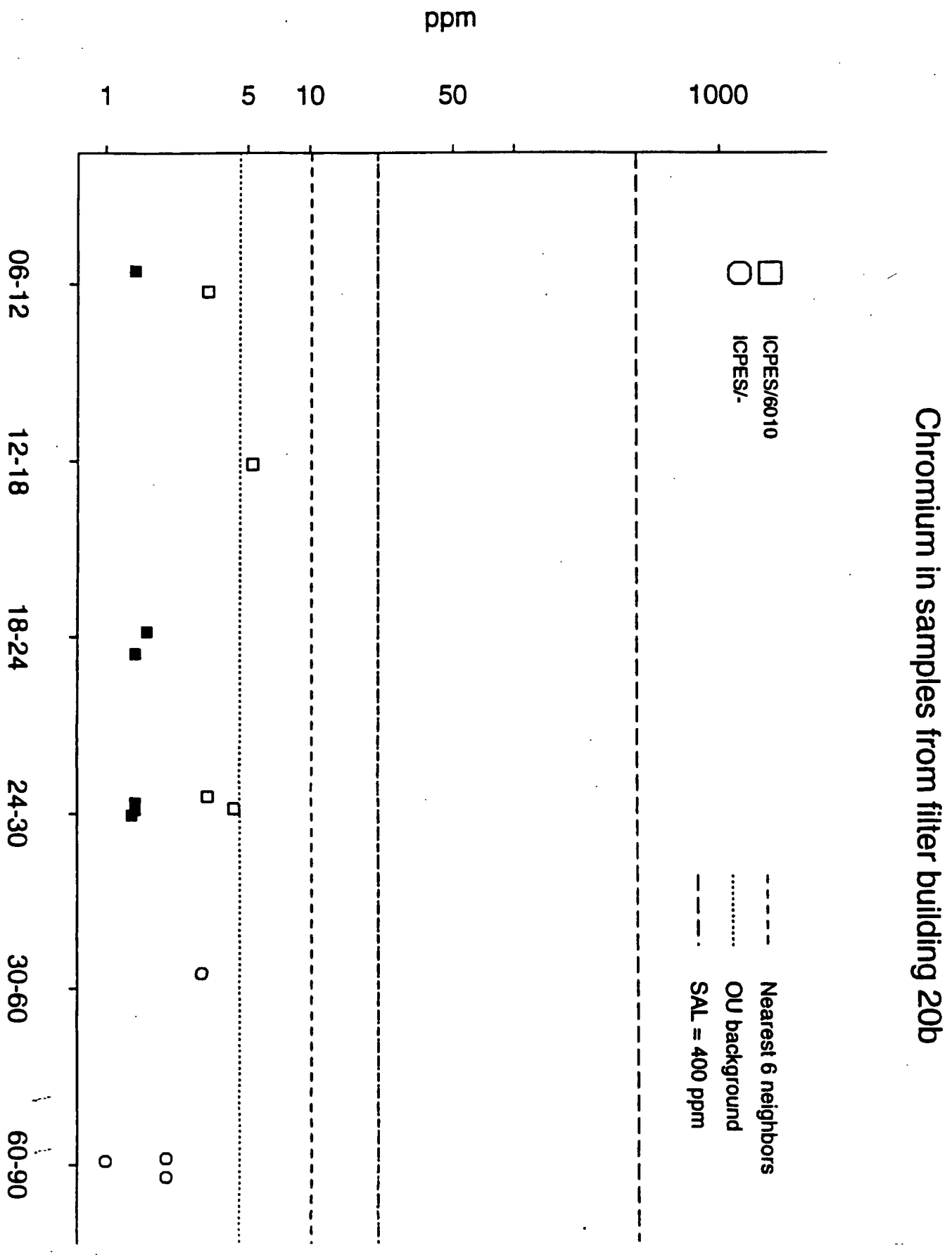
Cadmium in samples from filter building 20a

Decreasing with depth, P<0.01

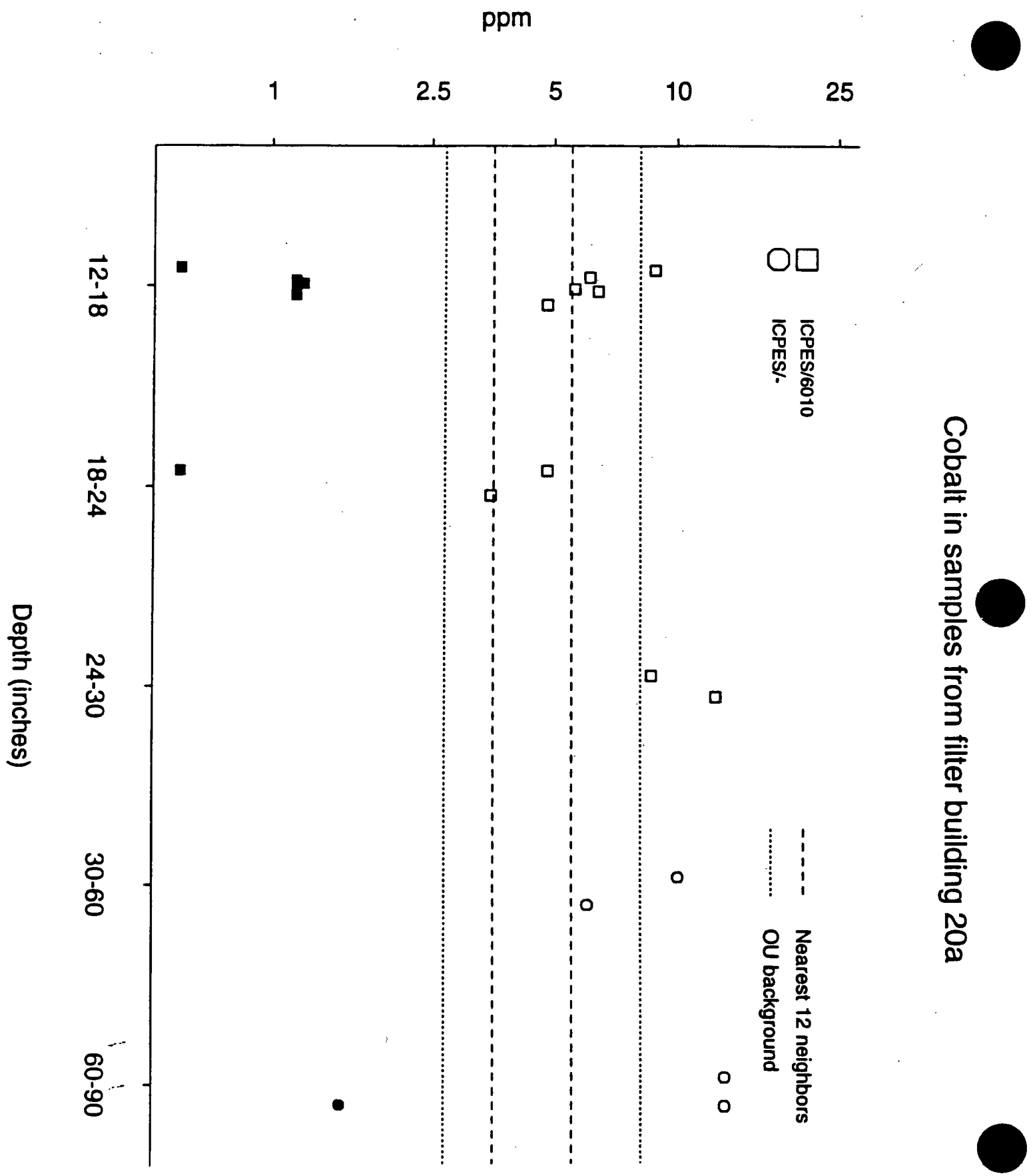


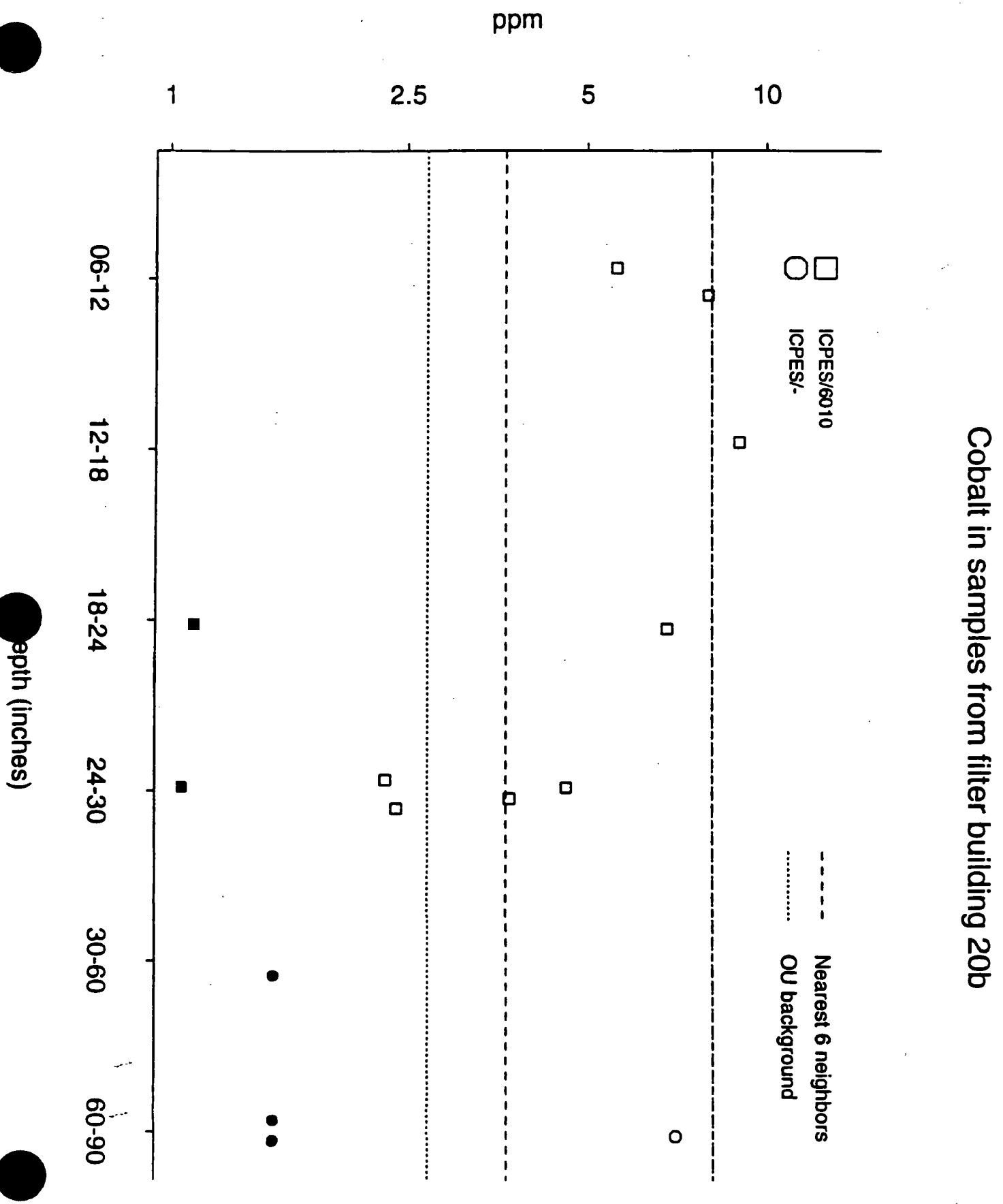
Cadmium in samples from filter building 20b

