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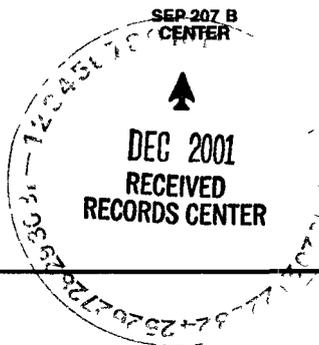
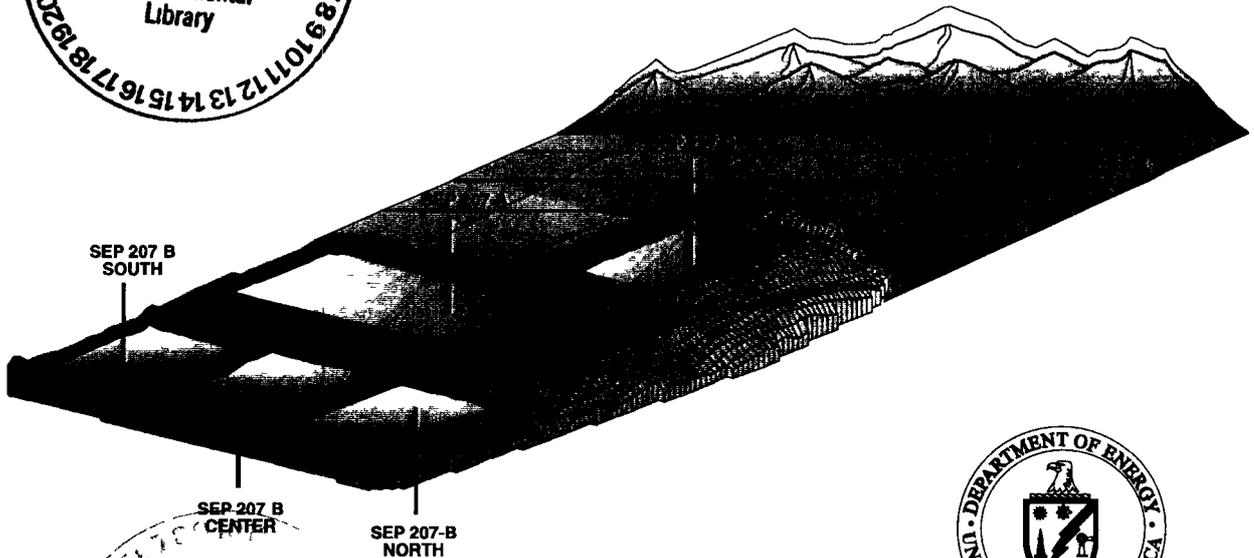
OU4 Solar Evaporation Ponds Interim Measure/Interim Remedial Action Environmental Assessment Decision Document

U S Department of Energy
Rocky Flats Environmental Technology Site
Golden, Colorado

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Revision: Proposed

Part II
Volume 1- Sections 1 through 8



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DOCUMENT ORGANIZATION

Operable Unit 4 Solar Evaporation Pond Interim Measure/Interim Remedial Action - Environmental Assessment Decision Document

- Part I - Executive Summary and Introduction
- Part II - **Operable Unit 4 Phase I RCRA Facility Investigation/Remedial Investigation Report**
- Volume 1 - Sections 1 through 8
(Figures for Section 3 are in Volume 2)
 - Volume 2 - Section 3 Figures
 - Volume 3 - Appendices A through G
 - Volume 4 - Appendices H through L
 - Volume 5 - Appendices M through O
 - Volume 6 - Appendices P through Q
 - Volume 7 - Appendices R through V
 - Volume 8 - Appendices W through AA
- Part III - Interim Measure/Interim Remedial Action Design Analysis
- Part IV - Recommended Interim Measure/Interim Remedial Action Alternative
- Part V - Post-Closure Monitoring and Assessment Plan

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**SOLAR EVAPORATION PONDS
OU4 IM/IRA ENVIRONMENTAL ASSESSMENT DECISION DOCUMENT**

**PART II
PHASE I RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION**

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OPERABLE UNIT NO. 4
LIST OF ACRONYMS AND ABBREVIATIONS

ADT	average daily traffic
AG	aboveground
AIP	Agreement in Principle
ANOVA	analysis of variance
APEN	Air Pollution Emission Notice
AR	Treatability Studies Annual Reports
ARAR(s)	Applicable or Relevant and Appropriate Requirement(s)
ARF	airborn release fraction
ASTM	American Society for Testing and Materials
ATM-m ³ /mole	atmospheres per cubic meter per mole
ATSDR	Agency for Toxic Substance and Disease Registry
BDL	below (analytical) detection limit
bgs	below ground surface
BRA	Baseline Risk Assessment
BTEX	benzene, toluene, ethylbenzene, and xylene
CAD/FAD	Corrective Action Decision/Final Action Decision
CAMU	Corrective Action Management Unit
CAP	cement asbestos pipe
CCR	Colorado Code of Regulations
CD	Consolidated-Drained
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
CDOT	Colorado Department of Transportation
CEC	cation exchange capacity
CE	cognizant engineer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
CI	cast iron
CLP	Contract Laboratory Program
CLT	comprehensive list of technologies/process options
cm ²	square centimeters
cm/day	centimeters per day
cm/sec	centimeters per second
CMP	corrugated metal pipe
CMS/FS	Corrective Measures Study/Feasibility Study
COC(s)	contaminants of concern
COEM	Conduct of Engineering Manual

OPERABLE UNIT NO. 4
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

COL	colluvium
cpm	counts per minute
CRDL	contract-required detection limit
CRQL	contract-required quantitation limit
CSI	Construction Specified Institute
CU	consolidated-undrained
DCF	dose conversion factor
DCG	Derived Concentration Guide
DCN	Document Change Notice
°C	degrees Celsius
DOE	United States Department of Energy
DOT	U S Department of Transportation
dpm	disintegrations per minute
dpm/kg	disintegrations per minute per kilogram
DQO	data quality objective
DQR	data quality requirement
EA	Environmental Assessment
ECD	electron capture detector
EE	Environmental Evaluation
EIS	Environmental Impact Statement
EM	electromagnetic
EMD	Environmental Management Division
EPA	United States Environmental Protection Agency
EPRI	Electric Power Research Institute
ES&H	Environmental Safety and Health
°F	degrees Fahrenheit
FDC	frequency domain capacitance
FFCA	Federal Facilities Compliance Agreement
FID	Flame Ionization Detector
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FML	flexible membrane liner
FO	field operations
FR	Federal Register
FRP	Fiberglass Reinforced Plastic
FS	Feasibility Study
FSP	Field Sampling Plan

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OPERABLE UNIT NO. 4
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

ft/ft	feet per foot
ft msl	feet above mean sea level
ft/yr	feet per year
g/cm ³	grams per cubic centimeter
GC/FID	Gas Chromograph/Flame Ionization Detector
GCL	geosynthetic clay liners
GIS	Geographic Information System
gpm	gallons per minute
GPR	ground-penetrating radar
GRA	General Response Action
GRRASP	General Radiochemistry and Routine Analytical Services Protocols
HEAST	Health Effects Assessment Summary Table
HELP	Hydrologic Evaluation of Landfill Performance
HEPA	high-efficiency particulate air
HHEM	Human Health Evaluation Manual
HHRA	Human Health Risk Assessment
HHS	Human Health Standard
HM	hot measurement
HQ	hazard quotient
HSU	Hydrostratigraphic Unit
IAG	Interagency Agreement
ICP	Inductively Coupled Plasma Arc Method
ICR	incremental cancer risk
IDL	instrument detection limit
IDM	Investigation-Derived Material
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
IRIS	Integrated Risk Information System
ITPH	Interceptor Trench Pump House
ITS	Interceptor Trench System
K	hydraulic conductivity
KAL	Cretaceous Arapahoe/Laramie
KS	Kolmogorov-Smirnov
LDR	land disposal restriction

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OPERABLE UNIT NO. 4
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

LHSU	Lower Hydrostratigraphic Unit
LL	liquid limit
LOEL	lowest observed effect

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OPERABLE UNIT NO. 4
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

m	meter
MCL	maximum contaminant level
MEPAS	Multimedia Exposure Pathway Assessment System
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/L	milligrams per liter
m/yr	meters per year
MHz	megahertz
mph	miles per hour
MTR	minimum technology requirement
NAAQS	National Ambient Air Quality Standards
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NOEL	no observed effect
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NSC	non-safety class
NTGS	National Technical Guidance Series
NTS	Nevada Test Site
O&M	operations & maintenance
OPWL(s)	original process waste line(s)
OU	Operable Unit
OU4	Operable Unit 4
PA	Protected Area
PAH	polynuclear or polycyclic aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCBs	polychlorinated biphenyls
pCi/L	picocuries per liter
PCOC(s)	potential contaminant(s) of concern
PCE	tetrachloroethene
pH	negative log hydronium ion concentration moles per liter (potential of hydrogen)
PI	plasticity index
PID	Photoionization Detector
PL	plastic limit

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OPERABLE UNIT NO. 4
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

PM10	particulate matter less than 10 microns
PMR	Power Modification Request
PNA	polynuclear aromatic hydrocarbons
PNL	Pacific Northwest Laboratory
PP	proposed plan
PPCD	DOE's Plan for Prevention of Contaminant Dispersion
PPE	personal protective equipment
PQAP	Project Quality Assurance Program Plan
PRG(s)	preliminary remediation goal(s)
PSZ	Perimeter Security Zone
PVC	polyvinyl chloride
QA	quality assurance
QAA	Quality Assurance Addendum
QAP	Quality Assurance Plan
QAPjP	Quality Assurance Project Plan
QC	quality control
RA	remedial action
RAAMP	Radiological Ambient Air Monitoring Program
RAGS	Risk Assessment Guidance for Superfund
RAS	routine analytical services
RCRA	Resource Conservation and Recovery Act
RF	respirable fraction
RFA	Rocky Flats Alluvium
RfC	reference concentration
RfD	reference dose
RFEDS	Rocky Flats Environmental Database System
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RFP	Rocky Flats Plant
RL	reporting limit
ROD	Record of Decision
ROI	Radiological Operating Instruction
RQD	rock quality designation
RSP	respirable suspended particulates
SAP	Sampling and Analysis Plan
SAS	special analytical service

OPERABLE UNIT NO. 4
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

SCS	Soil Conservation Service
SEP(s)	Solar Evaporation Pond(s)
SF	slope factor
SL	shrinkage limit
SOP	Standard Operating Procedure
SOW	Statement of Work
SPT	Standard Penetration Test
SS	stainless steel
SSH&SP	Site-Specific Health and Safety Plan
STL	steel
STP	Sewage Treatment Plant
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	to-be-considered documents
TCA-1,1,1	trichloroethane
TCE	trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TDR	time domain reflectometry
TDS	total dissolved solids
TICs	tentatively identified compounds
TMTS	Temporary Modular Tank System
TOC	total organic carbon
TSDF	Treatment, Storage, or Disposal Facility
TSP	Treatability Studies Plan
TSS	total suspended solids
UCL	upper confidence level
UG	underground
UHSU	upper hydrostratigraphic unit
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
UTL	upper threshold limit
UV	ultraviolet
VCP	vitrified clay pipe
VFA	Valley Fill Alluvium

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OPERABLE UNIT NO. 4
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

VOC	volatile organic compound
WARP	Well Abandonment and Replacement Program
WCS	weathered bedrock
WQPL	water quality parameters list
WRS	Wilcoxon Rank Sum
ZPA	Zero Period Acceleration

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**SOLAR EVAPORATION PONDS
OU4 IM/IRA ENVIRONMENTAL ASSESSMENT DECISION DOCUMENT
PART II
PHASE I RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION**

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PART II

PHASE I RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION

II.1 INTRODUCTION

The Operable Unit 4 (OU4) Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) at the Rocky Flats Environmental Technology Site (RFETS) operated by the U S Department of Energy (DOE) was an integrated investigation undertaken to satisfy the requirements of RCRA (as amended), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Colorado Hazardous Waste Act (CHWA), under the requirements of the Interagency Agreement (IAG) of 1991. This investigation pertained to the characterization of sources and soils at the Solar Evaporation Ponds (SEPs) located within OU4, which are also designated as Individual Hazardous Substance Site 101 (IHSS 101). The investigation was designed to evaluate the potential for the SEPs to act as continuing sources of contaminants, and to evaluate whether contaminants are present in subsurface soils, including the vadose zone soils. This document is Part II of the Interim Measures/Interim Remedial Action Environmental Assessment Decision Document (IM/IRA EA DD) for OU4.

Historic sources of contaminants at OU4 have been liquids and sludges disposed in the SEPs. These liquids and sludges may have entered the subsurface and may continue to be a source of contaminants beneath the SEPs. The contaminants within the liquids and sludges are identified in the pre-IAG draft *Solar Evaporation Ponds Closure Plan* (DOE, 1988), and the *Analysis of Solar Pond Sludge and Water* (Weston, 1991). According to these documents, the SEPs received wastes including low-level radioactive process wastes containing high nitrate concentrations, neutralized acidic wastes containing aluminum hydroxide, and additional wastes containing sanitary sewage sludge, lithium metal, sodium nitrate, ferric chloride, lithium chloride, sulfuric acid, ammonium persulfates, hydrochloric and nitric acids, hexavalent chromium, and cyanide solutions. No solvents or other organics were reported to be routinely discharged to the SEPs.

The DOE conducted characterization studies for the sludge materials contained within the SEPs prior to implementing the OU4 Phase I RFI/RI program. Therefore, the OU4 Phase I RFI/RI program did not address sludge characterization. The previous sludge characterization studies provide adequate data for the inclusion of the sludge as a component of the OU4 IM/IRA. Detailed reports were generated from the sludge characterization programs which are referenced in this report.

Appendix II A contains summary tables identifying both chemical and radiological sampling results from the sludge that was previously treated to produce pondcrete and sludge that was contained in a clarifier adjacent to Building 788. The report entitled "*Pond Sludge Waste Characterization Report and Waste Characterization Report*" (Halliburton-NUS, 1992)

provided the sludge sampling results for the SEPs and the clarifier. The pondcrete chemical sampling data was derived from the report entitled "*Characterization of Pondcrete at the Rocky Flats Plant*" (Lockheed, 1994). Radiological data for the SEP sludges and pondcrete were contained in two reports prepared by Roy F. Weston, Inc., respectively (1991a, 1991b). The final table in Appendix II A was reproduced from Halliburton-NUS (1992) and identifies the sampling procedures used for SEP sludge characterization.

This section presents an overall summary of the basis for conducting the OU4 Phase I RFI/RI, as well as a brief description of the investigative objectives and activities. Figure II 1-1 shows the boundary of OU4 and the general area of the OU4 Phase I RFI/RI investigation.

II.1.1 Purpose and Organization of the OU4 Phase I RFI/RI Report

The purpose of the OU4 Phase I RFI/RI report is to present the data and evaluations that characterize the physical features of OU4, potential contaminant sources, and the surface and subsurface distribution of soil contaminants. The OU4 Phase I RFI/RI report is organized into seven sections, and all tables and figures are grouped behind their respective report sections. Section II 1, Introduction, provides a brief overview of the objectives and activities conducted for the OU4 Phase I RFI/RI and a summary of previous investigations at OU4. Section II 2, OU4 Field Investigation, describes the activities and methods used to complete the RFI/RI. Section II 3, Results of the OU4 Phase I RFI/RI, presents the data and results obtained from the field investigation. Section II 4, Nature and Extent of Contamination, integrates the historical and OU4 Phase I RFI/RI data, providing an evaluation of the lateral and vertical distribution of contaminants in surficial and subsurface soils, including vadose zone soils, and an evaluation of impacts from potential contaminant sources. Section II 5, Contaminant Fate and Transport, describes a site conceptual model and the properties of identified contaminants and their potential for migration at OU4. Section II 6, Summary and Conclusions, provides a summary of the findings of the OU4 Phase I RFI/RI, conclusions regarding the nature and extent of contamination, and recommendations for further activities. Section 7 presents summary data and information from the IHSS 176 characterization efforts that were conducted separately from the OU4 Phase I RFI/RI program. This section is included since OU4 has annexed IHSS 176 as a component of the OU4 IM/IRA. Section 8 contains the list of references. The evaluation of the effectiveness of the Interceptor Trench System (ITS) in capturing shallow ground water, originally scheduled for presentation in the OU4 Phase I RFI/RI report, is now presented in the OU4 Phase II RFI/RI Work Plan by agreement between DOE and the regulatory agencies.

II.1.2 OU4 Phase I RFI/RI Overview

The OU4 Phase I RFI/RI is part of a comprehensive, phased program of Operable Unit (OU) characterization, remedial investigation, feasibility studies, and remedial/corrective actions currently in progress at RFETS. The objectives of the OU4 Phase I RFI/RI were to

- Characterize the physical features of the site,

- Evaluate potential contaminant sources,
- Evaluate the presence or absence of contaminants in soils at the site, and
- Provide a baseline risk assessment The baseline risk assessment was delayed by agreement between the DOE, Colorado Department of Public Health and Environment (CDPHE), and U S Environmental Protection Agency (EPA) to allow development of additional risk data during the OU4 Phase II RFI/RI program which will be conducted during 1994 and 1995

Specific tasks identified to accomplish these objectives were to

- Investigate the former location of the Original Ponds,
- Characterize the vadose zone associated with the SEPs, including potential routes of contaminant migration,
- Evaluate the presence or absence of contaminants in the surficial and subsurface soils, and
- Assess the effectiveness of the ITS (The ITS assessment is presented in the OU4 Phase II RFI/RI Work Plan)

An evaluation of contaminant sources was conducted as part of the draft *Solar Evaporation Ponds Closure Plan* (DOE, 1988) and the *Analysis of Solar Pond Sludge and Water* (Weston, 1991a) No additional contaminant source characterization was conducted during this investigation Results from the earlier investigations are summarized in Appendix II A

To accomplish the remaining objectives of the OU4 Phase I RFI/RI, the Field Sampling Plan (FSP) was designed to provide for the characterization of the Original Ponds and existing SEPs (IHSS 101), the investigation of surficial and subsurface soils within the OU4 boundary, the investigation of vadose zone properties, and the description of the geology of OU4 Although an evaluation of the ITS to intercept and contain contaminated ground water moving within the vadose zone and the shallow saturated zone above bedrock was proposed as a OU4 Phase I RFI/RI task, data collected during the investigation were insufficient to complete the analysis Therefore, collection of additional data is proposed under the OU4 Phase II RFI/RI

The OU4 Phase I RFI/RI is separated into two parts characterization of the Original Ponds area and characterization of the existing SEPs Historical data, including aerial photographs and facilities drawings, were reviewed and field data were collected for the Original Ponds characterization Ground-penetrating radar (GPR), drilling, sampling, and chemical analyses comprised the field data collection activities The existing SEPs 207-A, 207-B North, and 207-B Center were characterized through visual inspections, radiological surveys, liner and subgrade sampling and analysis, and drilling, sampling and analysis of subsurface soils In

addition, a GPR survey was conducted to investigate the geophysical characteristics of the SEP 207-A liner and subgrade materials, and to determine if subsurface utilities were present beneath the pond. SEPs 207-B South and 207-C currently contain liquids and sludges and will be investigated at a later date.

Surficial soils in OU4 were evaluated using radiological surveys and chemical analyses. The radiological surveys included beta/gamma surveys. Alpha surveys were attempted but were not successful because of instrument damage. Damage to the instrument's thin film detector cover by grass and rocks has been observed during investigations of other OUs. Surficial soil samples were collected for chemical analysis at borehole locations, randomly selected locations, and discrete locations of interest such as areas of stressed vegetation and seeps.

The vadose zone investigation included drilling, soil sampling, and instrument installation for measuring physical and chemical characteristics of the vadose zone. Physical properties were determined from cores extracted for laboratory analyses during the soil sampling program. Hydrological properties were investigated through field permeability tests, laboratory analyses, neutron probe measurements, and water level measurements in monitoring wells. Chemical properties of the vadose zone were assessed through soil chemical analyses, a soil gas survey, chemical analyses of pore water collected from lysimeters, and column leaching tests performed on selected soil core samples.

The geological investigation included a historical review and compilation of data from existing boreholes, a drilling, sampling, and chemical analysis program, and a geophysical investigation. Boreholes drilled within OU4 aided the geological interpretation, augmented the historical data, and allowed additional soil samples to be obtained for chemical analysis. The geophysical investigations included a borehole geophysical program to aid in characterizing the subsurface materials, and a seismic refraction program to aid in delineating paleochannels and bedrock topography.

II.1.3 Previous OU4 Investigations

This section briefly describes the investigations previously conducted at OU4 and evaluates their usefulness for the current site characterization efforts. Information, data, and conclusions from the previous investigations have been used in this RFI/RI program to develop preliminary conceptual models and to develop a database. Appendix II B supplements this section and provides a tabulated summary of previous investigations in the SEPs area.

In 1951, before any buildings or structures were constructed, the area occupied by the existing SEPs was evaluated to determine the suitability of the site for a pond. A report was prepared that discussed the geology of the site and the ground water as it was known from document review and from a review of core samples extracted from boreholes for laboratory analyses (Mudge and Brown, 1952). Boreholes had been drilled in the vicinity of the proposed major buildings (including Buildings 771, 881, 444, and 123) to determine geotechnical properties of the subsurface materials for design purposes. Much of the ground water

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information in the Mudge and Brown report was obtained from a previous study of ground water conditions at the RFETS (Austin, 1951), which recommended drilling several wells upgradient and downgradient of the site to monitor the ground water. Both of these documents indicate that pediment gravels overlie impervious clays, but that the clays are fractured and capable of transmitting water downward. Mudge and Brown concluded that the area was not suitable for an unlined pond because of the potential for downward migration of water. Approximately two years after these studies, in 1953, the Original Ponds were constructed and lined with bentonite, as shown in Figure II 1-2.

In 1954, a spring on the hillside north of the Original Ponds was sampled and determined to be contaminated with nitrates. The Waste Disposal Coordination Group at the RFETS concluded that the contamination in the spring was a result of leakage from the original clay-lined pond. A test well (Well 0154) was dug at the northeastern corner of the Original Pond and the spring was enlarged so that water samples could be collected. These actions and the subsequent monitoring of the spring were reported in the monthly progress reports of the Rocky Flats Waste Disposal Coordination Group. The spring monitoring indicated an increase in both nitrate concentration and radioactivity. This indication prompted the construction of the asphalt-lined SEP 207-A in 1955 and the 207-B Series SEPs in 1960.

Upon completion of the 207-B Series SEPs in fall 1960, six monitoring wells shown on Figure II 1-2 as abandoned monitoring wells 0160, 0260, 0360, 0460, 0560, and 0660 (well 0660 is not shown) were installed near these ponds and were routinely monitored for nitrates and radionuclides through the late 1980s. These wells were subsequently abandoned and selectively replaced as part of the RFETS-wide Well Abandonment and Replacement Program (WARP). Monitoring of these wells was performed as part of the routine operation of the SEPs, but the data were not presented in a report.

During 1960, drainage tiles were installed between SEP 207-A and the 207-B Series SEPs, and east of the 207-B Series SEPs, as shown on Figure II 1-3. The purpose of the tiles was to intercept seeps beneath the eastern berm of SEP 207-A identified during construction of the 207-B Series SEPs and to prevent seeps from forming east of the 207-B Series SEPs after their construction. Between 1960 and 1970, the drainage tiles discharged water to ditches on the northern hillside. Discharged water was periodically collected and sampled for nitrates and radioactivity. During 1970, empty steel drums were partially buried at the discharge points to collect water, which was then pumped to SEP 207-A or SEP 207-B North. The buried drums are identified as Sumps 1 and 2 (EG&G, 1992b) and are shown on Figure II 1-3.

During the 1950s and early 1960s, the RFETS Site Survey Group periodically monitored the area around the SEPs for radioactivity. Monitoring was performed routinely as well as in response to specific events. As with the activities of the Waste Disposal Coordination Group, the Site Survey Group reported their activities in monthly progress reports which were not summarized in a report. One of the specific events that involved the Site Survey Group was removal of soil from Pond 2-Auxiliary (Figure II 1-2) in 1962 prior to the construction of Building 779.

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During 1966, three deep wells (0166, 0266, and 0366) were constructed to monitor the sitewide ground water conditions. Well 0266 was located east of the SEPs in the OU4 area and Well 0366 was located further east of the OU4 area, as shown on Figure II 1-2. The results of chemical analyses of waters from these wells were presented in the monthly reports of the Waste Disposal Coordination Group, however, these results were not summarized in any published documents.

As the use of the SEPs increased because of expanded production at the RFETS, the landslide potential of the hillside north of the SEPs was questioned. An investigation was performed on the stability of the hillside, which included drilling 10 boreholes (Woodward-Clyde & Associates, 1970). Many of the boreholes were equipped with a perforated casing to monitor water level fluctuations. The study concluded that the hillside was at high risk of failure, particularly with the probable addition of water from the SEPs themselves. It was recommended that a french drain system be installed to remove ground water.

In 1971, an additional well (Well 0671, Figure II 1-2) was installed on the hillside north of the SEPs. The well was installed as part of a program to expand sitewide ground water monitoring at the RFETS. The program was motivated by such events as the 1969 fire, cleanup of the 903 Pad contamination, and removal of the leaking drums from the Mound area, as well as by a general increased awareness of the need for environmental protection.

During October 1971, Trenches 1 and 2 were excavated northeast of SEP 207-B North and SEP 207-A, respectively. Initially, ground water collected in the partially buried drums located on the downhill ends of the trenches was manually pumped to the SEPs. By May 1972, automatic pumps were installed in the trenches. Shortly thereafter, Trench 3 was constructed. The locations of the trenches were selected based on visual observation of stressed vegetation. Observations were made by the plant personnel, but a formal study was not performed for this remedial action. The water collected in the trenches was analyzed and returned to the SEPs. The analytical results were not reported. In the spring 1973, the area experienced particularly high precipitation and the trenches were allowed to overflow to prevent overfilling the SEPs which were nearly full. Trenches 4 and 5 were installed in April 1974, and Trench 6 was installed in July 1974. Figure II 1-3 shows the locations of these trenches.

During 1974, the presence of nitrates in the soil north and northeast of the SEPs was recognized from stressed vegetation and soil analyses. An evaluation of the total quantity of nitrates present in the soil was undertaken to identify a cost-effective method of nitrate removal. Conditions were investigated by drilling 56 soil boreholes (Dow Chemical, 1974a) in grid patterns in three areas north of the SEPs known to have high concentrations of nitrates. Soil samples were collected at 1-foot intervals from each borehole located on Figure II 1-2. The study concluded that approximately 60 percent of the total quantities of nitrates was located within 5 feet of the ground surface. It was also stated that little, if any, nitrate contamination was entering North Walnut Creek, although the basis for this statement is not clear.

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Later that year, a presentation by the RFETS Environmental Group summarized the results of the nitrate-in-soil study (Dow Chemical, 1974b). Data presented indicated that an elongated nitrate anomaly in soils was present and centered around the bifurcated drainage entering North Walnut Creek from the south. According to the study, the data collected during the early 1970s indicated that the presence of nitrates in the soil was a seasonal problem. Several alternative solutions were presented that included the following, although none was subsequently implemented:

- *In situ* aqueous leaching followed by treatment of the leachate,
- Soil removal (the excavated material could be used as organic fertilizer), and
- *In situ* bioremediation

Several investigations unrelated to the SEPs were performed elsewhere at the RFETS in the early 1970s to delineate the shape of the bedrock surface beneath the alluvium, with particular emphasis on the channeling of ground water (Ackermann, 1974, de Oliveira, 1975). The bedrock paleotopographic surface was delineated using seismic refraction methods, and was shown to be highly irregular. An undulating bedrock paleotopographic surface is present beneath the existing SEPs.

During the early 1970s, the Water Control and Recycle Study was performed. Recommendations of the study were later implemented as the Water Control and Recycle Program. The study addressed the major surface water features at the RFETS, including the SEPs and North Walnut Creek. A portion of the project specifically addressed ground water transport of nitrate from the SEPs area into North Walnut Creek (Engineering-Science, Inc (ES), 1975). The ES report stated that during operation, cracks developed in the lining of the SEPs, and nitrate wastes entered the ground water and migrated downgradient. The nitrate-bearing ground waters discharged at the surface as seeps which were indicated by dead or stimulated vegetation, depending on the nitrate concentration. Nitrate was detected in the retention ponds constructed in the Walnut Creek drainage (A-series ponds) at levels that typically were below the drinking water standards for most of the year. The ES report suggested that radionuclides were not present in the seep water due to the filtering action of the soil and the ion exchange capacity of clay minerals.

As part of the Water Control and Recycle Study, 31 wells and boreholes were drilled by ES (TH series boreholes and wells with a 74 suffix, Figure II 1-2) and the new data were evaluated in conjunction with data collected during the previous two and a half years from the existing wells, trenches, and sumps in the area. Some of these wells currently exist at OU4. Based on the nitrate concentrations detected in the ground water samples, a nitrate plume was identified north of the SEPs extending toward North Walnut Creek. The results of the ground water study and the soil study performed the previous year suggested that the majority of the nitrates occurred in the more permeable soil lenses. It was further suggested that the nitrates would continue to be leached from the soil and transported with ground water toward North Walnut Creek.

A number of abatement measures were undertaken at the SEPs in the mid-1970s as part of the implementation of the Water Control and Recycle Program. Water and waste streams at the RFETS were identified, and a master plan was developed to transfer liquids between the various retention ponds in the creek drainage basins at RFETS and the SEPs. A new reverse-osmosis treatment plant constructed in Building 910 was placed in service in 1979 for removal of dissolved solids from post-treatment sanitary effluent. As part of the Water Control and Recycle Program, sanitary wastewater effluent was pumped from Building 995 (Sanitary Treatment Plant) to SEP 207-B South for flow equalization prior to treatment in Building 910. For various reasons, treatment efficiency of the system did not meet design criteria and Building 910 was effectively removed from service in 1984. The facility has been used intermittently to support SEP water treatment during closure. Two open beds adjacent to Building 910 originally were used to store brine from the reverse osmosis process. After discontinuation of that process, the beds were used for drying sludge from the Sanitary Treatment Plant.

As part of implementing the Water Control and Recycle Program, the 207-B Series SEPs were cleaned and prepared for water storage for the proposed reverse-osmosis plant in early 1975. This preparation involved moving liquid and sludge from the 207-B Series SEPs into SEP 207-A, installing a flexible membrane liner in SEP 207-B South, and rinsing the bottoms of the B-series SEPs with water. During the course of the work, low-level alpha contamination was detected around the perimeters of the SEPs. Soil contamination was also detected on the downwind side of SEP 207-A. Contaminated soil from around the SEPs and in the area of the proposed Building 910 was removed over the next several years. In the summer of 1976, the effectiveness of the cleanup of the 207-B Series SEPs was evaluated, and contamination was found on and under the liner and in nearby soil.

Later that year, a program of sampling and direct counting was initiated which consisted of coring the liner and augering into the deeper soil beneath some of the SEPs (predominantly SEP 207-B North). Based on these data, a map of activity levels in the vicinity of the SEPs was prepared. The following spring, soil removal at the SEPs was initiated on a larger scale. Throughout the soil removal activities, the air was monitored for increased radioactivity due to ground disturbance. Although a dust control program involving the applications of water or Coherex® (a petroleum-based dust suppressant) was implemented, operations were frequently halted because of potential health effects of excessive long-lived alpha concentrations in the air. Concurrently, contaminated soil was removed in the Triangle Area (IHSS 165) of OU6 east of OU4. Both programs removed sufficient soil so that radioactivity was no longer above the level of concern (250 counts per minute as measured using a Field Instrument for the Detection of Low-Energy Radiation [FIDLER]). The soil removal activities resulted in significant alteration of the surface topography.

From July 1975 to December 1975, a sitewide program was conducted to evaluate the non-nuclear remote sensing studies performed at the RFETS (Lackey and others, 1976). Several methods were employed to investigate the existence of possible faults or a shear zone near the site. As part of the program, the locations of seeps were identified at the RFETS. It was concluded that most of the leakage from the SEPs probably surfaced at seeps on the sloping sides.

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of the North Walnut Creek valley at the interface between the Rocky Flats Alluvium and the Arapahoe Formation. Additional hydrological and geological studies were recommended.

The design of the Perimeter Security Zone (PSZ - the triple-fenced zone surrounding the Protected Area [PA]) required drilling more than 100 boreholes to determine subsurface conditions. Fourteen of the boreholes were drilled in the area of the SEPs in late 1978. An additional investigation was performed in 1979 to evaluate an alignment change on the hillside north of the SEPs (CTL/Thompson, 1979). Previous investigators had identified the area as having a high potential for landslide movement (Woodward-Clyde & Associates, 1970). The CTL/Thompson report (1979) included a description of the subsurface soil and ground water conditions encountered in five of the boreholes in the area of greatest landslide potential. The field investigation found that the clay and claystone bedrock underlying the alluvium contained shear zones, indicating prior disturbance. The investigation also confirmed previous conclusions regarding landslide potential. The report concluded that most of the bedrock within the depths investigated was disturbed from past ground movements, the hillside was underlain by both ancient and recent landslides, and the planned construction of deep fills on the hillside for the PSZ would contribute to instability by loading the unstable, disturbed natural materials.

The CTL/Thompson report (1979) evaluated three stabilization options. The first, which was considered the most complex and costly, involved excavation of the disturbed soils and replacement with an engineered buttress fill. The second option was to de-water the hillside. The third option, which was the most strongly recommended, was to flatten the fill slopes or construct stabilizing berms downhill of the planned construction. The effectiveness of the de-watering option was considered somewhat uncertain because of limitations on the practical depth of de-watering and the presence of non-uniform water table conditions. The CTL/Thompson report (1979) concluded that ground water was flowing in distinct channels on the hillside as evidenced by the many distinct seepage areas at the ground surface and the variable depth to water in the boreholes. The conceptual design of a subsurface drainage system for the de-watering option involved 4-inch-diameter perforated pipe placed in trenches backfilled with clean coarse-grained sand. The trenches were to be on 100-foot centers and approximately 5 feet deep, graded to drain by gravity to a central collection sump. It is not known which, if any, of these options was implemented.

In 1981, it became necessary to remove excess ground water from the area where the fences and patrol roads associated with the PA were to be constructed. The installation of the fences and the patrol roads necessitated destruction of several of the ground water or seep collection trenches on the hillside north of the SEPs. The ITS was constructed in April 1981 (shown on Figure II 1-3), and the six trenches and two sumps were taken out of service. The hillside was significantly altered during the PA construction activities, with up to 25 feet of fill placed beneath the PSZ. Large quantities of fill materials also were placed in the area of the SEPs and are presumed to have different geotechnical properties than the previously characterized native soils.

To meet federal environmental regulations, an Environmental Impact Statement (EIS) for the RFETS was compiled in 1980. In that EIS, a synopsis of the environmental impact of the SEPs was presented based on the information known to date. Most of the information was extracted from previously existing documents, which are discussed in this report.

In early 1982, nitrate-contaminated surface water originating from seepage on the hillside below the SEPs was again observed. Surface water discharged from the seeps was directed by culverts down the hill into North Walnut Creek, bypassing the ITS ground water collection system. The culverts were originally designed to transport precipitation runoff down the north hillside. To remediate this problem, the ITS was retrofitted with the ITS Southern Extension to intercept surface water adjacent to the Patrol Road inside the PA, as shown on Figure II 1-3.

In the early 1980s, a program was initiated to remove and manage the sludge that had accumulated in the SEPs. The Sludge Removal Project required construction of Building 788, located between SEP 207-A and SEP 207-C, and associated structures for creating "pondcrete" (a mixture of SEP sludge and Portland cement) with the sludge. Two boreholes were drilled to characterize the foundation conditions in the vicinity of Building 788 (Foundation Engineering Company, 1984). Based on logs from these boreholes and on a 1962 report on the foundation investigation for Building 779, it was concluded that the interpretations of subsurface conditions were inconsistent. It was stated in the report that "local regulations would not permit recovery of soil samples for laboratory analysis," so the subsurface characterization was based on visually identified properties. Design recommendations included the requirement that utility line trenches in close proximity or leading into the building should be backfilled with impervious materials similar to the *in situ* soils to prevent impounding of water below the structures. Excavation and construction of Building 788 altered the geotechnical properties of the subsurface soils beneath the immediate area.

A 1985 investigation produced the first comprehensive evaluation of the RFETS hydrogeologic data collected to date (Hydro-Search, Inc., 1985). Both existing data and newly collected data were used in the characterization. Existing data included geologic logs from numerous boreholes, water level records, water quality data, and a review of published and unpublished reports. New data collected for the study included geophysical logs, single-hole drawdown recovery tests, and a location survey of the wells. The report provided sitewide characterization information such as geochemistry data for surface water, alluvial ground water, and bedrock ground water. The report also provided a summary of many historical reports. Some of the geophysical and hydrological testing activities were performed in wells in the SEP area. The report concluded that there were deficiencies and data gaps in the understanding of the overall site hydrogeology. However, the SEPs were identified as one of eight possible sources of high total dissolved solids (TDS) leaving the site. Shortly after submittal of the characterization report, an electromagnetic (EM) survey was performed at the periphery of the PSZ and in downgradient drainages in the buffer zone (Hydro-Search, Inc. 1986). The EM survey was performed to direct future site characterization efforts. The hillside soils north of the SEPs were found to be highly conductive, suggesting the presence of contaminated ground water. A recommendation of the report was to install new monitoring wells around the SEPs.

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In 1986, a RCRA Part B operating permit application was submitted to the Colorado Department of Health (CDH). The RFETS reported that the SEPs were an interim status unit scheduled to be closed. The SEPs were identified as a Solid Waste Management Unit (SWMU) (later to become an IHSS). A section pertaining to ground water protection was included in the RCRA Part B submittal in response to the 1986 Compliance Agreement between the RFETS and the agencies. Information regarding the ground water monitoring program and subsurface characterization was presented for the entire site and specifically for the SEPs. A program was initiated that included installation of 17 RCRA wells in the SEP area in 1986 (shown on Figure II 1-2 as wells identified with an 86 suffix), greatly expanding the ability to monitor subsurface conditions related to the SEPs. Hydrogeologic tests were conducted in some of these wells. A draft RCRA Interim Status Closure Plan (Rockwell International, 1986) was submitted for the SEPs which summarized testing results and outlined the method for removing the SEPs from service and properly disposing of the potentially-contaminated materials.

Eighteen boreholes were drilled in 1987 in the SEP area to acquire additional soil chemistry data specific to the SEPs. (The locations of these boreholes are designated with an 87 suffix and are shown on Figure II 2-18 in Section II 2, OU4 Field Investigation). This information was sought in response to comments on the draft RCRA Interim Status Closure Plan submitted in 1986 that were directed in part to the collection of additional characterization data. Two of these boreholes were completed as wells for more ground water monitoring capability. Subsurface conditions were evaluated based on 1987 data as well as on the additional data collected since submittal of the 1986 report. Boreholes not completed as wells were backfilled and no monuments were left indicating their location.

A draft Final Closure Plan was submitted in 1988 which presented a detailed plan for future characterization efforts. This closure plan addressed other SWMUs (IHSSs) in the area that are no longer part of OU4. Thirty-seven monitoring wells (designated with a 89 suffix, Figure II 2-18) were installed in 1989 to fulfill the commitments made in the 1988 Final Closure Plan. The monitoring plan was expanded to meet RCRA ground water monitoring requirements such as quarterly monitoring and an expanded analyte list. Since 1988, Annual RCRA Ground Water Monitoring Reports for Regulated Units have been submitted, which include monitoring data collected during the previous year and an evaluation of ground water conditions.

The additional 37 wells were drilled at locations identified as data gaps in the 1988 characterization. When drilled, lithologies logged in some of the 1989 boreholes did not agree with lithologies anticipated from 1988 data, prompting a close review of all of the lithologic data. Some of the archived cores were pulled and found to be incorrectly described in the lithologic logs. As a result, a program was initiated to re-log the core from the 1986, 1987, and 1989 drilling efforts, using strict quality control procedures. After a percentage of the cores was re-logged the following year, most of the original logs and the "new" logs of the same boreholes were found to be similar. It was concluded that the cores re-logged after the 1989 program and found to be inconsistent with the logs previously generated were isolated occurrences. The re-logging program resulted in greater consistency in logging procedures for future programs.

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During 1990, in response to the Agreement in Principle between the State of Colorado and the DOE, a study was begun addressing zero offsite water discharge. The ITS was evaluated as part of the study (ASI, 1991). The study assessed possible management alternatives for water collected by the ITS. The investigation included a review of analytical data of the water to be managed and a computation of the quantity of water collected. The quantitative study assessed discrete portions of the system in addition to the overall system. Each surface water monitoring site in the SEP area was assessed for both water quality and quantity, and an evaluation was made regarding variations in the sources of the contaminants identified. Similarly, data from each ground water monitoring well were assessed based on the specific geologic unit sampled and the variations in contaminants. The study recommended four management alternatives for the water collected by the ITS, including treatment by mechanical evaporation, treatment through the sewage treatment plant, separate treatment based on isolating discrete portions of the collected flow, and a combination of treatment through reverse osmosis and mechanical evaporation. Implementation of this study was preempted by the signing of the IAG in 1991. All of the ITS water is currently being collected in holding tanks and processed through the Building 374 treatment process. The Building 910 treatment process is available for treating ITS water but is not routinely used.

During 1992, there was a brief investigation addressing whether or not the 207-B Series SEPs were leaking into the uppermost aquifer (EG&G, 1992e). This was accomplished by sampling wells in the vicinity of the SEPs for a dye that was placed in the SEPs. The sampled wells were completed in either the alluvium or the silty claystones of the Arapahoe Formation. Based on this study, it was determined that no leakage was occurring from the 207-B Series SEPs.

The information presented in some of these preceding studies indicates that interpretations of subsurface conditions at the SEPs vary and are possibly dependent upon the study techniques used. For example, conclusions from a soil study performed during 1974 indicated that nitrate concentrations were greatest in the upper 5 feet of soil. Conversely, a study conducted during 1987 concluded that soil samples contained the highest nitrate concentrations just above the bedrock. The interpreted subsurface conditions are influenced by the investigation objectives, field and laboratory methods, the past and present condition of the SEPs, subsurface utilities, the ITS, and other engineered alterations.

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**SOLAR EVAPORATION PONDS
OU4 IM/IRA EA DECISION DOCUMENT
PART II
PHASE I RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION**

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II.2 OU4 FIELD INVESTIGATION

This section describes the activities conducted during the OU4 Phase I RFI/RI to accomplish the objectives described in Section II 1, Introduction. Deviations from the Work Plan, associated Technical Memoranda (TMs), and Standard Operating Procedures (SOPs) are noted, as appropriate. Table II 2-1 provides an overall summary of work completed during the investigation.

The liquids and sludges in the SEPs are currently being removed and stored. SEP 207-A was cleaned out during spring 1992. SEPs 207-B North and 207-B Center were cleaned out during summer 1993. Both SEPs 207-B South and 207-C are scheduled to be cleaned out during fiscal years 1994 and 1995.

II.2.1 Site Investigation Objectives and Overview

The following is a brief description of the objectives of the investigation, as described in Section II 7, Field Sampling Plan, of the OU4 Phase I RFI/RI Work Plan, with the exception of the Baseline Risk Assessment, which will be completed during the OU4 Phase II RFI/RI.

Characterize Original Ponds and existing ponds

- Characterize the types and distribution of contaminants and other unique features of the original pond
- Evaluate the relative significance of SEP liner materials as potential sources of contamination, and the effectiveness of liners as barriers to contaminant migration
- Characterize surficial soils potentially contaminated by aerosol dispersion in the vicinity of the SEPs
- Characterize the types and distribution of potential contaminants, variations in contaminants, hydrologic features, and other unique characteristics of vadose zone contamination in the SEPs area
- Locate and identify subsurface features such as piping, tanks, and structures in the vicinity of the SEPs
- Identify subsurface geologic features, such as subcropping sandstones and fractured bedrock, that may contribute to contaminant migration in the SEPs area

Characterize the ITS

- Evaluate the construction of the ITS to assess its effectiveness in intercepting SEP contaminants in ground water
- Characterize the location, types of contaminants, and variability in contaminant concentration in unconsolidated materials in the vicinity of the ITS

The data generated during the OU4 Phase I RFI/RI were used to evaluate the nature, extent, transport mechanisms, and fate of site contaminants, and were incorporated into the development and screening of remedial alternatives. Additionally, the data will be used to supplement the development of the OU4 Phase II RFI/RI Work Plan.

Field and laboratory activities were completed in accordance with the OU4 Phase I RFI/RI Work Plan, as modified by Technical Memorandum No 1, (TM1) *Vadose Zone Investigation*, and Technical Memorandum No 2, (TM2) *Modifications to Field Activities*. The following sections summarize specific activities completed to meet the objectives outlined above. The evaluation of the ITS is incorporated into the OU4 Phase II RFI/RI Work Plan.

II.2.1.1 Original and Existing Ponds Investigation Overview

The following is provided as an overview of the SEPs investigation.

II.2.1.1.1 Original Ponds

The investigation of the Original Ponds area was designed to characterize the types and distribution of contaminants in surface and subsurface soils, to evaluate the physical features and dimensions of the Original Ponds, and to identify the presence of pond construction materials (clay liner, piping, and other equipment) that may have been abandoned in place. The following tasks were completed during this investigation:

- Historical aerial photographs, engineering drawings, and associated documentation were reviewed to define the boundaries of the Original Ponds.
- A GPR survey in the vicinity of the Original Ponds area was completed to identify boundaries of the Ponds and abandoned equipment and construction materials that were buried. This survey was reduced in scope, as described in TM2, from that described in the Phase I Work Plan based upon historical data review. Areas in OU4 surveyed using GPR are shown on Figure II 2-1, and details of GPR survey lines in the Original Ponds area are shown on Figure II 2-2.
- Subsequent to the historical data review and GPR surveys, six boreholes were drilled in or adjacent to the Original Ponds area. Three boreholes were completed.

within the approximate boundaries of the Original Ponds, and three boreholes were drilled outside those boundaries. Subsurface soil samples were collected at each of the locations. Figure II 2-3 shows the locations of all boreholes drilled during the OU4 Phase I RFI/RI, and the approximate locations of the Original Ponds. Figure II 3 1-15 in Section II 3, Results of the OU4 Phase I RFI/RI, shows the six boreholes drilled to investigate the Original Ponds area.

- Surficial soil samples were collected at each of the borehole locations prior to drilling as part of the surficial soil sampling program.
- Surficial and subsurface soil samples were collected and analyzed for suspected contaminants. The analytical requirements and methods are described in Section II 2 3 1, Original Ponds Investigation, and in Section II 2 4, Surficial Soils Investigation (also subsequently summarized in Table II 2-4).

Section II 2 3 1, Original Ponds Investigation, provides a detailed description of the activities undertaken. The results of the Original Ponds investigation are presented and discussed in Section II 3 1 1, Original Ponds.

II.2.1.1.2 Existing Ponds (IHSS 101)

The objectives of the investigation of IHSS 101 included evaluating the presence of buried utilities and debris beneath the SEPs and evaluating whether contamination is present in subsurface, unconsolidated geologic materials. The following activities were completed as part of the investigation of IHSS 101.

- Visual inspections were made of SEPs 207-A, 207-B Center, and 207-B North to evaluate the integrity of the liners and to determine the accessibility and optimum location for the proposed boreholes.
- A GPR survey was completed to assess the presence of buried utilities and debris beneath a portion of SEP 207-A and to aid in the identification of breaches of the liner beneath the top asphalt coat. The locations of the GPR survey lines are shown on Figure II 2-4.
- An OU4-wide beta/gamma radiation survey was conducted that included the areas in the immediate vicinity of IHSS 101. Beta/gamma and alpha surveys were conducted within SEPs 207-A, 207-B Center, and 207-B North. Figures II 2-5 through II 2-8 show the locations where radiological measurements were made.
- A seismic refraction survey was completed to evaluate bedrock topography and the presence of paleochannels and/or buried channels in the vicinity of IHSS 101. Figure II 2-9 shows the locations of the seismic refraction lines.

- Twelve boreholes were completed and subsurface soil samples were obtained from within SEPs 207-A, 207-B Center, and 207-B North for characterization purposes at the locations shown on Figure II 2-10 Sixteen boreholes were completed between the ponds and around the perimeter of IHSS 101 (Figure II 2-3)
- Twelve samples of the asphaltic liner and sub-base material were collected from SEPs 207-A, 207-B Center, and 207-B North at the borehole locations within the SEPs, as shown on Figure II 2-10
- One deep borehole (No 42193) within SEP 207-A was drilled into bedrock, sampled, and geophysically logged primarily for geologic characterization purposes Subsurface samples were also collected and analyzed for geochemical characterization purposes, the results of which are discussed in Section II 3, Results of the OU4 Phase I RFI/RI
- Fifteen lysimeters were installed in the vicinity of IHSS 101 and throughout OU4 for vadose zone characterization purposes The locations of the lysimeters are shown on Figure II 2-11 Sixteen neutron probe access tubes were also installed for soil moisture measurements The locations of the access tubes are also shown on Figure II 2-11
- Soil, bedrock, asphalt, and pore water samples were collected and analyzed for suspected contaminants Section II 2 3 2, Existing SEPs (IHSS 101) Investigation, describes the analytical requirements and methods for the respective media The analytical parameters, sampling and analytical frequency, and analytical methods are summarized in Table II 2-4

Section II 2 3 2, Existing Ponds (IHSS 101) Investigation, describes in more detail the specific activities completed The results of the existing SEPs investigation are presented and discussed in Section II 3 1 2, Existing Solar Evaporation Ponds

II.2.1.2 Surficial Soils Investigation Overview

The objective of the surficial soils investigation was to evaluate whether contaminants are present in the upper 2 inches of the surficial soils Contaminants present in these soils are assumed to have been deposited by aerosol dispersion and deposition This objective was accomplished by completion of the following tasks

- An OU4-wide gamma radiation survey consisting of 311 data points was completed to evaluate the presence of radionuclides resulting from aerosol dispersion The gamma radiation survey locations are shown on Figure II 2-5

- Twenty-six random and 10 discrete surficial soil samples were collected to assess the presence of suspected contaminants, the locations of these samples are shown on Figure II 2-12. The analytical requirements and methods for analyzing these samples are described in Section II 2 4 2, Surficial Soil Sampling and Chemical Analysis, and are summarized in Table II 2-4.
- Surficial soil samples were obtained from the 36 borehole locations shown on Figure II 2-12 and were analyzed for the parameters listed in Table II 2-4 to augment the results from the random and discrete soil samples.

The results of the surficial soils investigation are presented and discussed in Section II 3 2, Surficial Soil Investigation Results. An evaluation of the nature and extent of potential surficial soil contamination is presented in Section II 4 0, Nature and Extent of Contamination.

II.2.1.3 Vadose Zone Investigation Overview

The design and rationale for the vadose zone investigation was described in TM1. The objectives of this investigation included:

- Characterizing potential contamination within the vadose zone. Evaluating the physical and hydrologic characteristics of the vadose zone that may contribute to contaminant migration, and acquiring an adequate understanding of the site to predict how the vadose zone will respond to changes in the hydrologic system,
- Evaluating the applicability of different vadose zone monitoring techniques, and,
- Developing a vadose zone data base to support future risk assessments, to support analysis of remedial alternatives, and to assist in the development of post-closure monitoring approaches.

The following activities were completed during this investigation:

- Approximately 200 subsurface soil samples from the vadose zone were collected for chemical analyses. The samples were collected from borehole locations shown on Figure II 2-3.
- Nine samples were collected for column leaching tests at the locations shown on Figure II 2-13.
- Twenty-five soil samples were collected for analysis of physical and hydrologic properties at the locations shown on Figure II 2-13. The analytical requirements and methods are described in Section II 2 5 2, Physical Properties of the Vadose Zone.

- Borehole permeability measurements were made using the Bengt-Arne-Torstensson (BAT™) system at the locations shown on Figure II 2-14
- Shallow soil permeability was measured at 19 locations using a Guelph permeameter. The locations of the Guelph permeameter tests are shown on Figure II 2-15
- Pore water samples were collected from lysimeters and chemically analyzed as described in Section II 2 5 4, Chemical Properties of the Vadose Zone. The locations of the lysimeters are shown on Figure II 2-11
- Relative moisture content in the vadose zone was measured using a neutron probe at the locations shown on Figure II 2-11
- Data loggers and pressure transducers were installed in five wells to measure the response of the water table to precipitation events and to evaluate responses attributable to secondary porosities. Water level measurements were collected at an additional 54 wells on a routine basis. The locations where water level measurements were taken are shown on Figure II 2-16
- Soil gas samples were collected at the 28 locations shown on Figure II 2-17 for the measurement of specific volatile organic compounds in the subsurface

Section II 2 5, Vadose Zone Investigation, provides a detailed description of the methods used to complete the investigation. The results of the vadose zone investigation are presented and discussed in Section II 3 3, Vadose Zone Investigation Results. The nature and extent of vadose zone contamination are described in Section II 4 4, Vadose Zone

II.2.1.4 Geologic Investigation Overview

The OU4 Phase I RFI/RI geologic investigation consisted of evaluating and incorporating all new and existing lithologic and geophysical data to refine the understanding of the subsurface geology beneath OU4. The purpose of this investigation was to identify geologic features, such as subcropping sandstones, paleochannels, and fractured bedrock that may act as preferential contaminant migration pathways. Channels or drainages that were backfilled with artificial fill during construction of the ITS and the PSZ also were investigated. The investigation was completed by integrating surface and subsurface geophysical measurements with historical and OU4 Phase I RFI/RI geologic data. Figure II 2-18 shows the locations of boreholes and monitoring wells in the OU4 area that were used to evaluate OU4 geology.

II.2.1.5 Interceptor Trench System Investigation Overview

The ITS was investigated to evaluate its effectiveness in capturing shallow ground water. The effectiveness would be determined by evaluating the extent to which the ITS is keyed into

bedrock and by evaluating the ground water head differential across the ITS. The investigation was accomplished by

- Reviewing historical records of flow measurements and water chemistry,
- Reviewing engineering drawings, associated documentation, and analyzing the ITS construction with respect to unweathered bedrock,
- Estimating ITS water balance, and
- Installing piezometer banks during the OU4 Phase I RFI/RI at the locations shown on Figure II 2-19 to measure water levels

The results of the ITS investigation are presented in the OU4 Phase II RFI/RI Work Plan

II.2.2 Summary of Procedural Guidance and Standards Documents

This section describes the applicable procedural guidance and documents that were used and/or developed for the OU4 Phase I RFI/RI

II.2.2.1 OU4 Phase I RFI/RI Work Plan

The Work Plan contains information concerning data needs and data quality objectives (DQOs), OU4 Phase I RFI/RI tasks, schedule, Field Sampling Plan (FSP), Human Health Risk Assessment (HHRA), Environmental Evaluation (EE), a Quality Assurance Addendum (QAA), SOPs, and addenda. The following is a summary of the components of the work plan

- Section 1 provides general introductory and overview information pertaining to the RFI/RI,
- Section 2 provides a review of historical information, previous investigations, and site physical characteristics, and a conceptual model of the nature, extent, and migration of site contaminants,
- Section 3 presents potential sitewide Applicable or Relevant and Appropriate Requirements (ARARs), as required by the IAG, and a discussion of their application to the RFI/RI activities at OU4,
- Section 4 discusses DQOs and work plan rationale for the OU4 Phase I RFI/RI,
- Section 5 specifies the tasks to be completed during the OU4 Phase I RFI/RI,
- Section 6 presents the proposed schedule for OU4 Phase I RFI/RI activities,

- Section 7 is the FSP,
- Section 8 discusses the Baseline Human Health Risk Assessment Plan (BRA),
- Section 9 discusses the EE,
- Section 10 discusses the site-specific QAA, and
- Section 11 presents the SOPs and Document Change Notices (DCNs) for conducting the work

No deviations from the work plan, as amended by TM2 described below, were noted during implementation of the field program

II.2.2.2 Technical Memorandum No. 1 - Vadose Zone Investigation

Prior to granting unconditional approval of the work plan, the CDPHE and EPA required the preparation of a technical memorandum addressing vadose zone characterization activities at OU4 TM1 to the Final OU4 Phase I RFI/RI Work Plan, *Vadose Zone Investigation*, presented the proposed vadose zone program and techniques to be implemented at OU4 In addition, TM1 presented SOPs for vadose zone monitoring activities The TM was structured such that specific activities were identified as "work elements " The activities completed during the OU4 Phase I RFI/RI, as required by TM1, are described in Section II 2 1 3, Vadose Zone Investigation Overview

The following paragraphs briefly describe deficiencies in the work elements identified in TM1

Work Element No 2 - Establish a three-dimensional geologic representation of the subsurface All data were integrated into a geographic information system (GIS) that was used to store and manipulate data, however, the spatial representation of data was determined to be most clearly shown on planimetric maps and cross-sections

Work Element No 3 - Identify potential vadose zone pathways This is largely completed, however, the spatial distribution of macropore flow zones versus intergranular flow zones was not determined

Work Element No 5 - Implement borehole plan All boreholes except for those planned for the double-ring infiltrometer tests were completed The double-ring infiltrometer tests were deleted from the program because of the accelerated project schedule, and the because data were determined to be available from tests being conducted elsewhere at the RFETS

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Work Element No 6 - Characterization of chemical and physical properties of soils.

This task was completed except for the quick-response, portable tensiometer measurements of soil cores. The tensiometer measurements were not made because the instrument was mistakenly thought to be inoperable, however, subsequent laboratory measurements of moisture content of a number of soil samples and calculations of matric potentials provided similar data.

Work Element No 8 - Infiltration, hydraulic conductivity, and storage

The two double-ring infiltrometer tests planned in TM1 were not completed due to the accelerated project schedule. The data were determined to be available from tests being conducted elsewhere at the RFETS. Neutron probe measurements were made in the 16 vadose zone monitoring locations, however, the probe was not calibrated against site-specific soils, and the data were not used to quantitatively measure *in situ* moisture content. The data were used successfully for qualitative interpretations of *in situ* moisture content variations.

Work Element No 10 - Conduct water balance

Vadose zone volumetric water calculations were not made because the neutron probe was not calibrated to site-specific soil moisture conditions.

Work Element No 11 - Pore liquid chemistry

One lysimeter was not installed due to a shallower-than-expected bedrock surface at borehole location 42693 north of SEP 207-A. This lysimeter was not relocated. The list of chemical parameters to be analyzed was revised and prioritized due to the limited quantity of pore water available during sampling.

Work Element No 13 - Estimate contaminant partitioning

The statement " evaluate potential remedial alternatives " found at the bottom of paragraph 2, page 2-24 of TM1 is addressed in Part III of the IM/IRA EA DD. Nitrate and major cations/anions were analyzed during the column leaching tests, metals and radionuclides were not analyzed due to the limited volumes of leachate obtained. Contaminant partitioning was not estimated because the necessary constituents were not analyzed.

Work Element No 14 - Characterization of vadose zone pathways

This work element was completed qualitatively to the extent possible with the available data. The data obtained were insufficient or inappropriate to establish the relationships proposed in TM1, such as transport pathway type for each geologic unit, vadose zone flux, pathway locations and orientations, the interrelationships between the different pathways, and a three-dimensional representation of the vadose zone flow system.

II.2.2.3 Technical Memorandum No. 2 - Modification to Field Activities

TM2 to the Final OU4 Phase I RFI/RI Work Plan, *Modifications to Field Activities*, was completed during May 1993. The purpose of TM2 was to document changes required for implementation of the work plan. The basis for modifying the work plan through TM2 included the technical reassessment of field investigation methods or technologies described in the work plan, clarification of vague or confusing language in the work plan, establishment of undefined procedures, inaccessibility of several of the SEPs due to the presence of liquids and/or sludges, and an increased level of understanding of the hydrogeologic and geochemical environment of OU4 during the period between completion of the work plan and implementation of field activities. Changes to the work plan identified in TM2 pertained specifically to Section 7.0, Field Sampling Plan. The changes or revisions addressed in TM2 included

- Modification to the surface soil radiological surveys to include only beta/gamma radiation surveys,
- Modifications to the visual surveys of the SEPs,
- Modification of the geophysical surveys and rationale for the modifications based on pilot study results,
- Modification of the surficial soil sampling procedures and rationale for placement of the random and discrete samples,
- Placement of interim boreholes adjacent to SEP 207-C and the 207-B series SEPs until the SEPs are drained and boreholes can be drilled inside them,
- Deletion, postponement, or modification of selected boreholes,
- Relocation of piezometer banks and installation of piezometers in boreholes, and
- Modification of the subsurface sampling program beneath SEP 207-A.

TM2 was closely followed and only a few deviations from the proposed work were noted. The deviations included

- Relocating surficial soil sample No. 400393 from approximately the midpoint of the western berm of SEP 207-A just south of Building 788 to the northwestern corner of SEP 207-A,
- Not collecting surficial soil samples from two of the boreholes drilled for the vadose zone investigation: borehole 45893 located in piezometer bank PZ04 on the hillside north of SEP 207-C, and borehole 46293 located in piezometer bank PZ01 on the hillside north of SEP 207-B North. Surficial soil samples were

collected from nearby locations and data from these two locations were thought to be redundant, and

- Collecting surficial soil samples from two planned borehole locations which were deleted from the program (A surficial soil sample was collected at borehole location 41893, which was deleted from the program because it was situated in OU6. A surficial soil sample was collected at borehole location 42693, which was located on the hillside north of SEP 207-A. This borehole was deleted from the program because bedrock directly underlies the surficial soils, which rendered that location inappropriate for obtaining vadose zone data from unconsolidated geologic materials.)

II.2.2.4 Document Change Notices to Standard Operating Procedures

DCNs also were submitted, as required by EG&G, to modify RFETS SOPs that govern field measurements and activities. The applicable DCNs submitted during Phase I are listed below and copies are included in Appendix II C.

DCNs to SOPs for OU4 Phase I RFI/RI Implementation

DCN No	Date	Document	Title
93 04	3/17/93	SOP 5-21000- OPS FO 14 (Rev 2)	Field Data Management
93 01	2/17/93	SOP 5-21000- OPS FO 06 (Rev 2)	Handling of Personal Protective Equipment
93 09	5/11/93	SOP 5-2100- OPS GT 06 (Rev 2)	Monitoring Wells and Piezometer Installation
93 03	5/11/93	SOP 5-21000- OPS FO 10 (Rev 2)	Receiving, Labeling, or Handling Environmental Material Containers

II.2.3 Original Ponds and Existing Ponds Investigation

The following sections describe the various components of the Original Ponds and existing ponds investigations. The original earthen ponds are former SEPs constructed during the early 1950s in and south of the area of current SEP 207-C. The existing SEPs are the five surface impoundments that currently exist in OU4 and comprise IHSS 101. These current impoundments are designated SEPs 207-A, 207-B North, 207-B Center, 207-B South, and 207-C.

II.2.3.1 Original Ponds Investigation

The primary objectives of the Original Ponds investigation included locating the boundaries of the ponds and locating any piping or other debris remaining in place after the ponds were removed. These objectives were met by reviewing historical aerial photographs and engineering drawings, and implementing GPR surveys, which are described below. Additional objectives of the investigation included characterizing the chemistry of the near-surface and subsurface soils, identifying the presence of former clay liner material, providing information on the depth to ground water, and better defining the underlying bedrock surface and zones of weathering. These activities also are described in the following subsections.

II.2.3.1.1 Historical Aerial Photographs Review

A number of aerial photographs were reviewed to determine the locations of the Original Ponds and to evaluate optimum locations for the OU4 Phase I RFI/RI boreholes. A listing of the photographs reviewed is presented in Table II 2-2.

II.2.3.1.2 Engineering Drawings Review

Engineering drawings were reviewed to determine the locations of the Original Ponds and any utilities or process waste lines present in the area. One purpose for this was review to optimize geophysical survey locations for a more accurate determination of whether GPR surveys are capable of locating utility corridors. Table II 2-3 lists the engineering drawings that were reviewed.

II.2.3.1.3 Ground Penetrating Radar Survey

A GPR survey of the Original Ponds area was completed during April 1993. Seven lines totaling 1,200 linear feet were recorded using a Geophysical Survey Systems, Inc. Model SIR System-6 GPR with a 300-megahertz antenna. The data were recorded on magnetic tape, and records were produced in the field to verify that the system was operating properly and that usable data were being collected. The tapes were later processed to eliminate background "noise" and to enhance the amplitude of anomalies detected along the lines. Section II 3 1 1, Original Earthen Ponds, presents and discusses the results of the GPR surveys.

II.2.3.1.4 Drilling, Sampling, and Chemical Analysis

The OU4 drilling program was implemented to accomplish specific objectives in different areas within OU4. These areas, as outlined in the Phase I Work Plan, include the Original Ponds area, the existing SEPs area, the ITS area, and the remainder of OU4. The methods for drilling and sampling at each location were similar throughout the program. To avoid repetition and redundancy, any subsequent description of drilling and subsurface sampling activities will be referred to this section. The following SOPs, as revised by DCNs, were adhered to, as applicable, during the drilling program.

- SOP GT 01 *Logging of Alluvial and Bedrock Materials*
- SOP GT 02 *Drilling and Sampling Using Hollow-Stem Auger Techniques*
- SOP GT 03 *Isolating Bedrock from the Alluvium with Grouted Surface Casing*
- SOP GT 05 *Plugging and Abandonment of Boreholes*
- SOP GT 06 *Monitoring Wells and Piezometer Installation*
- SOP GT 08 *Surface Soil Sampling*
- SOP GT 10 *Borehole Clearing*
- SOP GT 15 *Geophysical Borehole Logging*
- SOP FO 02 *Transmittal of Field QA Records*
- SOP FO 03 *General Equipment Decontamination*
- SOP FO 04 *Heavy Equipment Decontamination*
- SOP FO 06 *Handling of Personal Protective Equipment*
- SOP FO 08 *Handling of Drilling Fluids and Cuttings*
- SOP FO 10 *Receiving, Labeling, and Handling Environmental Materials Containers*
- SOP FO 11 *Field Communications*
- SOP FO 13 *Containerization, Preserving, Handling, and Shipping of Soil and Water Samples*
- SOP FO 14 *Field Data Management*
- SOP FO 15 *Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs)*
- SOP FO 16 *Field Radiological Measurements*
- SOP FO 18 *Environmental Sample Radioactivity*
- SOP FO 23 *Management of Drill Cuttings (draft)*

The samples collected were analyzed for the parameters listed in Table II 2-4

II.2.3.2 Existing Ponds (IHSS 101) Investigation

This section presents the components of the existing ponds (IHSS 101) investigation

II.2.3.2.1 Visual Inspections of SEP Liners

Visual inspections of the SEP liners were completed to evaluate the integrity of the liners and to identify potential cracks or breaches to determine the locations and accessibility of proposed boreholes. The visual inspections of each of the SEPs were used to locate boreholes both in areas of suspected liner deterioration and in areas where the liner appeared to be intact. The visual inspections were conducted by walking traverses across the SEP, plotting cracks or irregularities on a map, and taking photographs for a permanent record of the surface condition of the liner.

The visual inspection of SEP 207-A was completed in two phases on December 9, 1992 and February 26, 1993 because of the presence of ice and snow covering approximately half the SEP during December. The visual inspections of SEPs 207-B Center and 207-B North were

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completed during September 1993. The results of each of the visual inspections are summarized in Section II 3 1 2, Existing Ponds Investigation Results. Separate reports that include photographs detailing the findings of the visual inspections were prepared and are included in Appendix II D.

II.2.3.2.2 Radiological Surveys of the SEP Liner Surfaces

The objectives of the radiological surveys within the emptied SEPs were to identify the presence of radiological contamination on the surface of the SEP, define health and safety requirements, and assess the level of surficial radiological contamination of the liner. A brief summary of the principles behind the radiation surveys is presented below prior to discussing surveys performed in the SEPs.

Radiation: According to *The Health Physics and Radiological Health Handbook*, radioactivity is the spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nucleus of an unstable isotope. The major source of ionizing radiation to the general public occurs naturally as cosmic and terrestrial radiation. The natural background radiation level varies from location to location based upon the altitude and the presence, concentration, and proximity of primordial radioactive material (i.e., natural uranium spurs within the ground).

Workers within the nuclear industry are trained in the hazards associated with radiation. Therefore, depending upon the activity to be performed within the nuclear facility, the radiation worker may be exposed to ionizing radiation that is associated with their work or occupation, in addition to that from the natural background. The quantity and type of occupational radiation that a radiation worker receives is regulated and monitored by the nuclear facilities, which are themselves regulated and monitored by the federal government.

Exposure Monitoring: Based upon a historical evaluation, the types of radiation that are typically emitted by the radioactive materials that were located within the SEPs include gamma rays and alpha and beta particles. The radiation surveys that were conducted within OU4 included direct monitoring of alpha, beta, and gamma radiation. When the direct radiation surveys were being performed, the radiation monitor was detecting the combined background and occupational radiation exposure rate at the grid location in question. For the purposes of this study, the direct radiation survey results are referred to in units of either counts per minute (cpm) or cpm above background. As the phrase implies, cpm above background values include only that quantity of radiation that is in excess of the general background radiation level. General background radiation levels are determined on a daily basis at the RFETS by taking a direct radiation level reading in an area that should only be affected by natural background radiation.

Different instrumentation was used for each type of radiation monitoring. For the beta direct surveys, the minimum detectable activity for the instrumentation used was 100 cpm. For gamma survey instrumentation, the survey results documented within this report are presented

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as raw field measurements (i.e., background has not been subtracted from the measurement values) The minimum detectable activity for the direct alpha survey instrumentation was 250 cpm

Contamination Monitoring: Radioactive contamination is defined in simplest terms as the presence of radioactive material that may impact human health or the environment Contamination monitoring does not measure the exposure to specific types of radiation, but evaluates the presence and quantity of contamination The amount of contamination that can be "easily" removed is measured by wiping the surface in question with a treated cloth (smear) and then monitoring the smear for radiation Typically, smears are taken over a 100 square centimeter (cm²) surface area for consistency The measurements are reported in disintegrations per minute (dpm)/100 cm²

For both alpha and beta contamination surveys, the minimum detectable activity for the instrumentation used to count the smears is 3 dpm/100 cm² Those values noted as being less than (<) 3 dpm/100 cm² are delineated on the figures within this report as 0 dpm/100 cm²

Existing Ponds Alpha Surveys: The SEP alpha radiation surveys were conducted in accordance with guidelines established in RFETS Radiological Operating Instruction (ROI) 3 1, *Performance of Surface Contamination Surveys* Each of the surveys consisted of both an instrument survey of the surface of the SEP liner and a smear survey in order to investigate removable, non-fixed, alpha particles A Ludlum 12-1A® coupled to an air-proportional detector was used to perform the instrument surveys Eberline SAC-4® and BC-4® instruments were used to complete the smear surveys The alpha activity measurements were recorded on Radiological Contamination Survey Forms and are included in Appendix II E

The SEP 207-A alpha survey was completed during November 1992 and was described in memorandum RWN-019-92 To complete the surveys, a grid system with 136 square grid areas was established on the liner of the SEP at approximately 25 feet centers For most of the square grid areas, three alpha measurements were made for a total of 412 alpha measurements within SEP 207-A The alpha survey locations in SEP 207-A are shown on Figure II 2-6 Section II 3 1 2, Existing Ponds Investigation Results, presents and discusses the results of the alpha activity survey in SEP 207-A As mentioned, copies of the field forms are included in Appendix II E

To complete the SEPs 207-B Center and 207-B North alpha surveys, grid systems establishing a total of 165 square grid areas were made for each SEP, as shown on Figures II 2-7 and II 2-8 The surficial radiological measurements were taken near the center of each square grid area The alpha survey for SEP 207-B Center was performed during July 1993 in accordance with Radiological Sampling Plan RWN-024-93 The alpha survey for SEP 207-B North was performed during September 1993 in accordance with Radiological Sampling Plan RWN-033-93

Existing Ponds Beta/Gamma Surveys: The beta/gamma activity surveys in the SEPs were completed using a Bicron® Field Instrument for the Detection of Low-Energy Radiation (FIDLER) in accordance with guidelines established in ROI 6 6, *Use of the Bicron FIDLER (Field Instrument for the Detection of Low Energy Radiation)* and ROI 3 1, *Performance of Surface Contamination Surveys*. Copies of the Beta/Gamma Radiological Contamination Survey Forms are included in Appendix II E

The SEP 207-A beta/gamma survey was completed during November 1992 in accordance with and as described in memorandum RWN-015-92. The survey was accomplished by taking measurements within the SEP 207-A grid discussed above and shown on Figure II 2-6. The liner surface of each square grid area established within SEP 207-A was scanned with the FIDLER instrument and the highest one-minute scalar value was used as the representative measurement for that grid area. A total of 136 measurements was obtained during the FIDLER survey. Section II 3 1 2, Existing Solar Evaporation Ponds Investigation Results, presents and discusses the results of the FIDLER survey in SEP 207-A.

The beta/gamma surveys for SEP 207-B Center were performed during July 1993 and described in memorandum RWN-024-93. The beta/gamma surveys for SEP 207-B North were performed during September 1993 and described in memorandum RWN-033-93. The surface of the square grid areas established within SEPs 207-B Center and 207-B North were scanned with the FIDLER instrument and the highest one-minute scalar measurement was used as the representative value for that square grid area. A total of 165 measurements was obtained from each of the 207-B SEPs. A background measurement location against which to record liner measurements was established on the northern side of SEP 207-B North. These results are presented and discussed in Section II 3 1 2, Existing Ponds Investigation Results. Copies of the Beta/Gamma Radiological Contamination Survey Forms used for the surveys are included in Appendix II E.

II.2.3.2.3 Ground Penetrating Radar Survey

GPR surveys were completed only within and adjacent to SEP 207-A. The purpose of the surveys was to evaluate the applicability of GPR as a non-intrusive investigative method. These surveys were completed using a Geophysical Survey Systems, Inc. Model SIR System-6 GPR using both 300-MHz and 900-MHz antennas. Data were recorded on magnetic tape, and records were produced in the field to verify that the system was operating properly and that usable data were being collected.

Two pilot surveys were conducted during December 1992 to test the viability of using GPR in SEP 207-A. The first pilot survey was a field calibration test to evaluate the depth of penetration that GPR was capable of in this area. The second pilot survey was a comparative analysis test to evaluate two different antennas.

The field calibration test was conducted outside the southwestern corner of SEP 207-A, as shown on Figure II 2-4. Four GPR survey lines, totaling approximately 200 feet, were

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recorded using a 300 MHz antenna. These lines were located perpendicular to known utility corridors to evaluate the depth of penetration of the 300 MHz antenna. The results of this survey are presented and discussed in Section II.3.1.2, Existing Ponds Investigation Results.

The comparative analysis test was conducted within the western and southwestern portion of SEP 207-A. This test consisted of recording 11 lines spaced 20 feet apart that totaled 1,100 feet using a 300 MHz antenna. Six of the 11 lines, totaling 550 feet, were duplicated using a 900 MHz antenna for comparative purposes. The results of the comparative survey are discussed in Section II.3.1.2, Existing Solar Evaporation Ponds Investigation Results.

II.2.3.2.4 Liner and Subgrade Sampling and Analysis

Twelve asphalt liner and subgrade samples were collected from the SEPs as shown on Figure II 2-10. Six samples were collected within SEP 207-A during February 1993, and three samples were collected from each of SEPs 207-B Center and 207-B North during October and November 1993. Samples of the asphalt liner were not originally planned for the OU4 Phase I RFI/RI, however, it was suggested in the work plan that analyses may be useful for waste disposal purposes. Samples of the subgrade materials were originally planned to be collected at the locations (boreholes) specified for contaminant characterization purposes. The work plan originally specified that only five locations in SEP 207-A were to be sampled, however, the locations were modified on the basis of the visual survey (see TM2), and a sixth sampling location was added. The sixth borehole was originally located in the vicinity of the clarifier but was relocated during the field investigation due to the existence of surface facilities at the proposed location. The asphalt liner and subgrade samples were analyzed for the radionuclides and total metals listed in Table II 2-4.

The liner samples from each of the SEPs were collected by compositing the asphalt liner excavated for the boreholes and placing a split into a clean glass jar. There was no SOP available for collecting liner samples during this investigation. The subgrade material samples were collected using grab surficial soil sampling methods described in SOP GT 08, *Surface Soil Sampling*, as modified by DCN No 93 03. The results of the liner and subgrade samples are summarized and discussed in Section II.3.1.2, Existing Investigation Results. A complete listing of the analytical results for the liner and subgrade samples is included in Appendices II L and II M, respectively.

II.2.3.2.5 Borehole Drilling, Sampling, and Chemical Analysis:

Twelve boreholes were drilled within the SEPs for geochemical and geological characterization purposes, as shown on Figure II 2-3. Six boreholes were completed in SEP 207-A, and three boreholes were completed in each of SEPs 207-B Center and 207-B North. The boreholes were drilled and sampled using hollow-stem auger drilling techniques, as previously described. No deviations from the work plan, as amended by TM2, were recorded, and activities were completed using SOPs.

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The intervals required for collection of subsurface samples beneath the SEPs were specified in TM2 and varied from those required for subsurface samples collected outside the SEPs. Beneath the SEPs, the following sample collection intervals were required:

Composited over 2-foot intervals 2 feet below ground and every other 2 feet, one sample from bedrock	Radionuclides, target analytic list (TAL) metals Volatile organics
Composited over 4-foot intervals	Nitrate
Composited over 6-foot intervals	Semivolatile organics, pesticides, PCBs, cyanide, sulfide

The analytical parameters required for the subsurface samples also are summarized in Table II 2-4. Intermixing of unconsolidated soils and bedrock samples for analysis was minimized to the extent possible to eliminate mixing of samples with different natural chemistries. Samples generally were composited over 6-foot intervals (where appropriate), with the exception of the samples collected for volatile organic compound (VOC) analyses. Unconsolidated soils and bedrock material were not composited together for analysis. VOC samples were collected at discrete 2-foot intervals. The results of the borehole drilling and sampling within the SEPs are summarized and described in Section II 3 1 2, Existing Ponds Investigation Results. A complete listing of the chemical analytical results for the borehole is included in Appendix N.

II.2.4 Surficial Soils Investigation

This section describes the activities conducted as part of the surficial soils investigation. Activities included performing surface radiological surveys and collecting soils samples for chemical analysis.

II.2.4.1 Radiological Surveys

The OU4 Phase I RFI/RI objectives for the surficial soil radiological surveys included characterizing potentially contaminated soil resulting from aerosol dispersion of radionuclides in the vicinity of the SEPs and identifying dispersion trends. Radionuclide "hot spots" detected during this survey were further investigated with supplemental surficial soil sampling.

The OU4-wide radiological survey was conducted on a grid-system as shown on Figure II 2-5. The grid was established on 100-foot centers extending east from Building 771 to the eastern-most extension of the ITS. The grid extended from approximately 150 feet south of the SEPs to the northern edge of the ITS. Areas within the PSZ were excluded from the survey. The individual SEPs also were excluded from the OU wide survey, however, separate surveys of SEPs 207-A, 207-B Center, and 207-B North were conducted, as previously described. SEPs 207-B South and 207-C were not surveyed due to the presence of sludge and liquids. An additional survey point was placed at the center of each 100-foot square grid within the PA south of the PSZ. A total of 311 measurements was made, which differed from the 350 points

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estimated in the work plan due to the presence of buildings and structures, and lack of access to some of the SEPs

Alpha Survey The Phase I Work Plan field methods for the surficial soil radiological survey included measurement of both alpha and gamma/beta at all surficial radiological survey locations. However, only beta/gamma activity measurements were obtained due to limitations of the alpha instrument. The instrument became damaged from contact with irregular soil surfaces and vegetation. The justification for the elimination of the alpha measurements from the OU4-wide radiological survey is presented in TM2.

Beta/Gamma Survey Figure II 2-5 shows the grid locations for the OU4-wide surficial soil radiological survey where measurements were made. A total of 311 measurements out of 350 identified measuring locations for gamma/beta readings were obtained for the OU4-wide survey. Measurements were not collected at 39 locations because of buildings, SEPs 207-C and 207-B South which contained liquids and sludges, or other physical interferences.

The OU4-wide beta/gamma radiological survey was completed using a Bicon FIDLER instrument in accordance with SOP FO 16, *Field Radiological Measurements* and ROI 6 6, *Use of the Bicon FIDLER*. Documentation of each radiological measurement was recorded on Form FO 16A, *Results of Radiological Measurements In The Field*. Copies of the completed forms are contained in Appendix II F. All surficial radiological measurement locations were determined using pacing measurements and/or taping measurements. As discussed in TM2, the radiological survey grid locations were not to be land surveyed or tied to the RFETS datum unless a surficial soil sample was collected at that location.

II.2.4.2 Surficial Soils Sampling and Chemical Analysis

In addition to surface radiological surveys, the surficial soils program included the collection and laboratory chemical analysis of surficial soil samples. The samples were analyzed for the parameter groups listed in Table II 2-4. Table II 2-5 lists the specific chemical constituents in each parameter group for contract laboratory program (CLP) methods. The primary objective of the surficial soil sampling program was to identify and characterize any potential soil contamination resulting from aerosol dispersion.

The surficial soil sampling program consisted of three components:

- Collection of 26 samples from randomly chosen locations,
- Collection of 10 samples from discrete locations, and
- Collection of 36 samples from borehole locations

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The discrete locations were chosen based on high gamma radiation measurements, and proximity to ground water seeps, and to provide additional data for the baseline risk assessment. The analytical parameters for both the random and discrete surficial soil samples are listed in Table II 2-4.

The sample collection methods are described in SOP GT 08 as amended by a DCN requested by CDPHE. Pursuant to correspondence between CDPHE and DOE, dated September 1, 1992, surficial soil samples within the PA were collected with a "jig and scoop" at the center and four corners of a one-meter square centered on the sampling location. This sample was then homogenized in a stainless-steel bowl. In paved areas, such as beneath the SEP liners, grab samples were taken, rather than homogenized jig and scoop samples. A DCN was written to SOP GT 08 for these amended methods for sample collection. Documentation of each surficial soil sample collected was recorded on form GT 8A, *Surface Soil Data Collection Form*, and is included in Appendix II G.

Additional SOPs that were followed for the collection of surficial soil samples included

- SOP FO 03 *General Equipment Decontamination*
- SOP FO 13 *Containerization, Preserving, Handling and Shipping of Soil and Water Samples*
- SOP FO 16 *Field Radiological Measurements*
- SOP GT 07 *Logging of Test Pits and Trenches*

II.2.4.2.1 Random Locations

The 26 random surficial soil sample locations were selected, as described in TM2, by determining the dimensions of OU4, setting up a grid for the area, and selecting the coordinates for sampling locations using a random number table. The coordinates were then compared to areas of inaccessibility and discarded if they fell in inaccessible areas. The final sampling locations are shown on Figure II 2-12.

Three of the locations fell within SEP 207-A, an area undesirable for surficial soil samples because sampling from beneath the SEP liner did not support the objective of evaluating the extent of potential aerosol contaminant dispersion. These locations were moved to locations outside of the SEP 207-A perimeter, but near the original randomly selected location.

II.2.4.2.2 Discrete Locations

The collection of 10 discrete surficial soil samples at radionuclide "hot spot" locations identified in the OU4-wide radiological survey was modified due to the limited number of locations exhibiting anomalous radiation measurements. These discrete surficial soil sampling locations included three locations that exhibited elevated radiological activity (Nos 27, 28, and 29). Four of the 10 samples were relocated to ground water seep areas on the slope immediately north of the SEPs (Nos 30, 31, 32, and 33). The three remaining discrete soil samples were

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collected at locations to provide additional data for the baseline risk assessment (Nos 34, 35, and 36) These locations are shown on Figure II 2-12 Detailed justification and descriptions for each of these locations can be found in Section 3 4 of TM2

II.2.4.2.3 Borehole Locations

Surficial soil samples also were collected at 36 of the soil boreholes drilled for the Original Ponds, the vadose zone, and geologic investigations to complement the surficial soils program The locations of the surficial soil samples collected at borehole locations also are shown on Figure II 2-12 These samples were analyzed for the suite of parameters listed in Table II 2-4

II.2.5 Vadose Zone Investigation

The vadose zone investigation was designed to evaluate water storage and migration characteristics of the vadose zone, evaluate chemical quality of the unsaturated system at RFETS, and test various monitoring techniques The data were used to characterize and identify potential contaminant sources, evaluate the extent of vadose zone contamination, and aid in identifying potential subsurface migration pathways The scope of the vadose zone investigation is defined in TM1

To accomplish these activities, vadose zone monitoring, sampling, and data collection procedures were selected, which included soil moisture content measurements using a neutron probe, tensiometer measurements, and suction lysimeter measurements Additionally, TM1 specified that site-specific direct and indirect monitoring techniques and instrumentation be evaluated for their applicability to collect pore water and to measure soil moisture content Direct methods that were evaluated included collection of pore water, laboratory geotechnical testing for chemical and physical properties of vadose zone soils, borehole permeability testing, surface infiltration testing, and collection of soil gas samples Indirect methods that were evaluated included borehole geophysical logging and measurements of *in situ* soil moisture using a neutron probe A water balance also was estimated from the data in support of the evaluation of migration pathways and evaluation of the ITS The following sections describe the activities completed in support of the vadose zone investigation

II.2.5.1 Drilling, Soil Sampling, and Instrument Installation

As described in TM1, the locations for vadose zone testing were chosen to characterize representative conditions beneath OU4 Particular emphasis for selecting locations was placed on historical data that contained information on ground water seepage locations, surface water quality, pre-ITS and PSZ construction topography, construction history, and local hydrogeology A preliminary review of existing data and data from the initial boreholes drilled during the OU4 Phase I RFI/RI program allowed for a refinement of the proposed vadose zone borehole locations Seventeen soil boreholes were drilled, sampled, and instrumented in support of the vadose zone investigation (previously shown on Figure II 2-11) Sixteen of the boreholes were

equipped with suction lysimeters and neutron moderation access tubes. The remaining borehole was equipped with only a neutron moderation access tube. Of the 17 vadose zone boreholes proposed, eight were relocated to characterize the potential vadose zone migration pathways. Justifications for each relocation are detailed in TM1.

All boreholes were drilled and sampled in accordance with SOP GT 02, *Drilling and Sampling Using Hollow-Stem Auger Techniques*. No deviations from the SOPs were noted in the field records. During drilling, a BAT™ probe was pushed into the soils ahead of each auger flight to measure the range of *in situ* hydraulic conductivities and to evaluate the effectiveness of this system in low hydraulic conductivity soils. Section II 2 5 3 provides a detailed description of this system and its implementation.

Upon completion of drilling and sampling, each of the boreholes was equipped with neutron moderation probe access tubes for measuring *in situ* soil moisture content (Section II 2 5 3) and with suction lysimeters for sampling pore water (see Section II 2 5 4). The neutron moderation probe access tubes were constructed of 2-inch inside-diameter flush-threaded Schedule-40 Polyvinyl chloride (PVC) pipes and were installed against the borehole walls using decentralizing devices.

At least one suction lysimeter was installed in each borehole, the locations of which are shown on Figure II 2-11. Two lysimeters were installed in seven boreholes where the unsaturated thickness at that location was greater than 5 feet. The lysimeters, manufactured by Soil Moisture Equipment Company (Model 1920), consisted of a 1.9 inch outside-diameter PVC riser tube connected to a 2-bar air-entry porous ceramic cup, with a neoprene plug and air and water lines. SOP VZ 10, presented in Appendix B of TM1, describes the installation procedure for the lysimeters. Figure II 2-20 is a schematic diagram showing typical lysimeter installations. Appendix II H of this document includes completion logs of all lysimeters installed during the OU4 Phase I RFI/RI.

TM1 also specified that 16 boreholes were to be drilled to accommodate time domain reflectometry (TDR) and frequency domain capacitance (FDC) instruments to support the two proposed double-ring infiltration tests. The double-ring infiltrometer tests were not completed, and these boreholes were not drilled. The reason for not completing this work, by agreement between the CDPHE and EG&G, was that the data could not be obtained due to the accelerated project schedule. It also was agreed that infiltration data being collected elsewhere at the RFETS would be incorporated into the OU4 Phase I RFI/RI report.

II.2.5.2 Physical Properties of Vadose Zone

Twenty-five soil core samples from 14 vadose zone boreholes were collected for measurements of physical and hydrologic properties. The locations of the boreholes where the samples were collected are shown on Figure II 2-13. All samples were visually inspected in the field and screened for radionuclides and volatile organics according to health and safety

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protocols The samples were stored in a cooler upon collection, and shipped during September 1993 to a geotechnical laboratory for testing The laboratory tests included

- Particle size sieve and hydrometer tests (ASTM D422-63),
- Initial soil moisture content (ASTM D2216-80),
- Moisture retention drying curve analysis (ASTM D2325-68(81),
- Particle density (ASTM D854-91) and dry and saturated bulk density (Klute, 1986),
- Electrical conductivity (Rhodes, 1982),
- Atterberg limits (ASTM D4318-84),
- Saturated hydraulic conductivity [ASTM D2434-68(74) or Klute, 1986],
- Total organic carbon (ASTM D2579-85), and
- Cation exchange capacity (EPA Method 9081)

The results of these tests are presented and discussed in Section II 3 3 2, Physical Properties of the Vadose Zone

II.2.5.3 Hydraulic Properties of Vadose Zone

The capacity of geologic materials to transmit and retain fluids has a direct effect on the development of preferential contaminant migration pathways Physical properties of surficial and subsurface materials were evaluated to estimate saturated hydraulic conductivity, infiltration rates of water ponded on the ground surface, soil moisture matric potential relationships, and the time required for water in the vadose zone to reach the water table The following subsections and Section II 3 3, Vadose Zone Investigation Results, describe the methods for evaluating the aforementioned properties

II.2.5.3.1 Field Permeability Tests

In situ permeability of the vadose zone materials, which included the Rocky Flats Alluvium and the weathered Arapahoe Formation, was tested to evaluate the ranges in hydraulic conductivities of the different lithologic units within the vadose zone and to evaluate vadose zone testing equipment The tests included the BAT™ probe and Guelph Permeameter measurements Tests conducted using a BAT™ probe involved measuring water inflow rates and pressures into isolated portions of the lithologic units of interest in the vadose zone boreholes SOP SW 34 (draft), *In situ Sampling with BAT™ System*, provides a description of the procedures for using the BAT™ system for these measurements

In summary, the BAT™ system was developed by Bengt-Arne-Torstensson for *in situ* gas and/or liquid sampling The system uses drive points attached to 1-inch-diameter steel rods that are advanced into undisturbed soils to the target depth The BAT™ system drive point used during the OU4 Phase I RFI/RI consisted of a ceramic cup, through which falling head infiltration tests could be conducted to measure hydraulic conductivities BAT™ tests generally are limited to soils with hydraulic conductivities less than 10^{-6} cm/s

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Nineteen BAT™ hydraulic conductivity tests were completed at 14 locations (Figure II 2-14) by driving the ceramic cup point to the target depth, inserting a small volume of water (10 to 60 milliliters) into the formation, and pressurizing the column of water with small volumes of air. The resulting pressure reduction, or fall-off, was recorded via a pressure transducer and datalogger, and hydraulic conductivities were calculated. Generally, tests were conducted at approximately 5-foot intervals or when lithologic units of particular interest were encountered during drilling. Four of the 19 tests were unsuccessful (locations 41793, 42893, 43793, and 44093), principally due to the inability to drive the point through the Rocky Flats Alluvium. At the remaining 10 locations, 15 successful tests were completed. Section II 3 3 3, Hydraulic Properties of the Vadose Zone, presents and discusses the results of the BAT™ tests.

Twenty-four Guelph Permeameter tests were attempted at 19 locations, as specified in TM1 and shown on Figure II 2-15, to determine hydraulic conductivity of the near-surface soils. These tests were conducted adjacent to 18 of the OU4 Phase I RFI/RI boreholes and one existing monitoring well. The numeric designation of the test is associated with the corresponding borehole or well.

The Guelph permeameter is a constant-head permeameter, manufactured by Soil Moisture Corp., that provides a method for determining field-saturated hydraulic conductivity greater than 10^{-6} cm/s, matric flux potential, and soil sorptivity. The method involves measuring the steady-state rate of water recharge into the shallow soils from a cylindrical hole in which a constant head of water is maintained. Figure II 2-21 presents a schematic diagram of the testing apparatus. All tests were conducted in accordance with SOP VZ 2, *Procedure for Using the Guelph Permeameter*, presented in Appendix B of TM1.

Of the 24 tests, three failed due to borehole collapse or the inability to advance the power auger below grade. Duplicate tests were conducted at four locations: two on the northern end of SEP 207-A, one inside SEP 207-A, and one south of SEP 207-A. Section II 3 3 3, Field Measurements of Hydraulic Properties, presents and discusses the results of the Guelph tests.

As previously stated, two instrumented double-ring infiltrometer tests to measure infiltration rates were to be completed as part of the OU4 Phase I RFI/RI. They were not completed, however, available infiltration data from similar infiltration tests completed in OU2 are incorporated into the OU4 Phase I RFI/RI report as appropriate.

II.2.5.3.2 Laboratory Permeability Tests

Twenty-five soil core samples were collected from 14 vadose zone boreholes during the OU4 Phase I drilling program for laboratory permeability testing. The locations of the boreholes from which the samples were collected are shown on Figure II 2-13. The tests conducted included saturated hydraulic conductivity by ASTM D2434-68(74) and soil water characteristic curve tests by pressure-plate methods to measure the matric potential under varying moisture contents. Section II 3 3 4, Laboratory Measurements of Hydraulic Properties, presents and discusses the results of these tests.

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II.2.5.3.3 Neutron Probe Measurements

Figure II 2-11 shows the locations of the 16 vadose zone monitoring boreholes that were completed with neutron access tubes for measuring *in situ* soil moisture content with neutron moderation probes. The neutron probes and gauge assemblies used during this study were 503DR-1 5 and 503DR-2 hydroprobes manufactured by CPN Corporation. The primary components of these portable probes were the source (50 millicuries Americium-241/Beryllium) and detector, contained in the downhole probe, and the shielding and signal processor, housed within the body of the gauge. Neutron counts were measured at 1-foot intervals from the ground surface to near the bottom of the neutron access tube. The counts were averaged over a counting period of 32 seconds. Neutron counts are typically converted to approximate volumetric moisture content using either gauge-specific or field-generated calibration curves. Since the probes were not calibrated in accordance with TM1, the neutron count data are reported as recorded in the field. Section II 3 3 3, Field Measurements of Hydraulic Properties, presents and discusses the results of these measurements, including estimations of the saturation levels in the respective boreholes.

II.2.5.3.4 Water Level Measurements

The vertical fluctuation of the ground water table was measured by using pressure transducers and data loggers at five existing ground water monitoring wells within OU4 and by collecting manual water level measurements at approximately 50 additional piezometers and monitoring wells. The locations of these wells and piezometers are shown on Figure II 2-16. Data from these locations will be used to estimate integrated travel times from the ground surface to the water table and used in calculations for comparing water table fluctuations with precipitation events and changes in moisture content within the vadose zone. This estimate provides a means for calculating the vertical infiltration rates and water balance of the vadose zone and fluctuations of the water table.

II.2.5.4 Chemical Properties of Vadose Zone

This section briefly describes the activities conducted to obtain chemical data from the vadose zone.

II.2.5.4.1 Soil Chemical Analyses

Soil samples collected during vadose zone borehole drilling were analyzed for the parameter groups listed in Table II 2-4. Table II 2-5 lists the specific chemical constituents in each parameter group for CLP methods. In addition, the vadose zone physical and hydrologic property samples were analyzed for total organic carbon and cation exchange capacity. The nine soil samples collected for leaching tests discussed below were analyzed for nitrate, bulk density, specific gravity, and moisture content prior to commencing the column leaching tests. The results of these analyses are presented and discussed in Section II 3 3 6, Chemical Properties of the Vadose Zone.

II.2.5.4.2 Soil Gas Survey

Soil gas samples were obtained at 28 locations (Figure II 2 -17) by driving a stainless steel probe into the shallow subsurface soil to a depth of approximately 5 feet below grade. The probe was then retracted slightly to open the sample port. A vacuum was applied to the probe and, after purging the system of

a number of sample volumes, a soil gas sample was collected. The soil gas sample was analyzed onsite using a gas chromatograph with megapore capillary columns, dual photoionization detector and electron capture detector (PID/ECD) operated in series, and a computerized data system. Samples were analyzed for 1,1,1-trichloroethane (TCA), carbon tetrachloride, trichloroethene (TCE), and tetrachloroethene (PCE). The results of the soil gas survey are presented and discussed in Section II 3 3 6, Chemical Properties of the Vadose Zone.

II.2.5.4.3 Pore Water Analyses From Lysimeters

Figure II 2-11 shows the 15 vadose zone boreholes equipped with either a single or dual lysimeter. A total of 22 lysimeters was installed. Suction lysimeters were used to sample soil water within the vadose zone. Soil pore water was drawn into the lysimeter by applying a 60- to 80-centibar vacuum to the lysimeter with a hand pump. Water samples were extracted from the lysimeter by applying pressure to the air line using a hand pump, which drives the water through the water line to the well head. The pore water samples collected from each lysimeter were analyzed for the parameters listed in Table II 2-4. Table II 2-5 lists the specific chemical constituents in each parameter group for CLP methods. Subsequent sampling for analyses of nitrate and TAL metals was conducted at approximately 4-week intervals. Section II 3 3 6, Chemical Properties of the Vadose Zone, presents and discusses the results of the lysimeter pore water analyses.

II.2.5.4.4 Column Leaching Tests

Nine soil samples were collected from three locations in SEP 207-A and three locations on the slope north of the B-Series SEPs for column leaching tests, as shown on Figure II 2-13. In SEP 207-A, six samples were collected in core sleeves from each of the three vadose zone boreholes. On the slope north of the B-Series SEPs, a 3-inch-diameter brass tube was pushed to a depth of 9 inches below grade in an area which exhibited vegetative stress. Three samples were collected for analysis. Following the withdrawal of the sample tubes, the ends were sealed with Teflon® paper and plastic end caps and placed in a cooler maintained at 4 degrees Centigrade (°C) for shipment to the laboratory. One additional sample was sent as a quality control blank and consisted of 16-40 mesh Colorado silica sand that was used for the filter pack on the OU4 piezometers.

The nine samples were sent to Core Laboratories in Aurora, Colorado where leaching tests based on ASTM Method D4874 were conducted. Six-inch-long, 1- to 2-inch-diameter PVC columns were packed to the same bulk density as the core sample material. A 500 milligram-per-liter calcium bicarbonate leaching solution buffered to a pH of approximately 7 to 8 pH

units, which approximates the total dissolved solids content and chemical quality of vadose zone pore water or shallow alluvial ground water, was passed through the columns in a backflow mode. The flow rate through the columns was adjusted to 10 centimeters per day to approximate alluvial ground water flow rates. Samples were analyzed for nitrate, pH, and specific conductance after one, two, three, five, and 10 pore volumes passed through the columns. The first pore volume was also analyzed for major cations and anions. Although TM1 stated that all leachate samples were to be analyzed for major cations, anions, and possibly metals, the small (generally less than 25 milliliters) sample volumes only allowed for analyses of nitrate, pH, and specific conductance. Section II 3 3 6, Chemical Properties of the Vadose Zone, presents and discusses the results of the column leaching tests.

II.2.6 Geologic Investigation

Various sitewide studies have been conducted at the RFETS to characterize the media and assess the extent of radiological and chemical contaminant releases into the environment. In some manner, these reports discuss the geology at the RFETS and have been included in the historical review process for this OU4 Phase I RFI/RI. Specifically for OU4, the geological investigation included reviewing historical data and obtaining borehole information, in the form of borehole lithologic logs, from the 1986, 1987, 1989, and 1993 drilling programs. Although useful from a historical qualitative perspective, the pre-1986 borehole information was not incorporated into the quantitative geological analysis due to reported discrepancies within the data set. The OU4 Phase I RFI/RI geological investigation included a historical data review, a drilling, sampling and chemical analyses phase, and a geophysical investigation phase.

II.2.6.1 Historical Data Review

Geological data have been gathered in the SEPs area beginning with the initial feasibility and assessment study prior to construction of the SEPs at RFETS. Significant work has recently been conducted to further characterize the geology at the RFETS. A Geological Characterization Report for the RFETS (EG&G, 1991e) was prepared based on a comprehensive literature search, describing previously obtained core samples, reprocessing previously obtained seismic data, and analyzing selected samples for grain-size distribution. Additional investigative activities conducted at OU4 and other pertinent studies which were used in the OU4 Phase I RFI/RI Report are summarized in Appendix II A. The data from these studies have been assembled and evaluated.

II.2.6.2 Drilling, Sampling, and Chemical Analyses

The data requirements to fulfill the geologic characterization objectives of the OU4 Phase I RFI/RI varied among the different areas of OU4 investigated: the Original Ponds area, the existing ponds area, and the ITS and surrounding area. The following provides a brief description of the activities performed in each of the areas.

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Original Ponds Area

Six boreholes were drilled and sampled in and adjacent to the original ponds area. The information to be obtained from these boreholes for geological characterization purposes included subsurface lithology and soil chemistry, the identification of residual clay liner from the abandoned ponds, investigation of ground water levels and bedrock elevations, and the identification of possible routes of contaminant migration, such as fractures or other macropores or other more permeable zones.

Existing Ponds Area

Twenty-eight boreholes were drilled and sampled in the existing SEPs area, which included 12 completed through the SEPs and 16 completed around the perimeters. The information to be obtained from these boreholes for geologic characterization purposes include subsurface lithologies and soil chemistry, identify patterns of leakage from the ponds, identify preferential routes of contaminant migration, and investigate bedrock topography.

ITS and Surrounding Area

Nineteen boreholes were drilled and sampled in the ITS and surrounding area to characterize subsurface lithologies and soil chemistry, investigate ground water and bedrock elevations, evaluate the extent to which the ITS is keyed into bedrock, investigate the Arapahoe Sandstone subcrop, and to observe bedrock fractures.

Appendix II I includes lithologic logs from all boreholes completed during the OU4 Phase I RFI/RI.

II.2.6.3 Geophysical Investigations

This section discusses the geophysical investigations conducted as part of the OU4 Phase I RFI/RI.

II.2.6.3.1 Borehole Geophysics

The work plan specified that borehole geophysical logging be performed to aid in the characterization and correlation of subsurface geologic materials, ground water, and the original clay liner. Borehole geophysical logs using natural gamma ray, neutron, and resistivity geophysical methods were to be obtained from four boreholes within the Original Ponds area. Geophysical logs were obtained from boreholes 42193 and 44193 only, since the other two boreholes were deleted from the drilling program as described in TM2. All borehole logging was conducted according to SOP GT 15, *Geophysical Borehole Logging*.

The two boreholes that were geophysically logged were drilled with a hollow-stem auger in accordance with SOP GT 02, *Drilling and Sampling Using Hollow-Stem Auger Techniques*. To isolate the alluvium from the bedrock, steel casing was placed in the upper 18 feet of borehole 44193 and the upper 10 feet of borehole 42193. The borehole diameters from the bottom of the steel casing to total depth were 8 inches each.

To minimize direct contact of the logging tools with potentially contaminated materials, the boreholes were logged through 2-inch-diameter PVC pipe that was installed adjacent to the borehole walls. Boreholes 42193 and 44193 were logged to approximately 28 and 48 feet, respectively below ground surface (bgs) with the natural gamma and neutron tools. Only borehole 44193 was logged using the induction tool to a depth of approximately 48 feet bgs. Incomplete suites of logs were obtained from this borehole due to time constraints and RFETS requirements pertaining to contractor-owned radioactive sources.

The results of the borehole geophysical logging are discussed in Section II 3 5 3, Geophysical Investigation Results. Also presented in that section is a brief summary and interpretation of the parameters measured by the individual tools.

II.2.6.3.2 Seismic Refraction Survey

A seismic refraction survey was not specified in the work plan, but was implemented as a geophysical technique that could aid in the characterization of subsurface features. Seismic refraction profiles were investigated as a non-intrusive technique that would assist in mapping the weathered bedrock and ground water surface, facilitate in delineating possible bedrock paleochannels or channels filled during construction, and help to define subsurface geometries of lithologic units. Seven seismic refraction profiles representing approximately 4,950 linear feet were recorded in the area around the SEPs. Five profiles were located within the PA and two were located in the Buffer Zone north of the SEPs. All refraction surveys were conducted in accordance with SOP GT 18, *Surface Geophysical Surveys*. The locations of these surveys are shown on Figure II 2-9.

Seismic refraction techniques are used to evaluate the thickness and depth of geological layers from the seismic wave travel times. A seismic wave transmitted into the subsurface travels at different velocities in its host media and is refracted at interfaces between layers. This refraction affects the wave's travel path and resulting travel time. Using an array of recording devices (geophones) on the surface, travel times of the seismic wave can be measured. From the travel times, an interpretation can be made of the number of refracting layers, their thickness and depth, and the seismic velocity within each layer. The seismic velocity is directly related to the layer density.

Seismic refraction profiles were measured using a floating-point, signal-enhancement Oyo MX-160 seismograph attached to 24 in-line 100-Hertz geophones (per spread), spaced at 10-foot intervals. All adjacent spreads were laid out end-to-end with a one geophone overlap. A 10-pound sledgehammer striking a metal plate on the ground provided the energy source. Records

were made with the energy source placed at varied locations relative to the geophone array. The varied locations included each end of the spread, 5 feet away from each end, 40 feet away from each end, and in the middle of the spread. Surface elevations for each geophone were obtained by hand-level surveys using nearby monitoring wells as control points. Data were recorded on a computer disk and were analyzed using a computer program (SEISREFA), produced by Oyo Corp., that provides a depth-to-reflector analysis and printout. The results and interpretation of these refraction surveys are presented and discussed in Section II 3 5 3, Geophysical Investigation Results.

II.2.7 Field Investigation Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) requirements for all field activities are specified in the Site-Wide Quality Assurance Project Plan (QAPjP), the OU4 Phase I RFI/RI Work Plan, and in various SOPs, such as FO 02, Transmittal of Field QA Records, FO 14, Field Data Management, and GT 01, Logging Alluvial and Bedrock Material. All activities in the field were conducted in accordance with the applicable SOPs, as amended by DCNs, and technical memoranda for this project.

II.2.7.1 Documentation of Activities/Procedures

Complete documentation of all field activities was maintained in accordance with all available and applicable SOPs. Two levels of QA/QC field documentation were implemented during the OU4 Phase I RFI/RI field activities. QC was accomplished by either the assistant site manager or the site manager, and included a completeness review of each sampling location field file. The purpose of the completeness review was to ensure that all appropriate field records were being maintained. QA was accomplished by the field QA officer prior to transmission of the field records to the Environmental Management Division (EMD) records center and the EG&G project manager. This final review further ensured that all appropriate field records were maintained.

Appendix II J includes copies of Form FO 2A, Field QA Records Transmission Form, that accompanied the completed package of records from each sampling location to the EMD records center and the EG&G project manager. This form lists all field QA records associated with each particular sampling location.

II.2.7.2 Audits of Procedures

Periodic field audits were performed by the project's assistant site manager or site manager throughout the OU4 Phase I RFI/RI field program. These audits were conducted to ensure strict adherence to the work plan and all applicable technical memoranda, SOPs, and DCNs. Field audits also were performed by the EG&G subcontractor [Science Applications International Corp. (SAIC)]. Field audit reports were prepared and submitted to the EG&G project manager.

Health and safety audits were conducted by EG&G's Industrial Hygiene Department throughout the OU4 Phase I RFI/RI field program. These audits included review of health and safety training records for each individual involved in the field program, and field audits to ensure that the project's health and safety plan was being followed. Results of these audits were transmitted to the EG&G project manager. The field site safety officer also conducted health and safety audits of all field crews throughout the project. Those audits focused on proper use of field instruments and the proper use of personal protective equipment.

II.2.7.3 Deficiencies

Deficiency reports were prepared for incomplete or inaccurate documentation of activities, for not following procedures, or for not properly implementing the site health and safety plan. As appropriate, corrective actions were undertaken and documented. Appendix II K includes copies of the deficiency reports and corrective actions.

II.2.7.4 Data Management

All field data were managed in strict adherence to SOP FO 02, Transmittal of Field QA Records. The data were entered onto floppy disks and transmitted to EG&G in accordance with procedures. All procedures for quality control, verification, entry, archiving, and security, as specified in SOP FO 14, Field Data Management, were strictly maintained. Appendix II J includes copies of Form FO 2A, Field QA Records Transmission Form, for all sampling locations. This form lists all pertinent field QA records associated with each particular sampling location.

II.2.7.5 Field Quality Control Samples

Field QC samples consisted of duplicates and equipment rinsate blanks and were obtained for surficial soil samples, borehole samples, and lysimeter pore water samples. Although specified in the Work Plan, no trip blanks or field preservative blanks were collected and submitted for analysis per EG&G requirements. Table 7.4 of the Phase I Work Plan specifies the field QC sample collection frequency. Section II 3.6, Quality Assurance/Quality Control Results, presents and discusses the numbers of QC samples collected during the OU4 Phase I RFI/RI.

As discussed in Section II 3.6, the field QC sample collection requirements presented in the Work Plan were not fully met because the field subcontractor was unable to adequately track the number of duplicates or rinsates collected during the program. Not fully meeting the field QC sample collection requirements does not impact the quality, usability, or reliability of the data. As further discussed in Section II 3.6, the duplicate sample Relative Percent Differences (RPDs) were within acceptable limits (with the exception of toluene), and it is not expected that additional field duplicate samples would change this assessment.

The number of equipment rinsate samples collected did not fully meet the QC sample collection requirements presented in the Work Plan. However, the analytical results for the equipment rinsate samples that were collected indicated that equipment decontamination was adequate to minimize cross-contamination between samples. Additionally, the presence of site contaminants in the equipment rinsate blanks were at sufficiently low levels that decisions presented in this IM/IRA EA DD are not influenced by possible cross-contamination of samples from improperly cleaned sampling equipment.

TABLE II.2-1

PHASE I RFI/RI FIELD PROGRAM TASKS, PROPOSED WORK, AND COMPLETED WORK

Task	Proposed Work	Completed Work
OU4-WIDE INVESTIGATIONS		
Investigate contaminant dispersion	Implement OU4-wide radiological survey per SOP FO 16 and EMRG 6 6	Performed gamma (FIDLER) survey of all OU4 study areas excluding SEP structures
Characterize surface contaminants	Collect surficial soil samples following SOP GT 08, as amended by CDH	Performed gamma (FIDLER) and alpha radiological surveys of SEPs 207-A, 207-B North, and 207-B Center Collected 26 random and 10 discrete surficial soil samples Surficial samples at 36 Phase I boreholes were also applicable to the surficial sampling program
ORIGINAL PONDS STUDY AREA		
Locate residual original pond features and other buried utilities and structures, and distinguish between unconsolidated and consolidated material	Implement GPR survey per SOP GT 18	Evaluated six GPR survey profiles in the area of the original ponds In addition, evaluated one seismic profile from the sitewide seismic survey along the eastern-most extent of the original ponds area
Characterize lithologies and soil chemistry, identify residual clay liner from abandoned ponds, investigate ground water and bedrock elevations, and identify migration pathways	Implement drilling and sampling plan per SOP GT 1 and GT 2 at four work plan locations	Drilled and sampled six boreholes to aid in the characterization of the original ponds area Located boreholes 42893 and 43593 solely for the original ponds investigation Boreholes 40993, 41993, 42393, and 42993 double as original and existing ponds analytical borehole locations
Determine infiltration characteristics, identify perched water horizons, and characterize soil pore water quality	Implement a vadose zone monitoring program per Technical Memorandum No 1	Installed two vadose zone monitoring wells, performed two Guelph permeameter tests, and collected five intact physical properties samples as required by TM1 (Note These physical properties samples were collected from analytical borings which double as original and existing ponds locations) Follow-up monitoring of pore water liquids and in-place moisture content occurred from May 1 - September 15, 1993 Soil gas measurements were taken at seven locations

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TABLE II.2-1 (continued)

PHASE I FIELD PROGRAM TASKS, PROPOSED WORK, AND COMPLETED WORK

Task	Proposed Work	Completed Work
EXISTING SEPs (IHSS 101) STUDY AREA		
Evaluation of SEP liner materials for effectiveness as a migration barrier	Perform visual survey and GPR of SEP structures	Completed visual surveys of SEPs 207-A, 207-B North, and 207-B Center. Conducted a limited GPR survey on the SEPs 207-A asphalt liner.
Evaluation of SEP liner materials as potential contaminant sources	No investigative items specified in work plan	Performed chemical analysis on asphalt liner and subgrade materials at six locations in SEP 207-A and three analyses of liners in SEPs 207-B North and 207-B Center for evidence of contamination.
Characterize surface contaminants	Collect surficial soil samples following SOP GT 8, as amended by CDH	Performed gamma (FIDLER) and alpha radiological surveys of SEP 207-A, 207-B North and 207-B Center.
Locate underground utility lines and structures, and distinguish between unconsolidated and consolidated material	Implement GPR survey per SOP GT 18	GPR techniques were applied to Pond 207-A. Additionally, the site-wide seismic refraction survey incorporated four survey lines to aid in characterization of the subsurface of OU4.
Characterize lithologies and soil chemistry, identify patterns of leakage, identify migration pathways, and investigate ground water and bedrock elevations	Implement drilling and sampling plan per SOP GT 1 and GT 2 at 26 work plan locations	Drilled and sampled 28 boreholes to aid in the characterization of the existing SEPs area. Boreholes 40993, 41993, 42393, and 42993 double as original and existing SEPs analytical borehole locations. Borehole 44193 was advanced for geologic data and logged with borehole geophysics. Seven of these analytical boreholes were completed as piezometers.

TABLE II.2-1 (continued)

PHASE I FIELD PROGRAM TASKS, PROPOSED WORK, AND COMPLETED WORK

Task	Proposed Work	Completed Work
Determine infiltration characteristics, identify perched water horizons, and characterize soil pore water quality	Implement a vadose zone monitoring program per TM1	Installed nine vadose zone monitoring wells, performed four BAT permeability tests, performed eight Guelph permeameter tests, and collected 19 intact physical properties samples as required by TM1, five of which were collected from borings which doubled as original ponds locations. Follow-up monitoring of soil pore liquids and in-place moisture content occurred from May 1 - September 15, 1993. Soil gas measurements were taken at 15 locations, and three soil samples were collected for column leach testing
INTERCEPTOR TRENCH SYSTEM (ITS) AND SURROUNDING AREA		
Characterize lithologies and soil chemistry, identify migration pathways, investigate ground water and bedrock elevations, evaluate extent to which ITS is keyed into bedrock, investigate Arapahoe sandstone subcrop, and observe bedrock fracture	Implement drilling and sampling plan per SOP GT 1 and GT 2 at 19 work plan locations. Five of these locations were designated as deep geologic borings	Drilled and sampled 19 boreholes to characterize this area. Completed five of the characterization boreholes as piezometers, either singly or as part of a nest. Borehole 44193 was advanced past bedrock contact as a deep geologic boring and was subsequently logged using borehole geophysical techniques
Evaluate hydraulic capture of the ITS and investigate migration pathways	Install four piezometer nests per SOP GT 6 and GW 1	Installed an additional 12 piezometers as elements of four piezometer nests
Correlate perched water horizons with downslope seeps, determine infiltration characteristics, and characterize soil pore water quality	Implement a vadose zone monitoring program per TM1	Installed three vadose zone monitoring wells, performed 10 BAT permeability tests, performed 13 Guelph permeameter tests, and collected 11 intact physical properties samples as required by TM1. Follow up monitoring of soil pore water chemistry and in place moisture content occurred from May 1 - September 15, 1993. Soil gas measurements were taken at 7 locations, and column leach samples were collected at three locations

TABLE II.2-2

LIST OF PHOTOGRAPHS REVIEWED

Negative No	Date	Type	Comments
02245-0	08/31/54	OA	ORIGINAL POND
01935-00	09/19/56	CU	2A AT COMPLETION WITH 2 AND 2-AUXILIARY
01934-00	09/19/56	CU	2A AT COMPLETION - VIEW FROM NORTHEAST
01937-00	09/19/58	CU	2A AT COMPLETION - VIEW OF EASTERN BERM ONLY
01936-00	09/19/56	CU	2A AT COMPLETION WITH 2 AND 2D
01933-01	09/19/56	CU	2A AT COMPLETION - EASTERN BERM
01931-00	09/19/56	CU	2A AT COMPLETION - SOUTHWESTERN CORNER
01932-00	09/19/56	CU	2A AT COMPLETION - EASTERN PORTION
05288-00	07/13/60	CU	207-B SOUTH - WITH BUBBLED ASPHALT
05290-00	07/13/60	CU	207-B SOUTH - WITH BUBBLED ASPHALT
05289-00	07/13/60	CU	207-B SOUTH - WITH BUBBLED ASPHALT
05287-00	07/13/60	CU	207-B SOUTH - WITH BUBBLED ASPHALT
11451-00	10/15/64	OA	SEPs 2, 2D, 207-A, AND 207B
10829-06	09/21/65	CU	A-SERIES DRAINAGE W/2, 2D, AND 207-A, 2 IS DRY, VEGETATION DISTURBANCE ON HILLSIDE
13676-09	06/05/69	LAO	SITE FROM NORTH W/2 & 2D, 207-A, 207B
13677-03	06/05/69	LAO	POND 2 & CORNER OF 2D SHORTLY BEFORE CLEANOUT AND DEMOLITION
14444-08	05/15/70	LAO	SITE FROM NORTHEAST W/ 207-A, 207B, 2 GONE
15334-09	05/25/71	LAO	SEPs 207-A, 207B, AND 207-C
21042-12	10/14/76	CU	207-A - EASTERN PORTION

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TABLE II.2-2 (continued)

LIST OF PHOTOGRAPHS REVIEWED

Negative No	Date	Type	Comments
21043-12	10/14/76	CU	207-A - EASTERN PORTION
21042-11	10/14/76	CU	TAR ON POND WALL
21042-09	10/14/76	CU	207-B NORTH OR SOUTH - DRIED TAR
21042-10	10/14/76	CU	TAR ON POND WALL
21043-06	10/14/76	CU	207-B NORTH OR SOUTH SHOWING FML
21043-07	10/14/76	CU	207-B NORTH OR SOUTH SHOWING FML
21043-05	10/14/76	CU	207-B NORTH OR SOUTH SHOWING FML
21043-03	10/14/76	CU	TAR ON POND WALL
21043-04	10/14/76	CU	207-A NORTHEASTERN CORNER
21041-11	10/14/76	CU	207-B CENTER & AREA OF CONTAMINATED SOIL
21041-12	10/14/76	CU	207-B CENTER AND SOUTH & CONTAMINATED SOIL
21041-10	10/14/76	CU	207-B NORTH (EMPTY) AND CENTER (FULL)
21041-08	10/14/76	CU	207-B SOUTH CLEAN-OUT W/ PIPING
21041-09	10/14/76	CU	207-B NORTH CLEANED OUT
21042-07	10/14/76	CU	207-B SOUTH (EMPTY)
21042-08	10/14/76	CU	207-B NORTH OR SOUTH - DRIED TAR
21042-06	10/14/76	CU	207-B NORTH OR SOUTH PIPING
21042-02	10/14/76	CU	207-B NORTH OR SOUTH PIPING
21042-03	10/14/76	CU	207-B NORTH OR SOUTH PIPING

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TABLE II 2-2 (continued)

LIST OF PHOTOGRAPHS REVIEWED

Negative No	Date	Type	Comments
42090-38	06/06/91	LOA	GENERAL AREA FROM EAST

Photograph No	Date	Type	Comments
AIN-41	07/01/37	USDA	AERIAL PHOTOGRAPH
DV 34-33	07/14/51	CAPS	AERIAL PHOTOGRAPH
WFS 6230	09/21/53	EPA	AERIAL PHOTOGRAPH
AIN-2N-88	07/02/55	EPA	AERIAL PHOTOGRAPH
113-41	08/11/62	CAPS	AERIAL PHOTOGRAPH
115-28	05/05/63	CAPS	AERIAL PHOTOGRAPH
VBBL 3-7	10/15/64	EPA	AERIAL PHOTOGRAPH
119-17	04/29/65	CAPS	AERIAL PHOTOGRAPH
123-263	04/15/66	CAPS	AERIAL PHOTOGRAPH
127-207	04/29/67	CAPS	AERIAL PHOTOGRAPH
129-386	04/10/68	CAPS	AERIAL PHOTOGRAPH
AIN IKK 154	08/07/69	EPA	AERIAL PHOTOGRAPH
132-26	04/25/70	CAPS	AERIAL PHOTOGRAPH
VCUC 2-88	08/06/71	EPA	AERIAL PHOTOGRAPH
135-94	04/24/72	CAPS	AERIAL PHOTOGRAPH
136-8	10/26/72	CAPS	AERIAL PHOTOGRAPH

TABLE II.2-2 (continued)

LIST OF PHOTOGRAPHS REVIEWED

Photograph No	Date	Type	Comments
139-52	10/13/73	CAPS	AERIAL PHOTOGRAPH
140-20	04/27/74	CAPS	AERIAL PHOTOGRAPH
141-7	11/07/74	CAPS	AERIAL PHOTOGRAPH
142-27	10/15/75	CAPS	AERIAL PHOTOGRAPH
144-20	10/08/76	CAPS	AERIAL PHOTOGRAPH
146-26	10/12/77	CAPS	AERIAL PHOTOGRAPH
VEQC-C-3-179	08/17/78	EPA	AERIAL PHOTOGRAPH
67	06/01/80	EPA	AERIAL PHOTOGRAPH
483-26	10/05/83	EPA	AERIAL PHOTOGRAPH
43	05/22/86	EPA	AERIAL PHOTOGRAPH
37263-00	12/16/87	RFP	AERIAL PHOTOGRAPH
005	06/07/88	EPA	AERIAL PHOTOGRAPH
41744-17	03/11/91	RFP	AERIAL PHOTOGRAPH

Photograph Types

OA - Overhead Aerial

CU - Close-Up

LAO - Low-Angle Oblique

USDA - U S Department of Agriculture

CAPS - Colorado Aerial Photographic Service

EPA - U S Environmental Protection Agency

RFP - Rocky Flats Plant

TABLE II 2-3

LIST OF ENGINEERING DRAWINGS REVIEWED

DRAWING NUMBER	TITLE	DATE
1-1454-207	PROCESS WASTE-FAC 207 EVAPORATION POND	08/07/53
1-3398-207	IND WASTE FAC 207, 3 ACRE EVAPORATION POND PLAN & SECTION	04/26/56
2-4184	UNDERGROUND UTILITIES LAYOUT ZONES G-5 AND H-5	03/31/59
2-4185	UNDERGROUND UTILITIES LAYOUT ZONES G-6, G-7, H-6, H-7	03/31/59
1-6217-207	IND WASTE FAC 207, 3 1-ACRE EVAPORATION POND ADDITION PLAN, SECTIONS & DETAILS	09/10/59
1-6218-207	IND WASTE FAC 207, 3 1-ACRE EVAPORATION POND ADDITION DETAILS	09/22/59
16887-1	POND LINING DETAIL AND DRAINAGE PLAN, FAC 207	8/61
16887-2	POND LINING DETAIL AND DRAINAGE PLAN, REPAIR OF WASTE DISPOSAL EVAP POND-FAC 207	1960/1961
1-8080-207	POND LINING DETAIL AND DRAINAGE PLAN, REPAIR OF WASTE DISPOSAL EVAP POND 2-B, SHEET 1 OF 2	1960/1961
1-8081-207	POND LINING DETAIL AND DRAINAGE PLAN, REPAIR OF WASTE DISPOSAL EVAP POND 2-B	1960/1961
D-11120-1	POND 2-A RELINING DETAILS	09/03/63
E-14602-1	UTILITY PLAN BUILDING 79	02/28/66
19379-1	EVAPORATION POND 207-C PLAN & DETAILS	05/14/70
19379-2	EVAPORATION POND 207-C TEMPORARY PUMP SHED SLAB PLAN & SECT	11/04/70
19379-4	EVAPORATION POND 207-C PIPING SYSTEM DETAILS	01/04/71

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TABLE II 2-3 (continued)

LIST OF ENGINEERING DRAWINGS REVIEWED

DRAWING NUMBER	TITLE	DATE
19379-3	EVAPORATION POND 207-C PIPING SYSTEM PLAN & DETAILS	01/04/71
19923-1	REPAIR EVAP PONDS, POND 207-A	03/16/71
19923-2	REPAIR EVAP PONDS, POND 207-C	03/16/71
19379-5	EVAPORATION POND 207-C, REVISED DRAINAGE PLAN	02/08/72
29147-1	POND TRANSFER SYSTEM AREA PLAN	04/10/75
29147-2	POND TRANSFER SYSTEM PUMP ASSEMBLY	04/10/75
25573-1	NITRATE INTERCEPTOR TRENCHES PLAN	06/09/75
27452-210	WATER CONTROL AND RECYCLE DETAILS	07/27/77
28103-X01	MEMBRANE POND LINER, PHASE 1-POND 207-B SOUTH, TITLE SHEET/AREA PLOT PLAN	03/27/78
28103-101	MEMBRANE POND LINER PHASE 1, PLAN AND SECTIONS	03/27/78
28103-102	MEMBRANE POND LINER PHASE 1, SECTIONS AND DETAILS	03/27/78
28103-201	MEMBRANE POND LINER PHASE 1, PLAN	03/27/78
28103-202	MEMBRANE POND LINER PHASE 1, SECTIONS AND DETAILS	03/27/78
28103-203	MEMBRANE POND LINER PHASE 1, SECTIONS AND DETAILS	03/27/78
27588-2	R O WATER USE PROJECT PAVING DETAILS AROUND POND	12/14/78
27550-033	PERIMETER SECURITY ZONE, N E CORNER PLAN	04/30/82
27550-040	PERIMETER SECURITY ZONE, BLDG #207 PLAN	05/10/82

TABLE II.2-3 (continued)

LIST OF ENGINEERING DRAWINGS REVIEWED

DRAWING NUMBER	TITLE	DATE
27550-050	PERIMETER SECURITY ZONE, BLDG #771 PLAN	05/10/82
27452-209	WATER CONTROL & RECYCLE POND AREA PIPING AND TIE-INS	05/12/82
27550-200	SUBSURFACE WATER COLLECTION SYSTEM-MECH	05/13/82
27550-201	SUBSURFACE WATER COLLECTION SYSTEM-ELECT	06/12/82
26637-01	NITRATE COLLECTION FRENCH DRAIN PLAN	06/16/82
26637-02	NITRATE COLLECTION DETAILS AND SECTIONS	06/16/82
27550-202	SUBSURFACE WATER COLLECTION SYSTEM-ELECT	12/14/82

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TABLE II 2-4

REQUESTED ANALYSES, FREQUENCY, AND ANALYTICAL METHODS FOR OU4 MEDIA SAMPLES

SAMPLE TYPE	OU4 STUDY AREA	ANALYTICAL PARAMETERS	COMPOSITE COLLECTION/ ANALYTICAL FREQ	ANALYTICAL METHOD
Surficial Soil Samples	All Areas Including SEP 207A Subgrade SEP 207B Subgrade Random Samples Discrete Samples Borehole Samples	Nitrate TAL Metals Uranium ^{233/235} 236 238 Plutonium ^{239/240} Americium ²⁴¹ Cesium ¹³⁷ Strontium ⁹⁰ Gross Alpha, Gross Beta Tritium TCL Semivolatile Organics Pesticides PCBs	each sample each sample	EPA 353 1 or 353 2 CLP Methods GRASSP 1 GRASSP 1 GRASSP 1 GRASSP 1 GRASSP 1 GRASSP 1 GRASSP 1 CLP Methods CLP Methods CLP Methods
Borehole Subsurface Soil Samples	Existing/Original SEPs Area	Nitrate TAL Metals Uranium ^{233/235} 236 238 Plutonium ^{239/240} Americium ²⁴¹ Cesium ¹³⁷ Strontium ⁹⁰ Gross Alpha, Gross Beta Tritium TCL Volatile Organics TCL Semivolatile Organics Cyanide, Sulfide Pesticides PCBs	each sample each sample	EPA 353 1 or 353 2 CLP Methods GRASSP 1 GRASSP 1 GRASSP 1 GRASSP 1 GRASSP 1 GRASSP 1 GRASSP 1 CLP Methods CLP Methods EPA 335 2 or 335 3, EPA 376 CLP Methods CLP Methods

TABLE II.2-4 (continued)

REQUESTED ANALYSES, FREQUENCY, AND ANALYTICAL METHODS FOR OU4 MEDIA SAMPLES

SAMPLE TYPE	OU4 STUDY AREA	ANALYTICAL PARAMETERS	COMPOSITE COLLECTION/ ANALYTICAL FREQ	ANALYTICAL METHOD
Borehole Subsurface Soil Samples	Immediately beneath SEP 207A SEP 207B-Center SEP 207B-North	Nitrate TAL Metals Uranium ^{233/235} 236 238 Plutonium ^{239/240} Americium ²⁴¹ Cesium ¹³⁷ Strontium ⁹⁰ Gross Alpha, Gross Beta Tritium TCL Volatile Organics TCL Semivolatile Organics Cyanide, Sulfide Pesticides PCBs	composited over every 4 feet composited over every 2 feet collected at 2 feet intervals composited over every 6 feet composited over every 6 feet composited over every 6 feet composited over every 6 feet	EPA 353 1 or 353 2 CLP Methods GRASSP ¹ GRASSP ¹ GRASSP ¹ GRASSP ¹ GRASSP ¹ GRASSP ¹ GRASSP ¹ GRASSP ¹ CLP Methods CLP Methods EPA 335 2 or 335 3, EPA 376 CLP Methods CLP Methods
	ITS/Surrounding Area	Nitrate Uranium ^{233/235} 236 238 Gross Alpha and Gross Beta Tritium TCL Volatile Organics Cyanide, Sulfide	each sample each sample each sample each sample each sample each sample	EPA 353 1 or 353 2 GRASSP ¹ GRASSP ¹ GRASSP ¹ CLP Methods EPA 335 2 or 335 3, EPA 376

TABLE II.2-4 (continued)

REQUESTED ANALYSES, FREQUENCY, AND ANALYTICAL METHODS FOR OU4 MEDIA SAMPLES

SAMPLE TYPE	OU4 STUDY AREA	ANALYTICAL PARAMETERS	COMPOSITE COLLECTION/ ANALYTICAL FREQ	ANALYTICAL METHOD
Soil Gas	All Areas	1, 1, 1 - Trichloroethane Carbon Tetrachloride Trichloroethene Tetrachloroethene Oxygen Carbon Dioxide Methane	each sample each sample each sample each sample each sample each sample each sample	Field Gas Chromatography Field Gas Chromatography Field Gas Chromatography Field Gas Chromatography Field Infrared Analyzer Field Infrared Analyzer Field Infrared Analyzer

Notes CLP - EPA Statement of Work Contract Laboratory Program
 GRASP¹ - Methods specified in RFP's General Radiochemistry and Routine Analytical Services Protocol
 ASTM - American Society for Testing and Materials
 * - Analyses requested but not performed

TABLE II.2-5

LISTS OF CONSTITUENTS ANALYZED BY CLP METHODS

TARGET ANALYTE LIST (TAL) METALS

Aluminum	Magnesium
Antimony	Manganese
Arsenic	Mercury
Barium	Molybdenum
Beryllium	Nickel
Cadmium	Potassium
Calcium	Selenium
Cesium	Silicon
Chromium	Silver
Cobalt	Sodium
Copper	Strontium
Iron	Thallium
Lead	Tin
Lithium	Vanadium
	Zinc

PESTICIDES AND POLYCHLORINATED BIPHENYLS

4,4'-DDD	Endosulfan sulfate
4,4'-DDE	Endrin
4,4'-DDT	Endrin ketone
Aldrin	Heptachlor
Aroclor-1016	Heptachlor epoxide
Aroclor-1221	Methoxychlor
Aroclor-1232	Toxaphene
Aroclor-1242	Alpha-bhc
Aroclor-1248	Alpha-chlordane
Aroclor-1254	Beta-bhc
Aroclor-1260	Delta-bhc
Dieldrin	Gamma-bhc (lindane)
Endosulfan I	Gamma-chlordane
Endosulfan II	

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TABLE II.2-5 (continued)

LISTS OF CONSTITUENTS ANALYZED BY CLP METHODS

TARGET COMPOUND LIST (TCL)
VOLATILE ORGANIC COMPOUNDS

1,1,1-Trichloroethane	Carbon tetrachloride
1,1,2,2-Tetrachloroethane	Chlorobenzene
1,1,2-Trichloroethane	Chloroethane
1,1-Dichloroethane	Chloroform
1,1-Dichloroethene	Chloromethane
1,2-Dichloroethane	Dibromochloromethane
1,2-Dichloroethene	Decanal
1,2-Dichloropropane	Ethylbenzene
1-Hexanol, 2-Ethyl-2-Butanone	Hexanal
2-Hexanone	Methylene chloride
2-Heptanone	Pentanal
4-Methyl-2-pentanone	Styrene
Acetone	Tetrachloroethene
Acetic acid, methyl ester	Toluene
Benzene	Total xylenes
Bromodichloromethane	Trichloroethene
Bromoform	Vinyl acetate
Bromomethane	Vinyl chloride
Carbon disulfide	cis-1,3-Dichloropropene
	trans-1,3-Dichloropropene

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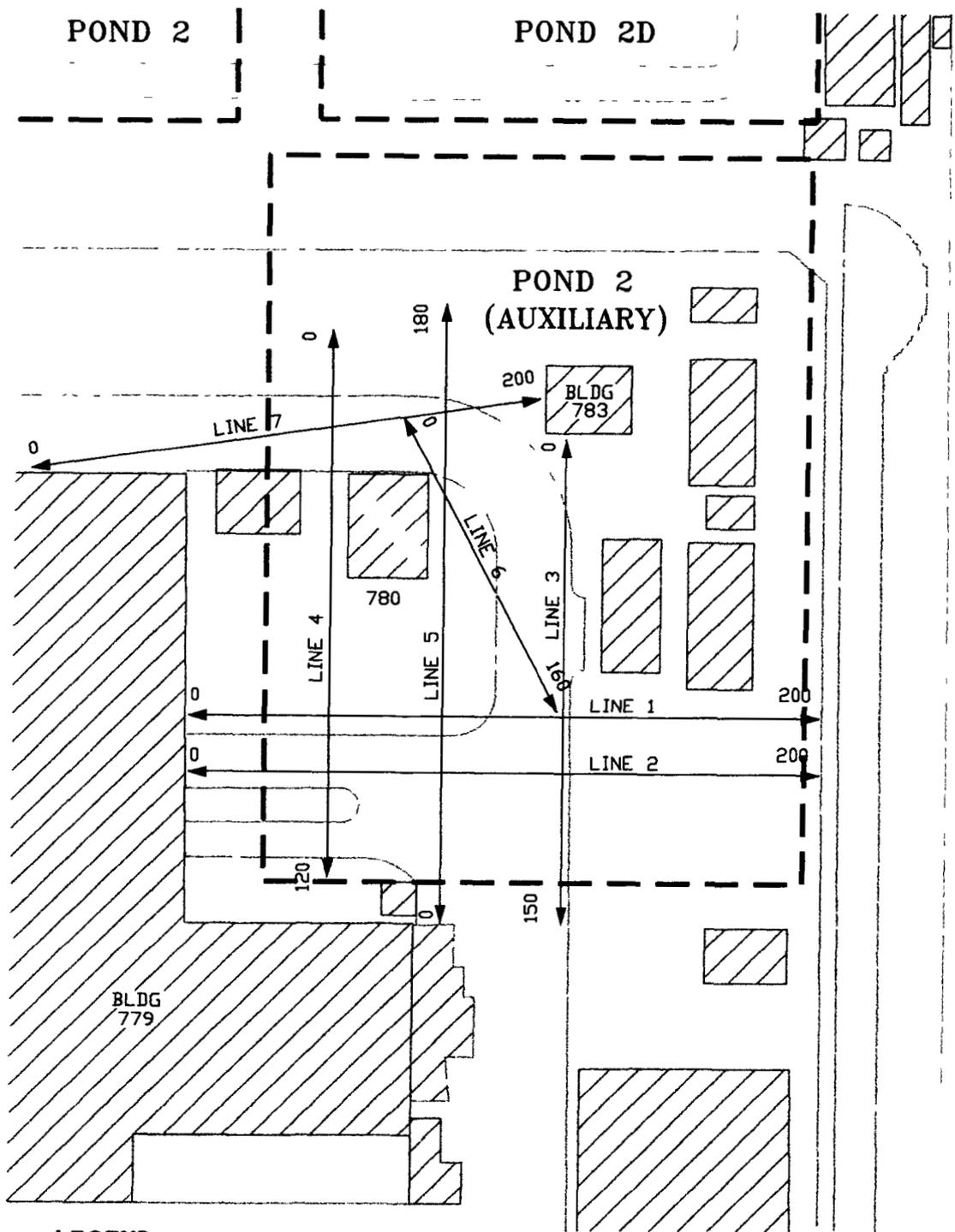
TABLE II.2-5 (continued)

LISTS OF CONSTITUENTS ANALYZED BY CLP METHODS

TARGET COMPOUND LIST (TCL)
SEMIVOLATILE ORGANIC COMPOUNDS

1,2,4-Trichlorobenzene	Benzyl alcohol
1,2-Dichlorobenzene	bis(2-chloroethoxy)Methane
1,3-Dichlorobenzene	bis(2-chloroethyl)Ether
1,4-Dichlorobenzene	bis(2-chloroisopropyl)Ether
2,4,5-Trichlorophenol	bis(2-ethylhexyl)Phthalate
2,4,6-Trichlorophenol	Butyl benzyl phthalate
2,4-Dichlorophenol	Carbazole
2,4-Dimethylphenol	Chrysene
2,4-Dinitrophenol	di-n-Butyl phthalate
2,4-Dinitrotoluene	di-n-Octyl phthalate
2,6-Dinitrotoluene	Dibenzo(a,h)anthracene
2-Chloronaphthalene	Dibenzofuran
2-Chlorophenol	Diethyl phthalate
2-Fluorobiphenyl	Dimethyl phthalate
2-Methylnaphthalene	Fluoranthene
2-Methylphenol	Fluorene
2-Nitroaniline	Hexachlorobenzene
2-Nitrophenol	Hexachlorobutadiene
3,3'-Dichlorobenzidine	Hexachlorocyclopentadiene
3-Nitroaniline	Hexachloroethane
4-Chloro-3-Methylphenol	Indeno(1,2,3-cd)pyrene
4-Chloroaniline	Isophorone
4-Chlorophenyl phenyl ether	n-Nitroso-di-n-propylamine
4-Methylphenol	n-Nitrosodiphenylamine
4-Nitroaniline	Naphthalene
4-Nitrophenol	Nitrobenzene
Acenaphthene	Pentachlorophenol
Acenaphthylene	Phenanthrene
Anthracene	Phenol
Benzo(a)anthracene	Pyrene
Benzo(a)pyrene	
Benzo(b)fluoranthene	
Benzo(ghi)perylene	
Benzo(k)fluoranthene	
Benzoic acid	

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LEGEND

-  Paved Roads
-  Buildings
-  GPR Survey Line and Station Location Numbers
-  Original Pond Area

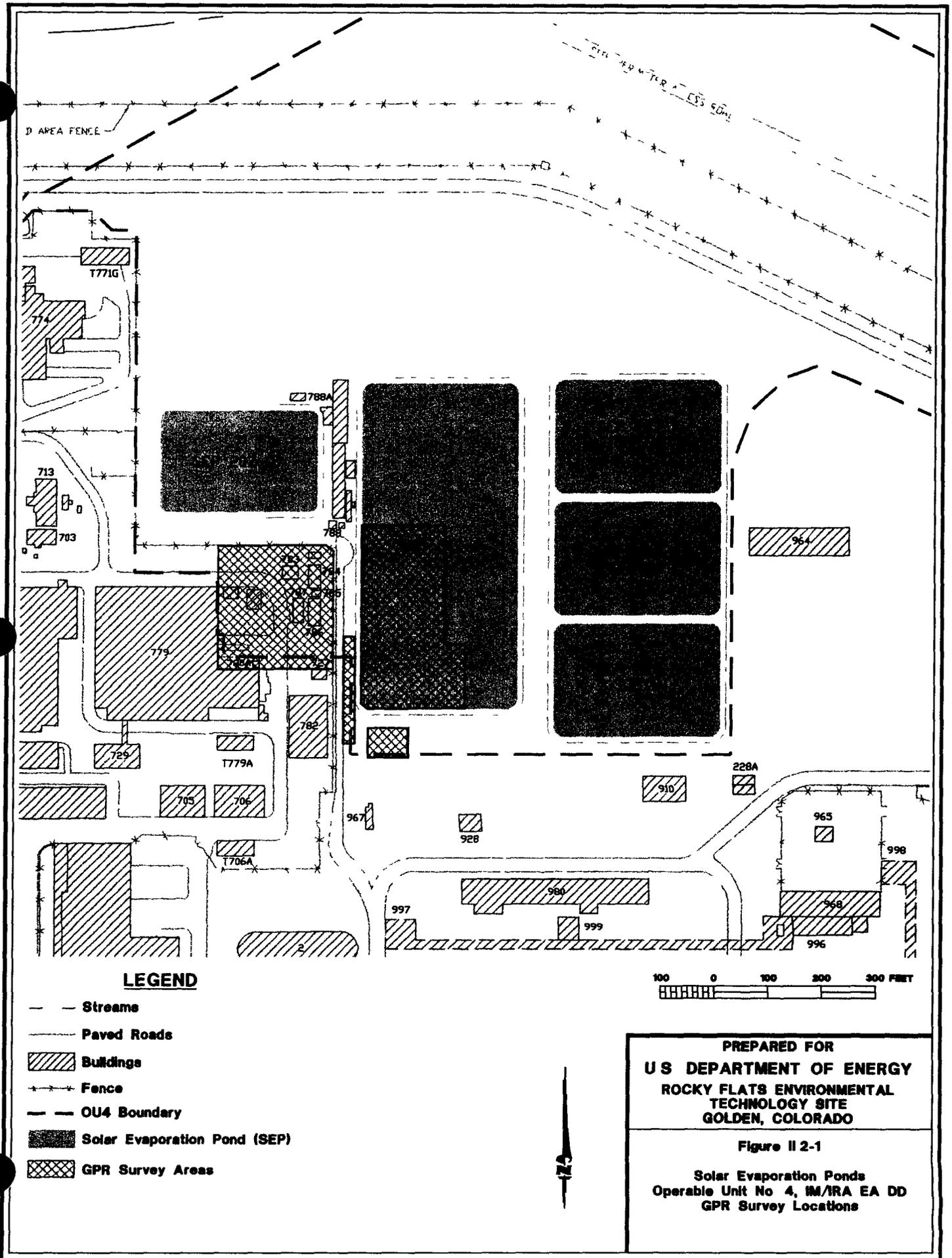


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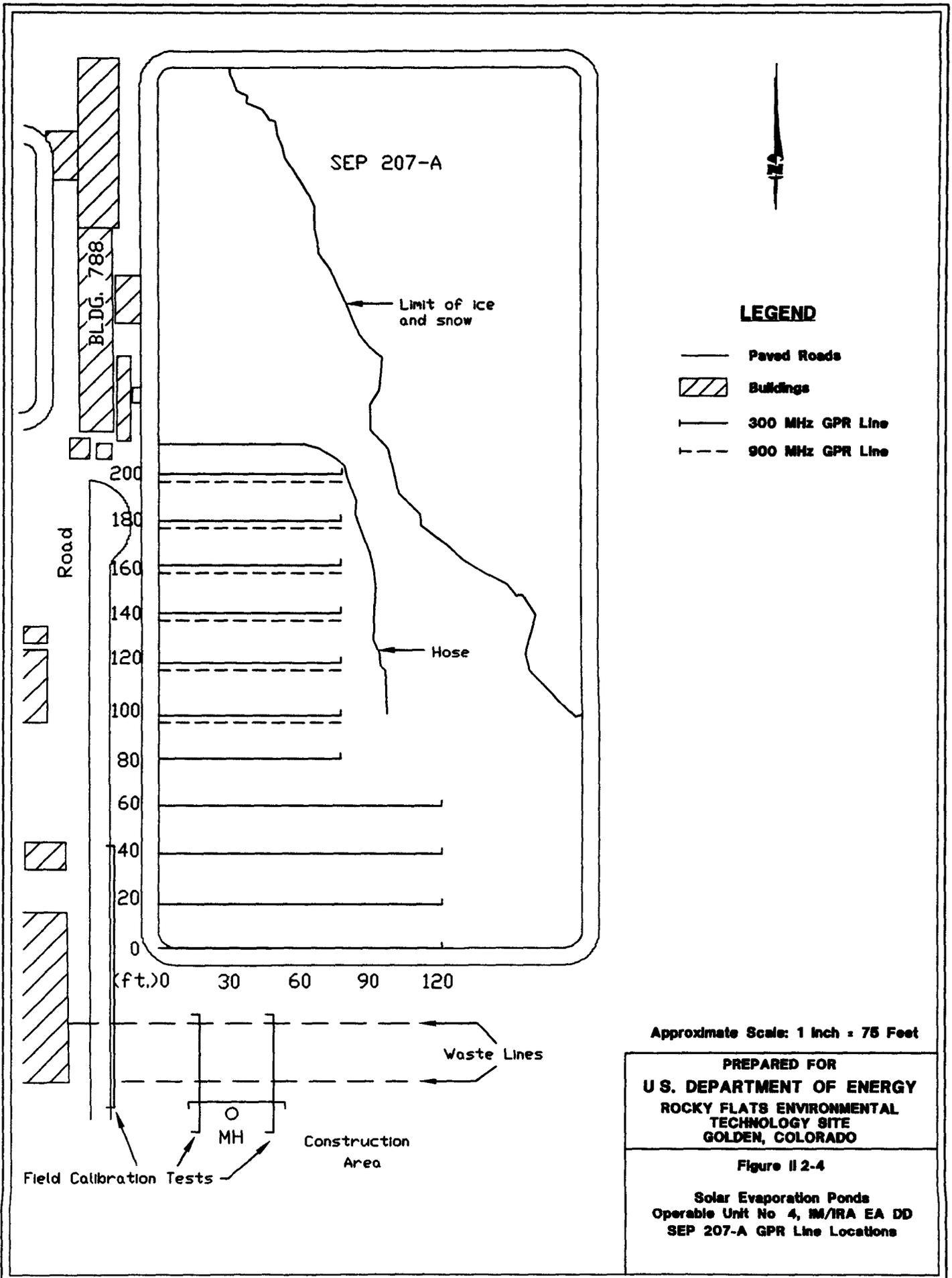
Figure II 2-2

Solar Evaporation Ponds
 Operable Unit No 4, MM/RA EA DD
 Original Ponds GPR Line Locations

100



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17	372 371	374 373	376 375	384 385	383 387	386 388	396 395	398 397	400 399	409 408	410 407	411 412	
16	370 369 368	377 378 379	382 381 380	389 390 391	394 393 392	401 402 403	404 405 406	413 415 416	417 418 419				
15	365 366 367	364 363 362	361 360 359	356 357 358	355 353 354	350 352 351	349 347 348	346 345 344					
14	322 321 320	323 324 325	328 327 326	329 331 330	332 333 334	337 336 335	338 339 340	343 342 341					
13	317 319	316 318	315 314	312 313	311 310	308 307	306 305	303 302	300 301	299 298	297 296	295 294	
12	274 273 272	275 277 276	278 279 280	283 282 281	286 284 285	287 289 288	291 292 290	295 294 293					
11	271 270 269	266 267 268	265 264 263	262 261 260	257 258 259	256 255 254	251 252 253	250 249 248					
10	224 225	226 228	227 229	230 232	234 235	236 237	241 240	242 243	244 245	247 246			
9	221 222 223	219 220 218	215 216 217	213 214 212	210 211 209	207 208 206	205 204 203	201 202 200					
8	178 177 176	179 181 180	183 184	185 187 186	189 188	193 190	195 194	197 198 199					
7	174 175 173	172 171	170 169	168 167	166 165	164 163	162 161	158 159	156 157	155 152	154 153		
6	151 150 149	148 147	146 145	144 143	142 141	140 139	138 137	136 135	134 133	132 131	130 128		
5	106 105 104	107 108	109 110	111 112	113 114	115 116	117 118	119 120	121 122	124 123	127 125	126	
4	103 102 101	100 99	98 96	97 95	93 94	93 92	90 89	88 87	86 84	85 83	83 82	81 80	
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1	5 3 6	4 1	2 1	8 7	12 10	15 13	17 16	20 19	24 22	27 26			
	A	B	C	D	E	F	G	H					



LEGEND

200 Location Where Radiological Survey Reading Was Taken

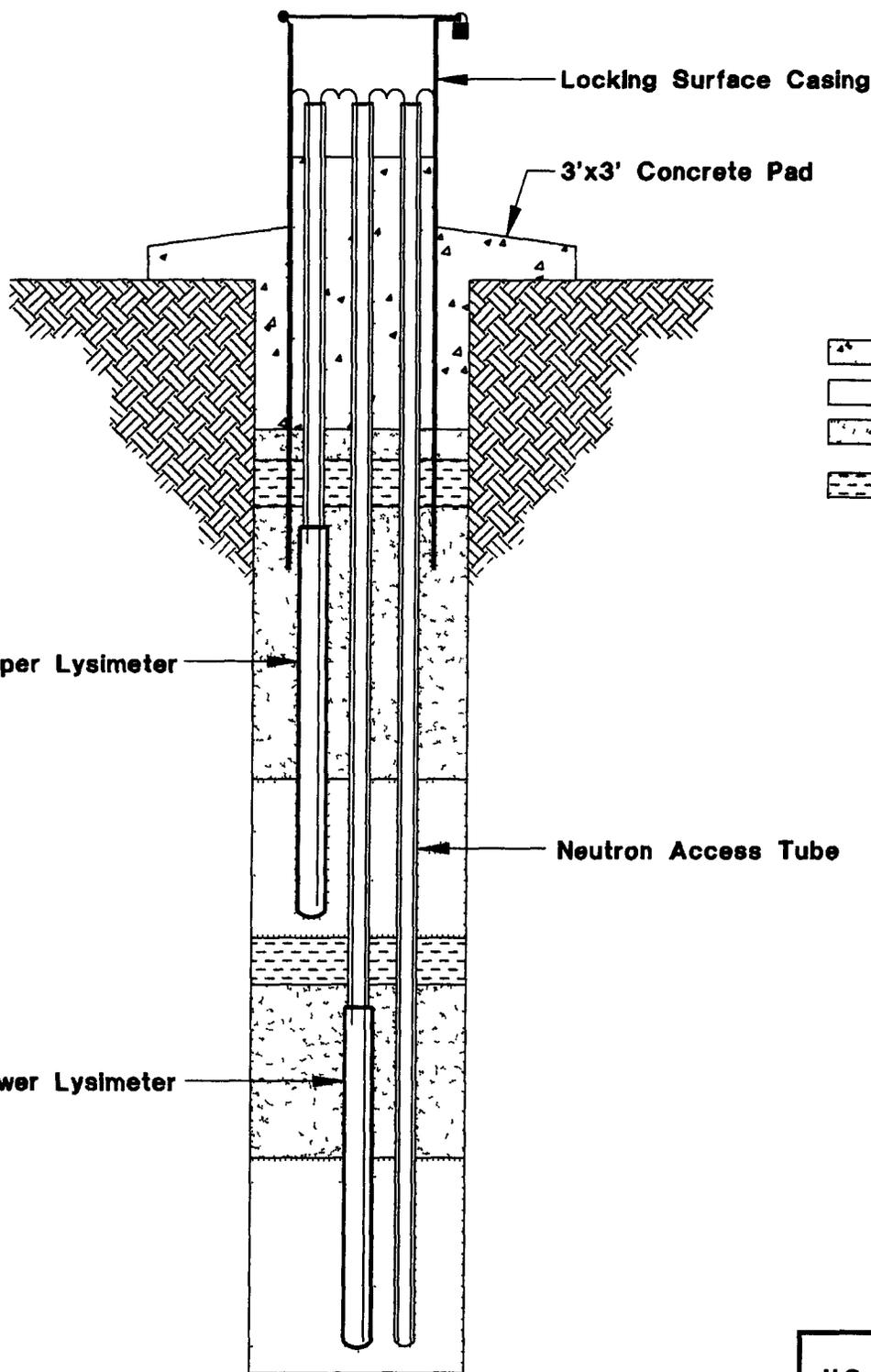
Approximate Scale: 1 Inch = 75 Feet

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Figure II 2-6

Solar Evaporation Ponds
 Operable Unit No 4, IM/IRA EA DD
 Grid Used For Radiological Survey Of
 SEP 207-A

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LEGEND

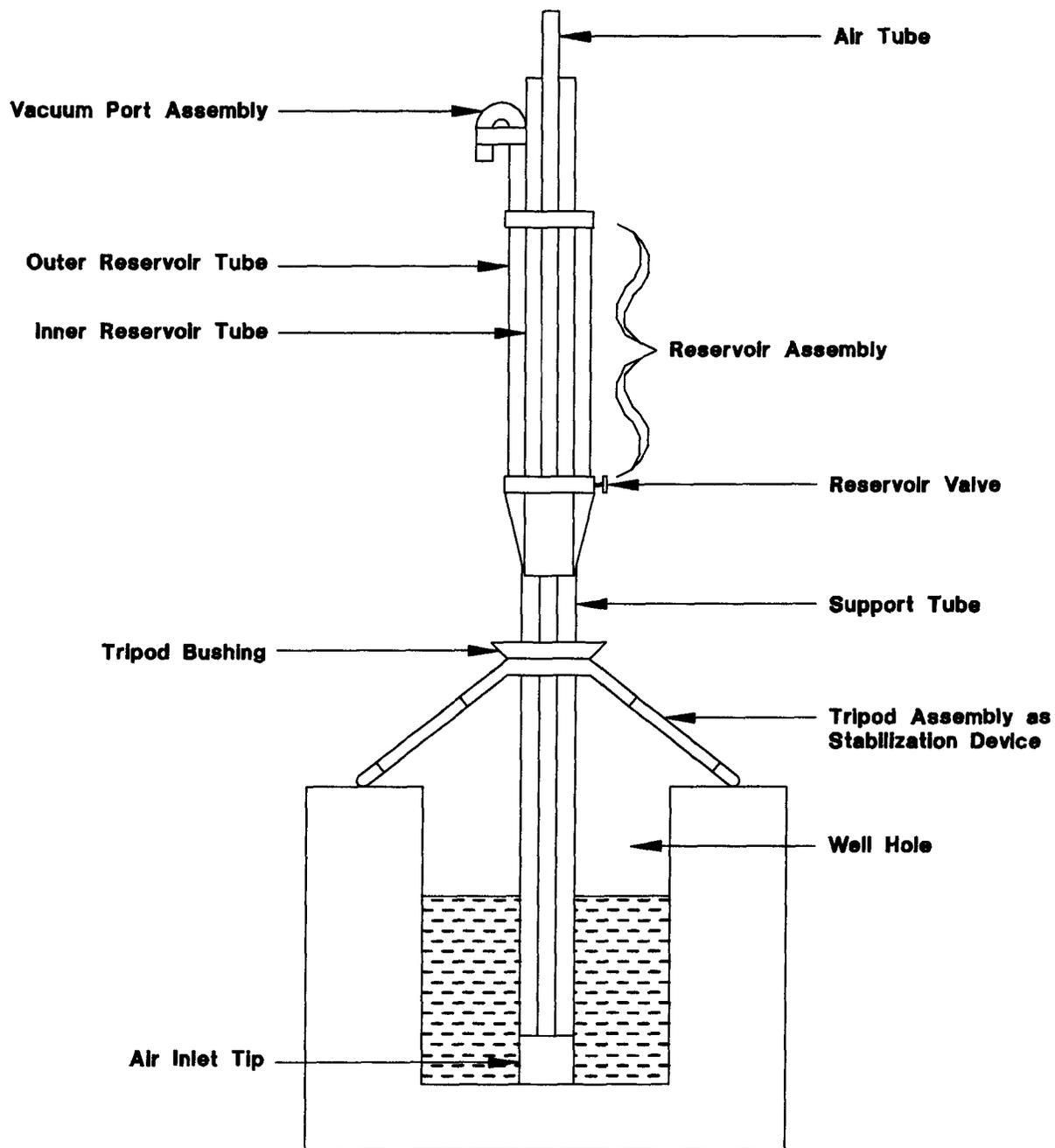
-  Concrete
-  Silica Flour (200 Mesh)
-  Colorado Silica Sand (or Equivalent)
-  Bentonite Seal

Not To Scale

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Figure II.2-20
 Solar Evaporation Ponds
 Operable Unit No 4, IM/IRA EA DD
 Schematic Diagram of Typical Lysimeter
 Installation

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Not To Scale

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Figure II.2-21

Solar Evaporation Ponds
 Operable Unit No. 4, IM/IRA EA DD
 Schematic Diagram of Guelph
 Permeameter Test Installation

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II.3 RESULTS OF THE OU4 PHASE I RFI/RI

Results of the OU4 Phase I RFI/RI, supplemented with tables and figures summarizing the data, are presented in this section including

- Characterization of the potential sources of contamination associated with the original earthen ponds and existing Solar Evaporation Ponds (Section II 3 1),
- Results of the surficial soil radiological survey and sampling program including random, discrete and borehole surficial soils (Section II 3 2),
- Results of the vadose zone investigation as described in Technical Memorandum No 1, *Vadose Zone Investigation* (Section II 3 3),
- Summaries of the chemical analytical results for subsurface soil and bedrock (Section II 3 4),
- Geologic investigation results including an assessment of contaminant distribution adjacent to the ponds and in the remainder of OU4 (Section II 3 5), and
- Significant quality assurance/quality control results (Section II 3 6)

For the purposes of evaluating the extensive data and reporting the analytical results collected during the Phase I RFI/RI, a statistical analysis of the data was completed to determine the Potential Contaminants of Concern (PCOCs) A detailed description of the statistical procedures is presented in Appendix III A

To summarize the procedures described in Appendix III A , all available data for inorganic and radionuclide analytes were statistically evaluated to determine if the RFI/RI data were significantly different than background data The comparison process used four unique, non-parametric analysis of variance (ANOVA) comparison tests The tests included comparison of maximum RFI/RI observations for analytes to either a calculated, non-parametric 99% upper tolerance limit (UTL) or to the maximum background data, the slippage test, the quantile test, and the Gehan test

Analytes were classified as PCOCs if they failed one or more of the latter three tests Analyte data sets that contained values greater than the 99% UTL or greater than the maximum background by several orders of magnitude were considered PCOCs The latter scenario was a screen for "hot-spot" contamination Organic chemicals became PCOCs if detections of a particular chemical exceeded five percent of the samples analyzed Tables II 3 2-2 and II 3 4-1 list the surficial soil and subsurface soil and bedrock PCOCs, respectively

II.3.1 Results of Original and Existing Solar Evaporation Ponds Investigation

Several investigative activities were conducted to fulfill the OU4 Phase I RFI/RI Work Plan objectives for characterizing the original and existing SEPs (Section II 2 3) Activities included research of historical records, review of aerial photographs and engineering drawings, and field investigation activities including visual surveys, radiation surveys, surface and borehole geophysics, and sampling and analysis of pond liner, subgrade, surface soils, and subsurface soils The results from these activities are provided in this section

Historical information regarding the ponds is summarized from the 1988 Solar Evaporation Ponds Closure Plan (Rockwell, 1988) Descriptions in this report rely primarily on the 1988 information, however, this report includes additional information obtained since the release of the 1988 Solar Evaporation Ponds Closure Plan An extensive Solar Evaporation Pond History Timeline is included in Appendix II B, in which construction information, potential releases, cleanup activities, leakage monitoring, and pond repairs are documented Figure II 3 1-1 graphically presents SEP construction chronology in timeline format

II.3.1.1 Original Earthen Ponds

The investigation of the original SEPs area was designed to characterize the types and distribution of contaminants in surficial and subsurface soils, to evaluate the physical features and dimensions of the original SEPs, and to identify the presence of pond construction materials (clay liner), as well as piping and other equipment that may have been abandoned in place

The specific objectives of the Original Ponds, or earthen ponds, investigation were two-fold First, identify the contaminants present and their spatial distribution, and second, define the boundaries and physical features of the Original Ponds, as well as the presence of pond construction materials and associated equipment The configuration and exact locations of the Original Ponds were unclear prior to implementation of the OU4 Final Work Plan Activities completed for the Original Pond investigation indicated the presence of not one, but three individual earthen-lined ponds in that area, necessitating the need to change the reference from original pond to original earthen ponds Field activities were emphasized in the southernmost earthen pond area (Pond 2-Auxiliary) because SEP 207-C, which currently contains fluids and sludges, exists in the general area once occupied by the other two earthen ponds (Ponds 2 and 2D)

The three earthen ponds are no longer evident in the field, but were constructed near the current SEPs during the 1950s Regrading and removal of the soil and clay liners of the original earthen ponds in the 1960s made it difficult to ascertain their exact location and how they may have impacted contamination in OU4, although a review of historical documents and aerial photographs yielded some information about them

The search for residual physical features involved a review of historical information related to the Original Ponds and geophysical surveys of the original Pond 2-Auxiliary area

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The geophysical surveys included borehole geophysics, a GPR survey of the area that was originally occupied by Pond 2-Auxiliary, as well as a portion of the sitewide seismic refraction survey that was conducted in the area (which was not useful for identifying the Original Ponds). The Original Ponds investigations included drilling and sampling six soil boreholes. The presence or absence of contaminants was documented through chemical analysis of soil and vadose zone pore water.

II.3.1.1.1 Historical Update of Original Earthen Ponds

The original Solar Evaporation Pond, Pond 2, was constructed in October 1953 (Figure II 3 1-1) in the vicinity of present-day SEP 207-C by building dikes and lining the area with clay. The location of Pond 2 with respect to the existing SEP 207-C is shown in Figure II 3 1-2. The elevation of the pond floor is unknown, but it was reported to be at the same elevation as the surrounding topography (approximately 5,979 feet above mean sea level). Wastes were first discharged to Pond 2 in December 1953. Seepage areas were discovered and the pond liner was repaired as needed with the addition of more clay. In 1955, plans were made to construct SEP 207-A when it became apparent that additional storage would be required for the winter of 1955/1956. In September 1955, a second earthen pond was constructed southeast of Pond 2.

This second pond was designated Pond 2-Auxiliary and was built adjacent to the southeastern corner of Pond 2 as shown in Figure II 3 1-2. Wastes entered Pond 2-Auxiliary through a weir at the corner common with Pond 2. Pond 2-Auxiliary was originally unlined, but was lined in January 1957 with clay. Routine use of Ponds 2 and 2-Auxiliary ceased in August 1956 when Solar Pond 2A (later designated SEP 207-A) was placed in service, but limited use of Ponds 2 and 2-Auxiliary continued into the early 1960s.

A third clay-lined pond was constructed in April 1959 to prevent SEP 207-A from overflowing, and to support denitrification experiments pertinent to the SEPs. The denitrification experiments continued unsuccessfully until the fall of 1959. This third pond was located immediately east of Pond 2 as shown in Figure II 3 1-2, and was designated either as Pond 2C or Pond 2D, with existing Pond 2-Auxiliary receiving the remaining designation (EG&G, 1992b). The new pond is believed to have been designated Pond 2D. This convention is used for the remainder of this report.

Pond 2-Auxiliary was removed, and the area was regraded in October 1962 in anticipation of the construction of Building 779. Analyses of soil from the bottom of Pond 2-Auxiliary showed 11,000 to 75,000 disintegrations per minute per kilogram (dpm/kg) of radioactive contamination (Hill, 1962a). Contaminated soil from Pond 2-Auxiliary was placed in one of the East Trenches in OU2 on the Rocky Flats Plant site. The clay lining of Pond 2-Auxiliary was also removed. Pond 2 and Pond 2D remained in place until 1969 when the area was regraded in preparation for construction of SEP 207-C. Soil from the area of the old clay-lined pond was possibly used in the construction of SEP 207-C (Rockwell International, 1988).

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II.3.1.1.2 Historical Photograph and Engineering Drawing Evaluation

Aerial Photographs

An interpretation of a series of historical photographs was completed to further define and delineate the location, orientation, and eventual disposition of the earthen-lined ponds in the area of the SEPs (Table II 2-2 lists the photographs reviewed)

A summary of the evaluation of the relevant historical photos (Figures II 3 1-3 through II 3 1-9) follows

- 1954, August Figure II 3 1-3 is an August 1954 aerial photograph of the original Pond 2 which appears to be in use. No other evidence of disturbed ground is apparent in the vicinity of the pond.
- 1956, September Figures II 3 1-4 and II 3 1-5 are two September 1956 ground oblique photos. They show the original Pond 2 meeting the northwestern corner of Pond 2-Auxiliary, with a recently completed SEP 207-A to the east. Both Ponds 2 and 2-Auxiliary contain liquid and appear to be in use. Their combined length extends as far north and south as SEP 207-A.
- 1966, July Figure II 3 1-6 is a July 1966 aerial photo showing current SEPs 207-A and 207-B North, Center, and South, as well as Ponds 2 and 2D, which are oriented side-by-side directly west of SEP 207-A. Building 779 is already completed.
- 1969, June Figure II 3 1-7 is a June 1969 oblique aerial photo showing that Ponds 2 and 2D still exist.
- 1969, July Figure II 3 1-8 is a July 1969 low-altitude oblique photo. This close-up of pond area shows construction activity related to the regrading of the ground surface around Ponds 2 and 2D underway.
- 1970, May Figure II 3 1-9 is a May 1970 low-altitude oblique photo showing that Ponds 2 and 2D have been regraded and that SEP 207-C has not yet been constructed.

Engineering Drawings

The most complete set of engineering drawings for the SEPs are in Appendix 1 to the 1988 Solar Evaporation Pond Closure Plan (Rockwell, 1988). These drawings were reviewed to determine the locations of the Original Ponds relative to the present SEPs so that boreholes

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could be located appropriately to investigate the presence or absence of Original Pond liner and construction materials. Figure II 3 1-5 is an engineering drawing from 1955 which provides the general location of Pond 2 and 2-Auxiliary with respect to SEP 207-A. The drawing is a design drawing for the construction of SEP 207-A, and contains few details about Ponds 2 and 2-Auxiliary. The drawing indicates that Pond 2 and 2-Auxiliary shared not only a common corner, but also a significant amount of berm. The configuration of Ponds 2 and 2-Auxiliary as shown on this drawing is not substantiated by the aerial photograph review in which only the corners of the ponds adjoin (Figure II 3 1-5). The configuration shown in aerial photographs is considered a more accurate record of the history of Ponds 2 and 2-Auxiliary.

II.3.1.1.3 Ground Penetrating Radar

The primary objective in using GPR in the original SEP area was to locate the boundaries of the Original Ponds and to locate any piping or other fittings not removed at the time the ponds themselves were removed. It is apparent from the aerial photo review and engineering drawing review that Ponds 2 and 2D were located in the area of existing SEP 207-C. Therefore, the primary objective was modified based on the review of historical information to scan the subsurface materials in an attempt to identify remains of one of the former cells, Pond 2-Auxiliary. The GPR survey was therefore conducted in the area south of SEP 207-C and west of SEP 207-A, in a limited areal extent of where Pond 2-Auxiliary is known to have existed.

Profiles were laid out west to east and from north to south in order to obtain representative GPR sample responses throughout the area. Buildings, ventilator fans, well casings, hydrants, and stored materials prohibited GPR profiling in many areas. Figure II 3 1-11 shows the approximate location of the profiles taken. Using a facility drawing of the area, GPR line locations were based upon distances from building and area features, like building entrance pads and hydrants. Distances along the GPR profiles were paced-off as the survey was conducted. Known or estimated depths of water lines could serve to establish the depth of GPR penetration. Using a 300-MHz antenna, the maximum depth of the investigation was estimated to be approximately 10 feet.

Figure II 3 1-12 shows the interpreted results of the Original Pond survey using the 300-MHz antenna. The amount of subsurface and surface cultural obstacles hindered or masked detection of the Original Pond. A circular anomaly of unknown origin, approximately 35 feet in diameter adjacent to Building 779, was detected on three GPR profiles. This anomaly reflects disturbed soils, possibly representing an excavated area associated with the Original Ponds or foundation construction associated with Building 779 or former Building T707. The diffuse and shallow GPR signature is not characteristic of underground storage tanks or former tank excavations, and no further investigation of this anomaly is recommended. Other GPR anomalies confirmed the location of several pipes and trenches shown on facility drawings. GPR anomalies occurring approximately 10 feet away from the facility drawing location of six process waste lines may indicate a drafting error in facility drawings. The interpretation also identified non-documented trenches and pipes which may serve as a contaminant pathway. Figures II 3 1-13 and II 3 1-14 are color-enhanced profiles of GPR lines 1 and 5, respectively. Selected

anomalies are identified on each profile which are representative of features interpreted from the survey of the original SEPs area

II.3.1.1.4 Subsurface Investigation

Unconsolidated materials in the area corresponding to the suspected location of the original earthen ponds were investigated by drilling boreholes to provide information on soil chemistry in near-surface and subsurface soils, identify old clay liner material (if present), provide information on depth to ground water, and provide information on weathered bedrock underlying the Original Ponds

Six boreholes (Figure II 3 1-15) were drilled during the OU4 Phase I RFI/RI drilling program in areas suspected to be within the historical location of the original earthen ponds as identified from the historical data review. This represented an increase in the scope of the investigation from that stated in the work plan by increasing the number of boreholes from four to six, the rationale for which was presented in TM2. Four boreholes were drilled specifically to investigate the presence of remnants of the original earthen ponds (40993, 41993, 42893, and 43593), and two other boreholes, one of which was relocated from within SEP 207-C (42393) and another which was initially considered an "around ponds" borehole (42993), provide information on the Original Pond area. Boreholes 41993 and 42393 were completed adjacent to the western edge of SEP 207-C in the historical location of Pond 2. Boreholes 40993 and 42993 were completed adjacent to the northwestern and southeastern corners of Pond 2D, respectively. Boreholes 42893 and 43593 were completed within the historical Pond 2-Auxiliary. Three of these boreholes, 41993, 42993, and 43593, were completed as piezometers to collect alluvial ground water elevation data. Two of the boreholes (40993 and 42893) were completed as vadose zone monitoring locations, and lysimeters and neutron access tubes were installed. Physical property analyses were conducted on samples from boreholes 40993 and 42893. Borehole geophysical measurements were made in borehole 42993.

As previously mentioned, boreholes 41993 and 42393 were completed adjacent to the western edge of SEP 207-C and adjacent to the historical location of Pond 2. This conclusion is based on aerial photo interpretation (Figure II 3 1-8) and field observations during the OU4 Phase I RFI/RI drilling program. Figure II 3 1-8 (July 1969 Regrading of Ponds 2 and 2B) shows a dirt road and what appears to be a trench between the western edge of Pond 2 and the north-south trending fence just west of Pond 2. At this time, only a single-lane dirt road is present between the western edge of SEP 207-C and the fence. Boreholes 41993 and 42393 are approximately 10 and 12 feet east of the fence, respectively. The assumption that boreholes 41993 and 42393 are completed adjacent to the historical location of Pond 2 is based solely on the north-south trending fence (reference point), west of the SEP 207-C, which is presumed to have remained in existence since the time that Pond 2 was in operation and the present day. Boreholes 40993 and 42993 were completed adjacent to the northwestern and southeastern corners of Pond 2D, respectively.

Examination and detailed logging of the soil cores recovered during drilling indicated that subsurface soils consist predominantly of sandy gravel with some silt and clay. Logs of the soil cores did not indicate that the boreholes were from fill material, however, there was other evidence suggestive of the historical compacted clay or silt liner. Vertical, clay-filled fractures were observed in cores from borehole 41993, and the Atterberg Limits tests of samples from borehole 42893 indicated the presence of plastic clays that were markedly different from clays typically found in the Rocky Flats Alluvium.

The gravel fraction found in the alluvium is generally well-graded and consisted predominately of angular to sub-rounded clasts of blue-gray quartzite that range from 20 to 85 percent by volume. The sand fraction consists of fine-to coarse-grained, angular to sub-rounded quartz which ranged from 7 to 48 percent by volume. Figures II 3 5-8 and II 3 5-10, presented and discussed in Section II 3 5, show detailed subsurface lithology in the Original Ponds area.

The subcropping bedrock lithologies encountered in the Pond 2, 2D, and 2-Auxiliary area consisted of claystone, silty sandstone, sandy claystone, and silty claystone. Claystone bedrock was encountered at depths ranging from 7 0 feet below grade at borehole 43593 to 12 9 feet below grade at borehole 42993. Silty claystone bedrock was observed at approximately 7 2 feet below grade in borehole 42893 located in the suspected central portion of Pond 2-Auxiliary. The claystone bedrock consists predominantly of light gray to brown, very fine to fine-grained, slightly calcareous claystone that does not contain any visible bedding. Silty claystone was observed in borehole 42993, located in the suspected southeastern portion of Pond 2D, at 12 9 feet below grade.

A silty sandstone subcropping unit was encountered in boreholes 40993, 41993, and 42393. The silty sandstone was observed at approximately 9 7 (40993), 7 6 (41993), and 8 1 (42393) feet below grade. The sandstone unit encountered in borehole 40993, located north of SEP 207-C, contained interbedded claystone lenses approximately 0 3 to 1 0 feet thick from 9 7 to 27 6 feet below grade. Claystone was encountered from 27 6 to a total depth of 34 5 feet below grade. The silty sandstone unit encountered in borehole 41993, located west of SEP 207-C, was present from 7 6 to 15 5 feet below grade. A silty claystone was observed below that from 15 5 to a total depth of 20 0 feet below grade. The sandstone unit encountered in borehole 42393, located west of SEP 207-C, was present at approximately 8 1 to 14 0 feet below grade. Claystone bedrock was observed from 14 0 to a total depth of 15 1 feet below grade. The sandstone is light gray to brownish yellow, well-rounded, very fine-to-fine-grained quartz with some clay and silt. The sandstone contained argillaceous cement and horizontal bedding.

Ground water was encountered in borehole 42993 at 10 9 feet below grade during drilling, however, it was not encountered in boreholes 42893 and 43593. Ground water was encountered at 26 3 feet below grade in borehole 40993 and at 7 8 feet below grade in borehole 41993 during drilling. Ground water also was observed during drilling at a depth of 4 3 feet below grade in borehole 42393. The ground water levels found during drilling are only indicative of the relative permeabilities of the subsurface materials at each particular borehole. None of the boreholes were allowed to remain open after drilling for a sufficient period of time.

to obtain static water levels, and the ground water levels observed do not necessarily represent true static ground water levels

Little of the visually observed subsurface material was considered indicative of remnants of the original earthen ponds, which is consistent with historical records indicating that the liners were removed or regraded. The subsurface materials appeared to be relatively uniform throughout the area, with the exception of vertical clay-filled fractures in borehole 41993 and the presence of plastic clays in borehole 42893, as previously noted. The analytical results of soil and bedrock samples are presented and discussed in Section II 3 4, Subsurface Soil and Bedrock Chemical Analytical Results

II.3.1.2 Existing Solar Evaporation Ponds Investigation Results

Activities conducted at SEPs 207-A, 207-B Center, and 207-B North to meet the objectives of the OU4 Phase 1 RFI/RI Work Plan included visual surveys of the liners, alpha and beta/gamma radiation surveys of the pond liners, ground penetrating radar, liner and subgrade sampling and analysis, and subsurface sampling and analysis. Results from these activities are presented in this section and in Section II 3 4, Subsurface Soil and Bedrock Chemical Analytical Results

II.3.1.2.1 Visual Surveys of Liners

The objectives of the visual liner surveys as stated in the OU4 Phase I RFI/RI Work Plan were to identify cracks or liner breaches and to locate boreholes both in areas where the liner integrity was questionable and in areas where the liner appeared intact. The purpose for locating boreholes in these respective areas was to evaluate whether the observable breaches in the liners allowed for leakage of pond fluids.

The liner inspections were conducted in SEP 207-A on two separate occasions on December 9, 1992, and again on February 26, 1993. On December 9, 1992 approximately two-thirds of the liner was exposed for visual inspection. The northeastern one-third of the SEP was covered with ice and snow. On February 26, 1993 the pond liner was inspected after the ice and snow-covered ice had melted. The area in the northeastern edge of the pond surrounding the sump was observed to have standing water approximately 4 inches deep.

Results of the visual surveys are depicted on Figure II 3 1-16. Figure II 3 1-16 is a sketch of the pond which includes approximate locations of cracks, breached, or bubbled areas, and vantage points from which photographs were taken. Photographs, as well as the complete visual inspection report, are included in Appendix II D.

The uppermost layer of pond liner material was observed to be extensively cracked and otherwise deteriorated throughout most of the inspected area. The northeastern one-third of the pond liner exhibited the least amount of cracking and bubbling, and the western and southern two-thirds of the pond liner and berm slopes exhibited the most extensive cracking and bubbling.

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Bubbles and cracking in the liner are believed to be caused by thermal/ultraviolet deterioration during periods when the liner was exposed. Several long continuous cracks were observed in the liner, which had deteriorated, causing localized widening and exposing significant portions of the underlying liner. Some of the cracks contained soil and gravelly material, perhaps entrapped in the liner and unable to be removed during the sludge cleaning operation. It could not be visually determined if the soil and gravelly material were indicative of full liner breaches.

Visual observations of the SEP 207-A liner did not allow conclusive identification of obvious liner breaches because it was unable to be determined if observed cracks extended through the underlying asphaltic concrete. The visual results were therefore compared to results from a pilot geophysical study using ground penetrating radar technology. As further discussed later in this section, the 900 MHz antenna aided the evaluation of breaches or cracks through the liner. The visual survey confirmed that the liner has deteriorated and cracked areas are present.

Based on the visual and geophysical survey, three boreholes were located in areas displaying the most damaged liner, and three boreholes were located in areas where the liner was considered to be relatively intact. Boreholes 42193, 43393, and 43693 were located in areas where liner cracks were observed. Boreholes 41593, 42493, and 42593 were located in areas of relatively intact liner. The resulting borehole locations in SEP 207-A are shown in Figure II 3 1-16. Documentation of the borehole location changes was included in TM2.

Visual inspections of the 207-B Center and 207-B North SEPs asphaltic liners were conducted on September 1, 1993. As with the SEP 207-A inspection, these visual inspections were conducted by walking around the perimeter of the ponds and on the pond floor, taking photographs of selected features, and making a map showing the approximate locations of pertinent features. Figures II 3 1-17 and II 3 1-18 are sketches showing the results of the visual inspections. Appendix II D includes more detailed reports of the surveys and includes the photographs documenting liner conditions at the time of the survey.

The liners on both SEP 207-B Center and 207-B North are in deteriorated conditions. The liner surfaces are rough and irregular. Tar tack coats, originally applied as seals over asphaltic concrete, are missing from most areas of the pond floors. A pattern of thin, shallow cracks is typically present on areas of bare asphaltic concrete where the tar tack coat is missing. Where the tar tack coat is present, the liner surface is typically rough and irregular and no longer smooth.

Several potential breaches in the liners were noted during the initial inspection and during subsequent trips into the SEPs. Potential liner breaches were noted on the pond floor where cobbles are pressed down into the asphaltic concrete. Borehole 46693 in SEP 207-B North was located next to a cobble pressed into the liner. A circular hole approximately 4 inches in diameter was noted in the extreme southwestern corner of SEP 207-B North, near the drain pipe, on November 4, 1993. The depth of this hole is unknown. Borehole 46593 is located approximately 40 feet northeast of this hole.

Potential liner breaches on the berm slopes were noted in both ponds, however the SEP 207-B Center berm slopes are more extensively cracked than the SEP 207-B North berm slopes. The berm slopes on both ponds appear to have a more recently installed fabric material and tar tack coat. The berms of SEP 207-B Center are in a deteriorated condition with numerous obvious cracks that extend down to soil. Weeds are growing either in or through many of the cracks in the berms, as documented in the photographs presented in Appendix II D.

II.3.1.2.2 Radiological Surveys of the SEPs

Alpha, beta, and gamma radiological surveys were conducted at the existing SEPs following the methodologies previously described in Section II 2 3 2. These surveys were conducted to determine the radiological characteristics of the SEP liners.

SEP 207-A

Alpha and beta radioactivity survey data obtained within SEP 207-A are presented in Table II 3 1-1. For any given survey point, both alpha and beta smear counts were obtained from the same smear paper and recorded on the field form. The alpha survey consisted of collection of two types of alpha measurements, one for total alpha activity for the selected medium, and one for the removable alpha radioactivity on the media surface. Subtraction of the two values provides the quantity of fixed alpha radioactivity, or that bound into the media. The first measurement was an instrument scan of the grid square for total alpha activity. Instrument readings less than 250 counts per minute (cpm) are considered to be below action limits specified in the EG&G Environmental Management Radiological Guideline (EMRG) 3 1. The locations where instrument readings were above 250 cpm, and therefore above EG&G action levels, were near the southern edge of the pond, the eastern-central portion of the pond, the western area near the old clarifier, and in the northeastern region close to the sump. Figure II 3 1-19 shows the results of the total alpha activity measurements from SEP 207-A.

Removable alpha radioactivity was measured using swipe and smear sampling procedures, the results of which are shown on Figure II 3 1-20. The NRC has established 20 disintegrations per minute (dpm) per 100 cm² as the limit for acceptable surface contamination levels for removable contamination from transuranic elements (Pu-239/240 and Am-241) when considering the unrestricted release of facilities or equipment. The survey points where this limit was exceeded are located primarily in the northern section of the pond, although one isolated reading in the southwestern portion of the pond exceeded the limit.

Removable beta radioactivity data were also obtained and were compared to NRC guidelines. These guidelines establish 1,000 dpm/100 cm² as the limit for acceptable surface contamination levels for removable contamination resulting from beta-gamma emitters when considering the unrestricted release of facilities or equipment. If strontium-90 (Sr-90) is known to be present, the limit is 200 dpm/100 cm². All SEP 207-A beta readings were below the more stringent limit of 200 dpm/100 cm² and ranged from 0 to 63 dpm/100 cm². The majority of beta measurements (219 out of 419 - 52%) were equal to zero.

The gamma survey results from SEP 207-A are presented in Table II.3 1-2. Because the data were obtained from SEP 207-A and did not include background readings, an action level for the SEP 207-A survey was derived from standard RFETS practice and from RFETS EMRG 6 6. Using calculation procedures in EMRG 6 6, anomalous values can be computed from the instrument checkpoint reading plus two times the square root of the instrument checkpoint. Readings above 3,618 cpm were therefore considered anomalous. FIDLER readings for the SEP 207-A survey are shown in Figure II 3 1-21. Survey readings higher than 3,618 cpm occur primarily in the southern half of the pond and near the sump in the north/northeastern corner. The highest relative readings are located in the extreme southwestern corner of the pond. Interpretation of these results indicates that 57 percent (77 of 136) of the 100 m² grid areas contain anomalous readings that are characterized by gamma emissions exceeding the calculated background.

SEP 207-B Center

Table II 3 1-3 presents the results of the radiological surveys of SEP 207-B Center. Figure II 3 1-22 presents the results of the direct alpha radiation activity survey conducted in SEP 207-B Center. The survey records are included in Appendix II E. The majority of the direct alpha readings are below the minimum detectable activity (250 cpm) of the instrument used to perform the surveys. Of the direct alpha readings that are above or at the lower limit of detection, the readings range from 250 to 800 cpm. In this instance, the majority of the higher readings are located in the northeastern quadrant of the pond.

Figure II 3 1-23 presents the results of the removable (smear) alpha contamination survey. The field records are included in Appendix II E. The alpha contamination results for SEP 207-B Center range from 0-24 dpm/100 cm². The contamination results are slightly higher in the western half of the pond, with sporadic results up to 15 dpm/100 cm² elsewhere. The highest detection (24 dpm/100 cm²) is located approximately 32.5 feet east and 27.5 feet north of the southwestern corner of the pond.

Figures II 3 1-24 and II 3 1-25 present the results for the direct beta radiation survey and removable (smear) beta contamination survey in SEP 207-B Center. The field records for the SEP 207-B Center surveys are included in Appendix II E.

The majority of the direct beta readings are below the lower limit of detection (100 cpm) of the instrument used to perform the surveys. Of the direct beta readings that are above or at the lower limit of detection, the readings range from 100 to 500 cpm with one major exception - a single hot spot with a reading of 6,000 cpm located in the southwestern corner of SEP 207-B Center. This anomaly could be a result of the contribution from the contaminated drain pipe or of a "hot particle" located within the asphalt matrix. The higher direct survey readings have a slight tendency to be on the western side of the pond.

The beta contamination (smear) results for SEP 207-B Center range from 0 to 111 dpm/100 cm². The majority of the detections, particularly the higher values, are located on the

western half of the pond, with sporadic detections elsewhere. If a hot particle is the explanation for this direct survey result, then it is probably located within the asphalt matrix, and therefore not loose, as the contamination result for that location is only 48 dpm/100 cm². As with the direct beta results, the beta contamination results have a tendency to be higher on the western side of the pond. There is no readily apparent correlation between the beta contamination and direct reading results.

Table II 3 1-3 and Figure II 3 1-26 present the results of the gamma radiation survey conducted in SEP 207-B Center. The field records for this survey are included in Appendix II E. The direct reading gamma results range from 208 to 2,980 cpm above background. The highest direct gamma and beta readings were detected in the same location, in the southwestern corner of the pond. This fact lends credence to the hypothesis that either a "hot particle" is located within the asphalt matrix in that location or that the drain pipe is contaminated and is accounting for the direct readings noted in that location.

SEP 207-B North

Table II 3 1-4 and Figures II 3 1-27 and II 3 1-28 present the results of the direct and removable alpha radiation survey results. The field records for these surveys are included in Appendix II E.

The majority of the direct alpha readings are below the minimum detectable activity (250 cpm) of the instrument utilized to perform the surveys. Of the direct alpha readings that are above or at the lower limit of detection, the readings range from 250 to 300 cpm. These readings tend to be toward the western side of the pond.

The alpha contamination results (smear results) for SEP 207-B North range from 0 to 12 dpm/100 cm² and are slightly higher in the western half of the pond. The two highest contamination results (12 dpm/100 cm²) are located approximately 10 feet east and 15-25 feet north of the southwestern corner of the pond. Again, the higher readings have a tendency to be on the western side of the pond.

Figures II 3 1-29 and II 3 1-30 present the results of the direct and removable beta radiation survey results. The field records are included in Appendix II E.

The majority of the direct beta readings are below the lower limit of detection (100 cpm) of the instrument used to perform the surveys. Of the direct beta readings that are above or at the lower limit of detection, the readings generally ranged from 400 to 700 cpm.

The beta contamination (smear) results for SEP 207-B North range from 0 to 60 dpm/100 cm². The detections are generally located throughout the pond basin, however, there is a slight tendency for the majority of the higher detections to be located on the western side of the pond. There is no readily apparent correlation between the beta contamination and direct reading results.

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Figure II 3 1-31 presents the results of the gamma radiation survey in SEP 207-B North. The field records are included in Appendix II E.

The direct reading gamma results range from -8 to 1,263 cpm above background, with one notable exception. Located approximately 50 feet north and 30 feet east of the southwestern corner, a single "hot spot" was detected. The direct reading for this location is 3,890 cpm above background. Based upon the location of this hot spot, there is a possible correlation with the alpha contamination results as alpha smears of 6 dpm/100 cm² were also noted in this same area. Additionally, this hot spot is located approximately in the same location as the discolored water mark near the northwestern corner of the pond. A possible explanation for this hot spot is that a minute particle of radioactive material remains entrenched within the asphalt matrix.

II.3.1.2.3 SEP Ground Penetrating Radar Surveys

Ground penetrating radar surveys of the SEPs were only conducted in SEP 207-A, as specified in the OU4 Phase I RFI/RI Work Plan.

Figure II 3 1-32 shows the location of the GPR survey within SEP 207-A and the calibration survey conducted adjacent to SEP 207-A. The primary inherent difficulty with GPR is establishing depth of penetration of the signal in a new area. Attempts were made during the calibration survey to detect a known buried sewer line and a waste discharge line with a 300-MHz antenna. Four lines were recorded for the calibration survey. This survey consisted of a three line detail survey and a single line survey along the road on the southwestern side of SEP 207-A. Neither survey was successful in identifying the pipelines, perhaps due to less than desirable depth of penetration for the GPR. Since the depths and diameters of the two buried pipes are not known, the actual depth of penetration could not be established. Based upon prior interpretation, experience, and knowing a probable depth of burial for the lines, depth of GPR penetration attained in the survey was estimated to be approximately five feet or less.

The GPR investigation within SEP 207-A attempted to survey the materials beneath the liner, survey for any man-made buried objects, and survey the pond liner for possible breaches. The 300-MHz antenna and the 900-MHz antenna were used in SEP 207-A. Eleven lines were recorded in the southwestern corner of SEP 207-A using a 300-MHz antenna which surveyed the liner and below the liner. Figure II 3 1-33 depicts a typical 300-MHz antenna record. There were no anomalous responses within the area of the survey, indicating that the pond liner and the upper subgrade are relatively uniform and there were no near-surface buried objects. The depth of investigation could not be established, but is estimated to be approximately five feet or less.

The six northern 300-MHz GPR lines were duplicated using a 900-MHz antenna. The more sensitive 900-MHz antenna was used to survey for any discontinuities in the pond liner, survey beneath the liner, survey the shallow subsurface materials, and assist the visual inspection process by identifying potential liner breaches. Figure II 3 1-34 shows a typical 900-MHz

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record and GPR responses encountered during the SEP 207-A survey. The depth of penetration was unknown but is estimated to be less than 3 feet.

Several anomalies appear on the six 900-MHz survey lines. Interpreted GPR moisture and crack anomalies can be correlated to the observed pond liner deterioration zones or cracks seen during the visual inspection. Other GPR anomalies are associated with the pond liner or materials beneath the liner. Figure II 3 1-35 shows an interpretation of these features. Since the position of the GPR lines and the spacing along the lines is approximate, the exact shape and position of these anomalies is also approximate. Two linear anomalies of unknown origin are pronounced. The western anomaly, seen on all 900-MHz lines, is elongated and is roughly parallel to the western edge of the pond. It has been referred to as Zone 2 in the figures. Approximately 100 feet long and 20 feet wide, Zone 2 seems to be encapsulated by Zone 1. Below these two zones and in Zone 3 a lenticular anomaly can be seen on the three northernmost 900-MHz GPR lines. Without borehole information, the significance of the elongated and lenticular anomalies can only be conjectured. Possible explanations for the elongated anomaly, since it has closely spaced layers, is that it may represent a compaction feature or a liner construction variation. The lenticular anomaly may also be associated with liner construction or liner modification, but its shape appears to be conducive to channeling fluids. Other anomalies appear to be isolated although there is a good match between the observed liner cracks and interpreted moisture plumes.

II.3.1.2.4 SEP Liner and Subgrade Sampling and Analysis

Twelve asphalt liner samples and 12 subgrade (material immediately underlying the asphalt liner) samples were collected from the SEPs. Six samples of each media were collected from SEP 207-A, and three samples each of asphalt and subgrade material were collected from SEPs 207-B North and 207-B Center. The sampling locations are shown on Figure II 3 1-36.

The asphalt samples were submitted for determination of TAL metals and radiochemical analytes. Cyanide analyses were originally requested and were provided for the samples from the 207-B SEPs, however, cyanide analyses were deleted from the SEP 207-A samples per a request from EG&G. Gross alpha and gross beta analyses were deleted from the liner analyte suite because the analysis method requires a densely compacted, homogeneous sample to provide accurate results. The discontinuous sample matrix provided by the asphalt samples would not allow reliable analysis results for gross alpha and gross beta. Tritium was also deleted because the analysis method is dependent on the moisture content of the sample, and the asphalt liner sample was anticipated to contain negligible moisture.

Liner Analytical Results

Analytical results for the target analyte list metals and radiochemical analytes in the asphalt liner samples are included in Tables II 3 1-5 through II 3 1-8. Selected chemicals analyzed are mapped and discussed in this section if they also appeared on the potential contaminants of concern (PCOC) list for surficial soils. Analytical results for the TAL metals

beryllium, cadmium, and sodium are plotted on Figures II 3 1-37 through II 3 1-39 Analytical results for the radionuclides americium-241, cesium-134, plutonium-239/240, uranium-233/234, uranium-235, and uranium-238 are plotted on Figures II 3 1-40 through II 3 1-45

Beryllium

Beryllium analytical results for the liner samples are presented on Figure II 3 1-37 Beryllium was not detected in any of the SEP 207-A samples, however, it was detected in two of the SEP 207-B North samples and in all three of the SEP 207-B Center samples None of the detections exceeded 0.70 mg/kg Although not an appropriate comparison, but to put these results into perspective, the calculated background level of beryllium in surficial soils was calculated to be 0.92 mg/kg

Cadmium

Cadmium analytical results for the liner samples are presented on Figure II 3 1-38 Cadmium was detected in all 12 asphalt samples at concentrations ranging from 0.80 to 69.7 mg/kg SEP 207-B North contained significantly higher concentrations of cadmium in the liner samples than the other SEPs, as shown on Figure II 3 1-38 This is attributable to either higher cadmium concentrations in the particular waste streams that went into SEP 207-B North, or to less efficient sludge removal and liner cleaning activities than the other two SEPs For comparative purposes, the calculated background concentration of cadmium in surficial soils is 0.64 mg/kg and is 2.3 mg/kg for subsurface soils

Sodium

Sodium analytical results for the liner samples are presented on Figure II 3 1-39 Sodium concentrations in the liner samples ranged from 135 to 1,050 mg/kg Sodium concentrations in the liner samples from SEP 207-B Center were generally higher (702, 746, and 1,050 mg/kg) than the other two SEPs sampled This also may be attributable to the chemistry of the waste streams disposed of in that SEP For comparative purposes, the background concentration of sodium in surficial soils is 165 mg/kg and is 2,720 mg/kg in subsurface soils

Americium-241

Americium-241 analytical results for the liner samples are presented on Figure II 3 1-40 Americium was not detected in any of the SEP 207-A liner samples, however, it was detected in each of the 207-B SEP samples The americium results for SEP 207-B Center were relatively uniform and ranged from 0.449 to 0.584 picocuries per gram (pCi/g) The americium results from SEP 207-B North were notably higher and ranged from 1.734 to 4.032 pCi/g For comparative purposes, the background concentration for americium in surficial soils 0.027 pCi/g and 0.01 pCi/g for subsurface soils

Cesium-134

Cesium-134 analytical results for the liner samples are presented on Figure II 3 1-41. None of the liner samples analyzed contained cesium-134 above the laboratory detection limits.

Plutonium-239/240

Plutonium-239/240 analytical results for the liner samples are presented on Figure II 3 1-42. Plutonium concentrations ranged from below the detection limit to 3.126 pCi/g. With the exception of one sample from the southern end of SEP 207-A, the plutonium concentrations are slightly higher in the 207-B SEPs than in SEP 207-A. For comparative purposes, the background concentration for plutonium in surficial soils is 0.062 pCi/g and 0.02 pCi/g for subsurface soils.

Uranium-234

Uranium-234 analytical results for the liner samples are presented on Figure II 3 1-43. These concentrations ranged from 0.68 to 4.66 pCi/g. No discernable differences among the respective SEP analyses are apparent. The uranium-234 isotope was not specifically analyzed in background samples.

Uranium-235

Uranium-235 analytical results for the liner samples are presented on Figure II 3 1-44. Uranium-235 concentrations ranged from below the detection limit to 0.11 pCi/g. No discernable differences among the respective SEP analyses is apparent. All detections of uranium-235 in the liner samples were similar to the background surficial and subsurface soil concentrations of 0.09 pCi/g and 0.10 pCi/g, respectively.

Uranium-238

Uranium-238 analytical results for the liner samples are presented on Figure II 3 1-45. Uranium-238 concentrations ranged from 0.52 to 2.68 pCi/g and did not show significant variations between the three SEPs sampled. For comparative purposes, the background concentration for uranium-238 in surficial soils is 1.270 pCi/g and 0.63 pCi/g for subsurface soils.

Subgrade Analytical Results

Following liner excavation, 12 subgrade samples were collected from the material directly below the SEP asphalt liners: six from SEP 207-A and three each from SEPs 207-B Center and 207-B North. Each sample was collected from the top 2 inches of soil or subgrade material immediately underlying the liners. The specific depths at which the subgrade samples were collected varied due to the variable thickness of the asphalt liner. The subgrade samples were

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analyzed for nitrate, TAL metals, radiochemical analytes, TCL semivolatile organic compounds, pesticides, and PCBs. Tables II 3.1-9 and II 3.1-10 present the subgrade analytical results for the subsurface PCOCs. Figures II 3.1-46 through II 3.1-61 present the results graphically. Although calcium, manganese, potassium, and sodium appear on the PCOC list, they were not mapped and discussed because they are common rock-forming elements and their presence at OU4 is more likely to be related to natural soil chemistry than to contaminant releases.

Barium

Barium analytical results from the subgrade samples are presented on Figure II 3.1-46. Concentrations ranged from 37.5 to 93.7 mg/kg. No discernable patterns of barium concentrations were apparent between the three SEPs sampled. None of the samples exceeded the subsurface soil background concentration of 93.87 mg/kg.

Cadmium

Cadmium analytical results from the subgrade samples are presented on Figure II 3.1-47. Concentrations ranged from below the detection limit to 56.7 mg/kg. None of the three samples from SEP 207-B Center was above the detection limit. Cadmium was detected in each of the six samples from SEP 207-A, however, the concentrations were low. The cadmium concentrations detected at SEP 207-B North were notably higher than the other two SEPs sampled, and ranged from 23.7 to 56.7 mg/kg. The background subsurface soil concentration for cadmium is 2.3 mg/kg.

Lithium

Lithium analytical results from the subgrade samples are presented on Figure II 3.1-48. Concentrations ranged from 10.1 to 46.6 mg/kg. As with cadmium, the lithium concentrations are higher beneath SEP 207-B North than the other two SEPs sampled. None of the results, however, exceeded the background subsurface soil concentration of 83.2 mg/kg.

Nitrate/Nitrite

Nitrate/nitrite (as nitrogen) analytical results from the subgrade samples are presented on Figure II 3.1-49. Nitrate concentrations ranged from 22.1 to 5,170 mg/kg. All of the results exceeded the background concentration for nitrate in subsurface soils of 7.1 mg/kg. The results of the analyses from SEP 207-B Center are questionable despite being validated. The sample from location 46993 in the northwestern part of the SEP reportedly contained nitrate at a concentration of 5,170 mg/kg, which is approximately two orders of magnitude greater than the other two samples from that SEP. None of the other PCOCs analyzed from this location showed correspondingly elevated results, which would be expected if a significant release had occurred at this location.

Zinc

Zinc analytical results from the subgrade samples are presented on Figure II 3 1-50. Zinc concentrations ranged from 18.2 to 66.0 mg/kg. No discernable differences between the analytical results of the respective SEPs are apparent. Ten of the 12 samples exceeded the subsurface soil background concentration of 23.64 mg/kg.

Americium-241

The americium-241 analytical results from the subgrade samples are presented on Figure II 3 1-51. The americium concentrations ranged from 0.0114 to 44.68 pCi/g. The results of samples from SEP 207-B North are higher than SEP 207-B Center and generally higher than SEP 207-A. All of the subgrade samples exceeded the americium subsurface soil background concentration of 0.01.

Cesium-134

The cesium-134 analytical results from the subgrade samples are presented on Figure II 3 1-52. The cesium-134 results are questionable, despite being validated, with zero and negative numbers reported. For nearly all results, the counting error is greater than the reported result. Cesium-134 was not measured in the background samples.

Cesium-137

The cesium-137 analytical results from the subgrade samples are presented on Figure II 3 1-53. The concentrations of cesium-137 ranged from below the detection limit to 0.415 pCi/g. None of the samples analyzed exceeded the background concentration of 0.166 pCi/g.

Gross Beta

The gross beta analytical results from the subgrade samples are presented on Figure II 3 1-54. The gross beta concentrations ranged from 23.5 to 51.5 pCi/g. The results from each of the SEPs were generally consistent with each other, and no notable trends were apparent. The subsurface soil background concentration is 27.99 pCi/g.

Plutonium-239/240

The plutonium-239/241 analytical results from the subgrade samples are presented on Figure II 3 1-55. Plutonium concentrations in the subgrade samples ranged from 0.02 to 19.8 pCi/g. All of the samples were at or above the subsurface background soil concentration of 0.02 pCi/g. The plutonium subgrade sample concentrations from SEP 207-B North were higher than those from SEP 207-B Center and higher than all but one of the samples from SEP 207-A.

Radium-226

The radium-226 analytical results from the subgrade samples are presented on Figure II 3 1-56. The concentrations in the subgrade samples ranged from 1.1 to 10.76 pCi/g. As with other radionuclides, SEP 207-B North appears to show higher concentrations than the other two SEPs sampled. All the samples analyzed exceeded the background subsurface soil concentration of 0.65 pCi/g.

Strontium-89/90

The strontium-89/90 analytical results from the subgrade samples are presented on Figure II 3 1-57. The strontium concentrations ranged from below detection limits to 1.094 pCi/g. The highest strontium concentration occurred at location 46893 on the eastern side of SEP 207-B Center. Five of the 12 samples analyzed exceeded the subsurface soil background concentration of 0.54 pCi/g.

