Department of Energy
Oak Ridge Operations
Paducah Site Office
P.O. Box 1410
Paducah, KY 42001

June 12, 2000

Mr. Carl R. Froede Jr., P.G.
United States Environmental Protection Agency
Region IV
DOE Remedial Section
Federal Facilities Branch
Waste Management Division
61 Forsyth Street
Atlanta, Georgia 30303

Mr. Michael V. Welch, P.E.
Manager
Hazardous Waste Branch
Kentucky Department for Environmental Protection
14 Reilly Road, Frankfort Office Park
Frankfort, Kentucky 40601

Dear Mr. Froede and Mr. Welch:

SITE EVALUATION REPORT FOR WASTE AREA GROUPING 8 AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, JUNE 2000, DOE/OR/07-1867&D1

Enclosed for your review is the subject document. The Waste Area Grouping (WAG) 8 Report addresses the findings of the WAG 8 Site Evaluation (SE) conducted this past summer and fall at the Paducah Gaseous Diffusion Plant (PGDP). Based on the new PGDP Operable Unit Strategy, WAG 8 information addressed in this SE will be used to support the Surface Water Operable Unit's (SWOU's) future reports and remedial activities. If applicable, future WAG 8 activities will be addressed/conducted as part of the SWOU.

Per the PGDP Regulatory Commitments, this document is due to the regulatory agencies on June 22, 2000. In keeping with the present project schedule, the DOE requests that the Environmental Protection Agency and the Kentucky Department for Environmental Protection submit comments by July 22, 2000. In order for the comments to be incorporated in a timely manner, we ask that your comments be provided electronically to castanedajr@ornl.gov. The DOE appreciates your timeliness in the review of this document.

If you have any questions or require additional information, please call J. Raúl Castañeda at (270) 441-6809.

Sincerely,

W. Don Seaborg, Site Manager
Paducah Site Office

Enclosure

cc w/out enclosure:
G. W. Benedict, UE-50
R. H. Blumenfeld, CC-10
DMC/Kevil
G. L. Dover, BJC/Kevil
C. Hudson, CJE/Kevil
R. R. Nelson, EM-90
R. A. Pratt, BJC/Kevil
T. Taylor/L. Martin, KDEP/Frankfort

BECHTEL JACOBS
Bechtel Jacobs Company LLC

DOE Contract No. DE-AC05-98OR22700
Job No. 23900
June 12, 2000

Mr. W. Don Seaborg
Paducah Site Manager
U.S. Department of Energy
P. O. Box 1410
Paducah, KY 42002-1410

Subject: *Site Evaluation Report for Waste Area Grouping 8 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, June 2000, DOE/OR/07-1867&D1

Dear Mr. Seaborg:

Enclosed for your issuance to the regulatory agencies for review are 10 copies (three for the U.S. Environmental Protection Agency and seven for the State of Kentucky) of the subject document and three copies for the U.S. Department of Energy's (DOE's) Paducah Site office. Bechtel Jacobs Company LLC will issue the document to the remaining recipients per the standard distribution list for D1 Primary Documents. The Waste Area Grouping (WAG) 8 Report addresses the findings of the WAG 8 Site Evaluation (SE) conducted this past summer and fall at the Paducah Gaseous Diffuison Plant (PGDP). Per the PGDP regulatory commitments, this document is due to the regulatory agencies on June 22, 2000. Comments on the noted document are due back to DOE, per the Federal Facility Agreement, within 30 calendar days of this date (i.e., comments due July 22, 2000).

Per the PGDP Operable Unit (OU) strategy, WAG 8 information addressed in this SE will be used to support future reports and remedial activities for the Surface Water OU. If applicable, future WAG 8 activities will be addressed and conducted as part of the Surface Water OU.

If you have any questions or need additional information, please contact Robert Pratt of my staff at (270) 441-5060.

Sincerely,

Gordon L. Dover
Paducah Manager of Projects

GLD:ams
LTR-PAD/MP-AM-00-0086

Enclosure: *Site Evaluation Report for Waste Area Grouping 8 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, June 2000, DOE/OR/07-1867&D1

c/enc: Standard Distribution for D1 Documents

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D. B. Williams	X		X		X	
Environmental Protection Agency						
Carl R. Froede, Jr. (3)			X		X	
Kentucky Department of Fish and Wildlife						
W. L. Davis			X		X	
LAN-CON						
D. F. Hutcheson	X			X		X
Murray State University						
Dr. J. F. Mateja			X		X	
Natural Resources Trustees						
S. Alexander			X		X	
J. A. Barber			X		X	
A. Loudermilk			X		X	
A. B. Perkins			X		X	
Site Specific Advisory Board						
J. Craig Rhodes			X (electronic, if available)		X (electronic, if available)	
SSAB Office File (2)			X (1 hard and 1 electronic, if available)		X (1 hard and 1 electronic, if available)	
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J. A. Volpe			X		X	
M. V. Welch			X		X	
Tennessee Valley Authority						
T. Whitaker				X		X
U.S. Enrichment Corporation						
T. M. Taimi				X		X
U.S. Geological Survey						
T. Mesko			X		X	
West Kentucky Wildlife Management Area						
T. Kreher			X		X	

D0--Bechtel Jacobs Company/DOE internal draft
D1--EPA/KY first draft
D2--EPA/KY final draft (comments incorporated)

CERTIFICATION

Document Identification: **Site Evaluation Report for Waste Area Grouping 8 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

U.S. Department of Energy (DOE)
Owner and Operator

W. Don Seaborg, Paducah Site Manager — Date Signed: 6/7/00

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Bechtel Jacobs Company LLC
Co-Operator

Gordon L. Dover, Paducah Manager of Projects — Date Signed: 6/7/00

DOE/OR/071867&D1
Primary Document

Site Evaluation Report for Waste Area Grouping 8 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—June 2000

Prepared for the
U.S. Department of Energy
Office of Environmental Management

by

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
Paducah Gaseous Diffusion Plant

T N & Associates, Inc.

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

PREFACE

This integrated Site Evaluation Report for Waste Area Grouping 8 at the Paducah Gaseous Diffusion Plant (DOE/OR/07-1867&D1) was prepared in accordance with requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Resource Conservation and Recovery Act of 1976 (RCRA).

In accordance with Section IV of the Federal Facility Agreement for the Paducah Gaseous Diffusion Plant, this integrated technical document was developed to satisfy both CERCLA and RCRA corrective action requirements. The phases of the investigation process are referenced by CERCLA terminology within this document to reduce the potential for confusion.

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CONTENTS

APPENDICES

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FIGURES

TABLES

(Tables 5.1 through 5.12 are located in Appendix G, Risk Tables)

EXHIBITS

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ACRONYMS

amsl	above mean sea level
AOC	area of concern
ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	Contract Laboratory Program
COPC	chemical of potential concern
CPT	cone penetrometer
CSL	Close Support Laboratory
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DPT	direct push technology
DQO	data quality objective
DWRC	dual wall reverse circulation
ECD	electron capture detector
EDD	electronic data deliverable
ELCD	electrolytic conductivity detector
EMEF	Environmental Management and Enrichment Facilities
EPA	U.S. Environmental Protection Agency
ERWM	Environmental Restoration and Waste Management
FFA	Federal Facility Agreement
FOD	frequency of detection
FOP	field operating procedure
FS	feasibility study
GC	gas chromatograph
GSA	generator storage area
HCDD	heptachlorodibenzo-p-dioxin
HCDF	heptachlorodibenzofuran
HSWA	Hazardous and Solid Waste Amendments of 1984
I.D.	inside diameter
IATA	International Air and Transportation Association
ID	identification
IDW	investigation-derived waste
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
LCD	Lower Continental Deposits
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LMES	Lockheed Martin Energy Systems, Inc. (also referred to as Energy Systems)
MDL	method detection limit
MgF_2	magnesium flouride
MS	mass spectrometer
MSA	method of standard additions
MS/MSD	matrix spike/matrix spike duplicate
NFA	no further action
O.D.	outside diameter
OCDD	octachlorodibenzo-p-dioxin
OCDF	octachlorodibenzofuran

OOCE	out-of-control event
OREIS	Oak Ridge Environmental Information System
ORO	Oak Ridge Operations
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PA/SI	preliminary assessment/site investigation
PCB	polychlorinated biphenyl
PCDD	pentachlorodibenzo-p-dioxin
PCDF	pentachlorodibenzofuran
pCi/g	picoCurie per gram
PEMS	Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
PID	photoionization detector
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act of 1976
RGA	Regional Gravel Aquifer
RI	remedial investigation
RPD	relative percent difference
SAA	satellite accumulation area
SDWA	Safe Drinking Water Act of 1974
SE	site evaluation
SI	site investigation
SMO	Sample Management Office
SSL	Soil Screening Level
SVOA	semivolatile organic analyte
SWMU	solid waste management unit
TAL	Target Analyte List
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TCE	trichloroethene
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
TLD	thermoluminescent dosimeter
TSCA	Toxic Substances Control Act of 1976
TVA	Tennessee Valley Authority
UCD	Upper Continental Deposits
UCRS	Upper Continental Recharge System
UF_4	uranium tetrafluoride
UF_6	uranium hexafluoride
VOA	volatile organic analyte
WAC	waste acceptance criteria
WAG	waste area grouping
WKWMA	West Kentucky Wildlife Management Area

EXECUTIVE SUMMARY

NOTICE

EPA threshold levels have been used in this report to recommend possible future disposition of the units investigated. The reader should be aware that these recommendations are subject to review and change following the development and approval of chemical-specific action levels by the PGDP Core Team. These action levels, which will be used to determine whether a unit is a candidate for an early action, no further action, or further investigation, were not established at the time this report was prepared. After approval of the action levels, additional analyses to determine the future disposition of each unit may be performed at the direction of the Core Team.

In 1999 and 2000, the U.S. Department of Energy conducted a Site Evaluation (SE) for Waste Area Grouping (WAG) 8 at the Paducah Gaseous Diffusion Plant in Paducah, Kentucky. The WAG 8 area consists of five sites that were considered a potential source for trichloroethylene (TCE) and polychlorinated biphenyls (PCBs). Four of the five sites are electrical switchyards, and the fifth site (the C-340 Reduction and Metals Facility) is an inactive uranium hexafluoride (UF_6) conversion facility (Fig. 1.3). Historical information and previous sampling activities at these sites indicate that there may have been releases associated with the operation of the electrical switchyards and at the C-340 Building. Because the electrical switchyards are currently active, safety concerns restrict characterization activities within these areas and the completion of a Remedial Investigation/Feasibility Study until operations cease. Therefore, to evaluate the impact of these potential releases, an SE has been conducted. The primary difference between an SE and an RI is that an SE is not designed to provide full characterization of the site or to fully define the nature and extent of contamination. The WAG 8 SE, however, provides much more than the usual scope of a typical SE, which generally consists of limited sampling to determine whether contamination is present at a site. The goals of the WAG 8 SE were to confirm or deny the presence of contaminants at each of the sites, evaluate migration pathways to determine if the sites are presently sources of off-site contamination, and to determine if these contaminants are present at concentrations that could pose unacceptable levels of risk to on-site receptors. To achieve these goals, the focus of the SE was to collect information about surface water, surface soil, subsurface soil, and the shallow groundwater to support the evaluation process. Based on the results of the SE, a recommended path forward has been made for each site.

ELECTRICAL SWITCHYARDS

Specific information related to activities conducted within the electrical switchyards is limited. However, it is known that ongoing routine transformer maintenance and replacement have been performed throughout the operational history of these facilities. Many of the transformers and capacitors contained in these switchyards used PCB-laden oil as an insulating fluid. Another likely source of PCBs at the switchyards was an underground oil distribution system, which has been abandoned and replaced by an aboveground system because of reported leaks and maintenance problems. TCE was reportedly used as an electrical equipment cleaner and solvent during maintenance activities at the switchyards.

The only documented release for any of the four WAG 8 switchyard sites was a spill of approximately 345 gal of non-PCB oil from a transformer at the C-531 Electrical Switchyard [Solid Waste Management Unit (SWMU) 82] in December 1990. The oil spread over a large area of the

switchyard and into an adjacent ditch. Approximately 125 55-gal drums of gravel and soil were excavated from the switchyard to remediate the spill.

C-531 Electrical Switchyard (SWMU 82)

The C-531 Electrical Switchyard (SWMU 82) is an active switchyard located in the eastern portion of the Paducah Gaseous Diffusion Plant (PGDP). The facility has been in operation since 1951 and supplies electrical power to the C-331 and C-333 Cascade Buildings. The site is enclosed by an 8-ft-tall chain link fence and is covered with gravel underlain by a drainage system that discharges runoff into ditches along the eastern side of the SWMUs. This runoff is eventually discharged to Kentucky Pollutant Discharge Elimination System (KPDES) Outfall 010.

Several semivolatile organic analytes (SVOAs), radionuclides, PCBs, and dioxin/furans were detected in the surface soil samples collected from the drainage ditch at SWMU 82. Detections of individual PCBs, at a maximum concentration of 1,183 μg/kg for PCB 1260, and dioxin/furans, at a maximum concentration of 25.3 μg/kg for octachloro-dibenzo[b,e][1,4]dioxin, represent residual contaminants from historical leaks and spills at the site. Low levels of SVOAs are known to be ubiquitous to PGDP, and radiocuclides are not process-related to the electrical switchyards. No site-derived contaminants were detected in the subsurface soil at SWMU 82. The absence of site-derived contaminants in the subsurface at SWMU 82 indicates that leaching of contaminants from the soil to groundwater is not a significant contaminant migration pathway.

Only a small quantity of technetium-99 [23.4 (±9.1) pCi/L] was detected in storm water collected at this SWMU. Technetium-99 is not a process-related contaminant at the electrical switchyard and, therefore, site-derived contaminants are not being transported via the storm water migration pathway.

Concentrations of individual contaminants in soils at SWMU 82 exceed de minimis levels for total dioxins/furans, total polycyclic aromatic hydrocarbons (PAHs), total PCBs, thorium-234, and uranium-238. Maximum contaminant concentrations also exceed ecological risk-based and regulatory criteria at SWMU 82.

Because the switchyard is in operation, WAG 8 SE sampling was confined to the periphery of the site. Based on the findings of this SE, further evaluation of the site may be necessary.

C-533 Electrical Switchyard (SWMU 83)

The C-533 Electrical Switchyard (SWMU 83) is an active switchyard located in the eastern portion of PGDP. The facility has been in operation since 1951 and supplies electrical power to the C-331 and C-333 Cascade Buildings. The site is enclosed by an 8-ft-tall chain link fence and is covered with gravel underlain by a drainage system that discharges runoff into ditches along the eastern side of the SWMUs. This runoff is eventually discharged to KPDES Outfall 010.

Surface soil samples collected in the drainage ditch at SWMU 83 contained low concentration of several SVOAs (maximum concentration only slightly above the method detection limit). Low levels of SVOAs are known to be ubiquitous to PGDP. Several metals (aluminum, beryllium, nickel, vanadium, iron, and magnesium) were detected in the subsurface at concentrations that only slightly exceeded background levels. The absence of site-derived contaminants in the subsurface at SWMU 82 indicates that leaching of contaminants from the soil to groundwater is not a significant contaminant migration pathway.

Only a small quantity of technetium-99 [17.4 (±8.9) pCi/L] was detected in the storm water collected at this SWMU. Technetium-99 is not a process-related contaminant at the electrical switchyard, and therefore site-derived contaminants are not being transported via the storm water migration pathway.

Maximum concentrations of "total PAHs," and the individual components benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded their industrial use risk-based benchmarks for an on-site industrial worker in surface soil at SWMU-83. By contrast, comparison of soil contaminant concentrations to U.S. Environmental Protection Agency (EPA) soil screening levels (SSLs) did not indicate exceedances for any specific compounds for which such benchmarks are available. However, fluoranthene, phenathrene, pyrene, and total PAHs exceeded ecological screening benchmarks.

Because the switchyard is in operation, WAG 8 SE sampling was confined to the periphery of the site. Based on the findings of this SE, further evaluation of the site may be necessary.

C-535 Electrical Switchyard (SWMU 84)

The C-535 Electrical Switchyard (SWMU 84) is located in the northeastern portion of PGDP immediately north of the C-335 and C-337 Cascade Buildings. The facility has been in operation since 1951 and currently provides power to various PGDP facilities. The site is surrounded by an 8-ft-tall chain link fence and is covered with crushed gravel. The site has an underground drainage system that discharges to a shallow drainage ditch located on the northern side of the switchyard. The drainage ditch eventually discharges to the North/South Diversion Ditch and then to KPDES Outfall 001.

Several SVOAs, cesium-137, PCBs, and dioxins/furans were detected in the surface soil samples collected from the drainage ditch at SWMU 84. Detections of PCBs, at a maximum concentration of 380 μg/kg, and dioxin/furans, at a maximum concentration of 6.79 μg/kg, represent residual contaminants from historical leaks and spills at the site. Low levels of SVOAs are known to be ubiquitous to PGDP, and radiocuclides are not process-related to the electrical switchyards. No site-derived contaminants were detected in the subsurface soil at SWMU 84. The lack of site-derived contaminants in the subsurface at SWMU 84 indicates that leaching of contaminants from the soil to groundwater is not a significant contaminant migration pathway.

Only a small quantity of technetium-99 [17.9 (±8.9) pCi/L] was detected in the storm water collected at this SWMU. Technetium-99 is not a process-related contaminant at the electrical switchyard and, therefore, site-derived contaminants are not being transported via the storm water migration pathway.

Maximum concentrations and activities of total dioxin/furans, total PAHs, total PCBs, and cesium-137 detected in surface soil at SWMU-84 exceeded their industrial use RBCs, reflecting the potential for these compounds to exceed *de minimis* levels of risk or hazard at the appropriate locations. Five of 14 detected dioxin/furans exceeded their congener-specific risk-based criteria (RBCs), by a factor of 30 in the case of octachlorodibenzo-p-dioxin (OCDD). Three of four detected PAHs exceeded their congener-specific RBCs, as typified by benzo(a)pyrene, which exceeded its benchmark 100-fold. PCBs -1254 and -1260 also displayed exceedances of their respective industrial use RBCs.

No contaminants were detected in surface or subsurface soil in excess of their soil-to-groundwater SSLs. However, fluoranthene, pyrene, phenanthrene, total PAHs, and total PCBs (including PCBs -1254 and -1260, individually) exceeded one or more risk-based or regulatory ecological screening criteria.

Because the switchyard is in operation, WAG 8 SE sampling was confined to the periphery of the site. Based on the findings of this SE, further evaluation of the site may be necessary.

C-537 Electrical Switchyard (SWMU 85)

The C-537 Electrical Switchyard (SWMU 85) is located in the northeastern portion of PGDP immediately northeast of the C-335 and C-337 Cascade Buildings. The switchyard has been in operation since 1951 and currently provides power to various PGDP facilities. The site is surrounded by an 8ft-tall chain link fence and is covered with crushed gravel. The site has an underground drainage system that discharges to a shallow drainage ditch located on the northern side of the switchyard. The drainage ditch eventually discharges to the North/South Diversion Ditch and then to KPDES Outfall 001.

Several SVOAs, PCBs, and dioxin/furans were detected in the surface soil samples collected from the drainage ditch at SWMU 85. Detections of PCBs, at a maximum concentration of 71 μg/kg, and dioxin/furans, at a maximum concentration of 9.18 μg/kg, represent residual contaminants from historical leaks and spills at the site. Low levels of SVOAs are known to be ubiquitous to PGDP. No contaminants were detected in the subsurface soil at SWMU 85. The absence of contaminants in the subsurface at SWMU 85 indicates that leaching of contaminants from the soil to groundwater is not a significant contaminant migration pathway.

Only a small quantity of technetium-99 [16.2 (±8.8) pCi/L] was detected in the storm water collected at this SWMU. Technetium-99 is not a process-related contaminant at the electrical switchyard, and therefore site-derived contaminants are not being transported via the storm water migration pathway.

The maximum detected concentrations of total dioxins/furans, total PAHs, and total PCBs exceeded their respective industrial use RBCs in at least one sample at SWMU-85. Six of 12 dioxin/furan congeners exceeded their congener-specific RBCs in one sample at this location, with OCDD exceeding its RBC by a factor of 45. Benzo(b)fluoranthene exceeded its benchmark by a factor of 35.

Fluoranthene, pyrene, total dioxins/furans, and total PCBs exceeded ecological risk-based and regulatory screening criteria.

Because the switchyard is in operation, WAG 8 SE sampling was confined to the periphery of the site. Based on the findings of this SE, further evaluation of the site may be necessary.

C-340 Reduction And Metals Facility

The C-340 Reduction and Metals Facility is located on the eastern side of PGDP. The facility was constructed in 1957 and was used to convert UF_6 to uranium tetrafluoride (UF_4) to produce hydrogen fluoride and to convert UF_4 to uranium metal. Metals and reduction operations were discontinued in 1975. Since that time part of the C-340 Building was used intermittently as a training center and a valve testing area. The building was closed and abandoned in 1992; it is currently unoccupied and considered a radiologically contaminated area. The C-340 Building is divided into four sections and occupies an area of approximately 40,000 ft^2. The building is currently slated for decontamination and decommissioning.

Contamination in the C-340 Building consists of radiological and chemical contaminants remaining from the uranium metal production process previously performed in the building. Documentation pertaining to potential releases are unknown, however it is likely that some of the process feedstock, product material, by-products, uranium metal scraps, sludges, and ancillary materials could have been carried outside the building through the building ventilation and drainage systems during process spills.

Surface soils at the C-340 Building contain elevated levels of SVOAs, PCBs, dioxins/furans, metals, and radionuclides over most of the site. PAHs are present at concentrations in excess of 100,000 µg/kg. PCBs exhibited concentrations that exceeded 500,000 µg/kg for some congeners. Radiological constituents are distributed throughout the site at particularly high activity levels for the thorium and uranium series radioisotopes.

Subsurface soil contained technetium-99 at an activity of 7.36 (± 3.48) pCi/g and metals at maximum concentrations equal to or less than twice background levels. The isolated occurrences of contaminants found in the subsurface soil indicate that infiltration of groundwater is not a significant contaminant migration pathway at the C-340 Building.

A number of metals (aluminum, beryllium, chromium, lead, and nickel), total dioxin/furans, total PAHs, total PCBs, and several radionuclides (americium-241, cesium-137, cobalt-60, protactinium-234m, thorium-234, and uranium-234/235/238) exceed analyte-specific RBCs.

Based on comparisons of surface and subsurface soil concentrations to contaminant-specific soil-to-groundwater SSLs, benzo(a)pyrene and the PCBs -1242, -1254, and -1260 exceeded their appropriate criteria in at least one sample. These same mixtures (plus PCB-1248) exceeded their respective risk- and regulatory-based ecological screening criteria by factors of up to 3000. However, since the C-340 Building is an industrial site and suitable wildlife habitat is limited, potential exposure of ecological receptors to contaminated soil is reduced.

Because of the levels of contamination found at the C-340 Building, it is concluded that this facility has been a source for the release of contaminants into the environment. Contamination is generally confined to the surface soils surrounding the building. Due to a lack of surface water at the C-340 Building during the WAG 8 SE, surface water runoff was not collected, and it is not known whether the site is currently contributing to off-site receptors via the surface water migration pathway. However, the distribution of contaminants found in the surface soil adjacent to C-340 Building at SWMUs 82 and 83 indicates that these peripheral areas may fall within the "contaminant halo" surrounding the C-340 Building.

Soil at the C-340 Building contains contaminants at concentrations in excess of risk-based screening levels for industrial workers derived using target risks of 1E-4. Additionally, this site may be a source of off-site contamination. The C-340 Building is currently scheduled for decontamination and decommissioning. Based on the findings of this SE, further evaluation of the C-340 Building area may be necessary.

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1. INTRODUCTION

This section presents a review of the regulatory background under which the Waste Area Grouping (WAG) 8 Site Evaluation (SE) was conducted, the purpose and scope of the report, and an overview of the current and past activities conducted at each of the sites investigated. The report organization is also presented.

1.1 REGULATORY BACKGROUND

The Paducah Gaseous Diffusion Plant (PGDP), located in western Kentucky, is an active uranium enrichment facility owned by the U.S. Department of Energy (DOE) (Fig. 1.1). On July 1, 1993, DOE leased the plant production operations facilities to the United States Enrichment Corporation. On April 1, 1998, Bechtel Jacobs Company LLC replaced Lockheed Martin Energy Systems, Inc. (LMES) in implementing the Environmental Management and Enrichment Facilities (EMEF) Program.

DOE and DOE's M&I Contractor have undertaken to identify, investigate, and remediate, as necessary, all solid waste management units (SWMUs) and areas of concern (AOCs) at PGDP. The regulatory drivers for the SE performed at WAG 8 are the Resource Conservation and Recovery Act of 1976 (RCRA) permits issued July 16, 1991, as amended by provisions of Hazardous and Solid Waste Amendments of 1984 (HSWA). The Commonwealth of Kentucky issued the basic RCRA permit to PGDP that contains provisions to address hazardous waste management. The U.S. Environmental Protection Agency (EPA) issued the corrective action module of the RCRA permit (also known as the HSWA permit) because that portion of the RCRA program had not yet been delegated to Kentucky. The HSWA Permit, combined with the Hazardous Waste Management permit issued by Kentucky, constitutes the RCRA-Part B permit for PGDP. The HSWA provisions require evaluation of hazardous constituent releases and implementation of interim and final corrective measures to address such releases.

In June 1994, PGDP was identified as a Superfund site under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and placed on the National Priorities List. Both RCRA and CERCLA requirements are coordinated by the Federal Facility Agreement (FFA) that has been negotiated by DOE, EPA, and the Commonwealth of Kentucky. The FFA is intended to satisfy the requirements for an interagency agreement under Section 120 of CERCLA. Figure 1.2 displays the cross-walk between RCRA and CERCLA requirements and the resultant FFA document pertaining to each. This SE report is intended to fulfill the requirements of the CERCLA Preliminary Assessment/Site Investigation (PA/SI) Report and the RCRA Facility Assessment Report to identify releases and determine the need for further investigation.

To facilitate the remediation process at PGDP and focus investigations toward the most effective and efficient remedial actions, operable units (OUs) have been defined. These OUs consist of three types: source control units (i.e., units that may contribute contamination to other units), integrator units (i.e., units that "collect" contamination from source control units—in the specific instance of the PGDP, the groundwater and surface water units), and D&D units (decomissioning and decontamination units for abandoned facilities and structures). Five integrator OUs exist at PGDP: groundwater, surface water, surface soil, burial grounds, and comprehensive sitewide (DOE 1998a).

1.2 PURPOSE AND SCOPE

The WAG 8 area is shown in Fig. 1.3. WAG 8 consists of five sites that were considered potential contributors of the dense, nonaqueous-phase liquid trichloroethene (TCE) found in the Northeast Plume (Fig. 1.4) and for polychlorinated biphenyls (PCBs). Four of the five sites are electrical switchyards; the fifth site is an abandoned uranium hexafluoride (UF_6) conversion facility.

The primary objective of the WAG 8 SE was to collect surface water, surface and subsurface soils, and shallow groundwater data to assess whether any site has released contaminants to the environment. Additional objectives were to determine whether any of the sites are ongoing sources of off-site contamination or whether they pose an unacceptable risk to on-site receptors. The focus of the sampling effort was biased along known or suspected migration pathways and was intended to provide a basis for a recommendation of either no further action (NFA) or for additional evaluation at each site.

The objectives of the WAG 8 SE report are accomplished by answering the following questions: (1) Are contaminants found from the environmental sampling and analyses that could have been derived at each site? (2) Do primary migration pathways (i.e., storm water and groundwater) currently carry site-derived contaminants? (3) Does the risk evaluation demonstrate a greater than 1×10^{-7} risk to industrial workers? Finally, this report discusses whether mitigating circumstances exist that influence potential exposure at each site. Factors such as mobility of specific contaminants, site conditions, and engineering controls will be considered.

Historical information had indicated that there have been potential releases associated with the four electrical switchyards. Because these facilities are currently active, safety concerns restrict site characterization activities within these areas and the completion of a remedial investigation (RI)/feasibility study (FS) until operations cease. The primary difference between this SE and an RI is that this SE was not designed to provide full characterization of the site or to fully define the nature and extent of contamination. The WAG 8 SE, however, provides much more than the usual scope of a PA/SI, which generally consists of limited sampling to determine whether contamination is present at a site.

The WAG 8 SE involves four main differences from the RI/FS process: (1) the need for additional sampling will not be addressed in the technical working group meetings; (2) this SE report summarizes the results and findings from the field effort; (3) a screening-level risk assessment has been completed for the SE; and (4) the SE allows for the recommendation of NFA or additional evaluation and does not require an FS, although an additional evaluation may be required to evaluate time-critical removal actions if a particular site poses an imminent risk to human health and ecology. With the exception of these differences, all other aspects of this SE are similar to those of an RI, including the sampling methodology and procedures, analytical methods and data quality, data and records management, quality assurance (QA) requirements, health and safety protocol, and waste management activities. The WAG 8 data are consistent with the CERCLA process and end use.

1.3 WAG 8 BACKGROUND INFORMATION

1.3.1 Electrical Switchyards

The electrical switchyards are composed of a series of high voltage transformers set on a gravel surface and enclosed by an 8-ft-tall chainlink fence. The switchyards are equipped with an underdrain system designed to collect storm water from the entire site and direct it to a series of pipes that discharge to ditches located along the side of the switchyards.

1.3.1.1 Location and physical description

The C-531 and C-533 Electrical Switchyards (SWMU 82 and SWMU 83, respectively) (Figs. 1.5 and 1.6) are located in the eastern portion of PGDP immediately east of the C-331 and C-333 cascade buildings. These switchyards have been in operation since 1951 and supply electrical power to the C-331 and C-333 Buildings. The sites are covered with gravel and underlain by a drainage system that discharges runoff into ditches along the eastern side of the SWMUs. This runoff is pumped to the C-617 lagoon for treatment before it is eventually discharged to Kentucky Pollutant Discharge Elimination System (KPDES) Outfalls 010.

The C-535 and C-537 Electrical Switchyards (SWMU 84 and SWMU 85, respectively) (Figs. 1.7 and 1.8) are located in the northeastern portion of PGDP immediately north and northeast, respectively, of the C-335 and C-337 Buildings. These SWMUs have been in operation since 1951 and supply electrical power to the C-535 and C-537 Cascade Buildings. Underground drainage pipes from C-535 and C-537 discharge to drainage ditches located on the northern side of the switchyards. These drainage ditches connect to the C-616 water treatment facility and lagoons and eventually discharge to the North/South Diversion Ditch and then to KPDES Outfall 001.

1.3.1.2 Electrical switchyards site history

Specific information related to activities conducted within the electrical switchyards is limited. However, it is known that ongoing routine transformer maintenance and replacement have been performed throughout the operational history of these facilities. In the past many of the transformers and capacitors in these switchyards used PCB-laden oil as an insulating fluid. It is not uncommon for the transformers to rupture, thereby releasing insulating fluid to the ground. It was also common for the capacitors and transformers to develop slow leaks over time. PCB-containing transformer oil consists of approximately 0.05 percent PCBs carried in a light to medium hydrotreated petroleum distillate.

Another likely source of PCBs at the switchyards was the abandoned underground oil distribution systems. To supply oil to each of the switchyard transformer stations, a pumphouse was located between each of the pairs of switchyards. Pumphouse 540-A was located between Switchyards 531 and 533, and Pumphouse 541-A was located between Switchyards 535 and 537. These underground distribution systems have been replaced by aboveground systems because of leaks and maintenance problems. TCE was reportedly used as an electrical equipment cleaner and solvent during maintenance activities.

The only documented release for any of the four WAG 8 switchyards was a spill of approximately 345 gal of non-PCB-bearing oil from a transformer at the C-531 Electrical Switchyard (SWMU 82) in December 1990. The oil spread over a large area of the switchyard and reportedly migrated to KPDES Outfall 012. Approximately 125 55-gal drums of gravel and soil were excavated in 1992 to remediate the spill.

1.3.1.3 Results of previous sampling in the electrical switchyards

The results of previous SIs included in the WAG 8 SE have been summarized in the WAG 8 Work Plan (DOE 1998b). Included in the work plan are site maps showing the locations of all historical survey points. A brief synopsis of the historical findings for each site is presented in the following paragraphs.

C-531 Electrical Switchyard (SWMU 82). SWMU 82 was investigated during the CERCLA Phases I and II SIs performed by CH2M Hill (CH2M Hill 1991 and 1992, respectively). Sampling activities conducted during the Phase I SI included the collection of surface and shallow subsurface soil samples [maximum depth of 5 ft below ground surface (bgs)] from two locations (H103 and H105) within the drainage ditch surrounding SWMU 82 (Fig. 1.9). Samples from these locations were analyzed for PCBs and dioxins/furans only. Additional surface soil samples (0–0.5 ft bgs) were collected during the Phase II SI at locations H337, H338, H340, H341, and H342. These samples were analyzed for PCBs only. PCB-1260 and octachlorodibenzo-p-dioxin (OCDD) were detected in the surface soil samples collected from the SWMU 82 drainage ditches. PCB-1260 was detected in three of seven samples at concentrations ranging from 23 to 200 µg/kg. OCDD was detected in two of five surface soil samples at a maximum concentration of 7.5J µg/kg. H308, located south of the switchyard, had a detection of PCB-1260 at 330 µg/kg.

C-533 Electrical Switchyard (SWMU 83). SWMU 83 was also investigated during the CERCLA Phases I and II investigations (CH2M Hill 1991 and 1992, respectively). Sampling activities conducted during the Phase I SI included the collection of surface and shallow subsurface soil samples (maximum depth of 5 ft bgs) from three locations (H100, H101, and H112) within the drainage ditch surrounding SWMU 83 (Fig. 1.10). Additional surface soil samples (0–0.5 ft bgs) were collected during the Phase II SI at locations H329, H330, H343, H344, H345, H346, and H347. Samples were analyzed for PCBs only, except for H035 and H101, which were analyzed for volatile organic analytes (VOAs) and PCBs. PCB-1260 (maximum concentration 42,000 µg/kg), PCB-1248 (maximum concentration 4,900 µg/kg), and xylenes (maximum concentration 3J µg/kg) were detected in the surface soil samples.

C-535 Electrical Switchyard (SWMU 84). SWMU 84 was investigated during the CERCLA Phase I SI (CH2M Hill 1991). Previous investigative activities completed in the area of the C-535 Electrical Switchyard included the collection of surface and shallow subsurface soil samples (maximum depth of 5 ft bgs) from two locations (H107 and H108) (Fig. 1.11). All samples were analyzed for VOAs, PCBs, and selected radionuclides. PCB-1260 was detected in surface soil samples from both locations at maximum concentrations of 63 µg/kg, and the dioxin OCDD was observed at 4.8J µg/kg. PCB-1260 was also detected in the shallow subsurface soil samples from boring H108 but was not detected in soil boring H107. No VOAs were reported in any of the samples analyzed. Technetium-99 was the only radionuclide reported from the samples collected during the Phase I SI at activities of much less than 1 pCi/g in subsurface soils from soil boring H108.

C-537 Electrical Switchyard (SWMU 85). SWMU 85 was investigated during the CERCLA Phase I and Phase II investigations. Sampling activities included the collection of surface and shallow subsurface soil samples (maximum depth of 15 ft bgs) from four soil boring locations (H109, H110, H111, and H348) (Fig. 1.12). Samples were analyzed for VOAs, PCBs, and radionuclides. No contaminants were detected in soil borings H109, H111, or H348. Chloromethane (480J µg/kg) and total xylenes (250J µg/kg) were detected in the sample from 3 to 5 ft bgs from H110. No radiological activities exceeding minimum detectable activities were reported for any of the samples analyzed.

1.3.1.4 Rationale for field sampling

The general investigative approach and analytical requirements were the same for all four switchyards because the preliminary chemicals of potential concern (COPCs) (PCBs and TCE), release mechanisms, and migration pathways are identical. The sampling strategy for the electrical switchyards targeted the surface runoff/drainage, surface and subsurface soils, and shallow groundwater of the Upper Continental Recharge System (UCRS). Surface water runoff in the immediate vicinity of the electrical switchyards discharges directly into the adjacent drainage ditch or is discharged to the ditch by way of an underdrain system. Surface soil samples were taken within these ditches to determine if a secondary

source had been created by migration of contaminants via the surface water pathway to the surface soils. In addition, surface water samples were collected during or immediately after storm events that created flow within the underdrain system. Samples were taken at points where the underdrain pipes discharge into the adjacent drainage ditch. This rationale allowed for the evaluation of ongoing contaminant releases from the switchyards.

Potential sampling locations at the electrical switchyard sites, however, were severely limited by the presence of electrical transformers, numerous high-voltage overhead power lines, buildings, and roads. In most instances only one side of each electrical switchyard was determined to be safe for conducting environmental sampling.

Subsurface soil samples were collected by using direct push technology (DPT) at multiple locations surrounding each switchyard. Soil samples were obtained at various intervals to a maximum depth ranging from 30 to 60 ft bgs. In addition, a shallow groundwater sample was collected in each DPT boring when subsurface conditions were favorable. These samples provided a means to assess potential contaminant migration through subsurface soils to the Regional Gravel Aquifer (RGA). Contingency samples were planned for deep groundwater sampling from the RGA and the upper McNairy if contaminants were observed in shallow groundwater. However, significant levels of contaminants were not found in the shallow groundwater and subsurface soil samples, and therefore samples of the middle and lower RGA and McNairy groundwater were not collected.

1.3.2 C-340 Reduction and Metals Facility

The C-340 Reduction and Metals Facility was used to convert UF_6 to uranium tetrafluoride (UF_4) to produce hydrogen fluoride and to convert UF_4 to uranium metal. The facility is slated for decontamination and decommissioning.

1.3.2.1 Location and physical description

The C-340 Reduction and Metals Facility (Fig. 1.13) is located on the eastern side of the PGDP. The building occupies an area of approximately 40,000 ft^2 and is divided into the following four sections.