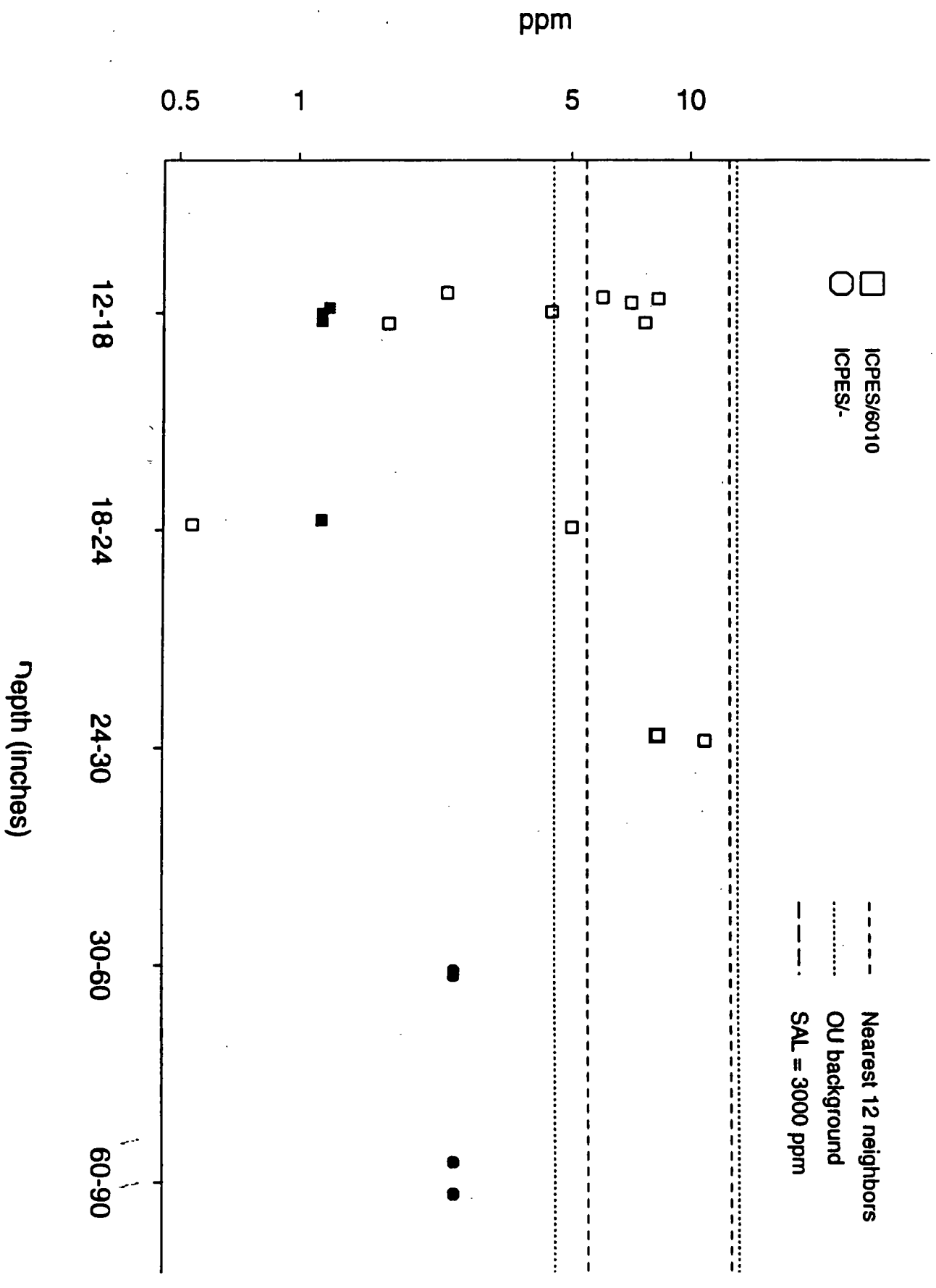

Chromium in samples from filter building 20a
ppm
5
10
50
1000
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 400 ppm
12-18
18-24
24-30
30-60
60-90
Depth (inches)

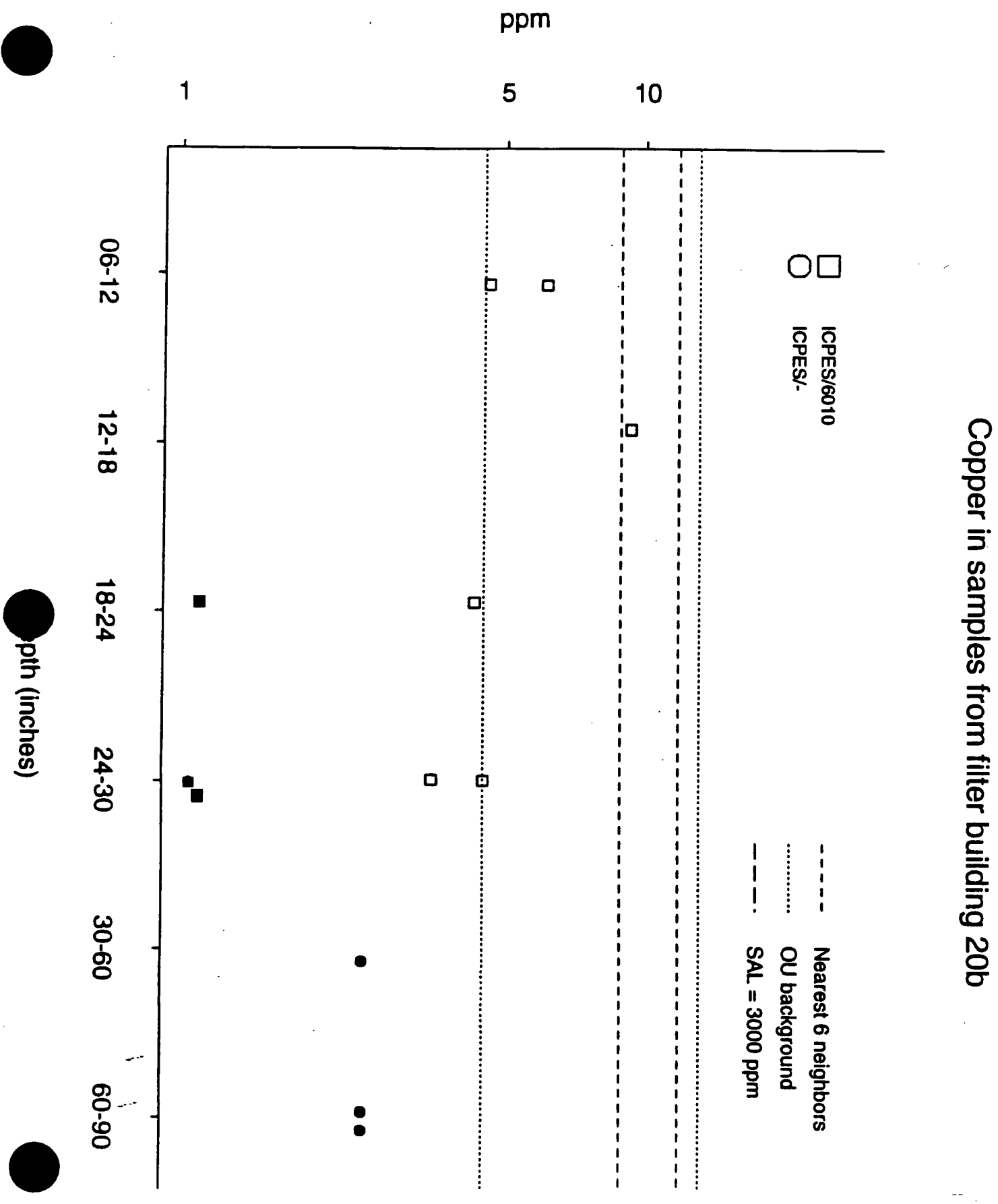


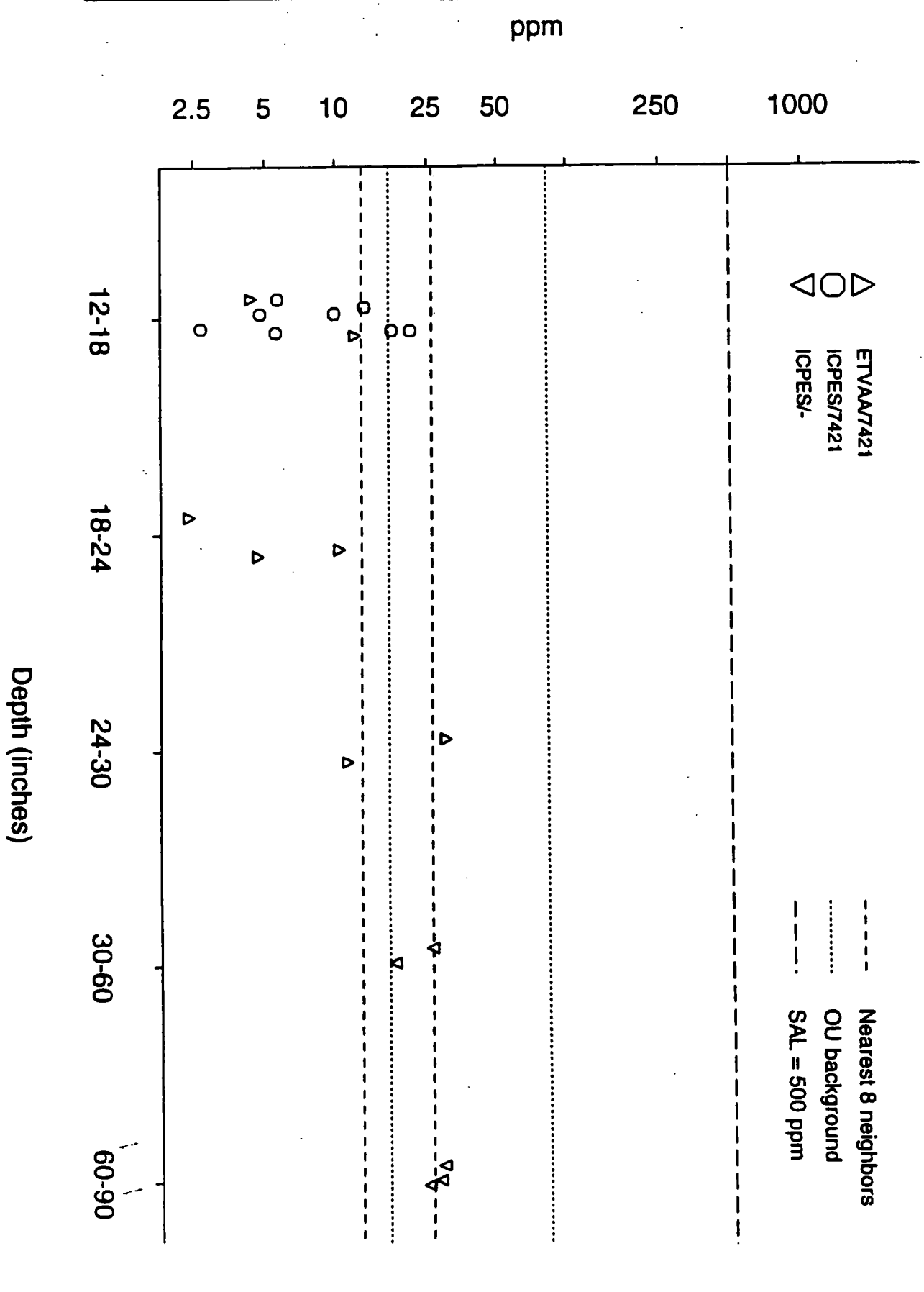
Chromium in samples from filter building 20b