Tritium

The tritium analytical results from the subgrade samples are presented on Figure II 3 1-58. Concentrations ranged from 2,044 to 50,300 picocuries per liter (pCi/L), and all detections exceeded the background subsurface soil concentration of 212 pCi/L. Similar to other radionuclides, tritium concentrations appear consistently higher beneath SEP 207-B North than the other two SEPs sampled.

Uranium-233/234

The uranium-233/234 analytical results from the subgrade samples are presented on Figure II 3 1-59. Uranium 233/234 concentrations ranged from 1.009 to 63.4 pCi/g, all of which exceeded the subsurface soil background concentration of 0.53 pCi/g. Uranium-233/234 is generally higher beneath SEP 207-B North.

Uranium-235

The uranium-235 analytical results from the subgrade samples are presented on Figure II 3 1-60. Uranium 235 concentrations ranged from 0.04 to 1.69 pCi/g. The subsurface soil background concentration for uranium-235 is 0.1 pCi/g, which was exceeded at seven of the 12 locations sampled. As with uranium-233/234, uranium-235 is generally higher beneath SEP 207-B North than the other two SEPs sampled.

Uranium-238

The uranium-238 analytical results from the subgrade samples are presented on Figure II 3 1-61. Uranium 238 concentrations ranged from 1.0 to 25.5 pCi/g, all of which exceeded the subsurface soil background concentration of 0.63 pCi/g. The highest concentrations appear

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to be present beneath SEP 207-B North, the northern and eastern portions of SEP 207-A, and beneath the northern side of SEP 207-B Center

In summary, the subsurface PCOCs generally appear to be higher in the subgrade samples beneath SEP 207-B North than the other two SEPs sampled, however, exceptions have been observed. There is no consistent correlation between the subgrade analytical results and the liner analytical results. For some elements, the subgrade analyses are higher than the associated liner analyses, and for some elements, the subgrade analyses are lower than the liner analyses. For example, americium was not detected in any of the SEP 207-A liner samples, yet was detected in the subgrade. Conversely, americium was detected in liner samples from SEP 207-B Center at concentrations approximately an order of magnitude greater than the subgrade samples.

There does appear to be a correlation between observed breaches in the liner and subgrade analytical results. Borehole 46693 in SEP 207-B North was located adjacent to a cobble pressed into the liner material. Subgrade samples from this borehole consistently showed the highest concentrations of the PCOCs compared to the other samples from each of the respective SEPs.

II.3.1.2.5 Drilling, Sampling, and Chemical Analysis

This section briefly describes observations made during drilling the boreholes through the SEPs. Section II 3 5, Geologic Investigation Results, provides a detailed analysis of the geology and subsurface conditions beneath OU4. Chemical analytical results from borehole samples collected from beneath the SEPs are presented in Section II 3 4, Subsurface Chemical Analytical Results.

The SEP borehole locations were placed at sites where breaches in the liners were observed in and at sites where the liner was intact. Boreholes 42193, 43393, 43693, and 46693 were drilled in locations where the liner cracks were observed, and the remaining boreholes were drilled where the liner appeared to remain intact. The borehole locations and identification numbers were previously shown on Figure II 3 1-36.

The SEP 207-A boreholes were drilled and sampled during March and April, 1993. The SEP 207-B boreholes were drilled and sampled during November, 1993. Drilling and sampling the 207-B boreholes was difficult due to the presence of larger cobbles beneath SEP 207-A that prevented auger advancement. Samples from these boreholes were collected by driving the sampler with the 140-pound hammer on the rig, and augers were only partially advanced in the boreholes. Boreholes were advanced to depths ranging from 7.9 to 31.3 feet below the pond bottoms. The boreholes were abandoned after drilling with the exception of boreholes 41593, 42493 and 43693, which were completed as vadose zone monitoring locations (lysimeters). None of the SEP boreholes were completed as piezometers.

A review of the borehole logs indicated that subsurface soils consisted predominantly of sandy gravel with smaller amounts of sandy silt and clayey silt. The gravel fraction was generally well graded and consisted of coarse-grained, sub-angular to sub-rounded gray quartzite that ranged from 10 to 84 volume percent. The sandy silt fraction consisted of fine-grained, sub-angular, quartz, which ranged from 10 to 56 volume percent.

Claystone bedrock was encountered at depths ranging from 5.0 to 10.0 feet below grade in the southern and eastern portion of SEP 207-A (Boreholes 42593, 43393, and 43693), 5.5 to 11.5 feet below grade in SEP 207-B Center, and 6.5 to 7.8 feet beneath SEP 207-B North. The claystone bedrock is grayish brown to yellowish brown, very fine to fine-grained, is slightly friable, and contains thin horizontal bedding. A subcropping unit of sandy siltstone and clayey sandstone was encountered in the northern and eastern portion of SEP 207-A (Boreholes 41593, 42193, and 42493). This unit consists predominantly of light gray to light yellowish brown, very fine to fine-grained quartz with a silt and clay fraction that ranges from 53 to 83 volume percent. There is abundant iron oxide staining and caliche-filled vertical fractures with no visible bedding. A more detailed description of subsurface conditions is presented in Section II 3.5, Geologic Investigation, which also includes cross-sections that depict the geology beneath the SEPs.

Ground water is typically shallow beneath the SEPs. Observations of ground water encountered during drilling the SEP 207-A boreholes are not available, however, these observations were made for the 207-B boreholes. The presence of ground water during drilling is generally related to the relative permeabilities of subsurface units and is not typically indicative of static conditions. The OU4 Phase II RFI/RI Work Plan provides a more detailed description of hydrogeologic conditions beneath the SEPs.

Water was encountered during drilling of borehole 46893 in SEP 207-B Center at 9.6 feet. No standing water was observed during drilling of borehole 46993, however, moist bedrock samples were collected below 5.5 feet. Standing water was encountered in borehole 47093 at a depth of 6 feet. Water was encountered during drilling in SEP 207-B North only in borehole 46593 at 5.75 feet. No standing water was observed during the drilling of the other two boreholes.

II.3.2 Surficial Soil Sampling Results

The results of surficial soil sampling activities at OU4 are discussed in this section. Results of surface radiological surveys are discussed in Section II 3 2 1, OU4-Wide Radiological Surveys, and the analytical results of random, discrete, and borehole surficial soil samples are discussed in Section II 3 2 2, Surficial Soil Sampling and Analysis.

II.3.2.1 OU4-Wide Radiological Survey Results

The objective of the OU4-wide radiological survey was to determine if surficial soil contamination existed in the vicinity of the SEPs.

II.3.2.1.1 Alpha Radiological Survey Results

OU4-wide alpha radiological surveys were not conducted due to instrument limitations. The rationale for not completing this task was provided in Technical Memorandum No 2.

II.3.2.1.2 Beta/Gamma Radiological Survey Results

The OU4-wide gamma radiation survey results are listed in Table II 3 2-1, and survey locations are shown on Figure II 3 2-1. The FIDLER readings summarized in Table II 3 2-1 represent the 60-second gross scaler reading. The FIDLER provides a value for area background specific to that day's meteorologic and site conditions. The adjusted FIDLER measurement is simply the difference of the FIDLER scaler reading and the background.

The statistically derived upper tolerance limit was established as a basis for identification of potentially anomalous survey readings, and is a value statistically derived from the entire OU4 sitewide survey of FIDLER measurements. The upper tolerance limit was established using FIDLER data within OU4 only, and is therefore only applicable to OU4. The value of 2,473 counts per minute (cpm) was derived by calculating the mean cpm plus two standard deviations (Table II 3 2-1).

There were no obvious trends apparent in the OU4-wide gamma radiation survey other than in the vicinity of SEP 207-A, as shown on Figure II 3 2-1. Three anomalous values were obtained on the banks of SEP 207-A. This is most likely indicative of deposits resulting from splashing and wind dispersion along the berms of the SEP.

The upper tolerance limit was also used as the basis for recommending supplemental soil sample collection at surficial soil locations SS402793, SS402893, and SS402993, which correspond to radiologic survey locations T16, V20, and M21, respectively. Locations B18, P16, R8, and R10 were also considered for further evaluation, but these locations were either covered with asphalt without a nearby exposed soil surface or were immediately adjacent to buildings that may have influenced readings. All remaining FIDLER values for the sitewide survey were below the upper tolerance limit and were not considered for further investigation.

II.3.2.2 Surficial Soil Sampling and Analysis Results

Surficial soil samples were collected randomly at 26 locations in OU4. Ten discrete samples were also collected at locations with elevated radiological readings, at seeps, and in areas where data gaps exist for the generation of the Baseline Risk Assessment. Surficial soil samples were also collected at all borehole locations to complement the surficial soil program. Figure II 3 2-2 shows the location of surficial soil samples. The 26 randomly collected surficial soil samples are designated SS400193 through SS402693. The ten discrete surficial samples are designated with sample identification numbers SS402793 through SS403693. The borehole surficial soil sample numbers are designated with the borehole location identification. The rationale for locating the random and discrete surficial soil samples, and the sample collection methodology were presented in Section II 2 4 2. Subgrade samples collected from boreholes drilled beneath the liner in SEPs 207-A, 207-B North, and 207-B Center are not included in this surficial soils discussion. They were presented previously in Section II 3 1 1.

Surficial soil samples were analyzed for the TAL metals, nitrate, radionuclides, TCL semivolatile organic compounds, pesticides, and PCBs. Appendix II O presents a complete list of the analytical results for all chemicals analyzed. As previously noted, statistical methods were used to screen the data and determine the PCOCs for surficial soil samples at OU4, which are listed in Table II 3 2-2 and discussed further in this section. Of the PCOCs listed in Table II 3 2-2, calcium, silicon, and sodium were not mapped and will not be discussed because they are common rock-forming elements and are not likely to be present as a result of waste disposal activities at the SEPs.

The surficial soil analytical results were compared to background surficial soil samples collected from the Rock Creek area in the RFETS buffer zone for the OU1 and OU2 Remedial Investigations. Table II 3 2-3 provides a data summary of the OU4 surficial soil PCOCs. This summary includes the numbers of samples collected, the number of detections of each PCOC, the ranges of the detections, and numbers and percentages of the detections that exceeded background.

II.3.2.2.1 Non-Radiological Inorganic Potential Contaminants of Concern

This section presents the results of the analyses for the non-radiological PCOCs, beryllium, cadmium, mercury, nitrate, and silver. For the most part, the highest concentrations for each of the respective PCOCs occurs in the immediate vicinity of the SEPs, with the exception of nitrate. Nitrate appears most elevated in the vicinity of the ground water seeps located north of SEPs 207-A and 207-C. The analytical results are presented in tabular format in Table II 3 2-4 and graphically on Figures II 3 2-3 through II 3 2-7. The figures show all analytical results above background in red for clarity. The following are discussions of each of the PCOCs.

Beryllium

Beryllium ranged from below detection limit to 9.6 milligrams per kilogram (mg/kg). As shown on Figure II 3 2-3, the highest beryllium concentration was detected in sample SS402893, near the northeastern corner of SEP 207-A. Elevated beryllium was also observed in sample SS403093, located in a seep between and north of SEP 207-A and SEP 207-B-North, near the 207-B drain tile discharge (which is discussed in more detail in Section II 4, Nature and Extent of Contamination). The only other beryllium concentrations above detection limit were from samples in the immediate vicinity of SEP 207-A, and one sample from borehole 41793 located immediately east of SEP 207-B-North. Beryllium was detected in 11 of the 72 (15 percent) surficial soil samples analyzed above background. It is noted, however, that the calculated background concentration of 0.92 mg/kg is less than the contract-required detection limit (CRDL) for beryllium.

Cadmium

Figure II 3 2-4 shows the results of the surficial soil cadmium analyses. Cadmium ranged from below detection limit to 382 mg/kg and was detected in 37 of the 72 samples analyzed (51 percent). As with beryllium, all the detections of cadmium are above background since the calculated background value of 0.64 mg/kg is below the CRDL for cadmium. The highest concentration (382 mg/kg) was detected near a drainage tile seep between and north of SEPs 207-A and 207-B North. Other elevated cadmium concentrations were detected near the western, eastern, and northeastern berms of SEP 207-A (Samples SS402793, SS400593, and SS4002893, respectively). The locations where cadmium was not detected are generally the sampling locations that are distal from the SEPs, such as in the buffer zone.

Mercury

Mercury concentrations ranged from below detection limit to 1.8 mg/kg as shown on Figure II 3 2-5. Twenty of the 72 samples analyzed (26 percent) contained mercury above detection limits. The highest concentration occurred in surficial soil sample SS402793, on the western perimeter of SEP 207-A. Coincidentally, the second highest cadmium concentration in OU4 was also detected in this sample. Other concentrations of mercury above detection limits were located in the immediate vicinity of the SEPs, and sporadically in the ITS area outside the PA. These detections also are above background since the calculated background concentration for mercury of 0.03 mg/kg is below the CRDL for mercury.

Nitrate/Nitrite

Nitrate/Nitrite was detected above the detection limit in all surficial soil samples analyzed. The distribution of nitrate/nitrite is shown on Figure II 3 2-6. The highest concentrations occurred in samples located in the seep areas north of SEP 207-A and SEP 207-C. The four discrete samples collected to investigate seep areas were found to contain some of the highest nitrate/nitrite concentrations within OU4 surficial soils and ranged from

approximately 250 mg/kg to 765 mg/kg. Soil samples collected in the immediate SEP vicinity were much lower in concentration, generally between 10 and 100 mg/kg. Nitrate/nitrite was detected above 10 mg/kg in approximately 29 percent of the samples, and above 100 mg/kg in approximately 10 percent of samples analyzed. Of the 72 samples analyzed, 67 (93 percent) exceeded the calculated background concentration of 1.11 mg/kg.

Silver

Silver was detected in five of the 72 samples analyzed (7 percent), as shown on Figure II 3 2-7. Each of these detections exceeded the calculated background concentration of 0.58 mg/kg, since the background concentration is below the CRDL for silver. The five detections all occur on the berms of the SEPs as shown on Figure II 3 2-7.

In summary, the highest concentrations of the non-radiological inorganic PCOCs generally occur in the immediate vicinity of the SEPs, predominantly on the berms. Detections are also observed in the seep area north of the SEPs and at the drainage tile outfall between SEPs 207-A and 207-B North. The highest nitrate concentrations occur in the seep areas north of the SEPs. Section II 4 provides greater detail regarding the extent of these PCOCs at OU4.

II.3.2.2.2 Radionuclide Potential Contaminants of Concern

This section presents the results of the surficial soil radionuclide analyses. The analytical results are tabulated in Table II 3 2-5 and are presented graphically on Figures II 3 2-8 through II 3 2-15. All results above background are indicated in red on the figures.

Americium-241

The surficial soil americium-241 analytical results are presented on Figure II 3 2-8. Americium was detected in 69 of the 71 samples analyzed (two results were rejected), all of which exceeded the calculated background for americium of 0.027 pCi/g. The americium concentrations ranged from 0.028 to 220 pCi/g. The highest concentrations occur in the immediate vicinity of the SEPs on the berms. Section II 4, Nature and Extent of Contamination, discusses the distribution of americium in greater detail.

Cesium-134

Cesium-134 was analyzed in only 27 samples and was detected in 22 of the 27 (81 percent). The results are presented on Figure II 3 2-9 and Table II 3 2-5. Cesium concentrations ranged from -0.067 to 0.0319 pCi/g. Negative results are not unusual for radionuclide analyses and indicate that the result is less than background at the laboratory making the measurements. No background measurements of cesium-134 were made at the RFETS, and thus all the detections are shown in red on Figure II 3 2-9. No discernable distribution of cesium-134 is apparent on Figure II 3 2-9.

Gross Alpha

Figure II 3 2-10 shows the results of surficial soil gross alpha analyses, which are also listed in Table II 3 2-5. Gross alpha was detected in 65 of the 72 samples analyzed (90%), and 31 of the 72 samples (43 percent) exceeded the calculated background value of 22.9 pCi/g. The highest gross alpha measurements were made of samples from the berm between SEP 207-A and the 207-B SEPs, and from the seep areas north of the SEPs.

Plutonium-239/240

Figure II 3 2-11 shows the results of surficial soil plutonium-239/240 analyses, which are also listed in Table II 3 2-5. Plutonium was detected in 60 of the 71 samples analyzed (85 percent - 11 samples were rejected). The calculated background concentration of 0.062 pCi/g was exceeded in 52 of the 71 (73 percent) of the samples analyzed. Plutonium concentrations in surficial soils ranged from 0.01 to 56 pCi/g. The highest concentrations occur in the immediate vicinity of the SEPs on the berms and just north of SEPs 207-A and 207-B North where the drain tile exits.

Tritium

Figure II 3 2-12 shows the results of surficial soil tritium analyses, which are also listed in Table II 3 2-5. Tritium was detected in 47 of the 72 samples analyzed (65 percent). Tritium concentrations in surficial soils ranged from 59.5 to 227,000 pCi/L. The highest concentrations occur in the seep area north of the SEPs and in the buffer zone overlying the ITS.

Uranium-233/234

Figure II 3 2-13 shows the results of surficial soil uranium-233/234 analyses, which are also listed in Table II 3 2-5. Uranium-233/234 was detected in all of the samples analyzed, however, it was detected above the calculated background level of 1.22 pCi/g in only 38 of the 72 (53 percent) samples analyzed. Uranium-233/234 concentrations in surficial soils ranged from 0.457 to 41 pCi/g. The highest concentrations occur in the vicinity of the SEPs and just north of SEPs 207-A and 207-B North where the drain tile exits.

Uranium-235

Figure II 3 2-14 shows the results of surficial soil uranium-235 analyses, which are also listed in Table II 3 2-5. Uranium-235 was detected in 63 of the 72 (88 percent) of the samples analyzed, however, it was detected above the calculated background level of 0.09 pCi/g in only 26 of the 72 (36 percent) samples analyzed. Uranium-235 concentrations in surficial soils ranged from 0.0191 to 2.3 pCi/g. The highest concentration occurs just north of SEPs 207-A and 207-B North where the drain tile exits.

Uranium-238

Figure II 3 2-15 shows the results of surficial soil uranium-238 analyses, which are also listed in Table II 3 2-5. Uranium-238 was detected in all of the samples analyzed, however, it was detected above the calculated background level of 1.27 pCi/g in only 31 of the 72 (43 percent) samples analyzed. Uranium-238 concentrations in surficial soils ranged from 0.515 to 27 pCi/g. The highest concentrations occur just north of SEPs 207-A and 207-B North where the drain tile exits, in the seep areas below that point, and in the immediate vicinity of the SEPs.

In summary, the radionuclide PCOCs are broadly distributed in OU4 at concentrations that exceed their respective background concentrations. In general, the highest concentrations are found on the berms of the SEPs and in the seep area on the hillside north of the SEPs. Section II 4 provides a more detailed description of their nature and extent.

II.3.2.2.3 Organic Compounds

Table II 3 2-6 provides a summary of the organic PCOC detections including estimated values that lie below the Contract Required Quantitation Limit (CRQL) and the instrument detection limit (those qualified with a "J"). Non-detectable results are not listed in Table II 3 2-6, however, all results are presented in Appendix II O. The organic PCOC results (including non-detects) are also presented on Figures II 3 2-16 through II 3 2-28. Estimated values are qualified and are shown in the figures in black. Detections that are above the CRQL are shown in red.

Benzo(a)anthracene

The surficial soil analytical results for benzo(a)anthracene are presented on Figure II 3 2-16 and in Table II 3 2-6. Of the 72 samples analyzed, 47 samples (65 percent) had detectable concentrations, including estimated values. Only 6 of 47 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the six detections above the CRQL, only two lie in OU4, as shown on Figure II 3 2-16. These occur in the northwestern panhandle adjacent to the PSZ and on the berm near the southwestern corner of SEP 207-A.

Benzo(a)pyrene

The surficial soil analytical results for benzo(a)pyrene are presented on Figure II 3 2-17 and in Table II 3 2-6. Of the 72 samples analyzed, 51 samples (71 percent) had detectable concentrations including estimated values. Only 8 of 51 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the eight detections above the CRQL, only four lie in OU4, as shown on Figure II 3 2-16. These occur in the northwestern panhandle adjacent to the PSZ, on the berm near the southwestern corner of SEP 207-A, and in the seep area north of SEP 207-C.

Benzo(b)fluoranthene

The surficial soil analytical results for benzo(b)fluoranthene are presented on Figure II 3 2-18 and in Table II 3 2-6. Of the 72 samples analyzed, 57 samples (79 percent) had detectable concentrations including estimated values. Thirteen of the 57 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the 13 detections above the CRQL, nine lie in OU4, as shown on Figure II 3 2-18. These occur in the northwestern panhandle adjacent to the PSZ, on the berm near the southwestern corner of SEP 207-A, on the western and northern berms of SEP 207-C, and in the seep area north of SEP 207-C.

Benzo(ghi)perylene

The surficial soil analytical results for benzo(ghi)perylene are presented on Figure II 3 2-19 and in Table II 3 2-6. Of the 72 samples analyzed, 37 samples (51 percent) had detectable concentrations including estimated values. Only four of the 37 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the four detections above the CRQL, only one lies in OU4, as shown on Figure II 3 2-19. It occurs in the northwestern panhandle adjacent to the PSZ.

Benzo(k)fluoranthene

The surficial soil analytical results for benzo(k)fluoranthene are presented on Figure II 3 2-20 and in Table II 3 2-6. Of the 72 samples analyzed, 58 samples (81 percent) had detectable concentrations including estimated values. Only 12 of 58 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the 12 detections above the CRQL, seven lie in OU4, as shown on Figure II 3 2-20. These occur in the northwestern panhandle adjacent to the PSZ, on the berms near the northern edge and the southwestern corner of SEP 207-C, on the berm at the northwestern corner of SEP 207-A, and in the seep area north of SEP 207-C.

Bis(2-ethylhexyl)phthalate

The surficial soil analytical results for bis(2-ethylhexyl)phthalate are presented on Figure II 3 2-21 and in Table II 3 2-6. Of the 72 samples analyzed, 57 samples (79 percent) had detectable concentrations including estimated values. Eleven of the 57 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the 11 detections above the CRQL, only four lie in OU4, as shown on Figure II 3 2-21. These occur at the drainage tile outfall just north of SEPs 207-A and 207-B North, in the seep area north of that location, and off the northeastern corner of SEP 207-B North.

Chrysene

The surficial soil analytical results for chrysene are presented on Figure II 3 2-22 and in Table II 3 2-6. Of the 72 samples analyzed, 49 samples (68 percent) had detectable concentrations including estimated values. Only eight of the 49 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the eight detections above the CRQL, only four lie in OU4, as shown on Figure II 3 2-22. These occur in the northwestern panhandle adjacent to the PSZ, in the seep area north of SEP 207-C, and on the berm near the southwestern corner of SEP 207-A.

Di-n-butyl phthalate

The surficial soil analytical results for di-n-butyl phthalate are presented on Figure II 3 2-23 and in Table II 3 2-6. Of the 72 samples analyzed, 30 samples (42 percent) had detectable concentrations including estimated values. Only four of the 30 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the four detections above the CRQL, two lie in OU4, as shown on Figure II 3 2-23. These occur near the southwestern corner of SEP 207-A.

Fluoranthene

The surficial soil analytical results for fluoranthene are presented on Figure II 3 2-24 and in Table II 3 2-6. Of the 72 samples analyzed, 59 samples (82 percent) had detectable concentrations including estimated values. Thirteen of the 59 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the 13 detections above the CRQL, nine lie in OU4, as shown on Figure II 3 2-24. These occur in the northwestern panhandle adjacent to the PSZ, on the berm near the southwestern corner of SEP 207-A, on the western and northern berms of SEP 207-C, and in the seep area north of SEP 207-C.

Indeno(1,2,3-cd)pyrene

The surficial soil analytical results for indeno(1,2,3-cd)pyrene are presented on Figure II 3 2-25 and in Table II 3 2-6. Of the 72 samples analyzed, 42 samples (58 percent) had detectable concentrations including estimated values. Only four of the 42 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the four detections above the CRQL, only one lies in OU4, as shown on Figure II 3 2-25. It occurs in the northwestern panhandle adjacent to the PSZ.

Phenanthrene

The surficial soil analytical results for phenanthrene are presented on Figure II 3 2-26 and in Table II 3 2-6. Of the 72 samples analyzed, 31 samples (43 percent) had detectable concentrations including estimated values. Eleven of the 31 detections were above the CRQL,

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the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the 11 detections above the CRQL, seven lie in OU4, as shown on Figure II 3 2-26. These occur in the northwestern panhandle adjacent to the PSZ, in the seep area north of SEP 207-C, and on the berms near the southwestern corner of SEP 207-A and north side of SEP 207-C.

Pyrene

The surficial soil analytical results for pyrene are presented on Figure II 3 2-27 and in Table II 3 2-6. Of the 72 samples analyzed, 59 samples (82 percent) had detectable concentrations including estimated values. Fourteen of the 59 detections were above the CRQL, the remainder were estimated concentrations that lie below the CRQL, but above the instrument detection limit. Of the 14 detections above the CRQL, 10 lie in OU4, as shown on Figure II 3 2-27. These occur in the northwestern panhandle adjacent to the PSZ, in the seep area north of SEP 207-C, and on the berms near the southwestern and northeastern corners of SEP 207-A and western and northern berms of SEP 207-C.

Aroclor-1254

The surficial soil analytical results for the PCB Aroclor-1254 are presented on Figure II 3 2-28 and in Table II 3 2-6. Of the 72 samples analyzed, only six samples (8 percent) had detectable concentrations. All of the detections were above the CRQL. Of the six detections above the CRQL, only two lie in OU4, as shown on Figure II 3 2-28. These occur at the southern berm of SEP 207-A and adjacent to the eastern berm of SEP 207-B Center.

In summary, the organic PCOCs detected in the surficial soils at OU4 have a very limited distribution. For the most part, they typically occur together at only a few locations in the northwestern panhandle adjacent to the PSZ, in the seep area north of SEP 207-C, and on the berms near the southwestern corner of SEP 207-A and western and northern berms of SEP 207-C. Other sporadic locations include samples immediately south of SEP 207-A, the drainage tile discharge north of SEP 207-A and 207-B North, and the eastern side of SEP 207-B Center. The nature and extent of these organic PCOCs are discussed in greater detail in Section II 4.

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II.3.3 VADOSE ZONE INVESTIGATION RESULTS

This section presents the results of the vadose zone investigation. The vadose zone investigation was conducted to characterize the physical and chemical properties of the vadose zone geologic materials and pore waters, to evaluate the distribution of contaminants in the vadose zone, and to characterize vadose zone migration pathways and flow system. Samples were gathered on a random basis from boreholes within suspected migration pathways and are believed to be representative sampling of both alluvium and bedrock materials. Section II 2 5 describes the data collection procedures. Data gathered during this investigation also facilitated selection of equipment for closure and post-closure monitoring. Physical and chemical properties of the vadose zone geologic materials and pore waters were determined by field and laboratory methods. Measurement of some of these properties allowed determination of parameters that control contaminant flow and transport in the vadose zone beneath the OU4.

II.3.3.1 Definition of the Vadose Zone

The vadose zone is defined in this report as the subsurface interval between the ground surface and the uppermost ground water table where pore water is at less than atmospheric pressure. The vadose zone includes geologic materials consisting of the Rocky Flats Alluvium (RFA), colluvium, valley fill alluvium, disturbed materials, and artificial fill materials which are collectively referred to as RFA and associated soils. Bedrock strata of the Arapahoe Formation may also be included in the vadose zone where the water table is below the top of bedrock. Because the ground water table fluctuates seasonally, the thickness of the vadose zone also varies seasonally. The thickness of the vadose zone is least in the spring when the ground water table is at its highest elevation. The greatest thickness of the vadose zone is during the late summer and fall when ground water levels are at their lowest elevation. The vadose zone varies in thickness from about zero at seep locations on the north hill slope to about 20 feet in the area of the ITS. A complete description of the vadose zone is contained within Section II 3 3 3.

II.3.3.2 Laboratory-Determined Physical Properties of the Vadose Zone

Laboratory-determined physical and hydraulic properties of vadose zone soils and bedrock lithologies were determined by D. B. Stephens and Associates (DBS) of Albuquerque, New Mexico. Twenty-five undisturbed core samples ("physical property samples") were selected from 14 vadose zone borings drilled for the installation of lysimeters and neutron probe access tubes. These core samples were collected during the late winter and early spring of 1993. Fourteen additional core samples were selected from five borings drilled in SEPs 207-B North and 207-B Center during November 1993 ("B-pond samples"). These samples were only analyzed for gravimetric moisture content by IT Corporation's laboratory in St. Louis, Missouri. The physical property samples and the B series SEPs samples are listed in Table II 3 3-1, while Figure II 3 3-1 shows the location of these samples. Eight RFA soil and three bedrock lithology types comprise the physical property samples. Three RFA soil and one bedrock lithology type comprise the B Series SEP samples.

The laboratory tests performed and methods used are listed in Table II 3 3-2 Laboratory methods included procedures developed by the American Society of Testing and Materials (ASTM), EPA, and the American Society of Agronomy (Methods of Soil Analysis [MOSA], Klute, 1986) The laboratory data and methods are presented in Appendix II P

II.3.3.2.1 Moisture Content

The relative wetness of soil or rock is usually expressed in terms of volumetric or gravimetric moisture content. Volumetric moisture content is the ratio of the volume of water within a soil or rock to the total material volume Volumetric moisture content, at any degree of saturation, represents the depth of water per unit depth of soil (Hillel, 1982) Volumetric moisture content is expressed in volume percent (percent, cm^3/cm^3) Gravimetric moisture content is the ratio of the mass of water within the soil or rock to the mass of the dry soil or rock Gravimetric moisture content is expressed in weight percent (percent, g/g) Initial volumetric and gravimetric moisture content is a measure of the *in situ* soil moisture content at the time of sample collection Saturated moisture content is the moisture content of a sample fully saturated at the laboratory Initial and saturated moisture contents were determined using ASTM Method D2216-92.

The relative wetness of a soil or rock is largely influenced by the fractional percentage of coarse and fine particle sizes Geologic materials with larger percentages of fine particle fractions generally have higher porosities and moisture contents (high "moisture-holding capacity" soils) Generally, soils composed of coarser particle fractions have larger voids and lower porosity, both attributes that minimize the quantity of water in the soil under both saturated and unsaturated conditions (low "moisture-holding capacity" soils) Within the vadose zone, soils composed of predominantly coarse particles are typically much drier than fine-grained soils at the same matric potential ("soil suction")

Moisture-holding capacity in geologic materials is also influenced by the type of clay mineral Some clays have expandable lattices that allow for significant absorption of water within the double layer of a clay platelet The double layer size depends upon the surface charge density of the clay, the cation valence and ionic radius, and the concentrations of cations in the surrounding pore water During saturation, the double layer is extended and the clay platelets swell, affecting the comparison of calculated porosity and saturated volumetric moisture content Here the calculated porosity is computed from particle and dry bulk density, while saturated moisture content is determined analytically

Initial Gravimetric Moisture Content

Initial volumetric and gravimetric moisture contents determined for physical property samples are presented in Table II 3 3-3 The physical property samples consist of 16 RFA and associated soils and nine bedrock cores Also listed in Table II 3 3-3 are the initial gravimetric moisture contents determined for the 13 RFA and associated soils and one bedrock core samples collected from beneath the B Series SEPs Samples collected from beneath the B Series SEPs

may have lower initial moisture contents because these samples were collected during the fall when the vadose zone is thicker

Initial gravimetric moisture content for the 29 RFA and associated soils ranged between 2.1 and 24.6 percent and averaged 12.1 ± 5.2 percent (\pm represents standard deviation). The minimum initial gravimetric moisture contents (3.3 and 2.1 percent) were measured in boreholes 43193 (sample BH40600AE) and 44393 (sample BH40405AE). The relative wetness of these samples is limited because they are composed of about 96 and 62 percent coarse-grained particles, respectively. The maximum initial gravimetric water content (24.6 percent) was observed at borehole 44093 (sample BH40407AE). This sample has a high moisture-holding capacity because it is composed of about 65 percent fine-grained particles and has a porosity of about 46 percent.

The initial gravimetric moisture contents for the nine bedrock siltstone and claystone samples ranged between 15.5 and 25.1 percent and averaged 20.4 ± 3.3 percent. The minimum initial gravimetric moisture content is from a siltstone collected between 12.0 and 12.7 feet below ground surface (ft bgs) at borehole 44393 (sample BH40406AE). The maximum initial gravimetric moisture content of 25.1 percent was measured in a sample collected between 10.3 and 11.0 ft bgs at borehole 40393 (sample BH40404AE). This sample was collected within the saturated zone near the ITS. The only bedrock sandstone sample analyzed had an initial gravimetric moisture content of 11.0 percent. This sample was collected between 10.0 and 10.8 ft bgs at borehole 40993 (sample BH40609AE).

Figure II 3 3-2 is a graph of initial gravimetric moisture content versus depth below ground surface (bgs). In the RFA and associated soils, initial gravimetric moisture content varies to a depth of about 10 ft bgs. This is apparent because of the range of moisture contents observed over these depths. Although there are limited data for the deeper RFA and associated soils, there may be a slight general increase in moisture content with depth below 10 feet.

Soils with higher clay contents generally have higher moisture-holding capacity than sandy soils. Figure II 3 3-3 is a graph of clay content versus initial gravimetric moisture content. This figure shows an apparent boundary at approximately 40 percent clay content for RFA and associated soils. Core samples with less than 40 percent clay are representative of the RFA, whereas core samples containing greater than about 40 percent clay are representative of bedrock siltstone and claystone lithologies. Because of the higher clay content, the bedrock lithologies generally have a higher initial and saturated gravimetric moisture content than the RFA and associated soils.

Several of the samples shown on Figure II 3 3-3 are labeled because they show unique physical properties. Sample BH40401AE (borehole 40593) was collected from between 20.3 and 21.0 ft bgs and was assigned to the RFA and associated soils. Containing 55 percent clay content, this sample plots above the apparent 40 percent clay content boundary and within the bedrock lithologies on Figure II 3 3-3. A bedrock sandstone sample collected between 10.0 and 10.8 ft bgs at borehole 40993 (sample BH40609AE) plots within the area of the RFA and

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associated soils because the sample contains 15 percent clay content. However, the gravimetric moisture content of this bedrock sandstone sample is approximately 8 percent wetter than other sandy soils (samples BH40405AE and BH40600AE).

Initial Volumetric Moisture Content

For the physical property samples consisting of 16 RFA and associated soils and nine bedrock cores, initial volumetric moisture content was calculated from the initial gravimetric moisture content and the dry bulk density of the sample using ASTM Method D2216-90. Initial volumetric moisture content (θ_v , percent cubic centimeter per cubic centimeter [percent, cm^3/cm^3]) is calculated using the following volumetric-gravimetric moisture equation:

$$\theta_v = \omega * \rho_b / \rho_w$$

where ω is gravimetric moisture content (percent gram per gram [percent, g/g]), ρ_b is the dry bulk density (grams per cubic centimeter [g/cm^3]), and ρ_w is density of water (assumed to be $1.0 \text{ g}/\text{cm}^3$).

For the 13 RFA and associated soils and the one bedrock samples obtained from beneath SEPs 207-B North and 207-B Center, the initial gravimetric moisture content was converted to volumetric moisture content using a statistical correlation between dry bulk density and initial gravimetric moisture content ($\omega = -39.32 * \rho_b + 82.24$, - see Section II 3 3 2 3 and Figure II 3 3-7) and the above volumetric-gravimetric moisture equation. Excluding the driest soil samples, a correlation coefficient of 0.84 was obtained. Initial volumetric moisture contents are presented in Table II 3 3-3.

Initial volumetric moisture content for surface and RFA and associated soils ranged between 3.7 and 35.6 percent and averaged 20.7 ± 7.5 percent. The initial volumetric moisture content for the bedrock siltstone and claystone samples ranged between 26.9 and 39.3 percent and averaged 33.1 ± 4.0 percent. The sandstone sample (borehole 40993) has a volumetric moisture content of 19.4 percent. The minimum and maximum initial volumetric moisture contents were measured for the same samples as the initial gravimetric moisture content.

Figure II 3 3-4 shows initial volumetric moisture content versus coarse (gravel + sand) soil particle fraction. Similar to Figure II 3 3-3, this figure shows that the RFA and associated soils and bedrock lithologies occur as two distinct groups. RFA and associated soils generally have more than 30 percent coarse particle fraction, whereas the bedrock lithologies have less than 10 percent coarse particle fraction. Exceptions are soil sample BH40401AE (borehole 40593), a possible colluvial claystone because the log description for that cored interval includes a trace of rounded gravel and plant roots, and bedrock sandstone sample BH40609AE (borehole 40993), with more than 50 percent coarse particle fraction.

Several samples are labeled on Figure II 3 3-4 because they exhibit unique physical properties. Sample BH40608AE, collected from borehole 40993 north of SEP 207-C between

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4.0 and 4.7 ft bgs, exhibited an initial volumetric moisture content of 12.6 percent. Approximately 82 percent of this sample is composed of sand and gravel. This sample was collected from a similar depth as samples BH40600AE and BH40405AE (borehole 43193 and 44393, respectively) but is approximately three to four times wetter volumetrically.

Sample BH40401AE was collected from a depth between 20.3 and 21.0 ft bgs in borehole 40593. The soil contains about 98 percent fine-grained fraction but has an initial volumetric moisture content of 33.9 percent which is more moist than other similar textured samples (BH40406AE, BH40603AE, and BH40610AE). This sample is located within the ITS area and slightly above the water table.

Sample BH40407AE, collected from borehole 44093 from a depth between 4.0 and 4.5 ft bgs, has a initial volumetric moisture content of 24.6 percent and a coarse grain fraction of 35 percent. This sample has a finer-grained texture than the other RFA soil samples and is close to the apparent 30 percent coarse-fraction boundary for RFA and associated soils.

Adjustment of Initial Volumetric Moisture Content

In general, within the vadose zone, water movement occurs within the fine-grained soils because of the smaller soil capillaries. Moisture movement only occurs between the coarser fragments at higher moisture contents. Reinhart (1961) and Mehuys and others (1975) suggest that the presence of appreciable coarse soil particles, greater than 2 millimeters (mm) in diameter, may introduce error in moisture content and unsaturated hydraulic conductivity determinations. Because the RFA and associated soils commonly contain particle sizes greater than 2 mm, adjustment of the initial volumetric moisture contents using Reinhart's (1961) method was conducted to allow comparison of the laboratory-calculated volumetric moisture contents and calculated unsaturated hydraulic conductivities.

The initial volumetric moisture contents were adjusted using the following formula

$$\theta_f = \theta_i / [1 - \{(\rho_b / \rho_s) * (1 - W)\}]$$

where θ_f represents the adjusted initial volumetric moisture content (percent, cm^3/cm^3), θ_i is the initial volumetric moisture content (percent, cm^3/cm^3), W is the fractional weight of the minus 2 mm fraction (g/g), ρ_b is the dry bulk density (g/cm^3), and ρ_s is the particle density (g/cm^3).

Table II 3 3-4 shows the results of the initial volumetric moisture content adjustments. The adjustment generally increased the initial volumetric moisture content in RFA and associated soils an average of 44 percent. Fine-grained bedrock lithologies exhibited essentially no change in corrected moisture content because of the lack of a coarse-fraction component. Coarse-textured samples exhibited the largest increase in adjusted moisture content. Sample BH40612AE showed the largest moisture content difference changing from 17.9 to 31.4 percent. Figure II 3 3-5 shows the correlation between the initial and adjusted volumetric moisture contents for both the physical property samples and the B-pond samples. These figures indicate

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that the initial moisture content of the fine-grained soils and bedrock lithologies (less than 10 percent coarse fraction) did not change. However, significant increases in initial moisture content are noted for most of the RFA and associated soil samples.

Saturated Moisture Content

Saturated volumetric moisture content was determined in the laboratory using ASTM Method D2216-90 by fully saturating the dry soil sample with water. The weight of the saturated soil sample was measured and the saturated moisture content calculated. In general, the volumetric moisture content at saturation ranges between 25 and 40 percent for sandy soils and ranges up to 60 percent for clayey soils (Hillel, 1982).

Saturated volumetric moisture content for the RFA and associated soils ranged between 24.4 and 53.5 percent and averaged 36.1 ± 7.6 percent. The minimum saturated volumetric moisture content of 24.4 percent was determined for sample BH40600AE. This sample was collected from borehole 43193 at a depth between 4.0 and 4.7 ft bgs and is composed of about 62 percent gravel and sand. The maximum saturated moisture content of 53.5 percent was determined for sample BH40611AE. This sample was collected from borehole 42893 at a depth between 3.0 and 3.7 ft bgs in the Original Pond area. This soil is composed of approximately 60 percent gravel and sand with 35 percent clay fraction. Atterberg tests revealed that sample BH40611AE is characterized by a high liquid limit of 107 and a high plasticity index of 74. These Atterberg results suggest an absorptive clay mineral composition. The physical properties of the Original Pond sample suggest that at least the clay fraction is probably representative of non-native fill material. In contrast, sample BH40600AE contains 18 percent clay particles with a liquid limit of 30 and a plasticity index of 10.

Saturated volumetric moisture content for the bedrock samples ranged between 36.3 and 51.2 percent and averaged 43.4 ± 4.8 percent. The minimum saturated volumetric moisture content of 36.3 percent was determined for a bedrock sandstone sample (BH40609AE) collected between 10.0 and 10.8 ft bgs at borehole 40993. The clay content of this sample is approximately 14 percent. The maximum saturated volumetric moisture content of 51.2 percent was determined for sample BH40404AE collected from borehole 40393 at a depth between 10.3 and 11.0 ft bgs. The bedrock claystone sample is composed of about 62 percent clay. The saturated volumetric moisture content for this sample exceeded the calculated porosity of 42.6 percent.

Comparison of the saturated volumetric moisture content with calculated porosity in Table II 3 3-5 for the physical property samples shows some discrepancies where saturated moisture content is higher than the calculated porosity. This apparent discrepancy only occurs in soils with high clay contents and is a result of the sorption of water within and on the clay mineral. During saturation the double layer of the clay platelet is extended and the uptake of water by clay platelets results in an overestimate of saturated moisture content.

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II.3.3.2.2 Porosity

The structure of a soil is related to many important physical properties, especially those pertaining to the retention and transport of water. Soil structure can be measured in several ways, but it is most useful to determine the amount, size, configuration, and distribution of soil pores because they are one of the most important hydraulic parameters. Porosity is an index of the soil structure and distribution of soil pores, and assesses the relative fraction of pore volume (or voids) within a soil or rock material. Coarse-textured soils are less porous than fine-textured soils, though the mean size of individual pores is greater in coarse-textured geologic materials (Hillel, 1982). The larger pore size of the coarse-textured soils reduces the moisture-holding capacity of the soil, especially in the vadose zone.

Porosity was calculated using the methods of Danielson and Sutherland (1986). Soil and bedrock porosities were calculated using laboratory-determined dry bulk densities and particle densities. Dry bulk density and particle density are presented in Table II 3 3-4. The formula used to calculate porosity is shown below:

$$\phi = (1 - (\rho_b / \rho_s)) * 100$$

where ϕ is porosity (percent), ρ_b is dry bulk density (g/cm^3), and ρ_s is particle density (g/cm^3). Calculated porosities for the physical property samples are presented in Table II 3 3-5. Saturated moisture contents are included in Table II 3 3-5 for comparison.

Figure II 3 3-6 is a graph showing the relationship between porosity and coarse-grained soil fraction. RFA and associated soils generally exhibit higher fractions of coarse-grained particles than the bedrock lithologies. This figure exhibits this general relationship where the bedrock lithologies occur below about 10 percent coarse fraction and the RFA and associated soils occur above about 30 percent coarse fraction. Exceptions include RFA and associated soils sample BH40401AE (possibly a "reworked" claystone) and bedrock sandstone sample BH40609AE.

Calculated porosities for the soils range between 26.1 and 45.6 percent and average 36.1 ± 4.9 percent. The minimum porosity of 26.1 percent was calculated from sample BH40608AE. This sample was collected from borehole 40993 between 4.0 and 4.7 ft bgs. Approximately 18 percent of this sample is finer than sand. Sample BH40407AE exhibited the maximum porosity of 45.6 percent. This sample was collected between 4.0 and 4.7 ft bgs at borehole 44093 and is composed of approximately 65 percent silt and clay.

Bedrock lithologies exhibit calculated porosities that range between 31.7 and 43.6 percent and averaged 38.8 ± 3.9 percent. The minimum porosity of 31.7 percent was calculated for sample BH40406AE from borehole 44393. The sample was collected between 12.0 and 12.7 ft bgs and is composed of about 42 percent clay and 56 percent silt. Sample BH40402AE was collected from borehole 40593 between a depth of 25.3 and 26.0 ft bgs exhibited the maximum porosity of 43.6 percent. This sample is composed of about 60 percent clay.

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As mentioned above in the saturated moisture content section, some of the soils and bedrock lithologies have higher saturated moisture content than the calculated porosities. This difference between these two parameters may be related to the hydrating capacity of smectite clay minerals.

II.3.3.2.3 Soil and Bedrock Densities

Particle, dry bulk, and saturated bulk density were determined for the soil and bedrock lithologies from the physical property samples. These densities are related to the composition, texture, and structure of the soil and bedrock samples. Soils structure is the arrangement and organization of particles in the soil (Hillel, 1982). Particle density is the density of the minerals composing the soil matrix and is defined as the mass of a dry soil particle (no voids) per unit volume of the soil particles. Dry or saturated bulk density is the mass of the dry or saturated soil (including void spaces) per unit volume of soil.

Soil Particle Density

In most mineral soils, the mean particle density is between about 2.6 and 2.7 g/cm³. This density range is approximately equal to the density of quartz (2.65 g/cm³), a common constituent of most soils. Aluminosilicate clay minerals have a similar density. Iron and manganese oxide aggregates and coatings generally increase the average particle density.

Particle densities were determined using ASTM method D854-92, which measures the specific gravity of soil particles less than 4.75 mm. Specific gravity was determined on a dry soil sample using a pycnometer. Table II 3-3-6 lists the laboratory-determined particle density, dry bulk density, and saturated bulk density results for soil and bedrock samples.

The mean particle density of all of the samples tested, both soil and bedrock samples, is 2.66 ± 0.03 g/cm³. The particle density of bedrock lithologies is slightly higher than RFA and associated soils. Particle densities in the RFA and associated soils range between 2.59 and 2.71 g/cm³ and average 2.65 g/cm³. Bedrock lithologies particle densities range between 2.66 and 2.73 g/cm³ and average 2.69 g/cm³.

The heaviest particle density samples (BH40404AE and BH40610AE) contain iron oxide stains on the claystones at the depth sampled, as indicated on the borehole log 40393 at a depth of 10.3-11.0 ft bgs and log 40993 at a depth of 32.7-33.8 ft bgs. The least dense sample BH40611AE (borehole 42893) is from the Original Pond area with a density of 2.58 g/cm³. This sample represents a soil composed of predominantly montmorillonite clays, as indicated by the Atterberg tests, which has a density of 2.5 g/cm³ and also has absorbed water with a density of 1.0 g/cm³. This provides additional evidence that soils in the Original Pond area may not be native and may represent remnants of former bentonite liner material.

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Dry Bulk Density

Dry bulk density is the ratio of the mass of the dry soil solids to the bulk volume of the soil. The bulk volume includes the volume of the soil solids and pore space, and thus is needed to calculate porosity. Dry bulk density is not an invariant quantity for a given soil because it varies with the structural condition of the soil. In particular, it is related to its looseness or degree of compaction, as well as swelling and shrinkage characteristics that are dependent on clay mineral type, clay content and amount of residual wetness sorbed on the clay platelets.

Dry bulk density was determined in the laboratory using the methods of Blake and Hartge (1986). Dry bulk density is determined by measuring the weight and volume of the dry soil. Dry bulk density is then calculated by the ratio of the mass of the dry soil to the soil volume. Table II 3 3-6 lists the dry bulk and saturated bulk densities determined for the soil and bedrock samples.

The computed dry bulk density of RFA and associated soils ranged between 1.45 and 1.95 g/cm³ and average 1.70 ± 0.13 g/cm³. Bedrock siltstones and claystones exhibit dry bulk densities that range between 1.52 and 1.84 g/cm³ and average 1.63 ± 0.10 g/cm³. The only bedrock sandstone sample (BH40609AE) has a dry bulk density of 1.76 g/cm³.

Figure II 3 3-7 is a graph showing the relationship between dry bulk density and initial gravimetric moisture content for the physical property samples. This figure indicates that dry bulk density is inversely proportional to gravimetric moisture content. Using this data, dry bulk densities were computed for the samples obtained beneath the B series SEPs which allowed volumetric moisture contents to be calculated. In general, the lower dry bulk densities are associated with soils that have higher high clay contents and the bedrock lithologies. An exception to this generality is sample BH40405AE that contains 89 percent sand and exhibits a dry bulk density of 1.71 g/cm³, which is similar to soils with much higher clay content.

Saturated Bulk Density

Saturated bulk density expresses the ratio of the mass of saturated soil to its total volume. Saturated bulk density, when compared with particle density, provides a qualitative measure of porosity and clay content within a sample. In general, soils characterized by relatively high clay percentages and corresponding high porosity measurements have low saturated bulk densities.

Saturated bulk density was determined in the laboratory using the methods of Blake and Hartge (1986) by measuring the weight and volume of the saturated soil. Saturated bulk density was then calculated by the ratio of the mass of the saturated soil to the soil volume. Table II 3 3-6 lists the saturated bulk density results.

The mean saturated bulk density of all of the samples analyzed is 2.07 ± 0.08 g/cm³. The mean saturated bulk density for the RFA and associated soils and the bedrock lithologies is similar, 2.06 g/cm³ and 2.08 g/cm³, respectively. The saturated bulk density for RFA and

associated soils ranges between 1.98 and 2.22 g/cm³. Bedrock lithologies exhibit a saturated bulk density between 1.89 and 2.22 g/cm³. The highest saturated bulk densities were exhibited by samples BH40406AE (a siltstone) and BH40608AE (a silty gravel), whereas the lowest saturated bulk density was measured in sample BH40407AE (high in clay content).

II.3.3.2.4 Particle Size Characteristics

The materials that compose the solid phase within a soil or a rock include discrete mineral particles of various sizes, as well as amorphous compounds that may coat the soil particles. Soils can be classified by their particle size distribution and mineral composition. Together, these two attributes of the solid phase determine the physical and chemical behavior of the soil.

Texture, particle size distribution, and specific surface area are the static properties of the soil solid phase. The static properties are the enduring attributes of the solid phase capable of being measured and having a relevance to the behavior of the soil or rock.

For the physical property samples, particle size characteristics were determined in the laboratory using sieve and hydrometer methods presented in ASTM D422-63(90). Sand and gravel fractions are determined by sieve analysis and silt and clay fractions are measured by a hydrometer.

Texture refers to the size range of particles in the solid phase. The term has both qualitative and quantitative connotations. Coarse and gritty are qualitative descriptions, while the measured distribution of particle sizes or the proportions of the various size ranges of particles are quantitative descriptions. Table II 3-7 shows the quantitative distribution of particle sizes and classification of soils by the Unified Soil Classification System (USCS). Typically, the textural size fractions are gravel, sand, silt, and clay.

One visual method of identifying different lithology and depositional environments is to display textural fractions on a textural triangle (Hillel, 1982). Figure II 3-8 is a textural triangle showing United States Department of Agriculture (USDA) classification of the physical property soil and bedrock samples based on sand, silt, and clay fractions normalized to 100 percent. The textural class names also are shown for comparison. Generally, RFA and associated soils are classified as sandy clay loam, clay loam, or loam. Less common soil types represented by RFA and associated soils include sand (BH40405AE, a possible construction fill), silty clay (BH40401AE, Original Pond area), and clay (BH40611AE, possibly reworked claystone). Bedrock lithologies are classified as a silty clay or clay. The bedrock sandstone sample (BH40609AE) is classified as a sandy loam.

The textural triangle shows that most of the samples contain between 20 and 50 percent clay. When compared with other size categories, clay particles have significantly greater surface area per unit mass, resulting in higher physicochemical activity. Clay particles absorb water and

hydrate to form an electrostatic double layer with exchangeable cations. Surface activity of a clay is also expressed during hydration through the release of heat (heat of wetting)

Dividing the samples into textural classes, as in the textural triangle, places a preconceived grouping upon a continuous array of particle sizes and excludes the cobble and gravel portions. Figure II 3 3-9 shows the continuous nature of particle sizes in sample BH40600AE (borehole 43193). The information obtained from this representation of particle size distribution includes the diameter of the largest grains in the assemblage and the grading pattern. The shape of the distribution curve is related to the amount of grading during deposition. Soils with a preponderance of several particle sizes are well graded similar to sample BH40600AE (Figure II 3 3-9). Poorly graded particle distributions have a steeper slope. Bedrock samples with steep slope particle distributions are typically referred to as well sorted similar to Figure II 3 3-10 (sample BH40605AE). In general, RFA and associated soils are well graded while bedrock lithologies are well sorted.

Figure II 3 3-11 shows a composite of sieve and hydrometer analyses for the RFA and associated soils. Individual particle size distribution curves are presented in Appendix II P. Four distinct particle size distribution curves are evident on Figure II 3 3-11 (groups 1-4). Finer-grained soils typically occur along the upper portion of figure-like sample BH40401AE (group 1) and the coarse-grained soils occur along the base of the figure-like sample BH40405AE (groups 2 and 4). Samples BH40401AE and BH40405AE are poorly graded soils. The majority of RFA and associated soils occur within an envelope describing well graded soil textures in the central portion of Figure II 3 3-11 (group 3).

Figure II 3 3-12 shows composite sieve and hydrometer analyses for the bedrock lithologies. Three distinct particle size distribution curves are present on this figure. The lowermost curve represents the Arapahoe Sandstone sample (BH40609AE). Bedrock claystones are the uppermost group of particle size distribution curves. Immediately between the claystone and sandstone samples are the bedrock siltstone particle size distribution curves.

Several indices that aid in characterizing the particle size distribution curves were calculated and are presented in Table II 3 3-8. These indices include the uniformity index (C_u), the median particle diameter (d_{50}), the particle sizes at 10 (d_{10}), 30 (d_{30}), and 60 (d_{60}) percent, and the index of curvature (C_c). The d_{10} , d_{30} , and d_{60} indices represent the particle diameter (in mm) corresponding to 10, 30, and 60 percent of the soil passing that screen diameter by weight, respectively. The uniformity index is

$$C_u = d_{60}/d_{10}$$

while the index of curvature is defined as

$$C_c = (d_{30})^2 / ((d_{10}) * (d_{60}))$$

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In general, well-sorted soils have C_u indices less than 10, while well-graded soils can have C_u indices greater than 1,000 (Holtz and Kovacs, 1981). A sandy soil is considered to be well graded if the index of curvature is between 1 and 3 and has a uniformity index greater than 6 (Holtz and Kovacs, 1981)

Four RFA soil samples had computed uniformity indices. Samples BH40405AE and BH40602AE (SW and G soil types, respectively) exhibit C_u values of 6.7 and 933 and C_c values of 0.85 and 0.045, respectively. Although the uniformity index criterion classifies these samples as well graded ($C_u > 4$ for gravels and > 6 for sands), the index of curvature indicates that these samples are poorly graded [$(1 < C_c < 3)$ (Holtz and Kovacs, 1981)]. Samples BH40608AE and BH40612AE (GM and GC soil types, respectively) exhibit C_u indexes of 4250 and 2500 and C_c values of 7.8 and 13, respectively. These samples are not well graded. Uniformity indexes were not computed for any of the bedrock samples because C_u are relevant for only coarse grained soils.

The median particle diameter (d_{50}) for the RFA and associated soils ranges between 0.0017 and 11 mm and average 2.0 ± 3.7 mm. This range in median particle size diameters indicates that the RFA is composed of a large range of soil particle sizes that are well graded.

Bedrock siltstones and claystones exhibit median particle diameters between 0.0014 and 0.11 mm. The average median particle diameter is 0.02 ± 0.044 mm. The largest median particle diameter (0.11 mm) was exhibited by a bedrock sandstone sample. This narrow range of particle sizes indicates that the bedrock lithologies are well sorted.

II.3.3.2.5 Atterberg Limits

Atterberg Limits represent a series of tests that determine the moisture content of a soil when it changes from one physical condition to another. In general, these tests classify soils for structural purposes, but these tests also identify the predominant clay mineral present (Holtz and Kovacs, 1981). Knowing the predominant clay mineral present within a sample aids in identifying the relative moisture-holding capacity of different soils (Holtz and Kovacs, 1981). Materials used in the tests are soil particles that pass through a No. 40 sieve (finer than 0.42 mm). The liquid limit, the plastic limit, and the shrinkage limit comprise the more common Atterberg Limits indices.

The liquid limit (LL) is the water content at which a trapezoidal groove of specified shape, cut in moist soil held in a special cup, is closed after 25 taps on a hard rubber plate. The plastic limit (PL) is the water content at which the soil begins to break apart and crumble when rolled by hand into threads one-eighth inch in diameter. The shrinkage limit (SL) is the water content at which the soil reaches its theoretical minimum volume as it dries out from a saturated condition (Sowers and Sowers, 1970). The LL and PL are reported in terms of percent of mass per mass (percent, g/g).

For vadose zone characterization, the LL represents the total moisture potentially held in the diffused double layer and any water held by absorption. The PL represents the innermost moisture of the diffused double layer and absorbed water (Sowers and Sowers, 1970). The difference between the LL and the PL is the plasticity index (PI). The PI represents the range in water contents at which the soil is in the plastic state and represents the potential changes in water content of the diffused double layer or the moisture-holding capacity. Since the PI is a measure of the moisture-holding capacity of the fine-fraction, it provides an indication of the mineralogy of the clay fraction (Sowers and Sowers, 1970). This relationship was identified in 1948 by Casagrande (Holtz and Kovacs, 1981).

Table II 3 3-9 lists the results of Atterberg tests for physical property samples. Four of the 25 samples were coarse-textured and did not have sufficient fines to complete Atterberg Limits. Atterberg tests for the remaining samples were conducted using ASTM Method D4318-84.

Figure II 3 3-13 shows the relationship between PI and clay mineralogy. Casagrande's kaolinite, montmorillonite, and illite zones as defined by Holtz and Kovacs (1981) are shown for comparison. This figure, termed a soils plasticity chart, differentiates clay-like materials from those that are silt-like. The clay-like materials occur above the A-line on Figure II 3 3-13, while the silt-like materials occur below this line. For the samples tested, the RFA and associated soils and the bedrock samples are all clay-like. Two extremes are noted on Figure II 3 3-13. The RFA soil sample taken from the Original Pond area is noted because it has a high PI and high moisture-holding capacity. Additionally, the apparent separation from the other RFA and associated soil samples suggest that this sample is not native to the OU4 site. The Arapahoe Sandstone sample is the other extreme because it has a low PI and low moisture-holding capacity. Based on Figure II 3 3-13, these values of LL and PI suggest that the tested samples are characterized by a mixture of montmorillonite and illite clays.

Of the twelve coarse-grained RFA and associated soil samples, eight were measured. These coarse-grained samples have a PI range between 10 and 74. The mean PI is approximately 26.3 ± 20 . This lithology group contains the largest PI (taken from the Original Pond area). The four fine-grained soils exhibit a narrower PI range. Their PI range is between 18 and 38 and averages 26 ± 9 . For all of the RFA and associated soils, the mean PI is 23.3 ± 7 .

The PI for eight bedrock siltstone and claystone samples ranges between 25 and 55 and averaged about 36 ± 11 . Sample BH40609AE (the Arapahoe Sandstone) exhibits the smallest PI value of 3.

Results

Moisture contents are reflective of the lithology of the sample (amount of fines and type of clays) and the relative position of the sample taken with respect to the water table. Additionally, core samples taken at shallow depths may be subject to the effects of

evapotranspiration losses or variances in moisture migration pathways. These variances may be reflected on Figure II 3 3-2

Sample BH40608AE, collected from borehole 40993 north of SEP 207-C exhibited an initial volumetric moisture content of 12.6 percent. Approximately 82 percent of this sample is composed of sand and gravel. Samples with similar coarse fraction are BH40612AE (borehole 43693) and BH40613AE (borehole 41593). Although these samples are collected from shallower depths, the corrected volumetric moisture contents are approximately 10 percent wetter than sample BH40608AE. This is attributed to the A-pond liner trapping vertically moving moisture. Additionally, sample BH40613AE, located on the north end of SEP 207-A, is approximately 7 percent wetter than sample BH40612AE, located on the south end of SEP 207-A (Table II 3 3-4). This dissimilarity in corrected volumetric moisture content may indicate seepage occurring beneath the north end of SEP 207-A.

The Arapahoe Sandstone (Sample BH40609AE, if it is representative), contains clays that are not as adsorptive as other RFA and associated soils or other bedrock samples tested (Figure II 3 3-13). This bedrock sample appears to be texturally similar to the RFA and associated soils, while soil sample BH40401AE appears to be texturally similar to the claystones.

A comparison of the saturated moisture contents and the calculated porosities indicates that there are sorptive clays within the RFA and associated soils. The greatest differences are associated with the higher PI and LL Atterberg values.

Sample BH40611AE (Original Pond area) has an LL value of 107 and a PI value of 74. Figure II 3 3-13 shows the uniqueness of this sample relative to the others. The high LL and the location of the sample suggests that this soil sample may contain remnants of the Original Ponds' compacted bentonitic clay liner. Based upon its Casagrande plot position (Figure II 3 3-13), the sample contains montmorillonite clays, which further indicates that the material represents the bentonitic clay soil reportedly used for the liner.

II.3.3.3 Field Measurements of Hydraulic Properties of the Vadose Zone

Various equipment and techniques were used to characterize hydraulic properties of the vadose zone at OU4. The approach included field permeability tests, neutron moisture monitoring, and laboratory characterization of hydrologic properties of soil cores collected from the vadose zone. The results of the field permeability tests and neutron moisture monitoring are presented in this section (Section II 3 3 3) and the laboratory results are presented in Section II 3 3 4.

Field permeability measurements were performed to provide estimates of field-saturated hydraulic conductivity at shallow depths within a variety of lithologic materials that comprise the vadose zone at OU4, and to evaluate the effectiveness of BAT™ test equipment and Guelph permeameter to provide hydraulic conductivity measurements in the RFA soil and lithologic materials at OU4. Neutron moisture monitoring was conducted to determine the areal and

vertical distribution of moisture in the vadose zone and to evaluate if percolation of precipitation occurs at the site and is indicated by the presence of wetting fronts

II.3.3.3.1 BAT™ Tests

As proposed in TM1, 32 to 48 field-saturated hydraulic conductivity tests were planned during drilling of 16 vadose zone boreholes at OU4 (two to three tests per borehole) Using this approach, unsaturated alluvial and weathered bedrock materials were tested to provide field-saturated hydraulic conductivity estimates for each type of subsurface material

The BAT™ test uses a porous ceramic downhole probe and hydraulic pressure sensing equipment to perform permeability tests operationally similar to a small-scale slug test During the test, water can be injected or withdrawn from the tested interval and estimates of hydraulic conductivity are derived from transient pressure readings, flow rate, and borehole/test configuration geometry BAT™ tests are usually limited to soils with saturated hydraulic conductivities less than 10^{-7} cm/s and are accurate to within one order of magnitude For the OU4 Phase 1 RFI/RI investigation at OU4, only vadose zone materials were tested Details of the test procedure and analyses performed are presented in EG&G SOP Manual 5-21000-OPS, SW 34 (draft)

During the field investigation, tests were attempted at 14 of the 16 vadose zone boreholes Fifteen tests were successfully completed in 14 boreholes Five of these tests were performed in alluvial materials and 10 were performed in bedrock lithologies The test depths ranged between about 3 to 27 feet Difficulties in advancing the BAT™ probe or damage to the ceramic filter precluded successful completion of several tests attempted within gravelly horizons of the RFA Most of the tests completed were in the bedrock lithologies, however, some tests in the RFA were successful Tests in the last two vadose zone boreholes (41593 and 42493) were not attempted because gravelly conditions were encountered in the RFA Three test attempts in the claystone bedrock were not successful because of high pore pressures or damage to the probe tip

Results of BAT™ tests and the conditions encountered at each vadose zone borehole are presented in Table 3 3-10 Figure II 3 3-14 also presents results of BAT™ testing during the OU4 Phase I RFI/RI Field Investigation at OU4

As summarized in Table II 3 3-11, test results for alluvial clays and silts range from 9.1×10^{-10} to 3.5×10^{-8} cm/s One test of a sand horizon within an alluvial gravel resulted in a field-saturated hydraulic conductivity greater than 3.1×10^{-7} cm/s Field-saturated hydraulic conductivities for bedrock siltstones and claystones ranged from less than 1.0×10^{-10} to 1.0×10^{-9} cm/s, while one test of a silty sandstone yielded a field-saturated hydraulic conductivity of 1.1×10^{-7} cm/s

BAT™ permeability test results for alluvial and sandy materials yielded higher field-saturated hydraulic conductivity values than the bedrock siltstone and claystones However,

hydraulic conductivity results for BAT™-tested alluvial and bedrock materials were substantially lower than saturated hydraulic conductivities presented in the Geologic Characterization Report (EG&G, 1991) for similar saturated alluvial and bedrock materials tested using slug and pumping test methods. Likewise, BAT™ test results are about 100 times lower than results for similar but shallower materials tested using the Guelph permeameter. This variance may be due to smearing of fines onto the ceramic cup of the BAT™ probe tip. The small area of influence intrinsic in the BAT™ test methodology may contribute to this observed discrepancy between hydraulic conductivities.

II.3.3.3.2 Guelph Tests

As proposed in TM1, approximately 25 Guelph permeameter tests were to be performed at various locations to provide field-saturated hydraulic conductivity and matric flux potential estimates for near-surface materials at OU4. Guelph tests are usually limited to soils with a saturated hydraulic conductivity greater than 10^{-6} cm/s. Therefore, most of the Guelph tests were completed in the RFA.

Tests were attempted adjacent to 13 of the 16 vadose zone boreholes and at six other boreholes within OU4. A total of 24 tests were attempted, 21 tests were successful. The depths of the tests ranged from 5.5 to 29.0 inches. Tests were completed in alluvial units consisting of silts, clays, gravels, and sand, and bedrock units composed of claystone and sandstone.

Field-saturated hydraulic conductivity and matric flux potential using the method of Elrick *et al* (1989) were determined using the Guelph permeameter data. Matric flux potential (ϕ_m) is defined as

$$\phi_m = \int_{\psi_x}^0 K(\psi) d\psi$$

where ψ_x is matric potential at the wetting front and $K(\psi)$ is unsaturated hydraulic conductivity (a function of matric potential). Matric potential is the sum of the capillary and adsorptive forces exerted on soil water by the soil matrix, commonly known as "soil suction". Field-saturated hydraulic conductivity and matric flux potential are estimated using the measured steady-state flux rate into the borehole, the pressure head (H), the well radius (a), a dimensionless shape factor (C), and a parameter α^* that is expressed as

$$\alpha^* = \frac{K_{fs}}{\phi_m}$$

where K_{fs} is field-saturated hydraulic conductivity. The α^* parameter can be interpreted as the inverse of the matric potential at the wetting front ($|\psi_x| \sim \alpha^{*-1}$). The shape factor, C, is determined from a graph of C versus H/a for different ranges of α^* . It has been shown that the determination of K_{fs} and ϕ_m is not strongly dependent on α^* (Elrick *et al*, 1989). An α^*

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value of 12 cm^{-1} suggested by White and Sully (1987) was used throughout this study. Guelph permeameter field test results were analyzed using both the two-head, simultaneous equations approach and the one-head approach.

Results of Guelph permeameter tests and conditions encountered at each test location borehole are presented in Table 3-3-12. Figure II 3-3-15 also presents results of Guelph permeameter testing during the OU4 Phase I RFI/RI Field Investigation at OU4.

As summarized in Table II 3-3-13, Guelph permeameter field-saturated hydraulic conductivity measurements for RFA clays and silts range from less than 1.0×10^{-6} to $1.6 \times 10^{-3} \text{ cm/s}$. One test of a sand horizon within silty sand resulted in a K_{fs} of $4.8 \times 10^{-4} \text{ cm/s}$. Results for alluvial gravels ranged from less than 1.0×10^{-6} to $1.1 \times 10^{-3} \text{ cm/s}$. Calculated matric flux potential ranged between 6.1×10^{-1} and 4.3×10^{-5} centimeters squared per second (cm^2/s).

Results for tests performed in shallow bedrock sandstone horizons ranged from 3.2×10^{-6} to $2.1 \times 10^{-5} \text{ cm/sec}$. One test performed in a shallow bedrock claystone and resulted in a K_{fs} of $8.4 \times 10^{-6} \text{ cm/sec}$. Calculated matric flux potentials ranged between 2.7×10^{-3} and $2.1 \times 10^{-4} \text{ cm}^2/\text{s}$. Although these results appear to be consistent with expected ranges for materials tested, field-saturated hydraulic conductivity and matric flux potential values encompass a range of up to three orders of magnitude. Results from tests performed in similar materials at similar depths varied by more than two orders of magnitude.

Guelph permeameter test results show a high degree of K_{fs} variation between sites and at depth for individual sites. This variability is attributed primarily to the presence of heterogeneities within the soils. Attempts were made to use a two-head solution to determine hydraulic conductivity and matric flux potential using steady-state flux measured in the field at two different heads (where the second is larger than the first and influences a larger area). A portion of the measurements analyzed with the two-head solution yielded negative results, which suggests that the scale of heterogeneities at these sites is smaller than the area sampled by the Guelph permeameter. Whenever negative results were obtained using the two-head method, a one-head analytic technique, which assumes knowledge of the α^* parameter, was followed.

Variations also were observed due to irregular borehole geometries. Difficulties in advancing a test borehole in the gravelly material were encountered at three locations, even though three different methods of shallow borehole advancement were attempted throughout the testing program. Successful borehole advancement often resulted in irregular borehole geometries due to the removal of cobbles. The solution method used to determine hydraulic conductivity and matric flux potential relies somewhat on the assumption of regular borehole geometry. Therefore, the results of some Guelph tests may exhibit errors because of an irregular borehole geometry.

II.3.3.3 Neutron Probe Measurements

Neutron probes operate on the principle of neutron moderation to determine neutron counts that may be correlated with soil moisture content. The probes contain a radioactive source, commonly americium-241/beryllium, that emits high energy neutrons, and a detector that senses thermal (slow) neutrons. Thermalized neutron capture emits a pulse of energy that is counted by the detector. Approximately 70 percent of the neutron slowing is due to collisions with hydrogen atoms (Dickey, 1990). Because most hydrogen in soil is in the form of water molecules, a correlation can be developed between thermalized neutron count and moisture content. This relationship is usually linear for the moisture commonly encountered in soils.

The neutron probes used during this study were 503DR-1 5 and 503DR-2 hydroprobes manufactured by CPN Corporation. The primary components of these portable probes are the source (50 millicurie americium-241/beryllium) and detector which are contained in the downhole probe, and the shielding and signal processor which are housed within the body of the probe. In the fully-retracted position, the probe is shielded within the body of the probe.

Neutron Probe Calibration

The 503DR Hydroprobe determines hydrogen content within a spherical volume of soil, sometimes known as the sphere of influence, which has a radius of approximately 6 inches (CPN Corporation, 1984). These measurements are affected by a number of factors including soil bulk density, soil chemistry, access tube material and diameter, and void space between the access tube and the borehole. As a result, it is usually necessary to calibrate the neutron probe to site-specific conditions if they are significantly different from the conditions under which the factory calibration was determined and if it is desirable to report neutron probe measurements in terms of water content. Because relative differences in moisture content and wetting front movement were the primary focus during neutron moisture monitoring, the neutron probe was not calibrated to site moisture conditions. The factory calibration was used and neutron counts are presented instead of moisture content. Comparison of changes in direct neutron counts between monitoring events allows detection of very small changes in moisture content.

Neutron moisture measurements are influenced by the moisture content in the native soil and the access tube/lysimeter completion materials, the composition of the access tube, and proximity to lysimeters and lysimeter riser tubes. The borehole completion material consists of silica flour, Colorado silica sand, or bentonite depending on the interval. The native soil and borehole completion materials have different moisture contents due to their different characteristics. Their relative influence on the neutron probe reading is not known. The neutron access tube, lysimeters, and lysimeter riser tubes are constructed of polyvinyl chloride (PVC). PVC contains chlorine, which also is a neutron capturing element. Therefore, the proximity of the neutron probe to lysimeters or riser tubes may also influence the measurement. Because the monitoring instrumentation geometry and borehole completion materials are highly variable, neutron probe measurements are not affected equally at all locations or intervals within a borehole.

Standard Count

A standard count was taken prior to each monitoring event. The standard count is the average of a series of neutron counts taken under standard conditions. CPN Corporation recommends that the standard count be taken in the silicon-based paraffin shield housed in the body of the probe by placing the probe on the carrying case's lead plate. The shield is not 100 percent effective, and as a result, the standard count is affected by surrounding conditions such as surface moisture and nearby objects. To minimize the effect of surrounding conditions, each standard count was taken with the probe placed on the concrete pad adjacent to vadose zone monitoring location 44393 and at least 5 feet from the nearest object.

The standard count is used to determine if the probe's electronics and other components are functioning correctly (Dickey, 1990). The CPN 503DR standard count is a series of 32, 8-second counts. The probe displays the average reading (standard count), previous reading, and the chi-squared ratio. The chi-squared ratio should fall between 0.75 and 1.25 at least 95 percent of the time if the probe is functioning correctly. Additionally, the difference between the current and previous standard counts should be within 0.707 times the square root of their average at least 95 percent of the time (CPN Corporation, 1984).

Neutron Probe Calibration Transfer

Two different neutron probes were used during this study. To allow comparison of neutron data obtained from these two different probes, it was necessary to determine a calibration transfer between the original probe and the replacement. Thirty-two, eight-second counts, representing the extreme values of moisture content, were measured at two intervals with both probes at vadose zone monitoring location 40593. The average measurements from the first gauge were used to construct a calibration curve for the second gauge. The neutron data were then corrected for the count differences using the calibration factor.

Results

The objectives of the neutron moisture measurements were to characterize relative moisture content and seasonal wetting of the vadose zone, to determine if flow is occurring, and to establish a baseline for future measurements within OU4. Measurements were made at approximately bimonthly intervals for five months at 16 vadose zone monitoring installations (Figure II 3 3-16). By comparing successive neutron count profiles and noting changes in neutron counts with depth, it is possible to determine wetting fronts and changes in water storage.

To obtain neutron count measurements, the probe was placed on top of the protective surface casing and the probe was lowered into the neutron access tube to predetermined intervals marked with cable stops. Neutron counts, 32 seconds in duration, were taken at 1-foot intervals from the top to the bottom of the neutron access tube or to the level of standing water, if encountered.

Neutron count profiles for 16 monitoring locations are presented as Figures II 3 3-17 through II 3 3-32. Table II 3 3-14 summarizes the neutron moisture monitoring results. Although changes in neutron count profiles are visible at some locations, there is no evidence of a vertically moving wetting front at any of the monitoring locations. Changes in neutron count profiles reveal four primary moisture and water storage trends:

- A seasonal declining water table south and east of the SEPs,
- Drainage in soils above the water table during decreases in ground water level,
- A seasonal decrease in water storage between ground surface and about 3 feet at most locations, and
- Static neutron count profiles beneath SEP 207-A

Neutron count profiles at neutron monitoring locations 41793, 43193, 44093, and 44393 show evidence of a declining water table. These monitoring locations are situated south and east of the SEPs. Location 40293, situated near North Walnut Creek, also shows a water level decline. Hydrographs from location 3887 confirm that the water table elevations were decreasing at these locations. These locations show a decrease in moisture content in the lower to middle portions of the monitored intervals. Most of the other neutron monitoring locations appear to show a relatively static water table as summarized in Table II 3 3-14. The fluctuation of the water table as evidenced by the neutron probe data is less than the fluctuations observed in the monitoring wells and piezometers.

During seasonal fluctuations of the water table, soils that are situated just above the water table drain as the water table elevation decreases. Drainage is evident at neutron monitoring locations 41793, 43193, 44093, and 44393. Drainage of the soils results in decreased neutron counts because the soils are less moist. This decrease in moisture content results in an increase in the matric potential of these materials.

The effects of evaporation are evident at many of the neutron monitoring locations. Evaporation produces an upward vertical flux of moisture movement in the vadose zone. Drying of the upper foot of soil is very common and extends to depths of as much as 3 feet. Evidence of surface drying is most pronounced at neutron monitoring locations 40293, 40393, 40793, and 41293 north of the SEPs.

Neutron count profiles at monitoring locations 40993, 41593, 42493, and 43693, which are situated beneath or adjacent to the SEPs, indicate static moisture conditions at depth. Most of the variations in the neutron count measurements are small and reflect only slight changes in moisture content. The transient effects of evapotranspiration are minimized beneath the SEPs because the asphalt liners retard evapotranspiration.

The effects of the neutron/lysimeter boring completion materials on neutron measurements are evident at the locations that show water level declines. Evidence of water level decline is most pronounced in the soil intervals adjacent to Colorado silica sand and least pronounced adjacent to bentonite. This was determined by plotting the neutron/lysimeter completion on the borehole logs presented in Appendix II H. The well-sorted, coarse-grained Colorado silica sand drains rapidly as the water table declines and a decrease in the neutron counts is observed. Moisture characteristic curves of coarse-grained, poorly-graded materials, such as Colorado silica sand, rapidly decrease in moisture content when their air-entry pressure is reached. This characteristic is less pronounced in fine-grained materials with a uniform pore-size distribution such as silica flour and bentonite. Neutron count measurements adjacent to bentonite show little to no change as the water table declines because of the high air entry pressures associated with these materials. Therefore, neutron moisture readings adjacent to bentonite may not be representative of changing moisture conditions in surrounding materials. The effect of the non-native access tube/lysimeter completion materials on the neutron count measurements suggests that the neutron access tubes should not be installed in the same borehole as the lysimeters. In addition to the effect of the completion materials, sampling of the lysimeters also may cause localized changes in the moisture content.

II.3.3.4 Laboratory Measurements of Hydraulic Conductivity of the Vadose Zone

Hydraulic conductivity (K) is a measure of the ease that water moves through soil or rock and is dependent on the texture, or particle-size distribution, and the structure, or arrangement of the soil particles. K is the proportionality factor in Darcy's equation ($v = K * i$) and relates the velocity (v) of water in a porous medium to the hydraulic gradient (i). Determination of the ability of unsaturated and saturated geologic materials to transmit liquids is one of the more important site characterization parameters and is critical for the design of vadose zone monitoring systems. The EPA (1992) characterizes hydraulic conductivities as follows:

Hydraulic Conductivity (cm/sec)	Description
$K > 10^{-3}$	High
$10^{-3} > K > 10^{-5}$	Moderate
$10^{-5} > K > 10^{-6}$	Low
$K < 10^{-6}$	Inhibited

Laboratory measurements of saturated hydraulic conductivity (K_s) and soil moisture characteristics were conducted by DBS on 25 undisturbed core samples selected from the borings drilled for lysimeter and neutron access tube installation. These parameters were measured to provide data to allow calculation of the unsaturated hydraulic conductivity (K_{us}) and to provide soil hydraulic data for IM/IRA engineered barrier performance modeling. The results of these analyses and the calculated K_{us} values are presented in the following sections.

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II.3.3.4.1 Saturated Hydraulic Conductivity

K_s was measured for each of the intact soil samples selected for physical property analysis. Laboratory measurement of K_s was conducted using either the constant head (ASTM D2434-68) or falling head (Klute, 1986) method. The constant head method is used to measure K_s for soils containing less than 10 percent silt and clay and hydraulic conductivities between 1 and 10^{-5} cm/s. The falling head method is used to measure K_s in fine-grained soils with hydraulic conductivities between 10^{-3} and 10^{-7} cm/s. Sample BH40405AE, a gravelly sand from borehole 44393, was the only sample analyzed by the constant head method. The results of the K_s determinations are presented in Table II 3 3-15 for RFA and associated soils and in Table II 3 3-16 for the bedrock lithologies.

The laboratory-measured K_s of RFA and associated soils ranged between 7.1×10^{-2} and 1.0×10^{-9} cm/s. Three samples exhibited K_s values greater than 1.0×10^{-3} cm/sec and a geometric mean of 5.8×10^{-3} cm/sec. These samples are representative of soils with a high K_s . The remaining RFA samples exhibited K_s values less than 1.0×10^{-4} cm/sec and a geometric mean of 1.0×10^{-6} cm/sec. Most of the samples analyzed exhibited K_s values between 10^{-5} and 10^{-6} cm/s. Soils with K_s values less than 10^{-5} are representative of low to inhibited K_s .

The laboratory-measured K_s of bedrock lithologies ranged between 1.8×10^{-5} and 3.6×10^{-9} cm/s. All of the bedrock samples exhibited K_s values less than 1.0×10^{-5} cm/s. Siltstones and claystones exhibited a geometric mean of 3.8×10^{-8} cm/sec. A single bedrock sandstone sample (BH40609AE) from borehole 40993 yielded a K_s value of 1.8×10^{-5} cm/s.

Figure II 3 3-33 shows the relationship between K_s and depth bgs. No apparent relationship exists between K_s and depth. However, with few exceptions, this figure shows that the RFA K_s values are typically greater than 10^{-6} cm/s and that the bedrock lithologies exhibit K_s values less than 10^{-7} cm/s.

II.3.3.4.2 Soil Moisture Characteristics

The amount of saturated pore space available for water movement within a soil varies with the volumetric water content. Thus, a direct relationship exists between the volumetric water content and the hydraulic conductivity of a soil. Maximum hydraulic conductivity occurs when a soil is fully saturated. As a soil desaturates, pores become air filled, which decreases the pore volume capable of transmitting water. The first pores to desaturate are the largest, most conductive pores. As a result, desaturation is often accompanied by a rapid decrease in hydraulic conductivity.

Defining the relationship between moisture content and hydraulic conductivity in a soil is necessary for describing and simulating the movement of water in an unsaturated soil. The relationship between the soil water content and the pressure head (or matric potential) is a

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fundamental hydraulic characteristic of vadose zone soils This relationship is defined by the moisture characteristic or water retention curve

Soil moisture characteristics of the initial drainage curve for RFA and associated soils and bedrock lithologies were determined by DBS using both pressure-plate and thermocouple psychrometric methods presented in MOSA, Chapter 26 (Klute, 1986), ASTM D2325-68 (ASTM, 1992), ASTM D3152 (ASTM, 1992), and Jones and others (1990) The moisture characteristic curve developed for the soil and bedrock samples was mapped by establishing a series of equilibria by drainage from zero to approximately 15 bars pressure head

The results of the soil moisture characteristic analyses are summarized in Table II 3 3-17 Tables II 3 3-18 and II 3 3-19 show the matric potential relative to the initial moisture content of each sample This table also shows the calculated unsaturated hydraulic conductivity (K_{us}) for the RFA and bedrock samples, respectively Calculated K_{us} is discussed in the following section Graphs of the moisture content versus pressure head are presented in Appendix II S Figure II 3 3-34 shows an example of the pressure head-moisture content relationship for a soil sample from borehole 40993 This figure indicates that moisture content decreases rapidly with increasing pressure head (or matric potential) The initial moisture content of the soil sample is shown on the figure indicating that the sample at the time of collection had a matric potential of approximately 3,200 cm (3.2 bars) Minimal water movement occurs in the vadose zone below about 0.3 bars of pressure

II.3.3.4.3 Unsaturated Hydraulic Conductivity

Soil water retention data obtained from the moisture characteristic analyses were used to calculate the K_{us} of each sample analyzed K_{us} , as a function of moisture content and/or pressure head, was calculated using RETention Curve (RETC), a computer program developed by van Genuchten and others (1991) for the EPA A closed-form analytical solution based on Mualem's (1976) theoretical model was used to predict K_{us} from soil moisture characteristics RETC uses a non-linear least-squares method to fit the experimental data to a moisture characteristic function Input parameters consist of matric potential-moisture content data pairs and saturated moisture content

Mualem (1976) described the theoretical basis for the procedure used to estimate K_{us} from the moisture characteristic curve according to the following formula,

$$K_r = \frac{S_e^{0.5} \int_0^{S_e} \frac{1}{h(x)} d(x)}{\left[\int_0^1 \frac{1}{h(x)} d(x) \right]^2}$$

where K_r is the relative K , h is the negative pressure head as a function of dimensionless moisture content (S_e), and

$$S_e = \frac{(\theta - \theta_r)}{(\theta_s - \theta_r)}$$

where subscripts r and s indicated saturated and residual values of moisture content. The relationship between dimensionless moisture content and pressure head is given by the following equation,

$$S_e = \left[\frac{1}{1 + (\alpha \psi)^n} \right]^m$$

where m is equal to $1-1/n$. α , n , and m are obtained by a non-linear least-squares numerical procedure applied to measured moisture retention data using the technique developed by van Genuchten (1980) and van Genuchten and others (1991).

The results of these calculations are shown in Tables II 3 3-18 and II 3 3-19 for the RFA and bedrock lithologies, respectively. The K_{us} results using the corrected initial moisture contents also are shown for comparison. Figure II 3 3-35 is an example of the calculated K_{us} -moisture content function for a soil sample from borehole 40993.

Figure II 3 3-36 shows the relationship between K_{us} and moisture content. RFA and bedrock lithology K_{us} values are clustered as two separate groups, however, the RFA data exhibit a wider range of K_{us} values. K_{us} values for the RFA range between 4.6×10^{-6} and 2.2×10^{-20} cm/s and have a geometric mean of 7.2×10^{-14} cm/s. The bedrock K_{us} values typically range between 4.2×10^{-11} and 6.4×10^{-15} cm/s and have a geometric mean of 1.5×10^{-13} cm/s. Figure II 3 3-37 depicts K_{us} versus depth. K_{us} values do not appear to change with depth since the K_{us} data exhibit a wide range of values at similar depths.

K_{us} values also were calculated for the corrected initial moisture content values by calculating an initial moisture content for the < 2 mm size fraction and are termed "corrected K_{us} ". Corrected K_{us} values for the RFA range between 1.2×10^{-5} and 2.0×10^{-16} cm/s, and have a geometric mean of 6.9×10^{-10} cm/s. Corrected K_{us} values for the bedrock are similar to the uncorrected results because the initial moisture contents did not change because a > 2 mm size fraction is not present. Corrected K_{us} values for the RFA varied consistently from the initial K_{us} .

II.3.3.5 Water Level Measurements

Water level measurements were gathered from historical records and from an active field monitoring program. Monitoring was conducted using automated and manual alluvium water level measurement techniques according to SOPs VZ 5 and GW 1. Two hydrostratigraphic regimes were examined as part of the OU4 Phase I RFI/RI investigation. The upper hydrostratigraphic unit (Upper HSU) is defined as the unconfined saturated zone consisting of the alluvium and weathered bedrock strata. The alluvium regime consists of RFA, construction fill, valley fill alluvium, colluvium, and landslide soil materials.

Alluvium water level measurements were obtained at four automated monitoring locations in OU4 in order to correlate water level changes with precipitation events. These data allow an estimate of the approximate travel time for infiltration to reach the water table. The automated monitoring program was later expanded to include manual alluvium water level monitoring to identify the vertical extent of the vadose zone, to provide greater detail on water table configuration and fluctuations in OU4 than was previously available through RCRA alluvium monitoring programs, and to allow comparison of historical hydrographs when the SEPs were in operation to water levels after SEPs 207-A, 207-B North, and 207-B Center were drained. Alluvium water level fluctuations recorded in 1993 are examined in Section II 3 3 5 3. Historical alluvium water level fluctuations are discussed in Section II 3 3 5 4. The configuration of the alluvium and Upper HSU water tables is presented in Section II 3 3 5 5. Water table fluctuations adjacent to the SEPs are presented in Section II 3 3 5 6. Section II 3 3 5 7 discusses the thickness and extent of the vadose zone.

Generally, water level elevations in the alluvium and the Upper HSU are highest during the spring and lowest in the fall through winter months. The hydrograph from monitoring location B208789 (Figure II 3 3-38), located near North Walnut Creek in the northwestern corner of OU4, is an example of recharge to the alluvium during the spring. Figure II 3 3-39 shows the near-cyclic repetition of wetting and drying for monitoring location P209789, located approximately 200 feet east of SEP 207-B Center. This hydrograph depicts proximal spring alluvium recharge events and the subsequent summer through winter drying episodes. Figure II 3 3-39 also depicts that these episodes are not uniform in magnitude, duration, or periodicity. These near-cyclic wetting and drying episodes of the alluvium water table cause the water level fluctuations observed at OU4 and the varying thickness of the vadose zone.

II.3.3.5.1 Automated Alluvium Water Level Measurements

One Hermit 1000B® and three Well Sentinel LTM 3000® dataloggers equipped with pressure transducers were used to automatically measure and record water table elevations within the alluvium. Data logger measurements were programmed to automatically record alluvium water levels at four-hour intervals. The purpose of the data collected at these locations was to evaluate the alluvium water table response to precipitation events. Figure II 3 3-40 presents locations and durations of monitoring at each well or piezometer equipped with automated data.

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loggers and vented pressure transducers throughout the alluvium water level monitoring investigation

Alluvium water level elevations at monitoring locations 2286, 2686, and 41193 were measured between March and October, 1993. Monitoring well 2286 is located just south of the center portion of the southern berm around SEP 207-C, while monitoring locations 2686 and 41193 are situated off the southeastern corner and northeast of SEP 207-A, respectively. The data logger at monitoring location 3787 was also installed in late March, 1993. This data logger was incorrectly programmed and provided erroneous data. Logging equipment from monitoring location 3787 was moved southeast approximately 150 feet to monitoring well cluster P207689 and P207789 on April 13, 1993, due to the abandonment of monitoring location 3787 under the Well Abandonment and Replacement Program (WARP). A vented transducer was installed in bedrock piezometer P207789 and attached to the data logger at nearby monitoring location P207689 to evaluate potential bedrock-alluvium water level fluctuations in this area. The data logger malfunctioned and was removed on July 14, 1993. Surface-vented pressure transducers were used to alleviate the need to correct alluvium water level elevations for barometric pressure variation.

Hydrographs of alluvium water level elevations collected using automated data loggers are presented on Figures II 3 3-41 through II 3 3-44. Daily precipitation data are also shown on these figures. The precipitation data were obtained from the RFETS meteorological station.

Generally, hydrographs for monitoring well 2286 and 2686, and piezometers 41193 and P207689 (Figures II 3 3-41 through II 3 3-44, respectively) show a spring wetting cycle followed by a drying period. Only wells 2286, 2686, and P207689 hydrographs appear to correlate to precipitation events. The hydrograph for monitoring location 41193 (Figure II 3 3-43) shows a continual decline and no apparent response to precipitation events. Two periods of precipitation were specifically evaluated to determine if infiltration of precipitation occurs at OU4.

II.3.3.5.2 Water Table Response to Precipitation

Data obtained from the automated water level monitoring were used to evaluate potential water table responses to precipitation in the alluvium. TM1 proposed using neutron probe data, lag times between precipitation events, and water table elevation fluctuations to identify the mechanism of water movement through the vadose zone. Precipitation data (inception time, total precipitation, and duration), coupled with potential responses of the alluvium water table, were used to estimate vertical hydraulic conductivity for selected locations. Site-specific precipitation data were obtained from RFETS and are believed to be representative of OU4 site conditions. Generally, monitoring well hydrographs 2286, 2686, 41193, and P207689 (Figures II 3 3-41 through II 3 3-44, respectively) show water table elevation increases during spring precipitation events followed by a summer through fall drying period, resulting in decreased water level elevations.

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Two periods of precipitation were used to evaluate infiltration. The first period examined was March 26 through April 17, when 2.3 inches of total precipitation were recorded. This period represents a series of precipitation events that were often greater than 0.2 inches/day. This first precipitation period was preceded by a dry period of low precipitation and frequency in February and early March, 1993. The second precipitation period evaluated was a three-day event that occurred between June 16 and June 18, 1993. Approximately 1.6 inches of total precipitation fell in three days, followed by approximately one month of dry conditions. These two precipitation periods were evaluated for monitoring wells 2286, 2686, and 41193. Water level data were not recorded at monitoring location P207689 during the first and second precipitation periods due to data logger malfunctions, although the water table at P207689 appears to increase approximately 0.5 feet in response to precipitation events occurring between May 9 and May 12, 1993. Because the first and the second precipitation periods occurred as several separate events, neither period is ideal for examining the movement of wetting fronts or estimating hydraulic conductivities.

For the first precipitation period, alluvium water table elevations increased 1.2, 1.7, and 2.3 feet at monitoring wells 2286, 2686, and 41193, respectively. These alluvium water table responses occurred following about 2.3 inches of total precipitation between March 26 and April 17. At monitoring location 2286, the datalogger was not in operation until March 31, so the water table elevation increase from the precipitation event that started on March 26 may have been larger than was recorded. Although the datalogger was in place for monitoring location 2686, the water table elevation shows no trend reversal associated with the first precipitation period.

Monitoring location 2286 (Figure II 3 3-41) appears to be most sensitive to precipitation events, while piezometer 41193 (Figure II 3 3-43) is least sensitive. Monitoring location 2286 is installed in an area of clayey gravels to well-graded gravels with little fines, while piezometer 41193 is installed in silty gravel.

If it is assumed that precipitation events cause the water table to rise, the hydraulic conductivity of the water-bearing stratum can be calculated using the lag time between the inception of precipitation and the initiation of water table rise. Lag times could not be calculated between precipitation onset and a possible water table response for 2286 and 2686 monitoring wells. However, for 41193 there is a water table elevation trend reversal for which a lag time can be calculated. The depth to the water table is approximately 5.4 feet. The lag time between onset of precipitation of March 26, 1993, and the water table elevation reversal is approximately 4 days. Assuming that this precipitation event caused the water table to rise, the hydraulic conductivity calculated is 4.8×10^{-4} cm/s at this location.

A water table response to a precipitation event that occurred on June 17, 1993, was recorded at monitoring locations 2286 and 2686. The event produced 1.57 inches of precipitation in three days and appears to have offset declining water level trends in both hydrographs. Alluvium water level elevation increases of 1.08 feet and 0.23 feet were recorded in locations 2286 and 2686, respectively. These increases are smaller than the increases recorded during the

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spring precipitation event The lag time between the start of the second precipitation event and the water table response appears to be approximately 8 hours at monitoring location 2286, and 24 hours at location 2686

As a result of the water table response to precipitation evaluations, three general mechanisms of infiltration and subsequent recharge of the alluvium are suggested

- Uniform areal infiltration through the vadose zone interstitial soil pore space,
- Rapid localized percolation through macropores, and
- Localized recharge occurring in limited areas where runoff ponds in drainages or depressions

Recharge at the site probably consists of a combination of these processes

Generally, interstitial flow is characterized as flow through intergranular pores within the soil matrix This flow mechanism is described by the Richard's equation (see below) for unsaturated flow in a porous medium,

$$\frac{\partial \theta}{\partial t} = - \frac{\partial}{\partial z} \left(K \frac{\partial \Psi}{\partial z} \right) - \frac{\partial K}{\partial z}$$

where K is the hydraulic conductivity relative to the moisture content θ , t is time, Ψ is the matric potential, and z is the vertical direction Richard's equation is analogous to Darcy's equation for flow in a saturated porous medium

Macropore flow occurs in materials that have dual porosity Dual porosity can be viewed as a network of macropores within a less permeable interstitial soil matrix Macropores may be represented by a wide variety of soil structures, such as desiccation cracks, root channels, rodent holes, and manmade features

Localized recharge may occur in areas where the hydraulic properties of the soil, such as hydraulic conductivity, and topography are more conducive to vertical movement These conditions may occur naturally or they may be due to manmade features such as drainage depressions, buried utilities, or construction fill with high hydraulic conductivities Drainage depressions can collect more water than is provided through natural precipitation These depressions provide a potential reservoir of water that can infiltrate and recharge ground water Areas with buried utilities and construction fill can have higher hydraulic conductivities due to excavation and subsequent refilling with materials whose bulk density is less than the soils removed, or filled with gravel and sand that have a much higher hydraulic conductivity than the native material

Generally, recharge dominated by interstitial flow through clayey soils would be characterized by relatively long lag times between precipitation and water table responses, while macropore infiltration would be characterized by shorter lag times. Because of the low hydraulic conductivities at the site, macropore flow probably is the predominant recharge mechanism.

The near-surface alluvium that governs interstitial flow for monitoring locations 2286, 2686, and 41193 are similar, in that they are primarily coarse-grained soils. Although the soils are similar in texture, they are not representative of RFA throughout OU4. To a depth of the approximate water table at monitoring location 2286, the alluvium is composed of clayey gravels to well-graded gravels with few fines. At monitoring location 2686, the alluvium is composed of poorly-graded gravels to poorly-graded sands. The alluvium at piezometer location 41193 is composed of silty gravels to well-graded gravels.

Guelph permeameter field-saturated hydraulic conductivities (K_{fs}) for alluvial gravels similar to soils surrounding the data logger monitoring locations range from less than 1.0×10^{-6} to 1.1×10^{-3} cm/s (Section II 3 3 3 2). Laboratory measured K_{fs} values of RFA and associated soils have a broader range. Using the K_{fs} geometric mean of 5.8×10^{-3} cm/s for the three sandy soil samples (Section II 3 3 4 1), the calculated time of arrival for infiltrating precipitation ranges between two and ten hours, depending upon the water table depth. Calculated infiltration travel times for the RFA clay- and silt-rich soils, using a K_{fs} geometric mean of 1.0×10^{-6} cm/s (Section II 3 3 4 1), yields arrival times between about 2 and 7 years for infiltration to travel to depths of 2 and 7 ft bgs. Site-specific data indicate that water table responses to precipitation events range between 8 and 24 hours at the data logger monitoring locations. The discrepancies between the calculated and the actual arrival times is probably accounted for by the heterogeneities present within the RFA.

If precipitation percolates on an areal basis through the vadose zone, as data suggest for the coarse-grained alluvium at these monitoring locations, it should also infiltrate but at a much slower rate in the fine-grained RFA.

Approximately one-half of the neutron probes were installed in alluvium that generally is finer-grained and has a lower hydraulic conductivity than materials surrounding the data logger monitoring locations. Neutron moisture profiles obtained approximately one month after the second precipitation event showed no evidence of a downward-moving wetting front at any of the neutron monitoring locations. Evidence of significant wetting front movement was not observed at any of the neutron probe monitoring locations. Detection of macropore flow with the neutron probe would have required essentially continuous monitoring to measure the anticipated rapid increase and decrease in moisture as the infiltration moved through the macropore.

II.3.3.5.3 Alluvium Water Level Measurements

Alluvium water level elevations were collected at wells and piezometers within the OU4 area between March 31, 1993 and September 20, 1993. Water level measurements are currently

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monitored at most of the monitoring wells and piezometers in OU4. The purpose of collecting additional alluvium water level data within OU4 was to better determine the thickness, configuration, extent, and fluctuations of the vadose zone than was previously evaluated using RCRA alluvium monitoring program data. Three alluvium water level data sets comprise the 1993 alluvium water level monitoring program for OU4. These data sets are the RCRA quarterly water levels, the automated water level measurements, and the additional manual alluvium water level elevations. This section will examine fluctuations in the alluvium water table using these data.

Figure II 3 3-45 shows locations monitored during the 1993 alluvium water level monitoring program, and the alluvium and bedrock wells that were considered as part of the Upper HSU. Historical and 1993 quarterly alluvium water level measurements from the RCRA alluvium monitoring program were also obtained from RFEDS. Historical and 1993 alluvium water level elevations were integrated to produce long-term hydrographs. Hydrographs and water level elevation data for the alluvium water levels monitored in 1993 and composite historical hydrographs are presented in Appendix II T.

Alluvium water level elevations collected between March and October, 1993, demonstrate a water table fluctuation ranging from a decrease of 9.4 feet to an increase of about 4 feet. The maximum decrease of 9.4 feet was measured at monitoring location 46293 which is approximately 200 feet north of SEP 207-A. Here the spring water table was 1.7 feet above ground level, indicating artesian conditions. The maximum increase of about 4 feet was measured at monitoring location 46393 near the ITS in the northern buffer zone. Not all wells and piezometers were monitored for the entire duration but their high and low water level values are similar to historical values.

Figure II 3 3-46 shows the distribution of the ground water fluctuations recorded during the 1993 alluvium water level monitoring program. Two areas of declining water level are depicted, one approximately 200 feet east and one approximately 200 feet north of the SEPs, where alluvium water level fluctuations of approximately 6 and 9 feet occurred, respectively. In the immediate area of the SEPs, ground water fluctuations are relatively stable, generally fluctuating by about 3 feet or less.

In the ITS area, monitoring location 46393 increased in water elevation by approximately 4 feet. This piezometer was the only one to show an increasing water level trend and suggests a localized source of recharge, perhaps a leaking portion of the ITS. This monitoring location is also in close proximity to a mapped slump block scarp. The scarp may also act as a localized pathway for alluvium waters. Monitoring location 46393 was selectively positioned downgradient of an interceptor drain to evaluate the effectiveness of the ITS.

Several areas were dry throughout the monitoring program, while other areas were initially saturated and became dry during the summer. Specifically, piezometer 41993 located just west of SEP 207-C was wet in March and dry in October. Four of the five piezometers clustered approximately 400 feet northeast of SEP 207-B North were continuously dry.

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throughout the monitoring period. The ITS is assumed to be effective in draining these topographically higher locations. The only wet monitoring location of the five, piezometer 44893, is situated in a bedrock low as depicted in refraction seismic Line 7. Monitoring location 44893 is wetter because flow may be occurring along a small bedrock paleo-channel identified on Line 7.

Two other piezometers, 45593 and 46093, also were continuously dry during the monitoring period. Both piezometers are within the PA and approximately 250 feet north of the SEPs. These piezometers were installed as push well points and may provide questionable data since the well screen may have been smeared with clay during installation. Since the data from these piezometers are questionable, both piezometers are not considered in any of the ground water level maps. Table II 3 3-20 provides a summary of the 1993 fluctuations recorded.

A comparison of the water level fluctuations was made by dividing the water level fluctuation by its duration period. This value represents the hydraulic conductivity of the soil in the interval of the water table decline. Although these values are assumed to be relative they are calculated over various time periods within the 1993 alluvium water level monitoring program and thus received slightly differing amounts of precipitation. Some of the time periods lasted the entire measurement period while other time periods were early in the alluvium water level measurement period, prior to the well going dry. Despite these varying time periods, most calculations were made during the initial water level decline when most of the precipitation occurred, or were averaged over the majority of the monitoring period. Most of the hydrographs appeared to decline at a uniform rate (Appendix II T).

Figure II 3 3-47 depicts two zones of relatively high hydraulic conductivity. These two zones nearly coincide with the maximum fluctuation zones shown in Figure II 3 3-46. The maximum relative hydraulic conductivity is approximately 8.2×10^{-5} cm/s at monitoring location 45793. Monitoring location 45793 is approximately 200 feet north of SEP 207-C. The second zone is centered about the northeastern corner of SEP 207-B South and has a hydraulic conductivity of 3.1×10^{-5} cm/s. The central portion of the OU4 area, including most of the SEPs, in a trend from southwest to northeast, has relative hydraulic conductivities that are less than 1.0×10^{-5} cm/s. In the ITS area, alluvium water levels are controlled by the artificial drains, limiting the water level fluctuations. Due to this artificial control, the relative hydraulic conductivities are less than 1×10^{-5} cm/s (Figure II 3 3-47).

Several of the monitoring locations that were dry during the 1993 alluvium water level monitoring program are within the ITS area and are shown with hydraulic conductivities of zero which represents a dry monitoring location. Additionally, the two push well points (45593 and 46093) also are represented by zero hydraulic conductivity even though they are adjacent to the highest relative hydraulic conductivity area.

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II.3.3.5.4 Alluvium and Upper HSU Ground Water Hydrographs

Manual alluvium and bedrock water level elevations made in 1993 are incorporated with the RCRA historical water levels as hydrographs. These hydrographs and the water level measurement data are presented in Appendix II T. A summary of the historical alluvium water level elevations, including 1993 elevations, are presented in Table II 3 3-21. Table II 3 3-21 presents historical minimum, maximum, and average water level elevations and the range of water level fluctuations.

Historical alluvium water level measurements exhibit water table fluctuations ranging up to 9.4 feet, and an average of 2.5 feet, throughout OU4. The maximum fluctuations of 9.4 and 9.03 feet, were measured at monitoring locations 46293 and B208789, respectively. Monitoring location 46293, discussed previously, is approximately 200 feet north of SEP 207-A, while monitoring location B208789 is approximately 800 feet north of SEP 207-C in the buffer zone along North Walnut Creek. The historic minimums are represented by dry wells.

Monitoring locations P209989 and 76192 are both dry wells that are screened in fine-grained soils. Monitoring location P209989 is located approximately 600 feet north of SEP 207-C within the North Walnut Creek drainage and adjacent to the ITS. Monitoring location 76192 is located approximately 800 feet east of SEP 207-B Center and outside the PA. Other dry wells were installed in 1993, mainly within the confines of the ITS.

Figure II 3 3-48 shows the distribution of the absolute magnitudes of the historical alluvium water level fluctuations. These fluctuations are comparable with the 1993 alluvium water level fluctuations, although some of the historical magnitudes are slightly greater. The greatest differences are within the North Walnut Creek drainage basin. Along North Walnut Creek, monitoring locations B208789 and 1386 have historical fluctuations of 9.03 and 7.4 feet, respectively. Adjacent to SEP 207-A, monitoring location 2686 has a historical water level fluctuation 2.1 feet greater than the observed 1993 fluctuation of 0.8 feet. Adjacent to the 207-B Series SEPs, the historical water level fluctuation is about 8.1 feet. This fluctuation area is approximately 200 feet east of SEP 207-B South. At monitoring location 2286, just south of SEP 207-C, the historical fluctuation is 5.8 feet and the 1993 fluctuation is 1.6 feet. This fluctuation difference of 4.2 feet results in an additional high fluctuation area that did not appear on the 1993 alluvium ground water fluctuation map (Figure II 3 3-46). The highest fluctuation observed is 9.4 feet and is located approximately 200 feet north of SEP 207-A. With the historical data included, a zero fluctuation area is projected beneath SEP 207-A. This area is coincident with a bedrock high underneath the central portion of SEP 207-A (Figure II 3 5-6).

II.3.3.5.5 Potentiometric Surfaces

For the purposes of describing the OU4 water table configuration, spring and fall 1993 potentiometric maps from Upper HSU elevation data were prepared (Figures II 3 3-49 and II 3 3-50). Water level data nearest the 15th of April and the 15th of September 1993 were chosen for presentation, where possible. Both maps reflect Upper HSU potentiometric surfaces.

at these approximate times. Water level data used to prepare these maps were obtained from the OU4 Phase I RFI/RI water level measurement program and water level data from the RFEDS data base where appropriate.

Figures II 3 3-49 and II 3 3-50 were generated using the above-mentioned water level data. Figures II 3 3-49 and II 3 3-50 depict contoured areas where ground water is present and absent in the RFA. The top of bedrock is considered the lower limit of ground water in the RFA. These areas are depicted as "dry alluvium" which is designated by a stipple pattern, and "saturated alluvium" which shows potentiometric contours. The dry alluvium areas were calculated by intersecting the Upper HSU potentiometric map surface with the top of bedrock surface. The dry alluvium areas represent areas where the Upper HSU water table elevation is below the top of bedrock. Alluvium wells that were dry during these periods occur within these dry alluvium areas. The intervening saturated alluvium areas are approximately coincident with the paleotopographic channels present on the bedrock surface and represent areas where ground water probably is flowing in the RFA.

Figure II 3 3-49 depicts the April 1993 Upper HSU potentiometric surface for OU4. April 1993 was selected to represent the high water table, even though maximum water table elevations were not necessarily recorded in all wells during that period. Similarly, a low water table map is presented as Figure II 3 3-50, and reflects the Upper HSU potentiometric surface for September 1993. Figure II 3 3-50 was selected to represent the low water table, however, all wells did not exhibit the lowest water table elevation during that period. The major difference between the April and September 1993 potentiometric surfaces is that the extent of dry alluvium areas are larger in September because the ground water typically are about 3 to 5 feet lower in the fall.

Both figures (Figures II 3 3-49 and II 3 3-50) show a similar configuration to the potentiometric surface. OU4 is situated on the crest of a ground water divide that directs ground water flow to the north, east, and south. Ground water flows generally north-northeast toward North Walnut Creek, and east toward the confluence of North and South Walnut Creeks. During high water levels in the spring, ground water elevations range from about 5965 ft msl beneath the SEPS to about 5837 ft msl along the lower reaches of North Walnut Creek. Similar ranges in ground water level elevations are present during September (Figure II 3 3-50), but the elevations average about 3 to 5 feet less.

The April and September 1993 potentiometric maps are consistent in water level elevation with the 1992 RCRA alluvium water level maps (DOE, 1992) for the second and third quarters. However, the primary difference between these maps and the RCRA maps occurs in the interpretation of the dry alluvium areas and the areas of channelized alluvium ground water flow.

II.3.3.5.6 Water Table Fluctuations Adjacent to the SEPs

To estimate water table fluctuations adjacent to the SEPs a comparison of the historical alluvium maximum and minimum water level elevations was conducted. Figure II 3 3-48 shows

the results of these comparisons. Generally, most of the wells and piezometers adjacent to the SEPs have only been monitored since 1989, thus the fluctuations do not represent the extremes that may have occurred during the operational life of the SEPs

As Figure II.3 3-48 depicts, in the area adjacent to the SEPs, an approximate 6-foot water level fluctuation in the alluvium water table is common, with a maximum fluctuation of approximately 9 feet. These larger fluctuations may not be representative of fluctuations that might occur under the SEPs, but are localized anomalies outside of the SEP areas. The least amount of alluvium water table fluctuation is at the southern ends of SEPs 207-A and 207-B South, where less than 3 feet of fluctuation is common. In this area, the maximum fluctuation is 4.2 feet and it occurs at monitoring well 3787 on the eastern berm of SEP 207-B South.

SEP 207-A

Surrounding SEP 207-A piezometers 41693, 42993, 43893, and 43993, have alluvium water level fluctuations of 0.4, 1.9, 1.4 and 1.4 feet, respectively. Piezometer 41693 is 100 feet south of the northeastern corner, 42993 is on the western side, 43893 is adjacent to the southwestern corner, and 43993 is adjacent to the southeastern corner of SEP 207-A. Combining these fluctuation values with nearby historical fluctuations generates a decreasing trend surface toward the center of SEP 207-A because of the lack of well control in this area. Although depicted as a null fluctuation area in the center of SEP 207-A, this area may fluctuate by 2-to-3 feet as does monitoring well 2686 on the southeastern corner of SEP 207-A. At the southern end of SEP 207-A at piezometer 43893, the maximum alluvium ground water elevation is also projected to be within 4 feet of the base of the SEP liner.

SEPs 207-B North, Center, and South

Minimum depths to the water table beneath the SEPs were estimated and the results are listed in Table II 3 3-22. Minimum Upper HSU water table depth occurs beneath the southwestern corner of SEP 207-B South where the ground water table is at the base of the SEP liner, while at the southern end of SEP 207-B South at monitoring well 3887, the maximum alluvium ground water elevation is 0.7 feet higher than the base of the SEP liner. Water levels beneath SEPs 207-B Center and North are about 5 feet below the base of the liner.

SEP 207-C

The maximum Upper HSU water table depth occurs beneath the northern portion of SEP 207-C where the water table is as much as 20 feet, or more, below the bottom of the SEP. South of SEP 207-C historical alluvium fluctuations of 5.8 feet are found in monitoring location 2286. This value is similar to Arapahoe Sandstone water level fluctuations found in monitoring locations 41993 and 42393 on the western side of SEP 207-A. Limited well control around SEP 207-C limits the accuracy of the water depth prediction in the area.

Beneath the northern portion of SEP 207-C, The Arapahoe Sandstone subcrops and effectively desaturates the RFA. Piezometers 41993 and 42393 on the western side of SEP 207-C confirm that the water table occurs within the sandstone at a maximum elevation of approximately 5,972 ft msl or a projected depth of about 6 feet beneath the pond liner. South of SEP 207-C, at monitoring well 2286, the maximum alluvium water table elevation is projected to be within 4 feet of the base of the pond liner.

Effect of Draining SEP 207-A

An evaluation of the historical alluvium and bedrock hydrographs was conducted to determine if alluvium water levels have been affected by the draining of SEP 207-A in 1992, or if the fluctuations were typical for the site. The closest wells with historical alluvium water level data to SEP 207-A were evaluated. The hydrograph for alluvium monitoring well 2686, located near the southeastern corner of SEP 207-A, shows no effects of SEP 207-A being drained. Although its maximum ground water elevation in 1993 was less than in 1992, it is still higher than in previous years 1988, 1989, and 1991. The minimum ground water elevation value for the winter of 1992-1993 is similar to the elevation observed during the 1990-1991 winter. Alluvium monitoring well 3887, situated south of SEP 207-B South, also shows no effects from the draining of SEP 207-A. The closest wells with historical bedrock water level data to SEP 207-A were evaluated. The hydrographs for bedrock monitoring wells P208989, P209889, and 3086, located near the northeastern corner of SEP 207-A, shows an additional one-half foot lower water elevation since SEP 207-A was drained. Monitoring well P208889, located near the northeastern corner of SEP 207-B North, also shows about one-half foot lower water elevation. These downgradient wells may be reflecting the effects of draining SEP 207-A. Water table fluctuations from upgradient bedrock monitoring wells P210189, P209189, and P209389 are all within their historical variations.

II.3.3.5.7 Vadose Zone Thickness

To understand the range of vadose zone thickness across the OU4 site, the minimum thickness of the vadose zone at OU4 was estimated by subtracting the maximum Upper HSU potentiometric map from the 1986 topographic map. The resulting isopach map is depicted in Figure II 3 3-51. Similarly, the maximum vadose zone thickness was estimated by subtracting the minimum Upper HSU potentiometric surface from the 1986 topographic map to produce the isopach map shown in Figure II 3 3-52. Both vadose zone isopach maps identified areas that are characterized by very thin vadose zones around the SEPs and thicker areas within the North Walnut Creek drainage.

Figure II 3 3-51 depicts the minimum thickness of the vadose zone. During maximum Upper HSU water table conditions, vadose zone thickness ranges from approximately zero, at seep locations and beneath the southwestern corner of SEP 207-B South, to greater than 20 feet. Potential seeps occur north of SEP 207-A and 207-C, 207-B North, east of SEP 207-B Center and along portions of North Walnut Creek. Thick vadose zone areas occur at the northern edge of SEPs 207-A and 207-C, and approximately 500 feet north of SEP 207-A.

Figure II 3.3-52 depicts the maximum vadose zone thickness during low water table in the Upper HSU. Vadose zone thickness ranges from approximately zero to greater than 25 feet. Thin vadose zone areas and seeps occur in the vicinity of piezometer 46293, approximately 200 feet north of SEP 207-A, near piezometer 41993 approximately 50 feet west of SEP 207-C, and near monitoring well B208089 approximately 500 feet northeast of SEP 207-B. North. Thick vadose zone areas occur at the northern edge of SEPs 207-A and 207-C, and approximately 500 feet north of SEP 207-A.

II.3.3.6 Chemical Properties of the Vadose Zone

Chemical properties of the vadose zone were characterized to allow a determination of the distribution of potential contaminants in the RFA and associated soils and pore water, the ability of the vadose zone soils to retard contaminant movement, and to support risk assessment activities. The distribution of contaminants in vadose zone soils is presented in Section II 3 3 4. Discussion of chemical parameters, such as cation exchange capacity, and the results of pore water analyses are discussed below.

II.3.3.6.1 Cation Exchange Capacity (CEC)

Cation exchange is the interchange between a cation in solution and another cation on the surface of any surface-active material. Cation exchange in most soils occurs on clay minerals and organic matter. Cation exchange capacity (CEC) is a laboratory measure of the sum total of exchangeable cations that a soil can adsorb. CEC is expressed in units of milliequivalents per 100 grams of soil (meq/100g soil).

Clays have a highly variable CEC, ranging from less than 10 for oxide clays to over 100 for 2:1 clays (swelling clays), such as montmorillonite. The amounts and kinds of cations adsorbed are significantly affected by cation valence and hydrated ionic radius. Cations with a greater valence are adsorbed more strongly than cations of a lower valence. A cation with the smallest hydrated ionic radius is more strongly adsorbed. For some of the more common exchangeable cations, the cation replaceability series is usually $Al > Ca > Mg > K > Na$. Table II 3 3-23 shows the range of CEC values presented in the literature for selected clay and oxide minerals.

CEC was determined for 25 RFA soil and bedrock samples using EPA Method 9081A (EPA, 1990). Method 9081A is applicable to most soil and rock materials, including calcareous and noncalcareous soils. In Method 9081A, a soil sample is mixed with an excess of sodium acetate solution, resulting in an exchange of the added sodium ions for the soil matrix cations. Subsequently, the sample is washed with isopropyl alcohol. An ammonium acetate solution is then added, which replaces the adsorbed sodium with ammonium. The concentration of displaced sodium is then determined by atomic adsorption, emission spectroscopy, or an equivalent analytical method.

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The results of the CEC determinations are presented in Table II 3 3-24. The results are reported in milliequivalents sodium per 100 grams (meq Na/100g) of soil. Soils from the RFA exhibit CEC values between 2 and 66 meq Na/100g. The average CEC for these materials is 30 meq Na/100g. Soils from the bedrock strata exhibit CEC values between 13 and 51 meq Na/100g. The average CEC for these materials is about 39 meq Na/100g. The lowest CEC values measured were from sandy soil or rock types. In a recent EPA document (EPA, 1992), CEC ranges were quantitatively defined as follows:

CEC Range (meq Na/100g soil)	Description
< 12	Low
12 - 20	Medium
> 20	High

Using the EPA classification presented above, the CEC of most of the soil and bedrock lithologies analyzed during this investigation can be categorized as high. Because of the high CEC, the RFA and associated soils beneath the SEPs have a high capacity to sorb and retard cation movement. Since the total organic carbon (TOC) content (Section II 3 3 6 3) of the RFA and associated soils is generally low, CEC is probably associated with the clay mineral fraction of the soils. A comparison of the RFA soil CEC values with those presented in Table II 3 3-23 suggests that the predominant clay mineral in the RFA is illite.

Figure II 3 3-53 shows CEC versus depth bgs. No apparent relationship exists between CEC and depth since CEC exhibits a wide range of values at shallow depths. Figure II 3 3-54 is a graph showing the relationship between CEC and clay content. CEC appears to be directly related to clay content as anticipated. This figure also suggests that the clays present in the RFA sorb more strongly per volume percent than the clays comprising the bedrock lithologies. However, bedrock lithologies appear to be slightly more sorptive on average than the RFA.

II.3.3.6.2 Soil Electrical Conductivity

Soil electrical conductivity (EC) is a measure of the total salt/solute content of a soil sample. EC is the ratio of the electrical current density to the electrical field in the soil and is expressed as milligrams of potassium chloride per kilogram of soil (mg KCl/kg soil). Soil EC, total ionic concentration, and osmotic pressure are positively correlated and can be related to important effects on soil properties.

EC has been quantitatively characterized by the EPA (1992) as follows:

Electrical Conductivity (percent total salt content)	Description
< 0.1 %	Nonsaline
0.1% - 0.15 %	Slightly Saline
0.15 % - 0.35 %	Moderately Saline
0.35 % - 0.70 %	Very Saline
> 0.70 %	Extremely Saline

Electrical conductivity (EC) was determined for the 25 soil and bedrock samples selected for chemical properties analysis. EC was determined using a 1:1 soil/water extract as presented in Rhoades (1986). The results of the EC determinations are presented in Table II 3-3-24. Soils from the RFA exhibit EC values between 57 and 8600 mg KCl/kg soil (0.01% and 0.86% total salt as KCl). The average EC for these materials is 1559 mg KCl/kg soil (0.16% total salt as KCl). EC values in this range are representative of nonsaline to extremely saline soils (EPA, 1992). Average EC value for RFA and associated soils are representative of moderately saline conditions at OU4.

Soils from the bedrock strata exhibit EC values between 130 and 3100 mg KCl/kg soil (0.01% and 0.31% total salt as KCl). The average EC for these materials is about 1681 mg KCl/kg soil (0.17% total salt as KCl). EC values in this range are representative of nonsaline to moderately saline soils (EPA, 1992). Average EC value for RFA and associated soils are representative of moderately saline conditions. Figure II 3-3-55, a graph of EC versus depth bgs, suggests that EC does not vary with depth, but does indicate that bedrock lithologies typically have a higher salt content than the RFA.

II.3.3.6.3 Total Organic Carbon (TOC)

Total Organic Carbon (TOC) is natural material of plant or animal origin that decays in the soil to form humus. Humus and other organic carbon materials are an important component of soils and rocks because of their high sorptive capacity which retards potential contaminant movement. TOC concentrations are characterized by the EPA (1992) as follows:

Total Organic Content (percent)	Description
< 2 %	Sparse
2 % - 4 %	Moderate
> 4 %	Abundant

Total organic carbon was determined for the 25 soil and bedrock samples selected for chemical properties analysis. The results of the TOC analyses are presented in Table II 3 3-24 in parts per million (ppm). TOC was determined using ASTM Method D2579-85. Soils from the RFA exhibit TOC values between 0.01 and 1.40 percent. The average TOC for these materials is 0.46 percent. Soils from the bedrock strata exhibit TOC values between 0.03 and 0.21 percent. The average TOC for these materials is about 0.09 percent. RFA and associated soils typically have higher concentrations of TOC than bedrock lithologies, however, both units are classified as having sparse TOC concentrations according to the EPA classification presented above.

Figures II 3 3-56 through II 3 3-58 show the relationship between TOC and depth, clay content, and CEC, respectively. No apparent relationship exists between TOC and depth. However, these figures indicate that TOC concentrations in the RFA are greater than bedrock lithologies. TOC concentrations do not vary with clay content in the RFA. A correlation between clay content and TOC content may be present for bedrock lithologies. This correlation may be expected since higher clay contents in the Arapahoe Formation indicate deposition in a quiet environment where organic carbon could accumulate more readily. The Arapahoe Formation is known to contain small coal seams.

Figure II 3 3-58 suggests that CEC and TOC are directly related since an increase in TOC concentration for both the RFA and bedrock lithologies results in a higher CEC. This relationship is expected since the total CEC of soils is related to sorption on mineral species as well as organic carbon.

II.3.3.6.4 Soil Gas Survey

A soil gas survey was primarily conducted in the vicinity of SEP 207-C to determine if volatile organic constituents are present in the subsurface. The results of the soil gas survey are presented in Table II 3 3-25. Figure II 3 3-59 shows the location of the soil gas sampling locations. Results of the survey included detection of carbon tetrachloride at four locations, trichloroethene (TCE) at one location, and perchloroethene (PCE) at one location. The concentrations of TCE and PCE detected were less than one microgram per liter ($\mu\text{g/L}$). Carbon tetrachloride was detected at concentrations up to 2.4 $\mu\text{g/L}$. The locations where these compounds were detected generally overlie an area where these constituents have been detected in ground water. The VOCs detected do not appear to be sourced from the SEPs, since VOCs generally were not detected in the vadose zone soil laboratory analyses.

II.3.3.6.5 Pore Water Analyses

Pore waters were collected from single and dual lysimeters installed in the vadose zone at 15 locations in OU4. The locations of the lysimeters are shown on Figure II 3 3-60. The suite of parameters analyzed during each sampling round varied depending upon the quantity of pore water obtained during sampling. Analysis of constituents was prioritized according to the priority analyte list presented in TM1, and listed in Table II 3 3-26.

Summaries of the results of pore water field analyses are presented in Table II 3 3-27. Results of the chemical parameter classes are presented in Tables 3 3-28 through 3 3-32. Pore water results for some of the PCOCs and other parameters are shown on Figures II 3 3-61 through II 3 3-71. The constituent maps presented in these figures and in the following discussion include both PCOCs and other constituents. The data are summarized on these figures using the concentration mean and range detected during the six-month lysimeter sampling program. The data discussions presented below included only validated results. The complete suite of lysimeter pore water analytical results is presented in Appendix II V.

Pore water samples from some of the lysimeters were not obtained because the location was dry or because the lysimeter was damaged. Pore water samples were never obtained from locations 40293 and 40593. The lower lysimeter at location 44093 was apparently damaged during installation and was not sampled. The lower lysimeter at location 40993 appears to be completed in the saturated zone and the pore water samples obtained represent a measure of ground water quality at that location.

Numerous chemical constituents were detected in the pore water samples. However, the following discussion is limited to the vadose zone soil PCOCs that were found in the pore water samples. Since regulatory standards are not available for pore waters, the pore water constituent concentrations were compared with the background RFA ground water quality data established for RFETS. The pore water data were compared to the 99 percent UTL established in the Background Geochemical Characterization Report (EG&G, 1993). Figures II 3 3-61 through II 3 3-71 show the mean and range of concentrations of the PCOC constituents. The figure also indicates the number of samples used to calculate the mean and the number of samples comprising the range. The mean is calculated using only concentrations above the detection limit.

Barium

Barium was detected in both the upper and lower lysimeter pore water samples. Barium was also detected in the laboratory method blank and may reflect laboratory contamination. Barium concentrations in the upper lysimeter pore waters ranged between not detected and 1,470 $\mu\text{g/L}$. Concentrations of barium in the lower lysimeter pore waters ranged between not detected and 976 $\mu\text{g/L}$. The highest concentration of barium was detected in the upper lysimeter at location 43693 and in the lower lysimeter at location 43193. Pore waters from the upper lysimeters at 40993, 43193, and 43693 exceeded the 99 percent UTL of 208 $\mu\text{g/L}$ for background RFA ground water. Pore water samples from the lower lysimeters at 40993 and 43193 exceeded the 99 percent UTL of 208 $\mu\text{g/L}$. Pore water from the lower lysimeter at 40993 probably represents ground water quality since the lysimeter appears to be installed in the saturated zone. Figure II 3 3-61 shows the mean and range of barium concentrations in vadose zone pore waters.

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Cadmium

The distribution of cadmium in vadose zone pore waters is limited. Cadmium was only detected in the upper lysimeter at location 41593 and in the lower lysimeter at location 43193. Cadmium concentrations in the upper lysimeters ranged between not detected and 53.9 $\mu\text{g/L}$. Cadmium in the lower lysimeters ranged between not detected and 23.6 $\mu\text{g/L}$. Cadmium was detected in the upper lysimeter at location 41593 (beneath SEP 207-A) at a concentration of 54 $\mu\text{g/L}$. Cadmium was detected in the lower lysimeter at location 43193 at a concentration of 6 $\mu\text{g/L}$. A 99 percent UTL has not been developed for cadmium in RFA ground water. Figure II 3 3-62 shows the mean and range of cadmium concentrations in vadose zone pore waters.

Lithium

Lithium is found in both the upper and lower lysimeters, however, its distribution is limited to lysimeters located beneath SEP 207-A. Lithium was also found in the laboratory method blank and may result from laboratory contamination. Lithium concentrations in the upper lysimeters ranged between not detected and 2,710 $\mu\text{g/L}$. The highest lithium concentrations in the upper lysimeters were observed at locations 41593, 43193, and 43693 which are located beneath SEP 207-A. Lithium concentrations in the lower lysimeters ranged between not detected and 990 $\mu\text{g/L}$. The highest concentrations were observed in lower lysimeters 42493 and 43193. These lysimeters are also located beneath SEP 207-A. None of pore waters exceeded the 99 percent UTL of 76 $\mu\text{g/L}$ for background RFA ground water. Figure II 3 3-63 shows the mean and range of lithium concentrations in vadose zone pore waters.

Zinc

Zinc is found in both the upper and lower lysimeters at locations generally beneath SEP 207-A. Zinc concentrations in the upper lysimeters ranged between not detected and 106 $\mu\text{g/L}$. The highest zinc concentrations in the upper lysimeters occurred at locations 41593, 43693, and 43793. The locations are either under or adjacent to SEP 207-A. Zinc concentrations in the lower lysimeters ranged between not detected and 51.3 $\mu\text{g/L}$. The highest zinc concentrations in the lower lysimeters occurred at locations 40993, 43193, and 43793. Lower lysimeter 40993 appears to be installed in the saturated zone and the pore water quality probably is representative of ground water quality. None of the zinc concentrations exceeded the 99 percent UTL of 245 $\mu\text{g/L}$ for background RFA ground water. Figure II 3 3-64 shows the mean and range of zinc concentrations in vadose zone pore waters.

Nitrate/Nitrite

Nitrate/nitrite is probably the most widely distributed contaminant in the vadose zone at OU4. Samples of pore water were most frequently analyzed for nitrate/nitrite during the sampling events since it was selected as the first priority analyte. Nitrate/nitrite was analyzed for as many as five sampling events at some locations. Figure II 3 3-65 shows both the mean and range of nitrate/nitrite concentrations detected at each lysimeter location. In general,

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nitrate/nitrite concentrations are highest for pore waters from both the upper and lower lysimeter locations adjacent to or beneath the SEPs

The maximum concentration of nitrate/nitrite detected in pore water from the upper lysimeter locations was at location 43693. The maximum concentration detected at that location was 4,446 milligrams per liter (mg/L or parts per million [ppm]) and averaged 3,317 mg/L. Similar concentrations also were detected at upper lysimeter locations 40993 and 41593. Lysimeters 41593 and 43693 are completed beneath SEP 207-A. Upper lysimeter 40993 is completed adjacent to the berm on the northern side of SEP 207-C.

Nitrate/nitrite concentrations in lower lysimeter pore waters are highest at location 43193 where concentrations range up to 1,340 mg/L and average 1,190 mg/L. Lower lysimeter 40993 has an average nitrate/nitrite concentration of 12,770 mg/L, and ranges between not detected and 17,600 mg/L. As mentioned above, this lysimeter is completed in the saturated zone and the sample probably is a measure of ground water quality.

Many of the upper and lower lysimeters exceeded the 99 percent UTL of 3.2 mg/L for background RFA ground water. Concentrations exceeding the 99 percent UTL for nitrate/nitrite were anticipated for the pore waters because of the high solubility of these compounds. Concentrations of nitrate/nitrite in vadose zone soils and pore waters are similar, which suggests that the nitrate/nitrite is primarily contained in the soil moisture.

Gross Alpha

Gross alpha was detected at seven of the lysimeter locations. Gross alpha activities in the upper lysimeter pore waters ranged between not-detected and 3,329 picocuries per liter (pCi/L). Upper lysimeter 43693 exhibited the highest gross alpha activity of 3,329 pCi/L. The gross alpha activity in pore waters from five of the upper lysimeters (40993, 41593, 43193, 43693 and 43793) exceeded the 99 percent UTL of 13.3 pCi/l for background RFA ground water. All of these lysimeters are located beneath or adjacent to the SEPs.

Gross alpha activity in pore waters from the lower lysimeters ranged between not detected and 6,300 pCi/L. Lower lysimeter 40993 exhibited the highest gross alpha activity of 6,300 pCi/L. Pore water from this location probably represents a measure of ground water quality. Gross alpha activity in pore water from the lower lysimeters at 40993, 42493 and 43193 exceeded the 99 percent UTL of 13.3 pCi/L for background RFA ground water. Lysimeter 40993 is located north of SEP 207-C and lysimeters 42493 and 43193 are located beneath SEP 207-A. Figure II 3-3-66 shows the mean and range of gross alpha activities in vadose zone pore waters.

Gross Beta

Gross beta activity was detected at nine of the lysimeter locations. Gross beta activities in upper lysimeter pore waters ranged between not detected and 1,925 pCi/L. Upper lysimeter

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43693 exhibited the highest gross beta activity of 1,925 pCi/L. Gross beta activity in pore water from upper lysimeters at 40993, 41293, 41593, 43193, 43693 and 43793 exceeded the 99 percent UTL of 15.5 pCi/L for background RFA ground water. These lysimeters are located adjacent to or beneath the SEPs.

Gross beta activity in pore waters from the lower lysimeters ranged between about 8 and 5,400 pCi/L. Lower lysimeter 40993 exhibited the highest gross beta activity of 5,400 pCi/L. Pore water from this location probably represents ground water quality. Gross beta activity in pore water from lower lysimeters at 40993, 42493, 43193 and 43793 exceeded the 99 percent UTL of 15.5 pCi/L for background RFA ground water. Lysimeter 40993 is located north of SEP 207-C, the other lysimeters are located beneath SEP 207-A. Figure II 3 3-67 shows the mean and range of gross beta activities in vadose zone pore waters.

Tritium

Tritium was detected at three of the lysimeter locations (40993, 43193, and 43793). Tritium activity in the upper lysimeter pore waters ranged between not detected and 6,318 pCi/L. Tritium activities generally are highest for pore waters from upper lysimeter locations. Upper lysimeters 40993, 41593, and 43693 exhibited tritium activities of 2,000 pCi/L, 2,163 pCi/L, and 6,318 pCi/L, respectively. Tritium activity in pore water from upper lysimeters at 40993, 41293, 41593, 43193, 43693, and 43793 exceeded the 99 percent UTL of 1,387 pCi/L for background RFA ground water.

Tritium was detected in pore water at lower lysimeters 40993, 43193, and 43793. The range of tritium activity is between not detected and 5,600 pCi/L. Lower lysimeter 43193 exhibits the highest tritium activity of 5,600 pCi/L. Tritium activity in pore water from lower lysimeters at 40993, 42493, 43193, and 43793 exceed the 99 percent UTL of 1,387 pCi/L for background RFA ground water. Lysimeter 40993 is located north of SEP 207-C, the other lysimeters are located beneath SEP 207-A. Figure II 3 3-68 shows the mean and range of tritium activities in vadose zone pore waters.

Uranium-233/234

Uranium-233/234 was detected at both the upper and lower lysimeters. Uranium-233/234 was also detected in the laboratory method blank. Elevated uranium-233/234 activities generally occurred beneath or adjacent to the SEPs. Uranium-233/234 activities in the upper lysimeters ranged between 0.11 and 733 pCi/L. The highest activity occurred in pore water from lysimeter 43693. Uranium-233/234 activity in pore water from upper lysimeters at 41593, 42893, 43193, 43693, 43793, and 44393 exceeded the 99 percent UTL of 2.83 pCi/L for background RFA ground water.

Uranium-233/234 activities in the lower lysimeters ranged between 0.48 pCi/L and 3,400 pCi/L. The highest activity 3,400 pCi/L occurred at location 40993. Pore water from the lower lysimeter at 40993 may represent ground water quality at that location. Uranium-233/234

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activity in pore water from lower lysimeters at 40993, 42493, and 43193 exceeded the 99 percent UTL of 2.83 pCi/L for background RFA ground water. Figure II 3 3-69 shows the mean and range of uranium-233/234 activities in vadose zone pore waters.

Uranium-235

Uranium-235 was detected in pore water from both the upper and lower lysimeters. Uranium-235 was also detected in the laboratory method blank. Uranium-235 activities in pore water from the upper lysimeters ranged between not detected and 47 pCi/L. The highest uranium-235 activity occurred at upper lysimeter 43693 which is situated beneath SEP 207-A. Uranium-235 activity in pore water from upper lysimeters at 41593 and 43693 exceeded the 99 percent UTL of 2.83 pCi/L for background RFA ground water.

Uranium-235 activities in pore water from the lower lysimeters ranged between 0.18 and 120 pCi/L. The highest activity occurred at location 40993 which is a lysimeter completed in the saturated zone. Lysimeter 40993 is located north of SEP 207-C. Pore water from this location probably is a measure of ground water quality. Uranium-235 activity in pore water from lower lysimeters at 40993, 42493, and 43193 exceeded the 99 percent UTL of 2.83 pCi/L for background RFA ground water. Figure II 3 3-70 shows the mean and range of uranium-235 activities in vadose zone pore waters.

Uranium-238

Uranium-238 was detected in pore water from both the upper and lower lysimeters. Uranium-238 was also detected in the laboratory method blank. Uranium-238 activities in pore water from the upper lysimeter locations ranged between 0.075 pCi/L and 671 pCi/L. The highest activity occurred at locations 41593 and 43693. Both of these lysimeters are completed beneath SEP 207-A. Uranium-238 activity in pore water from upper lysimeters at 41593, 42893, 43193, 43693, and 43793 exceeded the 99 percent UTL of 2.83 pCi/L for background RFA ground water.

Uranium-238 activities in pore water from the lower lysimeters ranged between 0.57 and 3,700 pCi/L. The highest activity occurred at locations 40993, 42493, and 43193. Lysimeter 40993 is located north of SEP 207-C and is completed in the saturated zone. Lysimeters 42493 and 43693 are located beneath SEP 207-A. Uranium-238 activity in pore water from lower lysimeters at 40993, 42493, and 43193 exceeded the 99 percent UTL of 2.83 pCi/L for background RFA ground water. Figure II 3 3-71 shows the mean and range of uranium-238 activities in vadose zone pore waters.

II.3.3.6.6 Column Leaching Tests

In order to assess contaminant partitioning between soil and water under controlled, laboratory conditions, column leaching tests were conducted using contaminated soils from OU4 to assess the mobility of nitrate, and to estimate the relative volume of infiltrating water required.

to flush this relatively mobile contaminant from soils. Nine samples of surface and RFA and associated soils were collected from beneath SEP 207-A and from downgradient seepage areas for use in these column leaching tests. One additional sample of 16-40 mesh Colorado silica sand was used as a blank column.

Soil samples were disaggregated and packed into PVC cylinders to enable a leaching solution to flow through the samples under pressure. Leachate was subsequently collected for analysis. Column leaching tests were conducted by Core Laboratories, Inc. of Aurora, Colorado based on ASTM Method D4874 - *Standard Test Method for Leaching Solid Waste in a Column Apparatus*. Leaching solutions were designed to approximate the composition of rainwater, thereby simulating natural infiltration conditions. Ten pore volumes were collected from seven of the 10 columns and analyzed. Water flow through three of the columns was limited because of the low soil hydraulic conductivities or possibly bacterial growth in the columns.

Leachate was analyzed for nitrate, as well as pH, specific conductance, and major cations and anions. Flow rates through the columns were anticipated to be equivalent to approximately 10 cm/day. Permeability changes in many of the columns prohibited attaining flow rates of this magnitude, however, resulting in lower flow rates and longer test durations than anticipated. As a result, testing of three of the columns was terminated prior to collection of the planned 10 pore volumes. Test methodology, results, and conclusions are discussed in detail below.

Column Leaching Test Method

Nine soil samples were collected in stainless steel core sleeves from the OU4 area for use in the column leaching tests. A description of the samples collected is provided in Table II 3 3-33. Six samples were collected from borings penetrating the vadose zone beneath SEP 207-A. Three samples were collected from seepage areas on the hillside located north of SEP 207-A. One sample of 16-40 mesh Colorado silica sand, routinely used at RFETS as sand filter pack in monitoring well and piezometer installations, was submitted for construction of a blank column.

Column leaching tests were conducted in accordance with ASTM Method D4874 - *Standard Test Method for Leaching Solid Waste in a Column Apparatus*. Columns were constructed using 6-inch lengths of 1-inch or 2-inch diameter clear Schedule 40 PVC tubing and end slip caps. One-inch diameter tubing was used for columns 5, 6, 7, and 8 where poor core recovery or the presence of large pebbles precluded availability of sufficient granular material to completely fill a 2-inch column. Flow distribution disks and end support plates were constructed of open cell polyethylene. All construction materials were decontaminated prior to use by washing with laboratory detergent and triple-rinsing with deionized water.

Samples were removed from the core sleeves and gently disaggregated, minimizing drying of the soil. Large pebbles were removed from the samples. An aliquot of the soil was retained for determination of specific gravity, moisture content, and nitrate concentration. Sample mass required to pack each column to the field bulk density was determined, so that the

bulk density of sample in the packed column would be equivalent to the bulk density of the sample core. The columns were packed with sample in five layers using a non-metallic tamping tool, and each layer was scored prior to adding the next lift.

The columns were saturated in a backflow mode using argon-pressurized distilled water. Pore volumes calculated from sample specific gravity and column volume were verified by monitoring the volume of fluid required to saturate the sample. The rate of saturation was visually monitored, and attempts were made to adjust flow to achieve a linear flow rate of approximately 10 cm/day. For the 6-inch columns, saturation would ideally have been achieved over a period of 36 hours. Subsequently, one pore volume could then be collected every 36 hours. This flow rate was only achieved in columns 1, 7, 8, and 10. The permeability in the remaining columns was insufficient to attain the desired flow rate under fluid pressures of 4 to 8 atmospheres. Flow rates achieved in each column, and corresponding test durations, are presented in Table II 3 3-34.

Analysis of the distilled water leach fluid indicated a pH of 5.67, with undetectable nitrate and specific conductance. The first pore volume collected from each column was analyzed for major cations, major anions, nitrate, pH, and specific conductance. Subsequent pore volumes 2, 3, 5, and 10 were analyzed for nitrate, pH, and specific conductance. Pore volumes 4, 6, 7, 8, and 9 were collected and retained for possible later testing. After termination of the leaching portion of the study, the leached soils were removed from their columns and analyzed for nitrate.

Results

Results of the column leaching tests are presented in Appendix II W, and summarized in Tables 3 3-34 through 3 3-37. Flow through columns 5 and 9, described as greenish-gray clayey sandstone and green-gray claystone, respectively, decreased dramatically following saturation, and only one complete leachate pore volume was collected from each column during the 16-week test duration. Soil in columns 1 and 3, which was collected from the seepage area on the slope north of SEP 207-A, initially contained less than 10 mg/kg nitrate. These low initial nitrate concentrations were insufficient for determination of a distinct leaching profile for these columns. Similarly, column 10, the blank prepared with Colorado silica sand, contained low to nondetected nitrate concentrations in both soil and leachate.

Eight to 10 pore volumes were collected from columns 2, 4, 6, 7, and 8. These five columns contained detectable nitrate concentrations in the initial soil and in the leachate. Nitrate, pH, and specific conductance results are summarized in Table II 3 3-35, and presented in Figures II 3 3-72 through II 3 3-75. Nitrate concentration and specific conductance decrease with each pore volume passed through the columns. As shown in Table II 3 3-36, leachate water quality in pore volume 1 ranged from a predominately calcium-sodium bicarbonate type for low nitrate soils and low dissolved solids leachate, to a sodium nitrate-type water for high nitrate soils and higher dissolved solids leachate. These differences reflect the impact of SEP waters on the vadose zone soils.

Both the initial leachate concentration and the number of pore volumes required to decrease leachate concentrations below specific concentration thresholds appear to be directly related to the initial nitrate concentration in soil, as shown in Figure II 3 3-72 and Table II 3 3-37. A similar trend is evident in the specific conductance results, as shown in Figure II 3 3-73. The correspondence between these two parameters suggests that specific conductance may be controlled primarily by nitrate concentration. Figure II 3 3-74 demonstrates, however, that this correlation is only evident for specific conductance above 1,000 to 2,000 $\mu\text{mhos/cm}$ at 25°C. Measurements of leachate pH increased in some columns during the duration of the test, but decreased in others, as shown in Figure II.3 3-75. No apparent cause for these disparate trends was noted.

Final nitrate concentrations were measured in the soils following collection of leachate pore volume 10. The nitrate concentration was uniformly below 10 mg/kg, with most soils retaining less than 1 mg/kg nitrate. A nitrate mass balance was calculated to determine whether the nitrate collected in leachate was sufficient to explain the observed decrease in soil concentrations. Subtraction of final soil nitrate mass and the nitrate mass leached from the soil in each pore volume would be equal to the initial soil nitrate mass, assuming conservation of nitrate during the column test. Table II 3 3-38 presents the results of this nitrate mass balance calculation. Initial and final nitrate masses in each column were calculated as the product of dry soil weight and soil nitrate concentration, while nitrate removed with each leachate pore volume was calculated as the product of pore volume and leachate nitrate concentration. Nitrate concentrations for leachate pore volume 4, and for pore volumes 6, 7, 8, and 9, were estimated as the mean nitrate concentrations of pore volumes 3 and 5, and 5 and 10, respectively.

Results of the mass balance calculation indicate that 33 to 111 percent of the nitrate present in the initial soil was detected in the leachate and final soil analyses (Table II 3 3-37). Loss of nitrate is most likely the result of nitrate reduction and/or denitrification occurring under anaerobic conditions within the columns. Columns were pressurized using inert argon gas, allowing oxygen to be consumed by bacteria present in the soils. The two soils with the highest initial nitrate concentrations, columns 6 and 9, also experienced a rapid loss of permeability, possibly due to bacterial growth. Several soils removed from the columns were described as odoriferous by the analyst, verifying the presence of reducing conditions. Following consumption of oxygen, nitrate is reduced through bacterial activity to either ammonium ion (NH_4^+) or nitrogen gas (N_2).

Major ion equivalent balances for pore volume 1 show a deficiency of cationic species in six of the seven leachates containing nitrate. The presence of ammonium, a positively charged ionic species which was not analyzed in leachate, is presumed to account for this apparent ion imbalance. For leachates where nitrate was absent, the sum of anionic species and cationic species measured on an equivalent basis agreed within 1 percent of each other.

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Interpretation

The results of the column leaching tests indicate that nitrate can be readily leached from OU4 soils into ground water by either natural or induced infiltration provided that uniform intergranular flow is established. Investigations of infiltration in the OU4 area have indicated, however, that recharge to the water table occurs primarily through local disturbed features and macropores present within the vadose zone. These mechanisms imply that infiltrating water contacts only a limited fraction of vadose zone soils before reaching the water table. While nitrate in or adjacent to these macropores and disturbed features will be leached from the soils, nitrate in surrounding regions not in direct contact with the infiltrating water will be retained in intergranular pore water and bound to the unsaturated soil by soil matric potential. This retained nitrate will remain a potential source of ground water contamination, to be mobilized by surface disturbance and unusual precipitation or high water table conditions.

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II.3.4 Subsurface Soil and Bedrock Analytical Results

This section presents the results of the subsurface soil and bedrock PCOC analyses from samples collected during the OU4 Phase I RFI/RI Section II 4, Nature and Extent of Contamination, provides a detailed analysis of the occurrence of these PCOCs Table II 3 4-1 lists the PCOCs detected in OU4 Figure II 3 4-1 is a map showing the locations of the boreholes from which samples were collected Figures II 3 4-2 through II 3 4-61 show the analytical results of individual PCOCs by depth intervals In general, these figures show the analytical results for samples that were collected from within the 0-6 foot depth interval, the 6-12 foot depth interval, and all results collected at depths greater than 12 feet For those samples that straddled the respective intervals, the results are posted in the interval from which the majority of the sample was collected Specific sample collection depth intervals are reported next to each result

For the figures pertaining to inorganic and radionuclide PCOCs, the results that are posted in red exceed their respective background concentrations that were calculated as the 95 percent upper confidence limit from background data presented in the 1993 Background Geochemical Characterization Report (EG&E, 1993) For the figures pertaining to the organic PCOCs, results that are posted in black are either not-detected or estimated results (those qualified with "J", meaning the concentration was estimated above the instrument detection limit but below the CRQL) Results in red are detections without the "J" qualifier Appendix II N provides a complete list of all subsurface soil and bedrock chemical analytical results

Multiple results are posted at the locations beneath the SEPs for each particular interval referenced in the figures because two sampling plans were followed for collecting the subsurface samples The samples from beneath the SEPs were collected according to the following plan

Composited over 2 feet intervals 2 feet below ground and every other 2 feet, and one sample from bedrock	Radionuclides, TAL metals
Composited over 4 feet intervals	Volatile organics
Composited over 6 feet intervals	Nitrate
	Semivolatile organics, pesticides, PCBs, cyanide, sulfide

Samples from the remaining boreholes outside the SEPs were composited over 6-foot intervals, with the exception of volatile organic compounds, which were collected at discrete 2-foot intervals Since most of the boreholes were terminated at the top of bedrock, many of the samples collected consist of composites that were less than six feet in length

II.3.4.1 Non-Radiological Inorganic Potential Contaminants of Concern

This section presents the results of the subsurface soil and bedrock analyses for the non-radiological inorganic PCOCs A summary of the analytical results is presented in Table II 3 4-2 Although calcium, manganese, potassium, and sodium were identified statistically to be

PCOCs, they were not mapped because they are common rock-forming elements that are naturally-occurring at relatively high concentrations. Section II.4, Nature and Extent of Contamination, provides a detailed analysis of the occurrence of these PCOCs.

Barium

The subsurface analytical results for barium are presented graphically on Figures II 3 4-2 through II 3 4-4 and are listed in Table II 3 4-3. Barium was detected in all borehole samples analyzed (136 total), and the results ranged from 9.7 mg/kg to 4,150 mg/kg. Of the 136 samples analyzed, 51 exceeded the background concentration of 93.9 mg/kg and are posted on the figures in red. The highest concentration was detected in a sample from a depth of 10 to 13 feet at borehole 43693 in the southern part of SEP 207-A. There does not appear to be a consistent pattern to the distribution of barium in the subsurface, but a general increase in concentration with depth proximal to the SEPs is suggested by the data.

Cadmium

The subsurface analytical results for cadmium are presented graphically on Figures II 3 4-5 through II 3 4-7 and are listed in Table II 3 4-3. Cadmium was detected in 28 of the 136 samples analyzed (21 percent), and the detections ranged from 1.1 mg/kg to 547 mg/kg. Twenty-one of the samples exceeded the calculated background concentration of 2.3 mg/kg and are shown on the figures in red. As can be seen in the figures, the locations where cadmium exceeds background are directly beneath the SEPs and immediately north of SEP 207-A and SEP 207-B North at the drainage tile outfall. Cadmium was not detected in samples collected from below 12 feet.

Cyanide

The subsurface analytical results for cyanide are presented graphically on Figures II 3 4-8 through II 3 4-10 and are listed in Table II 3 4-3. Cyanide was detected in 18 of 94 samples analyzed (19 percent), and the detections ranged from 0.525 mg/kg to 43 mg/kg. Cyanide was not analyzed in the background samples, and all detections are posted on the figures in red. Cyanide was detected primarily in the immediate vicinity of the SEPs, however, a few sporadic detections are observed north of the SEPs and in the buffer zone. The highest concentrations of cyanide occur immediately beneath the SEPs in the 0-6 foot depth interval.

Lithium

The subsurface analytical results for lithium are presented graphically on Figures II 3 4-11 through II 3 4-13 and are listed in Table II 3 4-3. Lithium was detected in nearly all of the samples analyzed (134 out of 136), and the detections ranged from 2.6 mg/kg to 79.9 mg/kg. None of these detections, however, exceeded the calculated background concentration of 83.2 mg/kg.

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Nitrate/Nitrite

The nitrate/nitrite (as nitrogen) analytical results are presented on Figures II 3 4-14 and II 3 4-15 and in Table 3 4-3. Nitrate is detected in nearly all the samples analyzed (109 out of 110), and concentrations ranged from 0.0 (this result was validated and not qualified as non-detected) to 6,100 mg/kg. Of the 109 detections, 72 exceeded the calculated background concentration of 7.1 mg/kg. Nitrate is broadly distributed in OU4 soils, but the highest concentrations occur in the 0-6 foot depth interval immediately beneath the SEPs and at the water table both in the vicinity of the SEPs and in the buffer zone.

Zinc

The subsurface analytical results for zinc are presented graphically on Figures II 3 4-16 through II 3 4-18 and are listed in Table II 3 4-3. Zinc was detected in all of the samples analyzed, and the detections ranged from 7.2 mg/kg to 168 mg/kg. Seventy-eight of the samples exceeded the calculated background concentration of 23.64 mg/kg and are shown on the figures in red. Zinc is broadly distributed throughout OU4 above background concentrations, but there is no discernable pattern to the distribution, either horizontally or vertically. The highest zinc detection (168 mg/kg) is found in the 0-5 foot interval at borehole 44393 located south of OU4. The second highest concentration detected (160 mg/kg) is found in the 47.6 to 50.2 foot interval of borehole 44193 located south and east of OU4. There is no apparent correlation between the zinc concentrations detected and proximity to the SEPs, but as with barium, a general increase in zinc concentrations with depth is suggested by the data.

In summary, some of the inorganic, non-radiological PCOCs appear to be elevated, either beneath or in close proximity to the SEPs, with concentrations that appear to decrease with depth. Nitrate is broadly distributed throughout OU4, but the highest concentrations occur immediately beneath the SEPs and at the water table both in the vicinity of the SEPs and in the buffer zone. Cyanide was detected primarily in the immediate vicinity of the SEPs, however, sporadic detections above background occur in the buffer zone. The highest cyanide detections occur immediately beneath the SEPs in the 0-6 feet depth interval. The locations where cadmium exceeds background are directly beneath the SEPs and immediately north of SEP 207-A and SEP 207-B North at the drainage tile outfall. No samples from beneath 12 feet exceeded the detection limit for cadmium. Lithium was determined to be a PCOC by statistical methods but was not detected above background concentrations in any samples from OU4. Barium and zinc do not appear to have any apparent correlation with proximity to the SEPs, but a general trend of increasing concentrations of barium and zinc is suggested by the data.

II.3.4.2 Radionuclide Potential Contaminants of Concern

This section presents the results of the subsurface soil and bedrock analyses for the radiological PCOCs. A summary of the analytical results is presented in Table II 3 4-2, and a complete listing of these results is presented in Table II 3 4-4. Section II 4, Nature and Extent of Contamination, provides a detailed analysis of the occurrence of these PCOCs.

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Americium-241

The americium-241 analytical results are presented on Figures II 3 4-19 through II 3 4-21 and in Table II 3 4-4. Americium-241 was detected in 78 of the 96 samples analyzed (81 percent), and concentrations ranged from 0.0017 pCi/g to 6.1 pCi/g. Fifty of the detections exceeded the calculated background concentration of 0.01 pCi/g. The highest concentrations of americium-241 are found in the uppermost six feet of soil immediately beneath the SEPs and berms. Detections above background are also found throughout the total lengths of some boreholes, including borehole 40993 north of SEP 207-C, where americium-241 is detected at a depth of 31 to 35 feet.

Cesium-134

The cesium-134 analytical results are presented on Figures II 3 4-22 through II 3 4-24 and in Table II 3 4-4. Cesium-134 was detected in 49 of the 90 samples analyzed (54%), and concentrations ranged from -0.0013 pCi/g to 0.01 pCi/g. Negative results are not unusual for radionuclide analyses and indicate that the result is below the calibrated background for the testing equipment. Cesium-134 was not analyzed in background soils. There does not appear to be any discernable pattern to the distribution of cesium-134 in the subsurface, either horizontally or vertically.

Cesium-137

The cesium-137 analytical results are presented on Figures II 3 4-25 through II 3 4-27 and in Table II 3 4-4. Cesium-137 was detected in 91 of 96 samples analyzed (95 percent) and concentrations ranged from -0.0378 pCi/g to 0.42 pCi/g. Only two of the detections exceeded the calculated background of 0.166 pCi/g. These occurred adjacent to the SEPs in the 0-6 foot interval in the berm between SEPs 207-A and 207-B Center, and just east of the berm for SEP 207-B North.

Gross Beta

The gross beta analytical results are presented on Figures II 3 4-28 through II 3 4-30 and in Table II 3 4-4. Gross beta was detected in all samples analyzed and concentrations ranged from 10 pCi/g to 55 pCi/g. Fifty-one of the 134 samples exceeded the calculated background of 27.99 pCi/g. Gross beta results above background are found throughout OU4, and there is little correlation of results with proximity to the SEPs.

Plutonium-239/240

The plutonium-239/240 analytical results are presented on Figures II 3 4-31 through II 3 4-33 and in Table II 3 4-4. Plutonium-239/240 was detected in 78 of 96 samples analyzed (81 percent) and concentrations ranged from -0.0028 pCi/g to 25 pCi/g. Thirty-seven of the detections exceeded the calculated background of 0.02 pCi/g. These lie predominantly in the

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0-6 foot interval beneath the SEPs Plutonium-239/240 was not detected above background below 12 feet

Radium-226

The radium-226 analytical results are presented on Figures II 3 4-34 through II 3 4-36 and in Table II 3 4-4 Radium-226 was detected in 82 of the 94 samples analyzed (87 percent) and concentrations ranged from 0 37 pCi/g to 6 838 pCi/g Fifty-nine of the detections exceeded the calculated background of 0 65 pCi/g All of the samples obtained from beneath SEPs 207-B North and Center exceeded background, compared with only about half of the samples from beneath SEP 207-A exceeding background All of the radium-226 analyses of samples from 12 feet below the SEPs exceeded background

Strontium-89/90

The strontium-89/90 analytical results are presented on Figures II 3 4-37 through II 3 4-39 and in Table II 3.4-4 Strontium-89/90 was detected in 66 of the 96 samples analyzed (69 percent) and concentrations ranged from 0 0139 pCi/g to 0 88 pCi/g Only 12 of the detections exceeded the calculated background of 0 54 pCi/g These lie beneath the SEPs

Tritium

The tritium analytical results are presented on Figures II 3 4-40 through II 3 4-42 and in Table II 3 4-4 Tritium was detected in 115 of the 133 samples analyzed (87 percent) and concentrations ranged from 63 97 pCi/L to 62,000 pCi/L Of the 133 samples analyzed, 102 detections exceeded the calculated background of 212 2 pCi/L The highest concentrations are found immediately beneath the SEPs in the 0-6 foot interval, however, elevated concentrations are also detected elsewhere in OU4 in the saturated zone, such as in the buffer zone

Uranium-233/234

The uranium-233/234 analytical results are presented on Figures II 3 4-43 through II 3 4-45 and in Table II 3 4-4 Uranium-233/234 was detected in 133 of the 134 samples analyzed (99 percent) and concentrations ranged from 0 242 pCi/g to 21 pCi/g Of the 133 detection, 125 exceeded the calculated background of 0 53 pCi/g The highest concentrations are found immediately beneath the SEPs in the 0-6 foot interval, however, elevated concentrations are also detected elsewhere in OU4 in the saturated zone, such as in the buffer zone

Uranium-235

The uranium-235 analytical results are presented on Figures II 3 4-46 through II 3 4-48 and in Table II 3 4-4 Uranium-235 was detected in 122 of the 134 samples analyzed (91 percent) and concentrations ranged from -0 0104 pCi/g to 0 87 pCi/g Of the 122 detections,

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33 exceeded the calculated background of 0.1 pCi/g. These are found primarily beneath the SEPs, with the highest concentrations occurring in the 0-6 foot interval.

Uranium-238

The uranium-238 analytical results are presented on Figures II 3 4-49 through II 3 4-51 and in Table II 3 4-4. Uranium-238 was detected in nearly all of the 134 samples analyzed (133 out of 134) and concentrations ranged from 0.39 pCi/g to 11.46 pCi/g. Of the 133 detections, 123 exceeded the calculated background of 0.63 pCi/g. As with the other uranium isotopes, the highest concentrations of uranium-238 are found beneath the SEPs, primarily in the 0-6 foot interval. All of the samples that are below background are found either at the perimeter of the SEPs or outside of OU4.

In summary, the radionuclide PCOCs are found at their highest concentrations beneath the SEPs, usually in the 0-6 foot interval. Some of the radionuclides (such as uranium-233/234 and uranium-238) exceeded background concentrations throughout the total depth of many of the boreholes. Strontium-89/90, plutonium-239/240, and americium-241 concentrations decrease to below background levels below 12 feet.

II.3.4.3 Organic Potential Contaminants of Concern

This section presents the analytical results for the organic PCOCs, which include acetone, bis(2-ethylhexyl)phthalate, methylene chloride, and toluene, from subsurface samples. These compounds were determined to be PCOCs because they were detected in greater than five percent of the samples analyzed (as further described in Appendix III A). Section II 4, Nature and Extent of Contamination, provides a detailed analysis of their occurrences.

Table II 3 4-2 includes summary statistics for these compounds. Table II 3 4-5 presents the analytical data for these compounds for each sample analyzed. Figures II 3 4-52 through II 3 4-61 present the results graphically. In these figures, non-detections and detections qualified with a "J" (estimated concentrations above the instrument detection limit, but below the CRQL) are shown in black. Detections that have no laboratory qualifiers are posted in red to differentiate them from estimated results.

Acetone

The analytical results for acetone in subsurface soil and bedrock samples are presented on Figures II 3 4-52 through II 3 4-54 and in Table II 3 4-5. Acetone was detected in 38 of 146 samples analyzed (26 percent), and the detections ranged from 8 µg/kg to 140 µg/kg. Detectable concentrations of acetone occur throughout OU4, including at depth in the buffer zone. Despite the widespread occurrence of acetone throughout the RFETS and the suspicion that it is a field- or laboratory-introduced contaminant, the highest detections do occur beneath the SEPs or berms surrounding them, which is described in further detail in Section II 4.

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Methylene Chloride

The analytical results for methylene chloride in subsurface soil and bedrock samples are presented on Figures II 3 4-55 through II 3 4-57 and in Table II 3 4-5. Methylene chloride was detected in 74 of 146 samples analyzed (51 percent), and the detections ranged from 1 $\mu\text{g}/\text{kg}$ to 71 $\mu\text{g}/\text{kg}$. Detectable concentrations of methylene chloride occur throughout OU4, including at depth in the buffer zone. It is suspected that methylene chloride is a field- or laboratory-introduced contaminant, because there is no discernable pattern to the distribution of methylene chloride in the subsurface, either horizontally or vertically, and it is found throughout the subsurface at the RFETS.

Toluene

The analytical results for toluene in subsurface soil and bedrock samples are presented on Figures II 3 4-58 through II 3 4-60 and in Table II 3 4-5. Toluene was detected in virtually all of the 146 samples analyzed (145 of 146), and the detections ranged from 2 $\mu\text{g}/\text{kg}$ to 1,200 $\mu\text{g}/\text{kg}$. Toluene is known to occur throughout the RFETS, as well as throughout OU4. There is no pattern to the distribution, either horizontally or vertically, and it is suspected that toluene is a field- or laboratory-introduced contaminant as discussed further in Section II 4. Additionally, most of the duplicate pairs collected and analyzed for toluene failed the Relative Percent Difference (RPD) test as discussed in Section II 3 6, Quality Assurance/Quality Control Results, thus casting doubts upon the accuracy and validity of the toluene analyses.

Bis(2-ethylhexyl)phthalate

The analytical results for bis(2-ethylhexyl)phthalate in subsurface soil and bedrock samples are presented on Figure II 3 4-61 and in Table II 3 4-5. Bis(2-ethylhexyl)phthalate was detected in 8 of 36 samples analyzed (22 percent), and the detections ranged from 38 $\mu\text{g}/\text{kg}$ to 5,300 $\mu\text{g}/\text{kg}$. Detectable concentrations of bis(2-ethylhexyl)phthalate do not appear to be related to SEP waste management activities because the detections typically occur at depth, and the highest concentration (and the only one not qualified with a "J") occurs south and east of OU4 at a depth of 41.6 to 47.6 feet below ground surface.

In summary, the organic PCOCs are widespread in OU4 and appear to have little relationship to the SEPs, with the exception of acetone. It is possible that acetone may be related to SEP waste management activities since the highest concentrations detected occur beneath the SEPs. Section II 4 discusses the presence of organics in the OU4 subsurface in greater detail, including the suspicion that these organics may be field- or laboratory-introduced contaminants.

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II.3.5 Geologic Investigation Results

This section presents the results of geologic investigations conducted within OU4 during the OU4 Phase I RFI/RI. The findings discussed in this section are based upon previous investigations, OU4 Phase I RFI/RI soil boreholes, and geophysical surveys. Figure II 3 5-1 shows the locations of the monitoring wells, boreholes, piezometers, and vadose zone monitoring locations (collectively referred to as boreholes) used in evaluating the subsurface geology at OU4.

Subsurface drilling was implemented at OU4 to determine the lateral and vertical extent of contaminants in the vadose zone. Data developed from the subsurface investigation will be used to assess the current and potential human health or environmental risk presented by soil contamination at the site. The data gathered were incorporated into a lithofacies and hydrogeologic model to predict current and future vadose zone migration pathways and rates of flow. The conceptual hydrogeologic model will be used to assess the potential impact of the vadose zone (pore water) contamination to ground water.

The hydrogeologic model accounts for spatial variations in flow rates caused by heterogeneities in sediment properties. Sediment properties such as grain size (particularly the fine-grained constituent), mineralogy, porosity, permeability, and macroporosity, are variables which control and cause hydraulic heterogeneities in the subsurface. The composition and stratigraphic distribution of sediment properties is controlled by depositional environment. Sediment properties of artificially placed sediments is solely controlled by their physical properties. The lithofacies model developed for OU4 relates the stratigraphic distribution and physical properties of sedimentary facies to depositional environment, and compares spatial trends in sediment properties to hydraulic parameters, such as hydraulic conductivity, transmissivity, and storativity.

The SEPs are proximal to the topographic surface and generally do not penetrate the water table. However, during periods of increased recharge, such as in the spring, the water table rises to a level that puts it in contact with the eastern side of SEPs 207-A and 207-B South. Contaminants are found in surrounding soils and/or have leached through the unsaturated zone into the subjacent unconfined aquifer. Thus, development of a depositional model that allows prediction of vadose zone contaminant pathways is essential to designing environmental restoration and remediation activities at OU4.

II.3.5.1 Distribution and Description of Surficial Geologic Units

This section identifies a textural-based facies model (lithofacies) for the Rocky Flats Alluvium, describes other surficial geologic units and summarizes the subcropping and shallow bedrock geology within OU4. The lithofacies model developed from the subsurface geologic data describes and graphically represents the nature and distribution of heterogeneities in the Rocky Flats Alluvium. These lithofacies are used to build conceptual models of alluvial facies.

which delineate large-scale trends and variances in unsaturated and saturated hydraulic conductivity

Surficial materials in the OU4 area consist of the Rocky Flats Alluvium, landslide and slump colluvium, valley fill alluvium, and artificial fill materials. These materials unconformably overlie the Arapahoe Formation bedrock, or in the case of the latter three, if not of sufficient depth, the Rocky Flats Alluvium. The spatial locations of these units were determined in part from a comparison of the OU4 surface topography in 1951 and 1986, and in part from borehole geologic data.

Figure II 3 5-2 displays the surface topography in 1951, prior to ground disturbance from installation of the security fence and the Interceptor Trench System (ITS). Surface elevations range from approximately 5981 feet to 5960 feet above mean sea level (msl) from west to east across the central portion of OU4, and from 5975 feet to 5890 feet above msl from south to north across the central portion of OU4. The area around the SEPs inside the PA fence is flat to gently sloping, the area north of the PA slopes at approximately 2 feet per foot (ft/ft) down into the North Walnut Creek drainage.

Probable slump block features are identified on Figure II 3 5-2, and are designated Slump-1 through Slump-4. These slump features may be the result of over-steepening along the pediment surface, exceeding the angle of repose due to incision by surface drainage and creeks. Conversely, these slump features may have resulted from construction of the SEPs. Figure II 3 5-3 displays the surface topography of the same area in 1986, after construction of the security fence and ITS. Figure II 3 5-4 is a comparative map of the 1951 and 1986 topographic surfaces. This map shows areas that may have been excavated or back-filled with artificial material since 1951.

Core samples from boreholes 44893 and 44993, in the vicinity of the ITS, contained fragments of claystone bedrock and plant roots intermixed with alluvial materials at depths up to 14 feet below the surface. These samples may signify landslide colluvial material or artificial fill materials from installation of the ITS. In either case, these deposits may have altered the drainage patterns of both surface runoff and ground water.

Based on these topographic and borehole data, previous studies (Woodward-Clyde & Associates, 1970), and sitewide surficial geologic mapping by the U S Geological Survey (Shroba and Carrara, 1994), the surficial materials map shown on Figure II 3 5-5 was prepared. This map shows that OU4 is located on a bedrock pediment surface covered by Rocky Flats Alluvium. Landslide and slump colluvial deposits are present on the hillside north of the SEPs area. Valley fill alluvium is present in the drainage of North Walnut Creek. Artificially-placed materials are present around and immediately beneath the SEPs.

II.3.5.1.1 Rocky Flats Alluvium

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The youngest aerially extensive stratigraphic unit at OU4 is the early Pleistocene (Nebraskan or Aftonian) Rocky Flats Alluvium. In some eastern plant site locations, outcrops of the slightly younger (Kansan or Yarmouth) Verdos and (Illoian or Sangamonian) Slocum Alluvium have been mapped (Epis and others, 1980, Weimer, 1973; Scott, 1960); however, these units are not present at OU4. The Rocky Flats Alluvium was deposited by highly unstable ephemeral and/or spasmodically active braided streams and debris flows. Deposition took place on a pediment within a coalescing alluvial fan/apron braidplain system. Coarse gravel was most likely deposited in channels by debris flows. Models depicting a depositional system of coalescing alluvial fans aggraded by debris flow and braided stream deposition suggest that sand and fine gravel were deposited in channels and along banks, forming natural levees, while silt and clay would commonly be found on floodplains and transverse and longitudinal bars.

Eastward-flowing streams dissected the Rocky Flats alluvial terrace in several locations. In a few locations, the erosional sub-alluvial pediment surface (unconformity) has been eroded, exposing the Late Cretaceous (Late Maastrichtian)- Early Tertiary (Early Paleocene) Arapahoe Formation and the Late Cretaceous (Mid to Late Maastrichtian) Laramie Formation.

The source of boulders and cobbles in the Rocky Flats Alluvium is the Precambrian igneous and metamorphic rocks which crop out in Coal Creek Canyon. These rocks are primarily quartzites, mica schists, quartz monzonites, and granodiorites. Other lesser constituent source rocks are the steeply east-dipping sedimentary formations exposed at the mouth of Coal Creek Canyon. Finer-grained clastics (sands, silts, and clays) are derived from the chemical and mechanical weathering of these crystalline rocks.

Alluvial sediments at OU4 are presumed to have been deposited in a medial-fan depositional environment based upon the following observations and assumptions. Mid-fan deposits commonly consist of a braided network of shallow channels with debris flow, water-lain, and some sheet flood deposits. Debris flows comprise interdigitated sheets with non-erosive basal contacts, or occupy channels cut by water flow. Water-lain deposits commonly show erosive, channeled contacts and internal stratification related to bedload transport or bedform migration. Sheet flood deposits accumulate due to spreading of sediment-laden water as it exits a stream channel and are generally thin, widespread sheets of sand and fine gravel. Although sheet flood deposits are found in the mid-fan position, they are most commonly located in the distal or "toe" of fan positions. Well developed channels, sieve deposits, and coarse debris flows are most common on the upper fan (near fanhead trench). This study indicates that a majority of the alluvial material at OU4 is the shallow braided network type.

Figure II 3 5-6 is a surficial materials (colluvium, alluvium, artificial fill) isopach map of the OU4 area. This map indicates that the current maximum thickness of the Rocky Flats Alluvium is approximately 15 feet. A comparison with Figure II 3 5-4 indicates that approximately 5 feet of Rocky Flats Alluvium has been removed from some OU4 areas. Therefore, the Rocky Flats Alluvium was probably no more than 20 feet thick at OU4 before commencement of plant activities.

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II.3.5.1.2 Lithofacies of the Rocky Flats Alluvium

A lithofacies classification was developed for OU4 that groups sediments with similar textural compositions. This lithofacies scheme assumes that texturally similar sediments were deposited by similar processes in a similar environment. This assumption seems valid since the alluvium is at least crudely stratified, and several trends and consistencies were noted during the logging process and subsequent data evaluation. Notable trends include a correlation between the bedrock surface elevation and basal alluvium sediment properties. Notable consistencies include stratigraphic and lateral associations between sediment type. The lithofacies classification was developed based on these observations and other textural criteria. The lithofacies classification developed is shown in Table II 3 5-1.

Physical criteria (composition) for each lithofacies shown in Table II 3 5-1 are listed in order of decreasing pertinence. The first two percentage ranges after "composition" (in bold-face type) are primary sedimentary criteria which are always true for materials categorized. The third percentage range after "composition" is violated only in the case of "maverick" sediments where the sediment cannot be classified another way without violating the primary criteria. For example, if a sediment contained 5 percent gravel, 60 percent sand, and 35 percent fines (silt and clay), it would be classified as the sandy lithofacies because the primary criteria are met, albeit the third compositional range is not. Placing this sedimentary unit into any other lithofacies would violate primary criteria.

Although there is a wide variation in composition of the Rocky Flats Alluvium, more than one classification was never possible following this criteria. The only sediments which could not be simply classified using this system would have to contain equal amounts of sand and fines in the range between 45 percent to 49 percent, and 0 percent to 9 percent gravel. Sediments with equal amounts of sand and fines in this narrow range were not encountered during this investigation.

This lithofacies classification, like the Unified Soil Classification System (USCS), is subdivided primarily by textural (grain size) parameters. Grouping of similar sedimentary facies cannot be accomplished using only the USCS system. However, since all drill core was initially logged using the USCS, the lithofacies system presented in Table II 3 5-1 incorporates USCS terminology. The USCS system is not applicable because it was not designed or intended to be used for geologic or hydrogeologic modeling. For this reason, USCS categories often overlap into more than one lithofacies. For example, a sediment categorized as a USCS "GC" containing 11 percent fines (silt and clay), 25 percent sand, and 60 percent gravel would be placed in the sandy gravel lithofacies, whereas a USCS "GC" containing 40 percent fines, 25 percent sand, and 35 percent gravel would be placed in the clayey gravel lithofacies. Two primary shortcomings of the USCS system for modeling purposes are noted below for those unfamiliar with it.

- A change of 1 percent in constituent grain size near the 50 percent total volume range (D_{50}) drastically changes how the sediment is classified. Additionally, a change of 1 percent at D_{50} does not drastically alter how the unit would be classified geologically or hydrogeologically and thus conceptually modeled.
- USCS units with more than 50 percent coarse material (fine sand [>0.75 mm] and coarser) but with an appreciable amount of fines ranging from ~12 percent to 49 percent are summarily classified as "SC"/"SM" or "GC"/"GM" depending on a greater sand or gravel constituent. This large variation in percent fines within any individual unit is not consistent with hydrogeological modeling objectives because this would allow orders of magnitude in variation for values of hydraulic conductivity within any given unit.

Geometries for each facies are also assigned in order to graphically represent and dimensionally model variances in heterogeneity, thereby illustrating the alluvial stratigraphy. Figure II 3 5-7 shows the locations of geologic cross-sections and the boreholes that were used in their construction. Figures II 3 5-8 through II 3 5-12 depict the spatial distribution of the alluvial lithofacies at OU4. Figures II 3 5-8 and II 3 5-9 are cross-sections drawn approximately parallel to dip direction. Figures II 3 5-10 through II 3 5-12 are cross-sections drawn approximately parallel to strike direction. All borehole and well logs used in the construction of these cross-sections are found in Appendix II I.

An unconformity representing a depositional hiatus greater than 60 million years separates the Rocky Flats Alluvium from the underlying Arapahoe and Laramie Formations. The "top of bedrock" surface (unconformity) upon which the Rocky Flats Alluvium rests is a nonplanar eroded mountain-front pediment. A pediment is defined as a gently inclined planate erosion surface carved in bedrock and generally veneered with fluvial gravels (Miall, 1985). It appears that the irregular, undulating nature of the pediment surface was controlled in part by stream incisement and subsequent deposition of the basal Rocky Flats Alluvium. Incised channels on the bedrock surface may represent an important influence on present-day ground water flow paths. Figure II 3 5-13 is a top-of-bedrock surface elevation map. This figure shows the undulating nature of the Rocky Flats Alluvium depositional surface and the location of incised bedrock channels. This bedrock surface elevation map was generated using borehole data and geophysical techniques described in Section II 3 5 3.

When alluvial material was first carried out of Coal Creek Canyon and onto the bedrock pediment surface by debris flow and other fluvial mechanisms, it was initially transported along and deposited in topographic lows and channels on the pediment surface. The lithologic relationships defined in the OU4 area are consistent with the nature (physical composition, geometry, and spatial location) of alluvial deposits documented by many investigators (Rust and Koster, 1984, Miall, 1981) using modern analogs. Therefore, if the described lithofacies are valid, it would be expected that channel deposits (cross-bedded gravelly sands and thalweg sandy gravels of the Sandy and Sandy Gravel Lithofacies) occur in lows and channels on the top of bedrock surface. In a similar fashion, overbank, levee, and crevasse-splay (Clay & Silt

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Lithofacies) deposits would be expected to occupy highs along the banks of channels, and linguoid and transverse bars (Clayey-Silty Lithofacies) would be expected in channels and along channel margins. If the described lithofacies classification system did not delineate depositional sediment packages (i.e. if USCS units were used), a random distribution of units would be expected.

Figure II 3 5-14 was constructed by plotting the alluvial lithofacies represented in the basal one foot of the Rocky Flats Alluvium on the bedrock surface elevation map. This map shows a definite order of lithofacies deposition. Sands are located in channel scours (top of bedrock lows), clays are located above and roughly parallel to channels where overbank deposits would be expected (top of bedrock highs), and clayey gravel and lithofacies containing re-worked bedrock occupy positions proximal to channel bends and where linguoid or transverse bars might be expected. Therefore, the physical, depositional, geometric, and spatial characteristics of the described lithofacies appear valid and can be correlated laterally and stratigraphically throughout OU4.

Figures II 3 5-8 through II 3 5-12 indicate that coarser Rocky Flats Alluvium with less silt and clay content, Sandy and Sandy Gravel Lithofacies, generally occur in central, south-central, and southwestern areas of OU4 (Figures II 3 5-8, II 3 5-10, II 3 5-11, II 3 5-12). Finer-grained sediments of the Clay & Silt Lithofacies, occur in northern and north-central areas of OU4 (Figure II 3 5-9, II 3 5-12). Northeastern and north-central areas contain matrix-supported gravels of the Clayey-Silty Lithofacies that are proximal to the surface, and clast-supported gravels of the Sandy Gravel Lithofacies at depth and in unconformable contact with the underlying bedrock (Figures II 3 5-8 and II 3 5-9). Poor borehole control in the southeastern portion of OU4 precludes any possible general assumptions about this area.

Although the areas surrounding the SEPs are mapped as "disturbed ground" (Figure II 3 5-5) and the berms which surround them consist of artificial fill, the subjacent alluvial material is Rocky Flats Alluvium. The Rocky Flats Alluvium beneath the SEPs consists largely of the Sandy and Sandy Gravel Lithofacies. The alluvium beneath the 207-B Series SEPs contains some fine-grained alluvium (Clay & Silt and Clayey-Silty Gravel Lithofacies) near the alluvium-bedrock contact, otherwise the alluvium is coarse-grained. The alluvium beneath SEP 207-A contains fine-grained alluvium (Clay & Silt and Clayey-Silty Gravel Lithofacies) in northern areas, whereas the alluvium in central and southern portions of SEP 207-A contain coarse-grained material. The alluvium beneath SEP 207-C is inferred to consist entirely of coarse-grained material (Sandy and Sandy Gravel Lithofacies) from borehole data obtained around its perimeter.

II.3.5.1.3 Landslide and Slump Colluvium

Landslide colluvium deposits have been identified along the banks of North Walnut Creek within the OU4 area by Woodward-Clyde & Associates (1970) and during the current U.S. Geological Survey (USGS) sitewide surficial geology mapping project (Shroba and Carrara, 1994). These landslides occur primarily in the upper bedrock claystones and involve downward

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and outward movement along curved slip planes. Landslides are recognized by a curved scarp at the top, a coherent mass of material downslope that may be rotated back toward the slip plane, and hummocky topography at the base. Landslide deposits are expressed in weakly consolidated, grass-covered slopes as bulges or low wavelike swells (EG&G, 1992e)

The slope between the inside of the security fence and the PA security road consists of landslide colluvium deposits that have been disturbed by construction activities and/or artificially filled. The area north of the SEPs to the security fence has been mapped and modeled as colluvium. Some of this material, proximal to the SEPs, may be Rocky Flats Alluvium. The remaining areas along the south bank of North Walnut Creek consist of landslide and slump colluvium that has also been disturbed by construction and/or artificially filled (Figure II 3 5-9, this study, Shroba and Carrara, 1994)

Four isolated bedrock slump-blocks are interpreted to be north of the SEPs. These slump blocks are shown on Figure II 3 5-2. The northernmost slump (labeled 2 on Figure II 3 5-2) is also depicted on Figure II 3 5-6 as an approximately 35-foot-thick deposit northeast of the PA security road. The characteristics of this slump-block are described by features observed in boreholes B208489, B208389, SP1487, 46393, 40193, and 46493. Boreholes B208389 and B208489 are interpreted to be within the toe of the slump-block. Figure II 3 5-15 is an idealized cross-section of a slump block. It shows colluvium and semi-consolidated "weathered" bedrock moving downslope along curved slip planes. Lithological descriptions from these borehole logs include bedrock slickensides, calcite-filled fractures (at 30 to 90 degrees), roots, and iron and manganese oxide stains. The northernmost slump (labeled 2 on Figure II 3 5-2) does have a thin subsurface soil cover (approximately 3 feet) that is interpreted to be toward the center of the slump block. Boreholes 46393, 40193, and 46493 are interpreted to be within the scarp, and have thicker subsurface soils (approximately 15 to 20 feet). Lithological descriptions from these boreholes include plant roots at approximately 14 feet, iron-oxide staining, caliche nodules, fractures from micro-fractures to badly broken core, and moist core material. Similar lithological descriptions are noted in borehole logs 46193 and 46293 which are associated with the slump block along the crest of the hill. Push-well point 46093, also associated with this slump block, has a thin subsurface soil (approximately 0.5 feet) that is interpreted to be indicative of a borehole position on top of a slump block. Boreholes 46193 and 46293 are interpreted to be near or in the scarp. Lithological descriptions from these boreholes include thicker subsurface soils (approximately 2 to 8 feet), iron oxide staining, argillaceous cement, calcite-filled fractures (10 to 40 degrees), and moist core material.

Other non-landslide colluvial material along slopes in OU4 were derived chiefly by smaller scale gravity slumping of the Rocky Flats Alluvium. Colluvium is primarily composed of fine-grained material, which coarsens in a downslope direction. Grain-size variations are the result of sorting associated with slope failure set in motion by frequent stream incisement.

II.3.5.1.4 Valley Fill Alluvium

Figure II.3.5-6 shows that the maximum thickness of valley fill alluvium is approximately 35 feet along North Walnut Creek drainage in the northern and northeastern portions of OU4. Valley fill alluvium is commonly composed of light brown to brownish gray humic clay, silt, sand, and gravelly sand with silty and cobbly gravel lenses. Gravel pebbles and cobbles are most commonly composed of quartzite, pebbles and cobbles of granite, gneiss, and sandstone are less common. Shroba and Carrara (1994) recognized two stages of valley fill alluvium: a Post-Piney Creek and a Piney Creek Alluvium. The Piney Creek Alluvium forms low terraces about 3 to 6 feet above modern stream level, and contains calcium carbonate veinlets and locally one or more buried soil horizons. The Post-Piney Creek Alluvium forms modern stream channels and floodplains, and does not contain secondary calcium carbonate. These deposits appear to represent the most recent natural deposits of surficial materials in the OU4 area.

II.3.5.1.5 Autochthonous Constituents of Surficial Materials - Caliche and Calcrete

Some stratigraphic intervals of the sediments described in preceding paragraphs contain significant quantities (25 to 80 percent) of caliche and/or calcrete. Caliche, or calcium carbonate, often forms by evaporation of vadose zone water, which causes changes in the partial pressure of carbon dioxide in the soil zone. Early stages of caliche formation may produce either a powdery granular calcite or development of indurated nodules, termed calcrete (Blatt et al, 1980).

In the alluvial facies, caliche formed *in situ* after deposition of the alluvial facies (Gile et al, 1966, Brown, 1956), whereas younger colluvial and valley fill material may contain reworked sediments containing caliche. Some caliche zones have a significant lateral extent. These intervals indicate significant secondary precipitation and/or replacement of caliche/calcrete by subsurface evaporation of soil moisture in the vadose zone, primarily in the "C" soil horizon. Their presence suggests areas where a capillary fringe is or was present. These intervals may be significant hydrogeologically if they represent areas of low or no recharge to the Upper Hydrostratigraphic Unit (Upper HSU) (i.e., areas of significant surface evaporation). Caliche-rich intervals are by no means ubiquitous at any stratigraphic level or area and thus may add an additional complexity and/or uncertainty to recharge models. However, they are most commonly encountered in the upper 10 feet of the subsurface.

II.3.5.1.6 Anomalous Constituents of Surficial Materials - Reworked Bedrock

Some stratigraphic intervals of the Rocky Flats Alluvium and associated sediments contain clasts or significant quantities of reworked bedrock. This material, primarily clasts of very well-sorted claystone or indurated sandstone that display "characteristic" bedrock color and mineralogy, are depositionally significant for two reasons: they specifically indicate areas (places, such as channel bends) where stream velocity decreased and rip-up clasts of bedrock were deposited, and indicate periods (time, as measured by stratigraphic interval) of increased bedrock erosion. Areas where stream velocity decreased enough to deposit transported load are likely to be located at stream channel bends and side bars. The Clayey-Silty Gravel and Clayey & Silty Lithofacies usually contain reworked bedrock proximal to the alluvial-bedrock contact.

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Lithofacies containing reworked bedrock stratigraphically higher or to the east of OU4 are likely to be found in the Sandy and Sandy Gravel Lithofacies. This may indicate a depositional evolution of the fan system (i.e., as the fan matured, the depositional base level shifted to the east and transported material became increasingly coarse).

Further, the recognition of re-worked bedrock material on the unconformable bedrock surface is essential to correctly identify the alluvial-bedrock contact which delineates the surface separating materials with differing hydraulic properties. The importance of this differentiation cannot be overstated. Several historical borehole logs, and logs generated during this study (i.e., borehole 44193) contain(ed) incorrect bedrock calls resulting from a failure to recognize this unit.

II.3.5.2 Physical Description of Bedrock

Significant work has been conducted recently to refine the characterization of the bedrock at Rocky Flats. The Phase I and II Geologic Characterization Reports for Rocky Flats Plant (EG&G, 1991b, 1992e) were prepared to characterize the bedrock at RFP based on a comprehensive literature search, relogging and describing previously obtained core samples, reprocessing previously obtained seismic data, analyzing core samples for grain size distribution, and surface geologic mapping. Data and results of the Phase I and II characterizations that are pertinent to OU4, and the information obtained during the OU4 Phase I RFI/RI, are summarized in this section. OU4 Phase I RFI/RI borehole drilling into bedrock was conducted to determine subcropping bedrock lithologies and to visually determine the presence or absence of weathered or unweathered claystone, fractures in claystone, and weathered or unweathered coarse-grained bedrock units near SEPs 207-A, 207-B Series, and 207-C.

II.3.5.2.1 General Bedrock Geology

Early workers assigned bedrock beneath OU4 to the Laramie Formation (Spencer, 1961, Blume, 1972). During the late 1970s and 1980s, additional preliminary geologic information led to reassignment of bedrock beneath and surrounding the plant site as the slightly younger Late Maastrichtian (Latest Cretaceous)-Early Paleocene (Early Tertiary) Arapahoe Formation (Hurr, 1976, Rockwell International, 1986, 1988a, EG&G, 1990, 1991b). During this period a lack of structural data, coupled with sparse subsurface lithologic and paleontologic control, suggested a thickness in excess of 200 feet for the Arapahoe Formation beneath the plant site. This stratigraphic assignment was based on the subsurface control available at that time and on projections of the Arapahoe Formation from known locations (i.e., Standley Reservoir).

Since the late 1980s a considerable mass of geologic information has been gathered at the plant site. This new information suggests that structural features, such as faults, do exist at and near the plant site, thereby nullifying any simple stratigraphic projections. Further, recent palynologic investigations (EG&G, 1993a) have revealed a marine origin (Laramie Formation) for claystones immediately beneath channel sands. Based on this new information, it is permissible for sediments of the Laramie Formation to underlie, or be in close proximity to,

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alluvial terrace gravels in some locations on the pediment surface. In other areas, fluvial sediments of the Arapahoe Formation have cut into the finer-grained marine sediments of the Laramie Formation. Thus sediments of the Laramie Formation may lie under or adjacent to Arapahoe Formation sediments, depending on spatial proximity to the deepest part of Arapahoe Formation fluvial channels. Therefore, the formational assignment of subcropping claystones is dependent upon proximity to channel sands currently assigned to the Arapahoe Formation. Claystones intercalated with channel sands are also assigned to the Arapahoe Formation, darker colored carbonaceous claystones not associated with channel sands are assigned to the Laramie Formation.

However, since stratigraphic assignments (age determinations) are beyond the scope of this investigation, and unlike physical properties are not paramount to hydrogeologic modeling, they are used only for clarity in a discussion. For example, there are lithological data supporting an Arapahoe Formation assignment for shallow and subcropping sandstones. Therefore, these sandstones and intercalated claystones are referred to as Arapahoe Formation sediments for descriptive purposes. The proper stratigraphic assignment of subcropping and deeper siltstones and claystones cannot be made equivocally. Therefore, these sediments are simply referred to as bedrock siltstones and claystones.

The bedrock package beneath OU4 is composed of claystone and silty claystone with sandy siltstone and intercalated lenticular sandstone bodies. Each of the various lithologies and their distribution in the subsurface is described in this section. Figure II 3 5-16 is a subcropping bedrock map. Figure II 3 5-16 shows the distribution of bedrock lithologic units that are in contact with the various surficial units described in the previous section. Figures II 3 5-8 through II 3 5-12 show the stratigraphic and lateral distribution of these bedrock units at depth. These figures indicate that claystone is the predominate subcropping lithology with minor, but hydrogeologically important, areas of siltstone and sandstone.

The bedrock lithologies have also been variously altered by weathering. As previously mentioned, since the bedrock pediment surface was subjected to erosion prior to the deposition of surficial units, approximately the upper 30 feet of bedrock exhibits the effects of weathering. Weathering induced fractures and fracture fillings in bedrock clay- and siltstones, and imparted an additional degree of friability on coarser-grained sandstone units. Since weathering alters the hydraulic properties of the subcropping bedrock, the locations and thickness of weathered zones were identified in this investigation. The nature and extent of fractures are described in the following section (II 3 5 2 2), whereas the extent of the "weathered zone" is described in the seismic refraction section (II 3 5 4 3).

II.3.5.2.2 Bedrock Claystone

Claystones are laterally and stratigraphically the most common bedrock lithology beneath OU4. These claystones often contain a significant amount of silt, more rarely some sand, but can also be nearly pure clay. When claystones are proximal to the surface they commonly contain 1 to 6 feet of caliche. Most claystones are light-to-medium olive-gray, but occasionally

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range to olive black or dark yellowish-orange. They are commonly thinly to thickly horizontally laminated, and rarely thinly to moderately bedded or contain inclined stratification (3 to 15 degrees from horizontal)

Fractures in claystone bedrock were observed in OU4 Phase 1 boreholes 41593, 41693, 41793, 42093, 42493, 42593, 43593, 43793, 44093, 44393, 44693, 44793, 44893, 44993, 45293, 45393, 45693, 46193, 46293, 46393, 46593, and 46793. These fractures occurred 10 to 40 degrees from horizontal and commonly contained caliche or iron oxide. Since some of these fractured claystones are located beneath the SEPs, they offer potential migration pathways for contaminants to enter the subsurface system. Therefore, a specific discussion of fractured bedrock claystone beneath the SEPs is presented in Table II 3 5-2. Additionally, in order to provide a more complete geologic picture of the claystone immediately beneath the SEPs, or more specifically, where fractured claystone is not found, the discussion in Table II 3 5-2 is extended to include all boreholes that encountered claystone beneath the SEPs.

All observations listed in Table II 3 5-2 are summarized on Figure II 3 5-16 (the subcropping bedrock lithology map), Figures II 3 5-8 through II 3 5-12 (geologic cross-sections of the OU4 area), and Figures II 3 5-19 through II 3 5-25 (geophysical cross-sections of the OU4 area).

II.3.5.2.3 Bedrock Siltstone

Siltstones subcrop beneath northern portions of SEPs 207-A and 207-B North (Figure II 3 5-16). Bedrock siltstones beneath OU4 are brown to light yellowish brown, and rarely range to olive brown. Siltstones commonly contain horizontal bedding with manganese and iron oxide staining. The largest continuous subcropping siltstone body occurs adjacent to Arapahoe Formation sandstone north of SEPs 207-A and 207-B North (Figure II 3 5-16). Several studies of modern examples (Miall, 1985) indicate that siltstones found stratigraphically and laterally proximal to fluvial sandstones are commonly overbank or crevasse splay deposits. If this inferred association is true, this siltstone body was deposited synchronously with the sandstone and therefore is part of the Arapahoe Formation. Other isolated siltstone bodies subcrop in boreholes 41793, 40393, 44993, and 40093, and occur 20 to 60 feet below the larger inferred Arapahoe siltstone body. The lower stratigraphic position of these siltstones and their lateral association with claystones suggest they may be part of the Laramie Formation. The lateral extent of these subcrops is estimated using available data on Figure II 3 5-16.

Since it can be reasonably assumed that siltstones in general will exhibit higher values of hydraulic conductivity in comparison to claystones, it follows that they offer potential migration pathways for contaminants to enter the subsurface. Therefore, since some of these siltstones are located proximally or beneath the SEPs, a specific discussion of the siltstones encountered in boreholes near or beneath the SEPs is presented in Table II 3 5-3.

All these observations are summarized on Figure II 3 5-16 (the subcropping bedrock lithology map) and Figures II 3 5-8 through II 3 5-12 (geologic cross-sections of the OU4 area).

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II.3.5.2.4 Arapahoe Formation Sandstone

The depositional environment of the Arapahoe Formation has been interpreted as a subaerial fluvial system with associated channel, point bar, and floodplain deposits. In the OU4 area, the weathered Arapahoe sandstones that occur within approximately 30 feet of the base of the alluvium are pale orange, yellowish-gray, and dark yellowish-orange in color. These weathered sandstones commonly contain iron oxide staining. The unweathered sandstones are light gray and olive-gray. Most of sandstones are composed of very fine- to medium fine-grained, subangular to subrounded, poorly to moderately sorted, sand that commonly contains appreciable amounts of silt and clay. Arapahoe sandstones exhibit faint horizontal laminations or bedding and contain calcareous and argillaceous cement. Sandstone intervals in the OU4 area are commonly thinly to thickly interbedded and interlaminated with discontinuous siltstones or silty claystones.

An objective of the OU4 Phase 1 borehole drilling at OU4 was to delineate the extent of subcropping bedrock sandstone and visually determine the presence or absence of fractures in it. Fulfilling this objective, Figure II 3 5-16 depicts an estimation of the lateral extent of bedrock sandstone based upon currently available information. Additionally, the cross-sections shown on Figures II 3 5-8 through II 3 5-12 depict the interbedded, lenticular, and laterally discontinuous nature of these sandstone lenses. Fracture data for OU4 sandstones are presented in Table II 3 5-4 and in Appendix II I. Based on the OU4 cross-sections and the seismic refraction data, the Arapahoe sandstone appears to thin and nearly crop out in localized areas on the hillside north of SEPs 207-C and 207-A. The Arapahoe sandstone also subcrops over a limited area in eastern and southern portions of OU4 (Figure II 3 5-16).

Figure II 3 5-16 shows the extent of the subcropping sandstone in the area of SEPs 207-A and 207-C. This sandstone appears to be approximately 20 feet thick (borehole 41993 and refraction seismic data) and contains claystone intercalations. This sandstone is potentially a path of contaminant migration because of its higher hydraulic conductivity relative to the bedrock claystone.

The lateral and stratigraphic extent of Arapahoe Formation sandstones proximal to SEP 207-C create a complex hydrogeologic system. The complexity of the hydrogeologic system in this area produces large hydrostatic level fluctuations over short distances in the Upper HSU. Water levels in monitoring wells southern and western perimeters of SEP 207-C are considerably higher (10 to 15 feet) than the water levels indicated by neutron access tubes and found in monitoring wells to the north and northeast of the northern perimeter of SEP 207-C. The observed hydraulic responses are hydrogeologically linked to bedrock geology. The geometry of the bedrock geology is a direct result of the depositional system that deposited the sediments.

Areas south and east of SEP 207-C contain an approximately 7-foot thick subcropping sandstone unit that thins to approximately 2 feet to the east. An aquitard consisting of claystone and siltstone underlies this sandstone beneath SEP 207-C. This sandstone also underlies areas to the north and northeast, although it is 20 feet thicker. Geologic cross-sections through this

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area suggest that the sandstone stratum is wedge-shaped. This geometry is common in fluvial depositional systems and probably formed due to helical flow at a braid bend. The geometry of interbedded lateral and vertical accretion claystone deposits within the sandstone stratum also contributes to this area's complex hydraulic responses.

Ground water in this area generally occurs in the basal portion of the sandstone stratum where it is underlain by a claystone aquitard. As the sandstone stratum thickens to the north and northeast, hydrostatic levels decrease to depths that maintain a fairly consistent water column thickness above the aquitard. Exceptions to this scenario are found where interbedded claystones cause ground water to be "perched" above where it would normally be found if the sandstone was homogeneous and the system was at equilibrium. Site-specific geology and water measurements suggest perched ground water may occur in wells P209493 and 40993 when recharge events are occurring and the system is not at equilibrium.

A specific discussion of the sandstones encountered in boreholes near or beneath the SEPs is presented in Table II 3 5-4. All observations listed in Table II 3 5-4 are summarized on Figure II 3 5-16 (the subcropping bedrock lithology map) and on Figures II 3 5-8 through II 3 5-12 (geologic cross-sections of the OU4 area).

II.3.5.3 Bedrock Topography

An interpreted bedrock surface elevation map was prepared using borehole logs and seismic refraction data (Figure II 3 5-13). This surface is the eroded unconformable pediment surface. Interpretation of the data reveals a variable topographic bedrock surface with southwest-to-northeast trending linear ridges extending into the North Walnut Creek drainage from the OU4 pediment. Within the North Walnut Creek drainage, the closed bedrock contours and nearly closed contour highs are interpreted to be isolated bedrock slump blocks with probable multiple basal shear planes. The closed bedrock contour highs on the pediment ridge are interpreted to be weathered bedrock remnants or construction features associated with building the SEPs. Additionally, there are four bedrock topographic lows extending from the North Walnut Creek drainage. Bedrock surface lows are interpreted to be incised channels, the result of pre- and synchronous-Rocky Flats Alluvium erosion on the bedrock pediment "mesa" surface. Incised channels on modern stream slopes are pre-colluvium, or pre-Holocene. Generally, the ridges and highs are of low relief (approximately 5 to 8 feet) and broad in extent.

Pediment features include two small slump blocks on the northern end of the ponds and an inter-pond ridge. Refraction Line 3 is interpreted to be on a ridge of bedrock separating SEP 207-A and the 207-B Series SEPs. The closed contour highs on the northern ends of SEPs 207-C and 207-A are interpreted to be slump blocks. Boreholes 42093, 41593, and P209489 adjacent to these slump blocks contain abundant fractures (20 to 30 degrees) and caliche.

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II.3.5.3.1 Incised Bedrock Channels and Preferential Flow Paths

Buried incised bedrock channels and ridges are present at the base of the Rocky Flats Alluvium and are shown on Figure II 3 5-13. Five bifurcating incised bedrock surface channels are interpreted to be within the OU4 area. These incised channels are significant because they represent preferential flow paths for ground water and contaminants. The largest incised channel is interpreted to extend entirely through the OU4 area. This large incised channel is present near the northeastern corner of SEP 207-B North, where it bifurcates around a bedrock high which is covered with the Clayey & Silty Lithofacies, and extends northward as one channel toward the North Walnut Creek drainage. The southern extension of this incised channel appears to underlie SEPs 207-B North and 207-B Center and the southern portion of SEP 207-A. Another incised channel bifurcates into separate incised channels on the hillside northeastern corner of SEP 207-A. A topographic high in the bedrock surface occurs between these two incised channels. The remaining two incised channels are present east of the 207-B Series SEPs. These incised channels begin east of SEP 207-B South and extend northward toward North Walnut Creek. The other incised channel is further to the east. A bedrock topographic high approximately 350 feet east of the 207-B Series SEPs separates these bifurcated incised channels.

II.3.5.4 Geophysical Investigation Results

Borehole geophysical data and seismic refraction data were used to characterize the subsurface geology and bedrock paleotopography. The objectives of the borehole geophysical logging were to characterize the subsurface moisture and the geophysical signature of subsurface soils and bedrock materials. The purpose of the seismic refraction survey was to identify subsurface features (buried drainages and bedrock channels) that may provide potential pathways for contaminant migration.

While interpretation of the geophysical logs was limited to a qualitative analysis, qualitative and quantitative information was obtained from the seismic refraction survey. Quantitatively, the refraction survey aided in the interpretation of the bedrock surface in areas where borehole data were not available. The refraction data depict a variable bedrock surface with elevation changes of up to 15 feet over a horizontal distance of 50 feet in some areas. Qualitatively, the refraction survey depicts zones of highly weathered bedrock up to 30 feet thick, and delineates probable locations of incised channels.

II.3.5.4.1 Borehole Geophysics

Geophysical borehole logging techniques were employed in two boreholes which were advanced for geological investigation. These techniques included natural gamma, neutron, and resistivity for further characterization of the subsurface geology. Gamma logs measure natural radioactivity in formations and can be used to identify lithologies and correlate zones. Neutron logs are porosity logs that measure the hydrogen ion concentration in a formation. Where the pore space is filled with water, the neutron log measures liquid-filled porosity. The ability of rock to transmit an electrical current is almost entirely the result of water in the pore space (i.e.,

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minerals in grains of rock are nonconductive); therefore resistivity measurements can be used to determine porosity

The two wells selected for borehole logging were 42193 and 44193, both within the Protected Area (PA) at RFP. Borehole 42193, located northwest of SEP 207-A, was drilled 313 feet in total depth and terminated in bedrock claystone. Borehole 44193, located near the southeastern corner of the 964 Pad, was drilled 502 feet in total depth and terminated in silty claystone bedrock. Figures II 3 5-17 and II 3 5-18 show the results of these geophysical logging surveys combined with the lithology for each borehole.