- The reactor towers used for the UF_6 to UF_4 reduction process.
- The reduction furnaces that converted the UF_4 from the reactor tower to uranium metal through the firing of UF_4 and a powder magnesium mixture. Magnesium fluoride (MgF_2) slag was formed as a by-product from the conversion of UF_4 to uranium metal.
- The MgF_2 slag process, which turned slag into a fine powder for reuse as a liner material in the firing process.
- The magnesium powder storage building that supplied the reduction furnaces.

1.3.2.2 Site history

The facility was constructed in approximately 1957, and metals reductions operations ceased in 1975. Between 1975 and 1991, parts of the C-340 Building complex were intermittently used as a training center and a valve testing area. The C-340 Building was closed and abandoned in 1992, and the area surrounding the C-340 Building was fenced and posted as a Contamination Area based on a radiological survey.

Contamination in the C-340 Building consists of radiological and chemical contaminants remaining from the uranium metal production process previously performed in the building. Documentation pertaining to potential releases are unknown, however it is likely that some of the process feedstock, product material, by-products, uranium metal scraps, sludges, and ancillary materials could have been carried outside the building during process spills, through the building ventilation system, and through the building drainage system.

Several other SWMUs are located within the same geographic block as the C-340 Building. The C-540 Facility, an oil pumping station used to transfer oil to Switchyards 82 and 83, is located on the south side of the C-340 Building. A PCB waste staging area located beside the C-540 Facility has been designated as SWMU 56. Soil contaminated by PCBs in the vicinity of the C-540 Facility has been designated as SWMU 80. The C-540 Facility consists of an oil pump house and four aboveground storage tanks (Jacobs 1997). Past leaks and spills at the site resulted in the release of PCBs to the environment. As a result, SWMUs 56 and 80 were investigated as part of the WAG 23 RI (DOE 1994), and a removal action occurred in 1998 (DOE 2000a).

SWMU 74, located on the north end of the C-340 Building, represents another possible PCB contaminant source. A reported spill of PCB-containing water resulted in an excavation and cleanup action at the site (DOE 1994). Subsequent sampling near SWMU 74 indicated the presence of radionuclides, PCBs, and dioxins/furans within the surface soil.

Inside the C-340 Building, a small pressurized hydraulic system was used to operate some of the machinery. This system has been designated SWMU 101. Piping for the system contained approximately 125 gal of PCB-bearing oil. Leaks and spills from this system may also represent a potential source for PCBs detected at the C-340 Building.

1.3.2.3 Location and results of previous sampling

Several soil sampling locations were identified in the vicinity of the C-340 Building. Four of these locations (H309, H311, H327, and H330) are close enough to the C-340 Building to potentially allow identification of soil contaminants from the metals reduction process (Fig. 1.14). PCB concentrations observed in samples collected from these locations near the C-340 Building are as follows:

Boring	Compound	Concentration
H309	PCB-1260	6000JE µg/kg
H311	PCB-1254	1500 µg/kg
H327	PCB-1248	42,000 µg/kg
H330	PCB-1260	475,000E µg/kg

J = estimated below contract reporting limits
E = reported value was estimated because of interference

1.3.2.4 Rationale for field sampling

Potentially impacted media in the vicinity of the C-340 Building had not been adequately characterized. Additional data were collected for potential contaminants to provide sufficient data to support remedial action decisions to be made for the C-340 Building.

It was possible that contaminants from the metals reduction process were released from the facility and transported to nearby surface soils. The primary migration pathways were considered to be the airborne pathway from the building to the surface soils and infiltration through the surface soils to the subsurface soils and shallow groundwater. The sampling strategy for the C-340 Reduction and Metals Facility was to target the surface and subsurface soils surrounding the building. Shallow groundwater was not encountered at this site, and therefore no groundwater samples were collected.

1.4 REPORT ORGANIZATION

The WAG 8 SE represents the evaluation of five source control units and documents the results of the sampling and analysis activities conducted for WAG 8. The report is organized into seven sections and seven appendices and is presented in one volume. The report format follows the general outline for a CERCLA RI. The contents of each section of the WAG 8 SE are described here:

Section 1 of this report presents a brief overview of SWMUs 82, 83, 84, and 85 and the C-340 Building, as well as the rationale for field sampling. This section also discusses current and past activities conducted at each of the WAG 8 sites.

Section 2 describes the investigative methods used to sample the various media, the analytical sampling parameters, health and safety monitoring, decontamination practices, and waste management practices for the investigations.

Section 3 details the physical characteristics of each SWMU and the C-340 Building, including the topography, surface water hydrology, and geology. In addition, a description of the meteorology, ecology, demography, and land use at PGDP is presented.

Section 4 provides a discussion of the historical data and the analytical results obtained during the WAG 8 SE.

Section 5 presents the screening risk assessment, including the comparison of sampling results with background concentrations, risk-based concentrations (RBCs), and regulatory-established levels of concern. These data are then used to evaluate direct contact with soil for the industrial worker and extrapolation to groundwater ingestion by residents and ecological receptors.

The final sections (6 and 7) present the conclusions and references, respectively, of this report.

1.5 GROUNDWATER OU DATA

As part of the WAG 8 scope of work, two monitoring wells (MW-355 and MW-356) were installed in support of the Groundwater OU Investigation and long-term monitoring of the Northeast Plume. All data associated with installation of the two RGA wells (e.g., boring logs, analytical results, monitoring well construction, and forms) are presented in Appendix A. No interpretation of the data collected during the installation of these two monitoring wells is included in the WAG 8 SE. This information will be integrated into the ongoing Groundwater OU FS investigation.

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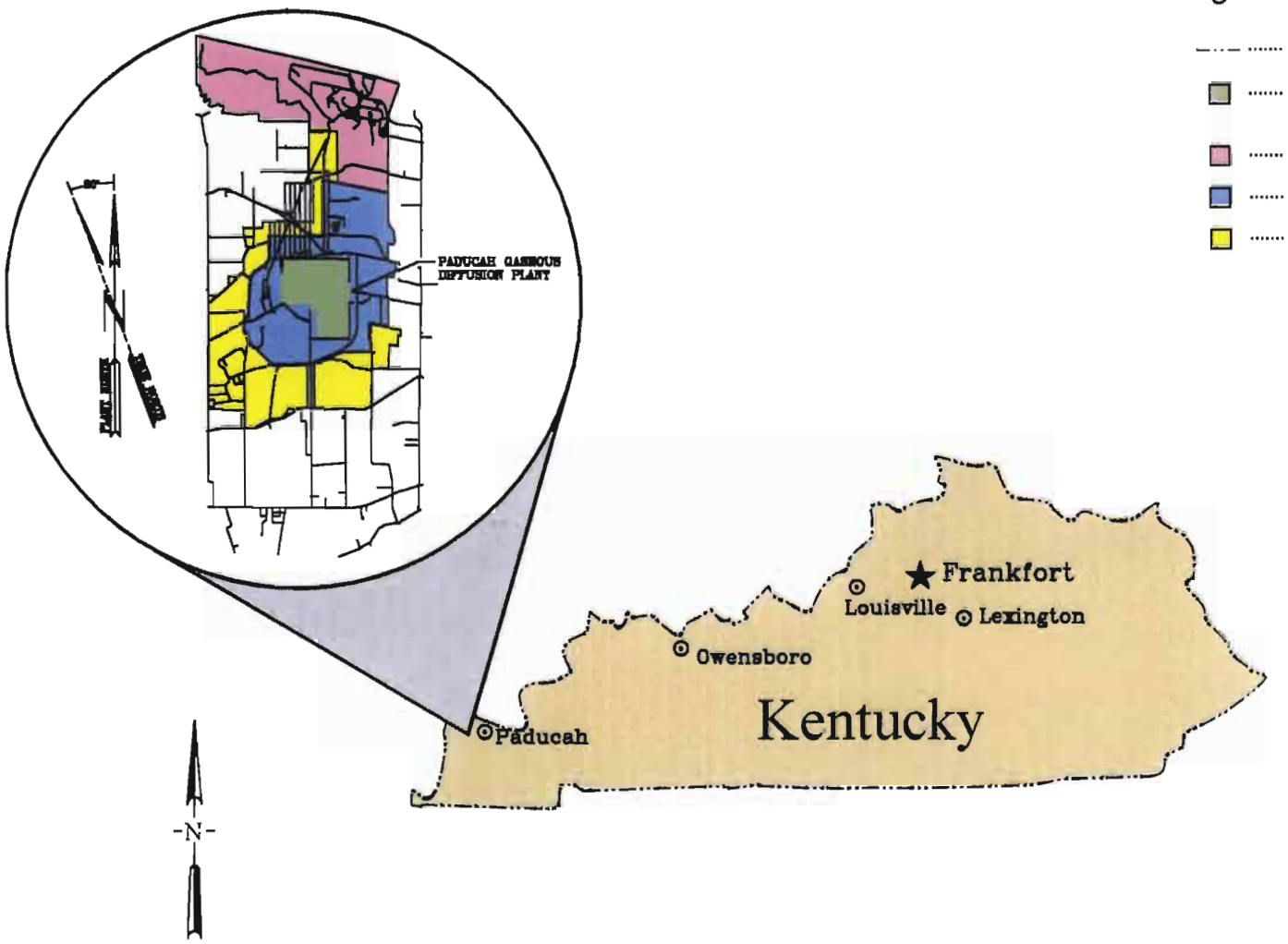


Figure 1.1 General Site Location Map for the Paducah Gaseous Diffusion Plant (PGDP) Paducah, Kentucky

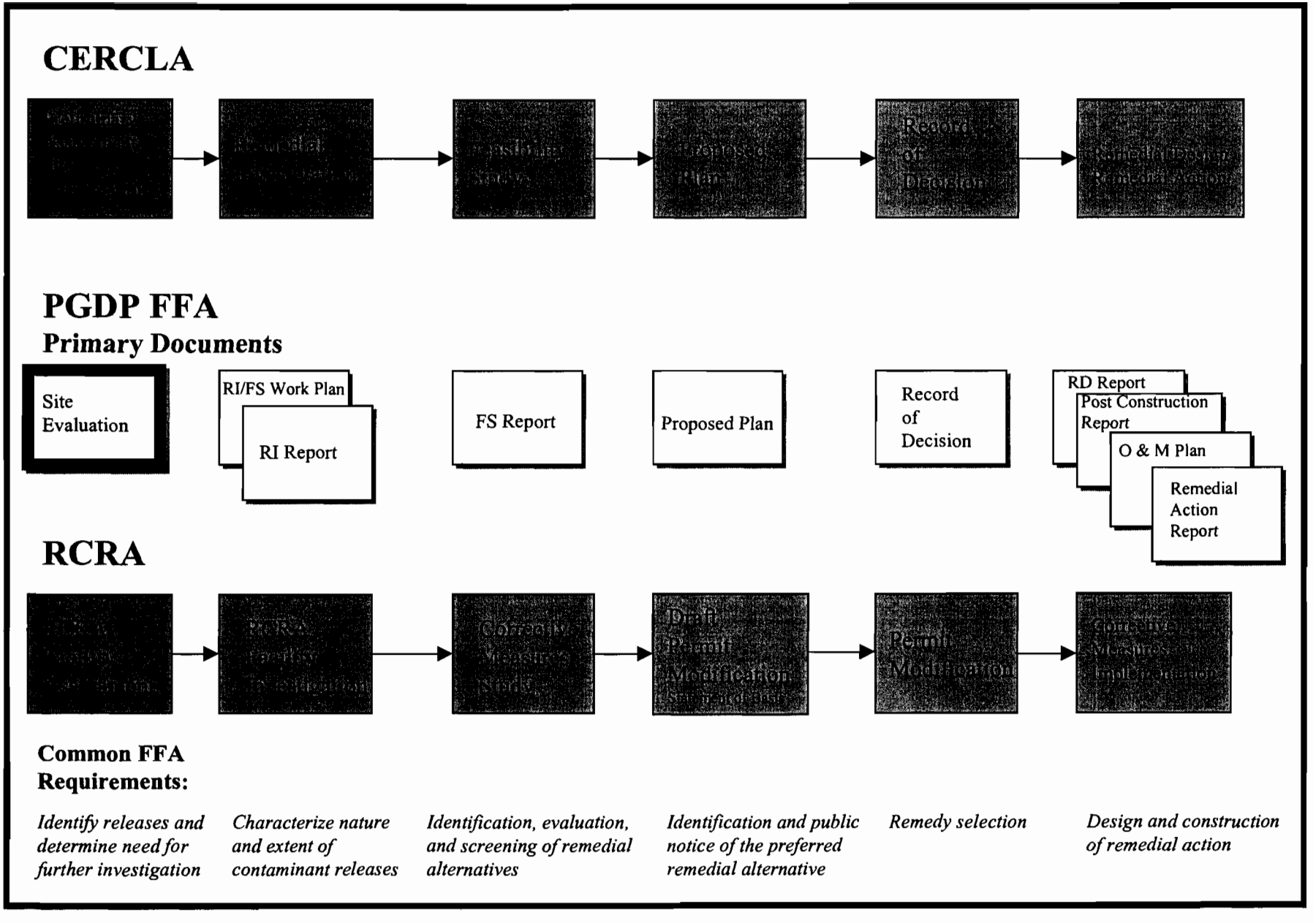


Figure 1.2 Fulfillment of RCRA and CERCLA requirements by the WAG 8 SE at PGDP

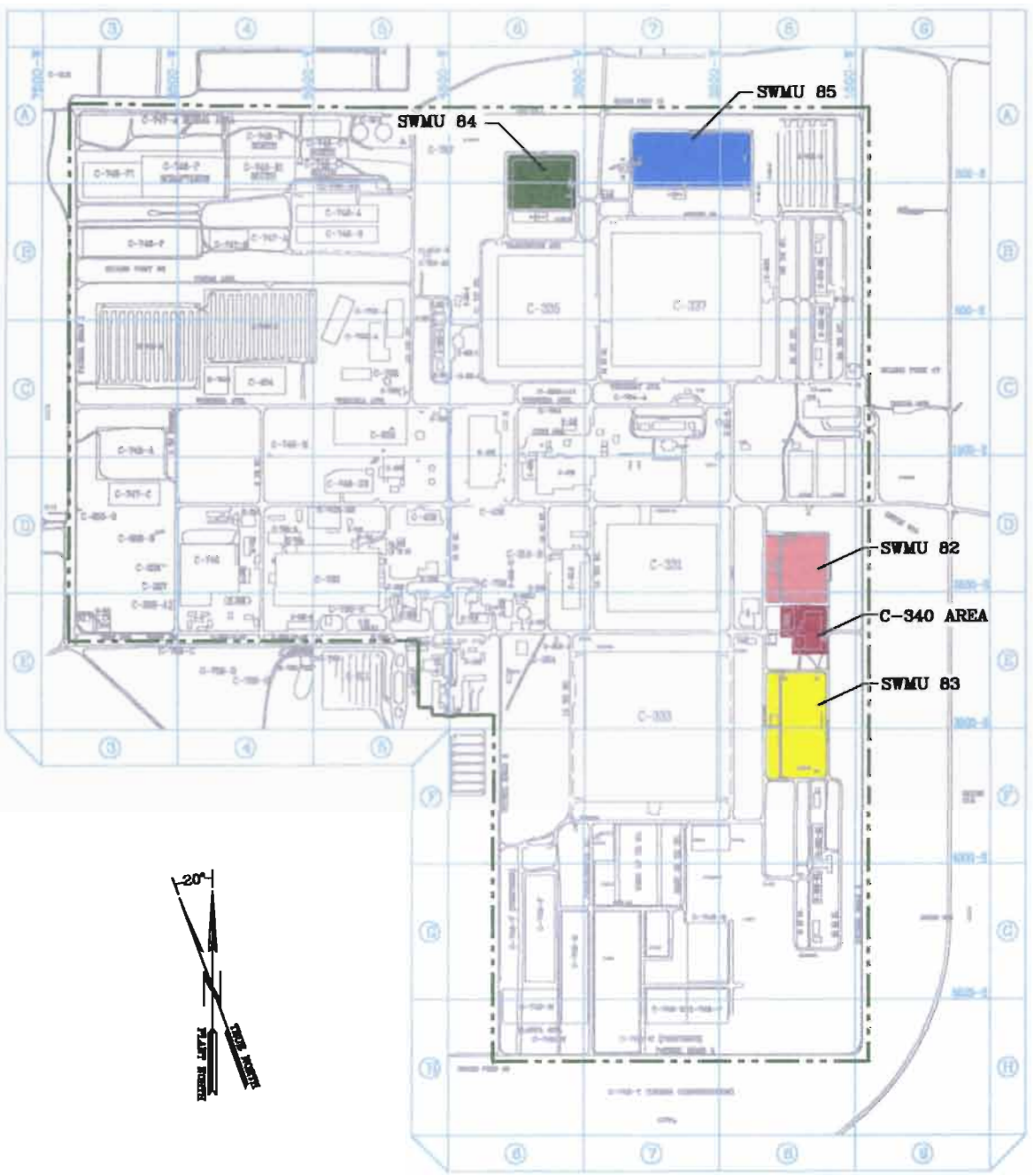


Figure 1.3 The C-340 Area and SWMUs included in the WAG 8 SE

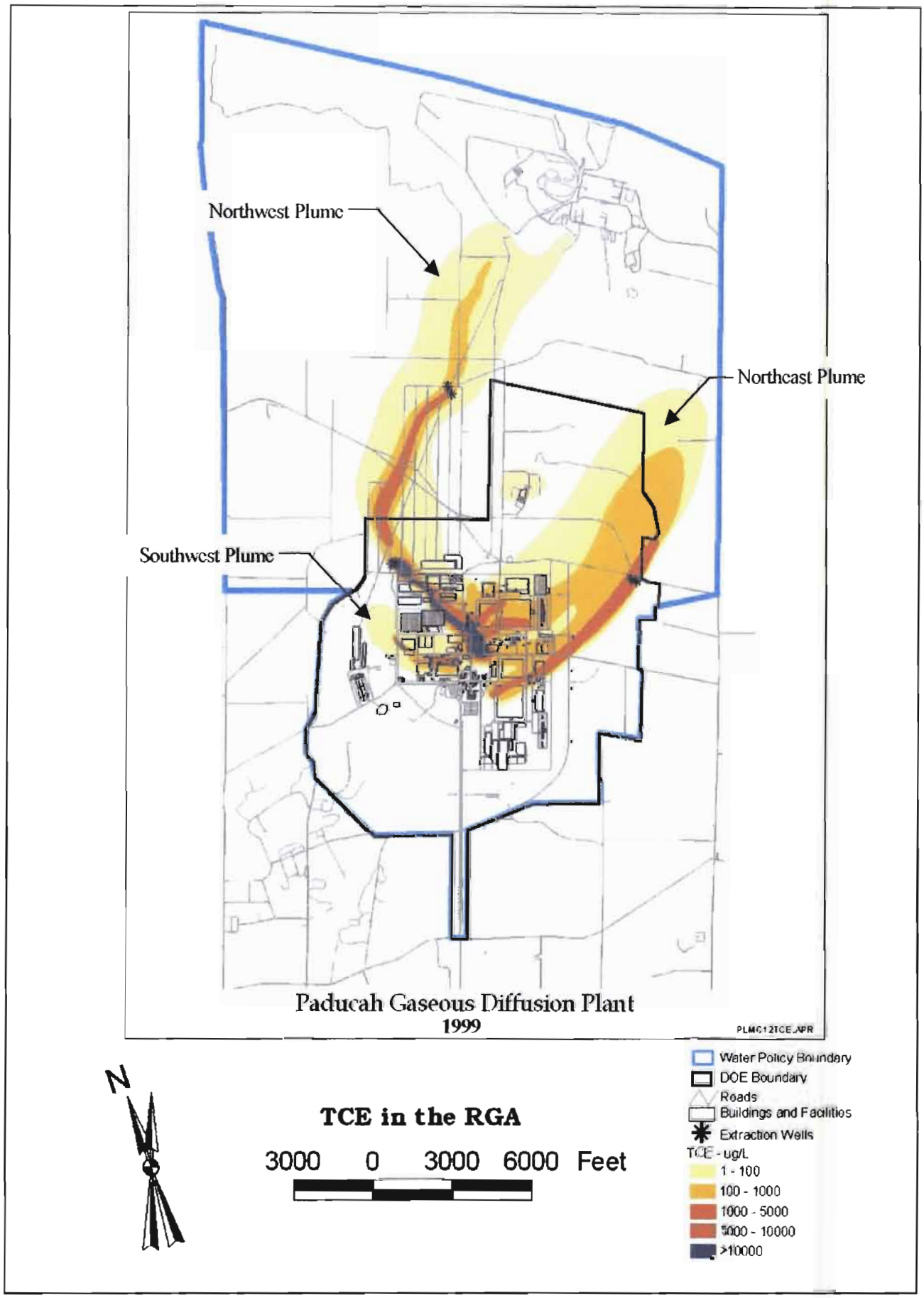


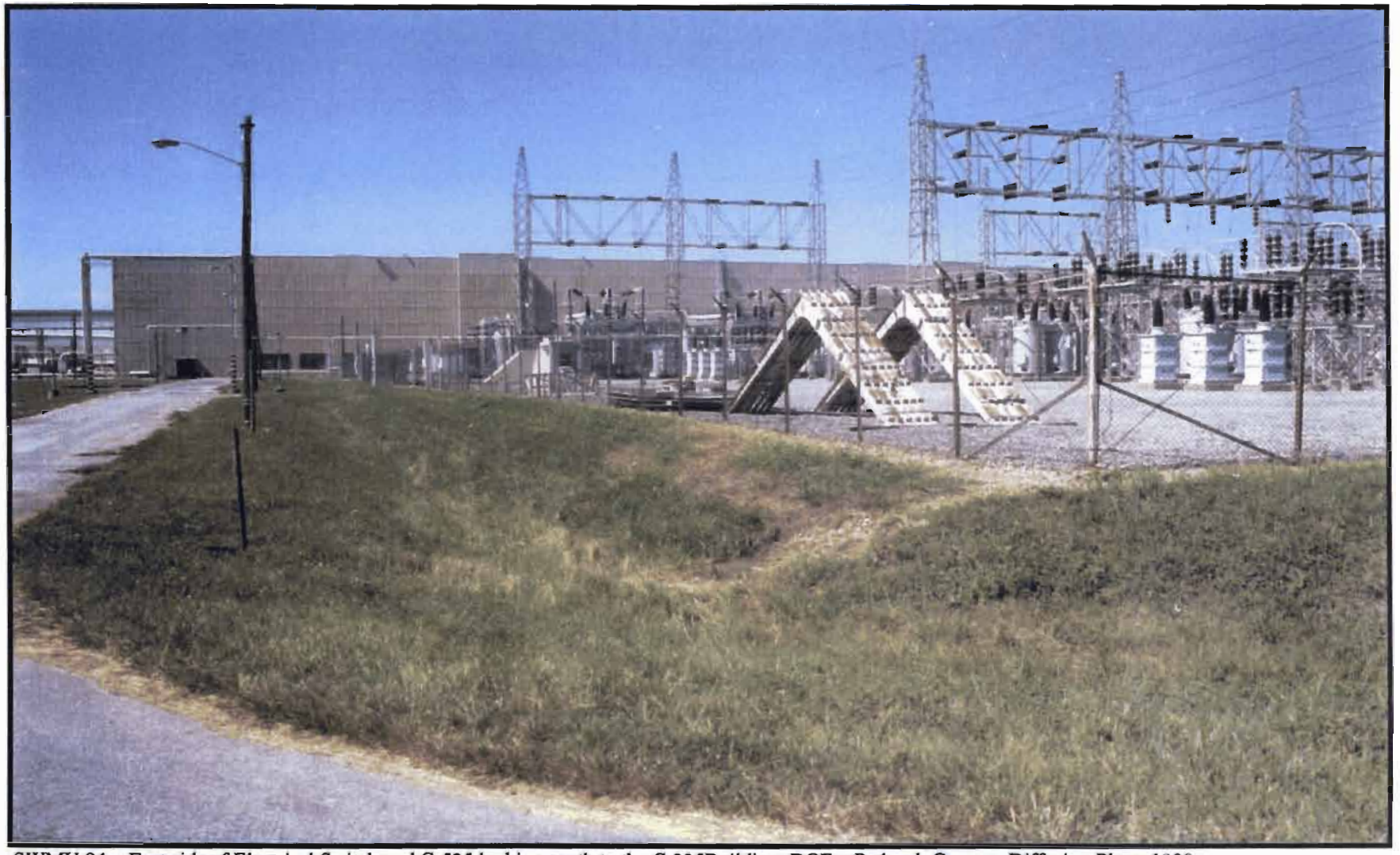
Figure 1.4 Location of Northeast, Northwest, and Southwest Plumes

SWMU 82 – East side of Electrical Switchyard C-531 looking north. DOE – Paducah Gaseous Diffusion Plant, 1999

Figure 1.5 SWMU 82

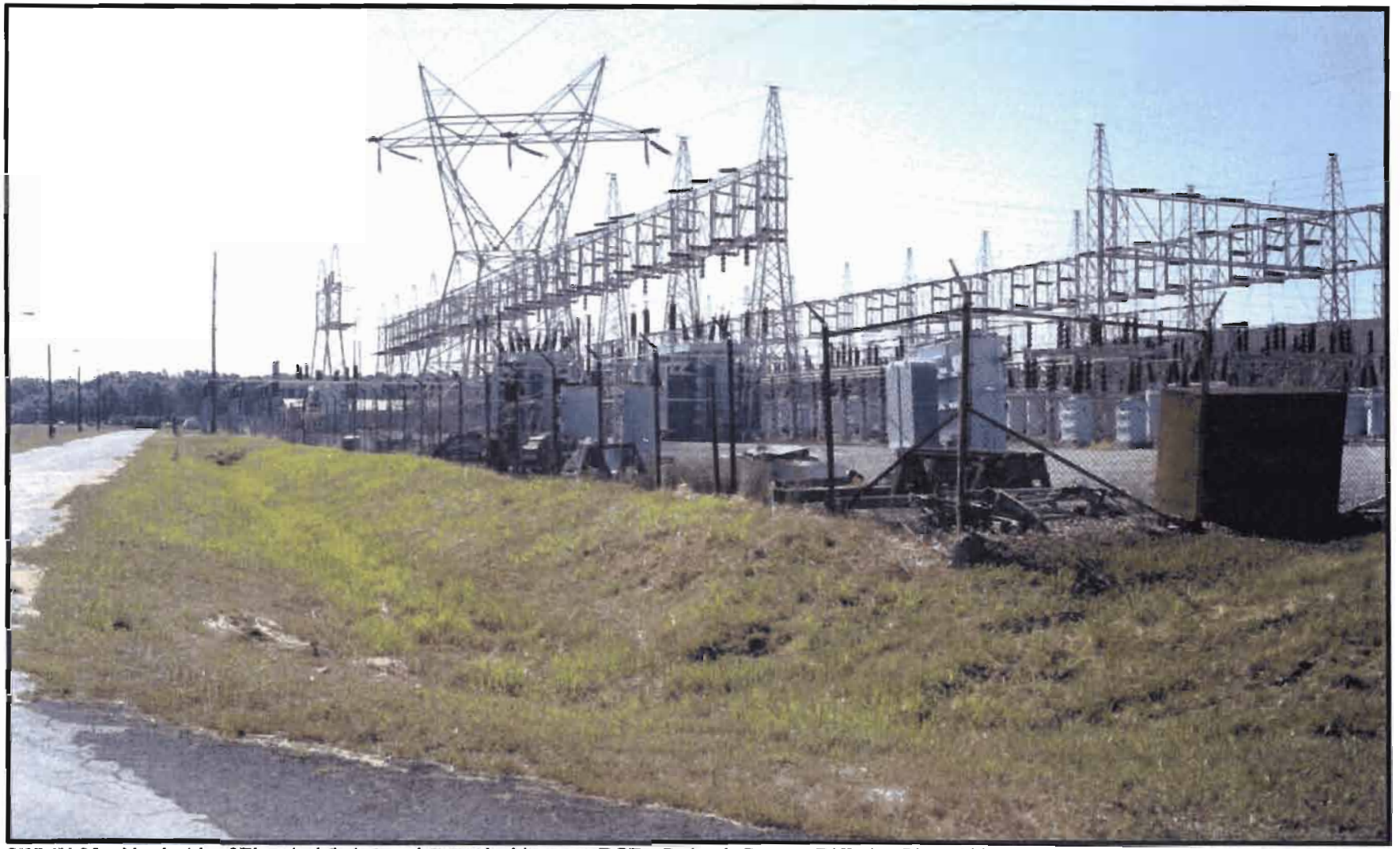
SWMU 83 – East side of Electrical Switchyard C-533 looking south. DOE – Paducah Gaseous Diffusion Plant. 1999.

Figure 1.6 SWMU 83



SWMU 84 – East side of Electrical Switchyard C-535 looking south to the C-335Building. DOE – Paducah Gaseous Diffusion Plant. 1999.

Figure 1.7 SWMU 84



SWMU 85 – North side of Electrical Switchyard C-537 looking east. DOE – Paducah Gaseous Diffusion Plant. 1999.

Figure 1.8 SWMU 85

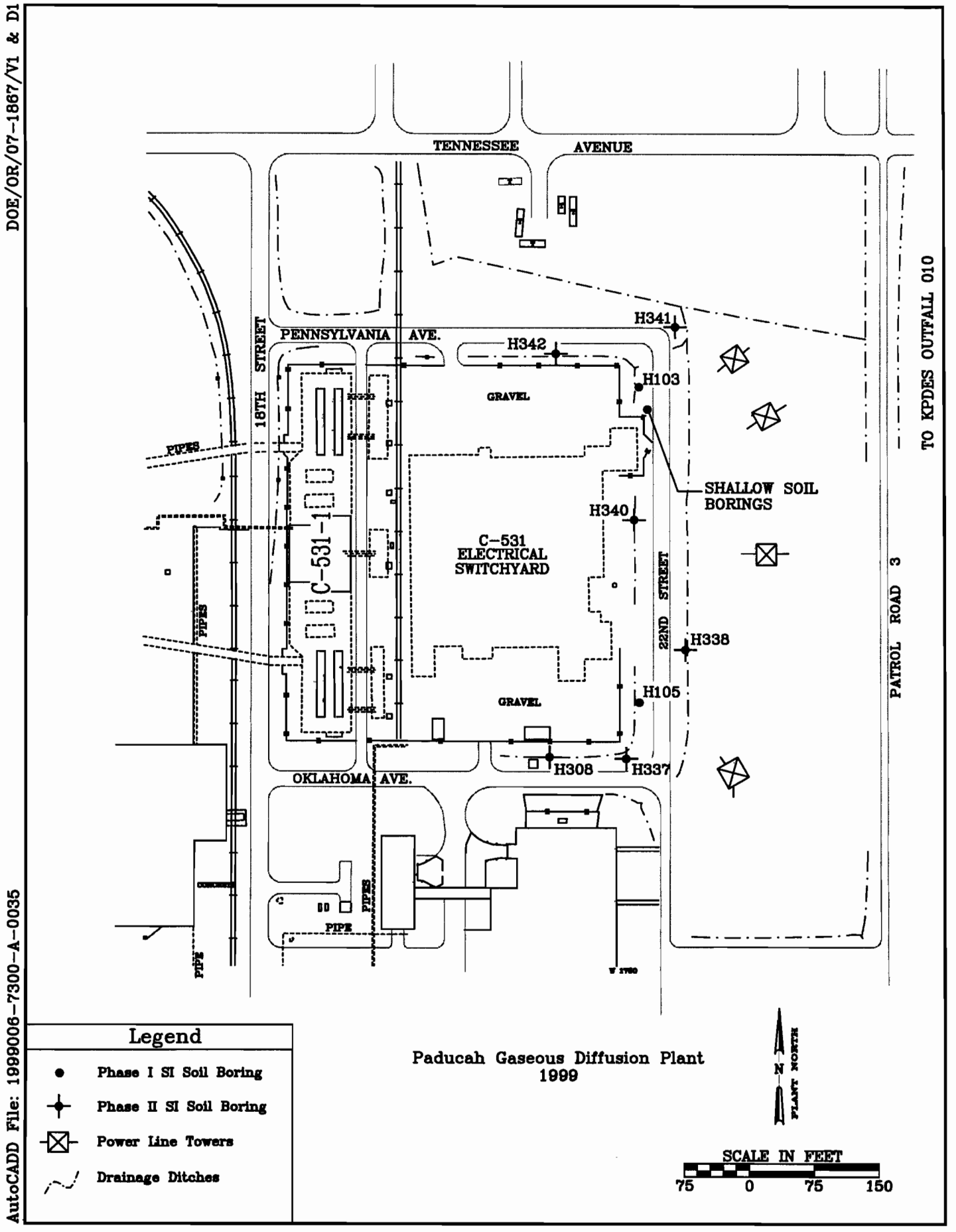


Figure 1.9 Site Map and Previous Sampling Locations for the C-531 Electrical Switchyard (SWMU 82)

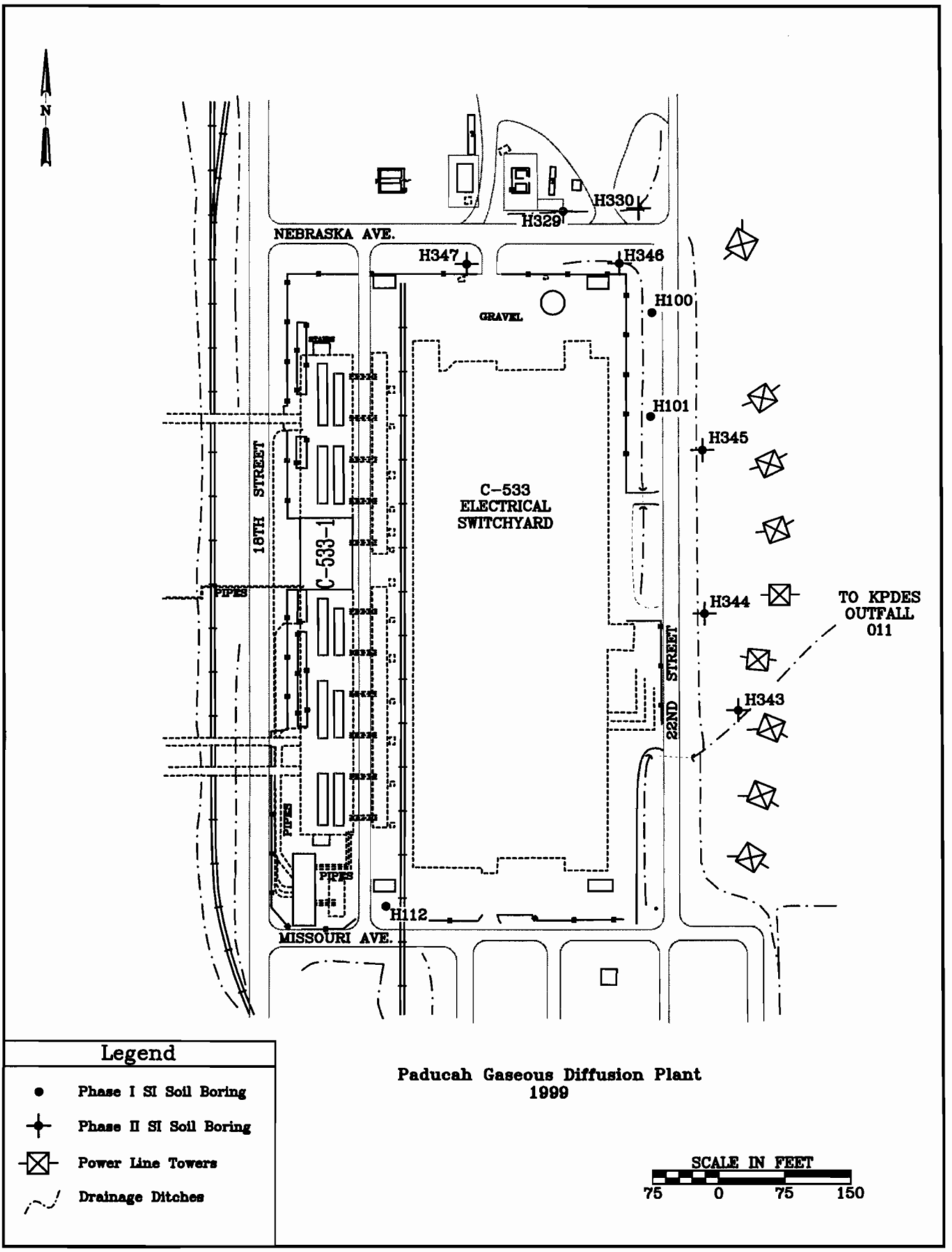


Figure 1.10 Site Map and Previous Sampling Locations for the C-533 Electrical Switchyard (SWMU 83)