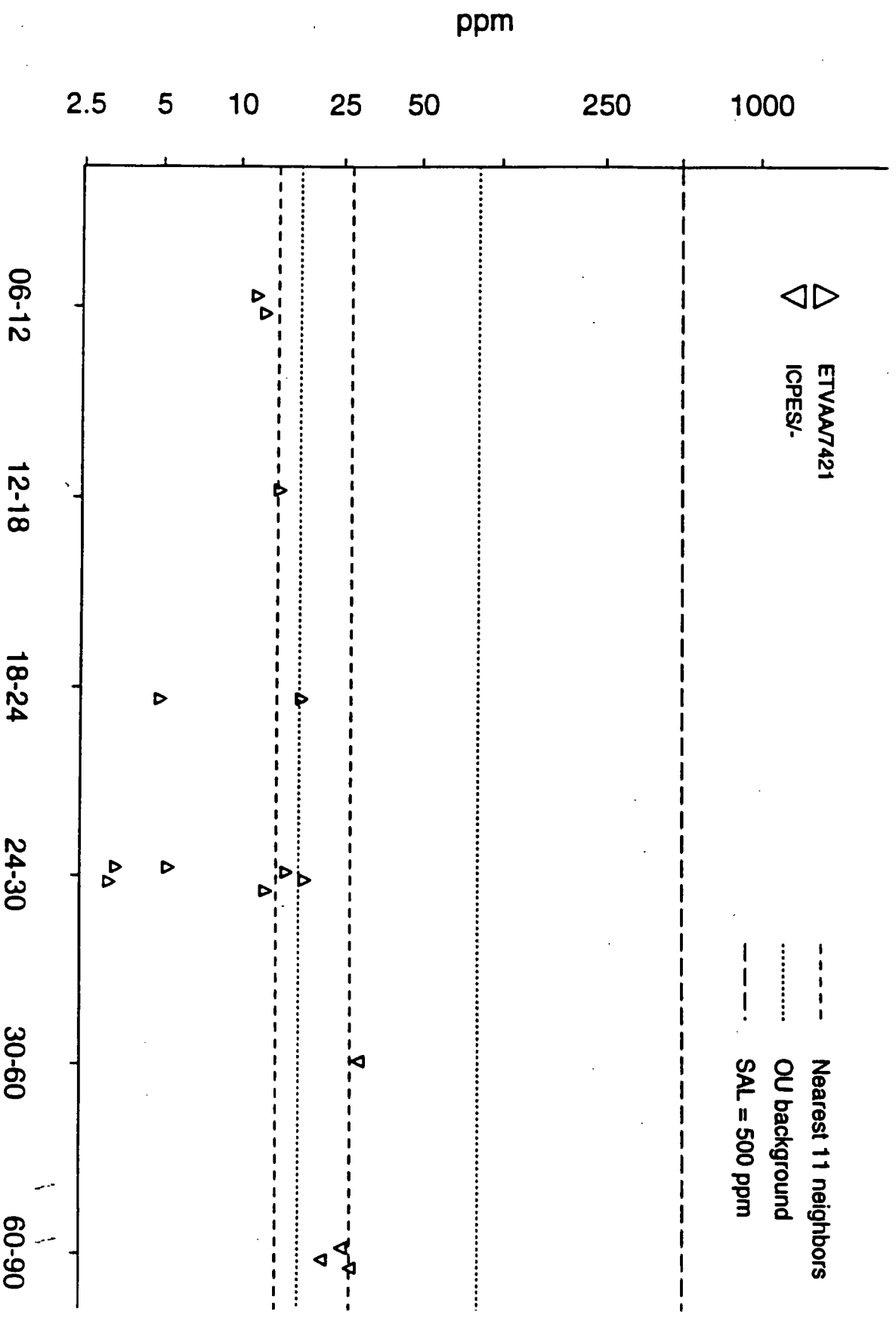

ppm
1
2.5
5
10
25
12-18
18-24
24-30
30-60
60-90
Depth (inches)
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
Cobalt in samples from filter building 20a

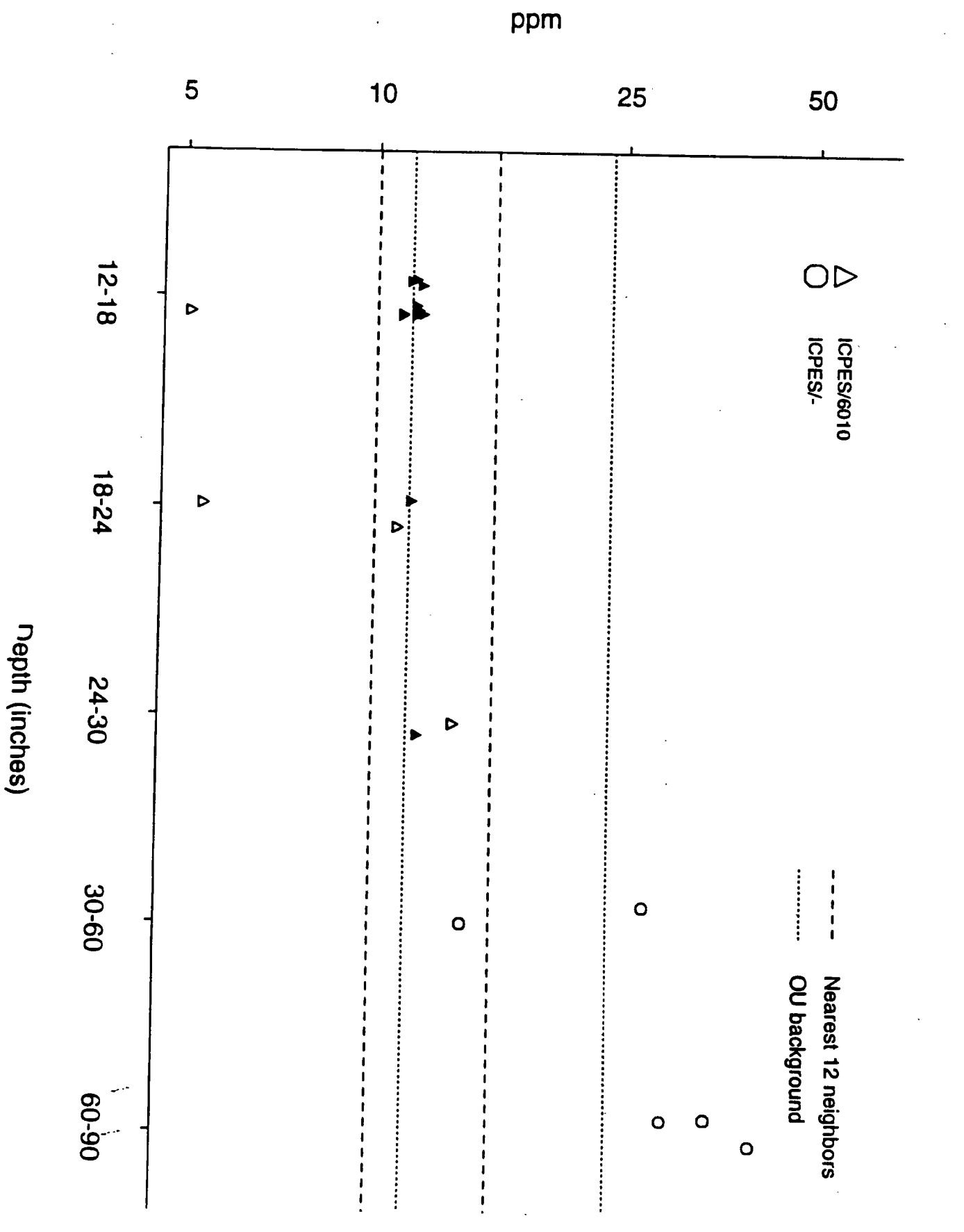

Cobalt in samples from filter building 20b
ppm
1
2.5
5
10
06-12
12-18
18-24
24-30
30-60
60-90
epth (inches)
ICPES/6010
ICPES/-
Nearest 6 neighbors
OU background

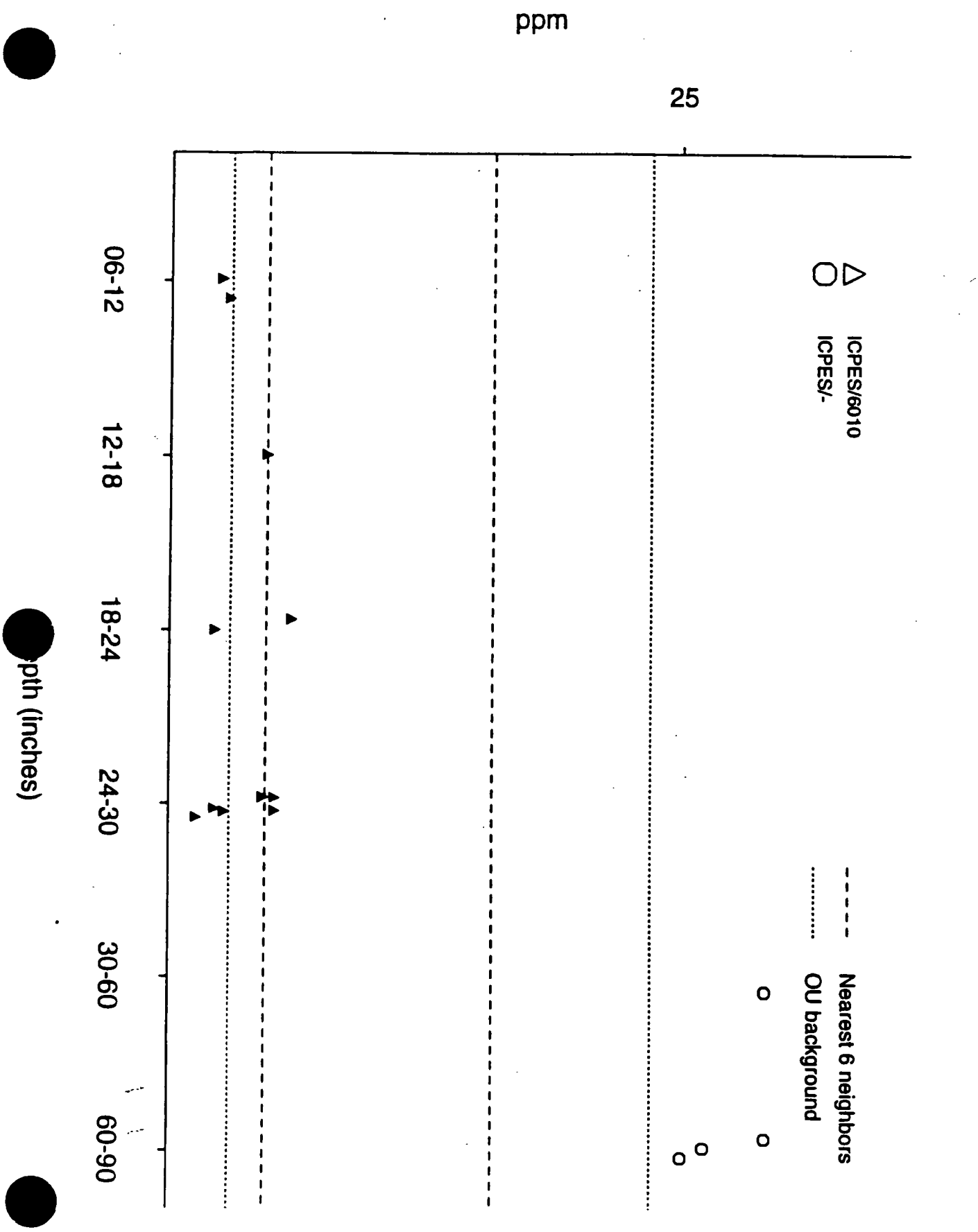

Copper in samples from filter building 20a
ppm
0.5
1
5
10
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 3000 ppm
12-18
18-24
24-30
30-60
60-90
Depth (inches)