Results from the borehole geophysics indicate that a porous saturated zone is present from approximately 12.1 to 15.0 feet below grade in borehole 42193. This porous saturated zone is within a sandy claystone. Below this zone is a less porous zone, reflected in the neutron log. At approximately 15.5 feet the neutron log indicates a decrease in porosity/moisture content which corresponds with a lithology change to a claystone. Based on the gamma and neutron responses observed in this borehole, it appears that there is a saturated/porous zone, consisting of sandy claystone, lying above a less porous zone of claystone.

Borehole geophysics indicate that saturated porous rocks are present between approximately 17.5 and approximately 48.6 feet below grade in borehole 44193. The most saturated/porous zone occurs between 20.0 and 21.5 feet below grade. A slightly less porous, less saturated zone is encountered at approximately 25.5 feet below grade and continues to approximately 29.5 feet below grade. This zone is entirely within a claystone unit. Another saturated/porous zone occurs at approximately 38 feet below grade, roughly coinciding with a lithology change from a claystone to a silty claystone. In this borehole, it appears that more porous units, depicted by a higher moisture content, are separated by less porous zones with lower moisture content.

The more porous intervals may serve as horizontal pathways for contaminant transport in the saturated intervals of the bedrock aquifer. Alternatively, the less porous zone may act as a barrier to vertical contaminant migration.

The gamma log response between alluvial and bedrock materials in these boreholes correlates with the lithologic logs. In borehole 42193, weathering of the clayey sandstone bedrock and caliche-filled fractures near the bedrock-alluvial contact delayed a sharp gamma response for approximately 2 feet where a "tight" sandy claystone was encountered. In borehole 44193, there was a lack of core recovery between 16.2 and 23.4 feet (the bedrock-alluvial contact lies within this interval). Therefore, the gamma log response was used to select the contact depth. The gamma log for 44193 contains a sharp kick at approximately 19 feet below the ground surface. This sharp response signifies the sudden change from coarse alluvial materials to finer-grained bedrock claystones and represents the alluvial-bedrock contact.

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II.3.5.4.2 Seismic Refraction Data Acquisition

Seven shallow seismic refraction survey lines were recorded in the OU4 area. The locations of these lines are shown on Figure II.3 5-7. The refraction data provide arrival time differences of an energy wave recorded by geophones at various distances from the energy source. These times are plotted versus distance to obtain depth profiles and velocity information using SEISREFRA, a ray-tracing computer program. The refraction depth profiles developed (Figures II 3 5-19 through II 3 5-25) were interpreted using geologic information to identify potential pathways of contaminant migration.

The seismic refraction data are limited by cultural noise, the accuracy of surveyed locations of the refraction lines, the surface geophone separation, and the geometry of the refraction survey. The evaporation fans along Line 4 provided the only cultural noise that impacted the OU4 survey, and therefore Line 4 was not used in the analysis. Surveyed accuracy of the refraction survey is estimated to be 1 to 2 feet vertically and approximately 5 feet horizontally, which is acceptable. The 1 to 2 foot variations observed between lithologic borehole logs and the refraction survey data are assumed to be a combination of the surveying accuracy, an elevation variation resulting from a spacial separation between the refraction line and the borehole, and the accuracy of the refraction survey analysis. The surface geophone separation of 10 feet restricts subsurface coverage separation to 5 feet. Additionally, the acquisition geometry of the refraction survey would theoretically allow interpretation to a depth of approximately 150 feet. This depth of investigation was restricted by the focus of the OU4 Phase 1 RFI/RI investigation to the near-surface geological materials (a depth of approximately 50 feet).

II.3.5.4.3 Seismic Refraction Data Results

The acquisition configuration used in the refraction survey of OU4 identified four refraction layers. While not every refraction depth profile exhibits all four layers, certain layers have common characteristics. These conclusions are drawn from using the geologic borehole logs in conjunction with the refraction depth profiles. Generally, the upper layer (Layer 1) is less than 5 feet thick and has a velocity ranging from 690 to 1,900 feet per second (fps). This layer is associated with the surficial or subsurface soils with a USCS ML classification and an alluvium Clayey & Silty Lithofacies classification. Coarser-grained subsurface soils tend to be geophysically incorporated (transparent), due to their similar acoustical properties of velocity and density, into the second layer (Layer 2). The second layer is approximately 10 feet thick and has a velocity ranging from 2,000 to 2,800 fps. This second layer is associated with the unconsolidated coarse-grained geological materials (GW, GP, GM, and GC of the USCS classification or the Sandy, Sandy Gravel, or Clayey-Silty Gravel Lithofacies) of the Rocky Flats Alluvium or weathered friable sandstones of the Arapahoe Formation. The third layer (Layer 3) is geophysically similar in velocity to the second layer. Borehole geology enables an interpreted separation between these two layers. Layer 3 ranges in thickness from 5 to 30 feet and has velocities that range between 2,000 to 3,600 fps. This third layer is associated with weathered bedrock lithologies. The slower velocities typically are weathered, semi-consolidated

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friable sandstones, and the higher velocities are associated with weathered silty claystones. The lowermost layer, Layer 4, represents velocities that are associated with consolidated silty claystones and claystones. Layer 4 ranges in velocity between 4,700 and 7,500 fps. The slower velocities are typically laminated siltstones or sandstones interbedded with claystones and the higher velocities are more massive claystones.

The refraction layers exhibit an undulating surface characteristic of fluvial-erosional processes. Interpreted bedrock elevation differences of approximately 15 feet over 50 feet horizontally are observed. Depth to bedrock, obtained from boreholes, confirmed the seismic refraction interpretation.

In some areas, the top of the bedrock is not interpreted as a sharp erosional contact but is gradational from weathered to a more consolidated surface. Weathering of the bedrock units affects the density and velocity measurements. The velocity change and/or density change within a lithology typically accounts for a refraction boundary. Weathering results in a gradational increase in velocity with depth, between Layers 3 and 4, the base of the weathered bedrock refraction boundary. Borehole geology supports this observation. Based upon the few deep boreholes that encountered weathered bedrock, the refraction data do not fully image the weathered zone, but image an intermediate, semi-consolidated weathered zone. In general, both borehole data and interpreted seismic refraction data along Line 2 indicate that the depth of bedrock weathering may be 30 feet or more. However, descriptions of the lithology from boreholes (P2088898 and P209589) along Line 5 also place the base weathering at approximately 30 feet into bedrock, but the refractor associated with the semi-consolidated "weathered" layer extends only to a depth of 10 feet into bedrock at these borehole locations. Even though the refraction data do not always detect the base of weathering, areas where more intense weathering has occurred can be identified. The deepest area of weathering or semi-consolidated bedrock is identified in the North Walnut Creek drainage, where approximately 30 feet of bedrock are affected.

Incorporating the refraction data into the bedrock surface map facilitated identification of potential contaminant pathways. The interpretation identified bedrock lows where potential incised channels may exist, located zones of "weathered" semi-consolidated bedrock where fracturing may be more extensive and permeabilities higher, distinguished the geometry of a subcropping sandstone lenses, and also identified potential slump-block features north of the SEPs. The following section discusses the depth profiles derived from the refraction survey and the integration of lithologic information from subsurface drilling.

II.3.5.4.4 Depth Profiles

Geologic data obtained for both historical and OU4 Phase 1 boreholes located along and adjacent to the refraction survey lines (Figure II 3 5-7) were used to relate the velocity layers to lithology and to map the alluvium-bedrock contact. Two designations are used for subsurface borings used in the interpretation of the refraction depth profiles and are termed "plotted" and "spotted" boreholes. Plotted boreholes are those found within about 20 feet of the refraction line.

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where ground elevation was approximately coincident with the refraction line. Spotted boreholes also occur at distances less than 20 feet, but are much lower or higher in elevation than the refraction line. Since the ground surface elevations of the spotted boreholes are different than the refraction line, discrepancies between the refraction depth profile and borehole geology occur. However, the geology from the spotted boreholes was used for lithologic characterization of the refraction layers.

Data used from the plotted boreholes included ground surface elevation, soil and lithologies observed, top of bedrock, and the total depth drilled. Only limited geologic information was used from the spotted boreholes because of the discrepancies caused by their distance from the refraction survey line. Although not specifically shown on the refraction depth profiles, the thickness of soil and bedrock lithologies between ground level and the top of bedrock, and thickness of coarse- and fine-grained alluvium, were used to supplement the refraction profile interpretation.

Geophysical Line 1 Depth Profile

Figure II 3 5-19 shows the depth profile results of the refraction survey for Line 1. This line is along the eastern edge of the 207-B Series SEPs. All four refraction layers are depicted. The upper layer and the third layer are not continuous along the refraction depth profile, but are present along the northern end of the line. Borehole geology indicates that the upper layer is generally composed of subsurface soils that are typically silty (USCS ML, or the Clayey & Silty Lithofacies). The upper layer (Layer 1) has a velocity signature of approximately 1,700 fps and has an approximate thickness of 1 to 3 feet, and thickens to 5 feet on the hillside north of the SEPs.

Based upon borehole geology, the second layer is composed of gravel and gravelly soils (GW, GM, GP, and GC, Sandy Gravel, Clayey-Silty Gravel Lithofacies). The other adjacent pond refraction profiles, Lines 2 and 3, have a similar layer. This layer may represent the major component used in the construction of the berms surrounding the 207-B Series SEPs. The material exhibits a velocity between 2,000 and 2,800 fps and is approximately 10 feet thick. For most of the depth profile, the second layer rests directly upon the competent bedrock surface (Layer 4). Along the northern 100 feet of the Line 1 refraction profile, an approximately 10-foot-thick section of semi-consolidated "weathered" bedrock exists. This zone may be associated with the more extensive and thicker intermediate weathering zones of North Walnut Creek.

Two spotted boreholes, P210289 and 05393, are approximately 15 feet to the west of Line 1 and have bedrock elevations 3 to 5 feet higher than the consolidated bedrock refractor. This variance is attributed to the boreholes being spatially separated from the profile. Seven additional boreholes are plotted along the depth profile and establish the lithology.

Geophysical Line 2 Depth Profile

Figure II 3 5-20 shows the refraction depth profile for Line 2. Three refraction layers are depicted. Line 2 is along the northern edge of SEPs 207-C, 207-A, and 207-B North. Line 2 is not continuous. Line 2 has a lateral gap in the recording of subsurface information of approximately 50 feet at the 230-foot station. This gap adjusts Line 2 to accommodate the offset configuration of SEPs 207-C and 207-A. Because the profile was acquired along the strike of the hillside, generally boreholes even as close as 5 feet could only be spotted and not plotted onto the profile because they were much different in elevation than the line. As a result, geologic and refraction interval data were compared on a thickness basis.

East of the 500-foot station on Line 2 (Figure II 3 5-20), the upper layer is interpreted to represent subsurface soils. Around the 800-foot station, this layer is composed of gravelly alluvium (USCS GW, GM, GP, and GC, Sandy Gravel Lithofacies). The material has a velocity of approximately 1,400 fps and an approximate thickness of 5 to 8 feet. Further to the west between the 500- to 700- foot stations, the layer thins to 1 to 3 feet thick and slows in velocity to 920 fps, which is interpreted to represent surficial or subsurface alluvium similar to the Clayey & Silty Lithofacies, or a USCS "ML". East of the 500-foot station, this upper layer rests upon the bedrock surface which is composed of a weathered sandy claystone to claystone. The depth of the semi-consolidated "weathered" zone is 10 to 15 feet below the bedrock surface.

Geophysical Line 3 Depth Profile

Figure II 3 5-21 shows the depth profile for Line 3. This line is along the eastern edge of SEP 207-A and the western edge of the 207-B Series SEPs (Figure II 3 5-7). All four refraction layers are depicted. The upper layer and the third layer are not continuous along the refraction depth profile, but are present along the extreme northern end of the line. The profile lithologies are derived from Line 3 intersecting within Line 2. The upper layer is classified as the Clayey & Silty Lithofacies and has a maximum thickness of about 2 to 3 feet. The semi-consolidated "weathered" layer, consisting of a silty-claystone, has a maximum thickness of about 10 feet.

The prevailing composition of the second layer of Line 3 is gravelly alluvium (Sandy Gravel, Clayey-Silty Gravel Lithofacies). The material has a velocity between 1,900 and 2,500 fps and is approximately 15 feet thick. For most of the refraction profile, the second layer rests directly upon the consolidated bedrock surface (Layer 4). The velocity of the consolidated layer ranges from 5,600 fps to 5,800 fps. This inter-pond consolidated layer is approximately 500 fps slower than the other refraction profiles for Layer 4.

Five plotted boreholes SP0587, 41693, P209089, SP0987, and 43993 are about 10 to 22 feet west of Line 3 and have bedrock elevations approximately 3 to 5 feet lower than the refractor. This variance is attributed to the boreholes being spatially separated from the profile.

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Geophysical Line 4 Depth Profile

Figure II 3 5-22 shows the depth profile results of the refraction survey for Line 4 and is included only for completeness. The data are disregarded due to interference from noise generated by the nearby evaporator fans

Geophysical Line 5 Depth Profile

Figure II 3 5-23 shows the depth profile for Line 5. This line is along the northern edge of the PA fence (Figure II 3 5-7). All four refraction layers are depicted. The upper layer is not continuous along the refraction depth profile, but is limited to the western end of the line. Using the lithologic description from borehole 40693, the upper layer consists of the Clayey & Silty Lithofacies and has a maximum thickness of 2 to 3 feet with a velocity of 780 fps. Lithologic information from borehole 42693 and the slightly slower velocity of 990 fps indicates the Clayey & Silty Lithofacies is also present in the 250- to 450-foot station area, but is interpreted to comprise only 1 to 2 feet of the second layer.

The second layer on Line 5 is nearly continuous, being absent only at the 1,130-foot station area where the bedrock is interpreted to crop out. Layer 2 is interpreted to be composed of both fine-grained and coarse-grained alluvium. The thickness of the second layer ranges from 0 to 10 feet thick, being the thickest at the 500- to 600-foot station area and at the 1,330-foot station. The second layer velocity ranges from 990 to 1,700 fps. Using the description of the lithology from the boreholes, the slower second layer velocities are alluvium similar to the Clayey & Silty Lithofacies, while the higher velocities are similar to the Clayey-Silty Gravel Lithofacies. The base of the second layer is interpreted to be the top of bedrock.

The third layer for Line 5 is interpreted to be the semi-consolidated "weathered" zone in which the bedrock acoustic properties have been altered by weathering. The semi-consolidated "weathered" layer ranges in velocity from 2,300 fps to 3,600 fps and ranges in thickness from 5 to 15 feet. Using the borehole lithology descriptions, the semi-consolidated "weathered" bedrock refraction layer is composed of silty claystone to clayey siltstone.

Along Line 5, Layer 4 has a velocity range from 5,800 to 7,500 fps. The 5,800 fps velocities are between the 900- to 1,330-foot stations. Using the deep log description of boreholes 3987 and P209589, this surface may represent a ground water table present within the bedrock. Higher velocities to the west are interpreted as consolidated bedrock. The highest velocity of the refraction survey (7,500 fps) is between the 450- and 500-foot stations.

Four boreholes 40693, SP1087, 42693, and P209889 are located between 10 and 25 feet from Line 5. Both ground elevations and bedrock elevations of the boreholes and the depth profile are approximately 3 to 7 feet apart. This variance is attributed to the boreholes being spatially separated from the refraction line.

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Geologic cross-section B-B' (Figure II 3 5-9) was constructed using the geologic data from boreholes on and adjacent to geophysical Line 5 for comparative purposes. The geophysical data correlates with borehole data quite well, the small discrepancies are attributed to the slight differences in alignment of the two lines.

Geophysical Line 6 and 7 Depth Profiles

Figures II 3 5-24 and II 3 5-25 show the depth profile results of the refraction survey for Lines 6 and Line 7, respectively. Lines 6 and 7 are within the North Walnut Creek drainage and display similar lithologies. Both lines indicate a thicker Layer 1 compared to the previous refraction depth profiles. The upper layer ranges in thickness from approximately 5 to 20 feet. Using the borehole geology descriptions along Line 7, the upper layer is composed of a more coarse-grained fraction which is reflected in a slightly higher velocity. The velocity for Layer 1 is 1,200 fps for Line 6 and 1,300 fps for Line 7. Within Layer 1 on Line 7, an additional layer is discerned. This layer is about 1 to 2 feet thick and has a velocity of 690 fps. For Lines 6 and 7, the depth profiles show the upper layer resting directly upon the semi-consolidated "weathered" bedrock layer. The velocity of the weathered layer ranges from 2,000 to 2,200 fps.

II.3.5.5 Summary

Based upon the geological investigations within OU4, four potential contaminant pathways were identified. These pathways are the incised bedrock channels which are often filled with material (Sandy, Sandy Gravel Lithofacies) that exhibits a relatively higher value of hydraulic conductivity ($\sim 10^{-2}$ to 10^{-4} cm/sec) than other alluvial or bedrock units, the semi-consolidated "weathered" bedrock zone identified by borehole and refraction seismic data, a sandy lens beneath the area of SEP 207-C, and fractures within the claystone bedrock.

There are incised bedrock channels that will affect the flow of subsurface fluids. The incised channels generally contain Sandy and Sandy Gravel Lithofacies, which have a higher value of hydraulic conductivity associated with them in comparison to the Clayey-Silty Gravel and Clayey and Silty Lithofacies. The incised channels and alluvium stratigraphic profile may affect the flow direction of fluids within the Rocky Flats Alluvium. Areas on Figure II 3 5-14 overlain by the Sandy or Sandy Gravel Lithofacies are potential contaminant pathways into bedrock, especially if these areas are underlain by a sandstone, siltstone, or fractured claystone (Figure II 3 5-16). The potential pathway is further mitigated or enhanced by the physical characteristics (i.e., predominant grain size, porosity) of the alluvial material lying stratigraphically above that shown on Figure II 3 5-14. Cross-sections showing the stratigraphy of alluvium (Figures II 3 5-8 through II 3 5-12) above potential pathways gleaned from Figures II 3 5-14 and II 3 5-16 suggest the area around SEP 207-C has the greatest potential for contaminant migration because of the underlying Arapahoe Formation sandstone.

Also, as indicated by the semi-consolidated "weathered" zone of the refraction data, the depth of the weathering has affected the upper portion of the bedrock surface. In North Walnut Creek, this zone has extended into the bedrock to a depth of approximately 30 feet. Based upon

the refraction data, the semi-consolidated "weathered" zone has a slower velocity than the consolidated bedrock indicating that the porosity of the weathered bedrock has increased. This is a potential migration pathway because weathering may have affected the transmission and retention properties of the upper bedrock strata.

The sandy lens of the Arapahoe Formation sandstone is larger than what is delineated by borehole control and extends to the west beyond the northwestern edge of SEP 207-C. This is a potential contaminant transport pathway because of its higher hydraulic conductivity relative to the claystones.

Lastly, the fractures associated with the slump blocks may provide a potential pathway for contaminant migration. The southern extent of the fractured bedrock at least involves the northern portion of the SEPs.

II.3.6 Quality Assurance/Quality Control Results

This section provides an evaluation and summarizes the results of the QA/QC procedures in place during the OU4 Phase I RFI/RI and evaluates whether QA/QC goals were met. Additionally, an evaluation of the usability of both the OU4 Phase I RFI/RI and the historical data sets is presented in this section. While summarized results are presented in these sections, individual compiled data groups from which the summary results were derived are listed in Appendix II Y.

II.3.6.1 Results of Audits/Deficiency Reports

The deficiency reports generated as a result of field QA audits during the OU4 Phase I RFI/RI were reviewed. The audit reports and corrective actions documents associated with the OU4 Phase I RFI/RI field activities are included in Appendix II K. During the field activities, several audits were conducted following the schedule outlined in the sitewide Quality Assurance Project Plan (QAPjP). A number of deficiencies were identified and the appropriate reports were generated. The following is a general summary of the deficiencies noted:

- Incorrect or incomplete information presented in the field logbooks,
- Incorrect completion of various field forms,
- Improper radiation screening and containerizing of PPE,
- Storage of more drums than permitted per pallet,
- Record package transmittal problems, and
- Use of hollow-stem auger drilling methods instead of drive sampler

All of these deficiencies were addressed, however, only two corrective action documents were prepared summarizing the actions taken to address the deficiencies. None of the deficiencies noted during the OU4 Phase I RFI/RI affected the quality of the data generated. In general, field activities, including sample collection and handling, were conducted within the quality requirements outlined in the QAPjP, Work Plan QAA, TM1, and TM2.

II.3.6.2 OU4 Phase I RFI/RI Data Management and Quality

This section provides a discussion and summary of the data management practices used during the OU4 Phase I RFI/RI and provides an evaluation of the data quality and usability.

II.3.6.2.1 Data Management

The data presented in the summary tables and figures throughout Section II 3 0 of this report represent the results of the OU4 Phase I RFI/RI obtained to meet the data quality objectives outlined in Sections 4 0, 7 0, 9 0, and 10 0 of the Work Plan and the subsequent technical memoranda (TM1 and TM2). Data quality objectives are qualitative and quantitative statements that specify the quality and quantity of data required to support the objectives of the OU4 Phase I RFI/RI. Data quality levels appropriate to the data need and data use are specified

in Table 4-1 of the OU4 Phase I RFI/RI Work Plan. Data quality levels are specified in Section 7.0 of the OU4 Phase I RFI/RI Work Plan.

During the field sampling and analysis program, a comprehensive set of field observations, field measurements, and laboratory data were generated to augment the historical data set for OU4. The data developed during the OU4 Phase I RFI/RI provide additional information to characterize the site physical features and to evaluate the nature and extent of contamination in the unsaturated zone.

The data obtained during OU4 Phase I RFI/RI were evaluated independently of the historical data set, and an evaluation of the OU4 Phase I RFI/RI data usability is presented here. The historical data were evaluated to determine usability for incorporation into the OU4 Phase I RFI/RI data set and in the evaluation of the nature and extent of contamination. The OU4 Phase I RFI/RI and historical data used include both validated and invalidated data sets. Rejected data are presented in the appendices but are not incorporated into the evaluation of the contaminant sources or statistical analyses.

All OU4 Phase I RFI/RI data are used in the determination of the data usability. Analytical data results from soil samples collected above the maximum vadose zone thickness (minimum historical ground water elevation) were used to determine the nature and extent of contamination in the vadose zone. More discussion on the rationale for using the data from the defined unsaturated horizon is presented in Section II.4.1, Data Quality and Useability.

Strict handling, storage, and shipping procedures following SOP-FO 13 were maintained throughout the field program. Documentation of field activities and data tracking sheets were maintained as specified in the various SOPs by the Field Activities Task Leader in the field office and were periodically transferred to EG&G and the QA contractor for review. QA records were maintained in the field trailer per Field Document Control procedures (SOP-FO 02). The QA records were transferred to EG&G on a specified schedule throughout the field program.

II.3.6.2.2 Data Usability Summary

The OU4 Phase I RFI/RI was conducted in accordance with the sitewide QAPjP and the SOPs as amended by the Work Plan, QAA, and existing TMs. Procedures for data quality control, verification, entry into RFEDS, archiving, and security followed SOP FO 14. DQOs were initially established in the Work Plan. The sampling and analysis activities were implemented using these Work Plan objectives and all addenda to these objectives as outlined in TM1 and TM2. Per EPA-guidance, DQOs are expressed in quantitative and qualitative terms of precision, accuracy, representativeness, completeness, and comparability that are referred to as the PARCC parameters.

This section presents the summary of the data usability for the OU4 Phase I RFI/RI data. The data usability summary evaluates how the data quality supports or limits the achievement

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of the prescribed DQOs, and how the quality of the data affects the usability of the data. Achievements of the individual PARCC parameters in relation to media and analytical method are described along with broad impacts to the data sets for the OU4 Phase I RFI/RI

The historical data usability is also described in this section. The historical data are presented separately because the laboratory and field quality control procedures for the historical data varied over time and varied from the OU4 Phase I RFI/RI data quality control procedures.

II.3.6.2.3 Data Validation

Analytical data collected during OU4 Phase I RFI/RI used EPA and other well-established methods that are identified in the GRRASP (EG&G, 1991) and QAPjP. The analytical data were reviewed and validated independently of the laboratory or the sample collection contractor, and the results were documented in data validation reports. Standard method-specific data validation procedures developed by the Environmental Restoration Division (ERD) and based on the EPA CLP data validation functional guidelines were used to validate the data.

The three classes of data quality used by ERD are

- V - Valid and usable without qualifications,
- A - Acceptable for use with qualifications, and
- R - Rejected

Other qualifiers, as presented in Table II 3 6-1, fall within these three basic categories. For the purposes of the OU4 Phase I RFI/RI, valid and acceptable data were considered of equal utility. Rejected data were not used in any statistical computations or contaminant source evaluation.

Table II 3 6-2 summarizes the status of the OU4 Phase I RFI/RI data validation by media and analyte group. As of March 1994, 87 percent of all OU4 Phase I RFI/RI data have been validated. Data that have not been validated at the time of preparation of this document are used to provide adequate quantities of data for contaminant evaluation and statistical analysis (invalidated data are noted in Appendix II Y). As identified from the validated data, the integrity of the data is confirmed by the large percentage of acceptable results. Of the 87 percent of the data that have been validated, only 1.26 percent have been rejected.

Listed in Table II 3 6-3 are summaries of the reason codes used in the data base by the data validation contractor. Table II 3 6-4 presents the reason codes which were identified for the rejection of data. The most common reasons identified for the rejection of data are related to the failure of the organic calibration criteria or surrogates being outside of method criteria (codes 40, 41, and 42). The second most common rejection criteria are related to laboratory control samples, transcription errors, or laboratory control sample relative percent error criteria not being met (codes 32, 52, or 62). The rejected data have not been used in the evaluation of

the contaminant sources or for statistical analysis. The overall low percentage of rejected data (< 2 percent) indicates that use of the invalidated data should not compromise the validity of the resulting conclusions.

II.3.6.2.4 Assessment of OU4 Phase I RFI/RI Data Usability

The quantitative criteria for measuring precision, accuracy, and completeness and the qualitative criteria for evaluation of representativeness and comparability are defined within the QAPjP. For the OU4 Phase I RFI/RI, analytical data were evaluated according to control limits specified in the referenced analytical method and/or in the data validation guidelines. For the radionuclides analyses, the accuracy objectives specified in the GRRASP for the RFETS sitewide QAPjP was followed. The specified criteria for precision and accuracy are described in the Work Plan QAA. Precision and accuracy for the non-analytical data were achieved through protocols outlined in the agency-approved SOPs and PCNs. The completeness objective for the OU4 field and analytical data was 100 percent, although the minimum acceptable goal set forth in the Work Plan was 90 percent. The methods and protocols used to select samples that were both representative and comparable are described in Work Plan and in the referenced SOPs of the FSP.

Precision

Precision is a measure of mutual agreement among individual measurements of the same property, under identical conditions. Precision is assessed by means of laboratory and field duplicates sample analysis. The objective of calculating sampling precision is to demonstrate that reproducibility of measurements between similar samples is acceptable. Precision is quantified by calculating the relative percent difference (RPD), which is the quotient of the difference between the field (real) and duplicate analytical result and the average of those results for the given analyte expressed as a percentage.

$$RPD = \left(\frac{(V_1 - V_2)}{(V_1 + V_2) / 2} \right) \times 100\%$$

Where RPD = Relative Percent Difference, and
V₁, V₂ = the values of the duplicate samples

For those analyses where the reported value is the detection limit, one-half the detection limit was used for calculating RPD.

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Field Precision

Following the field sample collection procedure, aqueous field duplicates from the vadose zone were collected using the same sampling technique that was used for the real samples. Soil sample duplicates were obtained by splitting the interval or collection area being sampled. Volatile organic duplicate soil samples were obtained by collecting two 3-inch brass sleeves in series within one split-spoon sampler.

Comparison of the data results from the real and duplicate samples provides a measure of the sample homogeneity and sampling technique precision with the amount of error attributed to sample technique and/or variability in the analyte concentration in the medium being sampled. The field precision objective specified in the OU4 Phase I RFI/RI Work Plan QAA is to obtain an RPD of ≤ 30 percent for water samples and ≤ 40 percent for homogeneous, nonaqueous samples (soil).

In conjunction with the precision objectives outlined in the QAA, the number of duplicate samples required to demonstrate precision was one duplicate pair for every 10 samples collected, or 10 percent of the field samples. Table II 3 6-5 lists the achieved field QC sample frequency for the OU4 Phase I RFI/RI. The overall duplicate ratio achieved is 6.25 percent, or one duplicate for every 15.6 field samples collected. The field duplicates collected during the borehole and surficial sampling programs each achieved a ratio of 1 in 14 and 1 in 17, respectively (Table II 3 6-5). The vadose zone extraction samples achieved a ratio of 1 in 21. This very low ratio of duplicates to samples is the result of the low production rate of vadose zone water from the lysimeters, making duplicate samples difficult to obtain.

A list of the duplicates and associated field samples (QC partners) is presented by method and analyte group in Table II 3 6-6. A summary table of the degree to which the field precision goals are met is provided in Table II 3 6-7. Calculated RPDs are presented in Table II Y-1 in Appendix II Y.

Based on the available analytical results, RPDs were calculated for a total of 67 duplicate pairs. Overall, a total of 89.5 percent of the field duplicates analyzed met the field precision goal. Approximately 13 percent of the total duplicate pairs were either not available, rejected, or validation had not been performed or requested. These samples were excluded from the analysis. For metals and radionuclides with failed RPDs and at concentrations near the quantitation limit as defined in the GRRASP, precision may be expressed as acceptable when the analyte concentration difference between the sample and duplicate fall within the CRQL of each other. Using this as a criterion, the overall precision goal is 93.2 percent.

All the 162 calculated RPDs from the field duplicate soil samples analyzed for pesticides and PCBs met the precision goals. Excluded from the analysis were 27 duplicate analyses that did not have available results.

Reproducibility between the field and duplicate samples for the metals and radionuclides is difficult to achieve in soils due to the inherent heterogeneous nature of the samples. Some

of the duplicate sample pairs analyzed for radionuclides reported concentrations near the minimum detectable activity (MDA) or were negative values. Reproducibility under these circumstances is difficult because of the analytical limitations and therefore, may not reflect poor field precision. Of the samples compared, radionuclide and metal field duplicate pairs met the RPD field precision goals in 64.8 percent and 84.4 percent, respectively. If the CRQL criteria were used, field precision goals were met in 87.0 percent for the radionuclide pairs and 91.4 percent for the metal pairs.

Semivolatile organic compound field duplicate pairs met the field precision goals in 94.6 percent of the samples compared. Review of the RPD calculations (Appendix II Y) indicates that 11 of the 29 failed RPD calculations are identified in one field duplicate pair (SS40038/SS40016). This amount of failed pairs associated with one sample may suggest either heterogeneity of the material collected or poor collection practices at this one specific location.

Initially, 12 duplicate soil pairs were collected for determination of volatile organic compound field precision goal (Table II 3 6-7). The initial percentage of analytes achieving the field precision goals is 78.8 percent. Review of the RPD calculations (Appendix II Y) indicates that the majority (68 of the 112) of the RPDs that exceed the precision goal are from two duplicate pairs (BH40197/BH40406 and BH40386/BH40561). These two pairs failed in all of the 34 chemical RPD tests. Removing these two failed duplicate pairs suggests that the overall field sampling methods were acceptable for collection of volatile organic compounds. Five acetone results and eight 2-butanone results were rejected by the data validators and therefore were not included in the statistical analysis of the precision criteria. For the toluene duplicate pairs, five of the nine remaining pair results failed to meet the RPD precision goals. Removal of all of these RPD failed pairs results in 98.3 percent of the remaining volatile duplicate samples achieving precision goals (Table II 3 6-7).

In summary, the purpose for collecting field duplicate samples is to evaluate the precision of the laboratory analyses and to evaluate the heterogeneity of contaminants in the sample matrices. Although the quantity of field QC samples was not fully met, the analytical requirements for the samples that were collected generally meet the QC requirements for precision. It is unlikely that collecting additional field duplicates would adversely affect this evaluation of precision.

Laboratory Precision

Laboratory precision is evaluated through the use of laboratory duplicates for inorganic analyses, and matrix spikes (MS) and matrix spike duplicates (MSD) for the organic analyses. Duplicate precision is calculated as an RPD, MS/MSD precision is assessed by calculating an RPD between the percent recoveries observed for the method-specific spiked compounds. As set forth in the OU4 Phase I RFI/RI Work Plan and the QAA, laboratory precision goals are mandated by the analytical method for each group and assessed for achievement during data validation. Data not meeting the precision goals set forth by the method are rejected.

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Accuracy

The accuracy of the field data obtained is a function of the sampling technique, potential for sample contamination, and the analytical capabilities of the laboratory. Accuracy means the nearness of a result (or the mean of a set of results) to the true value. Accuracy is assessed by analysis of reference samples of known concentrations, percent recoveries for spiked samples, and by review of blank data (field equipment rinsate, trip, or method blanks) which may have an effect on measurement accuracy. As set forth in the OU4 Phase I RFI/RI Work Plan, accuracy objectives for analytical data collected for the OU4 Phase I RFI/RI were evaluated according to the control limits specified in the reference analytical method and/or in the data validation guidelines. For the radionuclide analyses, the accuracy objectives are specified in the GRRASP. Specific criteria for accuracy are described in the QAA.

Field Accuracy

Field accuracy is assessed by comparing sample analyte concentrations to those present in associated field blanks. Only the equipment rinsate blanks were required by the QAA for the OU4 Phase I RI/RFI. The equipment rinsate blanks are used to monitor for sample cross contamination and the effectiveness of the decontamination process. The blanks are collected by rinsing decontaminated sampling equipment with laboratory-grade water, placing the liquid in the appropriate sample container, and preserving as is required.

Table II 3 6-5 presents the proposed and actual frequencies for equipment rinsate sampling. The field QC sample frequency goal is one in 20 or 5 percent. The total number of rinsate samples collected was 12, representing a ratio of approximately one in 43 or 2.3 percent. The ratio of surficial soil samples (1/28) to rinsate samples is the closest to achieving the proposed frequency ratio. Rinsate to borehole field samples (1/43) and vadose zone water samples (1/64) exceeded the proposed goal of one in 20.

Table II 3 6-8 presents the detections of organic compounds in the equipment rinsate blanks. The volatile organic compounds acetone and methylene chloride that were detected in the rinsate blanks are common laboratory solvents and are often inadvertently introduced into samples from the laboratory atmosphere, as noted in the CLP SOW for organic analyses. For these volatile compounds, the CRQL was exceeded twice in five analyzed rinsate samples. Other volatile compounds detected in the equipment rinsate samples include 1,1,2,2-tetrachloroethane (2 µg/L), 2-hexanone (5 µg/L), and 4-methyl-2-pentanone. These detections were below the CRQL. All of the volatiles have been detected in a number of soil samples (real) during the OU4 Phase I RFI/RI (Appendix II Y). A discussion of the utility of this data for evaluating the nature and extent of contamination is presented in Section II 4 0, Nature and Extent of Contamination.

The only semivolatile organic compound detected in the equipment rinsate blanks was dimethyl phthalate. It was detected above the laboratory's CRQL (10 µg/L), and as with the acetone and methylene chloride, dimethyl phthalate is a common laboratory contaminant.

Table II 3 6-9 presents the detections of metals in the equipment rinsate blanks. The most common metals identified in the rinsate samples were iron and silicon. Iron was detected in three rinsate samples analyzed and was above the laboratory's CRQL. Silicon was detected and was above the CRQL in four samples. Calcium, lead, sodium, and zinc were detected above the CRQL in vadose zone equipment rinsate sample number VE40834AE. Mercury was above the CRQL in one surface soil sample while the amount of tin was below the CRQL in one borehole. The results of the equipment rinsate samples do not alter the conclusions drawn regarding the surface soil or borehole soil chemistry related to metals because of the numerous other supporting field samples and controlled QC samples.

Nitrate/nitrite was detected at concentration above the CRQL in five of the six water quality equipment rinsate samples (Table II 3 6-10). Sulfide was detected in two rinsate samples analyzed. Comparison of the concentrations of nitrate/nitrite identified in the soil and vadose zone waters with the rinsate sample results indicates that the levels present in the rinsates do not alter the conclusions drawn regarding the distribution of nitrate/nitrite at the site. The level of sulfide present in the vadose zone rinsate sample may suggest that sulfide concentrations detected in the vadose zone should be scrutinized. Pesticides and PCBs did not occur in the equipment rinsate blanks.

As presented in Table II 3 6-11, the majority of the concentrations of radiological compounds detected in the rinsate samples were below the CRQL. The rinsate sample SS40579 did contain americium-241, plutonium-239/240, and uranium-233/234 above the CRQL without accounting for the potential error introduced by the analytical method. Rinsate sample BH40826 collected near borehole 46893 contained americium-241 and gross beta above the CRQL. In addition, borehole rinsate sample BH40025AE contained a gross beta result above the CRQL. The concentrations identified in these equipment rinsate samples are below or very close to the CRQL and do not appear to have adversely affected the quality of the associated field samples.

Due to the absence or low concentrations observed in the rinsate samples, the equipment blank data indicate that the sampling equipment was not a significant source contributing to the observed analyte concentrations in the soils and vadose zone pore water in OU4 Phase I RFI/RI samples. Although the quantity of equipment rinsate blanks required under the Work Plan was not met, the presence of site contaminants in the blanks were at sufficiently low levels that decisions presented in this IM/IRA EA DD could not be influenced by possible cross-contamination of samples from improperly clean sampling equipment.

Laboratory Accuracy

Accuracy of the laboratory data is assessed through the calculation of the percent recoveries (%R) from MS samples for inorganic analytes, MS/MSD samples for organic analytes, and any in-house or blind certified standard that the laboratory analyzes as part of the required QA/QC program. Acceptable accuracy for inorganic MS samples is routinely a recovery between 75 percent and 125 percent. The %R for the organic MS/MSD analyses is mandated by analytical methods for the specific spiked compounds. Acceptable accuracy of the

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in-house standards is a recovery between 80 percent and 120 percent. Use of method blanks analyses in the laboratory also assist in analytical accuracy. All these measurements are evaluated during the method data validation process. When analytical accuracy goals are not achieved, data are rejected.

Evaluation of the validation reason codes cited for data rejection as summarized in Table II 3 6-4 indicates that the rejection of data can often be associated with accuracy problems. However, as discussed in the validation section, less than 2 percent of the validated data have been rejected, which suggests that accuracy is not a significant problem with the currently validated data set.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic(s) of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with proper network design, sampling locations, and sampling methods.

Representativeness of the sources of contamination in OU4 subsurface soils, surface samples, and vadose zone fluids is supported by the extensiveness of the OU4 Phase I RFI/RI sampling effort in characterizing the investigation area. Representativeness is considered in project planning and is supported by the Work Plan, TMs, QAA, and associated operating procedures. The Work Plan and subsequent TMs were designed based on the results of the previous investigations and the DQOs identified. The sampling activities were designed and conducted to optimize the network of soil borings, piezometers, and vadose zone monitoring points to define the existing sources of contamination present in OU4. The plans and procedures are reviewed and approved by appropriate technical and agency representatives. As a result, the network and sampling design for the OU4 Phase I RFI/RI are assumed to be representative of site conditions.

Comparability

Comparability is used to express the confidence with which one set of data can be compared to another set. Comparability is promoted by using similar sampling and analytical methods and reporting data in uniform units. To achieve comparability for the OU4 Phase I RFI/RI data, all analyses and sampling techniques prescribed in the Work Plan and subsequent TMs are EPA-accepted or equivalent methods. The data are reported in uniform units for each method and media. Quantitation limits for the OU4 Phase I RFI/RI data may differ from the previous investigations, which is indicative of the differing analytical methods used during the previous investigations. A demonstration of the comparability of the data is the general consistency in the results between the various sample locations and different media analyzed.

Completeness

The objective of completeness is that the investigation provides enough planned data such that the objectives of the project are met. Completeness for the OU4 Phase I RFI/RI is evaluated by comparing the planned number to the actual number of samples collected and analyzed. The analytical results should be validated and deemed valid or acceptable to be considered in an assessment of completeness. The overall completeness goal for the OU4 Phase I RFI/RI is 90 percent.

The difficulty in assessing the completeness of the OU4 Phase I RFI/RI investigation based on the above guidelines is that the initial planned numbers of samples were not specified due to the anticipated variation in the extent of the alluvial soil section and ability to obtain vadose zone water samples. Therefore, the approach to quantifying completeness is to present a summary of the planned sampling locations and the number of actual locations sampled. The Work Plan and subsequent TMs did specify the number of boreholes and vadose zone sampling points to be collected and the types of analyses to be performed at each sample location. Samples not collected or locations not installed were due to extenuating circumstances related to access, weather, and subsurface conditions encountered. Finally, completeness of the data set at the time of the preparation of this report is affected by the 13 percent of data not yet validated (Table II 3 6-2). As indicated above, the invalidated data is still incorporated into the determination of the contaminant sources definitions, reducing the significance of this factor to the completeness determination.

As shown on Table II 3 6-12, the OU4 Phase I RFI/RI data set was to consist of 49 boreholes, six of which were to be deep boreholes, four nested piezometers, and 35 surficial soil samples. Based on the clarification presented in TM1 and TM2, the program was amended to include 43 total boreholes, which includes two deep boreholes and 16 boreholes converted to vadose zone monitoring points and geotechnical sampling locations, 78 surficial soil samples, and five shallow trenches. Based on a comparison with the actual work completed as presented in Table II 2-1, the OU4 Phase I RFI/RI data exceeded the completeness criteria of 90 percent.

II.3.6.3 Historical Data Management and Quality

The historical data that have been incorporated into this report supplement the OU4 Phase I RFI/RI data to ensure that contamination identified in previous investigations of OU4 is considered. As described in conjunction with the OU4 Phase I RFI/RI data, the historical data consist of both validated and invalidated data. Rejected data are presented but are not incorporated. The historical data available for incorporating into the OU4 Phase I RFI/RI data consist primarily of subsurface soil samples. No historical surficial samples, aqueous vadose zone samples, or trench samples were identified in the historical data base. All available borehole soil samples are used to demonstrate the validity and usability of the historical data. In defining the extent of contamination in the unsaturated zone, only the historical soil data from above the historical minimum ground water level were used. Additionally, historical data that were analyzed at the RFETS (identified in the T_GRP_CODE field with "RFME", "RFRA",

and "RFVO"), particularly during the period of time from 1987 to early 1989, were determined to be of questionable utility unless flagged with a "V" in the validation field

II.3.6.3.1 Historical Data Validation

Portions of the historical analytical data were reviewed and validated independently of the laboratory or the sample collection contractor, and the results were documented in data validation reports. Similar functional guidelines to those applied to the OU4 Phase I RFI/RI data were used to validate the historical data. The purpose of validating the historical data was to be able to incorporate the information for evaluating nature and extent of the contamination identified by the OU4 Phase I RFI/RI data. For this report, historical validated and acceptable data were considered of equal utility to the OU4 Phase I RFI/RI data. Rejected data were not used in any statistical computations or contaminant source evaluation. The reasons the historical data analyzed at the RFETS were of questionable utility are that there was poor or no documentation of the analytical methods used, no documentation of laboratory QA procedures used, and no reporting guidelines.

Table II 3 6-13 summarizes the status of the historical data validation by media and analytical method. As of March 1994, 70 percent of the historical data have been validated. Invalidated data are also used in the analysis of contamination distribution. As with the OU4 Phase I RFI/RI data, use of the invalidated data should not reduce the quality of the conclusions drawn except for the previously mentioned analyses of questionable use, which was not used in the evaluation of the nature and extent of contamination. A total of 1.25 percent of the historical data validated has been rejected.

Metals and radionuclides data obtained in 1987 and 1989 have been labeled "N" as not validated due to insufficient collection and analytical records. For this report, these data are considered useful for the purposes of evaluating the nature and extent of contamination.

Listed in Table II 3 6-14 are summaries of the validation code reasons identified in RFETS by the data validation contractor while analyzing the historical data. Table II 3 6-15 presents the reason codes which were identified for the rejection of data. The more common reasons identified for the rejection of data are related to documentation not being provided, key fields wrong, laboratory results not verifiable or not submitted, or LCS not submitted (codes 18, 84, 51, 74). These rejection rationales may be due to previous laboratory SOPs which have been improved since the historical data were obtained. The other common reasons for rejection of data were that the MDAs were calculated by reviewer, or that the laboratory control samples exceeded +/- 3 sigma (codes 78 and 32). As with the OU4 Phase I RFI/RI data, the rejected data were removed from the data summary. The overall low percentage of historical data (<2 percent) is similar to the OU4 Phase I RFI/RI data, indicating that the use of the unvalidated historical data should not compromise the validity of the resulting conclusions.

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II.3.6.3.2 Assessment of Historical Data Usability

The historical data usability is based on the PARCC parameters. Review of the available historical data indicates that duplicate samples are available to evaluate the field precision of data. Field rinsate or blanks are not available in the RFEDS data base. Therefore, the field accuracy of the historical data cannot be determined. The laboratory precision and accuracy are evaluated during the validation process. Historical data not meeting the laboratory precision or accuracy goals set forth by the methods are rejected. The representativeness and completeness of the historical data set are determined to be insufficient to characterize the contamination in the OU4 area.

Field Precision of Historical Data

The same procedure for determining the precision of the OU4 Phase I RFI/RI data was used for the historical data. All data available were included in this analysis. The field precision objective specified in the QAA is to obtain an RPD of ≤ 30 percent for water samples and ≤ 40 percent for homogeneous, nonaqueous samples (soil). For metals and radionuclides with failed RPDs and at concentrations near the quantitation limit, as defined in the GRRASP, precision may be expressed as acceptable when the analyte concentration difference between the sample and duplicate fall within the CRQL of each other. During the evaluation of the historical data, the CRQLs listed in Appendix B of the 1991 QAPjP were used to aid in determining precision.

In conjunction with the precision objectives outlined in the QAA for OU4 Phase I RFI/RI, the number of duplicate samples required to demonstrate precision was one duplicate pair for every 10 samples collected, or 10 percent of the field samples. A total of 412 real borehole soil samples and 25 associated duplicate soil samples are identified in the RFEDS data base. Based on these ratios, the overall field QC frequency for the historical data is 1 to 21 or 4.6 percent for the subsurface soil. A list of the historical duplicates and associated field samples (QC partners) is presented by method and analyte in Table II 3 6-16. A summary table of the degree to which the field precision goals were met is provided in Table II 3 6-17. Calculated RPDs are presented in Table II Y-2 in Appendix II Y.

Based on the available analytical results, 966 RPDs were calculated for 40 analyte duplicate pairs. Overall, a total of 82.9 percent of the field duplicate analyzed meet the field precision goals.

Using the CRQL criteria as well as the calculated RPDs, a total of 80.9 percent of the metals duplicate field samples achieved the precision goals. The radionuclide data had similar results with 83.7 percent of the data evaluated meeting the precision goals. Overall, 88.9 percent of the field duplicates met the precision goal.

Review of the radionuclides and the metal data indicates that only 60.5 percent and 72 percent, respectively, of the historical data set passed the RPD precision test. Although, the

metal data labeled RFME and the radionuclide data labeled RFRA in the T_GRP_CODE field cannot be validated due to the lack of proper collection and analytical records, these data were considered useful for evaluating the nature and extent of contamination

Eleven historical duplicate soil pairs were analyzed for volatile organic field precision (Table II 3 6-17) The percentage of analytes achieving the field precision goals was 96 2 percent Two semivolatile duplicate pairs with 132 RPDs were analyzed With two semivolatile RPDs failing, the field precision goal was 98 5 percent There were no water quality or pesticide/PCBs duplicate pairs available to determine the field precision

The results of the field precision evaluation indicate that QA of field sampling was adequate Variation in analytical results due to matrix interference should not be significant in the historical data for subsurface soils in OU4 The lack of documentation may prevent the use of much of the metals and radionuclide data present in the historical data set The data available for organics and water quality analytes are not sufficient to make a determination

II.3.6.3.3 OU4 Phase I RFI/RI and Historical Data Comparison

Comparability is used to express the confidence with which one set of data can be compared to another set Comparability is promoted by using similar sampling and analytical methods and by reporting data in uniform units To achieve comparability of the historical data in comparison with the OU4 Phase I RFI/RI data, the analyses and sampling techniques used should be EPA- accepted or equivalent methods, and should be similar

The objective of this comparison was to ensure that the analytes previously detected in the OU4 area were incorporated into the nature and extent evaluation The presence of previously detected analytes in the historical data was verified by the presence of that analyte in the OU4 Phase I RFI/RI data The validity of contaminants that were identified prior to the OU4 Phase I RFI/RI but not detected in OU4 Phase I RFI/RI data, was evaluated on an individual basis

Comparison of the analytes presented in the historical data to those in the OU4 Phase I RFI/RI data indicates primary differences occur in the record-keeping of some of the data The data in both sets were reported in consistent units and by consistent analytical methods (when that information was available) Both the OU4 Phase I RFI/RI and historical data sets have variable detection limits reported within the respective soils data sets The detection limit ranges and distribution of detection limits were similar in both data sets, suggesting that varying detection limits were not factors to be considered in comparing the data

A review of Tables II 3 6-2 and II 3 6-13 provided an initial comparison of the OU4 Phase I RFI/RI and historical data sets for OU4 Using total analyte results in the RFEDS data base, the OU4 Phase I RFI/RI data set containing 36,724 records is comparable to the historical data set containing 20,151 records The OU4 Phase I RFI/RI data set consisted of surficial and subsurface soils, bedrock, and as vadose zone pore water, while the historical data set contained

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only subsurface soils and bedrock data. The historical data contain fewer metal analyte records (6,994) than the OU4 Phase I RFI/RI subsurface soil data (9,498). The historical data also contain fewer radionuclide analyte records (2,465) than the OU4 Phase I RFI/RI subsurface soil (3,014) data. As mentioned above, the validity of the historical metals (RFME) and radionuclide (RFRA) data from RFEDS may be questionable. Therefore, the OU4 Phase I RFI/RI data set was given greater consideration in the evaluation of the nature and extent of contamination.

The following differences were noted when the historical and the OU4 Phase I RFI/RI radionuclides were compared. The OU4 Phase I RFI/RI data contain only gross alpha and gross beta determinations, while the historical data were divided into gross alpha and beta, as well as dissolved, suspended, and particle activity alpha and beta units. Plutonium-238 is not identified in the historical data set, but is included in the OU4 Phase I RFI/RI data.

Comparison of the historical volatile analyte list with the OU4 Phase I RFI/RI data indicates that the method lists are similar with additional analytes identified in the OU4 Phase I RFI/RI method. Trans-1,2-dichloroethene and 2-chloroethyl vinyl ether were not identified on the OU4 Phase I RFI/RI list, but are present on the historical method list. Based on the RFEDS data base, no surficial soils were analyzed for volatile organic compounds during any historical or OU4 Phase I RFI/RI investigations.

Comparison of the historical data analyte list for semivolatiles contains 4-hydroxy-4-methyl-2-pentanone, 1-methyl-2-pyrrolidinone, benzoperylene, and hexachlorobenzene as additional analytes not present on the OU4 Phase I RFI/RI data method list. No pesticides or PCBs were present in the historical data base. In addition, no vadose zone pore water samples were collected during the historical investigations.

Based on these evaluations, it was concluded that the historical data and OU4 Phase I RFI/RI data were considered to be of comparable quality and that there is general consistency in the results between the various sample locations and different sample periods. The historical data were incorporated as appropriate into the nature and extent evaluation.

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TABLE IL3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
1A	1	300	<250	0	24
	2	300	<250	3	0
	3	400	<250	3	3
	4	350	<250	0	3
	5	500	<250	3	0
	6	500	<250	0	0
1B	7	<250	<250	0	0
	8	<250	<250	0	21
	9	<250	<250	3	33
1C	10	<250	<250	3	33
	11	250	<250	0	0
	12	500	<250	0	0
1D	13	<250	<250	3	3
	14	<250	<250	0	12
	15	<250	<250	6	45
1E	16	<250	<250	3	0
	17	<250	<250	0	0
	18	<250	<250	0	0
1F	19	<250	<250	0	27
	20	<250	<250	6	0
	21	400	<250	0	0
1G	22	<250	<250	6	0
	23	300	<250	0	33
	24	<250	<250	3	0
1H	25	300	<250	3	0
	26	<250	<250	0	0
	27	<250	<250	3	33
2H	28	<250	<250	3	9
	29	<250	<250	0	0
	30	500	<250	3	3
2G	31	500	<250	3	0
	32	1000	<250	6	0
	33	500	<250	6	0
2F	34	<250	<250	3	15
	35	600	<250	6	0
	36	<250	<250	9	0
2E	37	250	<250	3	27
	38	250	<250	3	0
	39	500	<250	0	0
2D	40	<250	<250	0	6
	41	300	<250	3	6
	42	300	<250	6	24
2C	43	<250	<250	0	0
	44	250	<250	6	3
	45	500	<250	108	45
2B	46	<250	<250	0	18

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TABLE II.3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
	47	<250	<250	3	0
	48	600	<250	9	18
2A	49	<250	<250	6	48
	50	<250	<250	9	6
	51	<250	<250	0	0
	52	<250	<250	0	0
	53	<250	<250	0	0
	54	<250	<250	0	0
	55	<250	<250	18	36
3A	56	<250	<250	0	9
	57	<250	<250	15	0
	58	<250	<250	12	27
3B	59	800	<250	12	0
	60	800	<250	6	0
	61	800	<250	0	30
3C	62	<250	<250	0	0
	63	500	<250	3	0
	64	<250	<250	0	0
3D	65	300	<250	6	6
	66	<250	<250	3	0
	67	<250	<250	0	42
3E	68	<250	<250	3	0
	69	<250	<250	3	27
	70	600	<250	0	0
3F	71	<250	<250	3	27
	72	<250	<250	0	12
	73	<250	<250	3	18
3G	74	<250	<250	0	0
	75	500	<250	0	15
	76	<250	<250	9	9
3H	77	<250	<250	6	18
	78	500	<250	0	0
	79	500	<250	6	0
4H	80	<250	<250	3	0
	81	<250	<250	0	3
	82	<250	<250	3	24
4G	83	500	<250	3	0
	84	<250	<250	0	6
	85	500	<250	3	0
4F	86	<250	<250	9	0
	87	500	<250	0	0
	88	<250	<250	9	27
4E	89	<250	<250	9	9
	90	<250	<250	3	15
	91	<250	<250	0	0
4D	92	<250	<250	9	0

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TABLE II.3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
	93	<250	<250	12	0
	94	<250	<250	6	0
4C	95	<250	<250	0	0
	96	<250	<250	3	0
	97	300	<250	0	3
4B	98	<250	<250	9	3
	99	<250	<250	6	0
	100	300	<250	6	3
4A	101	<250	<250	0	0
	102	300	<250	3	0
	103	<250	<250	0	0
5A	104	700	<250	3	36
	105	<250	<250	3	0
	106	<250	<250	0	9
5B	107	<250	<250	3	18
	108	<250	<250	3	0
	109	<250	<250	6	12
5C	110	500	<250	3	18
	111	<250	<250	0	0
	112	<250	<250	0	6
5D	113	<250	<250	15	0
	114	<250	<250	0	30
	115	<250	<250	0	0
5E	116	<250	<250	3	12
	117	<250	<250	6	0
	118	300	<250	0	12
5F	119	<250	<250	0	0
	120	300	<250	3	0
	121	<250	<250	0	0
5G	122	<250	<250	6	0
	123	500	<250	6	9
	124	<250	<250	0	21
5H	125	<250	<250	6	3
	126	<250	<250	3	12
	127	<250	<250	3	0
6H	128	<250	<250	0	3
	129	<250	<250	3	12
	130	<250	<250	6	0
6G	131	300	<250	0	0
	132	1000	<250	6	21
	133	300	<250	12	15
6F	134	750	<250	3	6
	135	500	<250	6	15
	136	400	<250	0	6
6E	137	300	<250	6	36
	138	300	<250	0	0

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TABLE II.3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
	139	300	<250	3	0
6D	140	<250	<250	3	0
	141	<250	<250	0	0
	142	<250	<250	3	42
6C	143	<250	<250	3	3
	144	<250	<250	6	3
	145	<250	<250	0	33
6B	146	<250	<250	3	0
	147	<250	<250	6	0
	148	<250	<250	3	36
6A	149	<250	<250	3	27
	150	<250	<250	0	12
	151	<250	<250	0	0
7H	152	<250	<250	3	0
	153	<250	<250	0	0
	154	<250	<250	0	0
7G	155	500	<250	15	0
	156	1000	<250	6	0
	157	750	<250	3	0
7F	158	500	<250	3	0
	159	500	<250	9	3
	160	500	<250	0	9
7E	161	300	<250	0	6
	162	300	<250	3	0
	163	<250	<250	3	0
7D	164	<250	<250	0	0
	165	<250	<250	0	0
	166	<250	<250	3	3
7C	167	<250	<250	3	24
	168	<250	<250	12	0
	169	<250	<250	0	0
7B	170	<250	<250	0	0
	171	<250	<250	6	0
	172	<250	<250	6	3
7A	173	700	<250	0	0
	174	700	<250	6	0
	175	700	<250	3	0
8A	176	<250	<250	0	9
	177	<250	<250	6	0
	178	<250	<250	0	6
8B	179	<250	<250	0	0
	180	<250	<250	3	3
	181	<250	<250	0	0
8C	182	<250	<250	0	0
	183	<250	<250	9	0
	184	<250	<250	6	45

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TABLE II.3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
8D	185	<250	<250	0	21
	186	<250	<250	6	0
	187	<250	<250	0	6
8E	188	<250	<250	0	0
	189	300	<250	0	0
	190	300	<250	6	0
8F	191	300	<250	12	18
	192	500	<250	12	0
	193	500	<250	9	6
8G	194	500	<250	12	0
	195	500	<250	12	0
	196	500	<250	3	18
8H	197	<250	<250	0	0
	198	<250	<250	3	0
	199	<250	<250	18	0
9H	200	<250	<250	3	0
	201	<250	<250	3	0
	202	<250	<250	0	0
9G	203	500	<250	3	24
	204	699	<250	30	36
	205	600	<250	3	0
9F	206	500	<250	30	0
	207	750	<250	15	24
	208	500	<250	3	39
9E	209	500	<250	18	12
	210	500	<250	3	0
	211	500	<250	0	0
9D	212	<250	<250	9	0
	213	<250	<250	9	0
	214	<250	<250	3	30
9C	215	<250	<250	3	0
	216	<250	<250	15	0
	217	<250	<250	12	3
9B	218	<250	<250	12	0
	219	<250	<250	6	30
	220	<250	<250	6	0
9A	221	<250	<250	0	6
	222	<250	<250	0	0
	223	<250	<250	12	0
10A	224	<250	<250	3	0
	225	<250	<250	3	0
	226	<250	<250	6	21
10B	227	<250	<250	9	6
	228	<250	<250	6	0
	229	<250	<250	3	0
10C	230	<250	<250	15	0

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TABLE II.3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
	231	<250	<250	15	0
	232	<250	<250	9	0
10D	233	<250	<250	21	18
	234	<250	<250	6	0
	235	<250	<250	3	42
10E	236	<250	<250	3	0
	237	<250	<250	6	0
	238	<250	<250	6	6
10F	239	1500	<250	9	21
	240	500	<250	3	3
	241	1500	<250	21	0
10G	242	800	<250	15	0
	243	1500	<250	60	0
	244	1500	<250	45	0
10H	245	<250	<250	3	0
	246	<250	<250	3	0
	247	<250	<250	3	0
11H	248	<250	<250	3	21
	249	<250	<250	3	0
	250	<250	<250	0	6
11G	251	<250	<250	6	6
	252	<250	<250	90	0
	253	<250	<250	36	36
11F	254	<250	<250	21	27
	255	<250	<250	39	0
	256	<250	<250	18	0
11E	257	<250	<250	12	0
	258	<250	<250	12	0
	259	<250	<250	6	21
11D	260	<250	<250	9	9
	261	<250	<250	0	0
	262	<250	<250	12	18
11C	263	<250	<250	6	24
	264	<250	<250	12	0
	265	<250	<250	9	30
11B	266	250	<250	15	18
	267	250	<250	6	0
	268	250	<250	3	0
11A	269	500	<250	12	6
	270	750	<250	6	0
	271	250	<250	15	0
12A	272	500	<250	6	42
	273	500	<250	0	6
	274	500	<250	24	0
12B	275	250	<250	0	18
	276	250	<250	9	0

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TABLE II.3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
12C	277	250	<250	3	0
	278	<250	<250	9	36
	279	<250	<250	0	6
	280	<250	<250	15	0
12D	281	<250	<250	6	48
	282	<250	<250	6	21
	283	<250	<250	9	0
12E	284	<250	<250	18	45
	285	<250	<250	6	0
	286	<250	<250	24	0
12F	287	<250	<250	36	0
	288	<250	<250	18	0
	289	<250	<250	45	12
12G	290	<250	<250	99	0
	291	<250	<250	9	0
	292	<250	<250	6	33
12H	293	<250	<250	63	0
	294	<250	<250	0	9
	295	<250	<250	3	48
13H	296	<250	<250	6	0
	297	<250	<250	3	0
	298	<250	<250	0	3
13G	299	<250	<250	3	33
	300	<250	<250	15	0
	301	<250	<250	6	0
13F	302	<250	<250	12	33
	303	<250	<250	39	0
	304	<250	<250	54	15
13E	305	<250	<250	18	3
	306	<250	<250	9	57
	307	<250	<250	27	3
13D	308	<250	<250	36	39
	309	<250	<250	11	12
	310	<250	<250	6	9
13C	311	<250	<250	12	9
	312	<250	<250	3	24
	313	<250	<250	66	12
13B	314	<250	<250	33	12
	315	<250	<250	6	0
	316	<250	<250	12	3
13A	317	500	<250	0	0
	318	500	<250	3	0
	319	500	<250	0	15
14A	320	<250	<250	3	27
	321	<250	<250	6	0
	322	<250	<250	0	0

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TABLE II.3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
14B	323	<250	<250	3	63
	324	<250	<250	3	9
	325	<250	<250	6	0
14C	326	<250	<250	3	15
	327	<250	<250	15	0
	328	500	<250	12	3
14D	329	500	<250	21	9
	330	500	<250	30	6
	331	500	<250	6	3
14E	332	500	<250	15	33
	333	500	<250	42	0
	334	500	<250	48	9
14F	335	300	<250	9	9
	336	<250	<250	33	0
	337	<250	<250	9	6
14G	338	<250	<250	6	6
	339	250	<250	48	0
	340	250	<250	9	30
14H	341	250	<250	1	0
	342	<250	<250	26	0
	343	<250	<250	30	0
15H	344	<250	<250	3	0
	345	<250	<250	3	0
	346	2500	<250	0	18
15G	347	2500	<250	15	45
	348	2500	<250	6	0
	349	1000	<250	3	21
15F	350	1500	<250	9	12
	351	800	<250	9	0
	352	1500	<250	12	0
15E	353	1500	<250	39	0
	354	1500	<250	42	12
	355	800	<250	24	0
15D	356	750	<250	54	0
	357	250	<250	36	0
	358	<250	<250	21	39
15C	359	<250	<250	15	18
	360	<250	<250	18	3
	361	<250	<250	6	51
15B	362	<250	<250	12	60
	363	<250	<250	6	24
	364	<250	<250	9	0
15A	365	<250	<250	3	42
	366	<250	<250	3	0
	367	<250	<250	9	21
16A	368	<250	<250	0	21

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TABLE II.3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
	369	<250	<250	0	0
	370	<250	<250	9	0
17A	371	<250	<250	9	3
	372	<250	<250	0	0
	373	<250	<250	6	3
17B	374	<250	<250	0	0
	375	<250	<250	6	0
	376	<250	<250	0	0
16B	377	<250	<250	6	24
	378	<250	<250	9	0
	379	<250	<250	0	12
16C	380	<250	<250	9	9
	381	<250	<250	0	3
	382	<250	<250	0	3
17C	383	<250	<250	3	6
	384	<250	<250	0	15
	385	<250	<250	3	15
17D	386	<250	<250	6	0
	387	<250	<250	3	9
	388	<250	<250	6	0
16D	389	<250	<250	0	57
	390	400	<250	0	0
	391	500	<250	3	9
16E	392	1500	<250	45	0
	393	1000	<250	60	24
	394	1000	<250	33	0
17E	395	<250	<250	3	3
	396	<250	<250	3	0
	397	<250	<250	0	0
17F	398	<250	<250	6	0
	399	<250	<250	0	15
	400	<250	<250	0	0
16F	401	<250	<250	9	24
	402	<250	<250	3	0
	403	<250	<250	0	15
16G	404	<250	<250	21	12
	405	<250	<250	9	12
	406	<250	<250	6	6
17G	407	<250	<250	9	0
	408	<250	<250	6	0
	409	<250	<250	0	0
17H	410	<250	<250	0	9
	411	<250	<250	0	0
	412	<250	<250	3	12
16H	413	<250	<250	6	0
	414	<250	<250	0	0

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TABLE IL3.1-1

POND 207-A ALPHA AND BETA RADIATION SURVEY DATA

Grid Designation	Survey Point	Alpha Total Reading (cpm)	Alpha Swipe (cpm)	Alpha Smear (dpm/100cm ²)	Beta Smear (dpm/100cm ²)
	415	<250	<250	0	12
	416	<250	<250	0	24
	417	<250	<250	0	0
	418	<250	<250	6	0
	419	<250	<250	12	21

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TABLE IL3 1-2

POND 207-A GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Point	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Background (cpm)	Adjusted FIDLER Measurement (cpm)
1	34374	3500	3618	30756
2	9624	3500	3618	6006
3	4989	3500	3618	1371
4	4386	3500	3618	768
5	4326	3500	3618	708
6	8296	3500	3618	4678
7	9283	3500	3618	5665
8	8619	3500	3618	5001
9	4223	3500	3618	605
10	3882	3500	3618	264
11	4736	3500	3618	1118
12	4000	3500	3618	382
13	4084	3500	3618	466
14	3808	3500	3618	190
15	4714	3500	3618	1096
16	13642	3500	3618	10024
17	8573	3500	3618	4955
18	5129	3500	3618	1511
19	3098	3500	3618	-520
20	3029	3500	3618	-589
21	3053	3500	3618	-565
22	2935	3500	3618	-683
23	2976	3500	3618	-642
24	3958	3500	3618	340
25	27334	3500	3618	23716
26	4060	3500	3618	442
27	3896	3500	3618	278
28	3702	3500	3618	84
29	3696	3500	3618	78
30	3748	3500	3618	130
31	3949	3500	3618	331
32	5257	3500	3618	1639
33	4602	3500	3618	984
34	3179	3500	3618	-439
35	3104	3500	3618	-514
36	2625	3500	3618	-993
37	2976	3500	3618	-642
38	2848	3500	3618	-770
39	3227	3500	3618	-391
40	3958	3500	3618	340
41	5196	3500	3618	1578
42	3709	3500	3618	91
43	3777	3500	3618	159
44	3902	3500	3618	284
45	3849	3500	3618	231
46	3707	3500	3618	89
47	4165	3500	3618	547
48	4164	3500	3618	546
49	4224	3500	3618	606
50	3195	3500	3618	-423
51	3687	3500	3618	69
52	3018	3500	3618	-600
53	3933	3500	3618	315

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TABLE IL3 1-2

POND 207-A GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Point	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Background (cpm)	Adjusted FIDLER Measurement (cpm)
54	3288	3500	3618	-330
55	3725	3500	3618	107
56	14441	3500	3618	10823
57	5058	3500	3618	1440
58	3244	3500	3618	-374
59	2691	3500	3618	-927
60	3415	3500	3618	-203
61	5731	3500	3618	2113
62	4822	3500	3618	1204
63	4165	3500	3618	547
64	3298	3500	3618	-320
65	4307	3500	3618	689
66	3244	3500	3618	-374
67	3374	3500	3618	-244
68	3255	3500	3618	-363
69	3191	3500	3618	-427
70	3281	3500	3618	-337
71	3714	3500	3618	96
72	3976	3500	3618	358
73	4736	3500	3618	1118
74	3332	3500	3618	-286
75	3822	3500	3618	204
76	3119	3500	3618	-499
77	3108	3500	3618	-510
78	3741	3500	3618	123
79	6539	3500	3618	2921
80	3938	3500	3618	320
81	4164	3500	3618	546
82	5548	3500	3618	1930
83	3375	3500	3618	-243
84	3091	3500	3618	-527
85	3291	3500	3618	-327
86	3217	3500	3618	-401
87	3379	3500	3618	-239
88	5470	3500	3618	1852
89	3533	3500	3618	-85
90	3481	3500	3618	-137
91	3348	3500	3618	-270
92	3498	3500	3618	-120
93	3566	3500	3618	-52
94	5483	3500	3618	1865
95	5131	3500	3618	1513
96	4460	3500	3618	842
97	3627	3500	3618	9
98	3936	3500	3618	318
99	4621	3500	3618	1003
100	3744	3500	3618	126
101	3605	3500	3618	-13
102	3373	3500	3618	-245
103	3576	3500	3618	-42
104	3217	3500	3618	-401
105	3225	3500	3618	-393
106	3768	3500	3618	150

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TABLE IL3 1-2

POND 207-A GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Point	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Background (cpm)	Adjusted FIDLER Measurement (cpm)
107	3802	3500	3618	184
108	2875	3500	3618	-743
109	5197	3500	3618	1579
110	3244	3500	3618	-374
111	3374	3500	3618	-244
112	3255	3500	3618	-363
113	3949	3500	3618	331
114	2730	3500	3618	-888
115	2860	3500	3618	-758
116	3891	3500	3618	273
117	4611	3500	3618	993
118	4496	3500	3618	878
119	5805	3500	3618	2187
120	4041	3500	3618	423
121	3519	3500	3618	-99
122	4023	3500	3618	405
123	2814	3500	3618	-804
124	3320	3500	3618	-298
125	3873	3500	3618	255
126	3533	3500	3618	-85
127	3737	3500	3618	119
128	3590	3500	3618	-28
129	4265	3500	3618	647
130	3534	3500	3618	-84
131	3683	3500	3618	65
132	3488	3500	3618	-130
133	3366	3500	3618	-252
134	3463	3500	3618	-155
135	3869	3500	3618	251
136	3931	3500	3618	313

POND 207-A FIDLER BACKGROUND CALCULATION

The counts are gross cpm The FIDLER background calculation is based on standard RFP practice and EMRG 6 6

B = FIDLER Background

Bo = FIDLER Checkpoint Reading

$B = Bo + (2 * \text{sqrt}(Bo))$

$B = 3500 + 2 * 59 = 3618$

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TABLE IL3.1-3

SEP 207-B CENTER RADIATION SURVEY RESULTS

Grid Location	Alpha counts/min Direct	Alpha dpm/100cm2 Removable (Smear)	Beta counts/min Direct	Beta dpm/100cm2 Removable (Smear)	Gamma Background	Gamma counts/min Meter	Gamma Scaler	Gamma Scaler - Bkgrnd Results
1	< 250	9	6000	48	1694	5000	4674	2980
2	< 250	3	150	46	1694	3000	2566	872
3	< 250	12	150	61	1694	3000	2607	913
4	< 250	6	140	70	1694	2500	2323	629
5	< 250	9	120	50	1694	3000	2707	1013
6	< 250	12	150	54	1694	2500	2462	768
7	< 250	3	150	60	1694	2000	2200	506
8	< 250	12	150	100	1694	3000	2540	846
9	< 250	6	100	40	1694	3000	2563	869
10	< 250	6	250	43	1694	3000	2605	911
11	< 250	6	350	45	1694	3000	2921	1227
12	< 250	3	100	111	1694	2500	2389	695
13	< 250	3	100	66	1694	2000	2121	427
14	< 250	15	150	43	1694	3000	2847	1153
15	< 250	3	180	46	1694	2500	2518	824
16	< 250	9	160	69	1694	3000	3045	1351
17	< 250	6	200	44	1694	3000	2689	995
18	< 250	3	150	34	1694	2500	2159	465
19	300	3	180	40	1694	2500	2420	726
20	< 250	6	160	42	1694	3000	2647	953
21	< 250	3	200	28	1694	2500	2479	785
22	< 250	3	150	48	1694	2500	2315	621
23	< 250	3	180	64	1694	2500	2404	710
24	< 250	0	200	50	1694	2500	2340	646
25	< 250	3	200	38	1694	2500	2331	637
26	< 250	0	180	51	1694	2500	2365	671
27	< 250	0	200	37	1694	3000	2616	922
28	< 250	0	200	36	1694	2500	2294	600
29	< 250	3	220	47	1694	2500	2399	705
30	< 250	3	350	80	1694	2500	2436	742
31	< 250	0	150	36	1694	3000	2577	883
32	< 250	0	250	26	1694	2000	2181	487
33	< 250	0	180	60	1694	3000	2811	1117
34	< 250	0	200	55	1694	2500	2251	557
35	< 250	6	250	64	1694	2500	2403	709
36	< 250	3	200	72	1694	2500	2443	749
37	< 250	0	150	48	1694	2000	2158	464
38	< 250	3	250	70	1694	3000	2657	963
39	< 250	0	350	36	1694	2000	2094	400
40	< 250	3	300	50	1694	2500	2391	697
41	< 250	0	200	44	1694	3000	2794	1100
42	< 250	12	150	36	1694	2500	2311	617
43	< 250	0	100	38	1694	2500	2278	584
44	< 250	3	200	69	1694	3000	2758	1064
45	< 250	3	150	50	1694	2500	2258	564
46	250	0	300	48	1694	2500	2282	588
47	< 250	3	200	24	1694	2000	2029	335
48	< 250	3	250	60	1694	3000	2446	752

TABLE IL3.1-3

SEP 207-B CENTER RADIATION SURVEY RESULTS

Grid Location	Alpha counts/min Direct	Alpha dpm/100cm2 Removable (Smear)	Beta counts/min Direct	Beta dpm/100cm2 Removable (Smear)	Gamma Background	Gamma counts/min Meter	Scaler	Gamma Scaler - Bkgnd Results
49	300	0	250	21	1694	2500	2294	600
50	< 250	0	250	33	1694	2000	2067	373
51	< 250	0	200	27	1694	2500	2377	683
52	< 250	3	250	15	1694	2500	2298	604
53	250	0	200	90	1694	3000	2927	1233
54	< 250	9	300	15	1694	3000	2492	798
55	< 250	0	450	6	1694	3000	2859	1165
56	< 250	9	< BG	39	1694	2000	1937	243
57	< 250	12	< BG	21	1694	2000	1902	208
58	< 250	3	100	24	1694	2000	2117	423
59	< 250	3	< BG	0	1694	2000	2014	320
60	< 250	3	< BG	45	1694	2000	2033	339
61	< 250	12	150	36	1694	2000	1919	225
62	250	6	< BG	18	1694	2500	2379	685
63	250	18	250	75	1694	3000	2827	1133
64	< 250	9	100	0	1694	3000	2683	989
65	< 250	3	100	48	1694	2500	2348	654
66	< 250	18	150	6	1694	3000	2995	1301
67	250	6	< BG	18	1694	2500	2424	730
68	250	12	250	90	1694	2000	2162	468
69	< 250	3	150	60	1694	3000	2966	1272
70	250	21	< BG	0	1694	2500	2486	792
71	< 250	18	< BG	0	1694	2500	2446	752
72	< 250	24	150	39	1694	2000	2289	595
73	< 250	3	< BG	12	1694	4000	3551	1857
74	500	3	< BG	15	1694	3500	3829	2135
75	< 250	6	150	81	1694	2500	2533	839
76	< 250	9	< BG	30	1694	2000	2208	514
77	< 250	12	< BG	18	1694	3000	2646	952
78	< 250	6	< BG	54	1694	2500	2255	561
79	< 250	0	150	15	1694	3500	3536	1842
80	250	0	350	12	1694	4500	4245	2551
81	250	3	300	30	1694	2500	2525	831
82	< 250	0	150	0	1694	2000	2153	459
83	750	3	< BG	27	1694	3000	2804	1110
84	< 250	9	250	30	1694	2500	2286	592
85	300	3	150	21	1694	2500	2391	697
86	500	9	200	9	1694	3000	2895	1201
87	< 250	3	200	15	1694	2000	1938	244
88	300	0	< BG	3	1694	2500	2349	655
89	< 250	0	< BG	3	1694	3000	2592	898
90	250	3	100	18	1694	3000	2877	1183
91	< 250	6	< BG	15	1694	4000	4046	2352
92	< 250	3	< BG	0	1694	3000	2743	1049
93	250	0	< BG	0	1694	2500	2306	612
94	750	0	< BG	0	1694	2500	2316	622
95	300	6	< BG	0	1694	2500	2177	483
96	< 250	3	< BG	12	1694	2000	2189	495

TABLE IL3.1-3

SEP 207-B CENTER RADIATION SURVEY RESULTS

Grnd Location	Alpha	Alpha	Beta	Beta	Gamma Background	Gamma	Gamma Scaler	Gamma Scaler - Bkgrnd Results
	counts/min Direct	dpm/100cm2 Removable (Smear)	counts/min Direct	dpm/100cm2 Removable (Smear)		counts/min Meter		
97	< 250	3	< BG	0	1694	2500	2467	773
98	300	0	< BG	0	1694	2000	2034	340
99	250	6	100	18	1694	2500	2242	548
100	< 250	3	100	0	1694	2500	2415	721
101	< 250	0	200	9	1694	3000	3135	1441
102	< 250	3	< BG	0	1694	4000	3659	1965
103	< 250	0	< BG	0	1694	3000	2969	1275
104	< 250	3	100	0	1694	2500	2343	649
105	< 250	0	250	0	1694	2000	2170	476
106	250	3	< BG	0	1694	2500	2497	803
107	300	0	100	0	1694	2500	2209	515
108	400	15	< BG	15	1694	2500	2229	535
109	300	6	< BG	0	1694	2000	2083	389
110	< 250	0	150	21	1694	2500	2143	449
111	< 250	9	< BG	12	1694	3000	2647	953
112	< 250	3	400	6	1694	2500	2451	757
113	< 250	3	300	21	1694	3000	2519	825
114	300	0	< BG	36	1694	3000	2446	752
115	< 250	6	150	0	1694	3000	2775	1081
116	< 250	3	150	15	1694	2500	2390	696
117	250	12	100	0	1694	2000	2010	316
118	500	3	< BG	0	1694	2500	2316	622
119	< 250	0	< BG	18	1694	2500	2521	827
120	< 250	0	400	0	1694	2500	2511	817
121	< 250	0	300	0	1694	2500	2410	716
122	< 250	15	300	0	1694	3000	2588	894
123	< 250	3	150	18	1694	2500	2442	748
124	< 250	0	500	24	1694	2500	2359	665
125	< 250	3	< BG	12	1694	2500	2502	808
126	< 250	0	200	0	1694	3000	2611	917
127	< 250	6	200	0	1694	2500	2410	716
128	< 250	0	< BG	0	1694	3000	2416	722
129	< 250	0	150	12	1694	2500	2452	758
130	800	0	< BG	6	1694	2500	2216	522
131	< 250	0	< BG	15	1694	3000	2760	1066
132	300	12	< BG	0	1694	2000	2160	466
133	< 250	6	200	0	1694	2500	2450	756
134	< 250	6	< BG	0	1694	3000	2988	1294
135	< 250	0	350	0	1694	3000	2968	1274
136	250	3	100	0	1694	2500	2241	547
137	< 250	0	< BG	0	1694	2500	2356	662
138	500	0	200	0	1694	3000	2496	802
139	< 250	0	< BG	39	1694	3000	2612	918
140	800	0	200	0	1694	3000	2550	856
141	< 250	0	< BG	0	1694	3000	2961	1267
142	< 250	3	< BG	15	1694	2500	2344	650
143	250	9	< BG	0	1694	2500	2282	588
144	< 250	0	150	6	1694	2000	2190	496

TABLE IL3.1-3

SEP 207-B CENTER RADIATION SURVEY RESULTS

Grid Location	Alpha counts/min Direct	Alpha dpm/100cm2 Removable (Smear)	Beta counts/min Direct	Beta dpm/100cm2 Removable (Smear)	Gamma Background	Gamma counts/min Meter	Scaler	Gamma Scaler - Bkgrnd Results
145	< 250	3	250	30	1694	3000	2860	1166
146	< 250	0	< BG	6	1694	3000	3011	1317
147	< 250	0	< BG	0	1694	3000	2570	876
148	< 250	0	150	9	1694	3000	2894	1200
149	250	3	< BG	0	1694	3000	2750	1056
150	500	15	< BG	0	1694	2000	2014	320
151	600	3	< BG	21	1694	2500	2364	670
152	< 250	15	200	0	1694	2500	2305	611
153	< 250	0	150	0	1694	3000	2852	1158
154	< 250	6	< BG	3	1694	2500	2244	550
155	300	6	< BG	12	1694	2500	2221	527
156	< 250	6	< BG	6	1694	3000	2754	1060
157	< 250	3	150	0	1694	3500	3210	1516
158	< 250	0	< BG	3	1694	2500	2240	546
159	< 250	0	< BG	0	1694	2500	2327	633
160	< 250	3	< BG	0	1694	2500	2344	650
161	< 250	3	< BG	6	1694	2500	2210	516
162	< 250	0	< BG	9	1694	3000	2840	1146
163	< 250	0	< BG	0	1694	2500	2509	815
164	< 250	0	< BG	0	1694	2000	2071	377
165	< 250	3	400	0	1694	2500	2231	537

TABLE IL3.1-4

SEP 207-B NORTH RADIATION SURVEY RESULTS

Grid Location	Alpha counts/min Direct	Alpha dpm/100cm Removable (Smear)	Beta counts/min Direct	Beta dpm/100cm2 Removable (Smear)	Gamma Background	Scaler	Gamma Scaler - Bkgrnd Results
1	< 250	0	< 100	0	1699	2335	636
2	< 250	0	< 100	12	1699	2349	650
3	< 250	0	< 100	0	1699	2288	589
4	< 250	3	< 100	15	1699	2256	557
5	< 250	3	< 100	15	1699	2275	576
6	< 250	0	< 100	12	1699	2414	715
7	< 250	0	< 100	33	1699	2434	735
8	< 250	0	< 100	39	1699	2487	788
9	< 250	9	< 100	0	1699	2452	753
10	< 250	0	< 100	0	1699	2396	697
11	< 250	0	< 100	12	1699	2093	394
12	< 250	3	< 100	3	1699	2906	1207
13	< 250	3	< 100	0	1699	2730	1031
14	< 250	6	< 100	33	1699	2357	658
15	< 250	12	< 100	18	1699	2706	1007
16	300	12	< 100	36	1699	2623	924
17	250	3	< 100	0	1699	2741	1042
18	< 250	0	< 100	15	1699	2793	1094
19	300	6	< 100	0	1699	2337	638
20	250	0	< 100	15	1699	2581	882
21	< 250	0	< 100	0	1699	2495	796
22	250	0	< 100	6	1699	2375	676
23	< 250	3	< 100	0	1699	2266	567
24	< 250	6	< 100	54	1699	2770	1071
25	< 250	3	< 100	12	1699	2580	881
26	< 250	0	< 100	30	1699	2406	707
27	< 250	0	< 100	30	1699	2153	454
28	< 250	0	600	15	1699	2837	1138
29	< 250	3	< 100	24	1911	1903	-8
30	< 250	3	< 100	0	1911	1943	32
31	< 250	3	< 100	18	1911	2673	762
32	< 250	0	< 100	0	1699	2898	1199
33	300	0	< 100	30	1699	2550	851
34	250	0	500	9	1699	2422	723
35	< 250	9	< 100	54	1699	2689	990
36	< 250	0	< 100	12	1699	2478	779
37	< 250	0	< 100	0	1699	2622	923
38	< 250	0	< 100	21	1699	2275	576
39	250	3	< 100	0	1699	2206	507
40	300	3	< 100	3	1699	2290	591
41	< 250	3	< 100	9	1699	2716	1017
42	250	0	< 100	45	1699	2676	977
43	250	0	< 100	0	1699	2617	918
44	300	0	< 100	12	1699	2470	771
45	< 250	3	< 100	24	1699	2299	600
46	250	6	< 100	0	1699	2371	672
47	< 250	6	< 100	33	1699	2609	910
48	< 250	0	< 100	3	1699	2478	779

TABLE IL3.1-4

SEP 207-B NORTH RADIATION SURVEY RESULTS

Grid Location	Alpha counts/min Direct	Alpha dpm/100cm Removable (Smear)	Beta counts/min Direct	Beta dpm/100cm2 Removable (Smear)	Gamma Background	Scaler	Gamma Scaler - Bkgrnd Results
49	< 250	6	< 100	6	1699	2802	1103
50	< 250	3	< 100	36	1699	2681	982
51	250	3	< 100	48	1699	2441	742
52	300	3	< 100	30	1699	2861	1162
53	300	0	500	0	1699	2679	980
54	< 250	0	< 100	21	1699	2578	879
55	< 250	0	400	0	1699	2551	852
56	< 250	3	< 100	12	1699	2340	641
57	250	0	< 100	30	1699	2152	453
58	< 250	0	< 100	24	1699	2265	566
59	< 250	6	< 100	0	1699	2446	747
60	< 250	0	< 100	0	1699	2396	697
61	< 250	6	< 100	12	1699	2387	688
62	< 250	0	< 100	15	1699	2168	469
63	< 250	6	< 100	30	1699	2224	525
64	< 250	0	< 100	6	1699	2656	957
65	< 250	6	< 100	3	1699	5589	3890
66	< 250	0	< 100	0	1699	2317	618
67	< 250	0	< 100	33	1699	2366	667
68	< 250	3	< 100	30	1699	2334	635
69	250	0	< 100	6	1699	2396	697
70	300	0	< 100	18	1699	2760	1061
71	< 250	0	< 100	54	1699	2451	752
72	< 250	0	< 100	12	1699	2235	536
73	< 250	0	< 100	0	1699	2332	633
74	< 250	3	< 100	0	1699	2454	755
75	< 250	0	< 100	9	1699	2483	784
76	< 250	0	< 100	12	1699	2130	431
77	250	6	< 100	24	1699	2646	947
78	< 250	0	< 100	48	1699	2357	658
79	300	3	< 100	15	1699	2655	956
80	< 250	0	700	3	1699	2114	415
81	250	0	< 100	0	1699	2150	451
82	250	3	< 100	3	1699	2453	754
83	< 250	0	< 100	9	1699	2346	647
84	< 250	0	< 100	33	1699	2511	812
85	< 250	6	< 100	12	1699	2137	438
86	< 250	0	< 100	0	1699	2496	797
87	< 250	3	< 100	57	1699	2513	814
88	< 250	0	< 100	9	1699	2452	753
89	< 250	0	< 100	0	1699	2402	703
90	< 250	0	< 100	18	1699	2450	751
91	250	0	< 100	12	1911	2038	127
92	< 250	0	< 100	9	1699	2332	633
93	< 250	3	< 100	33	1699	2321	622
94	< 250	0	< 100	30	1911	2055	144
95	< 250	0	< 100	21	1699	2492	793
96	< 250	0	< 100	0	1911	2159	248

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TABLE II.3.1-4

SEP 207-B NORTH RADIATION SURVEY RESULTS

Grd Location	Alpha counts/min Direct	Alpha dpm/100cm Removable (Smear)	Beta counts/min Direct	Beta dpm/100cm2 Removable (Smear)	Gamma Background	Scaler	Gamma Scaler - Bkgrnd Results
97	< 250	6	< 100	0	1699	2566	867
98	< 250	0	< 100	6	1699	2481	782
99	< 250	3	< 100	15	1699	2115	416
100	< 250	0	< 100	24	1699	2493	794
101	< 250	0	< 100	0	1911	2203	292
102	< 250	0	< 100	27	1699	2550	851
103	< 250	6	< 100	6	1699	2342	643
104	< 250	0	< 100	3	1699	2580	881
105	250	3	< 100	0	1911	2149	238
106	< 250	0	< 100	15	1911	2233	322
107	< 250	0	500	0	1911	2117	206
108	< 250	3	< 100	36	1911	2083	172
109	< 250	0	< 100	12	1699	2330	631
110	< 250	3	< 100	9	1699	2246	547
111	< 250	6	< 100	54	1699	2354	655
112	< 250	0	< 100	0	1699	2360	661
113	< 250	0	< 100	0	1911	2436	525
114	250	0	< 100	39	1911	2149	238
115	< 250	3	< 100	12	1699	2464	765
116	250	3	< 100	21	1699	2013	314
117	< 250	0	< 100	6	1911	2002	91
118	< 250	0	< 100	0	1911	2020	109
119	< 250	3	< 100	60	1911	1980	69
120	< 250	3	< 100	33	1911	2210	299
121	< 250	3	< 100	9	1699	2505	806
122	< 250	0	< 100	21	1699	2446	747
123	< 250	3	< 100	12	1699	2451	752
124	250	0	< 100	27	1911	2176	265
125	< 250	0	< 100	0	1911	2324	413
126	300	0	< 100	9	1911	2075	164
127	250	0	< 100	12	1699	2301	602
128	< 250	3	< 100	30	1699	2426	727
129	< 250	0	< 100	18	1699	2216	517
130	< 250	0	< 100	24	1911	2218	307
131	< 250	0	< 100	21	1699	2418	719
132	< 250	0	< 100	0	1699	2250	551
133	< 250	9	< 100	15	1699	2583	884
134	< 250	3	< 100	0	1699	2719	1020
135	< 250	3	< 100	0	1699	2339	640
136	250	6	< 100	18	1911	2470	559
137	< 250	0	< 100	12	1911	2670	759
138	< 250	0	< 100	3	1699	2330	631
139	< 250	3	500	0	1699	2611	912
140	< 250	3	< 100	36	1699	2111	412
141	< 250	0	< 100	15	1911	2230	319
142	< 250	6	< 100	30	1911	2184	273
143	250	3	< 100	12	1699	2115	416
144	< 250	3	< 100	27	1699	2962	1263

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TABLE IL3.1-4

SEP 207-B NORTH RADIATION SURVEY RESULTS

Grid Location	Alpha counts/min Direct	Alpha dpm/100cm Removable (Smear)	Beta counts/min Direct	Beta dpm/100cm2 Removable (Smear)	Gamma Background	Scaler	Gamma Scaler - Bkgrnd Results
145	< 250	0	< 100	15	1699	2755	1056
146	< 250	3	< 100	0	1699	2703	1004
147	< 250	3	< 100	9		not meas	
148	< 250	3	< 100	30	1911	2054	143
149	300	0	< 100	18	1911	2113	202
150	< 250	0	< 100	48	1699	2505	806
151	250	0	< 100	0	1699	2446	747
152	250	6	< 100	15	1699	2156	457
153	< 250	0	< 100	18	1699	2360	661
154	< 250	0	< 100	18	1699	2253	554
155	< 250	3	< 100	21	1699	2306	607
156	< 250	0	< 100	18	1699	2445	746
157	< 250	0	< 100	12	1699	2611	912
158	< 250	0	< 100	30	1699	2758	1059
159	< 250	0	< 100	0	1699	2743	1044
160	< 250	9	< 100	12	1699	2680	981
161	< 250	3	< 100	9	1699	2653	954
162	< 250	3	< 100	3	1699	2482	783
163	< 250	0	< 100	24	1699	2573	874
164	250	0	< 100	15	1699	2239	540
165	< 250	6	< 100	0	1699	2253	554

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TABLE II.3.1-5

METAL ANALYTICAL RESULTS
 ASPHALT SAMPLES - SEP 207-A

(all results in mg/kg)

ANALYTE	BH41593 AS40501AE	BH42193 AS40502AE	BH42493 AS40503AE	BH42593 AS40504AE	BH43393 AS40505AE	BH43693 AS40506AE	RANGE OF DETECTION
Aluminum	2420	4250	3510	2850	3060	4520	2420 - 4520
Antimony	BDL (11 2)	BDL					
Arsenic	0 74	1 0	1 6	1 5	1 7	1 2	0 74 - 1 7
Barium ¹	29 6	47 7	50 1	37 5	26 9	57 5	26 9 - 57 5
Beryllium ²	BDL (0 20)	BDL					
Cadmium ^{1 2}	2 8	3 6	0 83	0 80	0 80	9 9	0 80 - 9 9
Calcium ^{1 2}	832	1040	1730	1100	1390	2010	832 - 2010
Chromium	5 7	10 2	7 4	5 9	8 4	37 5	5 7 - 37 5
Cobalt	1 4	2 6	3 4	2 2	2 8	3 2	1 4 - 3 4
Copper	7 0	11 5	9 9	7 7	4 4	22 1	4 4 - 22 1
Cesium	0 53	0 97	0 71	0 67	0 43	0 98	0 43 - 0 98
Cyanide ¹	NA						
Iron	5350	7950	7170	5940	5660	9340	5350 - 9340
Lead	107	7 9	80 4	11 4	26 5	74 2	7 9 - 107
Lithium ¹	4 1	8 1	4 7	3 8	6 5	13 4	3 8 - 13 4
Magnesium	1320	1800	2000	1650	1920	2350	1320 - 2350
Manganese ¹	95 8	117	124	104	101	122	95 8 - 124
Mercury ²	NA						
Molybdenum	BDL (6 2)	BDL					
Nickel	8 7	9 6	9 2	8 8	11 4	15 1	8 7 - 15 1
Potassium ¹	1050	2370	1420	1010	1050	2050	1010 - 2370
Selenium	BDL (0 6)	BDL (0 60)	BDL				
Silver ²	BDL (1 4)	BDL					
Sodium ^{1 2}	189	1000	233	135	472	473	135 - 1000
Strontium	5 4	6 4	11 1	7 1	5 4	14 8	5 4 - 14 8
Thallium	BDL (1 0)	BDL					
Tin	0 37	0 49	0 41	0 31	0 34	0 51	0 31 - 0 51
Vanadium	19 4	20 2	24 1	20 7	16 3	37 8	16 3 - 37 8
Zinc ¹	30 8	25 6	40 2	21 1	19 9	74 0	19 9 - 74 0

Notes ¹ Subsurface Soil and Bedrock Potential Contaminant of Concern
² Surficial Soil Potential Contaminant of Concern
 BDL(1 0) Below Detection Limit with the detection limit in parentheses
 NA Not Analyzed

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TABLE II.3.1-6

METAL ANALYTICAL RESULTS - ASPHALT SAMPLES 207-B SEPs

(all results in mg/kg)

ANALYTE	SEP 207-B North			SEP 207-B Center			RANGE OF DETECTION
	BH46593 AS40507AE	BH46693 AS40508AE	BH46793 AS40509AE	BH46893 AS40510AE	BH46993 AS40511AE	BH47093 AS40512AE	
Aluminum	3,940	4,220	3,680	3,980	4,890	4,200	3,680-4,890
Antimony	BDL(9 6)	BDL(9 7)	BDL(9 6)	BDL(9 4)	BDL(9 5)	BDL(9 5)	BDL
Arsenic	1 2(B)	1 1(B)	1 5(B)	1 0(B)	BDL(0 60)	0 85(B)	BDL - 1 5
Barium ¹	45 8	51 7	41 0	40 9	52 3	51 3	40 9 - 52 3
Beryllium ²	0 70(B)	0 42(B)	BDL(0 20)	0 26(B)	0 22(B)	0 46(B)	BDL - 0 70
Cadmium ^{1 2}	38 6	69 7	11 2	2 4	7 3	3 5	2 4 - 69 7
Calcium ^{1 2}	2,400	2,200	1,470	1,710	2,660	1,960	1,470-2,660
Chromium	13 8	25 6	16 3	12 2	26 9	11 9	11 9 - 26 9
Cobalt	3 9(B)	4 0(B)	4 1(B)	3 7(B)	4 2(B)	4 7(B)	3 7 - 4 7
Copper	19 9	24 6	16 2	10 8	19 6	11 5	10 8 - 19 6
Cesium	0 73(B)	1 3(B)	0 80(B)	0 80(B)	1 1(B)	0 85(B)	0 73- 1 3
Cyanide ¹	BDL(0 10)	BDL(0 10)	BDL(0 10)	BDL(0 10)	0 14(B)	0 17(B)	BDL - 0 17
Iron	7,440	7,800	7,130	7,770	9,400	7,960	7,130-9,400
Lead	6 0	6 0	7 2	3 8	6 1	6 8	3 8 - 7 2
Lithium ¹	7 9(B)	8 6(B)	7 0(B)	7 5(B)	10 9	6 4(B)	6 4 - 10 9
Magnesium	2,130	2,200	1,860	2,160	2,400	2,180	1,860-2,400
Manganese ¹	109	135	91 9	128	142	140	91 9 - 140
Mercury ²	NA						
Molybdenum	BDL(5 9)	BDL(6 0)	BDL(5 9)	BDL(5 8)	BDL(5 8)	BDL(5 9)	BDL
Nickel	16 2	16 2	11 2	12 7	15 8	12 9	11 2 - 16 2
Potassium ¹	1,740	1,860	1,490	1,700	2,200	2,030	1,490-2,200
Selenium	BDL(0 41)	BDL(0 41)	BDL(0 41)	BDL(0 40)	BDL(0 40)	BDL(0 40)	BDL
Silver ²	BDL(0 61)	BDL(0 62)	BDL(0 62)	BDL(0 60)	BDL(0 60)	BDL(0 61)	BDL
Sodium ^{1 2}	388(B)	413(B)	301(B)	702(B)	746(B)	1,050	301 - 1,050
Strontium	12 8(B)	13 3(B)	9 1(B)	9 2(B)	14 4(B)	12 3(B)	9 1 - 14 4
Thallium	BDL(0 82)	BDL(0 83)	BDL(0 82)	0 96(B)	BDL(0 80)	BDL(0 81)	BDL - 0 96
Tin	0 54(B)	0 62(B)	0 53(B)	0 53(B)	0 66(B)	0 57(B)	0 53 - 0 66
Vanadium	29 9	30 5	27 4	33 6	39 0	35 8	27 4 - 39 0
Zinc ¹	26 0	25 7	19 9	22 8	24 8	22 2	19 9 - 26 0

Notes ¹ Subsurface Soil and Bedrock Potential Contaminant of Concern
² Surficial Soil Potential Contaminant of Concern
BDL(1 0) Below Detection Limit with the detection limit in parentheses
(B) Element detected above the Instrument Detection Limit, but below the Method Detection Limit
NA Not Analyzed

TABLE II.3.1-7

RADIOCHEMISTRY ANALYTICAL RESULTS
ASPHALT SAMPLES - SEP 207-A
 (all results in pCi/g)

ANALYTE	BH41593 AS40501AE	BH42193 AS40502AE	BH42493 AS40503AE	BH42593 AS40504AE	BH43393 AS40505AE	BH43693 AS40506AE	RANGE OF DETECTIONS
Americium-241	< 0 003 (NA)	< 0 005 (NA)	< 0 003 (NA)	< 0 005 (NA)	< 0 005 (NA)	< 0 005 (NA)	BDL
Cesium-134	< 0 24 (NA)	< 0 20 (NA)	< 0 20 (NA)	< 0 18 (NA)	< 0 04 (NA)	< 0 17 (NA)	BDL
Cesium-137	< 0 10 (NA)	< 0 07 (NA)	< 0 09 (NA)	< 0 07 (NA)	< 0 08 (NA)	< 0 12 (NA)	BDL
Plutonium-239/240	0 107 (0 045)	0 071 (0 033)	< 0 007 (NA)	0 053 (0 035)	< 0 009 (NA)	2 231 (0 565)	BDL - 2 231
Plutonium-238	< 0 015 (NA)	< 0 009 (NA)	< 0 009 (NA)	0 016 (0 018)	< 0 010 (NA)	< 0 017 (NA)	BDL - 0 016
Strontium-89	0 2 (0 3)	0 1 (0 3)	0 5 (0 5)	0 0 (0 3)	0 1 (0 2)	0 0 (0 2)	0 0 - 0 5
Strontium-90	0 04 (0 37)	-0 02 (0 20)	-0 07 (0 16)	-0 01 (0 18)	-0 08 (0 18)	-0 10 (0 19)	-0 10 - 0 04
Uranium-238	1 74 (0 54)	2 68 0 53	0 69 0 31	0 52 (0 32)	1 18 (0 50)	1 32 (0 39)	0 52 - 2 68
Uranium-235	< 0 27 (NA)	< 0 26 (NA)	< 0 018 (NA)	0 10 (0 16)	< 0 26 (NA)	< 0 22 (NA)	BDL - 0 10
Uranium-234	1 87 (0 56)	4 66 (0 71)	0 68 (0 31)	0 81 (0 42)	1 22 (0 51)	1 80 (0 46)	0 68 - 4 66

Notes (0 23) Counting error in pCi/g
 < The result was less than the detection limit specified in the laboratory's Statement of Work
 NA Counting error was not applicable
 BDL Below Detection Limit

TABLE II.3.1-8

RADIOCHEMISTRY ANALYTICAL RESULTS
ASPHALT SAMPLES - 207-B SEPs
 (all results in pCi/g)

ANALYTE	SEP 207-B North			SEP 207-B Center			RANGE OF DETECTION
	BH46593 AS40507AE	BH46693 AS40508AE	BH46793 AS40509AE	BH46893 AS40510AE	BH46993 AS40511AE	BH47093 AS40512AE	
Americium-241	3 965 (0 363)	4 032 (0 309)	1 734 (0 157)	0 449 (0 059)	0 582 (0 072)	0 584 (0 071)	0 449 - 4 032
Cesium-134	< 0 25 (NA)	< 0 25 (NA)	< 0 22 (NA)	< 0 09 (NA)	< 0 22 (NA)	< 0 22 (NA)	Not Detected
Cesium-137	< 0 17 (NA)	< 0 16 (NA)	< 0 12 (NA)	< 0 14 (NA)	< 0 10 (NA)	< 0 17 (NA)	Not Detected
Plutonium-239/240	0 675 (0 078)	3 126 (0 203)	0 299 (0 050)	0 224 (0 045)	0 501 (0 064)	0 220 (0 044)	0 220 - 3 126
Strontium-89	0 3 (0 3)	0 5 (0 3)	0 5 (0 4)	0 4 (0 4)	0 2 (0 2)	0 3 (0 3)	0 2 - 0 5
Strontium-90	0 0 (0 2)	0 1 (0 2)	0 0 (0 2)	0 2 (0 2)	0 1 (0 2)	0 0 (0 2)	0 0 - 0 2
Uranium-238	0 90 (0 16)	0 74 (0 14)	0 69 (0 14)	1 34 (0 21)	1 43 (0 22)	1 70 (0 24)	0 69 - 1 70
Uranium-235	0 07 (0 04)	0 09 (0 05)	0 07 (0 04)	0 09 (0 05)	0 10 (0 05)	0 11 (0 05)	0 07 - 0 11
Uranium-234	1 54 (0 23)	1 11 (0 18)	1 26 (0 21)	1 76 (0 25)	1 77 (0 26)	2 20 (0 29)	1 11 - 2 20

Notes (0 23) Counting error in pCi/g

< The result was less than the detection limit specified in the laboratory's Statement of Work

NA Counting error was not applicable

TABLE II.3.1-9

ANALYTICAL RESULTS FOR POTENTIAL CONTAMINANTS OF CONCERN
IN SUBGRADE SAMPLES - SEP 207A

ANALYTE (units)	BH41593 SS40073AE	BH42193 SS40012AE	BH42493 SS40083AE	BH42593 SS40082AE	BH43393 SS40087AE	BH43693 SS40089AE	Background
Inorganic Compounds							
Barium (mg/kg)	93.7	52.4	37.5 (B)	43.2	90.3	58.6	93.87
Cadmium (mg/kg)	6.8	3.5	9.8	6	1.8	5.4	2.3
Calcium (mg/kg)	1,280	571 (B)	1,320	1,330	1,170	527 (B)	7,782
Cyanide (mg/kg)	NA	NA	NA	NA	NA	NA	NA
Lithium (mg/kg)	24.8	12.1 (B)	10.1 (B)	10.6 (B)	19.3 (B)	22.2	83.2
Manganese (mg/kg)	110.0	108.0	124.0	154.0	126.0	98.4	190.5
Nitrate/Nitrite (mg/kg)	1500	923	433	747	915	305	7.1
Potassium (mg/kg)	6,230	2,950	2,150	2,520	4,270	3,370	1,563
Sodium (mg/kg)	3,160	1,460	358 (B)	988 (B)	1,930	1,070	2,720
Sulfide (mg/kg)	NA	NA	NA	NA	NA	NA	43,000
Zinc (mg/kg)	66.0	29.2	27.8	27.6	35.0	31.4	23.6
Organic Compounds							
Acetone (ug/kg)	NA	NA	NA	NA	NA	NA	Non-Detect
Methylene Chloride (ug/kg)	NA	NA	NA	NA	NA	NA	Non-Detect
Toluene (ug/kg)	NA	NA	NA	NA	NA	NA	Non-Detect

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TABLE II.3-1-9 (continued)

ANALYTICAL RESULTS FOR POTENTIAL CONTAMINANTS OF CONCERN
IN SUBGRADE SAMPLES - SEP 207-A

ANALYTE (units)	BH41593 SS40073AE	BH42193 SS40012AE	BH42493 SS40083AE	BH42593 SS40082AE	BH43393 SS40087AE	BH43693 SS40089AE	Background
Radionuclides							
Americium-241 (pCi/g)	3 3 (0 37)	0 0652 (0 0283)	4 9 (0 8)	0 151 (0 049)	0 021 (0 0145)	2 17 (0 48)	0 01
Cesium-134 (pCi/g)	NA	NA	NA	NA	NA	NA	ND
Cesium-137 (pCi/g)	ND (0 25)	0 0885 (0 0658)	0 002 (0 07)	ND (0 082)	ND (0 093)	0 127 (0 077)	0 166
Gross Beta (pCi/g)	39 0 (4 9)	48 5 (10 1)	29 0 (5 3)	51 5 (10 7)	41 9 (8 8)	47 4 (9 9)	27 99
Plutonium-239/240 (pCi/g)	14 0 (1 9)	0 28 (0 078)	0 041 (0 03)	2 55 (0 57)	0 0192 (0 0128)	4 55 (1 02)	0 02
Radium-226 (pCi/g)	1 2 (0 33)	NA	1 1 (0 35)	NA	NA	NA	0 65
Strontium-89/90 (pCi/g)	ND (0 25)	0 557 (0 288)	ND (0 36)	0 575 (0 282)	1 0 (0 33)	0 569 (0 295)	0 54
Tritium (pCi/g)	13,000 (740)	50,300 (5,900)	2,400 (330)	13,300 (1,500)	46,400 (5,400)	5,630 (830)	212 2
Uranium-233/234 (pCi/g)	11 0 (1 7)	3 93 (0 87)	1 2 (0 17)	5 21 (1 2)	1 95 (0 47)	2 14 (0 52)	0 53
Uranium-235 (pCi/g)	0 29 (0 14)	0 165 (0 69)	0 039 (0 024)	0 219 (0 105)	0 0745 (0 0539)	0 0841 (0 0584)	0 1
Uranium-238 (pCi/g)	7 0 (1 2)	2 71 (0 61)	1 0 (0 15)	2 95 (0 71)	1 42 (0 36)	2 21 (0 53)	0 63

Notes ND (1 0) Not Detected with detection limit in parentheses
 (B) Element detected below method detection limit but above instrument detection limit
 NA Not Analyzed
 Radionuclide analysis counting error is presented in parentheses after the reported result

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TABLE II.3.1-10

ANALYTICAL RESULTS FOR POTENTIAL CONTAMINANTS OF CONCERN
IN SUBGRADE SAMPLES - SEP 207-B NORTH AND SEP 207-B CENTER

ANALYTE (units)	SEP 207-B NORTH		SEP 207-B CENTER		Background	
	BH46593 SS40507AE	BH46793 SS40509AE	BH46993 SS40511AE	BH47093 SS40512AE		
Inorganic Compounds						
Barium (mg/kg)	76 2	86 4	76 0	88 5	72 2	93 87
Cadmium (mg/kg)	56 7	23 7	24 4	ND (5 0)	ND (0 1)	2 3
Calcium (mg/kg)	15,600	984 (B)	918(B)	8,320	14,700	7,782
Cyanide (mg/kg)	NA	NA	NA	NA	NA	NA
Lithium (mg/kg)	4 6 6	46 3	36 0	10 9 (B)	11 2 (B)	83 2
Manganese (mg/kg)	109 0	94 6	97 9	185 0	221 0	190 5
Nitrate/Nitrite (mg/kg)	1,850	2,230	848	23 5	22 1	7 1
Potassium (mg/kg)	4,420	7,290	6,130	1,880	1,720	1,563
Sodium (mg/kg)	2,610	3,660	2,460	268 (B)	92 6 (B)	2,720
Sulfide (mg/kg)	NA	NA	NA	NA	NA	43,000
Zinc (mg/kg)	21 5	37 1	31 8	26 1	24 2	23 64
Organic Compounds						
Acetone (ug/kg)	NA	NA	NA	NA	NA	Non-Detect
Methylene Chloride (ug/kg)	NA	NA	NA	NA	NA	Non-Detect
Toluene (ug/kg)	NA	NA	NA	NA	NA	Non-Detect

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TABLE II.3.1-10 (continued)

ANALYTICAL RESULTS FOR POTENTIAL CONTAMINANTS OF CONCERN
IN SUBGRADE SAMPLES - SEP 207-B NORTH AND SEP 207-B CENTER

ANALYTE (units)	SEP 207-B NORTH		SEP 207-B CENTER		Background	
	BH46593 SS40507AE	BH46793 SS40509AE	BH46893 SS40510AE	BH46993 SS40511AE		
Radionuclides						
Americium-241 (pCi/g)	2 783 (0 304)	11 69 (1 32)	0 0697 (0 0166)	0 0286 (0 0123)	0 0114 (0 00747)	0 01
Cesium-134 (pCi/g)	-0 0155 (0 0146)	0 0016 (0 0131)	-0 02 (0 0139)	-0 0027 (0 0124)	0 0082 (0 0132)	NA
Cesium-137 (pCi/g)	0 0415 (0 0211)	0 0992 (0 0297)	0 008 (0 0133)	0 0142 (0 0158)	0 0087 (0 0135)	0 166
Gross Beta (pCi/g)	23 49 (2 94)	24 95 (3 03)	28 88 (3 33)	47 0 (4 56)	26 22 (3 15)	27 99
Plutonium-239/240 (pCi/g)	19 78 (2 25)	12 87 (1 39)	0 1876 (0 0326)	0 2787 (0 0462)	0 0388 (0 0212)	0 02
Radium-226 (pCi/g)	4 912 (0 646)	3 672 (0 651)	1 259 (0 335)	4 428 (0 681)	1 22 (0 461)	0 65
Strontium-89/90 (pCi/g)	0 1084 (0 0392)	0 0291 (0 0286)	1 094 (0 286)	0 5265 (0 18)	0 18 (0 0565)	0 54
Thorium (pCi/l)	32,470 (2,520)	25,690 (2,020)	4,103 (494)	15,500 (1,290)	2,044 (330)	212 2
Uranium-233/234 (pCi/g)	14 17 (2 52)	11 66 (2 0)	1 009 (0 286)	11 78 (2 02)	0 7124 (0 345)	0 53
Uranium-235 (pCi/g)	0 4828 (0 216)	0 3833 (0 178)	0 0357 (0 0531)	0 3993 (0 183)	0 0634 (0 0985)	0 1
Uranium-238 (pCi/g)	6 629 (1 3)	5 916 (1 12)	1 118 (0 305)	9 998 (1 74)	1 031 (0 428)	0 63

Notes ND (1 0) Not Detected with detection limit in parentheses
 (B) Element detected below method detection limit but above instrument detection limit
 NA Not Analyzed
 Radionuclide analysis counting error is presented in parentheses after the reported result

TABLE 3.2-1

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
A	A 24	2252	1947	2473	305
A	A 26	2116	1947	2473	169
A	A 28	1997	1947	2473	50
A	A 30	1974	1947	2473	27
B	B 8	2344	2311	2473	33
B	B 10	2360	2311	2473	49
B	B 12	2359	2311	2473	48
B	B 14	2169	2311	2473	-142
B	B 16	2286	2311	2473	-25
B	B 18	2827	2311	2473	516
B	B 20	1966	2311	2473	-345
B	B 22	2308	2311	2473	-3
B	B 24	2367	2311	2473	56
A	B 26	2020	1947	2473	73
A	B 28	1997	1947	2473	50
A	B 30	1852	1947	2473	-95
A	B 32	1667	1947	2473	-280
A	B 34	1956	1947	2473	9
A	B 36	2031	1947	2473	84
B	C 8	2325	2311	2473	14
B	C 10	2263	2311	2473	-48
B	C 12	2350	2311	2473	39
B	C 14	2320	2311	2473	9
B	C 16	2388	2311	2473	77
B	C 18	2423	2311	2473	112
B	C 20	2340	2311	2473	29
B	C 22	2483	2311	2473	172
B	C 24	2113	2311	2473	-198
B	C 26	2005	2311	2473	-306
B	C 28	2264	2311	2473	-47
B	C 30	2285	2311	2473	-26
B	C 32	2118	2311	2473	193
B	C 34	2018	2311	2473	-293
B	C 36	2171	2311	2473	-140
B	C 38	1996	2311	2473	-315
B	D 8	2204	2311	2473	-107

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TABLE 3.2-1 (continued)

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
B	D 10	2146	2311	2473	-165
B	D 12	2100	2311	2473	-211
B	D 14	2182	2311	2473	-129
B	D 16	2153	2311	2473	-158
B	D 18	2095	2311	2473	-216
B	D 20	2157	2311	2473	-154
B	D 22	2511	2311	2473	200
B	D 24	2222	2311	2473	-89
B	D 26	2281	2311	2473	-30
B	D 28	2284	2311	2473	-27
B	D 30	2122	2311	2473	-189
B	D 32	2056	2311	2473	-255
B	D 34	2129	2311	2473	-182
B	D 36	2084	2311	2473	-227
B	D 38	2144	2311	2473	-167
E	D 40	1743	1954	2473	-211
E	D 42	1721	1954	2473	-233
C	E 1	1296	1929	2473	-633
C	E 3	1527	1929	2473	-402
C	E 5	1534	1929	2473	-395
C	E 7	1596	1929	2473	-333
C	E 9	1661	1929	2473	-268
C	E 11	1505	1929	2473	-424
C	E 13	1456	1929	2473	-473
C	E 15	1665	1929	2473	-264
C	E 17	1494	1929	2473	-435
C	E 19	1547	1929	2473	-382
C	E 21	1529	1929	2473	-400
D	E 28	2056	1947	2473	109
D	E 30	1924	1947	2473	-23
D	E 32	1892	1947	2473	-55
D	E 34	2006	1947	2473	59
D	E 36	2012	1947	2473	65
D	E 38	1826	1947	2473	-121
E	E 40	1752	1954	2473	-202

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TABLE 3.2-1 (continued)

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
E	E 42	1759	1954	2473	-195
C	F 2	1493	1929	2473	-436
C	F 4	1807	1929	2473	-122
C	F 6	1458	1929	2473	-471
C	F 8	1436	1929	2473	-493
C	F 10	1541	1929	2473	-388
C	F 12	1664	1929	2473	-265
C	F 14	1434	1929	2473	-495
C	F 16	1491	1929	2473	-438
C	F 18	1936	1929	2473	7
C	F 20	1550	1929	2473	-379
C	F 22	1636	1929	2473	-293
C	F 24	1517	1929	2473	-412
C	G 5	1821	1929	2473	-108
C	G 9	1449	1929	2473	-480
C	G 11	1437	1929	2473	-492
C	G 13	1487	1929	2473	-442
C	G 15	1560	1929	2473	-369
C	G 17	1637	1929	2473	-292
C	G 19	1497	1929	2473	-432
C	G 21	1566	1929	2473	-363
C	G 23	1679	1929	2473	-250
D	G 32	1789	1947	2473	-158
D	G 34	2081	1947	2473	143
C	G 36	1983	1947	2473	36
D	G 38	2394	1947	2473	447
E	G 40	1803	1954	2473	-151
E	G 42	1671	1954	2473	-283
F	H 2	1799	1855	2473	-56
F	H 4	2010	1855	2473	155
F	H 6	1886	1855	2473	31
F	H 8	1582	1855	2473	-273
C	H 10	1666	1929	2473	-263
C	H 12	1394	1929	2473	-535
C	H 14	1395	1929	2473	-534

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TABLE 3.2-1 (continued)

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
C	H 16	1562	1929	2473	-367
C	H 18	1479	1929	2473	-450
C	H 20	1382	1929	2473	-547
C	H 22	1394	1929	2473	-535
C	H 24	1293	1929	2473	-636
C	H 26	1852	1929	2473	-77
F	I 7	1956	1855	2473	101
C	I 9	1754	1929	2473	-175
C	I 11	1427	1929	2473	-502
C	I 13	1508	1929	2473	-421
C	I 15	1280	1929	2473	-649
C	I 17	1580	1929	2473	-349
C	I 19	1517	1929	2473	-412
C	I 21	1715	1929	2473	-214
C	I 23	1582	1929	2473	-347
C	I 25	1411	1929	2473	-518
C	I 27	1584	1929	2473	-345
C	I 29	1402	1929	2473	-527
D	I 36	1780	1947	2473	-167
D	I 38	1837	1947	2473	-110
E	I 40	1562	1954	2473	-392
E	I 42	2206	1954	2473	252
F	J 8	1964	1855	2473	109
C	J 10	1643	1929	2473	-286
C	J 12	1296	1929	2473	-633
C	J 14	1457	1929	2473	-472
C	J 16	1693	1929	2473	-236
C	J 18	1453	1929	2473	-476
C	J 20	1770	1929	2473	-159
C	J 22	1750	1929	2473	-179
C	J 24	1421	1929	2473	-508
C	J 26	1572	1929	2473	-357
C	J 28	1546	1929	2473	-383
C	J 30	1434	1929	2473	-495
F	K 3	1722	1855	2473	-133

TABLE 3.2-1 (continued)

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
F	K 5	1852	1855	2473	-3
F	K 7	1576	1855	2473	-279
C	K 9	1756	1929	2473	-173
C	K 11	1535	1929	2473	-394
C	K 13	1453	1929	2473	-476
C	K 15	1446	1929	2473	-483
C	K 17	2023	1929	2473	94
C	K 19	1918	1929	2473	-11
C	K 21	1748	1929	2473	-181
C	K 23	1663	1929	2473	-266
C	K 25	1610	1929	2473	-319
C	K 27	1499	1929	2473	-430
C	K 29	1548	1929	2473	-381
C	K 31	1544	1929	2473	-385
C	K 33	1531	1929	2473	-398
E	K 40	1839	1954	2473	-115
E	K 42	1701	1954	2473	-253
F	L 4	1772	1855	2473	-83
F	L 6	1483	1855	2473	-372
F	L 8	1552	1855	2473	-303
J	L 28	1264	1429	2473	-165
J	L 30	1580	1429	2473	151
J	L 32	1239	1429	2473	-190
J	L 34	1403	1429	2473	-26
J	L 36	1529	1429	2473	100
F	M 3	1501	1855	2473	-354
F	M 5	1563	1855	2473	-292
F	M 7	1739	1855	2473	-116
C	M 9	1461	1929	2473	-468
H	M 11	2172	1834	2473	338
H	M 13	2220	1834	2473	386
H	M 15	2186	1834	2473	352
H	M 21	2443	1834	2473	609
J	M 29	1307	1429	2473	-122
J	M 31	1517	1429	2473	88

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TABLE 3.2-1 (continued)

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
J	M 33	1282	1429	2473	-147
J	M 35	1415	1429	2473	-14
J	M 37	1542	1429	2473	113
F	N 4	1409	1855	2473	-446
F	N 6	1501	1429	2473	-354
F	N 8	1638	1429	2473	-217
H	N 16	1507	1429	2473	-327
H	N 22	1591	1429	2473	-243
J	N 28	1253	1429	2473	-176
J	N 30	1544	1855	2473	115
J	N 32	1808	1429	2473	379
J	N 34	1443	1429	2473	14
J	N 36	1304	1429	2473	-125
J	N 38	1303	1429	2473	-126
J	N 40	1586	1429	2473	157
F	O 3	1587	1855	2473	-268
F	O 7	2074	1855	2473	219
C	O 9	1410	1929	2473	-519
H	O 15	2187	1834	2473	353
H	O 21	2200	1384	2473	366
J	O 29	1460	1429	2473	31
J	O 33	1652	1429	2473	223
J	O 35	1848	1429	2473	419
J	O 37	1473	1429	2473	44
J	O 39	1272	1429	2473	-157
F	P 2	1826	1855	2473	-29
F	P 4	1353	1855	2473	-502
F	P 8	1668	1855	2473	-187
C	P 10	1590	1929	2473	-339
H	P 16	2449	1834	2473	615
H	P 22	1584	1834	2473	-250
H	P 24	2148	1834	2473	314
H	P 26	2126	1834	2473	292
J	P 28	1760	1429	2473	331
J	P 32	2106	1429	2473	677

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TABLE 3.2-1 (continued)

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
J	P 34	2265	1429	2473	836
J	P 36	1721	1429	2473	292
J	P 38	1247	1429	2473	-182
J	P 40	1346	1429	2473	-83
F	Q 3	1980	1855	2473	125
F	Q 7	2017	1855	2473	162
F	Q 9	1748	1855	2473	107
F	Q 11	1448	1855	2473	-407
F	Q 13	1514	1855	2473	-341
F	Q 15	1636	1955	2473	-219
H	Q 21	2349	1834	2473	515
J	Q 33	2053	1429	2473	624
J	Q 35	1603	1429	2473	174
J	Q 37	1399	1429	2473	-30
J	Q 39	1592	1429	2473	163
F	R 2	1779	1855	2473	-76
F	R 4	1831	1855	2473	-24
F	R 6	1756	1855	2473	-99
F	R 8	2556	1855	2473	701
F	R 10	2572	1855	2473	717
F	R 12	1979	1855	2473	124
F	R 14	1383	1855	2473	-472
J	R 16	2156	1429	2473	727
H	R 22	1474	1834	2473	-360
J	R 28	1319	1429	2473	-110
J	R 30	2125	1429	2473	696
J	R 32	1859	1429	2473	430
J	R 34	1828	1429	2473	399
J	R 36	1347	1429	2473	-82
J	R 38	1300	1429	2473	-129
F	S 13	1960	1855	2473	105
F	S 15	1576	1855	2473	-279
H	S 21	2270	1834	2473	436
H	S 23	2419	1834	2473	585
H	S 25	2011	1834	2473	177

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TABLE 3.2-1 (continued)

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
H	S 27	2390	1834	2473	556
J	S 31	1339	1429	2473	-90
J	S 33	1799	1429	2473	370
J	S 35	1632	1429	2473	203
J	S 37	1492	1429	2473	63
F	T 12	1852	1855	2473	-3
F	T 14	1814	1855	2473	-41
J	T 16	3364	1429	2473	1935
H	T 22	2331	1934	2473	497
J	T 28	1253	1429	2473	-176
J	T 30	1151	1429	2473	-278
J	T 32	1453	1429	2473	24
J	T 34	1870	1429	2473	441
J	T 36	1825	1429	2473	396
J	U 31	1594	1492	2473	165
J	U 33	1673	1429	2473	244
J	U 35	1617	1429	2473	188
J	V 16	1713	1429	2473	284
H	V 18	2324	1834	2473	490
H	V 20	2448	1834	2473	614
H	V 21	2348	1834	2473	514
H	V 22	1343	1834	2473	-491
J	V 28	1230	1429	2473	-199
J	V 20	1463	1429	2473	34
J	V 30	1427	1429	2473	-2
J	V 32	1598	1429	2473	169
J	V 34	1614	1429	2473	185
J	W 17	2079	1429	2473	650
J	W 19	1609	1429	2473	180
J	W 21	1683	1429	2473	254
J	W 23	1557	1429	2473	128
J	W 25	1254	1429	2473	-175
J	W 27	1177	1429	2473	-252
J	W 31	1063	1429	2473	-366
J	W 33	1752	1429	2473	323

TABLE 3.2-1 (continued)

OU4-WIDE GAMMA (FIDLER) RADIATION SURVEY RESULTS

Survey Region	Grid Location	FIDLER Reading (cpm)	FIDLER Checkpoint (cpm)	Upper Tolerance Limit (cpm)	Adjusted FIDLER Measurement (cpm)
J	X 10	2023	1855	2473	168
F	X 12	1723	1855	2473	-132
F	X 14	1647	1855	2473	-208
J	X 16	1893	1429	2473	464
J	X 18	1844	1429	2473	415
J	X 20	1563	1429	2473	134
J	X 22	1246	1429	2473	-183
J	X 24	1368	1429	2473	-61
J	X 26	1225	1429	2473	-204
J	X 28	1219	1429	2473	-210
J	X 30	1974	1429	2473	545
J	X 32	1577	1429	2473	148
F	Y 7	2045	1855	2473	190
F	Y 9	1802	1855	2473	-53
J	Y 15	1614	1429	2473	185
J	Y 17	1923	1429	2473	494
J	Y 23	1495	1429	2473	66
J	Y 27	1958	1429	2473	529
J	Y 29	1893	1429	2473	464
J	Y 31	1485	1429	2473	56

Background Action Level Calculation

The calculated mean was obtained from a population of 301 FIDLER readings
 The value of background is represented by the 95% Upper Tolerance Limit

Upper Tolerance Limit = FIDLER Background
 Upper Tolerance Limit = Mean + 2(Std Dev) = 1769 + 2(352) = 2473 cpm

Notes Negative values in last column indicate the adjusted result is less than the checkpoint value

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TABLE II.3.2-2

POTENTIAL CONTAMINANTS OF CONCERN IN OU4 SURFICIAL SOILS

Non-Radiological Inorganics	Radionuclides	Semivolatile Organics	PCBs
Beryllium	Americium-241	Benzo(a)anthracene	Aroclor-1254
Cadmium	Cesium-134	Benzo(a)pyrene	
Calcium	Gross alpha	Benzo(b)fluoranthene	
Mercury	Plutonium-239/240	Benzo(ghi)perylene	
Nitrate/Nitrite	Tritium	Benzo(k)fluoranthene	
Silicon	Uranium-233/234	Bis(2-ethylhexyl)phthalate	
Silver	Uranium-235	Chrysene	
Sodium	Uranium-238	Di-n-butyl phthalate	
		Fluoranthene	
		Indeno(1,2,3-cd)pyrene	
		Phenanthrene	
		Pyrene	

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TABLE 3 2-3

SUMMARY OF PHASE I RFI/RI
SURFICIAL SOIL POTENTIAL CONTAMINANTS OF CONCERN

Chemical	Units	No of Samples Analyzed	No of Detects	Percentage of Detects	Minimum Detection	Counting Error	Maximum Detection	Counting Error	Background 95% UCL	No of Detects > 95% UCL	Percentage of Samples > 95% UCL
AMERICIUM-241	pCi/g	72	70	97.2	0.028	0.016	220	54	0.027	70	98.6
CESIUM-134	pCi/g	57	19	33.3	-0.067	0.0319	0.033	0.0262	NA	-	-
GROSS ALPHA	pCi/g	72	65	90.3	8.561	3.27	440	14	22.9	31	43.1
PLUTONIUM-239/240	pCi/g	72	60	83.3	0.0101	0.0108	56	10	0.062	52	73.2
TRITIUM	pCi/l	72	47	65.3	-59.5	215	227,000	23,000	NA	-	-
URANIUM-233,-234	pCi/g	72	72	100.0	0.457	0.149	41	3.4	1.22	38	52.8
URANIUM-235	pCi/g	72	63	87.5	0.0191	0.0296	2.3	0.28	0.09	26	36.1
URANIUM-238	pCi/g	72	72	100.0	0.515	0.16	27	2.3	1.27	31	43.1
BERYLLIUM	mg/kg	72	11	15.3	1.5		9.6		0.92	11	15.3
CADMIUM	mg/kg	72	37	51.4	1.3		382		0.64	37	51.4
CALCIUM	mg/kg	72	72	100.0	1110		248,000		8,283	39	54.2
MERCURY	mg/kg	72	20	27.8	0.07		1.8		0.03	18	25.0
NITRATE/NITRITE	mg/kg	72	72	100.0	0.66		765		1.11	67	93.1
SILICON	mg/kg	72	72	100.0	463		11,300		1,111.2	72	100.0
SILVER	mg/kg	72	5	6.9	1.3		3.6		0.58	5	6.9
SODIUM	mg/kg	72	12	16.7	378		2,440		165.4	12	16.7
BENZO(a)ANTHRACENE	ug/kg	72	47	65.3	38		1,900		NA	-	-
BENZO(a)PYRENE	ug/kg	72	51	70.8	36		2,100		NA	-	-
BENZO(b)FLUORANTHENE	ug/kg	72	57	79.2	32		3,300		NA	-	-
BENZO(ghi)PERYLENE	ug/kg	72	37	51.4	15		1,300		NA	-	-
BENZO(k)FLUORANTHENE	ug/kg	72	58	80.6	32		3,700		NA	-	-
BIS(2-ETHYLHEXYL)PHTHALAT	ug/kg	72	57	79.2	42		21,000		NA	-	-
CHRYSENE	ug/kg	72	49	68.1	36		2,200		NA	-	-
DI-n-BUTYL PHTHALATE	ug/kg	72	30	41.7	36		1,700		NA	-	-
FLUORANTHENE	ug/kg	72	59	81.9	40		4,700		NA	-	-
INDENO(1,2,3-c,d)PYRENE	ug/kg	72	42	58.3	42		1,600		NA	-	-
PHENANTHRENE	ug/kg	72	31	43.1	37		3,700		NA	-	-
PYRENE	ug/kg	72	59	81.9	48		3,600		NA	-	-
AROCOR-1254	ug/kg	72	6	8.0	282		11,900		NA	-	-

Notes 95% UCL - 95% Upper Confidence Limit calculated from data in the 1993 Background Geochemical Characterization Report
is defined as background
NA - Not Analyzed

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TABLE IL3 2-4

SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Detect Limit	Units	Lab Qual	* Valid *	
SS400193	SS40017AE	REAL	TRG	BERYLLIUM	11	11	MG/KG	U	V	
SS400293	SS40018AE	REAL	TRG	BERYLLIUM	14	14	MG/KG	U	V	
SS400393	SS40019AE	REAL	TRG	BERYLLIUM	33	5	MG/KG		V	
SS400493	SS40020AE	REAL	TRG	BERYLLIUM	11	1	MG/KG	U	V	
SS400593	SS40021AE	REAL	TRG	BERYLLIUM	46	5	MG/KG		V	
SS400693	SS40022AE	REAL	TRG	BERYLLIUM	22	5	MG/KG		V	
SS400793	SS40023AE	REAL	TRG	BERYLLIUM	12	12	MG/KG	U	V	
SS400893	SS40024AE	REAL	TRG	BERYLLIUM	13	1	MG/KG	U	V	
SS400993	SS40025AE	REAL	TRG	BERYLLIUM	12	1	MG/KG	U	V	
SS401093	SS40026AE	REAL	TRG	BERYLLIUM	11	11	MG/KG	U	V	
SS401193	SS40027AE	REAL	TRG	BERYLLIUM	14	1	MG/KG	U	V	
SS401293	SS40028AE	REAL	TRG	BERYLLIUM	11	11	MG/KG	U	V	
SS401393	SS40029AE	REAL	TRG	BERYLLIUM	14	14	MG/KG	U	V	
SS401493	SS40030AE	REAL	TRG	BERYLLIUM	11	11	MG/KG	U	V	
SS401593	SS40031AE	REAL	TRG	BERYLLIUM	13	13	MG/KG	U	V	
SS401693	SS40032AE	REAL	TRG	BERYLLIUM	11	1	MG/KG	U	V	
SS401793	SS40033AE	REAL	TRG	BERYLLIUM	12	1	MG/KG	U	V	
SS401893	SS40034AE	REAL	TRG	BERYLLIUM	11	1	MG/KG	U	V	
SS401993	SS40035AE	REAL	TRG	BERYLLIUM	12	12	MG/KG	U	V	
SS402093	SS40036AE	REAL	TRG	BERYLLIUM	13	1	MG/KG	U	V	
SS402193	SS40037AE	REAL	TRG	BERYLLIUM	12	1	MG/KG	U	V	
SS402293	SS40016AE	DUP	SS40038AE	TRG	BERYLLIUM	11	11	MG/KG	U	V
SS402293	SS40038AE	REAL	TRG	BERYLLIUM	11	11	MG/KG	U	V	
SS402393	SS40039AE	REAL	TRG	BERYLLIUM	12	1	MG/KG	U	V	
SS402493	SS40040AE	REAL	TRG	BERYLLIUM	13	1	MG/KG	U	V	
SS402593	SS40041AE	REAL	TRG	BERYLLIUM	13	1	MG/KG	U	V	
SS402693	SS40199AE	REAL	TRG	BERYLLIUM	11	1	MG/KG	U	V	
SS402793	SS40043AE	REAL	TRG	BERYLLIUM	18	5	MG/KG		V	
SS402893	SS40044AE	REAL	TRG	BERYLLIUM	96	5	MG/KG		V	
SS402993	SS40045AE	REAL	TRG	BERYLLIUM	18	5	MG/KG		V	
SS403093	SS40046AE	REAL	TRG	BERYLLIUM	25	5	MG/KG		V	
SS403193	SS40047AE	REAL	TRG	BERYLLIUM	13	5	MG/KG	U	V	
SS403293	SS40048AE	REAL	TRG	BERYLLIUM	15	5	MG/KG	U	V	
SS403393	SS40049AE	REAL	TRG	BERYLLIUM	14	5	MG/KG	U	V	
SS403493	SS40050AE	REAL	TRG	BERYLLIUM	12	5	MG/KG	U	V	
SS403593	SS40051AE	REAL	TRG	BERYLLIUM	11	5	MG/KG	U	V	
SS403693	SS40052AE	REAL	TRG	BERYLLIUM	12	5	MG/KG	U	V	
40093	SS40060AE	REAL	TRG	BERYLLIUM	14	1	MG/KG	U	V	
40193	SS40485AE	REAL	TRG	BERYLLIUM	14	1	MG/KG	U	V	
40293	SS40042AE	REAL	TRG	BERYLLIUM	14	1	MG/KG	U	V	
40393	SS40053AE	REAL	TRG	BERYLLIUM	13	1	MG/KG	U	V	
40593	SS40054AE	REAL	TRG	BERYLLIUM	13	1	MG/KG	U	V	
40693	SS40057AE	REAL	TRG	BERYLLIUM	19	5	MG/KG	U	V	
40793	SS40058AE	REAL	TRG	BERYLLIUM	17	5	MG/KG	U	V	
40893	SS40004AE	REAL	TRG	BERYLLIUM	12	12	MG/KG	U	V	
40993	SS40072AE	REAL	SS40412AE	TRG	BERYLLIUM	12	5	MG/KG	U	V
40993	SS40412AE	DUP	SS40072AE	TRG	BERYLLIUM	12	5	MG/KG	U	V
41193	SS40007AE	REAL	TRG	BERYLLIUM	18	2	MG/KG	U	V	
41293	SS40071AE	REAL	TRG	BERYLLIUM	15	5	MG/KG	U	V	
41693	SS40410AE	REAL	TRG	BERYLLIUM	15	1	MG/KG		V	
41793	SS40069AE	DUP	SS40077AE	TRG	BERYLLIUM	17	1	MG/KG		V
41793	SS40077AE	REAL	TRG	BERYLLIUM	21	1	MG/KG		V	
41893	SS40003AE	REAL	TRG	BERYLLIUM	12	1	MG/KG	U	V	
41993	SS40009AE	REAL	TRG	BERYLLIUM	12	1	MG/KG	U	V	

* Codes are explained in Table II 3 6-1
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TABLE II 3 2-4

**SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Detect Limit	Units	Lab Qual	* Valid *
	42093	SS40013AE DUP	SS40480AE	TRG	BERYLLIUM	1	1 MG/KG	U	V
	42093	SS40480AE REAL		TRG	BERYLLIUM	1	1 MG/KG	U	V
	42293	SS40078AE REAL		TRG	BERYLLIUM	12	5 MG/KG	U	V
	42393	SS40079AE REAL		TRG	BERYLLIUM	11	1 MG/KG	U	V
	42693	SS40080AE REAL		TRG	BERYLLIUM	16	2 MG/KG	U	V
	42993	SS40056AE REAL		TRG	BERYLLIUM	11	1 MG/KG	U	V
	43193	SS40084AE REAL		TRG	BERYLLIUM	11	1 MG/KG	U	V
	43293	SS40006AE REAL		TRG	BERYLLIUM	13	1 MG/KG	U	V
	43493	SS40086AE REAL		TRG	BERYLLIUM	11	5 MG/KG	U	V
	43593	SS40061AE REAL		TRG	BERYLLIUM	11	1 MG/KG	U	V
	43793	SS40088AE REAL		TRG	BERYLLIUM	36	1 MG/KG		V
	43893	SS40010AE REAL		TRG	BERYLLIUM	23	1 MG/KG		V
	43993	SS40091AE REAL		TRG	BERYLLIUM	11	1 MG/KG	U	V
	44093	SS40090AE REAL		TRG	BERYLLIUM	12	1 MG/KG	U	V
	44193	SS40011AE REAL		TRG	BERYLLIUM	11	11 MG/KG	U	V
	44393	SS40005AE REAL		TRG	BERYLLIUM	11	1 MG/KG	U	V
	44593	SS40001AE REAL		TRG	BERYLLIUM	11	11 MG/KG	U	V
	44793	SS40055AE REAL		TRG	BERYLLIUM	14	1 MG/KG	U	V
	44893	SS40070AE REAL		TRG	BERYLLIUM	14	1 MG/KG	U	V
	45693	SS40094AE REAL		TRG	BERYLLIUM	15	5 MG/KG	U	V
	45793	SS40015AE REAL		TRG	BERYLLIUM	14	5 MG/KG	U	V
	46193	SS40096AE REAL		TRG	BERYLLIUM	12	5 MG/KG	U	V
	SS400193	SS40017AE REAL		TRG	CADMIUM	11	11 MG/KG	U	JA
	SS400293	SS40018AE REAL		TRG	CADMIUM	125	14 MG/KG		V
	SS400393	SS40019AE REAL		TRG	CADMIUM	239	5 MG/KG		V
	SS400493	SS40020AE REAL		TRG	CADMIUM	11	1 MG/KG	UN	V
	SS400593	SS40021AE REAL		TRG	CADMIUM	133	5 MG/KG		V
	SS400693	SS40022AE REAL		TRG	CADMIUM	173	5 MG/KG		V
	SS400793	SS40023AE REAL		TRG	CADMIUM	12	12 MG/KG	U	JA
	SS400893	SS40024AE REAL		TRG	CADMIUM	13	1 MG/KG	UN	V
	SS400993	SS40025AE REAL		TRG	CADMIUM	12	1 MG/KG	UN	V
	SS401093	SS40026AE REAL		TRG	CADMIUM	25	11 MG/KG		JA
	SS401193	SS40027AE REAL		TRG	CADMIUM	14	1 MG/KG	UN	V
	SS401293	SS40028AE REAL		TRG	CADMIUM	11	11 MG/KG	U	JA
	SS401393	SS40029AE REAL		TRG	CADMIUM	21	14 MG/KG		JA
	SS401493	SS40030AE REAL		TRG	CADMIUM	11	11 MG/KG	U	JA
	SS401593	SS40031AE REAL		TRG	CADMIUM	15	13 MG/KG		JA
	SS401693	SS40032AE REAL		TRG	CADMIUM	11	1 MG/KG	UN	V
	SS401793	SS40033AE REAL		TRG	CADMIUM	12	1 MG/KG	UN	V
	SS401893	SS40034AE REAL		TRG	CADMIUM	61	1 MG/KG	N	JA
	SS401993	SS40035AE REAL		TRG	CADMIUM	23	12 MG/KG		JA
	SS402093	SS40036AE REAL		TRG	CADMIUM	13	1 MG/KG	UN	V
	SS402193	SS40037AE REAL		TRG	CADMIUM	12	1 MG/KG	UN	V
	SS402293	SS40016AE DUP	SS40038AE	TRG	CADMIUM	11	11 MG/KG	U	JA
	SS402293	SS40038AE REAL		TRG	CADMIUM	11	11 MG/KG	U	JA
	SS402393	SS40039AE REAL		TRG	CADMIUM	12	1 MG/KG	UN	V
	SS402493	SS40040AE REAL		TRG	CADMIUM	13	1 MG/KG	UN	V
	SS402593	SS40041AE REAL		TRG	CADMIUM	13	1 MG/KG	UN	V
	SS402693	SS40199AE REAL		TRG	CADMIUM	17	1 MG/KG	N	JA
	SS402793	SS40043AE REAL		TRG	CADMIUM	356	5 MG/KG		V
	SS402893	SS40044AE REAL		TRG	CADMIUM	194	5 MG/KG		V
	SS402993	SS40045AE REAL		TRG	CADMIUM	146	5 MG/KG		V
	SS403093	SS40046AE REAL		TRG	CADMIUM	382	5 MG/KG		V

* Codes are explained in Table II 3 6-1
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TABLE II.3 2-4

**SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Detect Limit	Units	Lab Qual	* Valid *
SS403193	SS40047AE	REAL	TRG	CADMIUM	1 9	5	MG/KG		JA
SS403293	SS40048AE	REAL	TRG	CADMIUM	2 5	5	MG/KG		JA
SS403393	SS40049AE	REAL	TRG	CADMIUM	1 4	5	MG/KG	U	V
SS403493	SS40050AE	REAL	TRG	CADMIUM	1 2	5	MG/KG	U	V
SS403593	SS40051AE	REAL	TRG	CADMIUM	1 1	5	MG/KG	U	V
SS403693	SS40052AE	REAL	TRG	CADMIUM	1 3	5	MG/KG		JA
40093	SS40060AE	REAL	TRG	CADMIUM	1 4	1	MG/KG	UN	V
40193	SS40485AE	REAL	TRG	CADMIUM	1 4	1	MG/KG	UN	V
40293	SS40042AE	REAL	TRG	CADMIUM	1 4	1	MG/KG	U	V
40393	SS40053AE	REAL	TRG	CADMIUM	1 3	1	MG/KG	U	V
40593	SS40054AE	REAL	TRG	CADMIUM	1 3	1	MG/KG	U	V
40693	SS40057AE	REAL	TRG	CADMIUM	1 9	5	MG/KG	U	V
40793	SS40058AE	REAL	TRG	CADMIUM	1 7	5	MG/KG	U	V
40893	SS40004AE	REAL	TRG	CADMIUM	3 1	1 2	MG/KG		JA
40993	SS40072AE	REAL	SS40412AE TRG	CADMIUM	3 2	5	MG/KG		V
40993	SS40412AE	DUP	SS40072AE TRG	CADMIUM	3 2	5	MG/KG		V
41193	SS40007AE	REAL	TRG	CADMIUM	8	2	MG/KG		V
41293	SS40071AE	REAL	TRG	CADMIUM	4 3	5	MG/KG		V
41693	SS40410AE	REAL	TRG	CADMIUM	14 3	1	MG/KG	N	JA
41793	SS40069AE	DUP	SS40077AE TRG	CADMIUM	2 5	1	MG/KG		V
41793	SS40077AE	REAL	TRG	CADMIUM	30 1	1	MG/KG		V
41893	SS40003AE	REAL	TRG	CADMIUM	6 3	1	MG/KG		V
41993	SS40009AE	REAL	TRG	CADMIUM	1 8	1	MG/KG	N	JA
42093	SS40013AE	DUP	SS40480AE TRG	CADMIUM	2 2	1	MG/KG	N	JA
42093	SS40480AE	REAL	TRG	CADMIUM	1 5	1	MG/KG	N	JA
42293	SS40078AE	REAL	TRG	CADMIUM	1 9	5	MG/KG		V
42393	SS40079AE	REAL	TRG	CADMIUM	1 1	1	MG/KG	U	V
42693	SS40080AE	REAL	TRG	CADMIUM	1 6	2	MG/KG	U	V
42993	SS40056AE	REAL	TRG	CADMIUM	1 7	1	MG/KG		V
43193	SS40084AE	REAL	TRG	CADMIUM	5 6	1	MG/KG		V
43293	SS40006AE	REAL	TRG	CADMIUM	3 5	1	MG/KG		V
43493	SS40086AE	REAL	TRG	CADMIUM	3 7	5	MG/KG		V
43593	SS40061AE	REAL	TRG	CADMIUM	1 1	1	MG/KG	U	V
43793	SS40088AE	REAL	TRG	CADMIUM	42 2	1	MG/KG	N	JA
43893	SS40010AE	REAL	TRG	CADMIUM	58 3	1	MG/KG		V
43993	SS40091AE	REAL	TRG	CADMIUM	1 1	1	MG/KG	U	V
44093	SS40090AE	REAL	TRG	CADMIUM	1 2	1	MG/KG	U	V
44193	SS40011AE	REAL	TRG	CADMIUM	1 1	1 1	MG/KG	U	JA
44393	SS40005AE	REAL	TRG	CADMIUM	1 9	1	MG/KG		V
44593	SS40001AE	REAL	TRG	CADMIUM	1 1	1 1	MG/KG	U	JA
44793	SS40055AE	REAL	TRG	CADMIUM	1 4	1	MG/KG	UN	V
44893	SS40070AE	REAL	TRG	CADMIUM	1 6	1	MG/KG	N	JA
45693	SS40094AE	REAL	TRG	CADMIUM	1 5	5	MG/KG	U	V
45793	SS40015AE	REAL	TRG	CADMIUM	1 9	5	MG/KG		V
46193	SS40096AE	REAL	TRG	CADMIUM	6 4	5	MG/KG		V
SS400193	SS40017AE	REAL	TRG	CALCIUM	25700	2269 9	MG/KG		V
SS400293	SS40018AE	REAL	TRG	CALCIUM	11600	2848 6	MG/KG		V
SS400393	SS40019AE	REAL	TRG	CALCIUM	19300	1000	MG/KG		V
SS400493	SS40020AE	REAL	TRG	CALCIUM	5960	1099	MG/KG	*	JA
SS400593	SS40021AE	REAL	TRG	CALCIUM	3090	1000	MG/KG		V
SS400693	SS40022AE	REAL	TRG	CALCIUM	9250	1000	MG/KG		V
SS400793	SS40023AE	REAL	TRG	CALCIUM	68400	2325 3	MG/KG		V
SS400893	SS40024AE	REAL	TRG	CALCIUM	7860	1305	MG/KG	*	JA

* Codes are explained in Table II 3 6-1
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TABLE II.3 2-4

SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Detect Limit	Units	Lab Qual	* Valid *	
SS400993	SS40025AE	REAL	TRG	CALCIUM	2240	1163	MG/KG	*	JA	
SS401093	SS40026AE	REAL	TRG	CALCIUM	3140	2263	7 MG/KG		V	
SS401193	SS40027AE	REAL	TRG	CALCIUM	5430	1408	MG/KG	*	JA	
SS401293	SS40028AE	REAL	TRG	CALCIUM	10800	2240	1 MG/KG		V	
SS401393	SS40029AE	REAL	TRG	CALCIUM	24200	2890	6 MG/KG		V	
SS401493	SS40030AE	REAL	TRG	CALCIUM	3500	2207	7 MG/KG		V	
SS401593	SS40031AE	REAL	TRG	CALCIUM	24300	2587	3 MG/KG		V	
SS401693	SS40032AE	REAL	TRG	CALCIUM	2810	1062	MG/KG	*	JA	
SS401793	SS40033AE	REAL	TRG	CALCIUM	5230	1178	MG/KG	*	JA	
SS401893	SS40034AE	REAL	TRG	CALCIUM	3450	1101	MG/KG	*	JA	
SS401993	SS40035AE	REAL	TRG	CALCIUM	40100	2314	8 MG/KG		V	
SS402093	SS40036AE	REAL	TRG	CALCIUM	15100	1284	MG/KG	*	JA	
SS402193	SS40037AE	REAL	TRG	CALCIUM	4610	1153	MG/KG	*	JA	
SS402293	SS40016AE	DUP	SS40038AE	TRG	CALCIUM	1290	2112	6 MG/KG		V
SS402293	SS40038AE	REAL	TRG	CALCIUM	1110	2120	9 MG/KG		V	
SS402393	SS40039AE	REAL	TRG	CALCIUM	8200	1157	MG/KG	*	JA	
SS402493	SS40040AE	REAL	TRG	CALCIUM	7610	1300	MG/KG	*	JA	
SS402593	SS40041AE	REAL	TRG	CALCIUM	6100	1342	MG/KG	*	JA	
SS402693	SS40199AE	REAL	TRG	CALCIUM	4730	1135	MG/KG	*	JA	
SS402793	SS40043AE	REAL	TRG	CALCIUM	7620	1000	MG/KG		V	
SS402893	SS40044AE	REAL	TRG	CALCIUM	5650	1000	MG/KG		V	
SS402993	SS40045AE	REAL	TRG	CALCIUM	63200	1000	MG/KG		V	
SS403093	SS40046AE	REAL	TRG	CALCIUM	248000	1000	MG/KG		V	
SS403193	SS40047AE	REAL	TRG	CALCIUM	18100	1000	MG/KG		V	
SS403293	SS40048AE	REAL	TRG	CALCIUM	55500	1000	MG/KG		V	
SS403393	SS40049AE	REAL	TRG	CALCIUM	31500	1000	MG/KG		V	
SS403493	SS40050AE	REAL	TRG	CALCIUM	7800	1000	MG/KG		V	
SS403593	SS40051AE	REAL	TRG	CALCIUM	7490	1000	MG/KG		V	
SS403693	SS40052AE	REAL	TRG	CALCIUM	5900	1000	MG/KG		V	
40093	SS40060AE	REAL	TRG	CALCIUM	5730	1372	MG/KG		V	
40193	SS40485AE	REAL	TRG	CALCIUM	6260	1422	MG/KG	*	JA	
40293	SS40042AE	REAL	TRG	CALCIUM	4530	2829	MG/KG		V	
40393	SS40053AE	REAL	TRG	CALCIUM	9760	1295	MG/KG		V	
40593	SS40054AE	REAL	TRG	CALCIUM	10400	2670	MG/KG		V	
40693	SS40057AE	REAL	TRG	CALCIUM	39400	1000	MG/KG		V	
40793	SS40058AE	REAL	TRG	CALCIUM	20400	1000	MG/KG		V	
40893	SS40004AE	REAL	TRG	CALCIUM	29700	2415	5 MG/KG		V	
40993	SS40072AE	REAL	SS40412AE	TRG	CALCIUM	13000	1000	MG/KG		V
40993	SS40412AE	DUP	SS40072AE	TRG	CALCIUM	12500	1000	MG/KG		V
41193	SS40007AE	REAL	TRG	CALCIUM	44100	1802	MG/KG		V	
41293	SS40071AE	REAL	TRG	CALCIUM	22800	1000	MG/KG		V	
41693	SS40410AE	REAL	TRG	CALCIUM	11300	1337	MG/KG	E	JA	
41793	SS40069AE	DUP	SS40077AE	TRG	CALCIUM	31500	1145	MG/KG		V
41793	SS40077AE	REAL	TRG	CALCIUM	30000	1138	MG/KG		V	
41893	SS40003AE	REAL	TRG	CALCIUM	10500	2436	MG/KG		V	
41993	SS40009AE	REAL	TRG	CALCIUM	6980	1192	MG/KG		V	
42093	SS40013AE	DUP	SS40480AE	TRG	CALCIUM	1870	1028	MG/KG		V
42093	SS40480AE	REAL	TRG	CALCIUM	2360	1030	MG/KG		V	
42293	SS40078AE	REAL	TRG	CALCIUM	56500	1000	MG/KG	*	JA	
42393	SS40079AE	REAL	TRG	CALCIUM	6990	2141	MG/KG		V	
42693	SS40080AE	REAL	TRG	CALCIUM	4630	1550	MG/KG		V	
42993	SS40056AE	REAL	TRG	CALCIUM	7430	2281	MG/KG		V	
43193	SS40084AE	REAL	TRG	CALCIUM	39500	1101	MG/KG		V	
43293	SS40006AE	REAL	TRG	CALCIUM	4680	1255	MG/KG		V	

* Codes are explained in Table II 3 6-1
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TABLE II.3 2-4

**SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Detect Limit	Units	Lab Qual	* Valid *
	43493	SS40086AE REAL	TRG	CALCIUM	79400	1000	MG/KG	•	JA
	43593	SS40061AE REAL	TRG	CALCIUM	4970	2101	MG/KG		V
	43793	SS40088AE REAL	TRG	CALCIUM	13500	1167	MG/KG	E	JA
	43893	SS40010AE REAL	TRG	CALCIUM	69600	1182	MG/KG		V
	43993	SS40091AE REAL	TRG	CALCIUM	15100	1130	MG/KG		V
	44093	SS40090AE REAL	TRG	CALCIUM	72500	1192	MG/KG		V
	44193	SS40011AE REAL	TRG	CALCIUM	1600	2255	3 MG/KG		V
	44393	SS40005AE REAL	TRG	CALCIUM	29800	2294	MG/KG		V
	44593	SS40001AE REAL	TRG	CALCIUM	21100	2199	5 MG/KG		V
	44793	SS40055AE REAL	TRG	CALCIUM	17000	1404	MG/KG		V
	44893	SS40070AE REAL	TRG	CALCIUM	5560	1449	MG/KG		V
	45693	SS40094AE REAL	TRG	CALCIUM	40700	1000	MG/KG		V
	45793	SS40015AE REAL	TRG	CALCIUM	16000	1000	MG/KG		V
	46193	SS40096AE REAL	TRG	CALCIUM	32100	1000	MG/KG		V
	SS400193	SS40017AE REAL	TRG	MERCURY	0 05	0 2	MG/KG	UN	R
	SS400293	SS40018AE REAL	TRG	MERCURY	0 14	0 3	MG/KG	BN	JA
	SS400393	SS40019AE REAL	TRG	MERCURY	0 2	0 2	MG/KG	N	JA
	SS400493	SS40020AE REAL	TRG	MERCURY	0 05	0 04	MG/KG	U	V
	SS400593	SS40021AE REAL	TRG	MERCURY	0 78	0 2	MG/KG	N	JA
	SS400693	SS40022AE REAL	TRG	MERCURY	0 11	0 2	MG/KG	UN	V
	SS400793	SS40023AE REAL	TRG	MERCURY	0 06	0 2	MG/KG	UN	R
	SS400893	SS40024AE REAL	TRG	MERCURY	0 06	0 05	MG/KG	U	V
	SS400993	SS40025AE REAL	TRG	MERCURY	0 06	0 05	MG/KG	U	V
	SS401093	SS40026AE REAL	TRG	MERCURY	0 07	0 2	MG/KG	BN	JA
	SS401193	SS40027AE REAL	TRG	MERCURY	0 07	0 06	MG/KG	U	V
	SS401293	SS40028AE REAL	TRG	MERCURY	0 05	0 2	MG/KG	UN	JA
	SS401393	SS40029AE REAL	TRG	MERCURY	0 07	0 3	MG/KG	UN	R
	SS401493	SS40030AE REAL	TRG	MERCURY	0 05	0 2	MG/KG	UN	R
	SS401593	SS40031AE REAL	TRG	MERCURY	0 08	0 3	MG/KG	BN	JA
	SS401693	SS40032AE REAL	TRG	MERCURY	0 05	0 04	MG/KG	U	V
	SS401793	SS40033AE REAL	TRG	MERCURY	0 06	0 05	MG/KG	U	V
	SS401893	SS40034AE REAL	TRG	MERCURY	0 05	0 04	MG/KG	U	V
	SS401993	SS40035AE REAL	TRG	MERCURY	0 05	0 2	MG/KG	UN	R
	SS402093	SS40036AE REAL	TRG	MERCURY	0 06	0 05	MG/KG	U	V
	SS402193	SS40037AE REAL	TRG	MERCURY	0 05	0 05	MG/KG	U	V
	SS402293	SS40016AE DUP	SS40038AE TRG	MERCURY	0 05	0 2	MG/KG	UN	JA
	SS402293	SS40038AE REAL	TRG	MERCURY	0 05	0 2	MG/KG	UN	JA
	SS402393	SS40039AE REAL	TRG	MERCURY	0 05	0 05	MG/KG	U	V
	SS402493	SS40040AE REAL	TRG	MERCURY	0 06	0 05	MG/KG	U	V
	SS402593	SS40041AE REAL	TRG	MERCURY	0 06	0 05	MG/KG	U	V
	SS402693	SS40199AE REAL	TRG	MERCURY	0 05	0 05	MG/KG	U	V
	SS402793	SS40043AE REAL	TRG	MERCURY	1 8	0 2	MG/KG	N	JA
	SS402893	SS40044AE REAL	TRG	MERCURY	0 34	0 2	MG/KG	N	JA
	SS402993	SS40045AE REAL	TRG	MERCURY	0 11	0 2	MG/KG	UN	JA
	SS403093	SS40046AE REAL	TRG	MERCURY	1 7	0 2	MG/KG	N	JA
	SS403193	SS40047AE REAL	TRG	MERCURY	0 13	0 2	MG/KG	UN	V
	SS403293	SS40048AE REAL	TRG	MERCURY	0 15	0 2	MG/KG	UN	V
	SS403393	SS40049AE REAL	TRG	MERCURY	0 14	0 2	MG/KG	UN	JA
	SS403493	SS40050AE REAL	TRG	MERCURY	0 12	0 2	MG/KG	U	V
	SS403593	SS40051AE REAL	TRG	MERCURY	0 11	0 2	MG/KG	U	V
	SS403693	SS40052AE REAL	TRG	MERCURY	0 12	0 2	MG/KG	U	V
	40093	SS40060AE REAL	TRG	MERCURY	0 21	0 1	MG/KG		V
	40193	SS40485AE REAL	TRG	MERCURY	0 07	0 06	MG/KG	U	V

* Codes are explained in Table II 3 6-1
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TABLE II.3 2-4

**SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result		Result	Detect		Lab Qual *	Valid *	
			Type	Chemical		Limit	Units			
40293	SS40042AE	REAL	TRG	MERCURY	0 21	0 3	MG/KG	JA		
40393	SS40053AE	REAL	TRG	MERCURY	0 13	0 05	MG/KG	U	V	
40593	SS40054AE	REAL	TRG	MERCURY	0 2	0 3	MG/KG		JA	
40693	SS40057AE	REAL	TRG	MERCURY	0 19	0 2	MG/KG	U	JA	
40793	SS40058AE	REAL	TRG	MERCURY	0 17	0 2	MG/KG	U	JA	
40893	SS40004AE	REAL	TRG	MERCURY	0 06	0 2	MG/KG	UN	R	
40993	SS40072AE	REAL	SS40412AE	TRG	MERCURY	0 12	0 2	MG/KG	U	JA
40993	SS40412AE	DUP	SS40072AE	TRG	MERCURY	0 12	0 2	MG/KG	U	JA
41193	SS40007AE	REAL	TRG	MERCURY	0 18	0 07	MG/KG	U	V	
41293	SS40071AE	REAL	TRG	MERCURY	0 15	0 2	MG/KG	U	JA	
41693	SS40410AE	REAL	TRG	MERCURY	0 13	0 05	MG/KG	U	V	
41793	SS40069AE	DUP	SS40077AE	TRG	MERCURY	0 11	0 05	MG/KG	U	V
41793	SS40077AE	REAL	TRG	MERCURY	0 11	0 05	MG/KG	U	V	
41893	SS40003AE	REAL	TRG	MERCURY	0 35	0 2	MG/KG		JA	
41993	SS40009AE	REAL	TRG	MERCURY	0 18	0 05	MG/KG		V	
42093	SS40013AE	DUP	SS40480AE	TRG	MERCURY	0 05	0 04	MG/KG	U	V
42093	SS40480AE	REAL	TRG	MERCURY	0 12	0 04	MG/KG		V	
42293	SS40078AE	REAL	TRG	MERCURY	0 18	0 2	MG/KG	U	V	
42393	SS40079AE	REAL	TRG	MERCURY	0 13	0 2	MG/KG		JA	
42693	SS40080AE	REAL	TRG	MERCURY	0 16	0 06	MG/KG	U	V	
42993	SS40056AE	REAL	TRG	MERCURY	0 14	0 2	MG/KG		JA	
43193	SS40084AE	REAL	TRG	MERCURY	0 33	0 04	MG/KG		V	
43293	SS40006AE	REAL	TRG	MERCURY	0 13	0 05	MG/KG	U	V	
43493	SS40086AE	REAL	TRG	MERCURY	0 17	0 2	MG/KG	U	V	
43593	SS40061AE	REAL	TRG	MERCURY	0 05	0 2	MG/KG	U	V	
43793	SS40088AE	REAL	TRG	MERCURY	0 48	0 05	MG/KG		V	
43893	SS40010AE	REAL	TRG	MERCURY	0 12	0 05	MG/KG	U	V	
43993	SS40091AE	REAL	TRG	MERCURY	0 11	0	MG/KG	U	V	
44093	SS40090AE	REAL	TRG	MERCURY	0 12	0 05	MG/KG	U	V	
44193	SS40011AE	REAL	TRG	MERCURY	0 05	0 2	MG/KG	UN	JA	
44393	SS40005AE	REAL	TRG	MERCURY	0 4	0 2	MG/KG		V	
44593	SS40001AE	REAL	TRG	MERCURY	0 05	0 2	MG/KG	UN	R	
44793	SS40055AE	REAL	TRG	MERCURY	0 07	0 1	MG/KG	U	V	
44893	SS40070AE	REAL	TRG	MERCURY	0 17	0 1	MG/KG		V	
45693	SS40094AE	REAL	TRG	MERCURY	0 15	0 2	MG/KG	UN	JA	
45793	SS40015AE	REAL	TRG	MERCURY	0 14	0 2	MG/KG	UN	JA	
46193	SS40096AE	REAL	TRG	MERCURY	0 12	0 2	MG/KG	U	V	
40093	SS40060AE	REAL	TRG	NITRATE/NITRIT	1 27	0 28	MG/KG		V	
40193	SS40485AE	REAL	TRG	NITRATE/NITRIT	4 7	0 28	MG/KG		V	
40293	SS40042AE	REAL	TRG	NITRATE/NITRIT	1 3	0 27	MG/KG		V	
40393	SS40053AE	REAL	TRG	NITRATE/NITRIT	1 4	0 27	MG/KG		V	
40593	SS40054AE	REAL	TRG	NITRATE/NITRIT	6 4	0 28	MG/KG		V	
40693	SS40057AE	REAL	DIL	NITRATE/NITRIT	29 8	1 08	MG/KG		V	
40793	SS40058AE	REAL	TRG	NITRATE/NITRIT	7 69	0 35	MG/KG		V	
40893	SS40004AE	REAL	TRG	NITRATE/NITRIT	2 94	0 2	MG/KG		V	
40993	SS40412AE	DUP	SS40072AE	DIL	NITRATE/NITRIT	22 8	0 71	MG/KG		V
40993	SS40072AE	REAL	SS40412AE	DIL	NITRATE/NITRIT	20 7	0 71	MG/KG		V
41193	SS40007AE	REAL	TRG	NITRATE/NITRIT	16 8	0 24	MG/KG		V	
41293	SS40071AE	REAL	DIL	NITRATE/NITRIT	38 9	1 33	MG/KG		V	
41693	SS40410AE	REAL	TRG	NITRATE/NITRIT	15 5	0 27	MG/KG		V	
41793	SS40069AE	DUP	SS40077AE	TRG	NITRATE/NITRIT	8 1	0 23	MG/KG		V
41793	SS40077AE	REAL	TRG	NITRATE/NITRIT	8 5	0 23	MG/KG		V	
41893	SS40003AE	REAL	TRG	NITRATE/NITRIT	7 8	0 24	MG/KG		V	

* Codes are explained in Table II 3 6-1
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TABLE II.3 2-4

**SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result		Result	Detect		Lab Qual * Valid *
			Type	Chemical		Limit	Units	
41993	SS40009AE	REAL	TRG	NITRATE/NITRIT	6 7	0 24	MG/KG	V
42093	SS40013AE	DUP SS40480AE	TRG	NITRATE/NITRIT	153	0 21	MG/KG	V
42093	SS40480AE	REAL	TRG	NITRATE/NITRIT	112	0 21	MG/KG	V
42293	SS40078AE	REAL	TRG	NITRATE/NITRIT	1 33	0 23	MG/KG	V
42393	SS40079AE	REAL	TRG	NITRATE/NITRIT	7 8	0 21	MG/KG	V
42693	SS40080AE	REAL	TRG	NITRATE/NITRIT	13 6	0 31	MG/KG	V
42993	SS40056AE	REAL	TRG	NITRATE/NITRIT	8 3	0 22	MG/KG	V
43193	SS40084AE	REAL	TRG	NITRATE/NITRIT	5 1	0 22	MG/KG	V
43293	SS40006AE	REAL	TRG	NITRATE/NITRIT	13 6	0 25	MG/KG	V
43493	SS40086AE	REAL	TRG	NITRATE/NITRIT	1 03	0 23	MG/KG	V
43593	SS40061AE	REAL	TRG	NITRATE/NITRIT	2 6	0 21	MG/KG	V
43793	SS40088AE	REAL	TRG	NITRATE/NITRIT	5 99	0 23	MG/KG	V
43893	SS40010AE	REAL	TRG	NITRATE/NITRIT	10	0 24	MG/KG	V
43993	SS40091AE	REAL	TRG	NITRATE/NITRIT	2 7	0 23	MG/KG	V
44093	SS40090AE	REAL	TRG	NITRATE/NITRIT	19 8	0 24	MG/KG	V
44193	SS40011AE	REAL	TRG	NITRATE/NITRIT	1 6	0 22	MG/KG	V
44393	SS40005AE	REAL	TRG	NITRATE/NITRIT	1 6	0 23	MG/KG	V
44593	SS40001AE	REAL	TRG	NITRATE/NITRIT	83 3	0 2	MG/KG	V
44793	SS40055AE	REAL	TRG	NITRATE/NITRIT	2 2	0 27	MG/KG	V
44893	SS40070AE	REAL	TRG	NITRATE/NITRIT	4 6	0 26	MG/KG	V
45693	SS40094AE	REAL	DIL	NITRATE/NITRIT	369	5 7	MG/KG	V
45793	SS40015AE	REAL	TRG	NITRATE/NITRIT	19 5	0 3	MG/KG	V
46193	SS40096AE	REAL	DIL	NITRATE/NITRIT	272	6 22	MG/KG	V
SS400193	SS40017AE	REAL	TRG	NITRATE/NITRIT	1	0 22	MG/KG	V
SS400293	SS40018AE	REAL	TRG	NITRATE/NITRIT	14 6	0 27	MG/KG	V
SS400393	SS40019AE	REAL	TRG	NITRATE/NITRIT	6 24	0 21	MG/KG	V
SS400493	SS40020AE	REAL	TRG	NITRATE/NITRIT	1 13	0 23	MG/KG	V
SS400593	SS40021AE	REAL	TRG	NITRATE/NITRIT	11 9	0 2	MG/KG	V
SS400693	SS40022AE	REAL	TRG	NITRATE/NITRIT	0 73	0 22	MG/KG	V
SS400793	SS40023AE	REAL	TRG	NITRATE/NITRIT	2 9	0 23	MG/KG	V
SS400893	SS40024AE	REAL	TRG	NITRATE/NITRIT	3 37	0 27	MG/KG	V
SS400993	SS40025AE	REAL	TRG	NITRATE/NITRIT	1 92	0 23	MG/KG	V
SS401093	SS40026AE	REAL	TRG	NITRATE/NITRIT	1 9	0 22	MG/KG	V
SS401193	SS40027AE	REAL	TRG	NITRATE/NITRIT	2 33	0 29	MG/KG	V
SS401293	SS40028AE	REAL	TRG	NITRATE/NITRIT	0 84	0 22	MG/KG	V
SS401393	SS40029AE	REAL	TRG	NITRATE/NITRIT	250	0 28	MG/KG	V
SS401493	SS40030AE	REAL	TRG	NITRATE/NITRIT	1 9	0 23	MG/KG	V
SS401593	SS40031AE	REAL	TRG	NITRATE/NITRIT	4 1	0 26	MG/KG	V
SS401693	SS40032AE	REAL	TRG	NITRATE/NITRIT	4 57	0 21	MG/KG	V
SS401793	SS40033AE	REAL	TRG	NITRATE/NITRIT	1 41	0 24	MG/KG	V
SS401893	SS40034AE	REAL	TRG	NITRATE/NITRIT	2 31	0 23	MG/KG	V
SS401993	SS40035AE	REAL	TRG	NITRATE/NITRIT	0 66	0 24	MG/KG	V
SS402093	SS40036AE	REAL	TRG	NITRATE/NITRIT	3 72	0 24	MG/KG	V
SS402193	SS40037AE	REAL	TRG	NITRATE/NITRIT	7 44	0 24	MG/KG	V
SS402293	SS40016AE	DUP SS40038AE	TRG	NITRATE/NITRIT	1 5	0 21	MG/KG	V
SS402293	SS40038AE	REAL	TRG	NITRATE/NITRIT	1 8	0 21	MG/KG	V
SS402393	SS40039AE	REAL	TRG	NITRATE/NITRIT	1 42	0 23	MG/KG	V
SS402493	SS40040AE	REAL	TRG	NITRATE/NITRIT	2 86	0 26	MG/KG	V
SS402593	SS40041AE	REAL	TRG	NITRATE/NITRIT	2 19	0 27	MG/KG	V
SS402693	SS40199AE	REAL	TRG	NITRATE/NITRIT	3 67	0 23	MG/KG	V
SS402793	SS40043AE	REAL	TRG	NITRATE/NITRIT	3 42	0 22	MG/KG	V
SS402893	SS40044AE	REAL	DIL	NITRATE/NITRIT	21 5	1 06	MG/KG	V
SS402993	SS40045AE	REAL	TRG	NITRATE/NITRIT	4 81	0 21	MG/KG	V
SS403093	SS40046AE	REAL	DIL	NITRATE/NITRIT	464	21 1	MG/KG	V

* Codes are explained in Table II 3 6-1
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TABLE IL3 2-4

SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result		Result	Detect		Lab Qual	* Valid *
			Type	Chemical		Limit	Units		
SS403193	SS40047AE	REAL	DIL	NITRATE/NITRIT	765	27.5	MG/KG		V
SS403293	SS40048AE	REAL	TRG	NITRATE/NITRIT	1.83	0.27	MG/KG		V
SS403393	SS40049AE	REAL	DIL	NITRATE/NITRIT	429	18.9	MG/KG		V
SS403493	SS40050AE	REAL	TRG	NITRATE/NITRIT	3.78	0.25	MG/KG		V
SS403593	SS40051AE	REAL	TRG	NITRATE/NITRIT	4.78	0.24	MG/KG		V
SS403693	SS40052AE	REAL	TRG	NITRATE/NITRIT	1.9	0.23	MG/KG		V
SS400193	SS40017AE	REAL	TRG	SILICON	1710	22.7	MG/KG		JA
SS400293	SS40018AE	REAL	TRG	SILICON	2540	28.5	MG/KG		JA
SS400393	SS40019AE	REAL	TRG	SILICON	6420	100	MG/KG		JA
SS400493	SS40020AE	REAL	TRG	SILICON	1720	22	MG/KG		JA
SS400593	SS40021AE	REAL	TRG	SILICON	3610	100	MG/KG		JA
SS400693	SS40022AE	REAL	TRG	SILICON	4200	100	MG/KG		JA
SS400793	SS40023AE	REAL	TRG	SILICON	1770	23.3	MG/KG		JA
SS400893	SS40024AE	REAL	TRG	SILICON	3660	26	MG/KG		JA
SS400993	SS40025AE	REAL	TRG	SILICON	2440	23	MG/KG		JA
SS401093	SS40026AE	REAL	TRG	SILICON	1350	22.6	MG/KG		JA
SS401193	SS40027AE	REAL	TRG	SILICON	3500	28	MG/KG		JA
SS401293	SS40028AE	REAL	TRG	SILICON	1210	22.4	MG/KG		JA
SS401393	SS40029AE	REAL	TRG	SILICON	2040	28.9	MG/KG		JA
SS401493	SS40030AE	REAL	TRG	SILICON	1130	22.1	MG/KG		JA
SS401593	SS40031AE	REAL	TRG	SILICON	1680	25.9	MG/KG		JA
SS401693	SS40032AE	REAL	TRG	SILICON	1260	21	MG/KG		JA
SS401793	SS40033AE	REAL	TRG	SILICON	3070	24	MG/KG		JA
SS401893	SS40034AE	REAL	TRG	SILICON	1600	22	MG/KG		JA
SS401993	SS40035AE	REAL	TRG	SILICON	1190	23.1	MG/KG		JA
SS402093	SS40036AE	REAL	TRG	SILICON	3630	26	MG/KG		JA
SS402193	SS40037AE	REAL	TRG	SILICON	2360	23	MG/KG		JA
SS402293	SS40016AE	DUP	SS40038AE	TRG	SILICON	1000	21.1	MG/KG	JA
SS402293	SS40038AE	REAL	TRG	SILICON	866	21.2	MG/KG		JA
SS402393	SS40039AE	REAL	TRG	SILICON	2060	23	MG/KG		JA
SS402493	SS40040AE	REAL	TRG	SILICON	4480	26	MG/KG		JA
SS402593	SS40041AE	REAL	TRG	SILICON	3730	27	MG/KG		JA
SS402693	SS40199AE	REAL	TRG	SILICON	1630	23	MG/KG		JA
SS402793	SS40043AE	REAL	TRG	SILICON	4030	100	MG/KG		JA
SS402893	SS40044AE	REAL	TRG	SILICON	4100	100	MG/KG		JA
SS402993	SS40045AE	REAL	TRG	SILICON	4910	100	MG/KG		JA
SS403093	SS40046AE	REAL	TRG	SILICON	11300	100	MG/KG		JA
SS403193	SS40047AE	REAL	TRG	SILICON	11300	100	MG/KG		JA
SS403293	SS40048AE	REAL	TRG	SILICON	10100	100	MG/KG		JA
SS403393	SS40049AE	REAL	TRG	SILICON	6120	100	MG/KG		JA
SS403493	SS40050AE	REAL	TRG	SILICON	2530	100	MG/KG	E	JA
SS403593	SS40051AE	REAL	TRG	SILICON	2210	100	MG/KG	E	JA
SS403693	SS40052AE	REAL	TRG	SILICON	2370	100	MG/KG	E	JA
40093	SS40060AE	REAL	TRG	SILICON	2340	27	MG/KG		JA
40193	SS40485AE	REAL	TRG	SILICON	4570	28	MG/KG		JA
40293	SS40042AE	REAL	TRG	SILICON	1190	28	MG/KG	N	JA
40393	SS40053AE	REAL	TRG	SILICON	3550	26	MG/KG		JA
40593	SS40054AE	REAL	TRG	SILICON	1240	27	MG/KG	N	JA
40693	SS40057AE	REAL	TRG	SILICON	3880	100	MG/KG		JA
40793	SS40058AE	REAL	TRG	SILICON	3430	100	MG/KG		JA
40893	SS40004AE	REAL	TRG	SILICON	1860	24.2	MG/KG		JA
40993	SS40072AE	REAL	SS40412AE	TRG	SILICON	2890	100	MG/KG	JA
40993	SS40412AE	DUP	SS40072AE	TRG	SILICON	2870	100	MG/KG	JA

* Codes are explained in Table II 3 6-1
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TABLE IL3 2-4

**SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Detect Limit	Units	Lab Qual	* Valid *
	41193	SS40007AE REAL	TRG	SILICON	4530	36	MG/KG		JA
	41293	SS40071AE REAL	TRG	SILICON	3320	100	MG/KG		JA
	41693	SS40410AE REAL	TRG	SILICON	2020	27	MG/KG	E	JA
	41793	SS40069AE DUP	SS40077AE TRG	SILICON	4070	23	MG/KG		JA
	41793	SS40077AE REAL	TRG	SILICON	4300	23	MG/KG		JA
	41893	SS40003AE REAL	TRG	SILICON	1110	24	MG/KG	N	JA
	41993	SS40009AE REAL	TRG	SILICON	1550	24	MG/KG		JA
	42093	SS40013AE DUP	SS40480AE TRG	SILICON	659	21	MG/KG		JA
	42093	SS40480AE REAL	TRG	SILICON	573	21	MG/KG		JA
	42293	SS40078AE REAL	TRG	SILICON	10400	100	MG/KG		JA
	42393	SS40079AE REAL	TRG	SILICON	808	21	MG/KG	N	JA
	42693	SS40080AE REAL	TRG	SILICON	3920	31	MG/KG		JA
	42993	SS40056AE REAL	TRG	SILICON	595	23	MG/KG	N	JA
	43193	SS40084AE REAL	TRG	SILICON	3160	22	MG/KG		JA
	43293	SS40006AE REAL	TRG	SILICON	2600	25	MG/KG		JA
	43493	SS40086AE REAL	TRG	SILICON	8430	100	MG/KG		JA
	43593	SS40061AE REAL	TRG	SILICON	463	21	MG/KG	N	JA
	43793	SS40088AE REAL	TRG	SILICON	1280	23	MG/KG	E	JA
	43893	SS40010AE REAL	TRG	SILICON	2610	24	MG/KG		JA
	43993	SS40091AE REAL	TRG	SILICON	1970	23	MG/KG		JA
	44093	SS40090AE REAL	TRG	SILICON	4400	24	MG/KG		JA
	44193	SS40011AE REAL	TRG	SILICON	1370	22	MG/KG		JA
	44393	SS40005AE REAL	TRG	SILICON	738	23	MG/KG	N	JA
	44593	SS40001AE REAL	TRG	SILICON	1460	22	MG/KG		JA
	44793	SS40055AE REAL	TRG	SILICON	1830	28	MG/KG		JA
	44893	SS40070AE REAL	TRG	SILICON	1690	29	MG/KG		JA
	45693	SS40094AE REAL	TRG	SILICON	9430	100	MG/KG		JA
	45793	SS40015AE REAL	TRG	SILICON	1280	100	MG/KG		JA
	46193	SS40096AE REAL	TRG	SILICON	4230	100	MG/KG	*	JA
	SS400193	SS40017AE REAL	TRG	SILVER	2 3	2 3	MG/KG	UN	JA
	SS400293	SS40018AE REAL	TRG	SILVER	2 8	2 8	MG/KG	UN	JA
	SS400393	SS40019AE REAL	TRG	SILVER	1 1	5	MG/KG	UN	V
	SS400493	SS40020AE REAL	TRG	SILVER	2 2	2	MG/KG	UN	JA
	SS400593	SS40021AE REAL	TRG	SILVER	1 6	5	MG/KG	BN	JA
	SS400693	SS40022AE REAL	TRG	SILVER	1 1	5	MG/KG	UN	V
	SS400793	SS40023AE REAL	TRG	SILVER	2 3	2 3	MG/KG	UN	JA
	SS400893	SS40024AE REAL	TRG	SILVER	2 6	3	MG/KG	UN	JA
	SS400993	SS40025AE REAL	TRG	SILVER	2 3	2	MG/KG	UN	JA
	SS401093	SS40026AE REAL	TRG	SILVER	2 3	2 3	MG/KG	UN	JA
	SS401193	SS40027AE REAL	TRG	SILVER	2 8	3	MG/KG	UN	JA
	SS401293	SS40028AE REAL	TRG	SILVER	2 2	2 2	MG/KG	UN	JA
	SS401393	SS40029AE REAL	TRG	SILVER	2 9	2 9	MG/KG	UN	JA
	SS401493	SS40030AE REAL	TRG	SILVER	2 2	2 2	MG/KG	UN	JA
	SS401593	SS40031AE REAL	TRG	SILVER	2 6	2 6	MG/KG	UN	JA
	SS401693	SS40032AE REAL	TRG	SILVER	2 1	2	MG/KG	UN	JA
	SS401793	SS40033AE REAL	TRG	SILVER	2 4	2	MG/KG	UN	JA
	SS401893	SS40034AE REAL	TRG	SILVER	2 2	2	MG/KG	UN	JA
	SS401993	SS40035AE REAL	TRG	SILVER	2 3	2 3	MG/KG	UN	JA
	SS402093	SS40036AE REAL	TRG	SILVER	2 6	3	MG/KG	UN	JA
	SS402193	SS40037AE REAL	TRG	SILVER	2 3	2	MG/KG	UN	JA
	SS402293	SS40016AE DUP	SS40038AE TRG	SILVER	2 1	2 1	MG/KG	UN	JA
	SS402293	SS40038AE REAL	TRG	SILVER	2 1	2 1	MG/KG	UN	JA
	SS402393	SS40039AE REAL	TRG	SILVER	2 3	2	MG/KG	UN	JA

* Codes are explained in Table II 3 6-1
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TABLE II.3 2-4

**SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result		Result	Detect		Lab Qual	* Valid *	
			Type	Chemical		Limit	Units			
SS402493	SS40040AE	REAL	TRG	SILVER	2.6	3	MG/KG	UN	JA	
SS402593	SS40041AE	REAL	TRG	SILVER	2.7	3	MG/KG	UN	JA	
SS402693	SS40199AE	REAL	TRG	SILVER	2.3	2	MG/KG	UN	JA	
SS402793	SS40043AE	REAL	TRG	SILVER	1.3	5	MG/KG	BN	JA	
SS402893	SS40044AE	REAL	TRG	SILVER	2.6	5	MG/KG	N	JA	
SS402993	SS40045AE	REAL	TRG	SILVER	1.1	5	MG/KG	UN	V	
SS403093	SS40046AE	REAL	TRG	SILVER	2.5	5	MG/KG	UN	V	
SS403193	SS40047AE	REAL	TRG	SILVER	1.3	5	MG/KG	UN	V	
SS403293	SS40048AE	REAL	TRG	SILVER	1.5	5	MG/KG	UN	V	
SS403393	SS40049AE	REAL	TRG	SILVER	1.4	5	MG/KG	UN	V	
SS403493	SS40050AE	REAL	TRG	SILVER	2.4	10	MG/KG	U	V	
SS403593	SS40051AE	REAL	TRG	SILVER	2.3	10	MG/KG	U	V	
SS403693	SS40052AE	REAL	TRG	SILVER	2.4	10	MG/KG	U	V	
40093	SS40060AE	REAL	TRG	SILVER	2.7	3	MG/KG	UN	JA	
40193	SS40485AE	REAL	TRG	SILVER	2.8	3	MG/KG	UN	JA	
40293	SS40042AE	REAL	TRG	SILVER	2.8	3	MG/KG	UN	JA	
40393	SS40053AE	REAL	TRG	SILVER	2.6	3	MG/KG	UN	JA	
40593	SS40054AE	REAL	TRG	SILVER	2.7	3	MG/KG	UN	JA	
40693	SS40057AE	REAL	TRG	SILVER	3.7	10	MG/KG	UN	V	
40793	SS40058AE	REAL	TRG	SILVER	3.4	10	MG/KG	UN	V	
40893	SS40004AE	REAL	TRG	SILVER	2.4	2.4	MG/KG	UN	JA	
40993	SS40072AE	REAL	SS40412AE	TRG	SILVER	3.6	10	MG/KG	N	V
40993	SS40412AE	DUP	SS40072AE	TRG	SILVER	2.4	10	MG/KG	UN	V
41193	SS40007AE	REAL	TRG	SILVER	3.6	4	MG/KG	UN	JA	
41293	SS40071AE	REAL	TRG	SILVER	3	10	MG/KG	UN	V	
41693	SS40410AE	REAL	TRG	SILVER	2.7	3	MG/KG	UN	JA	
41793	SS40069AE	DUP	SS40077AE	TRG	SILVER	2.3	2	MG/KG	UN	JA
41793	SS40077AE	REAL	TRG	SILVER	2.3	2	MG/KG	UN	JA	
41893	SS40003AE	REAL	TRG	SILVER	2.4	2	MG/KG	UN	JA	
41993	SS40009AE	REAL	TRG	SILVER	2.4	2	MG/KG	UN	JA	
42093	SS40013AE	DUP	SS40480AE	TRG	SILVER	2.1	2	MG/KG	UN	JA
42093	SS40480AE	REAL	TRG	SILVER	2.1	2	MG/KG	UN	JA	
42293	SS40078AE	REAL	TRG	SILVER	2.4	10	MG/KG	UN	JA	
42393	SS40079AE	REAL	TRG	SILVER	2.1	2	MG/KG	UN	JA	
42693	SS40080AE	REAL	TRG	SILVER	3.1	3	MG/KG	UN	JA	
42993	SS40056AE	REAL	TRG	SILVER	2.3	2	MG/KG	UN	JA	
43193	SS40084AE	REAL	TRG	SILVER	2.2	2	MG/KG	UN	JA	
43293	SS40006AE	REAL	TRG	SILVER	2.5	3	MG/KG	UN	JA	
43493	SS40086AE	REAL	TRG	SILVER	2.3	10	MG/KG	UN	JA	
43593	SS40061AE	REAL	TRG	SILVER	2.1	2	MG/KG	UN	JA	
43793	SS40088AE	REAL	TRG	SILVER	2.3	2	MG/KG	UN	JA	
43893	SS40010AE	REAL	TRG	SILVER	2.4	2	MG/KG	UN	JA	
43993	SS40091AE	REAL	TRG	SILVER	2.3	2	MG/KG	UN	JA	
44093	SS40090AE	REAL	TRG	SILVER	2.4	2	MG/KG	UN	JA	
44193	SS40011AE	REAL	TRG	SILVER	2.3	2.3	MG/KG	UN	JA	
44393	SS40005AE	REAL	TRG	SILVER	2.3	2	MG/KG	UN	JA	
44593	SS40001AE	REAL	TRG	SILVER	2.2	2.2	MG/KG	N	JA	
44793	SS40055AE	REAL	TRG	SILVER	2.8	3	MG/KG	UN	JA	
44893	SS40070AE	REAL	TRG	SILVER	2.9	3	MG/KG	UN	JA	
45693	SS40094AE	REAL	TRG	SILVER	2.9	10	MG/KG	UN	JA	
45793	SS40015AE	REAL	TRG	SILVER	2.8	10	MG/KG	UN	JA	
46193	SS40096AE	REAL	TRG	SILVER	2.5	10	MG/KG	UN	V	
SS400193	SS40017AE	REAL	TRG	SODIUM	227	2269.9	MG/KG	U	V	

* Codes are explained in Table II 3 6-1
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TABLE IL3 2-4

**SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Detect Limit	Units	Lab Qual	* Valid *
	SS400293	SS40018AE REAL	TRG	SODIUM	285	2848 6	MG/KG	U	V
	SS400393	SS40019AE REAL	TRG	SODIUM	213	1000	MG/KG	U	V
	SS400493	SS40020AE REAL	TRG	SODIUM	220	1099	MG/KG	U	V
	SS400593	SS40021AE REAL	TRG	SODIUM	204	1000	MG/KG	U	V
	SS400693	SS40022AE REAL	TRG	SODIUM	214	1000	MG/KG	U	V
	SS400793	SS40023AE REAL	TRG	SODIUM	233	2325 3	MG/KG	U	V
	SS400893	SS40024AE REAL	TRG	SODIUM	261	1305	MG/KG	U	V
	SS400993	SS40025AE REAL	TRG	SODIUM	233	1163	MG/KG	U	V
	SS401093	SS40026AE REAL	TRG	SODIUM	226	2263 7	MG/KG	U	V
	SS401193	SS40027AE REAL	TRG	SODIUM	282	1408	MG/KG	U	V
	SS401293	SS40028AE REAL	TRG	SODIUM	224	2240 1	MG/KG	U	V
	SS401393	SS40029AE REAL	TRG	SODIUM	901	2890 6	MG/KG	B	V
	SS401493	SS40030AE REAL	TRG	SODIUM	221	2207 7	MG/KG	U	V
	SS401593	SS40031AE REAL	TRG	SODIUM	259	2587 3	MG/KG	U	V
	SS401693	SS40032AE REAL	TRG	SODIUM	212	1062	MG/KG	U	V
	SS401793	SS40033AE REAL	TRG	SODIUM	236	1178	MG/KG	U	V
	SS401893	SS40034AE REAL	TRG	SODIUM	220	1101	MG/KG	U	V
	SS401993	SS40035AE REAL	TRG	SODIUM	231	2314 8	MG/KG	U	V
	SS402093	SS40036AE REAL	TRG	SODIUM	257	1284	MG/KG	U	V
	SS402193	SS40037AE REAL	TRG	SODIUM	231	1153	MG/KG	U	V
	SS402293	SS40016AE DUP	SS40038AE TRG	SODIUM	211	2112 6	MG/KG	U	V
	SS402293	SS40038AE REAL	TRG	SODIUM	212	2120 9	MG/KG	U	V
	SS402393	SS40039AE REAL	TRG	SODIUM	231	1157	MG/KG	U	V
	SS402493	SS40040AE REAL	TRG	SODIUM	260	1300	MG/KG	U	V
	SS402593	SS40041AE REAL	TRG	SODIUM	268	1342	MG/KG	U	V
	SS402693	SS40199AE REAL	TRG	SODIUM	227	1135	MG/KG	U	V
	SS402793	SS40043AE REAL	TRG	SODIUM	212	1000	MG/KG	U	V
	SS402893	SS40044AE REAL	TRG	SODIUM	390	1000	MG/KG	B	V
	SS402993	SS40045AE REAL	TRG	SODIUM	212	1000	MG/KG	U	V
	SS403093	SS40046AE REAL	TRG	SODIUM	1620	1000	MG/KG	B	V
	SS403193	SS40047AE REAL	TRG	SODIUM	2440	1000	MG/KG		V
	SS403293	SS40048AE REAL	TRG	SODIUM	310	1000	MG/KG	U	V
	SS403393	SS40049AE REAL	TRG	SODIUM	1270	1000	MG/KG	B	V
	SS403493	SS40050AE REAL	TRG	SODIUM	240	1000	MG/KG	U	V
	SS403593	SS40051AE REAL	TRG	SODIUM	227	1000	MG/KG	U	V
	SS403693	SS40052AE REAL	TRG	SODIUM	245	1000	MG/KG	U	V
	40093	SS40060AE REAL	TRG	SODIUM	274	1372	MG/KG	U	V
	40193	SS40485AE REAL	TRG	SODIUM	284	1422	MG/KG	U	V
	40293	SS40042AE REAL	TRG	SODIUM	283	2829	MG/KG	U	V
	40393	SS40053AE REAL	TRG	SODIUM	259	1295	MG/KG	U	V
	40593	SS40054AE REAL	TRG	SODIUM	267	2670	MG/KG	U	V
	40693	SS40057AE REAL	TRG	SODIUM	1150	1000	MG/KG	B	V
	40793	SS40058AE REAL	TRG	SODIUM	340	1000	MG/KG	U	V
	40893	SS40004AE REAL	TRG	SODIUM	242	2415 5	MG/KG	U	V
	40993	SS40072AE REAL	SS40412AE TRG	SODIUM	230	1000	MG/KG	U	V
	40993	SS40412AE DUP	SS40072AE TRG	SODIUM	240	1000	MG/KG	U	V
	41193	SS40007AE REAL	TRG	SODIUM	360	1802	MG/KG	U	V
	41293	SS40071AE REAL	TRG	SODIUM	300	1000	MG/KG	U	V
	41693	SS40410AE REAL	TRG	SODIUM	841	1337	MG/KG	B	V
	41793	SS40069AE DUP	SS40077AE TRG	SODIUM	229	1145	MG/KG	U	V
	41793	SS40077AE REAL	TRG	SODIUM	228	1138	MG/KG	U	V
	41893	SS40003AE REAL	TRG	SODIUM	244	2436	MG/KG	U	V
	41993	SS40009AE REAL	TRG	SODIUM	238	1192	MG/KG	U	V
	42093	SS40013AE DUP	SS40480AE TRG	SODIUM	339	1028	MG/KG	B	V

* Codes are explained in Table II 3 6-1
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TABLE II 3 2-4

SURFICIAL SOIL
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result		Result	Detect		Lab Qual	Valid *
			Type	Chemical		Limit	Units		
42093	SS40480AE	REAL	TRG	SODIUM	378	1030	MG/KG	B	V
42293	SS40078AE	REAL	TRG	SODIUM	240	1000	MG/KG	U	JA
42393	SS40079AE	REAL	TRG	SODIUM	214	2141	MG/KG	U	V
42693	SS40080AE	REAL	TRG	SODIUM	310	1550	MG/KG	U	V
42993	SS40056AE	REAL	TRG	SODIUM	381	2281	MG/KG	B	V
43193	SS40084AE	REAL	TRG	SODIUM	220	1101	MG/KG	U	V
43293	SS40006AE	REAL	TRG	SODIUM	251	1255	MG/KG	U	V
43493	SS40086AE	REAL	TRG	SODIUM	230	1000	MG/KG	U	JA
43593	SS40061AE	REAL	TRG	SODIUM	639	2101	MG/KG	B	V
43793	SS40088AE	REAL	TRG	SODIUM	233	1167	MG/KG	U	V
43893	SS40010AE	REAL	TRG	SODIUM	236	1182	MG/KG	U	V
43993	SS40091AE	REAL	TRG	SODIUM	226	1130	MG/KG	U	V
44093	SS40090AE	REAL	TRG	SODIUM	238	1192	MG/KG	U	V
44193	SS40011AE	REAL	TRG	SODIUM	225	2255	3 MG/KG	U	V
44393	SS40005AE	REAL	TRG	SODIUM	229	2294	MG/KG	U	V
44593	SS40001AE	REAL	TRG	SODIUM	220	2199	5 MG/KG	U	V
44793	SS40055AE	REAL	TRG	SODIUM	281	1404	MG/KG	U	V
44893	SS40070AE	REAL	TRG	SODIUM	290	1449	MG/KG	U	V
45693	SS40094AE	REAL	TRG	SODIUM	1490	1000	MG/KG		V
45793	SS40015AE	REAL	TRG	SODIUM	280	1000	MG/KG	U	V
46193	SS40096AE	REAL	TRG	SODIUM	1300	1000	MG/KG		JA

* Codes are explained in Table II 3 6-1
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TABLE IL3.2-5

**SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid *	Detect Limit
SS400193	SS40017AE	REAL	TRG	AMERICIUM-241	0 4795	0 0642	PCI/G			0 0026
SS400293	SS40018AE	REAL	TRG	AMERICIUM-241	2 783	0 295	PCI/G			0 0025
SS400393	SS40019AE	REAL	TRG	AMERICIUM-241	27	2 3	PCI/G		A	0 6
SS400493	SS40020AE	REAL	TRG	AMERICIUM-241	0 7054	0 0879	PCI/G			0 0026
SS400593	SS40021AE	REAL	TRG	AMERICIUM-241	92	6 9	PCI/G		A	0 5
SS400693	SS40022AE	REAL	TRG	AMERICIUM-241	55	4 1	PCI/G		A	1
SS400793	SS40023AE	REAL	TRG	AMERICIUM-241	1 147	0 129	PCI/G			0 0023
SS400893	SS40024AE	REAL	TRG	AMERICIUM-241	0 1974	0 0329	PCI/G		A	0 004
SS400993	SS40025AE	REAL	TRG	AMERICIUM-241	20 18	2 19	PCI/G		A	0 008
SS401093	SS40026AE	REAL	TRG	AMERICIUM-241	1 035	0 121	PCI/G			0 007
SS401193	SS40027AE	REAL	TRG	AMERICIUM-241	0 0333	0 0111	PCI/G		A	0
SS401293	SS40028AE	REAL	TRG	AMERICIUM-241	0 0584	0 0161	PCI/G			0 0026
SS401393	SS40029AE	REAL	TRG	AMERICIUM-241	0 2156	0 036	PCI/G			0 0026
SS401493	SS40030AE	REAL	TRG	AMERICIUM-241	1 238	0 143	PCI/G			0 0027
SS401593	SS40031AE	REAL	TRG	AMERICIUM-241	0 9783	0 118	PCI/G			0 0077
SS401693	SS40032AE	REAL	TRG	AMERICIUM-241	2 132	0 231	PCI/G			0 0043
SS401793	SS40033AE	REAL	TRG	AMERICIUM-241	0 1631	0 0284	PCI/G		A	0 003
SS401893	SS40034AE	REAL	TRG	AMERICIUM-241	16 43	1 8	PCI/G			0 0039
SS401993	SS40035AE	REAL	TRG	AMERICIUM-241	7 045	0 725	PCI/G			0 0071
SS402093	SS40036AE	REAL	TRG	AMERICIUM-241	0 126	0 0252	PCI/G		A	0 002
SS402193	SS40037AE	REAL	TRG	AMERICIUM-241	2 105	0 235	PCI/G		A	0 005
SS402293	SS40038AE	REAL	TRG	AMERICIUM-241	0 054	0 0188	PCI/G		A	0
SS402293	SS40016AE	DUP	SS40038A	TRG	AMERICIUM-241	0 07	0 023	PCI/G	A	0
SS402393	SS40039AE	REAL	TRG	AMERICIUM-241	1 381	0 154	PCI/G			0 0025
SS402493	SS40040AE	REAL	TRG	AMERICIUM-241	0 0522	0 0141	PCI/G		A	0
SS402593	SS40041AE	REAL	TRG	AMERICIUM-241	0 0363	0 0127	PCI/G		A	0
SS402693	SS40199AE	REAL	TRG	AMERICIUM-241	0 3602	0 0586	PCI/G		A	0
SS402793	SS40043AE	REAL	TRG	AMERICIUM-241	220	54	PCI/G			2 1
SS402893	SS40044AE	REAL	TRG	AMERICIUM-241	130	7 5	PCI/G		A	0 8
SS402993	SS40045AE	REAL	TRG	AMERICIUM-241	3 2	0 44	PCI/G		A	0 3
SS403093	SS40046AE	REAL	TRG	AMERICIUM-241	7 5	0 87	PCI/G			0 005
SS403193	SS40047AE	REAL	TRG	AMERICIUM-241	0 45	0 076	PCI/G			0 005
SS403293	SS40048AE	REAL	TRG	AMERICIUM-241	0 93	0 15	PCI/G			0 014
SS403393	SS40049AE	REAL	TRG	AMERICIUM-241	0 2	0 046	PCI/G			0 008
SS403493	SS40050AE	REAL	TRG	AMERICIUM-241	0 046	0 022	PCI/G			0 003
SS403593	SS40051AE	REAL	TRG	AMERICIUM-241	0 046	0 022	PCI/G			0 003
SS403693	SS40052AE	REAL	TRG	AMERICIUM-241	0 25	0 058	PCI/G			0 012
40093	SS40060AE	REAL	TRG	AMERICIUM-241	0 035	0 0167	PCI/G		V	0
40193	SS40485AE	REAL	TRG	AMERICIUM-241	0 0519	0 0213	PCI/G		V	0
40293	SS40042AE	REAL	TRG	AMERICIUM-241	0 028	0 016	PCI/G		V	0 012
40393	SS40053AE	REAL	TRG	AMERICIUM-241	0 081	0 026	PCI/G		V	0 008
40593	SS40054AE	REAL	TRG	AMERICIUM-241	0 04	0 016	PCI/G		V	0 004
40693	SS40057AE	REAL	TRG	AMERICIUM-241	0 58	0 1	PCI/G		V	0 022
40793	SS40058AE	REAL	TRG	AMERICIUM-241	2 1	0 24	PCI/G		V	0 024
40893	SS40004AE	REAL	TRG	AMERICIUM-241	1 5	0 23	PCI/G		V	0 03
40993	SS40072AE	REAL	SS40412A	TRG	AMERICIUM-241	2 5	0 36	PCI/G	V	0 054
40993	SS40412AE	DUP	SS40072A	TRG	AMERICIUM-241	2 5	0 33	PCI/G	V	0 026
41193	SS40007AE	REAL	TRG	AMERICIUM-241	4 5	0 7	PCI/G		V	0 027
41293	SS40071AE	REAL	TRG	AMERICIUM-241	2	0 44	PCI/G		B	0 008
41693	SS40410AE	REAL	TRG	AMERICIUM-241	12	2 7	PCI/G		A	0 05
41793	SS40077AE	REAL	TRG	AMERICIUM-241	8 962	0 903	PCI/G		A	0 0024
41793	SS40069AE	DUP	SS40077A	TRG	AMERICIUM-241	10 79	1 08	PCI/G	R	0 0081
41893	SS40003AE	REAL	TRG	AMERICIUM-241	1 13	0 25	PCI/G		V	0
41993	SS40009AE	REAL	TRG	AMERICIUM-241	0 43	0 042	PCI/G		A	0 01
42093	SS40480AE	REAL	TRG	AMERICIUM-241	0 46	0 044	PCI/G		V	0 01
42293	SS40078AE	REAL	TRG	AMERICIUM-241	0 0585	0 015	PCI/G		V	0 0042
42393	SS40079AE	REAL	TRG	AMERICIUM-241	0 23	0 046	PCI/G		V	0 005
42693	SS40080AE	REAL	TRG	AMERICIUM-241	0 34	0 054	PCI/G		V	0 006
42993	SS40056AE	REAL	TRG	AMERICIUM-241	0 56	0 06	PCI/G		V	0 02
43193	SS40084AE	REAL	TRG	AMERICIUM-241	6 879	0 681	PCI/G		R	0 0039
43293	SS40006AE	REAL	TRG	AMERICIUM-241	4 4	0 66	PCI/G		V	0 027
43493	SS40086AE	REAL	TRG	AMERICIUM-241	0 0856	0 0199	PCI/G		V	0 0025
43593	SS40061AE	REAL	TRG	AMERICIUM-241	0 098	0 03	PCI/G		V	0 008
43793	SS40088AE	REAL	TRG	AMERICIUM-241	110	18	PCI/G		A	0 052
43893	SS40010AE	REAL	TRG	AMERICIUM-241	1 7	0 34	PCI/G		V	0 047