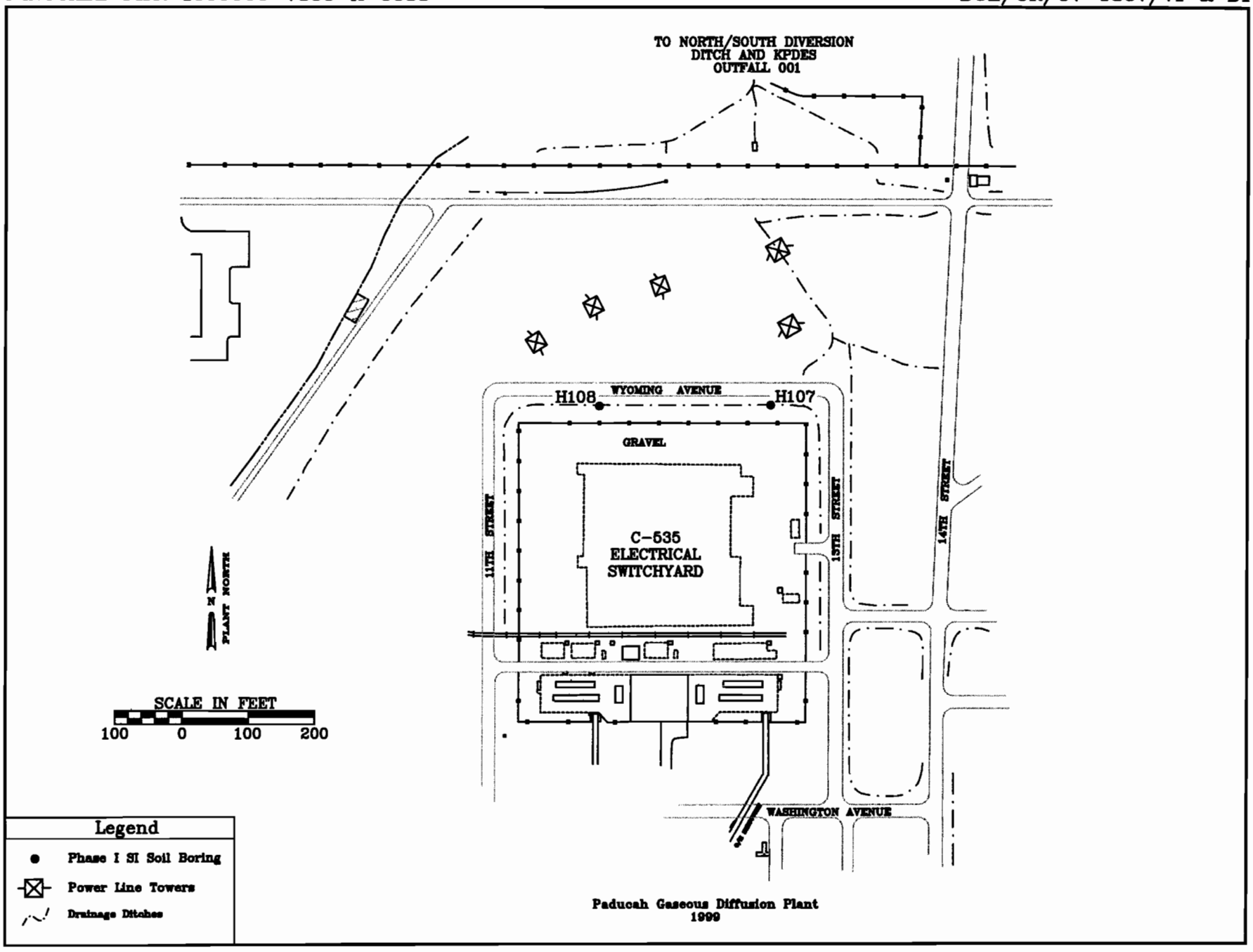


Figure 1.11 Site Map and Previous Sampling Locations for the C-535 Electrical Switchyard (SWMU 84)

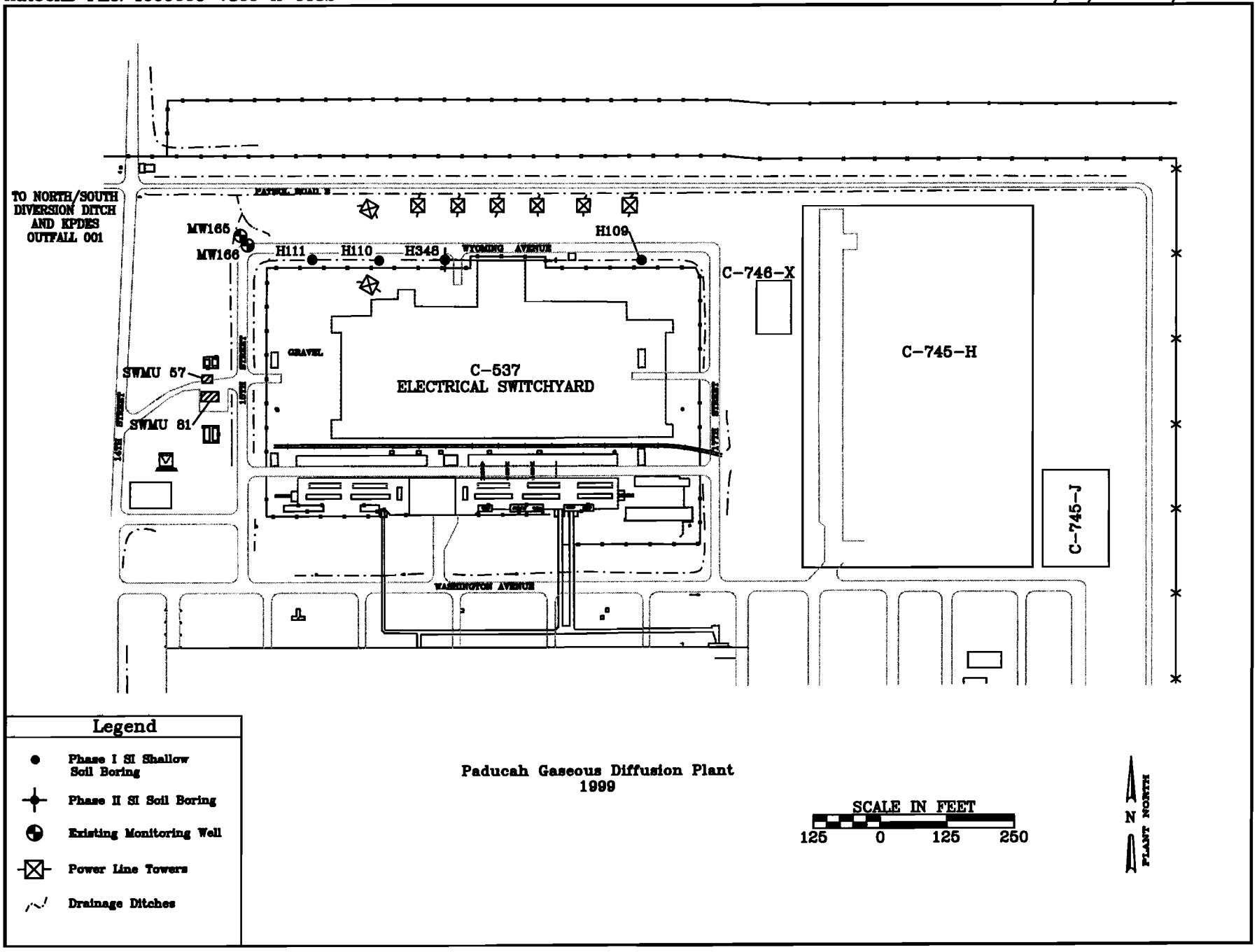


Figure 1.12 Site Map and Previous Sampling Locations for the C-537 Electrical Switchyard (SWMU 85)

C-340 – East side of Building C-340. DOE – Paducah Gaseous Diffusion Plant, 1999.

Figure 1.13 Building C-340

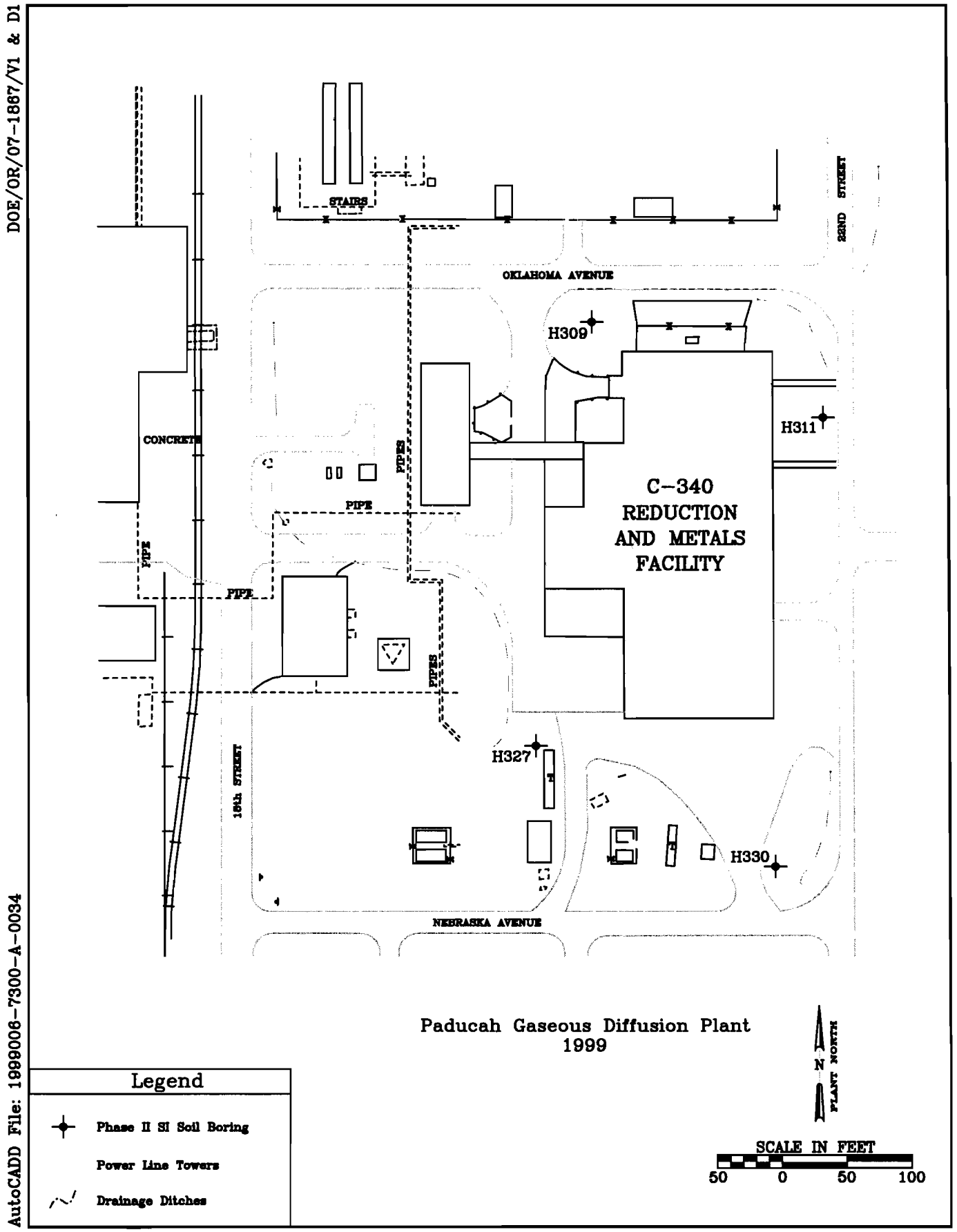


Figure 1.14 Site Map and Previous Sampling Locations for the C-340 Reductions and Metals Facility

2. FIELD INVESTIGATION

The WAG 8 SE field investigation was conducted during the summer of 1999 as outlined in the project work plan (DOE 1998b), which contained the Field Sampling Plan, Quality Assurance Project Plan, and Health and Safety Plan. This section describes the field investigation activities and methods used during the WAG 8 SE. Major topics include sampling activities, procedures, and equipment, as well as analyses conducted on samples.

All sampling at PGDP was conducted in accordance with procedures set forth in the DOE's M&I Contractor EMEF Program Procedures Manual. These procedures are consistent with EPA Region 4 Standard Operating Procedures (EPA 1996a).

2.1 SURFACE SOIL SAMPLING

Twenty-eight surface soil samples were collected in WAG 8 (Table 2.1). In accordance with DOE's M&I Contractor EMEF Procedure PTSA-4201, "Surface Soil Sampling," the uppermost 12 in. of soil was sampled as follows: the surface vegetation was removed from the sampling location, and a stainless steel hand auger [3-in. inside diameter (I.D.)] was used to obtain the required amount of sample material. The specified hand augers are designed to collect surface and shallow subsurface soil samples and are applicable to a variety of soil conditions, including sand, silt, and clay.

2.2 SUBSURFACE SOIL SAMPLING METHODS

One hundred twenty-one subsurface soil samples were collected in accordance with DOE's M&I Contractor EMEF Field Operating Procedure (FOP) PTSA-4202-IAD, "Subsurface Soil Sampling," during the WAG 8 field investigation (Table 2.2). Prior to the collection of samples, each site was prepared by completely covering the ground under the drilling truck and the sample preparation area with a 6-mil plastic sheet. Exclusion and construction zones were installed at the perimeter of the plastic cover.

The first samples collected were for VOAs. Approximately 4 cc of soil were placed into each 40-mL vial, which contained an equal amount of deionized water and hexane. In addition, a second VOA sample was collected and placed into an unpreserved, 4-oz septum top wide-mouth jar. The remaining sample material was placed into a clean stainless steel bowl, homogenized, and prepared in accordance with DOE's M&I Contractor EMEF Procedure PTSA-4204 IAD, "Composite Sample Preparation." Lithologic interpretation was completed concurrently with sample preparation in accordance with DOE's M&I Contractor EMEF Procedure PTSA-1203, "Lithologic Logging."

Soil samples were placed in prelabeled containers and sealed. The outer surface of the container was cleaned, scanned, and affixed with a radiological label to identify the outer radioactivity level of the container. The containers were secured with a custody seal and inserted into Ziploc™ bags before being packed in an insulated cooler. The cooler contained ice to maintain a 4°C (±2 C) temperature.

2.2.1 Direct Push Technology

Subsurface soil samples were collected by using DPT. DPT allows a discrete interval of soil to be obtained and a water sample to be extracted from a specific depth. DPT sampling produces a minimal

amount of investigation-derived waste (IDW) compared to other methods. Samples obtained by this method are noted throughout this report with the prefix "DPT."

The DPT equipment for WAG 8 was a truck-mounted unit. Samples were extracted from the subsurface by using a 30-in. by 1.5-in. I.D. stainless steel sampler with a removable acetate liner. Table 2.2 details the DPT sampling conducted in WAG 8.

2.2.2 Cone Penetrometer System

During the WAG 8 investigation, a 24-ton mobile electronic cone penetrometer (CPT) system was used to obtain geotechnical data at 14 sites (Table 2.3) to support the characterization of the subsurface stratigraphy. The CPT was used to select the depth interval for subsurface soil and water samples. For each location, the CPT was pushed by using a hydraulic system until refusal or until a predetermined depth was reached. The conductivity/piezocone provided a digital signal for in situ measurements of permeability, conductivity, and soil type. Rod inclination of the CPT hole was recorded during each downhole survey. The inclination of the boring was used to correct the tip stress measurement and guide the operator in keeping the rods in a vertical position. After the CPT survey was completed at each location, the hole was grouted from the bottom up by using a pressure grouting technique with tremmie pipe. CPT logs are included in Appendix A.

2.3 GROUNDWATER SAMPLES

Ten groundwater grab samples were collected during the WAG 8 SE to evaluate the potential of contaminant migration from the surface through the UCRS.

2.3.1 DPT Groundwater Sampling

A DPT rig was used to collect groundwater samples for the WAG 8 SE (Table 2.4). Samples were collected in accordance with DOE's M&I Contractor EMEF FOP PTSA-4303-IAD, "Groundwater Sampling." The sampling tool dimensions were 30-in. by 0.5-in. outside diameter (O.D.) with 0.004-in. vertically slotted screen. Water samples were collected with a stainless steel bailer capable of collecting approximately 200 mL.

In most instances, a groundwater sample was obtained at the terminal depth of the DPT boring after all soil samples had been collected and a static water level was achieved in the boring. Grab samples were attempted in the lower portion of the UCRS (greater than 35 ft bgs) if saturated sand was observed in the soil sample. If no sand was present at terminal depth, a 5-ft .010 slotted polyvinyl chloride (PVC) screen and riser (1.25-in. O.D.) were set to allow later sampling. Sampling of these well points was normally within 48–72 hours. Temporary well points were not constructed with sand pack, bentonite seals, or grout.

2.4 STORM WATER SAMPLES

Three storm water samples were collected at each SWMU at the underdrain discharge pipes from the electrical switchyards (Table 2.5). These samples were taken immediately after any rain event large enough to create flow sufficient for sampling from the discharge pipes. These samples were taken to evaluate whether the underdrain system is a release point or migration pathway to the local surface water system for contaminants contained within the switchyard pad. During the WAG 8 SE, no surface water

flow was observed in any of the ditches adjacent to the C-340 Buildings, and therefore no surface water samples were collected from that site.

Storm water runoff samples were collected by directly inserting the sample bottles into the pipe discharge flow or by submerging the sample bottle in the ditch. Samples were submitted for analysis for VOAs, PCBs, semivolatile organic analytes (SVOAs), and dioxins/furans.

2.5 ANALYTICAL METHODS

Due to the diversity of analytes to be investigated during the WAG 8 SE, and in an effort to reduce analytical costs while expediting receipt of analytical results, the following laboratories were used:

- Close Support Laboratory (CSL) located on site equipped with five gas chromatographs (GCs), one each for screening soil and groundwater samples for TCE and its degradation products (VOAs), one for screening soil and groundwater samples for SVOAs, and one for screening soil and groundwater samples for PCBs.

- CSL located on site equipped with a gas proportional radioactivity counter for gross alpha and gross beta screening of soil and water samples, a gamma spectrometer for gamma screening of soil, and a liquid scintillation counter for technetium-99 screening of water.

- Fixed-base laboratories for soil and groundwater samples.

- Fixed-base laboratory for geotechnical samples.

COPCs associated with various SWMUs investigated in the WAG 8 SE were compiled in the WAG 8 Work Plan based on the results of previous investigations. CSL screening techniques permitted quantitative measurement of contaminant levels with near fixed-base sensitivity, while reducing turnaround time to help guide the field sampling effort and also reducing the overall cost of field and analytical services for the WAG 8 SE. In particular, field screening was relied upon to assess the presence of TCE and its degradation products, SVOAs, radionuclides, and PCBs. Table 2.6 presents the types of analyses performed in the CSL. Table 2.7 presents the analytical methods and sample requirements for CSL analysis.

Results of field laboratory radiological screening were used to implement the radiological analysis procedures in Sect. 5.10 of the WAG 8 Work Plan (DOE 1998b). These procedures represented a radiological screening process for soils and water developed by DOE with input and concurrence from the regulatory agencies involved at PGDP. The procedures called for field laboratory screening of soil samples with activities greater than 2 times background and all water samples to determine the gross alpha to gross beta ratio. If the ratio of alpha to beta activity was less than 3:1, further fixed-base speciation analysis was not required, and samples collected for this purpose were not to be analyzed. In addition, a gross beta activity threshold for fixed-base analysis of 50 pCi/L for water samples was established. Samples with gross beta activity in excess of 50 pCi/L, as determined by the field laboratory screening samples, were to be further analyzed by fixed-base analyses for technetium-99. However, as the project progressed, few samples exhibited a gross alpha to beta ratio in excess of 3:1, even while having significantly high gross alpha and/or beta activity. As a result, it was decided to capture additional speciation data on these samples with significant activity, particularly water samples with exceedances of the Kentucky Department of Environmental Protection (KDEP) criteria for speciation analysis of groundwater due to alpha activity (15 pCi/L). Therefore, speciation analysis thresholds of 15 pCi/L gross alpha activity in groundwater samples and 50 pCi/g gross alpha or beta activity in soil samples were

established and used for the remainder of the project. For all samples that exceeded any of these established thresholds, fixed-base speciation analyses were also conducted.

In addition, a minimum of 10 percent of the total number of samples (by matrix) were split and submitted to an off-site fixed-base laboratory for analysis. These samples provided definitive data to confirm the results from the CSL screens. A separate sample aliquot was collected from each sample interval scheduled for off-site fixed-base laboratory analysis. This sample aliquot was analyzed at the CSL radiochemistry laboratory, where it underwent radiation screening to facilitate proper U.S. Department of Transportation (DOT) shipment to the off-site laboratories. A wipe sample also was collected from the exterior of each sample container in the field. The WAG 8 SE sample shipping team determined whether the samples could be shipped off site for analysis based on field wipe sample results and radiological screening sample results compared to limits specified by DOT, the International Air and Transportation Association (IATA), and DOE. The project DOT shipping specialist also prepared the shipment in accordance with DOT and IATA regulations for shipment of dangerous goods, if warranted.

2.5.1 CSL Analytical Methods

2.5.1.1 CSL VOA analysis for soil samples (hexane extraction)

A photoionization detector (PID)/electrolytic conductivity detector (ELCD)-equipped Hewlett-Packard HP5890 Series II GC was used to analyze VOAs in soil samples. A modification of the current version of the SW-846 8021 method (SW8021B) was used for these analyses. Decontaminated, non-sterile syringes (with ends cut off) were used to transfer an approximately 5-g aliquot of undisturbed soil from the sampling sleeve (soil core) to a 40-mL vial containing 5 mL of deionized water and 5 mL of hexane. The hexane extracts the VOAs from the soil/water solution. In the laboratory, surrogate-spiking solution was added to the hexane layer, and a syringe was used to sample the hexane layer in the vial. The hexane, along with the VOAs dissolved in it, was directly injected into the GC for analysis.

2.5.1.2 CSL VOA analysis for water samples

A PID/ELCD-equipped Hewlett-Packard HP5890 Series II GC was used to analyze VOAs in water samples. An OI Analytical Discrete Purging Multisampler (Model DPM-16) was used to conduct purge and trap sample introduction of aqueous samples for VOA analyses. A modification of the current version of the SW-846 8021 method (SW8021B) was used for these analyses. The method utilizes the purge and trap process as a sample introduction technique (SW5030B) for water samples. The purge was performed with a flow of helium through samples of water, followed by collection of the halogenated volatile organics in a multiple-phase sorbent trap at ambient temperature. After the purge cycle was completed, the trap was heated and backflushed, desorbing all trapped compounds into a GC column. GC analysis allows separation of these compounds from either the hexane extract or the desorbed trap, and detection with the ELCD and the PID. Quantitative analysis was achieved by comparison of sample values with standard values.

2.5.1.3 CSL SVOA analysis for water and soil samples

A Hewlett-Packard HP5890 Series II GC was equipped with a Hewlett-Packard HP5972 mass spectrometer (MS) detector and used to assess levels of SVOAs in water and soil samples. A measured volume of aqueous sample, usually 1 L, at a specified pH (acidic or basic) was serially extracted with methylene chloride by using a separatory funnel. The extract was dried, concentrated, and, as necessary, exchanged into a solvent compatible with the cleanup or determinative step to be used. For soil samples, a 30-g sample was mixed with anhydrous sodium sulfate to form a free-flowing powder. This was solvent extracted using sonication. The extract was separated from the sample by vacuum filtration or centrifugation. The extract was then ready for cleanup and/or analysis following concentration. The

analytes were then introduced into the GC/MS system by injecting the extract onto a narrow bore fused silica capillary column. The GC was temperature programmed to separate the compounds prior to detection by an MS, which was used to provide both qualitative and quantitative information. Quantitation was achieved by comparing the response of a major (quantitation) ion relative to an internal standard using a five-point calibration curve.

2.5.1.4 CSL PCB analysis for water and soil samples

Two Hewlett-Packard HP5890 Series II GCs were equipped with halogen-sensitive electron capture detectors (ECDs) and used to assess levels of PCB contamination in soil and water samples. One instrument served as a qualitative confirmation instrument, with a different column than the column the primary instrument used for quantitation. Water and soil samples were prepared similarly as for SVOA analysis, except that hexane was used for the extraction solvent. The samples were then introduced into the GC/ECD system by injecting the extract onto a narrow bore fused silica capillary column. The GC was temperature programmed to separate the compounds prior to detection by the ECD, which was used to provide both qualitative and quantitative information. Quantitation is achieved by comparing the response of the ECD on the column to a five-point curve response. A second instrument with a different column is used to analyze all positive result extracts for qualitative confirmation of Aroclor species.

2.5.1.5 CSL radiological analysis procedures

When appropriate for the sample matrix, SW-846 methods were used. When SW-846 methods were not available or not appropriate, other nationally recognized methods such as EPA, DOE, and American Society for Testing and Materials (ASTM) methods were used. The following procedure manuals were used as references for radiological analysis:

- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA 1980)
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846 (EPA 1986)
- Eastern Environmental Radiation Facility, *Radiochemistry Procedures Manual*, EPA-520/5-84-006, (EPA 1984)
- *Environmental Measurements Laboratory Procedures Manual*, HASL-300 (DOE 1982)

Gross alpha and gross beta assessments were performed using a Tennelec Series 5 Low Background Gas Proportional Counter.

Gamma activity was assessed in soils using a liquid-nitrogen cooled high purity germanium detector linked to an analog to digital converter and stored in a multichannel analyzer. The stored data were interpreted by a complex software program, generating results in units of radioactivity per unit sample volume.

Technetium-99 activity was assessed in water samples by filtering the water through 3M Empore Technetium Rad disks, then rinsing with deionized water to eliminate possible tritium presence, and counting on a liquid scintillation counter using a window determined by analysis of standards.

The following are definitions of the CSL data qualifiers:

A. Organic Analyses

U Indicated compound was analyzed for but not detected.

J Indicates a sample concentration value less than the reporting limit, but above the method detection limit (MDL).

E Identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.

D Identifies all compounds in a reanalysis previously identified in an analysis at a lower dilution factor.

B. Radiological Analyses

U or A Indicated compound was analyzed for but not detected.

2.5.2 Fixed-Base Laboratory Methods

Fixed-base laboratory analyses of soil and groundwater samples were performed at several laboratories. These laboratories were contracted through the DOE Oak Ridge Operations (ORO) Sample Management Office (SMO) and are DOE-approved, Nuclear Regulatory Commission-licensed laboratories. SW-846 methods were used for all samples, except those parameters for which other methods are necessary. The analyses followed SW-846 protocols, and "Forms Only" data packages were provided along with electronic data deliverables (EDDs). Table 2.8 summarizes the analytical methods and sample requirements of the fixed-base laboratories. The following are definitions of the fixed-base laboratory data qualifiers:

A. Inorganic Analysis

B This flag is used when the analyte is found in the associated blank as well as in the sample.

U The analyte was analyzed for but not detected.

J Indicates an estimated value.

E The reported value is estimated because of the presence of interference. An explanatory note must be included under comments on the cover page (if the problem applies to all samples) or on the specific Form I (if it is an isolated problem).

M Duplicate injection precision was not met.

N Spiked sample recovery was not within control limits.

S The reported value was determined by the method of standard additions (MSA).

W Postdigestion spike for furnace atomic absorption analysis is out of control limits (85 percent–115 percent), while sample absorbance is less than 50 percent of spike absorbance.

X Other specific flags may be required to properly define the results.

* Duplicate analysis was not within control limits.

\+ Correlation coefficient for the MSA is less than 0.995.

B. Organic Analysis

U Indicated compound was analyzed for but not detected.

J Indicates an estimated value. This flag is used under the following circumstances: (1) when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed and (2) when the mass spectral and retention time data indicate the presence of a compound that meets the pesticide/Aroclor identification (ID) criteria, and the result is less than the contract-required quantitation limit but greater than zero.

P This flag is used for a pesticide/Aroclor target analyte when there is greater than 25 percent difference for detected concentrations between the two GC columns.

C This flag applies to pesticide results where the ID has been confirmed by GC/MS.

B This flag is used when the analyte is found in the associated blank as well as in the sample.

E This flag identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.

D This flag identifies all compounds identified in an analysis at a secondary dilution factor.

X Other specific flags may be required to properly define the results.

Y Indicates matrix spike (MS)/matrix spike duplicate (MSD) recovery and/or relative percent difference (RPD) failed to meet acceptance criteria.

2.5.3 Analytical Data Quality

2.5.3.1 Precision, accuracy, representativeness, completeness, and comparability

Precision, accuracy, and completeness objectives for fixed-base laboratory measurements during the WAG 8 SE are presented in Table 9.2 of the WAG 8 Work Plan (DOE 1998b). CSL laboratory precision and accuracy objectives are presented in each CSL analytical method standard operating procedure. An assessment of the precision, accuracy, representativeness, completeness, and comparability of field laboratory data measurements and fixed-base laboratory analytical data was performed. The results of this assessment are discussed in the following paragraphs.

"Precision" is defined as the degree of agreement between repeated (replicate or duplicate) measurements of one property using the same method or technique. Field duplicate samples are collected as a measure of precision of the sample collection and analytical process. In addition, laboratory duplicates, laboratory control sample (LCS)/laboratory control sample duplicates (LCSDs) and/or MS/MSDs can be used to measure analytical precision. The RPD between the duplicate sample results is calculated and compared to the appropriate QA objective. For this field program, field duplicate samples were collected for all media at a frequency of 5 percent. The organic CSL objectives for precision were

met, with the exception of infrequent high RPDs on some semivolatile MS/MSD results. The radiological CSL objectives for precision were always met; however, precision calculations were not performed for duplicate samples with less than 3 times the minimum detectable activity. Table 2.9 contains summary information on the WAG 8 data precision, including average observed RPD information and the CSL RPD limit for each monitored analyte in both water and soil matrices.

"Accuracy" is defined as the degree of agreement of a measurement with an accepted reference or true value. Accuracy of laboratory analyses is estimated through the analysis of blank spikes, matrix spikes, or surrogate spikes. These laboratory quality control (QC) samples are analyzed as required by the appropriate analytical method. The recovery of each spiked analyte is calculated and compared to the appropriate QA objective. The organic CSL objectives for accuracy were met with a few exceptions, mostly on heavily contaminated samples and/or where matrix interference was clearly indicated. The radiological CSL objectives for accuracy were always met. Table 2.9 contains summary information on the WAG 8 CSL data accuracy, including average observed spike recovery information and the CSL control limits for each spiked analyte in both water and soil matrices.

"Representativeness" is defined as the degree to which data accurately and precisely represent the contamination at the site. The data collected during the SE were both accurate and precise. The samples required in the WAG 8 Work Plan (DOE 1998b) to define contamination were collected using standardized procedures designed to provide a true representation of the location sampled. Standardized, accepted analytical methods or modified standard methods, using National Institute of Standards and Technology traceable standards, were used to ensure that accurate, reproducible data were generated. Based on these criteria, the data from the WAG 8 SE were deemed representative.

"Completeness" is defined as a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected. In this SE, "overall completeness" refers to the percentage of valid measurements versus the total measurements planned. Table 9.2 of the WAG 8 Work Plan (DOE 1998b) specified an "overall completeness" objective of 90 percent for all analyses performed for both soil and groundwater matrices. Overall, for all base analyses, the WAG 8 SE achieved completeness of 87 percent for the base project. However, with contingency sampling data included in the base completeness calculation, overall project completeness is 89 percent. The overall soil completeness was mostly affected by sampling difficulties (i.e., early refusal during DPT drilling operations and lack of shallow groundwater); very little overall completeness was lost due to laboratory analytical failures.

"Comparability" is defined as the degree of confidence with which one data set can be compared to another. Data collected for this investigation were generally collected according to the WAG 8 SE Work Plan and its quality assurance project plan. The overall comparability of the data collected in the WAG 8 SE to historical data is good.

The organic CSL screening data generated for the WAG 8 SE, particularly for PCBs, were comparable, although of higher quality than previous organic CSL screening data. This increase in quality is based mainly on the use of surrogates, second-source LCSs, and MS/MSDs for all WAG 8 SE organic CSL methods.

The use of different gross beta (i.e., stronium-90 versus technetium-99) and gross alpha (i.e., americium-241 versus uranium-238) standards in the radiological CSL for the WAG 8 SE may have had some impact on comparability, both with historical radiological CSL data and with current and historical, fixed-base confirmation data. Because the fixed-base laboratories used for the WAG 8 SE were, for the most part, the same as those used in previous projects, using similar analytical methodology, there should

be an extremely high degree of confidence in the comparability of the current and historical, fixed-base definitive data.

2.5.3.2 Surveillances

During the WAG 8 SE, surveillances of the field activities and the CSL were conducted. Surveillance covered the following: CSL activities, sample management activities, log keeping and chain-of-custody documentation, equipment decontamination, waste management activities, sampling activities, implementation of quality-assured data policies, and well installation and development. ORO-SMO conducted laboratory surveillances of the fixed-base laboratories.

2.5.3.3 Data quality objectives

Data quality objectives (DQOs) are qualitative and quantitative criteria used to establish requirements for sample collection and analysis and are based on the intended uses of the data. The overall intent of DQOs is to generate data of appropriate quality to support the objectives of the evaluation.

2.5.3.4 CSL performance

All data generated at the CSL were of sufficient quality to support the project decision-making process. Detection limits are method- and matrix-specific. CSL reporting packages included sample results, summary information and/or chromatograms/raw instrument output for all QC samples and/or calibrations, chain-of-custody information, sample preparation and run logs, and other supporting documentation and data summaries. Reporting of SVOA conformed to standard SW-846 documentation for each analytical batch by date.

Included in the documentation were initial and continuing instrument calibration, performance results, determination of MDLs, identification and quantification of compounds and analytes detected, and laboratory QC samples. Selected data were conveyed to the data coordinator for direct download into the project database. The lead chemist reviewed results before the data were input to the project database. The following criteria were reviewed to determine acceptability:

- Holding times—All holding times were met.

- Initial calibration—All initial calibrations met acceptance criteria. If initial calibration criteria were not met, the instrument was recalibrated prior to use.

- Continuing calibration checks—Most continuing calibration checks met acceptance criteria. If continuing calibration criteria were not met, the failure was noted in the case narrative and/or in Out-of-Control Event (OOCE) Sheets in each data package, and in some cases, the affected samples were reanalyzed.

- Method blanks—If target compounds were found in the blank above the reporting limit and also in the associated samples, the samples were reprepared and reanalyzed.

- Laboratory duplicates and/or MS/MSDs—Most laboratory duplicates and/or MS/MSDs were within the acceptance criteria. If not, the problem was noted in the case narrative and/or OOCE Sheets with each data package.

- LCSs—An LCS was analyzed with every batch. LCSs rarely failed to meet acceptance criteria. For some SVOA analyses, one or two of the target LCS analytes may have failed, but if these were not detected in the associated samples, no action was taken other than notation in the case narrative and generation of an OOCE Sheet.

- Surrogate Standards—All organic CSL methods utilized surrogates with QC acceptance criteria. Samples were routinely reprepared and/or reanalyzed if surrogate recoveries were outside of QC acceptance criteria. Surrogate failures were infrequent, with the majority coming during the analysis of high-suspended solids water samples for SVOAs and PCBs.

Field laboratory results were confirmed by sending 10 percent of field laboratory samples to fixed-base laboratories for analysis. In general, all CSL data were assessed as usable for their intended purpose (field screening).

2.5.3.5 Fixed-base laboratory performance

Fixed-base laboratory performance was based on the results of laboratory QC samples, MS/MSD analysis, and adherence to laboratory procedures through data validation. The laboratories are audited annually by ORO-SMO and are contracted to follow the Analytical Master Specification documents for various analytical chemistry protocols mandated by ORO-SMO.

Some holding time problems were reported for VOA analyses by the fixed-base laboratories used during this investigation. These holding time exceedances were the most serious deficiencies, resulting in qualification or rejection of data. Initial calibration and continuing calibration deficiencies also led to laboratory qualification of some VOA data and rejection of some data during data validation, as discussed in the following section. Specific laboratory problems with the data were addressed and resolved during the data assessment phase.

One soil sample for SW-846 Method 8290 dioxin/furan analysis, from SWMU 85, was subjected to validation procedures. Of 17 possible analyte results, 9 were qualified by the data validator. Four results were qualified non-detect due to the presence of the analytes in the method blank, where the reported sample concentration was not greater than 5 times the concentration found in the method blank. Three analyte results were qualified as estimated due to matrix spike recoveries either above or below control limits. One analyte result for OCDD was qualified as estimated because the result (9.18 µg/kg) was above the upper range of the calibration standards. The result for 2,3,7,8-tetrachlorodibenzofuran was qualified as estimated non-detect with an estimated maximum possible concentration of 0.00132 µg/kg by the data validator.

2.5.3.6 Data validation

Data validation is a process performed for a data set by a qualified individual who did not participate in sampling, laboratory analysis, project management, or decision-making for the project. In the data validation process, the laboratory adherence to analytical method requirements is evaluated. WAG 8 data were validated according to the following DOE's M&I Contractor procedures:

- EMEF Intersite Procedure Environmental Restoration and Waste Management (ERWM)/ Environmental Restoration (ER)-P2209, "Radiochemical Data Verification and Validation," Rev. 0

- EMEF Intersite Procedure ERWM/ER-P2210, "Volatile and Semivolatile Data Verification and Validation," Rev. 0

- EMEF Intersite Procedure ERWM/ER-P2211, "Pesticide and PCB Data Verification and Validation," Rev. 0

- EMEF Intersite Procedure ERWM/ER-P2212, "Inorganic Data Verification and Validation," Rev. 0

As part of the data review process, findings were qualified as necessary to reflect data validation results. The following qualifiers were assigned by the data validators:

U The material was analyzed for but was not detected. The associated numerical value is the quantitation limit.

J Estimated value, either because QC criteria were not met or because the amount detected was below the documented quantitation limit.

UJ Undetected, but the number reported as the quantitation limit is an estimated value.

R Rejected, so data are of "information only" quality and should be supplemented with additional data for decision-making.

= Data were validated; however, no qualifier was added.

X Data were not validated.

Data generated by the fixed-base laboratories were independently validated on a frequency of 10 percent. Of the 20,204 total data points, 3278 (16 percent) were validated. A review of the data validation summary reports indicates that the majority of data quality parameters, including MS/MSD recovery and RPD criteria, for the validated data packages were within established method-specific limits. Grossly exceeded holding times affected significant portions of the VOA soil data. Other quality problems for individual samples and/or analytes were identified in each of the validated packages; in particular, there were repeated instances of laboratory blank and field QC contamination affecting VOA analytes, such as acetone and methylene chloride, and problems with continuing and initial calibrations for some of the same VOA analytes. Of the overall analytical data, 750 data points (3.7 percent) were rejected with 741 (99 percent) of these being VOA soil data points. No groundwater data were rejected during data validation.

2.5.4 Data Management

The WAG 8 Project Environmental Measurements System (PEMS) was used to manage field-generated data; import laboratory-generated data; add data qualifiers based on data verification, validation, and assessment; and transfer data to the Oak Ridge Environmental Information System (OREIS). PEMS included a tracking system to identify, track, and monitor each sample and associated data from point of collection through final data reporting.

The data verification processes for laboratory data were implemented for both hard-copy data and EDDs. The data packages were reviewed to confirm that all samples had been analyzed for the requested parameters.