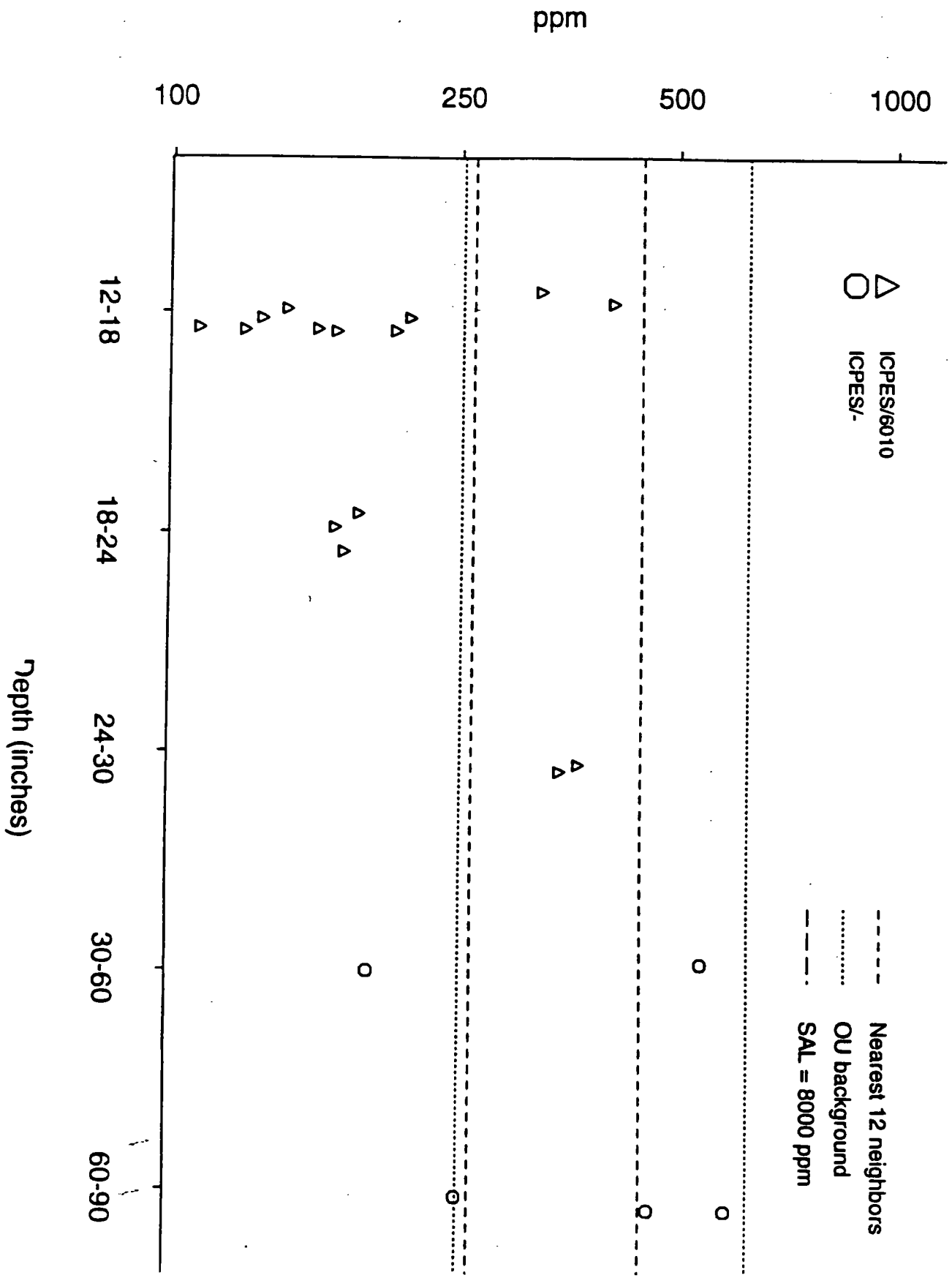

Copper in samples from filter building 20b
ppm
1
5
10
ICPES/6010
ICPES/-
Nearest 6 neighbors
OU background
SAL = 3000 ppm
06-12
12-18
18-24
24-30
30-60
60-90
pth (inches)

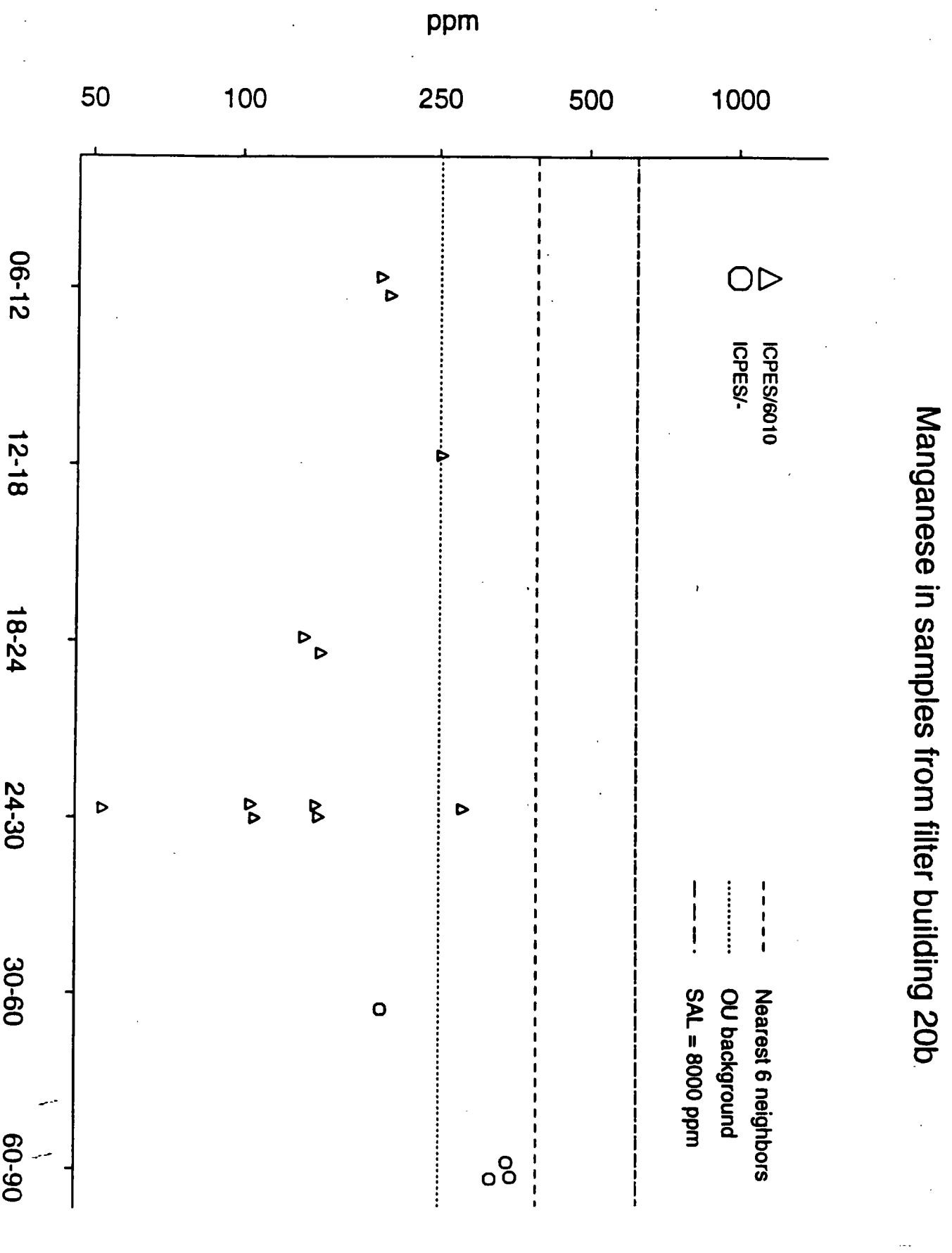

Lead in samples from filter building 20a
ppm
2.5
5
10
25
50
250
1000
12-18
18-24
24-30
30-60
60-90
Depth (inches)
ETVAA/7421
ICPES/7421
ICPES/-
Nearest 8 neighbors
OU background
SAL = 500 ppm

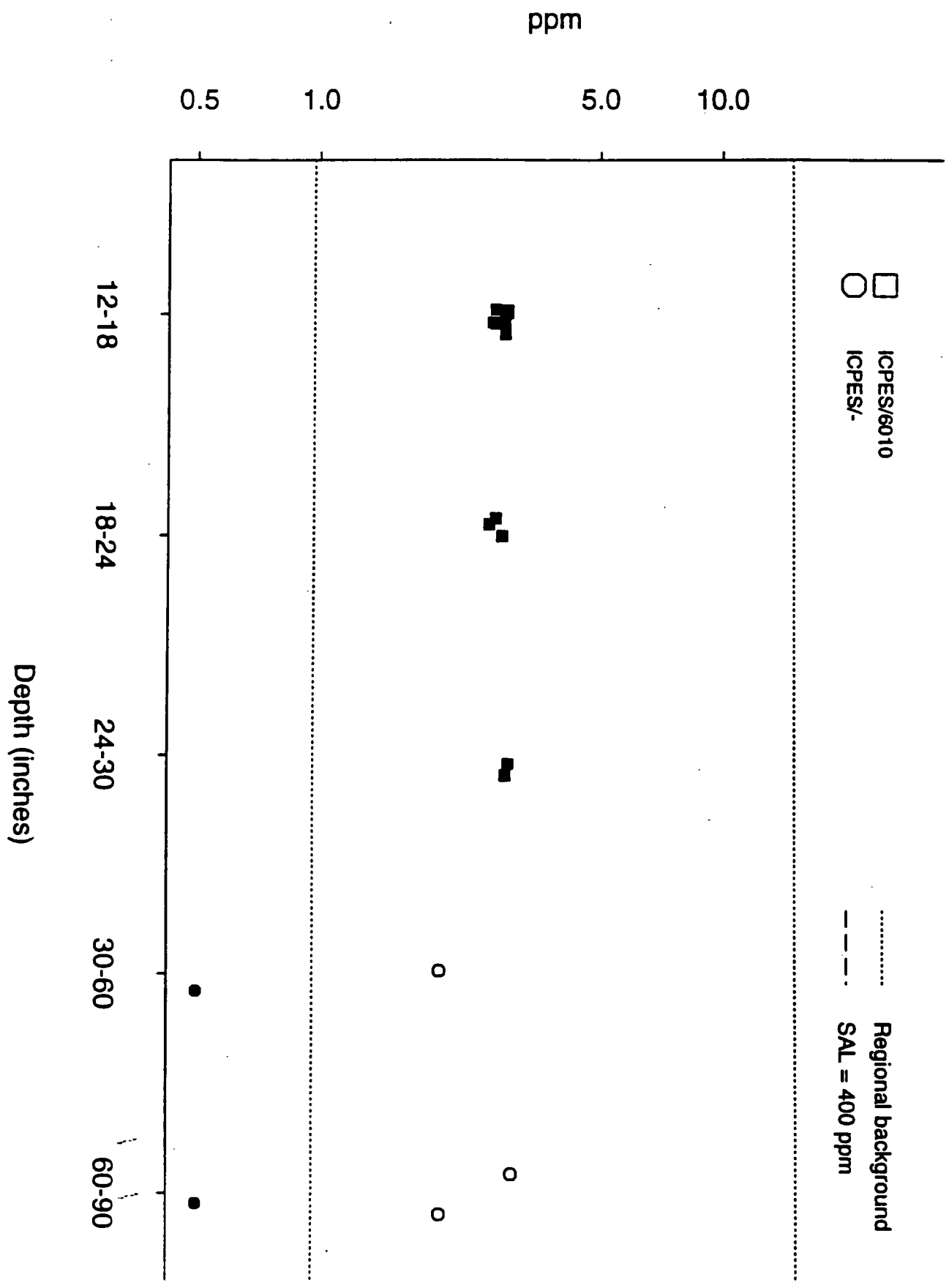

ppm
2.5
5
10
25
50
250
1000
06-12
12-18
18-24
24-30
30-60
60-90
ETVAA/7421
ICPES/-
Nearest 11 neighbors
OU background
SAL = 500 ppm
Lead in samples from filter building 20b
epth (inches)