TABLE II.3.2-5

SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid. *	Detect Limit
	44093	SS40090AE	REAL	TRG	AMERICIUM-241	0 97	0 23	PCI/G	V	0 059
	44193	SS40011AE	REAL	TRG	AMERICIUM-241	0 16	0 022	PCI/G	V	0 01
	44393	SS40005AE	REAL	TRG	AMERICIUM-241	0 408	0 101	PCI/G	V	0 01
	44593	SS40001AE	REAL	TRG	AMERICIUM-241	0 52	0 053	PCI/G	V	0 01
	44793	SS40055AE	REAL	TRG	AMERICIUM-241	0 2255	0 037	PCI/G	A	0 004
	44893	SS40070AE	REAL	TRG	AMERICIUM-241	0 0457	0 0211	PCI/G	V	0
	45693	SS40094AE	REAL	TRG	AMERICIUM-241	0 16	0 036	PCI/G	A	0 007
	45793	SS40015AE	REAL	TRG	AMERICIUM-241	1 5	0 32	PCI/G	V	0 06
	46193	SS40096AE	REAL	TRG	AMERICIUM-241	0 58	0 098	PCI/G	A	0 007
	SS400393	SS40019AE	REAL	TRG	CESIUM-134	0		PCI/G		0 2
	SS400593	SS40021AE	REAL	TRG	CESIUM-134	0		PCI/G		0 2
	SS400693	SS40022AE	REAL	TRG	CESIUM-134	0		PCI/G		0 2
	SS400893	SS40024AE	REAL	TRG	CESIUM-134	-0 0083	0 0294	PCI/G	J	0 0488
	SS400993	SS40025AE	REAL	TRG	CESIUM-134	0 0333	0 0262	PCI/G	J	0 0486
	SS401193	SS40027AE	REAL	TRG	CESIUM-134	-0 032	0 0289	PCI/G	J	0 0457
	SS401793	SS40033AE	REAL	TRG	CESIUM-134	0 0081	0 0264	PCI/G	J	0 0447
	SS402093	SS40036AE	REAL	TRG	CESIUM-134	0 0218	0 0289	PCI/G	J	0 0518
	SS402193	SS40037AE	REAL	TRG	CESIUM-134	-0 0669	0 0319	PCI/G	J	0 0476
	SS402493	SS40040AE	REAL	TRG	CESIUM-134	-0 0016	0 0332	PCI/G	J	0 0545
	SS402593	SS40041AE	REAL	TRG	CESIUM-134	-0 0346	0 0248	PCI/G	J	0 0379
	SS402693	SS40199AE	REAL	TRG	CESIUM-134	-0 01	0 0298	PCI/G	J	0 0482
	SS402793	SS40043AE	REAL	TRG	CESIUM-134	0		PCI/G		0 075
	SS402893	SS40044AE	REAL	TRG	CESIUM-134	0		PCI/G		0 2
	SS402993	SS40045AE	REAL	TRG	CESIUM-134	0		PCI/G		0 1
	SS403093	SS40046AE	REAL	TRG	CESIUM-134	0		PCI/G		0 11
	SS403193	SS40047AE	REAL	TRG	CESIUM-134	0		PCI/G		0 074
	SS403293	SS40048AE	REAL	TRG	CESIUM-134	0		PCI/G		0 075
	SS403393	SS40049AE	REAL	TRG	CESIUM-134	0		PCI/G		0 079
	SS403493	SS40050AE	REAL	TRG	CESIUM-134	0		PCI/G		0 073
	SS403593	SS40051AE	REAL	TRG	CESIUM-134	0		PCI/G		0 076
	SS403693	SS40052AE	REAL	TRG	CESIUM-134	0		PCI/G		0 074
	40093	SS40060AE	REAL	TRG	CESIUM-134	0 088		PCI/G	U	0
	40193	SS40485AE	REAL	TRG	CESIUM-134	0 079		PCI/G	U	0
	40293	SS40042AE	REAL	TRG	CESIUM-134	0		PCI/G	Z	0 079
	40393	SS40053AE	REAL	TRG	CESIUM-134	0		PCI/G	Z	0 11
	40593	SS40054AE	REAL	TRG	CESIUM-134	0		PCI/G	Z	0 12
	40693	SS40057AE	REAL	TRG	CESIUM-134	0		PCI/G	Z	0 14
	40793	SS40058AE	REAL	TRG	CESIUM-134	0		PCI/G	Z	0 14
	40893	SS40004AE	REAL	TRG	CESIUM-134	0		PCI/G		0 3
	40993	SS40072AE	REAL	SS40412A TRG	CESIUM-134	0		PCI/G	Z	0 15
	40993	SS40412AE	DUP	SS40072A TRG	CESIUM-134	0		PCI/G	Z	0 15
	41193	SS40007AE	REAL	TRG	CESIUM-134	0 006	0 205	PCI/G	V	0 11
	41293	SS40071AE	REAL	TRG	CESIUM-134	0 012	0 185	PCI/G	V	0 24
	41693	SS40410AE	REAL	TRG	CESIUM-134	0 005	0 074	PCI/G	V	0 099
	41793	SS40077AE	REAL	TRG	CESIUM-134	-0 0442	0 0334	PCI/G	J	0 0526
	41793	SS40069AE	DUP	SS40077A TRG	CESIUM-134	-0 0348	0 0464	PCI/G	J	0 0766
	41893	SS40003AE	REAL	TRG	CESIUM-134	0 068		PCI/G	U	0
	41993	SS40009AE	REAL	TRG	CESIUM-134	0		PCI/G		0 2
	42093	SS40480AE	REAL	TRG	CESIUM-134	0		PCI/G		0 08
	42293	SS40078AE	REAL	TRG	CESIUM-134	-0 0109	0 0291	PCI/G	J	0 0463
	42393	SS40079AE	REAL	TRG	CESIUM-134	0 003	0 091	PCI/G	V	0 12
	42693	SS40080AE	REAL	TRG	CESIUM-134	0 006	0 166	PCI/G	V	0 14
	42993	SS40056AE	REAL	TRG	CESIUM-134	0		PCI/G		0 1
	43193	SS40084AE	REAL	TRG	CESIUM-134	-0 239	0 0495	PCI/G	J	0 0549
	43293	SS40006AE	REAL	TRG	CESIUM-134	0		PCI/G	Z	0 1
	43493	SS40086AE	REAL	TRG	CESIUM-134	0 0067	0 0256	PCI/G	J	0 0436
	43593	SS40061AE	REAL	TRG	CESIUM-134	0		PCI/G	Z	0 075
	43793	SS40088AE	REAL	TRG	CESIUM-134	0 007	0 076	PCI/G	V	0 091
	43893	SS40010AE	REAL	TRG	CESIUM-134	0 002	0 07	PCI/G	V	0 11
	44093	SS40090AE	REAL	TRG	CESIUM-134	0		PCI/G	Z	0 077
	44193	SS40011AE	REAL	TRG	CESIUM-134	0		PCI/G		0 2
	44393	SS40005AE	REAL	TRG	CESIUM-134	0 085		PCI/G	U	0
	44593	SS40001AE	REAL	TRG	CESIUM-134	0		PCI/G		0 2
	44793	SS40055AE	REAL	TRG	CESIUM-134	0 0281	0 0284	PCI/G	J	0 0437

* Codes explained in Table II 3 6-1
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TABLE II.3.2-5

SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid. *	Detect Limit
44893	SS40070AE	REAL	TRG	CESIUM-134	0 076		PCI/G	U		0
45693	SS40094AE	REAL	TRG	CESIUM-134	0		PCI/G		Z	0 1
45793	SS40015AE	REAL	TRG	CESIUM-134	0		PCI/G		Z	0 075
46193	SS40096AE	REAL	TRG	CESIUM-134	0		PCI/G		Z	0 099
SS400193	SS40017AE	REAL	TRG	GROSS ALPHA	10 24	3 45	PCI/G			2 5456
SS400293	SS40018AE	REAL	TRG	GROSS ALPHA	19 98	4 93	PCI/G			2 6939
SS400393	SS40019AE	REAL	TRG	GROSS ALPHA	94	6 3	PCI/G		R	2
SS400493	SS40020AE	REAL	TRG	GROSS ALPHA	12 81	3 99	PCI/G			3 1669
SS400593	SS40021AE	REAL	TRG	GROSS ALPHA	170	17	PCI/G		R	4
SS400693	SS40022AE	REAL	TRG	GROSS ALPHA	54	9 7	PCI/G		R	5
SS400793	SS40023AE	REAL	TRG	GROSS ALPHA	17 6	4 52	PCI/G			2 1874
SS400893	SS40024AE	REAL	TRG	GROSS ALPHA	15	4 28	PCI/G		V	2 9
SS400993	SS40025AE	REAL	TRG	GROSS ALPHA	43 41	7 96	PCI/G		V	2 83
SS401093	SS40026AE	REAL	TRG	GROSS ALPHA	17 49	4 56	PCI/G			2 5456
SS401193	SS40027AE	REAL	TRG	GROSS ALPHA	12 08	3 7	PCI/G		V	2
SS401293	SS40028AE	REAL	TRG	GROSS ALPHA	11 68	3 82	PCI/G			3 1669
SS401393	SS40029AE	REAL	TRG	GROSS ALPHA	16 9	4 53	PCI/G			2 8434
SS401493	SS40030AE	REAL	TRG	GROSS ALPHA	24 44	5 55	PCI/G			2 7703
SS401593	SS40031AE	REAL	TRG	GROSS ALPHA	14 72	4 12	PCI/G			2 3753
SS401693	SS40032AE	REAL	TRG	GROSS ALPHA	11 9	3 78	PCI/G			2 8411
SS401793	SS40033AE	REAL	TRG	GROSS ALPHA	10 74	3 48	PCI/G		V	2
SS401893	SS40034AE	REAL	TRG	GROSS ALPHA	49 57	8 65	PCI/G			2 5404
SS401993	SS40035AE	REAL	TRG	GROSS ALPHA	29 83	6 19	PCI/G			2 1883
SS402093	SS40036AE	REAL	TRG	GROSS ALPHA	16 94	4 56	PCI/G		V	2 83
SS402193	SS40037AE	REAL	TRG	GROSS ALPHA	24 26	5 5	PCI/G		V	2 31
SS402293	SS40038AE	REAL	TRG	GROSS ALPHA	15 4	4 7	PCI/G		A	3 1
SS402293	SS40016AE	DUP	SS40038A	TRG	16 8	5	PCI/G		A	3 2
SS402393	SS40039AE	REAL	TRG	GROSS ALPHA	26 28	5 8	PCI/G			2 7737
SS402493	SS40040AE	REAL	TRG	GROSS ALPHA	14	4 13	PCI/G		V	2 83
SS402593	SS40041AE	REAL	TRG	GROSS ALPHA	17 48	4 56	PCI/G		V	2 31
SS402693	SS40199AE	REAL	TRG	GROSS ALPHA	28 42	6 05	PCI/G		V	2 4
SS402793	SS40043AE	REAL	TRG	GROSS ALPHA	440	14	PCI/G			3 6
SS402893	SS40044AE	REAL	TRG	GROSS ALPHA	200	11	PCI/G		R	3
SS402993	SS40045AE	REAL	TRG	GROSS ALPHA	59	6 3	PCI/G		R	4
SS403093	SS40046AE	REAL	TRG	GROSS ALPHA	250	11	PCI/G			1 9
SS403193	SS40047AE	REAL	TRG	GROSS ALPHA	46	5	PCI/G			2
SS403293	SS40048AE	REAL	TRG	GROSS ALPHA	34	4 2	PCI/G			2
SS403393	SS40049AE	REAL	TRG	GROSS ALPHA	32	4	PCI/G			2 8
SS403493	SS40050AE	REAL	TRG	GROSS ALPHA	36	4 6	PCI/G			2 8
SS403593	SS40051AE	REAL	TRG	GROSS ALPHA	26	3 9	PCI/G			2 6
SS403693	SS40052AE	REAL	TRG	GROSS ALPHA	28	4 2	PCI/G			3 5
40093	SS40060AE	REAL	TRG	GROSS ALPHA	13 8	4 4	PCI/G		A	3 3
40193	SS40485AE	REAL	TRG	GROSS ALPHA	11 9	4 1	PCI/G		A	3 4
40293	SS40042AE	REAL	TRG	GROSS ALPHA	17	3 5	PCI/G		A	3
40393	SS40053AE	REAL	TRG	GROSS ALPHA	21	3 8	PCI/G		A	3
40593	SS40054AE	REAL	TRG	GROSS ALPHA	28	4 1	PCI/G		A	2 1
40693	SS40057AE	REAL	TRG	GROSS ALPHA	24	3 7	PCI/G		A	2 4
40793	SS40058AE	REAL	TRG	GROSS ALPHA	36	4 3	PCI/G		A	2
40893	SS40004AE	REAL	TRG	GROSS ALPHA	11	3 2	PCI/G		V	3
40993	SS40072AE	REAL	SS40412A	TRG	43	4 9	PCI/G		A	2 2
40993	SS40412AE	DUP	SS40072A	TRG	40	4 4	PCI/G		A	1 7
41193	SS40007AE	REAL	TRG	GROSS ALPHA	47	5 3	PCI/G		A	2 9
41293	SS40071AE	REAL	TRG	GROSS ALPHA	27	4 4	PCI/G		A	3 9
41693	SS40410AE	REAL	TRG	GROSS ALPHA	65	6	PCI/G		A	2 8
41793	SS40077AE	REAL	TRG	GROSS ALPHA	36 07	6 99	PCI/G		Y	2 2839
41793	SS40069AE	DUP	SS40077A	TRG	36 31	7 07	PCI/G		Y	2 6982
41893	SS40003AE	REAL	TRG	GROSS ALPHA	22 7	6 2	PCI/G		A	3 6
41993	SS40009AE	REAL	TRG	GROSS ALPHA	11	2 6	PCI/G		V	2
42093	SS40480AE	REAL	TRG	GROSS ALPHA	9 7	4 1	PCI/G		V	4
42293	SS40078AE	REAL	TRG	GROSS ALPHA	9 143	3 3	PCI/G		A	2 6971
42393	SS40079AE	REAL	TRG	GROSS ALPHA	29	4 2	PCI/G		A	2 7
42693	SS40080AE	REAL	TRG	GROSS ALPHA	31	4 4	PCI/G		A	2 9
42993	SS40056AE	REAL	TRG	GROSS ALPHA	14	3 6	PCI/G		V	4
43193	SS40084AE	REAL	TRG	GROSS ALPHA	14 25	4 12	PCI/G		Y	2 7692

* Codes explained in Table II 3 6-1
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TABLE II.3.2-5

**SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid. *	Detect Limit
	43293	SS40006AE	REAL	TRG	GROSS ALPHA	52	5.4	PCI/G	A	2.8
	43493	SS40086AE	REAL	TRG	GROSS ALPHA	8561	3.27	PCI/G	A	29787
	43593	SS40061AE	REAL	TRG	GROSS ALPHA	28	4.3	PCI/G	A	3.2
	43793	SS40088AE	REAL	TRG	GROSS ALPHA	260	11	PCI/G	A	2.1
	43893	SS40010AE	REAL	TRG	GROSS ALPHA	110	7.8	PCI/G	A	3.9
	43993	SS40091AE	REAL	TRG	GROSS ALPHA	32	5.1	PCI/G	A	4.9
	44093	SS40090AE	REAL	TRG	GROSS ALPHA	20	3.8	PCI/G	A	3.4
	44193	SS40011AE	REAL	TRG	GROSS ALPHA	15	5	PCI/G	V	4
	44393	SS40005AE	REAL	TRG	GROSS ALPHA	183	5.4	PCI/G	A	3.9
	44593	SS40001AE	REAL	TRG	GROSS ALPHA	11	3.1	PCI/G	V	3
	44793	SS40055AE	REAL	TRG	GROSS ALPHA	14.4	4.04	PCI/G	V	1.88
	44893	SS40070AE	REAL	TRG	GROSS ALPHA	16.3	4.9	PCI/G	A	3.5
	45693	SS40094AE	REAL	TRG	GROSS ALPHA	17	3.1	PCI/G	R	2.4
	45793	SS40015AE	REAL	TRG	GROSS ALPHA	45	4.8	PCI/G	A	2.7
	46193	SS40096AE	REAL	TRG	GROSS ALPHA	43	4.8	PCI/G	R	2.1
	SS400193	SS40017AE	REAL	TRG	PLUTONIUM-239/240	0.2337	0.0505	PCI/G		0.0055
	SS400293	SS40018AE	REAL	TRG	PLUTONIUM-239/240	5.528	0.582	PCI/G		0.0124
	SS400393	SS40019AE	REAL	TRG	PLUTONIUM-239/240	15	2.6	PCI/G	R	0.9
	SS400493	SS40020AE	REAL	TRG	PLUTONIUM-239/240	0.8244	0.107	PCI/G		0.0096
	SS400593	SS40021AE	REAL	TRG	PLUTONIUM-239/240	32	3.3	PCI/G	R	0.3
	SS400693	SS40022AE	REAL	TRG	PLUTONIUM-239/240	28	3.6	PCI/G	R	0.8
	SS400793	SS40023AE	REAL	TRG	PLUTONIUM-239/240	0.4302	0.0714	PCI/G		0.0129
	SS400893	SS40024AE	REAL	TRG	PLUTONIUM-239/240	0.337	0.0584	PCI/G	A	0.008
	SS400993	SS40025AE	REAL	TRG	PLUTONIUM-239/240	10.05	1.11	PCI/G	A	0
	SS401093	SS40026AE	REAL	TRG	PLUTONIUM-239/240	1.527	0.182	PCI/G		0.0086
	SS401193	SS40027AE	REAL	TRG	PLUTONIUM-239/240	0.0463	0.0182	PCI/G	A	0
	SS401293	SS40028AE	REAL	TRG	PLUTONIUM-239/240	0.016	0.00857	PCI/G		0.0062
	SS401393	SS40029AE	REAL	TRG	PLUTONIUM-239/240	0.1907	0.0349	PCI/G		0.0052
	SS401493	SS40030AE	REAL	TRG	PLUTONIUM-239/240	2.734	0.316	PCI/G		0.0089
	SS401593	SS40031AE	REAL	TRG	PLUTONIUM-239/240	3.077	0.332	PCI/G		0.0079
	SS401693	SS40032AE	REAL	TRG	PLUTONIUM-239/240	1.864	0.208	PCI/G		0.0033
	SS401793	SS40033AE	REAL	TRG	PLUTONIUM-239/240	0.264	0.0447	PCI/G	A	0.005
	SS401893	SS40034AE	REAL	TRG	PLUTONIUM-239/240	7.448	0.758	PCI/G		0.0073
	SS401993	SS40035AE	REAL	TRG	PLUTONIUM-239/240	2.83	0.302	PCI/G		0.0061
	SS402093	SS40036AE	REAL	TRG	PLUTONIUM-239/240	0.3909	0.0773	PCI/G	A	0.011
	SS402193	SS40037AE	REAL	TRG	PLUTONIUM-239/240	9.219	1.02	PCI/G	A	0
	SS402293	SS40038AE	REAL	TRG	PLUTONIUM-239/240	0.0101	0.0108	PCI/G	A	0.009
	SS402293	SS40016AE	DUP	SS40038A	TRG	0.017	0.011	PCI/G	A	0
	SS402393	SS40039AE	REAL	TRG	PLUTONIUM-239/240	5.329	0.563	PCI/G		0.0036
	SS402493	SS40040AE	REAL	TRG	PLUTONIUM-239/240	0.1225	0.0336	PCI/G	A	0.009
	SS402593	SS40041AE	REAL	TRG	PLUTONIUM-239/240	0.0267	0.0134	PCI/G	J	0.004
	SS402693	SS40199AE	REAL	TRG	PLUTONIUM-239/240	1.446	0.177	PCI/G	A	0.007
	SS402793	SS40043AE	REAL	TRG	PLUTONIUM-239/240	56	10	PCI/G		0.03
	SS402893	SS40044AE	REAL	TRG	PLUTONIUM-239/240	76	7.1	PCI/G	R	1
	SS402993	SS40045AE	REAL	TRG	PLUTONIUM-239/240	0.96	0.45	PCI/G	R	0.6
	SS403093	SS40046AE	REAL	TRG	PLUTONIUM-239/240	19	3.2	PCI/G		0.018
	SS403193	SS40047AE	REAL	TRG	PLUTONIUM-239/240	0.5	0.06	PCI/G		0.001
	SS403293	SS40048AE	REAL	TRG	PLUTONIUM-239/240	2.1	0.22	PCI/G		0.001
	SS403393	SS40049AE	REAL	TRG	PLUTONIUM-239/240	0.46	0.058	PCI/G		0.003
	SS403493	SS40050AE	REAL	TRG	PLUTONIUM-239/240	0.12	0.022	PCI/G		0.006
	SS403593	SS40051AE	REAL	TRG	PLUTONIUM-239/240	0.08	0.018	PCI/G		0.006
	SS403693	SS40052AE	REAL	TRG	PLUTONIUM-239/240	0.16	0.026	PCI/G		0.008
	40093	SS40060AE	REAL	TRG	PLUTONIUM-239/240	0.0129	0.0085	PCI/G	A	0.005
	40193	SS40485AE	REAL	TRG	PLUTONIUM-239/240	0.0788	0.0351	PCI/G	A	0
	40293	SS40042AE	REAL	TRG	PLUTONIUM-239/240	0.039	0.018	PCI/G	A	0.002
	40393	SS40053AE	REAL	TRG	PLUTONIUM-239/240	0.089	0.046	PCI/G	A	0.015
	40593	SS40054AE	REAL	TRG	PLUTONIUM-239/240	0.06	0.024	PCI/G	A	0.003
	40693	SS40057AE	REAL	TRG	PLUTONIUM-239/240	1	0.15	PCI/G	V	0.002
	40793	SS40058AE	REAL	TRG	PLUTONIUM-239/240	3.3	0.65	PCI/G	V	0.027
	40893	SS40004AE	REAL	TRG	PLUTONIUM-239/240	1.2	0.081	PCI/G	R	0.007
	40993	SS40072AE	REAL	SS40412A	TRG	7.9	1.5	PCI/G	V	0.005
	40993	SS40412AE	DUP	SS40072A	TRG	7	1.3	PCI/G	V	0.014
	41193	SS40007AE	REAL	TRG	PLUTONIUM-239/240	3.4	0.57	PCI/G	V	0.011
	41293	SS40071AE	REAL	TRG	PLUTONIUM-239/240	1.9	0.52	PCI/G	A	0.037

* Codes explained in Table II 3 6-1
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TABLE IL3.2-5

**SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid *	Detect Limit	
	41693	SS40410AE	REAL	TRG	PLUTONIUM-239/240	4.9	1	PCI/G	V	0.006	
	41793	SS40077AE	REAL	TRG	PLUTONIUM-239/240	9.033	0.899	PCI/G	A	0.0078	
	41793	SS40069AE	DUP	SS40077A	TRG	PLUTONIUM-239/240	13.03	1.34	PCI/G	A	0.0179
	41893	SS40003AE	REAL	TRG	PLUTONIUM-239/240	1.04	0.27	PCI/G	A	0	
	41993	SS40009AE	REAL	TRG	PLUTONIUM-239/240	1.2	0.091	PCI/G	R	0.005	
	42093	SS40480AE	REAL	TRG	PLUTONIUM-239/240	0.26	0.027	PCI/G	R	0.004	
	42293	SS40078AE	REAL	TRG	PLUTONIUM-239/240	0.3215	0.0492	PCI/G	V	0.0077	
	42393	SS40079AE	REAL	TRG	PLUTONIUM-239/240	0.43	0.08	PCI/G	V	0.002	
	42693	SS40080AE	REAL	TRG	PLUTONIUM-239/240	0.31	0.06	PCI/G	V	0.007	
	42993	SS40056AE	REAL	TRG	PLUTONIUM-239/240	0.9	0.072	PCI/G	R	0.006	
	43193	SS40084AE	REAL	TRG	PLUTONIUM-239/240	5.324	0.532	PCI/G	A	0.0027	
	43293	SS40006AE	REAL	TRG	PLUTONIUM-239/240	4.2	0.61	PCI/G	A	0.002	
	43493	SS40086AE	REAL	TRG	PLUTONIUM-239/240	0.6421	0.0792	PCI/G	V	0.0071	
	43593	SS40061AE	REAL	TRG	PLUTONIUM-239/240	0.68	0.12	PCI/G	A	0.008	
	43793	SS40088AE	REAL	TRG	PLUTONIUM-239/240	17	3.7	PCI/G	V	0.006	
	43893	SS40010AE	REAL	TRG	PLUTONIUM-239/240	2.1	0.29	PCI/G	V	0.006	
	44093	SS40090AE	REAL	TRG	PLUTONIUM-239/240	0.39	0.17	PCI/G	A	0.029	
	44193	SS40011AE	REAL	TRG	PLUTONIUM-239/240	0.069	0.015	PCI/G	R	0.007	
	44393	SS40005AE	REAL	TRG	PLUTONIUM-239/240	0.211	0.063	PCI/G	A	0.01	
	44593	SS40001AE	REAL	TRG	PLUTONIUM-239/240	0.28	0.035	PCI/G	R	0.006	
	44793	SS40055AE	REAL	TRG	PLUTONIUM-239/240	0.4437	0.0779	PCI/G	A	0.007	
	44893	SS40070AE	REAL	TRG	PLUTONIUM-239/240	0.0266	0.0142	PCI/G	A	0.009	
	45693	SS40094AE	REAL	TRG	PLUTONIUM-239/240	0.16	0.046	PCI/G	B	0.003	
	45793	SS40015AE	REAL	TRG	PLUTONIUM-239/240	4.9	1.2	PCI/G	A	0.019	
	46193	SS40096AE	REAL	TRG	PLUTONIUM-239/240	1.2	0.22	PCI/G	B	0.015	
	SS400193	SS40017AE	REAL	TRG	TRITIUM	-59.5	215	PCI/L	J	0	
	SS400293	SS40018AE	REAL	TRG	TRITIUM	140.4	226	PCI/L	X	0	
	SS400393	SS40019AE	REAL	TRG	TRITIUM	94	130	PCI/L	U	V	200
	SS400493	SS40020AE	REAL	TRG	TRITIUM	37.05	220	PCI/L	X	0	
	SS400593	SS40021AE	REAL	TRG	TRITIUM	130	160	PCI/L	U	V	300
	SS400693	SS40022AE	REAL	TRG	TRITIUM	61	120	PCI/L	U	V	200
	SS400793	SS40023AE	REAL	TRG	TRITIUM	-7.8	218	PCI/L	J	0	
	SS400893	SS40024AE	REAL	TRG	TRITIUM	134.5	224	PCI/L	J	V	260
	SS400993	SS40025AE	REAL	TRG	TRITIUM	68.26	221	PCI/L	J	V	260
	SS401093	SS40026AE	REAL	TRG	TRITIUM	22.43	219	PCI/L	X	0	
	SS401193	SS40027AE	REAL	TRG	TRITIUM	164.8	226	PCI/L	J	V	260
	SS401293	SS40028AE	REAL	TRG	TRITIUM	74.12	222	PCI/L	X	0	
	SS401393	SS40029AE	REAL	TRG	TRITIUM	125.4	289	PCI/L	X	0	
	SS401493	SS40030AE	REAL	TRG	TRITIUM	155.1	226	PCI/L	X	0	
	SS401593	SS40031AE	REAL	TRG	TRITIUM	48.76	221	PCI/L	X	0	
	SS401693	SS40032AE	REAL	TRG	TRITIUM	113.1	224	PCI/L	X	0	
	SS401793	SS40033AE	REAL	TRG	TRITIUM	146.3	225	PCI/L	J	V	260
	SS401893	SS40034AE	REAL	TRG	TRITIUM	153.1	226	PCI/L	X	0	
	SS401993	SS40035AE	REAL	TRG	TRITIUM	10.73	219	PCI/L	X	0	
	SS402093	SS40036AE	REAL	TRG	TRITIUM	155.1	226	PCI/L	J	V	260
	SS402193	SS40037AE	REAL	TRG	TRITIUM	54.57	220	PCI/L	J	V	260
	SS402293	SS40038AE	REAL	TRG	TRITIUM	-5.8	167	PCI/L	JA	200	
	SS402293	SS40016AE	DUP	SS40038A	TRG	TRITIUM	-1.56	160	PCI/L	JA	200
	SS402393	SS40039AE	REAL	TRG	TRITIUM	-26.3	217	PCI/L	J	0	
	SS402493	SS40040AE	REAL	TRG	TRITIUM	137.5	225	PCI/L	J	V	260
	SS402593	SS40041AE	REAL	TRG	TRITIUM	56.56	220	PCI/L	J	V	260
	SS402693	SS40199AE	REAL	TRG	TRITIUM	179.3	227	PCI/L	J	V	260
	SS402793	SS40043AE	REAL	TRG	TRITIUM	34	260	PCI/L	U	420	
	SS402893	SS40044AE	REAL	TRG	TRITIUM	250	140	PCI/L	J	V	200
	SS402993	SS40045AE	REAL	TRG	TRITIUM	76	130	PCI/L	U	V	200
	SS403093	SS40046AE	REAL	TRG	TRITIUM	1600	300	PCI/L		350	
	SS403193	SS40047AE	REAL	TRG	TRITIUM	820	260	PCI/L		340	
	SS403293	SS40048AE	REAL	TRG	TRITIUM	550	240	PCI/L		340	
	SS403393	SS40049AE	REAL	TRG	TRITIUM	710	250	PCI/L		340	
	SS403493	SS40050AE	REAL	TRG	TRITIUM	940	300	PCI/L		480	
	SS403593	SS40051AE	REAL	TRG	TRITIUM	620	290	PCI/L		470	
	SS403693	SS40052AE	REAL	TRG	TRITIUM	490	280	PCI/L		450	
	40093	SS40060AE	REAL	TRG	TRITIUM	20100	2200	PCI/L	JA	615	
	40193	SS40485AE	REAL	TRG	TRITIUM	118000	12000	PCI/L	JA	1360	

* Codes explained in Table II 3 6-1
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TABLE IL3.2-5
SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid. *	Detect Limit
40293	SS40042AE	REAL	TRG	TRITIUM	300	270	PCI/L	U	A	420
40393	SS40053AE	REAL	TRG	TRITIUM	-980	1800	PCI/L	U	R	4100
40593	SS40054AE	REAL	TRG	TRITIUM	300	260	PCI/L	U	A	420
40693	SS40057AE	REAL	TRG	TRITIUM	520	260	PCI/L	U	V	390
40793	SS40058AE	REAL	TRG	TRITIUM	370	250	PCI/L	U	V	390
40893	SS40004AE	REAL	TRG	TRITIUM	-9.7	200	PCI/L	U	V	300
40993	SS40072AE	REAL	SS40412A TRG	TRITIUM	480	260	PCI/L		V	390
40993	SS40412AE	DUP	SS40072A TRG	TRITIUM	210	250	PCI/L	U	V	400
41193	SS40007AE	REAL	TRG	TRITIUM	640	260	PCI/L	U	A	380
41293	SS40071AE	REAL	TRG	TRITIUM	-260	290	PCI/L	U	R	570
41693	SS40410AE	REAL	TRG	TRITIUM	870	350	PCI/L	U	A	530
41793	SS40077AE	REAL	TRG	TRITIUM	5.818	217	PCI/L	J	V	252.7
41793	SS40069AE	DUP	SS40077A TRG	TRITIUM	11.64	218	PCI/L	J	V	252.7
41893	SS40003AE	REAL	TRG	TRITIUM	900	210	PCI/L	U	JA	270
41993	SS40009AE	REAL	TRG	TRITIUM	-87	220	PCI/L	U	V	400
42093	SS40480AE	REAL	TRG	TRITIUM	150	920	PCI/L	U	V	1000
42293	SS40078AE	REAL	TRG	TRITIUM	21.42	214	PCI/L	J	V	248.2
42393	SS40079AE	REAL	TRG	TRITIUM	140	230	PCI/L	U	A	380
42693	SS40080AE	REAL	TRG	TRITIUM	-860	320	PCI/L	U	R	750
42993	SS40056AE	REAL	TRG	TRITIUM	18	250	PCI/L	U	V	400
43193	SS40084AE	REAL	TRG	TRITIUM	48.48	219	PCI/L	J	V	252.7
43293	SS40006AE	REAL	TRG	TRITIUM	1200	730	PCI/L	U	A	1300
43493	SS40086AE	REAL	TRG	TRITIUM	129.3	219	PCI/L	J	V	248.2
43593	SS40061AE	REAL	TRG	TRITIUM	250	250	PCI/L	U	A	410
43793	SS40088AE	REAL	TRG	TRITIUM	250	290	PCI/L	U	A	490
43893	SS40010AE	REAL	TRG	TRITIUM	-270	280	PCI/L	U	R	540
43993	SS40091AE	REAL	TRG	TRITIUM	140	230	PCI/L	U	A	370
44093	SS40090AE	REAL	TRG	TRITIUM	240	260	PCI/L	U	A	430
44193	SS40011AE	REAL	TRG	TRITIUM	160	280	PCI/L	U	V	500
44393	SS40005AE	REAL	TRG	TRITIUM	280	131	PCI/L	U	JA	200
44593	SS40001AE	REAL	TRG	TRITIUM	180	370	PCI/L	U	V	600
44793	SS40055AE	REAL	TRG	TRITIUM	124.6	224	PCI/L	J	V	260
44893	SS40070AE	REAL	TRG	TRITIUM	227000	23000	PCI/L	U	JA	1120
45693	SS40094AE	REAL	TRG	TRITIUM	1300	280	PCI/L	U	A	340
45793	SS40015AE	REAL	TRG	TRITIUM	480	280	PCI/L	U	A	430
46193	SS40096AE	REAL	TRG	TRITIUM	280	230	PCI/L	U	A	360
SS400193	SS40017AE	REAL	TRG	URANIUM-233,-234	0.6646	0.223	PCI/G			0.0867
SS400293	SS40018AE	REAL	TRG	URANIUM 233,-234	2.872	0.639	PCI/G			0.0756
SS400393	SS40019AE	REAL	TRG	URANIUM 233,-234	2.3	0.44	PCI/G		V	0.1
SS400493	SS40020AE	REAL	TRG	URANIUM-233,-234	0.9283	0.245	PCI/G			0.0443
SS400593	SS40021AE	REAL	TRG	URANIUM-233,-234	14	1.4	PCI/G		V	0.1
SS400693	SS40022AE	REAL	TRG	URANIUM-233,-234	1.3	0.25	PCI/G		V	0.08
SS400793	SS40023AE	REAL	TRG	URANIUM-233,-234	1.213	0.329	PCI/G			0.0587
SS400893	SS40024AE	REAL	TRG	URANIUM-233,-234	0.9129	0.248	PCI/G		A	0.029
SS400993	SS40025AE	REAL	TRG	URANIUM-233,-234	1.822	0.37	PCI/G		A	0.026
SS401093	SS40026AE	REAL	TRG	URANIUM-233,-234	1.732	0.418	PCI/G			0.0947
SS401193	SS40027AE	REAL	TRG	URANIUM-233,-234	0.8618	0.24	PCI/G		A	0
SS401293	SS40028AE	REAL	TRG	URANIUM-233,-234	0.7488	0.211	PCI/G			0.0564
SS401393	SS40029AE	REAL	TRG	URANIUM-233,-234	5.822	0.905	PCI/G			0.0584
SS401493	SS40030AE	REAL	TRG	URANIUM-233,-234	1.327	0.288	PCI/G			0.0455
SS401593	SS40031AE	REAL	TRG	URANIUM-233,-234	1.284	0.328	PCI/G			0.0537
SS401693	SS40032AE	REAL	TRG	URANIUM-233,-234	2.312	0.51	PCI/G			0.0806
SS401793	SS40033AE	REAL	TRG	URANIUM-233,-234	0.7913	0.244	PCI/G		A	0.044
SS401893	SS40034AE	REAL	TRG	URANIUM-233,-234	3.31	0.558	PCI/G			0.0522
SS401993	SS40035AE	REAL	TRG	URANIUM-233,-234	1.2	0.288	PCI/G			0.0671
SS402093	SS40036AE	REAL	TRG	URANIUM-233,-234	0.8004	0.22	PCI/G		A	0.027
SS402193	SS40037AE	REAL	TRG	URANIUM-233,-234	0.9506	0.332	PCI/G		A	0.101
SS402293	SS40038AE	REAL	TRG	URANIUM-233,-234	0.457	0.149	PCI/G		A	0.02
SS402393	SS40016AE	DUP	SS40038A TRG	URANIUM-233,-234	0.693	0.208	PCI/G		A	0.034
SS402493	SS40039AE	REAL	TRG	URANIUM-233,-234	3.165	0.658	PCI/G			0.0821
SS402593	SS40040AE	REAL	TRG	URANIUM-233,-234	0.8139	0.225	PCI/G		A	0.022
SS402693	SS40041AE	REAL	TRG	URANIUM-233,-234	0.9642	0.246	PCI/G		A	0.015
SS402793	SS40199AE	REAL	TRG	URANIUM-233,-234	1.247	0.287	PCI/G		A	0.021
SS402893	SS40043AE	REAL	TRG	URANIUM-233,-234	7.9	0.73	PCI/G	B		0.006

* Codes explained in Table II 3 6-1
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TABLE II.3.2-5
SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid *	Detect Limit
SS402893	SS40044AE	REAL	TRG	URANIUM-233,-234	57	0.65	PCI/G		V	0.1
SS402993	SS40045AE	REAL	TRG	URANIUM-233,-234	1.1	0.3	PCI/G		V	0.1
SS403093	SS40046AE	REAL	TRG	URANIUM-233,-234	41	3.4	PCI/G	B		0.019
SS403193	SS40047AE	REAL	TRG	URANIUM-233,-234	5	0.41	PCI/G	B		0.021
SS403293	SS40048AE	REAL	TRG	URANIUM-233,-234	2.1	0.25	PCI/G	B		0.013
SS403393	SS40049AE	REAL	TRG	URANIUM-233,-234	3.3	0.37	PCI/G	B		0.006
SS403493	SS40050AE	REAL	TRG	URANIUM-233,-234	1.2	0.2	PCI/G	B		0.007
SS403593	SS40051AE	REAL	TRG	URANIUM-233,-234	1.2	0.2	PCI/G	B		0.018
SS403693	SS40052AE	REAL	TRG	URANIUM-233,-234	1.2	0.18	PCI/G	B		0.006
40093	SS40060AE	REAL	TRG	URANIUM-233,-234	1.27	0.27	PCI/G		A	0.019
40193	SS40485AE	REAL	TRG	URANIUM-233,-234	0.978	0.217	PCI/G		A	0.016
40293	SS40042AE	REAL	TRG	URANIUM-233,-234	1.3	0.36	PCI/G	B	A	0.026
40393	SS40053AE	REAL	TRG	URANIUM-233,-234	1	0.27	PCI/G		A	0.011
40593	SS40054AE	REAL	TRG	URANIUM-233,-234	1.3	0.35	PCI/G	B	A	0.016
40693	SS40057AE	REAL	TRG	URANIUM-233,-234	2.5	0.42	PCI/G	B	A	0.013
40793	SS40058AE	REAL	TRG	URANIUM-233,-234	1.9	0.38	PCI/G	B	A	0.011
40893	SS40004AE	REAL	TRG	URANIUM-233,-234	0.9	0.22	PCI/G		V	0.09
40993	SS40072AE	REAL	SS40412A TRG	URANIUM-233,-234	2.9	0.65	PCI/G	B	A	0.017
40993	SS40412AE	DUP	SS40072A TRG	URANIUM-233,-234	2.9	0.93	PCI/G		A	0.093
41193	SS40007AE	REAL	TRG	URANIUM-233,-234	2.4	0.69	PCI/G	B	V	0.042
41293	SS40071AE	REAL	TRG	URANIUM-233,-234	1.1	0.29	PCI/G	B	A	0.012
41693	SS40410AE	REAL	TRG	URANIUM-233,-234	2.3	0.55	PCI/G	B	A	0.017
41793	SS40077AE	REAL	TRG	URANIUM-233,-234	3.507	0.642	PCI/G		A	0.061
41793	SS40069AE	DUP	SS40077A TRG	URANIUM 233,-234	4.422	0.781	PCI/G		A	0.0717
41893	SS40003AE	REAL	TRG	URANIUM-233,-234	0.94	0.234	PCI/G		A	0.021
41993	SS40009AE	REAL	TRG	URANIUM-233,-234	0.99	0.27	PCI/G		A	0.1
42093	SS40480AE	REAL	TRG	URANIUM 233,-234	0.95	0.25	PCI/G		V	0.1
42293	SS40078AE	REAL	TRG	URANIUM-233,-234	1.426	0.388	PCI/G		A	0.0883
42393	SS40079AE	REAL	TRG	URANIUM 233,-234	0.99	0.39	PCI/G	B	V	0.066
42693	SS40080AE	REAL	TRG	URANIUM-233,-234	2.7	0.65	PCI/G	B	V	0.018
42993	SS40056AE	REAL	TRG	URANIUM-233,-234	0.93	0.25	PCI/G		V	0.1
43193	SS40084AE	REAL	TRG	URANIUM 233,-234	1.509	0.329	PCI/G		A	0.0644
43293	SS40006AE	REAL	TRG	URANIUM-233,-234	1.5	0.33	PCI/G		A	0.011
43493	SS40086AE	REAL	TRG	URANIUM-233,-234	1.52	0.352	PCI/G		A	0.0723
43593	SS40061AE	REAL	TRG	URANIUM 233,-234	0.97	0.29	PCI/G	B	A	0.014
43793	SS40088AE	REAL	TRG	URANIUM-233,-234	6.1	1.6	PCI/G	B	A	0.037
43893	SS40010AE	REAL	TRG	URANIUM-233,-234	2.1	0.48	PCI/G	B	V	0.052
43993	SS40091AE	REAL	TRG	URANIUM-233,-234	0.65	0.31	PCI/G	B	V	0.026
44093	SS40090AE	REAL	TRG	URANIUM-233,-234	0.91	0.28	PCI/G		A	0.014
44193	SS40011AE	REAL	TRG	URANIUM-233,-234	0.89	0.23	PCI/G		V	0.1
44393	SS40005AE	REAL	TRG	URANIUM-233,-234	0.702	0.188	PCI/G		A	0
44593	SS40001AE	REAL	TRG	URANIUM-233,-234	0.84	0.21	PCI/G		V	0.1
44793	SS40055AE	REAL	TRG	URANIUM-233,-234	0.8747	0.398	PCI/G		A	0.048
44893	SS40070AE	REAL	TRG	URANIUM-233,-234	0.875	0.271	PCI/G		A	0.044
45693	SS40094AE	REAL	TRG	URANIUM-233,-234	2.9	0.7	PCI/G	B	V	0.061
45793	SS40015AE	REAL	TRG	URANIUM-233,-234	2.4	0.47	PCI/G	B	A	0.012
46193	SS40096AE	REAL	TRG	URANIUM-233,-234	6.6	0.97	PCI/G	B	V	0.028
SS400193	SS40017AE	REAL	TRG	URANIUM-235	0.0517	0.0609	PCI/G	J		0.0792
SS400293	SS40018AE	REAL	TRG	URANIUM-235	0.0927	0.0842	PCI/G			0.0502
SS400393	SS40019AE	REAL	TRG	URANIUM-235	0.14	0.095	PCI/G	J	V	0.1
SS400493	SS40020AE	REAL	TRG	URANIUM-235	0.0463	0.0487	PCI/G	J		0.0492
SS400593	SS40021AE	REAL	TRG	URANIUM-235	0.75	0.19	PCI/G		V	0.08
SS400693	SS40022AE	REAL	TRG	URANIUM-235	0.031	0.042	PCI/G	U	V	0.08
SS400793	SS40023AE	REAL	TRG	URANIUM-235	0.0773	0.0724	PCI/G			0.0651
SS400893	SS40024AE	REAL	TRG	URANIUM-235	0.0244	0.0362	PCI/G	J	A	0.017
SS400993	SS40025AE	REAL	TRG	URANIUM-235	0.0766	0.0601	PCI/G	J	A	0.021
SS401093	SS40026AE	REAL	TRG	URANIUM-235	0.0979	0.0911	PCI/G	J		0.1168
SS401193	SS40027AE	REAL	TRG	URANIUM-235	0.0643	0.0582	PCI/G	J	A	0
SS401293	SS40028AE	REAL	TRG	URANIUM-235	0.032	0.0405	PCI/G	J		0.0508
SS401393	SS40029AE	REAL	TRG	URANIUM-235	0.0861	0.0638	PCI/G			0.0486
SS401493	SS40030AE	REAL	TRG	URANIUM-235	0.0191	0.0296	PCI/G	J		0.0423
SS401593	SS40031AE	REAL	TRG	URANIUM-235	0.1145	0.0843	PCI/G			0.0595
SS401693	SS40032AE	REAL	TRG	URANIUM-235	0.0451	0.0556	PCI/G	J		0.0647
SS401793	SS40033AE	REAL	TRG	URANIUM-235	0.026	0.0421	PCI/G	J	A	0.034

* Codes explained in Table II 3 6-1
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TABLE IL3.2-5

SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid *	Detect Limit	
SS401893	SS40034AE	REAL	TRG	URANIUM-235	0 133	0 0761	PCI/G			0 0378	
SS401993	SS40035AE	REAL	TRG	URANIUM-235	0 0541	0 0542	PCI/G	J		0 0607	
SS402093	SS40036AE	REAL	TRG	URANIUM-235	0 034	0 0406	PCI/G	J	A	0 015	
SS402193	SS40037AE	REAL	TRG	URANIUM-235	0 0539	0 0776	PCI/G	J	A	0 077	
SS402293	SS40038AE	REAL	TRG	URANIUM-235	0 0194	0 0276	PCI/G		A	0	
SS402293	SS40016AE	DUP	SS40038A	TRG	URANIUM-235	0 0462	0 0569	PCI/G	A	0 024	
SS402393	SS40039AE	REAL	TRG	URANIUM-235	0 1309	0 0975	PCI/G			0 0739	
SS402493	SS40040AE	REAL	TRG	URANIUM-235	0 0562	0 0543	PCI/G	J	A	0 032	
SS402593	SS40041AE	REAL	TRG	URANIUM-235	0 0321	0 0406	PCI/G	J	A	0 027	
SS402693	SS40199AE	REAL	TRG	URANIUM-235	0 0554	0 0509	PCI/G	J	A	0 015	
SS402793	SS40043AE	REAL	TRG	URANIUM-235	0 49	0 1	PCI/G			0 024	
SS402893	SS40044AE	REAL	TRG	URANIUM-235	0 3	0 12	PCI/G		V	0 08	
SS402993	SS40045AE	REAL	TRG	URANIUM-235	0 055	0 074	PCI/G	U	V	0 1	
SS403093	SS40046AE	REAL	TRG	URANIUM-235	2 3	0 28	PCI/G			0 006	
SS403193	SS40047AE	REAL	TRG	URANIUM-235	0 18	0 046	PCI/G	J		0 004	
SS403293	SS40048AE	REAL	TRG	URANIUM-235	0 086	0 04	PCI/G	J		0 005	
SS403393	SS40049AE	REAL	TRG	URANIUM-235	0 17	0 058	PCI/G	J		0 006	
SS403493	SS40050AE	REAL	TRG	URANIUM-235	0 05	0 034	PCI/G	J		0 007	
SS403593	SS40051AE	REAL	TRG	URANIUM-235	0 053	0 036	PCI/G	J		0 007	
SS403693	SS40052AE	REAL	TRG	URANIUM-235	0 065	0 036	PCI/G	J		0 006	
40093	SS40060AE	REAL	TRG	URANIUM-235	0 0998	0 0668	PCI/G		A	0 019	
40193	SS40485AE	REAL	TRG	URANIUM-235	0 0315	0 0388	PCI/G		A	0 016	
40293	SS40042AE	REAL	TRG	URANIUM-235	0 038	0 054	PCI/G	J	A	0 016	
40393	SS40053AE	REAL	TRG	URANIUM-235	0 08	0 068	PCI/G	BJ	A	0 019	
40593	SS40054AE	REAL	TRG	URANIUM-235	0 056	0 066	PCI/G	J	A	0 016	
40693	SS40057AE	REAL	TRG	URANIUM-235	0 18	0 09	PCI/G	J	A	0 013	
40793	SS40058AE	REAL	TRG	URANIUM-235	0 13	0 084	PCI/G	J	A	0 029	
40893	SS40004AE	REAL	TRG	URANIUM-235	0 014	0 028	PCI/G	U	V	0 1	
40993	SS40072AE	REAL	SS40412A	TRG	URANIUM-235	0 25	0 15	PCI/G	J	A	0 017
40993	SS40412AE	DUP	SS40072A	TRG	URANIUM-235	0 26	0 22	PCI/G	J	A	0 035
41193	SS40007AE	REAL	TRG	URANIUM-235	0 089	0 1	PCI/G	J	V	0 025	
41293	SS40071AE	REAL	TRG	URANIUM-235	0 088	0 072	PCI/G	J	A	0 012	
41693	SS40410AE	REAL	TRG	URANIUM-235	0 02	0 04	PCI/G	J	A	0 017	
41793	SS40077AE	REAL	TRG	URANIUM-235	0 1163	0 0805	PCI/G		A	0 0536	
41793	SS40069AE	DUP	SS40077A	TRG	URANIUM-235	0 0796	0 0677	PCI/G	A	0 0555	
41893	SS40003AE	REAL	TRG	URANIUM-235	0 0404	0 0408	PCI/G		A	0	
41993	SS40009AE	REAL	TRG	URANIUM-235	0 017	0 034	PCI/G	U	A	0 1	
42093	SS40480AE	REAL	TRG	URANIUM-235	0 076	0 061	PCI/G	U	V	0 1	
42293	SS40078AE	REAL	TRG	URANIUM-235	0 1241	0 0979	PCI/G		A	0 0739	
42393	SS40079AE	REAL	TRG	URANIUM-235	-0 008	0 001	PCI/G	U	V	0 066	
42693	SS40080AE	REAL	TRG	URANIUM-235	0 019	0 044	PCI/G	U	V	0 031	
42993	SS40056AE	REAL	TRG	URANIUM-235	0 11	0 093	PCI/G	J	V	0 1	
43193	SS40084AE	REAL	TRG	URANIUM-235	0 0749	0 0618	PCI/G		A	0 0583	
43293	SS40006AE	REAL	TRG	URANIUM-235	0 025	0 038	PCI/G	BJ	A	0 019	
43493	SS40086AE	REAL	TRG	URANIUM-235	0 0478	0 0538	PCI/G	J	A	0 0647	
43593	SS40061AE	REAL	TRG	URANIUM-235	0 07	0 07	PCI/G	J	A	0 014	
43793	SS40088AE	REAL	TRG	URANIUM-235	0 53	0 33	PCI/G		A	0 037	
43893	SS40010AE	REAL	TRG	URANIUM-235	0 21	0 13	PCI/G	J	V	0 046	
43993	SS40091AE	REAL	TRG	URANIUM-235	0 12	0 13	PCI/G	J	V	0 026	
44093	SS40090AE	REAL	TRG	URANIUM-235	0 065	0 068	PCI/G	J	A	0 024	
44193	SS40011AE	REAL	TRG	URANIUM-235	0 032	0 064	PCI/G	U	V	0 1	
44393	SS40005AE	REAL	TRG	URANIUM-235	0 0349	0 0295	PCI/G		A	0	
44593	SS40001AE	REAL	TRG	URANIUM-235	0 091	0 078	PCI/G	U	V	0 1	
44793	SS40055AE	REAL	TRG	URANIUM-235	0 0644	0 105	PCI/G	J	A	0 084	
44893	SS40070AE	REAL	TRG	URANIUM-235	0 0302	0 0605	PCI/G		A	0 031	
45693	SS40094AE	REAL	TRG	URANIUM-235	0 51	0 23	PCI/G	B	V	0 02	
45793	SS40015AE	REAL	TRG	URANIUM-235	0 18	0 1	PCI/G	J	A	0 02	
46193	SS40096AE	REAL	TRG	URANIUM-235	0 19	0 1	PCI/G	BJ	V	0 01	
SS400193	SS40017AE	REAL	TRG	URANIUM-238	0 6369	0 217	PCI/G			0 0818	
SS400293	SS40018AE	REAL	TRG	URANIUM-238	1 473	0 402	PCI/G			0 0976	
SS400393	SS40019AE	REAL	TRG	URANIUM-238	2 2	0 41	PCI/G		V	0 1	
SS400493	SS40020AE	REAL	TRG	URANIUM-238	0 8559	0 233	PCI/G			0 0443	
SS400593	SS40021AE	REAL	TRG	URANIUM-238	8 4	0 89	PCI/G		V	0 1	
SS400693	SS40022AE	REAL	TRG	URANIUM-238	1 3	0 23	PCI/G		V	0 07	

* Codes explained in Table II 3 6-1
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TABLE II.3.2-5
SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid *	Detect Limit
SS400793	SS40023AE	REAL	TRG	URANIUM-238	0 9091	0 275	PCI/G			0 0587
SS400893	SS40024AE	REAL	TRG	URANIUM-238	0 9765	0 259	PCI/G		A	0 029
SS400993	SS40025AE	REAL	TRG	URANIUM-238	1 276	0 29	PCI/G		A	0 015
SS401093	SS40026AE	REAL	TRG	URANIUM-238	1 429	0 368	PCI/G			0 1168
SS401193	SS40027AE	REAL	TRG	URANIUM-238	0 7836	0 227	PCI/G		A	0 017
SS401293	SS40028AE	REAL	TRG	URANIUM-238	0 7497	0 211	PCI/G			0 0538
SS401393	SS40029AE	REAL	TRG	URANIUM-238	3 574	0 608	PCI/G			0 0408
SS401493	SS40030AE	REAL	TRG	URANIUM-238	1 339	0 29	PCI/G			0 0381
SS401593	SS40031AE	REAL	TRG	URANIUM-238	0 7416	0 233	PCI/G			0 064
SS401693	SS40032AE	REAL	TRG	URANIUM-238	1 135	0 316	PCI/G			0 0837
SS401793	SS40033AE	REAL	TRG	URANIUM-238	1 032	0 287	PCI/G		A	0 02
SS401893	SS40034AE	REAL	TRG	URANIUM-238	2 517	0 453	PCI/G			0 0542
SS401993	SS40035AE	REAL	TRG	URANIUM-238	1 117	0 275	PCI/G			0 0651
SS402093	SS40036AE	REAL	TRG	URANIUM-238	0 9633	0 246	PCI/G		A	0 027
SS402193	SS40037AE	REAL	TRG	URANIUM-238	1 126	0 365	PCI/G		A	0
SS402293	SS40038AE	REAL	TRG	URANIUM-238	0 515	0 16	PCI/G		A	0 02
SS402293	SS40016AE	DUP	SS40038A	TRG	0 681	0 204	PCI/G		A	0 024
SS402393	SS40039AE	REAL	TRG	URANIUM-238	1 429	0 376	PCI/G			0 0783
SS402493	SS40040AE	REAL	TRG	URANIUM-238	1 148	0 28	PCI/G		A	0 032
SS402593	SS40041AE	REAL	TRG	URANIUM-238	1 228	0 288	PCI/G		A	0 034
SS402693	SS40199AE	REAL	TRG	URANIUM-238	1 325	0 298	PCI/G		A	0 026
SS402793	SS40043AE	REAL	TRG	URANIUM-238	6 3	0 61	PCI/G		B	0 006
SS402893	SS40044AE	REAL	TRG	URANIUM-238	4 7	0 56	PCI/G		V	0 09
SS402993	SS40045AE	REAL	TRG	URANIUM-238	1 5	0 35	PCI/G		V	0 1
SS403093	SS40046AE	REAL	TRG	URANIUM-238	27	2 3	PCI/G		B	0 014
SS403193	SS40047AE	REAL	TRG	URANIUM-238	3 3	0 29	PCI/G		B	0 024
SS403293	SS40048AE	REAL	TRG	URANIUM-238	2	0 24	PCI/G		B	0 005
SS403393	SS40049AE	REAL	TRG	URANIUM-238	2 3	0 29	PCI/G		B	0 015
SS403493	SS40050AE	REAL	TRG	URANIUM-238	1 5	0 23	PCI/G		B	0 016
SS403593	SS40051AE	REAL	TRG	URANIUM-238	1 2	0 2	PCI/G		B	0 007
SS403693	SS40052AE	REAL	TRG	URANIUM-238	1 3	0 2	PCI/G		B	0 006
40093	SS40060AE	REAL	TRG	URANIUM-238	1 04	0 24	PCI/G		A	0 019
40193	SS40485AE	REAL	TRG	URANIUM-238	0 978	0 217	PCI/G		A	0 016
40293	SS40042AE	REAL	TRG	URANIUM-238	1 2	0 35	PCI/G		B	0 016
40393	SS40053AE	REAL	TRG	URANIUM-238	1 2	0 29	PCI/G		B	0 019
40593	SS40054AE	REAL	TRG	URANIUM-238	1 2	0 34	PCI/G		B	0 016
40693	SS40057AE	REAL	TRG	URANIUM-238	1 9	0 36	PCI/G		B	0 043
40793	SS40058AE	REAL	TRG	URANIUM-238	1 1	0 28	PCI/G		B	0 011
40893	SS40004AE	REAL	TRG	URANIUM-238	0 82	0 2	PCI/G		V	0 09
40993	SS40072AE	REAL	SS40412A	TRG	1 6	0 43	PCI/G		B	0 017
40993	SS40412AE	DUP	SS40072A	TRG	1 2	0 53	PCI/G		B	0 06
41193	SS40007AE	REAL	TRG	URANIUM-238	0 89	0 36	PCI/G		B	0 042
41293	SS40071AE	REAL	TRG	URANIUM-238	1 1	0 28	PCI/G		B	0 02
41693	SS40410AE	REAL	TRG	URANIUM-238	2 6	0 6	PCI/G		B	0 029
41793	SS40077AE	REAL	TRG	URANIUM-238	2 268	0 464	PCI/G		A	0 0692
41793	SS40069AE	DUP	SS40077A	TRG	2 444	0 496	PCI/G		A	0 0742
41893	SS40003AE	REAL	TRG	URANIUM-238	0 738	0 199	PCI/G		A	0
41993	SS40009AE	REAL	TRG	URANIUM-238	0 69	0 21	PCI/G		A	0 1
42093	SS40480AE	REAL	TRG	URANIUM-238	0 66	0 19	PCI/G		V	0 1
42293	SS40078AE	REAL	TRG	URANIUM-238	1 013	0 312	PCI/G		A	0 0739
42393	SS40079AE	REAL	TRG	URANIUM-238	1 3	0 45	PCI/G		B	0 078
42693	SS40080AE	REAL	TRG	URANIUM-238	1 2	0 38	PCI/G		B	0 049
42993	SS40056AE	REAL	TRG	URANIUM-238	0 93	0 25	PCI/G		V	0 1
43193	SS40084AE	REAL	TRG	URANIUM-238	1 797	0 371	PCI/G		A	0 0625
43293	SS40006AE	REAL	TRG	URANIUM-238	1 4	0 32	PCI/G		B	0 019
43493	SS40086AE	REAL	TRG	URANIUM-238	0 9689	0 265	PCI/G		A	0 1015
43593	SS40061AE	REAL	TRG	URANIUM-238	0 88	0 28	PCI/G		B	0 014
43793	SS40088AE	REAL	TRG	URANIUM-238	5	1 4	PCI/G		B	0 062
43893	SS40010AE	REAL	TRG	URANIUM-238	5 2	0 95	PCI/G		B	0 025
43993	SS40091AE	REAL	TRG	URANIUM-238	1 1	0 43	PCI/G		B	0 026
44093	SS40090AE	REAL	TRG	URANIUM-238	0 78	0 25	PCI/G		B	0 014
44193	SS40011AE	REAL	TRG	URANIUM-238	0 74	0 23	PCI/G		V	0 1
44393	SS40005AE	REAL	TRG	URANIUM-238	0 708	0 19	PCI/G		A	0
44593	SS40001AE	REAL	TRG	URANIUM-238	0 92	0 21	PCI/G		V	0 08
44793	SS40055AE	REAL	TRG	URANIUM-238	1 015	0 437	PCI/G		A	0 084

* Codes explained in Table II 3 6-1
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TABLE II.3.2-5
SURFICIAL SOIL
RADIOLOGICAL POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code/Partner	Result Type	Chemical	Result	Error	Units	Qual *	Valid *	Detect Limit
	44893	SS40070AE	REAL	TRG	URANIUM-238	1 12	0 31	PCI/G	A	0 044
	45693	SS40094AE	REAL	TRG	URANIUM-238	1 9	0 53	PCI/G	B	0 02
	45793	SS40015AE	REAL	TRG	URANIUM-238	2 3	0 47	PCI/G	A	0 012
	46193	SS40096AE	REAL	TRG	URANIUM-238	4 1	0 67	PCI/G	B	0 01

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TABLE IL3.2-6

SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid *	Detect Limit
SS400193	SS40017AE	REAL		TRG	BENZO(a)ANTHRACENE	370	UG/KG	U	V	370
SS400293	SS40018AE	REAL		TRG	BENZO(a)ANTHRACENE	140	UG/KG	J	A	460
SS400393	SS40019AE	REAL		TRG	BENZO(a)ANTHRACENE	170	UG/KG	J	A	350
SS400493	SS40020AE	REAL		TRG	BENZO(a)ANTHRACENE	840	UG/KG		V	380
SS400593	SS40021AE	REAL		TRG	BENZO(a)ANTHRACENE	51	UG/KG	J	A	340
SS400693	SS40022AE	REAL		TRG	BENZO(a)ANTHRACENE	360	UG/KG	U	V	360
SS400793	SS40023AE	REAL		TRG	BENZO(a)ANTHRACENE	86	UG/KG	J	A	380
SS400893	SS40024AE	REAL		TRG	BENZO(a)ANTHRACENE	46	UG/KG	J	A	460
SS400993	SS40025AE	REAL		TRG	BENZO(a)ANTHRACENE	1900	UG/KG		V	380
SS401093	SS40026AE	REAL		TRG	BENZO(a)ANTHRACENE	103	UG/KG	J	A	360
SS401193	SS40027AE	REAL		TRG	BENZO(a)ANTHRACENE	480	UG/KG	U	V	480
SS401293	SS40028AE	REAL		TRG	BENZO(a)ANTHRACENE	360	UG/KG	U	V	360
SS401393	SS40029AE	REAL		TRG	BENZO(a)ANTHRACENE	470	UG/KG	U	V	470
SS401493	SS40030AE	REAL		TRG	BENZO(a)ANTHRACENE	56	UG/KG	J	A	380
SS401593	SS40031AE	REAL		TRG	BENZO(a)ANTHRACENE	330	UG/KG	J	A	430
SS401693	SS40032AE	REAL		TRG	BENZO(a)ANTHRACENE	94	UG/KG	J	A	360
SS401793	SS40033AE	REAL		TRG	BENZO(a)ANTHRACENE	410	UG/KG		V	390
SS401893	SS40034AE	REAL		TRG	BENZO(a)ANTHRACENE	120	UG/KG	J	A	380
SS401993	SS40035AE	REAL		TRG	BENZO(a)ANTHRACENE	140	UG/KG	J	A	400
SS402093	SS40036AE	REAL		TRG	BENZO(a)ANTHRACENE	38	UG/KG	J	A	400
SS402193	SS40037AE	REAL		TRG	BENZO(a)ANTHRACENE	850	UG/KG		V	390
SS402293	SS40038AE	REAL		TRG	BENZO(a)ANTHRACENE	59	UG/KG	J	A	350
SS402293	SS40016AE	DUP	SS40038AE	TRG	BENZO(a)ANTHRACENE	360	UG/KG	U	V	360
SS402393	SS40039AE	REAL		TRG	BENZO(a)ANTHRACENE	130	UG/KG	J	A	380
SS402493	SS40040AE	REAL		TRG	BENZO(a)ANTHRACENE	40	UG/KG	J	A	440
SS402593	SS40041AE	REAL		TRG	BENZO(a)ANTHRACENE	440	UG/KG	U	V	440
SS402693	SS40199AE	REAL		TRG	BENZO(a)ANTHRACENE	170	UG/KG	J	A	380
SS402793	SS40043AE	REAL		TRG	BENZO(a)ANTHRACENE	420	UG/KG		V	370
SS402893	SS40044AE	REAL		TRG	BENZO(a)ANTHRACENE	110	UG/KG	J	A	350
SS402993	SS40045AE	REAL		TRG	BENZO(a)ANTHRACENE	340	UG/KG	U	V	340
SS403093	SS40046AE	REAL		TRG	BENZO(a)ANTHRACENE	160	UG/KG	J	A	700
SS403193	SS40047AE	REAL		TRG	BENZO(a)ANTHRACENE	460	UG/KG	U	V	460
SS403293	SS40048AE	REAL		TRG	BENZO(a)ANTHRACENE	100	UG/KG	J	A	440
SS403393	SS40049AE	REAL		TRG	BENZO(a)ANTHRACENE	630	UG/KG	U	V	630
SS403493	SS40050AE	REAL		TRG	BENZO(a)ANTHRACENE	420	UG/KG	U	V	420
SS403593	SS40051AE	REAL		TRG	BENZO(a)ANTHRACENE	390	UG/KG	U	V	390
SS403693	SS40052AE	REAL		TRG	BENZO(a)ANTHRACENE	160	UG/KG	J	A	390
40093	SS40060AE	REAL		TRG	BENZO(a)ANTHRACENE	480	UG/KG	U	V	480
40193	SS40485AE	REAL		TRG	BENZO(a)ANTHRACENE	460	UG/KG	U	V	460
40293	SS40042AE	REAL		TRG	BENZO(a)ANTHRACENE	450	UG/KG	U	V	450
40393	SS40053AE	REAL		TRG	BENZO(a)ANTHRACENE	440	UG/KG	U	V	440
40593	SS40054AE	REAL		TRG	BENZO(a)ANTHRACENE	460	UG/KG	U	V	460
40693	SS40057AE	REAL		TRG	BENZO(a)ANTHRACENE	460	UG/KG	J	A	600
40793	SS40058AE	REAL		TRG	BENZO(a)ANTHRACENE	520	UG/KG	J	A	590
40893	SS40004AE	REAL		TRG	BENZO(a)ANTHRACENE	400	UG/KG	U	V	330
40993	SS40072AE	REAL	SS40412AE	TRG	BENZO(a)ANTHRACENE	320	UG/KG	J	A	390
40993	SS40412AE	DUP	SS40072AE	TRG	BENZO(a)ANTHRACENE	360	UG/KG	J	A	400
41193	SS40007AE	REAL		TRG	BENZO(a)ANTHRACENE	150	UG/KG	J	A	500
41293	SS40071AE	REAL		TRG	BENZO(a)ANTHRACENE	180	UG/KG	J	A	740
41693	SS40410AE	REAL		TRG	BENZO(a)ANTHRACENE	66	UG/KG	J	A	450
41793	SS40077AE	REAL		REX	BENZO(a)ANTHRACENE	79	UG/KG	J	A	390
41793	SS40069AE	DUP	SS40077AE	REX	BENZO(a)ANTHRACENE	110	UG/KG	J	A	380
41893	SS40003AE	REAL		TRG	BENZO(a)ANTHRACENE	102	UG/KG	J	A	400
41993	SS40009AE	REAL		REX	BENZO(a)ANTHRACENE	120	UG/KG	J	A	400
42093	SS40480AE	REAL		TRG	BENZO(a)ANTHRACENE	350	UG/KG	U	V	350
42093	SS40013AE	DUP	SS40480AE	TRG	BENZO(a)ANTHRACENE	340	UG/KG	U	V	340
42293	SS40078AE	REAL		TRG	BENZO(a)ANTHRACENE	380	UG/KG	U	JA	380
42393	SS40079AE	REAL		TRG	BENZO(a)ANTHRACENE	210	UG/KG	J	A	360
42693	SS40080AE	REAL		TRG	BENZO(a)ANTHRACENE	63	UG/KG	J	A	520
42993	SS40056AE	REAL		TRG	BENZO(a)ANTHRACENE	54	UG/KG	J	A	370
43193	SS40084AE	REAL		REX	BENZO(a)ANTHRACENE	53	UG/KG	J	A	360
43293	SS40006AE	REAL		REX	BENZO(a)ANTHRACENE	1100	UG/KG		JA	420
43493	SS40086AE	REAL		TRG	BENZO(a)ANTHRACENE	380	UG/KG	U	JA	380
43593	SS40061AE	REAL		TRG	BENZO(a)ANTHRACENE	69	UG/KG	J	A	350
43793	SS40088AE	REAL		TRG	BENZO(a)ANTHRACENE	57	UG/KG	J	A	380

* Codes are explained in Table III 3 6-1
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TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result Units	Qual *	Valid *	Detect Limit	
	43893	SS40010AE	REAL	TRG	BENZO(a)ANTHRACENE	110 UG/KG	J	A	400	
	43993	SS40091AE	REAL	TRG	BENZO(a)ANTHRACENE	380 UG/KG	U	V	380	
	44093	SS40090AE	REAL	REX	BENZO(a)ANTHRACENE	51 UG/KG	J	A	400	
	44193	SS40011AE	REAL	TRG	BENZO(a)ANTHRACENE	360 UG/KG	U	V	360	
	44393	SS40005AE	REAL	TRG	BENZO(a)ANTHRACENE	68 UG/KG	J	A	380	
	44793	SS40055AE	REAL	REX	BENZO(a)ANTHRACENE	440 UG/KG	U	V	440	
	44893	SS40070AE	REAL	TRG	BENZO(a)ANTHRACENE	440 UG/KG	U	V	440	
	45693	SS40094AE	REAL	TRG	BENZO(a)ANTHRACENE	210 UG/KG	J	A	480	
	45793	SS40015AE	REAL	TRG	BENZO(a)ANTHRACENE	490 UG/KG	J	A	500	
	46193	SS40096AE	REAL	TRG	BENZO(a)ANTHRACENE	80 UG/KG	J	A	420	
	SS400193	SS40017AE	REAL	TRG	BENZO(a)PYRENE	370 UG/KG	U	V	370	
	SS400293	SS40018AE	REAL	TRG	BENZO(a)PYRENE	170 UG/KG	J	A	460	
	SS400393	SS40019AE	REAL	TRG	BENZO(a)PYRENE	230 UG/KG	J	A	350	
	SS400493	SS40020AE	REAL	TRG	BENZO(a)PYRENE	900 UG/KG		V	380	
	SS400593	SS40021AE	REAL	TRG	BENZO(a)PYRENE	65 UG/KG	J	A	340	
	SS400693	SS40022AE	REAL	TRG	BENZO(a)PYRENE	45 UG/KG	J	A	360	
	SS400793	SS40023AE	REAL	TRG	BENZO(a)PYRENE	78 UG/KG	J	A	380	
	SS400893	SS40024AE	REAL	TRG	BENZO(a)PYRENE	63 UG/KG	J	A	460	
	SS400993	SS40025AE	REAL	TRG	BENZO(a)PYRENE	2100 UG/KG		V	380	
	SS401093	SS40026AE	REAL	TRG	BENZO(a)PYRENE	110 UG/KG	J	A	360	
	SS401193	SS40027AE	REAL	TRG	BENZO(a)PYRENE	480 UG/KG	U	V	480	
	SS401293	SS40028AE	REAL	TRG	BENZO(a)PYRENE	360 UG/KG	U	V	360	
	SS401393	SS40029AE	REAL	TRG	BENZO(a)PYRENE	470 UG/KG	U	V	470	
	SS401493	SS40030AE	REAL	TRG	BENZO(a)PYRENE	56 UG/KG	J	A	380	
	SS401593	SS40031AE	REAL	TRG	BENZO(a)PYRENE	350 UG/KG	J	A	430	
	SS401693	SS40032AE	REAL	TRG	BENZO(a)PYRENE	102 UG/KG	J	A	360	
	SS401793	SS40033AE	REAL	TRG	BENZO(a)PYRENE	470 UG/KG		V	390	
	SS401893	SS40034AE	REAL	TRG	BENZO(a)PYRENE	150 UG/KG	J	A	380	
	SS401993	SS40035AE	REAL	TRG	BENZO(a)PYRENE	160 UG/KG	J	A	400	
	SS402093	SS40036AE	REAL	TRG	BENZO(a)PYRENE	48 UG/KG	J	A	400	
	SS402193	SS40037AE	REAL	TRG	BENZO(a)PYRENE	980 UG/KG		V	390	
	SS402293	SS40038AE	REAL	TRG	BENZO(a)PYRENE	120 UG/KG	J	A	350	
	SS402293	SS40016AE	DUP	SS40038AE	TRG	BENZO(a)PYRENE	360 UG/KG	U	V	360
	SS402393	SS40039AE	REAL	TRG	BENZO(a)PYRENE	140 UG/KG	J	A	380	
	SS402493	SS40040AE	REAL	TRG	BENZO(a)PYRENE	48 UG/KG	J	A	440	
	SS402593	SS40041AE	REAL	TRG	BENZO(a)PYRENE	440 UG/KG	U	V	440	
	SS402693	SS40199AE	REAL	TRG	BENZO(a)PYRENE	210 UG/KG	J	A	380	
	SS402793	SS40043AE	REAL	TRG	BENZO(a)PYRENE	470 UG/KG		V	370	
	SS402893	SS40044AE	REAL	TRG	BENZO(a)PYRENE	130 UG/KG	J	A	350	
	SS402993	SS40045AE	REAL	TRG	BENZO(a)PYRENE	36 UG/KG	J	A	340	
	SS403093	SS40046AE	REAL	TRG	BENZO(a)PYRENE	180 UG/KG	J	A	700	
	SS403193	SS40047AE	REAL	TRG	BENZO(a)PYRENE	460 UG/KG	U	V	460	
	SS403293	SS40048AE	REAL	TRG	BENZO(a)PYRENE	110 UG/KG	J	A	440	
	SS403393	SS40049AE	REAL	TRG	BENZO(a)PYRENE	630 UG/KG	U	V	630	
	SS403493	SS40050AE	REAL	TRG	BENZO(a)PYRENE	420 UG/KG	U	V	420	
	SS403593	SS40051AE	REAL	TRG	BENZO(a)PYRENE	390 UG/KG	U	V	390	
	SS403693	SS40052AE	REAL	TRG	BENZO(a)PYRENE	200 UG/KG	J	A	390	
	40093	SS40060AE	REAL	TRG	BENZO(a)PYRENE	480 UG/KG	U	V	480	
	40193	SS40485AE	REAL	TRG	BENZO(a)PYRENE	460 UG/KG	U	V	460	
	40293	SS40042AE	REAL	TRG	BENZO(a)PYRENE	450 UG/KG	U	V	450	
	40393	SS40053AE	REAL	TRG	BENZO(a)PYRENE	440 UG/KG	U	V	440	
	40593	SS40054AE	REAL	TRG	BENZO(a)PYRENE	460 UG/KG	U	V	460	
	40693	SS40057AE	REAL	TRG	BENZO(a)PYRENE	550 UG/KG	J	A	600	
	40793	SS40058AE	REAL	TRG	BENZO(a)PYRENE	590 UG/KG		JA	590	
	40893	SS40004AE	REAL	TRG	BENZO(a)PYRENE	88 UG/KG	J	A	330	
	40993	SS40072AE	REAL	SS40412AE	TRG	BENZO(a)PYRENE	360 UG/KG	J	A	390
	40993	SS40412AE	DUP	SS40072AE	TRG	BENZO(a)PYRENE	420 UG/KG		JA	400
	41193	SS40007AE	REAL	TRG	BENZO(a)PYRENE	180 UG/KG	J	A	500	
	41293	SS40071AE	REAL	TRG	BENZO(a)PYRENE	230 UG/KG	J	A	740	
	41693	SS40410AE	REAL	TRG	BENZO(a)PYRENE	67 UG/KG	J	A	450	
	41793	SS40077AE	REAL	REX	BENZO(a)PYRENE	390 UG/KG	U	JA	390	
	41793	SS40069AE	DUP	SS40077AE	REX	BENZO(a)PYRENE	380 UG/KG	U	JA	380
	41893	SS40003AE	REAL	TRG	BENZO(a)PYRENE	130 UG/KG	J	A	400	
	41993	SS40009AE	REAL	REX	BENZO(a)PYRENE	140 UG/KG	J	A	400	

* Codes are explained in Table III 3 6-1
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TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid *	Detect Limit	
	42093	SS40480AE	REAL	TRG	BENZO(a)PYRENE	350	UG/KG	U	V	350	
	42093	SS40013AE	DUP	SS40480AE	TRG	BENZO(a)PYRENE	340	UG/KG	U	JA	340
	42293	SS40078AE	REAL	TRG	BENZO(a)PYRENE	380	UG/KG	U	JA	380	
	42393	SS40079AE	REAL	TRG	BENZO(a)PYRENE	240	UG/KG	J	A	360	
	42693	SS40080AE	REAL	TRG	BENZO(a)PYRENE	520	UG/KG	U	JA	520	
	42993	SS40056AE	REAL	TRG	BENZO(a)PYRENE	60	UG/KG	J	A	370	
	43193	SS40084AE	REAL	REX	BENZO(a)PYRENE	360	UG/KG	U	JA	360	
	43293	SS40006AE	REAL	REX	BENZO(a)PYRENE	1000	UG/KG		JA	420	
	43493	SS40086AE	REAL	TRG	BENZO(a)PYRENE	380	UG/KG	U	JA	380	
	43593	SS40061AE	REAL	TRG	BENZO(a)PYRENE	86	UG/KG	J	A	350	
	43793	SS40088AE	REAL	TRG	BENZO(a)PYRENE	57	UG/KG	J	A	380	
	43893	SS40010AE	REAL	TRG	BENZO(a)PYRENE	400	UG/KG	U	A	400	
	43993	SS40091AE	REAL	TRG	BENZO(a)PYRENE	380	UG/KG	U	V	380	
	44093	SS40090AE	REAL	REX	BENZO(a)PYRENE	400	UG/KG	U	JA	400	
	44193	SS40011AE	REAL	TRG	BENZO(a)PYRENE	360	UG/KG	U	V	360	
	44393	SS40005AE	REAL	TRG	BENZO(a)PYRENE	72	UG/KG	J	A	380	
	44793	SS40055AE	REAL	REX	BENZO(a)PYRENE	440	UG/KG	U	JA	440	
	44893	SS40070AE	REAL	TRG	BENZO(a)PYRENE	440	UG/KG	U	JA	440	
	45693	SS40094AE	REAL	TRG	BENZO(a)PYRENE	200	UG/KG	J	A	480	
	45793	SS40015AE	REAL	TRG	BENZO(a)PYRENE	530	UG/KG		V	500	
	46193	SS40096AE	REAL	TRG	BENZO(a)PYRENE	87	UG/KG	J	A	420	
	SS400193	SS40017AE	REAL	TRG	BENZO(b)FLUORANTHENE	370	UG/KG	U	V	370	
	SS400293	SS40018AE	REAL	TRG	BENZO(b)FLUORANTHENE	280	UG/KG	JX	A	460	
	SS400393	SS40019AE	REAL	TRG	BENZO(b)FLUORANTHENE	350	UG/KG	X	JA	350	
	SS400493	SS40020AE	REAL	TRG	BENZO(b)FLUORANTHENE	1400	UG/KG	X	JA	380	
	SS400593	SS40021AE	REAL	TRG	BENZO(b)FLUORANTHENE	64	UG/KG	J	A	340	
	SS400693	SS40022AE	REAL	TRG	BENZO(b)FLUORANTHENE	64	UG/KG	JX	A	360	
	SS400793	SS40023AE	REAL	TRG	BENZO(b)FLUORANTHENE	120	UG/KG	JX	A	380	
	SS400893	SS40024AE	REAL	TRG	BENZO(b)FLUORANTHENE	94	UG/KG	JX	A	460	
	SS400993	SS40025AE	REAL	TRG	BENZO(b)FLUORANTHENE	3300	UG/KG	X	JA	380	
	SS401093	SS40026AE	REAL	TRG	BENZO(b)FLUORANTHENE	170	UG/KG	JX	A	360	
	SS401193	SS40027AE	REAL	TRG	BENZO(b)FLUORANTHENE	76	UG/KG	JX	A	480	
	SS401293	SS40028AE	REAL	TRG	BENZO(b)FLUORANTHENE	360	UG/KG	U	V	360	
	SS401393	SS40029AE	REAL	TRG	BENZO(b)FLUORANTHENE	470	UG/KG	U	V	470	
	SS401493	SS40030AE	REAL	TRG	BENZO(b)FLUORANTHENE	96	UG/KG	JX	A	380	
	SS401593	SS40031AE	REAL	TRG	BENZO(b)FLUORANTHENE	530	UG/KG	X	JA	430	
	SS401693	SS40032AE	REAL	TRG	BENZO(b)FLUORANTHENE	190	UG/KG	JX	A	360	
	SS401793	SS40033AE	REAL	TRG	BENZO(b)FLUORANTHENE	750	UG/KG	X	JA	390	
	SS401893	SS40034AE	REAL	TRG	BENZO(b)FLUORANTHENE	270	UG/KG	JX	A	380	
	SS401993	SS40035AE	REAL	TRG	BENZO(b)FLUORANTHENE	260	UG/KG	JX	A	400	
	SS402093	SS40036AE	REAL	TRG	BENZO(b)FLUORANTHENE	71	UG/KG	JX	A	400	
	SS402193	SS40037AE	REAL	TRG	BENZO(b)FLUORANTHENE	1700	UG/KG	X	JA	390	
	SS402293	SS40038AE	REAL	TRG	BENZO(b)FLUORANTHENE	94	UG/KG	JX	A	350	
	SS402293	SS40016AE	DUP	SS40038AE	TRG	BENZO(b)FLUORANTHENE	360	UG/KG	U	V	360
	SS402393	SS40039AE	REAL	TRG	BENZO(b)FLUORANTHENE	210	UG/KG	JX	A	380	
	SS402493	SS40040AE	REAL	TRG	BENZO(b)FLUORANTHENE	69	UG/KG	JX	A	440	
	SS402593	SS40041AE	REAL	TRG	BENZO(b)FLUORANTHENE	440	UG/KG	U	V	440	
	SS402693	SS40199AE	REAL	TRG	BENZO(b)FLUORANTHENE	340	UG/KG	JX	A	380	
	SS402793	SS40043AE	REAL	TRG	BENZO(b)FLUORANTHENE	540	UG/KG		V	370	
	SS402893	SS40044AE	REAL	TRG	BENZO(b)FLUORANTHENE	140	UG/KG	J	A	350	
	SS402993	SS40045AE	REAL	TRG	BENZO(b)FLUORANTHENE	32	UG/KG	JX	A	340	
	SS403093	SS40046AE	REAL	TRG	BENZO(b)FLUORANTHENE	160	UG/KG	J	A	700	
	SS403193	SS40047AE	REAL	TRG	BENZO(b)FLUORANTHENE	460	UG/KG	U	V	460	
	SS403293	SS40048AE	REAL	TRG	BENZO(b)FLUORANTHENE	100	UG/KG	J	A	440	
	SS403393	SS40049AE	REAL	TRG	BENZO(b)FLUORANTHENE	90	UG/KG	JX	A	630	
	SS403493	SS40050AE	REAL	TRG	BENZO(b)FLUORANTHENE	52	UG/KG	JX	A	420	
	SS403593	SS40051AE	REAL	TRG	BENZO(b)FLUORANTHENE	43	UG/KG	JX	A	390	
	SS403693	SS40052AE	REAL	TRG	BENZO(b)FLUORANTHENE	210	UG/KG	J	A	390	
	40093	SS40060AE	REAL	TRG	BENZO(b)FLUORANTHENE	480	UG/KG	U	V	480	
	40193	SS40485AE	REAL	TRG	BENZO(b)FLUORANTHENE	460	UG/KG	U	V	460	
	40293	SS40042AE	REAL	TRG	BENZO(b)FLUORANTHENE	450	UG/KG	U	V	450	
	40393	SS40053AE	REAL	TRG	BENZO(b)FLUORANTHENE	70	UG/KG	JX	A	440	
	40593	SS40054AE	REAL	TRG	BENZO(b)FLUORANTHENE	460	UG/KG	U	V	460	
	40693	SS40057AE	REAL	TRG	BENZO(b)FLUORANTHENE	890	UG/KG	X	JA	600	

* Codes are explained in Table III 3 6-1
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TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid.*	Detect Limit	
	40793	SS40058AE	REAL	TRG	BENZO(b)FLUORANTHENE	910	UG/KG	X	JA	590	
	40893	SS40004AE	REAL	TRG	BENZO(b)FLUORANTHENE	400	UG/KG	U	V	330	
	40993	SS40072AE	REAL	SS40412AE	TRG	BENZO(b)FLUORANTHENE	570	UG/KG	X	JA	390
	40993	SS40412AE	DUP	SS40072AE	TRG	BENZO(b)FLUORANTHENE	690	UG/KG	X	JA	400
	41193	SS40007AE	REAL	TRG	BENZO(b)FLUORANTHENE	270	UG/KG	JX	A	500	
	41293	SS40071AE	REAL	TRG	BENZO(b)FLUORANTHENE	370	UG/KG	JX	A	740	
	41693	SS40410AE	REAL	TRG	BENZO(b)FLUORANTHENE	110	UG/KG	JX	A	450	
	41793	SS40077AE	REAL	REX	BENZO(b)FLUORANTHENE	180	UG/KG	JX	A	390	
	41793	SS40069AE	DUP	SS40077AE	REX	BENZO(b)FLUORANTHENE	200	UG/KG	JX	A	380
	41893	SS40003AE	REAL	TRG	BENZO(b)FLUORANTHENE	200	UG/KG	JX	A	400	
	41993	SS40009AE	REAL	REX	BENZO(b)FLUORANTHENE	240	UG/KG	JX	A	400	
	42093	SS40480AE	REAL	TRG	BENZO(b)FLUORANTHENE	40	UG/KG	JX	A	350	
	42093	SS40013AE	DUP	SS40480AE	TRG	BENZO(b)FLUORANTHENE	340	UG/KG	U	JA	340
	42293	SS40078AE	REAL	TRG	BENZO(b)FLUORANTHENE	380	UG/KG	U	JA	380	
	42393	SS40079AE	REAL	TRG	BENZO(b)FLUORANTHENE	370	UG/KG	X	JA	360	
	42693	SS40080AE	REAL	TRG	BENZO(b)FLUORANTHENE	130	UG/KG	JX	A	520	
	42993	SS40056AE	REAL	TRG	BENZO(b)FLUORANTHENE	100	UG/KG	JX	A	370	
	43193	SS40084AE	REAL	REX	BENZO(b)FLUORANTHENE	100	UG/KG	JX	A	360	
	43293	SS40006AE	REAL	REX	BENZO(b)FLUORANTHENE	1800	UG/KG	X	JA	420	
	43493	SS40086AE	REAL	TRG	BENZO(b)FLUORANTHENE	380	UG/KG	U	JA	380	
	43593	SS40061AE	REAL	TRG	BENZO(b)FLUORANTHENE	150	UG/KG	JX	A	350	
	43793	SS40088AE	REAL	TRG	BENZO(b)FLUORANTHENE	100	UG/KG	JX	A	380	
	43893	SS40010AE	REAL	TRG	BENZO(b)FLUORANTHENE	230	UG/KG	JX	A	400	
	43993	SS40091AE	REAL	TRG	BENZO(b)FLUORANTHENE	380	UG/KG	U	V	380	
	44093	SS40090AE	REAL	REX	BENZO(b)FLUORANTHENE	85	UG/KG	JX	A	400	
	44193	SS40011AE	REAL	TRG	BENZO(b)FLUORANTHENE	360	UG/KG	U	V	360	
	44393	SS40005AE	REAL	TRG	BENZO(b)FLUORANTHENE	110	UG/KG	JX	A	380	
	44793	SS40055AE	REAL	REX	BENZO(b)FLUORANTHENE	60	UG/KG	JX	A	440	
	44893	SS40070AE	REAL	TRG	BENZO(b)FLUORANTHENE	440	UG/KG	U	JA	440	
	45693	SS40094AE	REAL	TRG	BENZO(b)FLUORANTHENE	290	UG/KG	JX	A	480	
	45793	SS40015AE	REAL	TRG	BENZO(b)FLUORANTHENE	840	UG/KG	X	JA	500	
	46193	SS40096AE	REAL	TRG	BENZO(b)FLUORANTHENE	140	UG/KG	JX	A	420	
	SS400193	SS40017AE	REAL	TRG	BENZO(gh)PERYLENE	370	UG/KG	U	V	370	
	SS400293	SS40018AE	REAL	TRG	BENZO(gh)PERYLENE	110	UG/KG	J	A	460	
	SS400393	SS40019AE	REAL	TRG	BENZO(gh)PERYLENE	210	UG/KG	J	A	350	
	SS400493	SS40020AE	REAL	TRG	BENZO(gh)PERYLENE	590	UG/KG		JA	380	
	SS400593	SS40021AE	REAL	TRG	BENZO(gh)PERYLENE	70	UG/KG	J	A	340	
	SS400693	SS40022AE	REAL	TRG	BENZO(gh)PERYLENE	360	UG/KG	U	JA	360	
	SS400793	SS40023AE	REAL	TRG	BENZO(gh)PERYLENE	380	UG/KG	U	V	380	
	SS400893	SS40024AE	REAL	TRG	BENZO(gh)PERYLENE	58	UG/KG	J	A	460	
	SS400993	SS40025AE	REAL	TRG	BENZO(gh)PERYLENE	1300	UG/KG		JA	380	
	SS401093	SS40026AE	REAL	TRG	BENZO(gh)PERYLENE	69	UG/KG	J	A	360	
	SS401193	SS40027AE	REAL	TRG	BENZO(gh)PERYLENE	480	UG/KG	U	V	480	
	SS401293	SS40028AE	REAL	TRG	BENZO(gh)PERYLENE	360	UG/KG	U	V	360	
	SS401393	SS40029AE	REAL	TRG	BENZO(gh)PERYLENE	470	UG/KG	U	V	470	
	SS401493	SS40030AE	REAL	TRG	BENZO(gh)PERYLENE	380	UG/KG	U	V	380	
	SS401593	SS40031AE	REAL	TRG	BENZO(gh)PERYLENE	240	UG/KG	J	A	430	
	SS401693	SS40032AE	REAL	TRG	BENZO(gh)PERYLENE	80	UG/KG	J	A	360	
	SS401793	SS40033AE	REAL	TRG	BENZO(gh)PERYLENE	300	UG/KG	J	A	390	
	SS401893	SS40034AE	REAL	TRG	BENZO(gh)PERYLENE	130	UG/KG	J	A	380	
	SS401993	SS40035AE	REAL	TRG	BENZO(gh)PERYLENE	110	UG/KG	J	A	400	
	SS402093	SS40036AE	REAL	TRG	BENZO(gh)PERYLENE	400	UG/KG	U	V	400	
	SS402193	SS40037AE	REAL	TRG	BENZO(gh)PERYLENE	900	UG/KG		JA	390	
	SS402293	SS40038AE	REAL	TRG	BENZO(gh)PERYLENE	15	UG/KG	J	A	350	
	SS402293	SS40016AE	DUP	SS40038AE	TRG	BENZO(gh)PERYLENE	360	UG/KG	U	V	360
	SS402393	SS40039AE	REAL	TRG	BENZO(gh)PERYLENE	76	UG/KG	J	A	380	
	SS402493	SS40040AE	REAL	TRG	BENZO(gh)PERYLENE	440	UG/KG	U	V	440	
	SS402593	SS40041AE	REAL	TRG	BENZO(gh)PERYLENE	440	UG/KG	U	V	440	
	SS402693	SS40199AE	REAL	TRG	BENZO(gh)PERYLENE	180	UG/KG	J	A	380	
	SS402793	SS40043AE	REAL	TRG	BENZO(gh)PERYLENE	330	UG/KG	J	A	370	
	SS402893	SS40044AE	REAL	TRG	BENZO(gh)PERYLENE	140	UG/KG	J	A	350	
	SS402993	SS40045AE	REAL	TRG	BENZO(gh)PERYLENE	340	UG/KG	U	V	340	
	SS403093	SS40046AE	REAL	TRG	BENZO(gh)PERYLENE	130	UG/KG	J	A	700	
	SS403193	SS40047AE	REAL	TRG	BENZO(gh)PERYLENE	460	UG/KG	U	V	460	

* Codes are explained in Table III 3 6-1
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TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid.*	Detect Limit
SS403293	SS40048AE	REAL		TRG	BENZO(gh)PERYLENE	84	UG/KG	J	A	440
SS403393	SS40049AE	REAL		TRG	BENZO(gh)PERYLENE	630	UG/KG	U	V	630
SS403493	SS40050AE	REAL		TRG	BENZO(gh)PERYLENE	420	UG/KG	U	V	420
SS403593	SS40051AE	REAL		TRG	BENZO(gh)PERYLENE	390	UG/KG	U	V	390
SS403693	SS40052AE	REAL		TRG	BENZO(gh)PERYLENE	170	UG/KG	J	A	390
40093	SS40060AE	REAL		TRG	BENZO(gh)PERYLENE	480	UG/KG	U	V	480
40193	SS40485AE	REAL		TRG	BENZO(gh)PERYLENE	460	UG/KG	U	V	460
40293	SS40042AE	REAL		TRG	BENZO(gh)PERYLENE	450	UG/KG	U	V	450
40393	SS40053AE	REAL		TRG	BENZO(gh)PERYLENE	440	UG/KG	U	V	440
40593	SS40054AE	REAL		TRG	BENZO(gh)PERYLENE	460	UG/KG	U	V	460
40693	SS40057AE	REAL		TRG	BENZO(gh)PERYLENE	410	UG/KG	J	A	600
40793	SS40058AE	REAL		TRG	BENZO(gh)PERYLENE	400	UG/KG	J	A	590
40893	SS40004AE	REAL		TRG	BENZO(gh)PERYLENE	400	UG/KG	U	V	330
40993	SS40072AE	REAL	SS40412AE	TRG	BENZO(gh)PERYLENE	260	UG/KG	J	A	390
40993	SS40412AE	DUP	SS40072AE	TRG	BENZO(gh)PERYLENE	280	UG/KG	J	A	400
41193	SS40007AE	REAL		TRG	BENZO(gh)PERYLENE	120	UG/KG	J	A	500
41293	SS40071AE	REAL		TRG	BENZO(gh)PERYLENE	740	UG/KG	U	JA	740
41693	SS40410AE	REAL		TRG	BENZO(gh)PERYLENE	55	UG/KG	J	A	450
41793	SS40077AE	REAL		REX	BENZO(gh)PERYLENE	390	UG/KG	U	JA	390
41793	SS40069AE	DUP	SS40077AE	REX	BENZO(gh)PERYLENE	380	UG/KG	U	JA	380
41893	SS40003AE	REAL		TRG	BENZO(gh)PERYLENE	110	UG/KG	J	A	400
41993	SS40009AE	REAL		REX	BENZO(gh)PERYLENE	82	UG/KG	J	A	400
42093	SS40480AE	REAL		TRG	BENZO(gh)PERYLENE	350	UG/KG	U	V	350
42093	SS40013AE	DUP	SS40480AE	TRG	BENZO(gh)PERYLENE	340	UG/KG	U	JA	340
42293	SS40078AE	REAL		TRG	BENZO(gh)PERYLENE	380	UG/KG	U	JA	380
42393	SS40079AE	REAL		TRG	BENZO(gh)PERYLENE	200	UG/KG	J	A	360
42693	SS40080AE	REAL		TRG	BENZO(gh)PERYLENE	520	UG/KG	U	JA	520
42993	SS40056AE	REAL		TRG	BENZO(gh)PERYLENE	55	UG/KG	J	A	370
43193	SS40084AE	REAL		REX	BENZO(gh)PERYLENE	360	UG/KG	U	JA	360
43293	SS40006AE	REAL		REX	BENZO(gh)PERYLENE	520	UG/KG		JA	420
43493	SS40086AE	REAL		TRG	BENZO(gh)PERYLENE	380	UG/KG	U	JA	380
43593	SS40061AE	REAL		TRG	BENZO(gh)PERYLENE	71	UG/KG	J	A	350
43793	SS40088AE	REAL		TRG	BENZO(gh)PERYLENE	54	UG/KG	J	A	380
43893	SS40010AE	REAL		TRG	BENZO(gh)PERYLENE	87	UG/KG	J	A	400
43993	SS40091AE	REAL		TRG	BENZO(gh)PERYLENE	380	UG/KG	U	V	380
44093	SS40090AE	REAL		REX	BENZO(gh)PERYLENE	400	UG/KG	U	JA	400
44193	SS40011AE	REAL		TRG	BENZO(gh)PERYLENE	360	UG/KG	U	V	360
44393	SS40005AE	REAL		TRG	BENZO(gh)PERYLENE	81	UG/KG	J	A	380
44793	SS40055AE	REAL		REX	BENZO(gh)PERYLENE	440	UG/KG	U	JA	440
44893	SS40070AE	REAL		TRG	BENZO(gh)PERYLENE	440	UG/KG	U	JA	440
45693	SS40094AE	REAL		TRG	BENZO(gh)PERYLENE	160	UG/KG	J	A	480
45793	SS40015AE	REAL		TRG	BENZO(gh)PERYLENE	500	UG/KG	U	V	500
46193	SS40096AE	REAL		TRG	BENZO(gh)PERYLENE	420	UG/KG	U	V	420
SS400193	SS40017AE	REAL		TRG	BENZO(k)FLUORANTHENE	370	UG/KG	U	V	370
SS400293	SS40018AE	REAL		TRG	BENZO(k)FLUORANTHENE	330	UG/KG	JX	R	460
SS400393	SS40019AE	REAL		TRG	BENZO(k)FLUORANTHENE	430	UG/KG	X	JA	350
SS400493	SS40020AE	REAL		TRG	BENZO(k)FLUORANTHENE	1500	UG/KG	X	JA	380
SS400593	SS40021AE	REAL		TRG	BENZO(k)FLUORANTHENE	42	UG/KG	J	A	340
SS400693	SS40022AE	REAL		TRG	BENZO(k)FLUORANTHENE	78	UG/KG	JX	A	360
SS400793	SS40023AE	REAL		TRG	BENZO(k)FLUORANTHENE	130	UG/KG	JX	R	380
SS400893	SS40024AE	REAL		TRG	BENZO(k)FLUORANTHENE	110	UG/KG	JX	A	460
SS400993	SS40025AE	REAL		TRG	BENZO(k)FLUORANTHENE	3700	UG/KG	X	JA	380
SS401093	SS40026AE	REAL		TRG	BENZO(k)FLUORANTHENE	190	UG/KG	JX	R	360
SS401193	SS40027AE	REAL		TRG	BENZO(k)FLUORANTHENE	86	UG/KG	JX	A	480
SS401293	SS40028AE	REAL		TRG	BENZO(k)FLUORANTHENE	360	UG/KG	U	V	360
SS401393	SS40029AE	REAL		TRG	BENZO(k)FLUORANTHENE	470	UG/KG	U	V	470
SS401493	SS40030AE	REAL		TRG	BENZO(k)FLUORANTHENE	110	UG/KG	JX	R	380
SS401593	SS40031AE	REAL		TRG	BENZO(k)FLUORANTHENE	630	UG/KG	X	R	430
SS401693	SS40032AE	REAL		TRG	BENZO(k)FLUORANTHENE	210	UG/KG	JX	A	360
SS401793	SS40033AE	REAL		TRG	BENZO(k)FLUORANTHENE	850	UG/KG	X	JA	390
SS401893	SS40034AE	REAL		TRG	BENZO(k)FLUORANTHENE	300	UG/KG	JX	A	380
SS401993	SS40035AE	REAL		TRG	BENZO(k)FLUORANTHENE	300	UG/KG	JX	R	400
SS402093	SS40036AE	REAL		TRG	BENZO(k)FLUORANTHENE	80	UG/KG	JX	A	400
SS402193	SS40037AE	REAL		TRG	BENZO(k)FLUORANTHENE	1900	UG/KG	X	JA	390

* Codes are explained in Table III 3 6-1
60 wq1

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TABLE IL3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid *	Detect Limit
SS402293	SS40038AE	REAL		TRG	BENZO(k)FLUORANTHENE	100	UG/KG	JX	R	350
SS402293	SS40016AE	DUP	SS40038AE	TRG	BENZO(k)FLUORANTHENE	360	UG/KG	U	V	360
SS402393	SS40039AE	REAL		TRG	BENZO(k)FLUORANTHENE	240	UG/KG	JX	A	380
SS402493	SS40040AE	REAL		TRG	BENZO(k)FLUORANTHENE	78	UG/KG	JX	A	440
SS402593	SS40041AE	REAL		TRG	BENZO(k)FLUORANTHENE	440	UG/KG	U	V	440
SS402693	SS40199AE	REAL		TRG	BENZO(k)FLUORANTHENE	380	UG/KG	JX	A	380
SS402793	SS40043AE	REAL		TRG	BENZO(k)FLUORANTHENE	280	UG/KG	J	A	370
SS402893	SS40044AE	REAL		TRG	BENZO(k)FLUORANTHENE	81	UG/KG	J	A	350
SS402993	SS40045AE	REAL		TRG	BENZO(k)FLUORANTHENE	32	UG/KG	JX	A	340
SS403093	SS40046AE	REAL		TRG	BENZO(k)FLUORANTHENE	110	UG/KG	J	A	700
SS403193	SS40047AE	REAL		TRG	BENZO(k)FLUORANTHENE	460	UG/KG	U	V	460
SS403293	SS40048AE	REAL		TRG	BENZO(k)FLUORANTHENE	75	UG/KG	J	A	440
SS403393	SS40049AE	REAL		TRG	BENZO(k)FLUORANTHENE	110	UG/KG	JX	A	630
SS403493	SS40050AE	REAL		TRG	BENZO(k)FLUORANTHENE	62	UG/KG	JX	A	420
SS403593	SS40051AE	REAL		TRG	BENZO(k)FLUORANTHENE	50	UG/KG	JX	A	390
SS403693	SS40052AE	REAL		TRG	BENZO(k)FLUORANTHENE	130	UG/KG	J	A	390
40093	SS40060AE	REAL		TRG	BENZO(k)FLUORANTHENE	480	UG/KG	U	V	480
40193	SS40485AE	REAL		TRG	BENZO(k)FLUORANTHENE	460	UG/KG	U	V	460
40293	SS40042AE	REAL		TRG	BENZO(k)FLUORANTHENE	450	UG/KG	U	V	450
40393	SS40053AE	REAL		TRG	BENZO(k)FLUORANTHENE	85	UG/KG	JX	A	440
40593	SS40054AE	REAL		TRG	BENZO(k)FLUORANTHENE	460	UG/KG	U	V	460
40693	SS40057AE	REAL		TRG	BENZO(k)FLUORANTHENE	1100	UG/KG	X	JA	600
40793	SS40058AE	REAL		TRG	BENZO(k)FLUORANTHENE	1100	UG/KG	X	JA	590
40893	SS40004AE	REAL		TRG	BENZO(k)FLUORANTHENE	400	UG/KG	U	V	330
40993	SS40072AE	REAL	SS40412AE	TRG	BENZO(k)FLUORANTHENE	700	UG/KG	X	JA	390
40993	SS40412AE	DUP	SS40072AE	TRG	BENZO(k)FLUORANTHENE	850	UG/KG	X	JA	400
41193	SS40007AE	REAL		TRG	BENZO(k)FLUORANTHENE	330	UG/KG	JX	A	500
41293	SS40071AE	REAL		TRG	BENZO(k)FLUORANTHENE	460	UG/KG	JX	A	740
41693	SS40410AE	REAL		TRG	BENZO(k)FLUORANTHENE	140	UG/KG	JX	A	450
41793	SS40077AE	REAL		REX	BENZO(k)FLUORANTHENE	220	UG/KG	JX	A	390
41793	SS40069AE	DUP	SS40077AE	REX	BENZO(k)FLUORANTHENE	250	UG/KG	JX	A	380
41893	SS40003AE	REAL		TRG	BENZO(k)FLUORANTHENE	300	UG/KG	JX	A	400
41993	SS40009AE	REAL		REX	BENZO(k)FLUORANTHENE	360	UG/KG	JX	A	400
42093	SS40480AE	REAL		TRG	BENZO(k)FLUORANTHENE	59	UG/KG	JX	A	350
42093	SS40013AE	DUP	SS40480AE	TRG	BENZO(k)FLUORANTHENE	340	UG/KG	U	JA	340
42293	SS40078AE	REAL		TRG	BENZO(k)FLUORANTHENE	380	UG/KG	U	JA	380
42393	SS40079AE	REAL		TRG	BENZO(k)FLUORANTHENE	450	UG/KG	X	JA	360
42693	SS40080AE	REAL		TRG	BENZO(k)FLUORANTHENE	150	UG/KG	JX	A	520
42993	SS40056AE	REAL		TRG	BENZO(k)FLUORANTHENE	150	UG/KG	JX	A	370
43193	SS40084AE	REAL		REX	BENZO(k)FLUORANTHENE	120	UG/KG	JX	A	360
43293	SS40006AE	REAL		REX	BENZO(k)FLUORANTHENE	2200	UG/KG	X	JA	420
43493	SS40086AE	REAL		TRG	BENZO(k)FLUORANTHENE	380	UG/KG	U	JA	380
43593	SS40061AE	REAL		TRG	BENZO(k)FLUORANTHENE	190	UG/KG	JX	A	350
43793	SS40088AE	REAL		TRG	BENZO(k)FLUORANTHENE	130	UG/KG	JX	A	380
43893	SS40010AE	REAL		TRG	BENZO(k)FLUORANTHENE	220	UG/KG	JX	A	400
43993	SS40091AE	REAL		TRG	BENZO(k)FLUORANTHENE	380	UG/KG	U	V	380
44093	SS40090AE	REAL		REX	BENZO(k)FLUORANTHENE	100	UG/KG	JX	A	400
44193	SS40011AE	REAL		TRG	BENZO(k)FLUORANTHENE	360	UG/KG	U	V	360
44393	SS40005AE	REAL		TRG	BENZO(k)FLUORANTHENE	160	UG/KG	JX	A	380
44793	SS40055AE	REAL		REX	BENZO(k)FLUORANTHENE	89	UG/KG	JX	A	440
44893	SS40070AE	REAL		TRG	BENZO(k)FLUORANTHENE	440	UG/KG	U	JA	440
45693	SS40094AE	REAL		TRG	BENZO(k)FLUORANTHENE	340	UG/KG	JX	A	480
45793	SS40015AE	REAL		TRG	BENZO(k)FLUORANTHENE	970	UG/KG	X	JA	500
46193	SS40096AE	REAL		TRG	BENZO(k)FLUORANTHENE	170	UG/KG	JX	A	420
SS400193	SS40017AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	79	UG/KG	J	A	370
SS400293	SS40018AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	3300	UG/KG		V	460
SS400393	SS40019AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	350	UG/KG	U	JA	350
SS400493	SS40020AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	380	UG/KG	U	V	380
SS400593	SS40021AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	340	UG/KG	U	JA	340
SS400693	SS40022AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	360	UG/KG	U	JA	360
SS400793	SS40023AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	66	UG/KG	J	A	380
SS400893	SS40024AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	460	UG/KG	U	V	460
SS400993	SS40025AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	380	UG/KG	U	V	380
SS401093	SS40026AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	43	UG/KG	J	A	360

TABLE IL3.2-6

SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid.*	Detect Limit
SS401193	SS40027AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	68	UG/KG	J	A	480
SS401293	SS40028AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	360	UG/KG	U	V	360
SS401393	SS40029AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	470	UG/KG	U	V	470
SS401493	SS40030AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	68	UG/KG	J	A	380
SS401593	SS40031AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	430	UG/KG	U	V	430
SS401693	SS40032AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	42	UG/KG	J	A	360
SS401793	SS40033AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	270	UG/KG	J	A	390
SS401893	SS40034AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	740	UG/KG		V	380
SS401993	SS40035AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	540	UG/KG		V	400
SS402093	SS40036AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	45	UG/KG	J	A	400
SS402193	SS40037AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	270	UG/KG	J	A	390
SS402293	SS40038AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	43	UG/KG	J	A	350
SS402293	SS40016AE	DUP	SS40038AE	TRG	BIS(2-ETHYLHEXYL)PHTHALAT	360	UG/KG	U	V	360
SS402393	SS40039AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	380	UG/KG	U	V	380
SS402493	SS40040AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	440	UG/KG	U	V	440
SS402593	SS40041AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	440	UG/KG	U	V	440
SS402693	SS40199AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	340	UG/KG	J	A	380
SS402793	SS40043AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	370	UG/KG	U	JA	370
SS402893	SS40044AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	350	UG/KG	U	JA	350
SS402993	SS40045AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	340	UG/KG	U	JA	340
SS403093	SS40046AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	21000	UG/KG	BE	A	700
SS403193	SS40047AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	460	UG/KG	U	JA	460
SS403293	SS40048AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	440	UG/KG	U	JA	440
SS403393	SS40049AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	630	UG/KG	U	JA	630
SS403493	SS40050AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	420	UG/KG	U	V	420
SS403593	SS40051AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	44	UG/KG	J	A	390
SS403693	SS40052AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	180	UG/KG	J	A	390
40093	SS40060AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	480	UG/KG	U	V	480
40193	SS40485AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	1100	UG/KG		V	460
40293	SS40042AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	59	UG/KG	J	A	450
40393	SS40053AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	75	UG/KG	J	A	440
40593	SS40054AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	460	UG/KG	U	V	460
40693	SS40057AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	110	UG/KG	J	A	600
40793	SS40058AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	160	UG/KG	J	A	590
40893	SS40004AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	400	UG/KG	U	V	330
40993	SS40072AE	REAL	SS40412AE	TRG	BIS(2-ETHYLHEXYL)PHTHALAT	110	UG/KG	J	A	390
40993	SS40412AE	DUP	SS40072AE	TRG	BIS(2-ETHYLHEXYL)PHTHALAT	120	UG/KG	J	A	400
41193	SS40007AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	74	UG/KG	J	A	500
41293	SS40071AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	260	UG/KG	J	A	740
41693	SS40410AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	450	UG/KG	U	V	450
41793	SS40077AE	REAL		REX	BIS(2-ETHYLHEXYL)PHTHALAT	130	UG/KG	J	A	390
41793	SS40069AE	DUP	SS40077AE	REX	BIS(2-ETHYLHEXYL)PHTHALAT	160	UG/KG	J	A	380
41893	SS40003AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	4000	UG/KG		V	400
41993	SS40009AE	REAL		REX	BIS(2-ETHYLHEXYL)PHTHALAT	400	UG/KG	U	V	400
42093	SS40480AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	200	UG/KG	J	A	350
42093	SS40013AE	DUP	SS40480AE	TRG	BIS(2-ETHYLHEXYL)PHTHALAT	130	UG/KG	J	A	340
42293	SS40078AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	380	UG/KG	U	JA	380
42393	SS40079AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	360	UG/KG	U	JA	360
42693	SS40080AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	130	UG/KG	J	A	520
42993	SS40056AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	81	UG/KG	J	A	370
43193	SS40084AE	REAL		REX	BIS(2-ETHYLHEXYL)PHTHALAT	1000	UG/KG		V	360
43293	SS40006AE	REAL		REX	BIS(2-ETHYLHEXYL)PHTHALAT	600	UG/KG		JA	420
43493	SS40086AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	42	UG/KG	J	A	380
43593	SS40061AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	89	UG/KG	J	A	350
43793	SS40088AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	56	UG/KG	J	A	380
43893	SS40010AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	160	UG/KG	J	A	400
43993	SS40091AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	44	UG/KG	J	A	380
44093	SS40090AE	REAL		REX	BIS(2-ETHYLHEXYL)PHTHALAT	69	UG/KG	J	A	400
44193	SS40011AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	2600	UG/KG		V	360
44393	SS40005AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	3800	UG/KG		V	380
44793	SS40055AE	REAL		REX	BIS(2-ETHYLHEXYL)PHTHALAT	3600	UG/KG		V	440
44893	SS40070AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	440	UG/KG	U	V	440
45693	SS40094AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	73	UG/KG	J	A	480
45793	SS40015AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	180	UG/KG	J	A	500
46193	SS40096AE	REAL		TRG	BIS(2-ETHYLHEXYL)PHTHALAT	480	UG/KG		V	420

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TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid *	Detect Limit
	SS400193	SS40017AE	REAL	TRG	CHRYSENE	370	UG/KG	U	V	370
	SS400293	SS40018AE	REAL	TRG	CHRYSENE	190	UG/KG	J	A	460
	SS400393	SS40019AE	REAL	TRG	CHRYSENE	210	UG/KG	J	A	350
	SS400493	SS40020AE	REAL	TRG	CHRYSENE	950	UG/KG		V	380
	SS400593	SS40021AE	REAL	TRG	CHRYSENE	66	UG/KG	J	A	340
	SS400693	SS40022AE	REAL	TRG	CHRYSENE	360	UG/KG	U	V	360
	SS400793	SS40023AE	REAL	TRG	CHRYSENE	89	UG/KG	J	A	380
	SS400893	SS40024AE	REAL	TRG	CHRYSENE	61	UG/KG	J	A	460
	SS400993	SS40025AE	REAL	TRG	CHRYSENE	2200	UG/KG		V	380
	SS401093	SS40026AE	REAL	TRG	CHRYSENE	120	UG/KG	J	A	360
	SS401193	SS40027AE	REAL	TRG	CHRYSENE	480	UG/KG	U	V	480
	SS401293	SS40028AE	REAL	TRG	CHRYSENE	360	UG/KG	U	V	360
	SS401393	SS40029AE	REAL	TRG	CHRYSENE	470	UG/KG	U	V	470
	SS401493	SS40030AE	REAL	TRG	CHRYSENE	62	UG/KG	J	A	380
	SS401593	SS40031AE	REAL	TRG	CHRYSENE	390	UG/KG	J	A	430
	SS401693	SS40032AE	REAL	TRG	CHRYSENE	120	UG/KG	J	A	360
	SS401793	SS40033AE	REAL	TRG	CHRYSENE	470	UG/KG		V	390
	SS401893	SS40034AE	REAL	TRG	CHRYSENE	170	UG/KG	J	A	380
	SS401993	SS40035AE	REAL	TRG	CHRYSENE	160	UG/KG	J	A	400
	SS402093	SS40036AE	REAL	TRG	CHRYSENE	42	UG/KG	J	A	400
	SS402193	SS40037AE	REAL	TRG	CHRYSENE	1070	UG/KG		V	390
	SS402293	SS40038AE	REAL	TRG	CHRYSENE	64	UG/KG	J	A	350
	SS402293	SS40016AE	DUP	SS40038AE	TRG	360	UG/KG	U	V	360
	SS402393	SS40039AE	REAL	TRG	CHRYSENE	140	UG/KG	J	A	380
	SS402493	SS40040AE	REAL	TRG	CHRYSENE	44	UG/KG	J	A	440
	SS402593	SS40041AE	REAL	TRG	CHRYSENE	440	UG/KG	U	V	440
	SS402693	SS40199AE	REAL	TRG	CHRYSENE	210	UG/KG	J	A	380
	SS402793	SS40043AE	REAL	TRG	CHRYSENE	560	UG/KG		V	370
	SS402893	SS40044AE	REAL	TRG	CHRYSENE	130	UG/KG	J	A	350
	SS402993	SS40045AE	REAL	TRG	CHRYSENE	36	UG/KG	J	A	340
	SS403093	SS40046AE	REAL	TRG	CHRYSENE	180	UG/KG	J	A	700
	SS403193	SS40047AE	REAL	TRG	CHRYSENE	460	UG/KG	U	V	460
	SS403293	SS40048AE	REAL	TRG	CHRYSENE	120	UG/KG	J	A	440
	SS403393	SS40049AE	REAL	TRG	CHRYSENE	630	UG/KG	U	V	630
	SS403493	SS40050AE	REAL	TRG	CHRYSENE	420	UG/KG	U	V	420
	SS403593	SS40051AE	REAL	TRG	CHRYSENE	390	UG/KG	U	V	390
	SS403693	SS40052AE	REAL	TRG	CHRYSENE	220	UG/KG	J	A	390
	40093	SS40060AE	REAL	TRG	CHRYSENE	480	UG/KG	U	V	480
	40193	SS40485AE	REAL	TRG	CHRYSENE	460	UG/KG	U	V	460
	40293	SS40042AE	REAL	TRG	CHRYSENE	450	UG/KG	U	V	450
	40393	SS40053AE	REAL	TRG	CHRYSENE	440	UG/KG	U	V	440
	40593	SS40054AE	REAL	TRG	CHRYSENE	460	UG/KG	U	V	460
	40693	SS40057AE	REAL	TRG	CHRYSENE	590	UG/KG	J	A	600
	40793	SS40058AE	REAL	TRG	CHRYSENE	630	UG/KG		V	590
	40893	SS40004AE	REAL	TRG	CHRYSENE	96	UG/KG	J	A	330
	40993	SS40072AE	REAL	SS40412AE	TRG	380	UG/KG	J	A	390
	40993	SS40412AE	DUP	SS40072AE	TRG	450	UG/KG		V	400
	41193	SS40007AE	REAL	TRG	CHRYSENE	180	UG/KG	J	A	500
	41293	SS40071AE	REAL	TRG	CHRYSENE	240	UG/KG	J	A	740
	41693	SS40410AE	REAL	TRG	CHRYSENE	78	UG/KG	J	A	450
	41793	SS40077AE	REAL	REX	CHRYSENE	110	UG/KG	J	A	390
	41793	SS40069AE	DUP	SS40077AE	REX	160	UG/KG	J	A	380
	41893	SS40003AE	REAL	TRG	CHRYSENE	150	UG/KG	J	A	400
	41993	SS40009AE	REAL	REX	CHRYSENE	140	UG/KG	J	A	400
	42093	SS40480AE	REAL	TRG	CHRYSENE	350	UG/KG	U	V	350
	42093	SS40013AE	DUP	SS40480AE	TRG	340	UG/KG	U	V	340
	42293	SS40078AE	REAL	TRG	CHRYSENE	380	UG/KG	U	JA	380
	42393	SS40079AE	REAL	TRG	CHRYSENE	260	UG/KG	J	A	360
	42693	SS40080AE	REAL	TRG	CHRYSENE	77	UG/KG	J	A	520
	42993	SS40056AE	REAL	TRG	CHRYSENE	75	UG/KG	J	A	370
	43193	SS40084AE	REAL	REX	CHRYSENE	73	UG/KG	J	A	360
	43293	SS40006AE	REAL	REX	CHRYSENE	1200	UG/KG		JA	420
	43493	SS40086AE	REAL	TRG	CHRYSENE	380	UG/KG	U	JA	380
	43593	SS40061AE	REAL	TRG	CHRYSENE	89	UG/KG	J	A	350

* Codes are explained in Table III 3 6-1
60 wqt

TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid *	Detect Limit	
	43793	SS40088AE	REAL	TRG	CHRYSENE	69	UG/KG	J	A	380	
	43893	SS40010AE	REAL	TRG	CHRYSENE	140	UG/KG	J	A	400	
	43993	SS40091AE	REAL	TRG	CHRYSENE	380	UG/KG	U	V	380	
	44093	SS40090AE	REAL	REX	CHRYSENE	58	UG/KG	J	A	400	
	44193	SS40011AE	REAL	TRG	CHRYSENE	360	UG/KG	U	V	360	
	44393	SS40005AE	REAL	TRG	CHRYSENE	82	UG/KG	J	A	380	
	44793	SS40055AE	REAL	REX	CHRYSENE	440	UG/KG	U	V	440	
	44893	SS40070AE	REAL	TRG	CHRYSENE	440	UG/KG	U	V	440	
	45693	SS40094AE	REAL	TRG	CHRYSENE	210	UG/KG	J	A	480	
	45793	SS40015AE	REAL	TRG	CHRYSENE	570	UG/KG		V	500	
	46193	SS40096AE	REAL	TRG	CHRYSENE	96	UG/KG	J	A	420	
	SS400193	SS40017AE	REAL	TRG	DI-n-BUTYL PHTHALATE	370	UG/KG	U	V	370	
	SS400293	SS40018AE	REAL	TRG	DI-n-BUTYL PHTHALATE	460	UG/KG	U	V	460	
	SS400393	SS40019AE	REAL	TRG	DI-n-BUTYL PHTHALATE	350	UG/KG	U	V	350	
	SS400493	SS40020AE	REAL	TRG	DI-n-BUTYL PHTHALATE	41	UG/KG	J	A	380	
	SS400593	SS40021AE	REAL	TRG	DI-n-BUTYL PHTHALATE	65	UG/KG	J	A	340	
	SS400693	SS40022AE	REAL	TRG	DI-n-BUTYL PHTHALATE	360	UG/KG	U	V	360	
	SS400793	SS40023AE	REAL	TRG	DI-n-BUTYL PHTHALATE	380	UG/KG	U	V	380	
	SS400893	SS40024AE	REAL	TRG	DI-n-BUTYL PHTHALATE	460	UG/KG	U	V	460	
	SS400993	SS40025AE	REAL	TRG	DI-n-BUTYL PHTHALATE	49	UG/KG	J	A	380	
	SS401093	SS40026AE	REAL	TRG	DI-n-BUTYL PHTHALATE	360	UG/KG	U	V	360	
	SS401193	SS40027AE	REAL	TRG	DI-n-BUTYL PHTHALATE	480	UG/KG	U	V	480	
	SS401293	SS40028AE	REAL	TRG	DI-n-BUTYL PHTHALATE	360	UG/KG	U	V	360	
	SS401393	SS40029AE	REAL	TRG	DI-n-BUTYL PHTHALATE	470	UG/KG	U	V	470	
	SS401493	SS40030AE	REAL	TRG	DI-n-BUTYL PHTHALATE	380	UG/KG	U	V	380	
	SS401593	SS40031AE	REAL	TRG	DI-n-BUTYL PHTHALATE	430	UG/KG	U	V	430	
	SS401693	SS40032AE	REAL	TRG	DI-n-BUTYL PHTHALATE	360	UG/KG	U	V	360	
	SS401793	SS40033AE	REAL	TRG	DI-n-BUTYL PHTHALATE	390	UG/KG	U	V	390	
	SS401893	SS40034AE	REAL	TRG	DI-n-BUTYL PHTHALATE	1700	UG/KG		V	380	
	SS401993	SS40035AE	REAL	TRG	DI-n-BUTYL PHTHALATE	400	UG/KG	U	V	400	
	SS402093	SS40036AE	REAL	TRG	DI-n-BUTYL PHTHALATE	50	UG/KG	J	A	400	
	SS402193	SS40037AE	REAL	TRG	DI-n-BUTYL PHTHALATE	53	UG/KG	J	A	390	
	SS402293	SS40038AE	REAL	TRG	DI-n-BUTYL PHTHALATE	900	UG/KG		V	350	
	SS402293	SS40016AE	DUP	SS40038AE	TRG	DI-n-BUTYL PHTHALATE	360	UG/KG	U	V	360
	SS402393	SS40039AE	REAL	TRG	DI-n-BUTYL PHTHALATE	380	UG/KG	U	V	380	
	SS402493	SS40040AE	REAL	TRG	DI-n-BUTYL PHTHALATE	440	UG/KG	U	V	440	
	SS402593	SS40041AE	REAL	TRG	DI-n-BUTYL PHTHALATE	440	UG/KG	U	V	440	
	SS402693	SS40199AE	REAL	TRG	DI-n-BUTYL PHTHALATE	380	UG/KG	U	V	380	
	SS402793	SS40043AE	REAL	TRG	DI-n-BUTYL PHTHALATE	370	UG/KG	U	V	370	
	SS402893	SS40044AE	REAL	TRG	DI-n-BUTYL PHTHALATE	53	UG/KG	J	A	350	
	SS402993	SS40045AE	REAL	TRG	DI-n-BUTYL PHTHALATE	51	UG/KG	J	A	340	
	SS403093	SS40046AE	REAL	TRG	DI-n-BUTYL PHTHALATE	160	UG/KG	J	A	700	
	SS403193	SS40047AE	REAL	TRG	DI-n-BUTYL PHTHALATE	460	UG/KG	U	V	460	
	SS403293	SS40048AE	REAL	TRG	DI-n-BUTYL PHTHALATE	440	UG/KG	U	V	440	
	SS403393	SS40049AE	REAL	TRG	DI-n-BUTYL PHTHALATE	67	UG/KG	J	A	630	
	SS403493	SS40050AE	REAL	TRG	DI-n-BUTYL PHTHALATE	420	UG/KG	U	JA	420	
	SS403593	SS40051AE	REAL	TRG	DI-n-BUTYL PHTHALATE	390	UG/KG	U	V	390	
	SS403693	SS40052AE	REAL	TRG	DI-n-BUTYL PHTHALATE	390	UG/KG	U	V	390	
	40093	SS40060AE	REAL	TRG	DI-n-BUTYL PHTHALATE	480	UG/KG	U	V	480	
	40193	SS40485AE	REAL	TRG	DI-n-BUTYL PHTHALATE	79	UG/KG	J	A	460	
	40293	SS40042AE	REAL	TRG	DI-n-BUTYL PHTHALATE	450	UG/KG	U	JA	450	
	40393	SS40053AE	REAL	TRG	DI-n-BUTYL PHTHALATE	440	UG/KG	U	JA	440	
	40593	SS40054AE	REAL	TRG	DI-n-BUTYL PHTHALATE	460	UG/KG	U	V	460	
	40693	SS40057AE	REAL	TRG	DI-n-BUTYL PHTHALATE	66	UG/KG	J	A	600	
	40793	SS40058AE	REAL	TRG	DI-n-BUTYL PHTHALATE	80	UG/KG	J	A	590	
	40893	SS40004AE	REAL	TRG	DI-n-BUTYL PHTHALATE	400	UG/KG	U	V	330	
	40993	SS40072AE	REAL	SS40412AE	TRG	DI-n-BUTYL PHTHALATE	43	UG/KG	J	A	390
	40993	SS40412AE	DUP	SS40072AE	TRG	DI-n-BUTYL PHTHALATE	52	UG/KG	J	A	400
	41193	SS40007AE	REAL	TRG	DI-n-BUTYL PHTHALATE	500	UG/KG	U	JA	500	
	41293	SS40071AE	REAL	TRG	DI-n-BUTYL PHTHALATE	96	UG/KG	J	A	740	
	41693	SS40410AE	REAL	TRG	DI-n-BUTYL PHTHALATE	450	UG/KG	U	V	450	
	41793	SS40077AE	REAL	REX	DI-n-BUTYL PHTHALATE	390	UG/KG	U	V	390	
	41793	SS40069AE	DUP	SS40077AE	REX	DI-n-BUTYL PHTHALATE	380	UG/KG	U	V	380
	41893	SS40003AE	REAL	TRG	DI-n-BUTYL PHTHALATE	400	UG/KG	U	V	400	

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TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid *	Detect Limit	
	41993	SS40009AE	REAL	REX	DI-n-BUTYL PHTHALATE	400	UG/KG	U	V	400	
	42093	SS40480AE	REAL	TRG	DI-n-BUTYL PHTHALATE	36	UG/KG	J	A	350	
	42093	SS40013AE	DUP	SS40480AE	TRG	DI-n-BUTYL PHTHALATE	340	UG/KG	U	V	340
	42293	SS40078AE	REAL	TRG	DI-n-BUTYL PHTHALATE	380	UG/KG	U	JA	380	
	42393	SS40079AE	REAL	TRG	DI-n-BUTYL PHTHALATE	360	UG/KG	U	JA	360	
	42693	SS40080AE	REAL	TRG	DI-n-BUTYL PHTHALATE	62	UG/KG	J	A	520	
	42993	SS40056AE	REAL	TRG	DI-n-BUTYL PHTHALATE	370	UG/KG	U	V	370	
	43193	SS40084AE	REAL	REX	DI-n-BUTYL PHTHALATE	55	UG/KG	J	A	360	
	43293	SS40006AE	REAL	REX	DI-n-BUTYL PHTHALATE	79	UG/KG	J	A	420	
	43493	SS40086AE	REAL	TRG	DI-n-BUTYL PHTHALATE	380	UG/KG	U	JA	380	
	43593	SS40061AE	REAL	TRG	DI-n-BUTYL PHTHALATE	39	UG/KG	J	A	350	
	43793	SS40088AE	REAL	TRG	DI-n-BUTYL PHTHALATE	380	UG/KG	U	V	380	
	43893	SS40010AE	REAL	TRG	DI-n-BUTYL PHTHALATE	900	UG/KG		V	400	
	43993	SS40091AE	REAL	TRG	DI-n-BUTYL PHTHALATE	380	UG/KG	U	V	380	
	44093	SS40090AE	REAL	REX	DI-n-BUTYL PHTHALATE	400	UG/KG	U	V	400	
	44193	SS40011AE	REAL	TRG	DI-n-BUTYL PHTHALATE	91	UG/KG	J	A	360	
	44393	SS40003AE	REAL	TRG	DI-n-BUTYL PHTHALATE	730	UG/KG		V	380	
	44793	SS40055AE	REAL	REX	DI-n-BUTYL PHTHALATE	440	UG/KG	U	V	440	
	44893	SS40070AE	REAL	TRG	DI-n-BUTYL PHTHALATE	440	UG/KG	U	V	440	
	45693	SS40094AE	REAL	TRG	DI-n-BUTYL PHTHALATE	120	UG/KG	J	A	480	
	45793	SS40015AE	REAL	TRG	DI-n-BUTYL PHTHALATE	104	UG/KG	J	A	500	
	46193	SS40096AE	REAL	TRG	DI-n-BUTYL PHTHALATE	93	UG/KG	J	A	420	
	SS400193	SS40017AE	REAL	TRG	FLUORANTHENE	54	UG/KG	J	A	370	
	SS400293	SS40018AE	REAL	TRG	FLUORANTHENE	320	UG/KG	J	A	460	
	SS400393	SS40019AE	REAL	TRG	FLUORANTHENE	340	UG/KG	J	A	350	
	SS400493	SS40020AE	REAL	TRG	FLUORANTHENE	1700	UG/KG		V	380	
	SS400593	SS40021AE	REAL	TRG	FLUORANTHENE	108	UG/KG	J	A	340	
	SS400693	SS40022AE	REAL	TRG	FLUORANTHENE	47	UG/KG	J	A	360	
	SS400793	SS40023AE	REAL	TRG	FLUORANTHENE	200	UG/KG	J	A	380	
	SS400893	SS40024AE	REAL	TRG	FLUORANTHENE	110	UG/KG	J	A	460	
	SS400993	SS40025AE	REAL	TRG	FLUORANTHENE	4700	UG/KG		V	380	
	SS401093	SS40026AE	REAL	TRG	FLUORANTHENE	270	UG/KG	J	A	360	
	SS401193	SS40027AE	REAL	TRG	FLUORANTHENE	65	UG/KG	J	A	480	
	SS401293	SS40028AE	REAL	TRG	FLUORANTHENE	360	UG/KG	U	V	360	
	SS401393	SS40029AE	REAL	TRG	FLUORANTHENE	470	UG/KG	U	V	470	
	SS401493	SS40030AE	REAL	TRG	FLUORANTHENE	110	UG/KG	J	A	380	
	SS401593	SS40031AE	REAL	TRG	FLUORANTHENE	710	UG/KG		V	430	
	SS401693	SS40032AE	REAL	TRG	FLUORANTHENE	250	UG/KG	J	A	360	
	SS401793	SS40033AE	REAL	TRG	FLUORANTHENE	920	UG/KG		V	390	
	SS401893	SS40034AE	REAL	TRG	FLUORANTHENE	310	UG/KG	J	A	380	
	SS401993	SS40035AE	REAL	TRG	FLUORANTHENE	300	UG/KG	J	A	400	
	SS402093	SS40036AE	REAL	TRG	FLUORANTHENE	90	UG/KG	J	A	400	
	SS402193	SS40037AE	REAL	TRG	FLUORANTHENE	2100	UG/KG		V	390	
	SS402293	SS40038AE	REAL	TRG	FLUORANTHENE	150	UG/KG	J	A	350	
	SS402293	SS40016AE	DUP	SS40038AE	TRG	FLUORANTHENE	74	UG/KG	J	A	360
	SS402393	SS40039AE	REAL	TRG	FLUORANTHENE	310	UG/KG	J	A	380	
	SS402493	SS40040AE	REAL	TRG	FLUORANTHENE	92	UG/KG	J	A	440	
	SS402593	SS40041AE	REAL	TRG	FLUORANTHENE	440	UG/KG	U	V	440	
	SS402693	SS40199AE	REAL	TRG	FLUORANTHENE	370	UG/KG	J	A	380	
	SS402793	SS40043AE	REAL	TRG	FLUORANTHENE	1000	UG/KG		V	370	
	SS402893	SS40044AE	REAL	TRG	FLUORANTHENE	210	UG/KG	J	A	350	
	SS402993	SS40045AE	REAL	TRG	FLUORANTHENE	63	UG/KG	J	A	340	
	SS403093	SS40046AE	REAL	TRG	FLUORANTHENE	300	UG/KG	J	A	700	
	SS403193	SS40047AE	REAL	TRG	FLUORANTHENE	460	UG/KG	U	V	460	
	SS403293	SS40048AE	REAL	TRG	FLUORANTHENE	220	UG/KG	J	A	440	
	SS403393	SS40049AE	REAL	TRG	FLUORANTHENE	98	UG/KG	J	A	630	
	SS403493	SS40050AE	REAL	TRG	FLUORANTHENE	43	UG/KG	J	A	420	
	SS403593	SS40051AE	REAL	TRG	FLUORANTHENE	40	UG/KG	J	A	390	
	SS403693	SS40052AE	REAL	TRG	FLUORANTHENE	200	UG/KG	J	A	390	
	40093	SS40060AE	REAL	TRG	FLUORANTHENE	480	UG/KG	U	V	480	
	40193	SS40485AE	REAL	TRG	FLUORANTHENE	460	UG/KG	U	V	460	
	40293	SS40042AE	REAL	TRG	FLUORANTHENE	450	UG/KG	U	V	450	
	40393	SS40053AE	REAL	TRG	FLUORANTHENE	70	UG/KG	J	A	440	
	40593	SS40054AE	REAL	TRG	FLUORANTHENE	460	UG/KG	U	V	460	

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TABLE II.3.2-6

SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid *	Detect Limit
	40693	SS40057AE	REAL	TRG	FLUORANTHENE	1200	UG/KG		V	600
	40793	SS40058AE	REAL	TRG	FLUORANTHENE	1400	UG/KG		V	590
	40893	SS40004AE	REAL	TRG	FLUORANTHENE	190	UG/KG	J	A	330
	40993	SS40072AE	REAL	SS40412AE TRG	FLUORANTHENE	770	UG/KG		V	390
	40993	SS40412AE	DUP	SS40072AE TRG	FLUORANTHENE	800	UG/KG		V	400
	41193	SS40007AE	REAL	TRG	FLUORANTHENE	370	UG/KG	J	A	500
	41293	SS40071AE	REAL	TRG	FLUORANTHENE	430	UG/KG	J	A	740
	41693	SS40410AE	REAL	TRG	FLUORANTHENE	140	UG/KG	J	A	450
	41793	SS40077AE	REAL	REX	FLUORANTHENE	220	UG/KG	J	A	390
	41793	SS40069AE	DUP	SS40077AE REX	FLUORANTHENE	220	UG/KG	J	A	380
	41893	SS40003AE	REAL	TRG	FLUORANTHENE	270	UG/KG	J	A	400
	41993	SS40009AE	REAL	REX	FLUORANTHENE	290	UG/KG	J	A	400
	42093	SS40480AE	REAL	TRG	FLUORANTHENE	48	UG/KG	J	A	350
	42093	SS40013AE	DUP	SS40480AE TRG	FLUORANTHENE	340	UG/KG	U	V	340
	42293	SS40078AE	REAL	TRG	FLUORANTHENE	380	UG/KG	U	JA	380
	42393	SS40079AE	REAL	TRG	FLUORANTHENE	500	UG/KG		V	360
	42693	SS40080AE	REAL	TRG	FLUORANTHENE	130	UG/KG	J	A	520
	42993	SS40056AE	REAL	TRG	FLUORANTHENE	150	UG/KG	J	A	370
	43193	SS40084AE	REAL	REX	FLUORANTHENE	130	UG/KG	J	A	360
	43293	SS40006AE	REAL	REX	FLUORANTHENE	3000	UG/KG		JA	420
	43493	SS40086AE	REAL	TRG	FLUORANTHENE	380	UG/KG	U	JA	380
	43593	SS40061AE	REAL	TRG	FLUORANTHENE	130	UG/KG	J	A	350
	43793	SS40088AE	REAL	TRG	FLUORANTHENE	120	UG/KG	J	A	380
	43893	SS40010AE	REAL	TRG	FLUORANTHENE	280	UG/KG	J	A	400
	43993	SS40091AE	REAL	TRG	FLUORANTHENE	380	UG/KG	U	V	380
	44093	SS40090AE	REAL	REX	FLUORANTHENE	110	UG/KG	J	A	400
	44193	SS40011AE	REAL	TRG	FLUORANTHENE	52	UG/KG	J	A	360
	44393	SS40005AE	REAL	TRG	FLUORANTHENE	160	UG/KG	J	A	380
	44793	SS40055AE	REAL	REX	FLUORANTHENE	72	UG/KG	J	A	440
	44893	SS40070AE	REAL	TRG	FLUORANTHENE	440	UG/KG	U	V	440
	45693	SS40094AE	REAL	TRG	FLUORANTHENE	540	UG/KG		V	480
	45793	SS40015AE	REAL	TRG	FLUORANTHENE	1100	UG/KG		V	500
	46193	SS40096AE	REAL	TRG	FLUORANTHENE	190	UG/KG	J	A	420
	SS400193	SS40017AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	370	UG/KG	U	V	370
	SS400293	SS40018AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	110	UG/KG	J	A	460
	SS400393	SS40019AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	210	UG/KG	J	A	350
	SS400493	SS40020AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	650	UG/KG		JA	380
	SS400593	SS40021AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	73	UG/KG	J	A	340
	SS400693	SS40022AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	360	UG/KG	U	JA	360
	SS400793	SS40023AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	42	UG/KG	J	A	380
	SS400893	SS40024AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	61	UG/KG	J	A	460
	SS400993	SS40025AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	1600	UG/KG		JA	380
	SS401093	SS40026AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	74	UG/KG	J	A	360
	SS401193	SS40027AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	51	UG/KG	J	A	480
	SS401293	SS40028AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	360	UG/KG	U	V	360
	SS401393	SS40029AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	470	UG/KG	U	V	470
	SS401493	SS40030AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	380	UG/KG	U	V	380
	SS401593	SS40031AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	270	UG/KG	J	A	430
	SS401693	SS40032AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	90	UG/KG	J	A	360
	SS401793	SS40033AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	300	UG/KG	J	A	390
	SS401893	SS40034AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	140	UG/KG	J	A	380
	SS401993	SS40035AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	120	UG/KG	J	A	400
	SS402093	SS40036AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	43	UG/KG	J	A	400
	SS402193	SS40037AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	930	UG/KG		JA	390
	SS402293	SS40038AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	350	UG/KG	U	V	350
	SS402293	SS40016AE	DUP	SS40038AE TRG	INDENO(1,2,3-cd)PYRENE	360	UG/KG	U	V	360
	SS402393	SS40039AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	87	UG/KG	J	A	380
	SS402493	SS40040AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	440	UG/KG	U	V	440
	SS402593	SS40041AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	440	UG/KG	U	V	440
	SS402693	SS40199AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	170	UG/KG	J	A	380
	SS402793	SS40043AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	340	UG/KG	J	A	370
	SS402893	SS40044AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	150	UG/KG	J	A	350
	SS402993	SS40045AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	340	UG/KG	U	V	340
	SS403093	SS40046AE	REAL	TRG	INDENO(1,2,3-cd)PYRENE	110	UG/KG	J	A	700

* Codes are explained in Table III 3 6-1
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TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid *	Detect Limit
SS403193	SS40047AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	460	UG/KG	U	V	460
SS403293	SS40048AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	87	UG/KG	J	A	440
SS403393	SS40049AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	630	UG/KG	U	V	630
SS403493	SS40050AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	420	UG/KG	U	V	420
SS403593	SS40051AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	390	UG/KG	U	V	390
SS403693	SS40052AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	150	UG/KG	J	A	390
40093	SS40060AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	480	UG/KG	U	V	480
40193	SS40485AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	460	UG/KG	U	V	460
40293	SS40042AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	450	UG/KG	U	V	450
40393	SS40053AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	440	UG/KG	U	V	440
40593	SS40054AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	460	UG/KG	U	V	460
40693	SS40057AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	480	UG/KG	J	A	600
40793	SS40058AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	480	UG/KG	J	A	590
40893	SS40004AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	76	UG/KG	J	A	330
40993	SS40072AE	REAL	SS40412AE	TRG	INDENO(1,2,3-cd)PYRENE	270	UG/KG	J	A	390
40993	SS40412AE	DUP	SS40072AE	TRG	INDENO(1,2,3-cd)PYRENE	340	UG/KG	J	A	400
41193	SS40007AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	140	UG/KG	J	A	500
41293	SS40071AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	740	UG/KG	U	JA	740
41693	SS40410AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	60	UG/KG	J	A	450
41793	SS40077AE	REAL		REX	INDENO(1,2,3-cd)PYRENE	390	UG/KG	U	JA	390
41793	SS40069AE	DUP	SS40077AE	REX	INDENO(1,2,3-cd)PYRENE	380	UG/KG	U	JA	380
41893	SS40003AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	110	UG/KG	J	A	400
41993	SS40009AE	REAL		REX	INDENO(1,2,3-cd)PYRENE	90	UG/KG	J	A	400
42093	SS40480AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	350	UG/KG	U	V	350
42093	SS40013AE	DUP	SS40480AE	TRG	INDENO(1,2,3-cd)PYRENE	340	UG/KG	U	JA	340
42293	SS40078AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	380	UG/KG	U	JA	380
42393	SS40079AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	210	UG/KG	J	A	360
42693	SS40080AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	520	UG/KG	U	JA	520
42993	SS40056AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	58	UG/KG	J	A	370
43193	SS40084AE	REAL		REX	INDENO(1,2,3-cd)PYRENE	360	UG/KG	U	JA	360
43293	SS40006AE	REAL		REX	INDENO(1,2,3-cd)PYRENE	590	UG/KG		JA	420
43493	SS40086AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	380	UG/KG	U	JA	380
43593	SS40061AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	70	UG/KG	J	A	350
43793	SS40088AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	55	UG/KG	J	A	380
43893	SS40010AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	99	UG/KG	J	A	400
43993	SS40091AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	380	UG/KG	U	V	380
44093	SS40090AE	REAL		REX	INDENO(1,2,3-cd)PYRENE	400	UG/KG	U	JA	400
44193	SS40011AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	360	UG/KG	U	V	360
44393	SS40005AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	77	UG/KG	J	A	380
44793	SS40055AE	REAL		REX	INDENO(1,2,3-cd)PYRENE	440	UG/KG	U	JA	440
44893	SS40070AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	440	UG/KG	U	JA	440
45693	SS40094AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	170	UG/KG	J	A	480
45793	SS40015AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	410	UG/KG	J	A	500
46193	SS40096AE	REAL		TRG	INDENO(1,2,3-cd)PYRENE	79	UG/KG	J	A	420
SS400193	SS40017AE	REAL		TRG	PHENANTHRENE	41	UG/KG	J	A	360
SS400293	SS40018AE	REAL		TRG	PHENANTHRENE	220	UG/KG	J	A	460
SS400393	SS40019AE	REAL		TRG	PHENANTHRENE	310	UG/KG	J	A	350
SS400493	SS40020AE	REAL		TRG	PHENANTHRENE	1200	UG/KG		V	380
SS400593	SS40021AE	REAL		TRG	PHENANTHRENE	77	UG/KG	J	A	340
SS400693	SS40022AE	REAL		TRG	PHENANTHRENE	40	UG/KG	J	A	360
SS400793	SS40023AE	REAL		TRG	PHENANTHRENE	190	UG/KG	J	A	380
SS400893	SS40024AE	REAL		TRG	PHENANTHRENE	73	UG/KG	J	A	460
SS400993	SS40025AE	REAL		TRG	PHENANTHRENE	3700	UG/KG		V	380
SS401093	SS40026AE	REAL		TRG	PHENANTHRENE	190	UG/KG	J	A	360
SS401193	SS40027AE	REAL		TRG	PHENANTHRENE	480	UG/KG	U	V	480
SS401293	SS40028AE	REAL		TRG	PHENANTHRENE	360	UG/KG	U	V	360
SS401393	SS40029AE	REAL		TRG	PHENANTHRENE	470	UG/KG	U	V	470
SS401493	SS40030AE	REAL		TRG	PHENANTHRENE	65	UG/KG	J	A	380
SS401593	SS40031AE	REAL		TRG	PHENANTHRENE	680	UG/KG		V	430
SS401693	SS40032AE	REAL		TRG	PHENANTHRENE	160	UG/KG	J	A	360
SS401793	SS40033AE	REAL		TRG	PHENANTHRENE	610	UG/KG		V	390
SS401893	SS40034AE	REAL		TRG	PHENANTHRENE	220	UG/KG	J	A	380
SS401993	SS40035AE	REAL		TRG	PHENANTHRENE	180	UG/KG	J	A	400
SS402093	SS40036AE	REAL		TRG	PHENANTHRENE	55	UG/KG	J	A	400

* Codes are explained in Table III 3 6-1
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TABLE II.3.2-6

SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid.*	Detect Limit
SS402193	SS40037AE	REAL		TRG	PHENANTHRENE	1500	UG/KG		V	390
SS402293	SS40038AE	REAL		TRG	PHENANTHRENE	120	UG/KG	J	A	350
SS402293	SS40016AE	DUP	SS40038AE	TRG	PHENANTHRENE	48	UG/KG	J	A	360
SS402393	SS40039AE	REAL		TRG	PHENANTHRENE	180	UG/KG	J	A	380
SS402493	SS40040AE	REAL		TRG	PHENANTHRENE	65	UG/KG	J	A	440
SS402593	SS40041AE	REAL		TRG	PHENANTHRENE	440	UG/KG	U	V	440
SS402693	SS400199AE	REAL		TRG	PHENANTHRENE	190	UG/KG	J	A	380
SS402793	SS40043AE	REAL		TRG	PHENANTHRENE	950	UG/KG		V	370
SS402893	SS40044AE	REAL		TRG	PHENANTHRENE	180	UG/KG	J	A	350
SS402993	SS40045AE	REAL		TRG	PHENANTHRENE	38	UG/KG	J	A	340
SS403093	SS40046AE	REAL		TRG	PHENANTHRENE	290	UG/KG	J	A	700
SS403193	SS40047AE	REAL		TRG	PHENANTHRENE	460	UG/KG	U	V	460
SS403293	SS40048AE	REAL		TRG	PHENANTHRENE	180	UG/KG	J	A	440
SS403393	SS40049AE	REAL		TRG	PHENANTHRENE	74	UG/KG	J	A	630
SS403493	SS40050AE	REAL		TRG	PHENANTHRENE	420	UG/KG	U	V	420
SS403593	SS40051AE	REAL		TRG	PHENANTHRENE	390	UG/KG	U	V	390
SS403693	SS40052AE	REAL		TRG	PHENANTHRENE	74	UG/KG	J	A	390
40093	SS40060AE	REAL		TRG	PHENANTHRENE	480	UG/KG	U	V	480
40193	SS40485AE	REAL		TRG	PHENANTHRENE	460	UG/KG	U	V	460
40293	SS40042AE	REAL		TRG	PHENANTHRENE	450	UG/KG	U	V	450
40393	SS40053AE	REAL		TRG	PHENANTHRENE	440	UG/KG	U	V	440
40593	SS40054AE	REAL		TRG	PHENANTHRENE	460	UG/KG	U	V	460
40693	SS40057AE	REAL		TRG	PHENANTHRENE	860	UG/KG		V	600
40793	SS40058AE	REAL		TRG	PHENANTHRENE	1100	UG/KG		V	590
40893	SS40004AE	REAL		TRG	PHENANTHRENE	120	UG/KG	J	A	330
40993	SS40072AE	REAL	SS40412AE	TRG	PHENANTHRENE	490	UG/KG		V	390
40993	SS40412AE	DUP	SS40072AE	TRG	PHENANTHRENE	520	UG/KG		V	400
41193	SS40007AE	REAL		TRG	PHENANTHRENE	270	UG/KG	J	A	500
41293	SS40071AE	REAL		TRG	PHENANTHRENE	270	UG/KG	J	A	740
41693	SS40410AE	REAL		TRG	PHENANTHRENE	98	UG/KG	J	A	450
41793	SS40077AE	REAL		REX	PHENANTHRENE	140	UG/KG	J	A	390
41793	SS40069AE	DUP	SS40077AE	REX	PHENANTHRENE	200	UG/KG	J	A	380
41893	SS40003AE	REAL		TRG	PHENANTHRENE	180	UG/KG	J	A	400
41993	SS40009AE	REAL		REX	PHENANTHRENE	180	UG/KG	J	A	400
42093	SS40480AE	REAL		TRG	PHENANTHRENE	37	UG/KG	J	A	350
42093	SS40013AE	DUP	SS40480AE	TRG	PHENANTHRENE	340	UG/KG	U	V	340
42293	SS40078AE	REAL		TRG	PHENANTHRENE	380	UG/KG	U	JA	380
42393	SS40079AE	REAL		TRG	PHENANTHRENE	340	UG/KG	J	A	360
42693	SS40080AE	REAL		TRG	PHENANTHRENE	99	UG/KG	J	A	520
42993	SS40056AE	REAL		TRG	PHENANTHRENE	130	UG/KG	J	A	370
43193	SS40084AE	REAL		REX	PHENANTHRENE	81	UG/KG	J	A	360
43293	SS40006AE	REAL		REX	PHENANTHRENE	2300	UG/KG		JA	420
43493	SS40086AE	REAL		TRG	PHENANTHRENE	380	UG/KG	U	JA	380
43593	SS40061AE	REAL		TRG	PHENANTHRENE	57	UG/KG	J	A	350
43793	SS40088AE	REAL		TRG	PHENANTHRENE	87	UG/KG	J	A	380
43893	SS40010AE	REAL		TRG	PHENANTHRENE	170	UG/KG	J	A	400
43993	SS40091AE	REAL		TRG	PHENANTHRENE	380	UG/KG	U	V	380
44093	SS40090AE	REAL		REX	PHENANTHRENE	78	UG/KG	J	A	400
44193	SS40011AE	REAL		TRG	PHENANTHRENE	360	UG/KG	U	V	360
44393	SS40005AE	REAL		TRG	PHENANTHRENE	130	UG/KG	J	A	380
44793	SS40055AE	REAL		REX	PHENANTHRENE	440	UG/KG	U	V	440
44893	SS40070AE	REAL		TRG	PHENANTHRENE	440	UG/KG	U	V	440
45693	SS40094AE	REAL		TRG	PHENANTHRENE	390	UG/KG	J	A	480
45793	SS40015AE	REAL		TRG	PHENANTHRENE	940	UG/KG		V	500
46193	SS40096AE	REAL		TRG	PHENANTHRENE	150	UG/KG	J	A	420
SS400193	SS40017AE	REAL		TRG	PYRENE	54	UG/KG	J	A	370
SS400293	SS40018AE	REAL		TRG	PYRENE	350	UG/KG	J	A	460
SS400393	SS40019AE	REAL		TRG	PYRENE	570	UG/KG		V	350
SS400493	SS40020AE	REAL		TRG	PYRENE	1300	UG/KG		V	380
SS400593	SS40021AE	REAL		TRG	PYRENE	130	UG/KG	J	A	340
SS400693	SS40022AE	REAL		TRG	PYRENE	100	UG/KG	J	A	360
SS400793	SS40023AE	REAL		TRG	PYRENE	180	UG/KG	J	A	380
SS400893	SS40024AE	REAL		TRG	PYRENE	93	UG/KG	J	A	460
SS400993	SS40025AE	REAL		TRG	PYRENE	3600	UG/KG		V	380

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TABLE II.3.2-6

**SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid.*	Detect Limit
SS401093	SS40026AE	REAL		TRG	PYRENE	260	UG/KG	J	A	360
SS401193	SS40027AE	REAL		TRG	PYRENE	51	UG/KG	J	A	480
SS401293	SS40028AE	REAL		TRG	PYRENE	360	UG/KG	U	V	360
SS401393	SS40029AE	REAL		TRG	PYRENE	470	UG/KG	U	V	470
SS401493	SS40030AE	REAL		TRG	PYRENE	130	UG/KG	J	A	380
SS401593	SS40031AE	REAL		TRG	PYRENE	760	UG/KG		V	430
SS401693	SS40032AE	REAL		TRG	PYRENE	180	UG/KG	J	A	360
SS401793	SS40033AE	REAL		TRG	PYRENE	670	UG/KG		V	390
SS401893	SS40034AE	REAL		TRG	PYRENE	260	UG/KG	J	A	380
SS401993	SS40035AE	REAL		TRG	PYRENE	320	UG/KG	J	A	400
SS402093	SS40036AE	REAL		TRG	PYRENE	66	UG/KG	J	A	400
SS402193	SS40037AE	REAL		TRG	PYRENE	1900	UG/KG		V	390
SS402293	SS40038AE	REAL		TRG	PYRENE	130	UG/KG	J	A	350
SS402293	SS40016AE	DUP	SS40038AE	TRG	PYRENE	75	UG/KG	J	A	360
SS402393	SS40039AE	REAL		TRG	PYRENE	210	UG/KG	J	A	380
SS402493	SS40040AE	REAL		TRG	PYRENE	65	UG/KG	J	A	440
SS402593	SS40041AE	REAL		TRG	PYRENE	440	UG/KG	U	V	440
SS402693	SS40199AE	REAL		TRG	PYRENE	310	UG/KG	J	A	380
SS402793	SS40043AE	REAL		TRG	PYRENE	1100	UG/KG		V	370
SS402893	SS40044AE	REAL		TRG	PYRENE	370	UG/KG		V	350
SS402993	SS40045AE	REAL		TRG	PYRENE	57	UG/KG	J	A	340
SS403093	SS40046AE	REAL		TRG	PYRENE	310	UG/KG	J	A	700
SS403193	SS40047AE	REAL		TRG	PYRENE	460	UG/KG	U	V	460
SS403293	SS40048AE	REAL		TRG	PYRENE	210	UG/KG	J	A	440
SS403393	SS40049AE	REAL		TRG	PYRENE	90	UG/KG	J	A	630
SS403493	SS40050AE	REAL		TRG	PYRENE	49	UG/KG	J	A	420
SS403593	SS40051AE	REAL		TRG	PYRENE	390	UG/KG	U	V	390
SS403693	SS40052AE	REAL		TRG	PYRENE	210	UG/KG	J	A	390
40093	SS40060AE	REAL		TRG	PYRENE	480	UG/KG	U	V	480
40193	SS40485AE	REAL		TRG	PYRENE	460	UG/KG	U	V	460
40293	SS40042AE	REAL		TRG	PYRENE	450	UG/KG	U	V	450
40393	SS40053AE	REAL		TRG	PYRENE	71	UG/KG	J	A	440
40593	SS40054AE	REAL		TRG	PYRENE	460	UG/KG	U	V	460
40693	SS40057AE	REAL		TRG	PYRENE	1200	UG/KG		V	600
40793	SS40058AE	REAL		TRG	PYRENE	1400	UG/KG		V	590
40893	SS40004AE	REAL		TRG	PYRENE	180	UG/KG	J	A	330
40993	SS40072AE	REAL	SS40412AE	TRG	PYRENE	820	UG/KG		V	390
40993	SS40412AE	DUP	SS40072AE	TRG	PYRENE	880	UG/KG		V	400
41193	SS40007AE	REAL		TRG	PYRENE	340	UG/KG	J	A	500
41293	SS40071AE	REAL		TRG	PYRENE	420	UG/KG	J	A	740
41693	SS40410AE	REAL		TRG	PYRENE	150	UG/KG	J	A	450
41793	SS40077AE	REAL		REX	PYRENE	270	UG/KG	J	A	390
41793	SS40069AE	DUP	SS40077AE	REX	PYRENE	410	UG/KG		JA	380
41893	SS40003AE	REAL		TRG	PYRENE	290	UG/KG	J	A	400
41993	SS40009AE	REAL		REX	PYRENE	310	UG/KG	J	A	400
42093	SS40480AE	REAL		TRG	PYRENE	53	UG/KG	J	A	350
42093	SS40013AE	DUP	SS40480AE	TRG	PYRENE	340	UG/KG	U	V	340
42293	SS40078AE	REAL		TRG	PYRENE	380	UG/KG	U	JA	380
42393	SS40079AE	REAL		TRG	PYRENE	660	UG/KG		JA	360
42693	SS40080AE	REAL		TRG	PYRENE	210	UG/KG	J	A	520
42993	SS40056AE	REAL		TRG	PYRENE	170	UG/KG	J	A	370
43193	SS40084AE	REAL		REX	PYRENE	150	UG/KG	J	A	360
43293	SS40006AE	REAL		REX	PYRENE	2900	UG/KG		JA	420
43493	SS40086AE	REAL		TRG	PYRENE	380	UG/KG	U	JA	380
43593	SS40061AE	REAL		TRG	PYRENE	140	UG/KG	J	A	350
43793	SS40088AE	REAL		TRG	PYRENE	140	UG/KG	J	A	380
43893	SS40010AE	REAL		TRG	PYRENE	230	UG/KG	J	A	400
43993	SS40091AE	REAL		TRG	PYRENE	380	UG/KG	U	V	380
44093	SS40090AE	REAL		REX	PYRENE	140	UG/KG	J	A	400
44193	SS40011AE	REAL		TRG	PYRENE	48	UG/KG	J	A	360
44393	SS40005AE	REAL		TRG	PYRENE	190	UG/KG	J	A	380
44793	SS40055AE	REAL		REX	PYRENE	86	UG/KG	J	A	440
44893	SS40070AE	REAL		TRG	PYRENE	440	UG/KG	U	V	440
45693	SS40094AE	REAL		TRG	PYRENE	460	UG/KG	J	A	480
45793	SS40015AE	REAL		TRG	PYRENE	1200	UG/KG		V	500

* Codes are explained in Table III 3 6-1
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TABLE II.3.2-6

SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid.*	Detect Limit
	46193	SS40096AE	REAL	TRG	PYRENE	200	UG/KG	J	A	420
	SS400193	SS40017AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	SS400293	SS40018AE	REAL	TRG	AROCLOR-1254	220	UG/KG	U	V	220
	SS400393	SS40019AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	SS400493	SS40020AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	SS400593	SS40021AE	REAL	TRG	AROCLOR-1254	160	UG/KG	U	V	160
	SS400693	SS40022AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	SS400793	SS40023AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	SS400893	SS40024AE	REAL	TRG	AROCLOR-1254	220	UG/KG	U	V	220
	SS400993	SS40025AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	SS401093	SS40026AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	SS401193	SS40027AE	REAL	TRG	AROCLOR-1254	230	UG/KG	U	V	230
	SS401293	SS40028AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	SS401393	SS40029AE	REAL	TRG	AROCLOR-1254	230	UG/KG	U	V	230
	SS401493	SS40030AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	SS401593	SS40031AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	SS401693	SS40032AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	SS401793	SS40033AE	REAL	DIL	AROCLOR-1254	11900	UG/KG	D	JA	1900
	SS401793	SS40033AE	REAL	TRG	AROCLOR-1254	190	UG/KG	UX		190
	SS401893	SS40034AE	REAL	DIL	AROCLOR-1254	2960	UG/KG	D	JA	900
	SS401893	SS40034AE	REAL	TRG	AROCLOR-1254	180	UG/KG	UX		180
	SS401993	SS40035AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	190
	SS402093	SS40036AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	190
	SS402193	SS40037AE	REAL	TRG	AROCLOR-1254	960	UG/KG		JA	190
	SS402293	SS40038AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	SS402293	SS40016AE	DUP	SS40038AE	TRG	170	UG/KG	U	V	170
	SS402393	SS40039AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	SS402493	SS40040AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	SS402593	SS40041AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	SS402693	SS40199AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	SS402793	SS40043AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	SS402893	SS40044AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	SS402993	SS40045AE	REAL	TRG	AROCLOR-1254	160	UG/KG	U	V	160
	SS403093	SS40046AE	REAL	TRG	AROCLOR-1254	340	UG/KG	U	V	340
	SS403193	SS40047AE	REAL	TRG	AROCLOR-1254	220	UG/KG	U	V	220
	SS403293	SS40048AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	SS403393	SS40049AE	REAL	TRG	AROCLOR-1254	300	UG/KG	U	V	300
	SS403493	SS40050AE	REAL	TRG	AROCLOR-1254	200	UG/KG	U	V	200
	SS403593	SS40051AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	190
	SS403693	SS40052AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	190
	40093	SS40060AE	REAL	TRG	AROCLOR-1254	230	UG/KG	U	V	230
	40193	SS40485AE	REAL	TRG	AROCLOR-1254	220	UG/KG	U	V	220
	40293	SS40042AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	40393	SS40053AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	40593	SS40054AE	REAL	TRG	AROCLOR-1254	220	UG/KG	U	V	220
	40693	SS40057AE	REAL	TRG	AROCLOR-1254	290	UG/KG	U	V	290
	40793	SS40058AE	REAL	TRG	AROCLOR-1254	280	UG/KG	U	V	280
	40893	SS40004AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	160
	40993	SS40412AE	DUP	SS40072AE	TRG	190	UG/KG	U	V	190
	40993	SS40072AE	REAL	SS40412AE	TRG	190	UG/KG	U	V	190
	41193	SS40007AE	REAL	TRG	AROCLOR-1254	240	UG/KG	U	V	240
	41293	SS40071AE	REAL	TRG	AROCLOR-1254	360	UG/KG	U	V	360
	41693	SS40410AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	41793	SS40077AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	190
	41793	SS40069AE	DUP	SS40077AE	TRG	180	UG/KG	U	V	180
	41893	SS40003AE	REAL	DIL	AROCLOR-1254	7630	UG/KG	D	JA	1900
	41993	SS40009AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	190
	42093	SS40480AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	42093	SS40013AE	DUP	SS40480AE	TRG	160	UG/KG	U	V	160
	42293	SS40078AE	REAL	DL1	AROCLOR-1254	1800	UG/KG	U	V	1800
	42393	SS40079AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	42693	SS40080AE	REAL	TRG	AROCLOR-1254	250	UG/KG	U	V	250
	42993	SS40056AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	43193	SS40084AE	REAL	DIL	AROCLOR-1254	597	UG/KG	D	JA	350

* Codes are explained in Table III 3 6-1
60 wq1

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TABLE II.3.2-6

SURFICIAL SOIL
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	QC Code	QC Partner	Result Type	Chemical	Result	Units	Qual *	Valid.*	Detect Limit
	43293	SS40006AE	REAL	TRG	AROCLOR-1254	282	UG/KG		JA	200
	43493	SS40086AE	REAL	DL1	AROCLOR-1254	1800	UG/KG	U	JA	1800
	43593	SS40061AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	43793	SS40088AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	43893	SS40010AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	190
	43993	SS40091AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	44093	SS40090AE	REAL	TRG	AROCLOR-1254	190	UG/KG	U	V	190
	44193	SS40011AE	REAL	TRG	AROCLOR-1254	170	UG/KG	U	V	170
	44393	SS40005AE	REAL	TRG	AROCLOR-1254	180	UG/KG	U	V	180
	44793	SS40055AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	44893	SS40070AE	REAL	TRG	AROCLOR-1254	210	UG/KG	U	V	210
	45693	SS40094AE	REAL	TRG	AROCLOR-1254	230	UG/KG	U	V	230
	45793	SS40015AE	REAL	TRG	AROCLOR-1254	240	UG/KG	U	V	240
	46193	SS40096AE	REAL	TRG	AROCLOR-1254	200	UG/KG	U	V	200

* Codes are explained in Table III 3 6-1
60 wq1

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TABLE II.3.3-1

SAMPLES SELECTED FOR LABORATORY PHYSICAL AND CHEMICAL ANALYSIS
BY D.B. STEPHENS AND ASSOCIATES

Location	Sample Number	Geologic Unit	Depth Interval (feet)
40593	BH40396AE	Alluvium	3 2 - 3 9
40593	BH40397AE	Alluvium	10 0 - 10 7
40593	BH40398AE	Alluvium	15 3 - 16 0
40593	BH40401AE	Alluvium	20 3 - 21 0
40593	BH40402AE	Bedrock	25 3 - 26 0
40393	BH40403AE	Alluvium	3 3 - 4 0
40393	BH40404AE	Bedrock	10 3 - 11 0
44393	BH40405AE	Alluvium	4 3 - 5 0
44393	BH40406AE	Bedrock	12 0 - 12 7
44093	BH40407AE	Alluvium	4 0 - 4 5
44093	BH40408AE	Bedrock	13 1 - 13 8
43193	BH40600AE	Alluvium	4 0 - 4 7
41793	BH40601AE	Alluvium	4 1 - 4 8
41793	BH40602AE	Alluvium	7 0 - 7 7
41293	BH40603AE	Bedrock	4 1 - 4 8
43793	BH40604AE	Bedrock	12 0 - 12 8
40693	BH40605AE	Bedrock	2 1 - 2 8
40793	BH40606AE	Alluvium	4 0 - 4 5
40793	BH40607AE	Alluvium	6 1 - 6 8
40993	BH40608AE	Alluvium	4 0 - 4 7
40993	BH40609AE	Bedrock	10 0 - 10 8
40993	BH40610AE	Bedrock	32 7 - 33 8
42893	BH40611AE	Alluvium	3 0 - 3 7
43693	BH40612AE	Alluvium	1 1 - 1 7

TABLE II.3.3-1 (continued)

SAMPLES SELECTED FOR LABORATORY PHYSICAL AND CHEMICAL ANALYSIS
BY D.B. STEPHENS AND ASSOCIATES

Location	Sample Number	Geologic Unit	Depth Interval (feet)
40593	BH40396AE	Alluvium	3 2 - 3 9
40593	BH40397AE	Alluvium	10 0 - 10 7
40593	BH40398AE	Alluvium	15 3 - 16 0
41593	BH40613AE	Alluvium	0 4 - 1 1
46593	SS40140AE	Alluvium	0 58-0 67
46593	BH40700AE	Alluvium	0 75-2 75
46593	BH40702AE	Alluvium	2 75-4 75
46593	BH40703AE	Alluvium	4 75-6 75
46693	SS40141AE	Alluvium	0 33-0 5
46693	SS40141AE	Alluvium	0 33-0 5
46693	BH40728AE	Bedrock	8 6-14 8
46793	SS40142AE	Alluvium	0 33-0 5
46893	SS40143AE	Alluvium	0 3-0 5
47093	SS40145AE	Alluvium	0 5-0 67
47093	BH40815AE	Alluvium	0 7-4 7
47093	BH40824AE	Alluvium	0 7-4 7
47093	BH40816AE	Alluvium	0 7-6 8
47093	BH40817AE	Alluvium	4.8-8.8

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TABLE II.3.3-2

SUMMARY OF LABORATORY TESTS PERFORMED AND METHODS USED

Laboratory Sample Number	Initial Examination of Core Samples	Initial Moisture Content	Dry Bulk Density	Calculated Porosity	Saturated Bulk Density	Saturated Hydraulic Conductivity	Moisture Characteristics		Particle Size Distribution		Atterberg Limits	Particle Density	Chemical Analysis
							Hanging Column	Pressure Plate	Sieve	Hydrometer			
BH40396AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40397AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40398AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40401AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40402AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40403AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40404AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40405AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40406AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40407AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40408AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40600AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40601AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40602AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40603AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40604AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40605AE	X	X	X	X	X	X	X	X	X	X	X	X	X

TABLE II.3.3-2

SUMMARY OF LABORATORY TESTS PERFORMED AND METHODS USED
(continued)

Laboratory Sample Number	Initial Examination of Core Samples	Initial Moisture Content	Dry Bulk Density	Calculated Porosity	Saturated Bulk Density	Saturated Hydraulic Conductivity	Moisture Characteristics		Particle Size Distribution		Atterberg Limits	Particle Density	Chemical Analysis
							Hanging Column	Pressure Plate	Sieve	Hydrometer			
BH40606AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40607AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40608AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40609AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40610AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40611AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40612AE	X	X	X	X	X	X	X	X	X	X	X	X	X
BH40613AE	X	X	X	X	X	X	X	X	X	X	X	X	X
SS40140AE		X											
BH40700AE		X											
BH40702AE		X											
BH40703AE		X											
SS40141AE		X											
SS40141AE		X											
BH40728AE		X											
SS40142AE		X											

TABLE II.3.3-2

SUMMARY OF LABORATORY TESTS PERFORMED AND METHODS USED
(continued)

Laboratory Sample Number	Initial Examination of Core Samples	Initial Moisture Content	Dry Bulk Density	Calculated Porosity	Saturated Bulk Density	Saturated Hydraulic Conductivity	Moisture Characteristics		Particle Size Distribution		Atterberg Limits	Particle Density	Chemical Analysis
							Hanging Column	Pressure Plate	Sieve	Hydrometer			
SS40143AE		X											
SS40145AE		X											
BH40815AE		X											
BH40824AE		X											
BH40816AE		X											
BH40817AE		X											

TABLE II.3.3-3

RESULTS OF MOISTURE CONTENT ANALYSES

Sample Number	Initial Moisture Content	
	Gravimetric (%, g/g)	Volumetric (%, cm ³ /cm ³)
BH40396AE	9 4	16 6
BH40397AE	16 3	28 3
BH40398AE	18 2	29 0
BH40401AE	20 4	33 9
BH40402AE	24 2	36 7
BH40403AE	13 8	22 6
BH40404AE	25 1	39 3
BH40405AE	2 1	3 7
BH40406AE	15 5	28 5
BH40407AE	24 6	35 6
BH40408AE	20 4	33 5
BH40600AE	3 3	6 5
BH40601AE	14 4	24 4
BH40602AE	10 2	18 2
BH40603AE	20 2	31 4
BH40604AE	21 6	35 5
BH40605AE	21 6	34 8
BH40606AE	13 5	23 2
BH40607AE	14 1	22 7
BH40608AE	6 5	12 6
BH40609AE	11 0	19 4
BH40610AE	18 6	31 2

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TABLE II.3.3-3

**RESULTS OF MOISTURE CONTENT ANALYSES
(continued)**

Sample Number	Initial Moisture Content	
	Gravimetric (%, g/g)	Volumetric (%, cm ³ /cm ³)
BH40611AE	22.6	35.5
BH40612AE	10.0	17.9
BH40613AE	15.1	23.2
SS40140AE	14.98	25.6*
BH40700AE	14.48	24.8*
BH40702AE	6.48	12.5*
BH40703AE	11.29	20.3*
SS40141AE	9.17	17.1*
SS40141AE	9.27	17.2*
BH40728AE	16.01	26.9*
SS40142AE	10.54	19.2*
SS40143AE	10.29	18.8*
SS40145AE	12.27	21.6*
BH40815AE	10.58	19.3*
BH40824AE	10.92	19.8*
BH40816AE	7.18	13.7*
BH40817AE	8.15	15.3*

*Estimated Volumetric Moisture Contents from Analytical Gravimetric Moisture Contents

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TABLE II 3 3-4

RESULTS OF CORRECTIONS TO INITIAL MOISTURE CONTENT
FOR COARSE FRACTION

SAMPLE	LOCATION	DEPTH (FT)	USCS/ ROCK	ω	ρ_b	ρ_s	W	$\theta_1\%$	$\theta_1\%$
BH40396AE	40593	3 2-3 9	SM	9 4	1 76	2 65	7894	16 6	19 30
BH40397AE	40593	10 0-10 7	SC	16 3	1 73	2 65	7317	28 3	34 51
BH40398AE	40593	15 3-16 0	CL	18 2	1 59	2 65	7627	29 0	33 72
BH40401AE	40593	20 3-21 0	CH	20 4	1 66	2 65	9996	33 9	33 90
BH40402AE	40593	25 3-26 0	CLST	24 2	1 52	2 65	9988	36 7	36 70
BH40403AE	40393	3 3-4 0	SC	13 8	1 64	2 65	6718	22 6	28 25
BH40404AE	40393	10 3-11 0	CLST	25 1	1 57	2 65	9995	39 3	39 30
BH40405AE	44393	4 3-5 0	SW	2 1	1 71	2 65	6799	3 7	4 68
BH40406AE	44393	12 0-12 7	SLST	15 5	1 84	2 65	1 0	28 5	28 50
BH40407AE	44093	4 0-4 5	CH	24 6	1 45	2 65	8851	35 6	37 87
BH40408AE	44093	13 1-13 8	CLST	20 4	1 64	2 65	9999	33 5	33 50
BH40600AE	43193	4 0-4 7	GM	3 3	1 94	2 65	5615	6 5	9 56
BH40601AE	41793	4 1-4 8	SC	14 4	1 70	2 65	6363	24 4	31 69
BH40602AE	41793	7 0-7 7	GM	10 2	1 79	2 65	6312	18 2	24 27
BH40603AE	41293	4 1-4 8	CLST	20 2	1 55	2 65	9979	31 4	31 40
BH40604AE	43793	12 0-12 8	CLST	21 6	1 65	2 65	1 0	35 5	35 50
BH40605AE	40693	2 1-2 8	CLST	21 6	1 61	2 65	9921	34 8	34 80
BH40606AE	40793	4 0-4 5	ML	13 5	1 72	2 65	7188	23 2	28 29
BH40607AE	40793	6 1-6 8	GM	14 1	1 61	2 65	6434	22 7	29 10
BH40608AE	40993	4 0-4 7	GM	6 5	1 95	2 65	3472	12 6	24 23
BH40609AE	40993	10 0-10 8	SDST	11 0	1 76	2 65	9993	19 4	19 40

TABLE II 3 3-4 (continued)

RESULTS OF CORRECTIONS TO INITIAL MOISTURE CONTENT FOR COARSE FRACTION

SAMPLE	LOCATION	DEPTH (FT)	USCS/ ROCK	ω	ρ_b	ρ_s	W	θ_i %	θ_c %
BH40610AE	40993	32 7-33 8	SLST	18 6	1 68	2 65	9938	31 2	31 20
BH40611AE	42893	3 0-3 7	GC	22 6	1 57	2 65	5482	35 5	48 63
BH40612AE	43693	1 1-1 7	GC	10 0	1 79	2 65	3611	17 9	31 40
BH40613AE	41593	0 4-1 1	GC	15 1	1 54	2 65	3181	23 2	38 67
SS40140AE	46593	0 58-0 67	GM	14 98	1 71	2 65	44	25 6	40 1
BH40700AE	46593	0 75-2 75	GM	14 48	1 71	2 65	47	24 8	37 6
BH40702AE	46593	2 75-4 75	GM	6 48	1 93	2 65	47	12 5	20 4
BH40703AE	46593	4 75-6 75	GM	11 29	1 8	2 65	45	20 3	32 4
SS40141AE	46693	0 33-0 5	GC	9 17	1 86	2 65	42	17 1	28 8
SS40141AE	46693	0 33-0 5	GC	9 27	1 86	2 65	42	17 2	29 1
BH40728AE	46693	8 6-14 8	CLST	16 01	1 68	2 65	1 00	26 9	26 9
SS40142AE	46793	0 33-0 5	GM	10 54	1 82	2 65	45	19 2	30 8
SS40143AE	46893	0 3-0 5	GC	10 29	1 83	2 65	57	18 8	26 8
SS40145AE	47093	0 5-0 67	SM	12 27	1 76	2 65	61	21 6	29 1
BH40815AE	47093	0 7-4 7	GM	10 58	1 82	2 65	37	19 3	33 9
BH40824AE	47093	0 7-4 7	GM	10 92	1 81	2 65	37	19 8	34 7
BH40816AE	47093	0 7-6 8	GM	7 18	1 91	2 65	33	13 7	26 5
BH40817AE	47093	4 8-8 8	GM	8 15	1 88	2 65	29	15 3	30 9

ρ_b - Dry Bulk Density (g/cm³)
 ρ_s - Particle Density (g/cm³)
W - Fractional Weight of the <2mm (gm/gm)
 θ_i % - Initial Volumetric Content (% , cm³/cm³)
 θ_c % - Corrected Volumetric Content (% , cm³/cm³)
 ω - Mass Wetness

TABLE II.3.3-5

CALCULATED SOIL AND BEDROCK POROSITIES

Sample Number	Location	Depth (Ft)	Saturated Moisture Content (% , cm ³ /cm ³)	Calculated Porosity (%)
BH40396AE	40593	3 2-3 9	32 1	33 5
BH40397AE	40593	10 0-10 7	34 7	34 6
BH40398AE	40593	15 3-16 0	41 5	39 9
BH40401AE	40593	20 3-21 0	42 4	38 1
BH40402AE	40593	25 3-26 0	46 4	43 6
BH40403AE	40393	3 3-4 0	37 0	39 1
BH40404AE	40393	10 3-11 0	51 2	42 6
BH40405AE	44393	4 3-5 0	25 4	35 8
BH40406AE	44393	12 0-12 7	38 2	31 7
BH40407AE	44093	4 0-4 5	43 8	45 6
BH40408AE	44093	13 1-13 8	44 9	39 2
BH40600AE	43193	4 0-4 7	24 4	28 3
BH40601AE	41793	4 1-4 8	35 0	35 3
BH40602AE	41793	7 0-7 7	31 6	33 8
BH40603AE	41293	4 1-4 8	43 2	41 6
BH40604AE	43793	12 0-12 8	48 4	38 1
BH40605AE	40693	2 1-2 8	41 9	40 3
BH40606AE	40793	4 0-4 5	41 1	35 4
BH40607AE	40793	6 1-6 8	35 7	38 8
BH40608AE	40993	4 0-4 7	27 0	26 1
BH40609AE	40993	10 0-10 8	36 3	33 9
BH40610AE	40993	32 7-33 8	40 2	38 3
BH40611AE	42893	3 0-3 7	53 5	39 3
BH40612AE	43693	1 1-1 7	32 1	31 8
BH40613AE	41593	0.4-1.1	40.0	41.5

TABLE II.3.3-6

RESULTS OF SOIL AND BEDROCK DENSITY ANALYSES

Sample Number	Location	Depth (Ft)	Dry Bulk Density (g/cm ³)	Saturated Bulk Density (g/cm ³)	Particle Density (g/cm ³)
BH40396AE	40593	3 2-3 9	1 76	2 08	2 65
BH40397AE	40593	10 0-	1 73	2 08	2 65
BH40398AE	40593	15 3-	1 59	2 01	2 65
BH40401AE	40593	20 3-	1 66	2 08	2 68
BH40402AE	40593	25 3-	1 52	1 98	2 69
BH40403AE	40393	3 3-4 0	1 64	2 01	2 69
BH40404AE	40393	10 3-	1 57	2 08	2 73
BH40405AE	44393	4 3-5 0	1 71	1 97	2 67
BH40406AE	44393	12 0-	1 84	2 22	2 69
BH40407AE	44093	4 0-4 5	1 45	1 89	2 66
BH40408AE	44093	13 1-	1 64	2 09	2 70
BH40600AE	43193	4 0-4 7	1 94	2 19	2 71
BH40601AE	41793	4 1-4 8	1 70	2 05	2 62
BH40602AE	41793	7 0-7 7	1 79	2 10	2 70
BH40603AE	41293	4 1-4 8	1 55	1 98	2 66
BH40604AE	43793	12 0-	1 65	2 13	2 66
BH40605AE	40693	2 1-2 8	1 61	2 03	2 70
BH40606AE	40793	4 0-4 5	1 72	2 13	2 66
BH40607AE	40793	6 1-6 8	1 61	1 97	2 64
BH40608AE	40993	4 0-4 7	1 95	2 22	2 64
BH40609AE	40993	10 0-	1 76	2 12	2 66
BH40610AE	40993	32 7-	1 68	2 08	2 73
BH40611AE	42893	3 0-3 7	1 57	2 11	2 59
BH40612AE	43693	1 1-1 7	1 79	2 11	2 62
BH40613AE	41593	0.4-1.1	1.54	1.94	2.64

TABLE II.3.3-7

PARTICLE SIZE DISTRIBUTION AND USCS CLASSIFICATION

Sample	Total Sample Percent by Weight				USCS Soil or Rock Type	Percent by Weight Without Gravel Fraction		
	Gravel	Sand	Silt	Clay		Sand	Silt	Clay
BH40396AE	16	37	24	23	SM	44	29	27
BH40397AE	19	35	16	30	SC	43	20	37
BH40398AE	20	25	25	30	CL	31	31	38
BH40401AE	0	2	44	54	MH	2	44	54
BH40402AE	0	0	40	60	CLST	0	40	60
BH40403AE	22	40	16	22	SC	51	21	28
BH40404AE	0	0	38	62	CLST	0	38	62
BH40405AE	7	89	4	0	SW	96	4	0
BH40406AE	0	2	56	42	SLST	2	56	42
BH40407AE	6	29	25	40	MH	31	27	43
BH40408AE	0	0	44	56	CLST	0	44	56
BH40600AE	37	25	20	18	GM	40	32	28
BH40601AE	30	32	18	20	SC	46	26	28
BH40602AE	31	31	26	12	GM	45	38	17
BH40603AE	0	1	35	64	CLST	1	35	64
BH40604AE	0	0	44	56	CLST	0	44	56
BH40605AE	0	7	31	62	CLST	7	31	62
BH40606AE	27	13	32	28	ML	18	44	38
BH40607AE	30	21	26	23	GM	30	37	33
BH40608AE	59	23	9	9	GM	56	22	22
BH40609AE	0	55	31	14	SDST	55	31	14
BH40610AE	0	4	50	46	SLST	4	50	46
BH40611AE	41	19	5	35	GC	32	9	59
BH40612AE	57	26	8	9	GC	60	19	21
BH40613AE	59	21	7	13	GC	51	17	32

**TABLE II.3.3-8
PARTICLE SIZE DISTRIBUTION INDICES**

Sample Number	Location	d ₁₀ (mm)	d ₃₀ (mm)	d ₆₀ (mm)	C _u (mm)	C _c (mm)	USCS Classification
BH40396AE	40593	*	0 088	0 20	--	--	SM
BH40397AE	40593	*	0 15	0 55	--	--	SC
BH40398AE	40593	*	0 049	0 18	--	--	CL
BH40401AE	40593	*	0 0017	0 0033	--	--	CH
BH40402AE	40593	*	*	0 0020	--	--	CLST
BH40403AE	40393	*	0 56	1 3	--	--	SC
BH40404AE	40393	*	*	0 0019	--	--	CLST
BH40405AE	44393	0 24	1 1	1 6	6 7	0 85	SW
BH40406AE	44393	*	0 0039	0 0062	--	--	SLST
BH40407AE	44093	*	0 0064	0 057	--	--	CH
BH40408AE	44093	*	0 0014	0 0026	--	--	CLST
BH40600AE	43193	*	0 73	3 5	--	--	GM
BH40601AE	41793	*	0 37	1 2	--	--	SC
BH40602AE	41793	0 0015	0 36	1 4	9 33	0 045	GM
BH40603AE	41293	*	0 0014	0 0017	--	--	CLST
BH40604AE	43793	*	0 0014	0 0025	--	--	CLST
BH40605AE	40693	*	*	0 0018	--	--	CLST
BH40606AE	40793	*	0 035	0 097	--	--	ML
BH40607AE	40793	*	0 088	0 85	--	--	GM
BH40608AE	40993	0 0040	11	17	4250	7 8	GM
BH40609AE	40993	*	0 11	0 14	--	--	SDST
BH40610AE	40993	*	0 0027	0 0047	--	--	SLST
BH40611AE	42993	*	0 72	5 3	--	--	GC
BH40612AE	43693	0 0048	7 4	12	2500	13	GC
BH40613AE	41593	*	9 4	1 7	--	--	GC

NOTES SDST- Sandstone SLST-Siltstone CLST-Claystone

* -Value not reached with specified test -- No value computed $C_u = D_{60}/D_{10}$ $C_c = D_{30}^2/(D_{10} \times D_{60})$

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TABLE II.3.3-9

RESULTS OF ATTERBERG LIMIT ANALYSES

Sample Number	Liquid Limit (%, g/g)	Plastic Limit (%, g/g)	Plasticity Index (%, g/g)
BH40396AE	34	15	19
BH40397AE	49	26	23
BH40398AE	44	18	26
BH40401AE	61	26	35
BH40402AE	54	26	28
BH40403AE	50	17	32
BH40404AE	66	24	42
BH40405AE	NOT TESTED*		
BH40406AE	49	20	29
BH40407AE	79	38	41
BH40408AE	53	20	33
BH40600AE	30	20	10
BH40601AE	47	26	20
BH40602AE	NOT TESTED*		
BH40603AE	49	20	29
BH40604AE	79	24	55
BH40605AE	72	26	46
BH40606AE	43	22	21
BH40607AE	40	21	19
BH40608AE	31	17	13
BH40609AE	23	19	3
BH40610AE	48	23	25
BH40611AE	107	33	74
BH40612AE	NOT TESTED*		
BH40613AE	NOT TESTED*		

* Not enough sample to run the test

TABLE 3.3-10

BAT™ TEST RESULTS

Borehole ID	Test Depth (Feet)	Stratigraphic Unit	USCS Class.* or Lithology	Test Completed (Yes/No)	Measured Hydraulic Conductivity (cm/s)	Comments
40293	6 96	Bedrock	Claystone	Yes	3 1 x 10 ⁻¹⁰	
40393	5 38	RFA	ML	Yes	9 1 x 10 ¹⁰	
40393	12 34	Bedrock	Claystone	No	1x10 ¹⁰	Unable to obtain outflow after multiple attempts
40593	6 56	RFA	GM	No	--	Bent probe tip at 7,000 psi on gravels
40593	12 50	RFA	CL	Yes	1 1 x 10 ⁻⁸	
40593	18 77	RFA	CL	Yes	9 8 x 10 ¹⁰	Organic rich horizon
40593	26 84	Bedrock	Silty Claystone	Yes	3 5 x 10 ⁹	
40693	3 51	Bedrock	Claystone	Yes	1 9 x 10 ⁹	
40793	3 51	RFA	ML	Yes	3 5 x 10 ⁹	
40793	13 52	Bedrock	Silty Claystone	Yes	1 0 x 10 ⁻⁸	
40993	3 94	RFA	GM	No	--	Could not advance probe due to gravels
40993	11 84	Bedrock	Silty Sandstone	Yes	1 1 x 10 ⁷	
41293	5 58	Bedrock	Claystone	Yes	1 4 x 10 ⁹	
41593	0 - 5 9	RFA	GM/ML	No	--	Did not attempt test due to gravels
41793	3 94	RFA	GM	No	--	Could not advance probe due to gravels
42493	0 - 8 1	RFA	GM/GW	No	--	Did not attempt test due to gravels
42893	5 58	RFA	GC	No	--	Bent probe tip and cracked filter, gravels
42893	11 81	Bedrock	Claystone	No	--	Bent probe tip and cracked filter
43193	0 - 10 5	RFA	GW/GM	No	--	Could not advance probe due to gravels
43193	> 10 5	Bedrock	No recovery	No	--	Pore pressure too high, saturated conditions
43693	0 - 10 0	RFA	GM/GW	No	--	Could not advance probe due to gravels
43693	13 25	Bedrock	Claystone	Yes	1 8 x 10 ⁹	
43793	0 - 11 3	RFA	GM/GW	No	--	Could not advance probe due to gravels
43793	16 08	Bedrock	Claystone	No	--	Pore pressure too high, saturated conditions
44093	0 - 11 5	RFA	GM/GW	No	--	Could not advance probe due to gravels
44093	16 99	Bedrock	Claystone	Yes	3 2 x 10 ¹⁰	
44393	3 94	RFA	GM	No	--	Could not advance probe due to gravels
44393	3 51	RFA	GM	No	>3 1 x 10 ⁻⁷	Sand horizon, all water drained out of vial before end of test
44393	13 52	Bedrock	Claystone	Yes	1 7 x 10 ⁹	

USCS Class and Lithology extracted from final borehole logs

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TABLE II.3.3-11

BAT™ TEST RESULTS BY GEOLOGIC STRATUM

ROCKY FLATS ALLUVIUM			
Borehole ID	Test Depth (Feet)	Measured Hydraulic Conductivity (cm/s)	USCS* Classification
40393	5 38	9.1×10^{-10}	ML
40793	3 51	3.5×10^{-8}	ML
40593	12 50	1.1×10^{-8}	CL
40593	18 77	9.8×10^{-10}	CL
44393	3 51	$>3.1 \times 10^{-7}$	GM
BEDROCK			
Borehole ID	Test Depth (Feet)	Measured Hydraulic Conductivity (cm/s)	Lithology
40293	6 96	3.1×10^{10}	Claystone
40393	12 34	$<1.0 \times 10^{10}$	Claystone
40693	3 51	1.9×10^9	Claystone
41293	5 58	1.4×10^9	Claystone
43693	13 25	1.8×10^9	Claystone
44093	16 99	3.2×10^{10}	Claystone
44393	13 52	1.7×10^9	Claystone
40593	26 84	3.5×10^9	Silty Claystone
40793	13 52	1.0×10^9	Silty Claystone
40993	11 84	1.1×10^7	Silty Sandstone

* From final borehole logs

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TABLE II.3.3-12

GUELPH TEST RESULTS

Nearest Borehole or Well Location	Date of Test	USCS Soil Type	Rock Type	Borehole Advancement Method	Depth of Test	Results		Comments
						Hydraulic Conductivity K (cm/sec)	Matrix Flux Potential m(cm ² /sec)	
3186 1	14-Apr-93		SS	Power Auger	19 5 in	2 6 x 10 ⁻⁰⁵	2 1 x 10 ⁻⁰⁴	15 ft South of Well 3186, Single head formula
3186 2	22-Apr-93		SS	Power Auger	12 0 in	2 1 x 10 ⁻⁰⁵	1 8 x 10 ⁻⁰⁴	12 ft South of Well 3186, Single head formula
3186 3	22-Apr-93		SS	Power Auger	12 0 in	3 2 x 10 ⁻⁰⁶	2 7 x 10 ⁻⁰⁵	13 ft South of Well 3186, Single head formula
40393	22-Mar-93	OL	RFA	Hand Auger	17 5 in	<1 0 x 10 ⁻⁶	--	3 ft East of 40393, No infiltration in 1 hour
40593	22-Mar-93	ML	RFA	Hand Auger	14 0 in	9 0 x 10 ⁻⁰⁴	3 1 x 10 ⁻⁰³	2 25 ft North of 40593
40793 1	24-May-93	ML	RFA	Power Auger	29 0 in	4 17 x 10 ⁻⁰⁵	2 9 x 10 ⁻⁰⁴	3 ft North of 40793
40793 2	2-Jun-93	ML	RFA	Power Auger	11 0 in	3 8 x 10 ⁻⁰⁵	1 35 x 10 ⁻⁰³	3 7 ft North-west of 40793
40993	7-May-93	GC	RFA	Power Auger	12 0 in	<1 0 x 10 ⁻⁶	--	3 ft West of 40993
41293	7-Apr-93	GP	RFA	Power Auger	12 0 in	1 9 x 10 ⁻⁰⁵	1 6 x 10 ⁻⁰⁴	3 ft East of 41293
41593 1	8-Apr-93	GC	RFA	Power Auger	7 9 in	3 5 x 10 ⁻⁰⁴	7 9 x 10 ⁻⁰²	
41593 2	8-Apr-93	GC	RFA	Power Auger	7 9 in	5 15 x 10 ⁻⁰⁶	4 29 x 10 ⁻⁰⁵	Single head formula
41793	7-May-93	GP	RFA	Power Auger	12 0 in	1 57 x 10 ⁻⁰⁵	1 31 x 10 ⁻⁰⁴	3 ft West of 41793, Single head formula
42493	7-Apr-93	GM	RFA	Power Auger	5 5 in	4 3 x 10 ⁻⁰³	6 8 x 10 ⁻⁰¹	
42593	8-Apr-93	GM	RFA	Power Auger	8 0 in	--	--	Test failed due to hole caving in
42993	22-Apr-93		RFA	Power Auger	--	--	--	Could not advance power auger in material
43193	21-May-93	GM	RFA	Power Auger	--	--	--	Could not advance power auger in material
43693	29-Mar-93	GM	RFA	Split Spoon	23 0 in	<1 0 x 10 ⁻⁶	--	No infiltration in 1 hour
43793	2-Jun-93		RFA	Power Auger	17 0 in	<1 0 x 10 ⁻⁶	--	No infiltration in 36 minutes
44093	21-May-93	SM	RFA	Power Auger	14 5 in	6 7 x 10 ⁻⁰⁵	5 6 x 10 ⁻⁰⁴	2 ft South of 44093, Single head formula
44393 1	28-May-93	GM	RFA	Power Auger	7 0 in	1 08 x 10 ⁻⁰³	8 9 x 10 ⁻⁰³	3 ft North-east of 44393, single head formula
44393 2	28-May-93	GM	RFA	Power Auger	7 0 in	5 4 x 10 ⁻⁰⁵	4 5 x 10 ⁻⁰⁴	4 ft North-east of 44393, single head formula
44593	22-Apr-93	SM	RFA	Power Auger	10 0 in	4 8 x 10 ⁻⁰⁴	4 03 x 10 ⁻⁰³	5 ft East of 44593, Single head formula
44693	16-Apr-93		CS	Hand Auger	12 5 in	8 4 x 10 ⁻⁰⁶	7 0 x 10 ⁻⁰⁵	13 ft North of 44693, Single head formula
44793	10-May-93	OL	RFA	Hand Auger	19 0 in	1 6 x 10 ⁻⁰³	5 6 x 10 ⁻⁰³	13 ft North of 44793

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TABLE II.3.3-13

GUELPH PERMEAMETER TEST RESULTS
BY GEOLOGIC STRATUM

ROCKY FLATS ALLUVIUM

Nearest Borehole ID	Test Depth (Inches)	Hydraulic Conductivity (cm/s)	Matric Flux Potential (cm ² /s)	USCS Classification
40393	17.5	< 1.0 x 10 ⁻⁶	--	OL
44793	19.0	1.6 x 10 ⁻³	5.6 x 10 ⁻³	OL
40593	14.0	9.0 x 10 ⁻⁴	3.1 x 10 ⁻³	ML
40793 #1	29.0	4.2 x 10 ⁻⁵	2.9 x 10 ⁻⁴	ML
40793 #2	11.0	3.8 x 10 ⁻⁵	1.4 x 10 ⁻³	ML
40993	12.0	< 1.0 x 10 ⁻⁶	--	GC
41593 #1	7.9	3.5 x 10 ⁻⁴	7.9 x 10 ⁻²	GC
41593 #2	7.9	5.15 x 10 ⁻⁴	4.3 x 10 ⁻⁵	GC
41793	12.0	1.6 x 10 ⁻⁵	1.3 x 10 ⁻⁴	GP
42493	5.5	4.3 x 10 ⁻³	6.8 x 10 ⁻¹	GM
43693	23.0	< 1.0 x 10 ⁻⁶	--	GM
43793	17.0	< 1.0 x 10 ⁻⁶	--	GM
44393 #1	7.0	1.1 x 10 ⁻³	8.9 x 10 ⁻³	GM
44393 #2	7.0	5.4 x 10 ⁻⁵	4.5 x 10 ⁻⁴	GM
44593	10.0	4.8 x 10 ⁻⁴	4.0 x 10 ⁻³	SM

SHALLOW BEDROCK

Nearest Borehole ID	Test Depth (Inches)	Hydraulic Conductivity (cm/s)	Matric Flux Potential (cm ² /s)	Lithology
3186 #1	19.5	2.6 x 10 ⁻⁵	2.1 x 10 ⁻⁴	Sandstone
3186 #2	12.0	2.1 x 10 ⁻⁵	1.8 x 10 ⁻⁴	Sandstone
3186 #3	12.0	3.2 x 10 ⁻⁶	2.7 x 10 ⁻⁵	Sandstone
44693	12.5	8.4 x 10 ⁻⁶	7.0 x 10 ⁻⁵	Claystone

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TABLE II.3.3-14

SUMMARY OF NEUTRON PROBE MEASUREMENTS

Location	Estimated Depth To Water (ft bgs)	Water Table Condition	Depth To Bedrock (ft bgs)	Neutron Counts At Bedrock Contact
40293	1 9	Static	NA	NA
40393	6 0	Static	6 0	15,000
40593	22 1	Static	21 0	16,200
40693	1 6	Static	1 0	15,000
40793	7 3	Static	8 5	16,000
40993	≈ 25	Static	9 7	16,500
41293	3 6	Static	3 3	15,000
41593	5 8	Static	5 9	15,000
41793	10 2	Static	12 3	16,500
42493	ND	ND	8 1	14,000
42893	6 7	Static	7 2	17,000
43193	≈ 8	Decreasing	10 5	ND
43693	10 7	Static	10 0	15,500
43793	> 11	Decreasing	11 3	18,500
44093	11 3	Decreasing	11 4	16,000
44393	7 8	Decreasing	7 5	16,000

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TABLE II.3.3-15

SATURATED HYDRAULIC CONDUCTIVITY
ROCKY FLATS ALLUVIUM

Borehole Number	Sample Number	USCS	K _{sat} (cm/sec)	Method of Analysis	
				Constant Head	Falling Head
40593	BH40396AE	SM	2.9 x 10 ⁻⁶		X
40593	BH40397AE	SC	1.5 x 10 ⁻⁷		X
40593	BH40398AE	CL	6.8 x 10 ⁻⁸		X
40593	BH40401AE ¹	CH	3.0 x 10 ⁻⁹		X
40393	BH40403AE	SC	1.1 x 10 ⁻⁶		X
44393	BH40405AE	SW	7.1 x 10 ⁻²	X	
44093	BH40407AE	CH	1.2 x 10 ⁻⁶		X
43193	BH40600AE	GM	2.0 x 10 ⁻³		X
41793	BH40601AE	SC	1.2 x 10 ⁻⁵		X
41793	BH40602AE	GM	5.7 x 10 ⁻⁶		X
40793	BH40606AE	ML	5.0 x 10 ⁻⁶		X
40793	BH40607AE	GM	1.8 x 10 ⁻⁵		X
40993	BH40608AE*	GM	1.4 x 10 ⁻³		X
42893	BH40611AE ¹	GC	1.0 x 10 ⁻⁹		X
43693	BH40612AE	GC	1.4 x 10 ⁻⁶		X
41593	BH40613AE*	GC	1.1 x 10 ⁻⁴		X

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TABLE II.3.3-16

SATURATED HYDRAULIC CONDUCTIVITY
BEDROCK LITHOLOGIES

Borehole Number	Sample Number	Lithology	K_{sat} (cm/sec)	Method of Analysis	
				Constant Head	Falling Head
40593	BH40402AE	Claystone	1.6×10^{-8}		X
40393	BH40404AE ¹	Claystone	5.3×10^{-9}		X
44393	BH40406AE	Siltstone	5.1×10^{-9}		X
44093	BH40408AE	Claystone	1.3×10^{-7}		X
41293	BH40603AE	Claystone	1.0×10^{-7}		X
43793	BH40604AE	Claystone	4.3×10^{-9}		X
40693	BH40605AE ¹	Claystone	3.6×10^{-9}		X
40993	BH40609AE	Sandstone	1.8×10^{-5}		X
40993	BH40610AE	Siltstone	1.0×10^{-7}		X

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TABLE II.3.3-17

SUMMARY OF MOISTURE CHARACTERISTIC DATA

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm ³ /cm ³)
BH40396AE	0	32.1
	21	32.1
	82	30.0
	306	27.6
	1020	25.2
	3467	23.2
	15195	22.6
BH40397AE	0	34.7
	52	34.1
	204	32.4
	510	31.6
	1020	30.6
	5130	28.4
	14991	27.3
BH40398AE	0	41.5
	82	40.7
	316	37.4
	826	35.2
	1632	33.4
	5609	30.8
	14685	29.1
BH40401AE	0	42.4
	82	40.7
	316	37.7
	826	36.7
	1632	36.2
	5609	34.7
	14685	33.1
BH40402AE	0	46.4
	55	45.8
	206	44.8
	510	43.6
	1020	41.8
	5130	38.6
	14991	35.9

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TABLE II.3.3-17

SUMMARY OF MOISTURE CHARACTERISTIC DATA
(continued)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm ³ /cm ³)
BH40403AE	0	37 0
	22	36 8
	83	34 6
	306	32 5
	1020	29 8
	3467	26 9
	15195	24 1
BH40404AE	0	51 2
	82	50 5
	316	47 9
	826	45 1
	1632	43 0
	5609	38 1
	14685	34 6
BH40405AE	0	25 4
	6	24 4
	10	16 2
	51	4 3
	213	2 2
	1020	1 8
	15603	1 6
BH40406AE	0	38 2
	82	37 7
	316	34 8
	826	33 2
	1632	32 1
	5609	30 0
	14685	27 8
BH40407AE	0	43 8
	21	42 6
	85	41 1
	306	38 9
	1020	36 2
	3467	32 3
	15195	27 4