During the WAG 8 investigation, each sampling location and sample collected during the WAG 8 SE was assigned a discrete ID number, which consisted of a four-part alpha/numeric sequence. For example:

082-018-WA-095

Each segment of the sequence is used to designate information concerning the location from which a sample was collected, the medium from which it was collected, the nature of the sample, and the depth from which the sample was collected. The first three-digit code is a location definition corresponding to the SWMU or AOC from which the sample was collected. For example, "082" would indicate SWMU 82. This code is followed by another three-digit code used to define the boring or location within the SWMU (or area) from which the sample was collected. For example, "018" would indicate the 18th boring drilled in that area. The two-letter sequence is used to indicate the nature of the sample. The first letter identifies the matrix of the sample. Examples of the letters used to identify specific matrices include S, W, and L to identify soil, water, and sludge matrices, respectively. The second letter identifies the sequence of multiple samples collected from the same location or the type of QC sample for field QC samples collected. For example, "A" designates an original field sample, and "B" or "C" designates a second or third sample collected during another sampling event at the same location (i.e., a resampling). The letter "D" is used to designate a field duplicate sample. "E" designates an equipment rinsate sample, "F" designates a field blank sample, "R" designates refrigerator storage blank for VOAs, and "T" designates a trip blank sample. A "Q" was used for source water samples from the potable water and deionized water used during the project. The predetermined three-digit field is used to designate the approximate depth from which the sample was to have been collected. For example, "095" would mean the sample was to have been collected at 95 ft. In conclusion, for the example given, the sample ID code reads: *within SWMU 082, from boring location 18, a water sample was collected at approximately 95 ft bgs.*

2.5.5 Data Assessment

A large volume of data was generated during the WAG 8 SE. To confirm that the data set could be used in the decision-making process, the SE team performed various checks and reviews during and after the field work to maintain data consistency and identify problem areas. These checks and reviews included electronic verification and manual assessments by the SE team, as well as independent validation of fixed-base laboratory data.

2.5.5.1 Field data

Field data consist of data generated by the on-site CSL and measurements taken in the field during a sampling event. For example, measurements taken in the field during a groundwater sampling event included water temperature, specific conductivity, dissolved oxygen, and pH. The CSLs measured concentrations of TCE and its degradation products in soil and groundwater, SVOAs in soil and groundwater, and PCBs in soil and groundwater. The CSLs also measured gross alpha and beta activity in soil and groundwater, gamma activity in soil, and technetium-99 activity in water. The field preliminary CSL data underwent daily reviews by the lead chemist, and data management personnel reviewed final CSL data as a means of identifying data entry errors, missing data, and inconsistencies.

2.5.5.2 Fixed-base data

The fixed-base data consist of data generated by the off-site laboratories contracted for the project. These laboratories provided analyses of VOAs, SVOAs, PCBs, dioxins/furans, metals, radioisotopes, and soil properties. Ten percent of the fixed-base data was submitted to WAG 8 team validators for

independent validation of the data quality. A report was submitted on each data package when the package was returned to the SE team. The results of the validation were then included in the data set.

2.5.5.3 Final review

After each data package was received from the fixed-base laboratory and loaded into the PEMS database, a final review and assessment of all the data was completed. This effort included electronic verification, database queries targeting known problem areas, and manual assessment. For manageability, the data packages were divided by SWMU or AOC.

As a result of the final review, data records for all samples that exceeded holding times were flagged with a "T" in the verification field. Data records for all metals and radioisotopes in soils that exceeded established background levels for the site were flagged with an "I" in the verification field.

QC samples also were reviewed as a part of the data assessment process. These included equipment rinsate samples, trip blanks, refrigerator blanks, field blanks, and a comparison of field duplicate results. No problem areas were identified during assessment of these samples.

Holding time exceedances were a problem, however, particularly for some VOA analyses. All holding time exceedances were identified during the verification process, and the impact of those exceedances was evaluated. Analyses for organics and certain metals are particularly sensitive to holding times, whereas analyses for most metals and for radioisotopes are less sensitive. Both the analyses to be performed and the length of the holding time exceedances were evaluated to assess the potential impact. Records for those samples judged to be significantly impacted were assigned an assessment flag of "BL-T," meaning that the result may be biased low due to holding time exceedance. A total of 3,290 out of 20,204 (16 percent) records in the database were assigned the "BL-T" flag.

The "R" assessment flag was used to reject data that did not pass the review process. Rejected data included, for example, chemicals that had not been used on site or results that made no sense (e.g., if the dissolved concentration of a metal in groundwater exceeded the total concentration of the metal in the same sample). If the detected dissolved concentration was greater than 10 percent, the dissolved metal result was considered questionable. Also included as rejected data were samples with gross holding time exceedances. A portion of the VOA analyses conducted by the fixed-base laboratories had such exceedances. A total of 750 out of 20,204 records (3.7 percent) in the database were assigned the "R" flag. Only these data were excluded from use in the evaluation of contaminant nature and extent or fate and transport.

2.5.6 Field QC Procedures

EPA, DOE, the Commonwealth of Kentucky, and DOE's M&I Contractor procedures require that field QC samples be collected to assess data quality. The QC samples collected and analyzed included:

- equipment rinsates
- trip blanks
- field blanks
- duplicate samples
- refrigerator blanks

2.5.6.1 Equipment rinsates

Equipment rinsates were scheduled to be collected at a frequency of 1 in 20 samples. Appendix C provides the data from the equipment rinsate samples. A total of nine equipment rinsates were collected

during the project. Equipment rinsate samples were designated as XXX-XXX-WE-XXX samples in Appendix C.

2.5.6.2 Trip blanks

Trip blanks were collected at a frequency established by the direction of the DOE's M&I Contractor . A total of 28 trip blanks were analyzed during the project. Appendix C provides the results of the trip blank samples. Trip blank samples are designated as XXX-XXX-WT-XXX samples in Appendix C.

2.5.6.3 Field blanks

Field blanks were scheduled to be collected at a frequency of 1 in 20 samples. Appendix C provides the data from the field blanks. A total of nine field blanks were collected during the project. Field blank samples are designated as XXX-XXX-WF-XXX samples in Appendix C.

2.5.6.4 Duplicate samples

Field duplicates were collected and sent to the CSLs and fixed-base laboratories for analysis. Field duplicates were scheduled to be collected at a frequency of 10 percent of the total number of field samples collected by matrix. Six soil duplicate samples were collected during the project. Appendix C provides the results of the duplicate samples. Field duplicate samples are designated as XXX-XXX-SD-XXX for soil field duplicates.

2.5.6.5 Refrigerator blanks

Refrigerator blanks were collected and analyzed every two weeks during the project. Because the WAG 8 field investigation was conducted simultaneously with both the Data Gaps and the WAG 28 RI, these refrigerator blanks were divided among all three projects for which samples were being collected and stored prior to analysis. Four refrigerator blanks were assigned to the WAG 8 project. Refrigerator blank samples are designated as XXX XXX WR-XXX samples in Appendix C.

2.6 CIVIL SURVEY

Upon completion of the activities associated with the sampling points, soil borings, monitoring wells, and piezometers, a final survey of the location and elevation was conducted. The surveying was conducted in accordance with the DOE's M&I Contractor EMEF engineering specifications. The civil survey was performed by a state registered and licensed surveyor of the Commonwealth of Kentucky. Site locations were surveyed on the Kentucky State Plan Coordinate System and the PGDP Plane Coordinate System. Grid coordinates were measured to an accuracy of plus or minus 0.01 ft and tied to the U.S. Geological Survey National Geodetic Vertical Datum of 1929 or the North American Datum of 1983. Elevations were measured to a hundredth (0.01) of a foot. Surveying field activities were documented in field logbooks for archiving. The civil survey data are included in Appendix D.

2.7 HEALTH AND SAFETY MONITORING

To protect the health and safety of personnel during field activities, site safety professionals were assigned to observe, monitor, direct, and document each activity. In addition, a Radiation Protection Program was implemented to assure adherence to PGDP and DOE regulations. All of the site safety professionals were trained prior to the start of site monitoring activities. Trained and certified radiation control technicians supported the safety and health professionals.

Two major categories of monitoring were performed: work area monitoring and employee biological monitoring.

2.7.1 Work Area Monitoring

Several of the drilling and sampling locations for the WAG 8 SE were within the boundaries of known areas of surface radiation contamination. Before field activities began, an initial site radiation survey was performed that covered a 60-ft by 60-ft area around the point of sampling or drilling. The survey was to ensure that members of the sampling crew and the equipment were properly protected and that surface contamination, if present, was properly managed.

All radiation abnormalities were reported immediately to the DOE's M&I Contractor EMEF Health Physics Department and the project construction engineer.

Once the site had been thoroughly scanned for radiation and proper actions had been taken to protect workers from site hazards, equipment was moved onto the site and work zones (with barriers) were established. These zones included an outer construction zone and an inner exclusion zone. The exclusion zone was a strictly controlled area. Every person or item that passed into this zone was considered contaminated and could not be removed until fully scanned for radiation. This was accomplished by discrete measurements with the Ludlum 2224 and smear counting using the Ludlum 2929.

Once the ground surface was broken at a work site, air was continuously monitored with direct read instruments until field activities were completed. Tools and equipment in direct contact with soil were presumed to be contaminated until they were measured and were therefore smeared before they were cleared. If levels were above the release limits, the material was bagged and properly tagged. The bagged material was then surveyed again to confirm that levels were below the release limits. The material was then moved to a designated area until it could be properly decontaminated. Instrument readings were recorded in the field geologist logbook. Typically, readings were recorded from soil cuttings created during the drilling operations, air space monitoring at the drilling location, smears and direct measurements, and readings that met or exceeded the project action levels specified in the Health and Safety Plan.

The work area was also monitored to prevent overexposure to temperature extremes. On-site ambient temperature was measured and discussed on a daily basis. A site safety professional monitored cold and heat stress of personnel in the work area. This monitoring included close scrutiny of personnel behavior, obvious signs of overexertion, and heart rates of exposed personnel. Heart rate checks were performed periodically during each exposure period.

Excessive noise was surveyed at each source of elevated noise, including drill rigs, pressure washing equipment, generators, and other items equipped with combustion engines. Sound level monitoring data were recorded in field log books. Sound level surveys were performed with a Quest Model 2700 sound level meter at each source of elevated noise. Working conditions in the vicinity of this equipment were checked at regular intervals to confirm that the site was properly delineated with hearing conservation signs and to reassess the use of proper personal protective equipment (PPE). Hearing protection was required at any level equal to or above 85 decibels.

2.7.2 Employee Biological Monitoring

All personnel who were required to enter a zone of potential contamination were required to participate in the DOE's M&I Contractor Biological Monitoring Program. As part of this program, personnel wore thermoluminescent dosimeter (TLD) badges to track possible radiation exposure; in addition; quarterly urinalysis was conducted to document radiological ion uptake. Requirements of 29 *Code of Federal Regulations* 1910.120 were used for training and biological monitoring of WAG 8

field employees, including a physical examination consisting of blood analysis, audiometric testing, respiratory testing, and cardiopulmonary testing.

Upon arrival at the project site and before any participation in site work, employees were issued a TLD by DOE's M&I Contractor Health Physics Department personnel, and each person provided a urine sample to establish a baseline. The TLDs were exchanged and analyzed on a quarterly basis. The internal dose evaluation was performed each month and at the end of project participation.

2.8 WASTE HANDLING PRACTICES

A variety of potentially contaminated and noncontaminated wastes were generated during the WAG 8 SE activities. All wastes generated as a result of field-related investigative activities had the potential to contain contaminants related to past work activities. The drilling and sampling investigative activities resulted in the generation of IDW. This required the development of a waste management plan that concurred with the requirements stated in the Waste Acceptance Criteria (WAC) document (Bechtel Jacobs 1999). The Waste Generation Plan included waste minimization, segregation, waste generation forecast, proper containerization, labeling/marking, characterization, handling, storage, transportation, and disposal.

2.8.1 IDW Drilling Solids

IDW was generated by DPT, surface soil, and surface water sampling. In addition, IDW was created by drilling two borings using a Dual Wall Reverse Circulation (DWRC) method. Although these DWRC borings were performed during the WAG 8 SE field effort, the end use of the data will be incorporated in reports generated as part of the Groundwater OU. The handling of IDW for these borings, however, is discussed here.

DPT sampling generated minimal IDW. The majority of solid waste generated by the DPT method was PPE and plastic sheeting used as groundcover under the rig and sampling area. All IDW solids were placed in appropriately labeled pails and drums according to applicable regulations and DOE's M&I Contractor procedures.

DWRC drilling generated approximately 125 ft^3 of solids and several hundred gallons of IDW liquids (majority of which was generated during decontamination of sampling equipment). The IDW solids were placed into 55-gal drums and the liquids into 375-gal poly tanks and transported to the C-752-C Decontamination Pad for final separation. Any remaining liquids that separated from the solids in the 55-gal drums were decanted out of the drum, and the remaining solids dumped into roll-off bins. The liquid mixture of mud, silt, clay, and water was separated by natural gravity settling, by the addition of flocculation chemicals, and by processing the water through a filter press. The filter press removed the sand, silt, and clay-size particles from the water matrix. The solids were placed into properly labeled roll-off bins along with the drum solids.

Twenty-six drums of soil (26 ft^3) were generated during WAG 8 SE and placed into roll-off boxes. The roll-off boxes were labeled, and all required forms were completed for landfill disposal. No IDW from the WAG 8 SE investigation has been classified as hazardous waste. All soil IDW has been transferred to the DOE's M&I Contractor for disposal.

IDW liquids associated with solids were captured in 1000-gal poly tanks by processing soils through a filter press. This water was then transferred into 21,000-gal frac tanks prior to testing and discharge into the 001 Outfall. The residual soil was placed into roll-off bins.

2.8.2 Well IDW Water, Well Development Water, Decontamination Rinsate and Purge Water

Water generated during the WAG 8 SE was placed into 375-gal poly tanks and transported to the C-752-C Decontamination Pad. If the water had field analysis that showed the water free of contamination, the water was pumped through the filter press to remove all visual solid particles. Clear water from the filter press was collected in 1000-gal poly tanks and transferred into 21,000-gal frac tanks located at C-612-A Clamshell Area.

Decontamination water was generated from the cleaning of drilling and sampling equipment. All water was collected into sumps located at C-752-C Decontamination Pad. Water from the sumps was cross-referenced with all field and waste sampling laboratory sampling data results, and all water that was deemed noncontaminated was pumped through the filter press and transferred into the frac tanks at C-612-A Clamshell Area. Solids that were not pumped with the water were collected and placed into the solid roll-off bins.

Wastewater generated from the laboratories was collected and temporarily stored at generator storage area (GSA)/satellite accumulation areas (SAAs) located outside of each laboratory. Each container was sampled and, if found noncontaminated, was mixed with other clear water and pumped through the filter press.

All water generated by this project was sampled and analyzed for PCBs, radionuclides, VOA, and SVOAs as required by DOE and/or KPDES Outfall Permits. No wastewater from the drilling, sampling, laboratory, or decontamination operations has exceeded applicable concentrations; therefore, it has not been necessary to transfer IDW liquids into storage for later disposal.

2.8.3 PPE and Plastic Sheeting

Modified Level C (determined to be necessary at the C-340 Building) was the highest level of PPE worn during the WAG 8 SE. Remaining sites were investigated using modified level D. Expended PPE was considered IDW and was segregated by boring. Laboratory analyses for environmental samples taken from each boring were cross-referenced to the corresponding IDW sample. Noncontaminated PPE (such as Tyvek® coveralls, plastic sheeting, rubber shoes, etc.) and refuse were also bagged per each boring and placed into roll-off bins for disposal following plant protocol.

In accordance with field screening and laboratory data results, PPE and plastic that were determined to be contaminated were placed in drums and managed according to PGDP protocol. To date, seven drums of contaminanted PPE and plastic have been transferred into storage. Twenty-five cubic yards of clean PPE and plastic have been placed into roll-off bins and submitted for landfill disposal.

2.8.4 Laboratory Waste

Laboratory operations generated used sample containers, PPE, residual soil, and wastewater. Soil, water, and PPE were combined with the associated waste streams for each boring and processed according to PGDP protocol. At present, no waste has been determined to be RCRA, Toxic Substances Control Act of 1976 (TSCA), or low-level (radioactive) waste requiring transfer to storage.

2.8.5 IDW Forms

Request for Disposal (RFD) forms and Waste Container Log Sheets were completed as the waste was generated at the work site. PGDP supplied all required forms as needed. Completed forms were delivered to the DOE's M&I Contractor EMEF Waste Disposal Coordinator for approval.

2.8.6 IDW Labeling

IDW containers were labeled or marked per PGDP's WAC requirements.

2.8.7 IDW Storage

GSAs and SAAs were established as needed. The GSAs and SAAs were set up and inspected in accordance with PGDP WAC procedures. Inspection forms were submitted each month as required.

2.8.8 Types of Containers

Solid IDW that was generated at each boring location was placed in 55-gal open top drums with a minimum rating of DOT 1A2/X400/S and lined with a 15-mil-thick plastic liner and an absorbent pad. IDW liquids were stored in 375-, 1200-, and 21,000-gal tanks located at C-752-C Decontamination Pad and C-612-A Clamshell Area.

2.8.9 IDW Characterization, Sampling, and Analysis

Waste analyses were performed using EPA-approved procedures as applicable. Analysis required for hazardous waste classification was performed in accordance with EPA SW-846 (1986). Wastewater analysis was performed in accordance with Clean Water Act of 1972 and/or Safe Drinking Water Act of 1974 (SDWA) procedures.

2.9 DECONTAMINATION PRACTICES

All drilling rigs and drilling-related equipment such as drill rods, casing, liners, and bits were steam-cleaned at C-755, C-416, and C752-C Decontamination Pads. Drill and sampling equipment was decontaminated in accordance with DOE's M&I Contractor EMEF Procedure PTSA-5001-IAD, "Decontamination of Drilling-Related Equipment."

Drilling equipment was thoroughly steam-cleaned and rinsed and then allowed to air dry. The drill string was then wrapped in plastic and placed on the drilling rig and transported to the next boring site. Decontamination water was collected in sumps and processed through the filter press in conjunction with IDW liquids for the removal of suspended solids. The clear water was transported and transferred into a 21,000-gal frac tank.

Sampling equipment such as bowls, spoons, knives, and spatulas, including all stainless steel field sampling equipment, was decontaminated in accordance with DOE's M&I Contractor EMEF Procedure PTSA-5002-IAD, "Decontamination of Field Equipment." The decontamination process occurred in the following order:

1. Rinsed with potable water
2. Washed and scrubbed with phosphate-free detergent and water
3. Rinsed with clean tap water

4. Rinsed with deionized water
5. Rinsed with isopropanol
6. Rinsed with deionized water
7. Air dried
8. Wrapped in aluminum foil

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Table 2.1. Surface soil sampling

Site	Number of surface soil samples
SWMU 82	3
SWMU 83	3
SWMU 84	6
SWMU 85	4
C-340	12
TOTAL	28

Table 2.2. DPT soil sampling

Site	Number of locations	Number of soil samples
SWMU 82	4	24
SWMU 83	4	21
SWMU 84	5	27
SWMU 85	5	25
C-340	4	24
TOTAL	22	121

Table 2.3. CPT surveys

Site	Locations	Total depth
SWMU 82	3	60 ft each
SWMU 83	3	40 ft, 36 ft, 40 ft
SWMU 84	3	60 ft, 56 ft, 54 ft
SWMU 85	3	58 ft, 58 ft, 56 ft
C-340	2	60 ft each
TOTAL	14	748 ft

Table 2.4. DPT water sampling

Site	Number of locations	Number of water samples
SWMU 82	4	1
SWMU 83	4	1
SWMU 84	5	4
SWMU 85	5	4
C-340	4	0
TOTAL	22	10

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Table 2.5. Surface water sampling

Site	Number of surface water samples
SWMU 82	3
SWMU 83	3
SWMU 84	3
SWMU 85	3
C-340	0
TOTAL	12

Table 2.6. CSL analyses

Analysis	Parameters	Prep. method (matrix)	Analytical method
VOA	TCE and TCE degradation products	SW-846 5030B (water)	Modified SW-846 8021B
VOA	TCE and TCE degradation products	Hexane extraction (soil)	Modified SW-846 8021B
SVOA	CLP Semivolatile TCL analytes	SW-846 3510C (water)	Modified SW-846 8270C
SVOA	CLP Semivolatile TCL analytes	SW-846 3550B (soil)	Modified SW-846 8270C
PCB	Seven PCB Aroclors	SW-846 3510C (water)	Modified SW-846 8082
PCB	Seven PCB Aroclors	SW-846 3550B (soil)	Modified SW-846 8082

Notes: TCE = trichloroethene
CLP = Contract Laboratory Program
TCL = Target Compound List

Table 2.7. Analytical methods and sample requirements for CSL screening samples

Parameter	Matrix	Holding time	Reporting limit	Container	Preservative
VOA	Water	14 days	1 µg/L	Two 40-mL clear glass vials with Teflon™ septa	HCl; cool to 4°C
	Solid	14 days	500 µg/kg	One 40-mL glass vial with Teflon™-lined lid	Cool to 4°C, 5-mL deionized water, 5-mL hexane
SVOA	Water	7 days	10 µg/L	Two 1-L amber glass	Cool to 4°C
SVOA	Solid	14 days	500 µg/kg	4-oz. widemouth glass jar with Teflon™-lined lid	Cool to 4°C
PCBs	Water	7 days	100 µg/L	Two 1-L amber glass	Cool to 4°C
	Solid	14 days	500 µg/kg	4-oz. widemouth glass jar with Teflon™-lined lid	Cool to 4°C
Gross alpha and gross beta	Water	6 months	5 pCi/L	One 1-L plastic jar	None
	Solid	6 months	55 pCi/g	8-oz. PP Lermer Jar	None
Technetium-99	Water	6 months	17 pCi/L	One 1-L plastic jar	None
Gamma activity	Solid	6 months	55 pCi/g	8-oz. PP Lermer Jar	None

Notes:
µg/L = micrograms per liter
µg/kg = micrograms per kilogram
pCi/L = picoCuries per liter
pCi/g = picoCuries per gram
HCl = hydrogen chloride

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Table 2.8. Analytical methods, preservation, and container type for all samples analyzed by fixed-base laboratories

Analysis	Analytical method	Container type	Preservative
		Soil	
TCL metals	SW-846 6010A SW-846 7060 SW-846 7471 SW-846 7740	2- or 4-oz widemouth HDPE	None
Hexavalent chromium	SW-846 7196	2- or 4-oz widemouth HDPE	None
Cyanide	SW-846 9014-Total	4-oz widemouth HDPE	None
PCBs	SW-846 8082	4-oz widemouth amber glass	4°C
Dioxins/furans	SW-846 8290	4-oz widemouth amber glass	4°C
Radiological	RL-7111 EPA 901.1 HASL-300 SW-846 9310 RL-7116	4- or 8-oz widemouth HDPE	None
TCL SVOA	SW-846 3550/8270	4-oz widemouth amber glass	4°C
TCL VOA	SW-846 8260A or Modified SW-846 8021B	2-oz widemouth glass with Teflon™-septa or one 40-mL glass vial with Teflon™-lined lid	4°C
pH	SW-846 9045	2-oz widemouth HDPE	None
Geotechnical analyses	ASTM D422 ASTM D954	Shelby Tube	None
Percent moisture Bulk density	ASTM D2218 (percent moisture) ASTM D854-92 (bulk density)	8-oz widemouth HDPE or Ziploc Bag	None
TOC	SW-846 9060	4-oz widemouth amber glass	
		Groundwater	
Major ion analysis	EPA 310.2 SW-846 9056 EPA 376.1 EPA 340.2	250-mL HDPE 125-mL HDPE	Cool to 4°C
TCL metals	6010 7060 7130 7420 7470 7740 7840	(3) 1-L Plastic Two bottles filtered (0.45 and 5 μm) and one unfiltered	Cool to 4°C, HNO_3, pH < 2
Hexavalent chromium	SW-846 7196	250-mL HDPE	Cool to 4°C
Cyanide	SW-846 9010B	1-L HDPE	Cool to 4°C, NaOH to pH >12
PCBs	SW-846 8082	1-L amber glass bottle with Teflon™-lined lid	Cool to 4°C

Table 2.8. (continued)

Analysis	Analytical method	Container type	Preservative
Dioxins/Furans	SW-846 8290	1-L amber glass bottle with Teflon™-lined lid	Cool to 4°C
Radiological	RL-7122 (EPA 900.0)	1-L HDPE	HNO_3, pH < 2
	RL 7100	1-L HDPE	
	RL-7124	500-mL Boston Round HDPE	
	TIMS-3		
TCL SVOA	SW-846 3510/8270	1-L amber glass bottle with Teflon™-lined lid	Cool to 4°C
TCL VOA	SW-846 8260A	Three 40-mL glass vials with Teflon™-septa	Cool to 4°C, HCl, pH < 2
TOC	SW-846 9060	250-ml amber glass	Cool to 4°C H_2SO_4, pH < 2
Silica	EPA 370.1	250-mL HDPE	Cool to 4°C
Redox potential	ASTM 2580B	250-mL HDPE	Cool to 4°C
COD	EPA 410.4	250-ml amber glass	Cool to 4°C H_2SO_4, pH < 2
Total suspended solids	EPA 160.1	1-L HDPE	Cool to 4°C
Total dissolved solids	EPA 160.2		
Oil and grease	EPA 413.1	1-L amber glass	Cool to 4°C H_2SO_4, pH < 2

Notes:
TOC = total organic carbon
COD = chemical oxygen demand
HDPE = high density polyethylene
HNO_3 = nitric acid
NaOH = sodium hydroxide
H_2SO_4 = sulfuric acid

2.9 Average spike recovery and duplicate RPD for the close support laboratories

Parameter	Water				Soil			
VOA	**%R (MS/MSD)**	**Control Limits (%)**	**RPD (%)**	**RPD Limit (%)**	**%R (MS/MSD)**	**Control Limits (%)**	**RPD (%)**	**RPD Limit (%)**
Vinyl chloride	86/89	50-150	8.1	30	80/75	50-150	8.8	30
1,1-Dichloroethene	89/90	50-150	7.8	30	90/85	50-150	8.5	30
cis-1,2-Dichloroethene	96/98	50-150	5.3	30	92/89	50-150	8.7	30
trans-1,2-Dichloroethene	88/89	50-150	7.1	30	92/89	50-150	8.8	30
TCE	108/109	50-150	6.7	30	99/97	50-150	8.0	30
PCBs	**%R (LCS/LCSD)**	**Control Limits (%)**	**RPD (%)**	**RPD Limit (%)**	**%R (MS/MSD)**	**Control Limits (%)**	**RPD (%)**	**RPD Limit (%)**
Aroclor 1254	118/121	50-150	6.5	30	110/115	50-150	7.4	30
SVOA	**%R (LCS/LCSD)**	**Control Limits (%)**	**RPD (%)**	**RPD Limit (%)**	**%R (MS/MSD)**	**Control Limits (%)**	**RPD (%)**	**RPD Limit (%)**
Phenol	18/19	12-110	7.0	42	78/73	26-90	7.9	35
2-Chlorophenol	55/58	27-123	16.5	40	82/81	25-120	11.0	50
1,4-Dichlorobenzene	62/69	36-97	16.7	28	68/65	28-104	16.0	27
N-Nitroso-di-n-propylamine	72/75	41-116	11.9	38	79/83	41-126	11.4	38
1,2,4-Trichlorobenzene	52/55	39-98	13.6	28	61/59	38-107	14.4	23
4-Chloro-3-methylphenol	49/47	23-97	16.0	42	65/71	26-103	10.7	33
Acenaphthene	74/84	46-118	9.3	31	85/83	31-137	10.9	19
4-Nitrophenol	20/18	10-80	32.0	50	65/67	11-114	6.2	50
2,4-Dinitrotoluene	69/74	24-96	10.0	38	76/72	28-89	9.4	47
Pentachlorophenol	22/25	9-103	14.6	50	35/38	17-109	10.6	47
Pyrene	58/60	26-127	6.1	31	61/63	35-142	8.8	36
Technetium-99	**%R (LCS/MS)**	**Control Limits (%)**	**RPD Dup(%)**	**RPD Limit (%)**	**%R**	**Control Limits (%)**	**RPD Dup(%)**	**RPD Limit (%)**
Technetium-99	99/94	50-150	6.4	50	NA	NA	NA	NA
Gamma Spectroscopy	**%R**	**Control Limits (%)**	**RPD Dup(%)**	**RPD Limit (%)**	**%R (LCS)**	**Control Limits (%)**	**RPD Dup(%)**	**RPD Limit (%)**
Gamma activity (^{241}Am)	NA	NA	NA	NA	96	50-150	NC	50
Gamma activity (^{137}Cs)	NA	NA	NA	NA	108	50-150	40.9	50
Gamma activity (^{60}Co)	NA	NA	NA	NA	100	50-150	NC	50
Gross Alpha/Beta	**%R (LCS)**	**Control Limits (%)**	**RPD Dup(%)**	**RPD Limit (%)**	**%R (LCS)**	**Control Limits (%)**	**RPD Dup(%)**	**RPD Limit (%)**
Gross alpha	97	50-150	13.8	50	117	50-150	9.7	50
Gross beta	101	50-150	12.7	50	100	50-150	9.4	50

NA=Not Analyzed by the CSL in this matrix
NC=Not Calculated due to insufficient data

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3. PHYSICAL CHARACTERISTICS OF WAG 8

The on-site physical characteristics of PGDP have been detailed in previous investigations by Clausen et al. (1992a), CH2M Hill (1992), CDM Federal Programs (1992), and EDGe (1989). Miller and Douthitt (1993), TCT-St. Louis (1991), EDGe (1989), and Wehran (1981) have addressed the off-site physical characteristics. For this report, previous investigations of the geology and hydrogeology were used to describe the regional physical characteristics of western Kentucky and summarize the physical characteristic data compiled for the PGDP area.

3.1 REGIONAL TOPOGRAPHY AND SURFACE WATER

PGDP lies in the Jackson Purchase Region of western Kentucky between the Tennessee and Mississippi rivers, bounded on the north by the Ohio River. The confluence of the Ohio and Mississippi rivers is approximately 20 miles downstream (southwest) from the site. The confluence of the Ohio and Tennessee rivers is approximately 15 miles upstream (east) from the site. The western Kentucky region has gently rolling terrain between 330 and 500 ft above mean sea level (amsl). Tributaries of the Ohio, Tennessee, and Mississippi rivers dissect the region.

The average pool elevation of the Ohio River is 290 ft amsl, and the high-water elevation is 342 ft amsl (TCT-St. Louis 1991). Approximately 100 small lakes and ponds are on DOE property (TCT-St. Louis 1991). Seven settling basins and 17 gravel pits are also located within the boundary. A wetland area covering 165 acres is immediately south of the confluence of Bayou Creek and Little Bayou Creek (TCT-St. Louis 1991). All creeks that drain the site flow northward toward the Ohio River.

Local elevations range from 290 ft amsl along the Ohio River to 450 ft amsl in the southwestern portion of PGDP near Bethel Church Road. Generally, the topography in the PGDP area slopes toward the Ohio River at an approximate gradient of 27 ft per mile (CH2M Hill 1992). Within the 960 acres of the plant boundaries, ground surface elevations vary from 360 to 390 ft amsl. Primary land uses at PGDP include industry and wildlife management; secondary uses include agriculture and fishing.

3.2 METEOROLOGY

The region in which PGDP is located has a humid-continental climate characterized by extremes of both temperature and precipitation. Table 3.1 summarizes average monthly precipitation and temperature for the region between 1984 and 1996, based on data generated at Barkley Field Airport, located southeast of PGDP. The 13-year average monthly precipitation is 3.96 in., varying from an average of 2.59 in. in August to an average of 4.72 in. in February. The 13-year average monthly temperature is 57.9°F, varying from 34.5°F in January to 79.5°F in July.

Fig. 3.1 illustrates average wind speed and direction at Barkley Field Airport for 1996. The average prevailing wind has a speed of 7.9 mph and blows dominantly from south to southwest. Generally, stronger winds are recorded when the winds are from the southwest.

3.3 SOIL

The general soil map for Ballard and McCracken counties indicates that three soil associations are found within the vicinity of PGDP (USDA 1976): the Rosebloom-Wheeling-Dubbs association, the

Grenada-Calloway association, and the Calloway-Henry association. The predominant soil association in the vicinity of PGDP is the Calloway-Henry association, which consists of nearly level, somewhat poorly drained to poorly drained, medium-textured soils on upland positions. Several other soil groups also occur in limited areas of the region, including the Grenada, Falaya-Collins, Waverly, Vicksburg, and Loring.

The Henry and Calloway soil series are classified as fragiaqualfs and fragiudalfs, respectively. The fragipan horizon within these soils is a dense silty or loamy layer, which may be cemented by noncrystalline material. This diagnostic subsurface horizon greatly retards the vertical movement of water in the soil and is typically responsible for causing seasonal high-water tables in these soils. The lateral continuity and integrity of this layer may have been reduced due to construction activities (CH2M Hill 1991). The soil over the majority of PGDP is the Henry silt loam with a transition to Calloway, Falaya-Collins, and Vicksburg away from the site.

The soils in the vicinity of PGDP tend to have a low buffering capacity, with a pH ranging from 4.5 to 5.5. Low pH values are often associated with high cation exchange capacities, so these factors may alter the mobility of soil contaminants (particularly metals) (Birge et al. 1990). The cation exchange capacities range from 8.92 to 69.8 milliequivalents per liter.

Although the soil over most of PGDP may be Henry silt loam with a transition to Calloway, Falaya-Collins, and Vicksburg away from the site, many of the characteristics of the original soil have been lost due to industrial activity that has occurred over the past 45 years. Activities that have disrupted the original soil classifications include filling, mixing, and grading.

3.4 POPULATION AND LAND USE

The West Kentucky Wildlife Management Area (WKWMA) and sparsely populated agricultural lands surround PGDP. The closest communities to the plant are Heath, Grahamville, and Kevil, all of which are located within 5 miles of DOE reservation boundaries. The closest municipalities are Paducah, Kentucky, located 15 miles east of the facility; Cape Girardeau, Missouri, which is approximately 40 miles west of the plant; and the cities of Metropolis and Joppa, Illinois, which are located across the Ohio River from PGDP.

Historically, the economy of western Kentucky has been based on agriculture, although there has been increased industrial development in recent years. PGDP employs approximately 2500 people, and the Tennessee Valley Authority (TVA) Shawnee Steam Plant employs 500 people (Oakes et al. 1987). Total population within a 50-mile radius of PGDP is approximately 500,000; approximately 50,000 people live within 10 miles of the plant. The population of McCracken County is approximately 62,879.

In addition to the residential population surrounding the plant, WKWMA draws thousands of visitors each year for recreational purposes. Visitors use the area primarily for hunting and fishing; other activities include horseback riding, hiking, sanctioned field trials for hunting dogs, and bird watching. According to WKWMA management, an estimated 5000 anglers visit the area each year.

3.5 ECOLOGY

The following sections give a brief overview of the terrestrial and aquatic systems at PGDP. A more detailed description, including an identification and discussion of sensitive habitats and

threatened/endangered species, is contained in the *Investigation of Sensitive Ecological Resources Inside the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CDM 1994) and *Environmental Investigations at the Paducah Gaseous Diffusion Plant and Surrounding Area, McCracken County, Kentucky* (COE 1994).

3.5.1 Terrestrial Systems

The terrestrial component of the PGDP ecosystem includes the plants and animals that use the upland habitats for food, reproduction, and protection. The communities range from an oak and hickory forest in areas that have been undisturbed to managed fence rows and agricultural lands in the more developed areas. The main crops in the PGDP area include soybean, corn, tobacco, and various grain crops such as millet.

Old field grasslands constitute approximately 2000 acres of WKWMA. Much of this herbaceous community is dominated by members of the *Compositae* family and various grasses. Woody species, such as red maple, are also occasionally present. Some of this area includes remnant prairie, as indicated by the presence of eastern gama and Indian grasses. The shrub community represents a more diverse habitat, including both herbaceous and woody species. Within WKWMA, approximately 800 acres consist of scrub-shrub habitat. Dominant trees include cherry, persimmon, sumac, young hickory, and three species of oak, as well as scattered growths of sweetgum and hackberry. Forest and shrub tracts alternate with fence rows and transitional edge habitats along roads and power transmission-line corridors. Elm, locust, oak, and maple, with an understory of sumac, honeysuckle, blackberry, poison ivy, and grape, dominate fence row communities. Herbaceous growth in these areas includes clover, plantain, and numerous grasses.

Mice, rabbits, and a variety of other small mammals frequent open herbaceous areas. Birds identified in the area include red-winged blackbirds, quail, sparrows, and predators such as hawks and owls. In transitional areas, including fence rows, low shrub, and young forests, a variety of wildlife is present, including opossum, vole, mole, raccoon, and deer. Birds typically found in the transitional areas include red-winged blackbirds, shrikes, mourning doves, quail, turkeys, cardinals, and meadowlarks. Several groups of coyotes also reside in areas around PGDP. In addition to the larger mammals, mature forests contain squirrels, songbirds, and great horned owls. Muskrat and beaver are found in the aquatic habitats of the PGDP area. Many species of waterfowl also use these areas, including wood ducks, geese, herons, and various other migratory birds. Various reptiles, amphibians, and terrestrial invertebrates (e.g., insects and spiders) are present in all areas. Domestic livestock is abundant in surrounding farmlands.

3.5.2 Aquatic Systems

The aquatic communities in and around the PGDP area that could be impacted by plant discharges include two perennial streams, Bayou Creek and Little Bayou Creek; the North-South Diversion Ditch; a marsh located at the confluence of Bayou Creek and Little Bayou Creek; and other smaller drainage areas. The dominant taxa in the surface water include several species of sunfish, especially bluegill and green sunfish, as well as bass and catfish. Bluegills, green and longear sunfish, and stonerollers dominate shallow streams characteristic of the two area creeks.

3.5.3 Wetlands and Floodplains

Wetlands were identified during the 1994 COE environmental investigation of 11,719 acres surrounding PGDP. In that investigation, 1083 separate wetland areas were identified and grouped into 16 vegetation cover types (COE 1994). Wetlands inside the plant security fence are confined to portions

of drainage ditches traversing the site (CDM 1994). Functions and values of these areas as wetlands are low to moderate (Jacobs 1995); these areas provide some groundwater recharge, floodwater retention, and sediment/toxicant retention. While the opportunity for these functions and values is high, the effectiveness is low due to water exiting the area quickly via the drainage system. Other functions and values (e.g., wildlife benefits, recreation) are very low.