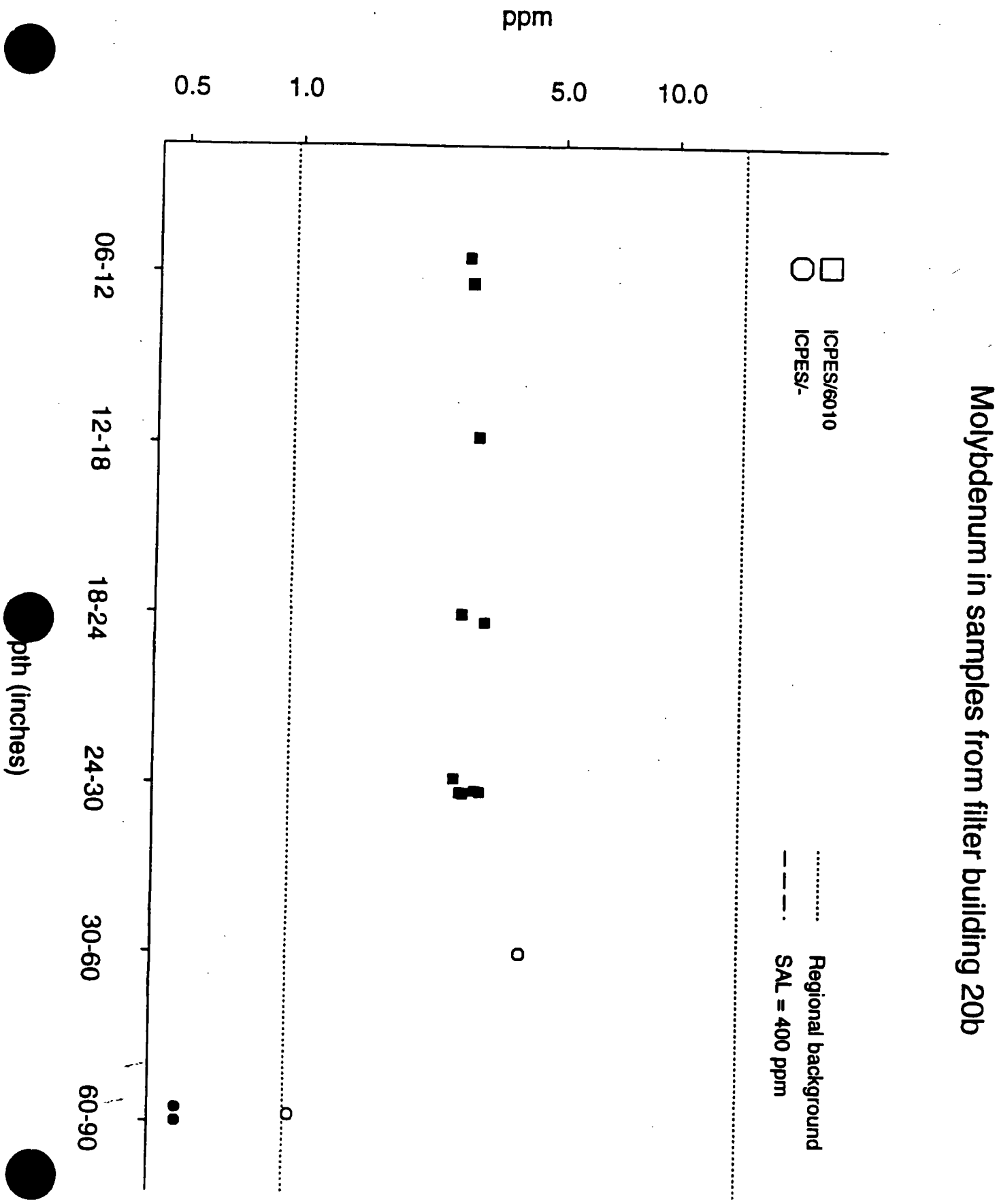

ppm
5
10
25
50
12-18
18-24
24-30
30-60
60-90
Depth (inches)
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
Lithium in samples from filter building 20a

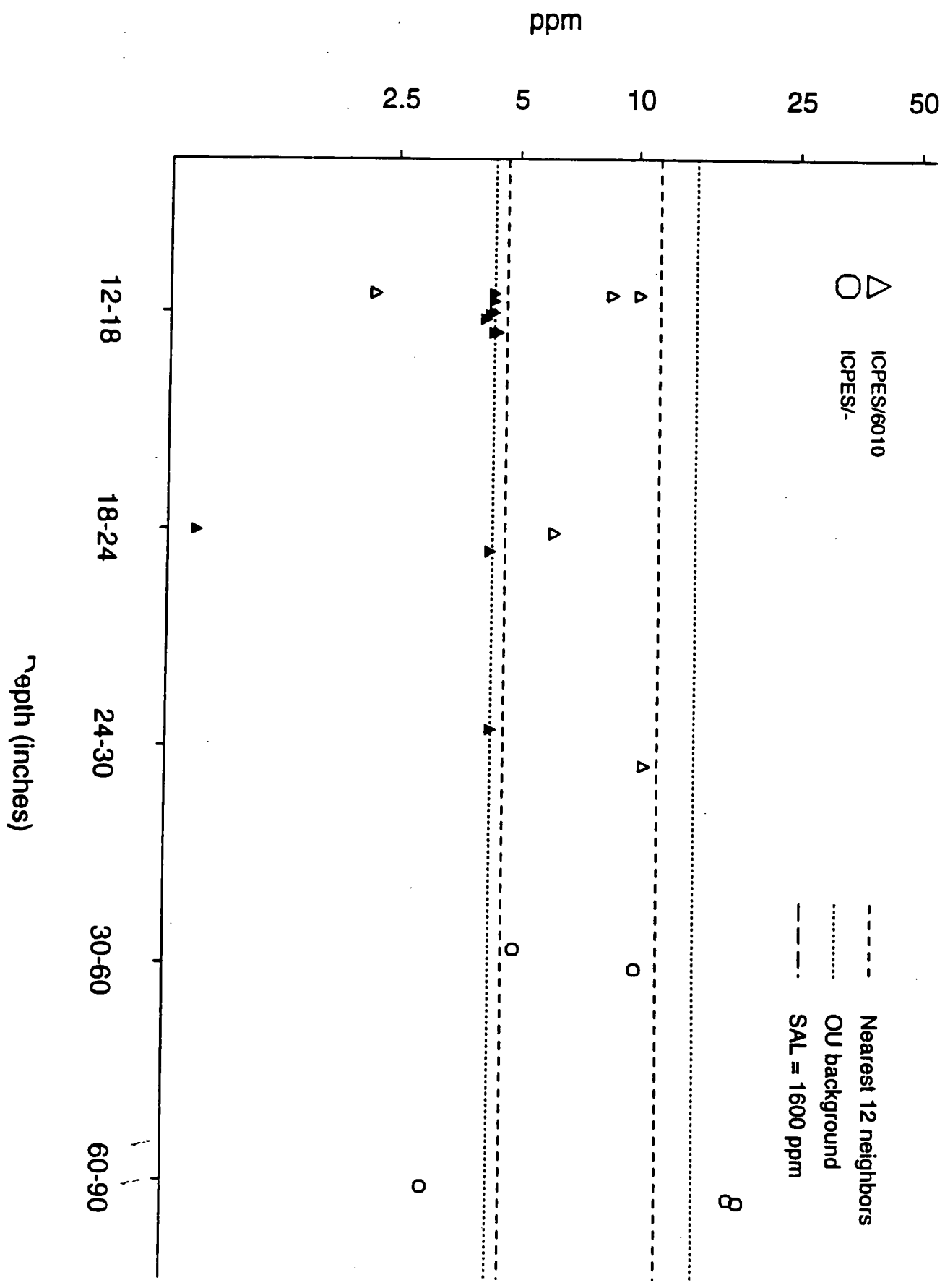

ppm
25
Lithium in samples from filter building 20b
ICPES/6010
ICPES/-
Nearest 6 neighbors
OU background
06-12
12-18
18-24
24-30
30-60
60-90
pth (inches)

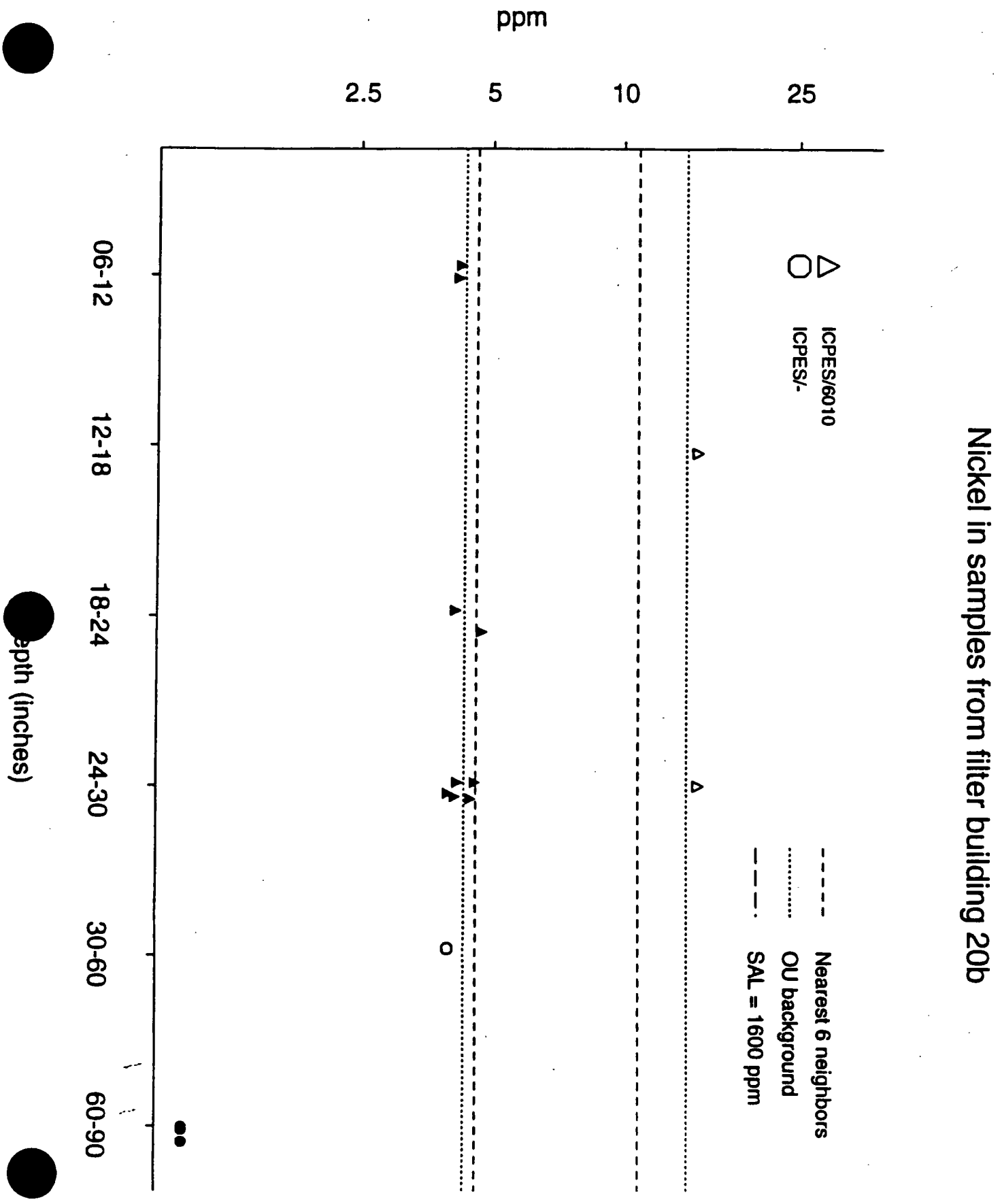

Manganese in samples from filter building 20a
ppm
100
250
500
1000
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 8000 ppm
12-18
18-24
24-30
30-60
60-90
Depth (inches)

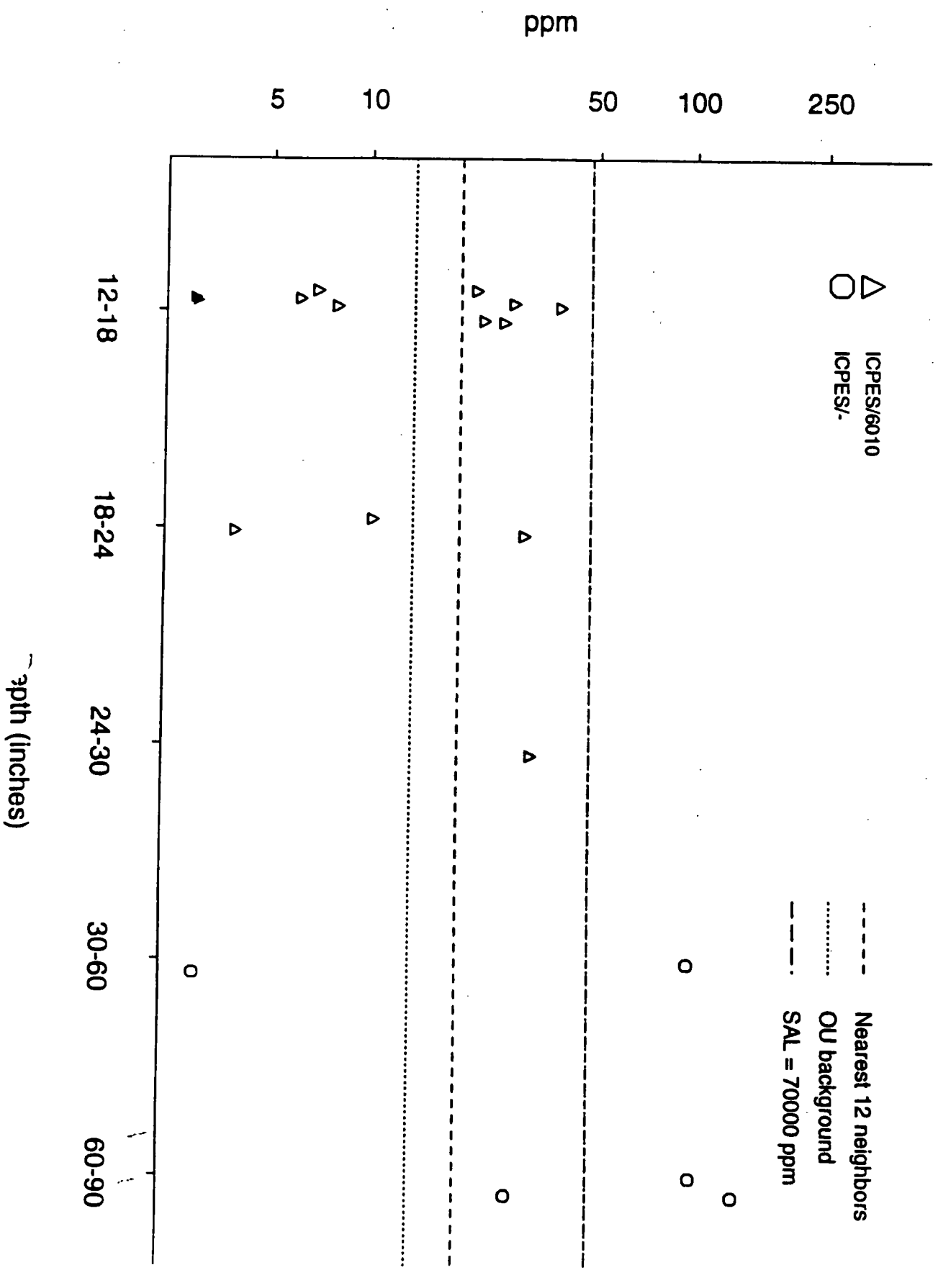

Manganese in samples from filter building 20b
ppm
50
100
250
500
1000
06-12
12-18
18-24
24-30
30-60
60-90
Depth (inches)
ICPES/6010
ICPES/-
Nearest 6 neighbors
OU background
SAL = 8000 ppm