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TABLE II.3.3-17

SUMMARY OF MOISTURE CHARACTERISTIC DATA
(continued)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm ³ /cm ³)
BH40408AE	0	44.9
	52	43.3
	204	41.6
	510	40.2
	1020	38.4
	5130	34.0
	14991	30.8
BH40600AE	0	24.4
	9	14.8
	41	11.1
	121	9.2
	357	7.9
	1030	6.9
	14685	5.3
BH40601AE	0	35.0
	21	32.9
	82	30.8
	306	28.3
	1020	25.9
	3467	22.5
	15195	18.6
BH40602AE	0	31.6
	19	27.4
	79	25.1
	204	23.5
	510	21.9
	1020	20.0
	5130	15.7
14991	14.9	
BH40603AE	0	43.2
	53	42.7
	204	40.7
	510	39.1
	1020	37.1
	5130	32.9
	14991	30.1

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TABLE II.3.3-17

SUMMARY OF MOISTURE CHARACTERISTIC DATA
(continued)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm ³ /cm ³)
BH40604AE	0	48.4
	82	48.1
	316	45.7
	826	44.0
	1632	42.6
	5609	39.0
	14685	35.6
BH40605AE	0	41.9
	82	39.9
	316	37.8
	826	36.0
	1632	34.6
	5609	31.0
	14685	31.0
BH40606AE	0	41.1
	21	39.9
	80	37.7
	306	34.7
	1020	31.4
	3467	28.8
	15195	26.2
BH40607AE	0	35.7
	20	34.2
	82	31.8
	306	28.9
	1020	25.9
	3467	23.3
	15195	20.9
BH40608AE	0	27.0
	13	20.1
	40	17.1
	122	15.1
	357	14.2
	1030	12.9
	14685	10.6

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TABLE II.3.3-17

SUMMARY OF MOISTURE CHARACTERISTIC DATA
(continued)

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm ³ /cm ³)
BH40609AE	0	36.3
	22	34.4
	78	30.2
	306	23.4
	1020	19.9
	3467	18.3
	15195	16.6
BH40610AE	0	40.2
	82	39.3
	316	36.8
	826	34.1
	1632	32.1
	5609	27.8
	14685	25.8
BH40611AE	0	53.5
	82	53.8
	316	49.0
	826	46.1
	1632	44.7
	5609	41.3
	14685	38.8
BH40612AE	0	32.1
	82	30.0
	316	26.1
	826	24.5
	1632	23.6
	5609	22.8
	14685	21.4
BH406013AE	0	40.0
	21	38.0
	53	37.4
	125	36.5
	357	35.1
	1030	33.1
	14685	29.0

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TABLE II 3.3-18

UNSATURATED HYDRAULIC CONDUCTIVITY
ROCKY FLATS ALLUVIUM

Borehole Number	Sample Number	Depth Interval (feet)	Calculated Unsaturated K (cm/day)	Corrected Unsaturated K (cm/day) ¹	Calculated Matric Potential (bars)	Corrected Matric Potential (bars) ¹
40393	BH40403AE	3 3-4 0	8 5X10 ¹⁰	4 0X10 ⁷	38 9	1 6
40593	BH40396AE	3 2-3 9	ND	ND	ND	ND
40593	BH40397AE	10 0-10 7	8 0X10 ⁹	1 0X10 ²	6 2	6 2
40593	BH40398AE	15 3-16 0	8 0X10 ¹⁰	1 25X10 ⁶	17 4	1 1
40593	BH40401AE	20 3-21 0	1 7X10 ¹¹	1 7X10 ¹¹	7 8	7 8
40793	BH40606AE	4 0-4 5	5 8X10 ¹¹	9 0X10 ⁸	123 2	3 1
40793	BH40607AE	6 1-6 8	1 4X10 ⁷	1 0X10 ⁴	4 9	0 25
40993	BH40608AE	4 0-4 7	2 8X10 ⁷	1 0	1 0	0 002
41593	BH40613AE	0 4-1 1	3 2X10 ¹³	1 0X10 ²	1231 8	0 01
41793	BH40601AE	4 1-4 8	2 0X10 ⁶	1 1X10 ³	1 6	0 06
41793	BH40602AE	7 0-7 7	1 7X10 ⁸	8 0X10 ⁶	2 5	0 1
42893	BH40611AE	3 0-3 7	1 9X10 ¹⁵	8 0X10 ⁷	1231 8	0 31
43193	BH40600AE	4 0-4 7	1 6X10 ⁸	2 0X10 ⁵	1 6	0 1
43693	BH40612AE	1 1-1 7	ND	1 6X10 ²	ND	0 03
44093	BH40407AE	4 0-4 5	5 0X10 ⁶	3 0X10 ⁵	1 0	0 3
44393	BH40405AE	4 3-5 0	4 0X10 ¹	9 0X10 ¹	0 1	0 05

ND - Not Determined, Initial Moisture Content Less Than Unsaturated Hydraulic Conductivity Function
1 - Initial Moisture Contents Corrected for the Presence of Coarse (>2mm) Fraction

TABLE II.3.3-19

UNSATURATED HYDRAULIC CONDUCTIVITY
BEDROCK LITHOLOGIES

Borehole Number	Sample Number	Depth Interval (feet)	Calculated Unsaturated K (cm/day)	Calculated Unsaturated K (cm/day)	Calculated Matric Potential (bars) ¹	Corrected Matric Potential (bars) ¹
40393	BH40404AE	10 3-11 0	1 4X10 ⁸	1 4X10 ⁸	3 9	3 9
40593	BH40402AE	25 3-26 0	1 4X10 ⁹	1 4X10 ⁹	9 8	9 8
40693	BH40605AE	2 1-2 8	9 0X10 ⁹	9 0X10 ⁹	1 23	1 23
40993	BH40609AE	10 0-10 8	3 6X10 ⁶	3 6X10 ⁶	1 6	1 6
40993	BH40610AE	32 7-33 8	4 5X10 ⁷	4 5X10 ⁷	2 5	2 5
41293	BH40603AE	4 1-4 8	1 2X10 ⁸	1 2X10 ⁸	8 7	8 7
43793	BH40604AE	12 0-12 8	5 5X10 ¹⁰	5 5X10 ¹⁰	15 5	15 5
44093	BH40408AE	13 1-13 8	1 8X10 ⁸	1 8X10 ⁸	6 2	6 2
44393	BH40406AE	12 0-12 7	2 6X10 ¹⁰	2 6X10 ¹⁰	9 8	9 8

¹ - Initial Moisture Content Corrected for the Presence of the Coarse (> 2 mm) Fraction

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TABLE II.3.3-20

SUMMARY OF 1993 ALLUVIUM WATER LEVEL FLUCTUATIONS

Well Number	Maximum Water Level Elevation (ft msl)	Minimum Water Level Elevation (ft msl)	Average Water Level Elevation (ft msl)	Trend in Water Level Change	Water Level Fluctuation (feet)	Period of Fluctuation (days)	Relative K (cm/sec)
1386	5837 9	5835 3	5836 6	Decreasing	2 6	172	5 33e-06
1586	5844 4	5843 2	5843 8	Decreasing	1 2	157	2 70e-06
1786	5863 6	5862 8	5863 2	Decreasing	0 8	157	1 80e-06
1886	5878 9	5878 3	5878 6	Decreasing	0 6	36	5 88e-06
2086	Abandoned	Well					
2286	5971 9	5970 3	5971 1	Decreasing	1 6	103	5 48e-06
2486	5976 2	5975 4	5975 8	Decreasing	0 8	155	1 82e-06
2686	5966 7	5965 9	5966 3	Decreasing	0 8	96	2 94e-06
2886	Abandoned	Well					
2986	5950 8	5950 8	5950 8	Decreasing	0 0	162	
3787	5962 7	5960 8	5961 8	Increasing	1 9	22	3 05e-05
3887	5965 4	5963 0	5964 2	Decreasing	2 4	101	8 38e-06
05093	5957 0	5955 3	5956 1	Decreasing	1 8	109	5 66e-06
05193	5962 0	5958 3	5960 1	Decreasing	3 8	120	1 10e-05
05293	5973 9	5973 7	5973 8	Decreasing	0 2	nd	
5687	5973 8	5972 2	5973 0	Increasing	1 6	142	3 97e-06
40193	5880 7	5880 7	5880 7	Dry	0 0	177	
41193	5957 6	5954 8	5956 2	Decreasing	2 8	54	1 83e-05
41693	5962 2	5961 8	5962 0	Increasing	0 4	96	1 47e-06
42993	5970 3	5968 4	5969 4	Decreasing	1 9	132	5 08e-06
43893	5968 6	5967 2	5967 9	Decreasing	1 4	163	3 03e-06
43993	5964 2	5962 8	5963 5	Decreasing	1 4	155	3 19e-06
44893	5915 5	5912 3	5913 9	Decreasing	3 2	172	6 56e-06
44993	5914 2	5914 2	5914 2	Dry	0 0	172	
45093	5916 3	5916 3	5916 3	Dry	0 0	172	
45293	5912 3	5912 3	5912 3	Dry	0 0	172	
45393	5907 0	5907 0	5907 0	Dry	0 0	172	
45593	5928 0	5928 0	5928 0	Dry	0 0	172	
45793	5948 5	5946 4	5947 5	Decreasing	2 1	9	8 23e-05
45993	5948 5	5945 7	5947 1	Decreasing	2 8	13	7 60e-05
46093	5925 6	5925 6	5925 6	Dry	0 0	172	
46293	5941 3	5931 9	5936 6	Decreasing	9 4	155	2 14e-05
46393	5881 9	5877 9	5879 9	Increasing	4 0	157	8 99e-06

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TABLE II.3.3-20 (continued)

SUMMARY OF 1993 ALLUVIUM WATER LEVEL FLUCTUATIONS

Well Number	Maxium Water Level Elevation (ft msl)	Minimum Water Level Elevation (ft msl)	Average Water Level Elevation (ft msl)	Trend in Water Level Change	Water Level Fluctuation (feet)	Period of Fluctuation (days)	Relative K (cm/sec)
46493	5887 3	5887 3	5887 3	Dry	0 0	166	
76192	5954 0	5954 0	5954 0	Dry	0 0	172	
B208089	5924 0	5923 3	5923 7	Decreasing	0 7	150	1 65e-06
B208589	5854 8	5852 5	5853 7	Decreasing	2 3	105	7 73e-06
B208789	5904 3	5901 3	5902 8	Decreasing	3 0	150	7 06e-06
B210489	5855 1	5852 0	5853 6	Decreasing	3 1	119	9 19e-06
P207489	ND	ND		ND			
P207689	5961 9	5959 2	5960 6	Decreasing	2 7	157	6 07e-06
P207889	5960 9	5955 1	5958 0	Decreasing	5 8	134	1 53e-05
P209289	5969 0	5969 0	5969 0	Dry	0 0	165	
P209789	5960 4	5954 4	5957 4	Decreasing	6 0	158	1 34e-05
P209989	5889 9	5889 9	5889 9	Dry	0 0	172	
P213989	5947 6	5947 6	5947 6	Dry	0 0	172	
P218389	5948 1	5943 8	5946 0	Decreasing	4 3	162	9 36e-06
P219089	ND	ND		ND			
P219189	5933 7	5933 5	5933 6	Increasing	0 2	28	2 52e-06
P219489	5947 5	5946 9	5947 2	Increasing	0 6	139	1 52e-06

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TABLE II.3.3-21

SUMMARY OF HISTORICAL UPPER HSU FLUCTUATIONS

Location	Screened Stratum	Maximum Historical Water Level (ft msl)	Minimum Historical Water Level (ft msl)	Fluctuation
1386	Alluvium	5839	< 5831 6	> 7 40
1586	Alluvium	5845 7	5843	2 70
1786	Alluvium	5865	5862 5	2 50
1886	Alluvium	5880 5	< 5878 25	> 2 50
2086	Alluvium	5951 5	< 5950	> 1 50
2286	Alluvium	5973 95	5968 2	5 75
2486	Alluvium	5976 25	< 5975	> 1 25
2686	Alluvium	5967 7	5964 75	2 95
2886	Alluvium	5961 2	5955 45	5 75
2986	Alluvium	5953 3	< 5950 81	> 2 49
3787	Alluvium	5963 1	5958 95	4 15
3887	Alluvium	5965 7	< 5962 88	2 82
5687	Alluvium	5973 85	5970 3	3 55
40193	Alluvium	< 5880 7	< 5880 7	DRY
41193	Alluvium	5957 6	5954 8	2 80
41693	Alluvium	5962 2	5961 8	0 40
42993	Alluvium	5970 3	5968 4	1 90
43893	Alluvium	5968 6	5967 2	1 40
43993	Alluvium	5964 2	5962 8	1 40
44893	Alluvium	5913 9	5912 3	1 60
44993	Alluvium	< 5914 2	< 5914 2	DRY
45093	Alluvium	< 5916 3	< 5916 3	DRY
45293	Alluvium	< 5912 3	< 5912 3	DRY
45393	Alluvium	< 5907	< 5907	DRY
45593	Alluvium	< 5928	< 5928	DRY
45793	Alluvium	5948 5	< 5946 4	> 2 10
45993	Alluvium	5948 5	< 5945 7	> 2 80
46093	Alluvium	< 5925 6	< 5925 6	DRY

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TABLE II.3.3-21 (continued)

SUMMARY OF HISTORICAL UPPER HSU FLUCTUATIONS

Location	Screened Stratum	Maximum Historical Water Level (ft msl)	Minimum Historical Water Level (ft msl)	Fluctuation
46293	Alluvium	5941 3	5931 9	9 40
46393	Alluvium	> 5881 9	ND	ND
46493	Alluvium	< 5887 3	< 5887 3	DRY
76192	Alluvium	< 5953 5	< 5953 2	0 30
B208089	Alluvium	5925 5	5922 7	2 80
B208589	Alluvium	5854 95	< 5852 51	> 2 44
B208789	Alluvium	5905 2	< 5896 17	> 9 03
B210489	Alluvium	5855 4	5851 95	3 45
P207489	Alluvium	5976 7	5973 75	2 95
P207689	Alluvium	5961 95	5958 95	3 00
P207889	Alluvium	5960 95	< 5955 12	> 5 83
P209289	Alluvium	5969 75	< 5968 93	> 0 82
P209789	Alluvium	5961 6	5953 55	8 05
P209989	Alluvium	< 5889 92	< 5889 92	DRY
P213989	Alluvium	5947 45	< 5947 38	> 0 07
P218389	Alluvium	5949 6	< 5943 7	5 90
P219089	Alluvium	> 5939 9	ND	ND
P219189	Alluvium	5933 6	5933 3	0 30
P219489	Alluvium	5947 6	5946 9	0 70
05093	Alluvium	5957	5955 7	1 30
05193	Alluvium	5962	5958 25	3 75
05293	Alluvium	5973 95	5973 7	0 25
3086	BEDROCK	5954 45	5950 8	3 65
3186	BEDROCK	< 5949 75	< 5949 75	DRY
41993	BEDROCK	5970 5	< 5964 2	6 30
42393	BEDROCK	5971 7	5967 25	4 45
43293	BEDROCK	5943 3	< 5941 4	1 90
43593	BEDROCK	5973 45	5971	2 45

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TABLE II.3.3-21 (continued)

SUMMARY OF HISTORICAL UPPER HSU FLUCTUATIONS

Location	Screened Stratum	Maximum Historical Water Level (ft msl)	Minimum Historical Water Level (ft msl)	Fluctuation
45693	BEDROCK	5937 25	< 5931 3	> 5 95
45893	BEDROCK	5949 2	5942 5	6 70
46193	BEDROCK	5929 8	5929 5	0 30
76292	BEDROCK	ND	ND	ND
B208289	BEDROCK	5836 3	< 5835 3	> 1 00
B208389	BEDROCK	5869 75	< 5869	> 0 75
B208489	BEDROCK	< 5847	< 5847	DRY
B210389	BEDROCK	5854 9	< 5850 2	> 4 70
P208989	BEDROCK	5952 4	5946 55	5 85
P209189	BEDROCK	5974 5	5967 6	6 90
P209489	BEDROCK	5953 6	< 5943	> 10 60
P209589	BEDROCK	5933 5	< 5929 6	> 3 90
P209889	BEDROCK	5938 4	5936 5	1 90
P210089	BEDROCK	5882 6	< 5876 8	> 5 80
P210189	BEDROCK	5970 9	5967 1	3 80
P219589	BEDROCK	> 5946 25	ND	ND
02691	BEDROCK	5931 05	5927 3	3 75]

Notes ND No data or inconclusive data to make selection
 >, < Water levels or fluctuation greater than or less than reported value
 DRY Water level was below base of screen for entire period

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TABLE II.3.3-22

**ESTIMATED MINIMUM DEPTHS TO ALLUVIUM WATER TABLE
SPRING, 1993**

POND	LOCATION	DEPTH (FT)
207-C	SOUTHWEST CORNER	< 10
207-C	CENTER	10 - 15
207-C	NORTH	15 - 20
207-A	NORTH END	10
207-A	CENTER	≈ 5
207-A	SOUTH END	≈ 5
207-B NORTH	CENTER	< 10
207-B CENTER	CENTER	≈ 5
207-B SOUTH	NORTHERN EDGE	< 5
207-B SOUTH	SOUTHWEST CORNER	0

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TABLE II.3.3-23

CATION EXCHANGE CAPACITY OF SELECTED MINERALS

Mineral	Cation Exchange Capacity	Reference
Kaolinite	3 - 15	1
Illite	10 - 40	1,2
Chlorite	20 - 50	1
Montmorillonite	80 - 120	1,2
Smectites	80 - 150	2
Vermiculite	120 - 200	2
Iron Hydroxides	10 - 25	1
Manganese Oxides	200 - 300	1

¹ Forstner and Wittman (1979)

² Drever (1982)

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TABLE II.3.3-24

RESULTS OF CEC, ELECTRICAL CONDUCTIVITY, AND TOC ANALYSES

Sample Number	CEC (meq Na/100g)	EC (mg KCl/Kg soil)	TOC (ppm)
BH40396AE	4 5	88	210
BH40397AE	27	360	5800
BH40398AE	37	100	1200
BH40401AE	41	2500	2700
BH40402AE	51	2000	590
BH40403AE	27	190	290
BH40404AE	38	3100	750
BH40405AE	2 0	57	120
BH40406AE	37	130	380
BH40407AE	57	250	13000
BH40408AE	42	1000	360
BH40600AE	22	280	3000
BH40601AE	66	390	14000
BH40602AE	6 5	330	1000
BH40603AE	46	1100	700
BH40604AE	44	1900	2100
BH40605AE	51	1800	2000
BH40606AE	40	290	5500
BH40607AE	30	210	3400
BH40608AE	23	1800	5900
BH40609AE	13	1900	330
BH40610AE	27	2200	540
BH40611AE	63	1200	6900
BH40612AE	20	8600	5300
BH40613AE	20	8300	5000

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TABLE II.3.3-25

SOIL GAS SURVEY RESULTS

Sample Location	1,1,1 TCA (ug/L)	Carbon Tetrachloride (ug/L)	TCE (ug/L)	PCE (ug/L)	Oxygen (%)	Carbon Dioxide (%)	Methane (%)
SG-1-1	BRL	BRL	ND	BRL	20.9	0	0.0
SG-2-1	BRL	BRL	ND	BRL	20.9	0	0.0
SG-2-2	BRL	ND	BRL	BRL	20.9	0	0.0
SG-3-1	BRL	ND	BRL	BRL	20.9	0	0.3
SG-4-1	BRL	ND	ND	BRL	20.0	0.3	0.0
SG-5-1	BRL	ND	BRL	BRL	20.9	0.0	0.0
SG-6-1	BRL	ND	BRL	0.25	20.9	0.0	0.0
SG-7-1	BRL	ND	BRL	BRL	20.9	0.0	0.0
SG-8-1	BRL	ND	ND	BRL	20.9	0.0	0.0
SG-9-1	BRL	BRL	ND	BRL	20.9	0.0	0.0
SG-10-1	BRL	BRL	ND	BRL	20.9	0.0	0.0
SG-11-1	BRL	BRL	ND	ND	20.9	0.0	0.0
SG-12-1	BRL	BRL	ND	ND	18.0	0.0	14.0*
SG-12-2	BRL	BRL	BRL	BRL	20.9	0.0	0.0
SG-13-1	BRL	BRL	BRL	BRL	20.9	0.0	0.0
SG-14-1	BRL	BRL	ND	BRL	20.9	0.0	0.0
SG-15-1	BRL	BRL	0.33	BRL	20.9	0.4	0.0
SG-16-1	BRL	ND	ND	ND	20.9	0.0	0.0

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TABLE II.3.3-25

SOIL GAS SURVEY RESULTS
(continued)

Sample Location	1,1,1 TCA (ug/L)	Carbon Tetrachloride (ug/L)	TCE (ug/L)	PCE (ug/L)	Oxygen (%)	Carbon Dioxide (%)	Methane (%)
SG-17-1	BRL	BRL	ND	BRL	20.9	0.0	0.0
SG-18-1	BRL	0.48	BRL	ND	20.9	0.0	0.0
SG-19-1	BRL	ND	ND	BRL	20.9	0.0	0.0
SG-20-1	BRL	ND	BRL	ND	20.9	0.0	0.0
SG-21-1	BRL	BRL	BRL	ND	20.9	0.0	0.0
SG-22-1	BRL	BRL	ND	ND	20.9	0.0	0.0
SG-23-1	BRL	BRL	ND	BRL	20.9	0.0	0.0
SG-24-1	BRL	BRL	BRL	BRL	20.9	0.0	0.0
SG-25-1	BRL	0.45	BRL	BRL	20.9	0.0	0.0
SG-26-1	BRL	2.40	BRL	BRL	20.9	0.0	0.0
SG-26-2	BRL	2.40	BRL	BRL	20.9	0.0	0.0
SG-27-1	BRL	BRL	ND	BRL	20.9	0.0	0.0
SG-28-1	BRL	BRL	BRL	ND	20.9	0.0	0.0
RL	1.0	0.10	0.25	0.30	1.0	0.5	0.5

Notes. Injection volume 1.0 ml, * 0.0 after purging
 ND - Not Detected, RL - Reporting Limit, BRL - Below Reporting Limit

TABLE II.3.3-26

**PRIORITY LIST OF PORE WATER ANALYTES
Presented in Technical Memorandum 1**

Nitrate/Nitrite as N
Specific Conductance
TCL Volatile Organics
pH
TAL Metals
Uranium-233/234,235,236, and 238
Plutonium-239/240
Americium-241
Cesium-137
Strontium-90
Gross Alpha/Beta
Tritium
TCL Semivolatile Organics
Major Inorganic Cations and Anions
Pesticides

TABLE II.3.3-27

PORE WATER RESULTS - FIELD PARAMETERS

Lysimeter Location	Upper/Lower	No of Samples	pH (Std Units)		Specific Conductance (microsiemens)		Temp (°C)		Sample Volume (ml)	
			Average	Range	Average	Range	Average	Range	Average	Range
40293	Upper	2	11.70	10.79-12.60	3.54	2.06-5.01	13.80	6.30-21.30	100	75-125
40393	Upper	12	11.59	10.79-12.92	1.94	1.62-2.58	15.08	6.50-24.20	510	75-720
40593	Lower	2	8.49	7.90-9.07	1.83	1.78-1.88	8.25	7.50-9.00	425	300-550
40793	Upper	18	10.23	9.78-10.86	0.81	0.52-1.18	16.32	7.60-23.80	403	100-750
40993	Upper	13	8.99	6.80-10.32	16.18	8.14-19.9	16.39	9.90-21.90	563	175-750
40993	Lower	16	9.54	6.89-10.89	19.99	19.99-19.99	16.16	12.70-20.3	650	300-750
41293	Upper	21	10.14	8.96-11.02	2.24	1.11-2.68	18.40	8.30-26.20	255	100-400
41593	Upper	17	6.79	6.21-9.00	15.04	1.24-19.9	20.79	8.90-29.60	368	200-600
41793	Upper	16	9.82	7.82-23.20	2.27	1.06-7.61	15.28	2.31-22.60	670	400-790
42493	Upper	1	7.60	N/A	2.04	N/A	10.30	N/A	600	N/A
42493	Lower	16	7.29	7.02-7.84	2.22	1.43-2.64	19.11	10.20-25.70	678	590-750
42893	Upper	18	7.28	7.04-7.80	1.93	0.77-2.47	19.54	9.50-29.20	547	200-775
43193	Upper	16	7.66	7.39-7.89	3.25	2.76-4.55	18.19	7.60-26.30	587	20-750
43193	Lower	14	7.02	6.50-7.31	9.72	8.55-11.21	15.38	7.40-19.90	688	500-800
43693	Upper	16	7.42	6.99-7.78	18.19	4.36-19.9	18.24	10.7-25.40	659	590-750
43793	Upper	18	8.17	7.05-9.72	2.11	1.15-2.90	19.14	7.90-27.10	454	75-775
43793	Lower	16	10.77	8.12-11.38	3.02	2.18-3.84	16.18	8.10-23.60	650	400-775
44093	Upper	17	8.01	6.89-9.55	0.90	0.51-1.29	16.41	7.20-23.50	643	400-700
44093	Lower	3	8.23	8.03-8.52	2.91	2.57-3.20	7.73	6.90-8.30	700	700-700
44393	Upper	15	8.47	7.31-9.80	1.03	0.50-1.35	18.51	8.50-24.80	653	300-770
44393	Lower	17	10.45	9.86-11.53	1.09	0.86-2.50	16.68	8.70-24.80	632	100-800

TABLE II.3.3-28

SEMIVOLATILE ORGANIC COMPOUNDS

<u>Chemical</u>	<u>Method</u>	<u>Procd</u>	<u>DetectsTotal</u>	<u>Units</u>	<u>Max Detect</u>	<u>Max Date</u>	<u>Min Detect</u>	<u>Min Date</u>	<u>Mean</u>	<u>Std Dev</u>	<u>MaxLoc</u>
4-NITROANILINE	BNACLP	100-01-6	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
4-NITROPHENOL	BNACLP	100-02-7	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
BENZYL ALCOHOL	BNACLP	100-51-6	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
4-BROMOPHENYL PHENYL ETHER	BNACLP	101-55-3	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2,4-DIMETHYLPHENOL	BNACLP	105-67-9	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
Sulfur, mol (S8)	BNACLP	10544500	1	1	UG/L	15-JUN-93	16	15-JUN-93	16 0000	0 0000	41593
4-METHYLPHENOL	BNACLP	106-44-5	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
1,4-DICHLOROBENZENE	BNACLP	106-46-7	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
4-CHLOROANILINE	BNACLP	106-47-8	1	17	UG/L	18-JUN-93	4	18-JUN-93	4 0000	0 0000	40993
BIS(2-CHLOROISOPROPYL)ETHER PHENOL	BNACLP	108-60-1	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
BIS(2-CHLOROETHYL)ETHER	BNACLP	108-95-2	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
BIS(2-CHLOROETHOXY)METHANE	BNACLP	111-44-4	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
BIS(2-CHLOROETHOXY)METHANE	BNACLP	111-91-1	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
Ethanol 2-butoxy-	BNACLP	111762	6	6	UG/L	15-JUN-93	75	08-JUN-93	50 0000	51 7494	41593
3-Hexenedinitrile	BNACLP	1119853	1	1	UG/L	15-JUN-93	20	15-JUN-93	20 0000	0 0000	41593
Ethanol 2-(2-butoxyethoxy)-	BNACLP	112345	1	1	UG/L	15-JUN-93	77	15-JUN-93	77 0000	0 0000	41593
Acetic acid, dodecyl ester	BNACLP	112663	1	1	UG/L	15-JUN-93	18	15-JUN-93	18 0000	0 0000	41593
Butane, 1,1-[oxybis(2,1-eth	BNACLP	112732	1	1	UG/L	09-JUN-93	12	09-JUN-93	12 0000	0 0000	43793
BIS(2-ETHYLHEXYL)PHTHALATE	BNACLP	117-81-7	16	17	UG/L	18-JUN-93	170	08-JUN-93	52 8750	220 4308	SW089
DI-n-OCTYL PHTHALATE	BNACLP	117-84-0	9	17	UG/L	18-JUN-93	86	08-JUN-93	17 4444	74 3655	40993
HEXACHLOROBENZENE	BNACLP	118-74-1	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
ANTHRACENE	BNACLP	120-12-7	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
1,2,4-TRICHLOROBENZENE	BNACLP	120-82-1	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2,4-DICHLOROPHENOL	BNACLP	120-83-2	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2,4-DINITROTOLUENE	BNACLP	121-14-2	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
Hexanedioic acid diocetyl es	BNACLP	123795	3	3	UG/L	18-JUN-93	420	18-JUN-93	190 0000	286 0070	SW089
Octadecanoic acid, butyl est	BNACLP	123955	1	1	UG/L	18-JUN-93	38	18-JUN-93	38 0000	0 0000	40793
PYRENE	BNACLP	129-00-0	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
DIMETHYL PHTHALATE	BNACLP	131-11-3	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
Cycloheptatrienylum, iodide	BNACLP	1316809	1	1	UG/L	09-JUN-93	20	09-JUN-93	20 0000	0 0000	43693
DIBENZOFURAN	BNACLP	132-64-9	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
Benzoic acid 3,5-bis(1,1-di	BNACLP	1421494	1	1	UG/L	08-JUN-93	10	08-JUN-93	10 0000	0 0000	40393
1,2-Benzenedicarboxylic acid	BNACLP	146509	3	3	UG/L	18-JUN-93	22	18-JUN-93	16 0000	7 8740	43193
3-Penten-2-ol	BNACLP	1569502	2	2	UG/L	18-JUN-93	13	09-JUN-93	12 0000	1 4142	SW089

TABLE II.3.3-28

SEMIVOLATILE ORGANIC COMPOUNDS

Chemical	Method	Procd	Defects/Total	Units	Max Detect	Max Date	Min Detect	Min Date	Mean	Std Dev	Max Loc
BENZO(g,h)PERYLENE	BNACLP	191-24-2	0	16	ND	01-JAN-00	ND	01-JAN-00	0	0	43193
INDENO(1,2,3-cd)PYRENE	BNACLP	193-39-5	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	43193
BENZO(b)FLUORANTHENE	BNACLP	205-99-2	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	41593
FLUORANTHENE	BNACLP	206-44-0	0	16	ND	01-JAN-00	ND	01-JAN-00	0	0	
BENZO(k)FLUORANTHENE	BNACLP	207-08-9	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
ACENAPHTHYLENE	BNACLP	208-96-8	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
CHRYSENE	BNACLP	218-01-9	0	16	ND	01-JAN-00	ND	01-JAN-00	0	0	
1,2-Benzenedicarboxylic acid	BNACLP	28553120	3	3	UG/L	18-JUN-93	12	01-JAN-00	0	0	
1,2-Benzenedicarboxylic acid	BNACLP	3648213	1	1	UG/L	18-JUN-93	18	18-JUN-93	21	18.4932	
2-FLUORO-4-NITROPHENOL	BNACLP	403190	1	1	UG/L	15-JUN-93	23	15-JUN-93	18	0	
BENZO(a)PYRENE	BNACLP	50-32-8	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
2,4-DINITROPHENOL	BNACLP	51-28-5	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
DIBENZO(a,h)ANTHRACENE	BNACLP	53-70-3	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
4,6-DINITRO-2-METHYLPHENOL	BNACLP	534-52-1	0	16	ND	01-JAN-00	ND	01-JAN-00	0	0	
1,3-DICHLOROBENZENE	BNACLP	541-73-1	0	16	ND	01-JAN-00	ND	01-JAN-00	0	0	
BENZO(a)ANTHRACENE	BNACLP	56-55-3	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
2-Butanone, 3-methyl-	BNACLP	563804	1	1	UG/L	09-JUN-93	32	01-JAN-00	0	0	
4-CHLORO-3-METHYLPHENOL	BNACLP	59-50-7	0	16	ND	01-JAN-00	ND	09-JUN-93	32	0	42493
2,6-DINITROTOLUENE	BNACLP	606-20-2	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
N-NITROSO-DI-n-PROPYLAMINE	BNACLP	621-64-7	0	16	ND	01-JAN-00	ND	01-JAN-00	0	0	
1-Hexadecanol acetate	BNACLP	629709	2	2	UG/L	18-JUN-93	11	18-JUN-93	0	0	
Octadecanoic acid, 2-methylp	BNACLP	646139	2	2	UG/L	15-JUN-93	24	18-JUN-93	14	5000	40793
BENZOIC ACID	BNACLP	65-85-0	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	41593
HEXACHLOROETHANE	BNACLP	67-72-1	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
4-CHLOROPHENYL PHENYL ETHER	BNACLP	7005-72-3	0	16	ND	01-JAN-00	ND	01-JAN-00	0	0	
Benzenesulfonamide 4-methyl	BNACLP	70553	1	1	UG/L	18-JUN-93	11	18-JUN-93	11	0	
2,5-Cyclohexadiene-1,4-dione	BNACLP	719222	3	3	UG/L	15-JUN-93	28	18-JUN-93	11	0	43793
HEXACHLOROCYCLOPENTADIENE	BNACLP	77-47-4	0	16	ND	01-JAN-00	ND	18-JUN-93	17	6667	41593
ISOPHORONE	BNACLP	78-59-1	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
Benzenesulfonamide N-ethyl-	BNACLP	80397	1	1	UG/L	09-JUN-93	16	01-JAN-00	0	0	
ACENAPHTHENE	BNACLP	83-32-9	0	16	ND	01-JAN-00	ND	09-JUN-93	16	0	43693
DIETHYL PHTHALATE	BNACLP	84-66-2	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
DI-n-BUTYL PHTHALATE	BNACLP	84-74-2	0	17	ND	01-JAN-00	ND	01-JAN-00	0	0	
PHENANTHRENE	BNACLP	85-01-8	0	16	ND	01-JAN-00	ND	01-JAN-00	0	0	

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TABLE II.3.3-28

SEMIVOLATILE ORGANIC COMPOUNDS

<u>Chemical</u>	<u>Method</u>	<u>Pcode</u>	<u>Detects/Total</u>	<u>Units</u>	<u>Max Detect</u>	<u>Max Date</u>	<u>Min Detect</u>	<u>Min Date</u>	<u>Mean</u>	<u>Std Dev</u>	<u>Max Loc</u>
BUTYL BENZYL PHTHALATE	BNACLP	85-68-7	1	17	2	18-JUN-93	2	18-JUN-93	2 0000	0 0000	40793
N-NITROSODIPHENYLAMINE	BNACLP	86-30-6	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
FLUORENE	BNACLP	86-73-7	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
HEXACHLOROBUTADIENE	BNACLP	87-68-3	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
PENTACHLOROPHENOL	BNACLP	87-86-5	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2,4 6-TRICHLOROPHENOL	BNACLP	88-06-2	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2-NITROANILINE	BNACLP	88-74-4	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2-NITROPHENOL	BNACLP	88-75-5	2	17	7	18-JUN-93	7	18-JUN-93	7 0000	0 0000	40993
NAPHTHALENE	BNACLP	91-20-3	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2-METHYLNAPHTHALENE	BNACLP	91-57-6	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2-CHLORONAPHTHALENE	BNACLP	91-58-7	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
3 3 -DICHLOROBENZIDINE	BNACLP	91-94-1	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2-METHYLPHENOL	BNACLP	95-48-7	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
1,2-DICHLOROBENZENE	BNACLP	95-50-1	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2-CHLOROPHENOL	BNACLP	95-57-8	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
2 4,5-TRICHLOROPHENOL	BNACLP	95-95-4	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
NITROBENZENE	BNACLP	98-95-3	0	16	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
Benzoic acid, 4-(1 1-dimethy	BNACLP	98737	1	1	14	09-JUN-93	14	09-JUN-93	14 0000	0 0000	43693
3 NITROANILINE	BNACLP	99-09-2	0	17	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	
Unknown	BNACLP	N/A	92	92	1700	18-JUN-93	8	09-JUN-93	94 1087	2064 5069	40993

TABLE II.3.3-29

PESTICIDES

Chemical	Method	Peocde	Detects Total	Units	Max Detect	Max Date	Min Detect	Min Date	Mean	Std Dev	Max Loc
HEPTACHLOR EPOXIDE	PESTCLP	1024-57 3	0	19	ND	01 JAN-00	ND	01 JAN-00	0 0000	0 0000	0 0000
ENDOSULFAN SULFATE	PESTCLP	1031-07 8	0	18	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
AROCLOR 1260	PESTCLP	11096-82-5	0	19	ND	01 JAN-00	ND	01 JAN-00	0 0000	0 0000	0 0000
AROCLOR 1254	PESTCLP	11097-69-1	0	19	ND	01 JAN-00	ND	01 JAN-00	0 0000	0 0000	0 0000
AROCLOR 1221	PESTCLP	11104-28-2	0	19	ND	01 JAN-00	ND	01 JAN-00	0 0000	0 0000	0 0000
AROCLOR 1232	PESTCLP	11141-16-5	0	18	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
AROCLOR-1248	PESTCLP	12672-29-6	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
AROCLOR 1016	PESTCLP	12674-11-2	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
ALDRIN	PESTCLP	309-00-2	0	19	ND	01-JAN-00	ND	01 JAN-00	0 0000	0 0000	0 0000
alpha BHC	PESTCLP	319-84-6	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
beta BHC	PESTCLP	319-85-7	0	18	ND	01 JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
delta BHC	PESTCLP	319-86-8	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
ENDOSULFAN II	PESTCLP	33213-65-9	0	19	ND	01 JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
4 4 DDT	PESTCLP	50-29-3	0	18	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
alpha CHLORDANE	PESTCLP	5103 71-9	0	18	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
gamma CHLORDANE	PESTCLP	5103-74-2	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
AROCLOR 1242	PESTCLP	53469-21 9	0	19	ND	01 JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
ENDRIN KETONE	PESTCLP	53494-70-5	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
gamma BHC (LINDANE)	PESTCLP	58 89-9	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
DIELDRIN	PESTCLP	60-57-1	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
ENDRIN	PESTCLP	72 20-8	0	19	ND	01 JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
METHOXYCHLOR	PESTCLP	72-43-5	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
4 4 DDD	PESTCLP	72 54 8	0	18	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
4 4 DDE	PESTCLP	72 55-9	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
HEPTACHLOR	PESTCLP	76-44-8	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
TOXAPHENE	PESTCLP	8001-35-2	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000
ENDOSULFAN I	PESTCLP	959-98 8	0	19	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	0 0000

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TABLE II.3.3-30

METALS

<u>Chemical</u>	<u>Method</u>	<u>Probe</u>	<u>Detects Total</u>	<u>Units</u>	<u>Max Detect</u>	<u>Max Date</u>	<u>Min Detect</u>	<u>Min Date</u>	<u>Mean</u>	<u>Std Dev</u>	<u>Max Loc</u>
LITHIUM	METADD	7439 93 2	18	27	UG/L	6170	02-SEP-93	24	984 2444	6887 3718	43693
MOLYBDENUM	METADD	7439 98-7	14	26	UG/L	3660	02-SEP-93	26	547 3571	3880 4452	40993
SILICON	METADD	7440-21-3	25	26	UG/L	288000	02-SEP-93	11300	71320 0000	349641 2447	43793
STRONTIUM	METADD	7440-24-6	25	26	UG/L	20100	02-SEP 93	190	2612 6400	21124 6198	40993
TIN	METADD	7440-31-5	0	27	ND	ND	01 JAN-00	ND	0 0000	0 0000	0 0000
CESIUM	METADD	7440-46-2	3	27	UG/L	75	03 SEP-93	39	59 0000	25 9230	42893
ALUMINUM	SMETCLP	7429 90-5	25	67	UG/L	10700	02 SEP 93	25	983 6040	13131 3438	40993
IRON	SMETCLP	7439 89-6	44	69	UG/L	37400	03 MAY-93	28	1798 2841	39303 5138	40993
LEAD	SMETCLP	7439-92-1	33	70	UG/L	1110	03 MAY-93	1	48 2109	1107 5482	40993
MAGNESIUM	SMETCLP	7439-95-4	57	65	UG/L	236000	02-SEP-93	0	20118 7719	389750 6824	43693
MANGANESE	SMETCLP	7439-96-5	51	69	UG/L	13100	10-AUG-93	1	924 9869	17970 2698	41593
MERCURY	SMETCLP	7439-97 6	0	70	ND	ND	01-JAN-00	ND	0 0000	0 0000	0 0000
NICKEL	SMETCLP	7440-02-0	45	66	UG/L	6460	03 MAY 93	0	159 5756	6378 0596	40993
POTASSIUM	SMETCLP	7440-09-7	61	67	UG/L	11400000	02-SEP 93	0	308694 7541	11722304 36	40993
SILVER	SMETCLP	7440 22-4	17	69	UG/L	21	30-JUN 93	4	10 2529	20 9361	42893
SODIUM	SMETCLP	7440-23-5	65	66	UG/L	24000000	02 SEP 93	0	905371 0000	26850099 11	40993
THALLIUM	SMETCLP	7440-28-0	38	67	UG/L	89	27-APR-93	0	2 3447	87 9198	43193
ANTIMONY	SMETCLP	7440-36-0	37	66	UG/L	ND	27-APR-93	0	0 0000	0 0000	40393
ARSENIC	SMETCLP	7440-38 2	60	66	UG/L	120	03-MAY-93	0	8 4283	144 7344	40993
BARIUM	SMETCLP	7440-39 3	58	67	UG/L	1470	03-MAY-93	0	122 2931	2264 0048	43693
BERYLLIUM	SMETCLP	7440-41 7	37	66	UG/L	ND	27-APR-93	0	0 0000	0 0000	40393
CADMIUM	SMETCLP	7440-43 9	10	68	UG/L	54	10-AUG 93	3	14 0100	56 6358	41593
CHROMIUM	SMETCLP	7440-47-3	40	66	UG/L	10200	03 MAY-93	0	255 5575	10071 1406	40993
COBALT	SMETCLP	7440-48-4	39	67	UG/L	2100	02 SEP 93	0	60 2564	2081 0808	40993
COPPER	SMETCLP	7440-50-8	10	68	UG/L	900	03-MAY-93	6	107 4400	838 2150	40993
VANADIUM	SMETCLP	7440-62 2	47	66	UG/L	730	03-MAY-93	0	24 7979	728 8568	40993
ZINC	SMETCLP	7440-66-6	52	69	UG/L	1270	02-SEP-93	6	104 2519	1821 4041	40993
CALCIUM	SMETCLP	7440-70 2	63	66	UG/L	3490000	02 SEP 93	0	110222 9302	3545054 245	40993
SELENIUM	SMETCLP	7782-49 2	49	66	UG/L	19	03 MAY 93	0	1 4000	24 9596	40993

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TABLE II.3.3-31

WATER QUALITY PARAMETERS

<u>Chemical</u>	<u>Method</u>	<u>Pcode</u>	<u>Detects Total</u>	<u>Units</u>	<u>Max Detect</u>	<u>Max Date</u>	<u>Min Detect</u>	<u>Min Date</u>	<u>Mean</u>	<u>Std Dev</u>	<u>Max Loc</u>
NITRATE/NITRITE	WQPL	1-005	75	UG/L	17600000	08-JUL-93	4	03-SEP-93	1064016	24881265	40993
SULFIDE	WQPL	18496-25-8	6	MG/L	43	25-JUN-93	1	18 JUN-93	17 9333	39 1716	44393
CYANIDE	WQPL	57 12 5	2	MG/L	1	25-JUN 93	0	25-JUN-93	0 3340	0 6590	40993

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TABLE II.3.3-32

RADIONUCLIDES

<u>Chemical</u>	<u>Method</u>	<u>Pcode</u>	<u>Detects</u>	<u>Total</u>	<u>Units</u>	<u>Max Detect</u>	<u>Max Date</u>	<u>Min Detect</u>	<u>Min Date</u>	<u>Mean</u>	<u>Std Dev</u>	<u>Max Loc</u>
PLUTONIUM 239/240	TRADS	10-12-8	1	1	PCI/L	0	26-MAY-93	0	26-MAY-93	0 0130	0 0000	SW089
TRITIUM	TRADS	10028 17-8	5	14	PCI/L	5600	18 MAY 93	620	18-MAY 93	2384 0000	3765 2517	43193
URANIUM 233 234	TRADS	11-08-5	14	14	PCI/L	3400	19-MAY-93	1	19-MAY 93	273 8571	3255 4179	40993
STRONTIUM 89 90	TRADS	11 10-9	1	1	PCI/L	1	26-MAY-93	1	26-MAY-93	0 6000	0 0000	SW089
GROSS BETA	TRADS	12587-47 2	15	15	PCI/L	5400	19-MAY-93	4	18-MAY-93	432 8067	5154 7995	40993
TOTAL RADIOCESIUM	TRADS	13-00-0	0	1	ND	ND	01 JAN-00	ND	01-JAN-00	0 0000	0 0000	40993
RADIUM 226	TRADS	13982 63-3	9	9	PCI/L	6	19 MAY-93	0	18-MAY-93	1 8044	5 2773	40993
GROSS ALPHA	TRADS	14127 62-9	10	15	PCI/L	6300	19-MAY-93	4	18-MAY-93	706 2500	5909 9173	40993
AMERICIUM 241	TRADS	14596-10-2	0	1	ND	ND	01-JAN-00	ND	01-JAN-00	0 0000	0 0000	40993
URANIUM 235	TRADS	15117 96-1	12	14	PCI/L	120	19-MAY-93	0	19-MAY 93	11 4763	113 7885	40993
RADIUM 228	TRADS	15262 20-1	2	2	PCI/L	5	18-MAY-93	3	19-MAY 93	4 1500	1 6263	43193
URANIUM-238	TRADS	7440-61-1	15	15	PCI/L	3700	19-MAY-93	0	19-MAY-93	264 5113	3560 4592	40993

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TABLE II.3.3-33

SOILS SELECTED FOR COLUMN LEACHING TESTS

Column ID	Location ID	Sample Number	Depth (feet)	Soil Description
1	SS404193	SS40101AE	0 - 0 75	no log- nearby BH41193 is silty sandy gravel with clay
2	SS404293	SS40102AE	0 - 0 75	no log- nearby BH41193 is silty sandy gravel with clay
3	SS404393	SS40103AE	0 - 0 75	log- nearby BH46293 is organic silt with gravel
4	42193	BH40456AE	4 0	dry, red clayey gravel, some quartzite, some lithic fragments
5	42193	BH40455AE	7 4 - 7 6	clayey sandstone, greenish gray, dry
6	42593	BH40458AE	3 0 - 3 6	tan sandy, clayey gravel, dry, abundant quartzite
7	42593	BH40459AE	6 6 - 7 6	greenish white sandy clayey gravel, dry, abundant quartzite
8	43393	BH40550AE	4 0	greenish white, dry, clayey gravel, some sand
9	43393	BH40551AE	8 0	green-gray claystone, dry, some small hematite nodules
10	Sandpack		NA	Colorado Silica sand - 1640 mesh

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TABLE IL3 3-34

COLUMN LEACHING TEST FLOW RATES AND DURATION

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
Pore Volume 1	Flow Rate (cm/day)	100	13	19	50	100	100	100	14	100
	Duration (days)	15	120	80	30	130	15	15	110	15
Pore Volume 2	Flow Rate (cm/day)	100	06	19	75	100	100	100		100
	Duration (days)	15	250	80	20	1030	15	15	1030	15
Pore Volume 3	Flow Rate (cm/day)	100	12	09	50	100	100	100		100
	Duration (days)	15	130	160	30	15	15	15		15
Pore Volume 4	Flow Rate (cm/day)	100	38	11	50	100	100	100		100
	Duration (days)	15	40	140	30	15	15	15		15
Pore Volume 5	Flow Rate (cm/day)	100	30	19	38	100	100	100		100
	Duration (days)	15	50	80	40	15	15	15		15
Pore Volume 6	Flow Rate (cm/day)	100	21	25	25	100	100	100		100
	Duration (days)	15	70	60	60	15	15	15		15
Pore Volume 7	Flow Rate (cm/day)	100	06	19	21	60	100	100		100
	Duration (days)	15	270	80	70	25	15	15		15
Pore Volume 8	Flow Rate (cm/day)	100	11	25	30	38	100	100		100
	Duration (days)	15	140	60	50	40	15	15		15
Pore Volume 9	Flow Rate (cm/day)	100	80	09	30	21	100	100		100
	Duration (days)	15	80	160	50	70	15	15		15
Pore Volume 10	Flow Rate (cm/day)	100		08	21	15	100	100		100
	Duration (days)	15		200	70	100	15	15		15
Average Flow Rate (cm/day)		100	17	16	39	73	100	100	nm	100
Average Duration (days)		150	1150	1100	450	325	150	150	1140	150

* =Incomplete Pore Volume
nm =Not Meaningful

TABLE IL3 3-35

NITRATE, SPECIFIC CONDUCTANCE, AND pH IN LEACHATE

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
Fore Volume 1	NO3 (mg/l, as N) Sp Conduct (umho/cm) pH (std units)	<0.1 135 2390 9.13	2 1080 8.79	280 1350 8.53	6290 6.24	777 10300 6.93	378 2840 7.74	973 7490 9.32	11600 44400 7.68	<0.1 78 7.59
Fore Volume 2	NO3 (mg/l, as N) Sp Conduct (umho/cm) pH (std units)	<0.1 0.2 1840 8.78	<0.1 925 8.99	3.8 473 8.67	344 4100 7.34	164 1300 7.85	269 3080 8.6	<0.1 24 7.29		
Fore Volume 3	NO3 (mg/l, as N) Sp Conduct (umho/cm) pH (std units)	<0.1 0.1 1360 8.37	<0.1 1210 8.42	<0.1 380 8.67	208 1850 7.44	91 787 7.78	115 1780 8.5	<0.1 20 7.22		
Fore Volume 5	NO3 (mg/l, as N) Sp Conduct (umho/cm) pH (std units)	<0.1 0.1 619 8.41	0.1 840 8.29	<0.1 319 8.61	4 98 7.69	2.9 111 7.95	102 949 8.66	<0.1 10 6.82		
Fore Volume 10	NO3 (mg/l, as N) Sp Conduct (umho/cm) pH (std units)	<0.1 148 7.76	<0.1 348 8.33	<0.1 172 9.1	<0.1 56 7.66	<0.1 84 8.01	<0.1 827 8.97	<0.1 12 7.34		

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TABLE II.3.3-36

CATION/ANION COMPOSITION OF LEACHATE - PORE VOLUME NO.1

Analyte	Units	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10
Sodium	mg/l	2	612	192	240	N/M	744	354	1230	8220	7
	meq/l	0.09	26.62	8.35	10.44	N/M	32.36	15.40	53.51	357.57	0.30
Potassium	mg/l	29	246	24	<5	N/M	<5	<5	437	160	<5
	meq/l	0.74	6.29	0.61	0.00	N/M	0.00	0.00	11.17	4.09	0.00
Calcium	mg/l	109	29	40	33	N/M	1150	147	2	1920	7
	meq/l	5.44	1.44	1.98	1.65	N/M	57.39	7.34	0.09	95.81	0.35
Magnesium	mg/l	12	57	12	5	N/M	148	34	<0.1	952	2
	meq/l	1.02	4.67	0.95	0.40	N/M	12.17	2.81	0.00	78.31	0.13
Bicarbonate	mg/l	431	1550	649	189	N/M	35	57	410	70	35
	meq/l	7.06	25.40	10.64	3.10	N/M	0.57	0.93	6.72	1.15	0.57
Carbonate	mg/l	<1	23	16	2	N/M	<1	<1	22	<1	<1
	meq/l	0.00	0.77	0.53	0.07	N/M	0.00	0.00	0.73	0.00	0.00
Sulfate	mg/l	<10	167	32	68	N/M	<10	54	179	1330	<10
	meq/l	0.00	3.48	0.67	1.42	N/M	0.00	1.12	3.73	27.69	0.00
Chloride	mg/l	4	110	13	23	N/M	120	33	72	1160	7
	meq/l	0.10	3.10	0.36	0.65	N/M	3.39	0.93	2.03	32.72	0.21
Nitrate	mg/l (N)	<0.1	135	2	280	N/M	777	378	973	11600	<0.1
	mg/l (NO3)	0	598	10	1239	N/M	3440	1673	4307	51350	0
	meq/l	0.00	9.64	0.16	19.99	N/M	55.48	26.99	69.48	828.28	0.00
Ion Balance	percent	0.8%	-4.1%	-1.9%	-33.7%	N/M	26.3%	-8.0%	-12.1%	-24.8%	0.2%

Notes N/M - Not Measured

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TABLE II.3.3-37

PORE VOLUMES REQUIRED TO DECREASE NO₃
CONCENTRATIONS IN LEACHATE

Column ID	Initial NO ₃ Concentration in Soil (mg/kg)	Pore Volumes Required	
		≤ 10 mg/L	≤ 0.1 mg/L
2	128	2	3
4	40	2	3
6	592	5	10
7	163	5	10
8	576	10	10

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TABLE II.3.3-38

NITRATE MASS BALANCE RESULTS

Parameters	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
Column Volume	172.4	172.4	172.4	172.4	74.6	74.6	74.6	74.6	172.4	172.4
Soil Mass	215.5	306.9	270.7	356.5	137.5	137.2	149.4	134.7	337.9	282.7
Void Volume	93.9	71.6	81.7	51.5	25.6	24.8	21.9	27.2	64.7	65.0
Initial Soil Parameters										
Specific Gravity	2.49	2.50	2.50	2.59	2.60	2.64	2.62	2.71	2.64	2.63
Bulk Density	1.25	1.78	1.57	2.01	2.08	2.01	2.00	1.97	1.96	1.96
Porosity	54	42	47	30	34	33	29	36	38	38
Moisture	10.6%	21.9%	19.7%	14.1%	8.1%	4.5%	8.7%	5.1%	19.4%	0.4%
Initial Nitrate Concentration in soil	0.2	128	9	40	1370	592	163	576	1420	10
Initial Nitrate Mass in soil	0	34	2	13	180	79	23	75	432	3
Pore Volume 1										
Calc Nitrate Concn in Leachate	<0.1	135	2.2	280	6290	777	378	973	11600	<0.1
Calc Nitrate Mass in Leachate	0.00	9.66	0.18	14.42	161.00	19.24	8.28	26.46	750.92	0.00
Pore Volume 2										
Calc Nitrate Concn in Leachate	<0.1	0.2	<0.1	3.8	344	344	164	269	<0.1	<0.1
Calc Nitrate Mass in Leachate	0.00	0.01	0.00	0.20	8.52	8.52	3.59	7.32	0.00	0.00
Pore Volume 3										
Calc Nitrate Concn in Leachate	<0.1	0.1	<0.1	<0.1	208	208	91	115	<0.1	<0.1
Calc Nitrate Mass in Leachate	0.00	0.01	0.00	0.00	5.15	5.15	1.99	3.13	0.00	0.00
Pore Volume 5										
Calc Nitrate Concn in Leachate	<0.1	0.1	0.1	<0.1	4	4	2.9	102	<0.1	<0.1
Calc Nitrate Mass in Leachate	0.00	0.01	0.01	0.00	2.72	2.72	1.09	5.72	0.00	0.00
Pore Volume 10										
Calc Nitrate Concn in Leachate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Calc Nitrate Mass in Leachate	0.00	0.00	0.02	0.00	0.25	0.25	0.16	6.93	0.00	0.00
Final Soil										
Final Nitrate Concentration in Soil	9.5	5.5	1.8	0.4	0.3	0.6	0.5	0.4	1670	0.6
Final Nitrate Mass in Soil	2.05	1.69	0.49	0.14	0.04	0.08	0.07	0.05	564.29	0.17
Nitrate Recovered	mm	33%	"mm	111%	mm	45%	65%	66%	mm	mm

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TABLE II.3.4-1

**POTENTIAL CONTAMINANTS OF CONCERN
IN OU4 SUBSURFACE SOILS AND BEDROCK**

NON-RADIOLOGICAL INORGANICS	RADIONUCLIDES	SEMI-VOLATILE ORGANICS	VOLATILE ORGANICS
barium	americium-241	bis(2-ethylhexyl)phthalate	acetone
cadmium	cesium-134		methylene chloride
calcium	cesium-137		toluene
cyanide	gross beta		
lithium	plutonium-239/240		
manganese	radium-226		
nitrate/nitrite	strontium-89/90		
potassium	tritium		
sodium	uranium-233/234		
sulfide	uranium-235		
zinc	uranium-238		

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TABLE II.3 4-2

SUMMARY OF SUBSURFACE SOIL AND BEDROCK ANALYTICAL RESULTS

Chemical	units	No of Samples	No of Detects	Percentage of Detects	Minimum Detection	Counting Error	Maximum Detection	Counting Error	95% UCL > 95% UCL	Background Error	No of Background	Detections > 95% UCL	Percentage of Samples > 95% UCL
BARIUM	mg/kg	136	136	100.0	9.7		4150		93.87		51	37.5	
CADMIUM	mg/kg	136	28	20.6	1.1	547			2.30		25	18.4	
CALCIUM	mg/kg	136	136	100.0	706	328,000			7,782		67	49.3	
CYANIDE	mg/kg	94	18	19.2	0.525	43			NA		-	-	
LITHIUM	mg/kg	136	134	98.5	2.6	79.9			83.20		0	0.0	
MANGANESE	mg/kg	136	136	100.0	27.4	3140			190.50		38	27.9	
NITRATE/NITRATE	mg/kg	111	110	99.1	0	6100			7.10		72	64.9	
POTASSIUM	mg/kg	136	136	100.0	180	21100			1,563		70	51.5	
SODIUM	mg/kg	136	70	51.5	139	10,200			2,720		18	13.2	
SULFIDE	mg/kg	93	9	9.7	12.7	18.6			43,000		0	0.0	
ZINC	mg/kg	136	136	100.0	7.2	168			23.64		78	57.4	
AMERICIUM-241	pCi/g	96	78	81.3	0.0017	0.0024	6.1	0.72	0.01		50	52.1	
CESIUM-134	pCi/g	90	49	54.4	-0.0013	0.0101	0.0123	0.0122	NA		-	-	
CESIUM-137	pCi/g	96	91	94.8	-0.0378	0.0177	0.42	0.15	0.166		3	3.1	
GROSS BETA	pCi/g	134	134	100.0	10	3.7	55	5.7	27.99		51	38.1	
PLUTONIUM-239/240	pCi/g	96	78	81.3	-0.0028	0.00328	25	2.9	0.02		37	38.5	
RADIUM-226	pCi/g	94	82	87.2	0.37	0.21	6.838	0.92	0.65		59	62.8	
STRONTIUM-89,90	pCi/g	96	66	68.8	0.0139	0.0276	0.88	0.26	0.54		12	12.5	
TRITIUM	pCi/l	133	115	86.5	63.97	218	62,000	1300	212.2		102	76.7	
URANIUM-233,-234	pCi/g	134	133	99.3	0.242	0.107	21	3.1	0.53		125	93.3	
URANIUM-235	pCi/g	134	122	91.0	-0.0104	0.0208	0.87	0.27	0.1		33	24.6	
URANIUM-238	pCi/g	134	133	99.3	0.39	0.134	11.46	1.81	0.63		123	91.8	
ACETONE	ug/kg	146	38	26.0	8	140			NA		-	-	
BIS(2-ETHYLHEXYL)- PHTHALATE	ug/kg	36	8	22.2	38	5,300			NA		-	-	
METHYLENE CHLORIDE	ug/kg	146	74	50.7	1	71			NA		-	-	
TOLUENE	ug/kg	146	145	99.3	2	1,200			NA		-	-	

Notes 95% UCL calculated from data presented in 1993 Background Geochemical Characterization Report (EG&G, 1993)
NA - Chemical not analyzed in background samples

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TABLE IL3 4-3

**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab Result	Qual	Valid	Detect Limit	Units
	40093	BH40167AE	0	6	REAL		BARIUM	106	V	47	MG/KG
	40093	BH40170AE	6	8	4 REAL		BARIUM	180	V	49	MG/KG
	40193	BH40488AE	0	6	REAL		BARIUM	142	V	47	MG/KG
	40193	BH40490AE	6	12	REAL		BARIUM	177	V	47	MG/KG
	40193	BH40493AE	12	18	REAL		BARIUM	236	V	49	MG/KG
	40193	BH40495AE	18	24	REAL		BARIUM	38 5 B	V	50	MG/KG
	40293	BH40118AE	0	2	9 REAL		BARIUM	134	V	48	MG/KG
	40393	BH40123AE	0	5	REAL		BARIUM	149	V	47	MG/KG
	40593	BH40128AE	0	5	REAL		BARIUM	193	V	46	MG/KG
	40593	BH40131AE	6	11	REAL		BARIUM	109	V	43	MG/KG
	40593	BH40365AE	12	18	REAL		BARIUM	124	V	49	MG/KG
	40593	BH40400AE	18	24	REAL		BARIUM	161	V	49	MG/KG
	40793	BH40413AE	0	5	REAL	BH40157AE	BARIUM	162	V	10	MG/KG
	40793	BH40157AE	0	5	REAL		BARIUM	130	V	10	MG/KG
	40793	BH40160AE	6	8	1 REAL		BARIUM	109	V	10	MG/KG
	40793	BH40414AE	8	13	REAL		BARIUM	93 3	V	10	MG/KG
	40893	BH40030AE	0	7	REAL		BARIUM	102	V	43	9 MG/KG
	40993	BH40201AE	0	6	REAL		BARIUM	114	V	10	MG/KG
	40993	BH40204AE	6	10	REAL		BARIUM	278	V	10	MG/KG
	40993	BH40206AE	10	20	REAL		BARIUM	34 5 B	V	10	MG/KG
	40993	BH40415AE	20	31	REAL		BARIUM	65 1	V	10	MG/KG
	40993	BH40416AE	31	35	REAL		BARIUM	104	V	10	MG/KG
	41193	BH40049AE	0	6	REAL		BARIUM	62	V	46	MG/KG
	41193	BH40052AE	6	8	REAL		BARIUM	74 9	V	42	MG/KG
	41293	BH40196AE	0	3	3 REAL		BARIUM	74 1	V	10	MG/KG
	41593	BH40418AE	2	4	REAL		BARIUM	100	V	10	MG/KG
	41593	BH40417AE	0	2	REAL		BARIUM	130	V	10	MG/KG
	41593	BH40424AE	6	7	9 REAL		BARIUM	45 7 B	V	10	MG/KG
	41593	BH40419AE	4	6	REAL		BARIUM	68 8	V	10	MG/KG
	41693	BH40217AE	0	6	REAL		BARIUM	92 3	V	47	MG/KG
	41693	BH40220AE	6	12	REAL		BARIUM	169	V	47	MG/KG
	41793	BH40243AE	0	5	REAL		BARIUM	75 5	V	44	MG/KG
	41793	BH40246AE	6	11	REAL		BARIUM	58 9	V	45	MG/KG
	41993	BH40062AE	0	6	REAL		BARIUM	68 8	V	44	MG/KG
	41993	BH40065AE	6	12	REAL		BARIUM	36 4 B	V	46	MG/KG
	42093	BH40483AE	0	6	REAL		BARIUM	54 4	V	43	MG/KG
	42093	BH40103AE	0	6	DUP	BH40483AE	BARIUM	71 8	V	47	MG/KG
	42193	BH40425AE	0	2	REAL		BARIUM	63 3	V	10	MG/KG
	42193	BH40426AE	2	4	REAL		BARIUM	65 9	V	10	MG/KG
	42193	BH40427AE	4	6	REAL		BARIUM	44 5 B	V	10	MG/KG
	42193	BH40432AE	6	9	9 REAL		BARIUM	34 1 B	V	10	MG/KG
	42193	BH40086AE	9	16	REAL		BARIUM	74 7 *	JA	10	MG/KG
	42193	BH40091AE	16	22	REAL		BARIUM	80 5 *	JA	10	MG/KG
	42193	BH40430AE	22	28	3 REAL		BARIUM	81 9 *	JA	10	MG/KG
	42193	BH40433AE	28	31	3 REAL		BARIUM	110	V	10	MG/KG
	42293	BH40253AE	0	7	6 1 REAL		BARIUM	110	V	10	MG/KG
	42293	BH40256AE	6	11	3 REAL		BARIUM	190	V	10	MG/KG
	42293	BH40258AE	11	12	9 REAL		BARIUM	52 3	V	10	MG/KG
	42393	BH40261AE	0	6	REAL		BARIUM	52 2	V	43	MG/KG
	42393	BH40264AE	6	8	1 REAL		BARIUM	38 B	V	42	MG/KG
	42493	BH40439AE	2	4	REAL	BH40112AE	BARIUM	117 *	JA	10	MG/KG
	42493	BH40438AE	0	2	REAL		BARIUM	268 *	JA	10	MG/KG
	42493	BH40112AE	2	4	DUP	BH40439AE	BARIUM	63 6 *	JA	10	MG/KG
	42493	BH40441AE	6	8	REAL		BARIUM	40 3 B*	JA	10	MG/KG
	42493	BH40440AE	4	6	REAL		BARIUM	49 4 *	JA	10	MG/KG
	42493	BH40445AE	8	10	2 REAL		BARIUM	53 2 *	JA	10	MG/KG
	42593	BH40446AE	0	2	REAL		BARIUM	73 7	V	10	MG/KG
	42593	BH40447AE	2	4	REAL		BARIUM	46 4	V	10	MG/KG

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TABLE IL3 4-3

**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab Result	Lab Qual	Valid	Detect Limit	Units	
	42593	BH40448AE	4	6	REAL		BARIUM	31	B	V	10	MG/KG
	42593	BH40449AE	6	8	REAL		BARIUM	16	9 B	V	10	MG/KG
	42593	BH40450AE	8	10	2 REAL		BARIUM	81	6	V	10	MG/KG
	42593	BH40290AE	10	2	16 8 REAL		BARIUM	90	2 *	JA	10	MG/KG
	42993	BH40141AE	1	6	REAL		BARIUM	69	8	V	47	MG/KG
	42993	BH40094AE	1	6	DUP	BH40141AE	BARIUM	99	3	V	46	MG/KG
	42993	BH40144AE	7	10	REAL		BARIUM	48	9	V	44	MG/KG
	43193	BH40306AE	0	5	REAL		BARIUM	143		V	47	MG/KG
	43193	BH40309AE	6	11	REAL		BARIUM	24	9 B	V	46	MG/KG
	43293	BH40041AE	0	6	REAL		BARIUM	105		V	47	MG/KG
	43293	BH40044AE	6	10	REAL		BARIUM	94	3	V	42	MG/KG
	43393	BH40510AE	0	2	REAL		BARIUM	87	4	V	10	MG/KG
	43393	BH40511AE	2	4	REAL		BARIUM	23	9 B	V	10	MG/KG
	43393	BH40517AE	6	7	6 REAL		BARIUM	240		V	10	MG/KG
	43393	BH40512AE	4	5	4 REAL		BARIUM	26	3 B	V	10	MG/KG
	43393	BH40324AE	7	6	12 6 REAL		BARIUM	120		V	10	MG/KG
	43493	BH40319AE	0	5	5 3 REAL		BARIUM	130		V	10	MG/KG
	43493	BH40573AE	0	5	3 DUP	BH40319AE	BARIUM	120		V	10	MG/KG
	43493	BH40322AE	5	3	11 3 REAL		BARIUM	140		V	10	MG/KG
	43593	BH40180AE	1	6	REAL		BARIUM	109		V	47	MG/KG
	43693	BH40518AE	0	2	REAL		BARIUM	144	*	JA	10	MG/KG
	43693	BH40519AE	2	4	REAL		BARIUM	88	6 *	JA	10	MG/KG
	43693	BH40521AE	6	8	REAL		BARIUM	30	1 B*	JA	10	MG/KG
	43693	BH40520AE	4	6	REAL		BARIUM	42	7 B*	JA	10	MG/KG
	43693	BH40522AE	8	10	REAL		BARIUM	23	B*	JA	10	MG/KG
	43693	BH40525AE	10	13	REAL	BH40563AE	BARIUM	4150	*	JA	10	MG/KG
	43693	BH40563AE	10	13	DUP	BH40525AE	BARIUM	285	*	JA	10	MG/KG
	43793	BH40332AE	0	6	REAL		BARIUM	87	7	V	10	MG/KG
	43793	BH40335AE	6	11	5 REAL		BARIUM	60	2	V	10	MG/KG
	43893	BH40070AE	0	6	REAL		BARIUM	129		V	48	MG/KG
	43893	BH40073AE	6	12	REAL		BARIUM	38	7 B	V	43	MG/KG
	43993	BH40353AE	0	6	REAL		BARIUM	89	3	V	47	MG/KG
	44093	BH40348AE	0	6	REAL		BARIUM	226		V	48	MG/KG
	44093	BH40351AE	6	10	4 REAL		BARIUM	69	6	V	43	MG/KG
	44193	BH40078AE	0	6	REAL		BARIUM	83		V	48	3 MG/KG
	44193	BH40081AE	6	12	REAL		BARIUM	55	1	V	42	8 MG/KG
	44193	BH40429AE	23	4	29 4 REAL		BARIUM	83	7	V	10	MG/KG
	44193	BH40568AE	29	4	35 4 REAL		BARIUM	85	7	V	10	MG/KG
	44193	BH40569AE	35	4	41 6 REAL		BARIUM	77	2	V	10	MG/KG
	44193	BH40570AE	41	6	47 6 REAL		BARIUM	66	6	V	10	MG/KG
	44193	BH40089AE	47	6	50 2 REAL		BARIUM	81	7	V	10	MG/KG
	44393	BH40033AE	0	5	REAL		BARIUM	90	1	V	43	MG/KG
	44593	BH40001AE	0	6	2 REAL		BARIUM	62		V	45	4 MG/KG
	44593	BH40005AE	6	2	11 4 REAL		BARIUM	49	8	V	45	5 MG/KG
	44793	BH40133AE	0	2	5 REAL		BARIUM	135		V	46	MG/KG
	44893	BH40188AE	0	5	REAL		BARIUM	147		V	46	MG/KG
	44893	BH40191AE	6	2	12 2 REAL		BARIUM	59	2	V	47	MG/KG
	45693	BH40374AE	0	6	REAL		BARIUM	98	4	V	10	MG/KG
	45793	BH40557AE	0	4	REAL		BARIUM	52		V	10	MG/KG
	45893	BH40377AE	0	6	REAL		BARIUM	77	1	V	10	MG/KG
	45893	BH40380AE	6	8	7 REAL		BARIUM	51	5	V	10	MG/KG
	45893	BH40382AE	8	7	22 REAL		BARIUM	77	3	V	10	MG/KG
	46193	BH40385AE	0	6	REAL	BH40562AE	BARIUM	364	*	JA	10	MG/KG
	46193	BH40562AE	0	6	DUP	BH40385AE	BARIUM	121	*	JA	10	MG/KG
	46593	BH40700AE	0	7	5 REAL		BARIUM	67	3	V	40	MG/KG
	46593	BH40702AE	2	7	5 REAL		BARIUM	31	9 B	V	40	MG/KG
	46593	BH40705AE	6	7	5 REAL		BARIUM	27	2 B	V	40	MG/KG
	46593	BH40703AE	4	7	5 REAL		BARIUM	32	4 B	V	40	MG/KG

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SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab			Detect	
							Result	Qual	Valid	Limit	Units
46593	BH40711AE	8 75	10 7	REAL		BARIUM	53 1		V	40	MG/KG
46593	BH40713AE	10 7	16 4	REAL		BARIUM	157		V	40	MG/KG
46693	BH40715AE	0 5	2 25	REAL		BARIUM	140		V	40	MG/KG
46693	BH40717AE	2 25	4 25	REAL		BARIUM	41 2 B		V	40	MG/KG
46693	BH40718AE	4 6	6 6	REAL		BARIUM	37 4 B		V	40	MG/KG
46693	BH40726AE	6 6	7 6	REAL		BARIUM	60 3		V	40	MG/KG
46693	BH40728AE	8 6	14 8	REAL		BARIUM	62 9		V	40	MG/KG
46793	BH40729AE	0 5	2 5	REAL		BARIUM	80 1 *		Y	40	MG/KG
46793	BH40731AE	2 5	4 5	REAL		BARIUM	112 *		Y	40	MG/KG
46793	BH40732AE	4 5	6 5	REAL		BARIUM	201 *		Y	40	MG/KG
46793	BH40740AE	6 5	8 5	REAL		BARIUM	25 5 B*		Y	40	MG/KG
46793	BH40742AE	8 5	14 7	REAL		BARIUM	164 *		Y	40	MG/KG
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	BARIUM	311 *		Y	40	MG/KG
46893	BH40743AE	0 5	2 5	REAL		BARIUM	120		Y	40	MG/KG
46893	BH40745AE	2 5	4 6	REAL		BARIUM	93 6		Y	40	MG/KG
46893	BH40746AE	4 6	6 6	REAL		BARIUM	114 B		Y	40	MG/KG
46893	BH40748AE	6 6	8 6	REAL		BARIUM	79 1		Y	40	MG/KG
46893	BH40749AE	8 6	10 6	REAL		BARIUM	69 4		Y	40	MG/KG
46893	BH40754AE	11 5	12 5	REAL		BARIUM	67		Y	40	MG/KG
46993	BH40757AE	1 3	3 1	REAL		BARIUM	116		Y	40	MG/KG
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	BARIUM	256		Y	40	MG/KG
46993	BH40759AE	3 3	5	REAL		BARIUM	29 2 B		Y	40	MG/KG
46993	BH40768AE	5 5	7	REAL		BARIUM	9 7 B		Y	40	MG/KG
46993	BH40770AE	7 2	13 1	REAL		BARIUM	27 B		Y	40	MG/KG
47093	BH40771AE	0 7	2 7	REAL		BARIUM	103		Y	200	MG/KG
47093	BH40773AE	2 7	4 7	REAL		BARIUM	76 6		Y	200	MG/KG
47093	BH40774AE	4 8	6 8	REAL		BARIUM	41 8 B		Y	200	MG/KG
47093	BH40776AE	6 8	8 8	REAL		BARIUM	36 3 B		Y	200	MG/KG
40093	BH40167AE	0	6	REAL		CADMIUM	1 4 N	JA		1	MG/KG
40093	BH40170AE	6	8 4	REAL		CADMIUM	1 6 N	JA		1	MG/KG
40193	BH40488AE	0	6	REAL		CADMIUM	1 2 UN	V		1	MG/KG
40193	BH40490AE	6	12	REAL		CADMIUM	1 2 UN	V		1	MG/KG
40193	BH40493AE	12	18	REAL		CADMIUM	1 2 UN	V		1	MG/KG
40193	BH40495AE	18	24	REAL		CADMIUM	1 2 UN	V		1	MG/KG
40293	BH40118AE	0	2 9	REAL		CADMIUM	1 2 U	V		1	MG/KG
40393	BH40123AE	0	5	REAL		CADMIUM	1 2 U	V		1	MG/KG
40593	BH40128AE	0	5	REAL		CADMIUM	1 1 U	V		1	MG/KG
40593	BH40131AE	6	11	REAL		CADMIUM	1 1 U	V		1	MG/KG
40593	BH40365AE	12	18	REAL		CADMIUM	1 2 U	V		1	MG/KG
40593	BH40400AE	18	24	REAL		CADMIUM	1 2 U	V		1	MG/KG
40793	BH40157AE	0	5	REAL		CADMIUM	1 2 U	V		5	MG/KG
40793	BH40413AE	0	5	REAL	BH40157AE	CADMIUM	1 2 U	V		5	MG/KG
40793	BH40160AE	6	8 1	REAL		CADMIUM	1 2 U	JA		5	MG/KG
40793	BH40414AE	8 1	13	REAL		CADMIUM	1 2 U	JA		5	MG/KG
40893	BH40030AE	0	7	REAL		CADMIUM	1 1 U	JA		1 1	MG/KG
40993	BH40201AE	0	6	REAL		CADMIUM	1 1 U	V		5	MG/KG
40993	BH40204AE	6	10	REAL		CADMIUM	1 1 U	V		5	MG/KG
40993	BH40206AE	10	20	REAL		CADMIUM	1 1 U	V		5	MG/KG
40993	BH40415AE	20	31	REAL		CADMIUM	1 1 U	JA		5	MG/KG
40993	BH40416AE	31	35	REAL		CADMIUM	1 2 U	JA		5	MG/KG
41193	BH40049AE	0	6	REAL		CADMIUM	1 2 U	V		1	MG/KG
41193	BH40052AE	6	8	REAL		CADMIUM	15 5	V		1	MG/KG
41293	BH40196AE	0	3 3	REAL		CADMIUM	1 1 U	V		5	MG/KG
41593	BH40417AE	0	2	REAL		CADMIUM	22 1	V		5	MG/KG
41593	BH40418AE	2	4	REAL		CADMIUM	1 3 U	V		5	MG/KG
41593	BH40419AE	4	6	REAL		CADMIUM	1 1 U	V		5	MG/KG
41593	BH40424AE	6	7 9	REAL		CADMIUM	1 2 U	V		5	MG/KG

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**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab		Detect Limit	Units
							Result	Qual		
41693	BH40217AE	0	6	REAL		CADMIUM	27 6	N	JA	1 MG/KG
41693	BH40220AE	6	12	REAL		CADMIUM	61 4	N	JA	1 MG/KG
41793	BH40243AE	0	5	REAL		CADMIUM	3 2	N	JA	1 MG/KG
41793	BH40246AE	6	11	REAL		CADMIUM	1 1	UN	JA	1 MG/KG
41993	BH40062AE	0	6	REAL		CADMIUM	1 1	UN	V	1 MG/KG
41993	BH40065AE	6	12	REAL		CADMIUM	1 2	UN	V	1 MG/KG
42093	BH40483AE	0	6	REAL		CADMIUM	1 1	UN	V	1 MG/KG
42093	BH40103AE	0	6	DUP	BH40483AE	CADMIUM	1 2	UN	V	1 MG/KG
42193	BH40426AE	2	4	REAL		CADMIUM	1 1	U	V	5 MG/KG
42193	BH40425AE	0	2	REAL		CADMIUM	5		V	5 MG/KG
42193	BH40427AE	4	6	REAL		CADMIUM	1 1	U	V	5 MG/KG
42193	BH40432AE	6	9 9	REAL		CADMIUM	1 1	U	V	5 MG/KG
42193	BH40086AE	9 9	16	REAL		CADMIUM	1 2	U	V	5 MG/KG
42193	BH40091AE	16	22	REAL		CADMIUM	1 3	U	V	5 MG/KG
42193	BH40430AE	22	28 3	REAL		CADMIUM	1 2	U	V	5 MG/KG
42193	BH40433AE	28 3	31 3	REAL		CADMIUM	1 2	U	V	5 MG/KG
42293	BH40253AE	0 7	6 1	REAL		CADMIUM	2 1		V	5 MG/KG
42293	BH40256AE	6 1	11 3	REAL		CADMIUM	1 2	U	V	5 MG/KG
42293	BH40258AE	11 3	12 9	REAL		CADMIUM	1 1	U	V	5 MG/KG
42393	BH40261AE	0	6	REAL		CADMIUM	1 1	U	V	1 MG/KG
42393	BH40264AE	6	8 1	REAL		CADMIUM	1 1	U	V	1 MG/KG
42493	BH40438AE	0	2	REAL		CADMIUM	362		V	5 MG/KG
42493	BH40439AE	2	4	REAL	BH40112AE	CADMIUM	547		V	5 MG/KG
42493	BH40112AE	2	4	DUP	BH40439AE	CADMIUM	340		V	5 MG/KG
42493	BH40440AE	4	6	REAL		CADMIUM	37 5		V	5 MG/KG
42493	BH40441AE	6	8	REAL		CADMIUM	1 1	U	V	5 MG/KG
42493	BH40445AE	8	10 2	REAL		CADMIUM	1 2	U	V	5 MG/KG
42593	BH40447AE	2	4	REAL		CADMIUM	1 1	U	V	5 MG/KG
42593	BH40446AE	0	2	REAL		CADMIUM	4 7		JA	5 MG/KG
42593	BH40448AE	4	6	REAL		CADMIUM	1 1	U	V	5 MG/KG
42593	BH40449AE	6	8	REAL		CADMIUM	1 1	U	V	5 MG/KG
42593	BH40450AE	8	10 2	REAL		CADMIUM	1 2	U	V	5 MG/KG
42593	BH40290AE	10 2	16 8	REAL		CADMIUM	1 2	U	V	5 MG/KG
42993	BH40141AE	1	6	REAL		CADMIUM	1 2	U	V	1 MG/KG
42993	BH40094AE	1	6	DUP	BH40141AE	CADMIUM	1 2	U	V	1 MG/KG
42993	BH40144AE	7	10	REAL		CADMIUM	1 1	U	V	1 MG/KG
43193	BH40306AE	0	5	REAL		CADMIUM	1 2	UN	JA	1 MG/KG
43193	BH40309AE	6	11	REAL		CADMIUM	2 5	N	JA	1 MG/KG
43293	BH40041AE	0	6	REAL		CADMIUM	1 2	U	V	1 MG/KG
43293	BH40044AE	6	10	REAL		CADMIUM	1 1	U	V	1 MG/KG
43393	BH40511AE	2	4	REAL		CADMIUM	1 1	U	V	5 MG/KG
43393	BH40510AE	0	2	REAL		CADMIUM	3 6		V	5 MG/KG
43393	BH40517AE	6	7 6	REAL		CADMIUM	1 2	U	V	5 MG/KG
43393	BH40512AE	4	5 4	REAL		CADMIUM	1 1	U	V	5 MG/KG
43393	BH40324AE	7 6	12 6	REAL		CADMIUM	1 2	U	V	5 MG/KG
43493	BH40319AE	0 5	5 3	REAL		CADMIUM	1 5		V	5 MG/KG
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	CADMIUM	1 1	U	V	5 MG/KG
43493	BH40322AE	5 3	11 3	REAL		CADMIUM	1 1	U	V	5 MG/KG
43593	BH40180AE	1	6	REAL		CADMIUM	1 2	U	V	1 MG/KG
43693	BH40518AE	0	2	REAL		CADMIUM	48 4		V	5 MG/KG
43693	BH40519AE	2	4	REAL		CADMIUM	1 3		JA	5 MG/KG
43693	BH40521AE	6	8	REAL		CADMIUM	1	U	V	5 MG/KG
43693	BH40520AE	4	6	REAL		CADMIUM	1 1	U	V	5 MG/KG
43693	BH40522AE	8	10	REAL		CADMIUM	1	U	V	5 MG/KG
43693	BH40525AE	10	13	REAL	BH40563AE	CADMIUM	1 3		JA	5 MG/KG
43693	BH40563AE	10	13	DUP	BH40525AE	CADMIUM	1 6		JA	5 MG/KG
43793	BH40332AE	0	6	REAL		CADMIUM	21 7		V	5 MG/KG
43793	BH40335AE	6	11 5	REAL		CADMIUM	37 6		V	5 MG/KG

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**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab			Detect Limit Units	
							Result	Qual	Valid		
43893	BH40070AE	0	6	REAL		CADMIUM	12	U	V	1 MG/KG	
43893	BH40073AE	6	12	REAL		CADMIUM	11	U	V	1 MG/KG	
43993	BH40353AE	0	6	REAL		CADMIUM	12	UN	JA	1 MG/KG	
44093	BH40348AE	0	6	REAL		CADMIUM	12	U	V	1 MG/KG	
44093	BH40351AE	6	10	4 REAL		CADMIUM	11	UN	JA	1 MG/KG	
44193	BH40078AE	0	6	REAL		CADMIUM	12	U	JA	12 MG/KG	
44193	BH40081AE	6	12	REAL		CADMIUM	11	U	JA	11 MG/KG	
44193	BH40429AE	23	29	4 REAL		CADMIUM	13	U	V	5 MG/KG	
44193	BH40568AE	29	35	4 REAL		CADMIUM	13	U	V	5 MG/KG	
44193	BH40569AE	35	41	6 REAL		CADMIUM	12	U	V	5 MG/KG	
44193	BH40570AE	41	47	6 REAL		CADMIUM	12	U	V	5 MG/KG	
44193	BH40089AE	47	50	2 REAL		CADMIUM	11	U	V	5 MG/KG	
44393	BH40033AE	0	5	REAL		CADMIUM	11	U	V	1 MG/KG	
44593	BH40001AE	0	6	2 REAL		CADMIUM	11	U	JA	11 MG/KG	
44593	BH40005AE	6	11	4 REAL		CADMIUM	11	U	JA	11 MG/KG	
44793	BH40133AE	0	2	5 REAL		CADMIUM	12	UN	V	1 MG/KG	
44893	BH40188AE	0	5	REAL		CADMIUM	12	UN	V	1 MG/KG	
44893	BH40191AE	6	12	2 REAL		CADMIUM	12	UN	V	1 MG/KG	
45693	BH40374AE	0	6	REAL		CADMIUM	13	U	V	5 MG/KG	
45793	BH40557AE	0	4	REAL		CADMIUM	11	U	V	5 MG/KG	
45893	BH40377AE	0	6	REAL		CADMIUM	11	U	V	5 MG/KG	
45893	BH40380AE	6	8	7 REAL		CADMIUM	12	U	V	5 MG/KG	
45893	BH40382AE	8	7	22 REAL		CADMIUM	12	U	V	5 MG/KG	
46193	BH40385AE	0	6	REAL	BH40562AE	CADMIUM	12	U	V	5 MG/KG	
46193	BH40562AE	0	6	DUP	BH40385AE	CADMIUM	12	U	V	5 MG/KG	
46593	BH40700AE	0	7	5 REAL		CADMIUM	63	7	V	1 MG/KG	
46593	BH40702AE	2	7	5 REAL		CADMIUM	0	61	U	V	1 MG/KG
46593	BH40705AE	6	7	5 REAL		CADMIUM	0	66	U	V	1 MG/KG
46593	BH40703AE	4	7	5 REAL		CADMIUM	0	67	U	V	1 MG/KG
46593	BH40711AE	8	7	5 REAL		CADMIUM	0	68	U	V	1 MG/KG
46593	BH40713AE	10	7	16 REAL		CADMIUM	0	73	U	V	1 MG/KG
46693	BH40715AE	0	5	2 25 REAL		CADMIUM	135		V	1 MG/KG	
46693	BH40717AE	2	2	5 REAL		CADMIUM	59		JA	1 MG/KG	
46693	BH40718AE	4	6	6 REAL		CADMIUM	3	6	U	JA	1 MG/KG
46693	BH40726AE	6	6	7 REAL		CADMIUM	0	73	U	V	1 MG/KG
46693	BH40728AE	8	6	14 REAL		CADMIUM	0	73	U	V	1 MG/KG
46793	BH40729AE	0	5	2 REAL		CADMIUM	35	6		Y	1 MG/KG
46793	BH40731AE	2	5	4 REAL		CADMIUM	0	71	U	Y	1 MG/KG
46793	BH40732AE	4	5	6 REAL		CADMIUM	1	1	B	Y	1 MG/KG
46793	BH40740AE	6	5	8 REAL		CADMIUM	0	73	U	Y	1 MG/KG
46793	BH40742AE	8	5	14 REAL		CADMIUM	0	68	U	Y	1 MG/KG
46793	BH40823AE	8	5	14 DUP	BH40742AE	CADMIUM	0	71	U	Y	1 MG/KG
46893	BH40743AE	0	5	2 REAL		CADMIUM	0	71	U	Y	1 MG/KG
46893	BH40745AE	2	5	4 REAL		CADMIUM	0	68	U	Y	1 MG/KG
46893	BH40746AE	4	6	6 REAL		CADMIUM	3	3	U	Y	1 MG/KG
46893	BH40748AE	6	6	8 REAL		CADMIUM	11	4		Y	1 MG/KG
46893	BH40749AE	8	6	10 REAL		CADMIUM	7		Y	1 MG/KG	
46893	BH40754AE	11	5	12 REAL		CADMIUM	4	8		Y	1 MG/KG
46993	BH40757AE	1	3	3 REAL		CADMIUM	0	64	U	Y	1 MG/KG
46993	BH40830AE	1	3	3 DUP	BH40757AE	CADMIUM	0	64	U	Y	1 MG/KG
46993	BH40759AE	3	3	5 REAL		CADMIUM	1	4		Y	1 MG/KG
46993	BH40768AE	5	5	7 REAL		CADMIUM	0	71	U	Y	1 MG/KG
46993	BH40770AE	7	2	13 REAL		CADMIUM	0	69	U	Y	1 MG/KG
47093	BH40771AE	0	7	2 REAL		CADMIUM	0	7	U	Y	5 MG/KG
47093	BH40773AE	2	7	4 REAL		CADMIUM	0	65	U	Y	5 MG/KG
47093	BH40774AE	4	8	6 REAL		CADMIUM	2	3		Y	5 MG/KG
47093	BH40776AE	6	8	8 REAL		CADMIUM	8	7		Y	5 MG/KG

TABLE IL3 4-3

SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab Result	Lab Qual	Valid	Detect Limit	Units
40093	BH40167AE	0	6	REAL		CYANIDE	0.57	U	V	0.5	UG/G
40093	BH40170AE	6	8.4	REAL		CYANIDE	0.582	U	V	0.5	UG/G
40193	BH40488AE	0	6	REAL		CYANIDE	0.544	U	V	0.5	UG/G
40193	BH40490AE	6	12	REAL		CYANIDE	0.562	U	V	0.5	UG/G
40193	BH40493AE	12	18	REAL		CYANIDE	0.588	U	V	0.5	UG/G
40193	BH40495AE	18	24	REAL		CYANIDE	2.68		V	0.5	UG/G
40293	BH40118AE	0	2.9	REAL		CYANIDE	0.602	U	V	0.5	UG/G
40393	BH40123AE	0	5	REAL		CYANIDE	0.605	U	V	0.5	UG/G
40593	BH40128AE	0	5	REAL		CYANIDE	0.556	U	V	0.5	UG/G
40593	BH40131AE	6	11	REAL		CYANIDE	0.504	U	V	0.5	UG/G
40593	BH40365AE	12	18	REAL		CYANIDE	0.586	U	V	0.5	UG/G
40593	BH40400AE	18	24	REAL		CYANIDE	4.26		V	0.5	UG/G
40793	BH40413AE	0	5	REAL	BH40157AE	CYANIDE	0.626	U		0.5	UG/G
40793	BH40157AE	0	5	REAL		CYANIDE	0.601	U		0.5	UG/G
40793	BH40160AE	6	8.1	REAL		CYANIDE	0.584	U		0.5	UG/G
40793	BH40414AE	8.1	13	REAL		CYANIDE	0.568	U		0.5	UG/G
40893	BH40030AE	0	7	REAL		CYANIDE	0.52	U	V	0	UG/G
40893	BH40030AE	0	7	REAL		CYANIDE	0.52	U		0.5	UG/G
40993	BH40201AE	0	6	REAL		CYANIDE	0.708		V	0.5	UG/G
40993	BH40204AE	6	10	REAL		CYANIDE	0.546	U	V	0.5	UG/G
40993	BH40206AE	10	20	REAL		CYANIDE	0.546	U	V	0.5	UG/G
40993	BH40415AE	20	31	REAL		CYANIDE	0.56	U	V	0.5	UG/G
40993	BH40416AE	31	35	REAL		CYANIDE	0.592	U	V	0.5	UG/G
41193	BH40049AE	0	6	REAL		CYANIDE	0.562	U	V	0.5	UG/G
41193	BH40052AE	6	8	REAL		CYANIDE	0.525	U	V	0.5	UG/G
41293	BH40196AE	0	3.3	REAL		CYANIDE	0.561	U		0.5	UG/G
41593	BH40419AE	4	6	REAL		CYANIDE	16.2		V	0.5	UG/G
41693	BH40217AE	0	6	REAL		CYANIDE	0.565	U		0.5	UG/G
41693	BH40220AE	6	12	REAL		CYANIDE	0.577	U		0.5	UG/G
41793	BH40243AE	0	5	REAL		CYANIDE	0.525		V	0.5	UG/G
41793	BH40246AE	6	11	REAL		CYANIDE	0.525		V	0.5	UG/G
41993	BH40062AE	0	6	REAL		CYANIDE	0.559	U	V	0.5	UG/G
41993	BH40065AE	6	12	REAL		CYANIDE	0.567	U	V	0.5	UG/G
42093	BH40103AE	0	6	DUP	BH40483AE	CYANIDE	0.584	U	V	0.5	UG/G
42093	BH40483AE	0	6	REAL		CYANIDE	0.586	U	V	0.5	UG/G
42193	BH40427AE	4	6	REAL		CYANIDE	43		V	0.5	UG/G
42193	BH40086AE	9.9	16	REAL		CYANIDE	0.589	U	V	0.5	UG/G
42193	BH40091AE	16	22	REAL		CYANIDE	0.527	U	V	0.5	UG/G
42193	BH40430AE	22	28.3	REAL		CYANIDE	0.555	U	V	0.5	UG/G
42193	BH40433AE	28.3	31.3	REAL		CYANIDE	0.575	U	V	0.5	UG/G
42293	BH40253AE	0.7	6.1	REAL		CYANIDE	0.16	U	V	0.5	MG/KG
42293	BH40256AE	6.1	11.3	REAL		CYANIDE	0.19	U	JA	0.5	MG/KG
42293	BH40258AE	11.3	12.9	REAL		CYANIDE	0.579	U	V	0.5	UG/G
42393	BH40261AE	0	6	REAL		CYANIDE	0.551	U	V	0.5	UG/G
42393	BH40264AE	6	8.1	REAL		CYANIDE	0.497	U	V	0.5	UG/G
42493	BH40440AE	4	6	REAL		CYANIDE	1.69		V	0.5	UG/G
42593	BH40448AE	4	6	REAL		CYANIDE	8.49		JA	0.5	UG/G
42593	BH40450AE	8	10.2	REAL		CYANIDE	0.574	U	JA	0.5	UG/G
42593	BH40290AE	10.2	16.8	REAL		CYANIDE	0.565	U	V	0.5	UG/G
42993	BH40094AE	1	6	DUP	BH40141AE	CYANIDE	0.568	U	V	0.5	UG/G
42993	BH40141AE	1	6	REAL		CYANIDE	0.559	U	V	0.5	UG/G
42993	BH40144AE	7	10	REAL		CYANIDE	0.535	U	V	0.5	UG/G
43193	BH40306AE	0	5	REAL		CYANIDE	0.599		V	0.5	UG/G
43193	BH40309AE	6	11	REAL		CYANIDE	0.492	U	V	0.5	UG/G
43293	BH40041AE	0	6	REAL		CYANIDE	0.595	U	V	0.5	UG/G
43293	BH40044AE	6	10	REAL		CYANIDE	0.5	U	V	0.5	UG/G
43393	BH40512AE	4	5.4	REAL		CYANIDE	0.896		JA	0.5	UG/G
43393	BH40324AE	7.6	12.6	REAL		CYANIDE	0.591	U	JA	0.5	UG/G

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TABLE II.3-4-3

**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab Result	Lab Qual	Valid	Detect Limit	Units
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	CYANIDE	0 574	U	V	0 5	UG/G
43493	BH40319AE	0 5	5 3	REAL		CYANIDE	0 559	U	V	0 5	UG/G
43493	BH40322AE	5 3	11 3	REAL		CYANIDE	0 553	U	V	0 5	UG/G
43593	BH40180AE	1	6	REAL		CYANIDE	0 614	U	V	0 5	UG/G
43693	BH40520AE	4	6	REAL		CYANIDE	1 91		V	0 5	UG/G
43793	BH40332AE	0	6	REAL		CYANIDE	0 56	U		0 5	UG/G
43793	BH40335AE	6	11 5	REAL		CYANIDE	0 543	U		0 5	UG/G
43893	BH40070AE	0	6	REAL		CYANIDE	0 601	U	V	0 5	UG/G
43893	BH40073AE	6	12	REAL		CYANIDE	0 5	U	V	0 5	UG/G
43993	BH40353AE	0	6	REAL		CYANIDE	0 508	U	V	0 5	UG/G
44093	BH40348AE	0	6	REAL		CYANIDE	0 597	U	V	0 5	UG/G
44093	BH40351AE	6	10 4	REAL		CYANIDE	0 521	U	V	0 5	UG/G
44193	BH40078AE	0	6	REAL		CYANIDE	0 536	U	V	0	UG/G
44193	BH40078AE	0	6	REAL		CYANIDE	0 536	U		0 5	UG/G
44193	BH40081AE	6	12	REAL		CYANIDE	0 519	U	V	0	UG/G
44193	BH40081AE	6	12	REAL		CYANIDE	0 519	U		0 5	UG/G
44193	BH40429AE	23 4	29 4	REAL		CYANIDE	0 533	U	V	0 5	UG/G
44193	BH40568AE	29 4	35 4	REAL		CYANIDE	0 545	U	V	0 5	UG/G
44193	BH40569AE	35 4	41 6	REAL		CYANIDE	0 522	U	V	0 5	UG/G
44193	BH40570AE	41 6	47 6	REAL		CYANIDE	0 575	U	V	0 5	UG/G
44193	BH40089AE	47 6	50 2	REAL		CYANIDE	0 535	U	V	0 5	UG/G
44393	BH40033AE	0	5	REAL		CYANIDE	0 535	U	V	0 5	UG/G
44593	BH40005AE	6 2	11 4	REAL		CYANIDE	0 544	U	V	0	UG/G
44593	BH40005AE	6 2	11 4	REAL		CYANIDE	0 544	U		0 5	UG/G
44793	BH40133AE	0	2 5	REAL		CYANIDE	0 587	U	V	0 5	UG/G
44893	BH40188AE	0	5	REAL		CYANIDE	0 56	U	V	0 5	UG/G
44893	BH40191AE	6 2	12 2	REAL		CYANIDE	0 565	U	V	0 5	UG/G
45693	BH40374AE	0	6	REAL		CYANIDE	0 629	U	V	0 5	UG/G
45793	BH40557AE	0	4	REAL		CYANIDE	0 597	U	JA	0 5	UG/G
45893	BH40377AE	0	6	REAL		CYANIDE	0 579	U	JA	0 5	UG/G
45893	BH40380AE	6	8 7	REAL		CYANIDE	0 593	U	JA	0 5	UG/G
45893	BH40382AE	8 7	22	REAL		CYANIDE	0 578	U	JA	0 5	UG/G
46193	BH40562AE	0	6	DUP	BH40385AE	CYANIDE	1 23		V	0 5	UG/G
46193	BH40385AE	0	6	REAL	BH40562AE	CYANIDE	1 53		V	0 5	UG/G
46593	BH40786AE	0 75	6 75	REAL		CYANIDE	0 54	U	V	0 5	UG/G
46593	BH40713AE	10 7	16 4	REAL		CYANIDE	0 6	U	V	0 5	UG/G
46693	BH40792AE	0 5	6 6	REAL		CYANIDE	6 81		V	0 5	UG/G
46693	BH40728AE	8 6	14 8	REAL		CYANIDE	1 94		V	0 5	UG/G
46793	BH40798AE	0 5	6 5	REAL		CYANIDE	30 7		V	0 5	UG/G
46793	BH40742AE	8 5	14 7	REAL		CYANIDE	1 28		V	0 5	UG/G
46893	BH40804AE	0 5	6 6	REAL		CYANIDE	2 02		V	0 5	UG/G
46893	BH40807AE	6 5	11 5	REAL		CYANIDE	0 51	U	V	0 5	UG/G
46993	BH40810AE	1 3	5	REAL		CYANIDE	0 52	U	V	0 5	UG/G
46993	BH40770AE	7 2	13 1	REAL		CYANIDE	0 59	U	V	0 5	UG/G
47093	BH40816AE	0 7	6 8	REAL		CYANIDE	0 53	U	V	0 5	UG/G
40093	BH40167AE	0	6	REAL		LITHIUM	5 1	B	JA	23	MG/KG
40093	BH40170AE	6	8 4	REAL		LITHIUM	8 9	B	JA	25	MG/KG
40193	BH40488AE	0	6	REAL		LITHIUM	5 6	B	JA	23	MG/KG
40193	BH40490AE	6	12	REAL		LITHIUM	3 7	B	JA	24	MG/KG
40193	BH40493AE	12	18	REAL		LITHIUM	5 4	B	JA	25	MG/KG
40193	BH40495AE	18	24	REAL		LITHIUM	4 3	B	JA	25	MG/KG
40293	BH40118AE	0	2 9	REAL		LITHIUM	5 3	B	JA	24	MG/KG
40393	BH40123AE	0	5	REAL		LITHIUM	3 2	B	JA	23	MG/KG
40593	BH40128AE	0	5	REAL		LITHIUM	7 3	B	JA	23	MG/KG
40593	BH40131AE	6	11	REAL		LITHIUM	7 8	B	JA	21	MG/KG
40593	BH40365AE	12	18	REAL		LITHIUM	6 7	B	JA	25	MG/KG
40593	BH40400AE	18	24	REAL		LITHIUM	11	B	JA	25	MG/KG

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**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab		Detect Limit	Units			
							Result	Qual					
40793	BH40157AE	0	5	REAL		LITHIUM	6	B	JA	10	MG/KG		
40793	BH40413AE	0	5	REAL	BH40157AE	LITHIUM	10	9	B	JA	10	MG/KG	
40793	BH40160AE	6	8	1	REAL	LITHIUM	6	3	B	JA	10	MG/KG	
40793	BH40414AE	8	13	REAL		LITHIUM	4	9	B	JA	10	MG/KG	
40893	BH40030AE	0	7	REAL		LITHIUM	6	9	B	V	21	9	MG/KG
40993	BH40201AE	0	6	REAL		LITHIUM	4	6	B	JA	10	MG/KG	
40993	BH40204AE	6	10	REAL		LITHIUM	4	3	B	JA	10	MG/KG	
40993	BH40206AE	10	20	REAL		LITHIUM	6	3	B	JA	10	MG/KG	
40993	BH40415AE	20	31	REAL		LITHIUM	7	7	B	JA	10	MG/KG	
40993	BH40416AE	31	35	REAL		LITHIUM	6	3	B	JA	10	MG/KG	
41193	BH40049AE	0	6	REAL		LITHIUM	10	4	B	JA	23	MG/KG	
41193	BH40052AE	6	8	REAL		LITHIUM	13	1	B	JA	21	MG/KG	
41293	BH40196AE	0	3	3	REAL	LITHIUM	6	B	JA	10	MG/KG		
41593	BH40417AE	0	2	REAL		LITHIUM	50	8	B	JA	10	MG/KG	
41593	BH40418AE	2	4	REAL		LITHIUM	16	4	B	JA	10	MG/KG	
41593	BH40424AE	6	7	9	REAL	LITHIUM	5	5	B	JA	10	MG/KG	
41593	BH40419AE	4	6	REAL		LITHIUM	7	7	B	JA	10	MG/KG	
41693	BH40217AE	0	6	REAL		LITHIUM	23	5	JA	23	MG/KG		
41693	BH40220AE	6	12	REAL		LITHIUM	79	9	JA	23	MG/KG		
41793	BH40243AE	0	5	REAL		LITHIUM	12	7	B	JA	22	MG/KG	
41793	BH40246AE	6	11	REAL		LITHIUM	10	3	B	JA	22	MG/KG	
41993	BH40062AE	0	6	REAL		LITHIUM	9	1	B	JA	22	MG/KG	
41993	BH40065AE	6	12	REAL		LITHIUM	2	3	U	JA	23	MG/KG	
42093	BH40483AE	0	6	REAL		LITHIUM	3	7	B	JA	22	MG/KG	
42093	BH40103AE	0	6	DUP	BH40483AE	LITHIUM	3	2	B	JA	23	MG/KG	
42193	BH40425AE	0	2	REAL		LITHIUM	27	2	JA	10	MG/KG		
42193	BH40426AE	2	4	REAL		LITHIUM	8	3	B	JA	10	MG/KG	
42193	BH40432AE	6	9	9	REAL	LITHIUM	3	3	B	JA	10	MG/KG	
42193	BH40427AE	4	6	REAL		LITHIUM	5	5	B	JA	10	MG/KG	
42193	BH40086AE	9	9	16	REAL	LITHIUM	2	6	B	JA	10	MG/KG	
42193	BH40091AE	16	22	REAL		LITHIUM	4	7	B	JA	10	MG/KG	
42193	BH40430AE	22	28	3	REAL	LITHIUM	4	2	B	JA	10	MG/KG	
42193	BH40433AE	28	31	3	REAL	LITHIUM	6	9	B	JA	10	MG/KG	
42293	BH40253AE	0	7	6	REAL	LITHIUM	15	8	B	JA	10	MG/KG	
42293	BH40256AE	6	11	3	REAL	LITHIUM	19	1	B	JA	10	MG/KG	
42293	BH40258AE	11	13	12	9	REAL	LITHIUM	9	5	B	JA	10	MG/KG
42393	BH40261AE	0	6	REAL		LITHIUM	5	2	B	JA	22	MG/KG	
42393	BH40264AE	6	8	1	REAL	LITHIUM	5	4	B	JA	21	MG/KG	
42493	BH40438AE	0	2	REAL		LITHIUM	34	2	JA	10	MG/KG		
42493	BH40439AE	2	4	REAL	BH40112AE	LITHIUM	18	6	B	JA	10	MG/KG	
42493	BH40112AE	2	4	DUP	BH40439AE	LITHIUM	10	8	B	JA	10	MG/KG	
42493	BH40441AE	6	8	REAL		LITHIUM	11	8	B	JA	10	MG/KG	
42493	BH40440AE	4	6	REAL		LITHIUM	12	6	B	JA	10	MG/KG	
42493	BH40445AE	8	10	2	REAL	LITHIUM	5	5	B	JA	10	MG/KG	
42593	BH40447AE	2	4	REAL		LITHIUM	9	5	B	JA	10	MG/KG	
42593	BH40446AE	0	2	REAL		LITHIUM	27	4	JA	10	MG/KG		
42593	BH40448AE	4	6	REAL		LITHIUM	9	4	B	JA	10	MG/KG	
42593	BH40449AE	6	8	REAL		LITHIUM	4	7	B	JA	10	MG/KG	
42593	BH40450AE	8	10	2	REAL	LITHIUM	4	9	B	JA	10	MG/KG	
42593	BH40290AE	10	2	16	8	REAL	LITHIUM	6	9	B	JA	10	MG/KG
42993	BH40141AE	1	6	REAL		LITHIUM	7	7	B	JA	23	MG/KG	
42993	BH40094AE	1	6	DUP	BH40141AE	LITHIUM	10	B	JA	23	MG/KG		
42993	BH40144AE	7	10	REAL		LITHIUM	5	6	B	JA	22	MG/KG	
43193	BH40306AE	0	5	REAL		LITHIUM	33	5	JA	24	MG/KG		
43193	BH40309AE	6	11	REAL		LITHIUM	8	B	JA	23	MG/KG		
43293	BH40041AE	0	6	REAL		LITHIUM	9	B	JA	23	MG/KG		
43293	BH40044AE	6	10	REAL		LITHIUM	3	3	B	JA	21	MG/KG	
43393	BH40511AE	2	4	REAL		LITHIUM	11	5	B	JA	10	MG/KG	

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**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab		Detect Limit	Units
							Result	Qual		
43393	BH40510AE	0	2	REAL		LITHIUM	30 9	JA	10	MG/KG
43393	BH40517AE	6	7 6	REAL		LITHIUM	18 2	B JA	10	MG/KG
43393	BH40512AE	4	5 4	REAL		LITHIUM	13 8	B JA	10	MG/KG
43393	BH40324AE	7 6	12 6	REAL		LITHIUM	9 3	B JA	10	MG/KG
43493	BH40319AE	0 5	5 3	REAL		LITHIUM	16 1	B JA	10	MG/KG
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	LITHIUM	16 2	B JA	10	MG/KG
43493	BH40322AE	5 3	11 3	REAL		LITHIUM	15 6	B JA	10	MG/KG
43593	BH40180AE	1	6	REAL		LITHIUM	11	B JA	24	MG/KG
43693	BH40518AE	0	2	REAL		LITHIUM	43 1	JA	10	MG/KG
43693	BH40519AE	2	4	REAL		LITHIUM	16 8	B JA	10	MG/KG
43693	BH40520AE	4	6	REAL		LITHIUM	10	B JA	10	MG/KG
43693	BH40521AE	6	8	REAL		LITHIUM	6 8	B JA	10	MG/KG
43693	BH40522AE	8	10	REAL		LITHIUM	7	B JA	10	MG/KG
43693	BH40525AE	10	13	REAL	BH40563AE	LITHIUM	8 6	B JA	10	MG/KG
43693	BH40563AE	10	13	DUP	BH40525AE	LITHIUM	6 9	B JA	10	MG/KG
43793	BH40332AE	0	6	REAL		LITHIUM	9 5	B JA	10	MG/KG
43793	BH40335AE	6	11 5	REAL		LITHIUM	20 8	B JA	10	MG/KG
43893	BH40070AE	0	6	REAL		LITHIUM	10	B JA	24	MG/KG
43893	BH40073AE	6	12	REAL		LITHIUM	2 6	B JA	21	MG/KG
43993	BH40353AE	0	6	REAL		LITHIUM	13 6	B JA	23	MG/KG
44093	BH40348AE	0	6	REAL		LITHIUM	10 7	B JA	24	MG/KG
44093	BH40351AE	6	10 4	REAL		LITHIUM	8 3	B JA	21	MG/KG
44193	BH40078AE	0	6	REAL		LITHIUM	7 9	B V	24 1	MG/KG
44193	BH40081AE	6	12	REAL		LITHIUM	5 8	B V	21 4	MG/KG
44193	BH40429AE	23 4	29 4	REAL		LITHIUM	6 2	B JA	10	MG/KG
44193	BH40568AE	29 4	35 4	REAL		LITHIUM	5 3	B JA	10	MG/KG
44193	BH40569AE	35 4	41 6	REAL		LITHIUM	7 9	B JA	10	MG/KG
44193	BH40570AE	41 6	47 6	REAL		LITHIUM	5 1	B JA	10	MG/KG
44193	BH40089AE	47 6	50 2	REAL		LITHIUM	4 4	B JA	10	MG/KG
44393	BH40033AE	0	5	REAL		LITHIUM	7 5	B JA	22	MG/KG
44593	BH40001AE	0	6 2	REAL		LITHIUM	8 8	B V	22 7	MG/KG
44593	BH40005AE	6 2	11 4	REAL		LITHIUM	10 9	B V	22 7	MG/KG
44793	BH40133AE	0	2 5	REAL		LITHIUM	8 1	B JA	23	MG/KG
44893	BH40188AE	0	5	REAL		LITHIUM	7 1	B JA	23	MG/KG
44893	BH40191AE	6 2	12 2	REAL		LITHIUM	6 5	B JA	24	MG/KG
45693	BH40374AE	0	6	REAL		LITHIUM	11 2	B JA	10	MG/KG
45793	BH40557AE	0	4	REAL		LITHIUM	6 4	B JA	10	MG/KG
45893	BH40377AE	0	6	REAL		LITHIUM	6 8	B JA	10	MG/KG
45893	BH40380AE	6	8 7	REAL		LITHIUM	5 6	B JA	10	MG/KG
45893	BH40382AE	8 7	22	REAL		LITHIUM	4 9	B JA	10	MG/KG
46193	BH40385AE	0	6	REAL	BH40562AE	LITHIUM	10 1	B JA	10	MG/KG
46193	BH40562AE	0	6	DUP	BH40385AE	LITHIUM	9 6	B JA	10	MG/KG
46593	BH40700AE	0 7 5	2 7 5	REAL		LITHIUM	12	B JA	20	MG/KG
46593	BH40702AE	2 7 5	4 7 5	REAL		LITHIUM	5 4	B JA	20	MG/KG
46593	BH40703AE	4 7 5	6 7 5	REAL		LITHIUM	10 9	B JA	20	MG/KG
46593	BH40705AE	6 7 5	8 7 5	REAL		LITHIUM	5 3	B JA	20	MG/KG
46593	BH40711AE	8 7 5	10 7	REAL		LITHIUM	5 5	B JA	20	MG/KG
46593	BH40713AE	10 7	16 4	REAL		LITHIUM	5 3	B JA	20	MG/KG
46693	BH40715AE	0 5	2 2 5	REAL		LITHIUM	60	JA	20	MG/KG
46693	BH40717AE	2 2 5	4 2 5	REAL		LITHIUM	11 9	B JA	20	MG/KG
46693	BH40718AE	4 6	6 6	REAL		LITHIUM	11 1	B JA	20	MG/KG
46693	BH40726AE	6 6	7 6	REAL		LITHIUM	11	B JA	20	MG/KG
46693	BH40728AE	8 6	14 8	REAL		LITHIUM	6 8	B JA	20	MG/KG
46793	BH40729AE	0 5	2 5	REAL		LITHIUM	31 6	Y	20	MG/KG
46793	BH40731AE	2 5	4 5	REAL		LITHIUM	18 8	B Y	20	MG/KG
46793	BH40732AE	4 5	6 5	REAL		LITHIUM	7 7	B Y	20	MG/KG
46793	BH40740AE	6 5	8 5	REAL		LITHIUM	9	B Y	20	MG/KG
46793	BH40742AE	8 5	14 7	REAL		LITHIUM	6 5	B Y	20	MG/KG

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TABLE IL3 4-3

**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab			Detect	
							Result	Qual	Valid	Limit	Units
46793	BH40823AE	8.5	14.7	DUP	BH40742AE	LITHIUM	5.8	B	Y	20	MG/KG
46893	BH40743AE	0.5	2.5	REAL		LITHIUM	8	B	Y	20	MG/KG
46893	BH40745AE	2.5	4.6	REAL		LITHIUM	10.5	B	Y	20	MG/KG
46893	BH40746AE	4.6	6.6	REAL		LITHIUM	5.5	B	Y	20	MG/KG
46893	BH40748AE	6.6	8.6	REAL		LITHIUM	6.3	B	Y	20	MG/KG
46893	BH40749AE	8.6	10.6	REAL		LITHIUM	2.6	B	Y	20	MG/KG
46893	BH40754AE	11.5	12.5	REAL		LITHIUM	5.1	B	Y	20	MG/KG
46993	BH40757AE	1.3	3.1	REAL		LITHIUM	25.6		Y	20	MG/KG
46993	BH40830AE	1.3	3.1	DUP	BH40757AE	LITHIUM	37.5		Y	20	MG/KG
46993	BH40759AE	3.3	5	REAL		LITHIUM	4.9	B	Y	20	MG/KG
46993	BH40768AE	5.5	7	REAL		LITHIUM	11.2	B	Y	20	MG/KG
46993	BH40770AE	7.2	13.1	REAL		LITHIUM	0.62	U	Y	20	MG/KG
47093	BH40771AE	0.7	2.7	REAL		LITHIUM	13	B	Y	100	MG/KG
47093	BH40773AE	2.7	4.7	REAL		LITHIUM	6.5	B	Y	100	MG/KG
47093	BH40774AE	4.8	6.8	REAL		LITHIUM	6.6	B	Y	100	MG/KG
47093	BH40776AE	6.8	8.8	REAL		LITHIUM	10.1	B	Y	100	MG/KG
40093	BH40167AE	0	6	REAL		NITRATE/NITRITE	1.6		V	0.24	MG/KG
40093	BH40170AE	6	8.4	REAL		NITRATE/NITRITE	2.3		V	0.24	MG/KG
40193	BH40488AE	0	6	REAL		NITRATE/NITRITE	1.93		V	0.23	MG/KG
40193	BH40488AE	0	6	REAL		NITRATE/NITRITE	1.93		V	0.23	MG/KG
40193	BH40490AE	6	12	REAL		NITRATE/NITRITE	2.19		V	0.23	MG/KG
40193	BH40490AE	6	12	REAL		NITRATE/NITRITE	2.19		V	0.23	MG/KG
40193	BH40493AE	12	18	REAL		NITRATE/NITRITE	3.99		V	0.24	MG/KG
40193	BH40493AE	12	18	REAL		NITRATE/NITRITE	3.99		V	0.24	MG/KG
40193	BH40495AE	18	24	REAL		NITRATE/NITRITE	142		V	0.24	MG/KG
40193	BH40495AE	18	24	REAL		NITRATE/NITRITE	142		V	0.24	MG/KG
40293	BH40118AE	0	2.9	REAL		NITRATE/NITRITE	2.2		V	0.24	MG/KG
40393	BH40123AE	0	5	REAL		NITRATE/NITRITE	0		V	0.24	MG/KG
40593	BH40128AE	0	5	REAL		NITRATE/NITRITE	1.6		V	0.23	MG/KG
40593	BH40131AE	6	11	REAL		NITRATE/NITRITE	4		V	0.22	MG/KG
40593	BH40365AE	12	18	REAL		NITRATE/NITRITE	13.2		V	0.24	MG/KG
40593	BH40400AE	18	24	REAL		NITRATE/NITRITE	387		V	0.24	MG/KG
40793	BH40157AE	0	5	REAL		NITRATE/NITRITE	6.45		V	0.24	MG/KG
40793	BH40413AE	0	5	REAL	BH40157AE	NITRATE/NITRITE	6.07		V	0.24	MG/KG
40793	BH40160AE	6	8.1	REAL		NITRATE/NITRITE	11.3		V	0.25	MG/KG
40793	BH40414AE	8.1	13	REAL		NITRATE/NITRITE	23.4		V	0.72	MG/KG
40893	BH40030AE	0	7	REAL		NITRATE/NITRITE	2.31		V	0.2	UG/G
40993	BH40201AE	0	6	REAL		NITRATE/NITRITE	170		V	4.66	MG/KG
40993	BH40204AE	6	10	REAL		NITRATE/NITRITE	57.3		V	4.42	MG/KG
40993	BH40206AE	10	20	REAL		NITRATE/NITRITE	1670		V	113	MG/KG
40993	BH40415AE	20	31	REAL		NITRATE/NITRITE	1080		V	113	MG/KG
40993	BH40416AE	31	35	REAL		NITRATE/NITRITE	505		V	23.9	MG/KG
41193	BH40049AE	0	6	REAL		NITRATE/NITRITE	12.1		V	0.23	MG/KG
41193	BH40052AE	6	8	REAL		NITRATE/NITRITE	41.8		V	0.24	MG/KG
41293	BH40196AE	0	3.3	REAL		NITRATE/NITRITE	48.9		V	2.19	MG/KG
41593	BH40418AE	0	4	REAL		NITRATE/NITRITE	2120		V	127	MG/KG
41593	BH40424AE	4	7.9	REAL		NITRATE/NITRITE	470		V	24.3	MG/KG
41693	BH40217AE	0	6	REAL		NITRATE/NITRITE	74.8		V	2.23	MG/KG
41693	BH40220AE	6	12	REAL		NITRATE/NITRITE	183		V	5.78	MG/KG
41793	BH40243AE	0	5	REAL		NITRATE/NITRITE	19		V	0.22	MG/KG
41793	BH40246AE	6	11	REAL		NITRATE/NITRITE	343		V	10.9	MG/KG
41993	BH40062AE	0	6	REAL		NITRATE/NITRITE	56.4		V	0.22	MG/KG
41993	BH40065AE	6	12	REAL		NITRATE/NITRITE	2.1		V	0.23	MG/KG
42093	BH40103AE	0	6	DUP	BH40483AE	NITRATE/NITRITE	26.3		V	0.23	MG/KG
42093	BH40483AE	0	6	REAL		NITRATE/NITRITE	22.3		V	0.24	MG/KG
42193	BH40426AE	0	4	REAL		NITRATE/NITRITE	6100		V	478	MG/KG
42193	BH40432AE	4	9.9	REAL		NITRATE/NITRITE	21.9		V	1.15	MG/KG

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**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab		Detect Limit	Units
							Result	Qual		
42193	BH40086AE	9 9	16	REAL		NITRATE/NITRITE	25 1		0 49	MG/KG
42193	BH40091AE	16	22	REAL		NITRATE/NITRITE	51		1 24	MG/KG
42193	BH40430AE	22	28 3	REAL		NITRATE/NITRITE	3 62		0 24	MG/KG
42193	BH40433AE	28 3	31 3	REAL		NITRATE/NITRITE	5 75		0 24	MG/KG
42293	BH40253AE	0 7	6 1	REAL		NITRATE/NITRITE	1 74	V	0 23	MG/KG
42293	BH40256AE	6 1	11 3	REAL		NITRATE/NITRITE	5 78	V	0 24	MG/KG
42293	BH40258AE	11 3	12 9	REAL		NITRATE/NITRITE	21 1	V	0 24	MG/KG
42393	BH40261AE	0	6	REAL		NITRATE/NITRITE	21 8	V	0 22	MG/KG
42393	BH40264AE	6	8 1	REAL		NITRATE/NITRITE	0 52	V	0 21	MG/KG
42493	BH40439AE	0	4	REAL	BH40112AE	NITRATE/NITRITE	1150	V	48 3	MG/KG
42493	BH40112AE	2	4	DUP	BH40439AE	NITRATE/NITRITE	987	V	51 2	MG/KG
42493	BH40441AE	4	8	REAL		NITRATE/NITRITE	17 1	V	0 22	MG/KG
42493	BH40445AE	8	10 2	REAL		NITRATE/NITRITE	11 8	V	0 24	MG/KG
42593	BH40447AE	0	4	REAL		NITRATE/NITRITE	1810	V	111	MG/KG
42593	BH40449AE	4	8	REAL		NITRATE/NITRITE	422	V	10 9	MG/KG
42593	BH40450AE	8	10 2	REAL		NITRATE/NITRITE	187	V	5 99	MG/KG
42593	BH40290AE	10 2	16 8	REAL		NITRATE/NITRITE	88 3		3 49	MG/KG
42993	BH40141AE	1	6	REAL		NITRATE/NITRITE	26	V	0 22	MG/KG
42993	BH40141AE	1	6	REAL		NITRATE/NITRITE	26		0 22	MG/KG
42993	BH40094AE	1	6	DUP	BH40141AE	NITRATE/NITRITE	34 7	V	0 23	MG/KG
42993	BH40094AE	1	6	DUP	BH40141AE	NITRATE/NITRITE	34 7		0 23	MG/KG
42993	BH40144AE	7	10	REAL		NITRATE/NITRITE	286		0 22	MG/KG
42993	BH40144AE	7	10	REAL		NITRATE/NITRITE	286	V	0 22	MG/KG
43193	BH40306AE	0	5	REAL		NITRATE/NITRITE	7 48	V	0 25	MG/KG
43193	BH40309AE	6	11	REAL		NITRATE/NITRITE	141	V	4 43	MG/KG
43293	BH40041AE	0	6	REAL		NITRATE/NITRITE	2 9	V	0 24	MG/KG
43293	BH40044AE	6	10	REAL		NITRATE/NITRITE	1 3	V	0 21	MG/KG
43393	BH40511AE	0	4	REAL		NITRATE/NITRITE	1610	V	212	MG/KG
43393	BH40517AE	4	7 6	REAL		NITRATE/NITRITE	2040	V	124	MG/KG
43393	BH40324AE	7 6	12 6	REAL		NITRATE/NITRITE	656	V	23 4	MG/KG
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	NITRATE/NITRITE	1 82	V	0 22	MG/KG
43493	BH40319AE	0 5	5 3	REAL		NITRATE/NITRITE	2 36	V	0 23	MG/KG
43493	BH40322AE	5 3	11 3	REAL		NITRATE/NITRITE	0 71	V	0 22	MG/KG
43593	BH40180AE	1	6	REAL		NITRATE/NITRITE	25 U	V	25	MG/KG
43693	BH40519AE	0	4	REAL		NITRATE/NITRITE	1000	V	44 3	MG/KG
43693	BH40521AE	4	8	REAL		NITRATE/NITRITE	349	V	10 3	MG/KG
43693	BH40525AE	10	13	REAL	BH40563AE	NITRATE/NITRITE	553	V	11 8	MG/KG
43793	BH40332AE	0	6	REAL		NITRATE/NITRITE	21 3	V	0 96	MG/KG
43793	BH40335AE	6	11 5	REAL		NITRATE/NITRITE	1 65	V	0 23	MG/KG
43893	BH40070AE	0	6	REAL		NITRATE/NITRITE	3 1	V	0 25	MG/KG
43893	BH40073AE	6	12	REAL		NITRATE/NITRITE	3 9	V	0 21	MG/KG
43993	BH40353AE	0	6	REAL		NITRATE/NITRITE	8 45	V	0 23	MG/KG
44093	BH40348AE	0	6	REAL		NITRATE/NITRITE	5 8	V	0 25	MG/KG
44093	BH40351AE	6	10 4	REAL		NITRATE/NITRITE	7 88	V	0 22	MG/KG
44193	BH40078AE	0	6	REAL		NITRATE/NITRITE	4 1	V	0 22	MG/KG
44193	BH40081AE	6	12	REAL		NITRATE/NITRITE	3 6	V	0 21	MG/KG
44193	BH40429AE	23 4	29 4	REAL		NITRATE/NITRITE	1 17		0 25	MG/KG
44193	BH40568AE	29 4	35 4	REAL		NITRATE/NITRITE	0 55		0 25	MG/KG
44193	BH40569AE	35 4	41 6	REAL		NITRATE/NITRITE	0 44		0 23	MG/KG
44193	BH40570AE	41 6	47 6	REAL		NITRATE/NITRITE	1 3		0 23	MG/KG
44193	BH40089AE	47 6	50 2	REAL		NITRATE/NITRITE	0 87		0 22	MG/KG
44393	BH40033AE	0	5	REAL		NITRATE/NITRITE	2 5	V	0 22	MG/KG
44593	BH40001AE	0	6 2	REAL		NITRATE/NITRITE	45 9	V	0 2	UG/G
44593	BH40005AE	6 2	11 4	REAL		NITRATE/NITRITE	15 5	V	0 2	UG/G
44793	BH40133AE	0	2 5	REAL		NITRATE/NITRITE	2 1	V	0 23	MG/KG
44893	BH40188AE	0	5	REAL		NITRATE/NITRITE	2 3	V	0 24	MG/KG
44893	BH40191AE	6 2	12 2	REAL		NITRATE/NITRITE	7 7	V	0 23	MG/KG
45693	BH40374AE	0	6	REAL		NITRATE/NITRITE	221	V	25 6	MG/KG

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**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab		Detect Limit	Units
							Result	Qual		
45793	BH40557AE	0	4	REAL		NITRATE/NITRITE	5	V	0.22	MG/KG
45893	BH40377AE	0	6	REAL		NITRATE/NITRITE	2.62	V	0.22	MG/KG
45893	BH40380AE	6	8.7	REAL		NITRATE/NITRITE	7.13	V	0.25	MG/KG
45893	BH40382AE	8.7	22	REAL		NITRATE/NITRITE	112	V	4.67	MG/KG
46193	BH40562AE	0	6	DUP	BH40385AE	NITRATE/NITRITE	396	V	6.09	MG/KG
46193	BH40385AE	0	6	REAL	BH40562AE	NITRATE/NITRITE	214	V	4.86	MG/KG
46593	BH40785AE	0.75	4.75	REAL		NITRATE/NITRITE	5200	V	0.5	UG/G
46593	BH40787AE	6.75	8.75	REAL		NITRATE/NITRITE	634	V	0.5	UG/G
46593	BH40790AE	8.75	10.7	REAL		NITRATE/NITRITE	507	V	0.5	UG/G
46593	BH40713AE	10.7	16.4	REAL		NITRATE/NITRITE	668	V	0.5	UG/G
46693	BH40791AE	0.5	4.25	REAL		NITRATE/NITRITE	462	V	0.5	UG/G
46693	BH40796AE	6.6	7.6	REAL		NITRATE/NITRITE	1030	JA	0.2	UG/G
46693	BH40728AE	8.6	14.8	REAL		NITRATE/NITRITE	558	JA	0.2	UG/G
46793	BH40797AE	0.5	4.5	REAL		NITRATE/NITRITE	2640	JA	0.2	UG/G
46793	BH40802AE	6.5	8.5	REAL		NITRATE/NITRITE	1050	JA	0.2	UG/G
46793	BH40742AE	8.5	14.7	REAL		NITRATE/NITRITE	791	JA	0.2	UG/G
46893	BH40803AE	0.5	4.6	REAL		NITRATE/NITRITE	115	JA	0.2	UG/G
46893	BH40805AE	4.6	8.6	REAL		NITRATE/NITRITE	162	JA	0.2	UG/G
46893	BH40808AE	11.5	12.5	REAL		NITRATE/NITRITE	496	JA	0.2	UG/G
46993	BH40809AE	1.3	5	REAL		NITRATE/NITRITE	311	JA	0.2	UG/G
46993	BH40814AE	5.5	7	REAL		NITRATE/NITRITE	2860	JA	0.2	UG/G
46993	BH40770AE	7.2	13.1	REAL		NITRATE/NITRITE	308	JA	0.2	UG/G
47093	BH40824AE	0.7	4.7	DUP	BH40815AE	NITRATE/NITRITE	91.2	JA	0.2	UG/G
47093	BH40815AE	0.7	4.7	REAL		NITRATE/NITRITE	46.9	JA	0.2	UG/G
47093	BH40817AE	4.8	8.8	REAL		NITRATE/NITRITE	128	JA	0.2	UG/G
40093	BH40167AE	0	6	REAL		ZINC	48.6	V	5	MG/KG
40093	BH40170AE	6	8.4	REAL		ZINC	70.9	V	5	MG/KG
40193	BH40488AE	0	6	REAL		ZINC	53.1	EN JA	5	MG/KG
40193	BH40490AE	6	12	REAL		ZINC	59.2	EN JA	5	MG/KG
40193	BH40493AE	12	18	REAL		ZINC	39.9	EN JA	5	MG/KG
40193	BH40495AE	18	24	REAL		ZINC	32.5	EN JA	5	MG/KG
40293	BH40118AE	0	2.9	REAL		ZINC	49.8	V	5	MG/KG
40393	BH40123AE	0	5	REAL		ZINC	55.1	E JA	5	MG/KG
40593	BH40128AE	0	5	REAL		ZINC	90.4	V	5	MG/KG
40593	BH40131AE	6	11	REAL		ZINC	34.1	V	4	MG/KG
40593	BH40365AE	12	18	REAL		ZINC	115	V	5	MG/KG
40593	BH40400AE	18	24	REAL		ZINC	67.4	V	5	MG/KG
40793	BH40413AE	0	5	REAL	BH40157AE	ZINC	54.3	V	10	MG/KG
40793	BH40157AE	0	5	REAL		ZINC	38.6	V	10	MG/KG
40793	BH40160AE	6	8.1	REAL		ZINC	22.8	JA	10	MG/KG
40793	BH40414AE	8.1	13	REAL		ZINC	44.2	JA	10	MG/KG
40893	BH40030AE	0	7	REAL		ZINC	22.6	V	4.4	MG/KG
40993	BH40201AE	0	6	REAL		ZINC	30.7	V	10	MG/KG
40993	BH40204AE	6	10	REAL		ZINC	9.9	V	10	MG/KG
40993	BH40206AE	10	20	REAL		ZINC	21.7	V	10	MG/KG
40993	BH40415AE	20	31	REAL		ZINC	61.2	JA	10	MG/KG
40993	BH40416AE	31	35	REAL		ZINC	71.3	JA	10	MG/KG
41193	BH40049AE	0	6	REAL		ZINC	23.6	E JA	5	MG/KG
41193	BH40052AE	6	8	REAL		ZINC	24.2	E JA	4	MG/KG
41293	BH40196AE	0	3.3	REAL		ZINC	19.6	V	10	MG/KG
41593	BH40417AE	0	2	REAL		ZINC	53.2	V	10	MG/KG
41593	BH40418AE	2	4	REAL		ZINC	16	JA	10	MG/KG
41593	BH40419AE	4	6	REAL		ZINC	11.8	JA	10	MG/KG
41593	BH40424AE	6	7.9	REAL		ZINC	17.6	V	10	MG/KG
41693	BH40217AE	0	6	REAL		ZINC	28.5	V	5	MG/KG
41693	BH40220AE	6	12	REAL		ZINC	50.9	JA	5	MG/KG
41793	BH40243AE	0	5	REAL		ZINC	14.9	JA	4	MG/KG

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**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab			Detect	
							Result	Qual	Valid	Limit	Units
41793	BH40246AE	6	11	REAL		ZINC	11 8		JA	4	MG/KG
41993	BH40062AE	0	6	REAL		ZINC	28 6		V	4	MG/KG
41993	BH40065AE	6	12	REAL		ZINC	18 1		V	5	MG/KG
42093	BH40483AE	0	6	REAL		ZINC	63		V	4	MG/KG
42093	BH40103AE	0	6	DUP	BH40483AE	ZINC	48 8		V	5	MG/KG
42193	BH40426AE	2	4	REAL		ZINC	15 1 N*		JA	10	MG/KG
42193	BH40425AE	0	2	REAL		ZINC	28 5 N*		JA	10	MG/KG
42193	BH40427AE	4	6	REAL		ZINC	9 6 N*		JA	10	MG/KG
42193	BH40432AE	6	9 9	REAL		ZINC	31 1 N*		JA	10	MG/KG
42193	BH40086AE	9 9	16	REAL		ZINC	46 8		V	10	MG/KG
42193	BH40091AE	16	22	REAL		ZINC	61 5		V	10	MG/KG
42193	BH40430AE	22	28 3	REAL		ZINC	54 9		V	10	MG/KG
42193	BH40433AE	28 3	31 3	REAL		ZINC	110 N*		JA	10	MG/KG
42293	BH40253AE	0 7	6 1	REAL		ZINC	35 7		JA	10	MG/KG
42293	BH40256AE	6 1	11 3	REAL		ZINC	39 3		JA	10	MG/KG
42293	BH40258AE	11 3	12 9	REAL		ZINC	19 8		V	10	MG/KG
42393	BH40261AE	0	6	REAL		ZINC	40 9		V	4	MG/KG
42393	BH40264AE	6	8 1	REAL		ZINC	30 9		V	4	MG/KG
42493	BH40439AE	2	4	REAL	BH40112AE	ZINC	37 5		V	10	MG/KG
42493	BH40438AE	0	2	REAL		ZINC	44 6		V	10	MG/KG
42493	BH40112AE	2	4	DUP	BH40439AE	ZINC	17 5		JA	10	MG/KG
42493	BH40441AE	6	8	REAL		ZINC	21 7		V	10	MG/KG
42493	BH40440AE	4	6	REAL		ZINC	21 1		V	10	MG/KG
42493	BH40445AE	8	10 2	REAL		ZINC	44 6		V	10	MG/KG
42593	BH40447AE	2	4	REAL		ZINC	15 8		V	10	MG/KG
42593	BH40446AE	0	2	REAL		ZINC	45 1		JA	10	MG/KG
42593	BH40448AE	4	6	REAL		ZINC	12 4		V	10	MG/KG
42593	BH40449AE	6	8	REAL		ZINC	9 8		V	10	MG/KG
42593	BH40450AE	8	10 2	REAL		ZINC	38 6		V	10	MG/KG
42593	BH40290AE	10 2	16 8	REAL		ZINC	56 3		V	10	MG/KG
42993	BH40141AE	1	6	REAL		ZINC	37 2		V	5	MG/KG
42993	BH40094AE	1	6	DUP	BH40141AE	ZINC	45 4		V	5	MG/KG
42993	BH40144AE	7	10	REAL		ZINC	10 3		V	4	MG/KG
43193	BH40306AE	0	5	REAL		ZINC	39 6		JA	5	MG/KG
43193	BH40309AE	6	11	REAL		ZINC	12 8		V	5	MG/KG
43293	BH40041AE	0	6	REAL		ZINC	39 4 E		JA	5	MG/KG
43293	BH40044AE	6	10	REAL		ZINC	25 E		JA	4	MG/KG
43393	BH40511AE	2	4	REAL		ZINC	20 N*		JA	10	MG/KG
43393	BH40510AE	0	2	REAL		ZINC	24 6 N*		JA	10	MG/KG
43393	BH40517AE	6	7 6	REAL		ZINC	46 6 N*		JA	10	MG/KG
43393	BH40512AE	4	5 4	REAL		ZINC	12 1 N*		JA	10	MG/KG
43393	BH40324AE	7 6	12 6	REAL		ZINC	76 9 N*		JA	10	MG/KG
43493	BH40319AE	0 5	5 3	REAL		ZINC	21 5		JA	10	MG/KG
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	ZINC	28 8		JA	10	MG/KG
43493	BH40322AE	5 3	11 3	REAL		ZINC	26 8		JA	10	MG/KG
43593	BH40180AE	1	6	REAL		ZINC	85 2		V	5	MG/KG
43693	BH40518AE	0	2	REAL		ZINC	27 2		V	10	MG/KG
43693	BH40519AE	2	4	REAL		ZINC	12 4		V	10	MG/KG
43693	BH40520AE	4	6	REAL		ZINC	14 5		V	10	MG/KG
43693	BH40521AE	6	8	REAL		ZINC	9 3		V	10	MG/KG
43693	BH40522AE	8	10	REAL		ZINC	12		V	10	MG/KG
43693	BH40525AE	10	13	REAL	BH40563AE	ZINC	91 6		V	10	MG/KG
43693	BH40563AE	10	13	DUP	BH40525AE	ZINC	57 3		V	10	MG/KG
43793	BH40332AE	0	6	REAL		ZINC	51 3		V	10	MG/KG
43793	BH40335AE	6	11 5	REAL		ZINC	21 4		V	10	MG/KG
43893	BH40070AE	0	6	REAL		ZINC	27 6 E		JA	5	MG/KG
43893	BH40073AE	6	12	REAL		ZINC	9 1 E		JA	4	MG/KG
43993	BH40353AE	0	6	REAL		ZINC	15 4		JA	5	MG/KG

TABLE IL3 4-3

**SUBSURFACE SOILS AND BEDROCK
NON-RADIOLOGICAL INORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Lab Result	Lab Qual	Valid	Detect Limit	Units
44093	BH40348AE	0	6	REAL		ZINC	30 7	E	JA	5	MG/KG
44093	BH40351AE	6	10 4	REAL		ZINC	13 7		V	4	MG/KG
44193	BH40078AE	0	6	REAL		ZINC	49 7		V	4 8	MG/KG
44193	BH40081AE	6	12	REAL		ZINC	20		V	4 3	MG/KG
44193	BH40429AE	23 4	29 4	REAL		ZINC	74 5	N*	JA	10	MG/KG
44193	BH40568AE	29 4	35 4	REAL		ZINC	73 3	N*	JA	10	MG/KG
44193	BH40569AE	35 4	41 6	REAL		ZINC	130	N*	JA	10	MG/KG
44193	BH40570AE	41 6	47 6	REAL		ZINC	60 4	N*	JA	10	MG/KG
44193	BH40089AE	47 6	50 2	REAL		ZINC	160	N*	JA	10	MG/KG
44393	BH40033AE	0	5	REAL		ZINC	168	E	JA	4	MG/KG
44593	BH40001AE	0	6 2	REAL		ZINC	31 8		V	4 5	MG/KG
44593	BH40005AE	6 2	11 4	REAL		ZINC	44 5		V	4 5	MG/KG
44793	BH40133AE	0	2 5	REAL		ZINC	43 5		V	5	MG/KG
44893	BH40188AE	0	5	REAL		ZINC	67 2		V	5	MG/KG
44893	BH40191AE	6 2	12 2	REAL		ZINC	28 8		V	5	MG/KG
45693	BH40374AE	0	6	REAL		ZINC	76 2	N*	JA	10	MG/KG
45793	BH40557AE	0	4	REAL		ZINC	21 9	N*	JA	10	MG/KG
45893	BH40377AE	0	6	REAL		ZINC	31 2		V	10	MG/KG
45893	BH40380AE	6	8 7	REAL		ZINC	35 2		V	10	MG/KG
45893	BH40382AE	8 7	22	REAL		ZINC	52 1		V	10	MG/KG
46193	BH40385AE	0	6	REAL	BH40562AE	ZINC	92 8		V	10	MG/KG
46193	BH40562AE	0	6	DUP	BH40385AE	ZINC	62 7		V	10	MG/KG
46593	BH40700AE	0 75	2 75	REAL		ZINC	10 5		V	4	MG/KG
46593	BH40702AE	2 75	4 75	REAL		ZINC	8 2		V	4	MG/KG
46593	BH40703AE	4 75	6 75	REAL		ZINC	12 2		V	4	MG/KG
46593	BH40705AE	6 75	8 75	REAL		ZINC	19 6		V	4	MG/KG
46593	BH40711AE	8 75	10 7	REAL		ZINC	67 1		V	4	MG/KG
46593	BH40713AE	10 7	16 4	REAL		ZINC	53 5		V	4	MG/KG
46693	BH40715AE	0 5	2 25	REAL		ZINC	45 3		V	4	MG/KG
46693	BH40717AE	2 25	4 25	REAL		ZINC	9 5		V	4	MG/KG
46693	BH40718AE	4 6	6 6	REAL		ZINC	17 2		V	4	MG/KG
46693	BH40726AE	6 6	7 6	REAL		ZINC	21 9		V	4	MG/KG
46693	BH40728AE	8 6	14 8	REAL		ZINC	42 5		V	4	MG/KG
46793	BH40729AE	0 5	2 5	REAL		ZINC	28 3	E	Y	4	MG/KG
46793	BH40731AE	2 5	4 5	REAL		ZINC	15 8	E	Y	4	MG/KG
46793	BH40732AE	4 5	6 5	REAL		ZINC	7 2	E	Y	4	MG/KG
46793	BH40740AE	6 5	8 5	REAL		ZINC	8	E	Y	4	MG/KG
46793	BH40742AE	8 5	14 7	REAL		ZINC	68 1	E	Y	4	MG/KG
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	ZINC	71 3	E	Y	4	MG/KG
46893	BH40743AE	0 5	2 5	REAL		ZINC	23 5		Y	4	MG/KG
46893	BH40745AE	2 5	4 6	REAL		ZINC	17 3		Y	4	MG/KG
46893	BH40746AE	4 6	6 6	REAL		ZINC	12 1	B	Y	4	MG/KG
46893	BH40748AE	6 6	8 6	REAL		ZINC	19		Y	4	MG/KG
46893	BH40749AE	8 6	10 6	REAL		ZINC	10		Y	4	MG/KG
46893	BH40754AE	11 5	12 5	REAL		ZINC	16 5		Y	4	MG/KG
46993	BH40757AE	1 3	3 1	REAL		ZINC	12 2		Y	4	MG/KG
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	ZINC	13 6		Y	4	MG/KG
46993	BH40759AE	3 3	5	REAL		ZINC	9 8		Y	4	MG/KG
46993	BH40768AE	5 5	7	REAL		ZINC	49		Y	4	MG/KG
46993	BH40770AE	7 2	13 1	REAL		ZINC	13 5		Y	4	MG/KG
47093	BH40771AE	0 7	2 7	REAL		ZINC	22		Y	20	MG/KG
47093	BH40773AE	2 7	4 7	REAL		ZINC	14 9		Y	20	MG/KG
47093	BH40774AE	4 8	6 8	REAL		ZINC	12 7		Y	20	MG/KG
47093	BH40776AE	6 8	8 8	REAL		ZINC	16 6		Y	20	MG/KG

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TABLE IL3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40993	BH40201AE	0	6	REAL		AMERICIUM-241	0 25		V	0 058
40993	BH40204AE	6	10	REAL		AMERICIUM-241	0 042		V	0 028
40993	BH40206AE	10	20	REAL		AMERICIUM-241	0 003 U		V	0 004
40993	BH40415AE	20	31	REAL		AMERICIUM-241	0 002 U		V	0 004
40993	BH40416AE	31	35	REAL		AMERICIUM-241	0 013 J		V	0 01
41193	BH40049AE	0	6	REAL		AMERICIUM-241	0 29 B		V	0 052
41193	BH40052AE	6	8	REAL		AMERICIUM-241	0 005 BJ		V	0 006
41293	BH40196AE	0	3 3	REAL		AMERICIUM-241	0 35		A	0 062
41593	BH40417AE	0	2	REAL		AMERICIUM-241	0 5		V	0 076
41593	BH40418AE	2	4	REAL		AMERICIUM-241	0 12		V	0 046
41593	BH40419AE	4	6	REAL		AMERICIUM-241	0 009 J		V	0 01
41593	BH40424AE	6	7 9	REAL		AMERICIUM-241	-0 002 U		V	0 003
41693	BH40217AE	0	6	REAL		AMERICIUM-241	2 7		A	0 42
41693	BH40220AE	6	12	REAL		AMERICIUM-241	0 28		A	0 048
41793	BH40243AE	0	5	REAL		AMERICIUM-241	2 1		A	0 39
41793	BH40246AE	6	11	REAL		AMERICIUM-241	0 069		A	0 03
41993	BH40062AE	0	6	REAL		AMERICIUM-241	0 28		A	0 03
41993	BH40065AE	6	12	REAL		AMERICIUM-241	0 U		A	0 007
42093	BH40103AE	0	6	DUP	BH40483AE	AMERICIUM-241	0 27		A	0 026
42193	BH40425AE	0	2	REAL		AMERICIUM-241	0 088		A	0 026
42193	BH40426AE	2	4	REAL		AMERICIUM-241	-0 003 U		A	0 005
42193	BH40427AE	4	6	REAL		AMERICIUM-241	0 005 J		A	0 008
42193	BH40432AE	6	9 9	REAL		AMERICIUM-241	0 001 U		A	0 004
42193	BH40086AE	9 9	16	REAL		AMERICIUM-241	0 003 U		A	0 006
42193	BH40091AE	16	22	REAL		AMERICIUM-241	0 003 U		A	0 006
42193	BH40430AE	22	28 3	REAL		AMERICIUM-241	0 U		A	0 004
42193	BH40433AE	28 3	31 3	REAL		AMERICIUM-241	0 002 U		A	0 006
42293	BH40253AE	0 7	6 1	REAL		AMERICIUM-241	0 0759		V	0 0175
42293	BH40256AE	6 1	11 3	REAL		AMERICIUM-241	0 003		V	0 00346
42293	BH40258AE	11 3	12 9	REAL		AMERICIUM-241	0 0067		V	0 00508
42393	BH40261AE	0	6	REAL		AMERICIUM-241	0 69		V	0 088
42393	BH40264AE	6	8 1	REAL		AMERICIUM-241	0 063		V	0 02
42493	BH40438AE	0	2	REAL		AMERICIUM-241	1 1		V	0 25
42493	BH40439AE	2	4	REAL	BH40112AE	AMERICIUM-241	0 17		V	0 04
42493	BH40112AE	2	4	DUP	BH40439AE	AMERICIUM-241	0 17		V	0 046
42493	BH40440AE	4	6	REAL		AMERICIUM-241	0 006 U		V	0 008
42493	BH40441AE	6	8	REAL		AMERICIUM-241	0 U		V	0 006
42493	BH40445AE	8	10 2	REAL		AMERICIUM-241	0 015 J		V	0 012
42593	BH40446AE	0	2	REAL		AMERICIUM-241	0 028		V	0 014
42593	BH40447AE	2	4	REAL		AMERICIUM-241	-0 001 U		V	0 005
42593	BH40448AE	4	6	REAL		AMERICIUM-241	0 002 BJ		V	0 004
42593	BH40449AE	6	8	REAL		AMERICIUM-241	0 011 J		V	0 008
42593	BH40450AE	8	10 2	REAL		AMERICIUM-241	0 003 U		V	0 006
42593	BH40290AE	10 2	16 8	REAL		AMERICIUM-241	0 U		A	0 004
43193	BH40306AE	0	5	REAL		AMERICIUM-241	0 9		A	0 12
43193	BH40309AE	6	11	REAL		AMERICIUM-241	0 011 J		A	0 01
43393	BH40510AE	0	2	REAL		AMERICIUM-241	0 021		A	0 012
43393	BH40511AE	2	4	REAL		AMERICIUM-241	0 008 J		A	0 006
43393	BH40512AE	4	5 4	REAL		AMERICIUM-241	-0 002 U		A	0 002
43393	BH40517AE	6	7 6	REAL		AMERICIUM-241	0 005 J		A	0 006
43393	BH40324AE	7 6	12 6	REAL		AMERICIUM-241	0 U		A	0 006
43493	BH40319AE	0 5	5 3	REAL		AMERICIUM-241	0 0302		V	0 0106
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	AMERICIUM-241	0 0408		V	0 0125
43493	BH40322AE	5 3	11 3	REAL		AMERICIUM-241	0 0079		V	0 00533
43593	BH40180AE	1	6	REAL		AMERICIUM-241	4		V	0 46
43693	BH40518AE	0	2	REAL		AMERICIUM-241	2 48		A	0 266
43693	BH40519AE	2	4	REAL		AMERICIUM-241	0 0058		A	0 0052
43693	BH40520AE	4	6	REAL		AMERICIUM-241	0 0034 J		A	0 00382
43693	BH40521AE	6	8	REAL		AMERICIUM-241	0 005 U		V	0 008
43693	BH40522AE	8	10	REAL		AMERICIUM-241	0 008 J		V	0 01

TABLE II 3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
43693	BH40525AE	10	13	REAL	BH40563AE	AMERICIUM-241	0 009	J	V	0 012
43693	BH40563AE	10	13	DUP	BH40525AE	AMERICIUM-241	0 004	U	V	0 006
43793	BH40332AE	0	6	REAL		AMERICIUM-241	6 1		A	0 72
43793	BH40335AE	6	11 5	REAL		AMERICIUM-241	0 072		A	0 03
43893	BH40070AE	0	6	REAL		AMERICIUM-241	1 4	B	V	0 15
43893	BH40073AE	6	12	REAL		AMERICIUM-241	0 004	BJ	V	0 006
43993	BH40353AE	0	6	REAL		AMERICIUM-241	0 2643		A	0 0394
44093	BH40348AE	0	6	REAL		AMERICIUM-241	1 8		V	0 19
44093	BH40351AE	6	10 4	REAL		AMERICIUM-241	0 0045		A	0 00402
44793	BH40133AE	0	2 5	REAL		AMERICIUM-241	0 0509		A	0 014
46593	BH40700AE	0 75	2 75	REAL		AMERICIUM-241	0 4892		A	0 065
46593	BH40702AE	2 75	4 75	REAL		AMERICIUM-241	0 0161		Y	0 0083
46593	BH40703AE	4 75	6 75	REAL		AMERICIUM-241	0 0046	J	A	0 00486
46593	BH40705AE	6 75	8 75	REAL		AMERICIUM-241	0 0087		A	0 00641
46593	BH40711AE	8 75	10 7	REAL		AMERICIUM-241	0 0334		A	0 0117
46593	BH40713AE	10 7	16 4	REAL		AMERICIUM-241	0 0428		A	0 0128
46693	BH40715AE	0 5	2 25	REAL		AMERICIUM-241	1 8		Y	0 197
46693	BH40717AE	2 25	4 25	REAL		AMERICIUM-241	0 1607		Y	0 0284
46693	BH40718AE	4 6	6 6	REAL		AMERICIUM-241	0 0144		A	0 00755
46693	BH40726AE	6 6	7 6	REAL		AMERICIUM-241	0 0683		A	0 0172
46693	BH40728AE	8 6	14 8	REAL		AMERICIUM-241	0 0328		A	0 0118
46793	BH40729AE	0 5	2 5	REAL		AMERICIUM-241	0 1672		V	0 0311
46793	BH40731AE	2 5	4 5	REAL		AMERICIUM-241	0 0062		V	0 00524
46793	BH40732AE	4 5	6 5	REAL		AMERICIUM-241	0 0217		V	0 00969
46793	BH40740AE	6 5	8 5	REAL		AMERICIUM-241	0 0081		V	0 0069
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	AMERICIUM-241	0 046		V	0 0144
46793	BH40742AE	8 5	14 7	REAL		AMERICIUM-241	0 0101		V	0 00717
46893	BH40743AE	0 5	2 5	REAL		AMERICIUM-241	0 0166		V	0 00756
46893	BH40745AE	2 5	4 6	REAL		AMERICIUM-241	0 0063		V	0 00634
46893	BH40746AE	4 6	6 6	REAL		AMERICIUM-241	0 0018	J	V	0 00248
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	AMERICIUM-241	0 0066		V	0 00495
46893	BH40748AE	6 6	8 6	REAL		AMERICIUM-241	0 0017	J	V	0 0024
46893	BH40749AE	8 6	10 6	REAL		AMERICIUM-241	0 0059		V	0 00447
46893	BH40754AE	11 5	12 5	REAL		AMERICIUM-241	0 0488		V	0 0135
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	AMERICIUM-241	0 051		V	0 0142
46993	BH40757AE	1 3	3 1	REAL		AMERICIUM-241	0 0027	J	V	0 0035
46993	BH40759AE	3 3	5	REAL		AMERICIUM-241	0 0063		V	0 00479
46993	BH40768AE	5 5	7	REAL		AMERICIUM-241	0 0067	J	V	0 00952
46993	BH40770AE	7 2	13 1	REAL		AMERICIUM-241	0 0065		V	0 00493
47093	BH40771AE	0 7	2 7	REAL		AMERICIUM-241	0 0135		V	0 00813
47093	BH40773AE	2 7	4 7	REAL		AMERICIUM-241	0 0049	J	V	0 00468
47093	BH40774AE	4 8	6 8	REAL		AMERICIUM-241	0 0157		V	0 00835
47093	BH40776AE	6 8	8 8	REAL		AMERICIUM-241	0 0304		V	0 011

TABLE IL3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40993	BH40201AE	0	6	REAL		CESIUM-134	0		Z	
40993	BH40204AE	6	10	REAL		CESIUM-134	0		Z	
40993	BH40206AE	10	20	REAL		CESIUM-134	0		Z	
40993	BH40415AE	20	31	REAL		CESIUM-134	0		Z	
40993	BH40416AE	31	35	REAL		CESIUM-134	0		Z	
41193	BH40049AE	0	6	REAL		CESIUM-134	0 009		V	0 23
41193	BH40052AE	6	8	REAL		CESIUM-134	0 003		V	0 105
41293	BH40196AE	0	3 3	REAL		CESIUM-134	0 005		V	0 079
41593	BH40417AE	0	2	REAL		CESIUM-134	0		Z	
41593	BH40418AE	2	4	REAL		CESIUM-134	0		Z	
41593	BH40419AE	4	6	REAL		CESIUM-134	0		Z	
41593	BH40424AE	6	7 9	REAL		CESIUM-134	0		Z	
41693	BH40217AE	0	6	REAL		CESIUM-134	0 007		V	0 096
41693	BH40220AE	6	12	REAL		CESIUM-134	0 005		V	0 08
41793	BH40243AE	0	5	REAL		CESIUM-134	0 005		V	0 082
41793	BH40246AE	6	11	REAL		CESIUM-134	0 005		V	0 078
41993	BH40062AE	0	6	REAL		CESIUM-134	0			
41993	BH40065AE	6	12	REAL		CESIUM-134	0			
42093	BH40103AE	0	6	DUP	BH40483AE	CESIUM-134	0			
42193	BH40425AE	0	2	REAL		CESIUM-134	0		Z	
42193	BH40426AE	2	4	REAL		CESIUM-134	0		Z	
42193	BH40427AE	4	6	REAL		CESIUM-134	0		Z	
42193	BH40432AE	6	9 9	REAL		CESIUM-134	0		Z	
42193	BH40086AE	9 9	16	REAL		CESIUM-134	0		Z	
42193	BH40091AE	16	22	REAL		CESIUM-134	0		Z	
42193	BH40430AE	22	28 3	REAL		CESIUM-134	0		Z	
42193	BH40433AE	28 3	31 3	REAL		CESIUM-134	0		Z	
42293	BH40253AE	0 7	6 1	REAL		CESIUM-134	0 0003	J	Z	0 0221
42293	BH40256AE	6 1	11 3	REAL		CESIUM-134	0 0053	J	Z	0 0312
42293	BH40258AE	11 3	12 9	REAL		CESIUM-134	0 0021	J	Z	0 0243
42393	BH40261AE	0	6	REAL		CESIUM-134	0		Z	
42393	BH40264AE	6	8 1	REAL		CESIUM-134	0		Z	
42493	BH40438AE	0	2	REAL		CESIUM-134	0		Z	
42493	BH40112AE	2	4	DUP	BH40439AE	CESIUM-134	0		Z	
42493	BH40439AE	2	4	REAL	BH40112AE	CESIUM-134	0		Z	
42493	BH40440AE	4	6	REAL		CESIUM-134	0		Z	
42493	BH40441AE	6	8	REAL		CESIUM-134	0		Z	
42493	BH40445AE	8	10 2	REAL		CESIUM-134	0		Z	
42593	BH40446AE	0	2	REAL		CESIUM-134	0		Z	
42593	BH40447AE	2	4	REAL		CESIUM-134	0		Z	
42593	BH40448AE	4	6	REAL		CESIUM-134	0		Z	
42593	BH40449AE	6	8	REAL		CESIUM-134	0		Z	
42593	BH40450AE	8	10 2	REAL		CESIUM-134	0		Z	
42593	BH40290AE	10 2	16 8	REAL		CESIUM-134	0		Z	
43193	BH40306AE	0	5	REAL		CESIUM-134	0 005		V	0 076
43193	BH40309AE	6	11	REAL		CESIUM-134	0 007		V	0 098
43393	BH40510AE	0	2	REAL		CESIUM-134	0		Z	
43393	BH40511AE	2	4	REAL		CESIUM-134	0		Z	
43393	BH40512AE	4	5 4	REAL		CESIUM-134	0		Z	
43393	BH40517AE	6	7 6	REAL		CESIUM-134	0		Z	
43393	BH40324AE	7 6	12 6	REAL		CESIUM-134	0		Z	
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	CESIUM-134	0 0279	J	Z	0 0207
43493	BH40319AE	0 5	5 3	REAL		CESIUM-134	-0 007	J	Z	0 025
43493	BH40322AE	5 3	11 3	REAL		CESIUM-134	0 0103	J	Z	0 0207
43593	BH40180AE	1	6	REAL		CESIUM-134	0		Z	
43693	BH40521AE	6	8	REAL		CESIUM-134	0		Z	
43693	BH40522AE	8	10	REAL		CESIUM-134	0		Z	
43693	BH40563AE	10	13	DUP	BH40525AE	CESIUM-134	0		Z	
43693	BH40525AE	10	13	REAL	BH40563AE	CESIUM-134	0		Z	
43793	BH40332AE	0	6	REAL		CESIUM-134	0 005		V	0 085

TABLE II.3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
43793	BH40335AE	6	11 5	REAL		CESIUM-134	0 007		V	0 098
43893	BH40070AE	0	6	REAL		CESIUM-134	0 003		V	0 102
43893	BH40073AE	6	12	REAL		CESIUM-134	0 003		V	0 102
44093	BH40348AE	0	6	REAL		CESIUM-134	0		Z	
46593	BH40700AE	0 75	2 75	REAL		CESIUM-134	-0 0064	J	V	0 0134
46593	BH40702AE	2 75	4 75	REAL		CESIUM-134	0 0035	J	Y	0 0135
46593	BH40703AE	4 75	6 75	REAL		CESIUM-134	0 0007	J	V	0 0132
46593	BH40705AE	6 75	8 75	REAL		CESIUM-134	-0 0117	J	V	0 0173
46593	BH40711AE	8 75	10 7	REAL		CESIUM-134	0 0085	J	V	0 0148
46593	BH40713AE	10 7	16 4	REAL		CESIUM-134	-0 0224	J	V	0 0246
46693	BH40715AE	0 5	2 25	REAL		CESIUM-134	-0 0002	J	Y	0 0151
46693	BH40717AE	2 25	4 25	REAL		CESIUM-134	-0 007	J	Y	0 0128
46693	BH40718AE	4 6	6 6	REAL		CESIUM-134	-0 0059	J	V	0 0163
46693	BH40726AE	6 6	7 6	REAL		CESIUM-134	-0 0093	J	V	0 0177
46693	BH40728AE	8 6	14 8	REAL		CESIUM-134	-0 0147	J	V	0 0175
46793	BH40729AE	0 5	2 5	REAL		CESIUM-134	-0 0017	J	V	0 0144
46793	BH40731AE	2 5	4 5	REAL		CESIUM-134	-0 0043	J	V	0 0147
46793	BH40732AE	4 5	6 5	REAL		CESIUM-134	0 0097	X	V	0 0145
46793	BH40740AE	6 5	8 5	REAL		CESIUM-134	0 0108	X	V	0 0142
46793	BH40742AE	8 5	14 7	REAL		CESIUM-134	0 0077	J	V	0 0138
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	CESIUM-134	0 0136	X	V	0 015
46893	BH40826AE	N/A		RNS		CESIUM-134	-0 32	J	Y	0 563
46893	BH40743AE	0 5	2 5	REAL		CESIUM-134	0 0025	J	V	0 0124
46893	BH40745AE	2 5	4 6	REAL		CESIUM-134	0 0122	J	V	0 0118
46893	BH40746AE	4 6	6 6	REAL		CESIUM-134	-0 0138	J	V	0 0124
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	CESIUM-134	-0 0095	J	V	0 0126
46893	BH40748AE	6 6	8 6	REAL		CESIUM-134	-0 0044	J	V	0 0135
46893	BH40749AE	8 6	10 6	REAL		CESIUM-134	-0 0043	J	V	0 013
46893	BH40754AE	11 5	12 5	REAL		CESIUM-134	-0 0172	J	V	0 0176
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	CESIUM-134	0 0105	J	V	0 0131
46993	BH40757AE	1 3	3 1	REAL		CESIUM-134	0 0123	J	V	0 0122
46993	BH40759AE	3 3	5	REAL		CESIUM-134	-0 0076	J	V	0 0122
46993	BH40768AE	5 5	7	REAL		CESIUM-134	-0 0315	J	V	0 0198
46993	BH40770AE	7 2	13 1	REAL		CESIUM-134	-0 0057	J	V	0 0136
47093	BH40771AE	0 7	2 7	REAL		CESIUM-134	-0 0075	J	V	0 0134
47093	BH40773AE	2 7	4 7	REAL		CESIUM-134	0 0027	X	V	0 0127
47093	BH40774AE	4 8	6 8	REAL		CESIUM-134	0 0116	X	V	0 0137
47093	BH40776AE	6 8	8 8	REAL		CESIUM-134	-0 0013	J	V	0 0101

TABLE IL3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40993	BH40201AE	0	6	REAL		CESIUM-137	0 004		V	0 11
40993	BH40204AE	6	10	REAL		CESIUM-137	0 002		V	0 07
40993	BH40206AE	10	20	REAL		CESIUM-137	0 002		V	0 07
40993	BH40415AE	20	31	REAL		CESIUM-137	0 002		V	0 1
40993	BH40416AE	31	35	REAL		CESIUM-137	0 002		V	0 07
41193	BH40049AE	0	6	REAL		CESIUM-137	0 21	U	V	0 29
41193	BH40052AE	6	8	REAL		CESIUM-137	0 003		V	0 11
41293	BH40196AE	0	3 3	REAL		CESIUM-137	0 16	U	V	0 16
41593	BH40417AE	0	2	REAL		CESIUM-137	0 01		V	0 14
41593	BH40418AE	2	4	REAL		CESIUM-137	0 01		V	0 12
41593	BH40419AE	4	6	REAL		CESIUM-137	0 01		V	0 12
41593	BH40424AE	6	7 9	REAL		CESIUM-137	0 003		V	0 07
41693	BH40217AE	0	6	REAL		CESIUM-137	0 087	U	V	0 15
41693	BH40220AE	6	12	REAL		CESIUM-137	0 004		V	0 103
41793	BH40243AE	0	5	REAL		CESIUM-137	0 42	J	V	0 15
41793	BH40246AE	6	11	REAL		CESIUM-137	0 004		V	0 106
41993	BH40062AE	0	6	REAL		CESIUM-137	0			
41993	BH40065AE	6	12	REAL		CESIUM-137	0			
42093	BH40103AE	0	6	DUP	BH40483AE	CESIUM-137	0			
42193	BH40425AE	0	2	REAL		CESIUM-137	0 01		V	0 16
42193	BH40426AE	2	4	REAL		CESIUM-137	0 003		V	0 07
42193	BH40427AE	4	6	REAL		CESIUM-137	0 003		V	0 07
42193	BH40432AE	6	9 9	REAL		CESIUM-137	0 003		V	0 08
42193	BH40086AE	9 9	16	REAL		CESIUM-137	0		V	0 09
42193	BH40091AE	16	22	REAL		CESIUM-137	0		V	0 1
42193	BH40430AE	22	28 3	REAL		CESIUM-137	0		V	0 09
42193	BH40433AE	28 3	31 3	REAL		CESIUM-137	0		V	0 06
42293	BH40253AE	0 7	6 1	REAL		CESIUM-137	0 0021	J	A	0 0232
42293	BH40256AE	6 1	11 3	REAL		CESIUM-137	-0 0138	J	A	0 0303
42293	BH40258AE	11 3	12 9	REAL		CESIUM-137	0 0074	J	A	0 0233
42393	BH40261AE	0	6	REAL		CESIUM-137	0 003		V	0 12
42393	BH40264AE	6	8 1	REAL		CESIUM-137	0 003		V	0 1
42493	BH40438AE	0	2	REAL		CESIUM-137	0 003		V	0 11
42493	BH40112AE	2	4	DUP	BH40439AE	CESIUM-137	0 003		V	0 8
42493	BH40439AE	2	4	REAL	BH40112AE	CESIUM-137	0 003		V	0 1
42493	BH40440AE	4	6	REAL		CESIUM-137	0 003		V	0 11
42493	BH40441AE	6	8	REAL		CESIUM-137	0 003		V	0 11
42493	BH40445AE	8	10 2	REAL		CESIUM-137	0 003		V	0 11
42593	BH40446AE	0	2	REAL		CESIUM-137	0		V	0 09
42593	BH40447AE	2	4	REAL		CESIUM-137	0 1	U	V	0 08
42593	BH40448AE	4	6	REAL		CESIUM-137	0		V	0 08
42593	BH40449AE	6	8	REAL		CESIUM-137	0		V	0 06
42593	BH40450AE	8	10 2	REAL		CESIUM-137	0 01		V	0 08
42593	BH40290AE	10 2	16 8	REAL		CESIUM-137	0		V	0 08
43193	BH40306AE	0	5	REAL		CESIUM-137	0 16	U	V	0 13
43193	BH40309AE	6	11	REAL		CESIUM-137	0 002		V	0 071
43393	BH40510AE	0	2	REAL		CESIUM-137	0 01		V	0 12
43393	BH40511AE	2	4	REAL		CESIUM-137	0 01		V	0 13
43393	BH40512AE	4	5 4	REAL		CESIUM-137	0 01		V	0 12
43393	BH40517AE	6	7 6	REAL		CESIUM-137	0 01		V	0 12
43393	BH40324AE	7 6	12 6	REAL		CESIUM-137	0 01		V	0 13
43493	BH40319AE	0 5	5 3	REAL		CESIUM-137	-0 0045	J	A	0 0328
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	CESIUM-137	0 0227	J	A	0 0271
43493	BH40322AE	5 3	11 3	REAL		CESIUM-137	0 0267	J	A	0 0213
43593	BH40180AE	1	6	REAL		CESIUM-137	0 003		V	0 07
43693	BH40518AE	0	2	REAL		CESIUM-137	0 1382	X	A	0 0398
43693	BH40519AE	2	4	REAL		CESIUM-137	-0 0022	J	A	0 028
43693	BH40520AE	4	6	REAL		CESIUM-137	-0 0037	J	A	0 0349
43693	BH40521AE	6	8	REAL		CESIUM-137	0 003		V	0 1
43693	BH40522AE	8	10	REAL		CESIUM-137	0 003		V	0 11

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TABLE II 3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
43693	BH40525AE	10	13	REAL	BH40563AE	CESIUM-137	0 003		V	0 07
43693	BH40563AE	10	13	DUP	BH40525AE	CESIUM-137	0 003		V	0 1
43793	BH40332AE	0	6	REAL		CESIUM-137	0 4	J	V	0 25
43793	BH40335AE	6	11 5	REAL		CESIUM-137	0 002		V	0 069
43893	BH40070AE	0	6	REAL		CESIUM-137	0 003		V	0 11
43893	BH40073AE	6	12	REAL		CESIUM-137	0 003		V	0 11
43993	BH40353AE	0	6	REAL		CESIUM-137	0 014	J	A	0 0348
44093	BH40348AE	0	6	REAL		CESIUM-137	0 003		V	0 11
44093	BH40351AE	6	10 4	REAL		CESIUM-137	-0 0177	J	A	0 0298
44793	BH40133AE	0	2 5	REAL		CESIUM-137	0 1506	X	A	0 0785
46593	BH40700AE	0 75	2 75	REAL		CESIUM-137	0 0033	J	V	0 0129
46593	BH40702AE	2 75	4 75	REAL		CESIUM-137	0 0052	J	Y	0 0142
46593	BH40703AE	4 75	6 75	REAL		CESIUM-137	0 0025	J	V	0 0133
46593	BH40705AE	6 75	8 75	REAL		CESIUM-137	0 0119	J	V	0 0174
46593	BH40711AE	8 75	10 7	REAL		CESIUM-137	-0 0119	J	V	0 0165
46593	BH40713AE	10 7	16 4	REAL		CESIUM-137	-0 0013	J	V	0 0224
46693	BH40715AE	0 5	2 25	REAL		CESIUM-137	0 03	J	Y	0 0178
46693	BH40717AE	2 25	4 25	REAL		CESIUM-137	-0 0177	J	Y	0 0137
46693	BH40718AE	4 6	6 6	REAL		CESIUM-137	0 0121	J	V	0 0157
46693	BH40726AE	6 6	7 6	REAL		CESIUM-137	0 006	J	V	0 0188
46693	BH40728AE	8 6	14 8	REAL		CESIUM-137	-0 0378	J	V	0 0177
46793	BH40729AE	0 5	2 5	REAL		CESIUM-137	0 0112	J	V	0 0157
46793	BH40731AE	2 5	4 5	REAL		CESIUM-137	0 0158	X	V	0 0141
46793	BH40732AE	4 5	6 5	REAL		CESIUM-137	-0 0042	J	V	0 0144
46793	BH40740AE	6 5	8 5	REAL		CESIUM-137	0 0066	X	V	0 0159
46793	BH40742AE	8 5	14 7	REAL		CESIUM-137	-0 005	J	V	0 0157
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	CESIUM-137	-0 0119	J	V	0 0167
46893	BH40826AE	N/A		RNS		CESIUM-137	-0 439	J	Y	0 596
46893	BH40743AE	0 5	2 5	REAL		CESIUM-137	0 0057	J	V	0 0128
46893	BH40745AE	2 5	4 6	REAL		CESIUM-137	0 0121	J	V	0 0121
46893	BH40746AE	4 6	6 6	REAL		CESIUM-137	-0 018	J	V	0 0127
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	CESIUM-137	-0 0025	J	V	0 0131
46893	BH40748AE	6 6	8 6	REAL		CESIUM-137	-0 0119	J	V	0 0136
46893	BH40749AE	8 6	10 6	REAL		CESIUM-137	-0 0023	J	V	0 0125
46893	BH40754AE	11 5	12 5	REAL		CESIUM-137	-0 0189	J	V	0 0175
46993	BH40757AE	1 3	3 1	REAL		CESIUM-137	-0 0128	J	V	0 0144
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	CESIUM-137	-0 006	J	V	0 0152
46993	BH40759AE	3 3	5	REAL		CESIUM-137	0 0058	X	V	0 0124
46993	BH40768AE	5 5	7	REAL		CESIUM-137	-0 0285	J	V	0 0196
46993	BH40770AE	7 2	13 1	REAL		CESIUM-137	0 0122	X	V	0 0127
47093	BH40771AE	0 7	2 7	REAL		CESIUM-137	-0 0108	J	V	0 0147
47093	BH40773AE	2 7	4 7	REAL		CESIUM-137	0 0151	X	V	0 0138
47093	BH40774AE	4 8	6 8	REAL		CESIUM-137	-0 003	J	V	0 0147
47093	BH40776AE	6 8	8 8	REAL		CESIUM-137	0 0003	X	V	0 0102

TABLE IL3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40093	BH40170AE	6	8.4	REAL		GROSS BETA	20		A	4.5
40193	BH40488AE	0	6	REAL		GROSS BETA	20.4		A	4.7
40193	BH40490AE	6	12	REAL		GROSS BETA	24.2		A	5.3
40193	BH40495AE	18	24	REAL		GROSS BETA	22.3		A	5
40293	BH40118AE	0	2.9	REAL		GROSS BETA	37		A	5.2
40393	BH40123AE	0	5	REAL		GROSS BETA	27	B	A	4.4
40593	BH40128AE	0	5	REAL		GROSS BETA	26	B	A	4.6
40593	BH40131AE	6	11	REAL		GROSS BETA	24	B	A	4.4
40593	BH40365AE	12	18	REAL		GROSS BETA	26	B	A	4.8
40593	BH40400AE	18	24	REAL		GROSS BETA	29		A	4.7
40793	BH40413AE	0	5	REAL	BH40157AE	GROSS BETA	22		V	4.6
40793	BH40157AE	0	5	REAL		GROSS BETA	19		V	4.4
40793	BH40160AE	6	8.1	REAL		GROSS BETA	18		V	4
40793	BH40414AE	8.1	13	REAL		GROSS BETA	23		V	4.4
40893	BH40030AE	0	7	REAL		GROSS BETA	22.4		A	5
40993	BH40201AE	0	6	REAL		GROSS BETA	35		V	5.1
40993	BH40204AE	6	10	REAL		GROSS BETA	31		V	4.8
40993	BH40206AE	10	20	REAL		GROSS BETA	12		V	3.8
40993	BH40415AE	20	31	REAL		GROSS BETA	19		V	4.1
40993	BH40416AE	31	35	REAL		GROSS BETA	15		V	4.6
41193	BH40049AE	0	6	REAL		GROSS BETA	33	B	A	4.7
41193	BH40052AE	6	8	REAL		GROSS BETA	42	B	A	5.3
41293	BH40196AE	0	3.3	REAL		GROSS BETA	21		V	4.7
41593	BH40417AE	0	2	REAL		GROSS BETA	46		V	5
41593	BH40418AE	2	4	REAL		GROSS BETA	40		V	4.9
41593	BH40419AE	4	6	REAL		GROSS BETA	24		V	3.8
41593	BH40424AE	6	7.9	REAL		GROSS BETA	21		V	3.9
41693	BH40217AE	0	6	REAL		GROSS BETA	33		V	4.4
41693	BH40220AE	6	12	REAL		GROSS BETA	28		V	4.5
41793	BH40243AE	0	5	REAL		GROSS BETA	24		V	4.3
41793	BH40246AE	6	11	REAL		GROSS BETA	30		V	4.5
41993	BH40062AE	0	6	REAL		GROSS BETA	15		V	2.3
41993	BH40065AE	6	12	REAL		GROSS BETA	13		V	2.3
42093	BH40103AE	0	6	DUP	BH40483AE	GROSS BETA	22		V	2.8
42093	BH40483AE	0	6	REAL		GROSS BETA	30.27		V	3.42
42193	BH40425AE	0	2	REAL		GROSS BETA	35		V	4.4
42193	BH40426AE	2	4	REAL		GROSS BETA	21		V	4.3
42193	BH40427AE	4	6	REAL		GROSS BETA	30		V	4.3
42193	BH40432AE	6	9.9	REAL		GROSS BETA	10		V	3.7
42193	BH40086AE	9.9	16	REAL		GROSS BETA	13		V	4.1
42193	BH40091AE	16	22	REAL		GROSS BETA	21		V	4.8
42193	BH40430AE	22	28.3	REAL		GROSS BETA	18		V	4.1
42193	BH40433AE	28.3	31.3	REAL		GROSS BETA	25		V	4.2
42293	BH40253AE	0.7	6.1	REAL		GROSS BETA	45.04		V	4.43
42293	BH40256AE	6.1	11.3	REAL		GROSS BETA	33.77		V	3.63
42293	BH40258AE	11.3	12.9	REAL		GROSS BETA	19.45		V	2.65
42393	BH40261AE	0	6	REAL		GROSS BETA	50		A	6
42393	BH40264AE	6	8.1	REAL		GROSS BETA	55		A	5.7
42493	BH40438AE	0	2	REAL		GROSS BETA	21		A	3.8
42493	BH40112AE	2	4	DUP	BH40439AE	GROSS BETA	15		A	3.6
42493	BH40439AE	2	4	REAL	BH40112AE	GROSS BETA	20		A	4.2
42493	BH40440AE	4	6	REAL		GROSS BETA	31		A	4.4
42493	BH40441AE	6	8	REAL		GROSS BETA	28		A	4.5
42493	BH40445AE	8	10.2	REAL		GROSS BETA	16		A	4.1
42593	BH40446AE	0	2	REAL		GROSS BETA	52		V	4.5
42593	BH40447AE	2	4	REAL		GROSS BETA	26		V	3.7
42593	BH40448AE	4	6	REAL		GROSS BETA	32		V	4.1
42593	BH40449AE	6	8	REAL		GROSS BETA	28		V	4.2
42593	BH40450AE	8	10.2	REAL		GROSS BETA	13		V	3.5
42593	BH40290AE	10.2	16.8	REAL		GROSS BETA	16		V	4.1

TABLE II.3-4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
42993	BH40141AE	1	6	REAL		GROSS BETA	31.9		A	6.8
42993	BH40094AE	1	6	DUP	BH40141AE	GROSS BETA	21		A	4.8
42993	BH40144AE	7	10	REAL		GROSS BETA	22		A	5
43193	BH40306AE	0	5	REAL		GROSS BETA	36		V	5.1
43193	BH40309AE	6	11	REAL		GROSS BETA	37		V	5.2
43293	BH40041AE	0	6	REAL		GROSS BETA	40		A	5
43293	BH40044AE	6	10	REAL		GROSS BETA	45		A	5
43393	BH40510AE	0	2	REAL		GROSS BETA	30		V	4.5
43393	BH40511AE	2	4	REAL		GROSS BETA	45		V	4.9
43393	BH40512AE	4	5.4	REAL		GROSS BETA	23		V	3.5
43393	BH40517AE	6	7.6	REAL		GROSS BETA	27		V	4.6
43393	BH40324AE	7.6	12.6	REAL		GROSS BETA	22		V	3.7
43493	BH40573AE	0.5	5.3	DUP	BH40319AE	GROSS BETA	15.55		V	2.37
43493	BH40319AE	0.5	5.3	REAL		GROSS BETA	18.07		V	2.53
43493	BH40322AE	5.3	11.3	REAL		GROSS BETA	16.72		V	2.47
43593	BH40180AE	1	6	REAL		GROSS BETA	46		A	5.8
43693	BH40518AE	0	2	REAL		GROSS BETA	31.42		V	3.49
43693	BH40519AE	2	4	REAL		GROSS BETA	22.04		V	2.83
43693	BH40520AE	4	6	REAL		GROSS BETA	26.58		V	3.15
43693	BH40521AE	6	8	REAL		GROSS BETA	22		A	3.5
43693	BH40522AE	8	10	REAL		GROSS BETA	20		A	4.3
43693	BH40563AE	10	13	DUP	BH40525AE	GROSS BETA	41		A	5.2
43693	BH40525AE	10	13	REAL	BH40563AE	GROSS BETA	21		A	4.4
43793	BH40332AE	0	6	REAL		GROSS BETA	37		V	4.9
43793	BH40335AE	6	11.5	REAL		GROSS BETA	35		V	4.9
43893	BH40070AE	0	6	REAL		GROSS BETA	16	B	A	4.7
43893	BH40073AE	6	12	REAL		GROSS BETA	34	B	A	5
43993	BH40353AE	0	6	REAL		GROSS BETA	18.29		V	2.54
44093	BH40348AE	0	6	REAL		GROSS BETA	42		A	5.3
44093	BH40351AE	6	10.4	REAL		GROSS BETA	17.42		V	2.51
44193	BH40078AE	0	6	REAL		GROSS BETA	20.6		A	4.7
44193	BH40081AE	6	12	REAL		GROSS BETA	30.9		A	6.6
44193	BH40429AE	23.4	29.4	REAL		GROSS BETA	19		V	4
44193	BH40568AE	29.4	35.4	REAL		GROSS BETA	24		V	4.2
44193	BH40569AE	35.4	41.6	REAL		GROSS BETA	27		V	4
44193	BH40570AE	41.6	47.6	REAL		GROSS BETA	27		V	4.3
44193	BH40089AE	47.6	50.2	REAL		GROSS BETA	18		V	3.8
44393	BH40033AE	0	5	REAL		GROSS BETA	30	B	A	5
44593	BH40001AE	0	6.2	REAL		GROSS BETA	25.5		A	5.6
44593	BH40005AE	6.2	11.4	REAL		GROSS BETA	21		A	4.7
44793	BH40133AE	0	2.5	REAL		GROSS BETA	26.87		V	3.17
44893	BH40188AE	0	5	REAL		GROSS BETA	24.1		A	5.3
44893	BH40191AE	6.2	12.2	REAL		GROSS BETA	30.3		A	6.5
45693	BH40374AE	0	6	REAL		GROSS BETA	22		V	4.1
45793	BH40557AE	0	4	REAL		GROSS BETA	19		V	3.5
45893	BH40377AE	0	6	REAL		GROSS BETA	20.95		V	2.76
45893	BH40380AE	6	8.7	REAL		GROSS BETA	22.6		V	2.88
45893	BH40382AE	8.7	22	REAL		GROSS BETA	22.62		V	2.86
46193	BH40562AE	0	6	DUP	BH40385AE	GROSS BETA	11		V	3.7
46193	BH40385AE	0	6	REAL	BH40562AE	GROSS BETA	24		V	3.8
46593	BH40700AE	0.75	2.75	REAL		GROSS BETA	19.39		V	2.62
46593	BH40702AE	2.75	4.75	REAL		GROSS BETA	25.47		Y	3.06
46593	BH40703AE	4.75	6.75	REAL		GROSS BETA	31.07		V	3.47
46593	BH40705AE	6.75	8.75	REAL		GROSS BETA	24.33		V	2.98
46593	BH40711AE	8.75	10.7	REAL		GROSS BETA	27.11		V	3.18
46593	BH40713AE	10.7	16.4	REAL		GROSS BETA	26.47		V	3.16
46693	BH40715AE	0.5	2.25	REAL		GROSS BETA	45.96		Y	4.49
46693	BH40717AE	2.25	4.25	REAL		GROSS BETA	35.32		Y	3.74
46693	BH40718AE	4.6	6.6	REAL		GROSS BETA	33.04		V	3.58
46693	BH40726AE	6.6	7.6	REAL		GROSS BETA	32.41		V	3.54

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TABLE II.3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
46693	BH40728AE	8 6	14 8	REAL		GROSS BETA	37 96		V	3 94
46793	BH40729AE	0 5	2 5	REAL		GROSS BETA	23 28		V	2 97
46793	BH40731AE	2 5	4 5	REAL		GROSS BETA	17 19		V	2 46
46793	BH40732AE	4 5	6 5	REAL		GROSS BETA	12 44		V	2 16
46793	BH40740AE	6 5	8 5	REAL		GROSS BETA	23 17		V	2 9
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	GROSS BETA	29 16		V	3 31
46793	BH40742AE	8 5	14 7	REAL		GROSS BETA	28 18		V	3 24
46893	BH40743AE	0 5	2 5	REAL		GROSS BETA	16 96		V	2 46
46893	BH40745AE	2 5	4 6	REAL		GROSS BETA	16 25		V	2 44
46893	BH40746AE	4 6	6 6	REAL		GROSS BETA	15 43		V	2 36
46893	BH40748AE	6 6	8 6	REAL		GROSS BETA	29 98		V	3 39
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	GROSS BETA	24 52		V	3 03
46893	BH40749AE	8 6	10 6	REAL		GROSS BETA	23 54		V	2 95
46893	BH40754AE	11 5	12 5	REAL		GROSS BETA	27 57		V	3 24
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	GROSS BETA	49 18		V	4 69
46993	BH40757AE	1 3	3 1	REAL		GROSS BETA	42 61		V	4 26
46993	BH40759AE	3 3	5	REAL		GROSS BETA	32 09		V	3 55
46993	BH40768AE	5 5	7	REAL		GROSS BETA	37 92		V	3 93
46993	BH40770AE	7 2	13 1	REAL		GROSS BETA	22 87		V	2 9
47093	BH40771AE	0 7	2 7	REAL		GROSS BETA	21 16		V	2 79
47093	BH40773AE	2 7	4 7	REAL		GROSS BETA	14 26		V	2 22
47093	BH40774AE	4 8	6 8	REAL		GROSS BETA	33 22		V	3 61
47093	BH40776AE	6 8	8 8	REAL		GROSS BETA	14 45		V	2 29

TABLE II.3-4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40993	BH40201AE	0	6	REAL		PLUTONIUM-239/	1 6		A	0 24
40993	BH40204AE	6	10	REAL		PLUTONIUM-239/	0 039		A	0 022
40993	BH40206AE	10	20	REAL		PLUTONIUM-239/	0 007	J	A	0 008
40993	BH40415AE	20	31	REAL		PLUTONIUM-239/	0 009	J	A	0 008
40993	BH40416AE	31	35	REAL		PLUTONIUM-239/	0 004	U	A	0 001
41193	BH40049AE	0	6	REAL		PLUTONIUM-239/	0 39		V	0 11
41193	BH40052AE	6	8	REAL		PLUTONIUM-239/	0 83		V	0 18
41293	BH40196AE	0	3 3	REAL		PLUTONIUM-239/	0 28		V	0 066
41593	BH40417AE	0	2	REAL		PLUTONIUM-239/	1		V	0 16
41593	BH40418AE	2	4	REAL		PLUTONIUM-239/	0 037		V	0 032
41593	BH40419AE	4	6	REAL		PLUTONIUM-239/	0 01	J	V	0 01
41593	BH40424AE	6	7 9	REAL		PLUTONIUM-239/	0	U	V	0 004
41693	BH40217AE	0	6	REAL		PLUTONIUM-239/	3		V	0 4
41693	BH40220AE	6	12	REAL		PLUTONIUM-239/	0 29		V	0 07
41793	BH40243AE	0	5	REAL		PLUTONIUM-239/	2 9		V	0 64
41793	BH40246AE	6	11	REAL		PLUTONIUM-239/	0 013	J	V	0 01
41993	BH40062AE	0	6	REAL		PLUTONIUM-239/	0 18		A	0 022
41993	BH40065AE	6	12	REAL		PLUTONIUM-239/	0 005	J	A	0 004
42093	BH40103AE	0	6	DUP	BH40483AE	PLUTONIUM-239/	1 3		A	0 095
42193	BH40425AE	0	2	REAL		PLUTONIUM-239/	0 058	B	A	0 028
42193	BH40426AE	2	4	REAL		PLUTONIUM-239/	0	U	A	0 003
42193	BH40427AE	4	6	REAL		PLUTONIUM-239/	-0 001	U	A	0 004
42193	BH40432AE	6	9 9	REAL		PLUTONIUM-239/	0 001	U	A	0 004
42193	BH40086AE	9 9	16	REAL		PLUTONIUM-239/	0 007	J	V	0 008
42193	BH40091AE	16	22	REAL		PLUTONIUM-239/	0 002	J	V	0 004
42193	BH40430AE	22	28 3	REAL		PLUTONIUM-239/	0	U	V	0 004
42193	BH40433AE	28 3	31 3	REAL		PLUTONIUM-239/	0 003	J	V	0 004
42293	BH40253AE	0 7	6 1	REAL		PLUTONIUM-239/	0 4016		A	0 0552
42293	BH40256AE	6 1	11 3	REAL		PLUTONIUM-239/	0 0116		A	0 00706
42293	BH40258AE	11 3	12 9	REAL		PLUTONIUM-239/	0 0138		V	0 00802
42393	BH40261AE	0	6	REAL		PLUTONIUM-239/	0 75	B	A	0 13
42393	BH40264AE	6	8 1	REAL		PLUTONIUM-239/	0 15	B	A	0 066
42493	BH40438AE	0	2	REAL		PLUTONIUM-239/	0 11		V	0 032
42493	BH40112AE	2	4	DUP	BH40439AE	PLUTONIUM-239/	0	U	V	0 004
42493	BH40439AE	2	4	REAL	BH40112AE	PLUTONIUM-239/	0 005	J	V	0 006
42493	BH40440AE	4	6	REAL		PLUTONIUM-239/	0 002	U	V	0 004
42493	BH40441AE	6	8	REAL		PLUTONIUM-239/	0 006	J	V	0 008
42493	BH40445AE	8	10 2	REAL		PLUTONIUM-239/	0 002	U	V	0 004
42593	BH40446AE	0	2	REAL		PLUTONIUM-239/	0 29		V	0 064
42593	BH40447AE	2	4	REAL		PLUTONIUM-239/	0 046		V	0 026
42593	BH40448AE	4	6	REAL		PLUTONIUM-239/	-0 001	U	V	0 004
42593	BH40449AE	6	8	REAL		PLUTONIUM-239/	0 018	J	V	0 01
42593	BH40450AE	8	10 2	REAL		PLUTONIUM-239/	-0 001	U	V	0 005
42593	BH40290AE	10 2	16 8	REAL		PLUTONIUM-239/	0 001	U	V	0 004
43193	BH40306AE	0	5	REAL		PLUTONIUM-239/	1 3		V	0 18
43193	BH40309AE	6	11	REAL		PLUTONIUM-239/	0 005	U	V	0 008
43393	BH40510AE	0	2	REAL		PLUTONIUM-239/	0 098	B	A	0 032
43393	BH40511AE	2	4	REAL		PLUTONIUM-239/	0 001	U	A	0 004
43393	BH40512AE	4	5 4	REAL		PLUTONIUM-239/	0 009	BJ	A	0 014
43393	BH40517AE	6	7 6	REAL		PLUTONIUM-239/	-0 004	U	A	0 001
43393	BH40324AE	7 6	12 6	REAL		PLUTONIUM-239/	0	U	A	0 01
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	PLUTONIUM-239/	0 2091		V	0 0363
43493	BH40319AE	0 5	5 3	REAL		PLUTONIUM-239/	0 2417		V	0 0421
43493	BH40322AE	5 3	11 3	REAL		PLUTONIUM-239/	0 0127		V	0 00802
43593	BH40180AE	1	6	REAL		PLUTONIUM-239/	25	B	A	2 9
43693	BH40518AE	0	2	REAL		PLUTONIUM-239/	0 9876		A	0 144
43693	BH40519AE	2	4	REAL		PLUTONIUM-239/	0 002	J	A	0 00912
43693	BH40520AE	4	6	REAL		PLUTONIUM-239/	0 0052	J	A	0 00916
43693	BH40521AE	6	8	REAL		PLUTONIUM-239/	-0 001	U	V	0 003
43693	BH40522AE	8	10	REAL		PLUTONIUM-239/	-0 001	U	V	0 004

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TABLE II.3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
43693	BH40563AE	10	13	DUP	BH40525AE	PLUTONIUM-239/	0 002	J	V	0 004
43693	BH40525AE	10	13	REAL	BH40563AE	PLUTONIUM-239/	0 003	J	V	0 004
43793	BH40332AE	0	6	REAL		PLUTONIUM-239/	4		V	0 49
43793	BH40335AE	6	11 5	REAL		PLUTONIUM-239/	0 026	J	V	0 014
43893	BH40070AE	0	6	REAL		PLUTONIUM-239/	0 61	B	V	0 1
43893	BH40073AE	6	12	REAL		PLUTONIUM-239/	0 14	B	V	0 048
43993	BH40353AE	0	6	REAL		PLUTONIUM-239/	0 1369		A	0 0288
44093	BH40348AE	0	6	REAL		PLUTONIUM-239/	0 048	B	A	0 022
44093	BH40351AE	6	10 4	REAL		PLUTONIUM-239/	0 0029	J	A	0 00514
44793	BH40133AE	0	2 5	REAL		PLUTONIUM-239/	0 1623		A	0 0291
46593	BH40700AE	0 75	2 75	REAL		PLUTONIUM-239/	0 9232		A	0 12
46593	BH40702AE	2 75	4 75	REAL		PLUTONIUM-239/	0 0214		Y	0 00977
46593	BH40703AE	4 75	6 75	REAL		PLUTONIUM-239/	0 0431		A	0 023
46593	BH40705AE	6 75	8 75	REAL		PLUTONIUM-239/	0 0069	J	A	0 0096
46593	BH40711AE	8 75	10 7	REAL		PLUTONIUM-239/	0 017		A	0 0153
46593	BH40713AE	10 7	16 4	REAL		PLUTONIUM-239/	0 0031	J	A	0 0107
46693	BH40715AE	0 5	2 25	REAL		PLUTONIUM-239/	0 706		Y	0 115
46693	BH40717AE	2 25	4 25	REAL		PLUTONIUM-239/	0 0493		Y	0 0206
46693	BH40718AE	4 6	6 6	REAL		PLUTONIUM-239/	0 01	J	R	0 0133
46693	BH40726AE	6 6	7 6	REAL		PLUTONIUM-239/	0 0047	J	A	0 00662
46693	BH40728AE	8 6	14 8	REAL		PLUTONIUM-239/	0 0005	J	A	0 00605
46793	BH40729AE	0 5	2 5	REAL		PLUTONIUM-239/	0 0449		V	0 0212
46793	BH40731AE	2 5	4 5	REAL		PLUTONIUM-239/	0 0079		V	0 00715
46793	BH40732AE	4 5	6 5	REAL		PLUTONIUM-239/	0 0186		V	0 0102
46793	BH40740AE	6 5	8 5	REAL		PLUTONIUM-239/	0 0062	J	V	0 00765
46793	BH40742AE	8 5	14 7	REAL		PLUTONIUM-239/	0 0056	J	V	0 0154
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	PLUTONIUM-239/	0 0049	J	V	0 00727
46893	BH40743AE	0 5	2 5	REAL		PLUTONIUM-239/	0 0382		A	0 0134
46893	BH40745AE	2 5	4 6	REAL		PLUTONIUM-239/	-0 0028	J	A	0 00328
46893	BH40746AE	4 6	6 6	REAL		PLUTONIUM-239/	0 0056	J	A	0 00789
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	PLUTONIUM-239/	0 0011	J	V	0 00385
46893	BH40748AE	6 6	8 6	REAL		PLUTONIUM-239/	0 0012	J	V	0 00314
46893	BH40749AE	8 6	10 6	REAL		PLUTONIUM-239/	0 0002	J	V	0 00211
46893	BH40754AE	11 5	12 5	REAL		PLUTONIUM-239/	0 0007	J	V	0 00252
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	PLUTONIUM-239/	0 0105		A	0 00731
46993	BH40757AE	1 3	3 1	REAL		PLUTONIUM-239/	0 0799		A	0 0206
46993	BH40759AE	3 3	5	REAL		PLUTONIUM-239/	0 0033	J	V	0 0074
46993	BH40768AE	5 5	7	REAL		PLUTONIUM-239/	0 014	J	A	0 0198
46993	BH40770AE	7 2	13 1	REAL		PLUTONIUM-239/	0 0023	J	V	0 00323
47093	BH40771AE	0 7	2 7	REAL		PLUTONIUM-239/	0 0126		V	0 00964
47093	BH40773AE	2 7	4 7	REAL		PLUTONIUM-239/	-0 0012	J	V	0 00417
47093	BH40774AE	4 8	6 8	REAL		PLUTONIUM-239/	0 0065	J	V	0 0116
47093	BH40776AE	6 8	8 8	REAL		PLUTONIUM-239/	0 0011	J	V	0 00367

TABLE II.3-4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40993	BH40201AE	0	6	REAL		RADIUM-226	1 1		V	0 3
40993	BH40204AE	6	10	REAL		RADIUM-226	0 67		V	0 27
40993	BH40206AE	10	20	REAL		RADIUM-226	0 4	J	V	0 17
40993	BH40415AE	20	31	REAL		RADIUM-226	0 63		V	0 16
40993	BH40416AE	31	35	REAL		RADIUM-226	0 93		V	0 17
41193	BH40049AE	0	6	REAL		RADIUM-226	0 7	U	A	0 59
41193	BH40052AE	6	8	REAL		RADIUM-226	0 52		A	0 3
41293	BH40196AE	0	3 3	REAL		RADIUM-226	0 84		V	0 28
41593	BH40417AE	0	2	REAL		RADIUM-226	0 88		V	0 33
41593	BH40418AE	2	4	REAL		RADIUM-226	0 69		V	0 34
41593	BH40419AE	4	6	REAL		RADIUM-226	0 59		V	0 33
41593	BH40424AE	6	7 9	REAL		RADIUM-226	0 53		V	0 24
41693	BH40217AE	0	6	REAL		RADIUM-226	0 82		V	0 29
41693	BH40220AE	6	12	REAL		RADIUM-226	0 38	J	V	0 25
41793	BH40243AE	0	5	REAL		RADIUM-226	0 55		V	0 32
41793	BH40246AE	6	11	REAL		RADIUM-226	0 49	J	V	0 24
42193	BH40425AE	0	2	REAL		RADIUM-226	1		V	0 43
42193	BH40426AE	2	4	REAL		RADIUM-226	0 73		V	0 26
42193	BH40427AE	4	6	REAL		RADIUM-226	0 48	J	V	0 28
42193	BH40432AE	6	9 9	REAL		RADIUM-226	0 37	J	V	0 21
42193	BH40086AE	9 9	16	REAL		RADIUM-226	0 7		V	0 21
42193	BH40091AE	16	22	REAL		RADIUM-226	0 89		V	0 23
42193	BH40430AE	22	28 3	REAL		RADIUM-226	0 84		V	0 24
42193	BH40433AE	28 3	31 3	REAL		RADIUM-226	0 89		V	0 24
42293	BH40253AE	0 7	6 1	REAL		RADIUM-226	0 4335	X	R	0 112
42293	BH40256AE	6 1	11 3	REAL		RADIUM-226	0 6753	X	R	0 138
42293	BH40258AE	11 3	12 9	REAL		RADIUM-226	0 5555	X	R	0 11
42393	BH40261AE	0	6	REAL		RADIUM-226	0 94		A	0 29
42393	BH40264AE	6	8 1	REAL		RADIUM-226	1 1		A	0 31
42493	BH40438AE	0	2	REAL		RADIUM-226	1 1			0 29
42493	BH40439AE	2	4	REAL	BH40112AE	RADIUM-226	0 86			0 28
42493	BH40112AE	2	4	DUP	BH40439AE	RADIUM-226	0 88			0 29
42493	BH40440AE	4	6	REAL		RADIUM-226	0 55			0 31
42493	BH40441AE	6	8	REAL		RADIUM-226	0 53			0 3
42493	BH40445AE	8	10 2	REAL		RADIUM-226	0 66			0 25
42593	BH40446AE	0	2	REAL		RADIUM-226	0 93		V	0 25
42593	BH40447AE	2	4	REAL		RADIUM-226	0 56		V	0 25
42593	BH40448AE	4	6	REAL		RADIUM-226	0 59		V	0 23
42593	BH40449AE	6	8	REAL		RADIUM-226	0 62		V	0 2
42593	BH40450AE	8	10 2	REAL		RADIUM-226	0 64		V	0 26
42593	BH40290AE	10 2	16 8	REAL		RADIUM-226	0 9		V	0 21
43193	BH40306AE	0	5	REAL		RADIUM-226	0 59		V	0 36
43193	BH40309AE	6	11	REAL		RADIUM-226	0 65		V	0 32
43393	BH40510AE	0	2	REAL		RADIUM-226	0 8		V	0 29
43393	BH40511AE	2	4	REAL		RADIUM-226	0 54		V	0 32
43393	BH40512AE	4	5 4	REAL		RADIUM-226	0 58		V	0 29
43393	BH40517AE	6	7 6	REAL		RADIUM-226	1 9		V	0 32
43393	BH40324AE	7 6	12 6	REAL		RADIUM-226	0 84		V	0 33
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	RADIUM-226	0 731	X	R	0 123
43493	BH40319AE	0 5	5 3	REAL		RADIUM-226	0 5432	X	R	0 138
43493	BH40322AE	5 3	11 3	REAL		RADIUM-226	0 5998	X	R	0 107
43593	BH40180AE	1	6	REAL		RADIUM-226	0 75		A	0 26
43693	BH40518AE	0	2	REAL		RADIUM-226	0 6367	X	R	0 121
43693	BH40519AE	2	4	REAL		RADIUM-226	0 5565	X	R	0 173
43693	BH40520AE	4	6	REAL		RADIUM-226	0 836	X	R	0 127
43693	BH40521AE	6	8	REAL		RADIUM-226	0 59			0 28
43693	BH40522AE	8	10	REAL		RADIUM-226	0 53			0 33
43693	BH40563AE	10	13	DUP	BH40525AE	RADIUM-226	0 71			0 33
43693	BH40525AE	10	13	REAL	BH40563AE	RADIUM-226	1			0 31
43793	BH40332AE	0	6	REAL		RADIUM-226	0 85		V	0 29