At PGDP, three bodies of water cause most area flooding: the Ohio River, Bayou Creek, and Little Bayou Creek. A floodplain analysis performed by COE (1994) indicated that much of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams. In addition, this analysis indicated that ditches within the plant area can contain the expected 100- and 500-year discharges.

3.5.4 WAG 8 Surface Features

PGDP is drained by Bayou Creek, Little Bayou Creek, their tributaries, and man-made drainage ditches that flow into the two creeks. Most of the WAG 8 SWMUs are drained by ditches that discharge into KPDES outfalls and Little Bayou Creek on the north and east sides of the plant.

3.6 GEOLOGY

PGDP is located in the Jackson Purchase Region of western Kentucky, which represents the northern tip of the Mississippi Embayment portion of the Coastal Plain Province (Fig. 3.2). The Jackson Purchase Region is an area of land that includes all of Kentucky west of the Tennessee River. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock. An idealized lithologic cross-section for the PGDP site is presented in Fig. 3.3. A lithostratigraphic column of the Jackson Purchase Region is shown in Fig. 3.4.

Within the Jackson Purchase Region, strata deposited above the Precambrian basement rock attain a maximum thickness of 12,000–15,000 ft. Exposed strata in the region range in age from Devonian to Holocene. The Devonian stratum crops out along the western shore of Kentucky Lake. Mississippian carbonates form the nearest outcrop of bedrock and are exposed approximately 9 miles northwest of PGDP in southern Illinois (Clausen et al. 1992b). The Coastal Plain deposits unconformably overlie Mississippian carbonate bedrock and consist of the following: the Tuscaloosa Formation, the sand and clays of the Clayton/McNairy Formations, the Porters Creek Clay, and the Eocene sand and clay deposits (undivided Jackson, Claiborne, and Wilcox Formations). Continental deposits uncomformably overlie the Coastal Plain deposits, which are in turn covered by loess and/or alluvium.

The focus of the WAG 8 SE is the near-surface geologic strata ranging in age from Pleistocene to Holocene. The geologic interpretations at WAG 8 were made based on information obtained during the WAG 8 SE and using existing borings and monitoring well logs from previous studies. Borings advanced during WAG 8 ranged in depths from surface to 62 ft bgs. Figures 3.5–3.9 are geologic cross-sections across each of the areas investigated during the WAG 8 SE. Boring logs used for the lithologic interpretation and cross-section construction are located in Appendix E.

The oldest unit encounterered during the WAG 8 SE were the Pleistocene Continental Deposits. The Continental Deposits can be informally divided into a lower unit (gravel facies) and an upper unit (clay facies). The following paragraphs describe the two distinct facies:

- **Lower Continental Deposits (LCD).** The LCD are found throughout the plant area and to the north but pinch out to the south, southeast, and southwest along the slope of the Porters Creek Terrace. The

LCD are dominantly valley-fill sequence consisting of chert gravel in a matrix of poorly sorted sand and silt that rests on an irregular, east-west trending erosional surface exhibiting steps or terraces. These alluvial terraces are former floodplains produced during glacial events. The LCD gravel deposit averages approximately 30 ft thick, but thicker deposits are found in deeper scour channels. The prominent fluvial gravel facies beneath PGDP is the lower part of the RGA flow system.

Only the top few feet of the LCD were encountered during the WAG 8 SE. The dominant lithology of the LCD at the WAG 8 sites is a poorly to moderately sorted, brownish-yellow, sandy, chert gravel that is the upper part of the RGA. The top of the RGA was encountered between 56 and 62 ft at SWMUs 84 and 85 and at the C-340 Building. The LCD was not penetrated by any of the borings installed at SWMU 83, where a "hard streak" was encountered that limited the deepest boring to only 38 ft, or at SWMU 82, where the deepest boring was terminated at 60 ft.

- **Upper Continental Deposits (UCD).** The UCD are primarily a fine-grained, clastic facies varying in thickness from 15 to 55 ft that consist of clayey silt with lenses of sand and occasional gravel. The UCD represent sediments deposited in a fluvial and lacustrine environment (Finch 1967, Frye et al. 1972). Widespread lacustrine sedimentation occurred along the present Ohio River and Tennessee River valleys when they became choked from draining glaciated areas, and when the sediment dammed valleys of tributaries, creating slackwater lakes that resulted in deposition of fine-grained sediments. Depending on stages of glaciation, periods of lacustrine deposition were followed by periods of erosion. As aggradation of the fluvial system continued, stream gradients in the ancestral Tennessee River and tributaries lessened. Lower gradients likely favored a transition from a braided environment to a meandering environment. A very gravelly lower sequence becoming sandier upwards identifies the transition in the subsurface.

  At the WAG 8 sites, the UCD is comprised of three zones. The uppermost zone consists dominately of silty clay to clayey silt to a depth of 15–20 ft. The middle zone consists of poorly sorted, dark yellowish-brown to yellow-brown silty sands and gravels that are interbedded with silts and clays. The middle zone differs from the upper zone by the presence of sand/gravel lenses and an increase in silt content. These coarser-grained sediments are prevalent between 20 and 40-ft bgs. The clay content of the UCD increases near the base so that the dominant lithology is a silty clay with only minor occurrences of lenticular sand and gravels. This silty clay unit acts as a semi-confining layer above the RGA. The contact between the middle and lower zones is generally gradational.

3.7 HYDROGEOLOGY

3.7.1 Surface Water

PGDP is located in the western portion of the Ohio River drainage basin. The plant is within the drainage areas of Bayou Creek and Little Bayou Creek and is situated on the divide between the two creeks (Fig. 3.10).

Bayou Creek is a perennial stream with drainage area of approximately 18.6 square miles that flows generally northward from approximately 2.5 miles south of the plant site to the Ohio River and extends along the western boundary of the plant. Little Bayou Creek, also a perennial stream, originates within WKWMA, flows northward to the Ohio River, and extends along the eastern boundary of the plant. The approximate drainage area of Little Bayou Creek is 8.5 square miles (CH2M Hill 1992). The confluence of the two creeks is approximately 3 miles north of the plant site, just upstream of the location at which the creeks discharge into the Ohio River. The drainage areas for both creeks are generally rural; however, they receive surface drainage from numerous swales that drain residential and commercial properties,

including WKWMA, PGDP, and the TVA Shawnee Steam Plant. A major portion of the flow in both creeks north of PGDP is effluent water from the plant, discharged through KPDES-permitted outfalls. Deer Lick, Snake Creek, and Slough Creek drain the northwestern portion of the PGDP boundary.

Discharge rate, specific conductivity, and temperature measurements were recorded at 74 main channel sites and 7 tributary sites of Bayou Creek and Little Bayou Creek August 15 and 16, 1989. Discharge for Bayou Creek during this time varied from 0.3 ft^3 per second (ft^3/s) at the farthest upstream site to 5.8 ft^3/s at the farthest downstream site. Tributary inflow along Bayou Creek was measured at 5.7 ft^3/s. Discharge for Little Bayou Creek varied from 0.7 ft^3/s at the farthest upstream site to 1.8 ft^3/s at the farthest downstream location. Total tributary inflow along Little Bayou Creek was 0.4 ft^3/s. Water temperature ranged between 20.0°C and 32.6°C. In Little Bayou Creek water temperature ranged between 14.5°C and 24.9°C. Both Bayou Creek and Little Bayou Creek appear to lose stream volume to shallow groundwater south of PGDP but gain stream volume from shallow groundwater north of the plant (CH2M Hill 1992).

U.S. Geological Survey maintains gauging stations on Bayou Creek 4.1 and 7.3 miles from the Ohio River and a station on Little Bayou Creek 2.2 miles upstream from its confluence with Bayou Creek. The mean monthly discharge at Bayou Creek varies from 6.53 to 60.7 ft^3/s at the downstream station and 6.53 to 60.7 ft^3/s at the upstream station. The mean monthly discharge on Little Bayou Creek ranges from 0.89 to 33.5 ft^3/s.

Man-made drainages receive storm water and effluent from PGDP. The plant monitors 17 outfalls, which have a combined average daily flow of approximately 4.9 million gallons per day (mgd) (Clausen et al. 1992a). Water flow in these ditches is intermittent based on seasonal rainfall. The plant ditches are generally considered to be located in areas where the local groundwater table is below the bottoms of the ditch channels. Therefore, the ditches probably function as influent (losing) streams most of the time, resulting in some discharge to the subsurface.

Surface water bodies in the vicinity of PGDP include the Ohio River, Metropolis Lake (located east of the Shawnee Steam Plant), and small ponds, clay and gravel pits, and settling basins scattered throughout the area. There is a marshy area just south of the confluence of Bayou Creek and Little Bayou Creek. The smaller surface water bodies are expected to have only localized effects on the regional groundwater flow pattern.

3.7.2 Groundwater

Local groundwater flow near PGDP occurs in the unconsolidated sediments of the Cretaceous McNairy Formation, Eocene Sands, Pliocene Terrace Gravel, Pleistocene LCD, and UCD. Terms used to describe the hydrogeologic flow systems which generally correspond to the lithostratigraphic units described above are the McNairy Flow System, Eocene Sands, Pliocene Terrace Gravel, RGA, and UCRS. Only components of the RGA and UCRS flow systems were encountered during the WAG 8 SE.

The RGA is a Pleistocene gravel deposit of the LCD overlying an erosional surface. The RGA is found throughout the plant area and to the north but pinches out to the south, southeast, and southwest along the slope of the Porters Creek Terrace. Regionally, RGA includes the Holocene-aged alluvium found adjacent to the Ohio River.

RGA is the dominant aquifer within the local flow system. Figure 3.11 shows the components of the flow system in the vicinity of PGDP (Davis et al. 1973). Toward the southern part of PGDP, RGA terminates against the Porters Creek Terrace. The restriction results in a high gradient and probably causes groundwater discharge to adjoining streams. In the north-central portion of the plant site, the

lower gradients are a result of the thickened Pleistocene sequence containing higher fractions of coarse sand and gravel. Northward, near the Ohio River, the hydraulic gradient increases as a result of either a thinner section of RGA or low-permeability bottom sediments in the Ohio River.

Regional groundwater flow within RGA trends north-northeast toward base level represented by the Ohio River. The hydraulic gradient varies spatially but is on the order of 1.0×10^{-4} to 1.0×10^{-3} ft/ft (Clausen et al. 1992a). Clausen et al. (1992a) reports hydraulic conductivities for RGA ranging from 1.0×10^{-4} to 1 cm/s. During the WAG 6 RI, values of hydraulic conductivity were measured from 1.8×10^{-7} to 9.4 cm/s (DOE 1998a). The range of eight orders of magnitude is due to depositional heterogeneities within the silt, sand, and gravel of the RGA.

On the west side of PGDP beneath WAG 8, sand constitutes up to 30 percent of the RGA. The sands are generally discontinuous, which impedes groundwater flow. The RGA is recharged by infiltration from UCRS and some underflow from the terrace gravels (DOE 2000b). At most locations within WAG 8, the first good water-bearing units were not encountered until the top of the porous RGA was drilled at a depth of approximately 55 to 60 ft bgs. No groundwater was encountered at the C-340 Building site.

The UCRS consists of clayey silt with lenses of sand and occasional gravel. At PGDP, the UCRS has been divided into three horizons that generally correspond to the UCD. At PGDP, a strong vertical gradient exists between UCRS and RGA, and a hydraulic head of as much as 30 ft has been documented. Therefore, groundwater generally flows downward from the UCRS into the RGA. As a result of the downward flow of water within the URCS, the term "recharge system" is often applied to the UCRS at PGDP.

When the HU2 layer is saturated, historical data show that hydraulic conductivity values range from 3.7×10^{-6} to 3.97×10^{-5} cm and storage coefficients range from 7.43×10^{-3} to 5.9×10^{-2} (DOE 1998a). As discussed previously, the lower clay unit of the HU3 serves as an aquitard. Regionally, the UCRS thickness ranges from 0 ft to 50 ft. In a study by Clausen et al. (1992b), UCRS hydraulic conductivity values ranged from 1×10^{-8} to 1×10^{-2} cm/s.

The UCRS permeable units are only seasonally saturated and may be considered perched groundwater aquifers. Although water-bearing zones that contained sufficient volume for sampling were not commonly encountered during the drilling of the WAG 8 borings, a few zones of perched groundwater as shallow as 30 to 35 ft bgs were collected from the UCRS at SWMUs 82 and 83.

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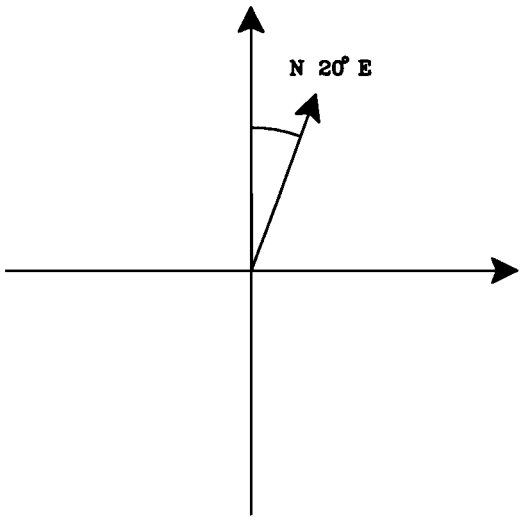
PARAMETER	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR AVG.
RESULT. SPEED (MPH)	1.2	2.7	1.9	3.0	3.8	2.0	0.9	0.6	0.6	1.3	0.7	1.4	1.0
RES. DIR. (TENS OF DEGS.)	27	27	32	23	20	22	34	35	06	26	07	25	25
MEAN SPEED (MPH)	9.8	9.3	8.9	9.6	7.7	5.4	4.9	3.8	4.5	6.0	7.5	7.9	7.1
PREVAIL. DIR. (TENS OF DEGS.)	20	20	32	20	20	20	21	03	23	20	02	21	20



PREVAILING WIND DIRECTION

Figure 3.1 Wind Speed and Direction
Monthly and Cumulative Averages for Barkley Field
Paducah, Kentucky

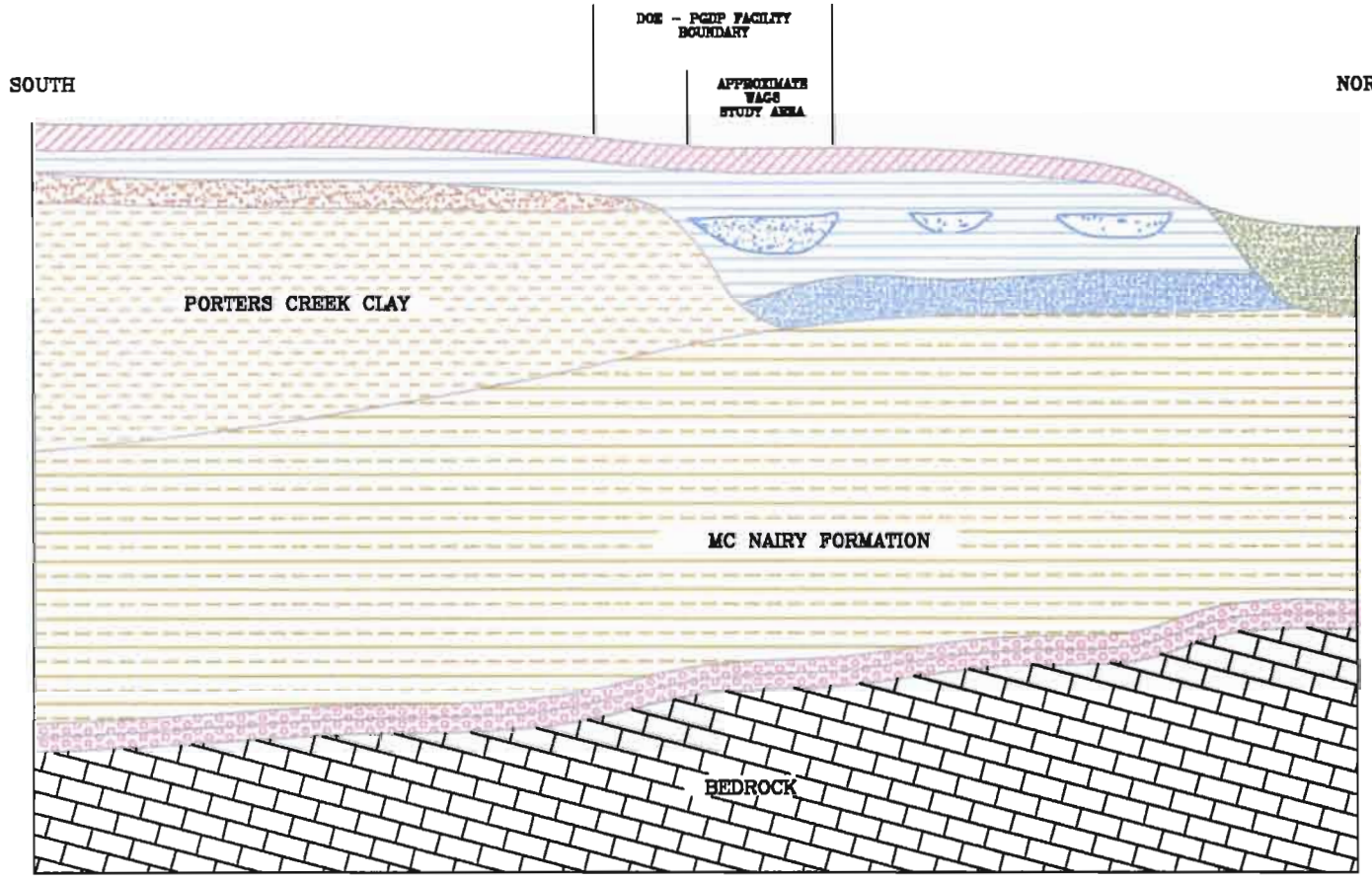


Figure 3.2 Generalized Geologic Cross Section
for the Paducah Gaseous Diffusion Plant

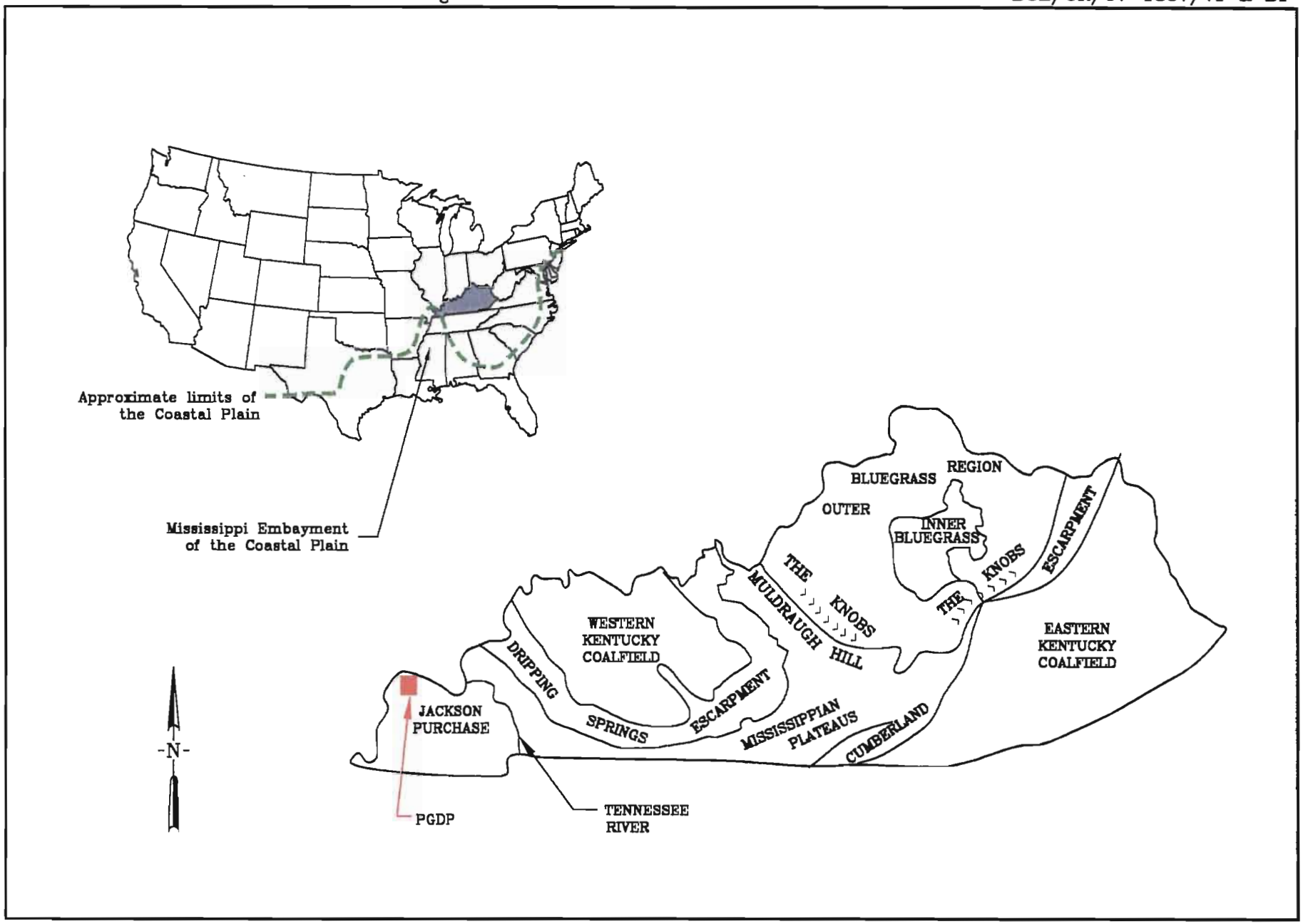
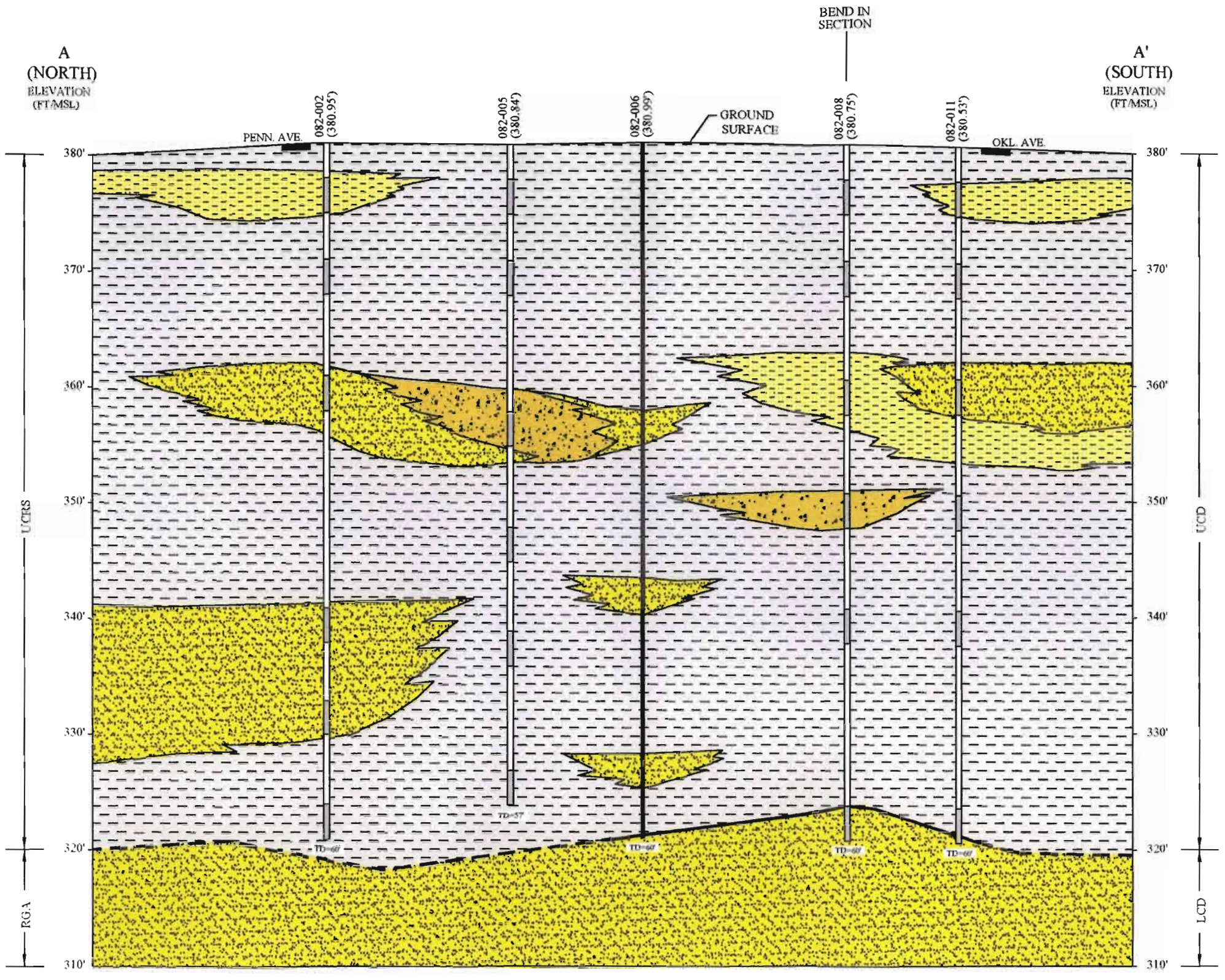
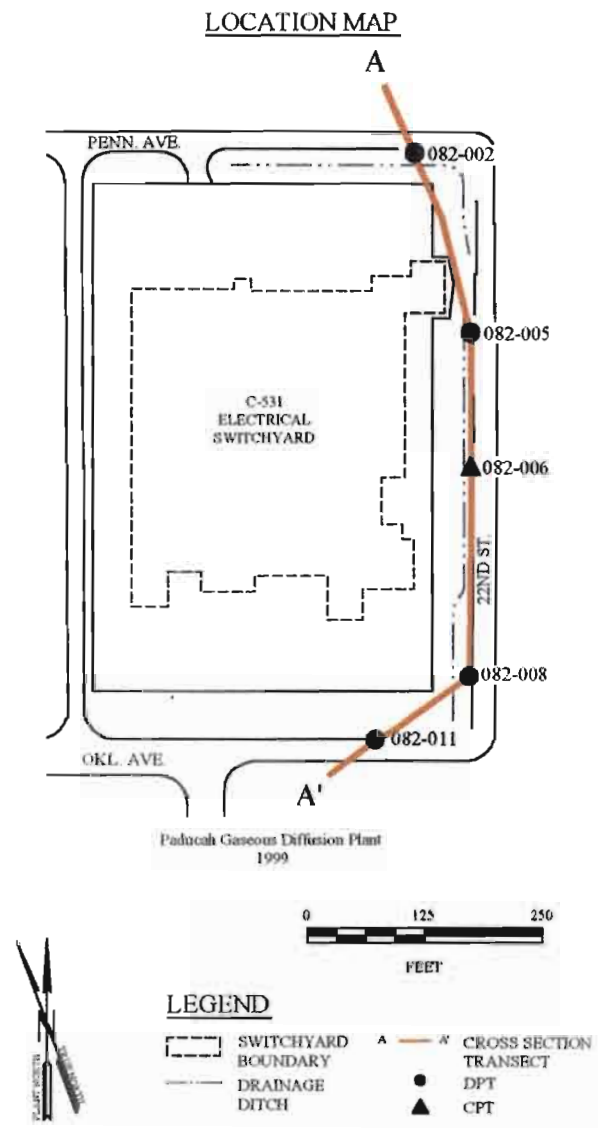


Figure 3.3 Physiographic Provinces for the Commonwealth of Kentucky

SYSTEM	SERIES	FORMATION	THICKNESS IN FEET	DESCRIPTION	HYDROGEOLOGIC SYSTEMS
Quaternary	Pleistocene and Recent	Alluvium	0 – 40	Brown or grey sand and silty clay or clayey silt with streaks of sand	Upper Continental Recharge System (UCRS)
	Pleistocene	Loess		Brown or yellowish-brown to tan to grey unstratified silty clay	
	Pleistocene	Continental Deposits	3 - 121	Upper Continental Deposits (Clay Facies) Orange to yellowish-brown to brown clayey silt, some very fine sand, trace of fine sand to gravel. Often micaceous.	
	Pliocene-Miocene (?)			Lower Continental Deposits (Gravel Facies) Reddish-brown silty and sandy gravel, silt and clay.	Regional Gravel Aquifer
Tertiary	Eocene	Eocene Sands (Undifferentiated)	0 - 100	Red brown, or white fine to coarse grained sand. Beds of white to dark grey clay are distributed at random.	McNairy Flow System
				White to grey sandy clay, clay conglomerate and boulders, scattered clay lenses and lenses of coarse red sand. Black to dark grey lignite clay, silt, or fine grained sand.	
	Paleocene	Porters Creek Clay	0 - 200	Dark grey, slightly to very micaceous clay. Fine grained clayey sand, commonly glauconitic in the upper part. Glauconitic sand and clay at the base. A gravel layer (Terrace Gravel) present atop the clay terrace, 2 – 8 feet thick.	
Cretaceous		Clayton and McNairy Formations	200 – 300	Greyish white to dark micaceous clay, often silty, interbedded with light grey to yellowish-brown very fine to medium grained sand. The upper part is mostly clay, the lower part is predominantly micaceous fine sand.	
		Tuscaloosa Formation	?	White, well rounded or broken chert gravel with clay.	
Mississippian		Mississippian Formation	500+	Dark grey limestone and interbedded chert, some shale.	

Figure 3.4 Lithostratigraphic column of the Jackson Purchase Region





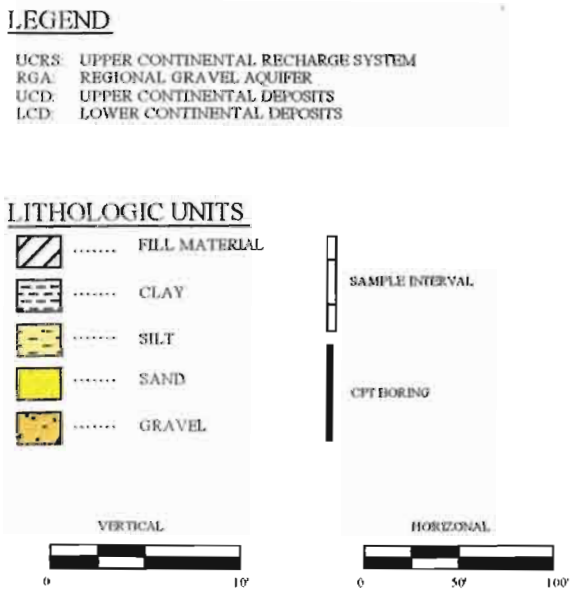
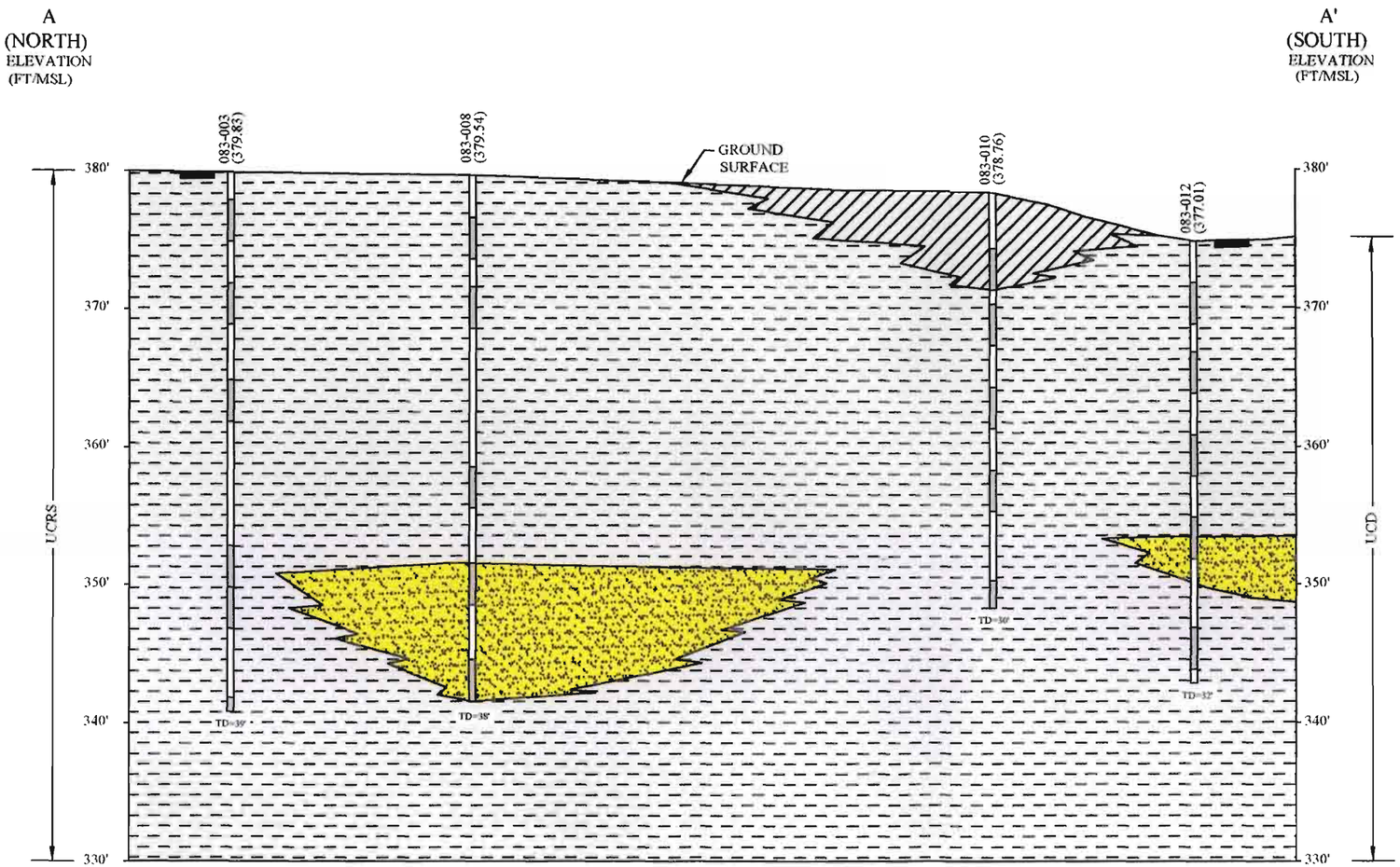
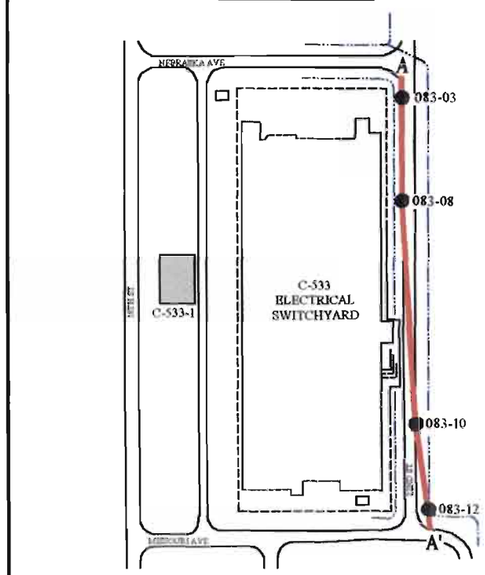


Figure 3.5 North - South Geologic Cross Section A - A' At SWMU 82





LEGEND

UCRS: UPPER CONTINENTAL RECHARGE SYSTEM
RGA: REGIONAL GRAVEL AQUIFER
UCD: UPPER CONTINENTAL DEPOSITS
LCD: LOWER CONTINENTAL DEPOSITS

LITHOLOGIC UNITS

FILL MATERIAL
CLAY
SILT
SAND
GRAVEL
SAMPLE INTERVAL

VERTICAL 0 10'
HORIZONAL 0 50' 100'

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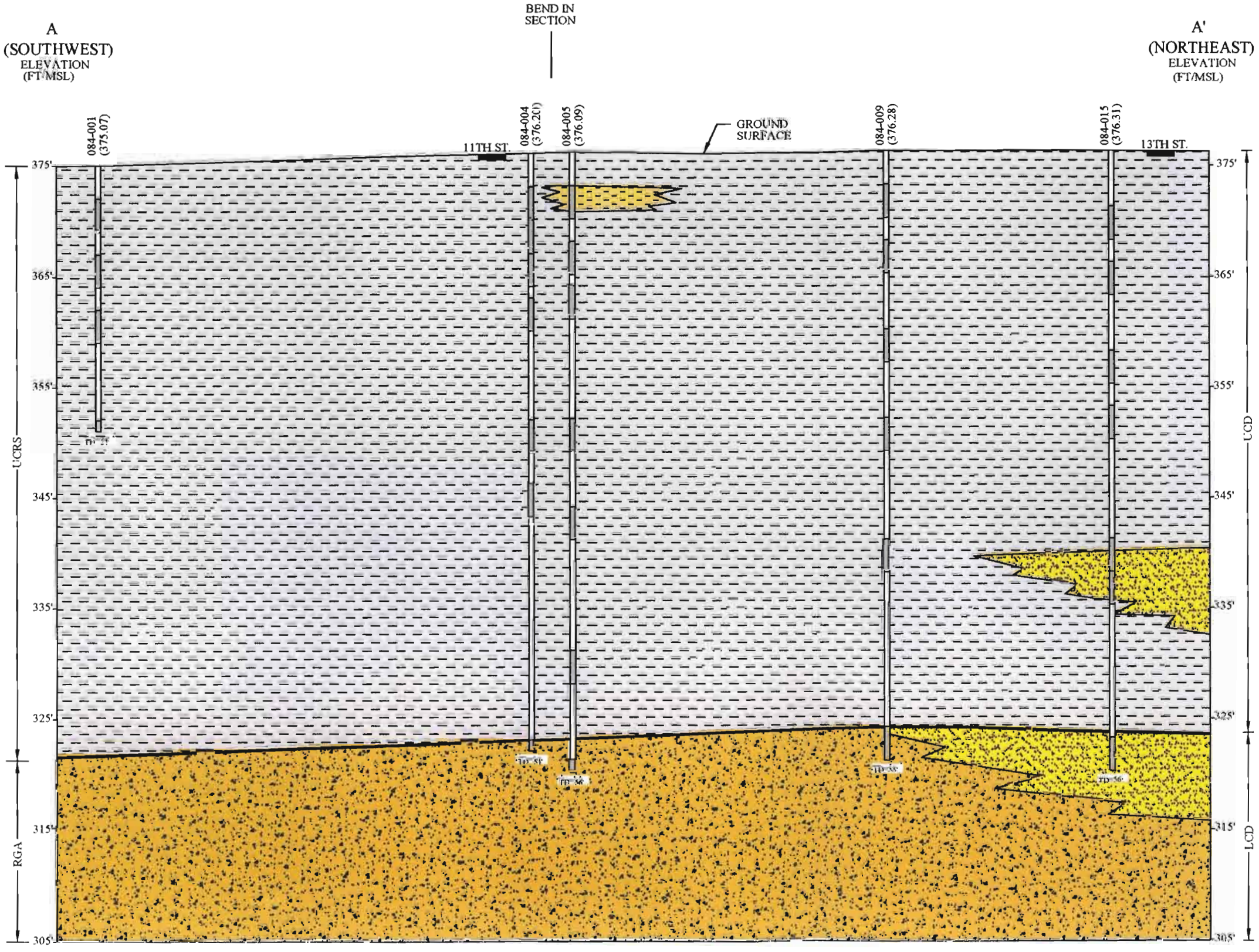
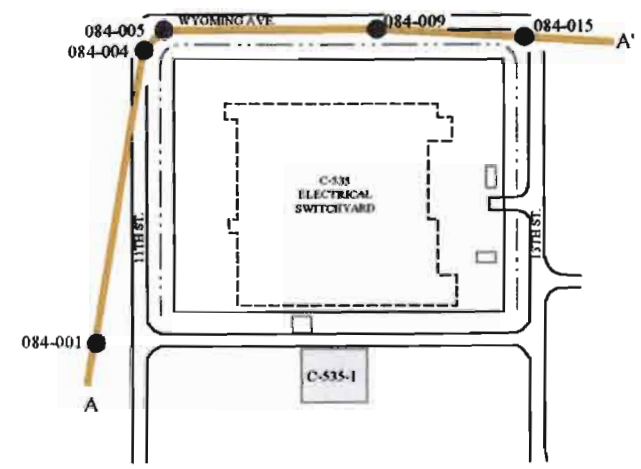
Figure 3.6 North - South Geologic Cross Section A - A' At SWMU 83.