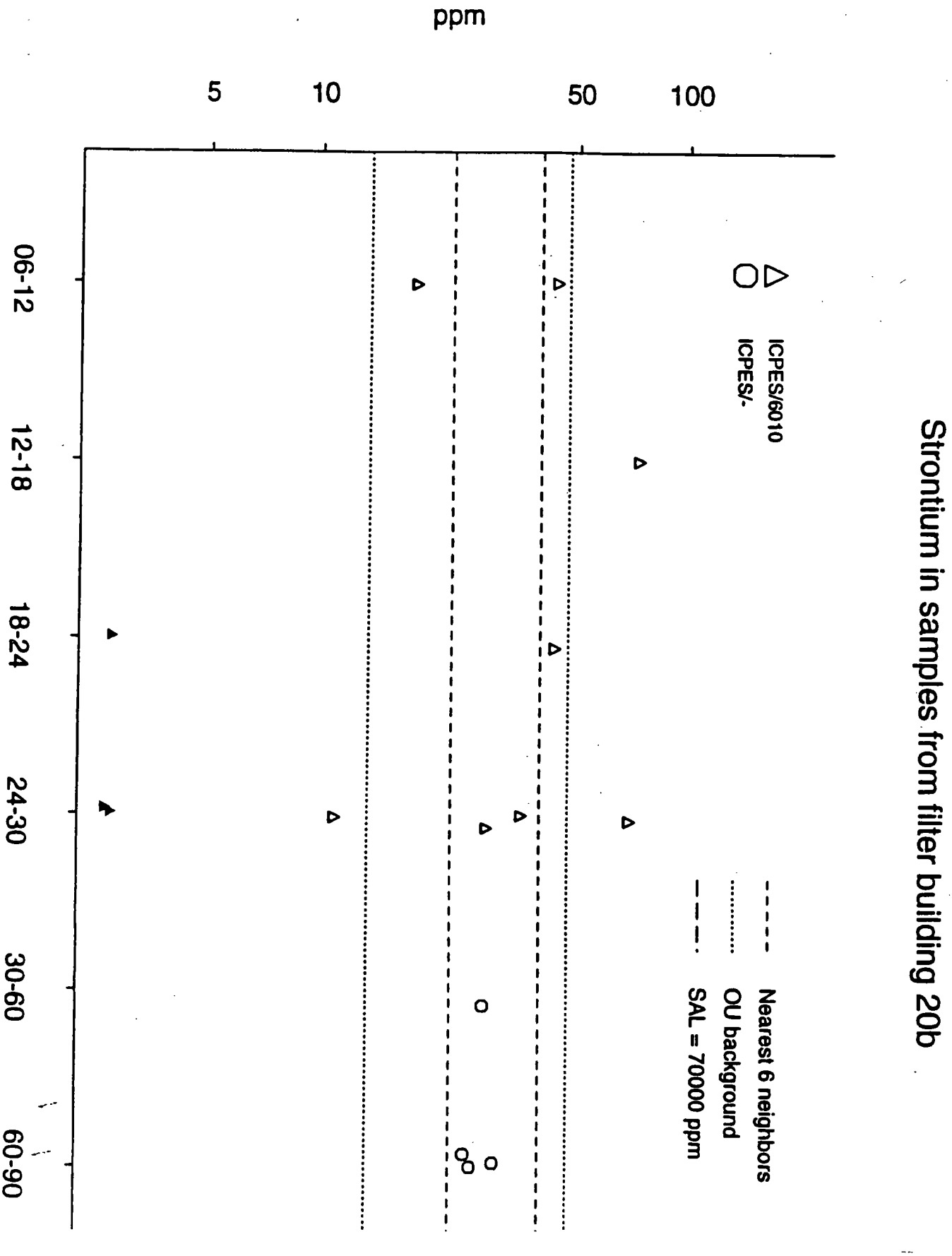

Molybdenum in samples from filter building 20a
ppm
0.5
1.0
5.0
10.0
12-18
18-24
24-30
30-60
60-90
Depth (inches)
ICPES/6010
ICPES/-
Regional background
SAL = 400 ppm

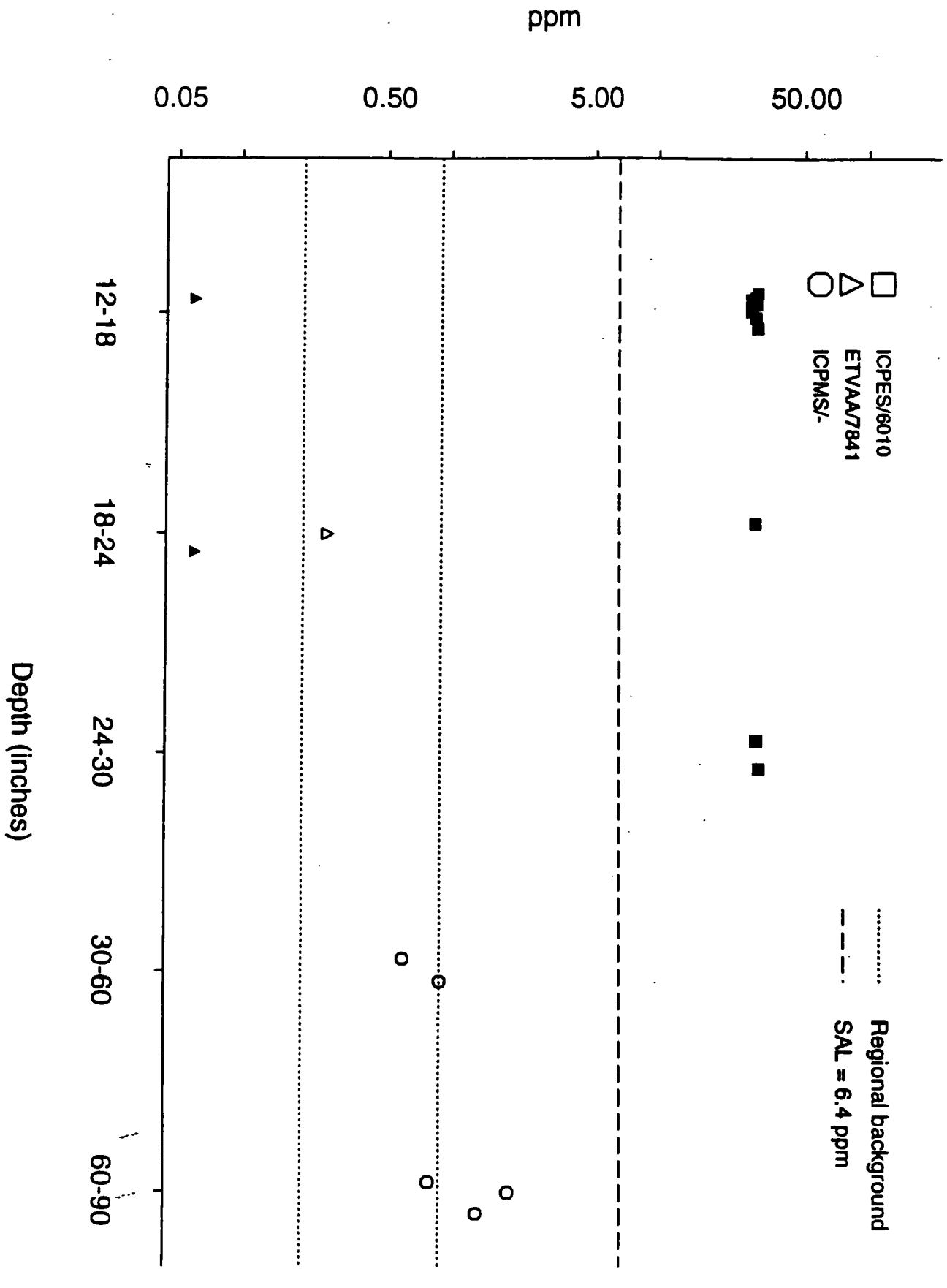

ppm
0.5
1.0
5.0
10.0
06-12
12-18
18-24
24-30
30-60
60-90
pth (inches)
ICPES/6010
ICPES/-
Regional background
SAL = 400 ppm
Molybdenum in samples from filter building 20b

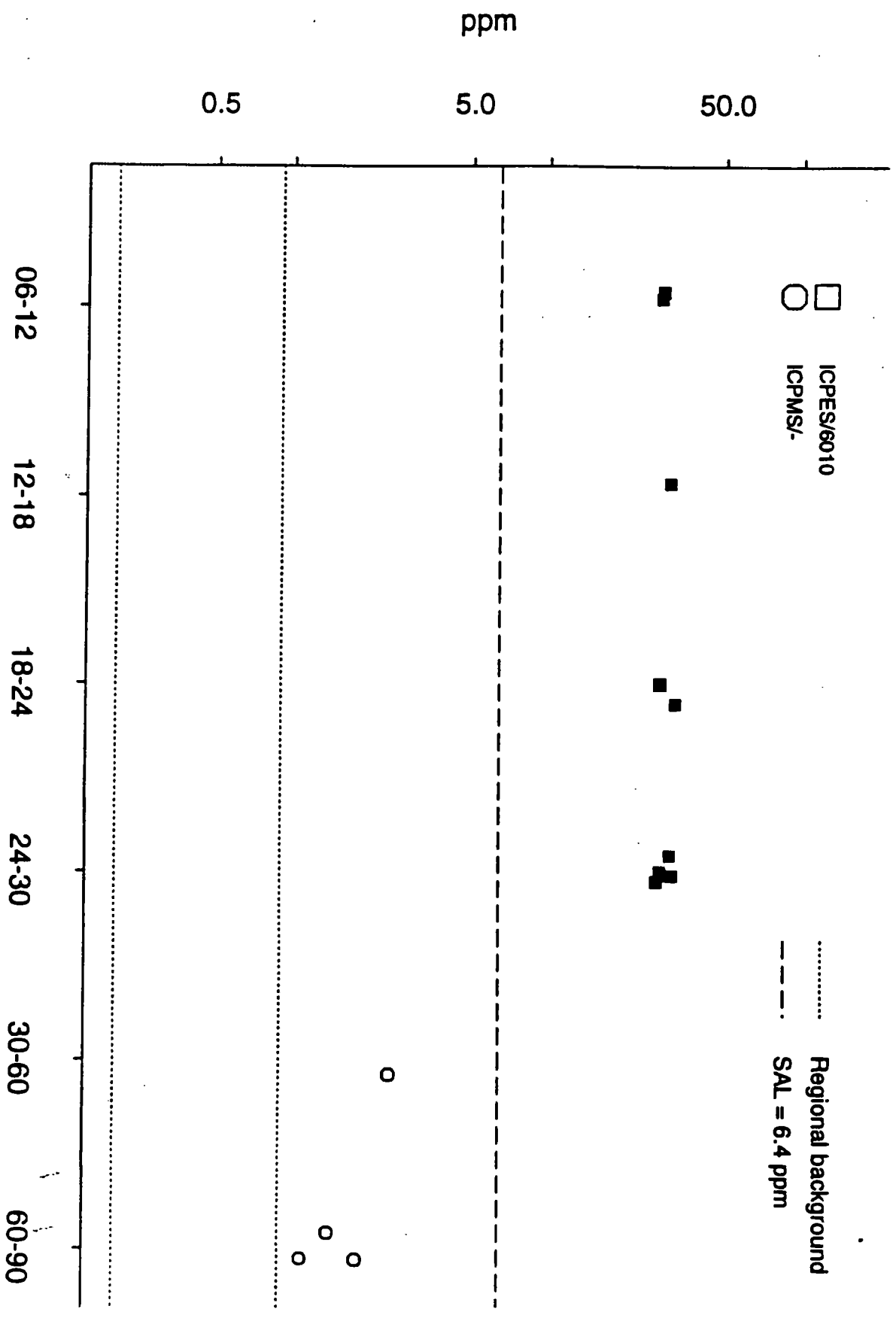

Nickel in samples from filter building 20a
ppm
2.5
5
10
25
50
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 1600 ppm
12-18
18-24
24-30
30-60
60-90
Depth (inches)