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**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
43793	BH40335AE	6	11.5	REAL		RADIUM-226	0.62		V	0.25
43893	BH40070AE	0	6	REAL		RADIUM-226	0.93		A	0.28
43893	BH40073AE	6	12	REAL		RADIUM-226	0.49	J	A	0.27
43993	BH40353AE	0	6	REAL		RADIUM-226	0.6609	X	R	0.112
44093	BH40348AE	0	6	REAL		RADIUM-226	0.75		A	0.22
44093	BH40351AE	6	10.4	REAL		RADIUM-226	0.5964	X	R	0.135
44793	BH40133AE	0	2.5	REAL		RADIUM-226	0.7531		R	0.123
46593	BH40700AE	0.75	2.75	REAL		RADIUM-226	1.822	X	V	0.423
46593	BH40702AE	2.75	4.75	REAL		RADIUM-226	1	X	Y	0.395
46593	BH40703AE	4.75	6.75	REAL		RADIUM-226	1.585	X	V	0.398
46593	BH40705AE	6.75	8.75	REAL		RADIUM-226	1.893	X	V	0.549
46593	BH40711AE	8.75	10.7	REAL		RADIUM-226	1.713	X	V	0.488
46593	BH40713AE	10.7	16.4	REAL		RADIUM-226	1.954	X	V	0.729
46693	BH40715AE	0.5	2.25	REAL		RADIUM-226	5.888	X	Y	0.856
46693	BH40717AE	2.25	4.25	REAL		RADIUM-226	1.243	X	Y	0.387
46693	BH40718AE	4.6	6.6	REAL		RADIUM-226	2.113	X	V	0.505
46693	BH40726AE	6.6	7.6	REAL		RADIUM-226	3.276	X	V	0.638
46693	BH40728AE	8.6	14.8	REAL		RADIUM-226	2.677	X	V	0.619
46793	BH40729AE	0.5	2.5	REAL		RADIUM-226	3.072	X	A	0.62
46793	BH40731AE	2.5	4.5	REAL		RADIUM-226	2.069	X	A	0.634
46793	BH40732AE	4.5	6.5	REAL		RADIUM-226	2.243	X	A	0.55
46793	BH40740AE	6.5	8.5	REAL		RADIUM-226	1.918	X	A	0.456
46793	BH40742AE	8.5	14.7	REAL		RADIUM-226	2.337	X	A	0.524
46793	BH40823AE	8.5	14.7	DUP	BH40742AE	RADIUM-226	2.66	X	A	0.621
46893	BH40743AE	0.5	2.5	REAL		RADIUM-226	0.9226	X	A	0.45
46893	BH40745AE	2.5	4.6	REAL		RADIUM-226	1.07	X	A	0.386
46893	BH40746AE	4.6	6.6	REAL		RADIUM-226	0.951	X	A	0.36
46893	BH40825AE	6.6	8.6	DUP	BH40748AE	RADIUM-226	2.205	X	A	0.526
46893	BH40748AE	6.6	8.6	REAL		RADIUM-226	1.623	X	A	0.441
46893	BH40749AE	8.6	10.6	REAL		RADIUM-226	1.507	X	A	0.398
46893	BH40754AE	11.5	12.5	REAL		RADIUM-226	2.075	X	A	0.561
46993	BH40830AE	1.3	3.1	DUP	BH40757AE	RADIUM-226	5.425	X	A	0.761
46993	BH40757AE	1.3	3.1	REAL		RADIUM-226	4.538	X	A	0.644
46993	BH40759AE	3.3	5	REAL		RADIUM-226	2.864	X	A	0.524
46993	BH40768AE	5.5	7	REAL		RADIUM-226	6.838	X	A	0.92
46993	BH40770AE	7.2	13.1	REAL		RADIUM-226	1.565	X	A	0.448
47093	BH40771AE	0.7	2.7	REAL		RADIUM-226	1.164	X	A	0.402
47093	BH40773AE	2.7	4.7	REAL		RADIUM-226	1.101	X	A	0.364
47093	BH40774AE	4.8	6.8	REAL		RADIUM-226	1.301	X	A	0.456
47093	BH40776AE	6.8	8.8	REAL		RADIUM-226	1.15	X	A	0.35

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**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40993	BH40201AE	0	6	REAL		STRONTIUM-89,9	0 32	J	A	0 21
40993	BH40204AE	6	10	REAL		STRONTIUM-89,9	0 42	J	A	0 2
40993	BH40206AE	10	20	REAL		STRONTIUM-89,9	0 12	U	A	0 16
40993	BH40415AE	20	31	REAL		STRONTIUM-89,9	0 26	U	A	0 19
40993	BH40416AE	31	35	REAL		STRONTIUM-89,9	0 08	U	A	0 21
41193	BH40049AE	0	6	REAL		STRONTIUM-89,9	0 49	J	V	0 18
41193	BH40052AE	6	8	REAL		STRONTIUM-89,9	0 5	J	V	0 28
41293	BH40196AE	0	3 3	REAL		STRONTIUM-89,9	0 14	U	A	0 21
41593	BH40417AE	0	2	REAL		STRONTIUM-89,9	0 25	U	V	0 18
41593	BH40418AE	2	4	REAL		STRONTIUM-89,9	0 32	J	V	0 21
41593	BH40419AE	4	6	REAL		STRONTIUM-89,9	0 17	U	V	0 18
41593	BH40424AE	6	7 9	REAL		STRONTIUM-89,9	0 24	U	V	0 18
41693	BH40217AE	0	6	REAL		STRONTIUM-89,9	0 3	BJ	A	0 19
41693	BH40220AE	6	12	REAL		STRONTIUM-89,9	0 49	BJ	A	0 27
41793	BH40243AE	0	5	REAL		STRONTIUM-89,9	0 33	BJ	A	0 21
41793	BH40246AE	6	11	REAL		STRONTIUM-89,9	0 45	J	A	0 29
41993	BH40062AE	0	6	REAL		STRONTIUM-89,9	-0 031	U	V	0 18
41993	BH40065AE	6	12	REAL		STRONTIUM-89,9	0 005	U	V	0 13
42093	BH40103AE	0	6	DUP	BH40483AE	STRONTIUM-89,9	0 079	U	V	0 17
42193	BH40425AE	0	2	REAL		STRONTIUM-89,9	0 21	U	V	0 22
42193	BH40426AE	2	4	REAL		STRONTIUM-89,9	0 28	U	V	0 24
42193	BH40427AE	4	6	REAL		STRONTIUM-89,9	0 47	J	V	0 21
42193	BH40432AE	6	9 9	REAL		STRONTIUM-89,9	0 67	J	V	0 26
42193	BH40086AE	9 9	16	REAL		STRONTIUM-89,9	0 21	U	A	0 18
42193	BH40091AE	16	22	REAL		STRONTIUM-89,9	0 24	U	A	0 2
42193	BH40430AE	22	28 3	REAL		STRONTIUM-89,9	-0 09	U	A	0 2
42193	BH40433AE	28 3	31 3	REAL		STRONTIUM-89,9	0 27	U	A	0 2
42293	BH40253AE	0 7	6 1	REAL		STRONTIUM-89,9	0 6828		A	0 178
42293	BH40256AE	6 1	11 3	REAL		STRONTIUM-89,9	0 1634		A	0 048
42293	BH40258AE	11 3	12 9	REAL		STRONTIUM-89,9	0 2596		A	0 0705
42393	BH40261AE	0	6	REAL		STRONTIUM-89,9	0 31	U	A	0 25
42393	BH40264AE	6	8 1	REAL		STRONTIUM-89,9	0 8	J	JA	0 4
42493	BH40438AE	0	2	REAL		STRONTIUM-89,9	0 34	J	V	0 23
42493	BH40439AE	2	4	REAL	BH40112AE	STRONTIUM-89,9	0 45	J	V	0 25
42493	BH40112AE	2	4	DUP	BH40439AE	STRONTIUM-89,9	0 28	U	V	0 32
42493	BH40440AE	4	6	REAL		STRONTIUM-89,9	0 24	U	V	0 18
42493	BH40441AE	6	8	REAL		STRONTIUM-89,9	0 27	J	V	0 19
42493	BH40445AE	8	10 2	REAL		STRONTIUM-89,9	0 27	U	V	0 2
42593	BH40446AE	0	2	REAL		STRONTIUM-89,9	0 74	J	V	0 32
42593	BH40447AE	2	4	REAL		STRONTIUM-89,9	0 26	U	V	0 21
42593	BH40448AE	4	6	REAL		STRONTIUM-89,9	0 38	J	V	0 18
42593	BH40449AE	6	8	REAL		STRONTIUM-89,9	0 35	U	V	0 26
42593	BH40450AE	8	10 2	REAL		STRONTIUM-89,9	0 4	J	V	0 27
42593	BH40290AE	10 2	16 8	REAL		STRONTIUM-89,9	0 34	U	A	0 25
43193	BH40306AE	0	5	REAL		STRONTIUM-89,9	0 62	J	JA	0 4
43193	BH40309AE	6	11	REAL		STRONTIUM-89,9	0 88	BJ	A	0 26
43393	BH40510AE	0	2	REAL		STRONTIUM-89,9	0 14	U	V	0 2
43393	BH40511AE	2	4	REAL		STRONTIUM-89,9	0 53	U	R	0 71
43393	BH40512AE	4	5 4	REAL		STRONTIUM-89,9	0 19	U	V	0 19
43393	BH40517AE	6	7 6	REAL		STRONTIUM-89,9	0 33	J	V	0 18
43393	BH40324AE	7 6	12 6	REAL		STRONTIUM-89,9	0 39	J	V	0 21
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	STRONTIUM-89,9	0 1257		A	0 0422
43493	BH40319AE	0 5	5 3	REAL		STRONTIUM-89,9	0 1481		JA	0 0492
43493	BH40322AE	5 3	11 3	REAL		STRONTIUM-89,9	0 0573		A	0 028
43593	BH40180AE	1	6	REAL		STRONTIUM-89,9	0 26	J	A	0 17
43693	BH40518AE	0	2	REAL		STRONTIUM-89,9	0 5517		V	0 148
43693	BH40519AE	2	4	REAL		STRONTIUM-89,9	0 5343		V	0 147
43693	BH40520AE	4	6	REAL		STRONTIUM-89,9	0 0515		V	0 028
43693	BH40521AE	6	8	REAL		STRONTIUM-89,9	0 36	J	V	0 21
43693	BH40522AE	8	10	REAL		STRONTIUM-89,9	0 41	U	JA	0 4

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**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
43693	BH40563AE	10	13	DUP	BH40525AE	STRONTIUM-89,9	0 28	J	V	0 17
43693	BH40525AE	10	13	REAL	BH40563AE	STRONTIUM-89,9	0 28	U	V	0 2
43793	BH40332AE	0	6	REAL		STRONTIUM-89,9	0 29	U	A	0 31
43793	BH40335AE	6	11 5	REAL		STRONTIUM-89,9	0 27	U	A	0 21
43893	BH40070AE	0	6	REAL		STRONTIUM-89,9	0 17	U	V	0 14
43893	BH40073AE	6	12	REAL		STRONTIUM-89,9	0 36	U	JA	0 37
43993	BH40353AE	0	6	REAL		STRONTIUM-89,9	0 1368		V	0 0465
44093	BH40348AE	0	6	REAL		STRONTIUM-89,9	0 34	J	A	0 21
44093	BH40351AE	6	10 4	REAL		STRONTIUM-89,9	0 028	J	V	0 0229
44793	BH40133AE	0	2 5	REAL		STRONTIUM-89,9	0 102		V	0 0373
46593	BH40700AE	0 75	2 75	REAL		STRONTIUM-89,9	0 1247		A	0 0425
46593	BH40702AE	2 75	4 75	REAL		STRONTIUM-89,9	0 1313		Y	0 0441
46593	BH40703AE	4 75	6 75	REAL		STRONTIUM-89,9	0 0162	J	A	0 0216
46593	BH40705AE	6 75	8 75	REAL		STRONTIUM-89,9	0 0347	J	A	0 0244
46593	BH40711AE	8 75	10 7	REAL		STRONTIUM-89,9	0 2754		A	0 0808
46593	BH40713AE	10 7	16 4	REAL		STRONTIUM-89,9	0 1207		A	0 0414
46693	BH40715AE	0 5	2 25	REAL		STRONTIUM-89,9	0 0786		Y	0 041
46693	BH40717AE	2 25	4 25	REAL		STRONTIUM-89,9	0 0583		Y	0 0292
46693	BH40718AE	4 6	6 6	REAL		STRONTIUM-89,9	0 1386		A	0 0463
46693	BH40726AE	6 6	7 6	REAL		STRONTIUM-89,9	0 2121		A	0 0633
46693	BH40728AE	8 6	14 8	REAL		STRONTIUM-89,9	0 6411		A	0 168
46793	BH40729AE	0 5	2 5	REAL		STRONTIUM-89,9	0 0619		A	0 0299
46793	BH40731AE	2 5	4 5	REAL		STRONTIUM-89,9	0 4763		A	0 127
46793	BH40732AE	4 5	6 5	REAL		STRONTIUM-89,9	0 7136		A	0 193
46793	BH40740AE	6 5	8 5	REAL		STRONTIUM-89,9	0 281		A	0 0809
46793	BH40742AE	8 5	14 7	REAL		STRONTIUM-89,9	0 2222		A	0 066
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	STRONTIUM-89 9	0 1437		A	0 0488
46893	BH40743AE	0 5	2 5	REAL		STRONTIUM-89,9	0 1741		A	0 0547
46893	BH40745AE	2 5	4 6	REAL		STRONTIUM-89 9	0 64		A	0 045
46893	BH40746AE	4 6	6 6	REAL		STRONTIUM-89,9	0 7258		A	0 181
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	STRONTIUM-89,9	0 3341		A	0 119
46893	BH40748AE	6 6	8 6	REAL		STRONTIUM-89,9	0 3162		A	0 116
46893	BH40749AE	8 6	10 6	REAL		STRONTIUM-89,9	0 0915		A	0 0425
46893	BH40754AE	11 5	12 5	REAL		STRONTIUM-89,9	0 1303		A	0 054
46993	BH40757AE	1 3	3 1	REAL		STRONTIUM-89,9	0 6789		A	0 182
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	STRONTIUM-89,9	0 4343		A	0 118
46993	BH40759AE	3 3	5	REAL		STRONTIUM-89,9	0 0139	J	A	0 0276
46993	BH40768AE	5 5	7	REAL		STRONTIUM-89,9	0 1645		A	0 0524
46993	BH40770AE	7 2	13 1	REAL		STRONTIUM-89 9	0 0867		A	0 0419
47093	BH40771AE	0 7	2 7	REAL		STRONTIUM-89,9	0 1972		A	0 0602
47093	BH40773AE	2 7	4 7	REAL		STRONTIUM-89,9	0 0947		A	0 0355
47093	BH40774AE	4 8	6 8	REAL		STRONTIUM-89,9	0 0424	J	A	0 0263
47093	BH40776AE	6 8	8 8	REAL		STRONTIUM-89,9	0 1139		A	0 0488

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**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40093	BH40170AE	6	8.4	REAL		TRITIUM	277		JA	123
40193	BH40488AE	0	6	REAL		TRITIUM	202		JA	118
40193	BH40490AE	6	12	REAL		TRITIUM	408		JA	549
40193	BH40495AE	18	24	REAL		TRITIUM	139		JA	112
40293	BH40118AE	0	2.9	REAL		TRITIUM	520		A	310
40393	BH40123AE	0	5	REAL		TRITIUM	160	U	A	230
40593	BH40128AE	0	5	REAL		TRITIUM	400		A	250
40593	BH40131AE	6	11	REAL		TRITIUM	980		JA	370
40593	BH40365AE	12	18	REAL		TRITIUM	-330	U	R	260
40593	BH40400AE	18	24	REAL		TRITIUM	1400		A	370
40793	BH40157AE	0	5	REAL		TRITIUM	250	U	A	240
40793	BH40413AE	0	5	REAL	BH40157AE	TRITIUM	350	U	A	240
40793	BH40160AE	6	8.1	REAL		TRITIUM	1100	B	A	280
40793	BH40414AE	8.1	13	REAL		TRITIUM	770		A	310
40893	BH40030AE	0	7	REAL		TRITIUM	2390		JA	360
40993	BH40201AE	0	6	REAL		TRITIUM	670	B	A	250
40993	BH40204AE	6	10	REAL		TRITIUM	440	B	A	240
40993	BH40206AE	10	20	REAL		TRITIUM	2900	B	A	350
40993	BH40415AE	20	31	REAL		TRITIUM	3100	B	A	360
40993	BH40416AE	31	35	REAL		TRITIUM	270	U	A	230
41193	BH40049AE	0	6	REAL		TRITIUM	-890	U	R	280
41193	BH40052AE	6	8	REAL		TRITIUM	2400		A	340
41293	BH40196AE	0	3.3	REAL		TRITIUM	120	U	A	290
41593	BH40417AE	0	2	REAL		TRITIUM	12000		A	720
41593	BH40418AE	2	4	REAL		TRITIUM	16000		A	740
41593	BH40419AE	4	6	REAL		TRITIUM	11000		A	620
41593	BH40424AE	6	7.9	REAL		TRITIUM	8000		A	520
41693	BH40217AE	0	6	REAL		TRITIUM	810	B	A	290
41693	BH40220AE	6	12	REAL		TRITIUM	1200	B	A	290
41793	BH40243AE	0	5	REAL		TRITIUM	1000		A	380
41793	BH40246AE	6	11	REAL		TRITIUM	3900	B	A	400
41993	BH40062AE	0	6	REAL		TRITIUM	800	U	V	580
41993	BH40065AE	6	12	REAL		TRITIUM	120	U	V	250
42093	BH40483AE	0	6	REAL		TRITIUM	136.3	J	V	224
42093	BH40103AE	0	6	DUP	BH40483AE	TRITIUM	75	U	V	400
42193	BH40425AE	0	2	REAL		TRITIUM	41000		A	1100
42193	BH40426AE	2	4	REAL		TRITIUM	34000		A	970
42193	BH40427AE	4	6	REAL		TRITIUM	28000		A	910
42193	BH40432AE	6	9.9	REAL		TRITIUM	1200		A	270
42193	BH40086AE	9.9	16	REAL		TRITIUM	1300	B	A	240
42193	BH40091AE	16	22	REAL		TRITIUM	1100	B	A	230
42193	BH40430AE	22	28.3	REAL		TRITIUM	590	B	A	200
42193	BH40433AE	28.3	31.3	REAL		TRITIUM	760	B	A	210
42293	BH40253AE	0.7	6.1	REAL		TRITIUM	160.2	J	V	221
42293	BH40256AE	6.1	11.3	REAL		TRITIUM	1952		V	327
42293	BH40258AE	11.3	12.9	REAL		TRITIUM	3168		V	407
42393	BH40261AE	0	6	REAL		TRITIUM	1300		A	300
42393	BH40264AE	6	8.1	REAL		TRITIUM	-12	U	A	230
42493	BH40438AE	0	2	REAL		TRITIUM	10000		A	600
42493	BH40112AE	2	4	DUP	BH40439AE	TRITIUM	6600		A	480
42493	BH40439AE	2	4	REAL	BH40112AE	TRITIUM	7000		A	490
42493	BH40440AE	4	6	REAL		TRITIUM	1100		A	280
42493	BH40441AE	6	8	REAL		TRITIUM	440		A	250
42493	BH40445AE	8	10.2	REAL		TRITIUM	270	U	A	240
42593	BH40446AE	0	2	REAL		TRITIUM	12000		A	630
42593	BH40447AE	2	4	REAL		TRITIUM	11000		A	600
42593	BH40448AE	4	6	REAL		TRITIUM	6700		A	480
42593	BH40449AE	6	8	REAL		TRITIUM	5100		A	430
42593	BH40450AE	8	10.2	REAL		TRITIUM	1400		A	290
42593	BH40290AE	10.2	16.8	REAL		TRITIUM	790	B	A	210

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**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error	
42993	BH40094AE	1	6	DUP	BH40141AE	TRITIUM	1500		JA	240	
42993	BH40141AE	1	6	REAL		TRITIUM	2700		JA	370	
43193	BH40306AE	0	5	REAL		TRITIUM	360	U	A	250	
43193	BH40309AE	6	11	REAL		TRITIUM	3800	B	A	390	
43293	BH40041AE	0	6	REAL		TRITIUM	-740	U	R	300	
43293	BH40044AE	6	10	REAL		TRITIUM	340	U	A	230	
43393	BH40510AE	0	2	REAL		TRITIUM	26000		A	960	
43393	BH40511AE	2	4	REAL		TRITIUM	20000		A	790	
43393	BH40512AE	4	5	4 REAL		TRITIUM	26000		A	880	
43393	BH40517AE	6	7	6 REAL		TRITIUM	62000		A	1300	
43393	BH40324AE	7	6	12 REAL		TRITIUM	13000		A	630	
43493	BH40319AE	0	5	3 REAL		TRITIUM	351	7	V	231	
43493	BH40573AE	0	5	3 DUP	BH40319AE	TRITIUM	322	9	V	229	
43493	BH40322AE	5	3	11 REAL		TRITIUM	165	6 J	V	221	
43593	BH40180AE	1	6	REAL		TRITIUM	1300		A	310	
43693	BH40518AE	0	2	REAL		TRITIUM	5336		V	558	
43693	BH40519AE	2	4	REAL		TRITIUM	14400		V	1210	
43693	BH40520AE	4	6	REAL		TRITIUM	21620		V	1730	
43693	BH40521AE	6	8	REAL		TRITIUM	11000		A	590	
43693	BH40522AE	8	10	REAL		TRITIUM	15000		A	680	
43693	BH40525AE	10	13	REAL	BH40563AE	TRITIUM	13000		A	640	
43693	BH40563AE	10	13	DUP	BH40525AE	TRITIUM	11000		A	580	
43793	BH40332AE	0	6	REAL		TRITIUM	600		A	360	
43793	BH40335AE	6	11	5 REAL		TRITIUM	770	B	A	280	
43893	BH40070AE	0	6	REAL		TRITIUM	300	U	A	250	
43893	BH40073AE	6	12	REAL		TRITIUM	92	U	A	220	
43993	BH40353AE	0	6	REAL		TRITIUM	109	6 J	V	223	
44093	BH40348AE	0	6	REAL		TRITIUM	570		A	340	
44093	BH40351AE	6	10	4 REAL		TRITIUM	350		V	235	
44193	BH40078AE	0	6	REAL		TRITIUM	329		JA	145	
44193	BH40081AE	6	12	REAL		TRITIUM	110		JA	154	
44193	BH40429AE	23	4	29	4 REAL	TRITIUM	920	B	A	220	
44193	BH40568AE	29	4	35	4 REAL	TRITIUM	590	B	A	200	
44193	BH40569AE	35	4	41	6 REAL	TRITIUM	570	B	A	210	
44193	BH40570AE	41	6	47	6 REAL	TRITIUM	880	B	A	340	
44193	BH40089AE	47	6	50	2 REAL	TRITIUM	550	B	A	220	
44393	BH40033AE	0	5	REAL		TRITIUM	260	U	A	240	
44593	BH40001AE	0	6	2 REAL		TRITIUM	118		JA	126	
44593	BH40005AE	6	2	11	4 REAL	TRITIUM	133		JA	124	
44793	BH40133AE	0	2	5 REAL		TRITIUM	155	7 J	V	225	
44893	BH40188AE	0	5	REAL		TRITIUM	144		JA	113	
44893	BH40191AE	6	2	12	2 REAL	TRITIUM	118		JA	177	
45693	BH40374AE	0	6	REAL		TRITIUM	1800		A	300	
45793	BH40557AE	0	4	REAL		TRITIUM	190	U	A	270	
45893	BH40377AE	0	6	REAL		TRITIUM	165	7 J	V	224	
45893	BH40380AE	6	8	7 REAL		TRITIUM	63	97 J	V	218	
45893	BH40382AE	8	7	22 REAL		TRITIUM	1045		V	273	
46193	BH40385AE	0	6	REAL	BH40562AE	TRITIUM	3300		A	360	
46193	BH40562AE	0	6	DUP	BH40385AE	TRITIUM	3200		A	360	
46593	BH40700AE	0	7	2	7	5 REAL	TRITIUM	25590	V	2010	
46593	BH40702AE	2	7	4	7	5 REAL	TRITIUM	12160		Y	1040
46593	BH40703AE	4	7	6	7	5 REAL	TRITIUM	7430		V	705
46593	BH40705AE	6	7	8	7	5 REAL	TRITIUM	9093		V	823
46593	BH40711AE	8	7	10	7 REAL	TRITIUM	11610		V	1000	
46593	BH40713AE	10	7	16	4 REAL	TRITIUM	4817		V	521	
46693	BH40715AE	0	5	2	2	5 REAL	TRITIUM	46610		Y	3540
46693	BH40717AE	2	2	4	2	5 REAL	TRITIUM	48400		Y	3670
46693	BH40718AE	4	6	6	6 REAL	TRITIUM	5644		V	579	
46693	BH40726AE	6	6	7	6 REAL	TRITIUM	43060		V	3280	
46693	BH40728AE	8	6	14	8 REAL	TRITIUM	21540		V	1720	

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**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
46793	BH40729AE	0 5	2 5	REAL		TRITIUM	34090		V	2630
46793	BH40731AE	2 5	4 5	REAL		TRITIUM	57980	X	V	4360
46793	BH40732AE	4 5	6 5	REAL		TRITIUM	42090	X	V	3210
46793	BH40740AE	6 5	8 5	REAL		TRITIUM	33180	X	V	2560
46793	BH40742AE	8 5	14 7	REAL		TRITIUM	14540		V	1210
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	TRITIUM	18020	X	V	1460
46893	BH40743AE	0 5	2 5	REAL		TRITIUM	3860		V	477
46893	BH40745AE	2 5	4 6	REAL		TRITIUM	5842		V	606
46893	BH40746AE	4 6	6 6	REAL		TRITIUM	8680		V	805
46893	BH40748AE	6 6	8 6	REAL		TRITIUM	6778	X	V	668
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	TRITIUM	4920	X	V	539
46893	BH40749AE	8 6	10 6	REAL		TRITIUM	5929	X	V	609
46893	BH40754AE	11 5	12 5	REAL		TRITIUM	8141	X	V	764
46993	BH40757AE	1 3	3 1	REAL		TRITIUM	13680		V	1160
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	TRITIUM	13220		V	1130
46993	BH40759AE	3 3	5	REAL		TRITIUM	5295	X	V	564
46993	BH40768AE	5 5	7	REAL		TRITIUM	21870		V	1760
46993	BH40770AE	7 2	13 1	REAL		TRITIUM	5802	X	V	607
47093	BH40771AE	0 7	2 7	REAL		TRITIUM	2417	X	V	354
47093	BH40773AE	2 7	4 7	REAL		TRITIUM	6639	X	V	643
47093	BH40774AE	4 8	6 8	REAL		TRITIUM	6074	X	V	604
47093	BH40776AE	6 8	8 8	REAL		TRITIUM	6668	X	V	660

TABLE IL3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40093	BH40170AE	6	8.4	REAL		URANIUM-233,-23	1.11		A	0.27
40193	BH40488AE	0	6	REAL		URANIUM-233,-23	0.866		A	0.198
40193	BH40490AE	6	12	REAL		URANIUM-233,-23	0.665		A	0.177
40193	BH40495AE	18	24	REAL		URANIUM-233,-23	1.25		A	0.26
40293	BH40118AE	0	2.9	REAL		URANIUM-233,-23	1.8	B	A	0.48
40393	BH40123AE	0	5	REAL		URANIUM-233,-23	1.6	B	V	0.49
40593	BH40128AE	0	5	REAL		URANIUM-233,-23	0.91	B	V	0.31
40593	BH40131AE	6	11	REAL		URANIUM-233,-23	0.99	B	V	0.39
40593	BH40365AE	12	18	REAL		URANIUM-233,-23	0.85	B	V	0.3
40593	BH40400AE	18	24	REAL		URANIUM-233,-23	0.95		A	0.32
40793	BH40413AE	0	5	REAL	BH40157AE	URANIUM-233,-23	1.5	B	A	0.19
40793	BH40157AE	0	5	REAL		URANIUM-233,-23	1.3	B	A	0.17
40793	BH40160AE	6	8.1	REAL		URANIUM-233,-23	1.3	B	A	0.17
40793	BH40414AE	8.1	13	REAL		URANIUM-233,-23	1.2	B	A	0.16
40893	BH40030AE	0	7	REAL		URANIUM-233,-23	0.518		A	0.158
40993	BH40201AE	0	6	REAL		URANIUM-233,-23	2.7	B	A	0.86
40993	BH40204AE	6	10	REAL		URANIUM-233,-23	1.2	B	A	0.5
40993	BH40206AE	10	20	REAL		URANIUM-233,-23	2.7	B	A	0.71
40993	BH40415AE	20	31	REAL		URANIUM-233,-23	1.9	B	A	0.5
40993	BH40416AE	31	35	REAL		URANIUM-233,-23	0.96	B	A	0.39
41193	BH40049AE	0	6	REAL		URANIUM-233,-23	0.75	B	V	0.33
41193	BH40052AE	6	8	REAL		URANIUM-233,-23	1.3	B	A	0.58
41293	BH40196AE	0	3.3	REAL		URANIUM-233,-23	1.3	B	A	0.4
41593	BH40417AE	0	2	REAL		URANIUM-233,-23	1.5	B	A	2.2
41593	BH40418AE	2	4	REAL		URANIUM-233,-23	1.2	B	A	1.7
41593	BH40419AE	4	6	REAL		URANIUM-233,-23	8.5	B	A	1.4
41593	BH40424AE	6	7.9	REAL		URANIUM-233,-23	1.8	B	A	0.42
41693	BH40217AE	0	6	REAL		URANIUM-233,-23	9.3	B	A	1.3
41693	BH40220AE	6	12	REAL		URANIUM-233,-23	3.4	B	A	0.63
41793	BH40243AE	0	5	REAL		URANIUM-233,-23	1.9	B	A	0.62
41793	BH40246AE	6	11	REAL		URANIUM-233,-23	1.2	B	A	0.54
41993	BH40062AE	0	6	REAL		URANIUM-233,-23	1		V	0.22
41993	BH40065AE	6	12	REAL		URANIUM-233,-23	0.38		V	0.17
42093	BH40483AE	0	6	REAL		URANIUM-233,-23	1.538		A	0.359
42093	BH40103AE	0	6	DUP	BH40483AE	URANIUM-233,-23	1.1		V	0.24
42193	BH40425AE	0	2	REAL		URANIUM-233,-23	2.1	B	V	3.1
42193	BH40426AE	2	4	REAL		URANIUM-233,-23	1.7	B	V	0.44
42193	BH40427AE	4	6	REAL		URANIUM-233,-23	1.1	B	V	0.45
42193	BH40432AE	6	9.9	REAL		URANIUM-233,-23	0.72	B	V	0.23
42193	BH40086AE	9.9	16	REAL		URANIUM-233,-23	0.99	B	A	0.17
42193	BH40091AE	16	22	REAL		URANIUM-233,-23	0.78	B	A	0.15
42193	BH40430AE	22	28.3	REAL		URANIUM-233,-23	0.83	B	A	0.15
42193	BH40433AE	28.3	31.3	REAL		URANIUM-233,-23	1	B	A	0.18
42293	BH40253AE	0.7	6.1	REAL		URANIUM-233,-23	0.8929		A	0.331
42293	BH40256AE	6.1	11.3	REAL		URANIUM-233,-23	0.9066		A	0.249
42293	BH40258AE	11.3	12.9	REAL		URANIUM-233,-23	0.9361		A	0.257
42393	BH40261AE	0	6	REAL		URANIUM-233,-23	1.6		A	0.38
42393	BH40264AE	6	8.1	REAL		URANIUM-233,-23	0.91		A	0.28
42493	BH40438AE	0	2	REAL		URANIUM-233,-23	3.8	B	A	0.82
42493	BH40439AE	2	4	REAL	BH40112AE	URANIUM-233,-23	0.91		A	0.36
42493	BH40112AE	2	4	DUP	BH40439AE	URANIUM-233,-23	1.5	B	A	0.45
42493	BH40440AE	4	6	REAL		URANIUM-233,-23	0.97	B	A	0.35
42493	BH40441AE	6	8	REAL		URANIUM-233,-23	0.84	B	A	0.3
42493	BH40445AE	8	10.2	REAL		URANIUM-233,-23	1	B	A	0.35
42593	BH40446AE	0	2	REAL		URANIUM-233,-23	11		A	2
42593	BH40447AE	2	4	REAL		URANIUM-233,-23	1		A	0.28
42593	BH40448AE	4	6	REAL		URANIUM-233,-23	1.5	B	A	0.36
42593	BH40449AE	6	8	REAL		URANIUM-233,-23	1.2	B	A	0.31
42593	BH40450AE	8	10.2	REAL		URANIUM-233,-23	1.2		A	0.31
42593	BH40290AE	10.2	16.8	REAL		URANIUM-233,-23	0.84	B	A	0.16

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**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
42993	BH40094AE	1	6	DUP	BH40141AE	URANIUM-233,-23	1 86		A	0 37
42993	BH40141AE	1	6	REAL		URANIUM-233,-23	1 8		A	0 37
42993	BH40144AE	7	10	REAL		URANIUM-233,-23	1 11		A	0 23
43193	BH40306AE	0	5	REAL		URANIUM-233,-23	1 B		A	0 29
43193	BH40309AE	6	11	REAL		URANIUM-233,-23	2 B		A	0 62
43293	BH40041AE	0	6	REAL		URANIUM-233,-23	1		A	0 3
43293	BH40044AE	6	10	REAL		URANIUM-233,-23	0 48		A	0 19
43393	BH40510AE	0	2	REAL		URANIUM-233,-23	4 9 B		V	0 81
43393	BH40511AE	2	4	REAL		URANIUM-233,-23	2 2 B		V	0 57
43393	BH40512AE	4	5 4	REAL		URANIUM-233,-23	4 B		V	0 65
43393	BH40517AE	6	7 6	REAL		URANIUM-233,-23	2 5 B		V	0 51
43393	BH40324AE	7 6	12 6	REAL		URANIUM-233,-23	1 B		V	0 34
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	URANIUM-233,-23	0 8643		A	0 238
43493	BH40319AE	0 5	5 3	REAL		URANIUM-233,-23	0 9911		A	0 252
43493	BH40322AE	5 3	11 3	REAL		URANIUM-233,-23	0 9099		A	0 252
43593	BH40180AE	1	6	REAL		URANIUM-233,-23	1 8		A	0 37
43693	BH40518AE	0	2	REAL		URANIUM-233,-23	5 115		A	0 533
43693	BH40519AE	2	4	REAL		URANIUM-233,-23	3 903		A	0 421
43693	BH40520AE	4	6	REAL		URANIUM-233,-23	3 404		A	0 371
43693	BH40521AE	6	8	REAL		URANIUM-233,-23	2 2 B		A	0 55
43693	BH40522AE	8	10	REAL		URANIUM-233,-23	5 4 B		A	1 1
43693	BH40525AE	10	13	REAL	BH40563AE	URANIUM-233,-23	1 5 B		A	0 46
43693	BH40563AE	10	13	DUP	BH40525AE	URANIUM-233,-23	1 5 B		A	0 47
43793	BH40332AE	0	6	REAL		URANIUM-233,-23	1 7 B		A	2 4
43793	BH40335AE	6	11 5	REAL		URANIUM-233,-23	1 1 B		A	0 47
43893	BH40070AE	0	6	REAL		URANIUM-233,-23	0 91 B		V	0 36
43893	BH40073AE	6	12	REAL		URANIUM-233,-23	1 2 B		V	0 38
43993	BH40353AE	0	6	REAL		URANIUM-233,-23	1 074			0 262
44093	BH40348AE	0	6	REAL		URANIUM-233,-23	0 78		A	0 26
44093	BH40351AE	6	10 4	REAL		URANIUM-233,-23	0 5887			0 189
44193	BH40078AE	0	6	REAL		URANIUM-233,-23	0 502		A	0 176
44193	BH40081AE	6	12	REAL		URANIUM-233,-23	0 404		A	0 143
44193	BH40429AE	23 4	29 4	REAL		URANIUM-233,-23	0 95 B		A	0 31
44193	BH40568AE	29 4	35 4	REAL		URANIUM-233,-23	1 5 B		A	0 54
44193	BH40569AE	35 4	41 6	REAL		URANIUM-233,-23	2 2 B		A	0 55
44193	BH40570AE	41 6	47 6	REAL		URANIUM-233,-23	1 7 B		A	0 25
44193	BH40089AE	47 6	50 2	REAL		URANIUM-233,-23	1 5 B		A	0 22
44393	BH40033AE	0	5	REAL		URANIUM-233,-23	0 67 B		V	0 24
44593	BH40001AE	0	6 2	REAL		URANIUM-233,-23	0 438		A	0 145
44593	BH40005AE	6 2	11 4	REAL		URANIUM-233,-23	0 242		A	0 107
44793	BH40133AE	0	2 5	REAL		URANIUM-233,-23	0 9501		A	0 236
44893	BH40188AE	0	5	REAL		URANIUM-233,-23	1 15		A	0 29
44893	BH40191AE	6 2	12 2	REAL		URANIUM-233,-23	1 05		A	0 24
45693	BH40374AE	0	6	REAL		URANIUM-233,-23	1 4 B		V	0 37
45793	BH40557AE	0	4	REAL		URANIUM-233,-23	0 59 B		A	0 19
45893	BH40377AE	0	6	REAL		URANIUM-233,-23	0 9945		A	0 142
45893	BH40380AE	6	8 7	REAL		URANIUM-233,-23	0 8543		A	0 122
45893	BH40382AE	8 7	22	REAL		URANIUM-233,-23	1 517		A	0 179
46193	BH40385AE	0	6	REAL	BH40562AE	URANIUM-233,-23	0 87 B		V	0 31
46193	BH40562AE	0	6	DUP	BH40385AE	URANIUM-233,-23	1 3 B		V	0 39
46593	BH40700AE	0 75	2 75	REAL		URANIUM-233,-23	2 208		A	0 533
46593	BH40702AE	2 75	4 75	REAL		URANIUM-233,-23	0 5662		Y	0 179
46593	BH40703AE	4 75	6 75	REAL		URANIUM-233,-23	2 343		A	0 522
46593	BH40705AE	6 75	8 75	REAL		URANIUM-233,-23	1 596		A	0 391
46593	BH40711AE	8 75	10 7	REAL		URANIUM-233,-23	0 8666		A	0 236
46593	BH40713AE	10 7	16 4	REAL		URANIUM-233,-23	1 055		A	0 321
46693	BH40715AE	0 5	2 25	REAL		URANIUM-233,-23	14 54		Y	2 37
46693	BH40717AE	2 25	4 25	REAL		URANIUM-233,-23	1 472		Y	0 358
46693	BH40718AE	4 6	6 6	REAL		URANIUM-233,-23	2 57		A	0 583
46693	BH40726AE	6 6	7 6	REAL		URANIUM-233,-23	3 825		A	0 759

TABLE II.3.4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
46693	BH40728AE	8.6	14.8	REAL		URANIUM-233,-23	1.547		A	0.418
46793	BH40729AE	0.5	2.5	REAL		URANIUM-233,-23	4.933		A	1.16
46793	BH40731AE	2.5	4.5	REAL		URANIUM-233,-23	1.154		A	0.41
46793	BH40732AE	4.5	6.5	REAL		URANIUM-233,-23	1.433		A	0.38
46793	BH40740AE	6.5	8.5	REAL		URANIUM-233,-23	1.579		R	0.751
46793	BH40742AE	8.5	14.7	REAL		URANIUM-233,-23	1.445		A	0.458
46793	BH40823AE	8.5	14.7	DUP	BH40742AE	URANIUM-233,-23	0.937		A	0.315
46893	BH40743AE	0.5	2.5	REAL		URANIUM-233,-23	1.026		V	0.312
46893	BH40745AE	2.5	4.6	REAL		URANIUM-233,-23	0.8734		V	0.293
46893	BH40746AE	4.6	6.6	REAL		URANIUM-233,-23	0.8201		V	0.255
46893	BH40748AE	6.6	8.6	REAL		URANIUM-233,-23	2.082		V	0.448
46893	BH40825AE	6.6	8.6	DUP	BH40748AE	URANIUM-233,-23	1.937		V	0.415
46893	BH40749AE	8.6	10.6	REAL		URANIUM-233,-23	1.994		V	0.482
46893	BH40754AE	11.5	12.5	REAL		URANIUM-233,-23	1.048		V	0.3
46993	BH40757AE	1.3	3.1	REAL		URANIUM-233,-23	13.99		V	2.17
46993	BH40830AE	1.3	3.1	DUP	BH40757AE	URANIUM-233,-23	12.98		V	1.93
46993	BH40759AE	3.3	5	REAL		URANIUM-233,-23	6.053		V	1.11
46993	BH40768AE	5.5	7	REAL		URANIUM-233,-23	10.99		V	1.76
46993	BH40770AE	7.2	13.1	REAL		URANIUM-233,-23	1.113		V	0.343
47093	BH40771AE	0.7	2.7	REAL		URANIUM-233,-23	0.6156		A	0.271
47093	BH40773AE	2.7	4.7	REAL		URANIUM-233,-23	0.3624		A	0.198
47093	BH40774AE	4.8	6.8	REAL		URANIUM-233,-23	1.515		A	0.405
47093	BH40776AE	6.8	8.8	REAL		URANIUM-233,-23	1.416		V	0.343

TABLE II.3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error	
40093	BH40170AE	6	8	4	REAL	URANIUM-235	0 0832		A	0 0667	
40193	BH40488AE	0	6		REAL	URANIUM-235	0 023		A	0 0344	
40193	BH40490AE	6	12		REAL	URANIUM-235	0 0329		A	0 0277	
40193	BH40495AE	18	24		REAL	URANIUM-235	0 0741		A	0 0503	
40293	BH40118AE	0	2	9	REAL	URANIUM-235	0 063 J		A	0 076	
40393	BH40123AE	0	5		REAL	URANIUM-235	0 023 U		V	0 054	
40593	BH40128AE	0	5		REAL	URANIUM-235	0 079 J		V	0 086	
40593	BH40131AE	6	11		REAL	URANIUM-235	0 053 U		V	0 088	
40593	BH40365AE	12	18		REAL	URANIUM-235	0 087 J		V	0 088	
40593	BH40400AE	18	24		REAL	URANIUM-235	0 064 BJ		A	0 074	
40793	BH40157AE	0	5		REAL	URANIUM-235	0 065 BJ		A	0 032	
40793	BH40415AE	0	5		REAL	BH40157AE URANIUM-235	0 068 BJ		A	0 034	
40793	BH40160AE	6	8	1	REAL	URANIUM-235	0 054 BJ		A	0 03	
40793	BH40414AE	8	1	3	REAL	URANIUM-235	0 058 BJ		A	0 03	
40893	BH40030AE	0	7		REAL	URANIUM-235	0 0091		A	0 0315	
40993	BH40201AE	0	6		REAL	URANIUM-235	0 035 U		A	0 08	
40993	BH40204AE	6	10		REAL	URANIUM-235	0 041 J		A	0 084	
40993	BH40206AE	10	20		REAL	URANIUM-235	0 08 J		A	0 098	
40993	BH40415AE	20	31		REAL	URANIUM-235	0 13 J		A	0 11	
40993	BH40416AE	31	35		REAL	URANIUM-235	0 094 J		A	0 11	
41193	BH40049AE	0	6		REAL	URANIUM-235	0 09 J		V	0 1	
41193	BH40052AE	6	8		REAL	URANIUM-235	0 076 U		A	0 14	
41293	BH40196AE	0	3	3	REAL	URANIUM-235	0 038 U		A	0 062	
41593	BH40417AE	0	2		REAL	URANIUM-235	0 59 B		A	0 2	
41593	BH40418AE	2	4		REAL	URANIUM-235	0 3 B		A	0 14	
41593	BH40419AE	4	6		REAL	URANIUM-235	0 27 BJ		A	0 14	
41593	BH40424AE	6	7	9	REAL	URANIUM-235	0 13 J		A	0 096	
41693	BH40217AE	0	6		REAL	URANIUM-235	0 39		A	0 15	
41693	BH40220AE	6	12		REAL	URANIUM-235	0 13 J		A	0 09	
41793	BH40243AE	0	5		REAL	URANIUM-235	0 069 J		A	0 098	
41793	BH40246AE	6	11		REAL	URANIUM-235	0 041 U		A	0 096	
41993	BH40062AE	0	6		REAL	URANIUM-235	0 12 J		V	0 068	
41993	BH40065AE	6	12		REAL	URANIUM-235	0 04 U		V	0 041	
42093	BH40103AE	0	6		DUP	BH40483AE URANIUM-235	0 047 U		V	0 048	
42093	BH40483AE	0	6		REAL	URANIUM-235	0 0614 J		A	0 0616	
42193	BH40425AE	0	2		REAL	URANIUM-235	0 87 B		V	0 27	
42193	BH40426AE	2	4		REAL	URANIUM-235	0 14 BJ		V	0 1	
42193	BH40427AE	4	6		REAL	URANIUM-235	0 18 J		V	0 16	
42193	BH40432AE	6	9	9	REAL	URANIUM-235	0 1 BJ		V	0 078	
42193	BH40086AE	9	9	16	REAL	URANIUM-235	0 059 J		A	0 036	
42193	BH40091AE	16	22		REAL	URANIUM-235	0 023 J		A	0 024	
42193	BH40430AE	22	28	3	REAL	URANIUM-235	0 021 U		A	0 026	
42193	BH40433AE	28	3	1	REAL	URANIUM-235	0 049 J		A	0 034	
42293	BH40253AE	0	7	1	REAL	URANIUM-235	0 02 J		A	0 0481	
42293	BH40256AE	6	1	1	REAL	URANIUM-235	0 0335 J		A	0 0451	
42293	BH40258AE	11	3	2	REAL	URANIUM-235	0 008 J		A	0 027	
42393	BH40261AE	0	6		REAL	URANIUM-235	0 044 J		A	0 054	
42393	BH40264AE	6	8	1	REAL	URANIUM-235	0 089 BJ		A	0 08	
42493	BH40438AE	0	2		REAL	URANIUM-235	0 29 J		A	0 17	
42493	BH40439AE	2	4		REAL	BH40112AE URANIUM-235	0 14 J		A	0 13	
42493	BH40112AE	2	4		DUP	BH40439AE URANIUM-235	0 069 J		A	0 08	
42493	BH40440AE	4	6		REAL	URANIUM-235	0 11 J		A	0 11	
42493	BH40441AE	6	8		REAL	URANIUM-235	0 086 J		A	0 086	
42493	BH40445AE	8	10	2	REAL	URANIUM-235	0 047 J		A	0 068	
42593	BH40446AE	0	2		REAL	URANIUM-235	0 26 J		A	0 16	
42593	BH40447AE	2	4		REAL	URANIUM-235	0 044 J		A	0 052	
42593	BH40448AE	4	6		REAL	URANIUM-235	0 075 J		A	0 068	
42593	BH40449AE	6	8		REAL	URANIUM-235	0 07 J		A	0 066	
42593	BH40450AE	8	10	2	REAL	URANIUM-235	0 071 J		A	0 064	
42593	BH40290AE	10	2	16	8	REAL	URANIUM-235	0 031 J		A	0 03

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TABLE II 3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
42993	BH40094AE	1	6	DUP	BH40141AE	URANIUM-235	0 0499		A	0 0451
42993	BH40141AE	1	6	REAL		URANIUM-235	0 0954		A	0 0649
42993	BH40144AE	7	10	REAL		URANIUM-235	0 0465		A	0 0443
43193	BH40306AE	0	5	REAL		URANIUM-235	0 097 J		A	0 08
43193	BH40309AE	6	11	REAL		URANIUM-235	0 063 J		A	0 09
43293	BH40041AE	0	6	REAL		URANIUM-235	0 014 U		A	0 034
43293	BH40044AE	6	10	REAL		URANIUM-235	0 067 BJ		A	0 068
43393	BH40510AE	0	2	REAL		URANIUM-235	0 086 BJ		V	0 07
43393	BH40511AE	2	4	REAL		URANIUM-235	0 085 J		V	0 092
43393	BH40512AE	4	5 4	REAL		URANIUM-235	0 14 BJ		V	0 084
43393	BH40517AE	6	7 6	REAL		URANIUM-235	0 13 BJ		V	0 092
43393	BH40324AE	7 6	12 6	REAL		URANIUM-235	0 088 BJ		V	0 09
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	URANIUM-235	0 0353 J		A	0 0434
43493	BH40319AE	0 5	5 3	REAL		URANIUM-235	0 0629 J		A	0 0583
43493	BH40322AE	5 3	11 3	REAL		URANIUM-235	0 0634		A	0 0592
43593	BH40180AE	1	6	REAL		URANIUM-235	0 1 BJ		A	0 074
43693	BH40518AE	0	2	REAL		URANIUM-235	0 1651		A	0 044
43693	BH40519AE	2	4	REAL		URANIUM-235	0 1128		A	0 0356
43693	BH40520AE	4	6	REAL		URANIUM-235	0 0767		A	0 0297
43693	BH40521AE	6	8	REAL		URANIUM-235	0 12 J		A	0 11
43693	BH40522AE	8	10	REAL		URANIUM-235	0 26 J		A	0 16
43693	BH40563AE	10	13	DUP	BH40525AE	URANIUM-235	0 21 J		A	0 16
43693	BH40525AE	10	13	REAL	BH40563AE	URANIUM-235	0 05 J		A	0 072
43793	BH40332AE	0	6	REAL		URANIUM-235	0 54		A	0 19
43793	BH40335AE	6	11 5	REAL		URANIUM-235	-0 005 U		A	0 001
43893	BH40070AE	0	6	REAL		URANIUM-235	0 028 J		V	0 056
43893	BH40073AE	6	12	REAL		URANIUM-235	0 024 J		V	0 048
43993	BH40353AE	0	6	REAL		URANIUM-235	0 0307 J			0 04
44093	BH40348AE	0	6	REAL		URANIUM-235	0 017 BJ		A	0 034
44093	BH40351AE	6	10 4	REAL		URANIUM-235	0 0241 J			0 0357
44193	BH40078AE	0	6	REAL		URANIUM-235	0 0913		A	0 0733
44193	BH40081AE	6	12	REAL		URANIUM-235	-0 0104		A	0 0208
44193	BH40429AE	23 4	29 4	REAL		URANIUM-235	0 059 J		A	0 072
44193	BH40568AE	29 4	35 4	REAL		URANIUM-235	-0 023 U		A	0 004
44193	BH40569AE	35 4	41 6	REAL		URANIUM-235	0 044 J		A	0 062
44193	BH40570AE	41 6	47 6	REAL		URANIUM-235	0 1 J		A	0 05
44193	BH40089AE	47 6	50 2	REAL		URANIUM-235	0 054 J		A	0 034
44393	BH40033AE	0	5	REAL		URANIUM-235	0 053 J		V	0 066
44593	BH40001AE	0	6 2	REAL		URANIUM-235	0 0194		A	0 0276
44593	BH40005AE	6 2	11 4	REAL		URANIUM-235	0 0093		A	0 0186
44793	BH40133AE	0	2 5	REAL		URANIUM-235	0 J		A	0 0321
44893	BH40188AE	0	5	REAL		URANIUM-235	0		A	0 0342
44893	BH40191AE	6 2	12 2	REAL		URANIUM-235	0 0271		A	0 0315
45693	BH40374AE	0	6	REAL		URANIUM-235	0 11 BJ		V	0 088
45793	BH40557AE	0	4	REAL		URANIUM-235	0 025 J		A	0 038
45893	BH40377AE	0	6	REAL		URANIUM-235	0 0293		A	0 0214
45893	BH40380AE	6	8 7	REAL		URANIUM-235	0 0195 J		A	0 0162
45893	BH40382AE	8 7	22	REAL		URANIUM-235	0 0564		A	0 0223
46193	BH40385AE	0	6	REAL	BH40562AE	URANIUM-235	0 062 J		V	0 076
46193	BH40562AE	0	6	DUP	BH40385AE	URANIUM-235	0 044 BJ		V	0 062
46593	BH40700AE	0 75	2 75	REAL		URANIUM-235	0 0742		A	0 0767
46593	BH40702AE	2 75	4 75	REAL		URANIUM-235	0 0565		Y	0 0528
46593	BH40703AE	4 75	6 75	REAL		URANIUM-235	0 044 J		A	0 0575
46593	BH40705AE	6 75	8 75	REAL		URANIUM-235	0 0276 J		A	0 0448
46593	BH40711AE	8 75	10 7	REAL		URANIUM-235	0 0364		A	0 0423
46593	BH40713AE	10 7	16 4	REAL		URANIUM-235	0 0288 J		A	0 0515
46693	BH40715AE	0 5	2 25	REAL		URANIUM-235	0 4156		Y	0 18
46693	BH40717AE	2 25	4 25	REAL		URANIUM-235	0 04 J		Y	0 0507
46693	BH40718AE	4 6	6 6	REAL		URANIUM-235	0 1591		A	0 112
46693	BH40726AE	6 6	7 6	REAL		URANIUM-235	0 1154		A	0 0909

TABLE II.3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
46693	BH40728AE	8 6	14 8	REAL		URANIUM-235	0 0364	J	A	0 054
46793	BH40729AE	0 5	2 5	REAL		URANIUM-235	0 3064		A	0 194
46793	BH40731AE	2 5	4 5	REAL		URANIUM-235	0 0749	J	A	0 0952
46793	BH40732AE	4 5	6 5	REAL		URANIUM-235	0 0289	J	A	0 0491
46793	BH40740AE	6 5	8 5	REAL		URANIUM-235	-0 0051	J	R	0 0102
46793	BH40742AE	8 5	14 7	REAL		URANIUM-235	0 0977	J	A	0 103
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	URANIUM-235	0 0532	J	A	0 0718
46893	BH40743AE	0 5	2 5	REAL		URANIUM-235	0 0314	J	V	0 0509
46893	BH40745AE	2 5	4 6	REAL		URANIUM-235	0 0384	J	V	0 0547
46893	BH40746AE	4 6	6 6	REAL		URANIUM-235	0 0283	J	V	0 0439
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	URANIUM-235	0 1049		V	0 0763
46893	BH40748AE	6 6	8 6	REAL		URANIUM-235	0 1179		V	0 0864
46893	BH40749AE	8 6	10 6	REAL		URANIUM-235	0 1386		V	0 103
46893	BH40754AE	11 5	12 5	REAL		URANIUM-235	0 0316	J	V	0 045
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	URANIUM-235	0 4983		V	0 174
46993	BH40757AE	1 3	3 1	REAL		URANIUM-235	0 5193		V	0 191
46993	BH40759AE	3 3	5	REAL		URANIUM-235	0 1713		V	0 112
46993	BH40768AE	5 5	7	REAL		URANIUM-235	0 3832		V	0 164
46993	BH40770AE	7 2	13 1	REAL		URANIUM-235	0 0118	J	V	0 0399
47093	BH40771AE	0 7	2 7	REAL		URANIUM-235	0 019	J	A	0 0505
47093	BH40773AE	2 7	4 7	REAL		URANIUM-235	0 0235	J	A	0 0471
47093	BH40774AE	4 8	6 8	REAL		URANIUM-235	0 1185		A	0 0969
47093	BH40776AE	6 8	8 8	REAL		URANIUM-235	0 019	J	V	0 04

TABLE II 3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
40093	BH40170AE	6	8.4	REAL		URANIUM-238	1.1		A	0.26
40193	BH40488AE	0	6	REAL		URANIUM-238	0.797		A	0.187
40193	BH40490AE	6	12	REAL		URANIUM-238	0.738		A	0.192
40193	BH40495AE	18	24	REAL		URANIUM-238	1.26		A	0.26
40293	BH40118AE	0	2.9	REAL		URANIUM-238	1.8	B	A	0.49
40393	BH40123AE	0	5	REAL		URANIUM-238	1.9	B	V	0.55
40593	BH40128AE	0	5	REAL		URANIUM-238	1.4	B	V	0.39
40593	BH40131AE	6	11	REAL		URANIUM-238	1.1	B	V	0.41
40593	BH40365AE	12	18	REAL		URANIUM-238	0.46	B	V	0.21
40593	BH40400AE	18	24	REAL		URANIUM-238	1.1	B	A	0.34
40793	BH40413AE	0	5	REAL	BH40157AE	URANIUM-238	1	B	A	0.15
40793	BH40157AE	0	5	REAL		URANIUM-238	1.2	B	A	0.16
40793	BH40160AE	6	8.1	REAL		URANIUM-238	1.1	B	A	0.15
40793	BH40414AE	8.1	13	REAL		URANIUM-238	1.3	B	A	0.17
40893	BH40030AE	0	7	REAL		URANIUM-238	0.427		A	0.142
40993	BH40201AE	0	6	REAL		URANIUM-238	1.7	B	A	0.64
40993	BH40204AE	6	10	REAL		URANIUM-238	0.87	B	A	0.42
40993	BH40206AE	10	20	REAL		URANIUM-238	2.5	B	A	0.69
40993	BH40415AE	20	31	REAL		URANIUM-238	2.2	B	A	0.54
40993	BH40416AE	31	35	REAL		URANIUM-238	1.1		A	0.43
41193	BH40049AE	0	6	REAL		URANIUM-238	0.9	B	V	0.36
41193	BH40052AE	6	8	REAL		URANIUM-238	1.1	B	A	0.51
41293	BH40196AE	0	3.3	REAL		URANIUM-238	1.2	B	A	0.37
41593	BH40417AE	0	2	REAL		URANIUM-238	8.3	B	A	1.3
41593	BH40418AE	2	4	REAL		URANIUM-238	5.7	B	A	0.93
41593	BH40419AE	4	6	REAL		URANIUM-238	4.4	B	A	0.8
41593	BH40424AE	6	7.9	REAL		URANIUM-238	1.2	B	A	0.32
41693	BH40217AE	0	6	REAL		URANIUM-238	5.1	B	A	0.81
41693	BH40220AE	6	12	REAL		URANIUM-238	1.5	B	A	0.36
41793	BH40243AE	0	5	REAL		URANIUM-238	1.4	B	A	0.52
41793	BH40246AE	6	11	REAL		URANIUM-238	1	B	A	0.49
41993	BH40062AE	0	6	REAL		URANIUM-238	0.77		V	0.18
41993	BH40065AE	6	12	REAL		URANIUM-238	0.52		V	0.21
42093	BH40103AE	0	6	DUP	BH40483AE	URANIUM-238	0.83		V	0.19
42093	BH40483AE	0	6	REAL		URANIUM-238	0.8473		A	0.245
42193	BH40425AE	0	2	REAL		URANIUM-238	1.1	B	V	1.7
42193	BH40426AE	2	4	REAL		URANIUM-238	1.1	B	V	0.34
42193	BH40427AE	4	6	REAL		URANIUM-238	1.1	B	V	0.46
42193	BH40432AE	6	9.9	REAL		URANIUM-238	0.93	B	V	0.26
42193	BH40086AE	9.9	16	REAL		URANIUM-238	1.1	B	A	0.17
42193	BH40091AE	16	22	REAL		URANIUM-238	1	B	A	0.18
42193	BH40430AE	22	28.3	REAL		URANIUM-238	0.94	B	A	0.17
42193	BH40433AE	28.3	31.3	REAL		URANIUM-238	1.1	B	A	0.18
42293	BH40253AE	0.7	6.1	REAL		URANIUM-238	0.8252		A	0.315
42293	BH40256AE	6.1	11.3	REAL		URANIUM-238	0.9267		A	0.252
42293	BH40258AE	11.3	12.9	REAL		URANIUM-238	0.4895		A	0.175
42393	BH40261AE	0	6	REAL		URANIUM-238	1.3	B	A	0.34
42393	BH40264AE	6	8.1	REAL		URANIUM-238	1.1	B	A	0.32
42493	BH40438AE	0	2	REAL		URANIUM-238	2.1	B	A	0.54
42493	BH40112AE	2	4	DUP	BH40439AE	URANIUM-238	0.76	B	A	0.29
42493	BH40439AE	2	4	REAL	BH40112AE	URANIUM-238	1.3	B	A	0.44
42493	BH40440AE	4	6	REAL		URANIUM-238	1.1	B	A	0.38
42493	BH40441AE	6	8	REAL		URANIUM-238	0.68	B	A	0.26
42493	BH40445AE	8	10.2	REAL		URANIUM-238	0.69	B	A	0.28
42593	BH40446AE	0	2	REAL		URANIUM-238	6.9		A	1.3
42593	BH40447AE	2	4	REAL		URANIUM-238	0.87		A	0.25
42593	BH40448AE	4	6	REAL		URANIUM-238	1.7		A	0.38
42593	BH40449AE	6	8	REAL		URANIUM-238	1.3		A	0.32
42593	BH40450AE	8	10.2	REAL		URANIUM-238	0.92		A	0.26
42593	BH40290AE	10.2	16.8	REAL		URANIUM-238	0.89	B	A	0.17

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TABLE IL3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
42993	BH40141AE	1	6	REAL		URANIUM-238	0 827		A	0 22
42993	BH40094AE	1	6	DUP	BH40141AE	URANIUM-238	0 489		A	0 157
42993	BH40144AE	7	10	REAL		URANIUM-238	0 768		A	0 184
43193	BH40306AE	0	5	REAL		URANIUM-238	1 1 B		A	0 31
43193	BH40309AE	6	11	REAL		URANIUM-238	1 7 B		A	0 56
43293	BH40041AE	0	6	REAL		URANIUM-238	0 92 B		A	0 28
43293	BH40044AE	6	10	REAL		URANIUM-238	0 88 B		A	0 27
43393	BH40510AE	0	2	REAL		URANIUM-238	4 4 B		V	0 74
43393	BH40511AE	2	4	REAL		URANIUM-238	2 3 B		V	0 58
43393	BH40512AE	4	5 4	REAL		URANIUM-238	3 B		V	0 52
43393	BH40517AE	6	7 6	REAL		URANIUM-238	2 2 B		V	0 47
43393	BH40324AE	7 6	12 6	REAL		URANIUM-238	1 7 B		V	0 46
43493	BH40573AE	0 5	5 3	DUP	BH40319AE	URANIUM-238	0 7812		A	0 223
43493	BH40319AE	0 5	5 3	REAL		URANIUM-238	0 962		A	0 248
43493	BH40322AE	5 3	11 3	REAL		URANIUM-238	0 768		A	0 227
43593	BH40180AE	1	6	REAL		URANIUM-238	1 2 B		A	0 29
43693	BH40518AE	0	2	REAL		URANIUM-238	6 266		A	0 643
43693	BH40519AE	2	4	REAL		URANIUM-238	3 949		A	0 425
43693	BH40520AE	4	6	REAL		URANIUM-238	2 604		A	0 295
43693	BH40521AE	6	8	REAL		URANIUM-238	2 6 B		A	0 62
43693	BH40522AE	8	10	REAL		URANIUM-238	4 7 B		A	1
43693	BH40525AE	10	13	REAL	BH40563AE	URANIUM-238	1 4 B		A	0 44
43693	BH40563AE	10	13	DUP	BH40525AE	URANIUM-238	1 5 B		A	0 47
43793	BH40332AE	0	6	REAL		URANIUM-238	5 9 B		A	0 94
43793	BH40335AE	6	11 5	REAL		URANIUM-238	0 72 B		A	0 36
43893	BH40070AE	0	6	REAL		URANIUM-238	1 4 B		V	0 47
43893	BH40073AE	6	12	REAL		URANIUM-238	0 68 B		V	0 28
43993	BH40353AE	0	6	REAL		URANIUM-238	1 083			0 264
44093	BH40348AE	0	6	REAL		URANIUM-238	0 83 B		A	0 27
44093	BH40351AE	6	10 4	REAL		URANIUM-238	0 5625			0 185
44193	BH40078AE	0	6	REAL		URANIUM-238	0 491		A	0 167
44193	BH40081AE	6	12	REAL		URANIUM-238	0 477		A	0 157
44193	BH40429AE	23 4	29 4	REAL		URANIUM-238	1 4 B		A	0 39
44193	BH40568AE	29 4	35 4	REAL		URANIUM-238	1 6 B		A	0 55
44193	BH40569AE	35 4	41 6	REAL		URANIUM-238	1 9 B		A	0 49
44193	BH40570AE	41 6	47 6	REAL		URANIUM-238	2 B		A	0 27
44193	BH40089AE	47 6	50 2	REAL		URANIUM-238	1 6 B		A	0 23
44393	BH40033AE	0	5	REAL		URANIUM-238	0 95 B		V	0 3
44593	BH40001AE	0	6 2	REAL		URANIUM-238	0 583		A	0 169
44593	BH40005AE	6 2	11 4	REAL		URANIUM-238	0 39		A	0 134
44793	BH40133AE	0	2 5	REAL		URANIUM-238	0 9583		A	0 237
44893	BH40188AE	0	5	REAL		URANIUM-238	1 07		A	0 28
44893	BH40191AE	6 2	12 2	REAL		URANIUM-238	1 08		A	0 24
45693	BH40374AE	0	6	REAL		URANIUM-238	1 4 B		V	0 37
45793	BH40557AE	0	4	REAL		URANIUM-238	0 73		A	0 22
45893	BH40377AE	0	6	REAL		URANIUM-238	0 9261		A	0 134
45893	BH40380AE	6	8 7	REAL		URANIUM-238	1 051		A	0 142
45893	BH40382AE	8 7	22	REAL		URANIUM-238	1 276		A	0 156
46193	BH40562AE	0	6	DUP	BH40385AE	URANIUM-238	1 5 B		V	0 42
46193	BH40385AE	0	6	REAL	BH40562AE	URANIUM-238	1 4 B		V	0 41
46593	BH40700AE	0 75	2 75	REAL		URANIUM-238	1 38		A	0 387
46593	BH40702AE	2 75	4 75	REAL		URANIUM-238	1 4		Y	0 315
46593	BH40703AE	4 75	6 75	REAL		URANIUM-238	1 768		A	0 429
46593	BH40705AE	6 75	8 75	REAL		URANIUM-238	1 472		A	0 371
46593	BH40711AE	8 75	10 7	REAL		URANIUM-238	1 237		A	0 294
46593	BH40713AE	10 7	16 4	REAL		URANIUM-238	1 273		A	0 359
46693	BH40715AE	0 5	2 25	REAL		URANIUM-238	5 284		Y	0 984
46693	BH40717AE	2 25	4 25	REAL		URANIUM-238	0 938		Y	0 268
46693	BH40718AE	4 6	6 6	REAL		URANIUM-238	1 594		A	0 418
46693	BH40726AE	6 6	7 6	REAL		URANIUM-238	1 968		A	0 466

TABLE II 3 4-4

**OU4 SUBSURFACE SOIL AND BEDROCK
RADIONUCLIDE POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Qual*	Valid*	Error
46693	BH40728AE	8 6	14 8	REAL		URANIUM-238	1 59		A	0 425
46793	BH40729AE	0 5	2 5	REAL		URANIUM-238	2 624		A	0 719
46793	BH40731AE	2 5	4 5	REAL		URANIUM-238	0 9931		A	0 374
46793	BH40732AE	4 5	6 5	REAL		URANIUM-238	1 233		A	0 344
46793	BH40740AE	6 5	8 5	REAL		URANIUM-238	1 257		R	0 651
46793	BH40742AE	8 5	14 7	REAL		URANIUM-238	1 546		A	0 479
46793	BH40823AE	8 5	14 7	DUP	BH40742AE	URANIUM-238	1 123		A	0 352
46893	BH40743AE	0 5	2 5	REAL		URANIUM-238	0 9252		V	0 292
46893	BH40745AE	2 5	4 6	REAL		URANIUM-238	0 7835		V	0 274
46893	BH40746AE	4 6	6 6	REAL		URANIUM-238	0 78		V	0 247
46893	BH40825AE	6 6	8 6	DUP	BH40748AE	URANIUM-238	1 531		V	0 353
46893	BH40748AE	6 6	8 6	REAL		URANIUM-238	1 578		V	0 37
46893	BH40749AE	8 6	10 6	REAL		URANIUM-238	1 786		V	0 447
46893	BH40754AE	11 5	12 5	REAL		URANIUM-238	1 072		V	0 303
46993	BH40830AE	1 3	3 1	DUP	BH40757AE	URANIUM-238	11 48		V	1 72
46993	BH40757AE	1 3	3 1	REAL		URANIUM-238	11 46		V	1 81
46993	BH40759AE	3 3	5	REAL		URANIUM-238	4 725		V	0 903
46993	BH40768AE	5 5	7	REAL		URANIUM-238	9 288		V	1 52
46993	BH40770AE	7 2	13 1	REAL		URANIUM-238	1 15		V	0 35
47093	BH40771AE	0 7	2 7	REAL		URANIUM-238	0 9419		A	0 347
47093	BH40773AE	2 7	4 7	REAL		URANIUM-238	0 5164		A	0 236
47093	BH40774AE	4 8	6 8	REAL		URANIUM-238	1 377		A	0 378
47093	BH40776AE	6 8	8 8	REAL		URANIUM-238	1 058		V	0 284

TABLE II.3 4-5

OU4 SUBSURFACE SOIL AND BEDROCK
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Units	Qual *	Val *	Detect Limit
40093	BH40168AE	1 3	1 5	REAL		ACETONE	11	UG/KG	U	V	11
40093	BH40169AE	4 3	4 55	REAL		ACETONE	12	UG/KG	U	V	12
40093	BH40171AE	9 7	9 95	REAL		ACETONE	61	UG/KG	U	R	61
40193	BH40486AE	1 1	1 3	REAL		ACETONE	14	UG/KG		V	11
40193	BH40487AE	5 1	5 3	REAL		ACETONE	11	UG/KG	U	JA	11
40193	BH40489AE	8 5	8 7	REAL		ACETONE	15	UG/KG	U	JA	12
40193	BH40491AE	12 9	13 1	REAL		ACETONE	8	UG/KG	J	A	12
40193	BH40492AE	16 7	16 9	REAL		ACETONE	35	UG/KG		V	12
40193	BH40494AE	21 2	21 4	REAL		ACETONE	34	UG/KG	U	JA	12
40193	BH40496AE	24 7	24 9	REAL		ACETONE	35	UG/KG	U	JA	12
40293	BH40119AE	1 6	1 8	REAL		ACETONE	12	UG/KG	U	R	12
40293	BH40120AE	5 8	6	REAL		ACETONE	12	UG/KG	U	R	12
40393	BH40124AE	1 7	1 9	REAL		ACETONE	12	UG/KG	U	V	12
40393	BH40125AE	5 8	6	REAL		ACETONE	14	UG/KG		V	12
40593	BH40098AE	1 5	1 7	DUP	BH40129AE	ACETONE	13	UG/KG	U	R	13
40593	BH40129AE	1 7	1 9	REAL		ACETONE	11	UG/KG	U	R	11
40593	BH40130AE	5	5 2	REAL		ACETONE	11	UG/KG	U	R	11
40593	BH40132AE	9 4	9 6	REAL		ACETONE	12	UG/KG	U	R	12
40593	BH40393AE	13 8	14	REAL		ACETONE	12	UG/KG	U	R	12
40593	BH40394AE	17 8	18	REAL		ACETONE	48	UG/KG		JA	24
40593	BH40399AE	21 8	22	REAL		ACETONE	47	UG/KG		JA	12
40693	BH40151AE	1 4	1 6	REAL		ACETONE	13	UG/KG	U	JA	13
40793	BH40158AE	1 3	1 5	REAL		ACETONE	64	UG/KG	U	V	64
40793	BH40159AE	5 3	5 5	REAL		ACETONE	12	UG/KG	U	JA	12
40793	BH40161AE	9 7	9 9	REAL		ACETONE	13	UG/KG	U	JA	12
40893	BH40031AE	0 55	0 8	REAL		ACETONE	220	UG/KG	U	JA	10
40893	BH40032AE	4 35	4 6	REAL		ACETONE	21	UG/KG	U	JA	10
40893	BH40029AE	6 75	7	REAL		ACETONE	16	UG/KG	U	JA	10
40993	BH40202AE	1 35	1 6	REAL		ACETONE	15	UG/KG		V	11
40993	BH40203AE	5 25	5 5	REAL		ACETONE	13	UG/KG		V	11
40993	BH40205AE	9 4	9 6	REAL		ACETONE	13	UG/KG		V	11
40993	BH40208AE	31 3	31 4	REAL		ACETONE	15	UG/KG		V	12
41193	BH40050AE	1 35	1 6	REAL		ACETONE	12	UG/KG	U	V	12
41193	BH40051AE	5 5	5 75	REAL		ACETONE	13	UG/KG		V	11
41193	BH40053AE	9 75	10 1	REAL		ACETONE	17	UG/KG		V	13
41293	BH40406AE	1 2	1 4	DUP	BH40197AE	ACETONE	11	UG/KG	U	V	11
41293	BH40197AE	1 4	1 6	REAL		ACETONE	56	UG/KG	U	JA	56
41293	BH40198AE	6	6 2	REAL		ACETONE	12	UG/KG	U	JA	12
41593	BH40210AE	1 85	2 1	REAL		ACETONE	57	UG/KG	U	V	57
41593	BH40211AE	4 85	5 1	REAL		ACETONE	16	UG/KG		JA	10
41593	BH40216AE	7 45	7 7	REAL		ACETONE	12	UG/KG	U	V	12
41693	BH40218AE	2 15	2 4	REAL		ACETONE	18	UG/KG	U	JA	10
41693	BH40219AE	5 55	5 7	REAL		ACETONE	29	UG/KG	U	JA	14
41693	BH40221AE	9 65	9 8	REAL		ACETONE	32	UG/KG	U	JA	11
41693	BH40223AE	17 1	17 4	REAL		ACETONE	38	UG/KG	U	JA	12
41793	BH40244AE	2 5	2 7	REAL		ACETONE	10	UG/KG	U	JA	10
41793	BH40245AE	5 4	5 6	REAL		ACETONE	11	UG/KG	U	JA	11
41993	BH40063AE	1 6	1 8	REAL		ACETONE	11	UG/KG	U	V	11
41993	BH40064AE	5 2	5 4	REAL		ACETONE	11	UG/KG	U	V	11
41993	BH40107AE	9 4	9 6	DUP	BH40066AE	ACETONE	11	UG/KG	U	R	11
41993	BH40066AE	9 6	9 8	REAL		ACETONE	12	UG/KG	U	R	12
42093	BH40484AE	1 3	1 5	REAL		ACETONE	52	UG/KG	J	A	57
42093	BH40104AE	5 7	5 9	REAL		ACETONE	35	UG/KG		V	12
42193	BH40436AE	1 8	2	REAL		ACETONE	24	UG/KG	U	V	24
42193	BH40437AE	6 1	6 3	REAL		ACETONE	11	UG/KG	U	V	11
42193	BH40090AE	9 5	9 7	REAL		ACETONE	12	UG/KG	U	V	12
42293	BH40254AE	3 7	3 9	REAL		ACETONE	17	UG/KG		JA	11
42293	BH40255AE	7 3	7 5	REAL		ACETONE	51	UG/KG		JA	10
42293	BH40257AE	10 9	11 1	REAL		ACETONE	42	UG/KG		JA	12
42393	BH40262AE	1	1 25	REAL		ACETONE	12	UG/KG	U	R	12
42393	BH40263AE	5 55	5 8	REAL		ACETONE	43	UG/KG		JA	10
42393	BH40265AE	10 1	10 4	REAL		ACETONE	12	UG/KG	U	V	12
42493	BH40113AE	2 2	2 4	DUP	BH40283AE	ACETONE	31	UG/KG	U	JA	12
42493	BH40283AE	2 4	2 6	REAL	BH40113AE	ACETONE	50	UG/KG	U	JA	13
42493	BH40284AE	4 7	4 9	REAL		ACETONE	24	UG/KG	U	JA	11
42493	BH40289AE	9 8	10	REAL		ACETONE	31	UG/KG	U	JA	12
42593	BH40291AE	1 7	1 9	REAL		ACETONE	140	UG/KG	B	V	12
42593	BH40292AE	5 4	5 6	REAL		ACETONE	140	UG/KG	B	V	11
42593	BH40294AE	9 8	10	REAL		ACETONE	120	UG/KG	B	V	12
42993	BH40095AE	1 1	1 35	DUP	BH40143AE	ACETONE	11	UG/KG	U	R	11

* Codes are explained in Table II 3 6-1
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TABLE IL3 4-5

OU4 SUBSURFACE SOIL AND BEDROCK
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Units	Qual *	Val *	Detect Limit
42993	BH40143AE	1 35	1 6	REAL		ACETONE	10	UG/KG	U	R	10
42993	BH40145AE	5 35	5 6	REAL		ACETONE	12	UG/KG	U	V	12
42993	BH40142AE	9 35	9 5	REAL		ACETONE	13	UG/KG	U	R	13
42993	BH40147AE	13 8	14	REAL		ACETONE	12	UG/KG	U	V	12
43193	BH40409AE	NA		RNS		ACETONE	13	UG/L	U	JA	10
43193	BH40411AE	1 3	1 5	DUP	BH40307AE	ACETONE	21	UG/KG	U	JA	21
43193	BH40307AE	1 5	1 7	REAL		ACETONE	25	UG/KG	U	JA	21
43193	BH40308AE	5 6	5 8	REAL		ACETONE	10	UG/KG	U	JA	10
43293	BH40042AE	2 25	2 5	REAL		ACETONE	13	UG/KG	U	V	13
43293	BH40043AE	5 15	5 3	REAL		ACETONE	11	UG/KG	U	V	11
43293	BH40045AE	11 1	11 3	REAL		ACETONE	12	UG/KG	U	V	12
43393	BH40325AE	2	2 2	REAL		ACETONE	15	UG/KG	U	JA	11
43393	BH40326AE	5 3	5 5	REAL		ACETONE	13	UG/KG	U	V	13
43393	BH40331AE	9 2	9 4	REAL		ACETONE	12	UG/KG	U	V	12
43493	BH40574AE	NA		RNS	BH40320AE	ACETONE	10	UG/L	U	V	10
43493	BH40575AE	NA		RNS	BH40322AE	ACETONE	10	UG/L	U	V	10
43493	BH40320AE	1 9	2 1	REAL		ACETONE	12	UG/KG	U	V	12
43493	BH40321AE	5 3	5 5	REAL		ACETONE	110	UG/KG		V	12
43493	BH40323AE	10 1	10 3	REAL		ACETONE	84	UG/KG		V	11
43593	BH40181AE	1 35	1 6	REAL		ACETONE	11	UG/KG	U	R	11
43593	BH40182AE	5	5 25	REAL		ACETONE	10	UG/KG	U	R	10
43593	BH40187AE	9 75	10	REAL		ACETONE	12	UG/KG	U	R	12
43693	BH40341AE	2 7	2 9	REAL		ACETONE	22	UG/KG	U	JA	11
43693	BH40342AE	6 3	6 5	REAL		ACETONE	11	UG/KG	U	V	11
43693	BH40344AE	9 3	9 5	REAL		ACETONE	11	UG/KG	U	V	11
43693	BH40347AE	12 6	12 8	REAL		ACETONE	28	UG/KG		V	12
43793	BH40333AE	1 25	1 4	REAL		ACETONE	11	UG/KG	U	JA	11
43793	BH40334AE	5 25	5 5	REAL		ACETONE	17	UG/KG	U	JA	12
43793	BH40336AE	9 25	9 4	REAL		ACETONE	11	UG/KG	U	JA	11
43793	BH40339AE	14 2	14 5	REAL		ACETONE	12	UG/KG	U	JA	12
43893	BH40007AE	NA		RNS		ACETONE	9	UG/L	J	A	10
43893	BH40071AE	1 15	1 3	REAL		ACETONE	23	UG/KG	U	JA	12
43893	BH40027AE	5 25	5 5	DUP	BH40072AE	ACETONE	31	UG/KG		V	11
43893	BH40072AE	5 5	5 75	REAL		ACETONE	17	UG/KG	U	JA	11
43893	BH40076AE	9 15	9 4	REAL		ACETONE	11	UG/KG	U	V	11
43893	BH40074AE	12 35	12 6	REAL		ACETONE	15	UG/KG	U	JA	11
43893	BH40077AE	15	15 25	REAL		ACETONE	61	UG/KG	U	JA	61
43993	BH40354AE	1 1	1 35	REAL		ACETONE	72	UG/KG		V	11
43993	BH40355AE	5 2	5 45	REAL		ACETONE	14	UG/KG		V	11
43993	BH40360AE	17	17 25	REAL		ACETONE	16	UG/KG	U	JA	13
44093	BH40349AE	1 3	1 5	REAL		ACETONE	15	UG/KG	J	A	23
44093	BH40350AE	5 55	5 8	REAL		ACETONE	11	UG/KG	B	V	11
44093	BH40352AE	14 55	14 8	REAL		ACETONE	15	UG/KG		V	12
44193	BH40079AE	0 3	0 5	REAL		ACETONE	56	UG/KG	U	JA	56
44193	BH40080AE	4 3	4 5	REAL		ACETONE	31	UG/KG	U	JA	11
44193	BH40082AE	8 4	8 6	REAL		ACETONE	11	UG/KG	U	V	11
44193	BH40084AE	13 8	14	REAL		ACETONE	12	UG/KG	U	JA	12
44393	BH40025AE	NA		RNS		ACETONE	8	UG/L	J	A	10
44393	BH40034AE	1 1	1 3	REAL		ACETONE	57	UG/KG	U	V	57
44393	BH40035AE	5 4	5 6	REAL		ACETONE	25	UG/KG	U	V	25
44393	BH40037AE	9 6	9 8	REAL		ACETONE	11	UG/KG	J	A	13
44593	BH40002AE	0 5	0 7	REAL		ACETONE	34	UG/KG	U	JA	10
44593	BH40003AE	5 6	5 8	REAL		ACETONE	27	UG/KG	U	JA	10
44593	BH40004AE	9 3	9 5	REAL		ACETONE	40	UG/KG	U	JA	10
44593	BH40006AE	13 8	14	REAL		ACETONE	38	UG/KG	U	JA	10
44793	BH40137AE	1 4	1 55	REAL		ACETONE	55	UG/KG	U	V	55
44793	BH40135AE	4 1	4 35	REAL		ACETONE	12	UG/KG	U	V	12
44893	BH40102AE	1 3	1 55	DUP	BH40190AE	ACETONE	11	UG/KG	U	R	11
44893	BH40190AE	1 55	1 8	REAL		ACETONE	11	UG/KG	U	R	11
44893	BH40189AE	5 55	5 8	REAL		ACETONE	11	UG/KG	U	R	11
44893	BH40192AE	7	7 2	REAL		ACETONE	13	UG/KG	U	V	13
44893	BH40195AE	12	12 2	REAL		ACETONE	11	UG/KG	U	V	11
44893	BH40194AE	15 9	16 1	REAL		ACETONE	12	UG/KG	U	V	12
45693	BH40375AE	1 05	1 3	REAL		ACETONE	13	UG/KG	U	V	13
45693	BH40376AE	5 35	5 6	REAL		ACETONE	12	UG/KG	U	V	12
45693	BH40373AE	8 55	8 8	REAL		ACETONE	12	UG/KG	U	V	12
45793	BH40558AE	1 25	1 5	REAL		ACETONE	65	UG/KG	U	JA	65
45793	BH40560AE	5 45	5 7	REAL		ACETONE	22	UG/KG	U	JA	11
45893	BH40457AE	NA		RNS		ACETONE	23	UG/L		V	10
45893	BH40378AE	2 2	2 4	REAL		ACETONE	17	UG/KG	U	JA	12

* Codes are explained in Table II 3 6-1
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TABLE II.3 4-5

**OU4 SUBSURFACE SOIL AND BEDROCK
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Units	Qual *	Val *	Detect Limit	
	45893	BH40379AE	5	5 25	REAL	BH40413AE	ACETONE	60	UG/KG	B	V	12
	45893	BH40556AE	5 25	5 5	DUP	BH40379AE	ACETONE	12	UG/KG	U	V	12
	45893	BH40381AE	9 25	9 5	REAL		ACETONE	11	UG/KG	U	V	11
	46193	BH40386AE	0 4	0 6	REAL	BH40561AE	ACETONE	60	UG/KG	U	V	60
	46193	BH40561AE	0 4	0 6	DUP	BH40386AE	ACETONE	17	UG/KG	U	JA	12
	46193	BH40387AE	7 6	7 8	REAL		ACETONE	23	UG/KG	U	JA	12
	46293	BH40566AE	2 4	2 6	REAL		ACETONE	21	UG/KG		V	13
	46293	BH40564AE	2 6	2 8	DUP	BH40563AE	ACETONE	12	UG/KG	U	V	12
	46593	BH40701AE	2 2	2 45	REAL		ACETONE	11	UG/KG	U	Y	10
	46593	BH40704AE	5 75	6 75	REAL		ACETONE	11	UG/KG	U	Y	10
	46593	BH40712AE	9 95	10 2	REAL		ACETONE	12	UG/KG	U	Y	10
	46693	BH40716AE	1 2	1 45	REAL		ACETONE	65	UG/KG		Y	10
	46693	BH40719AE	5 75	6	REAL		ACETONE	11	UG/KG	U	Y	10
	46693	BH40719AE	5 75	6	REAL		ACETONE	35	UG/KG		Y	10
	46693	BH40727AE	14 3	14 6	REAL		ACETONE	17	UG/KG		Y	10
	46793	BH40730AE	1 25	1 5	REAL		ACETONE	13	UG/KG	U	Y	10
	46793	BH40733AE	5 75	6	REAL		ACETONE	12	UG/KG	U	Y	10
	46793	BH40741AE	8 05	8 3	REAL		ACETONE	12	UG/KG	U	Y	10
	46893	BH40744AE	1 35	1 6	REAL		ACETONE	37	UG/KG		JA	10
	46893	BH40747AE	6 15	6 4	REAL		ACETONE	46	UG/KG		JA	10
	46893	BH40750AE	10	10 3	REAL		ACETONE	40	UG/KG		JA	10
	46893	BH40755AE	11 9	12 2	REAL		ACETONE	12	UG/KG	U	R	10
	46993	BH40820AE	2 4	2 65	DUP	BH40758AE	ACETONE	11	UG/KG	U	R	10
	46993	BH40758AE	2 65	2 9	REAL		ACETONE	11	UG/KG	U	R	10
	46993	BH40769AE	6 55	6 8	REAL		ACETONE	13	UG/KG	U	R	10
	42193	BH40427AE	4	6	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	45	UG/KG	J	A	360
	42293	BH40253AE	0 7	6 1	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	390	UG/KG	U	JA	390
	42293	BH40256AE	6 1	11 3	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	400	UG/KG	U	JA	400
	42293	BH40258AE	11 3	12 9	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	400	UG/KG	U	V	400
	42493	BH40440AE	4	6	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	38	UG/KG	J	A	360
	42593	BH40448AE	4	6	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	360	UG/KG	U	V	360
	42593	BH40450AE	8	10 2	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	380	UG/KG	U	V	380
	43393	BH40512AE	4	5 4	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	360	UG/KG	U	V	360
	43393	BH40324AE	7 6	12 6	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	390	UG/KG	U	V	390
	43493	BH40575AE	NA		RNS	BH40322AE	BIS(2-ETHYLHEXYL)PHTHALAT	10	UG/L	U	JA	10
	43493	BH40319AE	0 5	5 3	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	380	UG/KG	U	V	380
	43493	BH40573AE	0 5	5 3	DUP	BH40319AE	BIS(2-ETHYLHEXYL)PHTHALAT	370	UG/KG	U	V	370
	43493	BH40322AE	5 3	11 3	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	370	UG/KG	U	V	370
	43693	BH40520AE	4	6	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	50	UG/KG	J	A	360
	43693	BH40563AE	10	13	DUP	BH40525AE	BIS(2-ETHYLHEXYL)PHTHALAT	390	UG/KG	U	V	390
	46593	BH40786AE	0 75	6 75	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	360	UG/KG	U	V	330
	46593	BH40713AE	10 7	16 4	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	46	UG/KG	J	A	330
	46693	BH40792AE	0 5	6 6	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	380	UG/KG	U	V	330
	46693	BH40728AE	8 6	14 8	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	390	UG/KG	U	V	330
	46793	BH40798AE	0 5	6 5	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	370	UG/KG	U	V	330
	46793	BH40742AE	8 5	14 7	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	390	UG/KG	U	V	330
	46893	BH40804AE	0 5	6 6	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	370	UG/KG	U	Y	330
	46893	BH40807AE	6 5	11 5	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	350	UG/KG	U	Y	330
	46993	BH40810AE	1 3	5	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	350	UG/KG	U	Y	330
	46993	BH40770AE	7 2	13 1	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	390	UG/KG	U	Y	330
	47093	BH40816AE	0 7	6 8	REAL		BIS(2-ETHYLHEXYL)PHTHALAT	350	UG/KG	U	Y	330
	40093	BH40168AE	1 3	1 5	REAL		METHYLENE CHLORIDE	3	UG/KG	J	A	6
	40093	BH40169AE	4 3	4 55	REAL		METHYLENE CHLORIDE	12	UG/KG		V	6
	40093	BH40171AE	9 7	9 95	REAL		METHYLENE CHLORIDE	9	UG/KG	J	A	30
	40193	BH40486AE	1 1	1 3	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	5
	40193	BH40487AE	5 1	5 3	REAL		METHYLENE CHLORIDE	3	UG/KG	J	A	6
	40193	BH40489AE	8 5	8 7	REAL		METHYLENE CHLORIDE	9	UG/KG		V	6
	40193	BH40491AE	12 9	13 1	REAL		METHYLENE CHLORIDE	7	UG/KG		V	6
	40193	BH40492AE	16 7	16 9	REAL		METHYLENE CHLORIDE	11	UG/KG		V	6
	40193	BH40494AE	21 2	21 4	REAL		METHYLENE CHLORIDE	16	UG/KG		V	6
	40193	BH40496AE	24 7	24 9	REAL		METHYLENE CHLORIDE	11	UG/KG		V	6
	40293	BH40119AE	1 6	1 8	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	6
	40293	BH40120AE	5 8	6	REAL		METHYLENE CHLORIDE	1	UG/KG	J	A	6
	40393	BH40124AE	1 7	1 9	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	40393	BH40125AE	5 8	6	REAL		METHYLENE CHLORIDE	6	UG/KG		V	6
	40593	BH40098AE	1 5	1 7	DUP	BH40129AE	METHYLENE CHLORIDE	30	UG/KG		V	7

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TABLE II.3 4-5

OU4 SUBSURFACE SOIL AND BEDROCK
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Units	Qual *	Val *	Detect Limit	
	40593	BH40129AE	1 7	1 9	REAL		METHYLENE CHLORIDE	25	UG/KG	V	6	
	40593	BH40130AE	5	5 2	REAL		METHYLENE CHLORIDE	8	UG/KG	V	5	
	40593	BH40132AE	9 4	9 6	REAL		METHYLENE CHLORIDE	17	UG/KG	V	6	
	40593	BH40393AE	13 8	14	REAL		METHYLENE CHLORIDE	18	UG/KG	V	6	
	40593	BH40394AE	17 8	18	REAL		METHYLENE CHLORIDE	9	UG/KG	J	A	12
	40593	BH40399AE	21 8	22	REAL		METHYLENE CHLORIDE	19	UG/KG	V	6	
	40693	BH40151AE	1 4	1 6	REAL		METHYLENE CHLORIDE	7	UG/KG	V	6	
	40793	BH40158AE	1 3	1 5	REAL		METHYLENE CHLORIDE	32	UG/KG	U	V	32
	40793	BH40159AE	5 3	5 5	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	40793	BH40161AE	9 7	9 9	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	40893	BH40031AE	0 55	0 8	REAL		METHYLENE CHLORIDE	29	UG/KG	U	JA	5
	40893	BH40032AE	4 35	4 6	REAL		METHYLENE CHLORIDE	5	UG/KG	U	JA	5
	40893	BH40029AE	6 75	7	REAL		METHYLENE CHLORIDE	6	UG/KG	U	JA	5
	40993	BH40202AE	1 35	1 6	REAL		METHYLENE CHLORIDE	3	UG/KG	J	A	6
	40993	BH40203AE	5 25	5 5	REAL		METHYLENE CHLORIDE	1	UG/KG	J	A	5
	40993	BH40205AE	9 4	9 6	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	40993	BH40208AE	31 3	31 4	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	41193	BH40050AE	1 35	1 6	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	41193	BH40051AE	5 5	5 75	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
	41193	BH40053AE	9 75	10 1	REAL		METHYLENE CHLORIDE	7	UG/KG	V	7	
	41293	BH40406AE	1 2	1 4	DUP	BH40197AE	METHYLENE CHLORIDE	6	UG/KG	U	V	6
	41293	BH40197AE	1 4	1 6	REAL		METHYLENE CHLORIDE	28	UG/KG	U	V	28
	41293	BH40198AE	6	6 2	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	41593	BH40210AE	1 85	2 1	REAL		METHYLENE CHLORIDE	28	UG/KG	U	V	28
	41593	BH40211AE	4 85	5 1	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
	41593	BH40216AE	7 45	7 7	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	6
	41693	BH40218AE	2 15	2 4	REAL		METHYLENE CHLORIDE	8	UG/KG	V	5	
	41693	BH40219AE	5 55	5 7	REAL		METHYLENE CHLORIDE	39	UG/KG	V	7	
	41693	BH40221AE	9 65	9 8	REAL		METHYLENE CHLORIDE	16	UG/KG	V	6	
	41693	BH40223AE	17 1	17 4	REAL		METHYLENE CHLORIDE	20	UG/KG	V	6	
	41793	BH40244AE	2 5	2 7	REAL		METHYLENE CHLORIDE	3	UG/KG	J	A	5
	41793	BH40245AE	5 4	5 6	REAL		METHYLENE CHLORIDE	4	UG/KG	J	A	6
	41993	BH40063AE	1 6	1 8	REAL		METHYLENE CHLORIDE	6	UG/KG	V	5	
	41993	BH40064AE	5 2	5 4	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	5
	41993	BH40107AE	9 4	9 6	DUP	BH40066AE	METHYLENE CHLORIDE	6	UG/KG	V	6	
	41993	BH40066AE	9 6	9 8	REAL		METHYLENE CHLORIDE	5	UG/KG	J	A	6
	42093	BH40484AE	1 3	1 5	REAL		METHYLENE CHLORIDE	29	UG/KG	U	V	29
	42093	BH40104AE	5 7	5 9	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	42193	BH40436AE	1 8	2	REAL		METHYLENE CHLORIDE	12	UG/KG	U	V	12
	42193	BH40437AE	6 1	6 3	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
	42193	BH40090AE	9 5	9 7	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	42293	BH40254AE	3 7	3 9	REAL		METHYLENE CHLORIDE	6	UG/KG	U	JA	6
	42293	BH40255AE	7 3	7 5	REAL		METHYLENE CHLORIDE	5	UG/KG	U	JA	5
	42293	BH40257AE	10 9	11 1	REAL		METHYLENE CHLORIDE	6	UG/KG	U	JA	6
	42393	BH40262AE	1	1 25	REAL		METHYLENE CHLORIDE	7	UG/KG	V	6	
	42393	BH40263AE	5 55	5 8	REAL		METHYLENE CHLORIDE	5	UG/KG	V	5	
	42393	BH40265AE	10 1	10 4	REAL		METHYLENE CHLORIDE	5	UG/KG	J	A	6
	42493	BH40113AE	2 2	2 4	DUP	BH40283AE	METHYLENE CHLORIDE	7	UG/KG	V	6	
	42493	BH40283AE	2 4	2 6	REAL	BH40113AE	METHYLENE CHLORIDE	8	UG/KG	V	6	
	42493	BH40284AE	4 7	4 9	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	5
	42493	BH40289AE	9 8	10	REAL		METHYLENE CHLORIDE	7	UG/KG	V	6	
	42593	BH40291AE	1 7	1 9	REAL		METHYLENE CHLORIDE	69	UG/KG	V	6	
	42593	BH40292AE	5 4	5 6	REAL		METHYLENE CHLORIDE	31	UG/KG	V	5	
	42593	BH40294AE	9 8	10	REAL		METHYLENE CHLORIDE	65	UG/KG	V	6	
	42993	BH40095AE	1 1	1 35	DUP	BH40143AE	METHYLENE CHLORIDE	5	UG/KG	U	V	5
	42993	BH40143AE	1 35	1 6	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
	42993	BH40145AE	5 35	5 6	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
	42993	BH40142AE	9 35	9 5	REAL		METHYLENE CHLORIDE	7	UG/KG	U	V	7
	42993	BH40147AE	13 8	14	REAL		METHYLENE CHLORIDE	9	UG/KG	V	6	
	43193	BH40409AE	NA		RNS		METHYLENE CHLORIDE	16	UG/L	V	5	
	43193	BH40411AE	1 3	1 5	DUP	BH40307AE	METHYLENE CHLORIDE	2	UG/KG	J	A	11
	43193	BH40307AE	1 5	1 7	REAL		METHYLENE CHLORIDE	11	UG/KG	U	V	11
	43193	BH40308AE	5 6	5 8	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
	43293	BH40042AE	2 25	2 5	REAL		METHYLENE CHLORIDE	7	UG/KG	U	V	7
	43293	BH40043AE	5 15	5 3	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
	43293	BH40045AE	11 1	11 3	REAL		METHYLENE CHLORIDE	3	UG/KG	J	A	6
	43393	BH40325AE	2	2 2	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
	43393	BH40326AE	5 3	5 5	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	6
	43393	BH40331AE	9 2	9 4	REAL		METHYLENE CHLORIDE	3	UG/KG	J	A	6
	43493	BH40575AE	NA		RNS	BH40322AE	METHYLENE CHLORIDE	5	UG/L	U	V	5

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TABLE II 3 4-5

OU4 SUBSURFACE SOIL AND BEDROCK
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Units	Qual *	Val *	Detect Limit
43493	BH40574AE	NA		RNS	BH40320AE	METHYLENE CHLORIDE	5	UG/L	U	V	5
43493	BH40320AE	1 9	2 1	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
43493	BH40321AE	5 3	5 5	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
43493	BH40323AE	10 1	10 3	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
43593	BH40181AE	1 35	1 6	REAL		METHYLENE CHLORIDE	12	UG/KG		V	6
43593	BH40182AE	5	5 25	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
43593	BH40187AE	9 75	10	REAL		METHYLENE CHLORIDE	25	UG/KG		V	6
43693	BH40341AE	2 7	2 9	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
43693	BH40342AE	6 3	6 5	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
43693	BH40344AE	9 3	9 5	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
43693	BH40347AE	12 6	12 8	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
43793	BH40333AE	1 25	1 4	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
43793	BH40334AE	5 25	5 5	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
43793	BH40336AE	9 25	9 4	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
43793	BH40339AE	14 2	14 5	REAL		METHYLENE CHLORIDE	1	UG/KG	J	A	6
43893	BH40007AE	NA		RNS		METHYLENE CHLORIDE	5	UG/L	U	V	5
43893	BH40071AE	1 15	1 3	REAL		METHYLENE CHLORIDE	7	UG/KG		V	6
43893	BH40027AE	5 25	5 5	DUP	BH40072AE	METHYLENE CHLORIDE	3	UG/KG	J	A	5
43893	BH40072AE	5 5	5 75	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	6
43893	BH40076AE	9 15	9 4	REAL		METHYLENE CHLORIDE	6	UG/KG	J	A	6
43893	BH40074AE	12 35	12 6	REAL		METHYLENE CHLORIDE	10	UG/KG		V	5
43893	BH40077AE	15	15 25	REAL		METHYLENE CHLORIDE	31	UG/KG	U	V	31
43993	BH40354AE	1 1	1 35	REAL		METHYLENE CHLORIDE	7	UG/KG		V	6
43993	BH40355AE	5 2	5 45	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
43993	BH40360AE	17	17 25	REAL		METHYLENE CHLORIDE	5	UG/KG	J	A	7
44093	BH40349AE	1 3	1 5	REAL		METHYLENE CHLORIDE	11	UG/KG	J	A	12
44093	BH40350AE	5 55	5 8	REAL		METHYLENE CHLORIDE	19	UG/KG		V	6
44093	BH40352AE	14 55	14 8	REAL		METHYLENE CHLORIDE	12	UG/KG		V	6
44193	BH40079AE	0 3	0 5	REAL		METHYLENE CHLORIDE	28	UG/KG	U	JA	28
44193	BH40080AE	4 3	4 5	REAL		METHYLENE CHLORIDE	6	UG/KG	U	JA	6
44193	BH40082AE	8 4	8 6	REAL		METHYLENE CHLORIDE	5	UG/KG	U	JA	5
44193	BH40084AE	13 8	14	REAL		METHYLENE CHLORIDE	6	UG/KG	U	JA	6
44393	BH40025AE	NA		RNS		METHYLENE CHLORIDE	2	UG/L	J	A	5
44393	BH40034AE	1 1	1 3	REAL		METHYLENE CHLORIDE	28	UG/KG	U	V	28
44393	BH40035AE	5 4	5 6	REAL		METHYLENE CHLORIDE	13	UG/KG		V	12
44393	BH40037AE	9 6	9 8	REAL		METHYLENE CHLORIDE	4	UG/KG	J	A	6
44593	BH40002AE	0 5	0 7	REAL		METHYLENE CHLORIDE	14	UG/KG	U	JA	5
44593	BH40003AE	5 6	5 8	REAL		METHYLENE CHLORIDE	6	UG/KG	U	JA	5
44593	BH40004AE	9 3	9 5	REAL		METHYLENE CHLORIDE	7	UG/KG	U	JA	5
44593	BH40006AE	13 8	14	REAL		METHYLENE CHLORIDE	7	UG/KG	U	JA	5
44793	BH40137AE	1 4	1 55	REAL		METHYLENE CHLORIDE	27	UG/KG	U	V	27
44793	BH40135AE	4 1	4 35	REAL		METHYLENE CHLORIDE	7	UG/KG		V	6
44893	BH40102AE	1 3	1 55	DUP	BH40190AE	METHYLENE CHLORIDE	2	UG/KG	J	A	6
44893	BH40190AE	1 55	1 8	REAL		METHYLENE CHLORIDE	5	UG/KG	J	A	6
44893	BH40189AE	5 55	5 8	REAL		METHYLENE CHLORIDE	3	UG/KG	J	A	6
44893	BH40192AE	7	7 2	REAL		METHYLENE CHLORIDE	9	UG/KG		V	6
44893	BH40195AE	12	12 2	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	6
44893	BH40194AE	15 9	16 1	REAL		METHYLENE CHLORIDE	4	UG/KG	J	A	6
45693	BH40375AE	1 05	1 3	REAL		METHYLENE CHLORIDE	7	UG/KG	U	V	7
45693	BH40376AE	5 35	5 6	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	6
45693	BH40373AE	8 55	8 8	REAL		METHYLENE CHLORIDE	3	UG/KG	J	A	6
45793	BH40558AE	1 25	1 5	REAL		METHYLENE CHLORIDE	32	UG/KG	U	V	32
45793	BH40560AE	5 45	5 7	REAL		METHYLENE CHLORIDE	2	UG/KG	J	A	6
45893	BH40457AE	NA		RNS		METHYLENE CHLORIDE	5	UG/L	U	V	5
45893	BH40378AE	2 2	2 4	REAL		METHYLENE CHLORIDE	49	UG/KG		V	6
45893	BH40379AE	5	5 25	REAL	BH40413AE	METHYLENE CHLORIDE	71	UG/KG		V	6
45893	BH40556AE	5 25	5 5	DUP	BH40379AE	METHYLENE CHLORIDE	59	UG/KG		V	6
45893	BH40381AE	9 25	9 5	REAL		METHYLENE CHLORIDE	24	UG/KG		V	5
46193	BH40561AE	0 4	0 6	DUP	BH40386AE	METHYLENE CHLORIDE	7	UG/KG		V	6
46193	BH40386AE	0 4	0 6	REAL	BH40561AE	METHYLENE CHLORIDE	30	UG/KG	U	V	30
46193	BH40387AE	7 6	7 8	REAL		METHYLENE CHLORIDE	5	UG/KG	J	A	6
46293	BH40566AE	2 4	2 6	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	6
46293	BH40564AE	2 6	2 8	DUP	BH40563AE	METHYLENE CHLORIDE	6	UG/KG	U	V	6
46593	BH40701AE	2 2	2 45	REAL		METHYLENE CHLORIDE	5	UG/KG	U	Y	5
46593	BH40704AE	5 75	6 75	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5
46593	BH40712AE	9 95	10 2	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5
46693	BH40716AE	1 2	1 45	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5
46693	BH40719AE	5 75	6	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5
46693	BH40719AE	5 75	6	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5
46693	BH40727AE	14 3	14 6	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5

TABLE II.3 4-5

OU4 SUBSURFACE SOIL AND BEDROCK
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Units	Qual *	Val *	Detect Limit
46793	BH40730AE	1 25	1 5	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5
46793	BH40733AE	5 75	6	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5
46793	BH40741AE	8 05	8 3	REAL		METHYLENE CHLORIDE	6	UG/KG	U	Y	5
46893	BH40744AE	1 35	1 6	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
46893	BH40747AE	6 15	6 4	REAL		METHYLENE CHLORIDE	4	UG/KG	J	A	5
46893	BH40750AE	10	10 3	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
46893	BH40755AE	11 9	12 2	REAL		METHYLENE CHLORIDE	5	UG/KG	J	A	5
46993	BH40820AE	2 4	2 65	DUP	BH40758AE	METHYLENE CHLORIDE	6	UG/KG	U	V	5
46993	BH40758AE	2 65	2 9	REAL		METHYLENE CHLORIDE	5	UG/KG	U	V	5
46993	BH40769AE	6 55	6 8	REAL		METHYLENE CHLORIDE	6	UG/KG	U	V	5
40093	BH40168AE	1 3	1 5	REAL		TOLUENE	130	UG/KG		V	6
40093	BH40169AE	4 3	4 55	REAL		TOLUENE	170	UG/KG		V	6
40093	BH40171AE	9 7	9 95	REAL		TOLUENE	330	UG/KG		V	30
40193	BH40486AE	1 1	1 3	REAL		TOLUENE	47	UG/KG		V	5
40193	BH40487AE	5 1	5 3	REAL		TOLUENE	200	UG/KG		V	6
40193	BH40489AE	8 5	8 7	REAL		TOLUENE	150	UG/KG		V	6
40193	BH40491AE	12 9	13 1	REAL		TOLUENE	88	UG/KG		V	6
40193	BH40492AE	16 7	16 9	REAL		TOLUENE	230	UG/KG		V	6
40193	BH40494AE	21 2	21 4	REAL		TOLUENE	103	UG/KG		V	6
40193	BH40496AE	24 7	24 9	REAL		TOLUENE	120	UG/KG		V	6
40293	BH40119AE	1 6	1 8	REAL		TOLUENE	13	UG/KG		V	6
40293	BH40120AE	5 8	6	REAL		TOLUENE	56	UG/KG		V	6
40393	BH40124AE	1 7	1 9	REAL		TOLUENE	110	UG/KG		V	6
40393	BH40125AE	5 8	6	REAL		TOLUENE	88	UG/KG		V	6
40593	BH40098AE	1 5	1 7	DUP	BH40129AE	TOLUENE	140	UG/KG		V	7
40593	BH40129AE	1 7	1 9	REAL		TOLUENE	120	UG/KG		V	6
40593	BH40130AE	5	5 2	REAL		TOLUENE	180	UG/KG		V	5
40593	BH40132AE	9 4	9 6	REAL		TOLUENE	160	UG/KG		V	6
40593	BH40393AE	13 8	14	REAL		TOLUENE	150	UG/KG		V	6
40593	BH40394AE	17 8	18	REAL		TOLUENE	250	UG/KG		V	12
40593	BH40399AE	21 8	22	REAL		TOLUENE	110	UG/KG		V	6
40693	BH40151AE	1 4	1 6	REAL		TOLUENE	110	UG/KG		V	6
40793	BH40158AE	1 3	1 5	REAL		TOLUENE	1200	UG/KG		V	32
40793	BH40159AE	5 3	5 5	REAL		TOLUENE	150	UG/KG		V	6
40793	BH40161AE	9 7	9 9	REAL		TOLUENE	54	UG/KG		V	6
40893	BH40031AE	0 55	0 8	REAL		TOLUENE	1100	UG/KG		V	5
40893	BH40032AE	4 35	4 6	REAL		TOLUENE	72	UG/KG		V	5
40893	BH40029AE	6 75	7	REAL		TOLUENE	220	UG/KG		V	5
40993	BH40202AE	1 35	1 6	REAL		TOLUENE	130	UG/KG		V	6
40993	BH40203AE	5 25	5 5	REAL		TOLUENE	71	UG/KG		V	5
40993	BH40205AE	9 4	9 6	REAL		TOLUENE	23	UG/KG		V	6
40993	BH40208AE	31 3	31 4	REAL		TOLUENE	17	UG/KG		V	6
41193	BH40050AE	1 35	1 6	REAL		TOLUENE	21	UG/KG		V	6
41193	BH40051AE	5 5	5 75	REAL		TOLUENE	95	UG/KG		V	5
41193	BH40053AE	9 75	10 1	REAL		TOLUENE	180	UG/KG		V	7
41293	BH40406AE	1 2	1 4	DUP	BH40197AE	TOLUENE	55	UG/KG		V	6
41293	BH40197AE	1 4	1 6	REAL		TOLUENE	180	UG/KG		V	28
41293	BH40198AE	6	6 2	REAL		TOLUENE	100	UG/KG		V	6
41593	BH40210AE	1 85	2 1	REAL		TOLUENE	470	UG/KG		V	28
41593	BH40211AE	4 85	5 1	REAL		TOLUENE	97	UG/KG		V	5
41593	BH40216AE	7 45	7 7	REAL		TOLUENE	46	UG/KG		V	6
41693	BH40218AE	2 15	2 4	REAL		TOLUENE	96	UG/KG		V	5
41693	BH40219AE	5 55	5 7	REAL		TOLUENE	170	UG/KG		V	7
41693	BH40221AE	9 65	9 8	REAL		TOLUENE	89	UG/KG		V	6
41693	BH40223AE	17 1	17 4	REAL		TOLUENE	120	UG/KG		V	6
41793	BH40244AE	2 5	2 7	REAL		TOLUENE	140	UG/KG		V	5
41793	BH40245AE	5 4	5 6	REAL		TOLUENE	89	UG/KG		V	6
41993	BH40063AE	1 6	1 8	REAL		TOLUENE	210	UG/KG		V	5
41993	BH40064AE	5 2	5 4	REAL		TOLUENE	18	UG/KG		V	5
41993	BH40107AE	9 4	9 6	DUP	BH40066AE	TOLUENE	47	UG/KG		V	6
41993	BH40066AE	9 6	9 8	REAL		TOLUENE	28	UG/KG		V	6
42093	BH40484AE	1 3	1 5	REAL		TOLUENE	260	UG/KG		V	29
42093	BH40104AE	5 7	5 9	REAL		TOLUENE	200	UG/KG		V	6
42193	BH40436AE	1 8	2	REAL		TOLUENE	180	UG/KG		V	12
42193	BH40437AE	6 1	6 3	REAL		TOLUENE	21	UG/KG		V	5
42193	BH40090AE	9 5	9 7	REAL		TOLUENE	76	UG/KG		V	6
42293	BH40254AE	3 7	3 9	REAL		TOLUENE	18	UG/KG		JA	6
42293	BH40255AE	7 3	7 5	REAL		TOLUENE	57	UG/KG		JA	5

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**OU4 SUBSURFACE SOIL AND BEDROCK
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN**

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Units	Qual *	Val *	Detect Limit
	42293	BH40257AE	10 9	11 1	REAL	TOLUENE	93	UG/KG		JA	6
	42393	BH40262AE	1	1 25	REAL	TOLUENE	36	UG/KG		V	6
	42393	BH40263AE	5 55	5 8	REAL	TOLUENE	27	UG/KG		V	5
	42393	BH40265AE	10 1	10 4	REAL	TOLUENE	39	UG/KG		V	6
	42493	BH40113AE	2.2	2 4	DUP	BH40283AE	40	UG/KG		V	6
	42493	BH40283AE	2.4	2 6	REAL	BH40113AE	150	UG/KG		V	6
	42493	BH40284AE	4 7	4 9	REAL	TOLUENE	12	UG/KG		V	5
	42493	BH40289AE	9 8	10	REAL	TOLUENE	84	UG/KG		V	6
	42593	BH40291AE	1 7	1 9	REAL	TOLUENE	150	UG/KG		V	6
	42593	BH40292AE	5 4	5 6	REAL	TOLUENE	56	UG/KG		V	5
	42593	BH40294AE	9 8	10	REAL	TOLUENE	91	UG/KG		V	6
	42993	BH40095AE	1 1	1 35	DUP	BH40143AE	81	UG/KG		V	5
	42993	BH40143AE	1 35	1 6	REAL	TOLUENE	3	UG/KG	J	A	5
	42993	BH40145AE	5 35	5 6	REAL	TOLUENE	68	UG/KG		V	6
	42993	BH40142AE	9 35	9 5	REAL	TOLUENE	21	UG/KG		V	7
	42993	BH40147AE	13 8	14	REAL	TOLUENE	160	UG/KG		V	6
	43193	BH40409AE	NA		RNS	TOLUENE	5	UG/L	U	V	5
	43193	BH40411AE	1 3	1 5	DUP	BH40307AE	390	UG/KG		V	11
	43193	BH40307AE	1 5	1 7	REAL	TOLUENE	200	UG/KG		V	11
	43193	BH40308AE	5 6	5 8	REAL	TOLUENE	4	UG/KG	J	A	5
	43293	BH40042AE	2 25	2 5	REAL	TOLUENE	90	UG/KG		V	7
	43293	BH40043AE	5 15	5 3	REAL	TOLUENE	18	UG/KG		V	5
	43293	BH40045AE	11 1	11 3	REAL	TOLUENE	38	UG/KG		V	6
	43393	BH40325AE	2	2 2	REAL	TOLUENE	38	UG/KG		V	5
	43393	BH40326AE	5 3	5 5	REAL	TOLUENE	86	UG/KG		V	6
	43393	BH40331AE	9 2	9 4	REAL	TOLUENE	69	UG/KG		V	6
	43493	BH40574AE	NA		RNS	BH40320AE	5	UG/L	U	V	5
	43493	BH40575AE	NA		RNS	BH40322AE	5	UG/L	U	V	5
	43493	BH40320AE	1 9	2 1	REAL	TOLUENE	42	UG/KG		V	6
	43493	BH40321AE	5 3	5 5	REAL	TOLUENE	160	UG/KG		V	6
	43493	BH40323AE	10 1	10 3	REAL	TOLUENE	120	UG/KG		V	6
	43593	BH40181AE	1 35	1 6	REAL	TOLUENE	70	UG/KG		V	6
	43593	BH40182AE	5	5 25	REAL	TOLUENE	2	UG/KG	J	A	5
	43593	BH40187AE	9 75	10	REAL	TOLUENE	56	UG/KG		V	6
	43693	BH40341AE	2 7	2 9	REAL	TOLUENE	7	UG/KG		V	6
	43693	BH40342AE	6 3	6 5	REAL	TOLUENE	34	UG/KG		V	5
	43693	BH40344AE	9 3	9 5	REAL	TOLUENE	30	UG/KG		V	5
	43693	BH40347AE	12 6	12 8	REAL	TOLUENE	120	UG/KG		V	6
	43793	BH40333AE	1 25	1 4	REAL	TOLUENE	84	UG/KG		V	5
	43793	BH40334AE	5 25	5 5	REAL	TOLUENE	150	UG/KG		V	6
	43793	BH40336AE	9 25	9 4	REAL	TOLUENE	4	UG/KG	J	A	5
	43793	BH40339AE	14 2	14 5	REAL	TOLUENE	92	UG/KG		V	6
	43893	BH40007AE	NA		RNS	TOLUENE	5	UG/L	U	JA	5
	43893	BH40071AE	1 15	1 3	REAL	TOLUENE	37	UG/KG		V	6
	43893	BH40027AE	5 25	5 5	DUP	BH40072AE	29	UG/KG		V	5
	43893	BH40072AE	5 5	5 75	REAL	TOLUENE	21	UG/KG		V	6
	43893	BH40076AE	9 15	9 4	REAL	TOLUENE	110	UG/KG		V	6
	43893	BH40074AE	12 35	12 6	REAL	TOLUENE	170	UG/KG		V	5
	43893	BH40077AE	15	15 25	REAL	TOLUENE	130	UG/KG		V	31
	43993	BH40354AE	1 1	1 35	REAL	TOLUENE	73	UG/KG		V	6
	43993	BH40355AE	5 2	5 45	REAL	TOLUENE	15	UG/KG		V	5
	43993	BH40360AE	17	17 25	REAL	TOLUENE	73	UG/KG		V	7
	44093	BH40349AE	1 3	1 5	REAL	TOLUENE	150	UG/KG		V	12
	44093	BH40350AE	5 55	5 8	REAL	TOLUENE	170	UG/KG		V	6
	44093	BH40352AE	14 55	14 8	REAL	TOLUENE	140	UG/KG		V	6
	44193	BH40079AE	0 3	0 5	REAL	TOLUENE	290	UG/KG		V	28
	44193	BH40080AE	4 3	4 5	REAL	TOLUENE	22	UG/KG		V	6
	44193	BH40082AE	8 4	8 6	REAL	TOLUENE	33	UG/KG		V	5
	44193	BH40084AE	13 8	14	REAL	TOLUENE	150	UG/KG		V	6
	44393	BH40025AE	NA		RNS	TOLUENE	5	UG/L	U	V	5
	44393	BH40034AE	1 1	1 3	REAL	TOLUENE	780	UG/KG		V	28
	44393	BH40035AE	5 4	5 6	REAL	TOLUENE	300	UG/KG		V	12
	44393	BH40037AE	9 6	9 8	REAL	TOLUENE	75	UG/KG		V	6
	44593	BH40002AE	0 5	0 7	REAL	TOLUENE	210	UG/KG		V	5
	44593	BH40003AE	5 6	5 8	REAL	TOLUENE	62	UG/KG		V	5
	44593	BH40004AE	9 3	9 5	REAL	TOLUENE	97	UG/KG		V	5
	44593	BH40006AE	13 8	14	REAL	TOLUENE	120	UG/KG		V	5
	44793	BH40137AE	1 4	1 55	REAL	TOLUENE	670	UG/KG		V	27
	44793	BH40135AE	4 1	4 35	REAL	TOLUENE	120	UG/KG		V	6
	44893	BH40102AE	1 3	1 55	DUP	BH40190AE	130	UG/KG		V	6

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TABLE II.3 4-5

OU4 SUBSURFACE SOIL AND BEDROCK
ORGANIC POTENTIAL CONTAMINANTS OF CONCERN

Location	Sample No	Start Depth	End Depth	QC Code	QC Partner	Chemical	Result	Units	Qual *	Val *	Detect Limit
44893	BH40190AE	1 55	1 8	REAL		TOLUENE	110	UG/KG	V		6
44893	BH40189AE	5 55	5 8	REAL		TOLUENE	120	UG/KG	V		6
44893	BH40192AE	7	7 2	REAL		TOLUENE	130	UG/KG	V		6
44893	BH40195AE	12	12 2	REAL		TOLUENE	76	UG/KG	V		6
44893	BH40194AE	15 9	16 1	REAL		TOLUENE	97	UG/KG	V		6
45693	BH40375AE	1 05	1 3	REAL		TOLUENE	120	UG/KG	V		7
45693	BH40376AE	5 35	5 6	REAL		TOLUENE	110	UG/KG	V		6
45693	BH40373AE	8 55	8 8	REAL		TOLUENE	220	UG/KG	V		6
45793	BH40558AE	1 25	1 5	REAL		TOLUENE	450	UG/KG	V		32
45793	BH40560AE	5 45	5 7	REAL		TOLUENE	86	UG/KG	V		6
45893	BH40457AE	NA		RNS		TOLUENE	5	UG/L	U	V	5
45893	BH40378AE	2 2	2 4	REAL		TOLUENE	120	UG/KG	V		6
45893	BH40379AE	5	5 25	REAL	BH40413AE	TOLUENE	48	UG/KG	V		6
45893	BH40556AE	5 25	5 5	DUP	BH40379AE	TOLUENE	76	UG/KG	V		6
45893	BH40381AE	9 25	9 5	REAL		TOLUENE	66	UG/KG	V		5
46193	BH40386AE	0 4	0 6	REAL	BH40561AE	TOLUENE	360	UG/KG	V		30
46193	BH40561AE	0 4	0 6	DUP	BH40386AE	TOLUENE	170	UG/KG	V		6
46193	BH40387AE	7 6	7 8	REAL		TOLUENE	72	UG/KG	V		6
46293	BH40566AE	2 4	2 6	REAL		TOLUENE	160	UG/KG	V		6
46293	BH40564AE	2 6	2 8	DUP	BH40563AE	TOLUENE	110	UG/KG	V		6
46593	BH40701AE	2 2	2 45	REAL		TOLUENE	5	UG/KG	U	Y	5
46593	BH40704AE	5 75	6 75	REAL		TOLUENE	18	UG/KG	Y		5
46593	BH40712AE	9 95	10 2	REAL		TOLUENE	66	UG/KG	Y		5
46693	BH40716AE	1 2	1 45	REAL		TOLUENE	130	UG/KG	Y		5
46693	BH40719AE	5 75	6	REAL		TOLUENE	10	UG/KG	Y		5
46693	BH40719AE	5 75	6	REAL		TOLUENE	21	UG/KG	Y		5
46693	BH40727AE	14 3	14 6	REAL		TOLUENE	22	UG/KG	Y		5
46793	BH40730AE	1 25	1 5	REAL		TOLUENE	61	UG/KG	Y		5
46793	BH40733AE	5 75	6	REAL		TOLUENE	39	UG/KG	Y		5
46793	BH40741AE	8 05	8 3	REAL		TOLUENE	97	UG/KG	Y		5
46893	BH40744AE	1 35	1 6	REAL		TOLUENE	110	UG/KG	V		5
46893	BH40747AE	6 15	6 4	REAL		TOLUENE	57	UG/KG	V		5
46893	BH40750AE	10	10 3	REAL		TOLUENE	41	UG/KG	V		5
46893	BH40755AE	11 9	12 2	REAL		TOLUENE	59	UG/KG	V		5
46993	BH40820AE	2 4	2 65	DUP	BH40758AE	TOLUENE	30	UG/KG	V		5
46993	BH40758AE	2 65	2 9	REAL		TOLUENE	32	UG/KG	V		5
46993	BH40769AE	6 55	6 8	REAL		TOLUENE	66	UG/KG	V		5

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TABLE II.3.5-1

DESCRIPTION OF LITHOFACIES

SANDY LITHOFACIES:

Composition: > ~45% sand, < ~30% gravel, and < ~30% fines (silt and clay)

USCS classifications: "SW," "SP," "SM," "SC," "GC" divisions

Name: sand, gravelly sand, clayey sand, silty sand

Description, depositional mechanism & environment: very well to poorly sorted sands
Suspended load (water-lain) deposits predominantly deposited by grain flow, scour fill, sand wave, and dune (upper and lower flow regimes) deposits Channel sands, stream bed and bar deposits during periods of intermittent or normal stream flow and aggradation (sedimentation)

Geometry: channel sands, side and mid-stream bars, minor sheet flood deposits, often cut by sandy gravel lithofacies, cut and are laterally associated with Clayey Gravel Lithofacies, often contains reworked bedrock

Average Composition: (for all sediments classified) 22% gravel, 57% sand, 15% silt, 6% clay

Comments: May contain some "maverick" gravel-poor sediments with more than 30% but less than 45% fines

SANDY GRAVEL LITHOFACIES:

Composition: > ~45% gravel, < ~25% fines (silt and clay), 0-49% sand

USCS classification: "GW," "GP," "GC," and "GM" divisions

Name: gravel, sandy gravel, clayey gravel, silty gravel

Description, depositional mechanism & environment: poorly sorted, clast supported, sometimes clean gravel with no matrix (sieve deposits) Rapidly deposited (storm) channel deposits, stream flood and "break-out" deposits, slurry-type debris flows, sheet flood deposits Indicates periods of increased run-off and sedimentation as noted by great lateral and stratigraphic extent of this unit

Geometry: channel deposits, water-lain debris flows, thalweg channel lag, longitudinal bars, channel fill, cuts all lithofacies, clean gravel deposits usually rest on or cut sandy lithofacies

Average Composition: (for all sediments classified) 64% gravel, 23% sand, 8% silt, 5% clay

Comments: May also contain sand beds less than 1- foot thick

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TABLE II.3.5-1 (Continued)

DESCRIPTION OF LITHOFACIES

CLAYEY-SILTY GRAVEL LITHOFACIES:

Composition: > ~20% and < ~50% gravel, > ~25% fines (silt and clay), 0-45% sand

USCS classification: "GC," "GM," "SM" and "SC" divisions

Name: clayey gravel, silty gravel, clayey sand, silty sand

Description, depositional mechanism & environment: matrix-supported gravel, sands with appreciable gravel and fines Debris flows and bedload transport suggested by poor sorting, large grain-size range, and general lack of internal structure or framework

Presumed to indicate rapidly deposited sediment

Geometry: debris flows, channel fills & plugs, linguoid/transverse bars, laterally associated with the sandy lithofacies, lobate or incised into the sandy or clayey & silty lithofacies

Average Composition: (for all sediments classified) 38% gravel, 25% sand, 20% silt, 17% clay

CLAYEY & SILTY LITHOFACIES:

Composition: > ~45% fines (silt and clay), < ~45% sand, < ~20% gravel

USCS classification: "ML," "CL," "MH" and "CH" divisions

Name: clay, silty clay, sandy clay, gravelly clay, silt, gravelly silt, sandy silt, clayey silt

Description, depositional mechanism & environment: very well to poorly sorted clays and silts, often bedded and/or laminated Primarily suspended load deposition

Overbank, levee, crevasse-splay, waning flood and floodplain deposits

Geometry: generally planar deposits along the margins of channels, often lateral to the sandy or sandy gravel lithofacies, always on highs of the surface of deposition, "drape" deposit, does not cut any other lithofacies

Average Composition: (for all sediments classified) 7% gravel, 22% sand, 39% silt, 32% clay

TABLE II.3.5-2

DESCRIPTION OF CLAYSTONE ENCOUNTERED IN BOREHOLES

BOREHOLE NUMBER	DESCRIPTION
42593	<p>Located in the east-central portion of SEP 207-A, encountered silty claystone bedrock at 8 0 feet below grade. Abundant caliche was found at 8 3 feet, from 8 9 to 9 7 feet, at 10 3 and 11 4 feet below ground surface. The silty claystone also contained a iron-oxide-filled fracture at 14 1 feet and manganese-oxide coating on microfractures from 12 7 to 15 2 feet below grade. Manganese-oxide-coated microfractures were observed at 0 and 90 degrees from the horizontal between 12 7 and 12 9 feet below grade. Faint horizontal bedding was also observed in a sandy siltstone zone from 15 2 to 16 8 feet below grade. This borehole was advanced to a total depth of 16 8 feet below the pond bottom, ground water was not encountered.</p>
43393	<p>Located in the southwestern portion of SEP 207-A, encountered silty claystone bedrock at 5 0 feet below grade. Abundant caliche was observed from 5 0 to 5 5 feet below grade. Ironstone concretions were observed at 7 7, 8 5, and 11 0 feet below grade, and iron oxide staining was found from 5 0 to 11 8 feet below grade. This borehole was advanced to a total depth of 13 6 feet below the pond bottom, ground water was not encountered.</p>
43693	<p>Located in the south-central portion of SEP 207-A, encountered silty claystone bedrock with crude horizontal bedding at 10 0 feet below grade. Ironstone concretions were observed between 10 0 and 10 4 feet below grade. A manganese-oxide coating was found on microfractures between 11 2 and 11 6 feet below grade. This borehole was advanced to a total depth of 13 0 feet below the pond bottom, ground water was not encountered.</p>
46693	<p>Located in the north-central portion of SEP 207-B North, encountered claystone bedrock at 6 9 feet below grade. A caliche nodule was observed in this claystone at 7 3 feet below grade, an iron oxide concretion was also observed at 11 6 feet grade along with a trace of manganese staining from 6 9 to 14 8 feet below grade. This borehole was advanced to a total depth of 14 8 feet below the pond bottom, ground water was not encountered.</p>

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TABLE II.3.5-2 (Continued)

DESCRIPTION OF CLAYSTONE ENCOUNTERED IN BOREHOLE

46793	Located in the east-central portion of SEP 207-B North, encountered claystone bedrock at 6 5 feet below grade. A caliche-filled fracture and caliche nodules were observed in the claystone from 6 5 to 10 0 feet below grade. Iron oxide-filled fractures were observed from 12 6 to 14 4 feet below grade, and manganese oxide-filled fracture was also observed at 13 1 feet below grade. An unidentified crystalline material was observed in a fracture from 9 5 to 9 7 feet below grade. This borehole was advanced to a total depth of 14 7 feet below the pond bottom, ground water was not encountered.
46593	Located in the southwestern portion of SEP 207-B North, encountered claystone bedrock at 7 8 feet below grade. White caliche nodules were observed in the claystone at 9 2 and 11 8 feet below grade. Iron oxide staining on fracture surfaces were observed from 7 8 to 16 4 feet below grade. This borehole was advanced to a total depth of 16 4 feet below the pond bottom, ground water was encountered at 5 7 feet below grade.
46993	Located in the northwestern portion of SEP 207-B center, encountered claystone bedrock at 5 5 feet below grade. This claystone contained caliche nodules from 5 5 to 9 0 feet below grade, iron-oxide concretions at 5 9 and 6 3 feet below grade, and manganese-oxide staining from 5 5 to 13 1 feet below grade. This borehole was advanced to a total depth of 13 1 feet below the pond bottom, ground water was not encountered.
46893	Located in the east-central portion of SEP 207-B center, encountered claystone bedrock at 11 5 feet below grade. This claystone is non-friable and contains no visible bedding. This borehole was advanced to a total depth of 12 5 feet below the pond bottom, ground water was encountered at 9 6 feet below grade.
47093	Located in the south-central portion of SEP 207-B center, probably did not penetrate bedrock due to auger refusal. However, there was no recovery from 8 0 to 9 8 feet below ground level. Therefore, the bedrock contact may be as high as 8 0 feet below ground. This borehole was advanced to a total depth of 9 8 feet below the pond bottom, ground water was observed at a depth of 6 0 feet below grade.

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TABLE II.3.5-3

DESCRIPTION OF SILTSTONES ENCOUNTERED IN BOREHOLES

BOREHOLE NUMBER	DESCRIPTION
41593	Located in the north-central portion of SEP 207-A, encountered sandy siltstone bedrock at 5.9 feet below grade. This sandy siltstone contained abundant caliche-filled fractures and a trace of iron-oxide staining from 5.9 to 7.9 feet below grade. This borehole was advanced to a total depth of 7.9 feet below the pond bottom, ground water was not encountered.
42493	Located in the west-central portion of SEP 207-A, encountered a sandy siltstone at 8.1 feet below grade. This sandy siltstone contained caliche-filled vertical fractures, iron-oxide staining and a trace coating of manganese oxide from 8.9 to 10.2 feet below grade. Between 8.9 and 10.2 feet below grade, the sandy siltstone is interbedded with silty claystone. This borehole was advanced to a total depth of 10.2 feet below the pond bottom, ground water was encountered at 7.0 feet below grade.
41193	Located approximately 60 feet north of the northeastern corner of SEP 207-A, encountered clayey siltstone at 7.8 feet below grade. This clayey siltstone contained crude horizontal bedding, some manganese oxide staining, and a trace of iron-oxide staining. It also contained some thin clay laminations from 11.0 to 12.0 feet below grade. This borehole was advanced to a total depth of 13.6 feet below the pond bottom, ground water was not encountered.
41793	Located near the middle of the eastern perimeter of SEP 207-B North, encountered a clayey siltstone at approximately 12.3 feet below grade. Poor or no recovery precludes any definitive statements about this siltstone. This borehole was advanced to a total depth of 18.0 feet below the pond bottom, ground water was encountered at 10.0 feet below grade.

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TABLE II.3.5-4

DESCRIPTION OF SANDSTONES ENCOUNTERED IN BOREHOLES

BOREHOLE NUMBER	DESCRIPTION
41993	Located near the northwestern perimeter of SEP 207-C, encountered a horizontally bedded silty sandstone at 7.6 feet below grade. This non-calcareous fine-grained, well-sorted sandstone contains some frosted, medium-grained quartz sand. The silty sandstone contained silty claystone interbeds from 14.0 to 15.5 feet below grade, and exhibited sparse healed vertical fractures. Between 15.5 and 20.0 feet below grade, a silty claystone with silt- and sand-rich interbeds was observed. This borehole was advanced to a total depth of 20.0 feet below the pond bottom and encountered ground water at 7.8 feet below grade.
42393	Located near the southwestern perimeter of SEP 207-C, encountered a silty sandstone at approximately 8.1 feet below grade. This sandstone is slightly to non-calcareous, very fine- to fine-grained and very well- to well-sorted. It also contains approximately 5 to 10 percent well-rounded and frosted quartz sand. Claystone was observed at 14.0 feet below grade. This borehole was advanced to a total depth of 15.1 feet below the pond bottom and encountered ground water at 4.3 feet below grade.
42993	Located near the southeastern corner of the perimeter of SEP 207-C, penetrated a silty sandstone at 13.3 feet below grade. This sandstone lies below an approximately 0.4-foot-thick silty claystone at 12.9 feet below grade, which appears to be the top of bedrock. However, there was no core recovery from 10.0 to 12.9 feet below grade. This sandstone is non-calcareous, very fine- to fine-grained, well sorted, and contains a trace of rounded medium to coarse sand. This sandstone also contained clay clasts. The silty sandstone graded into a clayey siltstone at 13.8 feet. Since the sandstone was only 0.5 feet thick and occurred between claystone strata, it is not shown as a subcropping sandstone on Figure II 3.5-16. This borehole was advanced to a total depth of 18.4 feet below the pond bottom and encountered ground water at 10.9 feet below grade.

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TABLE II.3.5-4 (Continued)

DESCRIPTION OF SANDSTONES ENCOUNTERED IN BOREHOLES

40993	Located along the north-central perimeter of SEP 207-C, encountered a silty sandstone with faint horizontal bedding at 9.7 feet below grade. This sandstone is very fine- to fine-grained, moderately- to well-sorted, and contains frosted quartz grains. This sandstone is 1.8 feet thick and lies above a 16-foot interval of interbedded silty sandstone, claystone, and sandstone. This borehole was advanced to a total depth of 34.5 feet below the pond bottom and encountered ground water at 26.2 feet below grade.
42193	Located beneath the northwestern portion of SEP 207-A, encountered a clayey sandstone from 7.4 to 10.0 feet below the pond bottom. This clayey sandstone contained healed caliche-filled vertical fractures at 8.5 feet below grade. This sandstone is very fine- to fine-grained, well sorted, and contains a trace of rounded and frosted medium-grained quartz sand. Thin horizontal (ripple) bedding was observed from 7.4 to 10.0 feet. A sandy claystone with abundant thin horizontal laminations was encountered between 10.0 and 15.4 feet below the pond bottom. Claystone with interbedded siltstone was encountered from 15.4 to a total depth of 31.3 feet. This claystone contained horizontal laminations from 15.4 to 20.3 feet below grade. The siltstone/clayey siltstone also contained laminations between 26.7 and 27.9 feet below the pond bottom. Geophysical borehole logging was conducted in borehole 42193. This borehole was advanced to a total depth of 31.3 feet below the pond bottom.

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TABLE II.3.6-1

EXPLANATION OF QUALIFIERS AND CODES IN DATABASE

VALIDATION QUALIFIERS

A Data is acceptable, with qualification
 B Indicates compound was found in blank and sample
 E Associated values exceeds calibration range, dilute and reanalyze
 J Associated value is estimated quantity
 JA Estimated, acceptable
 R Data is rejected
 U Analyzed, not detected at/above method detection limit
 V Data is validated
 VA Data is valid, acceptable with qualifications
 Y Data will be validated
 Z Data will not be validated
 [] Indicates the sample was not validated

LABORATORY QUALIFIERS

U Undetected, analyzed for but not detected
 J Estimated value < sample's detection limit
 C Pesticide where ID confirmed by GC/MS-organic
 B Analyte found in blank and sample-organic
 E Concern exceeds calibration range of instrument-organic
 D Compounds identified using secondary dilution factor-organic
 A TIC suspected aldol-condensation product-organic
 X Lab software flag, entered manually-organic
 * Outside contract required QC limits-organic
 * Duplicate analysis outside control limits-inorganic
 N Spiked recovery not within control limits-inorganic
 W Post-digest spike outside of control limit-inorganic
 S Determined by MSA, can't be with + or W-inorganic
 + UNKN or MSA correlation coef < 0.995 for inorganic
 M Duplication injection precision not met-inorganic
 G Native analyte < 4x spike added-inorganic
 I Interference
 T Compound found in TCLP extract blank and sample
 B < method detection limit but > = instrument detection limit-inorganic
 D No surrogate/matrix spike recovery, extract diluted
 E Estimated due to interference-inorganic
 F Estimated, compound off-scale in both columns-organic
 X Results by calibration-GRRASP
 Y Indistinguish isomer in TIC-organic
 Z Quest ID, matrix interfer of columns-organic

SAMPLE TYPE

BH Borehole Soil Sample
 SS Surficial Soil Sample
 PT Pit/Trench Soil Sample
 VE Vadose Zone Water Extraction Sample

SAMPLE QC CODE

REAL Real
 DUP Duplicate
 RNS Rinsate
 SPLT Split
 MS Matrix Spike
 TB Trip Blank
 FB Field Blank
 MSD Matrix Spike Duplicate
 LR Lab Replica
 GEO Geotechnical Sample
 UNKN Unknown Sample QC Code
 CTRL Biological Control Sample
 REP Biological Replicate Sample

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TABLE II.3.6-2

SUMMARY OF VALIDATION RESULTS FOR PHASE I RFI/RI DATA

Analyte Group	Media	Total Results	Total Validated	Total Rejected	Percent Results Validated	Percent Results Rejected
Semivolatile Organics	BH	3,347	2,208	29	66	0 87
	SS	9,323	6,617	32	71	0 34
	VE	1,130	1,130	21	100	1 86
	TOTAL	13,800	9,955	82	72	0 59
Metals	BH	4,260	4,260	15	100	0 35
	SS	2,661	2,661	18	100	0 68
	VE	1,795	1,726	8	96	0 45
	PT	782	736	2	94	0 26
	TOTAL	9,498	9,383	43	99	0 45
Radionuclides	BH	1,603	1,571	36	98	2 25
	SS	1,118	830	42	74	3 76
	VE	123	123	0	100	0 00
	PT	170	170	1	100	0 59
	TOTAL	3,014	2,694	79	89	2 62
Volatile Organics	BH	5,710	5,674	178	99	3 12
	TOTAL	5,710	5,674	178	99	3 12
Pesticides/PCBs	BH	1,010	713	27	71	2 67
	SS	2,522	2,441	55	97	2 18
	VE	513	513	0	100	0 00
	TOTAL	4,045	3,667	82	91	2 03
Other Inorganics	BH	368	325	0	88	0 0
	SS	117	100	0	85	0 0
	VE	107	76	0	71	0 0
	PT	65	65	0	100	0 0
	TOTAL	657	566	0	86 15	0 00
	TOTAL ALL DATA	36,724	31,939	464	87	1 26

NOTES DATA INCLUDED FROM RFEDS AS OF MARCH 1994

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TABLE II.3.6-3

SUMMARY OF VALIDATION REASON CODES REFERRED TO
DURING PHASE I RFI/RI DATA VALIDATION

Reason Code	Times Referenced	Description
1	953	Holding times were exceeded
3	33	Initial calibration correlation coefficient < 0.995
4	21	Calibration verification criteria were not met
5	224	CRDL check sample recovery criteria were not met
7	203	Analyte values > IDL were found in the blanks
8	135	Negative bias was indicated in the blanks
9	86	Interference indicated in the ICP Interf Chk Smp
10	1373	Lab Control Sample recovery criteria were not met
11	246	Duplicate sample precision criteria were not met
12	905	Predigestion matrix spk crit were not met (+/- 25%)
13	16	Predigestion matrix spk crit were not met (< 30%)
14	140	Postdigestion matrix spk recov crit were not met
15	3	MSA was required but not performed
16	3	MSA calibration correlation coefficient < 0.995
17	135	Serial dilution criteria not met
18	420	Documentation was not provided
21	217	Reagent blanks exceeded MDA
27	37	Recovery criteria were not met
28	236	Duplicate analysis was not performed
30	219	Replicate precision criteria were not met
31	47	Replicate analysis was not performed
32	368	Lab control samples > +/- 3 sigma
35	31	tSIE criteria were not met
36	56	MDA exceeded the RDL
40	162	Organics initial calibration crit were not met
41	247	Organics cont calibration crit were not met
42	151	Surrogates were outside criteria
43	334	Internal standards outside criteria
45	1	Results were not confirmed
48	2	Linear range of instrument was exceeded
49	93	Method blank contamination
51	4	Nonverifiable lab results and/or unsubmitted data
52	2028	Transcription error
53	10	Calculation error
54	57	Incorrect reported activity or MDA
59	80	Blank activity exceeded RDL
60	64	Blank recovery criteria were not met
61	100	Replicate recovery criteria were not met
62	272	LCS relative percent error criteria not met
69	14	Samples not distilled
77	4	Detector efficiency criteria not met
78	402	MDAs were calculated by reviewer
79	15	Result obtained through dilution
83	4	Sample results were not included on Data Summary Table
85	237	Record added by QLI
88	24	Blank corrected results
89	4	Sample analysis was not requested
90	840	Sample result was validated due to re-analysis
99	117	See hardcopy for further explanation
Total	11373	

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TABLE II.3.6-4

SUMMARY OF VALIDATION REASON CODES FOR REJECTED DATA

Reason Code	No. of Times Referenced	Description
5	2	CRDL check sample recovery criteria were not met
8	23	Negative bias was indicated in the blanks
10	1	Lab Control Sample recovery criteria were not met
13	16	Predigestion matrix spk crit werent met (<30%)
14	2	Postdigestion matrix spk recov crit were not met
18	27	Documentation was not provided
21	3	Reagent blanks exceeded MDA
27	7	Recovery criteria were not met
30	8	Replicate precision criteria were not met
31	1	Replicate analysis was not performed
32	69	Lab control samples > +/- 3 sigma
35	3	tSIE criteria were not met
36	11	MDA exceeded the RDL
40	158	Organics initial calibration crit werent met
41	200	Organics cont calibration crit werent met
42	96	Surrogates were outside criteria
43	19	Internal standards outside criteria
45	1	Results were not confirmed
52	27	Transcription error
62	67	LCS relative percent error criteria not met
69	7	Samples not distilled
78	28	MDAs were calculated by reviewer
99	7	See hardcopy for further explanation
Total	783	

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TABLE II.3.6-5

FIELD QC FREQUENCY RESULTS
PHASE I RFI/RI DATA

MEDIA SAMPLE	REAL SAMPLES	DUPLICATE SAMPLES	REQUIRED RATIO	DUPLICATE RATIO	RINSATE SAMPLES	REQUIRED RATIO	RINSATE RATIO
Borehole Soil/Bedrock	303	22	1/10	1/14	7	1/20	1/43
Surficial Soil	84	5	1/10	1/17	3	1/20	1/28
Vadose Zone Pore Water	128	6	1/10	1/21	2	1/20	1/64
Total	515	33	1/10	1/16	12	1/20	1/43

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TABLE II.3.6-6

DUPLICATE AND ASSOCIATED REAL SAMPLES

ANALYTE GROUP AND SAMPLE TYPE	SAMPLE NUMBER	QC CODE	QC PARTNER	QC CODE	LOCATION	SAMPLE DATE	REMARKS
METALS							
BH	BH40094AE	DUP	BH40141AE	REAL	42993	20-Jan-93	
BH	BH40103AE	DUP	BH40483AE	REAL	42093	08-Jan-93	
BH	BH40112AE	DUP	BH40439AE	REAL	42493	23-Mar-93	
BH	BH40562AE	DUP	BH40385AE	REAL	46193	24-Mar-93	
BH	BH40563AE	DUP	BH40525AE	REAL	43693	25-Mar-93	
BH	BH 40573AE	DUP	BH40319AE	REAL	43493	21-Apr-93	
PT	TR40135AE	DUP	SS40124AE	REAL	TR44893	08-Jul-93	Some Real Data Not Available
PT	TR40136AE	DUP	SS40121AE	REAL	TR44793	08-Jul-93	Some Real Data Not Available
PT	TR40137AE	DUP	SS40107AE	REAL	TR44593	09-Jul-93	Some Real Data Not Available
SS	SS40013AE	DUP	SS40480AE	REAL	42093	08-Jan-93	
SS	SS40016AE	DUP	SS40038AE	REAL	SS402293	29-Dec-92	
SS	SS40069AE	DUP	SS40077AE	REAL	41793	09-Feb-93	
SS	SS40412AE	DUP	SS40072AE	REAL	40993	26-Feb-93	
VE	VE40719AE	DUP	VE40716AE	REAL	43193	27-Apr-93	
VE	VE40813AE	DUP	VE40809AE	REAL	41793	14-Jul-93	Some Real Data Not Available
VE	VE40835AE	DUP	VE40819AE	REAL	44393	04-Aug-93	Some Real Data Not Available
RADIONUCLIDES							
BH	BH40094AE	DUP	BH40141AE	REAL	42993	20-Jan-93	
BH	BH40103AE	DUP	BH40483AE	REAL	42093	08-Jan-93	
BH	BH40112AE	DUP	BH40439AE	REAL	42493	23-Mar-93	
BH	BH40562AE	DUP	BH40385AE	REAL	46193	24-Mar-93	
BH	BH40563AE	DUP	BH40525AE	REAL	43693	25-Mar-93	
BH	BH40573AE	DUP	BH40319AE	REAL	43493	21-Apr-93	
BH	BH40823AE	DUP	BH40742AE	REAL	46793	10-Nov-93	
BH	BH40825AE	DUP	BH40748AE	REAL	46893	19-Nov-93	
BH	BH40830AE	DUP	BH40757AE	REAL	46993	22-Nov-93	
PT	TR40135AE	DUP	SS40124AE	REAL	TR44893	08-Jul-93	Some Real Data Not Available
PT	TR40136AE	DUP	SS40121AE	REAL	TR44793	08-Jul-93	Some Real Data Not Available
PT	TR40137AE	DUP	SS40107AE	REAL	TR44593	09-Jul-93	Some Real Data Not Available

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TABLE II.3.6-6 (continued)

DUPLICATE AND ASSOCIATED REAL SAMPLES

ANALYTE GROUP AND SAMPLE TYPE	SAMPLE NUMBER	QC CODE	QC PARTNER	QC CODE	LOCATION	SAMPLE DATE	REMARKS
SS	SS40016AE	DUP	SS40038AE	REAL	SS402293	29-Dec-92	
SS	SS40069AE	DUP	SS40077AE	REAL	41793	09-Feb-93	
SS	SS40412AE	DUP	SS40072AE	REAL	40993	26-Feb-93	
SS	SS40146AE	DUP	SS40144AE	REAL	46993	22-Nov-93	
SS	SS40089AE	DUP		REAL	46993	10-Mar-93	Some Real Data Not Available
VOLATILES ORGANICS							
BH	BH40027AE	DUP	BH40072AE	REAL	43893	05-Feb-93	
BH	BH40095AE	DUP	BH40143AE	REAL	42993	20-Jan-93	
BH	BH40098AE	DUP	BH40129AE	REAL	40593	26-Jan-93	
BH	BH40102AE	DUP	BH40190AE	REAL	44893	14-Jan-93	
BH	BH40107AE	DUP	BH40066AE	REAL	41993	14-Jan-93	
BH	BH40113AE	DUP	BH40283AE	REAL	42493	23-Mar-93	
BH	BH40406AE	DUP	BH40197AE	REAL	41293	23-Feb-93	
BH	BH40411AE	DUP	BH40307AE	REAL	43193	12-Feb-93	
BH	BH40556AE	DUP	BH40379AE	REAL	45893	16-Mar-93	
BH	BH40561AE	DUP	BH40386AE	REAL	46193	24-Mar-93	
SEMI-VOLATILE ORGANICS							
BH	BH40563AE	DUP	BH40525AE	REAL	43693	25-Mar-93	Some Real Data Not Available
BH	BH40573AE	DUP	BH40319AE	REAL	43493	21-Apr-93	
SS	SS40013AE	DUP	SS40480AE	REAL	42093	08-Jan-93	
SS	SS40016AE	DUP	SS40038AE	REAL	SS402293	29-Dec-92	
SS	SS40069AE	DUP	SS40077AE	REAL	41793	09-Feb-93	
SS	SS40412AE	DUP	SS40072AE	REAL	40993	26-Feb-93	

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TABLE II.3 6-6 (continued)

DUPLICATE AND ASSOCIATED REAL SAMPLES

ANALYTE GROUP AND SAMPLE TYPE	SAMPLE NUMBER	QC CODE	QC PARTNER	QC CODE	LOCATION	SAMPLE DATE	REMARKS
WATER QUALITY PARAMETERS							
BH	BH40094AE	DUP	BH40141AE	REAL	42993	20-Jan-93	
BH	BH40103AE	DUP	BH40483AE	REAL	42093	08-Jan-93	
BH	BH40112AE	DUP	BH40439AE	REAL	42493	23-Mar-93	
BH	BH40562AE	DUP	BH40385AE	REAL	46193	24-Mar-93	
BH	BH40573AE	DUP	BH40319AE	REAL	43493	21-Apr-93	
BH	BH40830AE	DUP	BH40757AE	REAL	46993	22-Nov-93	
BH	BH40824AE	DUP	BH40815AE	REAL	47093	19-Nov-93	
PT	TR40135AE	DUP	SS40124AE	REAL	TR44893	08-Jul-93	Some Real Data Not Available
PT	TR40136AE	DUP	SS40121AE	REAL	TR44793	08-Jul-93	Some Real Data Not Available
PT	TR40137AE	DUP	SS40107AE	REAL	TR44593	09-Jul-93	Some Real Data Not Available
SS	SS40013AE	DUP	SS40480AE	REAL	42093	08-Jan-93	
SS	SS40016AE	DUP	SS40038AE	REAL	SS402293	29-Dec-92	
SS	SS40069AE	DUP	SS40077AE	REAL	41793	09-Feb-93	
SS	SS40412AE	DUP	SS40072AE	REAL	40993	26-Feb-93	
SS	SS40146AE	DUP	SS40144AE	REAL	46993	22-Nov-93	
VE	VE40718AE	DUP	VE40710AE	REAL	43193	27-Apr-93	Some Real & Dup Data Not Avail
VE	VE40779AE	DUP	VE40773AE	REAL	43693	25-Jun-93	Some Real Data Not Available
VE	VE40780AE	DUP	VE40774AE	REAL	42493	25-Jun-93	Some Real Data Not Available
VE	VE40835AE	DUP	VE40819AE	REAL	44393	04-Aug-93	Some Real Data Not Available
PESTICIDES/PCBs							
BH	BH40563AE	DUP	BH40525AE	REAL	43693	25-Mar-93	Some Real Data Not Available
BH	BH40573AE	DUP	BH40319AE	REAL	43493	21-Apr-93	
SS	SS40013AE	DUP	SS40480AE	REAL	42093	08-Jan-93	
SS	SS40016AE	DUP	SS40038AE	REAL	SS402293	29-Dec-92	
SS	SS40069AE	DUP	SS40077AE	REAL	41793	09-Feb-93	
SS	SS40412AE	DUP	SS40072AE	REAL	40993	26-Feb-93	

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TABLE II 3 6-7

SUMMARY OF FIELD PRECISION RESULTS
PHASE I RFI/RI DATA

Analytical Suite	Medium	Required RPD Value Between Duplicate Analyses	No of Duplicate Pairs with Data	No. of Duplicate Analyses	No of Duplicate Analyses Meeting RPDs	Overall Percentage of Duplicate Analyses Meeting RPD Goals
Volatle Organics	Soil	< =40%	11	358	282	78.8 %
Semi-Volatile Organics	Soil	< =40%	6	387	366	94.6 %
Radionuclides	Soil	< =40%	13	139	90	64.8 %
Metals	Soil	< =40%	13	372	314	84.4 %
Metals	Pore Water	< =30%	3	47	24	51.1 %
Pesticides/PCBs	Soil	< =40%	6	162	162	100 %
Cyanide, Nitrate, Sulfide	Soil	< =40%	11	19	15	78.9 %
Cyanide, Nitrate, Sulfide	Pore Water	< =30%	4	4	1	25.0 %

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TABLE II 3.6-8

ORGANIC COMPOUNDS DETECTED IN RINSATE SAMPLES
PHASE I RFI/RI DATA

LOCATION	SAMPLE NUMBER	TYPE	QC CODE	SAMPLE DATE	COMPOUND	RESULT (UG/L)	CRQL (UG/L)	LAB QUALIFIER	VALIDATION QUALIFIER
45893	BH40457AE	BH	RNS	16-MAR-93	1,1,2,2-TETRACHLOROETHANE	2 000	5 0	J	A
43193	BH40409AE	BH	RNS	12-FEB-93	2-HEXANONE	5 000	10 0	J	A
43193	BH40409AE	BH	RNS	12-FEB-93	4-METHYL-2-PENTANONE	5 000	10 0	J	A
43893	BH40007AE	BH	RNS	05-FEB-93	ACETONE	9 000	10 0	J	A
44393	BH40025AE	BH	RNS	05-FEB-93	ACETONE	8 000	10 0	J	A
45893	BH40457AE	BH	RNS	16-MAR-93	ACETONE	23 000	10 0		V
43193	BH40409AE	BH	RNS	12-FEB-93	METHYLENE CHLORIDE	16 000	5 0		V
44393	BH40025AE	BH	RNS	05-FEB-93	METHYLENE CHLORIDE	2 000	5 0	J	A
43493	BH40575AE	BH	RNS	22-APR-93	DIMETHYL PHTHALATE	18 000	10 00		V

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TABLE II 3.6-9

METAL COMPOUNDS DETECTED IN RINSATE SAMPLES
PHASE I RFI/RI DATA

LOCATION	SAMPLE NUMBER	TYPE	QC CODE	SAMPLE DATE	COMPOUND	RESUL T (UG/L)	CRQL (UG/L)	LAB QUALIFIER	VALIDATION QUALIFIER
46893	BH40826AE	BH	RNS	19-NOV-93	ALUMINIUM	31.1000	200.000	B	V
44393	BH40025AE	BH	RNS	05-FEB-93	ALUMINIUM	69.8000	200.000	B	V
41293	VE40834AE	VE	RNS	10-AUG-93	CALCIUM	28.6000	13.8000		JA
SS402893	SS40579AE	SS	RNS	27-MAY-93	IRON	56.2000	20.0000	B	V
SS402693	SS40200AE	SS	RNS	04-JAN-93	IRON	61.0000	100.000	B	V
44393	BH40025AE	BH	RNS	05-FEB-93	IRON	201.0000	100.000		V
43493	BH40575AE	BH	RNS	22-APR-93	LEAD	45.4000	2.0000	N	JA
41293	VE40834AE	VE	RNS	10-AUG-93	LEAD	36.2000	0.8000		JA
43593	SS40065AE	SS	RNS	25-JAN-93	MERCURY	0.2400	0.2000	*	JA
44393	BH40025AE	BH	RNS	05-FEB-93	SILICON	136.0000	100.000	*	JA
45893	BH40457AE	BH	RNS	16-MAR-93	SILICON	107.0000	100.000		V
SS402893	SS40579AE	SS	RNS	27-MAY-93	SILICON	190.0000	100.000		V
43493	BH40575AE	BH	RNS	22-APR-93	SILICON	130.0000	100.000		V
41293	VE40834AE	VE	RNS	10-AUG-93	SODIUM	140.0000	32.3000		JA
46893	BH40826AE	BH	RNS	19-NOV-93	TIN	59.8000	200.000	B	V
41293	VE40834AE	VE	RNS	10-AUG-93	ZINC	15.8000	2.5000		V

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TABLE II 3 6-10

WQHP COMPOUNDS DETECTED IN RINSATE SAMPLES
PHASE I RFI/RI DATA

LOCATION	SAMPLE NUMBER	TYPE	QC CODE	SAMPLE DATE	COMPOUND	RESUL T (UG/L)	CRQL (UG/L)	LAB QUALIFIER	VALIDATION QUALIFIER
44393	BH40025AE	BH	RNS	05-FEB-93	NITRATE/NITRITE	31.2000	20.0000		Y
45893	BH40457AE	BH	RNS	16-MAR-93	NITRATE/NITRITE	55.3000	20.0000		Y
43593	SS40065AE	SS	RNS	25-JAN-93	NITRATE/NITRITE	69.6000	20.0000		Y
SS402693	SS40200AE	SS	RNS	04-JAN-93	NITRATE/NITRITE	58.9000	20.0000		
SS402893	SS40579AE	SS	RNS	27-MAY-93	NITRATE/NITRITE	29.2000	20.0000		Y
45893	BH40457AE	BH	RNS	16-MAR-93	SULFIDE	1.8500	1.0000		Y
40393	VE40776AE	VE	RNS	25-JUN-93	SULFIDE	25.8000	1.0000		Y

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TABLE II.3.6-11

RADIONUCLIDES DETECTED IN RINSATE SAMPLES
PHASE I RFI/RI DATA

LOCATION	SAMPLE NUMBER	TYPE	QC CODE	SAMPLE DATE	COMPOUND	RESULT (PCI/L)	ERROR	CRQL (PCI/L)	LAB QUALIFIER	VALIDATION QUALIFIER
43493	BH40575AE	BH	RNS	22-APR-93	AMERICIUM-241	0 0032	00453	0 0068	J	A
43593	SS40065AE	SS	RNS	25-JAN-93	AMERICIUM-241	0 0035	00405	0 0000	J	A
46893	BH40826AE	BH	RNS	19-NOV-93	AMERICIUM-241	0 0111	00691	0 0068		V
SS402693	SS40200AE	SS	RNS	04-JAN-93	AMERICIUM-241	0 0029	00403	0 0000	J	A
SS402893	SS40579AE	SS	RNS	27-MAY-93	AMERICIUM-241	0 0460	011	0 0057		V
46893	BH40826AE	BH	RNS	19-NOV-93	CESIUM-134	-0 3200	563	0 9192	J	Y
46893	BH40826AE	BH	RNS	19-NOV-93	CESIUM-137	-0 4390	596	0 9737	J	Y
43493	BH40575AE	BH	RNS	22-APR-93	GROSS ALPHA	-0 0737	0378	0 3125	J	V
43593	SS40065AE	SS	RNS	25-JAN-93	GROSS ALPHA	0 0442	144	0 2600	J	A
44393	BH40025AE	BH	RNS	05-FEB-93	GROSS ALPHA	0 0372	133	0 2820	J	V
45893	BH40457AE	BH	RNS	16-MAR-93	GROSS ALPHA	0 1224	172	0 2700	J	V
46893	BH40826AE	BH	RNS	19-NOV-93	GROSS ALPHA	0 2597	244	0 3073	J	V
SS402693	SS40200AE	SS	RNS	04-JAN-93	GROSS ALPHA	-0 0760	0406	0 3000	J	A
43493	BH40575AE	BH	RNS	22-APR-93	GROSS BETA	0 2808	716	1 2373	J	V
43593	SS40065AE	SS	RNS	25-JAN-93	GROSS BETA	0 6948	751	1 5000	J	A
44393	BH40025AE	BH	RNS	05-FEB-93	GROSS BETA	1 4010	833	1 2046		V
45893	BH40457AE	BH	RNS	16-MAR-93	GROSS BETA	0 3815	702	1 1900	J	V
46893	BH40826AE	BH	RNS	19-NOV-93	GROSS BETA	1 5830	844	1 1877		V
SS402693	SS40200AE	SS	RNS	04-JAN-93	GROSS BETA	0 6100	748	1 5000	J	A
43493	BH40575AE	BH	RNS	22-APR-93	PLUTONIUM-239/240	0 0017	00244	0 0023	J	A
43593	SS40065AE	SS	RNS	25-JAN-93	PLUTONIUM-239/240	0 0038	00437	0 0000	J	A

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TABLE II.3.6-11 (continued)

RADIONUCLIDES DETECTED IN RINSATE SAMPLES
PHASE I RFI/RI DATA

LOCATION	SAMPLE NUMBER	TYPE	QC CODE	SAMPLE DATE	COMPOUND	RESULT (PCI/L)	ERROR	CRQL (PCI/L)	LAB QUALIFIER	VALIDATION QUALIFIER
44393	BH40025AE	BH	RNS	05-FEB-93	PLUTONIUM-239/240	0 0017	00322	0 0060	J	A
46893	BH40826AE	BH	RNS	19-NOV-93	PLUTONIUM-239/240	0 0000	00323	0 0029	J	V
SS402693	SS40200AE	SS	RNS	04-JAN-93	PLUTONIUM-239/240	0 0034	00445	0 0000	J	A
SS402893	SS40579AE	SS	RNS	27-MAY-93	PLUTONIUM-239/240	0 0210	00694	0 0041		A
43493	BH40575AE	BH	RNS	22-APR-93	STRONTIUM-89,90	-0 0539	282	0 6534	J	V
43593	SS40065AE	SS	RNS	25-JAN-93	STRONTIUM-89,90	-0 0256	275	0 6000	J	A
44393	BH40025AE	BH	RNS	05-FEB-93	STRONTIUM-89 90	0 2828	314	0 6523	J	V
46893	BH40826AE	BH	RNS	19-NOV-93	STRONTIUM-89 90	0 0661	33	0 6318	J	A
SS402693	SS40200AE	SS	RNS	04-JAN-93	STRONTIUM-89 90	-0 9480	241	0 9000	J	A
43493	BH40575AE	BH	RNS	22-APR-93	TRITIUM	-39 6000	238	269 000	J	V
43593	SS40065AE	SS	RNS	25-JAN-93	TRITIUM	115 8000	216	410 000	J	V
44393	BH40025AE	BH	RNS	05-FEB-93	TRITIUM	95 4300	225	590 000	X	V
45893	BH40457AE	BH	RNS	16-MAR-93	TRITIUM	-37 7000	225	263 700	J	V
46893	BH40826AE	BH	RNS	19-NOV-93	TRITIUM	-21 3000	224	262 200	J	V
SS402693	SS40200AE	SS	RNS	04-JAN-93	TRITIUM	-146 0000	203	400 000	J	V
43493	BH40575AE	BH	RNS	22-APR-93	URANIUM-233,-234	0 0742	14	0 2478	J	A
43593	SS40065AE	SS	RNS	25-JAN-93	URANIUM-233,-234	0 0509	102	0 0000	J	A
44393	BH40025AE	BH	RNS	05-FEB-93	URANIUM 233,-234	0 0000	164	0 1480	J	A
45893	BH40457AE	BH	RNS	16-MAR-93	URANIUM 233,-234	0 0661	148	0 2890	J	A
46893	BH40826AE	BH	RNS	19-NOV-93	URANIUM-233 -234	-0 0178	0179	0 2576	J	V
SS402693	SS40200AE	SS	RNS	04-JAN-93	URANIUM-233,-234	0 1563	182	0 0000	J	A

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TABLE II.3.6-11 (continued)

RADIONUCLIDES DETECTED IN RINSATE SAMPLES
PHASE I RFI/RI DATA

LOCATION	SAMPLE NUMBER	TYPE	QC CODE	SAMPLE DATE	COMPOUND	RESULT (PCI/L)	ERROR	CRQL (PCI/L)	LAB QUALIFIER	VALIDATION QUALIFIER
SS402893	SS40579AE	SS	RNS	27-MAY-93	URANIUM-233,-234	0 3100	22714	0 1767		V
43493	BH40575AE	BH	RNS	22-APR-93	URANIUM-235	-0 0078	0111	0 1989	J	A
43593	SS40065AE	SS	RNS	25-JAN-93	URANIUM-235	0 0000	153	0 0000	J	A
44393	BH40025AE	BH	RNS	05-FEB-93	URANIUM-235	-0 0218	0197	0 2650	J	A
45893	BH40457AE	BH	RNS	16-MAR-93	URANIUM-235	-0 0289	0222	0 2720	J	A
46893	BH40826AE	BH	RNS	19-NOV-93	URANIUM-235	0 0289	113	0 2817	J	V
SS402693	SS40200AE	SS	RNS	04-JAN-93	URANIUM-235	0 0000	156	0 0000	J	A
43493	BH40575AE	BH	RNS	22-APR-93	URANIUM-238	-0 0039	00783	0 1794	J	A
43593	SS40065AE	SS	RNS	25-JAN-93	URANIUM-238	-0 0122	.0142	0 1060	J	A
44393	BH40025AE	BH	RNS	05-FEB-93	URANIUM-238	0 0371	111	0 2530	J	A
45893	BH40457AE	BH	RNS	16-MAR-93	URANIUM-238	-0 0289	0222	0 2720	J	A
46893	BH40826AE	BH	RNS	19-NOV-93	URANIUM-238	0 0933	158	0 2576	J	V
SS402693	SS40200AE	SS	RNS	04-JAN-93	URANIUM-238	0 0917	149	0 1090	J	A

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TABLE II.3.6-12

LEVEL OF EFFORT SPECIFIED IN PHASE I RFI/RI WORK PLAN AND TECHNICAL MEMORANDA

Field Activities	Explanation	Phase I RFI/RI Work Plan 1/31/92	TM1 12/11/92	TM2 5/20/93	Proposed Analyses
Total Boreholes	includes unconsolidated materials boreholes, vadose zone boreholes, deep boreholes	49	N/A	43	nitrate, radionuclides, TCL volatile organics, TCL semivolatile organics, TAL metals, pesticides, PCBs, sulfide, cyanide
Vadose Zone Boreholes	subset of original total boreholes	to be determined	16	16	nitrate, radionuclides, TCL volatile organics, TCL semivolatile organics, TAL metals, pesticides, PCBs, sulfide, cyanide
Vadose Monitoring Wells (Lysimeters)	included in vadose boreholes	to be determined	16	16	nitrate, radionuclides, TCL volatile organics, TCL semivolatile organics, TAL metals, pesticides, PCBs, sulfide, cyanide
Geotechnical Properties Sampling	included in vadose boreholes	N/A	16	N/A	particle size tests, soil water content, bulk density, permeability, and/or hydraulic conductivity
Deep Boreholes	subset of original boreholes	6	N/A	2	nitrate, radionuclides, TCL volatile organics, TCL semivolatile organics, TAL metals, pesticides, PCBs, sulfide, cyanide
Piezometers	not included in total number of boreholes	nested piezometers at 4 locations	N/A	16	water level measurements, and tracer studies
Surficial Soil Samples	samples collected at 36 random and discrete locations, 36 borehole locations	35	N/A	78	nitrate, radionuclides, TCL semivolatile organics, TAL metals, pesticides, PCBs

(Compare with Table II 2-1)

TABLE II.3.6-12 (continued)

LEVEL OF EFFORT SPECIFIED IN PHASE I RFI/RI WORK PLAN
AND TECHNICAL MEMORANDA

Notes from TM1

- 1 Sixteen of the Phase I RFI/RI boreholes selected for vadose zone investigation
- 2 All 16 vadose boreholes to be instrumented with neutron access tubes and lysimeters
- 3 Eight of the 16 vadose boreholes to be instrumented with vertically-nested lysimeters
- 4 Sixteen boreholes to be instrumented for two double-ring infiltrometer tests
- 5 Twenty-five shallow boreholes to be instrumented for Guelph permeameter tests

Notes from TM2

- 1 Sixteen boreholes completed for vadose monitoring
- 2 Twenty-one boreholes completed as unconsolidated materials boreholes
- 3 Four unconsolidated boreholes still to be drilled because ponds have not been drained
- 4 Two deep boreholes still to be drilled because ponds not drained
- 5 Two deep boreholes completed
- 6 One unconsolidated borehole changed to a piezometer
- 7 The number and locations of the trenches were determined based on the analytical results from the surficial soil samples
- 8 There is no mention of the number or locations for Geotechnical sample analyses in the Phase I RFI/RI Work Plan
- 9 Sample intervals at a minimum of surface sample plus every two feet to two feet into groundwater or bedrock for volatile organics , composite sample of six feet intervals to ground water or bedrock for all other boreholes

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TABLE II 3 6-13

SUMMARY OF VALIDATION INFORMATION
REAL AND DUPLICATE SAMPLES - HISTORICAL DATA

ANALYTE	MEDIA	TOTAL RESULTS	TOTAL VALIDATED	TOTAL REJECTED	% RESULTS VALIDATED	% RESULTS REJECTED
SEMIVOLATILES	BH	1698	1495	8	88	0 47
METALS	BH	6994	6462	220	92	3 15
RADIONUCLIDES	BH	2465	1187	16	48	0 65
VOLATILES	BH	8994	4931	243	55	2 7
WATER QUALITY	BH	0	0	0	0 0	0 0
TOTAL		20151	14075	487	70	1 25

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TABLE II.3.6-14

SUMMARY OF VALIDATION CODES FOR HISTORICAL DATA

Reason Code	Times Referenced	Description
1	6	Holding times were exceeded
2	4	Holding times were grossly exceeded
5	2	CRDL check sample recovery criteria were not met
7	5	Analyte values > IDL were found in the blanks
8	7	Negative bias was indicated in the blanks
9	31	Interference indicat in the ICP Interf Chk Smpl
10	25	Lab Control Sample recovery criteria were not met
11	10	Duplicate sample precision criteria were not met
12	14	Predigestion matrix spk crit werent met (+/- 25%)
14	3	Postdigestion matrix spk recov crit were not met
17	5	Serial dilution criteria not met
18	41	Documentation was not provided
21	40	Reagent blanks exceeded MDA
28	8	Duplicate analysis was not performed
31	4	Replicate analysis was not performed
32	14	Lab control samples > +/- 3 sigma
36	21	MDA exceeded the RDL
40	29	Organics initial calibration crit werent met
41	37	Organics cont calibration crit werent met
49	2	Method blank contamination
51	46	Nonverifiable lab results and/or unsubmitted data
52	1	Transcription error
54	2	Incorrect reported activity or MDA
56	6	IDL changed due to significant figure discrep
59	9	Blank activity exceeded RDL
60	1	Blank recovery criteria were not met
61	4	Replicate recovery criteria were not met
70	3	Resolution criteria not met
74	12	LCS data not submitted
76	24	Instrument gain and/or efficiency not submitted
78	66	MDAs were calculated by reviewer
84	60	Key fields wrong
85	27	Record added by QLI
99	44	See hardcopy for further explanation
Total	613	

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TABLE II.3.6-15

SUMMARY OF VALIDATION REASON CODES
FOR REJECTED HISTORICAL DATA

Reason Code	No. of Times Referenced	Description
8	1	Negative bias was indicated in the blanks
9	6	Interference indicat in the ICP Interf Chk Smpl
28	2	Duplicate analysis was not performed
32	14	Lab control samples > +/- 3 sigma
36	9	MDA exceeded the RDL
40	26	Organics initial calibration crit werent met
41	37	Organics cont calibration crit werent met
51	6	Nonverifiable lab results and/or unsubmitted data
54	2	Incorrect reported activity or MDA
56	1	IDL changed due to significant figure discrep
78	5	MDAs were calculated by reviewer
84	6	Key fields wrong
85	8	Record added by QLI
99	10	See hardcopy for further explanation
Total	133	

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TABLE II.3.6-16

DUPLICATE AND ASSOCIATED REAL SAMPLES
HISTORICAL DATA

SAMPLE TYPE	SAMPLE NUMBER	QC CODE	QC PARTNER	LOCATION	SAMPLE DATE
METALS					
BH	BH00008EB	DUP	BH00006EB	40191	18-SEP-91
BH	BH37870005D	DUP	BH37870005	3787	16-JUL-87
BH	BH77403891014D	DUP	BH77403891014	P213289	29-AUG-89
BH	P2183891216D	DUP	P2183891216	P218389	08-NOV-89
BH	SEP04890006D	DUP	SEP04890006	P207689	05-MAY-89
BH	SEP06890306D	DUP	SEP06890306	P207889	01-MAY-89
BH	SEP1789BR0003	DUP	SEP1789BR0002	P208989	12-MAY-89
BH	SEP1889BR1218D	DUP	SEP1889BR1218	P209089	17-MAY-89
BH	SEP1989BR1622D	DUP	SEP1989BR1622	P209189	25-MAY-89
BH	SEP2189BR2026D	DUP	SEP2189BR2026	P209389	07-JUN-89
BH	SEP2689BR0410D	DUP	SEP2689BR0410	P209889	11-MAY-89
BH	SP0487004D	DUP	SP048704DH	SP0487	30-OCT-87
BH	SP1087017D	DUP	SP108717DH	SP1087	10-NOV-87
BH	SP13876DUP	DUP	SP138706DH	SP1387	06-NOV-87
BH	SP1587008D	DUP	SP158708DH	SP1587	12-NOV-87
RADIONUCLIDES					
BH	BH00008EB	DUP	BH00006EB	40191	18-SEP-91
BH	BH37870005D	DUP	BH37870005	3787	16-JUL-87
BH	P2183891216D	DUP	P2183891216	P218389	08-NOV-89
BH	SEP04890006D	DUP	SEP04890006	P207689	05-MAY-89
BH	SEP06890306D	DUP	SEP06890306	P207889	01-MAY-89
BH	SEP1789BR0003	DUP	SEP1789BR0002	P208989	12-MAY-89
BH	SEP1889BR1218D	DUP	SEP1889BR1218	P209089	17-MAY-89
BH	SEP1989BR1622D	DUP	SEP1989BR1622	P209189	25-MAY-89
BH	SEP2189BR2026D	DUP	SEP2189BR2026	P209389	07-JUN-89
BH	SEP2689BR0410D	DUP	SEP2689BR0410	P209889	11-MAY-89
BH	SP0487004D	DUP	SP048704DH	SP0487	30-OCT-87

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TABLE II.3.6-16 (continued)

DUPLICATE AND ASSOCIATED REAL SAMPLES
HISTORICAL DATA

SAMPLE TYPE	SAMPLE NUMBER	QC CODE	QC PARTNER	LOCATION	SAMPLE DATE
BH	SP1087017D	DUP	SP108717DH	SP1087	10-NOV-87
BH	SP13876DUP	DUP	SP138706DH	SP1387	06-NOV-87
BH	SP1587008D	DUP	SP158708DH	SP1587	12-NOV-87
SEMIVOLATILES					
BH	BH00008EB	DUP	BH00006EB	40191	18-SEP-91
BH	BH37870005D	DUP	BH37870005	3787	16-JUL-87
VOLATILES					
BH	BH37870005D	DUP	BH37870005	3787	16-JUL-87
BH	BH77403891214D	DUP	BH77403891214	P213289	29-AUG-89
BH	P2183891416D	DUP	P2183891416	P218389	09-NOV-89
BH	P2191890406D	DUP	P2191890406	P219189	30-NOV-89
BH	SEP04890002D	DUP	SEP04890002	P207689	05-MAY-89
BH	SEP06890002D	DUP	SEP06890002	P207889	01-MAY-89
BH	SEP1889BR0002D	DUP	SEP1889BR0002	P209089	17-MAY-89
BH	SEP1989BR0002D	DUP	SEP1989BR0002	P209189	25-MAY-89
BH	SEP2189BR2224D	DUP	SEP2189BR2224	P209389	07-JUN-89
BH	SEP2289BR1214	DUP	SEP2289BR1213	P209489	16-MAY-89
BH	SEP2689BR0002D	DUP	SEP2689BR0002	P209889	11-MAY-89
BH	SP0487004D	DUP	SP048704DH	SP0487	30-OCT-87

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TABLE II 3 6-17

SUMMARY OF FIELD PRECISION GOALS FOR HISTORICAL DATA

ANALYTE	NUMBER OF PAIRS	NUMBER OF PASSED PAIRS	NUMBER OF FAILED	% MEETING	REMARKS
SEMIVOLATILES	2	130	2	98.5	INITIAL
VOLATILES	12	395	15	96.3	INITIAL
					No results for SEP2289BR12 (34 RPDs)
					Rejected samples (7 RPDs)
	11	355	14	96.2	Corrected based upon above remarks
METALS	15	305	104	75.1	INITIAL
					No results for SEP1789BR (29 RPDs)
					Rejected samples (19 RPDs)
	14	260	101	72	Corrected based upon above remarks
RADIONUCLIDES	14	103	50	67.3	INITIAL
					Sample not available (18 RPDs)
					Rejected samples (1 RPD)
	13	84	50	62.7	Corrected based upon above remarks
PESTICIDES/PCBs	N/A				INITIAL
WATER QUALITY	N/A				INITIAL
TOTAL ALL DATA	40	826	170	82.9	Corrected based upon remarks

NOTES: DATA INCLUDED FROM RPEDS AS OF MARCH 1994

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**SOLAR EVAPORATION SEPs
 OU4 IM/IRA EA DECISION DOCUMENT
 PART II
 PHASE I RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION**

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II.4 NATURE AND EXTENT OF CONTAMINATION

To evaluate the impact of releases from the SEPs on the surface and subsurface (including the vadose zone) environments, an evaluation of the nature and extent of contamination was prepared and is discussed in this section. Cleanup activities associated with the OU4 Phase I IM/IRA will be conducted based on the extent determination, but the degree of soil remediation will be limited to acceptable risk levels or background, whichever is applicable, rather than to pre-release concentrations. Discussion of the nature and extent of contamination is limited to the PCOCs determined as part of the OU4 Phase I IM/IRA EA Decision Document (Section III 2.1 and Appendix III B). Both the horizontal and vertical extent of contamination was determined to provide an understanding of the three-dimensional distribution of contaminants in the surficial and subsurface soils and bedrock. These correlated analyses and evaluations considered specific criteria including

- Data quality and useability -- Both OU4 Phase I RFI/RI and historical analytical data from previous investigations were evaluated on an empirical basis to determine the adequacy of the data for use in assessing the nature and extent of contamination.
- Methodology for data evaluation -- Parameters and procedures to qualify data were established, including the consideration of background geochemical and radiological data, comparisons of recent and historical data, and development of potential contaminant lists.
- Chemical/physical nature of contaminants -- Based on the comparative analysis of historical and recent data, categories of chemical compounds were evaluated as PCOCs, including metals, semivolatile and volatile organics, radionuclides, and other parameters such as nitrate, cyanide, and pesticides/PCBs. Representative contaminants were selected from these categories based upon their presence above background 95% UCLs or above detection limits.

These criteria were incorporated in summarizing the nature and extent of contamination to assess the likelihood that the SEPs were a contaminant source. The summary evaluations considered variables such as background or pre-existing levels of a chemical constituent in the various geologic media, alternate sources (other than the SEPs) of contamination, postulated release mechanisms from the SEPs, identification of inconsistent data and analytical results, sampling errors, and contamination of samples by laboratory analyses. Through this process, the contaminants most likely to have originated from the SEPs were identified.

The following sections discuss the data quality and useability (Section II 4.1), the methodology used to develop a representative list of contaminants (Section II 4.2), background geochemical and radiological comparisons (Section II 4.3), the three-dimensional spatial distribution of surficial and subsurface contamination for each analyte group (Section II 4.4 and II 4.5), and a synopsis of the data presented (Section II 4.5).

II.4.1 Data Quality and Usability

As discussed in Section II 3 6, Quality Assurance/Quality Control Results, the surficial soil and subsurface data collected during the OU4 Phase I RFI/RI have been examined for useability and are considered to be adequate for evaluating the nature and extent of contamination

Tentatively identified organic compounds and historical data with a qualifier of "U" or validation result "R" (see Section II 3 6) were rejected for the purpose of evaluating nature and extent of contamination. There is little documentation of laboratory analytical procedures and QA/QC protocol for some historical chemical analyses. The historical analyses conducted from 1986 through early 1989 were not carried out in accordance with EPA/QAMS - 005/80. Despite this fact, if the historical data did not conflict or contradict Phase I RFI/RI data, historical data was used in the evaluation of nature and extent of contamination to the fullest extent possible.

Because no background data are available, the presence of organic compounds above the instrument detection limits is assumed to be indicative of organic compound contamination. Tables II Z-1 and II Z-2 in Appendix II Z list the PCOCs (including all organic compound detections) detected above the 95% UCL or detection limit for surficial and borehole soils, respectively. The 95% UCL was developed from the RFETS background soil geochemical data. The detection limits reported in the database vary, and may represent the contract-required quantification limit (CRQL), the instrument detection limit (IDL), or the method detection limit (MDL). Uncertainties regarding which detection limit is being applied necessitated the exclusive use of data above this limit for purposes of evaluating the nature and extent of organic compound contamination.

Furthermore, environmental sample analytical results are sensitive to subsequent organic compound contamination (more so than in the case of metals and radionuclides) through routine sampling and analytical procedures. Rinsate and blank sample results allow identification of suspect contaminants, however, rinsate and blank results are not available for every sample. Use of organic compound results below the detection limit, or those results whose validity could be challenged, results in a shotgun-type dispersion of sample locations and does little to clarify the extent of contamination. However, for completeness, all Phase I RFI/RI organic compound results, including those estimated concentrations (those flagged with a "J") below the detection limit are presented and discussed in Sections II 3 1, II 3 2, and II 3 4.

II.4.2 Methodology for Data Evaluation

Historical and Phase I RFI/RI activities have generated volumes of analytical data for metals, radionuclides, inorganic and organic compounds. All of the usable data, as described in Section II 3 6, Quality Assurance/Quality Control Results, have been assessed to determine which analytes are probable contaminants at OU4. The result of this data evaluation is a statistically sound and representative identification of potential contaminants of concern at OU4. This statistical assessment compared analyte concentrations from historical and Phase I RFI/RI samples to background analyte levels naturally present in alluvial and bedrock materials.

Elevated analyte concentrations were also compared to the historical SEP liquid and sludge analyses to determine if the presence of these materials is related to previous SEP operations

For a complete evaluation of unsaturated materials, the vadose zone appraised for nature and extent includes all portions of the subsurface that are unsaturated for any period of time, or all soil, alluvium, and bedrock above the historical low ground water level. This includes the uppermost portion of the UHSU that lies between the historical low and high ground water level that is seasonally saturated. This variably saturated zone averages between one and three feet in thickness across the OU4 pediment, but thickens along the slope north of the SEPs and east of SEP 207-B South. The maximum thickness of the zone of water table fluctuation east of SEP 207-B south, 8.05 feet, was recorded at well P209789, the maximum thickness north of the SEPs, 9.45 feet, was recorded North of SEP 207-A at well 46293. This unsaturated evaluation is necessary to identify the spatial distribution of contaminants in the vadose zone.

The sampling strategy established in the OU4 Phase I RFI/RI Work Plan specified six-foot composite samples in boreholes located outside of the SEPs and two foot composite samples from boreholes drilled through the SEPs. The sample intervals precluded attempts to positively correlate the presence or absence of contamination with specific geologic media. Specifically, a six-foot composite sample often included more than one alluvial lithofacies, or included vadose and saturated materials. Therefore, the contaminant distribution discussions in Sections II 4 4 and II 4 5 do not relate contaminant occurrence to geologic or hydrogeologic features, but focus on the lateral and vertical extent of contaminants in both the unsaturated and saturated strata.

II.4.3 Background Comparison

Phase I RFI/RI and historical OU4 data were compared to available surficial and vadose zone soil data outside of OU4 to evaluate the nature and extent of contamination at OU4. The Phase I RFI/RI surficial soil data for inorganic compounds and radionuclides were compared to data from the Rock Creek surficial soil background study conducted by DOE as part of the site-wide background data evaluation. The Phase I RFI/RI and historical subsurface soil data were compared to background data for the RFA that were identified in the Background Geochemical Characterization Report (EG&G, 1993). Data from these two studies were considered to be the most acceptable soil data for comparison to OU4 soils.

To evaluate the nature and extent of inorganic and radionuclide contamination in surficial soils and the subsurface, a background 95% UCL value for each analyte was calculated. The 95% UCL value was used to separate the OU4 analytical data set into naturally-occurring constituents and probable contaminants. Analytical results for a sample above the 95% UCL indicated that sample was collected from a probable contaminated area or hot spot. The method used to determine the UCL depended upon the sample population distribution (i.e., normal, log normal, or non-parametric distribution), a complete discussion on the 95% UCL calculation is found in Appendix III A.

Tables II 4 3-1 and II 4 3-2 list the potential contaminants of concern for surficial and subsurface materials respectively, for the Phase I RFI/RI and their associated background 95%

UCL values A summary of the analytical results for surficial and subsurface samples above 95% UCL is presented in Appendix II Z

II.4.4 Nature and Extent of Surficial Soil Contamination

Laboratory analytical results for surficial soils that were determined to be usable from the Phase I RFI/RI provided the basis for evaluating the nature and extent of surficial soil contamination within OU4 There are no historical surficial soil analytical data from OU4 The principal contaminants mapped at OU4 were selected from the PCOC list presented in Table II 4 3-1 Some of the PCOCs appeared to be naturally-occurring soil constituents, such as silicon, were not mapped Potential sources of the PCOCs are also suggested in the following summaries based on the observed distributions

Mapping the contaminant concentration data set identified potentially contaminated areas or hot spots Figure II 2-12 shows the locations where surficial soil samples were collected Figures II 4 4-1 through II 4 4-28 show the distribution of the PCOCs in surficial soils at OU4

II.4.4.1 Metals

The metal PCOCs are beryllium, cadmium, calcium, mercury, silver, and sodium These metals were detected above the background 95% UCL levels in OU4 surficial soils and are considered to represent potential contaminants

Beryllium

Beryllium was detected in twelve surficial soil samples above the background 95% UCL of 0.92 mg/kg The surficial distribution of beryllium is restricted primarily to the soils on the north, northeast, east, southeast, and southwest berms of SEP 207-A The highest concentration of 9.6 mg/kg, was reported from the northeastern berm of SEP 207-A at sampling location SS402893 The surficial soils on the eastern berm of SEP 207-B north also contain elevated levels of beryllium The locations and analytical results of surficial soil samples containing elevated levels of beryllium are shown on Figure II 4 4-1

Based on the distribution of the beryllium around SEPs 207-A and 207-B North, the source of beryllium contamination is likely to have been from SEP liquids which were transported via aerosol dispersion during periods of high wind or via overtopping of the SEPs Historical analyses of SEP 207-A sludges and liquids indicate the presence of beryllium at concentrations in excess of 1,000 ppm (1,000 mg/kg)

Cadmium

Cadmium was detected in concentrations above the background 95% UCL value of 0.64 mg/kg in 38 surficial soil samples at concentrations ranging from 1.3 to 382 mg/kg The highest concentration was detected at location SS403093 north of the berm between SEPs 207-A and 207-B North This location corresponds with the outfall of a drainage tile installed between SEP 207-A and the 207-B SEPs Elevated surficial cadmium concentrations were also detected along

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the southwestern berm of SEP 207-A at location SS402793 (356 mg/kg), and on the northeastern berm of SEP 207-A at location SS402893 (194 mg/kg). The majority of elevated concentrations were on berm areas immediately adjacent to the SEPs.

Locations showing low concentrations of cadmium included the "bone yard," an area east of the 207-B SEPs that was historically used for storage of discarded materials and equipment (borehole/location 41893 and 43293), and areas north of the SEPs near seep areas. The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of cadmium are shown on Figure II 4 4-2.

The cadmium levels observed in the surficial soil samples may have been derived from aerosol dispersion of SEP liquids or overtopping of the SEPs. The surficial soil cadmium concentrations are comparable to historical concentrations of cadmium detected in the SEP liquids and sludges.

Calcium

Calcium was detected in concentrations above the background 95% UCL value of 8,282.95 mg/kg in 40 surficial soil samples. The highest concentration, 248,000 mg/kg, was detected at location SS403093 north of the berm between SEPs 207-A and 207-B North. This location corresponds with the outfall of a drainage tile installed between SEPs 207-A and the 207-B SEPs. Elevated levels of calcium were also present along the berm between SEPs 207-B center and 207-B south, an area southeast of SEP 207-B south that includes the sludge drying staging area, and the southeastern berms of SEP 207-B south. The locations and analytical results of surficial soil samples containing elevated levels of calcium are shown on Figure II 4 4-3.

The calcium levels observed in the surficial soil samples may have been derived from aerosol dispersion of SEP liquids, the effluent from the drainage tile installed between SEPs 207-A and 207-B, spills or releases associated with sludge drying staging area, SEP overtopping, or from SEP liquids which leaked into the subsurface and re-emerged at seep areas north of the SEPs.

Mercury

Mercury was detected in concentrations above the background 95% UCL value of 0.03 mg/kg in 22 surficial soil samples. The highest detected concentrations were located on the southwestern berm of SEP 207-A at location SS402793 (1.8 mg/kg), and at the drainage tile outfall at location SS403093 (1.7 mg/kg). Elevated levels of mercury were also present along the northern and eastern berms of SEP 207-A, the eastern berm of SEP 207-B center, and in the bone yard. The locations and analytical results of surficial soil samples containing elevated levels of mercury are shown on Figure II 4 4-4.

The mercury levels observed in the surficial soil samples may have been derived from aerosol dispersion of SEP liquids, the effluent from the drainage tile installed between SEPs

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207-A and 207-B, SEP overtopping, or from SEP liquids which leaked into the subsurface and re-emerged at seep areas north of the SEPs

Silver

Silver was detected in six surficial soil samples above the background 95% UCL value of 0.58 mg/kg. The surficial distribution of silver is restricted to the soils on the northeast, east, and southwest berms of SEP 207-A, the east berm of SEP 207-B Center (one detection), south of OU4 (one detection), and the northern berm of SEP 207-C. The highest concentration of 3.6 mg/kg, was reported from the northern berm of SEP 207-C at borehole/location 40993. The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of silver are shown on Figure II 4 4-5.

Based on the distribution of the silver around SEPs 207-A and 207-C, the source of silver contamination is possibly from aerosol dispersion, as discussed in the case of beryllium.

Sodium

Sodium was detected in concentrations above the background 95% UCL value of 165.4 mg/kg in 13 surficial soil samples. The highest concentration, 2,440 mg/kg, was detected at location SS403193 north of the outfall of a drainage tile installed between SEPs 207-A and the 207-B SEPs. Elevated levels of sodium were also present in the seep area northwest of SEP 207-A, areas northeast and southeast of SEP 207-C that includes the industrial area northeast of building 779. The locations and analytical results of surficial soil samples containing elevated levels of sodium are shown on Figure II 4 4-6.

The sodium levels observed in the surficial soil samples may have been derived from the effluent from the drainage tile installed between SEPs 207-A and 207-B, spills or leaks around 207-C, SEP overlapping, or from SEP liquids which leaked into the subsurface and re-emerged at seep areas north of the SEPs 207-C and 207-A.

II.4.4.2 Organic Compounds

Semivolatile organic compounds (SVOCs) were found in surficial soil samples collected during the Phase I RFI/RI. The PCOC semivolatile organic contaminants detected include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, pyrene, indeno(1,2,3-cd)pyrene, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate.

These compounds are primarily fused polycyclic aromatic hydrocarbons. Other minor surficial SVOC analytes detected are plasticizers (phthalates). Appendix II Z presents the results of the organic analytes detected. Table II Z-1 lists the samples containing organic compounds above the detection limit. In general, none of these organic compounds are thought to originate from the OU4 waste stream, but may originate from asphalt particles, diesel or fuel oil releases, incomplete combustion products, or other similar sources.

Benzo(a)anthracene

Benzo(a)anthracene was found at six locations exceeding the detection limit. These locations include the industrial area west of OU4 near building 774 (four detections), the southwest berm of SEP 207-A (one detection), and east of OU4 in the bone yard at borehole/location 43293 (one detection). The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of benzo(a)anthracene are shown on Figure II 4 4-7. This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars.

Benzo(a)pyrene

Benzo(a)pyrene was found at eight locations exceeding the detection limit. These locations include the industrial area west of OU4 near building 774 (four detections), the seep area north of SEP 207-A (two detections), the southwest berm of SEP 207-A (one detection), and east of OU4 in the bone yard at borehole/location 43293 (one detection). The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of benzo(a)pyrene are shown on Figure II 4 4-8. This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars.

Benzo(b)fluoranthene

Benzo(b)fluoranthene was found within 11 areas (15 locations total) exceeding the detection limit. These areas include the industrial area west of OU4 near building 774 and on the west berm of SEP 207-C (five detections), the north berm of SEP 207-C (one detection), the seep area north of SEP 207-A (five detections), the southwest berm of SEP 207-A (one detection), the east berm of SEP 207B Center (one detection), south of OU4 (one detection), and east of OU4 in the bone yard at borehole/location 43293 (one detection). The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of benzo(b)fluoranthene are shown on Figure II 4 4-9. This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars.

Benzo(ghi)perylene

Benzo(ghi)perylene was found at four locations exceeding the detection limit. These locations include the industrial area west of OU4 near building 774 (three detections) and east of OU4 in the bone yard at borehole/location 43293 (one detection). The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of benzo(ghi)perylene are shown on Figure II 4 4-10. This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars.

Benzo(k)fluoranthene

Benzo(k)fluoranthene was found within 10 areas (13 locations total) exceeding the detection limit. These areas include the industrial area west of OU4 near building 774 (four detections), the west berm of SEP 207-C (one detection), the north berm of SEP 207-C (one

detection), the seep area northwest of SEP 207-A (four detections), the east berm of SEP 207B Center (one detection), and south of OU4 (one detection), and east of OU4 in the bone yard at borehole/location 43293 (one detection) The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of benzo(k)fluoranthene are shown on Figure II 4 4-11 This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars

Chrysene

Chrysene was found within seven areas (eight locations total) exceeding the detection limit These areas include the industrial area west of OU4 near building 774 (four detections), the seep area north of SEP 207-A (two detections), the southwest berm of SEP 207-A (one detection), and east of OU4 in the bone yard at borehole/location 43293 (one detection) The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of chrysene are shown on Figure II 4 4-12 This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars

Fluoranthene

Fluoranthene was found within 11 areas (15 locations total) exceeding the detection limit These areas include the industrial area west of OU4 near building 774 and the west berm of SEP 207-C (five detections), the north berm of SEP 207-C (one detection), the seep area north of SEP 207-A (five detections), the southwest berm of SEP 207-A (one detection), the eastern berm of SEP 207B Center (one detection), the area south of OU4 (one detection), and east of OU4 in the bone yard at borehole/location 43293 (one detection) The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of fluoranthene are shown on Figure II 4 4-13 This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars

Phenanthrene

Phenanthrene was found within nine areas (12 locations total) exceeding the detection limit These areas include the industrial area west of OU4 near building 774 (four detections), the north berm of SEP 207-C (one detection), the seep area north of SEP 207-A (four detections), the southwest berm of SEP 207-A (one detection), the east berm of SEP 207B Center (one detection), and east of OU4 in the bone yard at borehole/location 43293 (one detection) The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of phenanthrene are shown on Figure II 4 4-14 This analyte is a fused polycyclic aromatic hydrocarbon that is associated with explosives, asphalt and other operations involving coal tars

Pyrene

Pyrene was found within nine areas (16 locations total) exceeding the detection limit These areas include the industrial area west of OU4 near building 774 and the west berm of SEP 207-C (five detections), the north berm of SEP 207-C (one detection), the northwest berm and

seep area north of SEP 207-A (six detections), the southwest berm of SEP 207-A (one detection), the east berm of SEP 207B Center (one detection), south of OU4 (one detection) and east of OU4 in the bone yard at borehole/location 43293 (one detection) The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of pyrene are shown on Figure II 4 4-15 This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars

Indeno(1,2,3-cd)pyrene

Indeno(1,2,3-cd)pyrene was found at four locations exceeding the detection limit These locations include the industrial area west of OU4 near building 774 (three detections) and east of OU4 in the bone yard at borehole/location 43293 (one detection) The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of indeno(1,2,3-cd)pyrene are shown on Figure II 4 4-16 This analyte is a fused polycyclic aromatic hydrocarbon that is associated with asphalt and other operations involving coal tars

Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate was found within eight areas (13 locations total) exceeding the detection limit These areas do not coincide with areas where polycyclic aromatic hydrocarbons were detected The areas where this analyte was detected include the southern berm of SEP 207-A and near building 967 (two detections), the seep area north SEP 207-B North (two detections), the eastern berm of SEP 207-B center (two detection), and northern and southern portions of the bone yard east of OU4 (five detections), and areas outside of the PA on the hillside descending to North Walnut Creek (two detections) The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of bis(2-ethylhexyl)phthalate are shown on Figure II 4 4-17 This analyte is a plasticizer and is used in vacuum pumps

D1-n-butyl phthalate

D1-n-butyl phthalate was found within two areas (four locations total) exceeding the detection limit These areas do not coincide with areas where polycyclic aromatic hydrocarbons were detected The areas where this analyte was detected include the southern berm of SEP 207-A and near Building 967 (three detections), and an isolated area in the southern portion of the bone yard east of OU4 (one detection) The locations and analytical results of surficial soil samples and postulated adjacent areas containing elevated levels of d1-n-butyl phthalate are shown on Figure II 4 4-18 This analyte is a plasticizer and among other things is used in insect repellent

The distribution patterns of polycyclic aromatic hydrocarbons in surficial soils are shown in Figures II 4 4-7 through II 4 4-16 The highest concentrations of these compounds were consistently at location SS400993 west of SEP 207-C in the industrial area and at borehole/location 43293 in the bone yard east of the 207-B SEPs These compounds are common constituents of cooling and lubricating oils, diesel fuel, and asphalt These compounds

also are products from the incomplete combustion of fuels, which may result in atmospheric transport and deposition

The phthalates do not appear to be contaminants at OU4, but may result from field or laboratory contamination. Phthalates are common components in various plastics, potential sources include the inner latex gloves used by field sampling crews and laboratory personnel, and the plastic containers used for transport and storage of deionized water.

II.4.4.3 Radionuclides

Radionuclides were found in surficial soil samples collected during the Phase I RFI/RI. The radionuclide PCOCs are americium-241, plutonium-239/240, uranium-233/234, uranium 235, uranium 238, gross alpha ionizing radiation sources, tritium, and cesium-134. These radionuclides were detected above the background 95% UCL in OU4 surficial soil samples and are present in statistically significant quantities (Table II 4 3-1).

The detected radionuclides are by-products of nuclear weapons manufacturing, their decay products, and naturally occurring isotopes. The tables in Appendix II Z present the samples with radionuclide analytes that were above the background 95% UCL limit.

Americium-241

Americium-241 was detected above the background level of 0.027 pCi/g in 75 surficial soil samples. The highest concentrations of 220 pCi/g (location SS402793), 130 pCi/g (location SS402893), 110 pCi/g (borehole 43793), and 92 pCi/g (location SS400593) were detected on the southwest, northeast and eastern berms of SEP 207-A. The levels of americium-241 in the other surficial soils around the SEPs ranged from 0.5 to 27 pCi/g with the majority of the reported values below 10 pCi/g. The americium-241 concentrations reported in surficial soil samples downgradient, or north of the SEPs in the buffer zone, ranged from 0.25 to 0.02 pCi/g. Other notable measured concentrations occurred in samples from north of Building 713 at sample location SS400993 (20.18 pCi/g), southeast of SEP 207-B South at location SS401993 (7.04 pCi/g), and in the bone yard at borehole/location 43293 (4.40 pCi/g). The locations and analytical results of surficial soil samples containing elevated levels of americium-241 are shown on Figure II 4 4-19.

Aerosol dispersion of radionuclides from SEP liquids is a likely source for americium-241 detected in surficial soil samples. Americium-241 also appeared to be concentrated at the drainage tile outfall north of the SEPs. Elevated results from samples located north of the SEPs is also a likely result of SEP fluid leakage into the subsurface and emergence at seeps.

The americium-241 present in the surficial soils west of the SEPs in the industrial area near Building 777, north of Building 774, and east of the SEP area in the bone yard, do not appear to be related to suspected releases from the SEPs.

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Plutonium-239/240

Plutonium-239/240 was detected above the background level of 0.062 pCi/g in 56 surficial soil samples from OU4. The highest concentration detected was from location SS402793 (56 pCi/g) on the southwestern berm of SEP 207-A. Elevated concentrations also were detected at location SS403093 (19 pCi/g) near the drainage tile outfall north of the SEPs, along the eastern berm of SEP 207-A at borehole 43793 (17 pCi/g), and west of the SEPs in the industrial area at locations SS400993 (10.05 pCi/g) and SS402193 (9.22 pCi/g). Surficial soil samples collected north and down slope of the SEPs in the buffer zone displayed plutonium concentrations ranging from 0.013 to 0.44 pCi/g. The locations and analytical results of surficial soil samples containing elevated levels of plutonium-239/240 are shown on Figure II 4 4 20.

The distribution of plutonium-239/240 is similar to americium-241 except that there appear to be higher concentrations of plutonium north of SEP 207-C at locations 40993 (7.2 pCi/g), SS402393 (5.33 pCi/g), and 45793 (4.90 pCi/g). Samples from locations on the SEP berms commonly displayed elevated levels of americium and plutonium.

Elevated levels of plutonium-239/240 were found to be confined primarily to the surficial soils in the vicinity of the SEPs. The source of contamination is suspected to be aerosol dispersion of radionuclide-contaminated SEP liquids. Americium and plutonium also appeared to be concentrated at the drainage tile outfall north of the SEPs. Elevated results from samples located north of the SEPs is a likely result of SEP fluid releases into the subsurface and emergence at seeps or at the drainage tile outfall.

The plutonium-239/240 in the surficial soils west of the SEPs in the industrial area near Building 777, south of Building 774, and east of the SEP area in the bone yard, do not appear to be related to suspected releases from the SEPs.

Uranium-233 and 234

Concentrations of uranium-233/234 (U233/234) exceeded the background 95% UCL of 1.22 pCi/g in 39 surficial soil samples. The U233/234 concentrations ranged from a minimum of 1.24 pCi/g to a maximum of 41 pCi/g, only two of the 39 samples exceeded 8 pCi/g. These two samples included location SS403093 (41 pCi/g), near the outfall area of the SEP drainage tile, and location SS400594 (14 pCi/g), on the eastern berm of SEP 207-A. The locations and analytical results of surficial soil samples containing elevated levels of U233/234 are shown on Figure II 4 4-21.

Elevated levels of U233/234 were found to be confined primarily to the surficial soils in the vicinity of the SEPs. The source of contamination is suspected to be aerosol dispersion of radionuclide-contaminated SEP liquids. U233/234 also appeared to be concentrated at the drainage tile outfall north of the SEPs. Elevated results from samples located north of the SEPs is a likely result of SEP fluid releases into the subsurface and emergence at seeps or the drainage tile outfall.