LEGEND

UCRS.	UPPER CONTINENTAL RECHARGE SYSTEM
RGA:	REGIONAL GRAVEL AQUIFER
UCD:	UPPER CONTINENTAL DEPOSITS
LCD.	LOWER CONTINENTAL DEPOSITS

LITHOLOGIC UNITS

- FILL MATERIAL
- CLAY
- SILT
- SAND
- GRAVEL
- SAMPLE INTERVAL

VERTICAL
0 10'

HORIZONTAL
0 50' 100'

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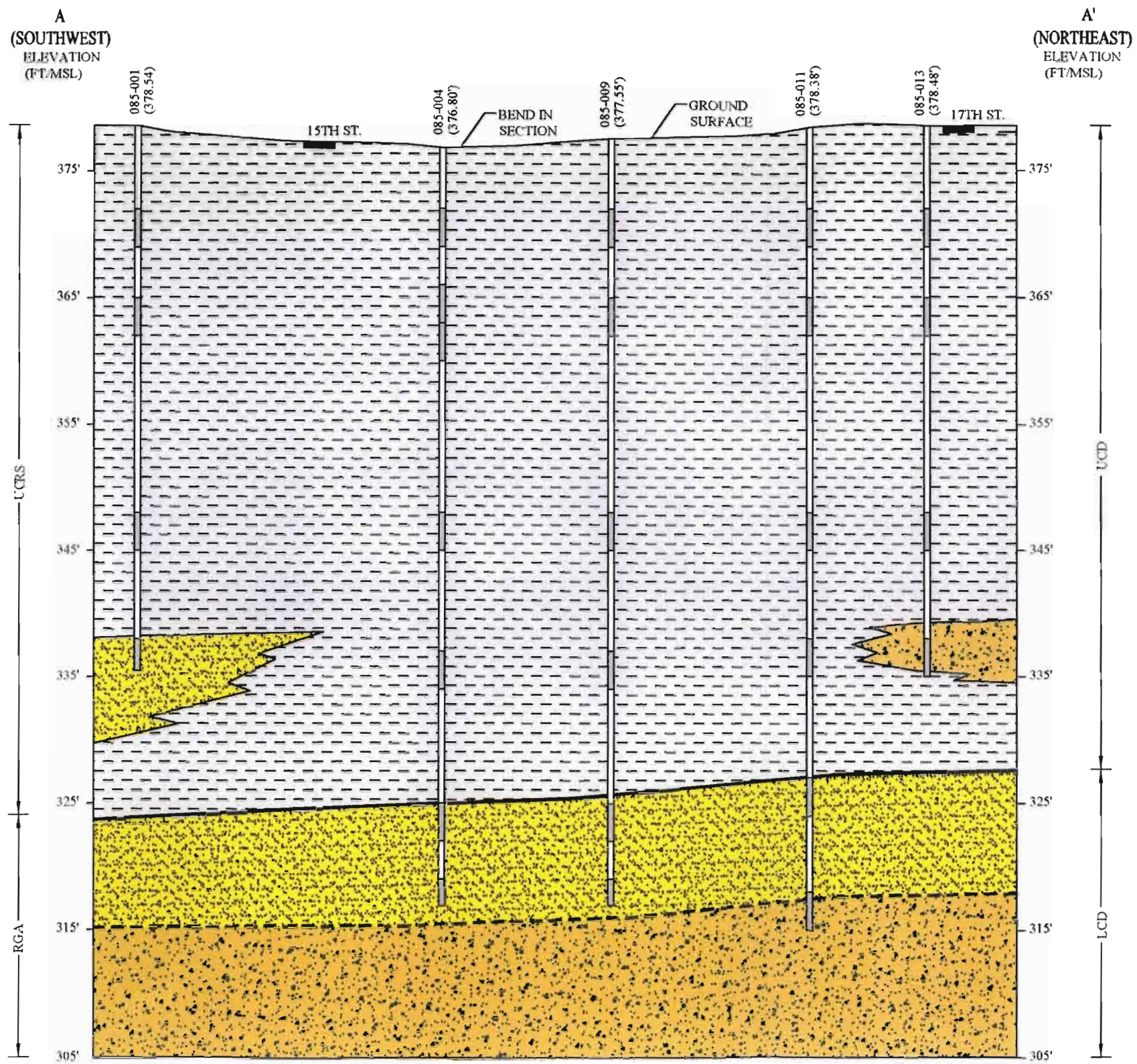
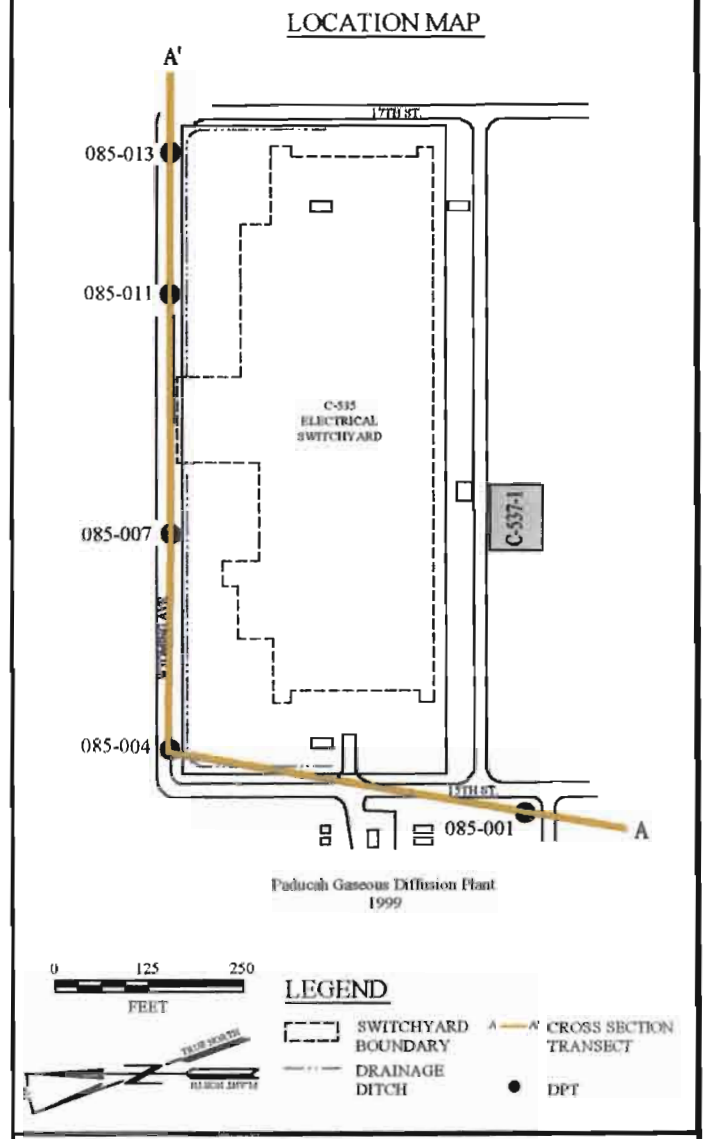
Figure 3.7 Southwest - Northeast Geologic Cross Section A - A' At SWMU 84.





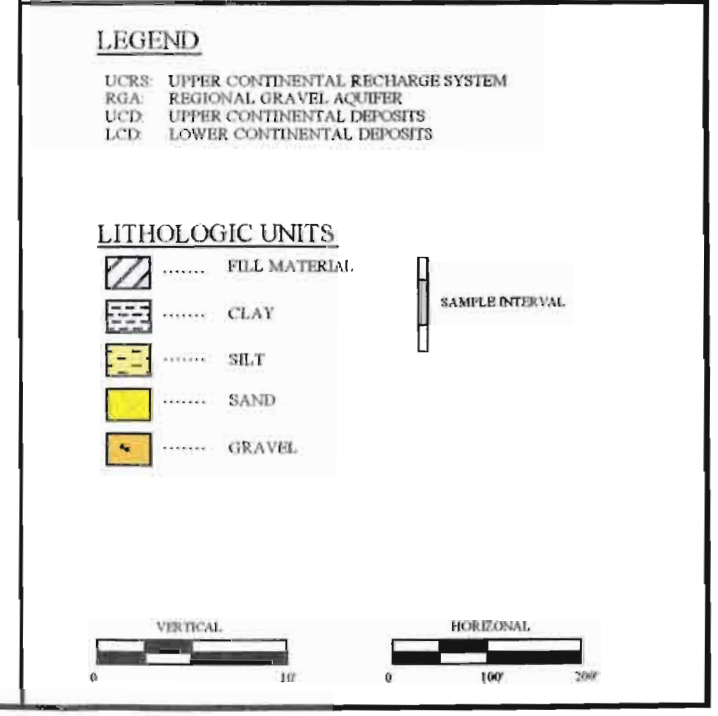


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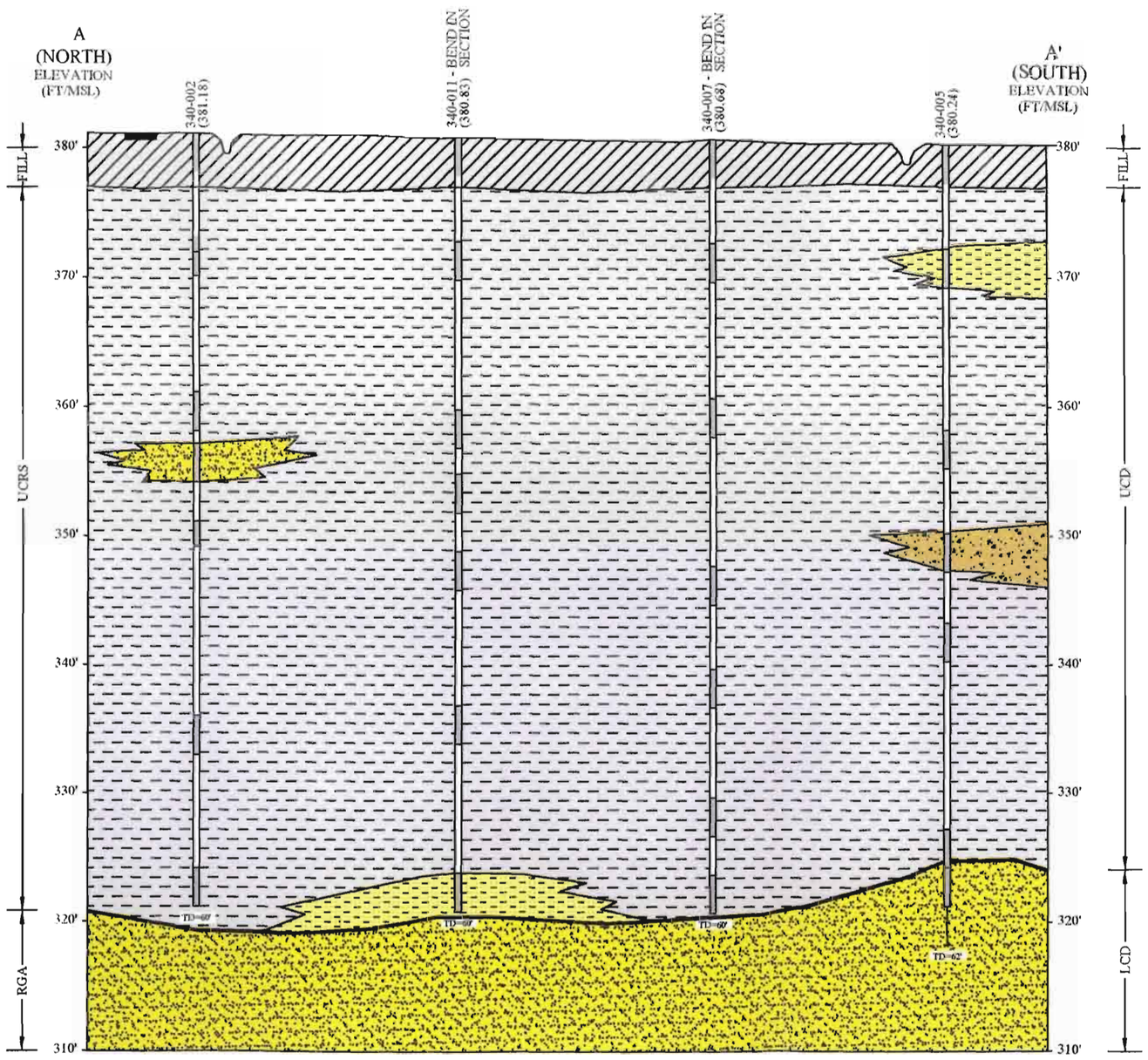
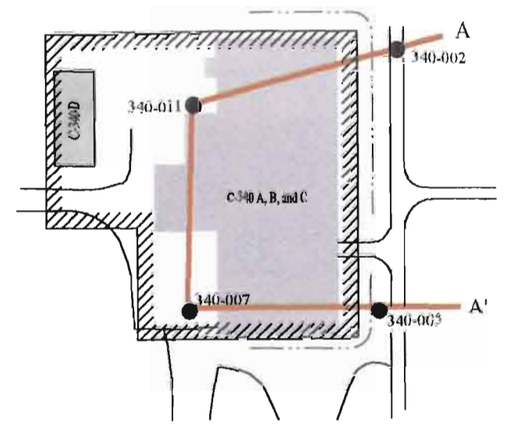
Figure 3.8 Southwest - Northeast Geologic Cross Section A - A' At SWMU 85

DOE/OR/07-1867/V1 & D1





LEGEND

UCRS: UPPER CONTINENTAL RECHARGE SYSTEM
RGA: REGIONAL GRAVEL AQUIFER
UCD: UPPER CONTINENTAL DEPOSITS
LCD: LOWER CONTINENTAL DEPOSITS

LITHOLOGIC UNITS

FILL MATERIAL
CLAY
SILT
SAND
GRAVEL
SAMPLE INTERVAL

VERTICAL
0 10'

HORIZONAL
0 50' 100'

AutoCAD Filename: 1999006-7300-B-0025.dwg

Figure 3.9 North - South Geologic Cross Section A - A' At C-340 Area

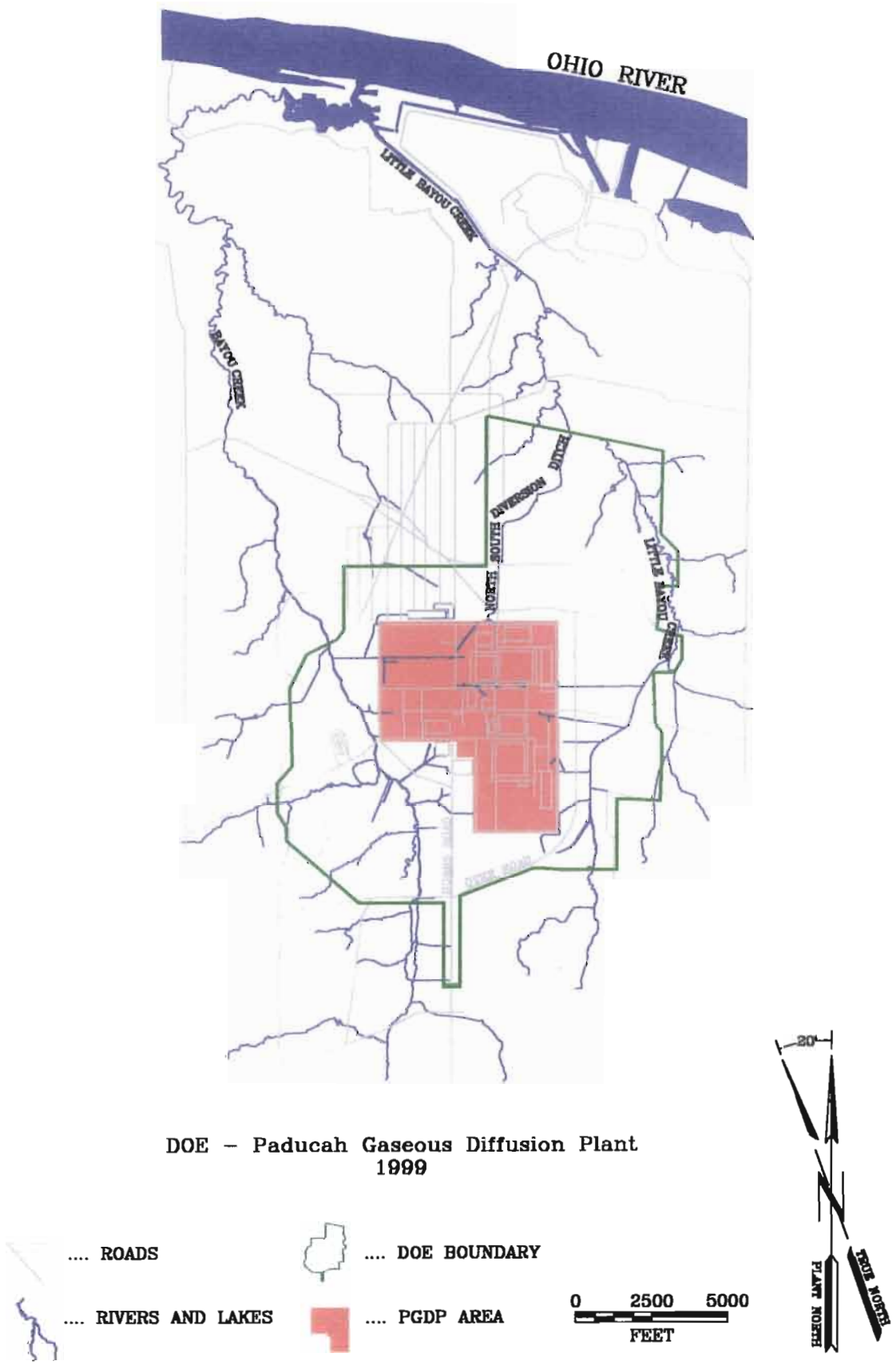


Figure 3.10 Regional Surface Water Drainage

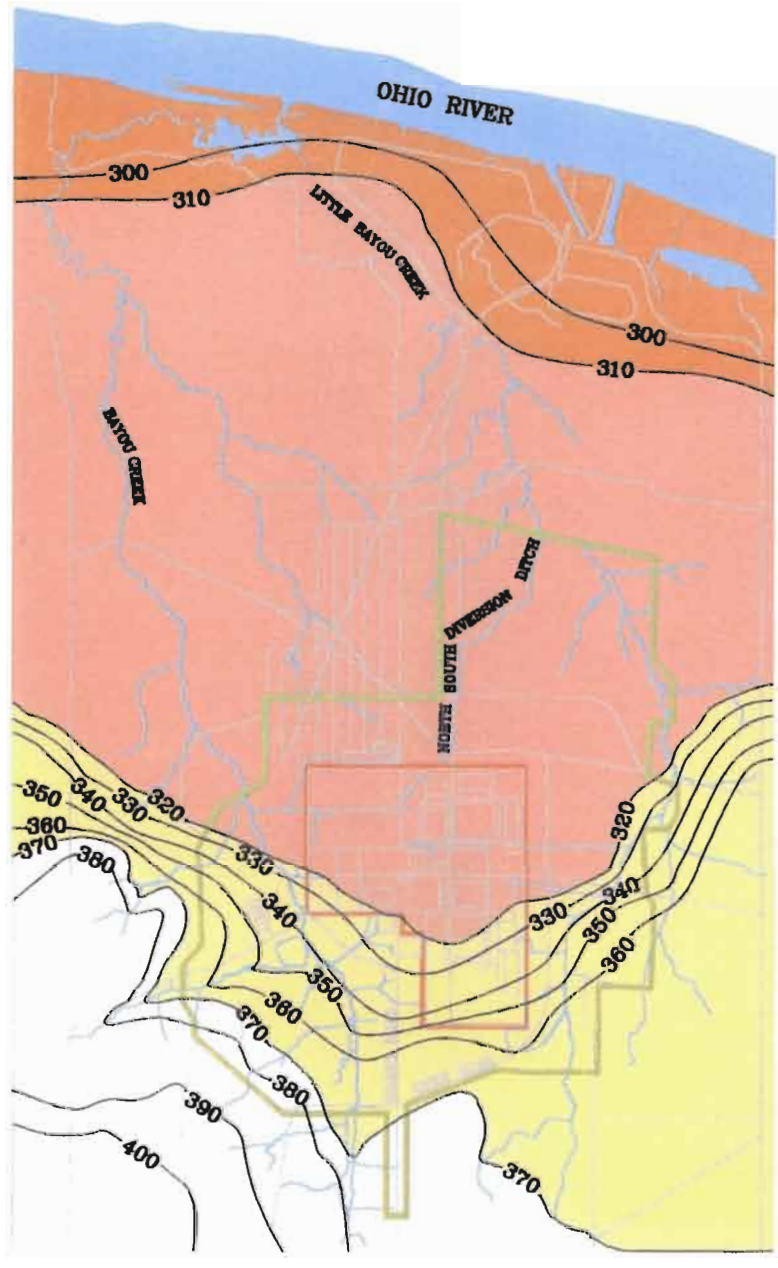


Figure 3.11 Geologic Components of the Regional Groundwater Flow System in the Vicinity of the Paducah Gaseous Diffusion Plant (PGDP)

Table 3.1. Thirteen-year average for precipitation and temperature, Barkley Regional Airport, Paducah, Kentucky

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Precipitation (inches)													
1984	1.21	4.74	5.83	8.45	6.50	1.58	5.44	3.96	6.80	5.88	4.75	9.99	**65.13**
1985	1.82	3.70	3.67	6.85	4.13	4.85	0.85	5.89	9.23	7.26	4.29	1.34	**53.88**
1986	1.44	3.73	3.16	1.55	8.51	1.50	7.07	4.33	3.69	4.45	3.59	3.11	**46.13**
1987	0.99	3.93	1.93	2.30	1.43	4.03	2.58	1.31	2.80	1.58	4.29	9.19	**36.36**
1988	3.50	5.15	4.60	2.13	3.14	0.41	3.08	1.05	3.49	3.81	9.56	3.05	**42.97**
1989	5.31	13.33	5.36	2.55	2.33	9.20	7.07	1.80	2.64	3.48	2.59	1.78	**57.44**
1990	5.38	9.05	3.69	4.76	7.49	2.14	4.03	1.34	2.38	4.45	2.33	9.59	**56.63**
1991	3.77	4.07	3.55	3.81	4.29	1.47	3.23	2.42	3.25	3.57	2.17	3.84	**39.44**
1992	2.13	2.68	3.38	2.07	2.08	3.57	6.90	3.47	5.81	3.51	3.45	1.79	**40.84**
1993	3.79	3.99	2.99	5.14	2.59	5.51	0.56	2.89	6.00	3.82	6.45	3.57	**47.30**
1994	4.06	2.70	3.55	7.39	0.71	2.34	2.40	1.73	3.43	2.93	3.55	3.72	**38.51**
1995	4.20	3.26	1.78	4.34	5.68	4.19	3.28	3.52	1.47	2.30	2.72	1.89	**38.63**
1996	3.38	1.09	3.25	4.62	5.22	7.81	6.11	0.11	7.26	4.13	8.89	4.90	**56.77**
POR= 13 years	3.15	4.72	3.60	4.30	4.16	3.74	3.98	2.59	4.44	3.92	4.47	4.44	**47.51**
Average Temperature (°F)													
1984	29.2	42.1	43.6	56.7	64.6	78.6	76.7	76.9	68.5	63.1	45.0	45.2	**57.5**
1985	23.9	32.0	51.3	60.9	66.8	73.3	78.4	74.8	68.8	62.4	52.5	31.3	**56.4**
1986	35.5	40.3	49.7	60.6	68.7	77.4	81.7	73.8	73.8	60.1	45.1	36.9	**58.6**
1987	33.5	40.9	50.2	57.4	73.0	78.2	79.5	79.8	71.6	53.4	50.9	41.1	**59.1**
1988	32.2	35.1	47.5	57.4	67.3	75.8	80.4	80.9	70.8	52.8	48.4	38.2	**57.2**
1989	41.4	32.8	48.1	57.3	64.6	73.6	78.3	77.7	69.3	59.9	48.6	27.1	**56.6**
1990	43.8	45.7	51.5	55.9	63.9	76.4	78.8	75.9	72.1	56.8	53.5	39.9	**59.5**

Table 3.1. (Continued)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1991	34.2	41.9	51.4	62.3	72.5	78.0	80.9	78.4	71.1	61.1	45.4	41.9	**59.9**
1992	38.1	45.6	49.7	59.2	66.0	73.6	79.7	74.0	69.0	58.5	48.2	38.7	**58.4**
1993	38.3	36.9	46.6	55.9	67.3	76.5	84.3	78.7	67.3	56.1	45.6	38.5	**57.7**
1994	29.1	39.6	47.6	60.4	64.1	78.2	78.1	75.0	67.5	59.8	52.4	42.5	**57.9**
1995	37.0	37.5	51.4	59.7	67.5	75.3	79.5	80.8	66.9	58.9	42.0	36.6	**57.8**
1996	32.7	37.9	41.0	53.9	69.7	75.3	75.9	76.6	67.8	58.3	43.0	40.2	**56.0**
POR= 13 years	34.5	39.2	48.6	58.2	67.5	76.2	79.5	77.1	69.7	58.5	47.8	38.3	**57.9**

4. ANALYTICAL RESULTS AND DISCUSSION

4.1 INTRODUCTION

Environmental data from the five sites investigated during the WAG 8 SE field activities have been compiled, screened, and evaluated to confirm or deny the presence of contaminants. Frequency of detection (FOD) and summary tables containing all analytes detected above screening levels are presented at the end of the section for each SWMU. Tables that contain a complete list by sample identification number of all samples analyzed during the WAG 8 SE and that provide information on which analytical groups (VOAs, SVOAs, PCBs, dioxins/furans, metals, and/or radionuclides) were tested for in each sample are referenced in the text and contained at the end of Sect. 4. A complete report of all analytical results for the samples collected during this investigation is provided in Appendix C.

The contamination discussed in this report is based on the presence of site-related contaminants in surface or subsurface soils and groundwater. For each SWMU or area investigated the data are reported in the following format:

- a description of contaminant impact on soil to approximately 60 ft bgs (typically the unsaturated zone, or approximately to the base of the UCD) at each of the five sites,
- a description of contaminant impact on shallow groundwater, and
- a summary of findings for each site.

4.1.1 Screening Process

The data screening process used in this SE was critical for determining when analytes represented site-related contaminants as opposed to constituents that occur naturally in the soil or groundwater. The screening process is described in the following paragraphs.

The results in the WAG 8 database were screened in a multiphase process. First, data collected during this SE were screened to eliminate those sample results that did not contain any detectable concentration/activities as determined by the analytical laboratory, data validations, or data assessment team. Data that passed the initial screening were then compared with historical data representative of naturally occurring conditions and concentrations in the surface and subsurface soil at PGDP (i.e., background data). Background values for metals and radionuclides in surface and subsurface soil were compiled from DOE (1997). Revised groundwater background data are currently being collected as part of the ongoing Groundwater OU study and were not available for this report.

Certain analytes have MDLs greater than background concentrations (e.g., cesium-137, selenium, silver, technetium-99, and mercury). For most analytes the difference is nominal and does not impact the screening process. For others, however, the MDL can be significantly higher than the estimated background concentration (e.g., antimony, cadmium, thorium, and uranium-235). Analytes in the latter group were further evaluated during the screening risk assessment, which was conducted as part of the WAG 8 SE (see Sect. 5).

Analyses of two inorganic analytes, lithium and total strontium (i.e., not radioisotopes of strontium), were obtained during the WAG 8 SE for some soil samples collected from SWMU 83 and from the C-340 Building area. These metals were not identified as COPCs and were not part of the Contract Laboratory Program Target Analyte List (TAL) proposed in the WAG 8 Work Plan. However, the analyses were

supplied when the laboratory scope of work specified SW-846 methods. Screening of lithium and strontium is problematic because no site-specific background data are available for these constituents. Therefore, lithium and strontium have not been included in the analytical results and discussion section for the WAG 8 sites. A review of these analytical results is included in Appendix F. For completeness, however, these analyses have been incorporated in the screening risk evaluation (Sect. 5) of the WAG 8 SE.

Tables 4.1 and 4.2 contain the background data for PGDP used to screen WAG 8 data. Because most organics such as VOAs, SVOAs, and PCBs are considered man-made, background levels for these compounds were set at zero. The analytical summary tables contain all VOAs, SVOAs, PCBs, metals, dioxins/furans, and radionuclide results that were detected at WAG 8 *above background screening levels.* Where an environmental sample result and a duplicate result were available for the same sample, all detections that exceed background levels were included in these summary tables. All compounds/analytes or radionuclides that passed the background screening (i.e., exceeded background levels) were considered to be site-related contaminants.

4.1.2 WAG 8 Soils and Groundwater

To check for the presence of contaminants at each of the five WAG 8 sites, samples of surface and subsurface soils, storm water runoff, and groundwater were collected and analyzed for suites of constituents in six groups: VOAs, SVOAs, PCBs, dioxins/furans, metals, and radionuclides. Table 4.3 summarizes the analytical groups tested by medium and shows which groups of analytes were detected at each of the SWMUs. Surface soils were not tested for VOAs, and dioxins/furans analyses were run on a minimum of 10 percent of the soil samples where PCBs were detected in the screening samples. Metals were not analyzed in surface soils, storm water, or groundwater samples. Due to a lack of water, neither storm water nor groundwater samples were collected at the C-340 Building. The five areas investigated were considered to be potential sources for PCBs and TCE. However, PCBs were found only in the surface soil at SWMUs 82, 84, and 85 and at the C-340 Building. TCE was detected only in the groundwater at SWMUs 82 and 85. Only those analytical groups that were tested and detected at levels above background are referenced in the SWMU-specific discussions (Sects. 4.1.4 through 4.1.8).

The text in this section focuses on describing the analytical results obtained from these samples and generally includes the following information:

- number of locations within each site from which samples were collected,
- depth range from which samples were collected,
- number and nature of individual constituents of each chemical group that were encountered, and
- description of analytical results.

An accompanying base map depicting soil sampling locations, facility structures, transportation pathways (e.g., roads), and topographic features (i.e., ditch locations) is provided for each SWMU for reference.

One of the objectives of the WAG 8 SE is to assess whether any of the WAG 8 sites are sources contributing to the Northeast Plume. The Northeast Plume is a groundwater plume of VOAs (notably TCE) that extends several miles off site to the north of PGDP (Fig. 1.4). To achieve this objective, groundwater samples were collected from between 35 ft and 62 ft at four of the WAG 8 sites. Due to slow recharge rates, no groundwater was collected at the C-340 Building. The water samples collected during the WAG 8 SE were analyzed for VOAs, SVOAs, PCBs, and radionuclides.

For each SWMU, a "Summary of Findings" statement provides a synopsis of the analytical results, including interpretations. The area or areas of concern at each site, the constituents involved, and the probable source or sources are described.

4.1.3 Data Tables and Figures

Tables and figures have been used extensively in this section to augment and clarify the discussion of the contaminants detected at each of the SWMUs (or areas) investigated during the WAG 8 SE. These tables and figures can be found at the end of this section following the text. For each SWMU discussion, the following tables have been prepared:

- **Analytical Groups Tested by Project Sample Identification**. This table lists all the samples, exclusive of duplicate and split samples, collected at each site. Samples are grouped by medium (surface soils, subsurface soils, storm water, and groundwater), and the analytical test performed on each sample is noted.

- **Frequency of Detection**. A FOD table has been prepared for each medium sampled at each of the WAG 8 sites. Most sites have four associated FOD tables. The FOD tables show how many samples were tested for a specific analyte, how often the constituent was detected at concentrations above background levels, and the maximum concentration reported for each constituent. If none of the constituents of a specific analyte group were detected, the FOD table presents how many samples were tested for that analytical group.

- **Detection of Analytes**. Following each FOD table is a Detection of Analytes table, which shows every analyte/compound/radionuclide that was detected above background levels in a particular medium at a particular site. The Detection of Analytes tables are organized by constituent and sorted by depth and project sample ID.

The following chart summarizes the tables that contain "frequency of detection" and "detection of analyte" information for each of the WAG 8 sites.

Frequency of Detection Tables:

WAG 8 Site	Surface Soil	Subsurface Soil	Storm Water	Groundwater
SWMU 82	Table 4.5	Table 4.7	Table 4.9	Table 4.11
SWMU 83	Table 4.14	Table 4.16	Table 4.18	Table 4.20
SWMU 84	Table 4.23	Table 4.25	Table 4.27	Table 4.29
SWMU 85	Table 4.32	Table 4.34	Table 4.36	Table 4.38
C-340 Reduction and Metals Facility	Table 4.41	Table 4.43	No table needed	No table needed

Detection of Analytes Tables:

WAG 8 Site				
SWMU 82	Table 4.6	Table 4.8	Table 4.10	Table 4.12
SWMU 83	Table 4.15	Table 4.17	Table 4.19	Table 4.21
SWMU 84	Table 4.24	Table 4.26	Table 4.28	Table 4.30
SWMU 85	Table 4.33	Table 4.35	Table 4.37	Table 4.39
C-340 Reduction and Metals Facility	Table 4.42	Table 4.44	No table needed	No table needed

To aid in the evaluation of radiological detections, laboratory radiological error values for all radionuclide detections above background levels are presented in Table 4.45. Radiological error has been used in the WAG 8 SE to evaluate the significance of reported radiological activities.

Figures have been prepared to show the sampling locations at each WAG 8 site. Additionally, site-specific figures are presented to augment the contaminant distribution discussion for those areas in which multiple widespread contaminants were found.

4.1.4 SWMU 82

4.1.4.1 Soil samples

Three surface soil samples were collected from the eastern side of the C-531 Electrical Switchyard in the ditch that parallels 22nd Street (Fig. 4.1). Each of the surface soil samples was analyzed for SVOAs, PCBs, and radionuclides. Dioxin/furans analyses were performed on two of the samples (082009SA001 and 082012SA001). Twenty-four subsurface samples were collected at SWMU 82 from four DPT borings installed along the eastern side of the SWMU, parallel to 22nd Street. The samples were collected between 1 ft and 60 ft bgs. All the samples were analyzed for VOAs and radionuclides; 20 samples were tested for SVOAs and 7 samples for PCBs (Table 4.4). Because metals contaminants are not known to be associated with normal electrical switchyard operations, no metals analyses were performed on the surface or subsurface samples from SWMU 82.

Surface soil analytical results

SVOAs. Sixteen SVOAs were present in the surface soil samples analyzed from SWMU 82 (Table 4.5). Fourteen of the 16 SVOAs compounds were polycyclic aromatic hydrocarbons (PAHs). The maximum detected concentration for any single SVOA compound was 5000 µg/kg for benzo(b)fluoranthene. Both the total number of SVOAs present in each soil sample and the total concentration of SVOAs (Fig. 4.2) for each sample increases from north to south across the SWMU.

PCBs. PCB-1260 was detected in two of three samples analyzed and was the only PCB detected at the site. The maximum concentration of PCB-1260 was 1183 µg/kg. The concentration of PCB-1260 was found to increase from north to south across the site (Fig. 4.2).

Dioxin/furans. Fifteen dioxin/furan compounds were reported at detectable levels from the two surface soil samples (082009SA001 and 082012SA001) that were analyzed for the compounds. Octachloro-dibenzo(b,e)(1,4)dioxin (OCDD) at 25.3 µg/kg was the compound reported at the highest concentration (Table 4.6). The total concentration of dioxins/furans and the highest individual detections for most compounds within the surface soils was found to increase from north to south across the site (Fig. 4.2).

Radionuclides. Uranium-234, uranium-238 and thorium-234 were detected in both of the surface soil samples (082009SA001 and 082012SA001) for which these radionuclides were analyzed. The highest activity for each radionuclide was from sample 082012SA001.