Nickel in samples from filter building 20b
ppm
2.5
5
10
25
06-12
12-18
18-24
24-30
30-60
60-90
epth (inches)
ICPES/6010
ICPES/-
Nearest 6 neighbors
OU background
SAL = 1600 ppm

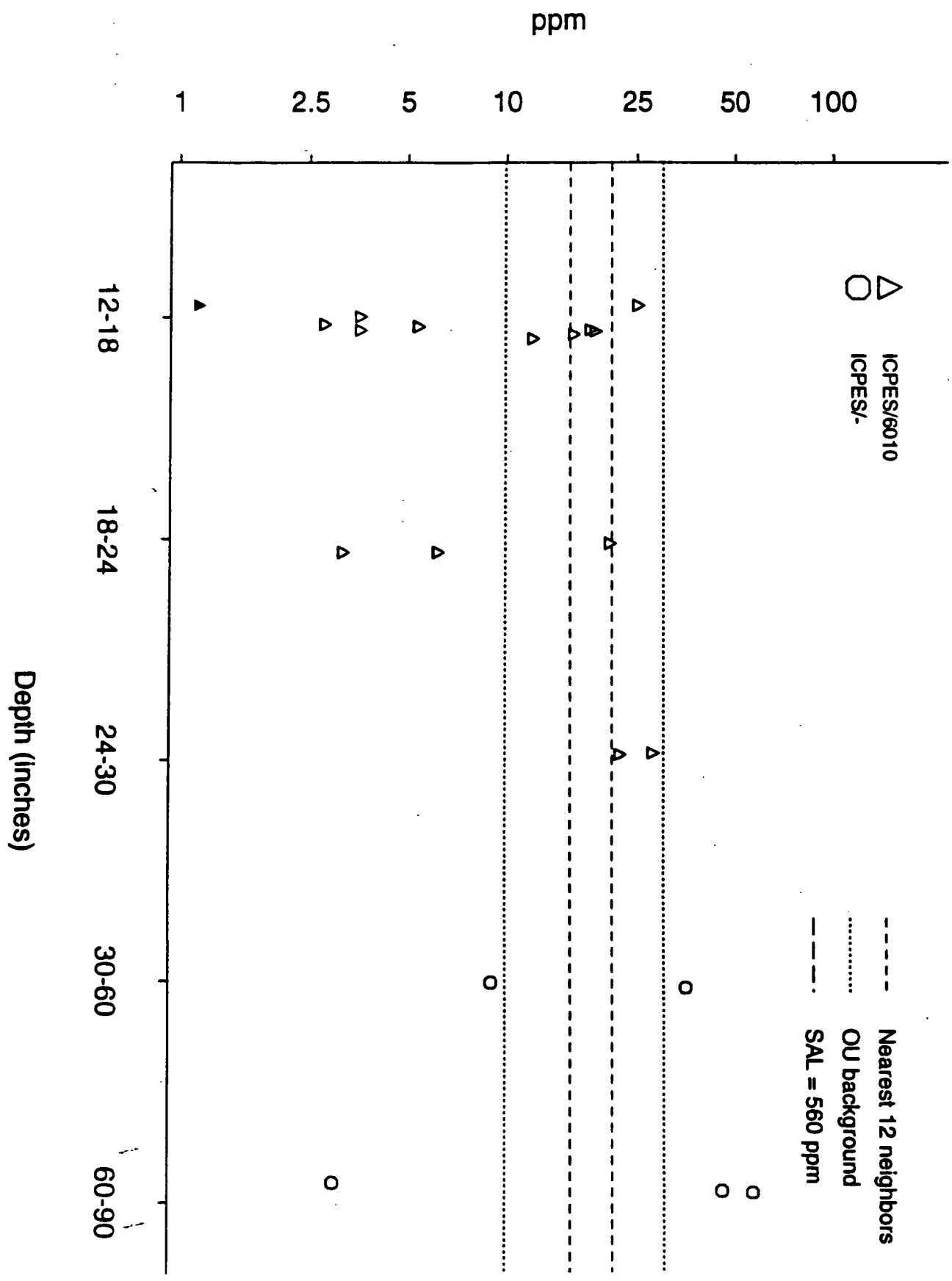

Strontium in samples from filter building 20a
ppm
5
10
50
100
250
12-18
18-24
24-30
30-60
60-90
epth (inches)
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 70000 ppm

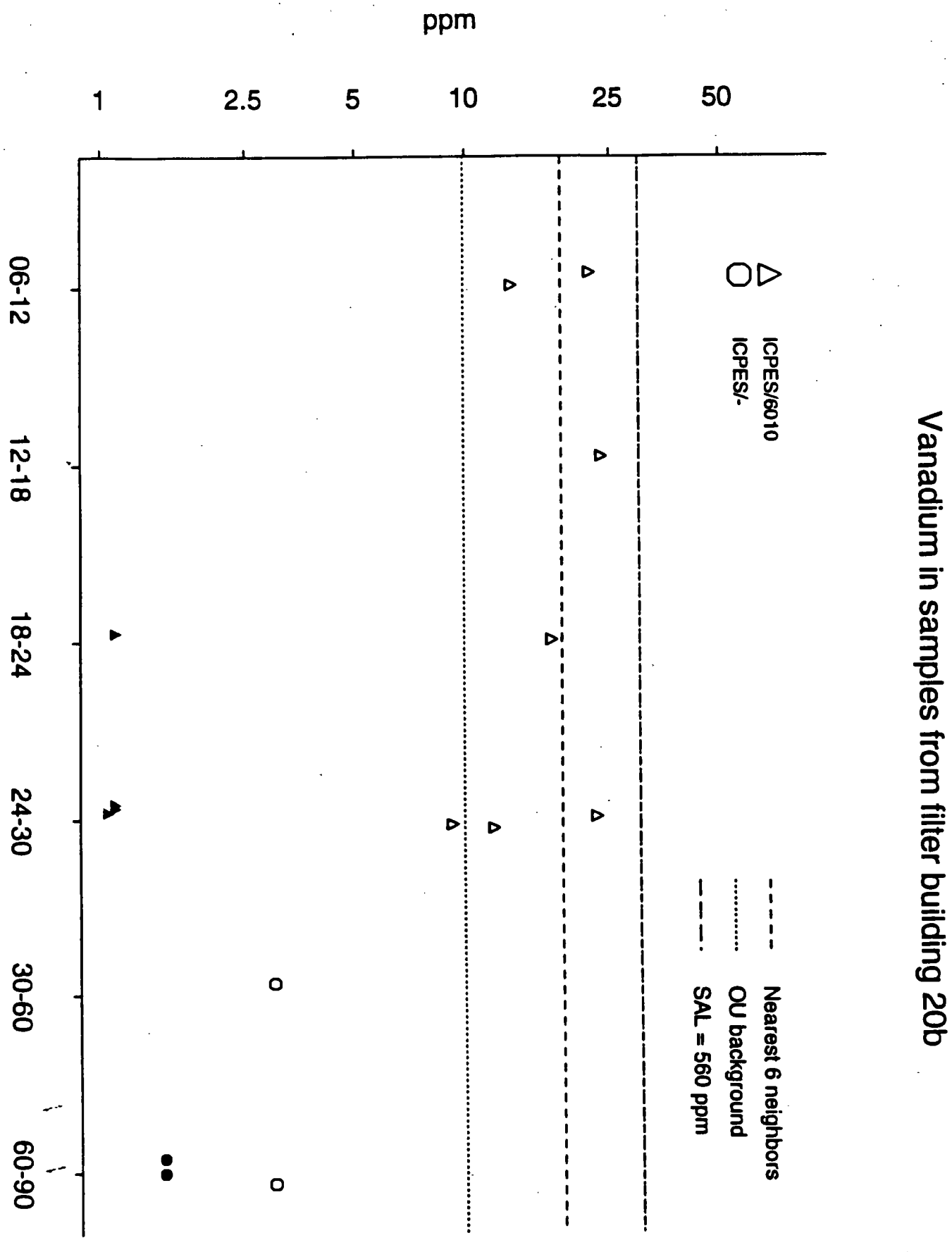

Strontium in samples from filter building 20b
ppm
5
10
50
100
ICPES/6010
ICPES/-
Nearest 6 neighbors
OU background
SAL = 70000 ppm
06-12
12-18
18-24
24-30
30-60
60-90
pth (inches)

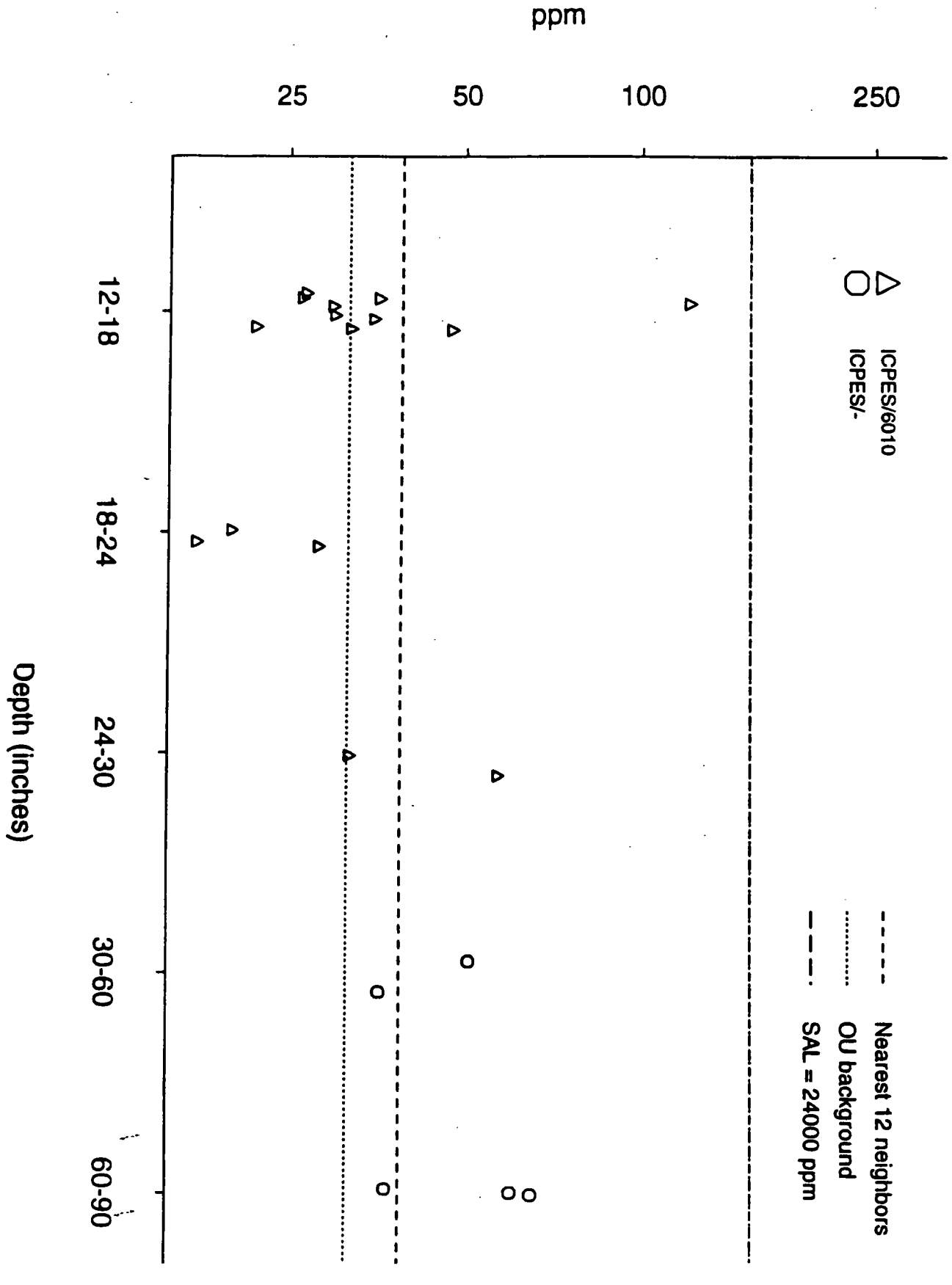

Thallium in samples from filter building 20a
ppm
0.05
0.50
5.00
50.00
Depth (inches)
12-18
18-24
24-30
30-60
60-90
ICPES/6010
ETVAA/7841
ICPMS/-
Regional background
SAL = 6.4 ppm