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The U233/234 in the surficial soils west of the SEPs in the industrial area near Building 779 and east of the SEP area in the bone yard, do not appear to be related to suspected releases from the SEPs

Uranium-235

Uranium-235 (U235) was detected in 26 surficial soil samples above the background 95% UCL of 0.090 pCi/g. The concentrations of uranium-235 in surficial soils ranged from 0.0927 to 2.3 pCi/g, with the maximum detection at location SS403093, near the outfall area of SEP drainage tile. Only one sample (SS403093, 2.3 pCi/g) out of the 26 detections, exceeded 0.75 pCi/g. The locations and analytical results of surficial soil samples containing elevated levels of U235 are shown on Figure II 4-4-22.

The locations and relative concentrations of U235 detections are similar to the distribution observed for U233/234. Elevated levels of U235 were found to be confined primarily to the surficial soils in the vicinity of the SEPs. The source of contamination is suspected to be aerosol dispersion of radionuclide-contaminated SEP liquids. U235 also appeared to be concentrated at the drainage tile outfall north of the SEPs. Elevated results from samples located north of the SEPs is a likely result of SEP fluid releases into the subsurface and emergence at seeps.

The U235 in the surficial soils east of the SEP area in the bone yard, do not appear to be related to suspected releases from the SEPs.

Uranium-238

Uranium-238 (U238) was detected in 33 surficial soil samples above the background 95% UCL of 1.27 pCi/g. The concentrations of U238 ranged from 1.27 to 27 pCi/g, with the highest concentration detected at location SS403093, near the SEP drainage tile outfall. Only one sample (SS403093, 27 pCi/g) out of the 33 detections, exceeded 8.4 pCi/g. The locations and analytical results of surficial soil samples containing elevated levels of U238 are shown on Figure II 4-4-23.

The locations and relative concentrations of U238 detections are similar to the distribution observed for U233/234 and U235. Elevated levels of U238 were found to be confined primarily to the surficial soils in the vicinity of the SEPs. The source of contamination is suspected to be aerosol dispersion of radionuclide-contaminated SEP liquids. U238 also appeared to be concentrated at the drainage tile outfall north of the SEPs. Elevated results from samples located north of the SEPs is a likely result of SEP fluid releases into the subsurface and emergence at seeps.

The U238 in the surficial soils east of the SEP area in the bone yard, do not appear to be related to suspected releases from the SEPs.

Gross Alpha

Gross alpha ionizing radiation was detected above the background 95% UCL of 22.9 pCi/g in 33 surficial soil samples from OU4. Only seven of the samples with elevated results exceeded 50 pCi/g. The highest concentration detected was from location SS402793 (440 pCi/g) on the southwestern berm of SEP 207-A. The second highest result was detected at borehole/location 43793 (260 pCi/g) on the eastern berm of SEP 207-A. Elevated concentrations were also detected at location SS403093 (250 pCi/g) near the drainage tile outfall north of the SEPs. The locations and analytical results of surficial soil samples containing elevated gross alpha levels are shown on Figure II 4-24.

The gross alpha distribution is similar to that of americium, plutonium, and the uranium isotopes. Samples collected from the southwestern, eastern, and northeastern berms of SEP 207-A often displayed elevated levels of americium, plutonium, and uranium isotopes. Gross alpha radiation was found to be confined primarily to the surficial soils in the vicinity of the SEPs. The source of contamination is suspected to be aerosol dispersion of radionuclide-contaminated SEP liquids. Elevated gross alpha values also appeared at the drainage tile outfall north of the SEPs.

Gross alpha radiation in surficial soils west of the SEPs in the industrial area near Building 730, south of Building 774, and east of the SEP area in the bone yard do not appear to be related to suspected releases from the SEPs.

Tritium

Tritium is highly mobile and most likely associated with the pore waters of the surficial soil. Since the detection limit is unknown for several tritium surficial soil samples, the background 95% UCL of 212.2 pCi/L for the vadose zone samples is used as a conservative lower limit for mapping purposes. Besides being consistent with the vadose zone map for tritium, this mapping value is conservative to the state of Colorado ground water standard of 500 pCi/L. Concentrations of tritium above this detection limit was reported in 22 surface soil samples. Sample results ranged from 250 to 329,000 pCi/L. Seven of the 22 samples had sample results above 1,000 pCi/L. Concentrations of 329,000 pCi/L (borehole/location 05293), 227,000 pCi/L (borehole/location 44893), 118,000 pCi/L (borehole/location 40193), and 20,100 pCi/L (location SS400993) were detected in samples taken outside the PA. Inside the PA three samples, borehole/location 45693 (1,300 pCi/L) in the seep area northwest of SEP 207-A, location SS403093 (1,600 pCi/L) and SS403193 (1,254 pCi/L) near the drainage tile outfall north of the SEPs exceeded 1,000 pCi/L. The locations and analytical results of surficial soil samples containing elevated levels of tritium are shown on Figure II 4-25.

Slightly elevated concentrations of tritium were found around the SEPs and in the bone yard. The greatest tritium concentrations were detected in samples collected to the north, or downslope of the SEPs in seep areas. Elevated results from samples collected north of the SEPs are likely from historic SEP fluid leakage into the subsurface and emergence at seeps. Tritium also appeared to be concentrated at the drainage tile outfall north of the SEPs.

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Cesium-134

Cesium-134 was not detected above the detection limit in surficial soil samples from OU4. However, surficial soil samples from 10 locations did have a result greater than a value of zero associated with them. The maximum results were 0.0333 pCi/g, detected in a sample from location SS400993 in the industrial area west of OU4, 0.0218 pCi/g, detected in a sample from location SS402093 in the buffer zone east of the SEPs, and 0.012 pCi/g, detected in a sample from borehole/location 41293 northeast of SEP 207-B North. All other samples were at least a magnitude less, and as previously noted, all were below the detection limit. The locations and analytical results of surficial soil samples containing elevated levels of cesium-134 are shown in Figure II 4 4-26.

II.4.4.4 Other PCOCs in Surficial Soils

Other PCOCs found in surficial soil samples collected during the Phase I RFI/RI included nitrate/nitrite and aroclor-1254 (a PCB). These PCOCs were detected above the background 95% UCL limit in OU4 surficial soils and are present in statistically significant quantities. The tables in Appendix II Z list the samples containing PCOC analytes above the background 95% UCL limit (Table II 4 3-1).

Nitrate/Nitrite

Nitrate/nitrite contamination above the background 95% UCL limit of 1.11 mg/kg was reported in 73 surficial soil samples. The higher concentrations, ranging from 250 to 765 mg/kg, were detected in six samples of soils from the seep areas north of the SEPs inside the PA, and the outfall area of the drainage tile installed between SEP 207-A and the 207-B SEPs. The majority of the berms around the SEPs displayed elevated levels of nitrate/nitrite contamination. Sample results were also significantly elevated southeast of SEP 207-B South where concentrations reached 83.3 mg/kg. Other outlying areas, such as the industrial area west of OU4, northern and southern portions of the bone yard, and seep areas on the slope north of the SEPs outside of the PA contained nitrate at levels generally less than 10 mg/kg. The locations and analytical results for nitrate/nitrite in surficial soil samples are shown on Figure II 4 4-27.

The elevated nitrate levels observed in the surficial soil samples may have been derived from aerosol dispersion of SEP liquids, the effluent from the drainage tile installed between SEPs 207-A and 207-B, spills or leaks associated with the sludge drying staging area, or from SEP liquids which leaked into the subsurface and re-emerged at seep areas north of the SEPs.

Pesticides/PCBs

The PCB aroclor-1254 was found above the detection limit in seven surficial soil samples. Only two of the seven aroclor-1254 occurred in OU4. The highest concentration detected was 11,900 µg/kg at location SS401793, north of Building 774 in the industrial area west of OU4. Aroclor-1254 was also detected on the southern berm of SEP 207-A, on the eastern berm of SEP 207-B Center and South, and east of OU4 in the bone yard at

boreholes/locations 41893 and 43293. The locations and analytical results of surficial soil samples containing aroclor-1254 are shown on Figure II 4 4-28. The areal distribution of aroclor-1254 in the surficial soils was limited, and no potential source of aroclor-1254 has been identified.

II.4.5 Nature and Extent of Subsurface Contamination

Laboratory analytical results from subsurface materials that were determined to be usable from the Phase I RFI/RI and the historical data sets provided the basis for evaluating the nature and extent of subsurface contamination within OU4. Development of the PCOC list from the usable Phase I RFI/RI data and background 95% UCL comparisons reduced detected analytes to the principal contaminants present at OU4. Potential sources of the PCOCs are also identified in the following summaries based on the observed distributions.

Appendix II Z contains a complete listing of all subsurface analytes that occurred at concentrations greater than background levels for metals, radionuclides, and other inorganic PCOCs, and above the detection limit for organics compounds. Table II 4 3-2, previously presented, contains a listing of the subsurface PCOCs and respective background UCLs.

Figures II 4 5-1 through II 4 5-20 show the horizontal and stratigraphic distribution of metal, organic, radionuclide, and other inorganic analytes at levels above the background 95% UCL in OU4. These maps display results from discrete samples at 2 foot intervals for volatile organics, and 2- and 6-foot composite borehole samples that include mixed intraformational lithologies, unconsolidated vadose and saturated materials, and bedrock lithologies. The subgrade samples that were previously described and displayed (Section II 3 1 2 4), are not presented in the figures in this section because they mostly consisted of construction material (gravels) in direct contact with the asphalt liners and are not thought to be representative of typical subsurface soils and bedrock at OU4. The presence of elevated concentrations of contaminants in the subgrade samples are, however, noted in this section, particularly where those contaminant concentrations are the highest observed.

Manganese and sulfide, although present on the PCOC list, are not mapped because they are naturally occurring primary constituents of subsurface materials. Lithium, although present on the PCOC list, was not mapped because it was not found at levels exceeding the background 95% UCL. Chloroform, di-n-butyl phthalate, and 2-butanone, although present on the PCOC list, are also not mapped because they were not detected in any Phase I RFI/RI samples and are not likely to be present.

II.4.5.1 Metals

The metal PCOCs are barium, cadmium, calcium, potassium, sodium, and zinc. These metals were detected above the background 95% UCL levels in subsurface soils, including the shallow vadose zone soils collected from directly beneath the SEPs.

Barium

Barium detections above the background 95% UCL of 93.87 mg/kg occurred in 31 Phase I RFI/RI boreholes at various depths. The concentration distribution of barium in the subsurface is primarily restricted to areas subjacent, adjacent, and north of the SEPs. The highest concentration of barium in the Phase I RFI/RI data set was 4,150 mg/kg (borehole 43693, located in the southern portion of SEP 207-A) at a depth of 10 to 13 feet in vadose zone silty claystone bedrock. The only other sample with a result exceeding 300 mg/kg was collected from borehole 46193 (located north of the SEP drainage tile outfall) at a depth of 0 to 6 feet (364 mg/kg).

Drill core from boreholes located in the buffer zone, downgradient of the SEPs, consistently displayed elevated levels of barium throughout the thickness of the vadose zone and underlying saturated strata. The highest detection in the buffer zone, 236 mg/kg, was recorded from the core of borehole 40193 at a depth of 12 to 18 feet, which is in either landslide/colluvium or artificial fill material within the vadose zone.

The highest barium concentration reported in the historical data set is 11,600 mg/kg and was detected in borehole P208889, located northeast of SEP 207-B North, at a depth of 3.5 to 9.5 feet. Other notable subsurface detections of barium from the historical data set include 1,100 mg/kg (borehole P208989, located west of the SEP drainage tile outfall), 390 mg/kg (borehole 3787, located on the eastern berm of SEP 207-B South), and 413 mg/kg (borehole 3987, located northeast of SEP 207-B North). All other detections in the historical data set are below 300 mg/kg.

The distribution of barium is displayed on Figures II 4-5-1. This figure schematically shows that barium concentrations generally increase with depth. Barium concentrations are greatest beneath the SEPs, particularly SEP 207-A, and north of the SEPs in the buffer zone.

Cadmium

Cadmium was detected at concentrations above the background 95% UCL of 2.3 mg/kg in 16 Phase I RFI/RI boreholes at various depths. The concentrations ranged from 2.5 to 547 mg/kg, with all but three of the samples measured at concentrations below 65 mg/kg. The highest cadmium concentrations were observed beneath SEP 207-A in borehole 42493 at the 0 to 2 foot (362 mg/kg) and the 2- to 4-foot (547 mg/kg) intervals, and beneath SEP 207-B North in borehole 46693 at the 0.5- to 2.25-foot (135 mg/kg) interval. In the three boreholes drilled in SEP 207-B North, the cadmium levels decreased with depth.

With the exception of several locations north and northeast of the SEPs in the buffer zone and/or outside of OU4, cadmium in the subsurface occurred beneath or in the immediate vicinity of the SEPs. Elevated cadmium concentrations also occurred at the outfall of the drainage tile between SEP 207-A and the 207-B SEPs. All historical detections were less than 101 mg/kg, however, the most elevated historical cadmium result (100.6 mg/kg at borehole SEP1087 from 19 to 21 feet) was anomalous and not confirmed by subsequent Phase I RFI/RI boreholes drilled and sampled nearby.

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The distribution of cadmium is displayed on Figure II 4 5-2 This figure schematically shows that cadmium concentrations generally decrease with depth Cadmium concentrations are greatest beneath the SEPs, particularly SEP 207-A This is consistent with historical liquid and sludge analyses from the SEPs, particularly SEP 207-A, which contained the highest concentrations in comparison to the other SEPs The elevated cadmium concentrations beneath the SEP liners typically decreased with depth This suggests that leakage through liner breaches has occurred and that cadmium appears to have sorbed readily on the immediately underlying material

Calcium

Calcium detections above the background 95% UCL of 7,782 mg/kg occurred in 38 Phase I RFI/RI boreholes at various depths The concentration of calcium in the subsurface is primarily restricted to areas subjacent and adjacent to the SEPs, in particular SEP 207-B North and Center, and SEP 207-A The highest concentration of calcium in the Phase I RFI/RI data set was 328,000 mg/kg (borehole 46793, located in the east-central portion of SEP 207-B North) at a depth of 6 5 to 8 5 feet in vadose zone claystone bedrock Other samples with calcium results of this magnitude were collected from vadose zone RFA beneath SEPs 207-A and 207-B Center The highest calcium concentration reported in the historical data set is 21,700 mg/kg and was detected in borehole 5687 at a depth of 2 to 3 5 feet These high concentrations may be attributable to the caliche layers which are common in the subsurface

The distribution of calcium is displayed on Figure II 4 5-3 This figure schematically shows that calcium is mobil or widespread beneath the SEPs and that concentrations do not generally increase with depth Calcium concentrations are greatest beneath the SEPs, particularly SEPs 207-B North and Center

Potassium

Potassium detections above the background 95% UCL of 1,562 86 mg/kg occurred in 35 Phase I RFI/RI boreholes at various depths The concentration distribution of potassium in the subsurface is primarily restricted to areas subjacent and adjacent to the SEPs, with particularly high concentrations immediately beneath SEP 207-A and 207-B North The highest concentration of potassium in the Phase I RFI/RI data set was 21,100 mg/kg (borehole 46693, located in the north-central portion of SEP 207-B North) at a depth of 0 5 to 2 25 feet in vadose zone RFA Other vadose zone samples with potassium results of this magnitude were collected from other boreholes (46793) in 207-B North, and in northern portions of SEP 207-A (41593)

The highest potassium concentration reported in the historical data set is 4,620 mg/kg and was detected in borehole P210189 (southern berm of SEP 207-C) at a depth of 3 to 9 feet

The distribution of potassium is displayed on Figure II 4 5-4 This figure schematically shows that potassium is rather stationary and is found in greater concentrations proximal to the SEPs Potassium concentrations are greatest beneath the SEPs, particularly SEPs 207-B North and 207-A

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Sodium

Sodium detections above the background 95% UCL of 2,720 mg/kg occurred in nine Phase I RFI/RI boreholes at various depths. The concentration distribution of sodium in the subsurface is restricted to areas subjacent to the SEPs, and beneath the northern berm of SEP 207-C. The highest concentration of sodium in the Phase I RFI/RI data set was 10,200 mg/kg (borehole 46693, located in the north-central portion of SEP 207-B North) at a depth of 0.5 to 2.25 feet in vadose zone RFA. Other vadose zone samples with elevated sodium results were collected from boreholes in SEPs 207-B North and Center, and SEP 207-A. Only two samples were reported as having slightly elevated sodium concentrations in the historical data set, both were collected proximal to the SEPs.

The distribution of sodium is displayed on Figure II 4 5-5. This figure schematically shows that like potassium, sodium is rather stationary and is found in greater concentrations proximal to the SEPs.

Zinc

Zinc detections above the background 95% UCL of 23.64 mg/kg occurred in 37 Phase I RFI/RI boreholes at various depths. The concentration distribution of zinc in the vadose zone is in shallow areas adjacent to the SEPs, deeper portions of the vadose zone, and subjacent saturated zone. The highest concentration of zinc in the Phase I RFI/RI data set was 168 mg/kg (borehole 44393, located south of SEP 207-A) at a depth of 0 to 5 feet in vadose zone RFA. The other samples with results exceeding 100 mg/kg were collected from the saturated zone beneath SEP 207-A (borehole 42193, 110 mg/kg at 28.3 to 31.3 feet), downgradient (north) of the SEPs in the buffer zone (borehole 40593, 115 mg/kg at 12 to 18 feet), or in the southern portion of the bone yard (borehole 44193, 130 and 160 mg/kg at 35.4 to 41.6 and 47.6 to 50.2 feet, respectively). However, the background 95% UCL for zinc in saturated bedrock may be significantly different than the vadose zone UCLs to which the data is compared.

The highest zinc concentration reported in the historical data set is 487 mg/kg and was detected in borehole P209689, located north of borehole 44193 in the bone yard, at a depth of 12.2 to 18.2 feet.

Drill core from boreholes located north or downgradient of the SEPs consistently displayed elevated levels of zinc throughout the thickness of the vadose zone. The distribution of zinc within OU4 is displayed on Figure II 4 5-6. This figure schematically shows that zinc concentrations generally increase with depth.

II.4.5.2 Organic Compounds

Semivolatile and volatile organic compounds (SVOCs and VOCs) were found in subsurface samples collected during the Phase I RFI/RI. The organic PCOCs are acetone, bis(2-ethylhexyl)phthalate, methylene chloride, and toluene. These organic compounds were detected above the detection limit in OU4 vadose zone materials and are present in statistically significant quantities. Chloroform, di-n-butyl phthalate, and 2-butanone, although present on the PCOC

list due to historical detections, are not mapped because they were not detected in any Phase I RFI/RI samples. Thus the accuracy and validity of historical organic analyses is questionable.

The detected organic analytes are primarily solvents and plasticizers (phthalates). Appendix II Z presents the organic analytes which were detected. The tables in Appendix II Z list the samples containing organic analytes above the detection limit.

Acetone

Acetone was detected at concentrations above the detection limit at various depths in a number of Phase I RFI/RI and historical boreholes. The concentrations of acetone ranged from 11 to 140 $\mu\text{g}/\text{kg}$ in the Phase I RFI/RI data set, with the maximum result from borehole 42593 in the east-central portion of SEP 207-A. The maximum detection in the historical data set, 2,700 $\mu\text{g}/\text{kg}$, was collected from borehole P210189, located on the southern berm of SEP 207-C.

The distribution of acetone is displayed on Figure II 4 5-7. This figure shows that the presence of acetone is widespread in OU4, and that concentrations show little variability or trends with depth. Acetone concentrations are greatest beneath the SEPs, particularly 207-C.

The detection of acetone in samples may be the result of laboratory-introduced contamination. This is suggested by the following observations:

- Relatively low detected concentrations,
- Ubiquitous occurrence and absence of concentration gradients,
- Observations that more than 50 percent of the sample analyses yielded results that were below the reported detection limit,
- Sporadic nature of the distribution of samples with positive contaminant identification,
- Acetone was detected in equipment rinse samples (Table II 3 6-8) and was occasionally reported in laboratory blanks, and
- Acetone compound is a common laboratory contaminant.

Methylene Chloride

Methylene chloride was detected at concentrations above the detection limit in a large number of Phase I RFI/RI and historical boreholes at various depths. The concentrations of methylene chloride ranged from 5 to 71 $\mu\text{g}/\text{kg}$ in the Phase I RFI/RI data set, with the maximum result from borehole 45893 north of SEP 207-C at a depth of 5 to 5.25 feet. The maximum detection in the historical data set that was not flagged with a "J" (estimated value between the instrument detection limit and required reporting limit) was 52 $\mu\text{g}/\text{kg}$ at borehole SP0687, located on the eastern edge of SEP 207-B North.

The distribution of methylene chloride is displayed on Figure II 4 5-8. This figure schematically shows that methylene chloride is widespread in OU4 and that concentrations do not generally increase with depth. Methylene chloride detections do not seem to be concentrated.

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beneath the SEPs nor are there any apparent trends in the data. The detection of methylene chloride in samples may be the result of laboratory-introduced contamination. This is suggested by the following:

- Relatively low detected concentrations,
- Ubiquitous occurrence and absence of concentration gradients,
- Sporadic nature of the distribution of samples with positive contaminant identification,
- Methylene chloride was detected in equipment rinse samples and was occasionally reported in laboratory blanks, and
- Methylene chloride is a known laboratory contaminant.

Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate was detected in one borehole above the detection limit in both the Phase I RFI/RI and historical data sets. The result of 5,300 $\mu\text{g}/\text{kg}$ was reported for a sample collected from 41.6 to 47.6 feet in borehole 44193 located in the southern portion of the bone yard (Phase I RFI/RI data set), and the result of 830 $\mu\text{g}/\text{kg}$ was reported for a sample collected from 2 to 3.5 feet in borehole SP0387 located on the southwestern berm of SEP 207-A (historical data set). As a result of the limited number of detections, a map was not prepared showing the distribution of this compound.

The detection of bis(2-ethylhexyl)phthalate in samples may be the result of secondary contamination. This is suggested by the following:

- Relatively low number of sample detections,
- Ubiquitous occurrence and absence of concentration gradients,
- Sporadic nature of the distribution of samples with positive contaminant identification, and
- Fact that this compound is a known secondary contaminant.

Toluene

Toluene was detected at concentrations above the detection limit at various depths in 48 Phase I RFI/RI boreholes. The concentrations of toluene ranged from 7 to 1,200 $\mu\text{g}/\text{kg}$ in the Phase I RFI/RI data set, with the maximum result from borehole 40793, located northwest of SEP 207-A. The only other reported result of this magnitude in the Phase I RFI/RI data set was 1,100 $\mu\text{g}/\text{kg}$, which was collected from borehole 40893, located north of SEP 207-B North. With the exception of two sample results, 780 $\mu\text{g}/\text{kg}$ detected in core from 44393, and 670 $\mu\text{g}/\text{kg}$ detected in core from borehole 44793, all other Phase I RFI/RI data for toluene were below 450 $\mu\text{g}/\text{kg}$. In the historical data set, only one detection, 6 $\mu\text{g}/\text{kg}$, was above the required reporting limit. The remaining results were all flagged with a "J" (estimated value).

Analysis of the vertical and horizontal distribution of toluene in the subsurface did not reveal definitive patterns, since there were numerous samples that yielded concentrations above

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the detection limit in the buffer zone north of the SEPs, as well as near the SEPs. However, the highest incidence of toluene contamination were often located near the seep areas north of the SEPs. Detections of toluene in the seep areas might be related to the low levels of toluene detected in ground water by other previous investigations.

The distribution of toluene is displayed on Figure II 4 5-9. This figure schematically shows that the distribution of toluene is widespread, that the elevated concentrations are not restricted to vadose zone soils beneath the SEPs, and that concentrations do not generally increase with depth.

Toluene detections in samples may not be solely sourced from to SEP wastes. It may have resulted from historical releases of toluene-contaminated SEP fluids or may be the result of laboratory-introduced contamination. This conclusion is based on:

- Ubiquitous occurrence and concentration gradients outside of the SEPs (north of the SEPs in the seep areas inside the PA),
- Sporadic nature of the distribution of samples with positive contaminant identification (i.e., south of the SEPs at borehole 44393, and northeast of the SEPs in the buffer zone at borehole 44793), and
- Fact that this compound is a known laboratory contaminant.

II.4.5.3 Radionuclides

Radionuclides were found in subsurface samples collected during the Phase I RFI/RI. The radionuclide PCOCs are americium-241, plutonium-239/240, uranium-233/234, uranium-235, uranium-238, gross beta ionizing radiation sources, radium-226, strontium-89/90, cesium-134, cesium-137, and tritium. These radionuclides were detected above the background 95% UCL in OU4 subsurface samples and are present in statistically significant quantities.

The detected radionuclides are by-products of nuclear weapons manufacturing, their decay products, and naturally occurring isotopes. The tables in Appendix II Z present the subsurface sample results of radionuclide analytes that were above the background 95% UCL.

Americium-241

Excluding the subgrade samples from beneath the asphalt liners, americium-241 was detected at various depths at concentrations above the background level of 0.01 pCi/g in 27 Phase I RFI/RI boreholes and 32 historical boreholes, primarily from locations around the SEPs. Americium concentrations ranged from 0.0101 to 6.10 pCi/g in the Phase I RFI/RI data set, with only 10 samples having values greater than 1 pCi/g. The greatest result from deeper than 0.5 feet below the surface was from borehole 43793 (between SEP 207A and SEP 207B Center) at a depth of 0.5 to 6 feet (6.1 pCi/g). The subsurface americium concentrations were significantly lower than those observed in samples from the surficial soils. All the sample results in the historical data set were less than 1 pCi/g. As previously displayed (Figure II 3 1-51), 10 subgrade samples had americium-241 values ranging from 0.0652 to 44.68 pCi/g with six

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samples having values reported greater than 1 pCi/g. The maximum concentration for these subgrade samples was reported from 46693 in a sample collected immediately below the SEP liner from 0.33 to 0.5 feet. This borehole is located in the north-central portion of SEP 207B North.

The americium-241 levels measured in borehole core samples indicated a trend of decreasing activity concentration as a function of depth. Americium-241 was not detected at levels above background values in the deep borehole bedrock samples collected. The distribution of americium-241 is displayed on Figure II 4-5-10. This figure schematically shows that americium concentrations are restricted to areas under and adjacent to the SEPs, and that concentrations generally decrease with depth. Americium concentrations are greatest immediately beneath the SEPs, particularly 207-B North.

Plutonium-239/240

Excluding the subgrade samples from beneath the asphalt liners, plutonium-239/240 was detected at concentrations above the background 95% UCL of 0.02 pCi/g in 27 Phase I RFI/RI boreholes and 32 historical boreholes at various depths, primarily from locations around the SEPs. Plutonium-239/240 concentration ranged from 0.0214 to 25 pCi/g. The highest concentration from these samples was reported in borehole 43593 drill core (25 pCi/g) near Building 779 at a depth of 1 to 6 feet. Only 12 of 110 samples taken from below 1 foot exceeded 1 pCi/g. From the historical data set, the maximum value was reported as 2.5 pCi/g with five samples greater than 1 pCi/g. These five historical samples were located both proximal to the surface and to the SEPs. As previously displayed (Figure II 3-1-55), nine subgrade soil samples had plutonium-239/240 values ranging from 0.1876 to 19.78 pCi/g, with six samples having results greater than 1 pCi/g. The highest subgrade soil sample result (19.78 pCi/g) was collected from borehole 46593 (0.58 to 0.67 feet) located in the west-central portion of SEP 207-B North. Other elevated levels of this magnitude were reported in samples taken from other boreholes within SEP 207-B North and 207-A.

The plutonium-239/240 concentrations detected in subsurface samples immediately beneath the SEP liners rapidly decreased to non-detectable levels as a function of depth. Plutonium-239/240 contamination was not detected above the background 95% UCL in any of the deeper bedrock samples.

Elevated levels of plutonium-239/240 were found to be confined near the ground surface in the vicinity of the SEPs or immediately beneath the SEP liners. This finding was supported by the low levels of contamination observed in the vadose zone soils and the decreasing concentrations observed in the boreholes located within the SEPs. The elevated concentrations detected at borehole 41593, 46593, and 46793, located in the northwestern corner of SEP 207-A and northeastern sections of SEP 207-B North, respectively, were considered to be indicative of a possible breach in the liner.

The distribution of plutonium-239/240 is displayed on Figure II 4-5-11. This figure schematically shows plutonium concentrations are restricted to areas under and adjacent to the

SEPs, and that concentration levels generally decrease with depth. Plutonium concentrations are greatest immediately beneath the SEPs, particularly 207-B North.

Uranium-233/234

Excluding the subgrade samples from beneath the asphalt liners, uranium-233/234 (U233/234) was detected at concentrations above the background 95% UCL of 0.53 pCi/g, in 44 Phase I RFI/RI boreholes and 39 historical boreholes at various depths. The U233/234 concentrations ranged from 0.58 to 63.4 pCi/g in the Phase I RFI/RI data set and from 0.54 to 7.10 pCi/g in the historical data set. The maximum concentration was reported from borehole 42193 below the SEP 207-A liner from 0 to 2 feet. Borehole 40993 (located north of SEP 207-C) samples also exhibited elevated levels of U233/234 (2.7 pCi/g). The most elevated value of U233/234 (7.1 pCi/g) in the historical data set was detected in borehole P210189, located immediately south of SEP 207-C. The maximum concentration was reported from borehole 46693 immediately below the SEP 207-B North liner from 0.33 to 0.5 feet. As previously displayed (Figure II 3 1-59), nine subgrade soil samples had U233/234 reported values ranging from 1.95 to 63.4 pCi/g. The maximum concentration (63.4 pCi/g) was reported from borehole 46693 below the SEP 207-B North liner from 0.33 to 0.5 feet. Other samples collected from immediately below the SEP liners (207-A, and 207-B North and Center) consistently displayed results of this magnitude.

The vertical concentration distribution of the U233/234 indicated that the concentrations generally decrease as a function of depth below the SEPs. The subsurface results indicate that the majority of the elevated concentrations of U233/234 were located beneath the SEPs. The distribution of U233/234 is displayed on Figure II 4 5-12. This figure schematically shows that elevated U233/234 concentrations are restricted to areas under and adjacent to the SEPs, that concentration levels generally decrease with depth, and that lower concentrations are also found north and downgradient of the SEPs. Elevated U233/234 concentrations were also detected at 20 to 31 feet in borehole 40993 (1.9 pCi/g) and in ground water north of SEP 207-C, suggesting that this SEP liner may have been breached at some point in time or contamination migrated from upgradient sources.

Uranium-235

Excluding the subgrade samples from beneath the asphalt liners, uranium-235 (U235) was detected at concentrations above the background 95% UCL of 0.1 pCi/g, in 16 Phase I RFI/RI boreholes and seven historical boreholes at various depths, from locations within and around the SEPs. The U235 concentrations ranged from 0.110 to 0.87 pCi/g in the Phase I RFI/RI data set and 0.11 to 0.30 in the historical data set. The greatest result from subsurface soils deeper than 0.5 feet below the surface in the Phase I RFI/RI data set (0.87 pCi/g) was from borehole 42193 in the northern portion of SEP 207-A at a depth of 0.5 to 2 feet. The most elevated value of U235 (0.30 pCi/g) in the historical data set was detected in borehole P210189, located on the southern berm of SEP 207-C. As previously displayed (Figure II 3 1-60), seven subgrade soil samples had reported values ranging from 0.165 to 1.689 pCi/g. The maximum concentration (1.689 pCi/g) was reported from borehole 46693 immediately below the SEP 207-B North liner from 0.33 to 0.5 feet.

The vertical concentration distribution of U235 indicated that the concentrations generally decrease as a function of depth below the SEPs. The vadose zone soil results indicated that the majority of the elevated concentrations of U235 (27 out of 33 total detections) were located beneath the SEPs. The distribution of U235 is displayed on Figure II 4 5-13. This figure schematically shows that elevated U235 concentrations are restricted to areas under and adjacent to the SEPs, and that concentration levels generally decrease with depth.

Uranium-238

Excluding the subgrade samples from beneath the asphalt liners, uranium-238 (U238) was detected at concentrations above the background 95% UCL of 0.63 pCi/g, in 44 Phase I RFI/RI boreholes and 42 historical boreholes at various depths. The U238 concentrations ranged from 0.68 to 11.46 pCi/g in the Phase I RFI/RI data set and from 0.66 to 3.9 pCi/g in the historical data set. The greatest result from vadose soils deeper than 0.5 feet below the surface was from borehole 42193 in the northern portion of SEP 207-A at a depth of 0.5 to 2 feet (11.87 pCi/g). The most elevated value of U238 (3.9 pCi/g) in the historical data set was detected in borehole 5687, located in the industrial area west of OU4 near Building 779. As previously displayed (Figure II 3 1-61), nine subgrade soil samples had U238 values ranging from 1.42 to 25.47 pCi/g. The maximum concentration (25.47 pCi/g) was reported from borehole 46693 immediately below the SEP 207-B North liner from 0.33 to 0.5 feet.

All elevated U238 sample results, greater than 2 pCi/g, are from vadose zone areas proximal to the SEPs. U238 was detected in vadose zone soil samples from boreholes 40293 (1.8 pCi/g) and 40393 (1.9 pCi/g) located in the buffer zone.

The vertical concentration distribution of the U238 indicated that the concentrations generally decrease as a function of depth below the SEPs. The distribution of U238 is displayed on Figure II 4 5-14. This figure schematically shows that elevated U238 concentrations are restricted to areas under and adjacent to the SEPs, concentration levels generally decrease with depth, and that lower level concentrations are also found north and downgradient of the SEPs.

Gross Beta

Excluding the subgrade samples from beneath the asphalt liners, gross beta ionizing radiation was detected at concentrations above the background 95% UCL of 27.99 pCi/g in 31 Phase I RFI/RI boreholes and 26 historical boreholes at various depths. The gross beta concentrations ranged from 28 to 55 pCi/g in the Phase I RFI/RI data set and 28 to 120 pCi/g in the historical data set. The maximum concentration was reported from borehole 42393 located on the western berm of SEP 207-C at a depth of 6 to 8.1 feet. The most elevated gross beta value in the historical data set was 120 pCi/g, detected in borehole P210189, located immediately south of SEP 207-C. As previously displayed (Figure II 3 1-54), subgrade soil samples from the SEPs had values ranging between 23.5 and 51.5 pCi/g. The maximum concentration was reported from below the liner in borehole/location 42593 in the east-central portion of SEP 207A.

The vertical concentration distribution of the gross beta indicated that the concentrations generally decrease as a function of depth. The analytical subsurface results indicated that the majority of the elevated gross beta concentrations were not necessarily located beneath the SEPs, but are found adjacent to the SEPs beneath the berms, in the industrial area west of OU4 (borehole 43593), and east of OU4 in the bone yard (borehole 43293). The gross beta analytical results distribution is displayed on Figure II 4 5-15. This figure schematically shows that elevated gross beta concentrations are not restricted to areas under or immediately adjacent to the SEPs, and that concentration levels do generally decrease with depth.

Radium-226

Excluding the subgrade samples from beneath the asphalt liners, radium-226 was detected at concentrations above the background 95% UCL of 0.65 pCi/g, in 23 Phase I RFI/RI boreholes and 23 historical boreholes at various depths. The radium-226 concentrations ranged from 0.66 to 6.83 pCi/g in the Phase I RFI/RI data set and 0.67 to 1.7 pCi/g in the historical data set. The greatest result from vadose zone soils deeper than 0.5 feet below the surface was from borehole 46993 in the northwestern portion of SEP 207-B Center at a depth of 5.5 to 7 feet (6.83 pCi/g). The most elevated value of radium-226 (1.7 pCi/g) in the historical data set was detected in boreholes P209889 located north of the SEP drainage tile outfall in the seep area, and in borehole P219189 located in the industrial area west of OU4 northwest of Building 774. As previously displayed (Figure II 3 1-56), subgrade soil samples from the SEPs had values ranging between 1.1 and 10.67 pCi/g. The maximum concentration was reported from borehole 46693 immediately below the SEP 207-B North liner from 0.33 to 0.5 feet.

The vertical concentration distribution of the radium-226 indicated that the concentrations generally do not decrease as a function of depth below the SEPs, as was noted for other radioisotopes. The subsurface results indicated that the majority of the elevated concentrations of radium (15 out of 24 total detections) were located beneath the SEPs. Further, only one Phase I RFI/RI detection was not located adjacent to SEPs (44793). The distribution of radium is displayed on Figure II 4 5-16. This figure schematically shows that elevated radium concentrations are restricted to areas under and adjacent to the SEPs, however, no concentration gradient (neither increasing nor decreasing) was observed.

Strontium-89/90

Excluding the subgrade samples from beneath the asphalt liners, strontium-89/90 was detected at concentrations above the background 95% UCL of 0.54 pCi/g, in nine Phase I RFI/RI boreholes and six historical boreholes at various depths, from locations within and around the SEPs. The strontium concentrations ranged from 0.55 to 0.88 pCi/g in the Phase I RFI/RI data set and from 0.60 to 1.10 in the historical data set. The greatest result from subsurface samples deeper than 0.6 feet below the surface was from borehole 43193 located on the eastern berm of SEP 207-B Center at a depth of 6 to 11 feet (0.88 pCi/g). The most elevated value of strontium (1.1 pCi/g) in the historical data set was detected in boreholes 3987 and SP1087, located northeast of SEPs 207-B and north of the northwestern corner of SEP 207-A, respectively. As previously displayed (Figure II 3 1-57), subgrade soil samples from beneath the SEPs had reported values ranging between 0.557 and 1.094 pCi/g. The maximum

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concentration (1 094 pCi/g) was reported from borehole 46893 immediately below the SEP 207-B Center liner from 0 4 to 0 6 feet Twelve other samples taken from immediately beneath the SEPs liners had results of this magnitude

The vertical distribution of strontium indicated that the concentrations generally decrease as a function of depth below the SEPs The subsurface results indicated that the majority of the elevated concentrations of strontium (10 out of 12 total detections) were located beneath the SEPs, the remaining detections occurred adjacent to the SEPs The distribution of strontium is displayed on Figure II 4 5-17 This figure schematically shows that elevated strontium concentrations are restricted to areas under and adjacent to the SEPs

Cesium-134 and Cesium-137

Cesium-134 was not detected above the detection limit in Phase I RFI/RI data, the historical data, or the subgrade samples Cesium-137 was detected above the detection limit twice in the Phase I RFI/RI data set, four times in the historical data set, and five times in the subgrade soils samples No maps showing the distribution of either cesium isotope were prepared of the Phase I RFI/RI or historical data set due to the limited number of detections Distribution of Cesium-134 and Cesium-137 of the subgrade soil samples were previously presented in Figures II 3 1-53 and 53, respectively A brief summary of the occurrences of cesium-137 is presented below

Cesium-137 was detected above the background 95% UCL of 0 166 pCi/g in boreholes 41793 (0 42 pCi/g) and 43793 (0 40 pCi/g) at depths of 0 to 5 and 0 to 6 feet, respectively Borehole 41793 is located on the eastern berm of SEP 207-B North, and borehole 43793 is located on the eastern berm of SEP 207-A Cesium-137 was detected in the historical boreholes P218389 at 0 to 2 9 feet (0 5 pCi/g) and at 2 9 to 10 5 feet (0 3 pCi/g), and in borehole P219489 at 0 to 3 feet (0 22 pCi/g) and P210289 at 0 to 3 feet (0 3 pCi/g) Borehole P218389 is located in the eastern portion of the bone yard, borehole P219489 is located southern portion of the bone yard, and borehole P210289 is located on the northeastern berm of SEP 207-B South

Tritium

Tritium was reported above the background 95% UCL of 212 2 pCi/L in 33 Phase I RFI/RI boreholes and six historical boreholes at various depths The tritium concentrations ranged from 277 to 62,000 pCi/L in the Phase I RFI/RI data set and from 220 to 7,430 pCi/L in the historical data set The maximum concentration was reported from borehole 43393 located in the southwestern quarter of SEP 207-A, at a depth of 4 to 7 6 feet All the Phase I RFI/RI tritium sample results of this magnitude (tens of thousands) were from samples collected beneath the SEPs Tritium sample results of a lesser magnitude (thousands and hundreds of pCi/L) were reported from widespread areas within OU4, including areas north of the SEPs and outside of the PA The most elevated tritium sample result (7,430 pCi/L) in the historical data set was detected in borehole P218389, located in the eastern portion of the bone yard As previously displayed (Figure II 3 1-58) show the distribution of the subgrade soil samples that range in reported concentrations from 2,044 to 50,300 pCi/L

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The vertical distribution of tritium indicated that concentrations generally decrease as a function of depth below the SEPs. The subsurface analytical results indicate that the majority of the elevated concentrations of tritium (63 out of 101 total detections) were located beneath the SEPs, and that the remaining detections occurred adjacent to or north and downgradient of the SEPs. The stratigraphic distribution of tritium is displayed on Figure II 4 5-18. This figure schematically shows that elevated tritium concentrations are restricted to areas under and adjacent to the SEPs.

II.4.5.4 Nitrate/Nitrite and Cyanide

Of the large number of inorganic chemicals analyzed for during the Phase I RFI/RI, only nitrate/nitrite and cyanide were detected at statistically significant concentrations in the subsurface and are considered to be PCOCs. The tables in Appendix II Z list the samples that contained these analytes above the background 95% UCL limit.

Nitrate and Nitrite

Nitrate and nitrite concentrations were detected in subsurface samples above the background 95% UCL of 7.1 mg/kg in 34 Phase I RFI/RI boreholes at various depths. Nitrate/nitrite concentrations ranged from 7.13 to 6,100 mg/kg in the Phase I RFI/RI data set. The maximum concentration was reported from borehole 42193, located in the northwestern portion of SEP 207-A at a depth of 0.5 to 4 feet. Other samples collected from beneath the SEP liners (at SEPs 207-A, 207-B North and Center) consistently displayed results of this magnitude. The only exception was borehole 40993, located north of SEP 207-C, where samples of this magnitude were also collected. Samples collected from areas north of the SEPs (both inside and outside of the PA) and east of the SEPs (in the bone yard) had nitrate/nitrite results in the tens or hundreds of mg/kg. Elevated nitrate/nitrite levels of 387 mg/kg (borehole/location 40593) and 142 mg/kg (borehole/location 40193) were reported from deeper bedrock material in the buffer zone. The samples from the buffer zone were taken from the same locations as those where elevated tritium levels were observed.

The vertical concentration distribution of the nitrate/nitrite indicated that the concentrations generally decrease as a function of depth below the SEPs, and drop off considerably at a depth correlative with the saturated zone. The vadose zone soil results indicated that the majority of the elevated concentrations of nitrate/nitrite are located beneath the SEPs. The distribution of nitrate/nitrite is displayed on Figure II 4 5-19. This figure schematically shows that elevated nitrate/nitrite concentrations are restricted to areas under and adjacent to the SEPs, and that concentration levels generally decrease with depth.

Cyanide

Cyanide contamination above the detection limit was reported in 15 Phase I RFI/RI boreholes at various depths. The highest concentrations were located beneath the northern half of SEP 207-A (boreholes 42193, 43 $\mu\text{g/g}$, and 41593, 16.2 $\mu\text{g/g}$) and the center of SEP 207-B North (borehole 46793, 30.7 $\mu\text{g/g}$). Concentrations of 4.26 $\mu\text{g/g}$ (borehole 40593) and 2.68 $\mu\text{g/g}$ (borehole 40193) were detected in bedrock in the buffer zone. The extent of cyanide in

the subsurface is shown on Figure II 4 5-20 The most extensive occurrence of cyanide is found at depths between 0 and 6 feet below ground level (bgl) in the areas beneath SEPs 207-A and 207-B North Cyanide occurs at deeper depths in the northeast corner of SEP 207-B North (between 6 and 12 feet bgl) and at two borehole locations (at depths greater than 12 feet bgl) situated along the northern boundary of OU4

II.4.6 Summary of the Nature and Extent of Contamination

This section provides a synopsis of the previously presented surficial and vadose zone soil analytical data

II.4.6.1 Surficial Soil Contamination Summary

The distribution of the metal PCOCs (beryllium, cadmium, calcium, mercury, silver, and sodium) in surficial soils indicates that the SEPs are likely to have been sources for these metals Surficial metal contamination may have been the result of aerosol dispersion of contaminated SEP liquids or overtopping of the SEPs The drainage tile between SEP 207-A and the 207-B SEPs appears to have discharged contaminants to the hillside north of the SEPs

The analyses of surficial soil samples consistently indicated that the most elevated concentrations of metal contaminants occurred on or adjacent to the SEP berms This is suspected to be the result of aerosol dispersion of SEP liquids, particularly from SEP 207-A, and subsequent accumulations of metals on surfaces in contact with SEP liquids The drainage tile located between SEP 207-A and the 207-B SEPs provides a conduit for the discharge of metals, either in solution or as suspended particulates, to the hillside north of the SEPs The occasional incidence of elevated metals in the seep areas north of the SEPs were attributed most likely to the local accumulation of metals transported in ground water that discharges to the ground surface

Elevated metal concentrations in surficial soils also occurred sporadically in outlying OU4 areas, particularly in the bone yard east of the SEPs and north of the SEPs on the OU4 hillside The bone yard area has been used extensively for the storage of discarded or used material and equipment at various times These contaminants may have been transported and deposited by wind dispersion

The sporadic distribution of SVOCs in surficial soils and their absence in vadose zone soils suggests that these contaminants are not related to waste management practices at the SEPs The SEPs have been lined and re-lined on several occasions with asphaltic material, and the staging of asphaltic construction materials or operation of a "hot-mix" batch plant may have contributed to the isolated sources of polycyclic aromatic hydrocarbon contamination

Additionally, isolated point sources, such as leakage of hydrocarbon compounds from vehicles, were likely contributors or sources for polycyclic aromatic hydrocarbons in surficial soils The presence of polycyclic aromatic hydrocarbons in surficial soils in and adjacent to the seeps north of the SEPs suggests contamination origination from fluids passing through the asphalt liners of the SEPs These fluids subsequently drained through the thin alluvial cover

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under the SEPs and continued north along the alluvial-claystone bedrock contact before resurfacing at the seeps

The distribution of the radionuclides in surficial soils indicates that surficial contamination on the SEP berms and nearby may have resulted primarily from aerosol dispersion of SEP liquids or SEP overtopping

Nitrate and nitrite has also been released from the SEPs. Although considered a highly mobile ionic species, nitrate is concentrated in the surficial soils proximal to the SEPs. The PCB aroclor-1254 does not display a distribution pattern consistent with contaminant migration from the SEPs

II.4.6.2 Subsurface Contamination Summary

The extent of the metal PCOCs in the subsurface was more limited than in the surficial soils, however, the general distribution is similar. Metal contaminants detected in the subsurface occurred predominantly in the immediate vicinity of and beneath the SEPs. With the exception of barium and zinc, concentrations of metal contaminants generally decreased with depth. The distribution of metals in the subsurface indicates that metals have entered the vadose zone from SEP liner breaches and were subsequently sorbed onto the soil matrix. Elevated metal concentrations in vadose zone soils also occurred at the outfall of the drainage tile on the hillside north of the SEPs. The source of the liquids drained by the tile is suspected to be the SEPs, particularly SEP 207-A, where liquid releases were partially captured by the drainage tile and discharged to the hillside. Sporadic locations of elevated metals concentrations in vadose zone soils also occur elsewhere in the OU4 area, particularly in the bone yard east of the SEPs. Elevated contaminants in this area are most likely related to past storage activities rather than to SEP waste management practices.

Only the VOCs toluene, acetone, and methylene chloride were detected at significant frequencies. Although toluene was frequently detected, the results of the duplicate sample evaluation (Section II 3 6) indicates that the analyses for toluene were not accurate or precise. The pervasive distribution of toluene in the subsurface at low levels indicates that external factors, such as cross-contamination during sampling or analysis, may have been responsible for the identification of toluene in samples. Acetone and methylene chloride were detected in equipment rinsate and laboratory blanks, which also suggests that these VOCs were introduced during sampling and laboratory activities. The ubiquitous distribution of contamination from bis(2-ethylhexyl)phthalate and other phthalates at low concentrations throughout OU4 and elsewhere at the RFETS also indicates that the source of these compounds may be sampling- or laboratory-introduced contamination.

The distribution of radionuclides beneath the SEPs indicated that concentration levels generally decreased with depth. With the exceptions of uranium-233/235, uranium-238, gross beta radiation sources, and tritium, the presence of radionuclide contaminants is generally restricted to areas beneath the SEPs and the drainage tile outfall area north of SEP 207-A and SEP 207-B North. The exceptions listed are found beneath the SEPs, and north, downgradient of the SEPs at seeps within the PA and further downslope (north) of the PA in the buffer zone.

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Further, the distribution of tritium in the buffer zone indicates that ground water has been a probable migration pathway for mobile analytes released from the SEPs

The distribution of nitrate in the subsurface in OU4 suggests that nitrate has a distribution pattern similar to that of tritium and that concentrations decrease with depth. Cyanide is present beneath SEP 207-A, north of the drainage tile outfall area, and north of SEP 207-C at shallow depths (0 to 6 feet). Cyanide is also found pervasively throughout the vadose zone beneath the northeastern portion of SEP 207-B North, and at depth (greater than 12 feet) northeast of the SEPs in the buffer zone.

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TABLE II.4.3-1

**SURFICIAL SOIL POTENTIAL CONTAMINANTS OF CONCERN
AND CALCULATED BACKGROUND CONCENTRATIONS**

<u>Potential Contaminant of Concern</u>	<u>Calculated Background 95% Upper Confidence Limit</u>
Americium-241 (pCi/g)	0 027
Cesium-134 (pCi/g)	ND
Gross alpha (pCi/g)	22 9
Plutonium-239,240 (pCi/g)	0 062
Tritium (pCi/L)	ND
Uranium-233,234 (pCi/g)	1 22
Uranium-235 (pCi/g)	0 09
Uranium-238 (pCi/g)	1 27
Beryllium (mg/kg)	0 92
Cadmium (mg/kg)	0 64
Calcium (mg/kg)	8282 95
Mercury (mg/kg)	0 03
Nitrate/Nitrite(mg/kg)	1 11
Silicon (mg/kg)	202 7
Silver (mg/kg)	0 58
Sodium (mg/kg)	165 4
Benzo(a)anthracene (ug/kg)	--
Benzo(a)pyrene (ug/kg)	--
Benzo(b)fluoranthene (ug/kg)	--
Benzo(ghi)perylene (ug/kg)	--
Benzo(k)fluoranthene (ug/kg)	--
Bis(2-ethylhexyl)phthalate (ug/kg)	--
Chrysene (ug/kg)	--
D1-n-butyl phthalate (ug/kg)	--
Fluoranthene (ug/kg)	--
Indeno(1,2,3-cd)pyrene (ug/kg)	--
Phenanthrene (ug/kg)	--
Pyrene (ug/kg)	--
Aroclor-1254 (ug/kg)	--

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TABLE II.4.3-2

SUBSURFACE SOIL AND BEDROCK POTENTIAL CONTAMINANTS OF CONCERN
AND CALCULATED BACKGROUND CONCENTRATIONS

<u>Potential Contaminant of Concern</u>	<u>Calculated Background 95% Upper Confidence Limit</u>
Americium-241 (pCi/g)	0 01
Cesium-134 (pCi/g)	ND
Cesium-137 (pCi/g)	0 166
Gross beta (pCi/g)	27 99
Plutonium-239,240 (pCi/g)	0 02
Radium-226 (pCi/g)	0 65
Strontium-89,90 (pCi/g)	0 54
Tritium (pCi/L)	212 2
Uranium-233,234 (pCi/g)	0 53
Uranium-235 (pCi/g)	0 1
Uranium-238 (pCi/g)	0 63
Barium (mg/kg)	93 87
Cadmium (mg/kg)	2 3
Calcium (mg/kg)	7781 79
Lithium (mg/kg)	83 2
Manganese(mg/kg)	190 5
Nitrate/Nitrite (mg/kg)	7 1
Potassium (mg/kg)	1562 86
Sodium (mg/kg)	2720
Sulfide (mg/kg)	43000
Zinc (mg/kg)	23 64
2-butanone (ug/kg)	--
Acetone (ug/kg)	--
Bis(2-ethylhexyl)phthalate (ug/kg)	--
Chloroform (ug/kg)	--
Di-n-butyl phthalate (ug/kg)	--
Methylene chloride (ug/kg)	--
Toluene (ug/kg)	--
Cyanide (mg/kg)	--

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**SOLAR EVAPORATION PONDS
 OU4 IM/IRA EA DECISION DOCUMENT
 PART II
 PHASE I RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION**

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II.5 CONTAMINANT TRANSPORT AND FATE

II.5.1 Introduction

An understanding of the transport and fate of potential contaminants in the surficial and vadose zone soils and pore waters is important in determining the interim remedial action alternatives for OU4. The mobility and persistence of contaminants within the vadose zone are affected by the physical and chemical properties of the contaminant and media, the release mechanism of a contaminant to a potential migration pathway, the migration rate, and the type and rate of contaminant degradation, retardation, or transformation during transport. The complex transport and fate interactions in the vadose zone govern the potential for a contaminant release to ground water at OU4 and define baseline criteria for interim remedial actions.

Although not an objective of the OU4 Phase I RFI/RI Work Plan, the processes that affect contaminant transport and fate at OU4 are discussed in this section. The discussion presented is based on the currently developed conceptual site model of variably-saturated vadose zone flow, the distribution of potential contaminants in the surficial and vadose zone soils, and the probable contaminant release pathways identified at OU4 during the Phase I RFI/RI. Contaminant fate and transport discussions presented in this section may be superseded by data and results developed during the OU4 Phase II RFI/RI.

Physical, hydraulic, and chemical characteristics of the vadose zone were previously discussed in Section II 3 3. The field and laboratory hydraulic parameters determined for the vadose zone also were described in Sections II 3 3 and II 3 5. The distribution and extent of potential vadose zone contaminants at OU4 were discussed in Sections II 3 2, II 3 3, II 3 4, II 4 4, and II 4 5. These descriptions of the media characteristics and contaminant distributions form the basis for the conceptual site model described in Section II 5 3.

II.5.1.1 Contaminant Sources

The primary source of contaminants at OU4 were the process fluids and sludges piped to the original and existing evaporation ponds for storage and treatment. Liquids and sludges have been contained in the original or existing evaporation ponds since approximately 1953, and include the introduction of both treated sanitary wastewaters from the plant and ground water pumped back from the ITS. The remaining liquids and sludges in SEPs 207-C and 207-B South are currently potential contaminant sources. However, the liquids and sludges are currently being removed from these ponds as part of the closure process.

Other sources of contaminants in soils at OU4 include potential leakage from original process waste lines (OPWL), infiltrating surface water, upgradient contaminated ground water, and aerosol (wind) dispersal and deposition. These contaminant sources are part of the upcoming OU4 Phase II RFI/RI and OU9 investigations and are not considered in this evaluation of contaminant transport and fate. However, these contaminant sources may be locally important at OU4.

Waste liquids and sludges placed in the SEPs were contaminated primarily with process metals, radionuclides, nitrates, and major cations and anions. The process metals and radionuclides are minor contaminant constituents in the liquid phase. Nitrate, major cations and anions, and total dissolved solids are the predominant contaminant constituents present in these liquids and sludges. Organic compounds, although present as demonstrated by chemical analyses of the pond sludges and liquids (Weston, 1991), are not a significant component of the waste streams disposed in the evaporation ponds.

The evaporation ponds may be conceptualized as mixing vessels, open to the atmosphere, in which the solids concentration is increased through evaporation of water to form a sludge. The sludges are composed of crystalline wastes, algae, and sediments. The liquids and sludges in the evaporation ponds undergo changes in chemistry through the mixture of cations, anions, and suspended solids. These reactions are complicated by the evaporative process combined with periodic dilution by rainfall and snowmelt, volatilization, photochemical reactions, and microbiological activity. These processes transform both the liquid and solid chemical composition into additional dissolved and complexed chemical constituents that can potentially be released to the vadose zone by leakage and wind dispersal. Leakage of fluids from the SEPs to the vadose zone beneath the ponds appears to have been the predominant release mechanism at OU4.

II.5.1.2 Affected Media

Both OU4 surficial and vadose zone soils have been affected by SEP releases. In addition, surface and ground water, wind, and anthropogenic processes also may have dispersed potential contaminants from the SEPs as well as from the industrial area to OU4. The additional contaminant pathways will be evaluated in the OU4 Phase II RFI/RI. General references to these pathways as possible contaminant transport mechanisms at OU4 are included in the following discussion of contaminant fate and transport, however a detailed discussion of their importance is not included. The Phase II RFI/RI report will provide a detailed discussion of the importance of these additional contaminant transport pathways.

II.5.1.2.1 Surficial Soils

The surficial soils affected include soils adjacent to the SEPs as well as soils located on the hillslope north of the SEPs. These soils were primarily contaminated by surface spills, pond overtopping, deposition of wind-blown aerosols derived from the ponds and particulate matter generated during past fires, residual debris remaining after pond repair and decommissioning, anthropogenic dispersion, and discharge of drain lines and contaminated ground water seepage to the north hillslope.

Contaminants detected in the surficial soils include the process metals, radionuclides, and nitrates. Semivolatile organic compounds occur sporadically in surficial soil samples, but their spatial distribution is irregular and localized. Aroclor-1254 was also detected in surficial soils, but most of those samples were collected outside the OU4 boundary east of the 207-B series SEPs.

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Contaminants present in the affected surficial soils may be transported to and mobilized in the vadose zone via infiltration and percolation of precipitation or leakage and soil-moisture redistribution from the SEPs. Mobilization of surficial soil contaminants may also occur via surface water runoff, as airborne fugitive dust, or through tracking by humans, animals, and vehicles. Transport of these contaminants is controlled by the chemical nature of the contaminants, particulate size and occurrence, wind speed and direction, and rate of infiltration and subsequent percolation through the vadose zone.

II.5.1.2.2 Vadose Zone Soils

The vadose zone is defined in this report as the subsurface interval between the ground surface and the uppermost ground water table. The vadose zone includes geologic materials consisting of the RFA, colluvium, valley fill alluvium, disturbed materials, and artificial fill materials. Bedrock strata of the Arapahoe Formation may also be included in the vadose zone where the water table is below the top of bedrock. Because the ground water table fluctuates seasonally, the thickness of the vadose zone also varies seasonally. The thickness of the vadose zone is least in the spring when the ground water table is at its highest elevation. The greatest thickness of the vadose zone generally is during the late summer and fall when ground water levels are at their lowest elevation. The vadose zone thickness determined during this investigation varies from about zero at seep locations on the northern hill slope to about 20 feet north of SEP 207-C and in the area of the ITS.

Contaminants detected in the vadose zone soils are similar to those found in the surficial soils with the exception of semivolatile organic compounds that were not detected in the vadose zone soils. The distribution of the contaminants in the vadose zone generally appears to be concentrated beneath the SEPs or in adjacent soils.

Release of contaminants to the vadose zone soils appears to have occurred primarily by leakage from the SEPs to the subsurface. The irregular distribution pattern of contaminants in the vadose zone soils suggests that migration occurred primarily from percolation and migration in areas of pond liner breaches, overtopping areas, and possibly subsurface pipeline releases. Release rates were probably highest to the vadose zone soils while the ponds were in operation because the liquid level in the SEPs provided a significant driving force (head) for leakage.

II.5.1.3 Potential Migration Pathways and Transport Processes

Surficial and vadose zone soils are the primary hosts for contaminants and the principal pathways for contaminant migration in the vadose zone at OU4. Contaminants present in surficial and vadose zone soils have the potential to be mobilized by percolation, leaching, and soil-moisture redistribution from these soils, through the vadose zone, and to be released to the shallow water table present as the Upper HSU beneath the site. The contaminants are subject to a variety of potential sorption/desorption and leaching processes involving infiltrating water from the surface. Contaminants with high aqueous solubilities are most susceptible to leaching, while contaminants with an affinity for sorptive solid phases are generally retarded in the vadose

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zone and exhibit low mobility. In areas where the vadose zone soils are thick or where alluvium ground water does not occur, the vadose zone soils may act as a natural barrier to migration. Other less important transport mechanisms at OU4 include surface water erosion, dissolution, runoff, wind erosion and transport of aerosols and fugitive dust, and anthropogenic transport. These transport processes were not investigated during the Phase I RFI/RI and are not discussed further in this section.

II.5.2 Contaminant Behavior, Mobility, and Fate

The chemical characteristics of the contaminants, the physical and chemical properties of the site soils, and the vadose zone flow system control contaminant behavior, mobility and fate. A discussion of the environmental characteristics that influence contaminant mobility is presented in Section II 5 2 1. General characteristics of the principal contaminants at OU4 are described in Section II 5 2 2. Specific chemical properties of radionuclides, nitrates, process metals, and organic compounds that control their behavior, mobility, and fate in subsurface environments are discussed in Sections II 5 2 2 1 through II 5 2 2 4.

II.5.2.1 Environmental Characteristics that Influence Mobility

The mobility of compounds in the subsurface is determined by a complex interaction between the inherent physical and chemical properties of the contaminant and the soil matrix, soil pore water, and gases contained in pore space between soil particles. Soil characteristics affecting constituent transport in the vadose zone can be categorized into physical and chemical components. Physical properties of the soil affecting contaminant mobility include permeability, porosity, degree of saturation, and temperature. Some of the chemical properties affecting mobility include pH, redox potential, ion exchange capacity, clay content, total organic carbon, and concentrations of major and minor ions and gases (Maidment, 1992).

Based on these properties and the physical and chemical characteristics of the contaminant, a variety of processes may occur which affect mobility. Some of these include sorption (adsorption and absorption), desorption, capillary retention, biodegradation, radioactive decay, precipitation, dissolution, complexation, volatilization, acid-base reactions, hydrolysis, and redox reactions. In combination with these processes, movement of compounds through the vadose zone is driven by diffusion in response to molecular concentration gradients, dispersion in response to heterogeneities in the permeability of the soils, and/or advection-type movement with the soil-moisture redistribution in response to hydraulic gradients (Maidment, 1992). In addition, fluctuations in the ground water table also affect physical and chemical conditions in the vadose zone and contaminant transport. These fluctuations are especially apparent on a seasonal basis at RFETS (Rockwell, 1988c).

For the purposes of this discussion, the primary concern is whether the PCOCs will remain in the vadose zone soils or dissolve in pore water and migrate to the shallow water table. Transport to the water table relies on chemical factors that promote constituent solubility, physical properties that influence sorption and capillarity, and flow conditions that allow water

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containing the dissolved constituents to move unimpeded. The following discussion focuses on the chemical conditions influencing solubility rather than establishing the actual rate of movement based on the geologic and hydraulic properties of the vadose zone. The description of the relevant soil characteristics (provided below) influencing mobility in the SEP area is based on information provided in Section II 3 3. Subsequent discussion in Section II 5 2 2 focuses on the interaction of these soils with the general PCOC chemical groups found at OU4, including radionuclides, nitrates, process metals, and organic constituents.

Geologic Characteristics

Vadose zone geologic characteristics in OU4 were determined during RFI/RI site characterization activities, including drilling of boreholes and piezometers and analysis of the lithologic and hydrologic data (Rockwell, 1988c, DOE, 1994). The surficial materials on the pediment where the ponds are constructed is predominantly composed of RFA. The alluvium consists of poorly sorted, unconsolidated clay, silt, sand, and gravel deposits. These deposits are mildly calcareous and weakly cemented in places. On the hill slopes descending to North and South Walnut Creeks, colluvial material exists, consisting predominately of clay with common occurrences of sandy clay and gravel. Much of the soil surrounding the SEPs has been disturbed and is generally described as unconsolidated clay, silt, sand, gravel, and pebbles (Rockwell, 1988c, DOE, 1994). These disturbed areas may have soils with higher permeability than the native soils. The clay that exists in each of these geologic units has the effect of decreasing soil porosity and permeability, thus reducing the hydraulic conductivity of the soils and the rate of contaminant transport.

Hydraulic Characteristics

The native soils present at the surface and in the subsurface of OU4 generally have low saturated permeabilities, ranging between 10^{-5} and 10^{-6} cm/s, because of their poor sorting and clay content. Areas where the native soils have been disturbed by excavation or construction activities may have higher saturated permeabilities because these soils may be less compacted or of different composition and texture. Because of the poorly sorted soils beneath the SEPs, uniform intergranular moisture flow through the vadose zone soils does not readily occur. The primary percolation pathways may be through macropores and disturbed soil areas present in the subsurface (Rockwell, 1988c). These soil characteristics have the effect of channeling water or contaminants vertically and laterally through preferred pathways in the soil, leaving some area unaffected by either the infiltrating water or contaminant release. These preferred pathways may result in localized areas of increased contaminant mobility as well as adjacent soils that are essentially unaffected by the percolating water. The clays present in the soils may limit contaminant mobility through cation exchange or sorption. More conservative contaminants such as nitrate will not be retarded by sorptive processes. Nitrate present in less permeable soils will be readily available for leaching and transport, but may leach at slow rates because of the low saturated permeabilities.

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Chemical Characteristics

Chemical characteristics of the RFA as presented in Section II 3 3 6 indicate that these clayey soils have a moderately high cation exchange capacity (30 meq Na/100 g), average electrical conductivity typical of moderately saline soils, and sparse total organic content (0.01 percent to 1.40 percent). Pore water analysis of pH ranged between 7 and 8.5, with the exception of one isolated pH measurement of 12 near SEP 207-C. This pH range indicates only slightly alkaline soil. These chemical characteristics of the soil have varying impacts on the mobilities of the different PCOC groups. The implications of these soil chemical characteristics will be discussed with each PCOC group below.

II.5.2.2 Contaminant Characteristics

Because of the complex interaction between the factors influencing chemical mobility, it is often difficult to predict the precise environmental fate of a given compound. However, compounds of similar chemical nature can be grouped or classified and their overall fate can be predicted on the basis of one or two predominant characteristics. Table II 5 2-1 lists the PCOCs in addition to relevant physical and chemical properties that influence mobility. The parameters summarized in the table are described as follows:

- Solubility values listed in the table are provided at a specific temperature and pH. Because the solubility of many compounds is pH and temperature dependent, this value does not completely describe the overall mobility. Rather, solubility must be examined in combination with soil matrix characteristics. The table values may be used to judge relative solubilities between compounds.
- The Henry's Law Constant provides a measure of the extent of chemical partitioning between air and water at equilibrium and is directly related to the compound's vapor pressure. The higher the Henry's Law Constant, the more likely a chemical is to partition into the gaseous phase from the water phase. Compounds with values greater than 10^{-3} atm-m³/mol are generally regarded as being volatile.
- K_{oc} is a measure of the partitioning between soil organic carbon and water at equilibrium. Similarly, K_{ow} is the partitioning between octanol (an organic compound used as a surrogate for lipids) and water. The greater the K_{oc} and K_{ow} , the greater the propensity to partition to the soil organic fraction rather than water.
- The half-life provides an overall measure of the persistence or fate of a compound in the soil matrix by evaluating rates of the most important degradation pathway. In soil, the most common processes are biodegradation, radioactive decay, and, for limited compounds, hydrolysis. Hydrolysis only applies to a limited number of chemicals that have a hydrolyzable group such as esters, aliphatics, halogens,

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amides, carbonates, and phosphate esters (Howard et al , 1991) Biodegradation is considered to be rapid if the half-life is between 1 and 7 days, moderately fast between 7 and 28 days, slow between 28 and 180 days, and resistant to biodegradation if greater than 180 days (Howard et al , 1991)

II.5.2.2.1 Radionuclides

Uranium, plutonium, and americium are the three actinides with unstable isotopes (radionuclides) of primary interest at OU4. In addition, tritium, one of the radioactive isotopes of hydrogen, is also of concern. The mobility of these radionuclides in the vadose zone is an important and highly complex aspect of a fate and transport analysis. As for most contaminants, but especially for actinides, their mobility in a porous media with any degree of water saturation must be thought of in terms of a three-phase (minimally) system. These three phases include the stationary solid mineral and organic matter phases of the vadose zone soils, the pore water aqueous phase, and the mobile solid phases in the form of suspended matter (particles and especially colloids) within the aqueous phase. Partitioning of contaminants between these phases is a function of their dissolved (solute) stability in the aqueous phase as controlled by pH, effective redox conditions, stability of contaminant complexes, concentration of complexing ligands, and solute affinity for the other two phases. Transfer of contaminants from the aqueous phase to either solid phase is controlled by the overall chemical environment of the aqueous phase (pH, ionic strength, etc.), the tendency of aqueous solutes to form polymers (which act as suspended solids), adsorption and desorption equilibrium and kinetic processes, the mineralogy and surface characteristics of the stationary or mobile (colloid) solids, and competition for available sorption sites between contaminants and non-contaminants. One additional complexity is the physical stability of the mobile solid (with any associated contaminants) relative to the stationary solid phase which is, in part, a function of flocculation or aggregation of suspended particles. Kim (1991), Dearlove et al (1991), and others discuss the potentially critical importance of mobile solid (colloid)-facilitated transport of actinides and the serious underestimation of the mobility of these contaminants which can result from colloids.

Uranium

Uranium is a multivalent actinide, but in surface and near-surface environments, the predominant aqueous form is U(VI) (uranyl). Similarly, typical secondary uranium solids are U(VI). The specific dissolved form of uranium is strongly dependent on the availability of complexing ligands, especially $\text{CO}_3^{=}$, PO_4^{3-} , and F^- , because formation constants of U(VI) complexes with these ligands are much larger than those of the hydroxide complexes. These complexes are neutral or anionic (Langmuir, 1978) for the pore water conditions expected beneath the SEPs. Limited geochemical equilibrium modeling (SOLMIN88) using a ground water sample from well P208989 as a surrogate for sub-pond pore waters predicted that the vast majority of dissolved uranium is present as a neutral uranyl carbonate (UO_2CO_3^0) complex. The next most abundant complex is $\text{UO}_2(\text{HPO}_4)_2^{2-}$.

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Sorption of uranyl onto amorphous iron(III) oxyhydroxides is known to be a potentially significant factor in uranyl mobility. Hsi and Langmuir (1985) show that for near-neutral pHs of 6 to 7, and 10^{-3} total dissolved carbon (similar to P208989 water) uranyl sorption on surfaces is very effective. However, at higher pH values and total dissolved carbon (TDC) of 10^{-2} to 10^{-3} molar, uranyl sorption on iron (III) oxyhydroxides is far less efficient and almost negligible (Hsi and Langmuir, 1985). It should be noted that lysimeter pore water pHs ranged between 7 and 9 and occasionally higher. Modeling also predicted that rutherfordine ($\text{UO}_2\text{CO}_3(\text{s})$) is near saturation in P208989 ground water. Although it is unlikely that rutherfordine would exist as an independent solid, this suggests the possibility of coprecipitation with calcite and/or the formation of a solid solution on caliche surfaces.

Uranium mobility in the immediate vicinity of the SEPs will be strongly affected by pH and the presence and concentration of old process waste in pore waters because it limits the availability of complexing ligands for uranyl. Original wastes were very acidic and neutralized wastes were very alkaline. The combination of abundant complexing ligands (e.g., CO_3^{2-} , PO_4^{3-}) and low or high pH may serve to severely limit attenuation of uranyl by sorption processes.

Plutonium

Plutonium, like uranium, is a multivalent actinide but, unlike uranium, more than one oxidation state is common in the natural aqueous environment and current understanding of their stability ranges is incomplete. Plutonium may be unique in its ability to coexist in four oxidation states in a single aqueous solution (Cleveland, 1979). Pu(III) and Pu(IV) are regarded together as the reduced forms of plutonium and have been studied as Pu(III,IV) (Hamilton-Taylor et al., 1993, Watters, 1983, and Cleveland, 1979). For natural waters, Pu(III,IV) should predominate in most ground waters or non-oxygenated (reduced) environments. Pu(III,IV) should predominate in moderately acidic natural water environments under all redox conditions. Oxidized forms of plutonium include Pu(V) and Pu(VI). Pu(V) should predominate in most natural oxygenated waters, while Pu(VI) is probably only significant in alkaline oxidized environments. The subsurface environment of OU4 is likely to be very complex with respect to plutonium because all of the above-mentioned environments have existed and/or continue to exist due to the changing chemistry of the pond waters and natural variations in redox conditions in the vadose and saturated zones. Cleveland et al. (1983) acknowledge the great complexity associated with plutonium chemistry in the natural environment and cautioned that tests of plutonium mobility must be site-specific.

Pu(III) in solution exists mainly as Pu(III) and is not very likely to form complexes (Cotton and Wilkenson, 1980). Although probably not relevant under ordinary environmental conditions, Pu(III) may have been the predominant form in the early process waste waters placed in the SEPs because of the extremely low pH and the fact that nitric acid (a major constituent of the waste) has little oxidizing power below 2 molar (Cotton and Wilkenson, 1980). Upon neutralization of the pond waters beginning in 1963, Pu(III) probably became a non-issue and any early pond leakage that may have become trapped in pore waters beneath the ponds was probably similarly neutralized by water-rock interaction.

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Pu(IV) is perhaps the most abundant species of plutonium under the environmental conditions expected at OU4. Pu(IV), which exists as Pu(IV), is strongly hydrolyzed and is the most readily complexed of all the oxidation states of plutonium. It forms complexes in the following order of preference for univalent ligands: $F^- > NO_3^- > Cl^-$, and for divalent ligands: $CO_3^{2-} > oxalate^{2-} > SO_4^{2-}$ (based on trends for the actinides in general, Cotton and Wilkinson, 1980), although little hard data for formation constants exist (Cleveland, 1979). Kim et al (1983) have determined stability constants for Pu(IV) carbonate complexes and demonstrated their existence above pH 8. Pu(IV)- CO_3^{2-} complexes are also suggested by the work of Sanchez et al (1985). Nash and Cleveland (1983) have tabulated stability constants for Pu(III and IV)- SO_4^{2-} complexes. In the pond waters and high nitrate pore and ground waters, Pu(IV)- NO_3^- complexes may exist. The tendency of Pu(IV) to complex also enhances its association with solid phases via sorption and makes it the predominant redox form in sediments and on organic matter. It is also possible that plutonium is sorbed as Pu(V) or Pu(VI) and undergoes reduction to Pu(IV) on the solid surface (Keeney-Kennicutt and Morse, 1985). Sanchez et al (1985) showed that Pu(IV) is strongly and rapidly sorbed to amorphous iron hydroxide (α -FeOOH) above pH 2 and at low alkalinities. Sorption was not affected by ionic strength, so it should not be influenced by simple dilution of SEP waters. At very high alkalinities ($< 1,000$ meq/L) Pu(IV) sorption was virtually nonexistent, again indicating that aqueous Pu(IV)- CO_3^{2-} may exist but only under extreme alkalinity conditions not relevant to OU4. Hamilton-Taylor et al (1993) noted that adsorption/desorption of Pu(III,IV) was highly asymmetric, resulting in desorption Kd values up to 36 times greater than adsorption retardation (Kd) values for low salinities ($< 1,000$ mg/L). This supports the observation that desorption is a slower process than adsorption in the case of reduced plutonium.

A very important aspect of Pu(IV) chemistry is its strong tendency for polymerization under all but the most acidic ($< pH 1$) conditions (Cleveland, 1979). The resulting polymers can range in molecular weight from 4,000 to 10^{10} Daltons and thus are present as colloids over at least part of their size range. Formation of Pu(IV) polymers is irreversible or nearly so and they increase in size and stability with time. The presence of these very stable, suspended polymers of Pu(IV) largely eliminates the relevance of complexation, sorption, and ionic sorption-based predictions of Kd values. Rather, the issues of retardation, attenuation, and source potential of vadose zone soils becomes a matter of physical stability of polymers, polymer colloids, polymers adsorbed on other colloids, and polymers adsorbed on stationary solids (Stumm and Morgan, 1981). Similarly, accurate determination of mobile (aqueous phase and mobile solid phase) plutonium concentrations, especially in ground waters, becomes a function of how rapidly water is removed from the aquifer environment - excessive rates may increase apparent mobile concentrations by removing polymers/colloids from the stationary solid phase (McCarthy and Degueudre, 1993).

Pu(V) and Pu(VI) are considered the oxidized forms of plutonium and exist in pure water as the dioxy cations $Pu(V)O_2^+$, and $Pu(VI)O_2^{2+}$, respectively, with the former dominating in most fresh water and sea water environments. Redox stability of the oxidized forms appears to be, in part, a solid-state reaction in as much as reduction to Pu(IV) is associated with adsorption, although the mechanism is unclear (Keeney-Kennicutt and Morse, 1985). $Pu(VI)O_2^{2+}$ is expected

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to be analogous to $U(VI)O_2^{2+}$ and form carbonate complexes and have similar sorption characteristics, while $Pu(V)O_2^+$ is expected to be less likely to sorb because of its monovalent charge (Cleveland, 1979). However, Sanchez et al (1985) demonstrated effective but slow (relative to $Pu(IV)$) sorption of $Pu(V)$ onto $\alpha FeOOH$ with a sorption edge at pH 4. The applicability of the oxidized plutonium species to OU4 is not clear, but they might be most relevant in the alkaline, oxidized SEP waters present after large-scale neutralization with caustic soda. Assuming either of the oxidized plutonium forms predominated in the post-neutralization pond waters, the removal of plutonium from pond leakage via sorption, and hence its K_d , would be a function of its complexation with available ligands.

Americium

The actinide americium contrasts with uranium and plutonium because of its singular valence state, $Am(III)$, which predominates over the entire range of natural conditions (Triay et al, 1991). This is due to the large redox potential between $Am(III)$ and both lower and higher valence states (Cotton and Wilkenson, 1980). Americium is similar to the lanthanides in many respects and is closely approximated by $Nd(III)$. Hydrolysis and complexation of $Am(III)$ by the carbonate ligand is well documented (Nitsche et al, 1989, Meinrath and Kim, 1991). The cationic complexes $Am(III)$, $AmOH^{2+}$, $Am(OH)_2^+$, and $Am(CO_3)^+$ predominate in differing relative amounts below pH 8.5. Above pH 8.5 the anionic complex $Am(CO_3)_2^-$ is predominant. As previously mentioned, $U(VI)$ is only cationic below pH 5 in the presence of carbonate ligand and $Pu(IV)$ is probably cationic only below pH 6.

The maximum concentration of americium in solution will be controlled by either the solubility of a solid Am -bearing phase or by sorption onto some solid. Furthermore, concentrations controlled by sorption should be lower than those controlled by the least soluble solid. Two americium solids have been identified in the $Am-CO_2-H_2O$ system (analogous to rutherfordine in the $U-CO_2-H_2O$ system), namely $AmOHCO_3(s)$ and $Am_2(CO_3)_3 \cdot 2H_2O(s)$ (Triay et al, 1991), but their minimum solubilities are on the order of 10^{-7} to $10^{-8}M$ or 10^7 to 10^8 pCi/L, while the maximum ^{241}Am activity in OU4 ground waters observed is 0.5 pCi/L and the maximum concentration in the pond waters in 1991 was 5.5 pCi/L. This suggests that these solids are not controlling $Am(III)$ concentrations at OU4. Stammose and Dolo (1990), Triay et al (1991), and others have investigated the sorption of $Am(III)$ onto various geologic materials and found the highest K_d values to occur above pH 6.

Effective sorption of americium does not automatically imply immobility of americium. Kim (1991) reports the strong, quantitative sorption of $Am(III)$ to alumina colloids above pH 5 and the pervasive and reversible sorption onto natural humic colloids in ground water. Additionally, $Am(III)$ is reported to form colloids through polymerization in near neutral solution, but was found to be less stable than $Pu(IV)$ colloids and tended to sorb onto other solid surfaces, including natural colloids. To the extent that any of these colloidal mobile solid phases remain stable in the aqueous phase, the result will be mobility of americium.

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Tritium

Tritium is a radioactive isotope of hydrogen that behaves differently than the metal radionuclides. Except for slight differences in vapor pressure, tritiated water behaves like ordinary water (Jacobs, 1974). A small fraction may associate with hydrogen-containing soil organic compounds or as part of structural hydroxyl groups (Jacobs, 1974, Stewart, 1967). However, for the most part, field studies have confirmed that tritium travels at about the same velocity as soil pore water and ground water (Brown, 1967), and can be expected to be readily transported to ground water.

II.5.2.2.2 Nitrate

Although nitrate is a naturally-occurring anion in soil organic matter and soil moisture, elevated nitrate concentrations are almost always due to anthropogenic activity. In the case of OU4, liquids placed in the SEPs are an obvious source of high nitrate in soils, soil pore water, and shallow ground water. Plutonium processing operations involve large quantities of nitric acid, parts of which ultimately become waste streams placed in the ponds. As the operation and designated use of the ponds changed over the years, so did the concentration of nitrate in effluents discharged to the ponds. Early pond waters contained upwards of 50,000 mg/L $\text{NO}_3\text{-N}$ (nitrate reported as nitrogen - to convert to nitrate as nitrate multiply by 4.42). A comprehensive sampling and analysis of pond waters in 1991 (Weston, 1991) found no more than 2,300 mg/L $\text{NO}_3\text{-N}$.

Inorganic nitrogen occurs in multiple valence states under environmental aqueous conditions and each forms a predominant compound or ion: N(-III) - NH_4^+ (ammonium), $\text{NH}_3(\text{g})$ (ammonia), N(0) - N_2 (nitrogen gas), N(+III) - NO_2^- (nitrite), N(+V) - NO_3^- (nitrate). $\text{N}_2(\text{g})$ is generally ignored in soil/ground water geochemical discussions when significant numbers of nitrogen-fixing plants or anaerobic denitrifying bacteria are absent because the non-biologically-mitigated kinetics of N_2 reduction and oxidation are extremely slow. In virtually all oxidized (surface) natural waters, nitrate is the dominant dissolved form of nitrogen, while ammonium should predominate in even mildly reducing environments. The intermediate oxidation state species, nitrite, is only dominant over a narrow redox range. In addition to the predominant NO_3^- form of nitrogen in waste streams, SEP 207-C contained significant (2,000+ mg/L) NO_2^- in 1991. Unfortunately, all lysimeter pore water samples and the vast majority of ground water samples were analyzed by Method 353.2 which determines $\text{NO}_3^- + \text{NO}_2^-$ ("Nitrate/Nitrite") and no NH_3^+ determinations were made, so little information exists on dissolved nitrogen redox speciation.

Since stable soluble forms of nitrogen exist under all redox conditions and since most nitrate and ammonium salts are highly soluble in water, dissolved nitrogen is very mobile, especially under relatively oxidizing conditions. The anionic NO_3^- and NO_2^- ions are very poorly sorbed to solid substrates, but NH_3^+ is strongly sorbed and retained on soil profiles. Consequently, it is likely that NO_3^- behaves conservatively in the OU4 environment but the overall nitrogen budget is incompletely known due to lack of information on the distribution of

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the least conservative nitrogen species, NH_3^+

II.5.2.2.3 Process Metals

These process metals are metals other than uranium, plutonium and americium, that were used in various operations at RFETS, and which have been components of the SEP waste streams. Table II 5 2-2 lists some of these metals and some relevant fate and transport properties. As a group, these metals are diverse in their chemical properties, and consequently it is difficult to make generalizations about their mobility, speciation, complexation, solubility, and sorption.

The mobility of the metal PCOCs primarily is controlled by the formation of soluble complexes and sorption to geologic material. Most metals will form positively charged hydroxyl complexes, under the anticipated OU4 soil pH and redox potential, which will tend to sorb to geologic materials given the relatively high CEC values. Metal mobility is increased in the presence of chloride, as chloride will form metal complexes that do not successfully compete with smaller, more highly charged cations for sorption sites (Riemsdijk and Hiemstra, 1993). Thus, the moderate salinity of soils in the vicinity of the SEPs may to some extent inhibit metal sorption.

II.5.2.2.4 Organic Compounds

The mobility of organics in the vadose zone is controlled by the type of organic compound (polar or nonpolar), the solubility and volatility of the compound, and the total organic carbon content of the soil matrix. Most organic compounds have high K_d values and preferentially partition onto the soil matrix, particularly onto the soil organic fraction. However, the K_d values for volatile organic compounds are generally low, and partitioning of the volatile organics is minimal. Given the relatively low total organic carbon content of the soils surrounding the SEPs, movement of dissolved VOCs will be relatively unimpeded and driven by their aqueous solubility. Water percolating through the vadose zone will dissolve small amounts of the organic constituents and ultimately transport them to the ground water table.

Organic solubility is not as sensitive to oxidation-reduction potential, pH, or the presence of ionic species as is the solubility of metals. Therefore, the solubilities provided in Table II 5 2-1 are valid for a wide range of environmental conditions. The chemical 1,4-dichlorobenzene will most readily migrate to ground water because of high solubility. With a relatively high Henry's Law constant, a fraction of 1,4-dichlorobenzene will be found in the vapor phase and will also be subject to migration. Bis(2-ethylhexyl)phthalate has a moderate solubility but a high K_d and thus will be relatively immobile. With a relatively fast half-life, it will biodegrade more readily than the other organics.

PCBs and the remaining organic PCOCs (which are all classified as polycyclic aromatic hydrocarbons) are much less soluble and have lower Henry's Law constants. Neither PCBs nor PAHs readily biodegrade. Therefore, a larger mass fraction of these compounds will remain

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in the soils rather than being dissolved in ground water

II.5.2.2.5 Fate of PCOCs

Although the fate of the PCOCs is not part of the Phase I RFI/RI, a discussion of the general factors and fate of PCOCs identified at OU4 is included in this section for completeness. The "fate" of a contaminant generally implies a permanent disposition or an ultimately stable form which is attained by one or more irreversible mechanisms. This general definition of fate may be applicable for many, but not all, anthropogenic organic compounds and some relatively short-lived radionuclides but highly recalcitrant organic compounds, long-lived radionuclides and metals in general must be viewed differently. In the latter cases, fate is governed by time, location, and physicochemical conditions - i.e., "permanent" must be defined in terms of time, the contaminant location within the hydrogeologic system and assumptions must be made about the stability of physicochemical conditions that might interrupt an otherwise "permanent" fate. For the purposes of this discussion, a time frame of about one thousand years is used because any remedial actions must be protective of human health and the environment for that time period. Changes in the physicochemical conditions at OU4 during this time period are more difficult to quantify.

Radionuclides

Radioactive decay is absolutely irreversible but the rate of the process (expressed as half-life) is unique for every radionuclide. To the extent that a radionuclide's half-life is sufficiently short to allow a significant amount of the parent nuclide to decay to some other radioactive or stable nuclide, the fate of the parent radionuclide is easily understood. In the context of the 1,000-year protection guideline mentioned above, only radionuclides whose half-lives are less than or equal to 1,000 years will decrease in abundance by radioactive decay to 50 percent or less of their original mass. Table II 5 2-3 lists radioactive PCOCs and the percent of their original mass remaining after 1,000 years. As a result of this process, Cs¹³⁴, Cs¹³⁷, Sr⁸⁹, Sr⁹⁰, and H³ (tritium) will be essentially totally transformed into other nuclides within 1,000-year protectiveness guideline. The fate of the other radionuclides listed in Table II 5 2-3 is not governed by radioactive decay but is a function of their chemical and physical retention within the subsurface environment during the 1,000-year protection period.

Table II 5 2-4 summarizes the fate of the long-lived radionuclides. Since the fate of these nuclides will likely be determined by physicochemical processes and not radioactive decay, the isotopes of each element are grouped and are expected to behave similarly, and ultimately have the same fate, in the subsurface environment at OU4.

Nitrate

Nitrate is the most widespread PCOC observed in the vadose zone and ground water at OU4. Since most metallic nitrate salts (including those of the calcium, magnesium, sodium and potassium) are readily soluble in water, it is likely that virtually all of the nitrate in the OU4

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vadose and saturated zones is dissolved in the available aqueous phase. It is, however, conceivable that isolated volumes of SEP leakage water could have evaporated in the near-

surface vadose zone, resulting in precipitation of nitrate salts, although nitrate salt precipitates were not observed during Phase I RFI/RI field activities.

Nitrate is typically the most common and most stable form of nitrogen in subsurface aqueous environments. Two natural mechanisms govern the fate of nitrate in subsurface waters and both mechanisms involve indigenous microorganisms, as do most nitrogen reactions at the earth's surface. *Assimilative nitrate reduction* involves the incorporation of nitrogen into microbe proteins and *denitrification* involves respirative energy production by microbes and generation of N_2 gas. The latter mechanism includes production and reaction of intermediate NO_2^- and N_2O . There has been no determination of non-nitrate nitrogen forms in subsurface environments at OU4, nor have there been any microcosm studies, so it is not possible to evaluate whether either of these fate mechanisms are operating. Assuming that the predominant form of subsurface nitrogen is nitrate, and given its anionic character (unlikely candidate for sorption) and the solubility of nitrate salts, it is assumed that nitrate behaves conservatively and ultimately migrates with the available subsurface aqueous phase.

Process Metals

Like the long-lived radionuclides, the fate of the metal PCOCs is a function of the prevailing subsurface physicochemical conditions, especially the chemical character of ground water or soil moisture. Trace concentrations of metals are most commonly controlled by sorption onto soil solids or coprecipitation with solids containing similar but more abundant metals. Table II 5 2-5 lists two metallic PCOCs.

Organic Constituents

Only a limited number of organic constituent PCOCs have been identified at OU4 and most of these compounds occur at relatively low concentrations. Ultimately, the ideal fate of any anthropogenic organic compound is "mineralization" or the transformation of all of the organic carbon to CO_2 , all of the hydrogen to H_2O and all other sub-constituents (e.g., Cl) to inorganic ionic forms (e.g., Cl^-). Partial mineralization may also take place, thus effectively eliminating the parent compound even though some other degradation compound, no matter how similar to the parent, may result. Likelihood of mineralization is strongly dependent on the chemical structure of a specific organic compound, the physicochemical conditions in the subsurface, and time. In general, compounds or parts of compounds with weaker (single) bonds are more easily broken under ambient physicochemical conditions found in the subsurface environment and are more easily mineralized than organic constituents with higher order bonds which are more resistant to mineralization. Groups of structurally-related organic compounds may be thought of as possessing similar fates or at least subject to similar degradation processes. Table II 5 2-6 groups the OU4 PCOCs according to their general structure and potential environmental fates.

II.5.2.3 Summary of the Behavior, Mobility, and Fate Processes

The mobility and ultimate fate of the PCOCs is driven by a combination of complex factors related to the soil matrix and contaminant properties. The important soil characteristics that control contaminant fate are the high clay content and the resulting high cation exchange capacity, low total organic carbon, slightly alkaline pH, soil moisture chemistry, and heterogeneous texture. Except for the low total organic carbon content, most of these characteristics will generally impede contaminant migration.

The metal radionuclides, uranium, plutonium, and americium, vary in mobility depending on the soil pH and redox conditions in the vadose zone. In contrast, tritium is present in soil pore water and may migrate to the shallow ground water.

The two most mobile organics are 1,4-dichlorobenzene and bis(2-ethylhexyl)phthalate which have moderate solubilities. The PCB and PAH compounds will remain in the vadose zone due to their low solubilities. Both nitrate and the soluble organics will tend to move rapidly through the soil column in areas that are consistently infiltrated with water. However, due to a channeling effect that may be present in the subsurface soils due to irregular intergranular spaces and infiltration preferring disturbed areas, pockets of nitrate and soluble organics may be less mobile because of their possible isolation from infiltration.

II.5.3 Conceptual Model of Vadose Zone Flow

A conceptual model of vadose zone flow (Figure II 5 3-1) was developed to provide an understanding of the proposed mechanisms for contaminant transport in the vadose zone and the natural flow limitations imposed by the current hydraulic conditions existing in the vadose zone beneath OU4. This model provides a foundation for formulating decisions concerning closure and remedial actions at the site as part of the OU4 Phase I IM/IRA.

The conceptual site model presented in this section is a representation of the OU4 vadose zone hydraulic system and the physical and chemical processes that affect transport of contaminants in the vadose zone media. The model describes known and suspected sources of contamination, types of contamination, affected media, and contaminant migration pathways. The conceptual site model presented here does not discuss the potential receptors nor evaluates the risk to the environment or human health. Proper development of a conceptual site model is important in determining the necessary interim closure and remediation options, and ultimately the risk posed to any potential receptor.

II.5.3.1 Regional and Local Recharge

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The central Rocky Mountain region, including the Front Range where the RFETS is located, is characterized by mean annual precipitation of 15 inches. Infiltration and percolation of precipitation is one of the primary sources of recharge at RFETS. Approximately 40 percent of this precipitation falls during the spring. Supercell storm events during the summer account for an additional 30 percent of the annual precipitation. Autumn and winter are drier seasons, and account for 19 and 11 percent of the annual precipitation, respectively. Snowfall averages 85 inches per year, occurring primarily between October and May. Other negligible sources of recharge include infiltration of stream flow along drainage that are above the bedrock-alluvium contact, and mountain-front recharge along the foothills. Pan evaporation rates for the RFETS area exceed 60 inches per year. Because of the limited precipitation, a net annual water loss occurs at the site, however, during the winter and spring, evaporation and transpiration rates are less, so recharge may occur.

During operation of the SEPs, recharge to the unconfined ground water system beneath the SEPs resulted primarily from infiltrating precipitation, leakage from the SEPs, and possibly broken OPWL lines. Leakage from the SEPs is currently limited since only SEP 207-C contains liquids that currently are being removed. Leakage from the SEPs, as demonstrated by nitrate contamination beneath the SEPs, was driven primarily by the hydraulic head existing in the ponds during their operation. At present, recharge at OU4 probably only occurs during the winter and spring when sufficient precipitation is available and evapotranspiration is less.

II.5.3.2 Variably-Saturated Vadose Zone Flow System

The primary control of contaminant fate and transport at OU4 is the presence of a variably saturated vadose zone beneath the site. This section describes the conceptual model of variably saturated flow in the vadose zone at OU4. Estimates of infiltration at the site are provided along with a discussion of the processes governing percolation, contaminant flow, and ground water recharge.

Recharge through the vadose zone at OU4 is seasonal and occurs primarily during the late winter through spring when precipitation exceeds bare soil evaporation and plant transpiration. Recharge probably occurs when the frequency and duration of precipitation events, in conjunction with less evapotranspiration, create an increase in the available moisture for infiltration and percolation.

Percolation probably occurs through macropores and through interstitial flow in localized areas of higher hydraulic conductivity soil. This is evidenced by the relatively rapid water table rise (during a precipitation event) that was observed at some of the piezometer locations at OU4. When deep percolation occurs, vadose zone flow is generally vertically downward from ground surface to the unconfined ground water table.

Maximum percolation rates by interstitial flow through the vadose zone soils can be estimated by assuming that the hydraulic conductivity of the soils under unit hydraulic gradient and a given matric potential (or "soil suction") is equivalent to the variably saturated flux. The

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geometric mean of the corrected unsaturated hydraulic conductivity determined during this investigation for the RFA at calculated matric potentials is about 7×10^{-10} cm/day. Therefore, assuming a unit hydraulic gradient, the flux through a unit area of the vadose zone is about 7×10^{-10} cm/day. Assuming that all of this flux reaches the saturated ground water system, an estimate of ground water recharge at OU4 is about 9×10^{-3} inches per year (in/yr). The estimate of infiltration at Beatty, Nevada, where rainfall is less than 5 inches, is about 2×10^{-3} in/yr (Nichols, 1986). Since precipitation at RFETS is about 15 in/yr, the estimated percolation rate for OU4 compares favorably with that for Beatty because precipitation at RFETS is about three times higher and the OU4 percolation estimate is also increased threefold.

This small amount of estimated interstitial percolation cannot account for the water table fluctuations observed at the site, providing further evidence that the predominant percolation mechanism at OU4 is macropore flow. This apparent lack of areal interstitial percolation through the alluvium as a source of ground water recharge may also suggest that the variations in Upper HSU ground water level observed at the site results from direct recharge from the bedrock strata (EG&G, 1993).

During operation of the SEPs, leakage from the ponds was probably the principal source of recharge through the alluvium to the ground water table. This leakage would have resulted in higher percolation flux rates beneath the ponds since the soil moisture contents would have been higher and the unsaturated hydraulic conductivity would approach saturated hydraulic conductivity. Higher moisture contents in these soils increases the unsaturated hydraulic conductivity, resulting in more rapid flow rates. Locally developed ground water mounds may have developed intermittently during pond operation.

Variances in calculated matric potential with depth were noted in the vadose zone, therefore hydraulic gradients are related to both changes in matric potential and elevation head. Observations concerning the soil moisture characteristics of the vadose zone soils indicate that hydraulic conductivity decreases rapidly with less than a 5 percent decrease from saturated moisture content. Consequently, soil-moisture redistribution in the vadose zone is not constant, but varies with the heterogeneous nature of the subsurface soils. The heterogeneous lithology of the vadose zone suggests that significant variations in hydraulic properties occur with depth. Consequently, variably saturated flow through the vadose zone soils is not uniform and may be significantly accelerated or decelerated by layers of varying hydraulic conductivity.

The apparent lack of areal interstitial percolation at OU4 suggests that contaminant transport occurs through localized areas of saturated flow, macropores or other areas of limited higher hydraulic conductivity. This type of flow system provides an irregular contaminant distribution pattern and minimizes the potential for recharge to mobilize contaminants present in the soil pores. Flow through soil macropores will limit contact with contaminants present in the adjacent vadose zone soil pores since macropore flow is localized and diffusive flow away from the macropore walls would be limited in volume.

II.5.3.3 Saturated Flow System

Although the saturated ground water system was not included as part of this investigation, information was obtained during the Phase I RFI/RI that provides some insight into subsurface ground water flow pathways. An understanding of the interaction of the variably saturated flow system present in the vadose zone and the saturated flow system is necessary to properly arrive at closure and remediation decisions proposed in the Phase I IM/IRA.

The saturated ground water zone immediately underlying the vadose zone at OU4 is termed the Upper HSU. This unit is composed of both RFA and associated soils, and weathered bedrock lithologies. Ground water flow within the Upper HSU at OU4 generally is controlled by the local topography. The SEPs are constructed on an east-west trending topographic ridge that is flanked to the north and south by tributaries of Walnut Creek. Ground water flow in the Upper HSU is generally toward North Walnut Creek north of the SEPs and toward South Walnut Creek south of the SEPs. An east-trending component of ground water flow is also present east of the SEPs, with flow occurring down the ridge crest toward the confluence of North and South Walnut Creeks. Ground water elevations range between about 5,965 feet above mean sea level (ft msl) beneath SEP 207-A and 5080 ft msl along North Walnut Creek.

Several important characteristics of the OU4 site hydrogeology control ground water flow and contaminant movement in the saturated zone beneath OU4. Ground water elevation data obtained from both the RFA and the bedrock lithologies indicate that the unconsolidated and weathered bedrock water-bearing strata are hydraulically connected. Vertical hydraulic gradients generally are downward from the alluvium to the bedrock adjacent to and beneath the SEPs, and upward along the reaches of North Walnut Creek. Because of the fluctuating ground water table beneath the site, this hydraulic connection provides a mechanism to desaturate the overlying alluvium. Potentiometric maps presented in Section II 3 3 indicate that the desaturated alluvium areas are smallest during the high water period in the spring and largest during the dry period in the fall and early winter. These desaturated areas appear to result in areas where the water table fluctuation is below the top of bedrock at low water level and in areas where the RFA is directly underlain by a sandstone member of the Arapahoe Formation. The latter mechanism is readily apparent along the northern edge of SEP 207-C where the RFA that is underlain by the Arapahoe Formation sandstone appears to be dry throughout the year.

Paleochannels present on the bedrock paleosurface appear to have controlled the depositional facies of the RFA that control ground water flow in the Upper HSU. Coarser-grained facies of the RFA are present in the paleochannels, providing a more permeable pathway for ground water flow. During periods of low water level, "channelized" flow in the alluvium is more apparent than during high water levels. Former surface water drainage that were buried during construction of the SEPs may also control ground water flow during high water level.

The RFA is composed of as many as four lithofacies. Soils present in each lithofacies have different hydraulic characteristics that are controlled by the relative percentage of coarse particle sizes that comprise the soil. Coarse-grained lithofacies generally have higher

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permeabilities than the finer-grained lithofacies. As mentioned above, these coarse-grained lithofacies appear to be situated in bedrock paleochannels. The combined features of increased hydraulic conductivity and "channelized" flow control the local ground water flow and contaminant transport rate.

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TABLE II.5.2-1

SELECTED PROPERTIES OF PCOCs

CAS Number	Chemical Name	Solubility (mg/l) (1*, 4*)	Vapor Pressure (mm Hg) (1*, 4*)	Henry's Law K (atm-m ³ /mole) (1*, 4*)	Log K _{ow} (1*, 4*)	Log K _{oc} (1*, 4*)	Molecular Weight	Specific Gravity	Half-Life Soil -days (2*)
Organic Compounds									
67-64-1	Acetone	1 00e+06	3e+02	3 97e-05	-0 24	-0 43	58	0 7899	1 - 7
309-00-2	Aldrin	1 75e-02	6e-06	4 96e-04	5 66	2 61	365	1 7	21 - 591 7
57-12-5	Cyanide (and compounds)	7 50e+04	1e+02	6 30e-01	-0 34	1 2	26		
72-54-8	DDD	1 00e+02	1e-06	2 16e-05	6 02	4 64	320	1 476	730 - 5833
72-55-9	DDE	1 20e-01	6e-06	2 34e-05	5 83	6	318	ND	730 - 5833
50-29-3	DDT	4 00e-03	2e-07	1 03e-04	6 44	6 26	355	1 56	730 - 5833
56-55-3	Benzo(a)anthracene	1 40e-02	1e-07	4 30e-06	5 8	6 14	228	1 274	102 - 679
50-32-3	Benzo(a)pyrene	4 00e-03	5e-09	<2 4E-6	6 09	5 6 to 6 29	252	1 351	57 - 1,059
205-99-2	Benzo(b)fluoranthrene	1 20e-03	5e-07	1 20e-05	6 59	5 74	252	NA	360 - 610
117-81-7	bis(2-Ethylhexyl)phthalate	4 00e-01	6e-08	1 10e-05	4 2	5	391	0 985	5 - 23
218-01-9	Chrysene	3 00e-03	6e-09	7 26e-20	5 7	5 39	228	1 274	372 - 993
106-46-7	Dichlorobenzene (1,4-)	9 06e+01	4e-01	4 45e-03	3 62	2 2	147	1 4581	28 - 180
75-34-3	Dichloroethane (1,1-)	5 06e+03	2e+02	1 90e-01	1 79	1 48	99	1 1757	32 - 154
107-06-2	Dichloroethane (1,2-)	8 65e+03	9e+01	1 31e-03	1 48	1 279	99	1 2453	100 - 180
75-35-4	Dichloroethene (1,1-)	6 40e+03	6e+02	1 90e-01	2 13	1 81	97	1 218	28 - 180
156-59-2	Dichloroethene (cis-1,2-)	3 50e+03	2e+02	7 59e-03	0 7	1 69	97		28 - 180
156-60-5	Dichloroethene (trans-1,2-)	6 30e+03	3e+02	6 74e-03	2 09	1 77	97	1 2565	28 - 180
60-57-1	Dieldrin	2 00e-01	2e-07	5 80e-05	5 48	4 55	381	1 75	175 - 1080
88-99-3	Diethylphthalate	1 20e+03	4e-03	8 46e-07	3	1 84	222	1 123	3 - 56
105-67-9	Dimethylphenol (2,4-)	7 87e+03	1e-01	1 70e-05	2 5	2 07	122	0 965	1 - 7
117-84-0	Dioctylphthalate	3 00e+00	1e-04	2 20e-04	9 2	8 99	391	0 978	7 - 28
1031-07-8	Endosulfan sulfate	1 17e-01	ND	2 60e-05	3 66	3 37	423	ND	
7421-93-4	Endrin (aldehyde form)	5 00e+01	2e-07	3 86e-07	5 6	4 43	381	ND	

TABLE II.5.2-1 (continued)

SELECTED PROPERTIES OF PCOCs

CAS Number	Chemical Name	Solubility (mg/l) (1*, 4*)	Vapor Pressure (mm Hg) (1*, 4*)	Henry's Law K (atm-m ³ /mole) (1*, 4*)	Log K _{ow} (1*, 4*)	Log K _{oc} (1*, 4*)	Molecular Weight	Specific Gravity	Half-Life Soil - days (2*)
100-41-4	Ethylbenzene	2 08e+02	7e+00	8 68e-03	3 15	2 41	106	0 8625	3 - 10
76-44-8	Heptachlor	5 60e-02	4e-03	2 30e-03	5 44	4 34	374	1 67	0 96 - 5 39
591-78-6	Hexanone (2-)	3 50e+04	4e+00	1 75e-03	1 38	2 13	100	0 83	
58-89-9	Lindane	Insoluble	negligible	6 95e-08	ND	2 50e+03	NA	0 9 to 1 4	12 3-3,796
206-44-0	Flouranthrene	2 42e-01	5e-06	1 69e-02	5 22	4 62	202	1 252	140 - 440
85-01-8	Phenanthrene	1 25e+00	7e-04	2 56e-05	4 5	4 2	178	0 98	16 - 200
N/A	PAH compounds (2*)	Insoluble	negligible	6 95e-08	ND	2 50e+03	NA	0 9 to 1 4	12 3 - 3796
1336-36-3	PCBs - Aroclors	3 10e-02	8e-05	1 07e-03	6 34	5 72	361	1 38	
100-42-5	Styrene	3 20e+02	5e+00	2 61e-03	3 16	2 87	104	0 909	14 - 28
127-18-4	Tetrachloroethene	4 85e+02	2e+01	1 53e-02	2 88	2 56	166	1 6227	180 - 360
108-88-3	Toluene	6 27e+02	2e+01	6 74e-03	2 8	2 18	92	0 86233	4 - 22
71-55-6	Trichloroethane (1,1,1-)	1 33e+03	1e+02	1 62e-02	2 49	2 18	134	1 339	28 - 180
79-01-6	Trichloroethene	1 47e+03	7e+01	1 17e-02	3 3	2 1	132	1 4642	180 - 360
1330-20-7	Xylene (mixed isomers)	1 98e+02	1e+01	4 20e-03	3 18	2 54	106	0 867	7 - 28
129-00-0	Pyrene	1 47e-01	2e-06	1 48e-05	5 12	4 84	202	1 27	210 - 1898
14797-55-8	Nitrate/Nitrite	9 21e+05	ND	ND	ND	ND	62/46	2 26	ND
Metals									
7429-90-5	Aluminum (and compounds)	NA	NA	NA		2 18	27	2 7	Persistent
7440-36-0	Antimony (and compounds)	NA	1e+00	NA		0	122	6 68	Persistent
7440-38-2	Arsenic (and compounds)	NA	NA	NA		0	75	5 73	Persistent
7440-39-3	Barium (and compounds)	NA	NA	NA	ND	0	137	3 6	Persistent
7440-41-7	Beryllium (and compounds)	NA	NA	NA	6 57	0	9	1 85	Persistent

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TABLE II.5.2-1 (continued)

SELECTED PROPERTIES OF PCOCs

CAS Number	Chemical Name	Solubility (mg/l) (1*, 4*)	Vapor Pressure (mm Hg) (1*, 4*)	Henry's Law K (atm-m ³ /mole) (1*, 4*)	Log K _{ow} (1*, 4*)	Log K _{oc} (1*, 4*)	Molecular Weight	Specific Gravity	Half-Life Soil -days (2*)
7440-43-9	Cadmium (and compounds)	NA	NA	NA	ND	0	112	8.65	Persistent
7440-47-3	Chromium (and compounds)	NA	NA	NA	ND	0	52	7.14	Persistent
7440-48-4	Cobalt (and compounds)	NA	NA	NA	NA	0	59	8.9	Persistent
7440-50-8	Copper (and compounds)	NA	NA	NA	NA	0	64	8.94	Persistent
7439-89-6	Iron (and compounds)	NA	NA	NA	1.69	1.69	56	7.86	Persistent
7439-92-11	Lead (and compounds)	NA	NA	NA	4.01	4.01	207	11.34	Persistent
7439-95-4	Magnesium (and compounds)	NA	NA	NA	0	0	24	1.74	Persistent
7439-96-5	Manganese (and compounds)	NA	NA	NA	0	0	55	7.47	Persistent
7440-09-7	Potassium (and compounds)	NA	NA	NA	0	0	39	0.86	Persistent
7782-49-2	Selenium (and compounds)	4.00e-04	NA	NA	0	0	79	4.28	Persistent
7440-22-4	Silver (and compounds)	NA	NA	NA	0	0	108	10.49	Persistent
7440-23-5	Sodium (and compounds)	4.00e+05	1e+00	NA	0.15	0	23	0.97	Persistent
7439-97-6	Mercury (and compounds)	2.00e+03	2e-03	NA	0.71	1.83	201	13.53	Persistent
7440-02-0	Nickel (and compounds)	NA	NA	NA	ND	0	59	8.9	Persistent
7440-24-6	Strontium-89	ND	10 (*at 898 C)	ND	ND	ND	88	2.6	1.03e+04
7440-28-0	Strontium-90	ND	10 (*at 898 C)	ND	ND	ND	88	2.6	5.20e+01
7440-62-2	Thallium (and compounds)	ND	10 (*at 898 C)	ND	ND	ND	88	2.6	Persistent
7440-62-2	Vanadium (and compounds)	NA	NA	NA	0	0	51	6.11	Persistent
7440-66-6	Zinc (and compounds)	1.00e+01	NA	NA	3.09	3.09	65	7.14	Persistent

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TABLE II.5.2-1 (continued)
SELECTED PROPERTIES OF PCOCs

CAS Number	Chemical Name	Solubility (mg/l) (1*, 4*)	Vapor Pressure (mm Hg) (1*, 4*)	Henry's Law K (atm-m ³ /mole) (1*, 4*)	Log K _{ow} (1*, 4*)	Log K _{oc} (1*, 4*)	Molecular Weight	Specific Gravity	Half-Life Soil -days (2*)
Radionuclides									
14596-10-2	Americium-241	soluble	ND	ND	ND	ND	241	ND	1 58e+05
7440-07-5	Plutonium-239	ND	ND	ND	ND	ND	239	ND	8 81E+06
	Plutonium-240	ND	ND	ND	ND	ND	240	ND	2 4E+06
10028-17-8	Tritium	ND	ND	ND	ND	ND	3	0 07	4 56e+03
7440-61-1	Uranium-238	insoluble	0	ND	ND	ND	238	19 05	1 63e+12
	Uranium-233						233		5 87e+07
	Uranium-234						234		8 94e+07
	Uranium-235						235		2 57e+11

Abbreviations K_{oc} -> organic carbon (soils) partition coefficient, K_{ow} -> octanol/water partition coefficient, ND -> not determined, NA -> Not Applicable

- 1* Information gathered from Superfund Public Health Evaluation Manual -- EPA540/1-86/060 [Supplemental information gathered from the Merck Index, Eleventh Edition, National Institute of Occupational Safety and Health -- Registry of Toxic Effects of Chemical Substances, Fate and Exposure Data, Volume 1-3 (Howard, et al, Lewis Publishers), Estimating Toxicity of Industrial Chemicals to Aquatic Organisms Using SARs, Volume I (USEPA 560/6-88-001), Envirofate Database (Chemical Information System)]
- 2* Information gathered from Handbook of Environmental Degradation Rates (Philip Howard, et al, Lewis Publishers, 1991) -- Rates represented with a single value (i e , 365 days), rather than a range (i e , 10-20 days), indicate rates for the selected medium (or media), and were gathered from the Envirofate database (see footnote 3*)
- 3* Miscellaneous half life and/or degradation rates gathered from Envirofate Database, Chemical Information System (Fein-Marquart Assoc)
- 4* Information gathered from Groundwater Chemicals Desk Reference (Montgomery, John H and Linda M Welkom, 1990) In the case of multiple referenced values, an average was taken If possible, vapor pressure and solubility were taken at 25 degrees C

TABLE II.5.2-2

SUMMARY OF PROCESS METAL CHARACTERISTICS

Metal	Redox States	Speciation/Complexation ($\log_{10} K_{s1}$) (1)	Solubility Controls	
			Precipitation ($\log_{10} K_{sp}$)	Sorption/Coprecipitation
Li	+I	Li ⁺		
Be	+II	Be ²⁺ , BeF ⁺ (?), BeOH ⁺ (?), Be ₃ O ₃ ^{2x2y} (g)		Weakly sorbed, non-linear isotherm, K _d = 0.425 (d)
Sr	+II	Sr ²⁺ , Sr(PO ₄) (5.5), SrEDTA (10.5)	SrCO ₃ (-9.0) SrHPO ₄ (-19.3)	Known to sorb on calcite at high pH (e)
Ba	+II	Ba ²⁺ , BaCO ₃ ^o (2.8), BaEDTA (9.6)	BaSO ₄ (-10.0) BaHPO ₄ (-19.8)	Known to sorb on calcite at high pH (e)
Cr	+III	Cr(OH) ²⁺ (10.0)		Strongly sorbed, sorption very redox dependent (a)
	+VI (easily reduced by Fe(III))	CrO ₄ ²⁻ Cr ₂ O ₇ ²⁻		Strongly sorbed for pH 4-7, CrO ₄ ²⁻ weakly sorbed, sorption very redox dependent (a)
Ni	+II	Ni ²⁺ , Ni-citrate (6.7), NiEDTA (20.4)	NiCO ₃ (-6.9)	Mobility limited by coprecip w Fe(III)Oxides (b) Known to sorb on calcite at high pH (e)
Cd	+II	Cd ²⁺ , Cd(OH) ₂ ^o , CdHCO ₃ ⁺ (c) CdEDTA (18.2)	CdCO ₃ (-13.7)	Mobility in non-sulfide environments is high (b) Known to sorb on calcite at intermediate and high pH (e) (f)
Hg	+II	Hg ²⁺ , Hg(OH) ₂ ^o (b), HgCl ⁺ (7.2), HgEDTA (23.5), CH ₃ Hg (soils, g)		Mobility limited by sorption on organic matter (b)

TABLE II.5.2-2 (continued)

SUMMARY OF PROCESS METAL CHARACTERISTICS

Explanation for Table II 5 2-2

- (1) Complexes cited were chosen on the basis of relevance or potential relevance to the OU4 environment Only detailed equilibrium-based modeling of vadose and saturated zone waters will provide site-specific information on the complexation of metals EDTA complexes are given where available as a representative of complexes with common industrial extraction ligands which are known to have been used at RFETS but not determined in waste streams Most $\log_{10}K_{s-1}$ values are from Morel (1983)
- (a) Davis et al (1993)
(b) Rose et al , (1979)
(c) Long and Angino (1977)
(d) Newman et al (1991)
(e) Zachara et al (1993)
(f) Cowan et al (1991)
(g) Logan and Traana (1993)

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TABLE II.5.2-3**Half-Lives of Radionuclide PCOCs**

PCOC Radionuclide	Half-life	Percent remaining at 1000 years
Am-241	458 yr	22 02
Cs-134	2 yr	≈ 0
Cs-137	30 yr	≈ 0
Pu-239	24300 yr	97 18
Pu-240	6537 yr	89 93
Ra-226	1620 yr	65 18
Sr-89	51 days	≈ 0
Sr-90	28 yr	≈ 0
H-3	12 3 yr	≈ 0
U-233	1 6 X 10 ⁵ yr	99 56
U-234	2 5 X 10 ⁵ yr	99 72
U-235	7 1 X 10 ⁸ yr	99 99
U-238	4 5 X 10 ⁹ yr	99 99

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TABLE II.5.2-4

General Fate of Radionuclide PCOCs

PCOC With Unstable Isotopes	Generalized Fate and Fate-Related Processes
Americium	<p>a) Soluble Am is probably present as a carbonate complex but is cationic below pH 8.5 and anionic at more alkaline pHs. Aqueous-phase Am may also be present as colloids or polymers.</p> <p>b) Sorption of Am is most effective above pH 6 but recommended "typical" K_ds are as low as 100.</p> <p>c) <i>The fate of Am is probably as a sorbed trace constituent on soil particles but the extent of mobility will likely change as ground water chemistry changes with the removal of the ponds.</i></p>
Plutonium	<p>a) Potential soluble forms of Pu are extremely diverse, very complex and their stabilities are strong functions of the overall water composition including pH, Eh and NO_3^-. Aqueous-phase Pu may also be present as colloids or polymers.</p> <p>b) Given the uncertainties connected with soluble forms, effectiveness of sorption is very difficult to predict. Effective sorption is well documented but often to mobile solid particles. K_ds for Pu in RFETS soils range from 43 to 2700.</p> <p>c) <i>The fate of Pu is probably long-term sorption on soil particles but the present pond-influenced ground water chemistry may result in off-site mobilization. With pond removal ground waters will evolve and the disposition of Pu will likely change.</i></p>
Radium	<p>a) Soluble Ra probably exists mainly as Ra^{2+}.</p> <p>b) RaSO_4 is extremely insoluble and effectively controls the concentration of mobile Ra by co-precipitation with other low solubility sulfates. K_ds for Ra are typically high relative to other PCOCs.</p> <p>c) <i>Ra will likely have limited mobility and tend to remain in the vadose zone.</i></p>
Uranium	<p>a) Soluble forms are neutral and anionic complexes of carbonate, phosphate and fluoride depending on relative concentrations.</p> <p>b) Sorption on iron oxides very effective at near neutral pHs but not under alkaline conditions. Co-precipitation with calcite is also a possible solid-phase form. "Typical, conservative" K_ds are low (on the order of 16).</p> <p>c) <i>At present, U probably has high potential for mobility in the vadose zone during ground water rises and eventual off-site mobilization in the saturated zone. If aqueous conditions become more neutral and dilute, long-term sorption and on-site fixation is increasingly likely.</i></p>

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TABLE II.5.2-5

General Fate of Metal PCOCs

PCOC	Generalized Fate and Fate-Related Processes
Barium	a) Soluble form most likely Ba ²⁺ b) BaSO ₄ (barite) is probably the most stable solid form although sorption or cationic exchange may limit solubility in absence of sulfate c) <i>Generally Ba would be expected to have very low mobility and to remain largely fixed in the vadose zone</i>
Cadmium	a) Soluble form of Cd may be as a carbonate complex b) Limited sorption of Cd to calcite is known at intermediate to high pHs Recommended K _d s are low (<10) c) <i>Mobility in non-sulfide environments very high Probably will be mobilized off-site</i>

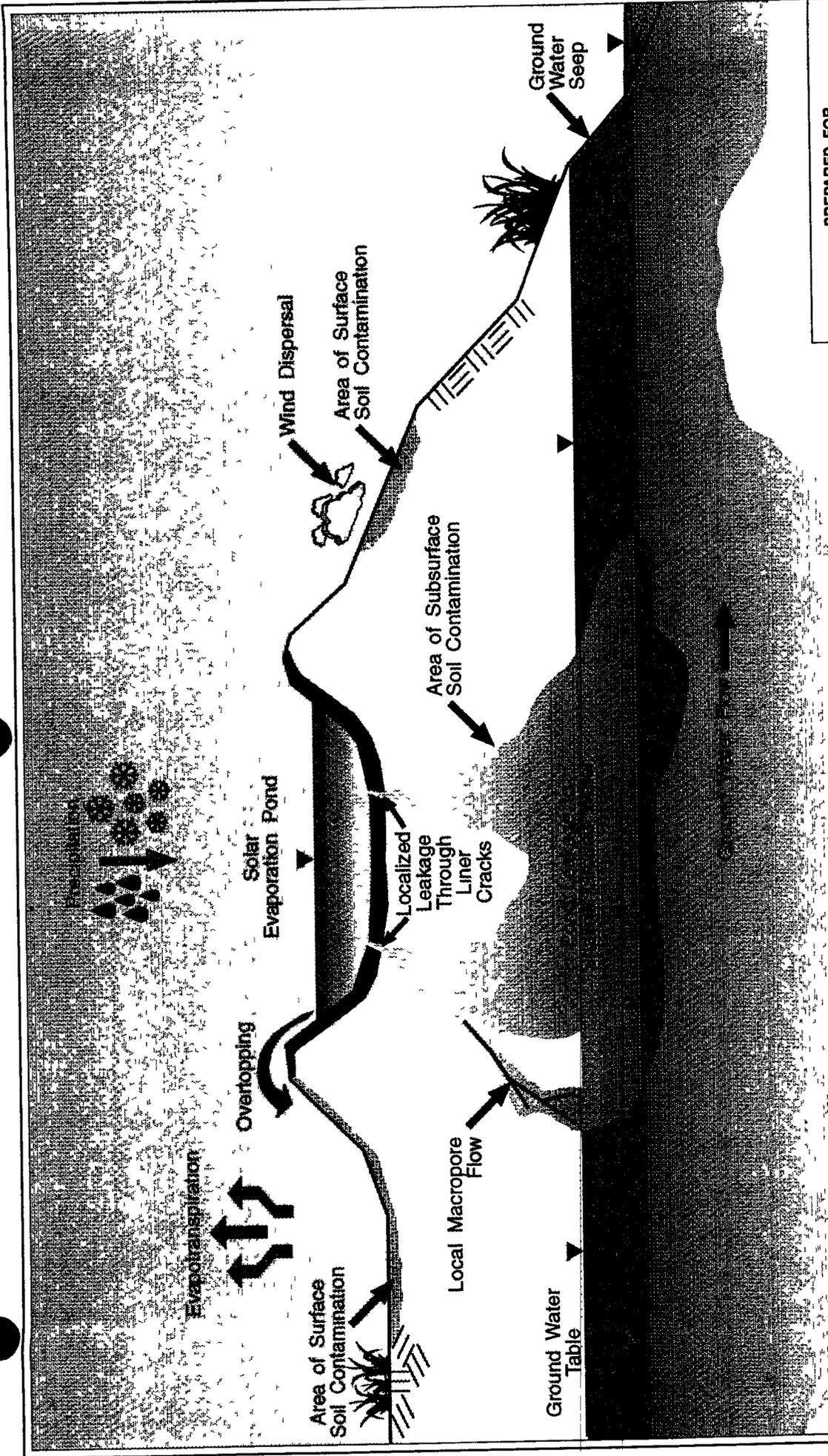
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TABLE II.5.2-6

General Fate of Organic Constituent PCOCs

PCOC	Generalized Fate and Fate-Related Processes
Substituted Aliphatics, Chlorinated Solvents	
Chloroform	a) Relatively high aqueous solubility b) Low K_{oc} c) High air/water partition d) Biodegradation possible under anaerobic conditions
Methylene chloride	e) <i>Probably have limited residency time in shallow subsurface environment with significant tendency to degrade to less chlorinated compounds</i>
(Mononuclear) Aromatics, Substituted Benzenes	
Bis(2-ethylhexyl) phthalate	a) Low aqueous solubility b) High K_{oc} c) Low air/water partition d) no data on degradation e) <i>Likely to remain in vadose and shallow saturated zone with limited tendency to degrade Information is limited</i>
Polynuclear (Polycyclic) Aromatic Hydrocarbons (PAHs)	
Benzo(a)anthracene	a) Very low aqueous solubility
Benzo(a)pyrene	b) Very high K_{oc}
Benzo(b)fluoranthene	c) Low to extremely low air/water partition
Benzo(k)fluoranthene	d) Aerobic and anaerobic biodegradation possible via decoupling of rings and subsequent oxidation similar to BTEX compounds
Chrysene	e) <i>Low mobility will result in parent compounds remaining in vadose zone and shallow saturated zone Sequential intermediate PAH degradation products will also remain in soils Monocyclic degradation products may undergo mineralization similar to BTEX</i>
Indeno(1,2,3-cd)pyrene	
Polychlorinated Biphenyls (PCBs)	
Aroclor-1254	a) Very low aqueous solubility b) Very high K_{oc} c) High air/water partition d) Limited potential for biodegradation by reductive dechlorination under anaerobic conditions e) <i>Very low mobility assures long residency time in vadose and especially in shallow saturated zones where air exchange is limited Although biodegradation is known, the compounds are quite recalcitrant in general</i>

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Figure II 5.3-1
 Solar Evaporation Ponds
 Operable Unit No 4, IMRA EA DD
 Conceptual Site Model

**SOLAR EVAPORATION PONDS
OU4 IM/IRA EA DECISION DOCUMENT
PART II
PHASE I RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION**

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II.6 CONCLUSIONS AND RECOMMENDATIONS

II.6.1 Evaluation of Original Ponds Area

The Original Ponds area was investigated to determine if compacted clay liners or other soil materials remain in the subsurface and to determine the potential extent of contaminants that may have been associated with the Original Ponds. The investigation included geologic boreholes, lysimeter/neutron access tube installations, and a ground-penetrating radar (GPR) survey to evaluate the subsurface conditions in this area.

The ground-penetrating radar survey did indicate the presence of an excavated area with artificial fill material of different composition than the native soils in the area of Pond 2 Auxiliary south of SEP 207-C. Subsurface soil descriptions obtained from the geologic boreholes support the presence of artificial fill in this area. A single soil sample collected from borehole 42893 was analyzed for physical and chemical properties. Atterberg Limits, particle size characteristics, and CEC determined for this soil sample (collected from between 3.0 and 3.7 ft bgs) indicate that the fill material may contain remnants of former bentonitic clay liner material. Borehole 41993 also may provide some indication of the presence of the former Original Ponds. Geologic data from this borehole indicate that non-native artificial fill material may occur down to depths of at least 8 ft bgs with clay-filled vertical fractures at depths of 12 ft bgs. Trenches and piping not found on facility drawings also were detected by the GPR survey. These unknown pipes may represent the location of the Original Ponds' process waste lines, which vary from the locations specified on as-built drawings.

Chemical analyses of soil samples collected from boreholes drilled in the Original Ponds area indicate few contaminants in either the surficial or subsurface soils. Contaminants that exceeded background include nitrate, zinc, americium-241, gross beta, plutonium-239/240, radium-226, tritium, and the uranium isotopes ($U^{233/234}$, U^{235} , U^{238}). These contaminants were largely detected in the boreholes drilled through the western berm of SEP 207-C and may be indicative of releases from SEP 207-C rather than the Original Ponds, or represent contamination from imported artificial fill material. Without exception, the concentrations of the aforementioned PCOCs detected in the Original Ponds area were lower than the PCOCs detected in samples collected from beneath the existing SEPs.

Chemical analyses of pore waters obtained from the lysimeter installed in borehole 42893 indicated that the following PCOCs, nitrate/nitrite, uranium-233/234, and uranium-238 were at concentrations above the RFETS background 99 percent UTL for ground water in the RFA.

II.6.2 Distribution and Extent of Contaminants in Surficial Soils

The objective of the surficial soils investigation was to evaluate whether contaminants that presumably resulted from aerosol dispersion are present in surficial soils. To accomplish the objective, an OU4-wide gamma radiation survey was completed. In addition, surficial soil samples were collected from 26 randomly selected locations, 10 discrete locations selected due

to proximity to seeps and to provide additional data for the baseline risk assessment, and 46 borehole locations, for a total of 72 surficial soil samples. The samples were analyzed for metals, radionuclides, semivolatile organic compounds, and nitrate/nitrite (as nitrogen)

The results of the surficial soil sample analyses indicate the presence of contaminants including metals, radionuclides, semivolatile organic compounds, and water quality parameters such as nitrate/nitrite and the PCB aroclor-1254. The metal and radionuclide concentrations that exceed background are grouped predominantly in the immediate vicinity of the SEPs, including on the berms between the SEPs. The distribution of the contaminants in this area supports the hypothesis that aerosol dispersion of contaminated pond liquids was a viable mechanism for the spread of contaminants in the immediate vicinity of the SEPs. The only exception appeared to be aroclor-1254, which was detected primarily outside of the OU4 boundary in all but two samples.

Surficial soils on the hillside north of the SEPs appear to have been contaminated largely through two mechanisms. Ground water discharges to the ground surface as seeps along the hillside north of the SEPs, and contaminants sorbed onto the soils in that area due to historical instances of pond overtopping. The drainage tile or pipe that is installed between SEP 207-A and the 207-B SEPs has an outfall on the hillside, and contaminants appear to have accumulated where discharged liquids contacted the ground surface.

Sporadic locations elsewhere at OU4 have elevated concentrations of metals and radionuclides that do not appear to be related to SEP waste management activities. In particular, elevated contaminant levels were identified at sampling locations east of the SEPs (i.e., the "bone yard" area outside of OU4 formerly used for the storage of discarded equipment), and west of the SEPs in the industrial area (also outside of OU4). Contaminants detected in the bone yard may have resulted from the material stored near those locations, while industrial area contaminants likely resulted from the outfall of building drains (Bowman's Pond area and Buildings 774 and 713).

Semivolatile organic compounds (primarily coal tar derivatives) were detected in the surficial soil samples at selected locations in OU4. A majority of the semivolatile organics detected occur at a small number of locations. The presence of these compounds is likely attributable to isolated point sources, including leakage of fuels and oils from vehicles. In addition, the asphaltic material used for lining the SEPs may also have contributed to the presence of the semivolatile organic compounds detected in the surficial soils.

II.6.3 Distribution and Extent of Contaminants in the Vadose Zone

II.6.3.1 Vadose Zone Soils

Forty-eight boreholes were drilled and sampled during the OU4 Phase I RFI/RI. One of the objectives for drilling these boreholes was to ascertain the presence or absence of contaminants in the vadose zone. The analytical results of the samples collected from the

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boreholes indicate that contaminants are present in the vadose zone. These contaminants include nitrate, metals, and radionuclides. Volatile organic compounds were detected infrequently at very low concentrations and are not thought to be contaminants related to SEP waste management operations. Toluene, acetone, and methylene chloride were detected in a large percentage of the subsurface samples. As discussed in Section II.4, these compounds are thought to be contaminants from field sampling practices or laboratory analytical techniques. No semivolatile organic compounds were detected in the vadose zone, except for bis(2-ethylhexyl)phthalate which is also thought to be a contaminant from field sampling practices.

The distribution of metals and radionuclides in the vadose zone closely parallels the distribution of those contaminants in surficial soils. The metals and radionuclides occur in the immediate vicinity of, and beneath, the SEPs. With the exception of barium, zinc, and radium-226, the contaminants typically show decreasing concentrations with depth. The exceptions listed are widely distributed, being found beneath the SEPs, downgradient (north) of the SEPs at seeps within the PA, and north of the PA in the buffer zone. The distribution of tritium in the buffer zone indicates that surface or ground water has been a transport mechanism for some analytes released from the SEPs.

The concentration distribution of water quality parameters in OU4 suggests that nitrate concentrations decrease with depth and that nitrate is distributed similar to tritium. This is anticipated since nitrate is very soluble and would move readily with pore water, surface water, or ground water. Cyanide is present beneath SEP 207-A, north of the drainage tile outfall area, and north of SEP 207-C at shallow depths (0 to 6 feet). Cyanide is also found throughout the vadose zone beneath the northeastern portion of SEP 207-B North, and at depth (greater than 12 feet) northeast of the SEPs in the buffer zone.

Like the surficial soils, sporadic detections of contaminants have been observed in the vadose zone soils and cannot be attributed to SEP operations. These sporadic detections occur most frequently beyond the OU4 boundary to the west near Building 779 and to the east of OU4 within or near the former storage area or bone yard.

II.6.3.2 Pore Water Analyses

Pore waters were collected from single and dual lysimeters installed in the vadose zone at 15 locations in OU4. The suite of parameters analyzed varied depending upon the quantity of pore water obtained during sampling. The results of the pore water analyses indicate that contaminants are dissolved in water existing in the vadose zone. Contaminants detected included metals, radionuclides, and nitrate/nitrite. Contaminants detected in the vadose zone pore waters are from locations adjacent to or below the SEPs.

Vadose zone soil metal PCOCs detected in pore water above the background 99 percent UTL for ground water include barium, cadmium, lithium, calcium, manganese, potassium, silicon, and sodium. Calcium, manganese, potassium, silicon, and sodium are typical naturally occurring soil pore water constituents and are not considered indicative of contamination.

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Nitrate/nitrite was also detected in pore water at many of the lysimeter locations. Of the radionuclides considered to be vadose zone soil PCOCs, gross beta, tritium, and uranium-233/234, uranium-235, and uranium-238, were detected above the background 99 percent UTL for RFA ground water.

Detections of both metal and radionuclide contaminants consistently occurred in six of the lysimeters Nos 40993, 41593, 42493, 43193, 43693, and 43793, which are located within or adjacent to the SEPs. The contaminant detections often exceeded the respective background 99 percent UTL for RFA ground water.

Pore water samples from some of the lysimeters were not obtained because either the location was dry (soil matric potential was greater than the vacuum applied to the lysimeter) or because the lysimeter was damaged. Attempts to collect pore water samples from locations 40293 and 40593 were unsuccessful due to the high soil matric potential. The lower lysimeter at location 44093 was apparently damaged during installation and could not be sampled. The lower lysimeter at location 40993 appears to be completed in the saturated zone and the pore water obtained represents a measure of ground water quality at that location.

II.6.4 Hydrogeologic Setting of OU4

The saturated ground water zone immediately underlying the vadose zone at OU4 is termed the Upper Hydrostratigraphic Unit (Upper HSU). This unit is composed of RFA, colluvium, weathered bedrock lithologies, and possibly artificial fill. Ground water flow directions within the Upper HSU at OU4 generally follow or conform to the local topography. The SEPs are constructed on an east-west trending topographic ridge that is flanked to the north and south by tributaries of Walnut Creek. Ground water flow in the Upper HSU is generally toward North Walnut Creek north of the SEPs and toward South Walnut Creek south of the SEPs. An east-trending component of ground water flow is also present east of the SEPs, with flow occurring down the ridge crest toward the confluence of North and South Walnut Creeks. Ground water elevations in OU4 range between about 5,965 feet above mean sea level (ft msl) beneath SEP 207-A, and 5,070 ft msl along North Walnut Creek.

Several important characteristics of the OU4 site hydrogeology appear to control ground water flow and contaminant movement in the saturated zone beneath OU4. Ground water elevation data obtained from both the RFA and the bedrock lithologies indicate that the alluvium and bedrock water-bearing strata are hydraulically connected. Because of the fluctuating ground water table beneath the site, this connection provides for a mechanism to desaturate the overlying alluvium. Vertical hydraulic gradients generally are downward from the alluvium to the bedrock adjacent to and beneath the ponds, and upward along the reaches of North Walnut Creek. Potentiometric maps presented in Section II 3 3 indicate that the desaturated alluvium areas are smallest during the high water period in the spring and largest during the dry period in the fall and early winter. These desaturated areas appear to result from water table fluctuations below the top of bedrock at low water level and areas where the RFA is directly underlain by a sandstone member of the Arapahoe Formation. The latter mechanism is readily apparent.

adjacent to SEP 207-C RFA underlain by the Arapahoe Formation sandstone stratum in this area appears to be dry throughout the year

Paleochannels present on the bedrock paleosurface appear to have controlled the depositional facies of the RFA which controls ground water flow in the alluvium. Coarser-grained facies of the RFA are present in the paleochannels providing a more permeable pathway for ground water flow. During periods of low water level, "channelized" flow in the alluvium is more apparent than during high water levels. Former surface water drainages that were buried during construction of the SEPs may also control ground water flow during high water level.

The RFA is composed of as many as four lithofacies. Soils present in each lithofacies have different hydraulic characteristics that are controlled by the relative percentage of coarse particle sizes that comprise the soil. Coarse-grained lithofacies generally have higher permeabilities than the finer-grained lithofacies. As mentioned above, the coarse-grained lithofacies appear to be situated in bedrock paleochannels. The combined features of increased hydraulic conductivity and "channelized" flow control the local ground water flow and contaminant transport rate.

In 1993, water level measurements within OU4 led to two primary conclusions: 1) alluvial water level fluctuations during the 1993 monitoring program appear normal based on historical alluvial water level measurements, and 2) alluvial water levels measured with transducers appear to have shown a response to spring precipitation events at three monitoring locations and to a summer precipitation event at two monitoring locations. These observations lead to the conclusion that the increase in alluvial water level elevations at these monitoring locations is due in large part to macropore flow, local areas of higher hydraulic conductivity, or recharge from upgradient locations. Additionally, recharge from vertical infiltration is believed to be localized, occurring at locations where hydraulic conditions are more favorable.

Ground water levels beneath the ponds were also evaluated during the investigation. Water levels beneath SEP 207-B South suggest that ground water is at the base of the liner during high water periods. Ground water levels beneath SEP 207-A range from about 4 feet below the base of the liner to greater than 12 feet under the northern end of SEP 207-A. Ground water levels beneath SEP 207-C range from about 4 feet to greater than 20 feet along the northern berm. Water level fluctuations at the site generally range up to 6 feet. Fluctuations are not as great beneath the SEPs, usually ranging less than 3 feet.

The thickness of the vadose zone at the site ranges from zero at seep locations to as much as 20 feet (during periods of low water level) at locations in the buffer zone south of North Walnut Creek.

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II.6.5 Vadose Zone Flow System

The primary control on contaminant fate and transport at OU4 for the more mobile contaminants is the presence of a variably saturated vadose zone beneath the site. Areal infiltration through the vadose zone at OU4 occurs primarily during the late winter through spring when precipitation exceeds bare soil evaporation and plant transpiration. Therefore, recharge through the vadose zone is seasonal and only occurs during this period.

Areal infiltration occurs through macropores and through interstitial flow in localized soil areas of higher hydraulic conductivity or where the vadose zone becomes saturated. This is evidenced by the relatively rapid response of the water table to a previous precipitation event that was observed at some of the piezometer locations at OU4. When deep areal infiltration occurs, variably saturated vadose zone flow is generally vertically downward from ground surface to the unconfined ground water table. Ground water recharge by interstitial infiltration is estimated for OU4 at 9×10^{-3} in/yr.

This small amount of areal interstitial infiltration cannot account for the water table fluctuations observed at the site, suggesting that the predominant infiltration mechanism at OU4 is probably macropore flow. This apparent lack of interstitial infiltration as a source of ground water recharge may also suggest that the variations in ground water levels observed at the site result from direct recharge to the bedrock strata.

Variations in matric potential with depth were observed in the vadose zone. Therefore, hydraulic gradients are related to both changes in matric potential and elevation head. Observations concerning the soil moisture characteristics of the vadose zone soils indicate that hydraulic conductivity decreases rapidly with less than a 5 percent decrease in moisture content. This rapid change in hydraulic conductivity with changes in moisture content may account for seasonal flow in the vadose zone. Consequently, flow in the vadose zone is not constant, but varies with the heterogeneous nature of the subsurface soils and their moisture content. The heterogeneous lithology of vadose zone suggests that significant variability in hydraulic properties and moisture content occurs with depth. Consequently, variably saturated flow through the vadose zone sediments is not uniform and may be significantly accelerated or decelerated by layers of varying moisture content and hydraulic conductivity.

The apparent lack of areal interstitial infiltration at OU4 suggests that contaminant transport occurs along areas of localized saturation or through macropores or other areas of limited higher hydraulic conductivity. This type of flow system minimizes the potential for areal infiltration to mobilize contaminants present in the soil pores (interstices). Flow through soil macropores also will limit contact with contaminants present in the vadose zone since macropore flow is localized and diffusive flow away from the macropore walls would be limited in volume.

II.6.6 Recommendations

The following paragraphs include recommendations to aid in the evaluation of the nature, extent, fate, and transport properties of OU4 contaminants

Geophysical Surveys

- The ground-penetrating radar survey of the Original Pond area south of SEP 207-C was successful in locating undocumented trenches and piping. It also indicated the presence of an excavated area adjacent to Building 779. It is recommended that a soil boring be positioned at the deepest portion of the excavation and examined for potential contaminants. As for the trenches and the piping that were not shown on the facility drawings, it is recommended that additional GPR surveys be conducted to determine the locations of the unknown trenches or pipes in the subsurface.
- The limited GPR survey within SEP 207-A did not locate any near-surface pipes, but it could not be determined what depth of penetration was being achieved with a 300 Mhz and a 900 Mhz antenna. Based upon the number of trenches and pipes observed within the Original Pond area, it is recommended that additional GPR surveys be attempted in and around the SEPs using a lower-frequency antenna for better depth penetration.
- The refraction survey, in conjunction with the borehole descriptions, proved to be successful in identifying the bedrock-alluvium interface, slump blocks, paleotopographic channels on top of the bedrock, major soil textural differences within the alluvium and bedrock, and a weathered zone within the bedrock. Piezometer 44893 in the buffer zone northeast of SEP 207-B North is situated in a paleotopographic low. Additional, more closely spaced refraction seismic surveys will better identify these paleotopographic bedrock surface channels. Several boreholes should also be drilled along the refraction seismic lines, and samples should be collected and analyzed for strength properties and density. This information will be used to more accurately correlate seismic wave travel times with soil and bedrock properties.

Water Level Measurements

- The draining of SEP 207-A, 207-B North, and 207-B Center appears to have had an impact on ground water levels, as evident from hydrographs. Water levels in the monitoring wells north of the SEPs appear to be lower by about 0.5 feet. Continued monthly water level measurements would verify the decrease.
- Because the ITS effectiveness evaluation demonstrated that underflow is occurring in some areas, additional piezometers or wells should be installed to determine

if contaminants are also moving beneath the ITS Conductivity measurements may also be useful for evaluating contaminated ground water moving beneath the ITS

- There appear to be dry alluvial and channelized alluvial flow areas within the ITS during the spring Additional piezometers within these areas would verify the presence of these dry areas and areas of channelized flow Additional seismic refraction data in this area would help identify well or piezometer placement areas
- An understanding of the hydrogeologic setting around SEP 207-C should be undertaken to determine if VOCs present in the ground water are sourced from the SEPs or from upgradient sources Tracer tests are recommended to determine if ground water in the Arapahoe Sandstone underlying and north of SEP 207-C discharges contaminants to the northern hillslope
- Monthly neutron moderation monitoring at all lysimeters is recommended for a full year to determine the seasonal water movement in the vadose zone Closely spaced neutron moderation monitoring should also be conducted daily or weekly following a large precipitation event

Recharge Studies

- To evaluate the presence and ability of macropores to recharge ground water in the OU4 area, recharge and infiltration tests should be conducted over small areas

Contaminant Analyses

- Small areas or "hot-spots" identified for remediation under the OU4 Phase I IM/IRA, particularly on the basis of historical analytical data, should be re-sampled for confirmation prior to incorporation into the final design
- It is recommended that all the lysimeters be re-sampled and analyzed for americium-241, plutonium-239/240, and other PCOCs that were not analyzed during the Phase I RFI/RI program in order to better identify the extent of contaminants in the vadose zone pore water

**SOLAR EVAPORATION PONDS
OU4 IM/IRA EA DECISION DOCUMENT
PART II
PHASE I RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION**

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(for Section II 7)**

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II 7 1 Previous Investigation	II 7-1
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II.7 CHARACTERIZATION OF IHSS 176

The S&W Contractor Storage Yard (IHSS 176) is located approximately 50 feet east of the SEPs. The areal extent of IHSS 176 is approximately 113, 110 square feet (2.6 acres). The site was used for storage of contractor materials since 1970. In 1985 some stored materials were designated as hazardous wastes. IHSS 176 is a component of OU 10 which was characterized by OU10 separately from the OU4 Phase I RFI/RI program. Figure II 7-1 presents a map depicting the IHSS 176 boundary in relation to the OU4 boundaries.

The physical characteristics of IHSS 176 are similar to the physical characteristics at OU4. The ground surface at IHSS 176 gently slopes to the northeast. Approximately 15 ft of alluvium and fill overlies the bedrock in the vicinity of IHSS 176. The alluvium observed in Well 2886 located 100 ft north of IHSS 176 consisted of a thin cobble layer resting atop claystone of the Arapahoe Formation which was overlain by approximately 8 ft of mixed gravel and clay. The groundwater flows to the northeast, and the depth to groundwater is estimated to be approximately 5 ft below the ground surface.

II.7.1 Previous Investigations

An initial soil characterization program to determine the nature and extent of soil contamination was conducted in 1988. Soil samples were obtained in 1988 from ten locations. One sample location was based on ground staining, five sample locations were based on historical use of the area, and four sample locations were based on the presence of hazardous waste discovered in 1985. The soil samples were collected from 1 ft deep excavations and were composited over the 1 ft deep interval except for volatile organic aromatic (VOA) samples, which were grab samples from a depth of 1 ft. Analysis of soil samples include hazardous substance list volatile organic aromatic compounds, hazardous substance list polynuclear aromatic hydrocarbons, and hazardous substance list metals, inorganics, and radionuclides.

Prior to soil sampling, a visual and a direct radiation survey using a FIDLER probe were conducted to identify areas of potential contamination. The FIDLER survey was conducted on October 19, 1988. Background was determined to be 500 counts per minute. All FIDLER readings were below background. Since no areas exceeded background, no additional soil samples were collected (Weston 1988). The results of this characterization program are presented in Appendix II AA. This information was presented in the Phase I/RFI/RI Work Plan for OU10 (EG&G 1992f).

II.7.2 Recent IHSS 176 Characterization

Additional characterization efforts have been conducted at IHSS 176 in 1993/1994. This additional characterization included surface soil sampling and soil-gas surveys. A total of twenty-eight locations were sampled for characterization of surface soil contamination. Eight located

within or along the IHSS boundaries, three on the east side of the IHSS, and seven situated north of the IHSS. Duplicate samples were collected at two of the sample locations. Figure II 7-2 presents the locations of the sampling points.

Appendix II AA provides the analytical results for the surface soil sampling. This information is also presented in the Rocky Flats Environmental Technology Site Operable Unit No. 10 Technical Memorandum No. 1 (EG&G 1994).

The purpose of the soil-gas survey in IHSS 176 was to locate possible occurrences and the horizontal extent of volatile organic compounds that may have been associated with stored materials such as solvents, fuel oils and possible spills. The IHSS 176 soil-gas survey was conducted on a 40-foot triangular grid. One-hundred-seventy soil-gas locations were sampled.

Acetone was observed at two locations on the northeastern corner of the IHSS 176 boundary. A maximum of 1.65 $\mu\text{g}/\text{L}$ was observed at location SG060394, and a minimum of 1.20 $\mu\text{g}/\text{L}$ was observed at location SG060294.

A concentration anomaly outside the IHSS boundary on the eastern side of the storage yard exists along the roadway. (Benzene was observed at four locations.) A maximum concentration of benzene, 1.40 $\mu\text{g}/\text{L}$, was observed at location SG061994. A minimum concentration of benzene, 1.06 $\mu\text{g}/\text{L}$, was observed at location SG063094. Toluene was also observed at two locations on the eastern side of the storage yard. A maximum toluene concentration of 1.69 $\mu\text{g}/\text{L}$, was observed at location SG060694. A minimum toluene concentration of 1.01 $\mu\text{g}/\text{L}$, was observed at location SG069194.

Benzene and toluene were observed at one location outside the IHSS boundary on the western side of IHSS 176. This occurrence is also next to a roadway through the storage yard. Benzene was observed in a concentration of 1.11 $\mu\text{g}/\text{L}$, and toluene was present at a concentration of 1.83 $\mu\text{g}/\text{L}$ at location SG063294. Also on the western side inside the IHSS 176 boundary, PCE was detected at a concentration of 1.70 $\mu\text{g}/\text{L}$ at location SG066994.

Outside the boundary on the northern side of IHSS 176, acetone was observed at one location. Acetone was present in a concentration of 1.90 $\mu\text{g}/\text{L}$ at SG056494.

Methane was detected at 73 soil-gas locations in IHSS 176. A minimum concentration of 10 ppm was observed at eleven locations, and a maximum concentration of 90 ppm was observed at five locations.

Analytical results of the IHSS 176 soil-gas survey are presented in Appendix II AA. This information is also presented in Rocky Flats Environmental Technology Site Operable Unit No. 10 Technical Memorandum No. 1 (EG&G 1994).

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II.7.3 Conclusions

The results of the IHSS 176 characterization effort indicate that the OU4 SEPs were a primary source of radionuclide and metal contamination to the IHSS 176 soils OU4 annexed IHSS 176 since the SEPs were a primary source of contamination, and because IHSS 176 is immediately adjacent to the OU4 SEPs and will likely be impacted by their closure

592

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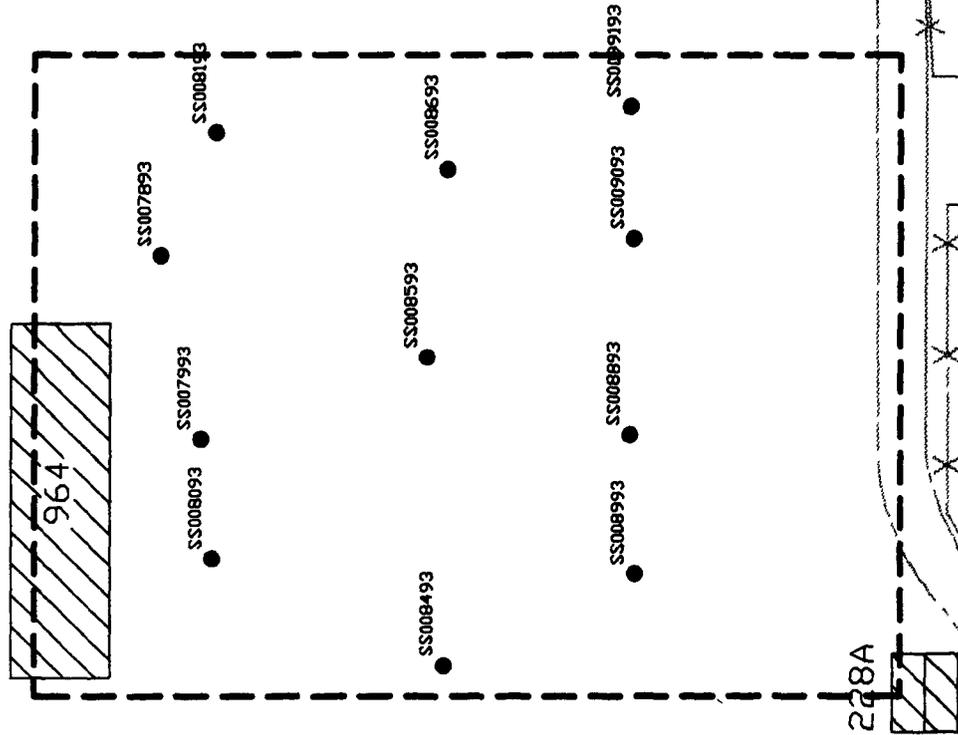
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- Paved Road
- ▨ Building
- · - · - Fence
- - - IHSS 176 Boundary
- SS008093 Sample Location with Identification Number



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Figure M.7-2

Solar Evaporation Ponds
Operable Unit 4, IM/RA EA DD
IHSS 176 Surface Soil Sample
Locations

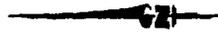


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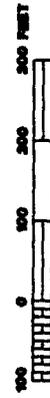
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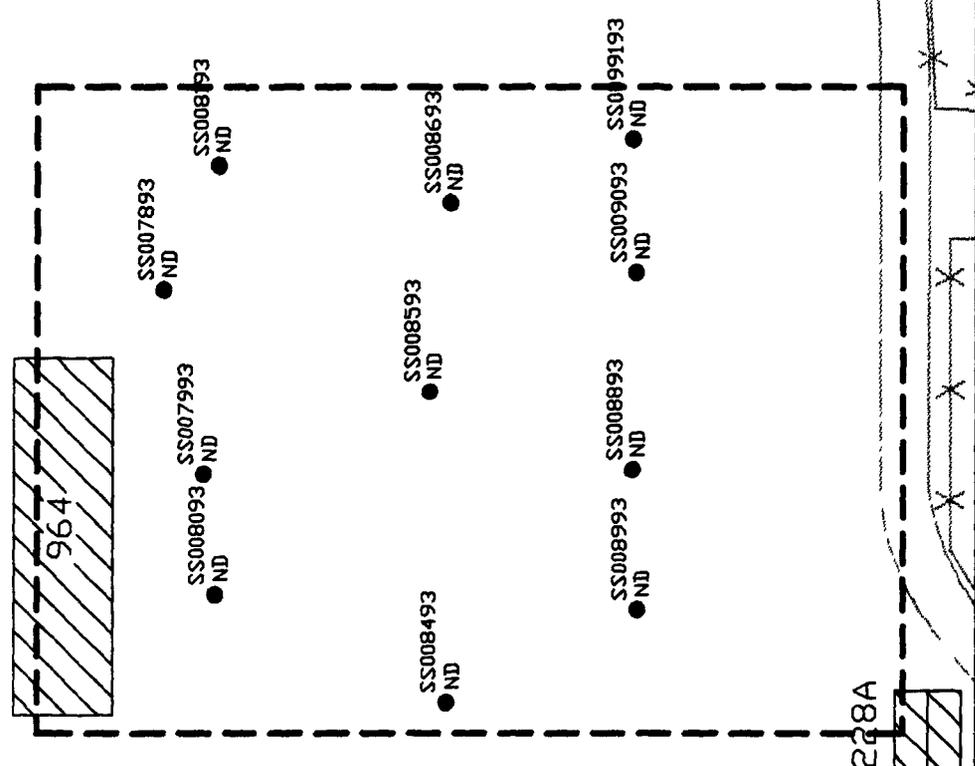
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- Stream
- Paved Roads
- ▨ Buildings
- - - Fence
- - - IHSS 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure M.7-3
Solar Evaporation Ponds
Operable Unit 4, M/RA EA DD
Surface Soil Sampling Results
Beryllium



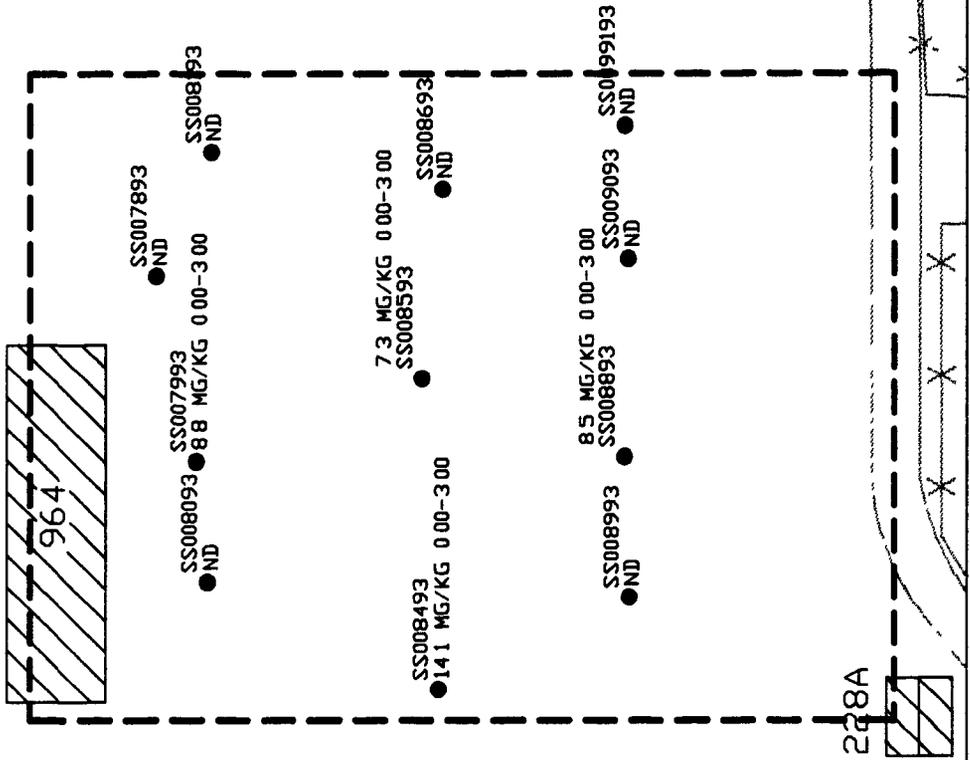
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LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- - - - - Fence
- - - - - HSS T76 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure E.7-4
 Solar Evaporation Ponds
 Operable Unit 4, IM/RA EA DD
 Surface Soil Sampling Results
 Cadmium

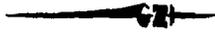
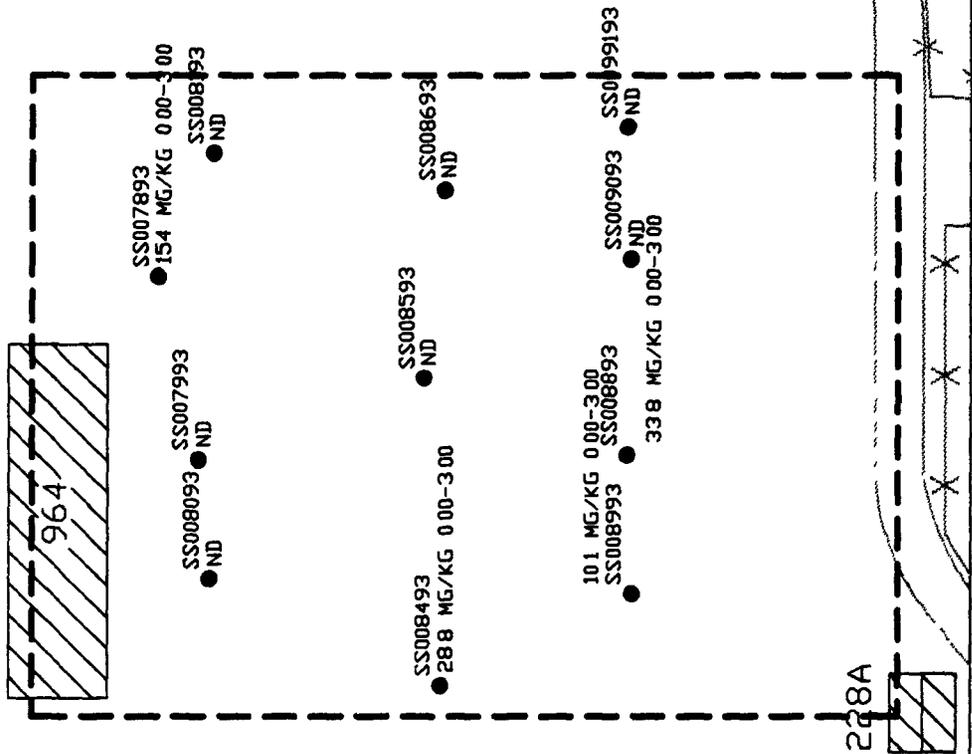
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LEGEND:

- - Streams
- Paved Roads
- ▨ Buildings
- - - - - Fence
- - - - - MRS 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure M.7-5

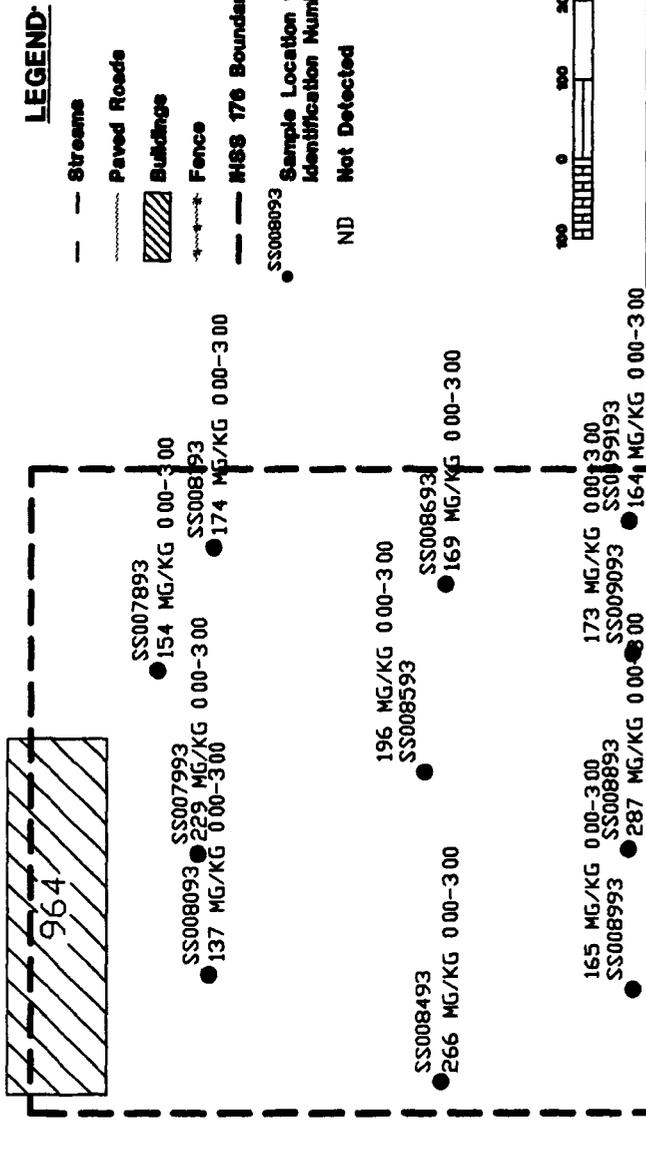
Solar Evaporation Ponds
Operable Unit 4, M/RA EA DD
Surface Soil Sampling Results
Arsenic

597

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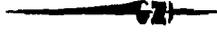
Figure M.7-6

Solar Evaporation Ponds
Operable Unit 4, M/RA EA DD
Surface Soil Sampling Results
Manganese

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NORTH

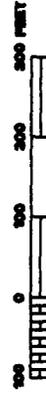
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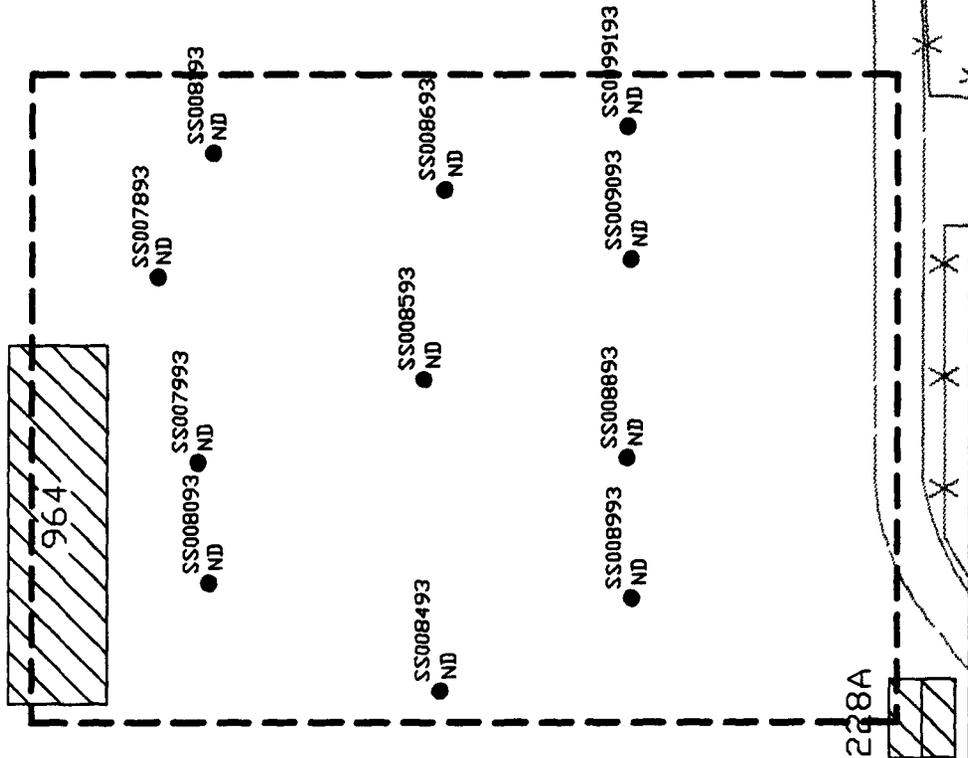
- - - Streams
- Paved Roads
- ▨ Buildings
- - - + - - Fence
- - - HSS 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure M.7-7

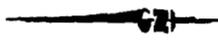
Solar Evaporation Ponds
Operable Unit 4, M/NRA EA DO
Surface Soil Sampling Results
Americium-241



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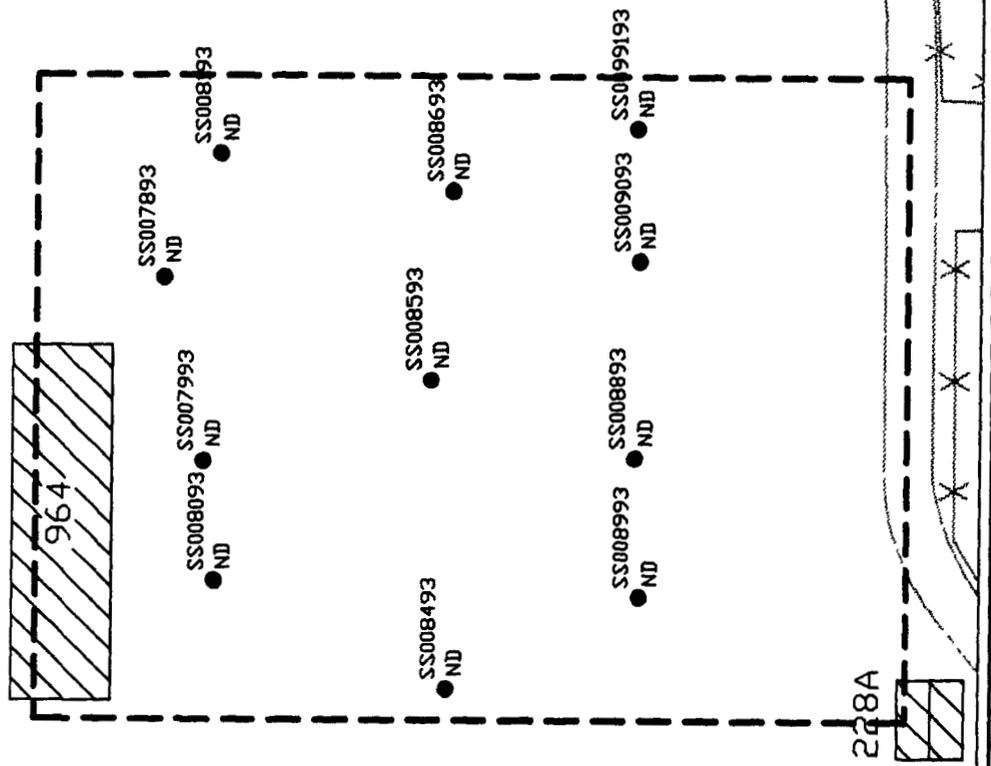
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- - - Streams
- Paved Roads
- ▨ Buildings
- - - Fence
- - - HISS 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure H.7-8
Solar Evaporation Ponds
Operable Unit 4, IM/IRA EA DO
Surface Soil Sampling Results
Cesium-134

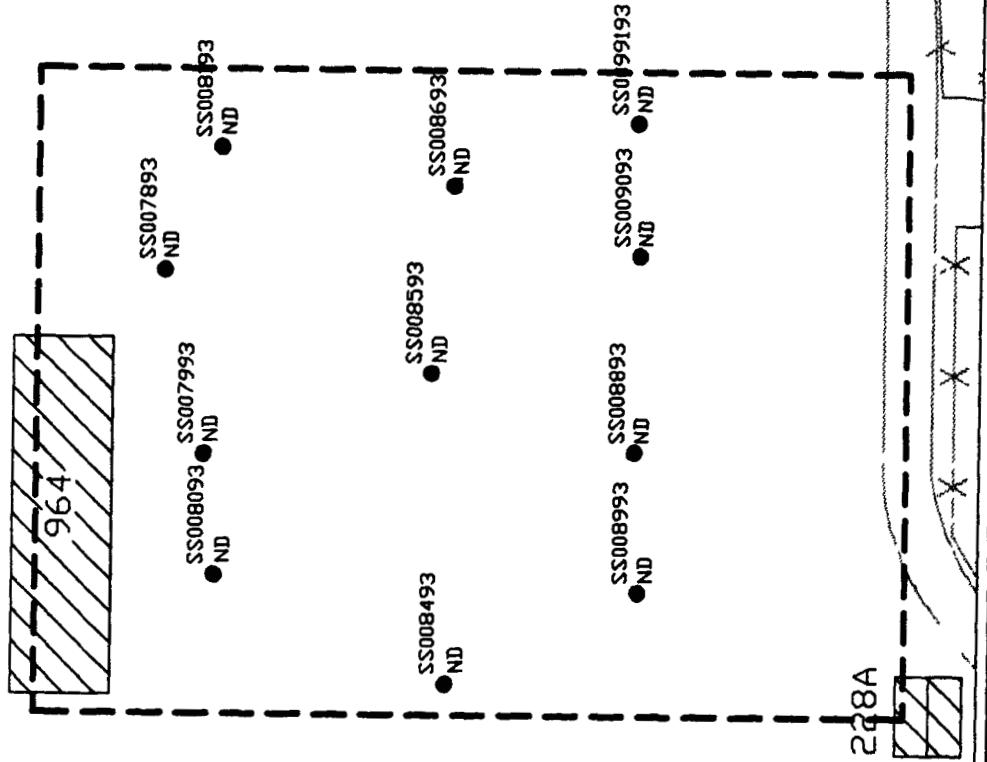


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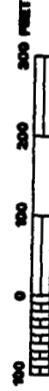
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SOUTH

910



LEGEND:

- - - Stream
- Paved Roads
- ▨ Buildings
- +--+ Fence
- - - HSS 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure E.7-8

Solar Evaporation Ponds
Operable Unit 4, BM/RA EA DD
Surface Soil Sampling Results
Plutonium-239/240

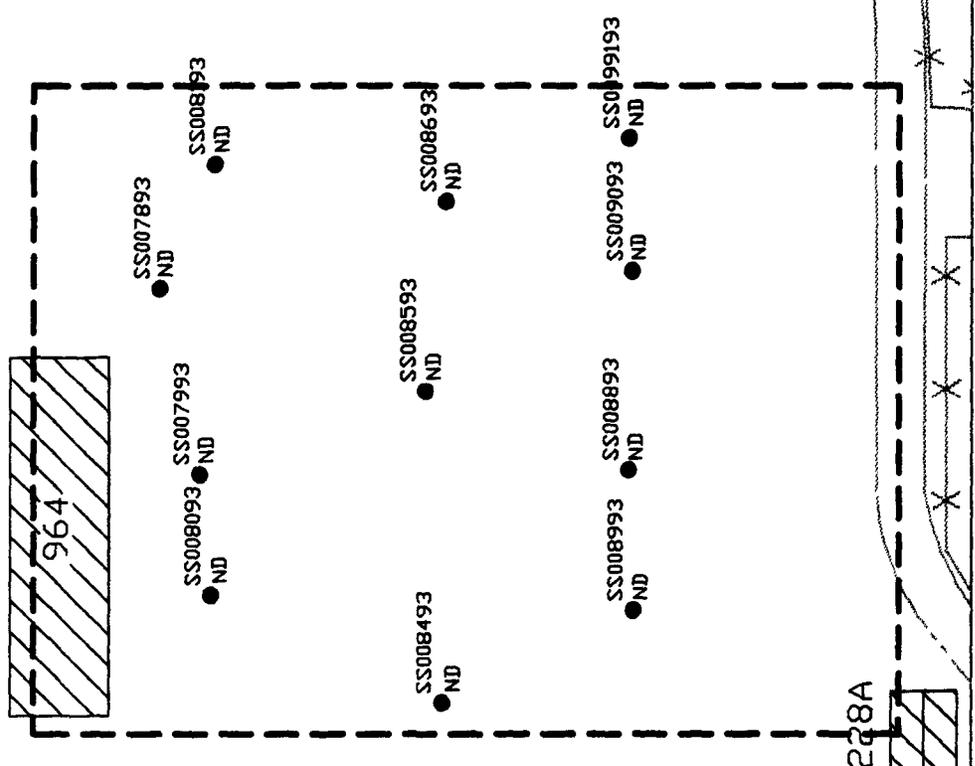
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LEGEND:

- - Streams
- - Paved Roads
- ▨ Buildings
- - - - Fence
- - - - M188 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure M.7-10

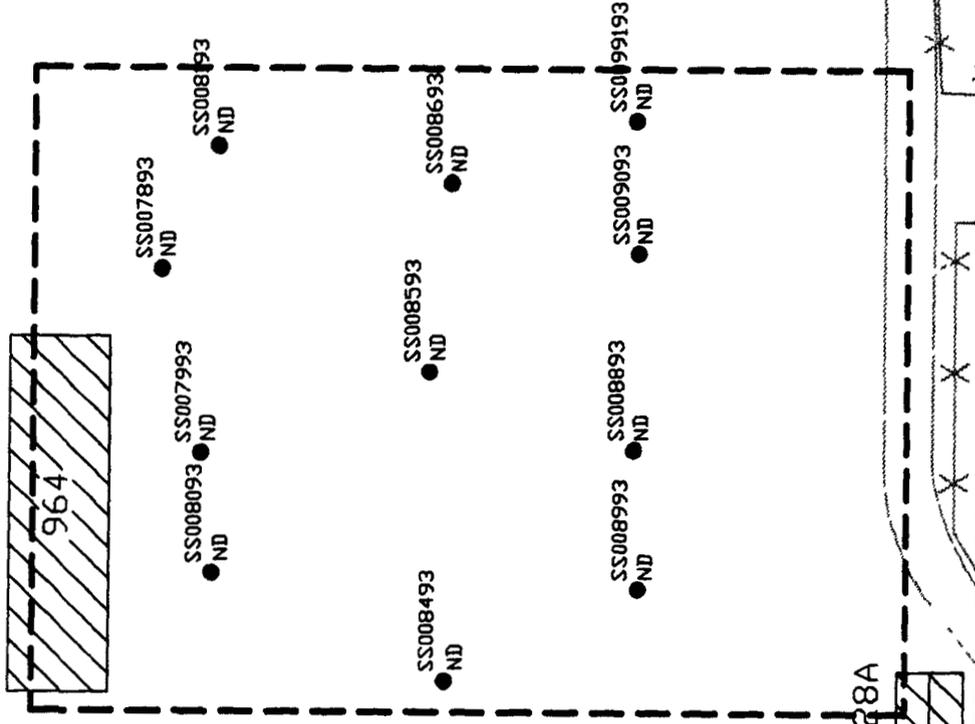
Solar Evaporation Ponds
 Operable Unit 4, M/RA EA DO
 Surface Soil Sampling Results
 Radium-226

602

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NORTH

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SOUTH



LEGEND:

- - - Stream
- Paved Road
- ▨ Buildings
- · - · - Fence
- - - HSS 178 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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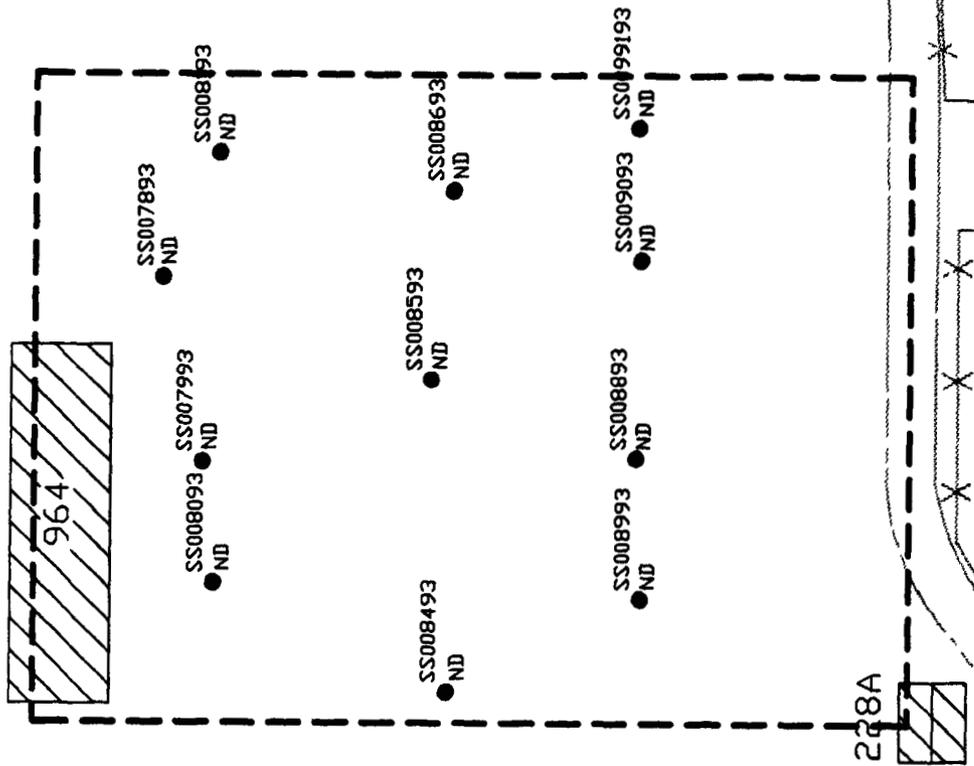
Figure E.7-11
 Solar Evaporation Ponds
 Operable Unit 4, MI/WA EA DO
 Surface Soil Sampling Results
 Radium-226

603

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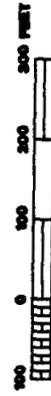
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LEGEND:

- - - Streams
- Paved Roads
- ▨ Buildings
- - - + - - Fence
- - - HSS 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure M.7-12

Solar Evaporation Ponds
Operable Unit 4, M/WRA EA DO
Surface Soil Sampling Results
Uranium-233

604

SEP 207-B
NORTH

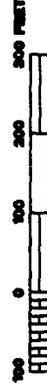
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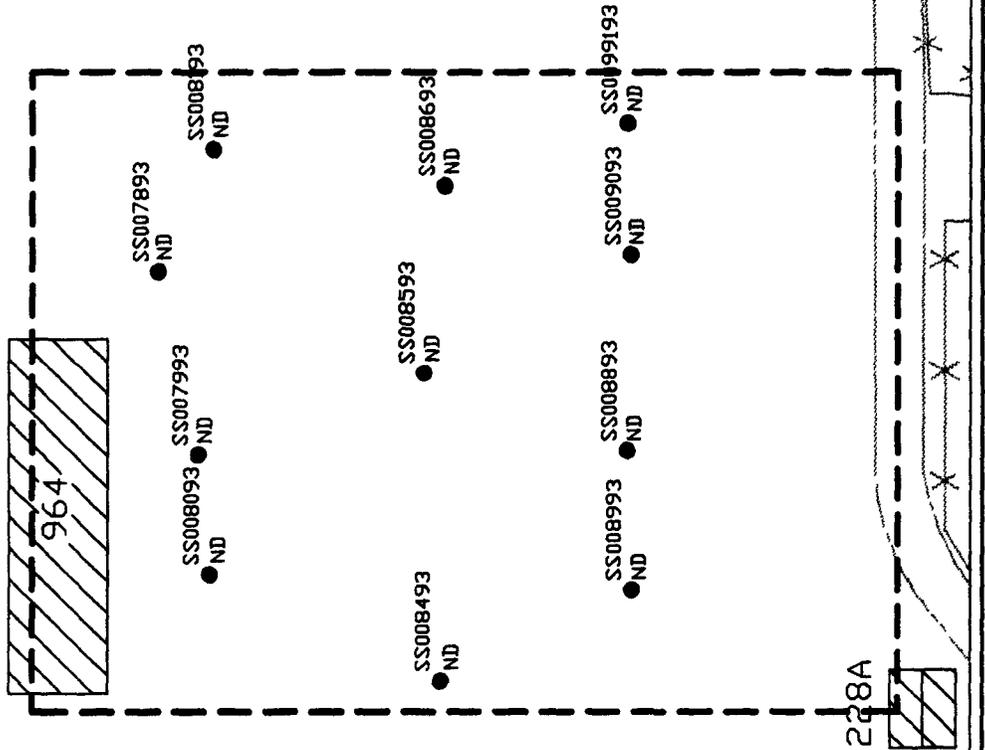
- - Streams
- Paved Roads
- ▨ Buildings
- +--+ Fence
- - - - - HHS 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure M.7-13

Solar Evaporation Ponds
 Operable Unit 4, M/RA EA DD
 Surface Soil Sampling Results
 Uranium-234

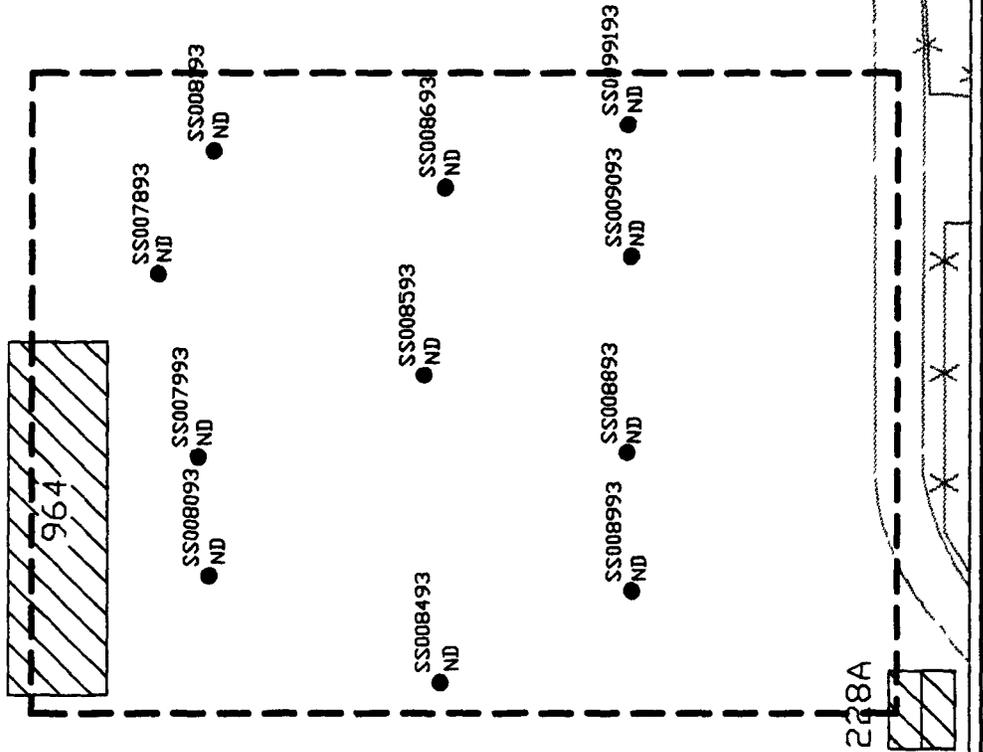


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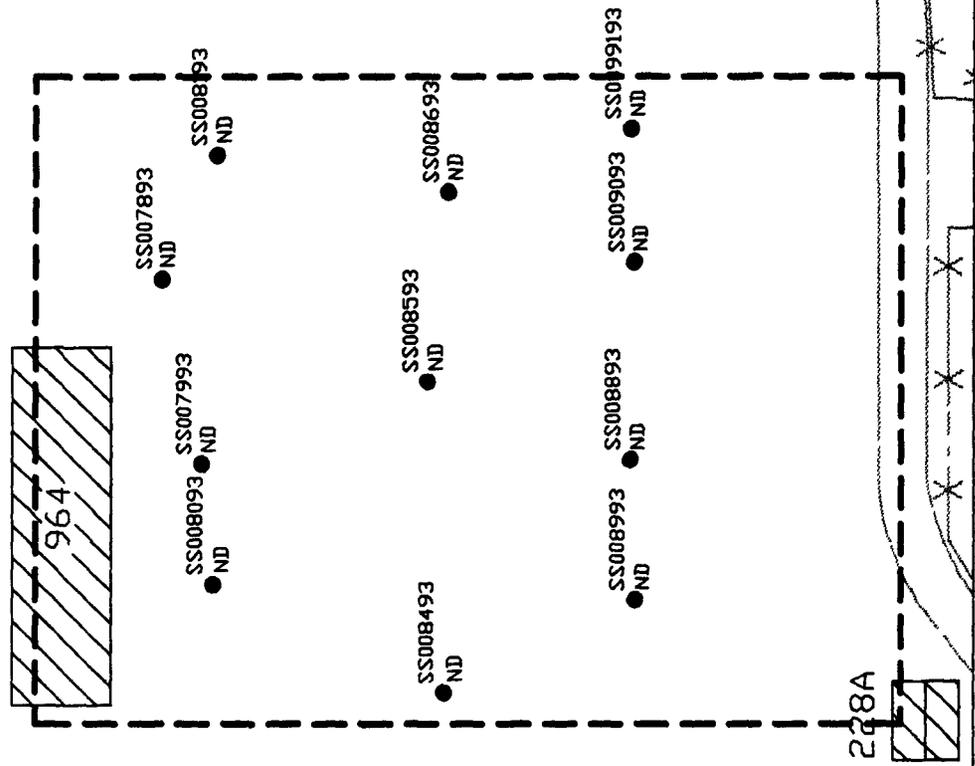
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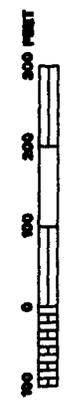
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SOUTH



LEGEND:

- Stream
- ==== Paved Roads
- ▨ Buildings
- - - - Fence
- - - - HISS 176 Boundary
- SS008093 Sample Location with Identification Number
- ND Not Detected



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Figure 8.7-15
Solar Evaporation Ponds
Operable Unit 4, IM/RA EA DD
Surface Soil Sampling Results
Uranium-238

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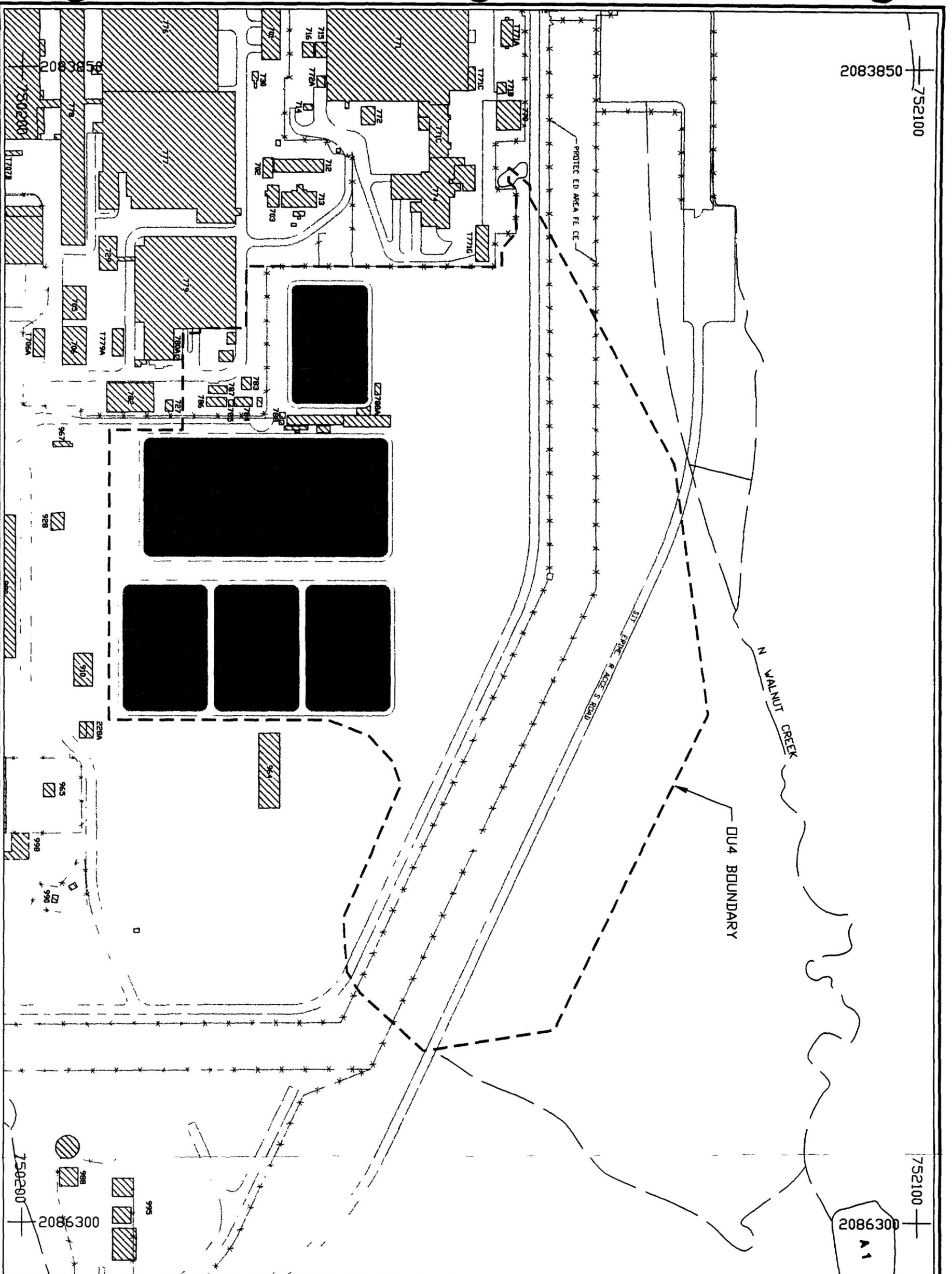
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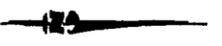
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LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- - - OU4 Boundary
- Solar Evaporation Pond (SEP)



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 ROCKY FLATS ENVIRONMENTAL
 TECHNOLOGY SITE
 GOLDEN, COLORADO

Figure II.1.1
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/RA EA DD
 Phase I RFI/RI Investigation Area

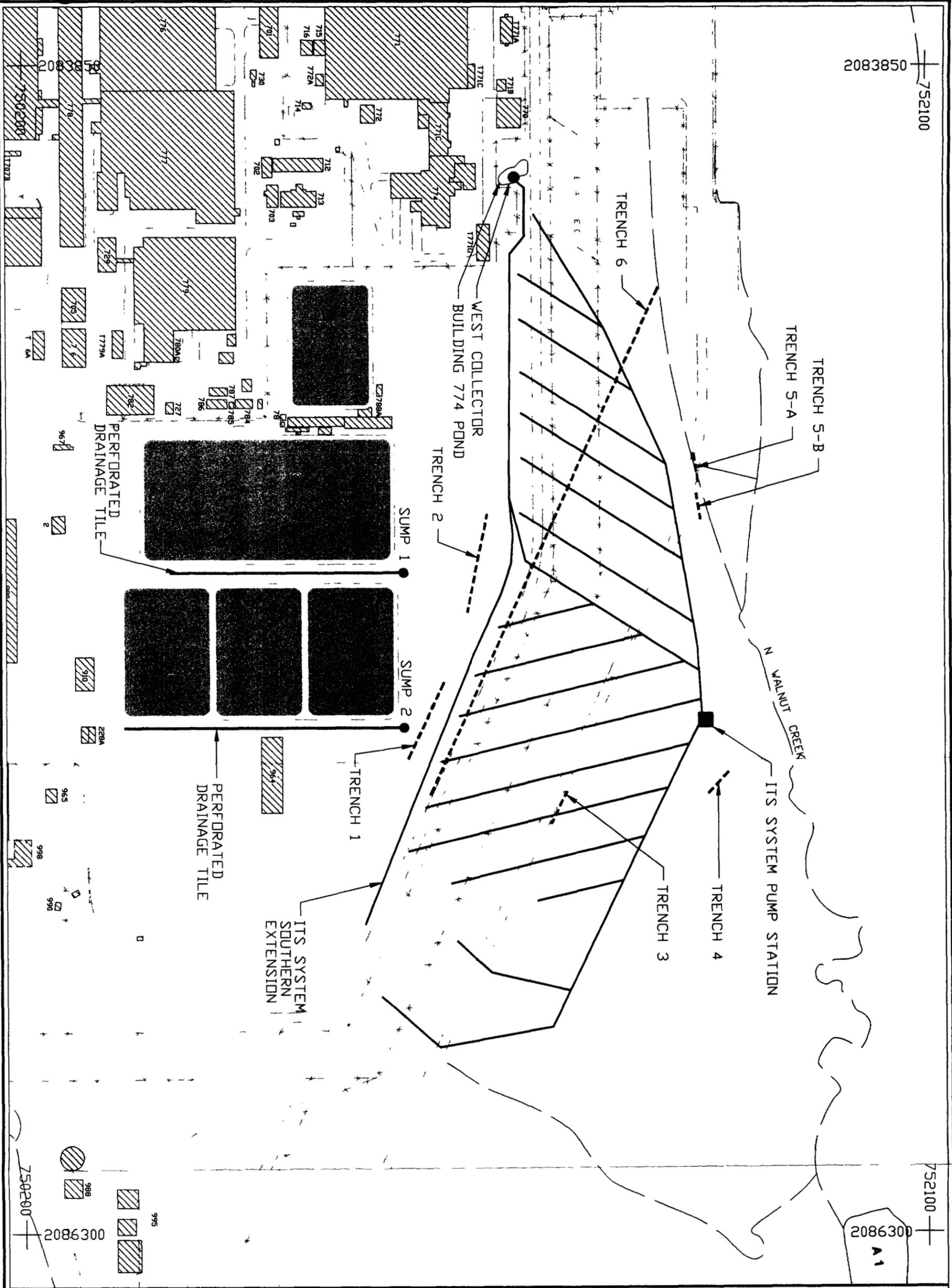
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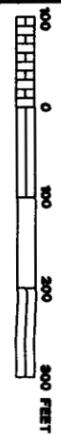


LEGEND

- Stream
- Paved Roads
- ▨ Buildings
- ▨ Fence
- Solar Evaporation Pond (SEP)
- ▬ Interceptor Trench System
- - - Former Trenches or French Drains
- Perforated Drainage Tile
- Sump Locations

NOTES

1 Actual lengths and construction details not known.



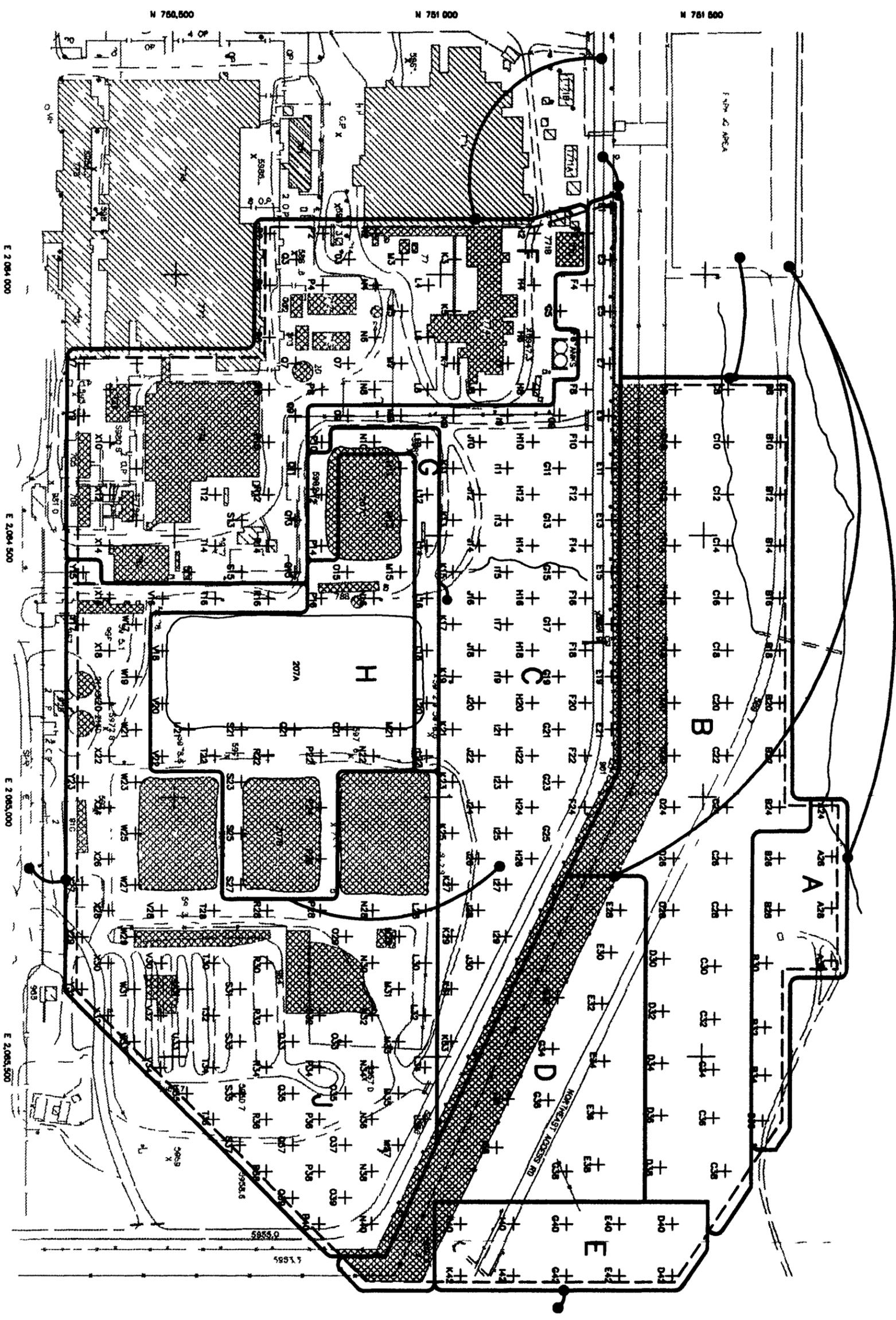
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 GOLDEN COLORADO

Figure II 13

Solar Evaporation Ponds
 Operable Unit No. 4 IM/RA EA DD
 ITS and Former Ground Water Collection
 Trenches and Sumps

183

* SEPs 207-A 207-B Center and 207-B North radiological surveys were completed by EG&G



LEGEND

- Roads
- Drainage/Stream
- + Grid Location of Radiological Reading
- FIDLER Checkpoint Reading Location
- Radiological Survey Boundary
- Surface Soil Sampling Location Boundary
- Areas Inaccessible for Radiological Survey

BOUNDED REGION	BACKGROUND READING (gpm)
A	1947
B	2311
C	1929
D	1947
E	1954
F	1855
G	1547
H	1834
J	1429



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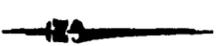
Figure B 2 5
 Salar Evaporation Ponds
 Operate Unit No 4, M/RA EA DD
 OU Wide FIDLER Survey

SEP 207-B NORTH

11	22	33	44	55	66	77	88	99	110	121	132	143	154	165
10	21	32	43	54	65	76	87	98	109	120	131	142	153	164
9	20	31	42	53	64	75	86	97	108	119	130	141	152	163
8	19	30	41	52	63	74	85	96	107	118	129	140	151	162
7	18	29	40	51	62	73	84	95	106	117	128	139	150	161
6	17	28	39	50	61	72	83	94	105	116	127	138	149	160
5	16	27	38	49	60	71	82	93	104	115	126	137	148	159
4	15	26	37	48	59	70	81	92	103	114	125	136	147	158
3	14	25	36	47	58	69	80	91	102	113	124	135	146	157
2	13	24	35	46	57	68	79	90	101	112	123	134	145	156
1	12	23	34	45	56	67	78	89	100	111	122	133	144	155

A B C D E F G H I J K L M N O

SEP 207-B SOUTH



LEGEND

150
Square Grid Area
With Survey Location

Approximate Scale: 1 inch = 25 Feet

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Figure H.2-7

Solar Evaporation Ponds
Operable Unit No. 4, M/RA EA DD
Grid Used for Radiological Survey Of
SEP 207-B Center

165

106

11	11	22	33	44	55	66	77	88	99	110	121	132	143	154	165
10	10	21	32	43	54	65	76	87	98	109	120	131	142	153	164
9	9	20	31	42	53	64	75	86	97	108	119	130	141	152	163
8	8	19	30	41	52	63	74	85	96	107	118	129	140	151	162
7	7	18	29	40	51	62	73	84	95	106	117	128	139	150	161
6	6	17	28	39	50	61	72	83	94	105	116	127	138	149	160
5	5	16	27	38	49	60	71	82	93	104	115	126	137	148	159
4	4	15	26	37	48	59	70	81	92	103	114	125	136	147	158
3	3	14	25	36	47	58	69	80	91	102	113	124	135	146	157
2	2	13	24	35	46	57	68	79	90	101	112	123	134	145	156
1	1	12	23	34	45	56	67	78	89	100	111	122	133	144	155