Subsurface soil analytical results

SVOAs. Bis(2-ethylhexyl)phthalate was present in one sample (5 percent of the analyses) at a concentration of 540 µg/kg, only slightly above the detection limit of 500 µg/kg (Table 4.7). Di-n-butyl phthalate was present in 3 of 20 subsurface soil samples at a maximum concentration 1600 µg/kg (Table 4.8). No other SVOAs were detected.

4.1.4.2 Water samples

Three storm water run-off samples were collected from the drain system at SWMU 82 (Fig. 4.1). Each of the storm water samples was analyzed for VOAs, SVOAs, and PCBs (Table 4.4). Radionuclide analyses were performed on two of the samples (082004WA000 and 082007WA000).

One UCRS groundwater sample was collected from location 082-008 near the southeast corner of the SWMU boundary, between 35 ft and 40 ft bgs. This sample was analyzed for VOAs and radionuclides. Per the WAG 8 Work Plan, neither the storm water nor the UCRS groundwater samples was analyzed for metals content.

Storm water analytical results

SVOAs. Three phthalates were each detected once in the storm water samples at concentrations that were below or only slightly above the 10 μg/L MDL (Table 4.9). Bis(2-ethylhexy)phthalate at 11 μg/L was the highest reported concentration for any of the phthalates (Table 4.10).

Radionuclides. Technetium-99 was present in sample 082007WA000 at a measured activity of 23.4 (±9.1) pCi/L. No other radionuclides were reported from the storm water samples.

Groundwater analytical results

VOAs. TCE at a concentration of 19 μg/L and *cis*-1,2-dichloroethene at a concentration of 0.2 μg/L were the only VOAs reported from the single UCRS water sample collected from SWMU 82 (Tables 4.11 and 4.12).

Radionuclides. Technetium-99 was present in sample 082008WA043 at a measured activity of 45 (±9.6) pCi/L.

4.1.4.3 Summary of findings

Limited sampling during the Phase I and Phase II SIs reported the presence of PCB-1260 and OCDD (a dioxin/furan compound) from the drainage ditch soil surrounding SWMU 82. The WAG 8 sampling of the surface soils at SWMU 82 has confirmed the presence of these contaminants at the site.

Water samples collected from the drainpipes that direct runoff from SWMU 82 indicate that only a small quantity of technetium-99 [23.4 (±9.1) pCi/L] is currently being transported by storm water flow at the site. Technetium-99 is not a process-related contaminant at the electrical switchyards, and low levels of technetium-99 are known to be ubiquitous to PGDP.

Surface soil samples collected in the drainage ditches into which the storm water empties contained concentrations of several SVOAs, radionuclides, PCBs, and dioxin/furans. Detections of PCBs at a maximum concentration of 1183 μg/kg and dioxin/furans at a maximum concentration of 25.3 μg/kg may represent residual contaminants from historical leaks and spills that occurred at SWMU 82. However, low levels of SVOAs are known to be ubiquitous to PGDP, and radionuclides are not process-derived from electrical switchyards. The detected SVOAs and radionuclides found in the ditch at SWMU 82 are interpreted to have been introduced by over-land sheet flow, storm drain overflows during extreme rainfall events, or by aerial deposition. In general, both the concentration and number of contaminants within each of the analytical groups detected in the surface soil at WAG 82 were found to increase from north to south, reaching maximums at a location directly across the street from the C-340 Building. High concentrations of all analytical groups were detected at the C-340 Building during the WAG 8 SE. This

observation supports the conclusions that contaminants have been introduced into the ditches at SWMU 82 from outside sources.

No site-derived contaminants were detected in the subsurface soil at SWMU 82, and only low levels of technetium-99 [maximum activity of 45 (±9.6) pCi/L] and TCE (maximum concentration of 19 μg/L) were found in a UCRS water sample. The technetium-99 and TCE in the groundwater are attributable to PGDP site-wide historical activities and are not related to SWMU 82 processes. The lack of site-derived contaminants in the subsurface soil of SWMU 82 indicates that leaching of contaminants from the soil to groundwater is not a significant contaminant migration pathway.

4.1.5 SWMU 83

4.1.5.1 Soil samples

Three surface soil samples were collected at SWMU 83 from the eastern side of the C-533 Electrical Switchyard. The samples were collected from the shallow ditch that parallels 22nd Street between Missouri and Nebraska avenues (Fig. 4.3). The samples were analyzed for SVOAs, PCBs, and radionuclides. Subsurface soil samples were collected from four DPT borings on the eastern side of the SWMU adjacent to 22nd Street. Twenty-one subsurface soil samples were collected between 1 ft and 39 ft bgs. All 21 of these samples were analyzed for the presence of VOAs. Nineteen samples were analyzed for the presence of SVOAs, 10 samples were tested for the presence of PCBs, and 15 samples were tested for the presence of metals and radionuclides.

Surface soil analytical results

SVOAs. Eight PAH compounds (Table 4.14) were detected in sample 083002SA001, which was collected from location 083-002 on the northeast side of the SWMU boundary. The maximum concentration for any of the compounds was 850 μg/kg for benzo(b)fluoranthene. The surface soil sample collected at location 083-009 had a single SVOA detection of this same compound at a concentration below the MDL (Table 4.15). The surface soil sample collected from location 082-006 on the eastern side of the SWMU had no detected SVOAs.

Subsurface soil analytical results

Metals. Six metals were detected at concentrations above background levels in subsurface soils from SWMU 83 (Table 4.16). The three common rock-forming minerals aluminum, iron, and magnesium were detected in 3 of 15, 1 of 15, and 1 of 15 analyses, respectively. The maximum concentration for each metal was only slightly above background levels. Beryllium, nickel, and vanadium each were reported at concentrations only slightly above background in 2 of 15 analyses. Most of the metals that were detected above screening levels were reported from two subsurface soil samples collected at location 083-012 between 3 to 6 and 28 to 31 ft bgs (Table 4.17).

Radionuclides. Radionuclides were not detected at activities above background levels in any of the 15 subsurface soil samples collected from SWMU 83.

4.1.5.2 Water samples

Three storm water samples collected from the drain system at SWMU 83 and one UCRS water sample collected from between 30 ft to 33 ft bgs from location 083-003 (Fig. 4.3) were analyzed for the presence of contaminant groups at SWMU 83. All three storm water samples were analyzed for the presence of VOAs SVOAs, and PCBs (Table 4.13). Two of the samples, 083004WA000, and

083007WA000, were analyzed for radionuclide activity. The UCRS water sample was tested for the presence of VOAs, SVOAs, and radionuclides.

Storm water analytical results

SVOAs. Two of the three storm water samples, 083004WA000 and 083007WA000, contained phthalates at concentrations that are below or slightly above detection limits (Table 4.18).

Radionuclides. Technetium-99 was the only radionuclide detected in the storm water samples and was present in both samples for which radionuclide analyses were performed (Table 4.19). The maximum activity of technetium-99 was 17.4 (±8.9) pCi/L, which only slightly exceeds the 14 pCi/L detection limit.

Groundwater analytical results

Radionuclides. Technetium-99 at an activity of 25.9 (±8.3) pCi/L was the only radionuclide detected in the UCRS water sample at SWMU 83 (Tables 4.20 and 4.21).

4.1.5.3 Summary of findings

Limited sampling of the surface soil and shallow subsurface soil to 15 ft bgs around the perimeter of SWMU 83 during the Phase I and Phase II SIs reported isolated occurrences of VOAs and PCBs. WAG 8 sampling conducted in these same areas at SWMU 83 did not confirm the presence of either VOAs or PCBs in the surface or subsurface soils samples.

Samples collected from the drainpipes that direct runoff from SWMU 83 indicate that only a small quantity of technetium-99 (slightly above MDL) is currently being transported by the storm water flow. Technetium-99 is not a process-related contaminant at the electrical switchyards, and low levels of technetium-99 are known to be ubiquitous to PGDP.

Surface soil samples collected in the drainage ditches into which the storm water empties contained low concentrations of several SVOAs. The highest concentration for any single SVOA detected at SWMU 83 was only slightly above MDL. Low levels of SVOAs are known to be ubiquitous to PGDP, and it is probable that these contaminants are unrelated to SWMU 83. The SVOAs may have been introduced into the ditch with over-land sheet flow, from overflowing storm drains caused by extreme rainfall events, or by aerial deposition. The SVOA content of the surface soil at SWMU 83 is greatest in the sampling location closest to the C-340 Building. It is possible that the source for these contaminants is located at that facility, where some of the highest SVOA concentrations during the WAG 8 SE were detected.

Several metals were detected in the subsurface at concentrations that exceeded background levels. However, the metals are present at concentrations that are only slightly above background levels and are, therefore, considered within the range of expected variability for naturally occurring soil.

Low levels of technetium-99 [maximum activity of 25.9 (±8.3) pCi/L] that were found in UCRS water samples are attributable to PGDP site-wide historical activities and are not related to SWMU 83 processes.

4.1.6 SWMU 84

4.1.6.1 Soil samples

Six surface soil samples were collected from the shallow ditches that border the north side of SWMU 84 (Fig. 4.4). All of these samples were analyzed SVOAs, PCBs, and radionuclides (Table 4.22). Two of the samples (084010SA001 and 084014SA001) were tested for dioxin/furans. Subsurface soil samples were collected at depths of 1 to 56 ft bgs from five DPT borings at SWMU 84. Four of the DPT locations were along the ditch parallel to Wyoming Avenue on the north side of the SWMU. The fifth DPT location was emplaced on the southwest side of the SWMU across 11th Street from the switchyard. Twenty-seven subsurface soil samples were collected for analyses. All 27 samples were tested for VOAs and radionuclides (Table 4.22). Twenty-five samples were analyzed for SVOAs, and 13 were tested for PCBs. Because metals contaminants are not known to be associated with normal electrical switchyard operations, no metals analyses were performed on the surface or subsurface samples from SWMU 84.

Surface soil analytical results

SVOAs. PAHs were detected in one of the six surface soil samples analyzed for SVOAs (Table 4.23). All the detections were below the detection limit of 500 µg/kg except for benzo(b)fluoranthene, which had a reported concentration of 510 µg/kg. This sample was from location 084-014 (Fig. 4.4), which was collected from the drainage ditch at the northeast corner of the SWMU near the junction of Wyoming Avenue and 13th Street. At this point the ditch flows into a culvert that crosses beneath Wyoming Avenue before finally flowing into Outfall 001 to the North-South Diversion Ditch.

PCBs. Two PCBs, 1254 and 1260, were each detected once in the surface soil samples collected for SWMU 84. Both PCB detections were from surface samples collected near the northeast corner of the SWMU in the drainage ditch south of Wyoming Avenue. The maximum concentration of PCBs was 380 µg/kg for PCB-1260 (Table 4.24).

Dioxin/furans. Fourteen dioxin/furan compounds were detected in the two surface soil samples (084010SA001 and 084014SA001) that were analyzed for the compounds. OCDD at 6.79 µg/kg was the compound reported at the highest concentration.

Radionuclides. Cesium-137 was reported from one of the six surface soil samples that were analyzed for radionuclides. The activity was 1.9 (±1.7) pCi/g (compared to a background at 0.49 pCi/g) from surface sample 084010SA001.

Subsurface soil analytical results

VOAs. Acetone was present in 8 of 27 analyses performed and was the only VOA detected in any of the subsurface soil samples from SWMU 84 (Table 4.25).

SVOAs. Three SVOA compounds were each detected once in the 25 samples that were analyzed for the presence of SVOAs. The concentration of two of the compounds, bis(2-cloroethoxy) methane and bis(2-ethylhexyl)phthalate, were below the MDL. Di-n-butyl phthalate was reported at a concentration of 3800 µg/kg from the 13- to 16-ft sample from location 084-004 (Table 4.26). Analyses of the split of this sample were nondetect for all SVOAs.

Radionuclides. Technetium-99 was the only radionuclide found at an activity above background level in any of the 25 samples that were analyzed for radionuclides. The activity of the technetium-99

was 5.84 (±6.98) pCi/g (compared to a background activity of 2.8 pCi/g) from the 24-ft to 27-ft bgs interval of boring 084-009.

4.1.6.2 Water samples

Three storm water samples were collected from the drain system that empties into the shallow surface ditch on the north side of SWMU 84 (Fig. 4.4). Each of the storm water samples was analyzed for VOAs, SVOAs, and PCBs (Table 4.22). Radionuclide analyses were performed on two of the samples. Four groundwater samples were collected from SWMU 84, one from the bottom of each of the DPT locations on the north side of the SWMU. The samples were collected from sands and gravels at approximately 55 ft to 58 ft bgs.

Storm water analytical results

SVOAs. One of the three storm water samples (084007WA000) contained two phthalates at concentrations that are near the MDL (Table 4.27).

Radionuclides. Technetium-99 was the only radionuclide detected in the storm water samples at SWMU 84 and was found in both samples analyzed for radionuclides (Table 4.28). The maximum activity of technetium-99 was 17.9 (±8.9) pCi/L from sample 084007WA000, which only slightly exceeds the 14 pCi/L detection limit.

Groundwater analytical results

VOAs. Two VOAs were detected in the groundwater at SWMU 84. 1,1-Dichloroethene was reported at a concentration of 0.1 µg/L in one (084005WA058) of the four samples (Table 4.29). Acetone, a probable laboratory-introduced contaminant, was present at 88 µg/L in one sample (084015WA056).

SVOAs. Bis(2-ethylhexyl) phthalate was found at a concentration of 21 µg/L in one of the four samples analyzed.

Radionuclides. Technetium-99 was the only radionuclide detected in the groundwater samples collected at SWMU 84. Technetium -99 was detected in all four of the groundwater samples (Table 4.30). The maximum reported activity was 45 (±9.1) pCi/L. The highest activity was from the 55-ft sample collected from station 084-009, which is located on the north-central side of the SWMU boundary adjacent to Wyoming Avenue.

4.1.6.3 Summary of findings

Surface and shallow subsurface soil was sampled to a depth of 5 ft at two locations on the north side of SWMU 84 during the Phase I SI. PCB-1260, OCDD, and technetium-99 were reported from these samples. Two PCBs (including -1260) and numerous dioxin/furans (including OCDD) were present in the surface soil samples analyzed during the WAG 8 SE, which confirms the presence of the contaminants at the site. Technetium-99 was found in a subsurface sample during the WAG 8 SE but was not present in the surface samples. No PCBs were detected in the subsurface samples, and dioxin/furans were not tested.

Samples collected from the drainpipes that direct runoff from SWMU 84 indicate that only a small quantity of technetium-99 (slightly above MDL) is currently being transported by storm water flow.

Technetium-99 is a process-related contaminant at the electrical switchyards, and low levels of technetium-99 are known to be ubiquitous to PGDP.

Surface soil samples collected in the drainage ditches into which the storm water empties contained low concentrations of several SVOAs, cesium-137, PCBs, and dioxin/furans. The highest concentration of any single SVOA detected at SWMU 84 was only slightly above MDL, and low levels of SVOAs are known to be ubiquitous to PGDP. Because radionuclides are not process-derived from electrical switchyards, the cesium-137 in the surface soil at SWMU 84 has been derived from a source other than the electrical switchyard. Contaminants unrelated to SWMU 84 could have been introduced into the ditch with over-land sheet flow, from overflowing storm drains caused by extreme rainfall events, or by aerial deposition. PCBs, at a maximum concentration of 380 μg/kg, and dioxin/furans, at a maximum concentration of 6.79 μg/kg, found in the surface soil within the ditch are interpreted to represent residual contaminants from historical leaks and spills that occurred at SWMU 84.

The only contaminant reported from the subsurface soil at SWMU 84 is a single detection of technetium-99 at a concentration of 2.1 times background. This radionuclide is not a site-derived contaminant.

4.1.7 SWMU 85

4.1.7.1 Soil samples

Four surface soil samples were collected from the drainage ditch that receives outflow from the storm drain system at SWMU 85 (Fig. 4.5). The ditch is located along the north side of the SWMU, south of and parallel to Wyoming Avenue. All four samples were analyzed for SVOAs, PCBs, and radionuclides. Based on the PCB results, one sample (085008SA001) was tested for the presence of dioxin/furan compounds. Based on the project work plan, no VOA or metals analyses were performed on surface soil samples from SWMU 85. Twenty-five subsurface soil samples were collected from the five DPT borings that were installed at the site. Four of the five DPT borings were located in the shallow ditch between the northern boundary of SWMU 85 and Wyoming Avenue. The fifth DPT location was near the southwest corner of the SWMU. Subsurface soil samples were collected from 1 to 60 ft bgs. All 25 samples were tested for VOAs, 20 samples were tested for SVOAs, 8 samples were tested for PCBs, and 22 samples were tested for the presence of radionuclides (Table 4.31).

Surface soil analyses

SVOAs. Six PAH compounds were detected from the four surface soil samples analyzed from SWMU 85 (Table 4.32). Benzo(b)fluoranthene, at a maximum concentration of 960 μg/kg, was the only PAH detected at a concentration that exceeded the MDL of 500 μg/kg and was also the only SVOA detected in more than one sample (Table 4.33). Sample 085003SA001, which was collected in the west-central part of the drainage ditch near the outfall from the storm water drain that drains the western part of the SWMU, contained most of the detected SVOA compounds (Fig. 4.5).

PCBs. PCB-1260 was noted below the MDL at 71 μg/kg in one of the four locations at SWMU 85.

Dioxin/furans. Sample 085008SA001, the only surface soil sample at SWMU 85 tested for dioxin/furans, contained 12 dioxin/furan compounds. The maximum concentration for any of the detected compounds was 9.18 μg/kg for OCDD.

Subsurface soil analytical results

No analytes/compounds/radionuclides were detected in any of the subsurface soil samples collected from SWMU 85 (Tables 4.34 and 4.35).

4.1.7.2 Water samples

Three storm water samples were collected from SWMU 85 where drainpipes discharge water collected from the SWMU into a shallow drainage ditch located along the northern boundary of the site (Fig. 4.5). All three of the samples were tested for the presence of VOAs, SVOAs, and PCBs. One sample (085012WA000) was tested for radionuclides (Table 4.31). Four groundwater samples were collected from DPT locations 085-001, 085-004, 085-007, and, 085-011 (Fig. 4.5). Three of the samples were collected between 55 ft and 58 ft bgs. The fourth sample, 085001WA060, was collected at approximately 35 ft bgs from a water-bearing UCRS sand. All four samples were analyzed for VOAs and radionuclides.

Storm water analytical results

VOAs. The only VOA detected in any of the storm water samples was the common laboratory contaminant methylene chloride (Table 4.36). The single detected result for methylene chloride was 10 µg/L, which is equal to the MDL for the compound.

Radionuclides. Technetium-99, at a concentration of 16.2 (±8.8) pCi/L, was the only radionuclide detected in the storm water samples (085012WA000) analyzed from SWMU 85 (Table 4.37).

Groundwater analytical results

VOAs. Three VOAs, each detected one time (Table 4.38), were found in the three deep groundwater samples collected at approximately 55 ft to 58 ft bgs. The shallow UCRS groundwater sample was nondetect for all VOAs. The three VOAs detected were TCE, 1,1-dichloroethene, and vinyl chloride (Table 4.39).

Radionuclides. Technetium-99 was reported from two of four groundwater samples collected from SWMU 85. The maximum activity for technetium-99 was 28 (±9.4) pCi/L from the 55- to 56-ft interval of location 085-004. The other detection of technetium-99 was 25 (±12.6) pCi/L from a sample collected from location 085-011 at 56 ft bgs.

4.1.7.3 Summary of findings

Sampling of the soil and groundwater at SWMU 85 during the Phase I and Phase II SIs found localized occurrences of chloromethane and xylenes in the shallow soil between 3 and 5 ft deep. VOAs, bis(2-ethylhexyl)phthalate, metals, and radionuclides were also reported from groundwater samples collected from two wells located at the northwest corner of the SWMU. Expanded sampling of the soil and groundwater at SWMU 85 during the WAG 8 SE did not confirm the presence of VOAs in the shallow subsurface. PCBs and dioxins/furans were detected during the WAG 8 investigation, but PCBs were not reported from the earlier study and dioxin/furan compounds were not on the list of targeted analytes for the Phase I and Phase II SIs. WAG 8 sampling did, however, substantiate the presence of TCE and technetium-99 in the groundwater at SWMU 85.

Water samples collected from the drainpipes that direct runoff from SWMU 85 indicate that only a small quantity of technetium-99 [16.2 (±8.8) pCi/L versus a MDL of 14 pCi/L] is currently being

transported by storm water flow at the site. Technetium-99 is not a process-related contaminant at the electrical switchyards, and low levels of technetium-99 are ubiquitous to PGDP.

Surface soil samples collected in the drainage ditches into which the storm water empties contained low concentrations of several SVOAs, one detection of PCB, and several dioxin/furans. Only one of the SVOA detections exceeded the MDL, and low levels of SVOAs are known to be ubiquitous to PGDP. The single PCB detection (PCB-1260 at a concentration of 71 μg/kg) and the detected dioxin/furans (maximum concentration of 9.18 μg/kg) are interpreted to represent residual contaminants from historical leaks and spills that occurred at SWMU 85.

No contaminants were detected in the subsurface soil at SWMU 85. The absence of contaminants in the shallow subsurface soil and UCRS groundwater indicate that infiltration of contaminants into the subsurface is not a major pathway for contamination migration. Because technetium-99 and TCE are not present in the UCRS soil or shallow groundwater, the presence of these contaminants in the deeper groundwater samples collected near the base of the UCRS/top of the RGA are most likely due to the location of SWMU 85 along the margin of the Northeast Plume.

4.1.8 C-340 Reduction and Metals Facility

4.1.8.1 Soil samples

Twelve surface soil samples were collected around the perimeter of the C-340 Building (Fig. 4.6). All 12 samples were analyzed for SVOAs, PCBs, metals, and radionuclides. Five samples in which PCBs were detected also were analyzed for the presence of dioxin/furans (Table 4.40). Per the WAG 8 Work Plan, VOA analyses were not performed on surface soil samples at the C-340 Building. Twenty-four subsurface samples were collected at the C-340 Building area from four DPT borings (Fig. 4.6). Samples were collected between 8 to 60 ft bgs. All 24 samples were analyzed for VOAs, and radionuclides (Table 4.40). Twenty samples were analyzed for SVOAs and metals, and five were tested for PCBs. Because no PCBs were detected, no dioxin/furan analyses were performed on the subsurface soil samples from the C-340 Building area.

Surface soil analyses

SVOAs. Numerous SVOAs (primarily PAH compounds) were detected in the surface soils that surround the C-340 Building. Nineteen separate compounds were identified (Table 4.41). Most of the compounds were detected in 6 or more of the 12 surface soil samples. The distribution of SVOAs around the C-340 Building, as reflected by the total SVOA concentrations for each sample, is depicted in Fig. 4.7. Total SVOA concentrations detected in the surface soil at the C-340 Building area ranges from 6260 to 1,072,100 μg/kg. High concentrations were found on all sides of the building, and no apparent trend could be discerned. The highest concentration was from location 340-008, which was collected on the southwest side of the building. Contingency surface soil samples (340-012 through 340-015) were collected near 340-008 to better define the contamination around location 340-008. The total SVOA content of the soil from these contingency samples was between 83,970 μg/kg and 355,851 μg/kg.

PCBs. PCBs were detected in 11 of 12 surface soil samples for which PCB compounds were tested. The list of PCBs detected and the FOD for each compound are PCB-1254 (6 of 12), PCB-1260 (5 of 12), PCB-1248 (3 of 12), and PCB-1242 (1 of 12) (Table 4.41). Total PCB concentrations have been plotted by location for surface soil samples surrounding the C-340 Building (Fig. 4.8). Samples collected from four locations, 340-008, 340-012, 340-014, and 340-015, all of which are located in a limited area on the southwest side of the C-340 Building, each had total PCB concentrations above 70,000 μg/kg. All other

locations tested for PCBs at the C-340 Building had total PCB concentrations between nondetect and 8100 μg/kg.

Dioxin/furans. Seventeen dioxin/furan compounds were reported in the five samples tested for this contaminant group. Most of the compounds were detected in all five samples (Table 4.42). The distribution of the dioxin/furan compounds, as reflected by the total detected concentration for all the dioxin/furan compounds in a sample, is presented in Fig. 4.8. No pattern can be established for the distribution of the dioxins/furans based on the available data other than to note that PCBs also were present in each of the samples containing dioxin/furans.

Metals. Twelve metals were detected at concentrations that exceeded background levels in the 12 surface soil samples collected at the C-340 Building (Table 4.41). Of these sodium, potassium, and aluminum are common rock-forming minerals that were each detected once at concentrations only slightly exceeding background levels. Others such as chromium, zinc, copper, and nickel were detected in 4 or more of the 12 samples at maximum concentrations ranging from 4 to 23 times background levels. The distribution of those metals that occurred more than four times at concentrations above background level and had maximum concentrations greater than twice background levels are plotted in Fig. 4.9. The highest concentrations for all four of the plotted metals were reported from location 340-008, which is located on the southwest side of the building. Other locations containing high concentrations for each of these metals were the contingency samples 340-012 through 340-015, which were collected surrounding location 340-008. Two additional metals, mercury and beryllium, also were detected at their maximum concentrations at location 340-008.

Radionuclides. Twelve surface soil samples were analyzed for radionuclides. Eight radionuclides were detected at activities that exceeded PGDP background levels. The FOD and maximum activity for the eight radionuclides and for total uranium are presented in Table 4.42. The measured activities and distribution for the radioisotopes detected above background levels from the surface soil samples are shown in Fig. 4.10. Thorium-234, technetium-99, uranium-234, and uranium-238 were the isotopes detected most often above background levels. The sample collected from 340-008 had the greatest activity for all four of these isotopes and also for protactinium-234m, plutonium 239/240, and total uranium. This sample was collected on the southwest side of the C-340 Building.

Subsurface soil analytical results

VOAs. Two VOAs were detected in the subsurface soil samples at the C-340 Building area. Methylene chloride (a common laboratory contaminant) was present in 5 of 24 samples that were analyzed for VOAs, and chloromethane was detected in 1 of 24 samples tested (Table 4.43). The range of detections of methylene chloride was between 6600 and 7800 μg/kg (Table 4.44). All of the detections were estimated quantities from samples collected between 8 and 56 ft bgs from location 340-005.

SVOAs. Isolated occurrences of several phthalates were reported from the 20 subsurface samples collected from the C-340 area that were tested for the presence of SVOAs. Of the phthalates, only the three detections of di-n-butyl-phalathate were above the MDL. The PAH benzo(b)fluoranthene was detected in two samples at concentrations below the MDL (Table 4.44).

Metals. Seven metals were found in the subsurface soil at concentrations that exceeded the PGDP background levels (Table 4.43). The three common rock-forming minerals, aluminum, iron, and magnesium, were detected in only 2 or 3 of 20 samples tested at maximum concentrations that slightly exceed background levels and are considered to be representative of naturally occurring concentrations. Calcium exceeded background in a single sample. Beryllium, vanadium, and chromium each exceeded background levels in 8, 4, and 2 samples, respectively, of the 20 subsurface samples that were tested for

metals. The maximum concentrations for these three elements exceeded background levels by 2.0, 1.6, and 1.7 times, respectively. The highest concentrations for two of these metals, beryllium and vanadium, and the second highest detection for chromium were from sample 340005SA033. The soil samples collected above and below this sample did not contain any metals above background levels.

Radionuclides. Technetium-99 was the only radionuclide detected above background levels in any of the 24 subsurface soils. The activity of technetium-99 was 7.36 (±3.48) pCi/g from sample 340002SA026, which was collected 24 to 27 ft bgs.

4.1.8.2 Summary of findings

Surface soils at the C-340 Building contain elevated levels of SVOAs, PCBs, dioxins/furans, metals, and radionuclides. PAHs represent a widely distributed group of contaminants at the C-340 Building site. Almost every surface soil sample contains a suite of PAHs, some in concentrations greater than 100,000 μg/kg. PCBs also occur site-wide with concentrations for some mixtures exceeding 500,000 μg/kg. Dioxin/furans are present throughout the site, and a suite of metals is found in excess of reference background concentrations. Radiological constituents are distributed throughout the site at particularly high activity levels for the thorium and uranium series radioisotopes.

Subsurface soil contains isolated occurrences of organic compounds that typically are found as laboratory contaminants. One detection of technetium-99 at an activity of 7.36 (±3.48) pCi/g and metals at maximum concentrations equal to or less than twice background levels were also detected in the subsurface soils. Due to the slow recharge rate of the shallow, water-bearing sands at the site, groundwater could not be collected at the C-340 Building. However, only isolated occurrences of contaminants were found in the subsurface soil, indicating that infiltration of groundwater is not a significant contaminant migration pathway. The generally low mobility (under conditions similar to those at the PGDP) of many of the compounds within the detected contaminant suites (metals, PAHs, PCBs, etc.) probably has contributed to the concentration of contaminants in the near surface soils.

Due to a lack of standing water (even following normal rainfall events) within the shallow ditches around the C-340 Building, no storm water could be collected at this site. Therefore, it is not known whether the site is contributing to this migration pathway. However, the distribution of contaminants in the surface soil adjacent to SWMUs 82 and 83 suggests that areas adjacent to the C-340 Building may fall within the "contaminant halo" surrounding the C-340 Building and that these contaminants (at SWMUs 82 and 83) may have been derived from the C-340 Building via surface water runoff.

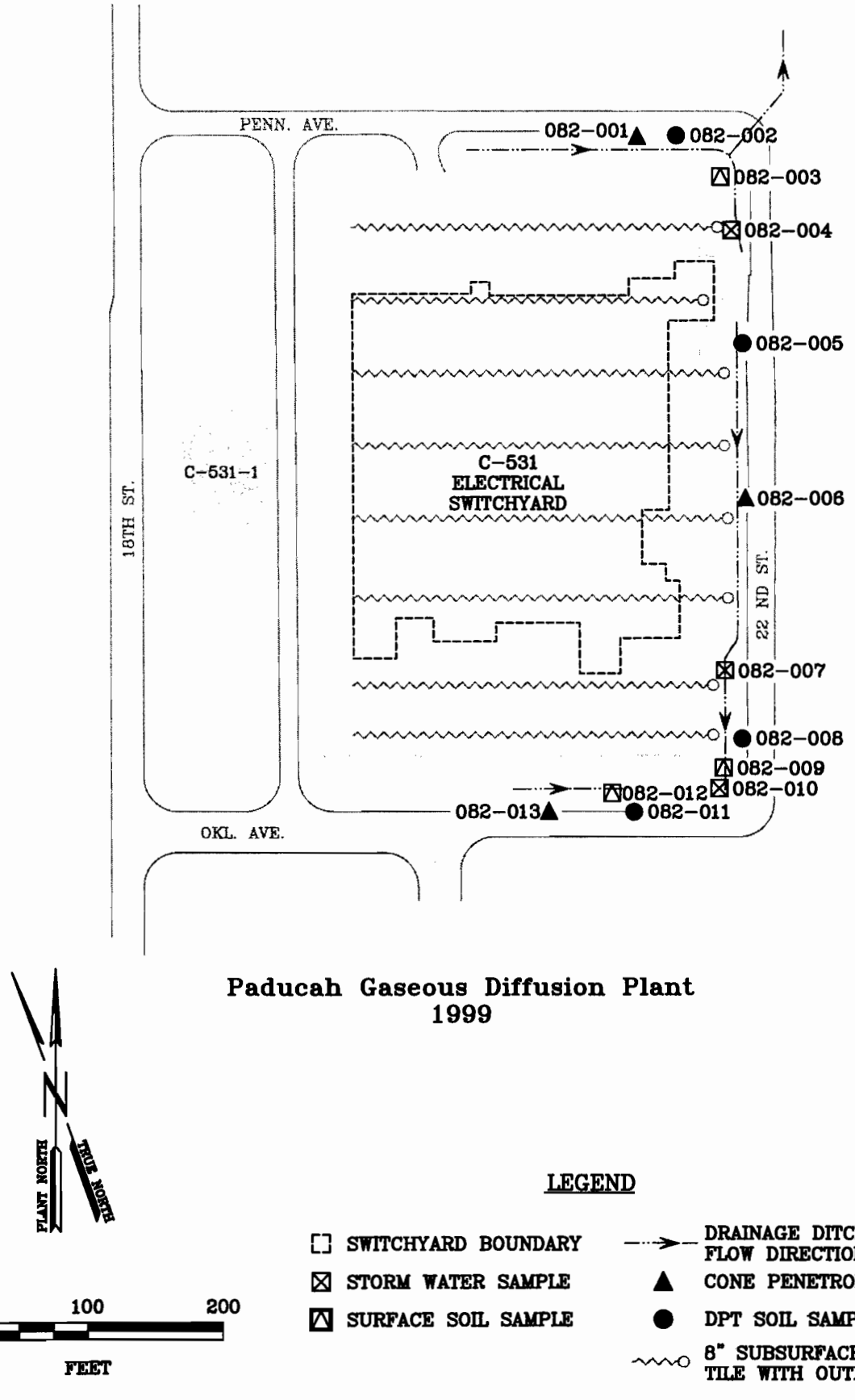


Figure 4.1 WAG 8 – SWMU 82 Sampling Locations

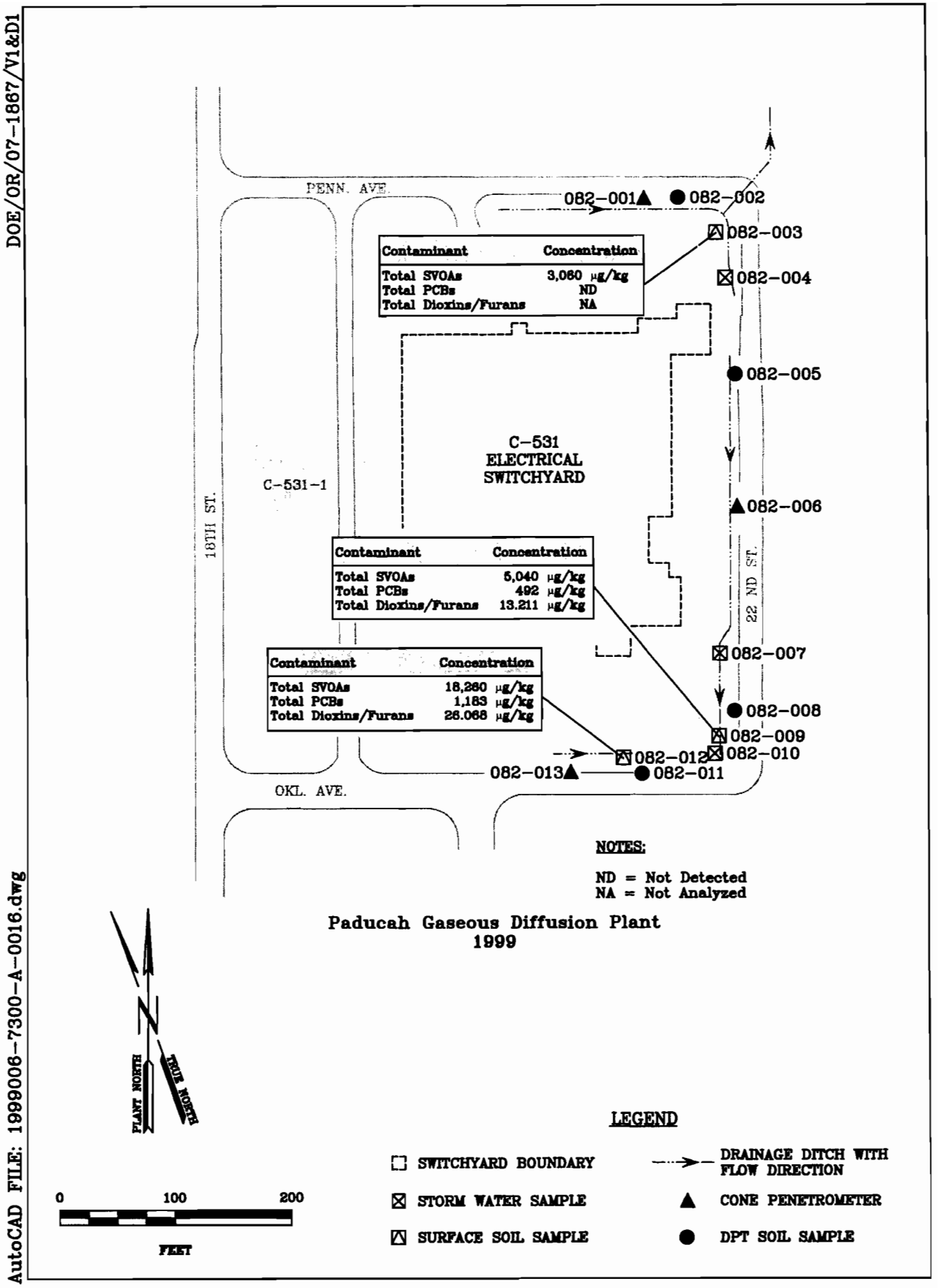


Figure 4.2 Plot Showing the Distribution of Total SVOAs, PCBs and Dioxins/Furans in Surface Soil Samples (0–1 ft) at SWMU 82