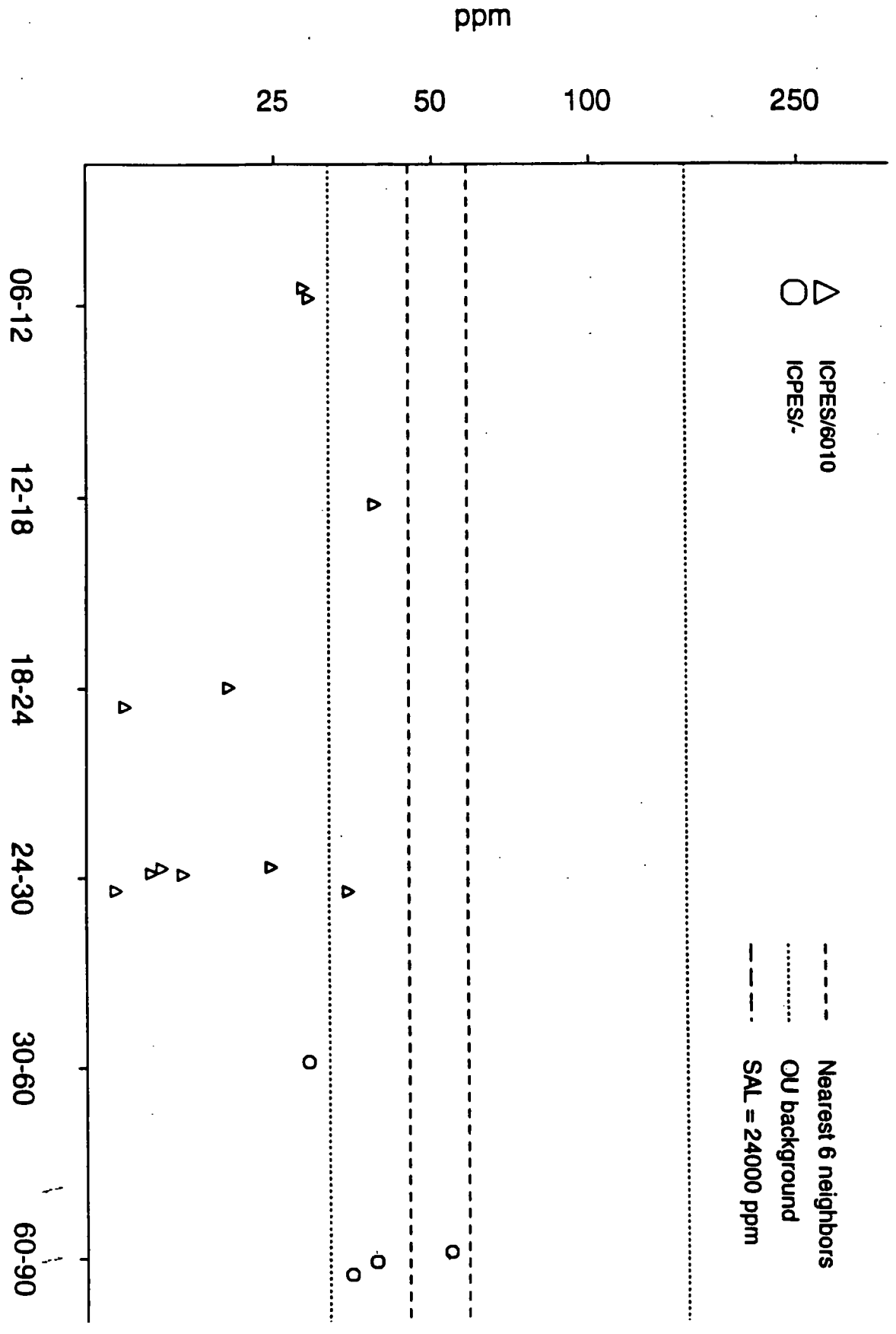


Thallium in samples from filter building 20b


Vanadium in samples from filter building 20a
ppm
1
2.5
5
10
25
50
100
Depth (inches)
12-18
18-24
24-30
30-60
60-90
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 560 ppm

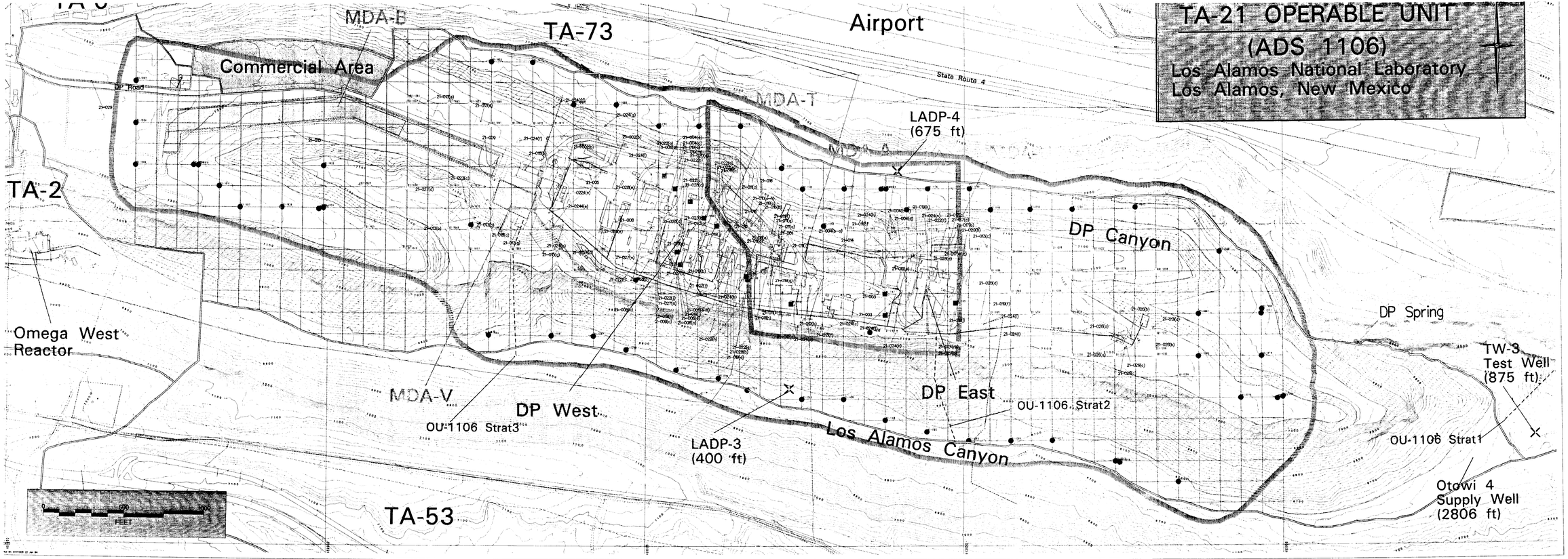

Vanadium in samples from filter building 20b
ppm
1
2.5
5
10
25
50
06-12
12-18
18-24
24-30
30-60
60-90
epth (inches)
ICPES/6010
ICPES/-
Nearest 6 neighbors
OU background
SAL = 560 ppm


Zinc in samples from filter building 20a
ppm
25
50
100
250
ICPES/6010
ICPES/-
Nearest 12 neighbors
OU background
SAL = 24000 ppm
12-18
18-24
24-30
30-60
60-90
Depth (inches)



Zinc in samples from filter building 20b


TA-21 OPERABLE UNIT
(ADS 1106)
Los Alamos National Laboratory
Los Alamos, New Mexico
TA-0
TA-73
MDA-B
Airport
Commercial Area
State Route 4
DP Road
MDA-T
LADP-4
(675 ft)
MDA-A
MDA-U
TA-2
DP Canyon
DP Spring
Omega West
Reactor
TW-3
Test Well
(875 ft)
MDA-V
DP West
DP East
OU-1106 Strat3
OU-1106 Strat2
OU-1106 Strat1
LADP-3
(400 ft)
Los Alamos Canyon
Otowi 4
Supply Well
(2806 ft)
TA-53
FEET
LEGEND
Contours, 100 ft
Contours, 10 ft
Fence, Industrial
Industrial Waste Line
PRS, Possible
PRS, Probable
PRS, Present
Power Line >13.2 kV
Power Line <13.2 kV
Radioactive Liquid Waste Line
Retaining Wall
Road, Dirt
Road, Paved
Road/Trail
Sewer Line
Storm Drain
Stratigraphic Section
Telephone Line
Water Line
Permanent Structure
Temporary Structure
Access Difficult or Impossible
TA-21 SURFACE GRID SAMPLE LOCATIONS
(1992 Samples)
FIRST ROUND
0-1" Deposition-Layer Soil Sample (Grid)
0-6" Surface Soil Sample (Grid) and
0-1" Deposition-Layer Soil Sample (Grid)
SECOND ROUND
0-1" Deposition-Layer Soil Sample (Grid)
0-6" Surface Soil Sample (Grid) and
0-1" Deposition-Layer Soil Sample (Grid)
0-1" Deposition-Layer Soil Sample
(Building Area)
0-6" Surface Soil Sample (Building Area)
and
0-1" Deposition-Layer Soil Sample
(Building Area)
Outfall Samples
University of California
Los Alamos National Laboratory
Earth & Environmental Sciences Division
FIMAD


TA-21 OPERABLE UNIT
(ADS 1106)
Los Alamos National Laboratory
Los Alamos, New Mexico
MDA-B
TA-73
Airport
Commercial Area
DP Road
State Route 4
MDA-T
MDA-A
LADP-4
(675 ft)
TA-2
DP Canyon
Omega West
Reactor
DP Spring
TW-3
Test Well
(875 ft)
MDA-V
DP West
DP East
OU-1106 Strat2
OU-1106 Strat3
LADP-3
(400 ft)
Los Alamos Canyon
OU-1106 Strat1
Otowi 4
Supply Well
(2806 ft)
TA-53
0
500
1000
FEET
Contours, 100 ft
Contours, 10 ft
Fence, Industrial
Industrial Waste Line
PRS, Possible
PRS, Probable
PRS, Present
Power Line >13.2 kV
Power Line <13.2 kV
Radioactive Liquid Waste Line
Retaining Wall
Road, Dirt
Road, Paved
Road/Trail
Sewer Line
Storm Drain
Stratigraphic Section
Telephone Line
Water Line
Non Process Area
Process Area
MDA A / MDA T Special Impact Area
TSTA Special Impact Area
Permanent Structure
Temporary Structure
Access Difficult or Impossible
TA-21 SURFACE GRID SAMPLE LOCATIONS
(1992 Samples)
FIRST ROUND
0-6" Surface Soil Sample (Grid)
SECOND ROUND
0-6" Surface Soil Sample (Grid)
Outfall Samples
Analyte Baseline Areas at
Technical Area 21 (OU 1106)
University of California
Los Alamos National Laboratory
Earth & Environmental Sciences Division
FIMAD
Produced by: Marcia Jones
Date: January 22, 1994
FIMAD Plot ID: G101808