A B C D E F G H I J K L M N O

SEP 207-B CENTER



LEGEND



150

Square Grid Area
With Survey Location

Approximate Scale: 1 inch = 25 Feet

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GOLDEN COLORADO

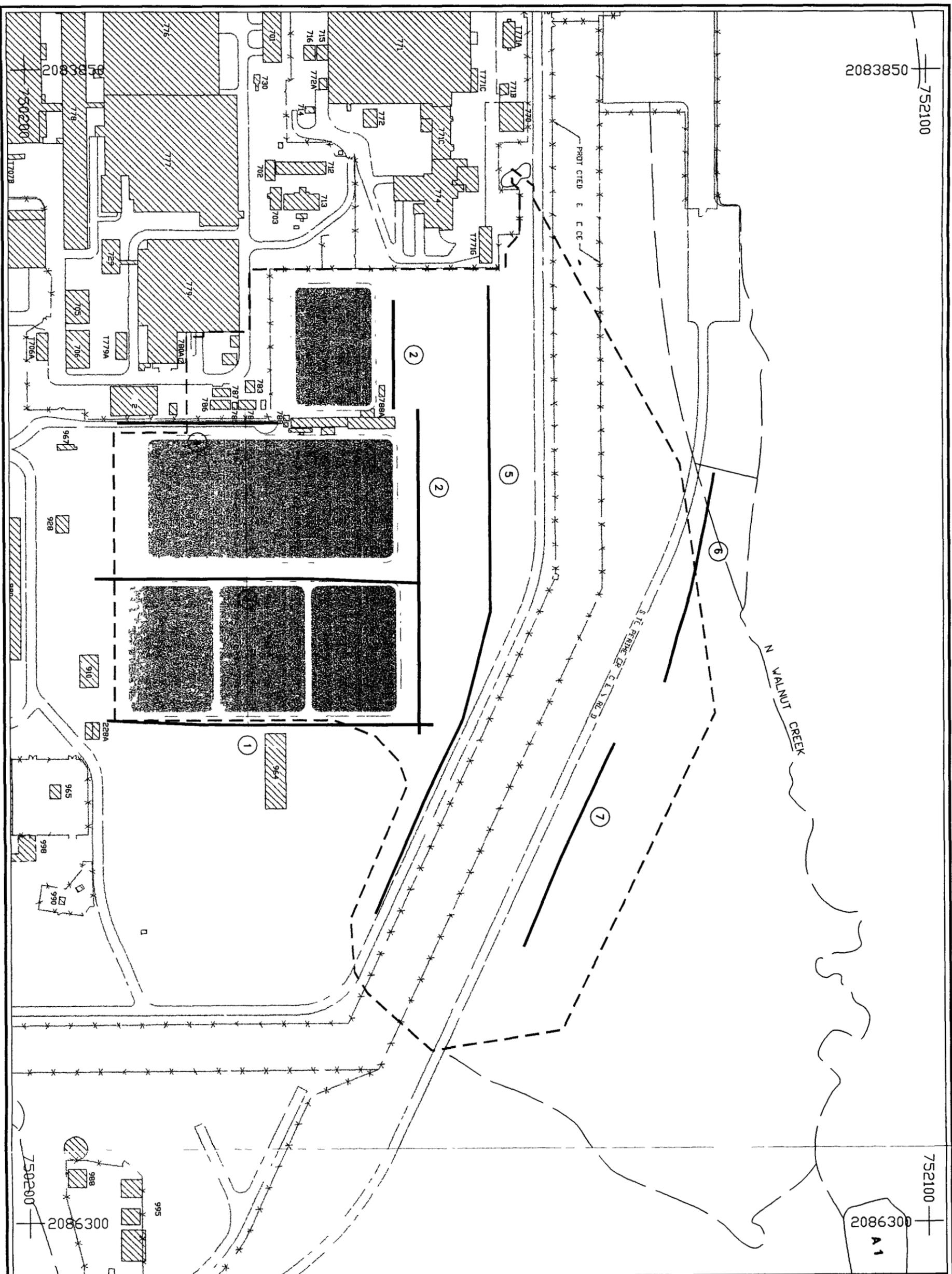
Figure R.2-8

Solar Evaporation Ponds
Operable Unit No. 4, M/RA EA DD
Grid Used for Radiological Survey of
SEP 207-B North

107

2083850
752100

752100
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A 1



LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- OUA Boundary
- ▨ Solar Evaporation Pond (SEP)
- Seismic Refraction Survey Line
- ① Refraction Line Number



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GOLDEN COLORADO

Figure II 2 9
 Solar Evaporation Ponds
 Operable Unit No 4 IM/IRA EA DD
 Location of Seismic Refraction Survey

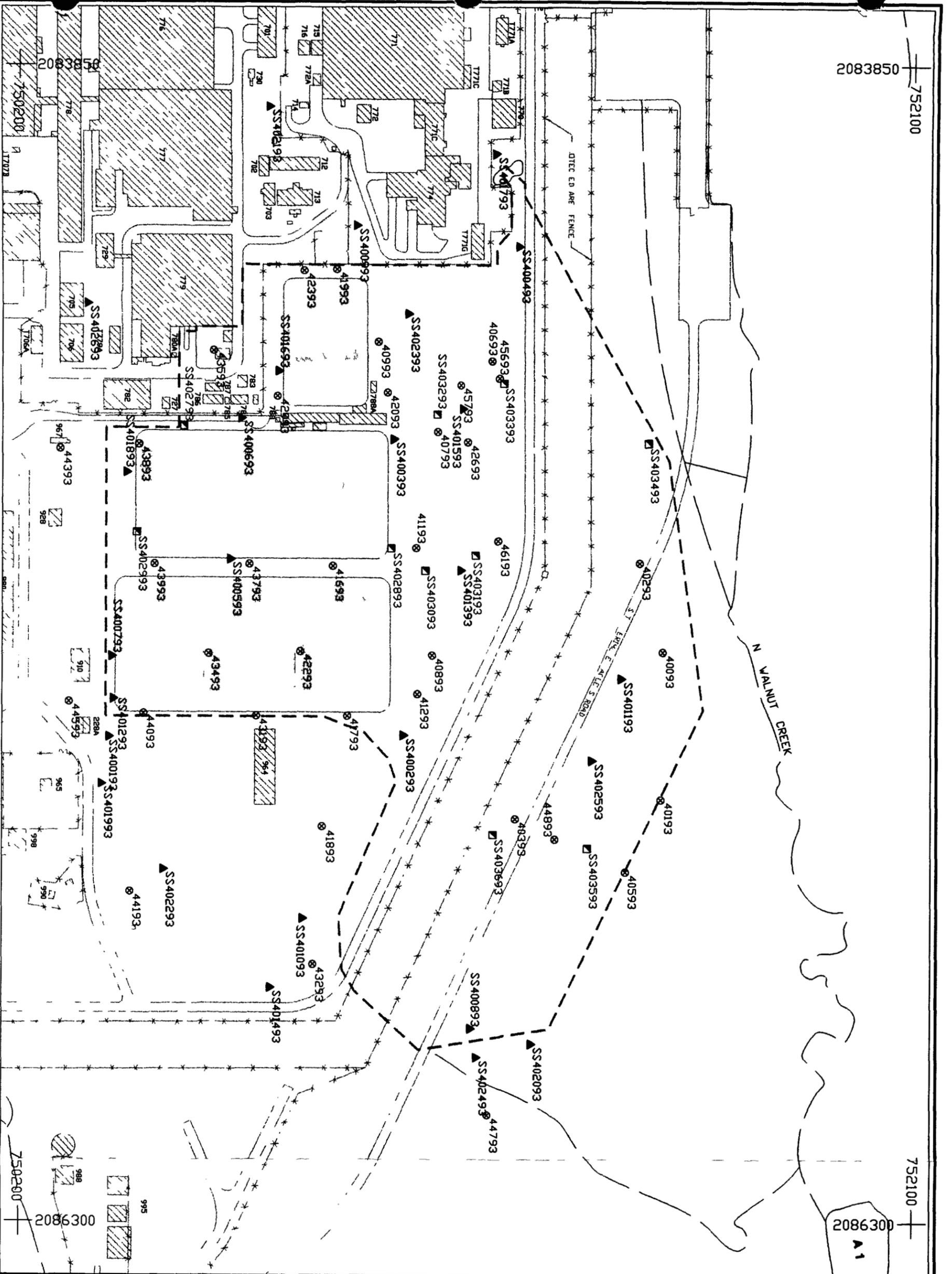
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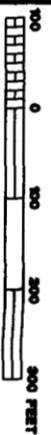
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A 1



LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- Fence
- Solar Evaporation Ponds (SEP)
- OUA Boundary
- ⊙ 44793 Borehole Surficial Soil Sampling Location
- ▲ SS402493 Random Surficial Soil Sampling Location
- SS403693 Discrete Surficial Soil Sampling Location



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Figure II 2 12

Solar Evaporation Ponds
 Operable Unit No. 4 IM/RA EA DD
 Locations of Surficial Soil Samples

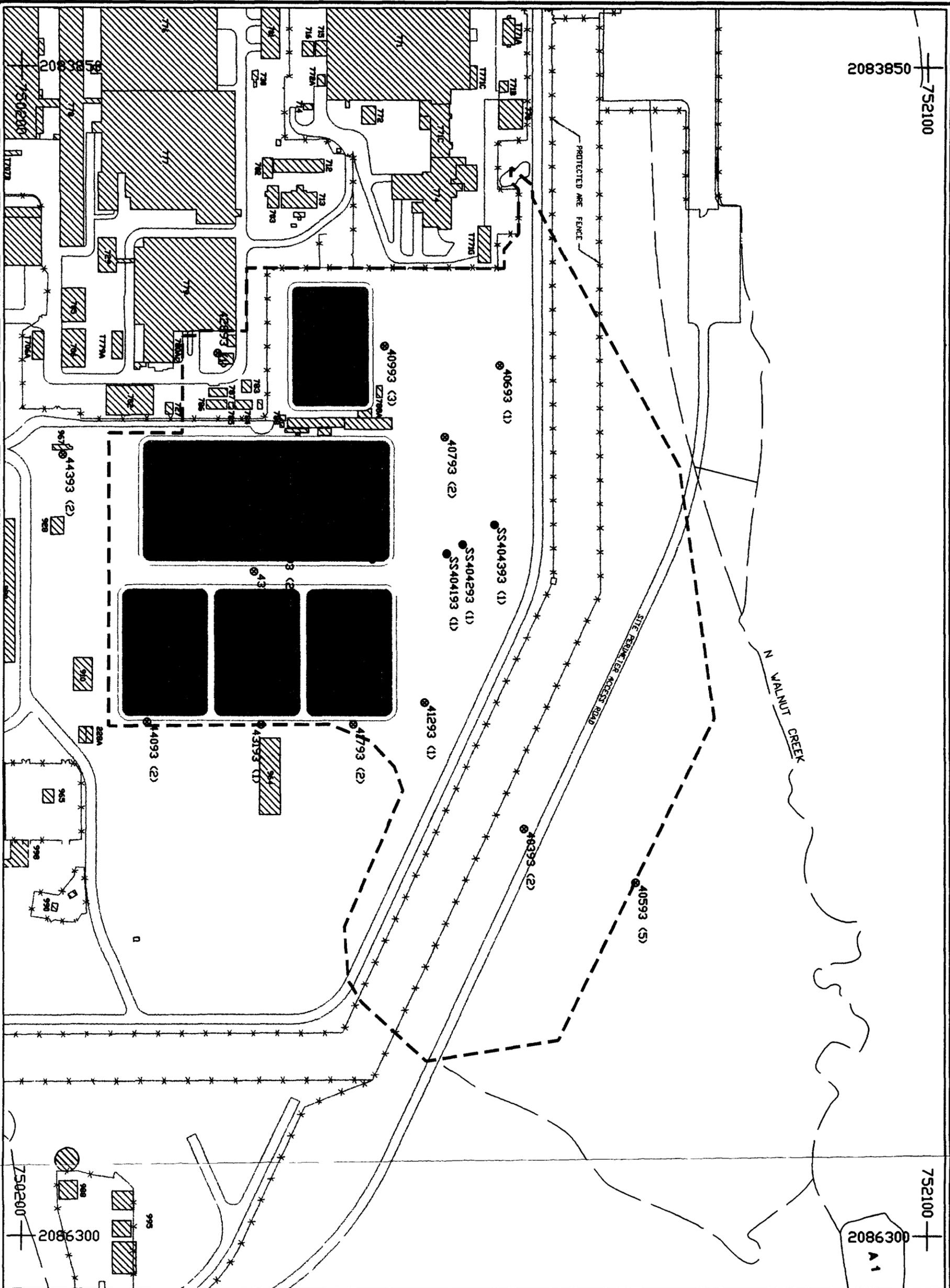
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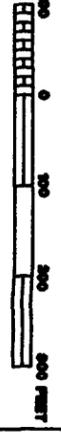
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A 1



LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- OJA Boundary
- Solar Evaporation Pond (SEP)
- 41293 Physical Properties Sample Location And Identification
- 42193 Column Leach Test Sample Location And Identification
- (2) Number Of Samples From Location



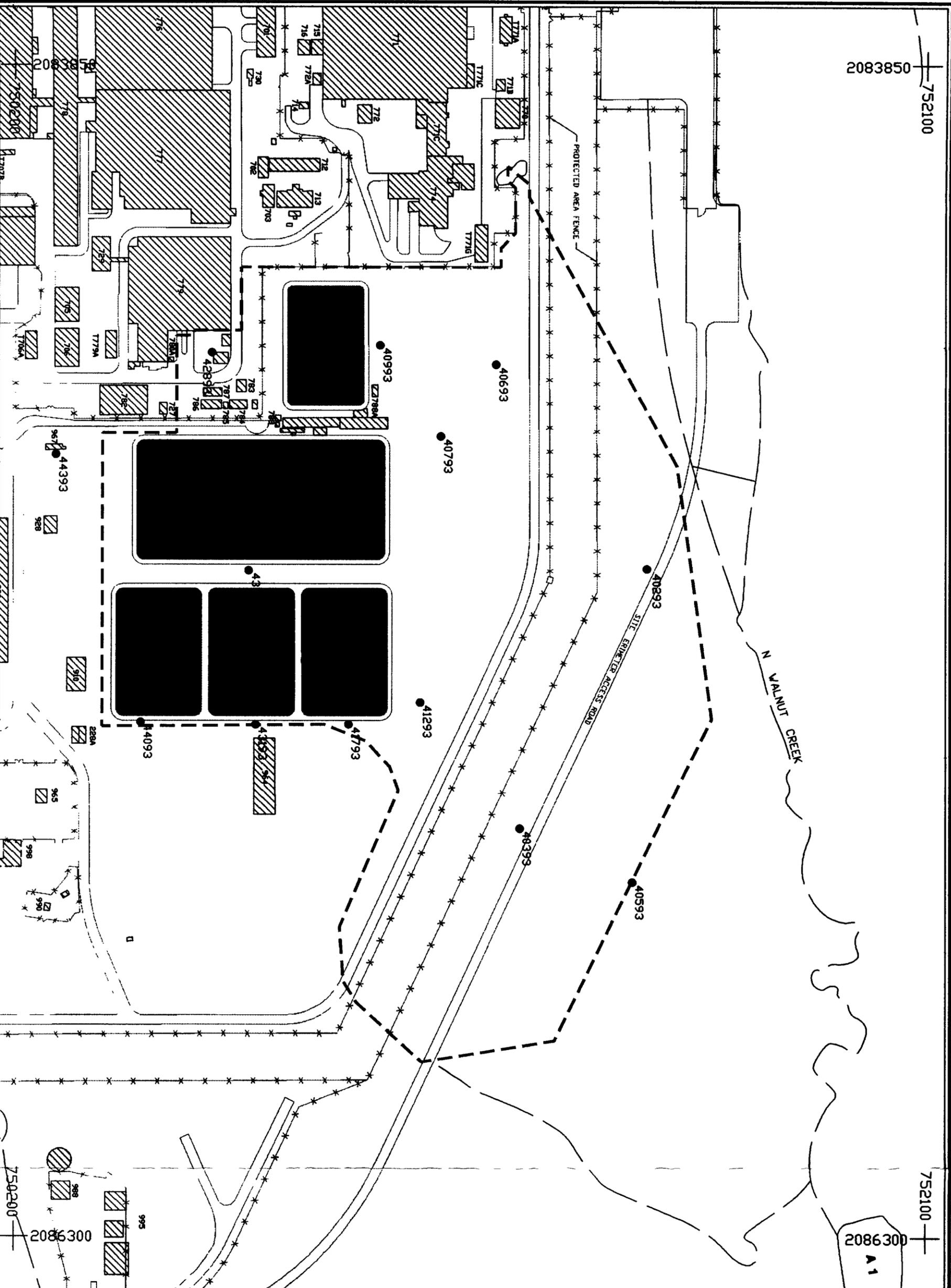
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Figure E.2-18

Solar Evaporation Ponds
 Operable Unit No. 4, M/RA EA DD
 Physical Properties And Column Leach
 Test Sample Locations

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A 1



LEGEND

- Stream
- Paved Roads
- ▨ Buildings
- *** Fence
- O&U Boundary
- Solar Evaporation Pond (SEP)
- 40593 BAT™ Test Location And Identification



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Figure R.2 14

Solar Evaporation Ponds
Operable Unit No. 4, IM/RA EA DD
BAT™ Permeability Testing Locations

115

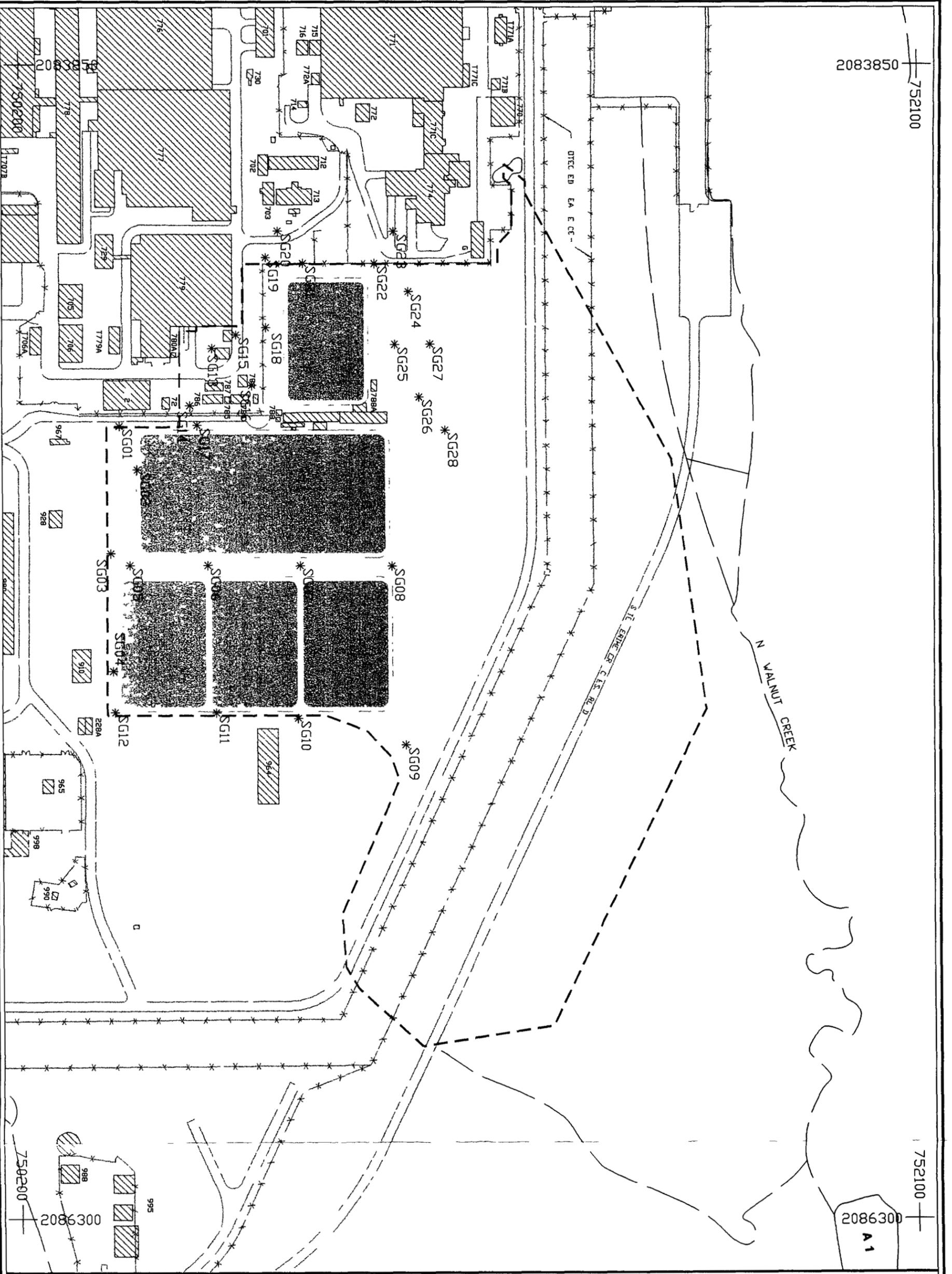
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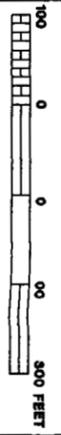
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A 1



LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *—*— Fence
- OUA Boundary
- Solar Evaporation Pond (SEP)
- * SG01 Sample Location and Identification



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Figure 11 2 17

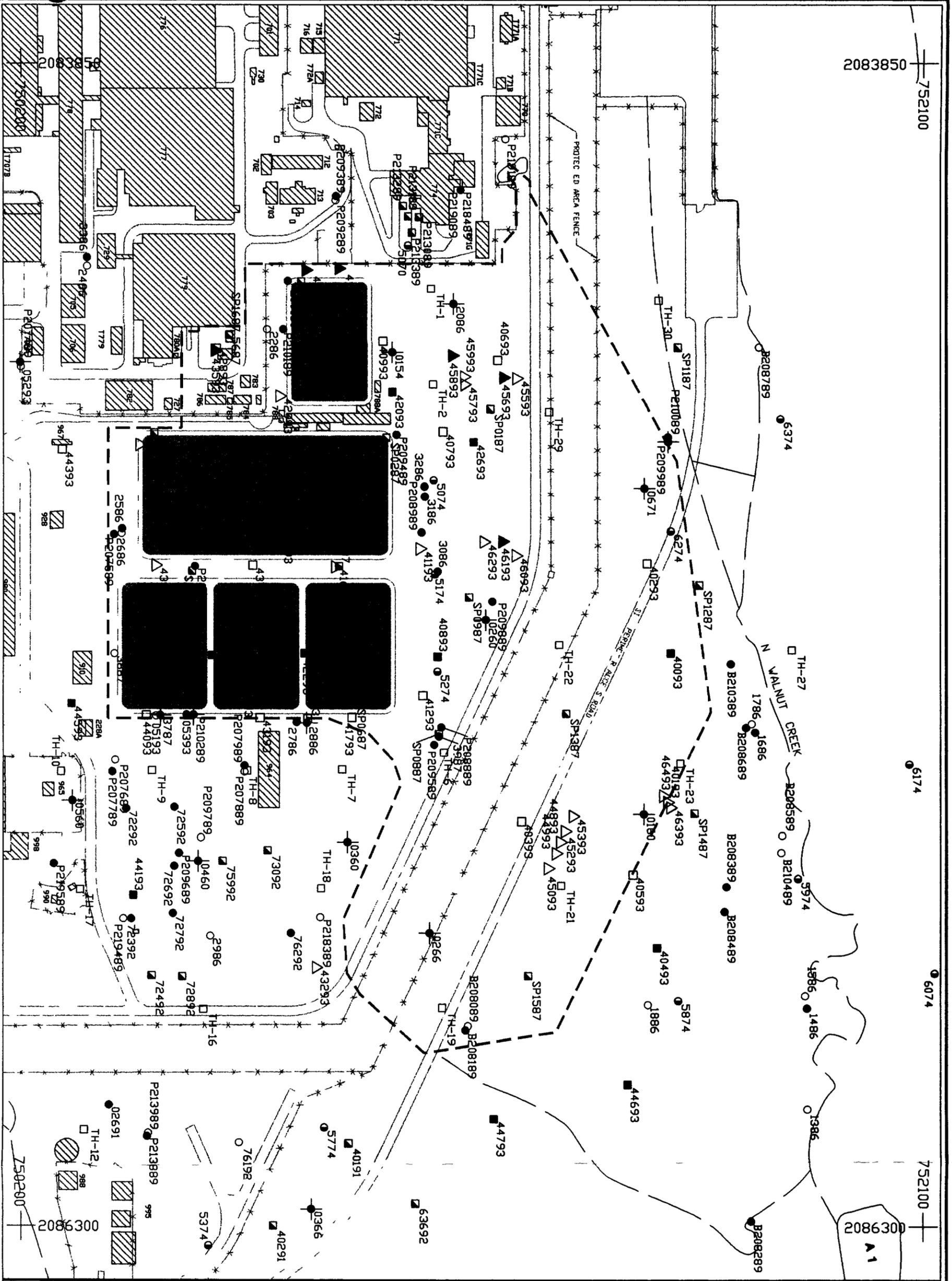
Solar Evaporation Ponds
 Operable Unit No. 4 IM/RA EA DD
 Soil Gas Sampling Locations

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6174 6074

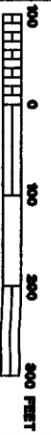
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LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- * * * Fence
- OUA Boundary
- Solar Evaporation Pond (SEP)
- Abandoned Monitoring Well and Identification
- △ 45093 Phase I Unconsolidated Materials Piezometer Location and Identification
- ▲ 41993 Phase I Bedrock Piezometer Location and Identification
- 41293 Phase I Vadose Zone Monitoring Location and Identification
- 44693 Phase I Soil Borehole Location and Identification
- 72992 Historical Soil Borehole Location and Identification
- 1886 Historical Alluvial Monitoring Well and Identification
- 76292 Historical Bedrock Monitoring Well and Identification
- TH 22 TH Boreholes and Identification
- 5074 Alluvial/Bedrock Monitoring Well and Identification



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Figure II 2.18

Solar Evaporation Ponds
 Operable Unit No. 4 M/RA EA DD
 Locations Of Phase I And Historical
 Boreholes and Monitoring Well
 Locations In OUA

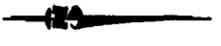
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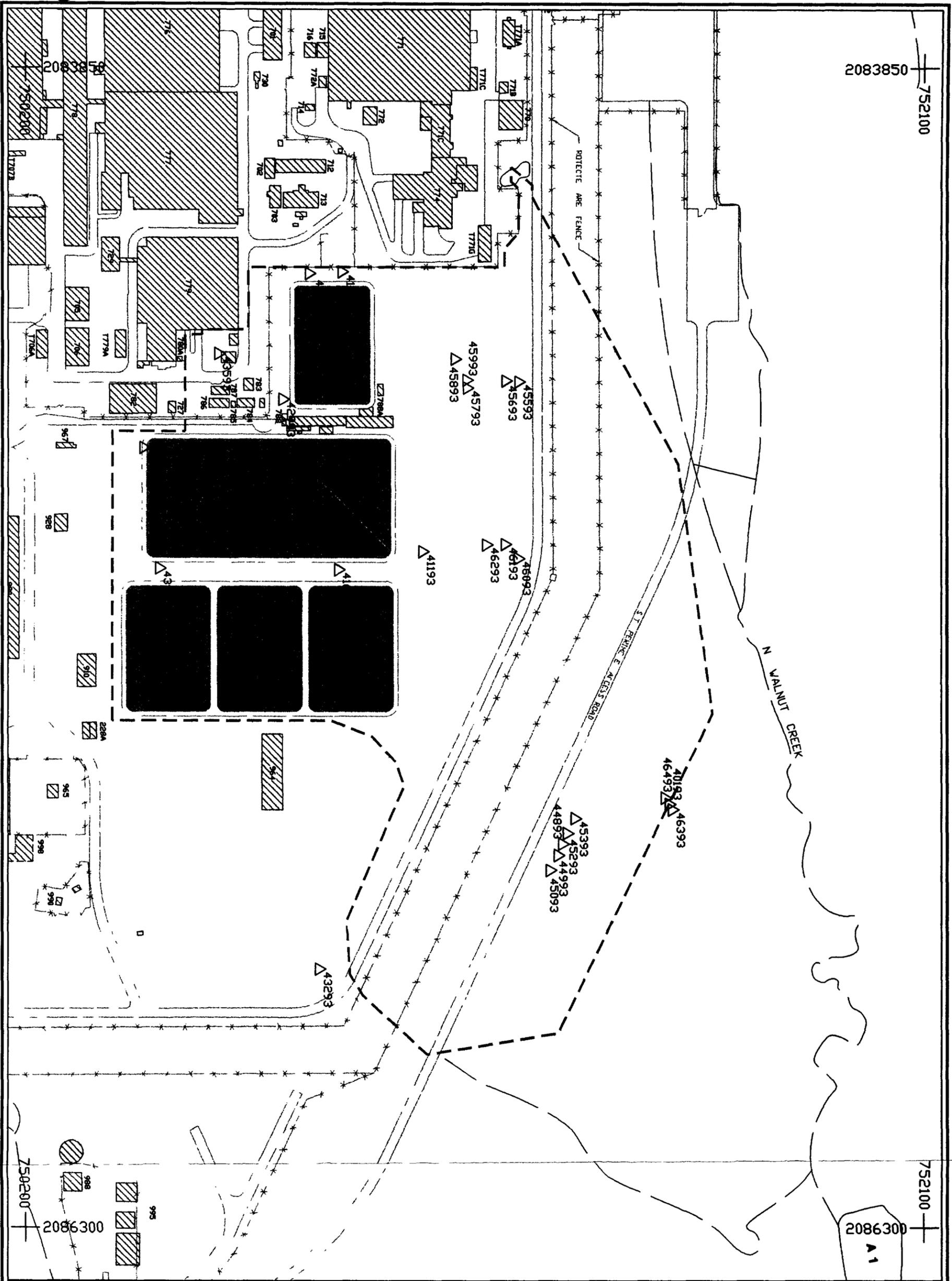
LEGEND

- - - Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- - - OUA Boundary
- Solar Evaporation Pond (SEP)
- △ 46093 Pizometer Location and Identification



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Figure E.2.19
 Solar Evaporation Ponds
 Operable Unit No. 4, M/RA EA DD
 Phase I Pizometer Locations



117

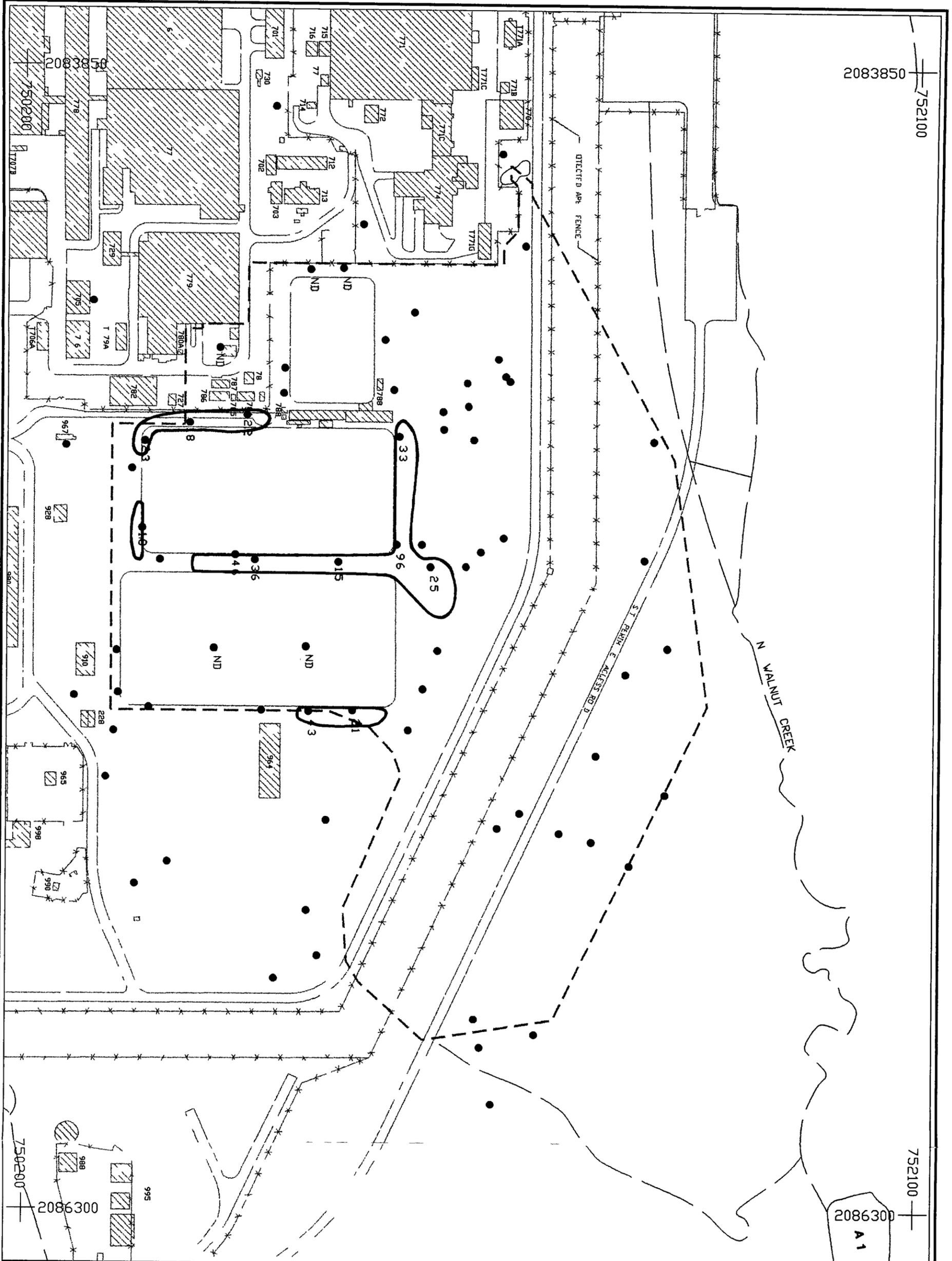
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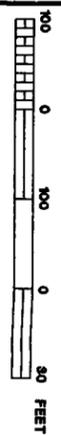


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- OU4 Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 25 Results in mg/kg
- E tent of Contamination Above Background 95/ UCL of 0.92 mg/kg

NOTES

1 Sample location without result indicates that value is less than 95% UCL



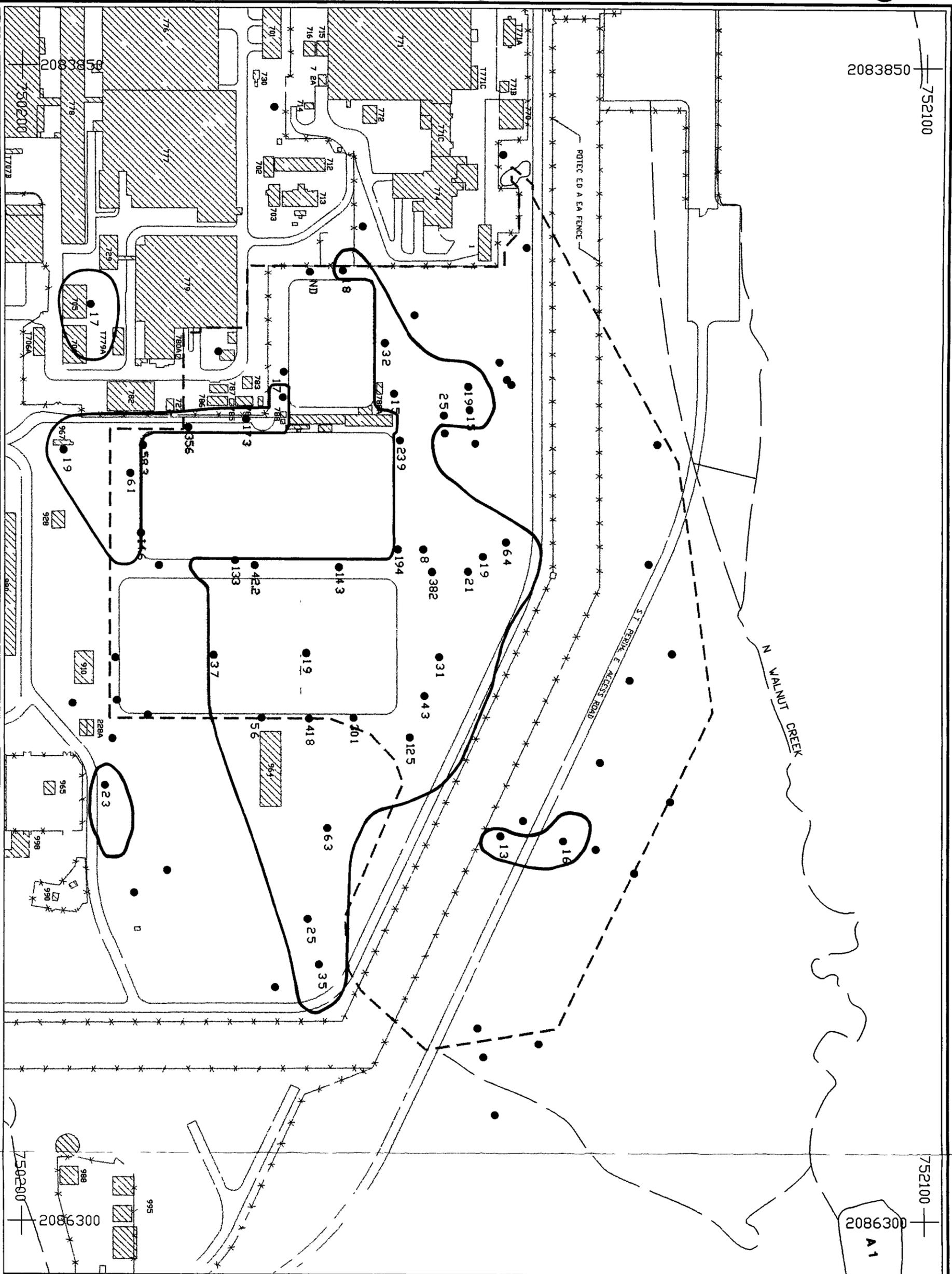
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Figure II 4 4 1
 Solar Evaporation Ponds
 Operable Unit No 4 IM/IRA EA DD
 Extent of Beryllium In Surficial Soils

501

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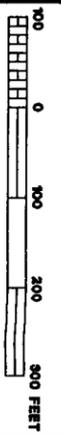
A 1

LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- O&U Boundary
- Sample Location
- 160 Results in mg/kg
- Extent of Contamination Above Background 95% UCL of 0.64 mg/kg

NOTES

1 Sample location without result indicates that value is less than 95% UCL

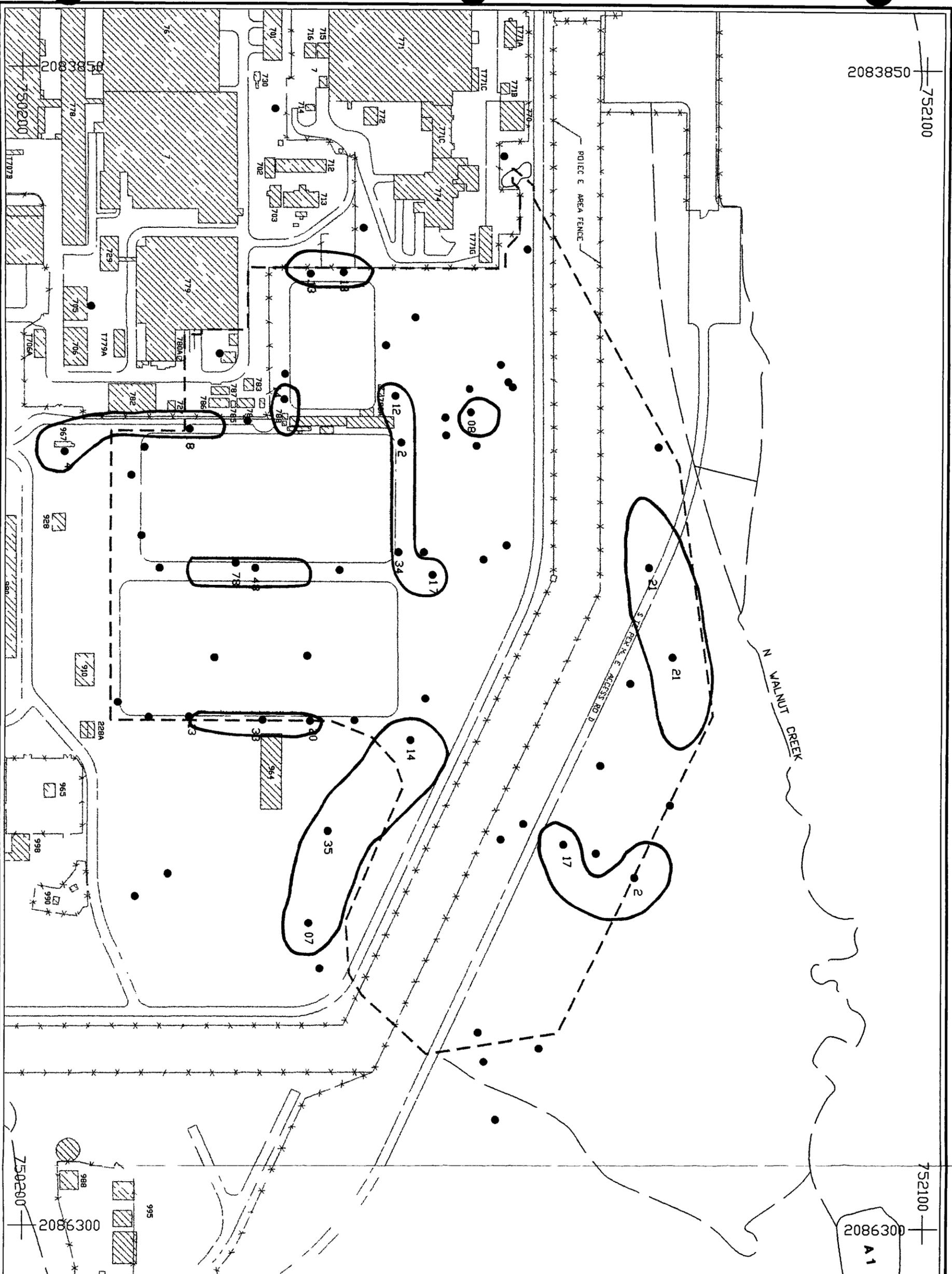


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Figure 11 4 4 2
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DD
 Extent of Cadmium in Surficial Soils

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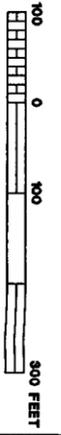


LEGEND

- Streams
- Paved Road
- ▨ Buildings
- *-*-* Fence
- O/U4 Bo d y
- Solar Evaporation Pond (SEP)
- Sample Location
- 014 Results in mg/kg
- Extent of Contamination Above Background 95% UCL of 0.03 mg/kg

NOTES

1 Sample location without result
Indicates that value is less than 95% UCL



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Figure II 4 4 4
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DD
 Extent of Mercury in Surficial Soils

503

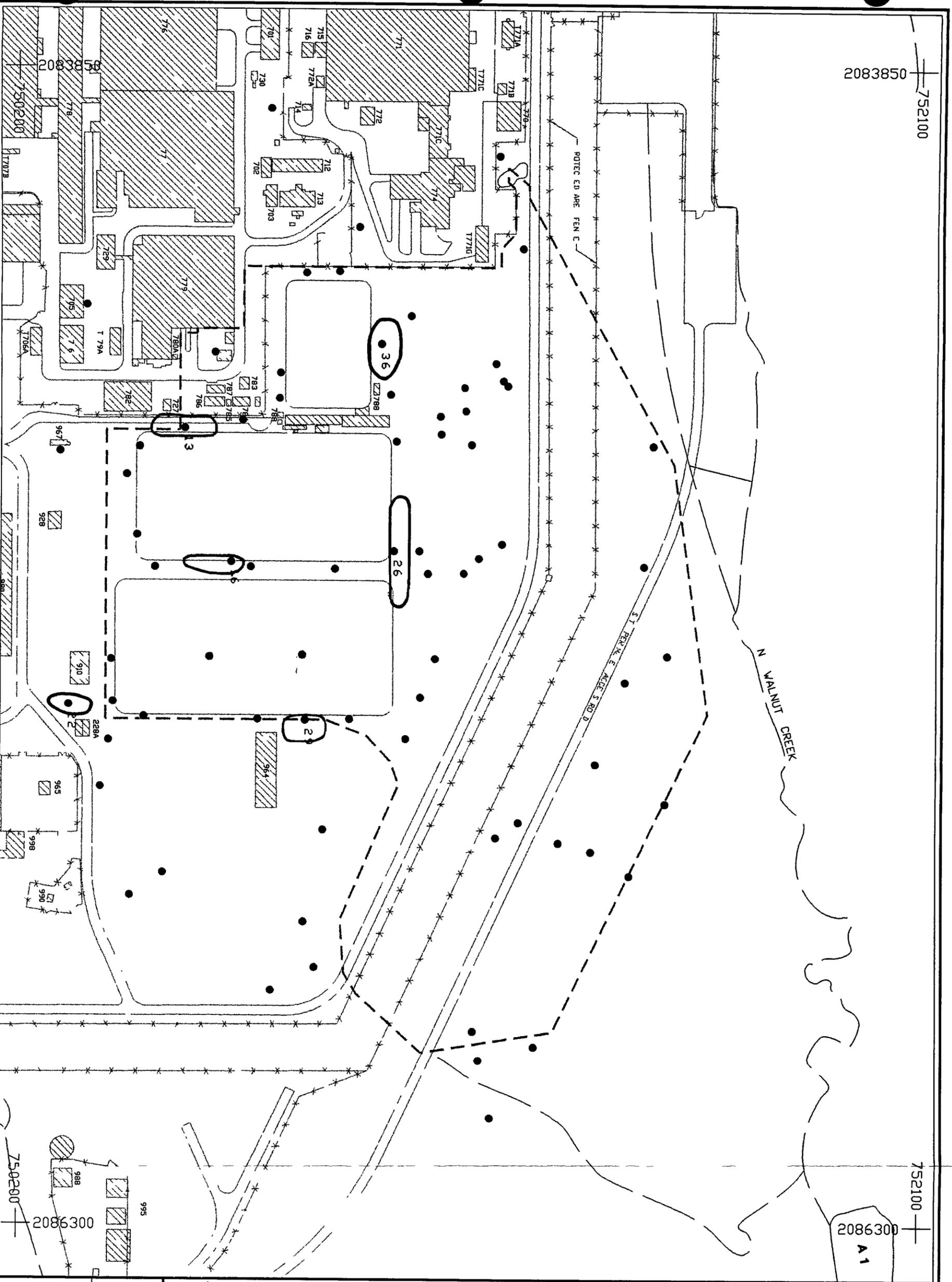
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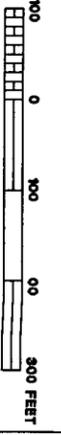


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- OU4 Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 36 Results in mg/kg
- Extent of Contamination Above Background
- 95% UCL of 0.58 mg/kg

NOTES

1 Sample location without result indicates that value is less than 95% UCL



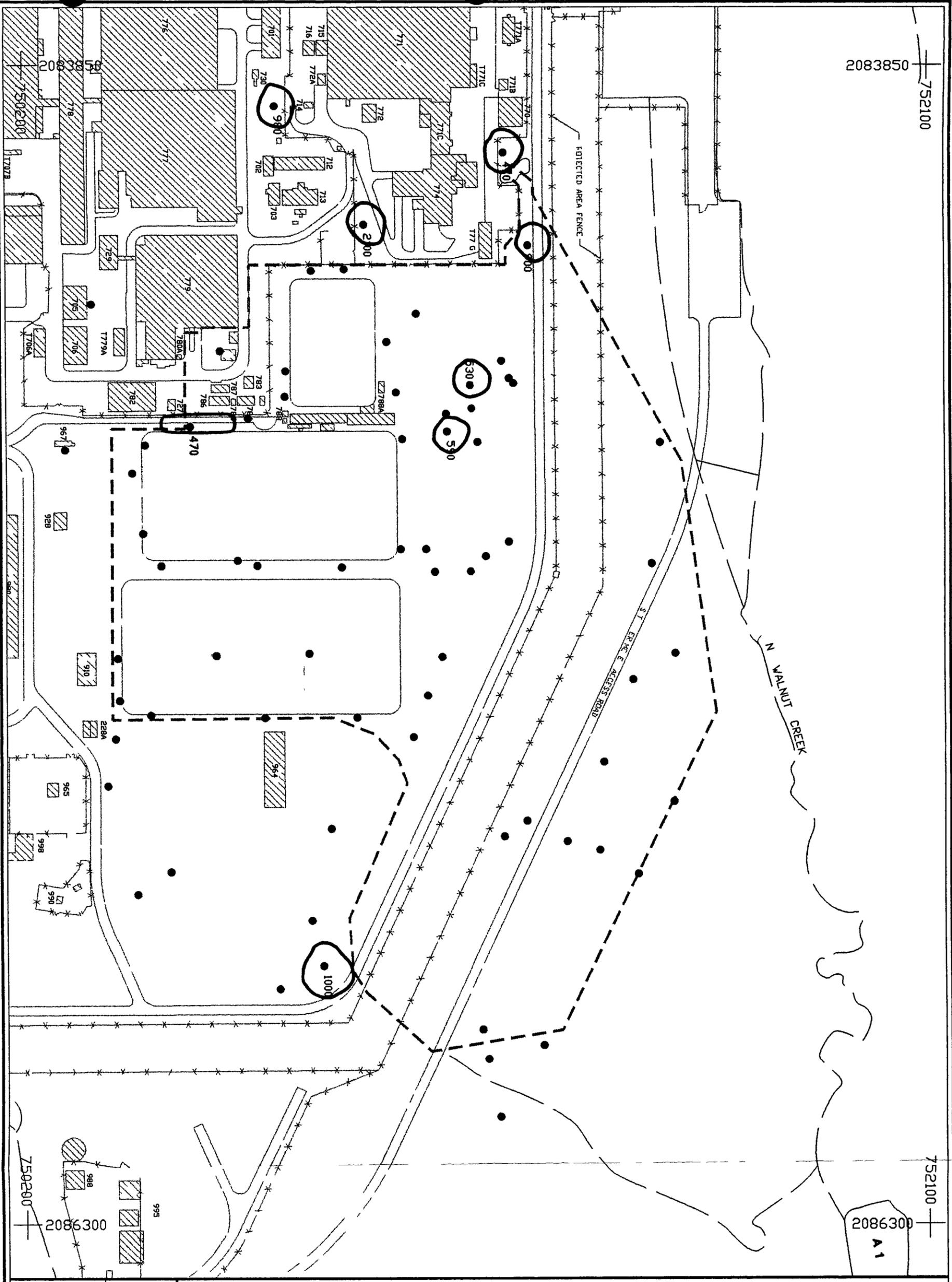
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Figure II 4 4 5

Solar Evaporation Ponds
 Operable Unit No 4 IM/IRA EA DD
 Extent of Silver in Surficial Soils

507

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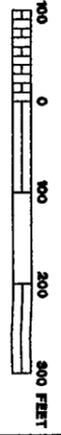
2086300
752100
A 1

LEGEND

- Stream
- Paved Roads
- ▨ Buildings
- - - Fence
- - - OU4 Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- Results in mg/kg
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 95' UCL



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Figure 11.4-4-8

Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DD
 Extent of Benzolaplyrene
 in Surficial Soils

508

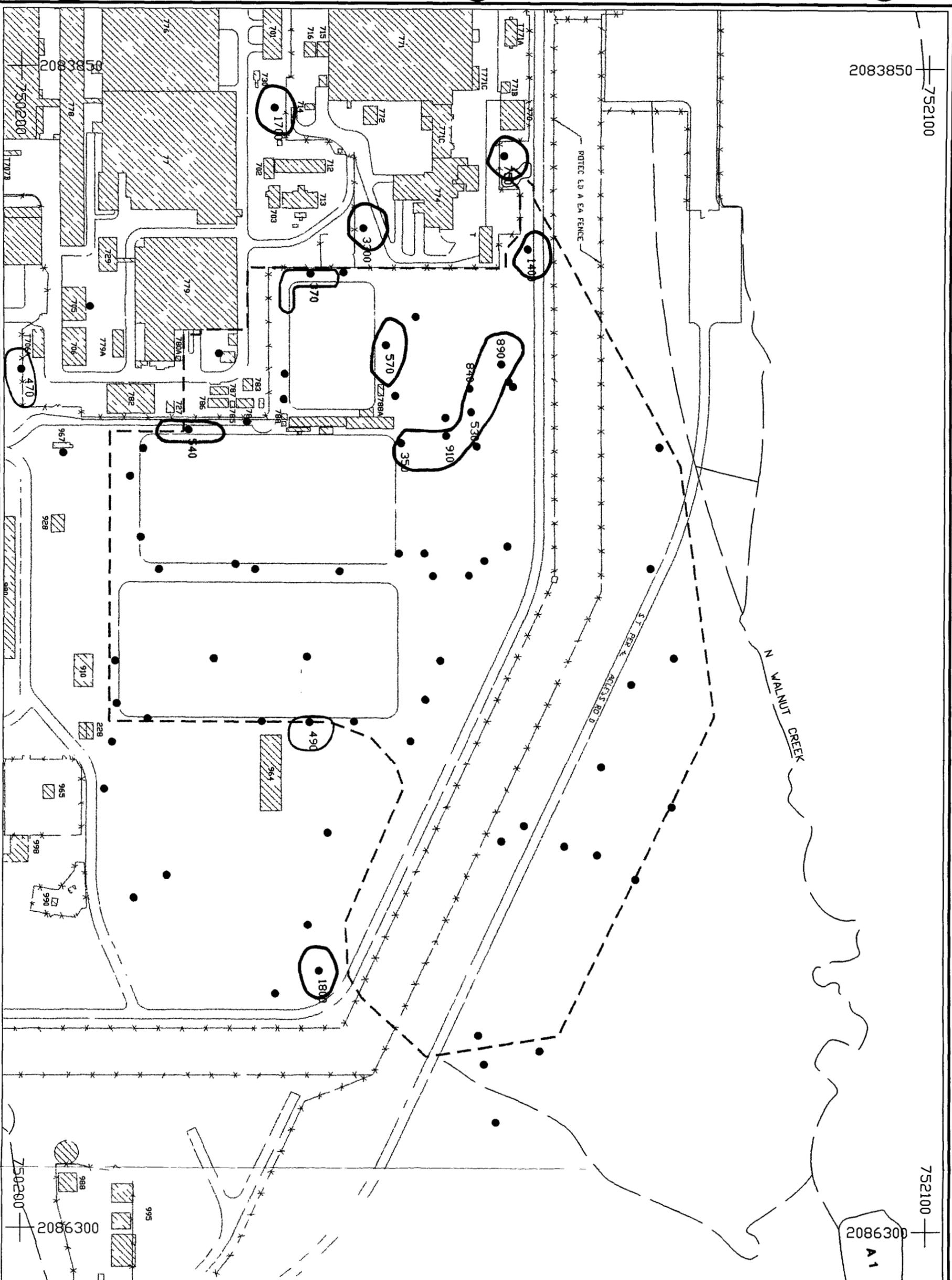
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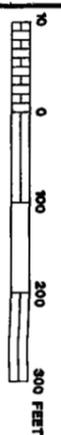


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- OU4 Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- Results in mg/kg
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 957 UCL



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Figure II 4.4 9
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DD
 Extent of Benzol(b)fluoranthene
 in Surficial Soils

589

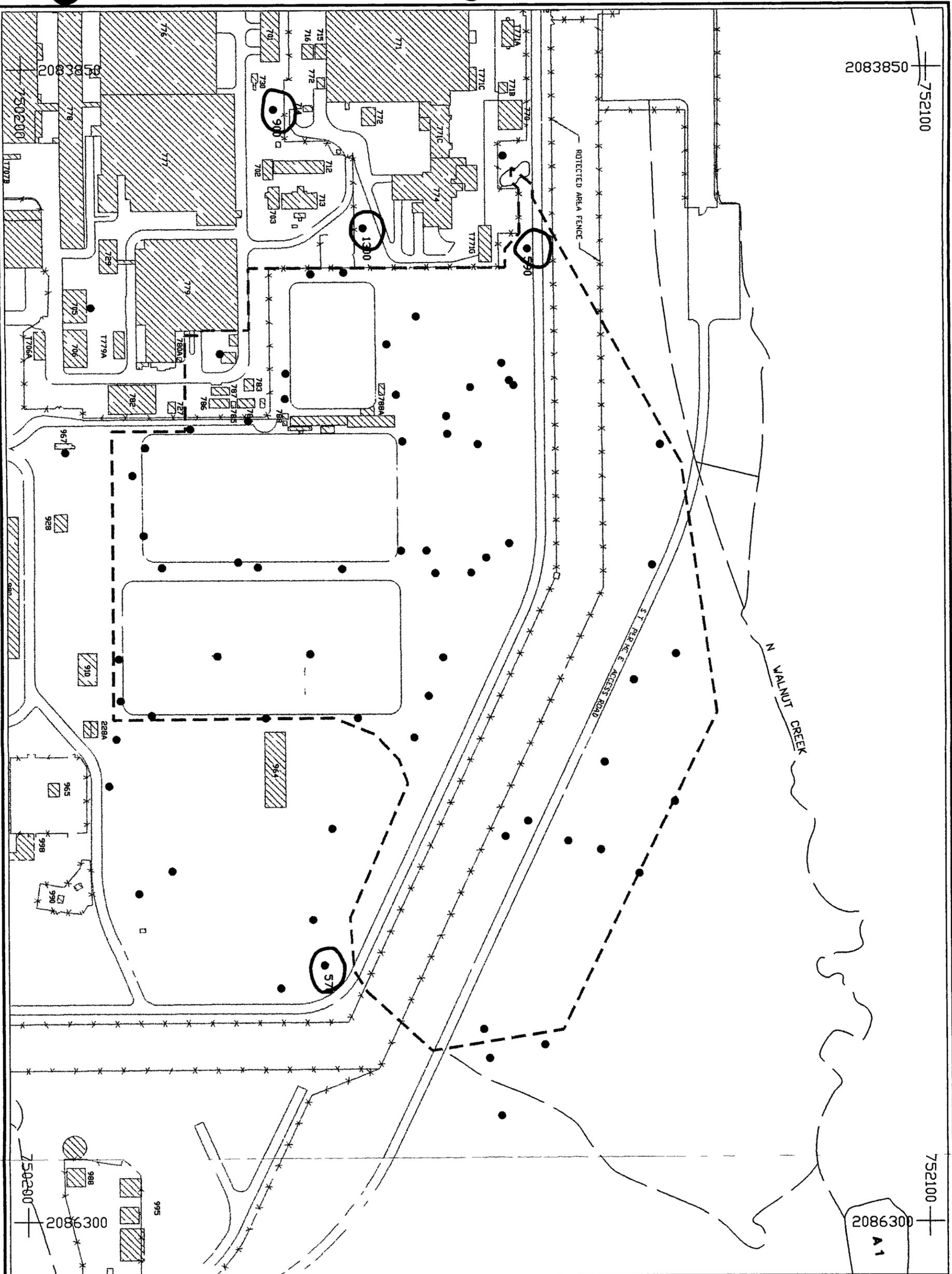
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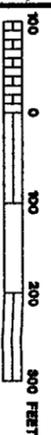


LEGEND

- Streams
- ==== Paved Roads
- ▨ Buildings
- *-*-* Fence
- OU4 Boundary
- ▭ Solar Evaporation Pond (SEP)
- Sample Location
- 570 Results In ug/Kg
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 957 UCL



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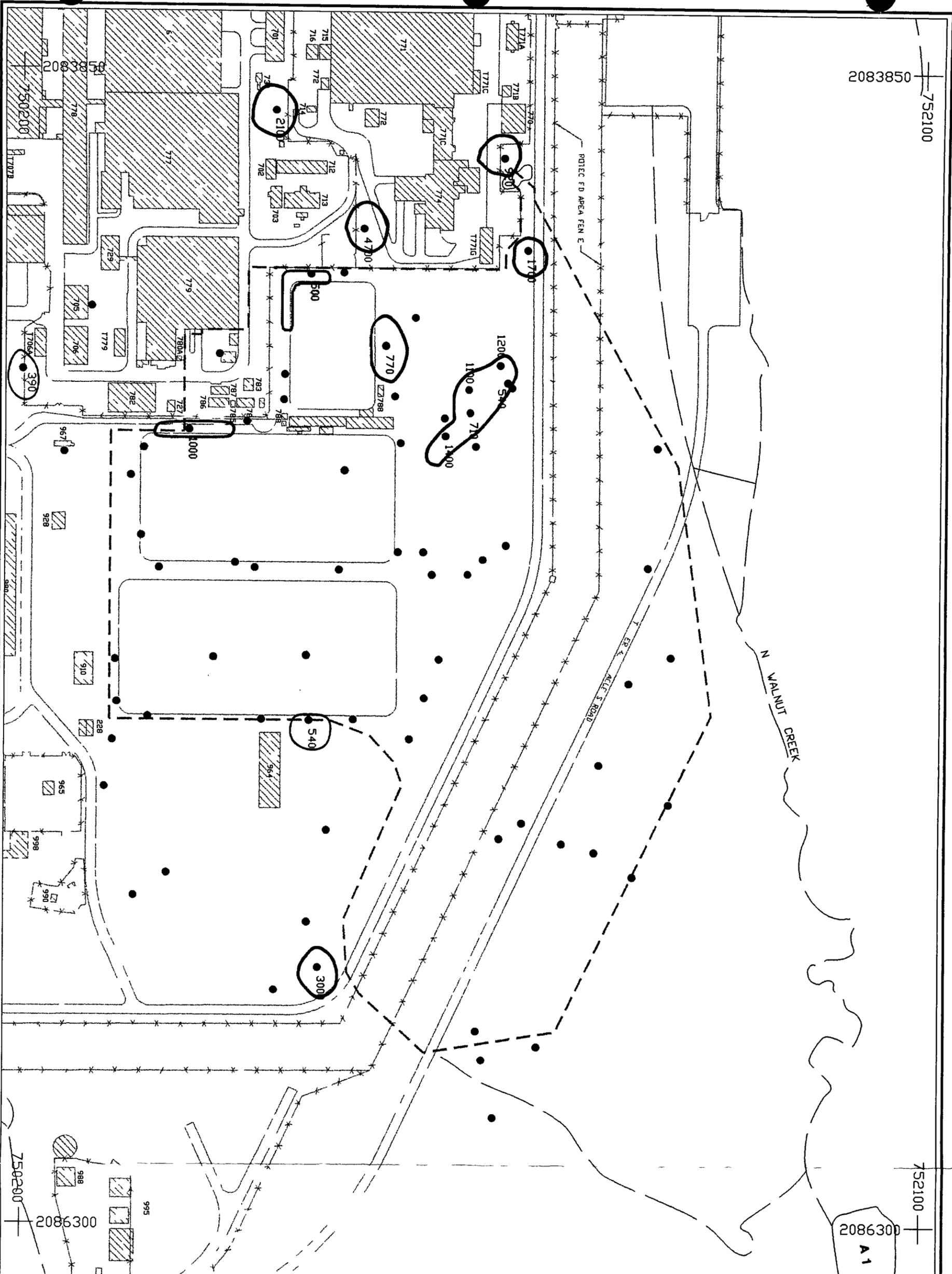
Figure 11 4-4-10

Solar Evaporation Ponds
 Operable Unit No. 4 IM/RA EA DD
 Extent of Benzofluorperylene
 In Surficial Soils

2083850
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752100

2086300
A 1

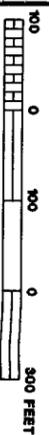


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *—*— Fence
- — — — — OU4 Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 770 Results in ug/kg
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 95/ UCL



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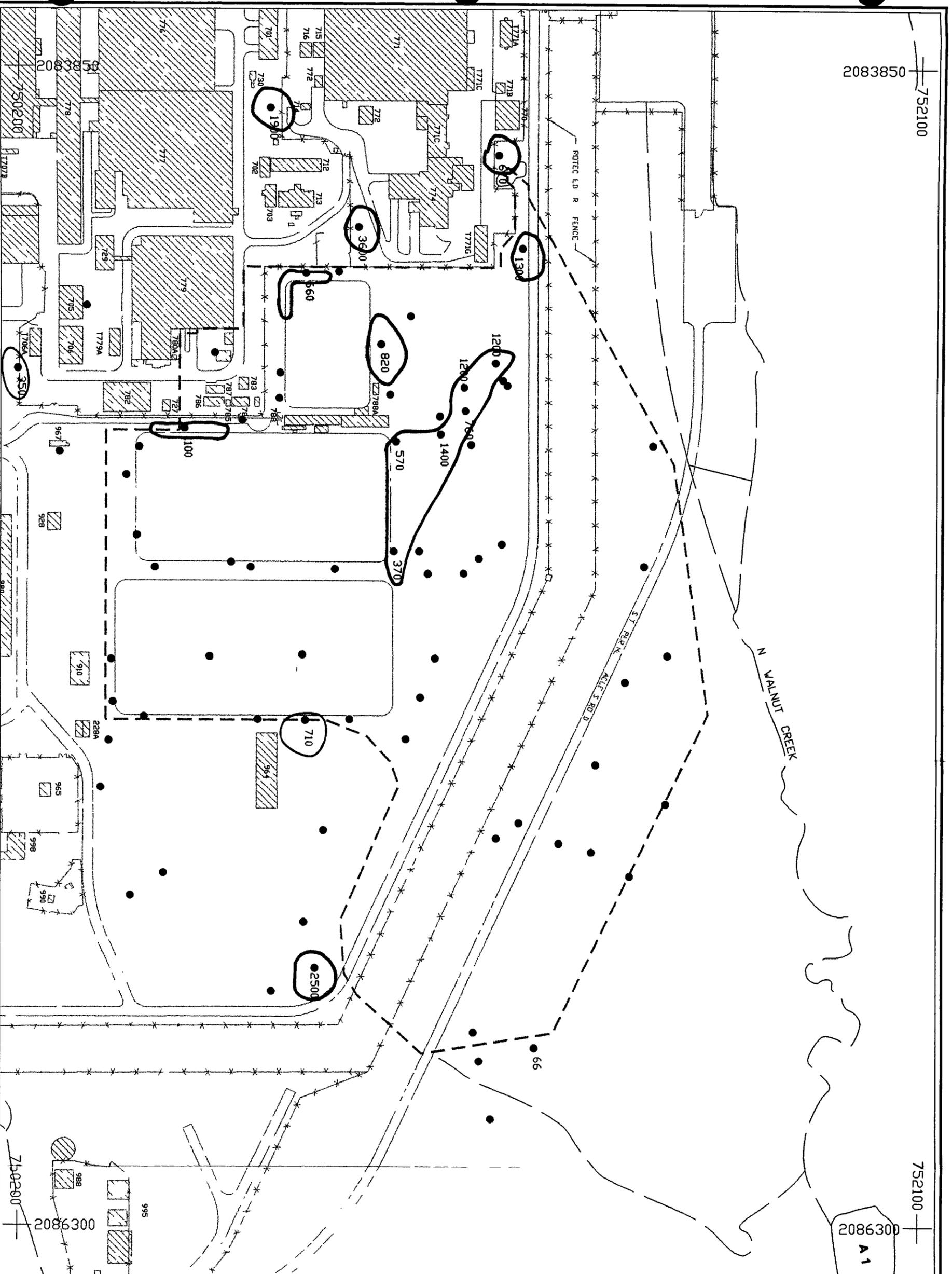
Figure II 4 4 13

Solar Evaporation Ponds
 Operable Unit No 4 IM/IRA EA DD
 Extent of Fluoranthene
 In Surficial Soils

512

2083850
752100

752100
2086300
A 1

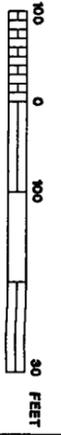


LEGEND

- Streams
- == Paved Roads
- ▨ Buildings
- x-x-x- Fence
- OU4 Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 570 Results in ug/kg
- Extent of Contamination Above Detect on Limit

NOTES

1 Sample location without result indicates that value is less than 95 / UCL



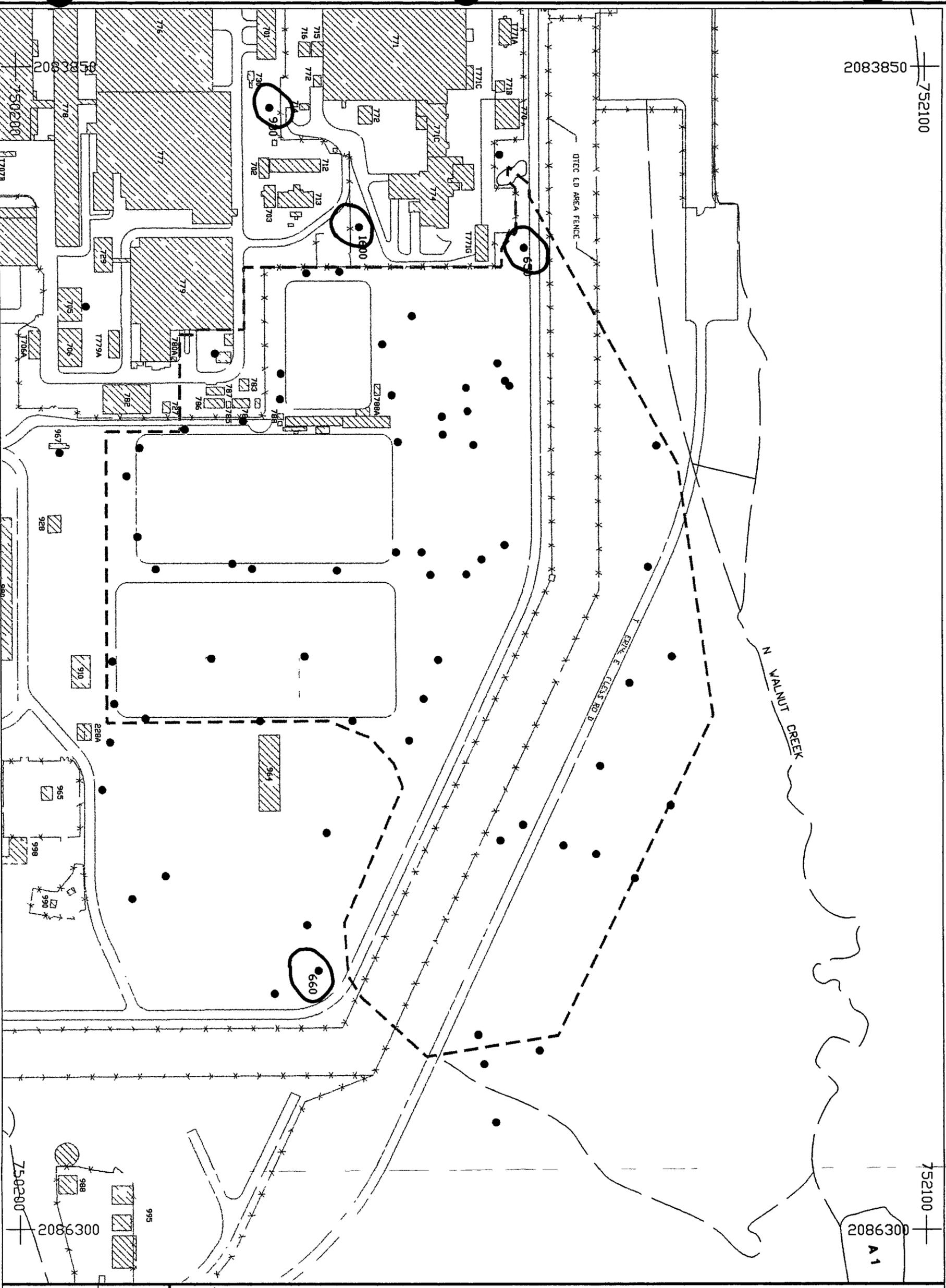
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Figure II 4 4 15
 Solar Evaporation Ponds
 Operable Unit No 4 IM/IRA EA DD
 Extent of Pyrene in Surficial Soils

514

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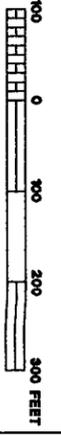
A 1

LEGEND

- Streams
- ==== Paved Roads
- ▨ Buildings
- *-*-* Fence
- OUA Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- Results in ug/kg
- 660
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 95 / UCL



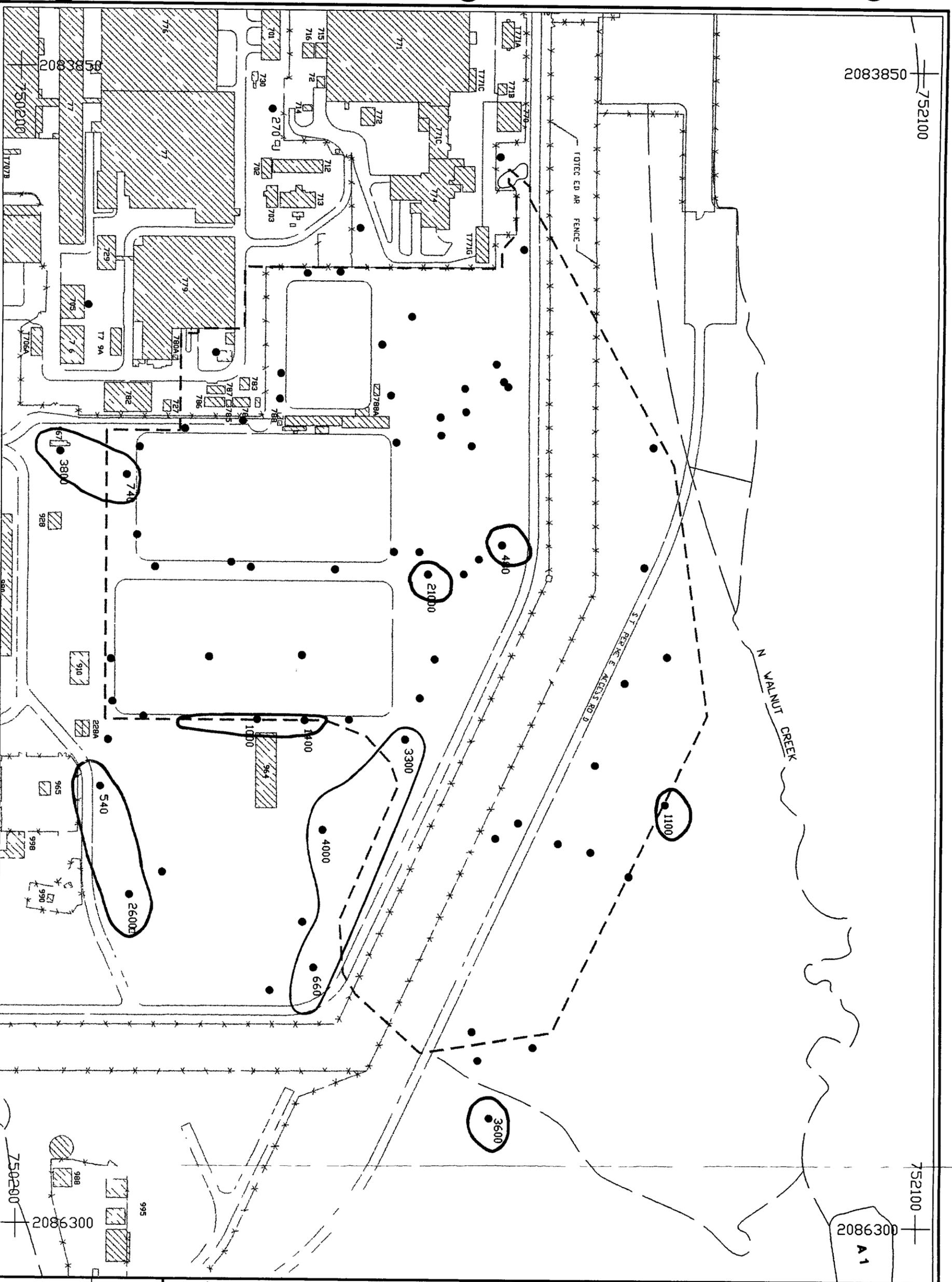
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Figure II 4 4 16
 Solar Evaporation Ponds
 Operable Unit No 4 IM/RA EA DD
 Extent of Indeno(1,2,3-cd)pyrene
 in Surficial Soils

5216

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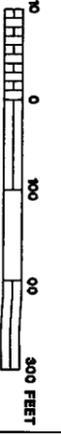


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- O&U Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- Results in ug/kg 540
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 95/ UCL



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Figure II 4 4 17

Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DD
 Extent of Bis(2-Ethylhexyl)phthalate
 In Surficial Soils

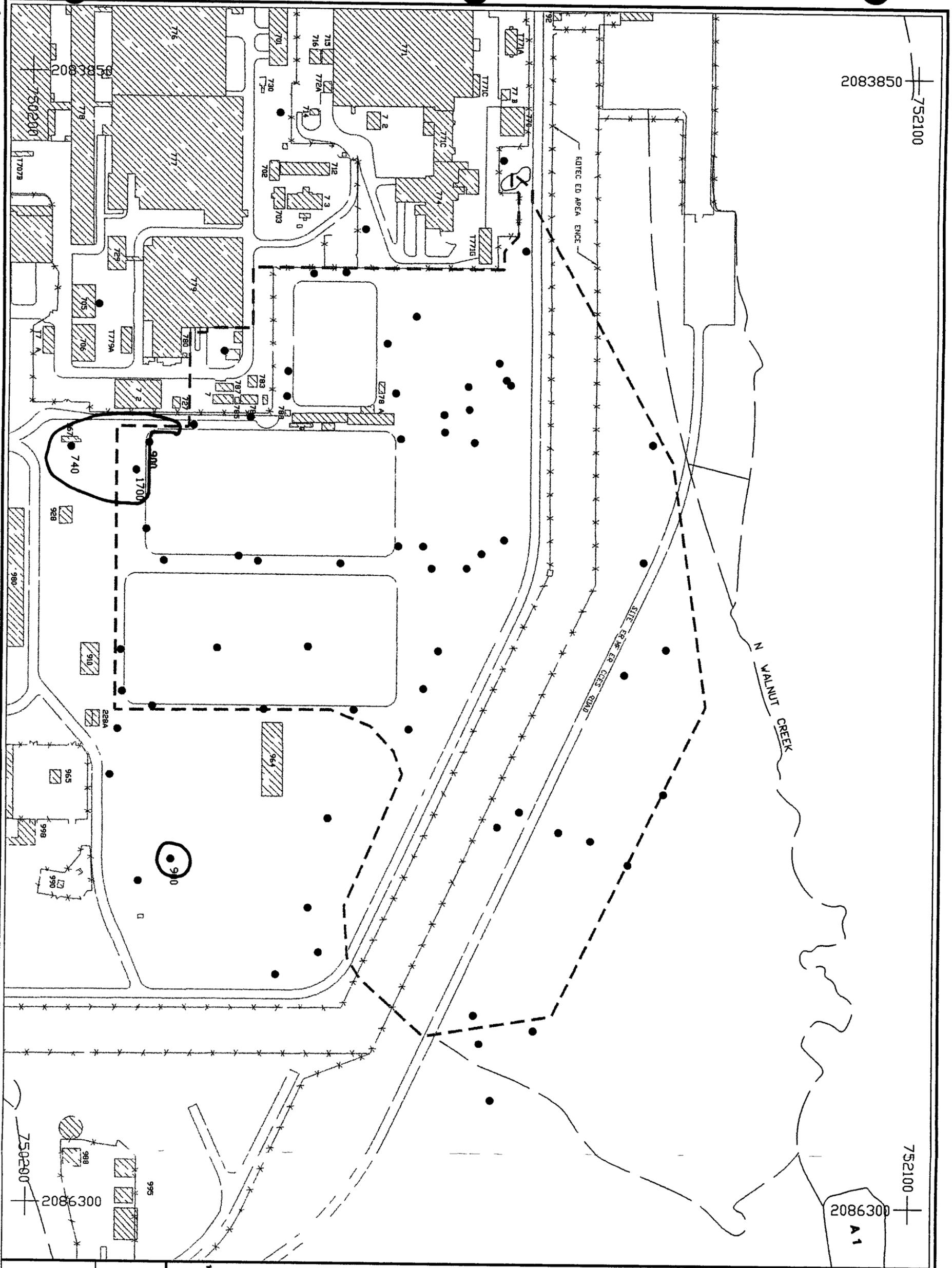
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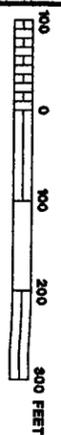


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- Fence
- OU4 Boundary
- ▭ Solar Evaporation Pond (SEP)
- Sample Location
- 900 Results in ug/kg
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 95% UCL



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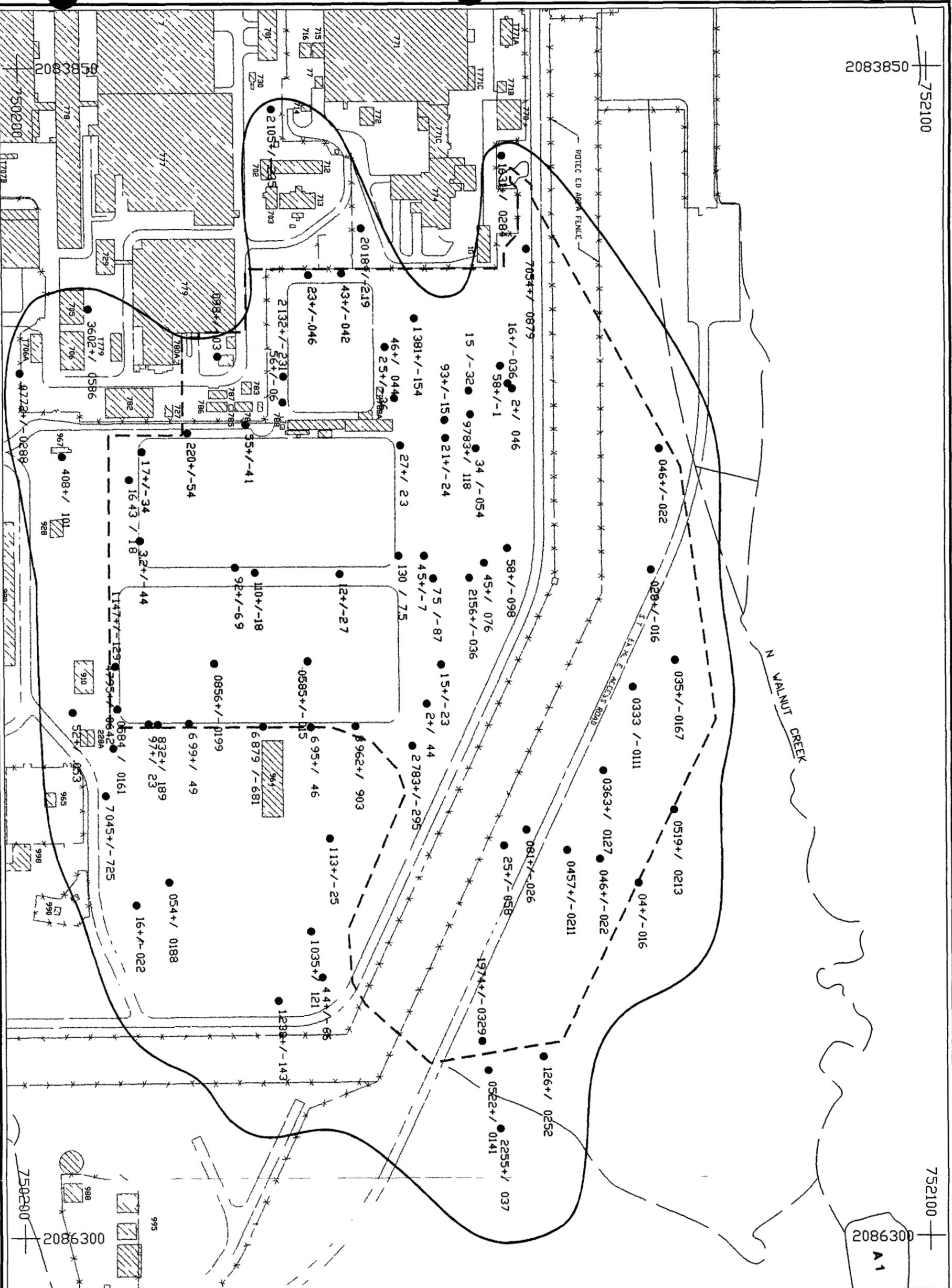
Figure II 4.4 18
 Solar Evaporation Ponds
 Operable Unit No. 4 ILM/IRA EA DD
 Extent of Di n butyl phthalate
 in Surficial Soils

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A1



LEGEND

- St eams
- ==== Paved Roads
- ▨ Buildings
- *-*-* Fence
- O&A Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 12 / 27 Result and error in pCi/g
- Extent of Contamination Above Background
- 95 / UCL

NOTES

1 Sample location without result indicates that value is less than 95 / UCL



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Figure II 4 4 19
 Solar Evaporation Ponds
 Operable Unit No 4 IM/RA EA DD
 Extent of Americium 241 in Surficial Soils

518

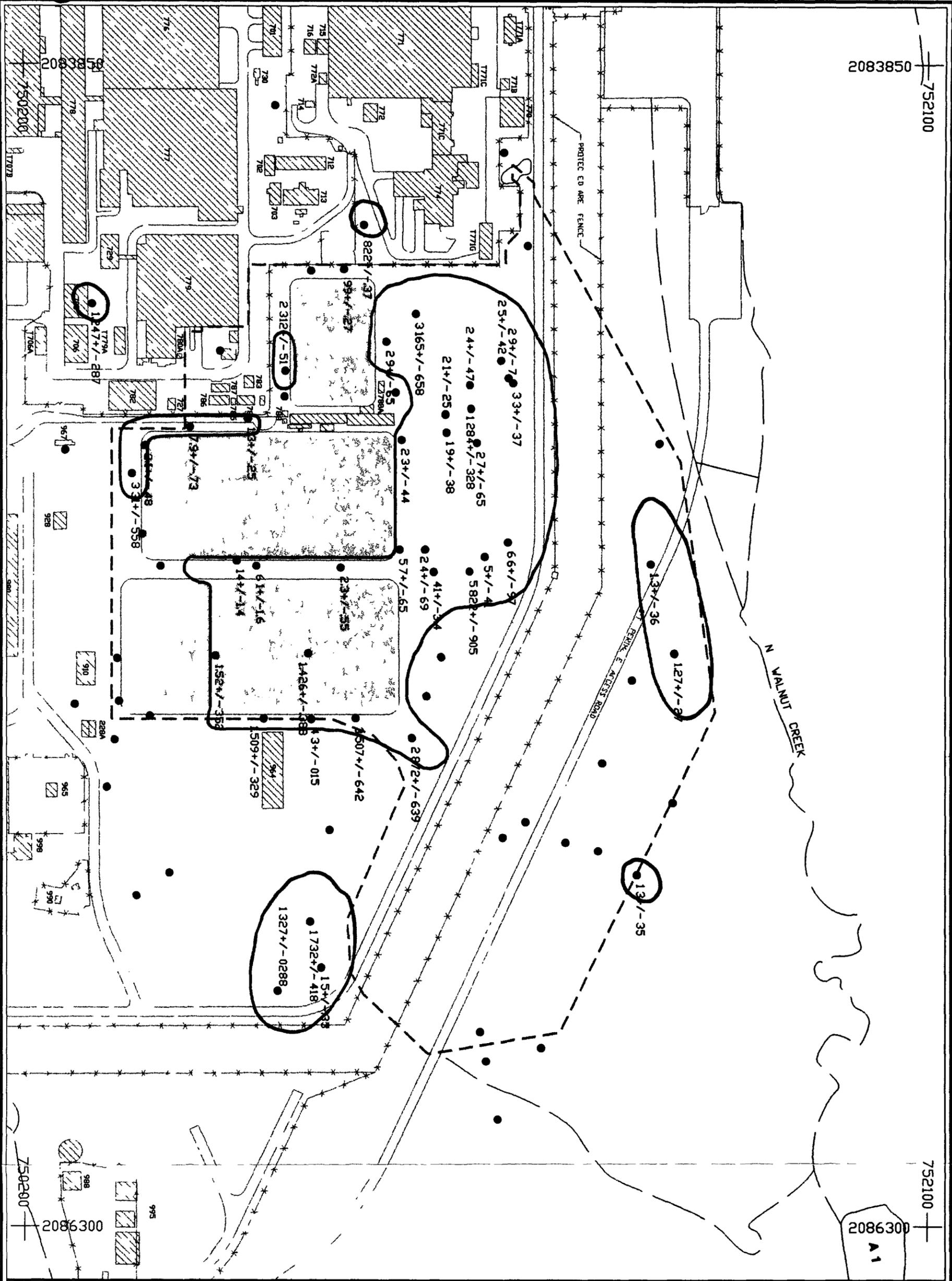
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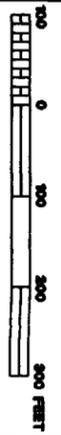


LEGEND

- Streams
- ==== Paved Roads
- ▨ Buildings
- *** Fence
- OUA Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 1 2 / 2 Result and Error in pci/g
- Extent of Contamination Above Background
- 95% UCL of 122 pci/g

NOTES

1 Sample location without result indicates that value is less than 95% UCL



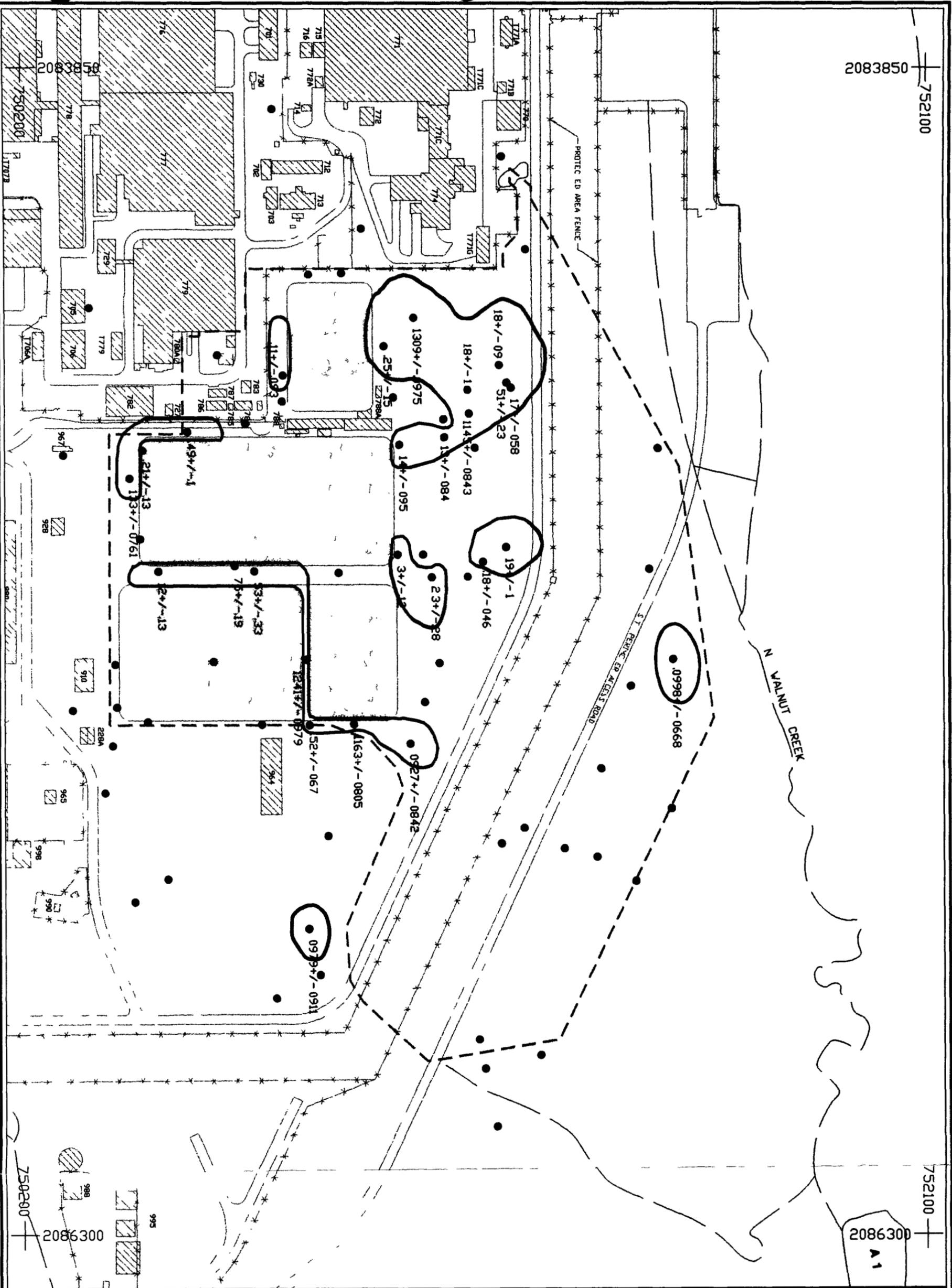
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Figure H.4.4-21
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/IMA EA DD
 Extent of Uranium 233/234
 in Surficial Soils

520

521

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752100



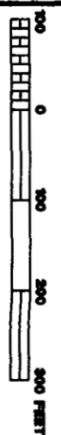
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A 1

LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- Fence
- OUA Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 12 / 13 Results and Error in PCI/g
- Extent of Contamination Above Background
- 95% UCL of 0.09 PCI/g

NOTES

1 Sample location without result indicates that value is less than 95% UCL



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Figure 11.4-22
Solar Evaporation Ponds
Operable Unit No. 4 IM/IRA EA DD
Extent of Uranium-235 in Surficial Soils

522

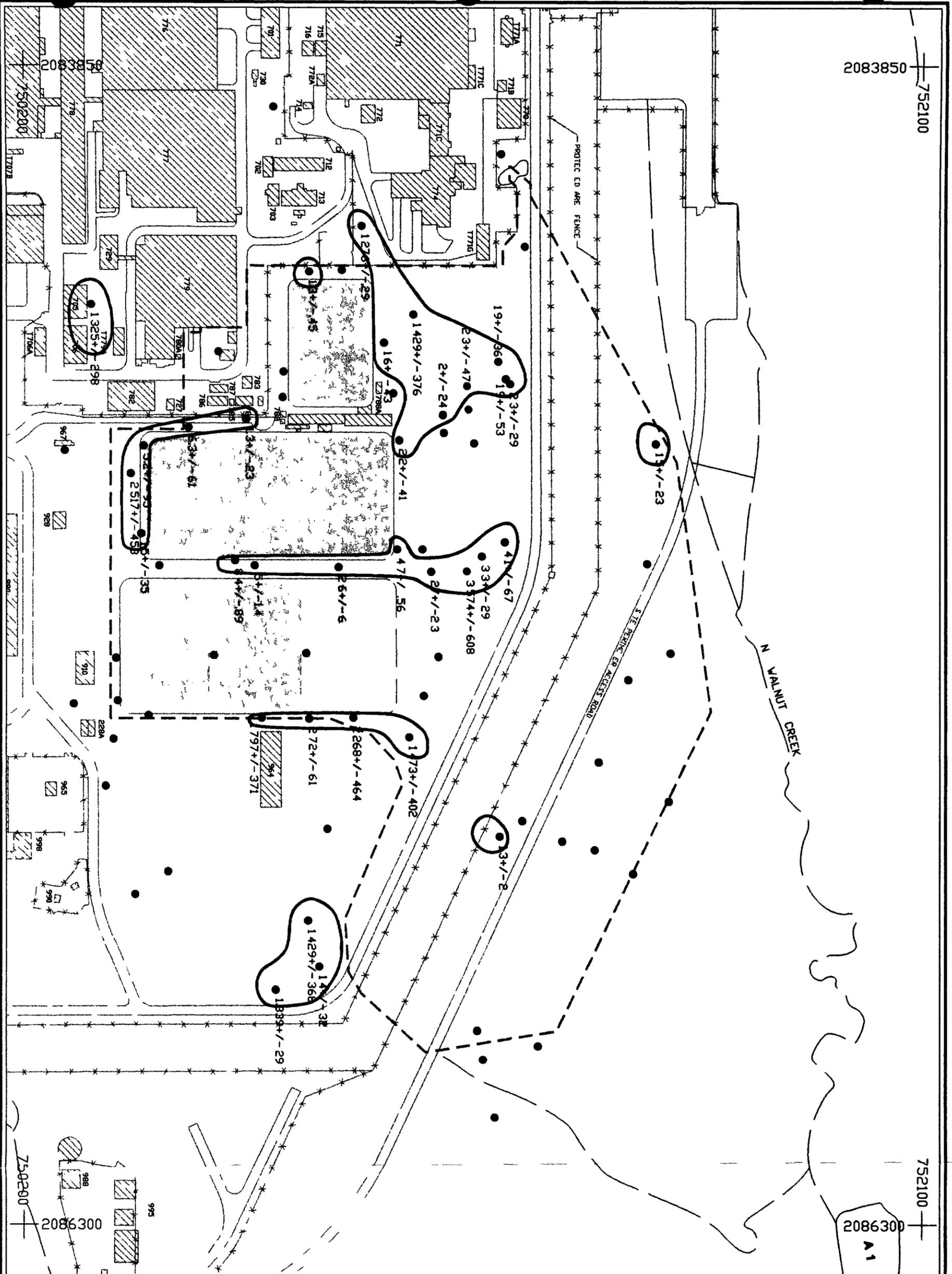
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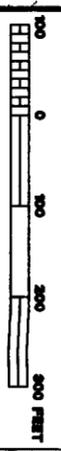


LEGEND

- Stream
- Paved Roads
- ▨ Buildings
- *** Fence
- ▨ Solar Evaporation Ponds (SEP)
- OU4 Boundary
- Sample Location
- 5 / 14 Results and Error in pCi/g
- Extent of Contamination Above Background
- 95% UCL of 127 pCi/g

NOTES

1. Sample location without result indicates that value is less than 95% UCL



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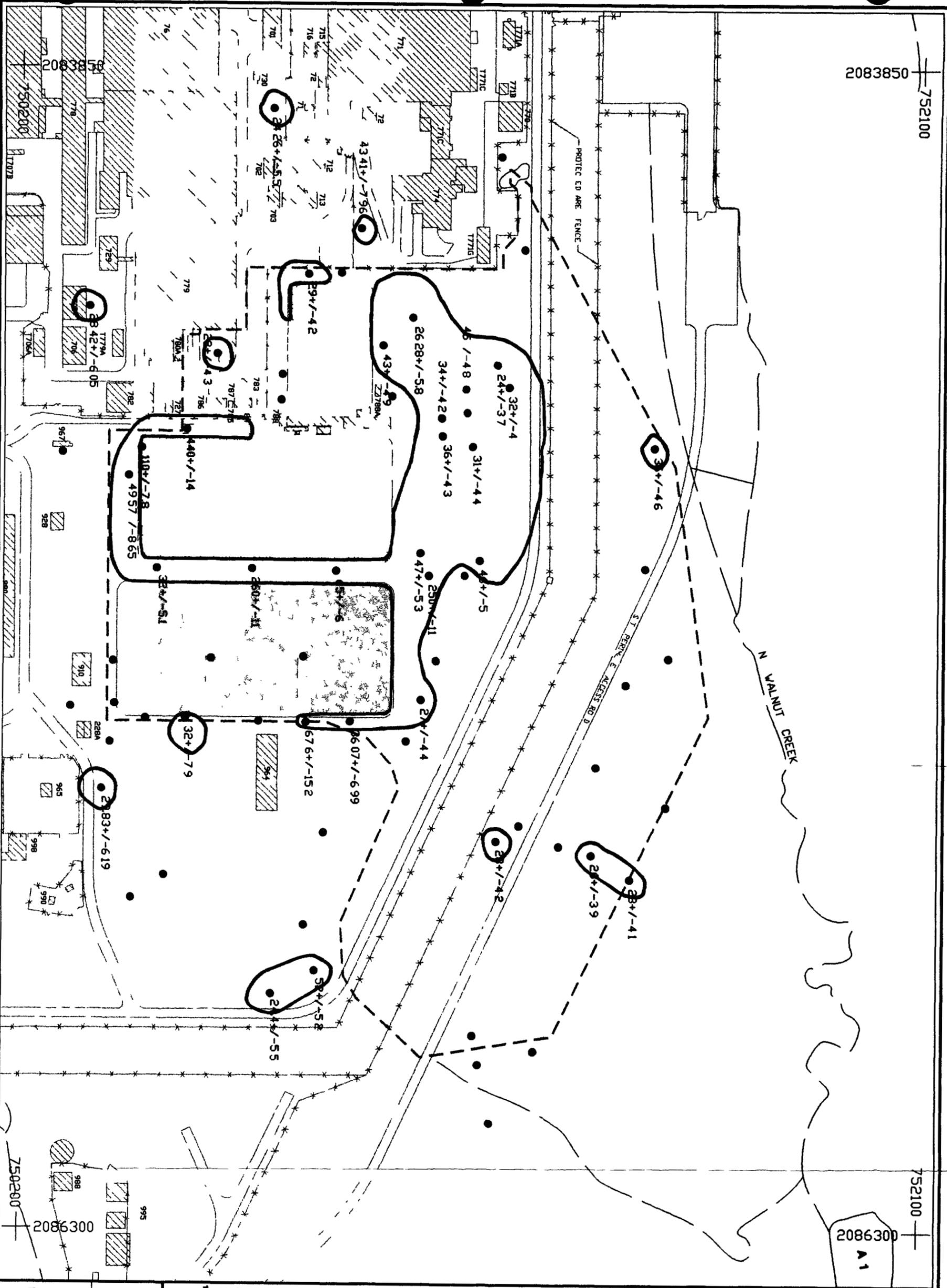
Figure II 4.4-23

Solar Evaporation Ponds
 Operable Unit No 4, IM/RA EA DD
 Extent of Uranium 238 in Surficial Soils

523

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LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- OUA Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 28 / 42 Results and Error in pCi/g
- Extent of Contamination Above Background
- 95% UCL of 22.9 pCi/g

NOTES

1. Sample location without result indicates that value is less than 95% UCL



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Figure II.4.4-24
 Solar Evaporation Ponds
 Operable Unit No. 4, IM/MA EA DD
 Extent of Grosse Alpha in Surficial Soils

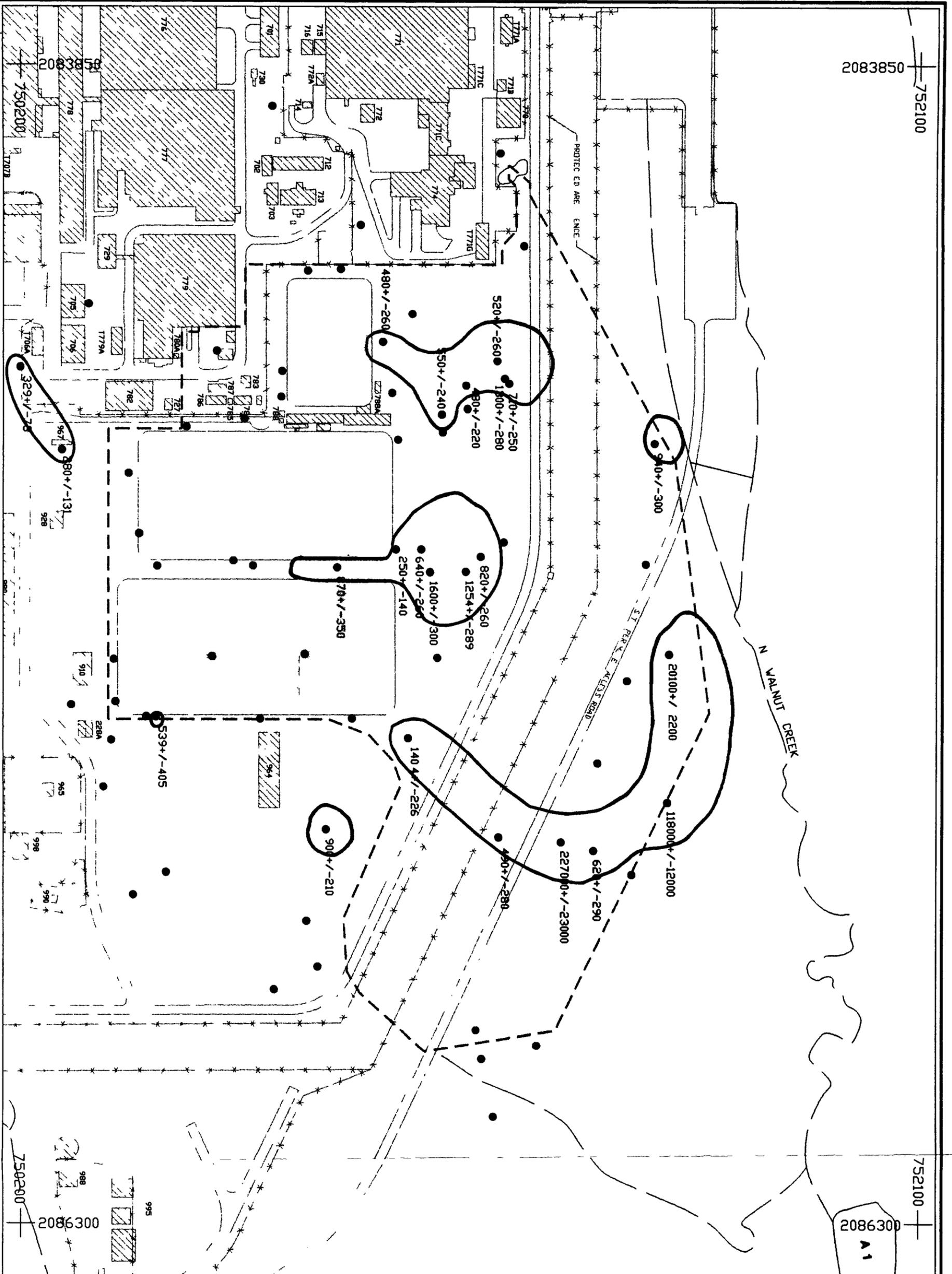
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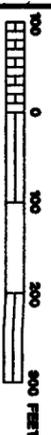


LEGEND

- Stream
- Paved Roads
- ▨ Buildings
- *** Fence
- OU4 Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 870 / 350 Results and Error in PCI/I
- Extent of Contamination Above Background
- 95% UCL of 212 PCI/I

NOTES

1 Sample location without result indicates that value is less than 95% UCL

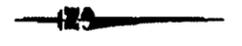
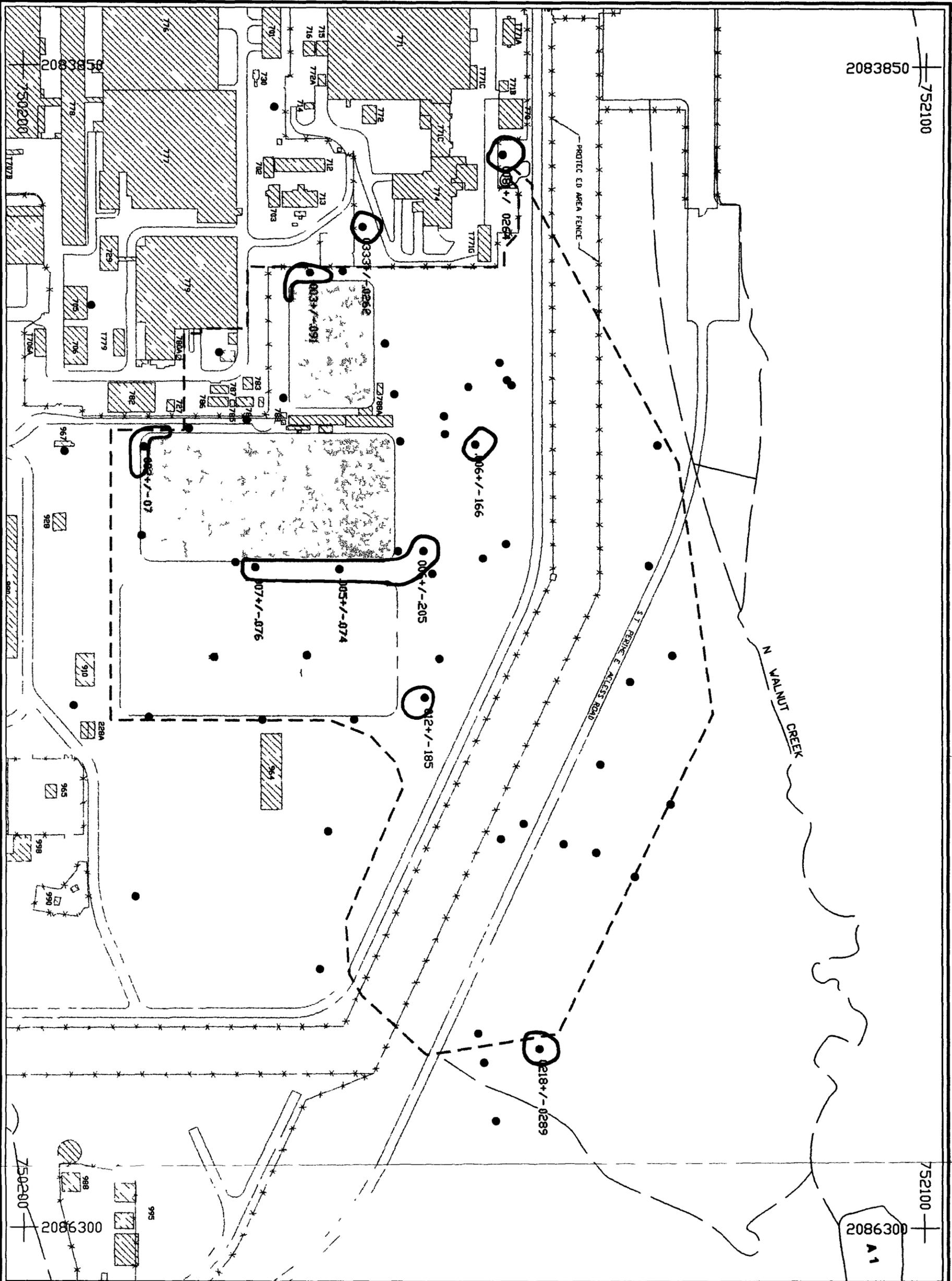


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Figure II.4.4-25
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DO
 Extent of Tritium in Surficial Soils

525

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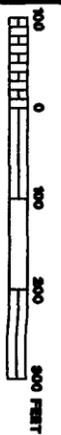


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- Fence
- O&U Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 002 / 07 Results and Error in pCi/g
- Extent of Contamination Above Detection Limit

NOTES

1. Background data not available



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Figure II 4.4-26

Solar Evaporation Ponds
Operable Unit No. 4, IM/RA EA DD
Extent of Cesium 134 in Surficial Soils

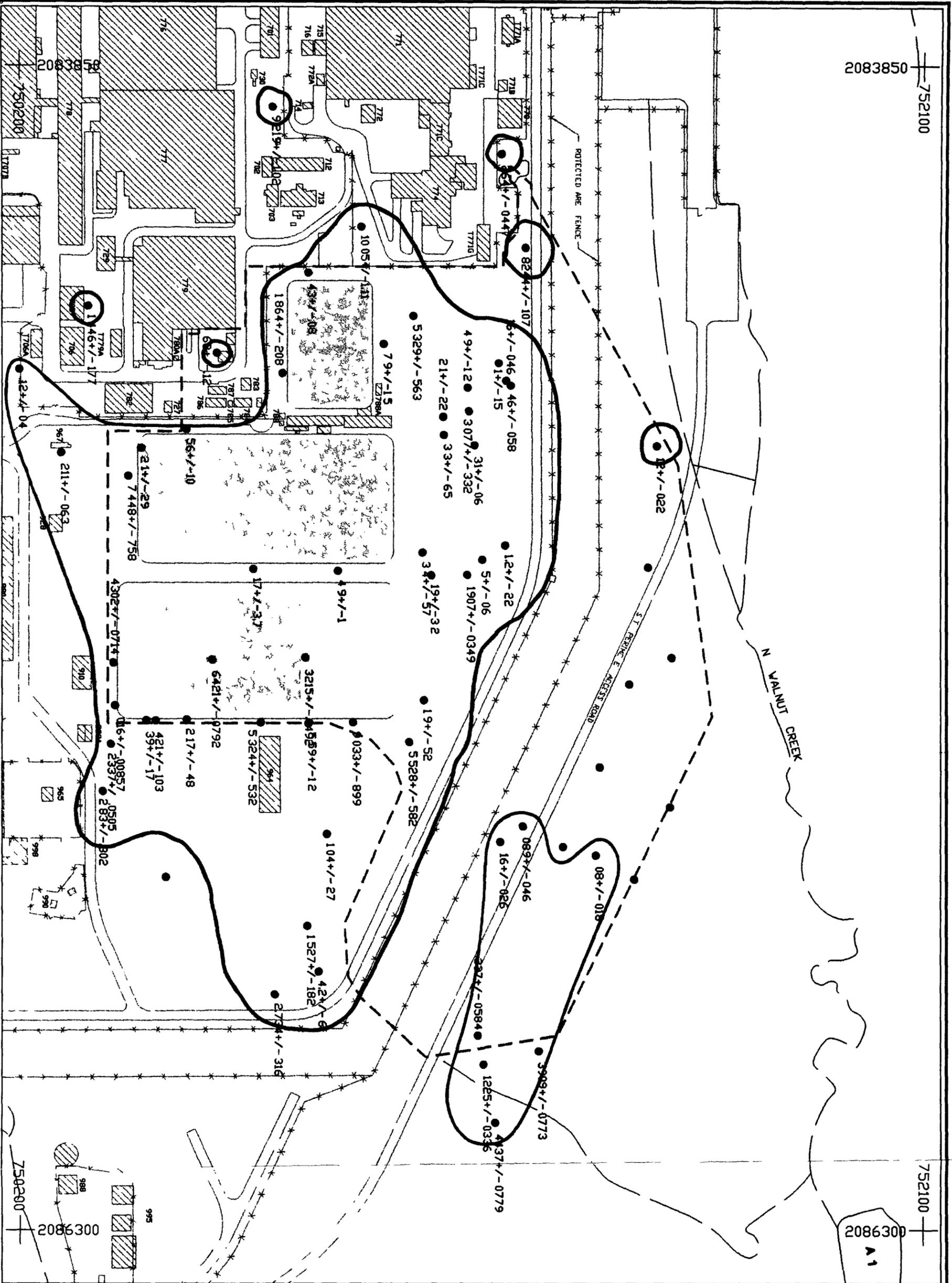
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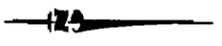
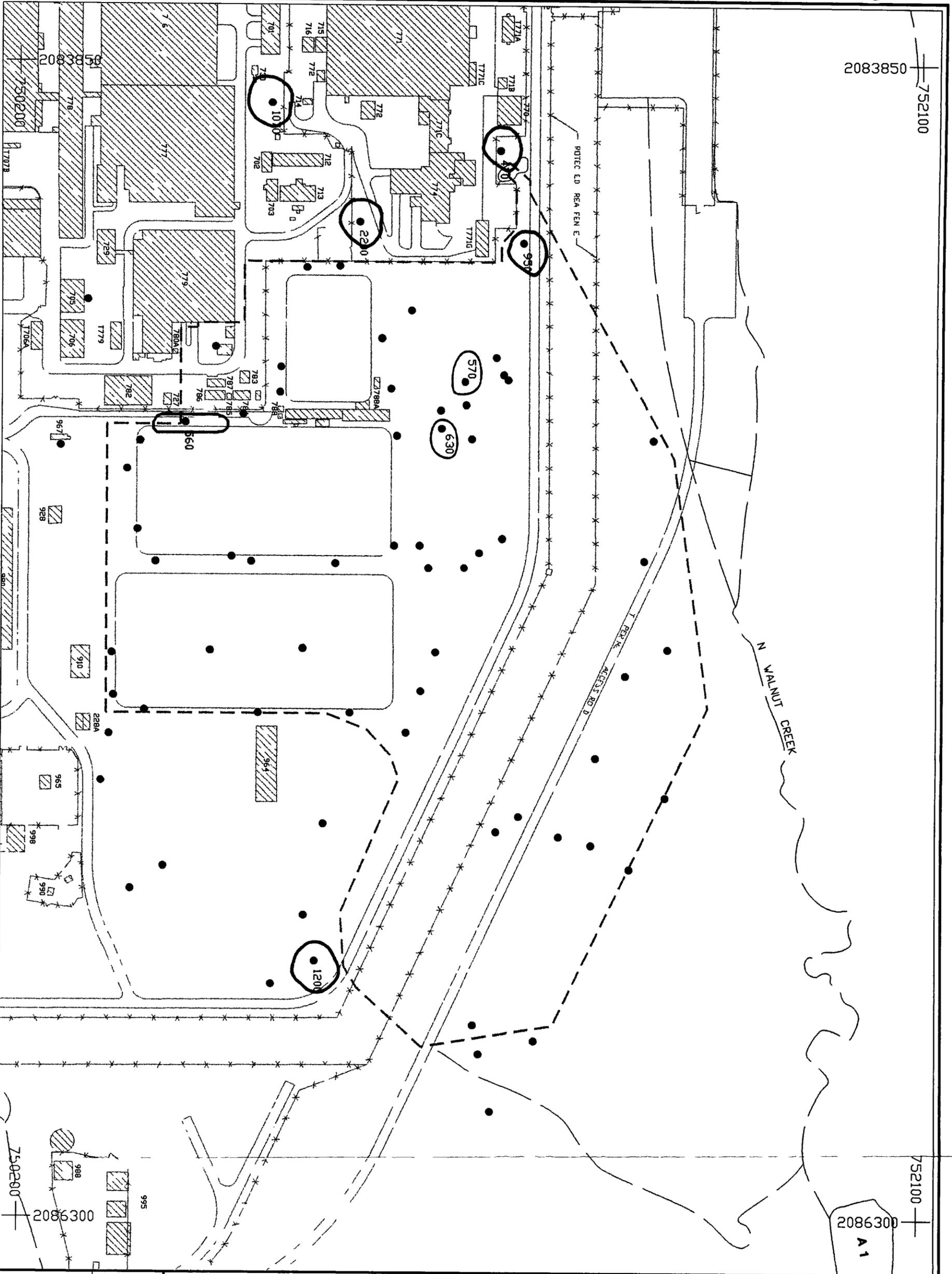
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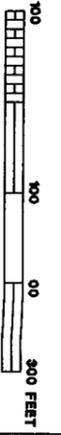


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- O&U Bou dary
- Solar Evaporation Pond (SEP)
- Sample Location
- 630 Results in ug/kg
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 95 / UCL

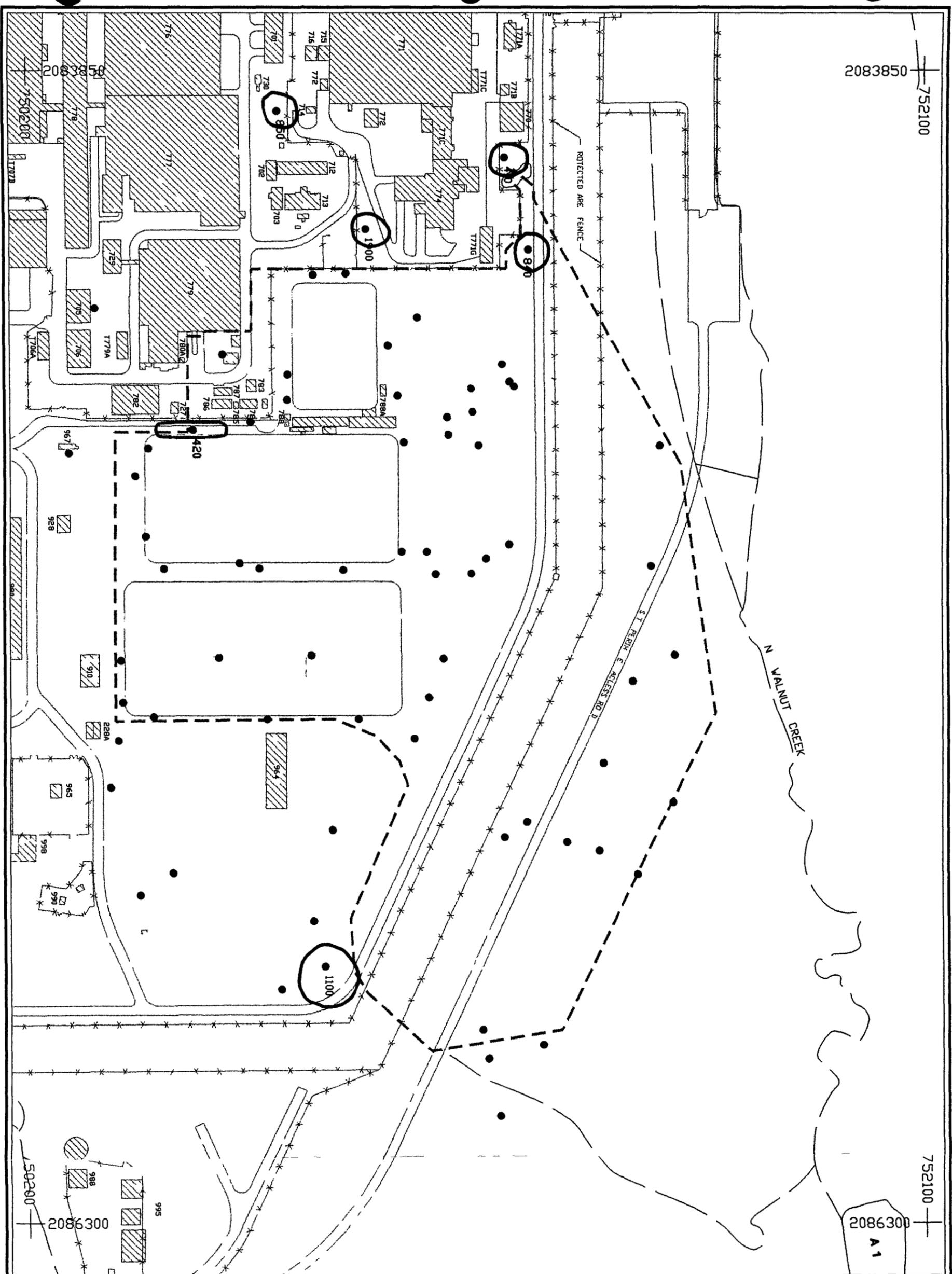


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Figure II 4 4 12

Solar Evaporation Ponds
 Operable Unit No. 4 IM/RA EA DD
 Extent of Chrysenes in Surficial Soils

506

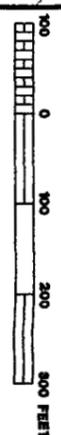


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- O&A Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- Results in mg/kg
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than 95% UCL



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Figure II 4.4.7
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/RA EA DD
 Extent of Benzolanthracene
 in Surficial Soils

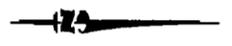
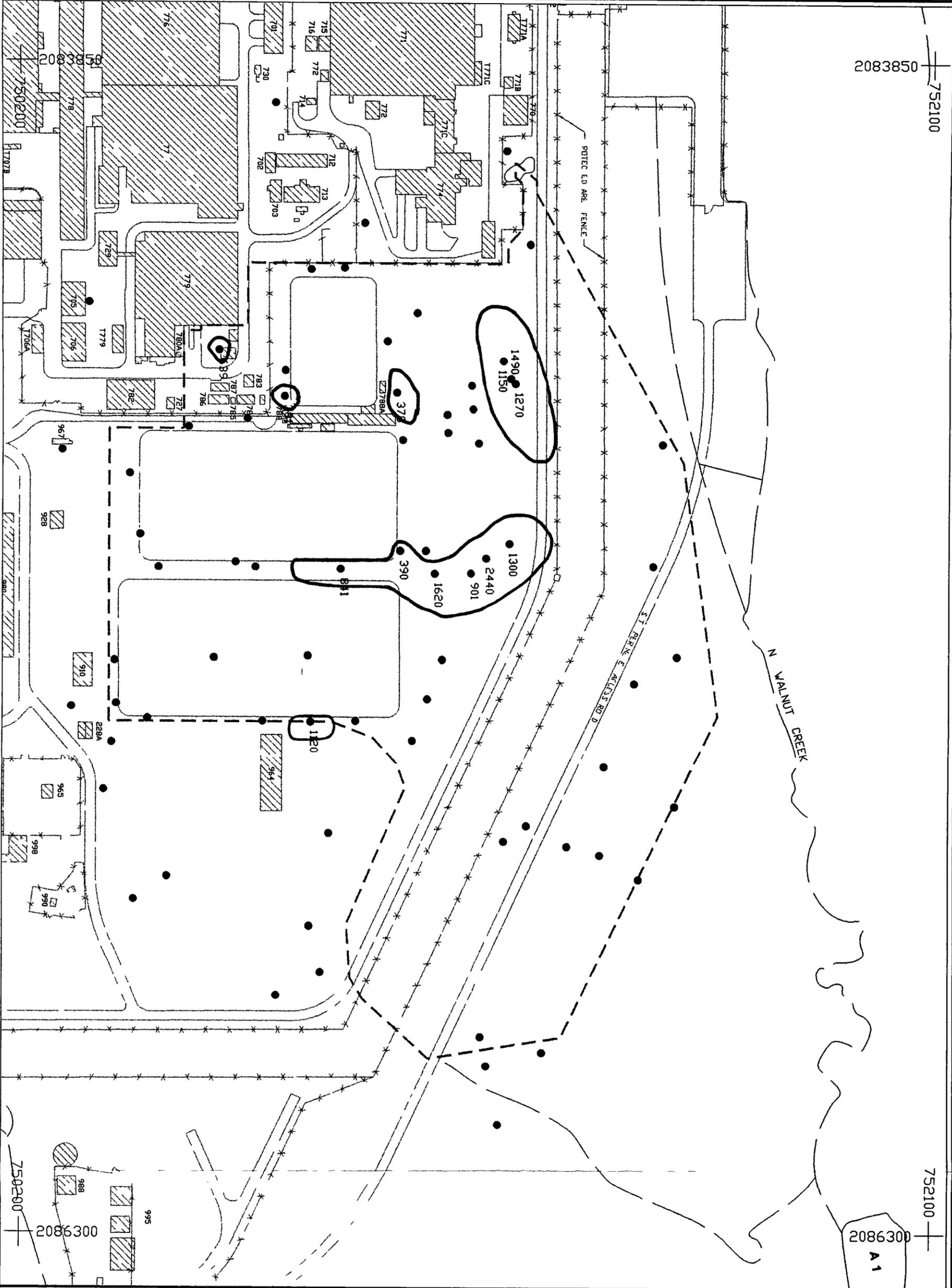
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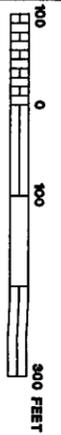


LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- O&U Bound ry
- Sample Location
- Solar Evaporation Pond (SEP)
- 378 Results in mg/kg
- Extent of Contamination Above Background
- 95 / UCL of 165 mg/kg

NOTES

1 Sample location without result indicates that value is less than 95 / UCL



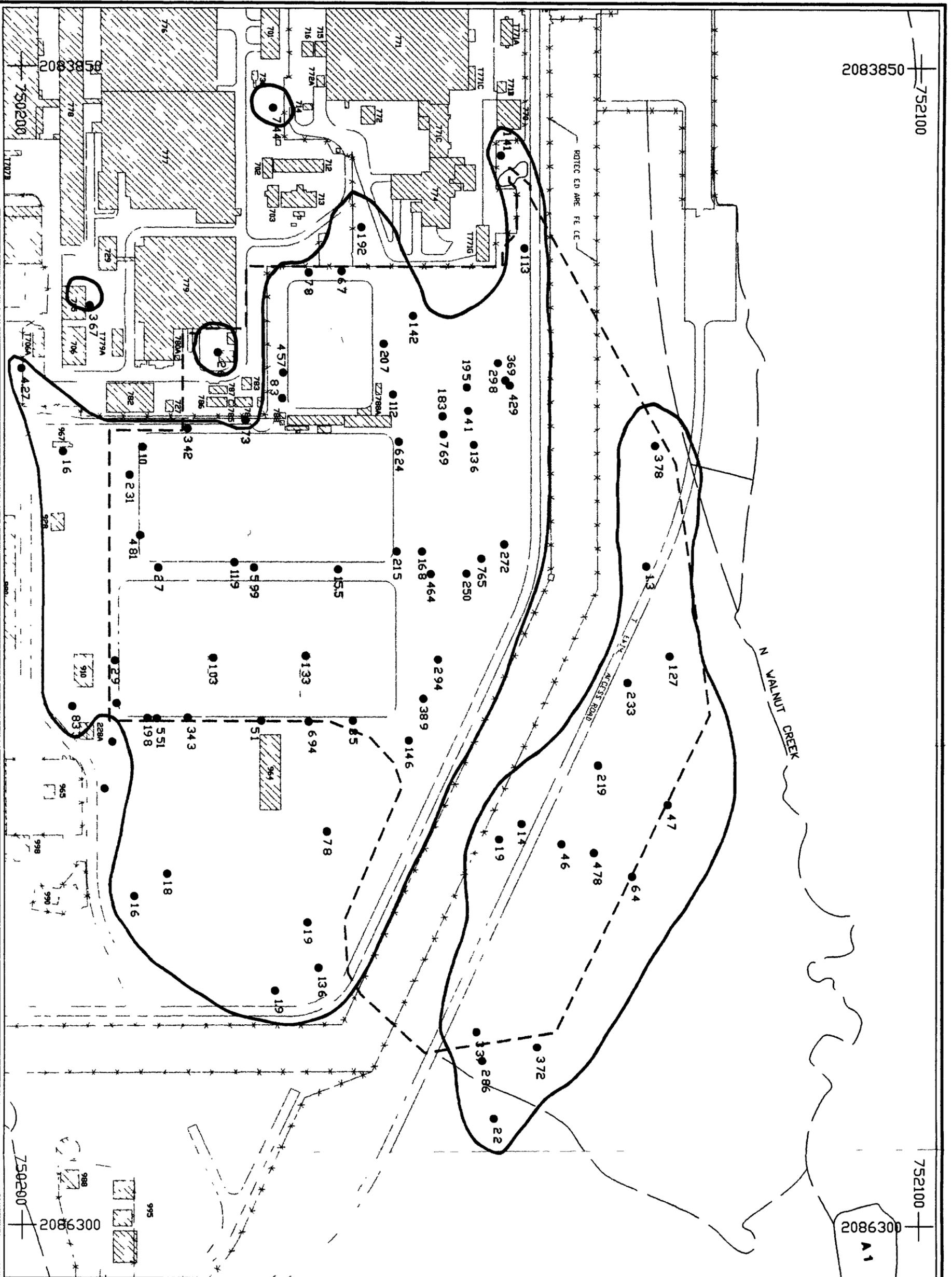
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Figure II 4 4 6
 Solar Evaporation Ponds
 Operable Unit No 4 IM/IRA EA DD
 Extent of Sodium in Surficial Soils

526

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LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- - - Fence
- - - OU4 Boundary
- Sample Location
- Results in mg/kg
- 286 Results in mg/kg
- Extent of Contamination Above Background
- 95% UCL of 111 mg/kg

NOTES

1 Sample location without result indicates that value is less than 95% UCL



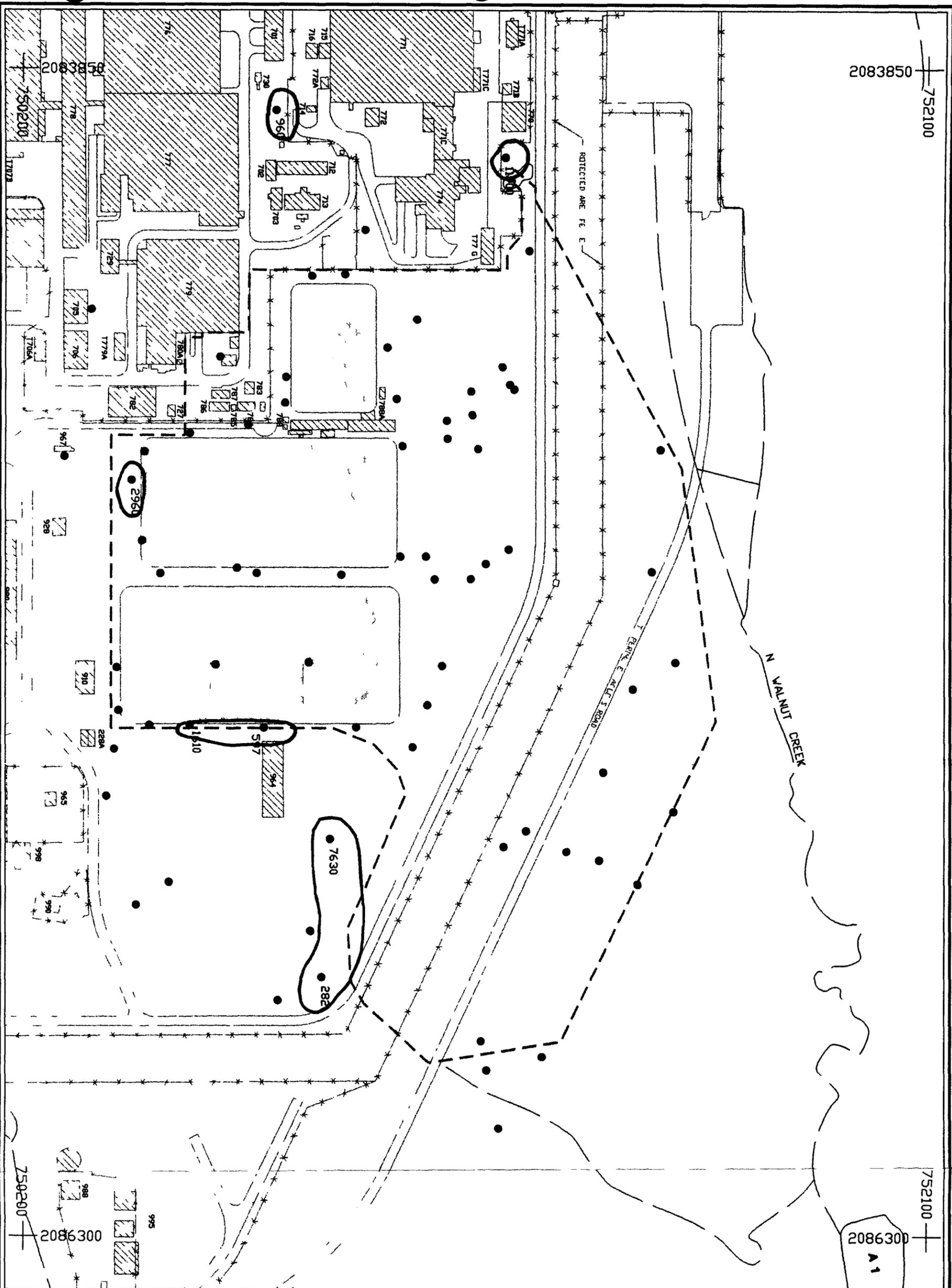
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Figure II 4.4-27
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/RA EA DD
 Extent of Nitrate/Nitrite
 in Surficial Soils

527

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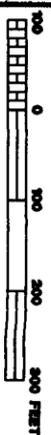
A1

LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- O/U4 Boundary
- Solar Evaporation Pond (SEP)
- Sample Location
- 282 Results in ug/kg
- Extent of Contamination Above Detection Limit

NOTES

1 Sample location without result indicates that value is less than the Detection Limit



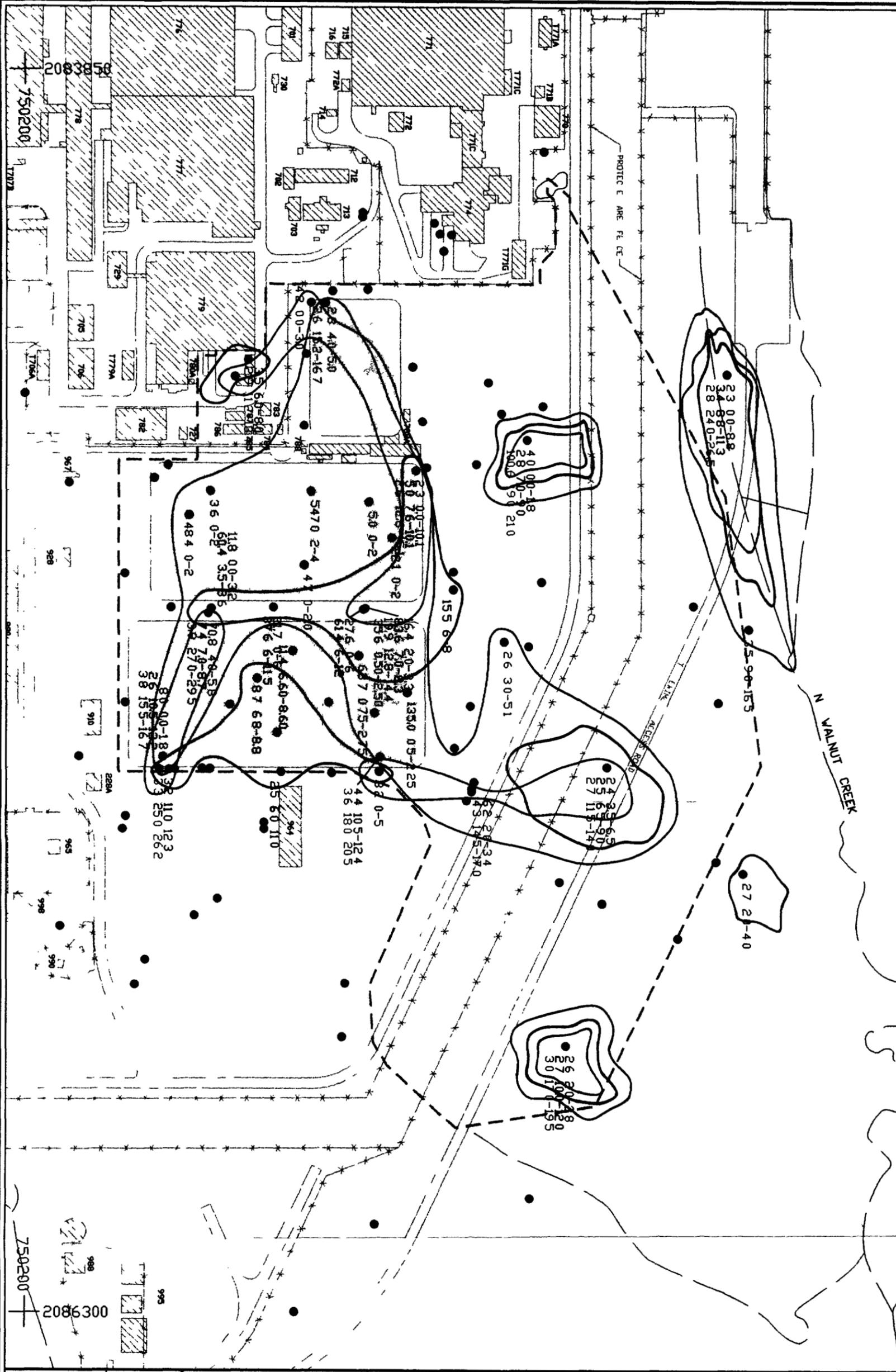
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Figure IL4-4-28

Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DD
 Extent of Arcoror 1254 in Surficial Soils

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LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- Solar Evaporation Ponds (SEP)
- O&U Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 23 mg/kg
- Extent of Contamination Above Background 95% UCL of 23 mg/kg
- Extent of Contamination Above Background 95% UCL of 23 mg/kg
- Below the UCL

Concentration Depth	Maximum Concentration Observed in Interval
17700 0-6 ft	
23978 6-12 ft	
10321 >12 ft	

NOTES

1. Sample location without result indicates that value is less than 95% UCL

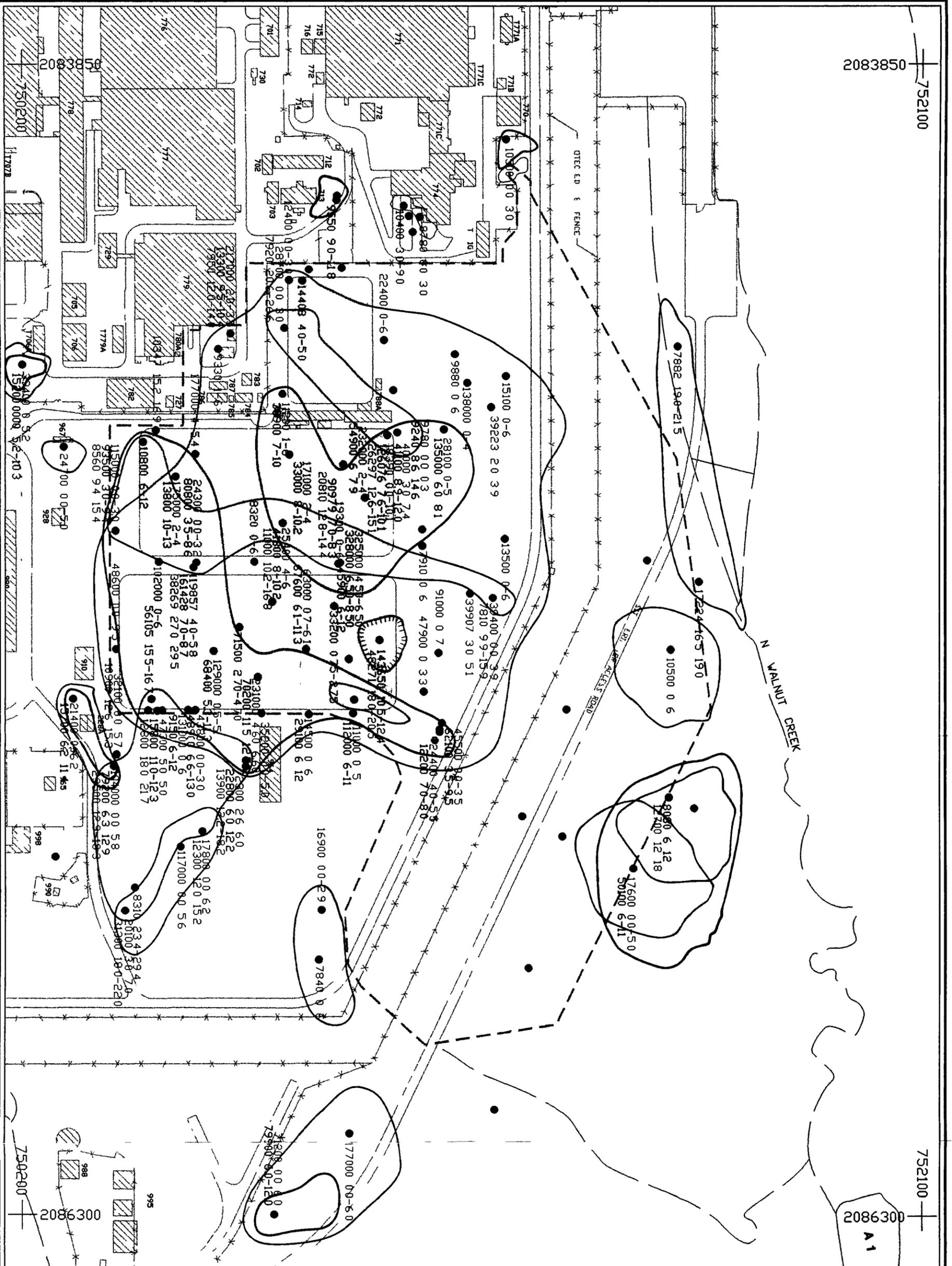


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Figure IL-5-2
Solar Evaporation Ponds
Operative Unit No. 4 M/RA EA DD
Extent of Cadmium in the subsurface

530

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LEGEND

- Streamline
- Paved Roads
- ▨ Buildings
- * * * * * Fence
- Solar Evaporation Ponds (SEP)
- OUA Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 7782 mg/Kg
- Extent of Contamination Above Background 95% UCL of 7782 mg/Kg
- Extent of Contamination Above Background 95% UCL of 7782 mg/Kg
- Extent of Contamination Above Background 95% UCL of 7782 mg/Kg

Concentration Depth

17700	0-6 ft	Maximum Concentration Observed In Interval
23978	6-12 ft	
10321	>12 ft	

NOTES

1 Sample location without result indicates that value is less than 95% UCL



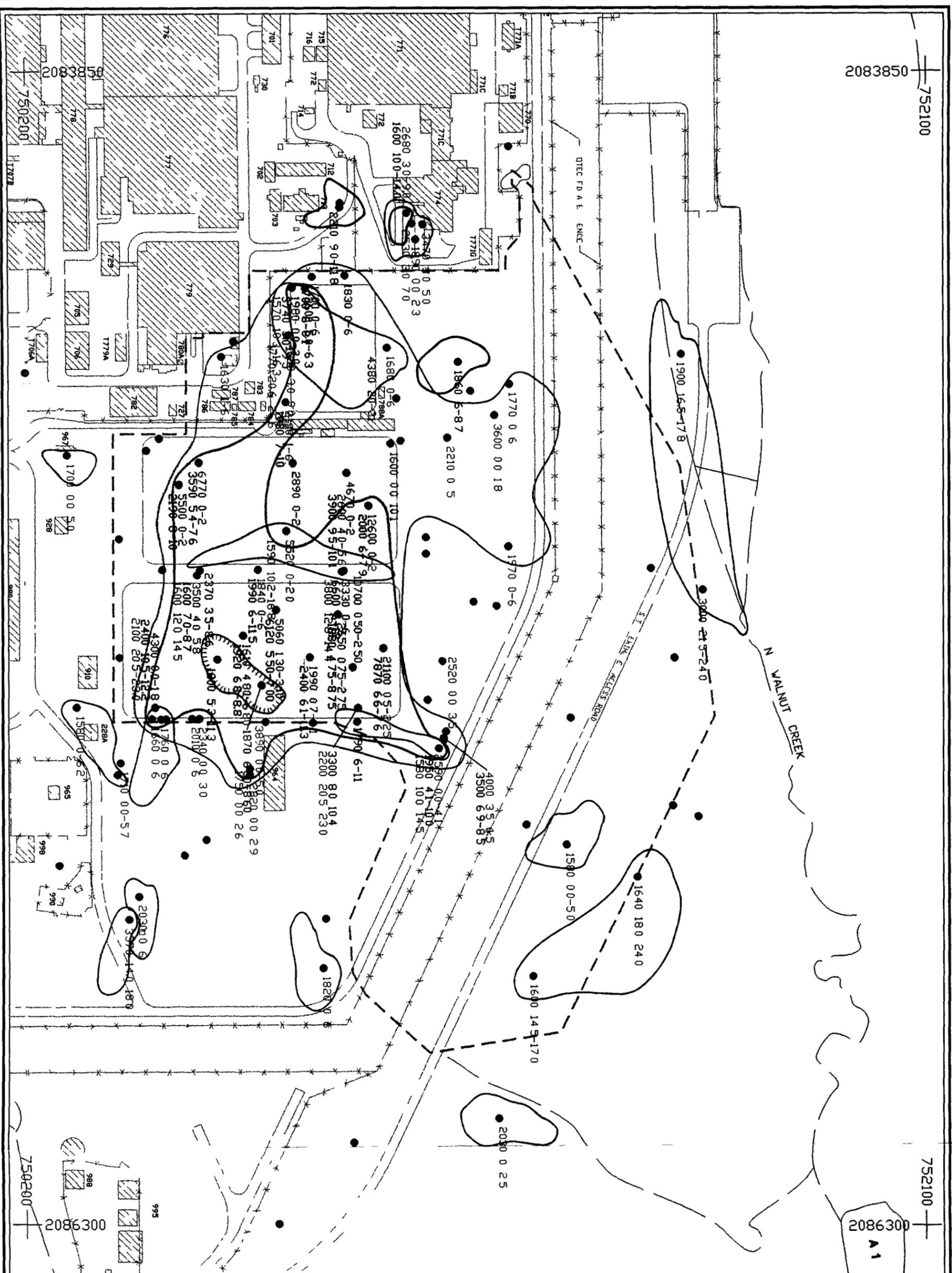
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Figure II 4.5 3

Solar Evaporation Ponds
Operable Unit No 4 IM/RA EA DD
Extent of Calcium in the subsurface

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LEGEND

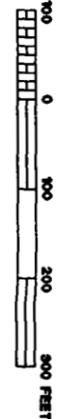
- Streams
- Paved Roads
- ▨ Buildings
- Fence
- ▭ Solar Evaporation Ponds (SEP)
- OUA Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 1563 mg/kg
- Extent of Contamination Above Background 95% UCL of 1563 mg/kg
- Extent of Contamination Above Background 95% UCL of 1563 mg/kg
- Extent of Contamination Above Background 95% UCL of 1563 mg/kg

CONCENTRATION DEPTH

Concentration Depth	Maximum Concentration Observed in Interval
17700 0 6 ft	
23978 6-12 ft	
10321 >12 ft	

NOTES

1 Sample location without result indicates that value is less than 95% UCL



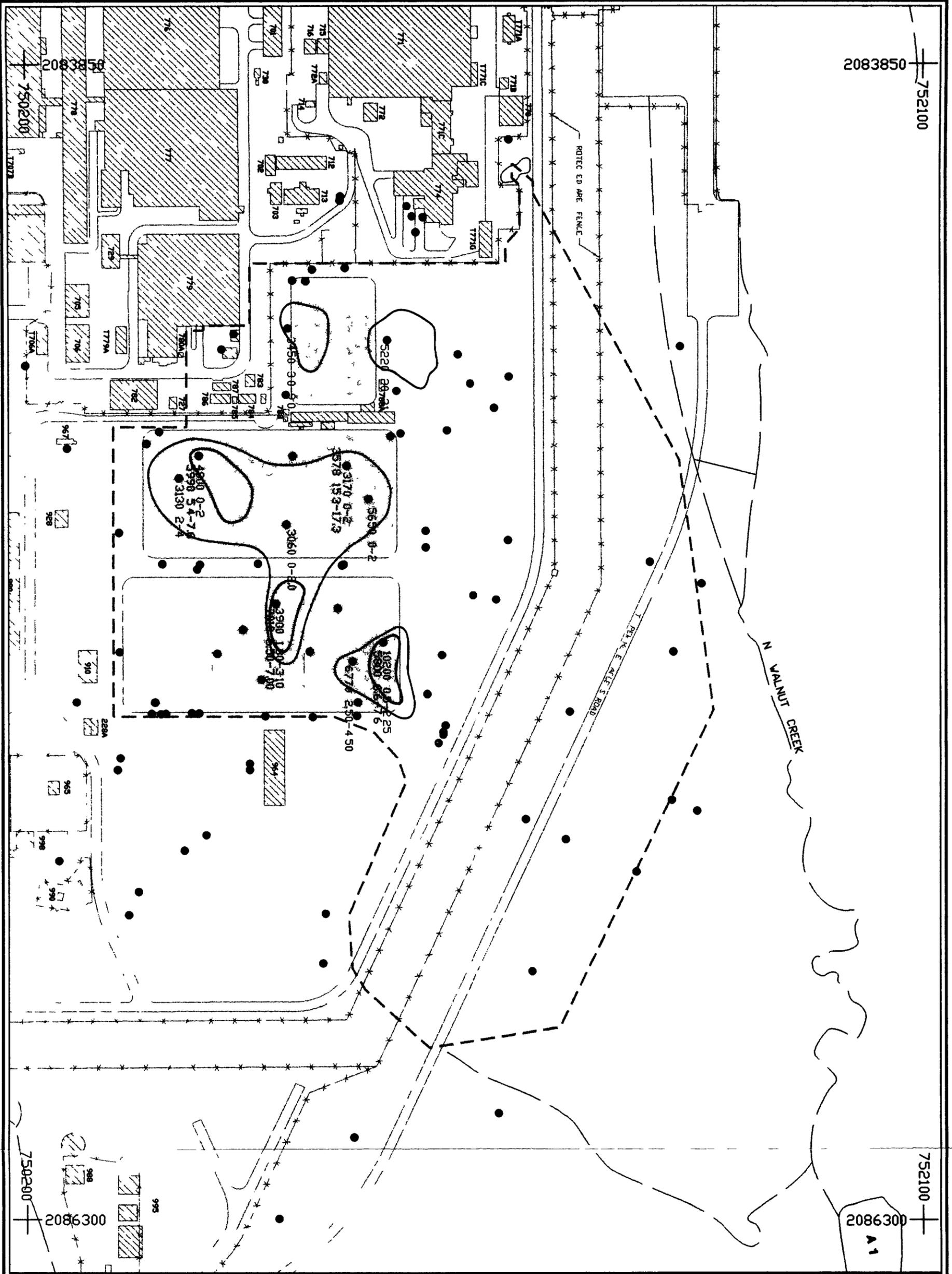
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Figure II 4.5.4

Solar Evaporation Ponds
Operable Unit No 4 IM/IRA EA DD
Extent of Potassium in the subsurface

532

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2086300
A1

LEGEND

- Stream
- Paved Roads
- ▨ Buildings
- *** Fence
- ▭ Solar Evaporation Ponds (SEP)
- OU4 Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 2720 mg/kg
- Extent of Contamination Above Background 95% UCL of 2720 mg/kg
- Extent of Contamination Above Background 95% UCL of 2720 mg/kg
- Extent of Contamination Above Background 95% UCL of 2720 mg/kg
- ||||| Below the UCL

Concentration	Depth	Maximum Concentration Observed in Interval
17700	0-6 ft	
23978	6-12 ft	
10321	>12 ft	

NOTES

1. Sample location without result indicating that value is less than 95% UCL



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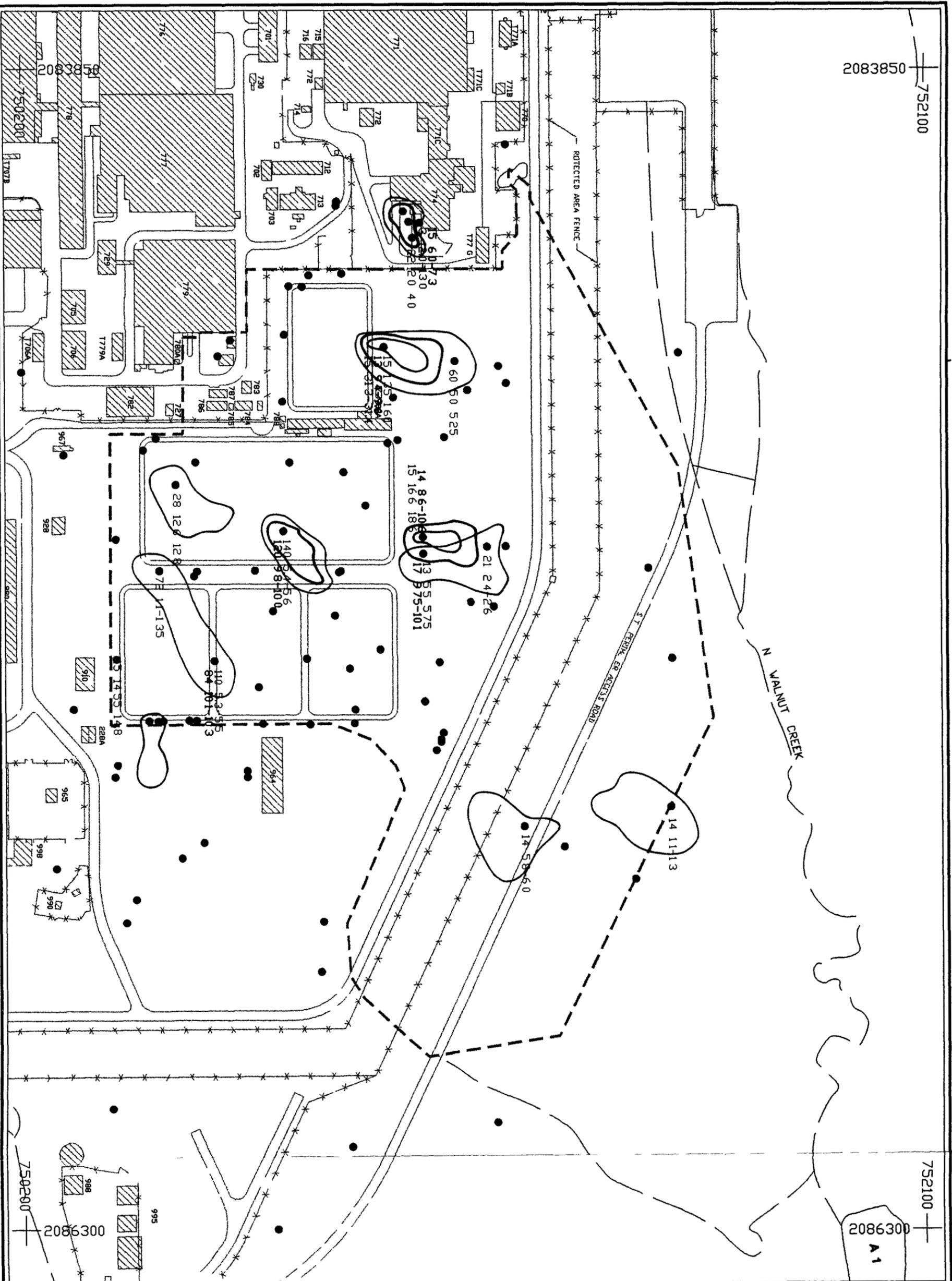
Figure R.4.5-5

Solar Evaporation Ponds
Operable Unit No. 4, M/RA EA DD
Extent of Sodium in the subsurface

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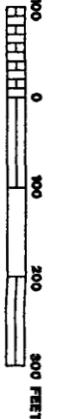
LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-* Fence
- Solar Evaporation Ponds (SEP)
- O&U Boundary
- Sample Location
- Extent of Contamination Above the Detection Limit
- Extent of Contamination Above the Detection Limit
- Extent of Contamination Above the Detection Limit
- ||||| Below the UCL

Concentration	Depth	Maximum Concentration Observed In Interval
17700	0-6 ft	
23978	6-12 ft	
10321	>12 ft	

NOTES

1 Sample location without result indicates that value is less than 95% UCL



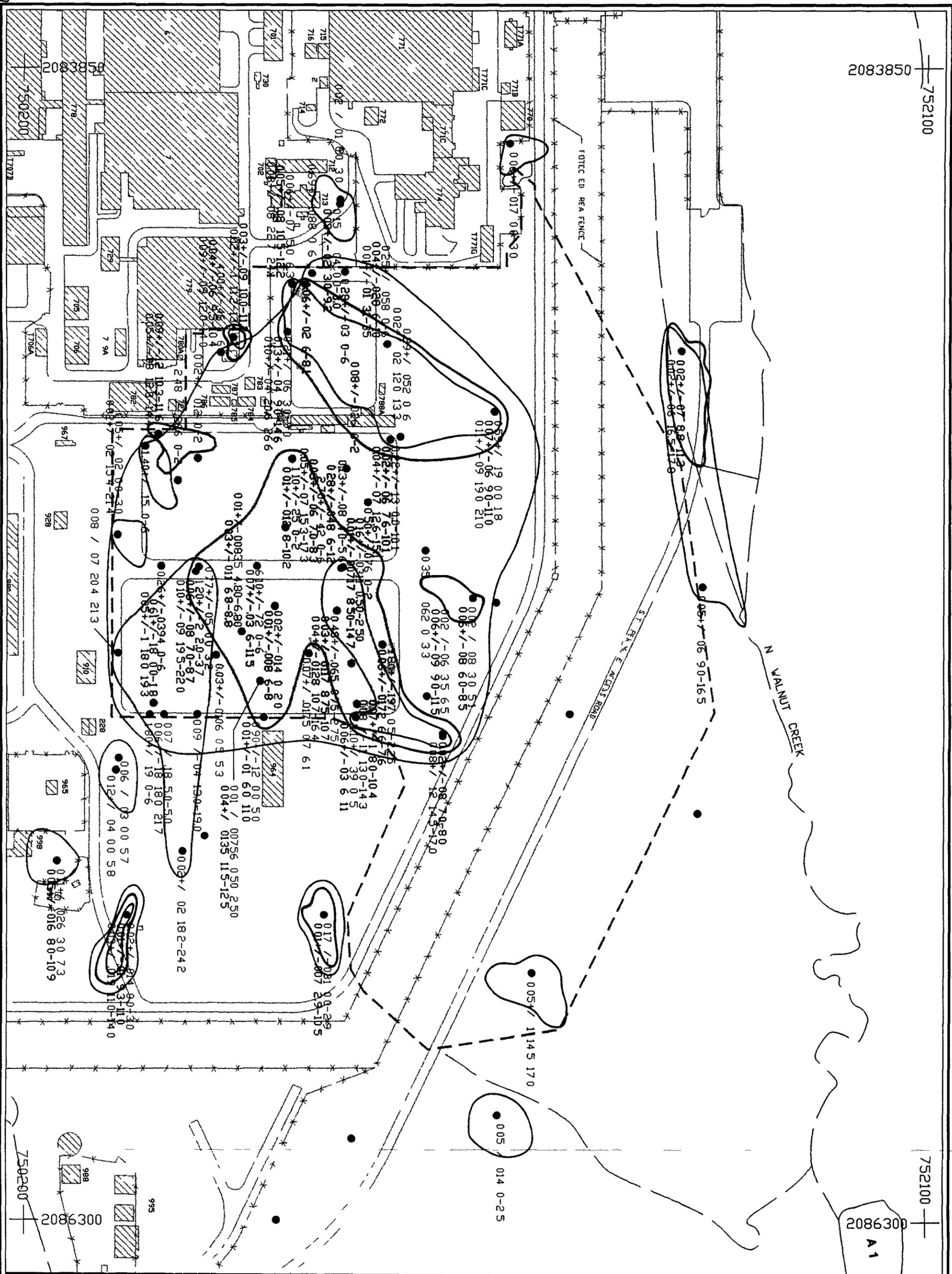
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Figure II 4-5-7

Solar Evaporation Ponds
 Operable Unit No. 4 ILM/IRA EA DD
 Extent of Acetone in Vadose Zone

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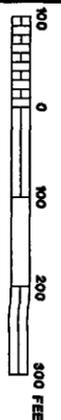
LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- Fence
- Solar Evaporation Ponds (SEP)
- Sample Location
- OU4 Boundary
- Extent of Contamination Above Background 95/ UCL of 0.01 pci/g
- Extent of Contamination Above Background 95% UCL of 0.01 pci/g
- Extent of Contamination Above Background 95/ UCL of 0.01 pci/g
- ||||| Below the UCL

Concentration	Depth	Maximum Concentration Observed in Interval
17700	0-6 ft	
23978	6-12 ft	
10321	>12 ft	

NOTES

1 Sample location without result indicates that value is less than 95/ UCL



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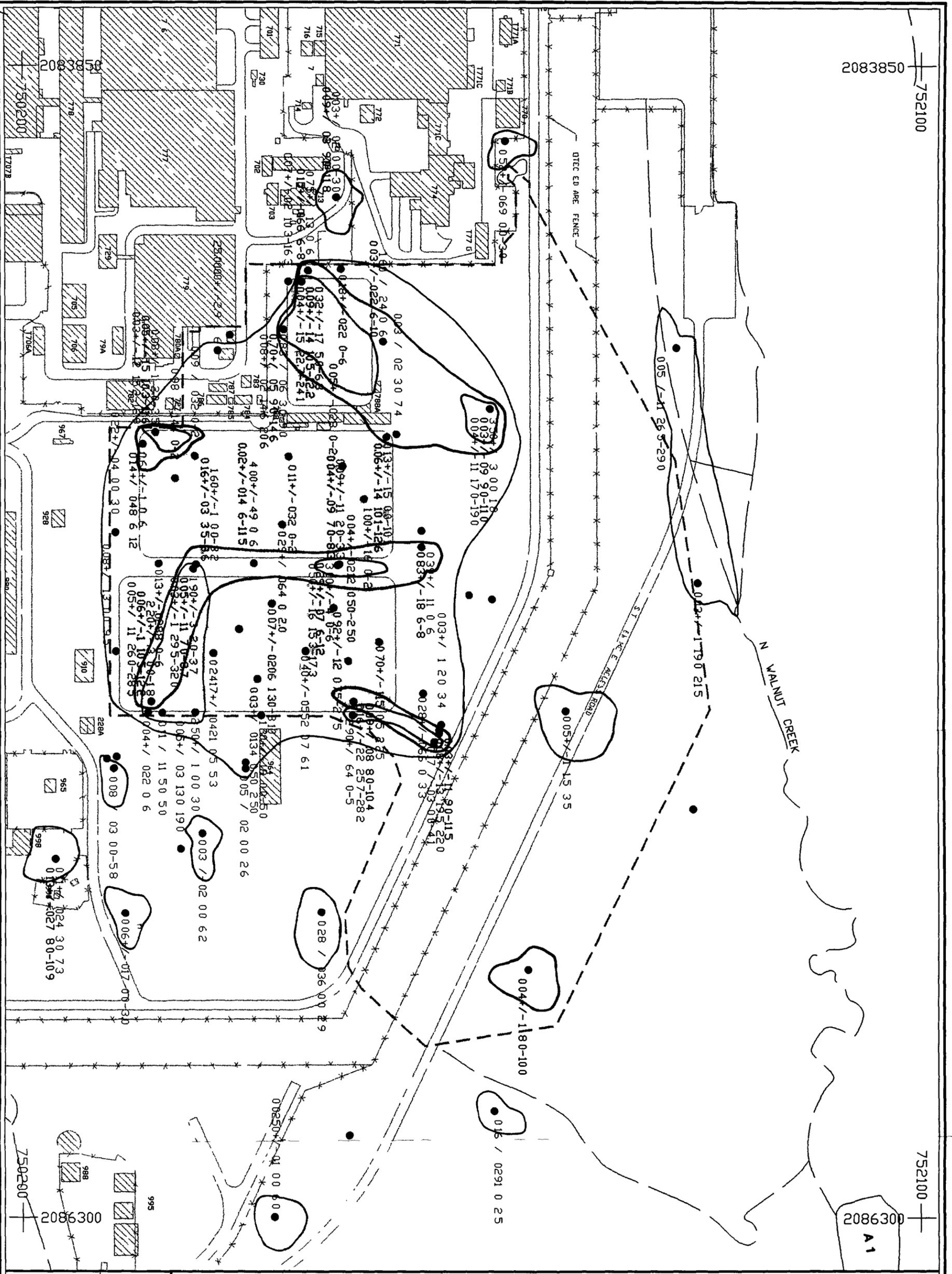
Figure II 4 5 10
Solar Evaporation Ponds
Operable Unit No 4 IM/IRA EA DD
Extent of Americium 241 in
the Subsurface

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LEGEND

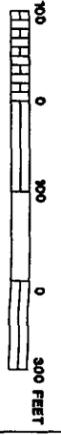
- Streams
- Paved Roads
- ▨ Buildings
- Fence
- Solar Evaporation Ponds (SEP)
- OU4 Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 0.02 pCi/g
- Extent of Contamination Above Background 95% UCL of 0.02 pCi/g
- Extent of Contamination Above Background 95% UCL of 0.02 pCi/g
- Below the UCL

Concentration Depth

17700	0 6 ft	Maximum Concentration
23978	6 12 ft	Observed Interval
10321	>12 ft	

NOTES

1 Sample location without result indicates that value is less than 95% UCL



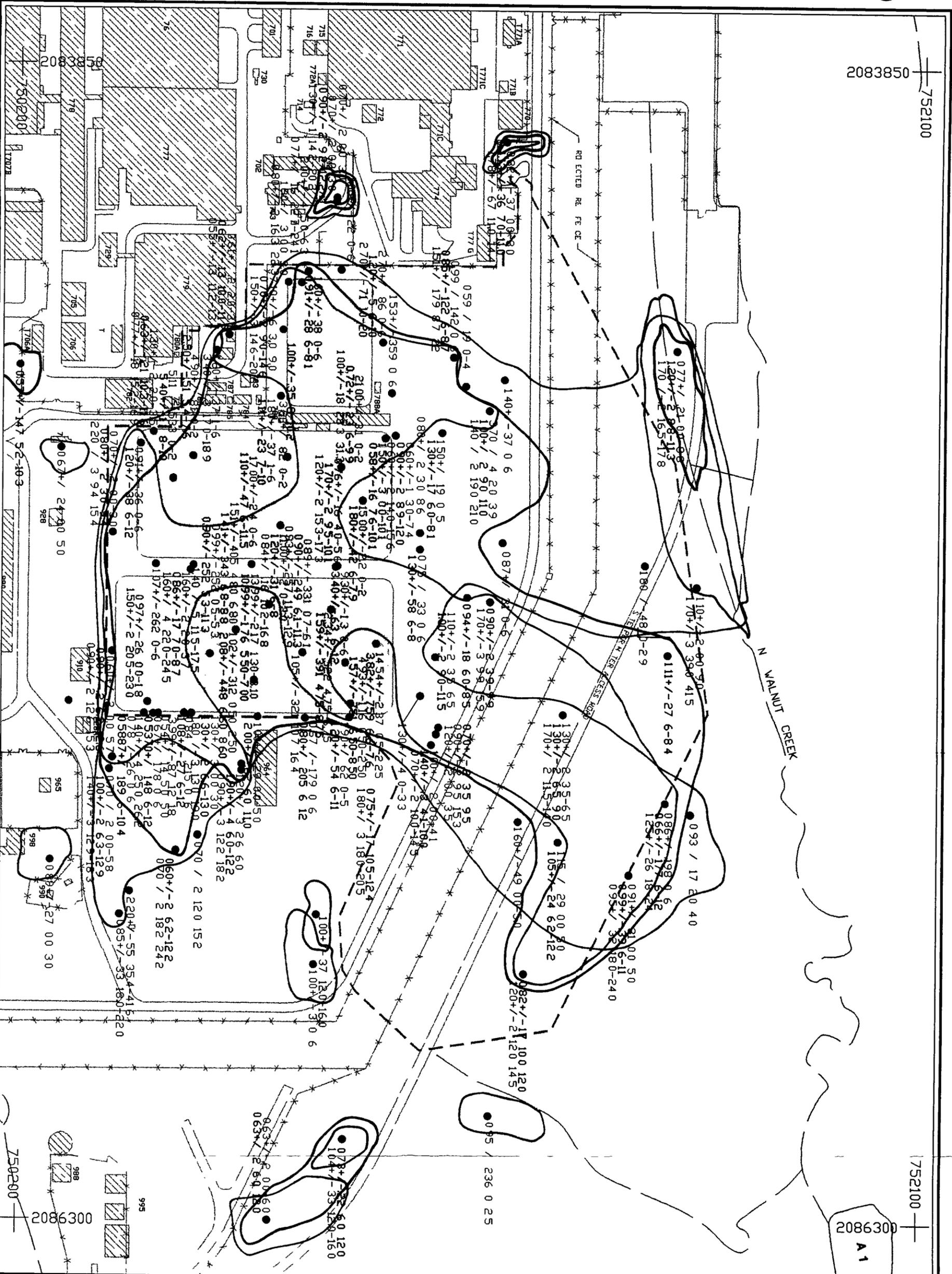
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Figure II 4 5 11

Solar Evaporation Ponds
Operable Unit No 4 IM/RA EA DD
Extent of Plutonium 239/240 in
the Subsurface

539

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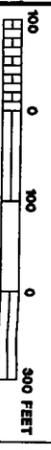
LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *** Fence
- ☐ Solar Evaporation Ponds (SEP)
- OU4 Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 0.53 pci/g
- Extent of Contamination Above Background 95% UCL of 0.53 pci/g
- Extent of Contamination Above Background 95% UCL of 0.53 pci/g
- Below the UCL

Concentration	Depth	Maximum Concentration Observed in Interval
17700	0-6 ft	
23978	6-12 ft	
10321	>12 ft	

NOTES

1 Sample location without result indicate that value is less than 95% UCL



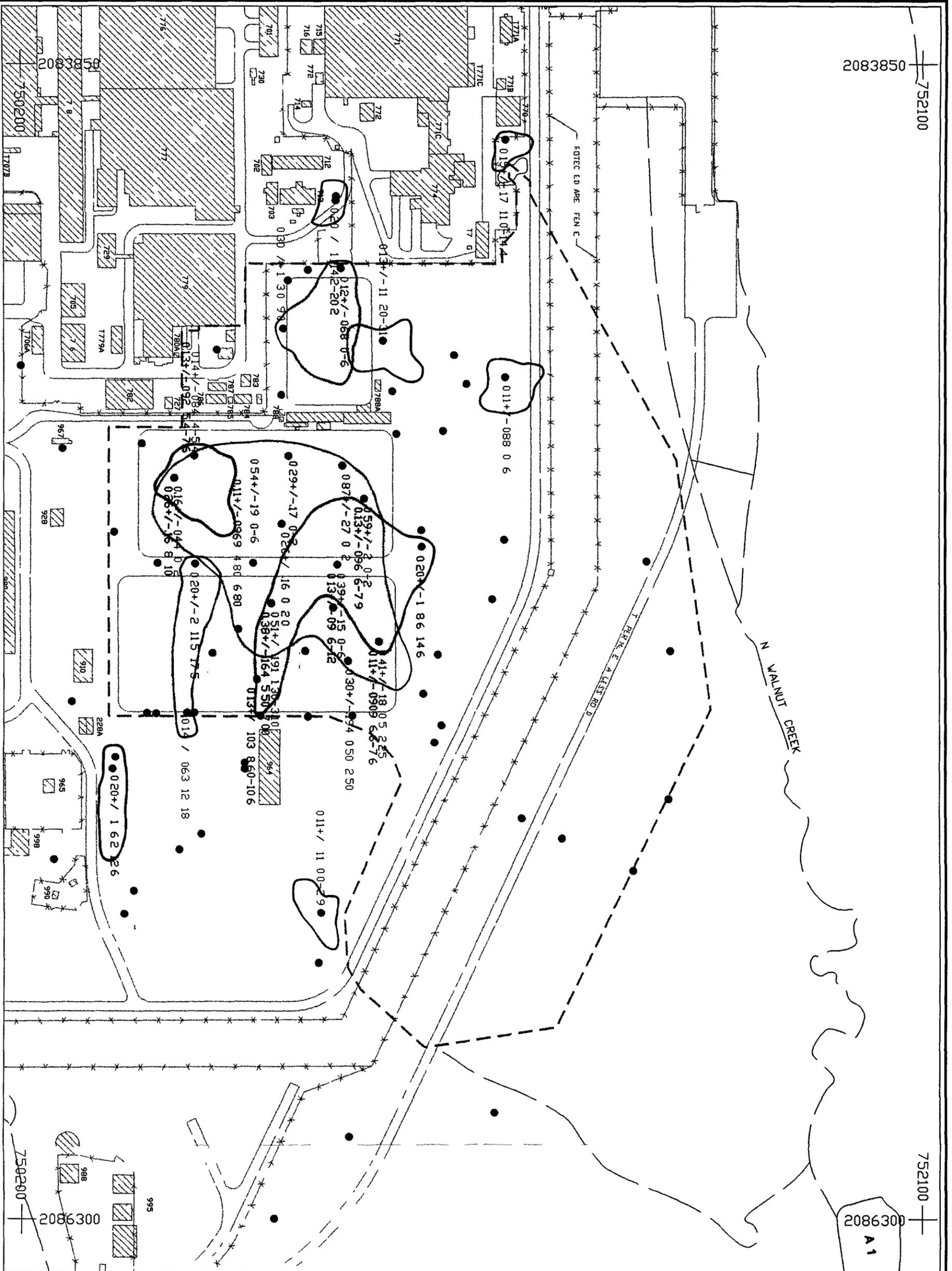
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Figure 11.4.5.12

Solar Evaporation Ponds
Operable Unit No. 4 IM/IRA EA DD
Extent of Uranium 233/234 in
the Subsurface

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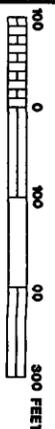
LEGEND

- Stream
- Paved Roads
- ▨ Buildings
- *— Fence
- ▭ Solar Evaporation Ponds (SEP)
- OU4 Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 0.1 pCi/g
- Extent of Contamination Above Background 95% UCL of 0.1 pCi/g
- Extent of Contamination Above Background 95% UCL of 0.1 pCi/g
- Below the UCL

Concentration	Depth	Maximum Concentration	Observed Interval
17700	0 6 ft		
23978	6 12 ft		
10321	>12 ft		

NOTES

1 Sample location without result indicates that value is less than 95% UCL



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Figure II 4 5 13

Solar Evaporation Ponds
Operable Unit No 4 IM/RA EA DD
Extent of Uranium 235 in
the Subsurface

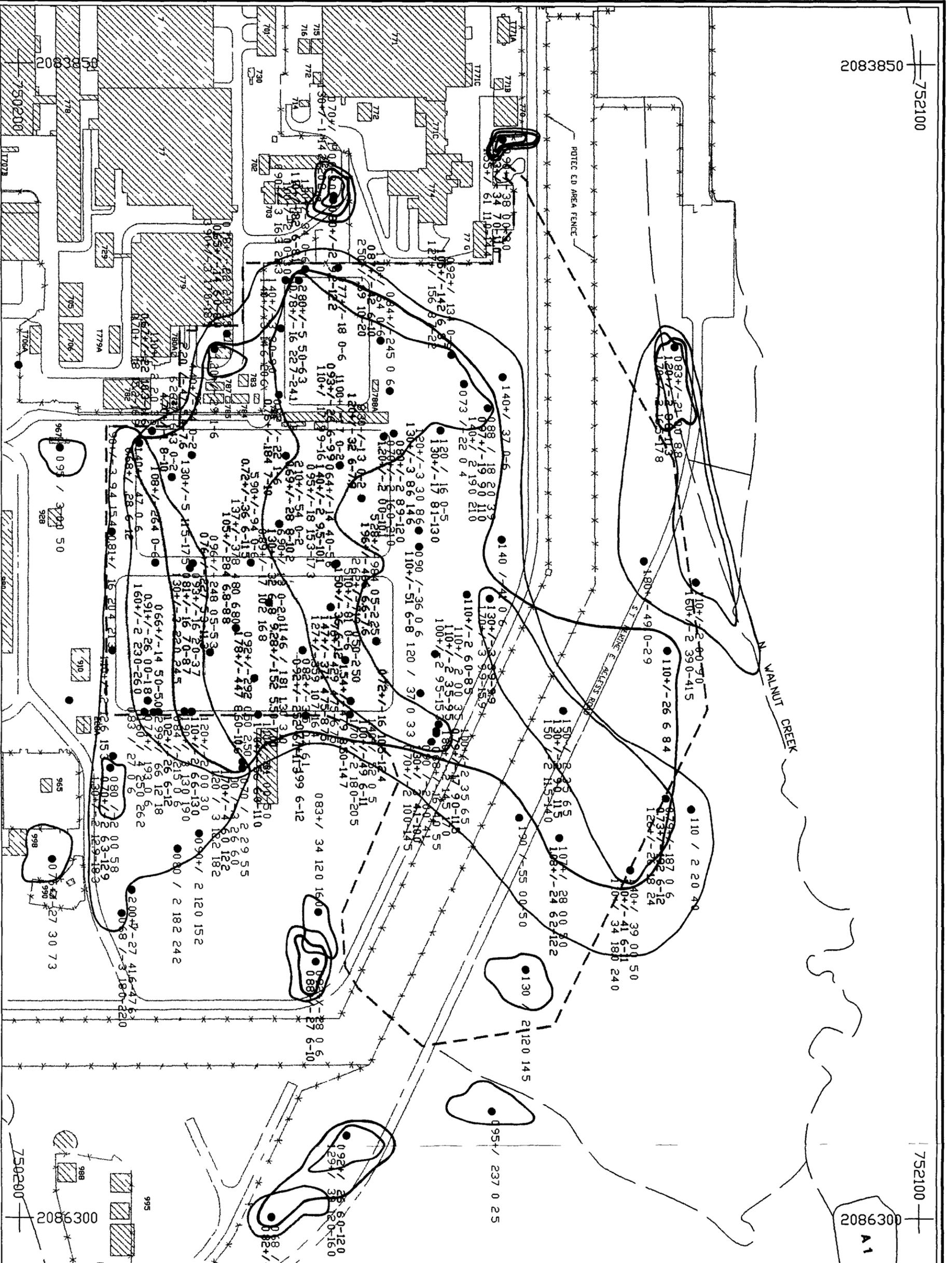
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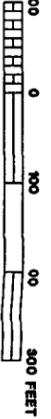
- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- Solar Evaporation Ponds (SEP)
- OU4 Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 0.63 pCi/g
- Extent of Contamination Above Background 95% UCL of 0.63 pCi/g
- Extent of Contamination Above Background 95% UCL of 0.63 pCi/g
- Below the UCL

Concentration Depth

17700	0.6 ft	Maximum Concentration Observed in Interval
23978	6-12 ft	
10321	>12 ft	

NOTES

1 Sample location without result indicates that value is less than 95% UCL



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Figure II 4-5-14

Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DD
 Extent of Uranium 238 in
 the Subsurface

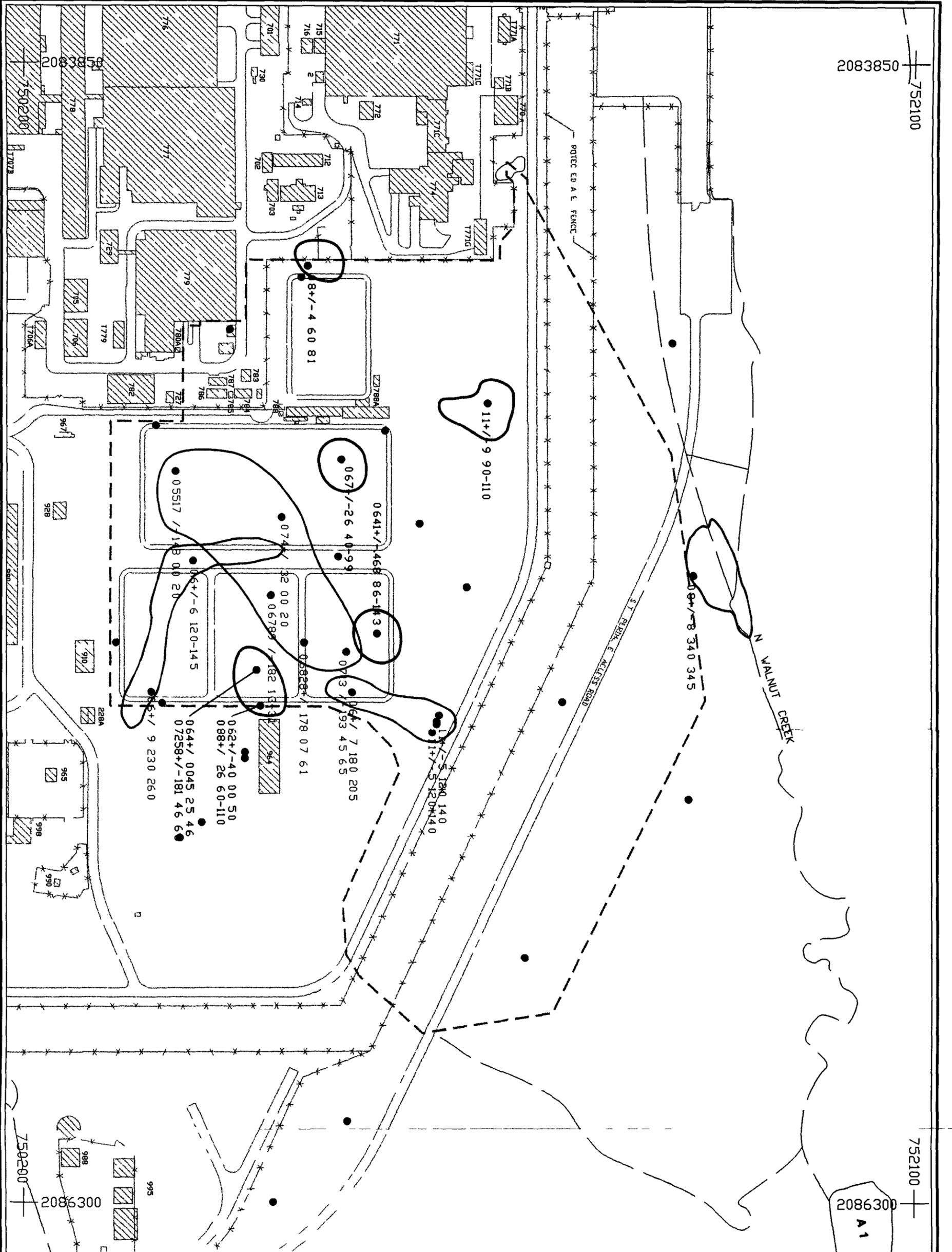
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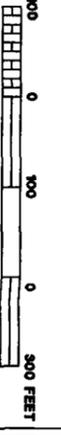
LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- Solar Evaporation Ponds (SEP)
- OUA Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 0.54 pci/g
- Extent of Contamination Above Background 95% UCL of 0.54 pci/g
- Extent of Contamination Above Background 95% UCL of 0.54 pci/g
- LLLLL Below the UCL

Concentration	Depth	Maximum Concentration Observed in Interval
17700	0-6 ft	
23978	6-12 ft	
10321	>12 ft	

NOTES

1 Sample location without result indicates that value is less than 95% UCL



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Figure II 4.5.17
 Solar Evaporation Ponds
 Operable Unit No. 4 IM/IRA EA DD
 Extent of Strontium 89/90 in
 the Subsurface

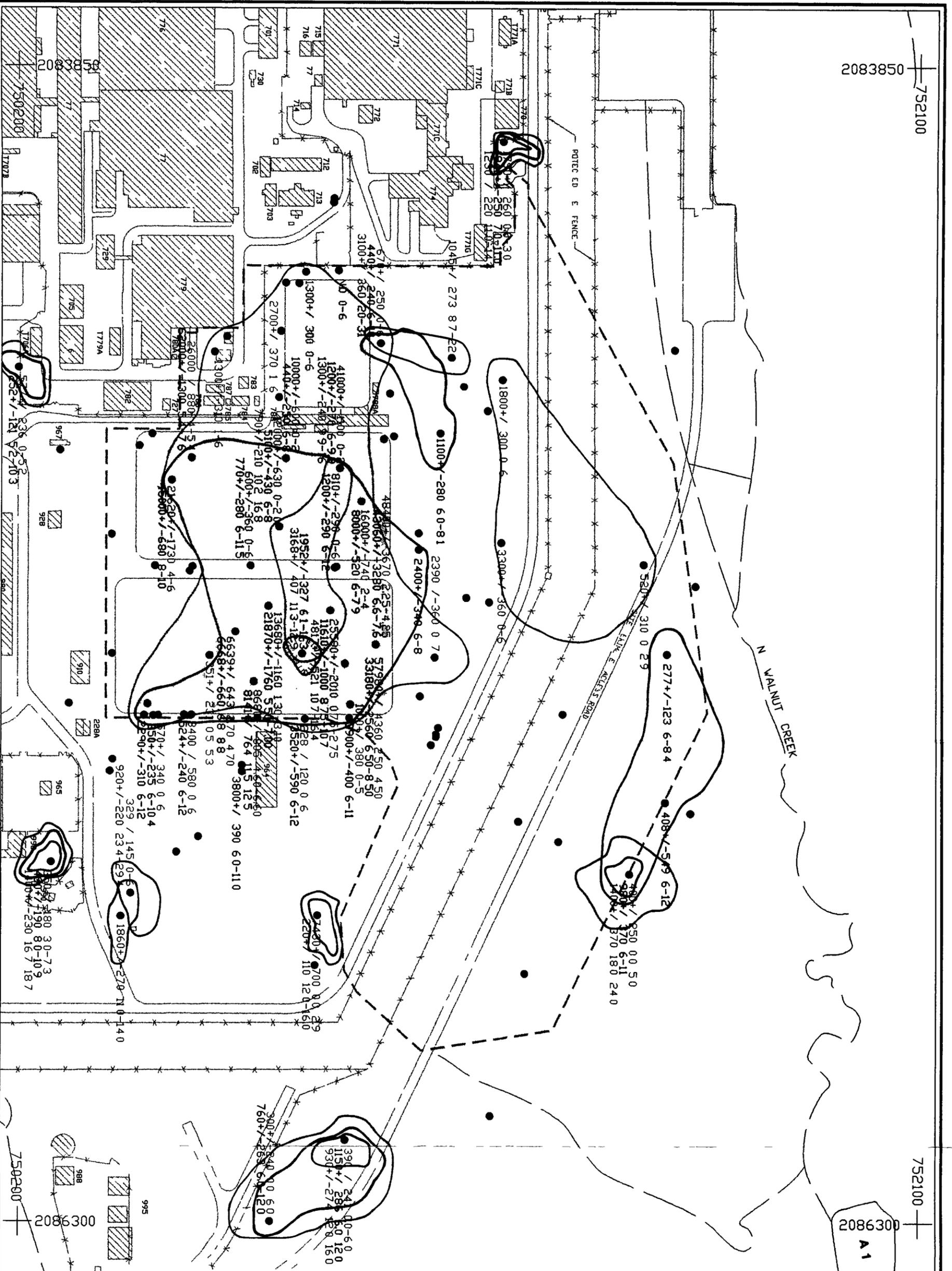
2083850

752100

752100

2086300

A1



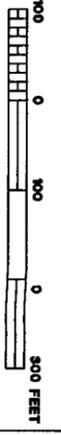
LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- Solar Evaporation Ponds (SEP)
- OU4 Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 212 pCi/l
- Extent of Contamination Above Background 95% UCL of 212 pCi/l
- Extent of Contamination Above Background 95% UCL of 212 pCi/l
- Below the UCL

Concentration Depth	Maximum Concentration Observed in Interval
17700	0-6 ft
23978	6-12 ft
10321	>12 ft

NOTES

1 Sample location without result indicates that value is less than 95% UCL



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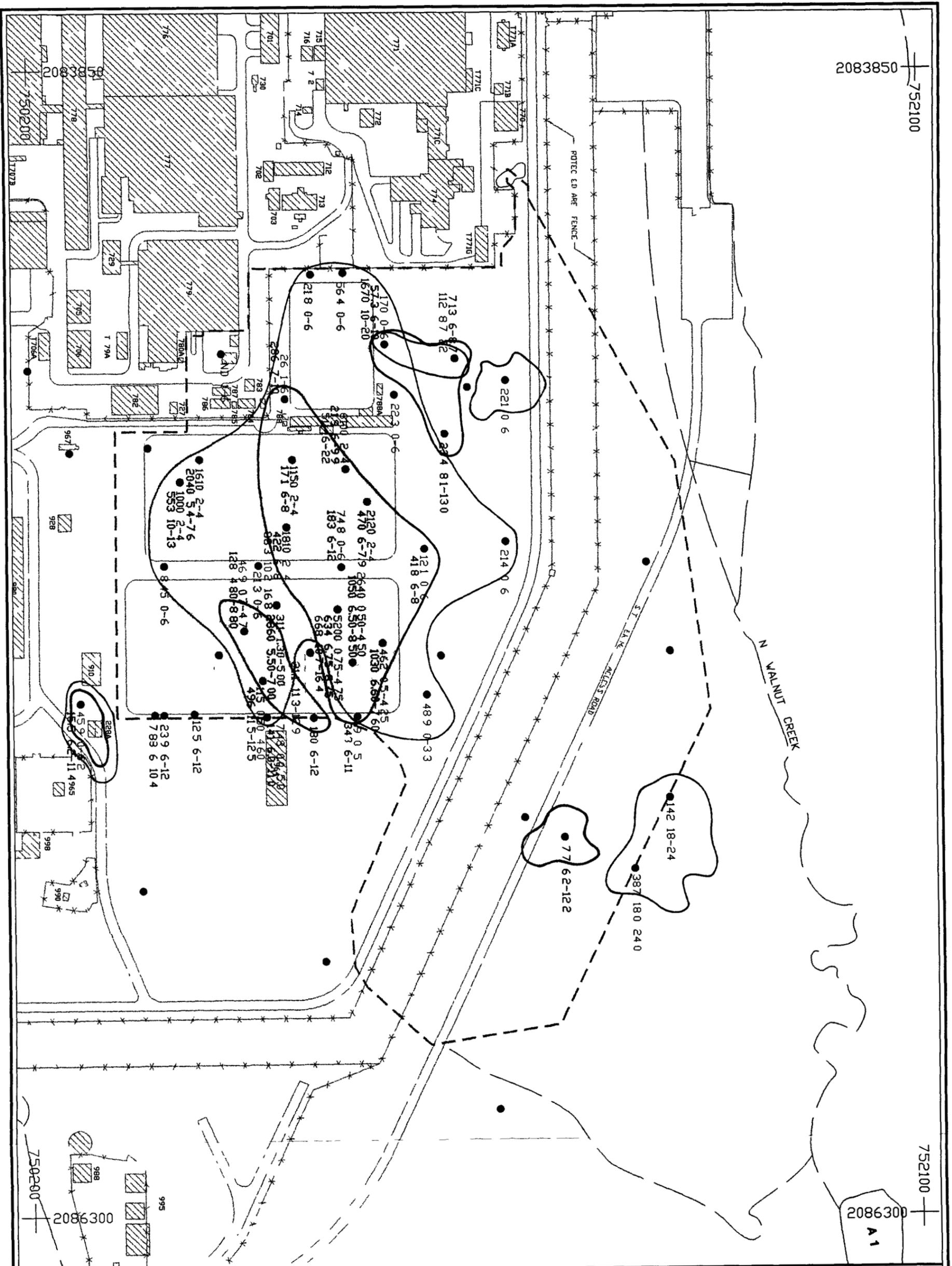
Figure II 4 5 18

Solar Evaporation Ponds
 Operable Unit No 4 IM/IRA EA DD
 Extent of Tritium in
 the Subsurface

5/16

2083850
752100

752100
2086300
A 1



LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- Fence
- Solar Evaporation Ponds (SEP)
- OU4 Boundary
- Sample Location
- Extent of Contamination Above Background 95% UCL of 71 mg/kg
- Extent of Contamination Above Background 95% UCL of 71 mg/kg
- Extent of Contamination Above Background 95% UCL of 71 mg/kg

Concentration	Depth	Maximum Concentration Observed In Interval
17700	0-6 ft	
23978	6-12 ft	
10321	>12 ft	

NOTES

1 Sample location without result indicates that value is less than 95% UCL



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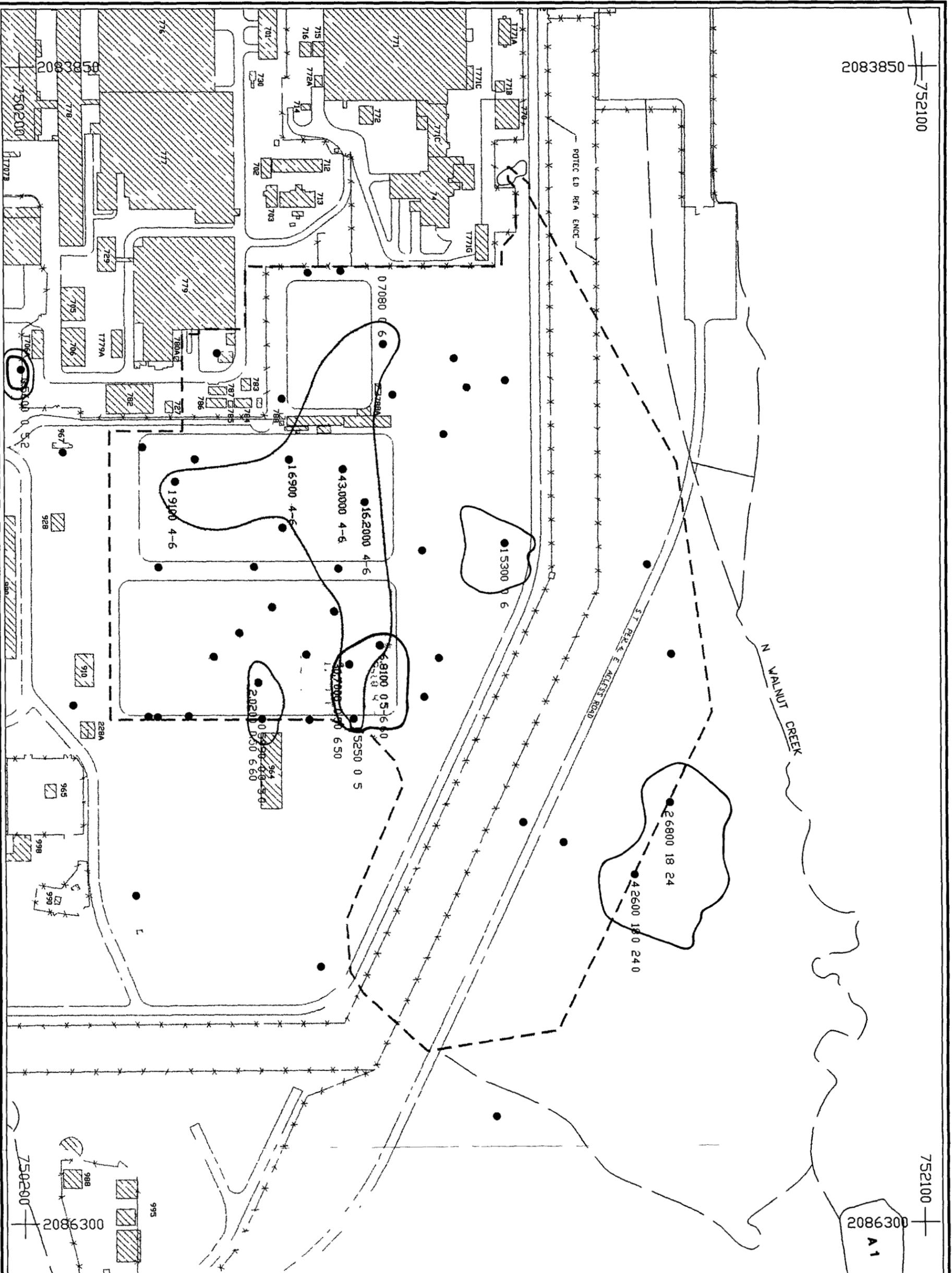
Figure II 4 5 19

Solar Evaporation Ponds
Operable Unit No 4 IM/IRA EA DD
Extent of Nitrate/Nitrite in the Subsurface

1547

2083850
752100

752100
2086300
A 1



LEGEND

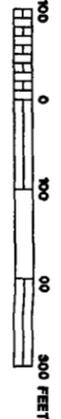
- Streams
- Paved Roads
- ▨ Buildings
- *-*-* Fence
- Solar Evaporation Ponds (SEP)
- O&U Boundary
- Sample Location
- Extent of Contamination Above the Detection Limit
- Extent of Contamination Above the Detection Limit
- Extent of Contamination Above the Detection Limit
- ||||| Below the UCL

Concentration Depth

17700	0.6 ft	Maximum
23978	6-12 ft	Concentration
10321	>12 ft	Observed In Interval

NOTES

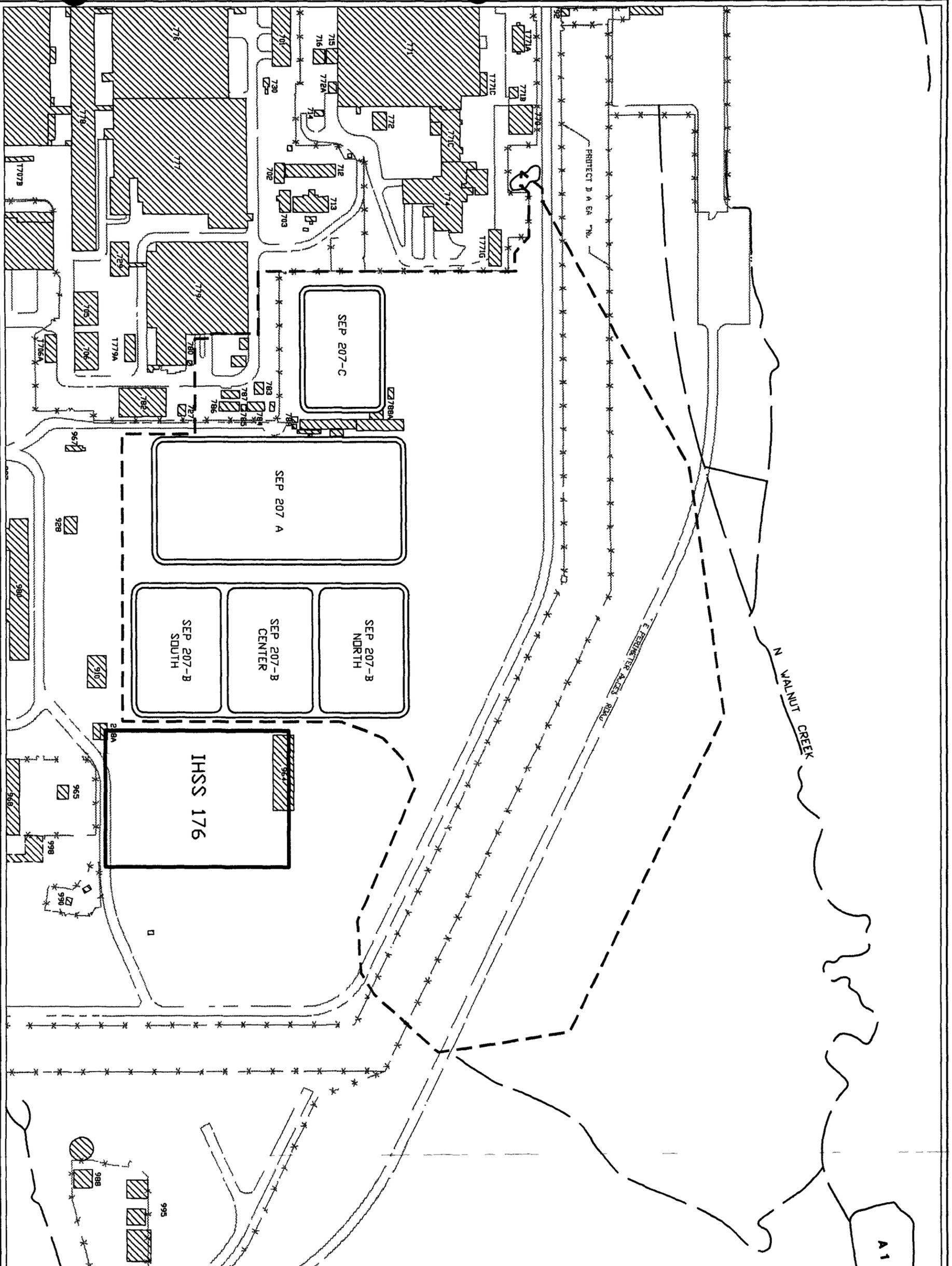
1 Sample location without result indicates that value is less than 95% UCL



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Figure 11.4.5.20
 Solar Evaporation Ponds
 Operable Unit No. 4 (M/RA EA DD)
 Extent of Cyanide in
 the Subsurface

2500

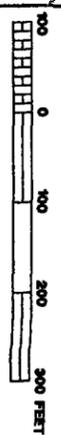


A 1



LEGEND

- Streams
- Paved Roads
- ▨ Buildings
- - - Fence
- OUA Boundary



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Figure # 7 1

Solar Evaporation Ponds
 Operable Unit No. 4, IM/RA EA DD
 IHSS 176 in Relation to OUA