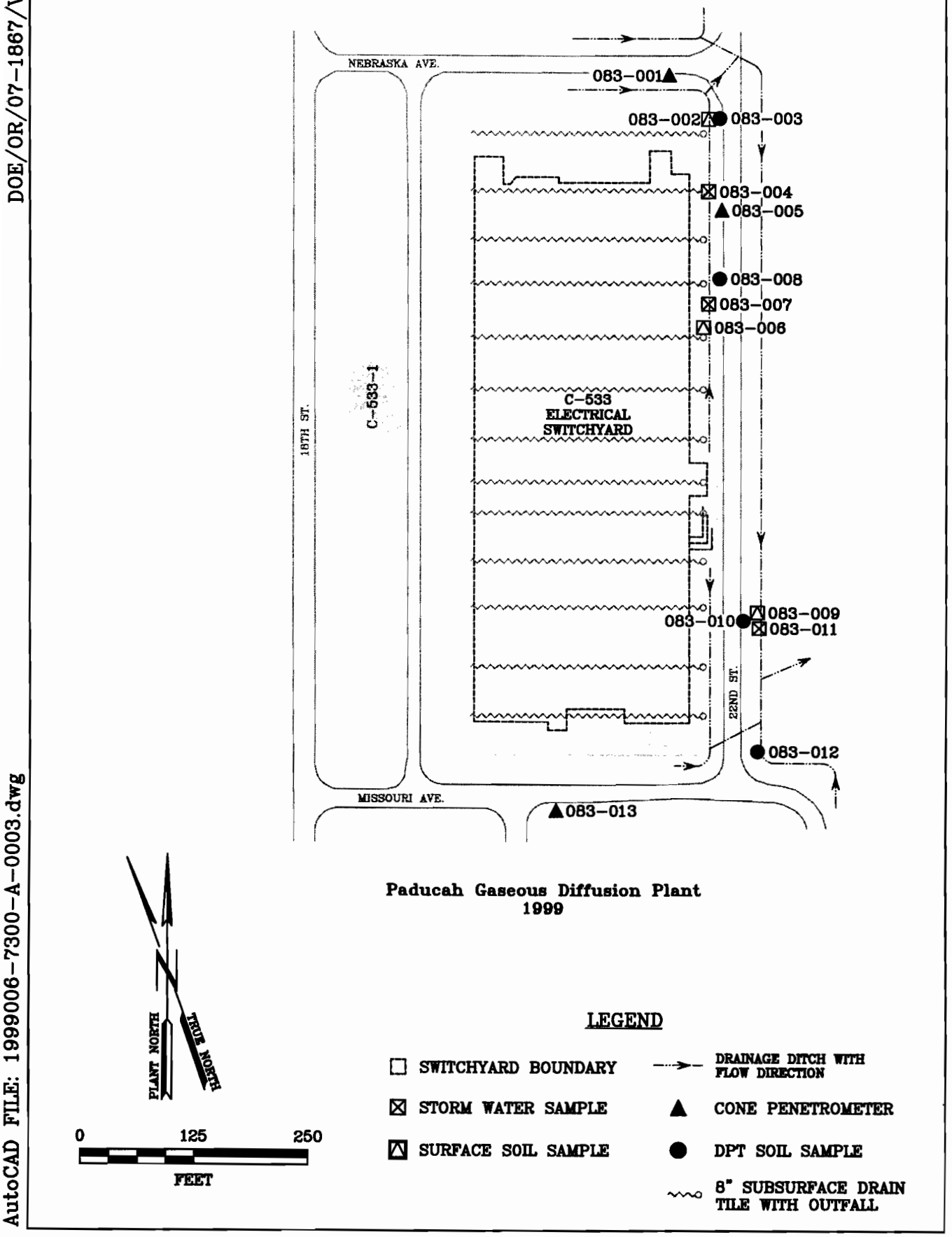


Figure 4.3 WAG 8 – SWMU 83 Sampling Locations

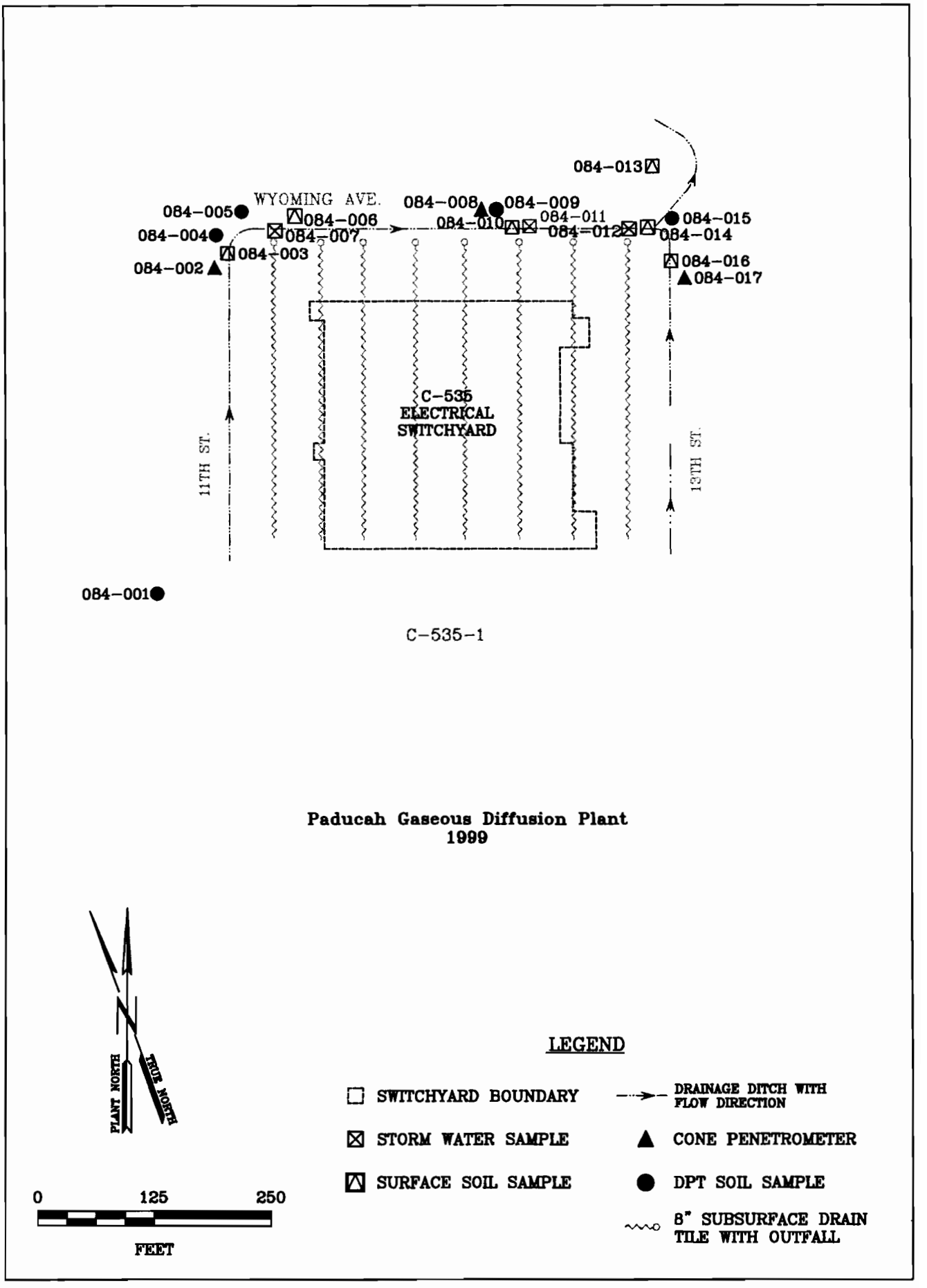
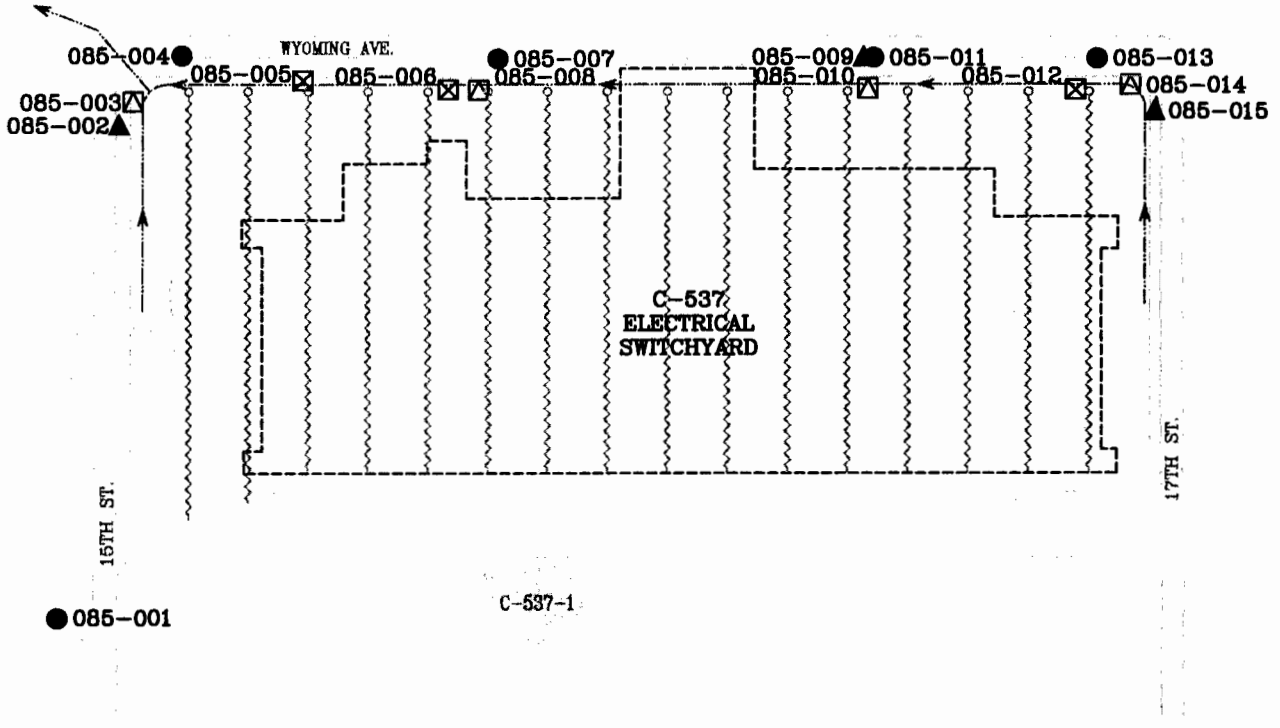
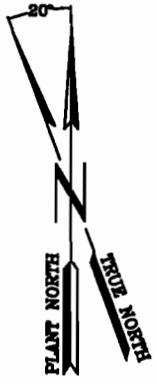
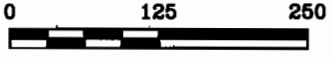


Figure 4.4 WAG 8 – SWMU 84 Sampling Locations





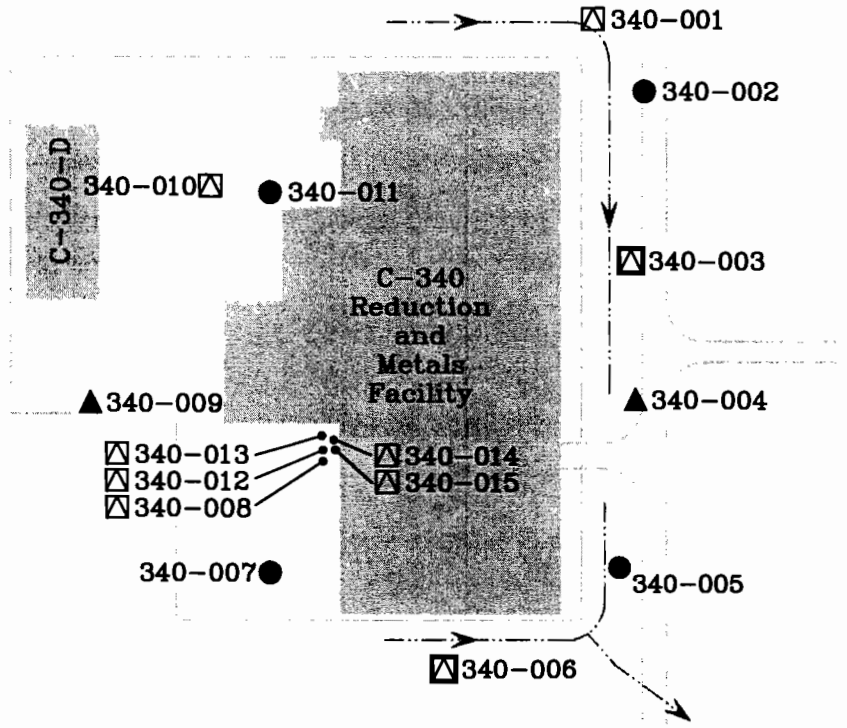
Paducah Gaseous Diffusion Plant
1999



LEGEND

- SWITCHYARD BOUNDARY
- DRAINAGE DITCH WITH FLOW DIRECTION
- STORM WATER SAMPLE
- CONE PENETROMETER
- SURFACE SOIL SAMPLE
- DPT SOIL SAMPLE

Figure 4.5 WAG 8 – SWMU 85 Sampling Locations

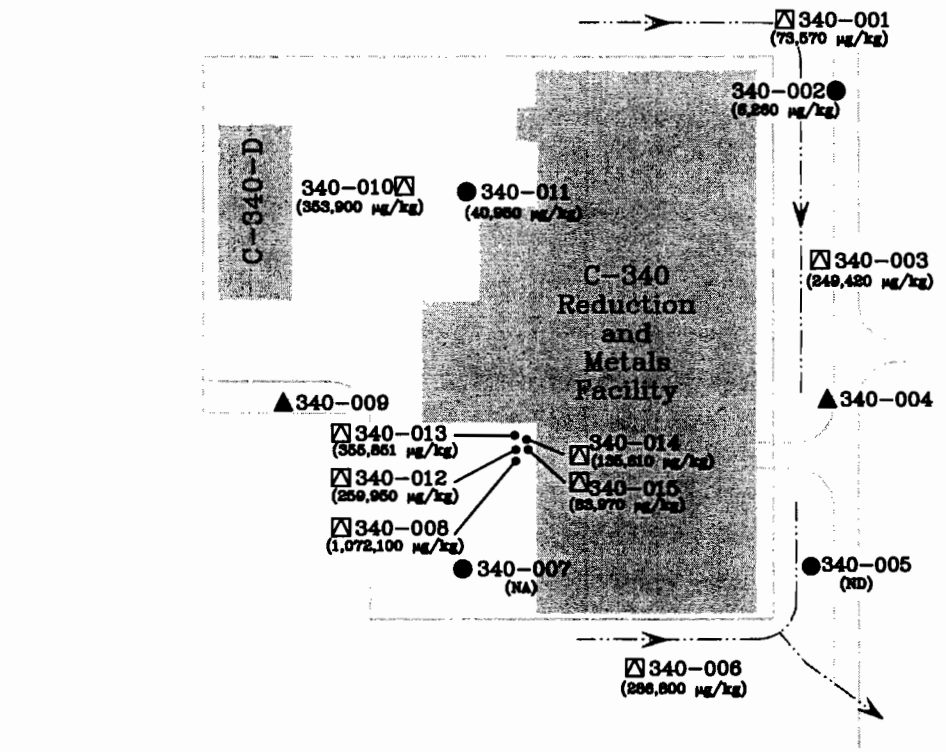


Paducah Gaseous Diffusion Plant
1999

LEGEND

BUILDING/STRUCTURE	DRAINAGE DITCH WITH FLOW DIRECTION
STORM WATER SAMPLE	CONE PENETROMETER
SURFACE SOIL SAMPLE	DPT SOIL SAMPLE

Figure 4.6 WAG 8 – C-340 Area Sampling Locations



Paducah Gaseous Diffusion Plant
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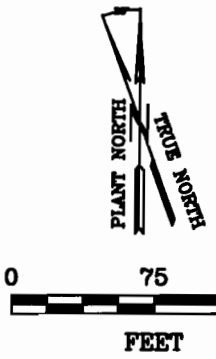


LEGEND

SURFACE SOIL SAMPLE (total SVOA µg/kg)

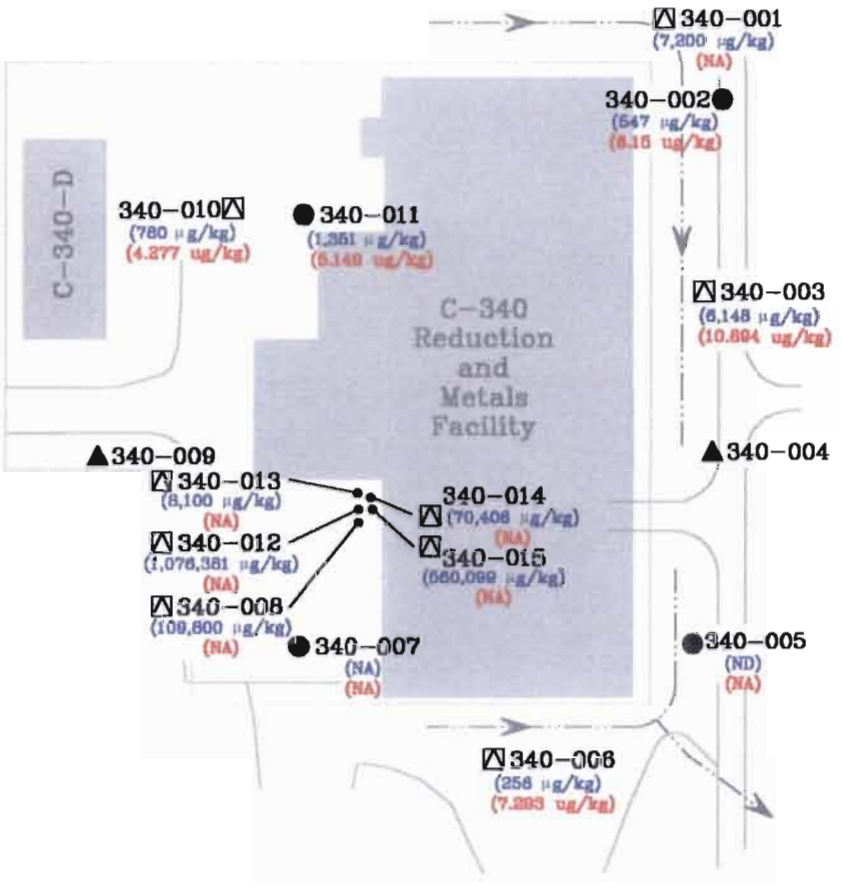
NA = NOT ANALYZED
ND = NOT DETECTED

DPT (total SVOA µg/kg)

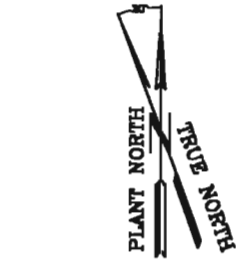
CONE PENETROMETER

DRAINAGE DITCH WITH FLOW DIRECTION

FIGURE 4.7 Plot of Total SVOA Concentrations by Station for Surface Soils at the C-340 Area



Paducah Gaseous Diffusion Plant
1999



0 75 150

FEET

LEGEND

SURFACE SOIL SAMPLE
(total PCBs µg/kg)
(total Dioxin/Furans µg/kg)

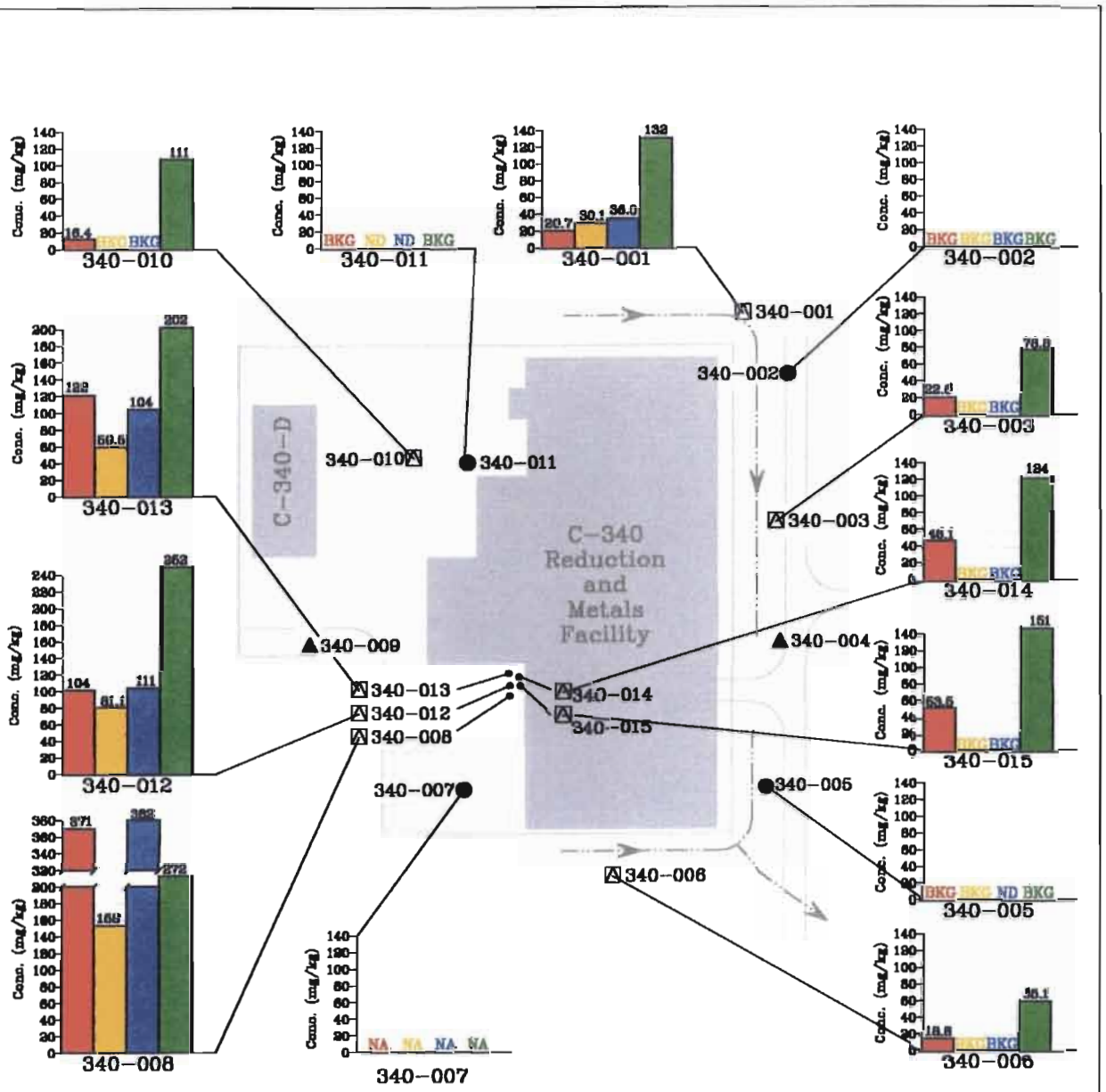
DPT
(total PCBs µg/kg)
(total Dioxin/Furans µg/kg)

NA = NOT ANALYZED
ND = NOT DETECTED

CONE PENETROMETER

DRAINAGE DITCH WITH FLOW DIRECTION

Figure 4.8 Plot of Total PCB and Dioxin/Furan concentrations by Station for Surface Soils at the C-340 Area



Paducah Gaseous Diffusion Plant
1999

LEGEND

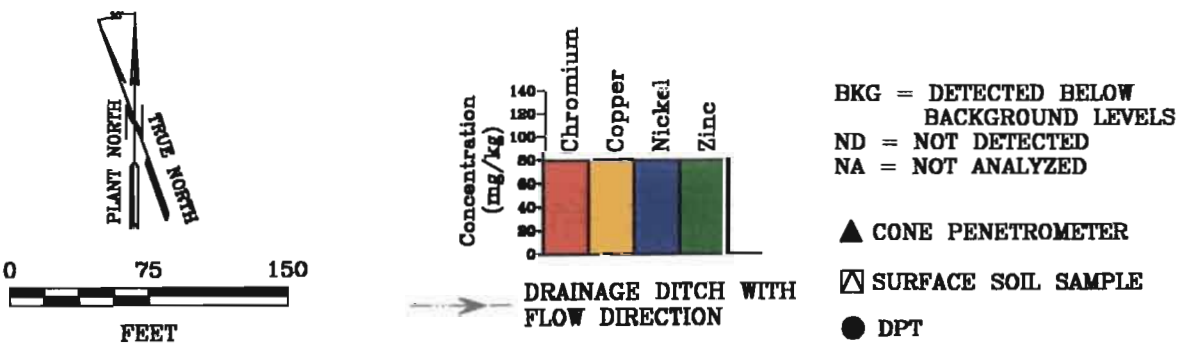
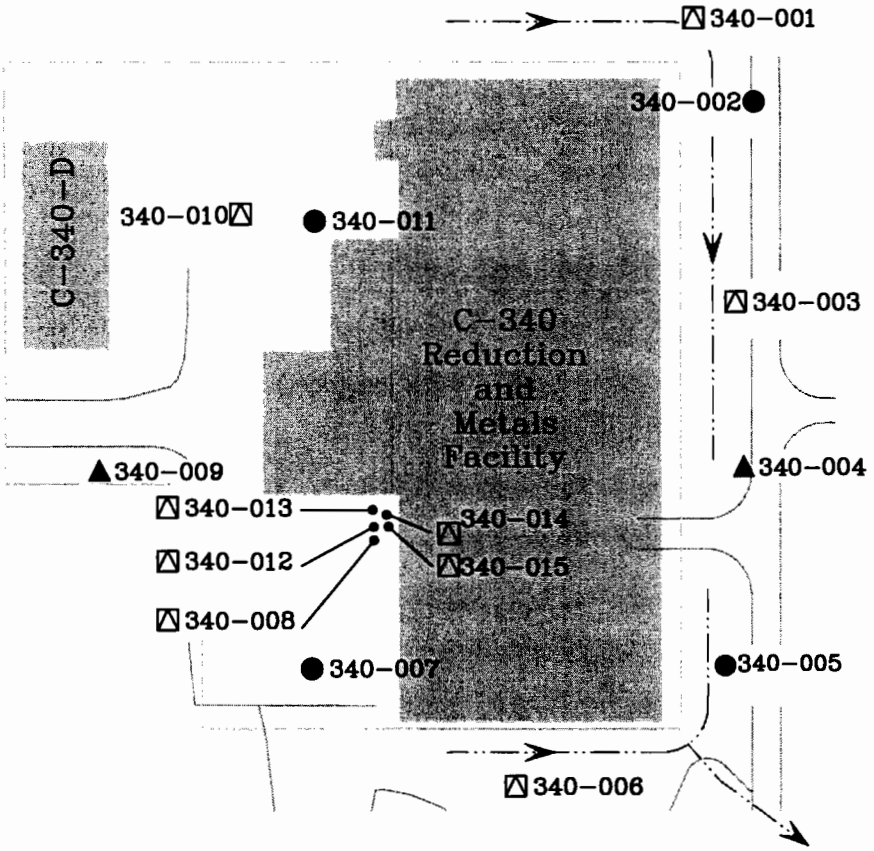
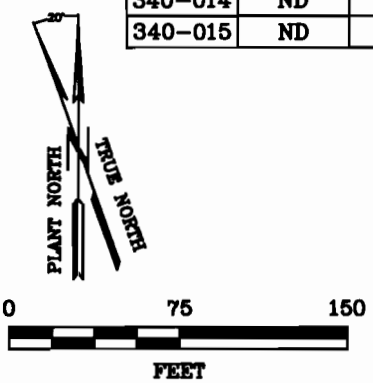


Figure 4.9 Map Showing Distribution of Chromium, Copper, Nickel and Zinc in the C-340 Area Surface Soils



Paducah Gaseous Diffusion Plant
1999

STATION	Np-237	Pu-239/240	Pa-234	Th-234	Tc-99	U-234	U-235	U-238
340-001	ND	ND	ND	306	8.3	26.5	ND	160
340-002	NA	NA	ND	9.3	ND	NA	ND	NA
340-003	NA	NA	ND	44	ND	NA	ND	NA
340-005	NA	NA	ND	ND	ND	NA	ND	NA
340-006	ND	ND	ND	26.2	ND	3.12	ND	26.4
340-007	NA	NA	NA	NA	NA	NA	NA	NA
340-008	ND	.304	5,000	2,890	105	379	49	2,740
340-010	ND	ND	ND	9.95	ND	3.16	ND	10.5
340-011	ND	ND	186	77	6.34	<	ND	9.73
340-012	ND	.27	2,400	1,320	21	158	36	994
340-013	.165	.116	ND	209	20.7	34.7	ND	204
340-014	ND	ND	ND	52	5.07	10.5	ND	51.8
340-015	ND	.079	880	486	ND	58.9	8.7	361



LEGEND

SURFACE SOIL SAMPLE

DPT SOIL SAMPLE

CONE PENETROMETER

< = DETECTED BELOW BACKGROUND LEVEL
ND = NOT DETECTED
NA = NOT ANALYZED

ALL ACTIVITIES IN pCi/g

DRAINAGE DITCH WITH FLOW DIRECTION

Figure 4.10 Summary of Radionuclide Detections Above Background by Station for Surface Soils at the C-340 Area

Analytical Results Qualifier Codes

Laboratory Qualifiers

Organic Analyses

B	Indicates that an analyte is found in the associated blank as well as in the sample.
E	Identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.
J	Indicates an estimated value.
U	Indicated compound was analyzed for, but not detected.
X	Other specific flags may be required to properly define the results.
Y	Indicates MS/MSD recovery and/or RPD failed to meet acceptance criteria.

Inorganic Analyses

*	Duplicate analysis was not within control limits.
B	Indicates that an analyte is found in the associated blank as well as in the sample.
E	The reported value is estimated because of the presence of interference.
J	Indicates an estimated value.
N	Spiked sample recovery was not within control limits.
U	Indicated compound was analyzed for, but not detected.
W	Post-digestion spike for furnace atomic absorption analysis is out of control limits (85% - 115%), while sample absorbance is less than 50% of spike absorbance.
X	Other specific flags may be required to properly define the results.

Radiological Analyses

A	Indicated compound was analyzed for, but not detected.
U	Indicated compound was analyzed for, but not detected.
X	Other specific flags may be required to properly define the results.

Validation Qualifiers

=	Data were validated; however, no qualifier was added.
J	Estimated value, either because QC criteria were not met or because the amount detected is below the documented quantitation limit.
R	Rejected, so data are of "information only" quality and should be supplemented with additional data for decision-making.
U	The material was analyzed for, but was not detected. The associated numerical value is the quantitation limit.
UJ	Undetected, but the number reported as the quantitation limit is an estimated value.
X	Data were not validated.

Assessment Qualifiers

BH-FB	Indicates that the analyte was detected in the associated field blank.
BL-T	Indictes that the result may be biased low due to holding time exceedance.
NR	Information requested from lab during data assessment.
R-C	Rejected data.

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Laboratory and Analytical Method Codes

LAB_CODE	Laboratory Type - Subcontract Laboratory
ONSE	Organic Close Support Laboratory (CSL) - ONSITE Environmental Labs, Inc.
PARGN	Radiological Close Support Laboratory (CSL) - Paragon Analytics, Inc.
PGDP	Fixed-base laboratory - USEC C-710 Laboratory, PGDP Paducah, KY
PORTS	Fixed-base laboratory - USEC Portsmouth, Ohio Laboratory
SWRI	Fixed-base laboratory - Southwest Research Institute

ANA_METHOD	Analytical Method Name (CSL or Fixed Base Method, Lab)
AS7300	Uranium-235 (Fixed Base Method, PGDP)
DNT	Gamma Spectroscopy of Soils/Tc-99 in Water (CSL Methods, PARGN)
EPA-310.1	Alkalinity (Fixed Base Method, PGDP)
EPA-340.2	Fluoride (Fixed Base Method, PGDP)
EPA-350.2	Ammonia (Fixed Base Method, PGDP)
EPA-370.1	Dissolved Silica (Fixed Base Method, PGDP)
EPA-376.1	Sulfide (Fixed Base Method, PGDP)
EPA-410.4 1978	Chemical Oxygen Demand (Fixed Base Method, PGDP)
EPA-900.0	Gross Alpha and Beta Activity in Water (Fixed Base Method, PGDP)
OA33499026	TCE and Degradation Species in Soils (Fixed Base/Confirmation Method, PORTS)
RL-7100	Technietium-99 in Water (Fixed Base Method, PGDP)
RL-7111	Gross Alpha and Beta Activity in Soil (Fixed Base Method, PGDP)
RL-7116	Technetium-99 in Soils (Fixed Base Method, PGDP)
RL-7120	Plutonium-239/240 in Soils (Fixed Base Method, PGDP)
RL-7124	Gamma Spectroscopy of Soils (Fixed Base/Confirmation Method, PGDP)
SM-2320 B 17	Bicarbonate Hardness (Fixed Base Method, PGDP)
SM-2580 B	Redox Potential (Fixed Base Method, PGDP)
SW846-6010A	Metals in Water or Soils by ICP (Fixed Base Method, PGDP)
SW846-7060	Arsenic in Water or Soils by GFAA (Fixed Base Method, PGDP)
SW846-7131	Cadmium in Water (Fixed Base Method, PGDP)
SW846-7421 E3R0	Lead in Water or Soils by Graphite Furnace AA (Fixed Base Method, PGDP)
SW846-7470	Mercury in Water by Cold Vapor AA (Fixed Base Method, PGDP)
SW846-7471	Mercury in Soil (Fixed Base Method, PGDP)
SW846-7740	Selenium in Water or Soil (Fixed Base Method, PGDP)
SW846-8021 M	TCE and Degradation Species in Soils and Water (CSL Method, ONSE)
SW846-8082	PCBs in Soil (Fixed Base Method, PGDP)
SW846-8082 M	PCBs in Water and Soils (CSL Method, ONSE)
SW846-8260	VOCs in Water and Soils by GC/MS (Fixed Base/Confirmation Method, PGDP)
SW846-8260A	VOCs in Water and Soils by GC/MS (Fixed Base/Confirmation Method, PORTS)
SW846-8270	SVOCs in Water and Soils by GC/MS (Fixed Base/Confirmation Method, PGDP)
SW846-8270 M	SVOCs in Water and Soils by GC/MS (CSL Method, ONSE)
SW846-8290	Dioxins/Furans in Soil and Water (Fixed Base Method, SWRI)
SW846-9014	Cyanide in Soil and Water (Fixed Base Method, PGDP)

Laboratory and Analytical Method Codes

LAB_CODE	Laboratory Type - Subcontract Laboratory
SW846-9040	pH in Water (Fixed Base Method, PGDP)
SW846-9060	Total Organic Carbon in Water (Fixed Base Method, PGDP)
SW846-9310	Gross Alpha and Beta Activity in Water and Soils (CSL Method, PARGN)

Table 4.1. Metals background values

Analytical Compound	Soil Background Data (a) (mg/kg)	
	Near Surface	Subsurface
Aluminum	13000	12000
Antimony	0.21	0.21
Arsenic	12	7.9
Barium	200	170
Beryllium	0.67	0.69
Boron	0	0
Cadmium	0.21	0.21
Calcium	200000	6100
Chromium	16	43
Cobalt	14	13
Copper	19	25
Cyanide	0	0
Iron	28000	28000
Lead	36	23
Lithium	0	0
Magnesium	7700	2100
Manganese	1500	820
Mercury	0.2	0.13
Nickel	21	22
Potassium	1300	950
Selenium	0.8	0.7
Silver	2.3	2.7
Sodium	320	340
Strontium	0	0
Thallium	0.21	0.34
Vanadium	38	37
Zinc	65	60

(a) Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE, 1997)

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Table 4.2. Radioactive isotope background values

Analytical Compound	Soil Background Data (a) (pCi/g)	
	Near Surface	Subsurface
Alpha activity	0	0
Americium-241	0	0
Beta activity	0	0
Cesium-137	0.49	0.28
Cobalt-60	0	0
Neptunium-237	0.1	0
Plutonium-239	0.025	0
Plutonium-239/240	0	0
Protactinium-234m	0	0
Technetium-99	2.5	2.8
Thorium-234	0	0
Uranium	0	0
Uranium-234	2.5	2.4
Uranium-235	0.14	0.14
Uranium-238	1.2	1.2

(a) Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE, 1997)

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Table 4.3. Analytical groups tested by media at WAG 8 sites

Media	Site	Analytical Group					
		VOA	SVOA	PPCB	DI/FURA (a)	METAL	RADS
Surface Soil	82	NA	**YES**	**YES**	**YES**	NA	**YES**
	83	NA	**YES**	ND	NA	NA	ND
	84	NA	**YES**	**YES**	**YES**	NA	**YES**
	85	NA	**YES**	**YES**	**YES**	NA	ND
	340	NA	**YES**	**YES**	**YES**	**YES**	**YES**
Subsurface Soil	82	ND	**YES**	ND	NA	NA	ND
	83	ND	ND	ND	NA	**YES**	ND
	84	**YES**	**YES**	ND	NA	NA	**YES**
	85	ND	ND	ND	NA	NA	ND
	340	**YES**	**YES**	ND	NA	**YES**	**YES**
Storm Water	82	ND	**YES**	ND	NA	NA	**YES**
	83	ND	**YES**	ND	NA	NA	**YES**
	84	ND	**YES**	ND	NA	NA	**YES**
	85	**YES**	ND	ND	NA	NA	**YES**
	340	NS	NS	NS	NS	NS	NS
Groundwater	82	**YES**	NA	NA	NA	NA	**YES**
	83	ND	ND	NA	NA	NA	**YES**
	84	**YES**	**YES**	NA	NA	NA	**YES**
	85	**YES**	NA	NA	NA	NA	**YES**
	340	NS	NS	NS	NS	NS	NS

(a) Dioxin/furan analyses not performed unless PCBs were detected in the sample

NA = analyses not performed for that media

ND = analyses performed but no detections reported

NS = media not sampled

YES = analytes detected in media

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Table 4.4. Analytical groups tested by sample at SWMU 82

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Surface Soil Samples						
082003SA001		X	X			X
082009SA001		X	X	X		X
082012SA001		X	X	X		X
Subsurface Soil Samples						
082002SA006	X	X	X			X
082002SA013	X	X	X			X
082002SA023	X	X				X
082002SA043	X	X				X
082002SA051	X	X				X
082002SA060	X	X				X
082005SA006	X	X	X			X
082005SA013	X	X	X			X
082005SA026	X					X
082005SA036	X	X				X
082005SA045	X	X				X
082005SA057	X	X				X
082008SA006	X	X	X			X
082008SA013	X					X
082008SA023	X					X
082008SA033	X					X
082008SA043	X	X				X
082008SA060	X	X				X
082011SA006	X	X	X			X
082011SA013	X	X	X			X
082011SA023	X	X				X
082011SA033	X	X				X
082011SA043	X	X				X
082011SA060	X	X				X
Storm Water Samples						
082004WA000	X	X	X			X
082007WA000	X	X	X			X
082010WA000	X	X	X			
Groundwater Samples						
082008WA043	X					X

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Table 4.5. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 82 surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
VOA		0 / 0				
SVOA	Anthracene	3 / 3	510.000	0.000	500	ug/kg
SVOA	Benz(a)anthracene	3 / 3	1,300.000	0.000	500	ug/kg
SVOA	Benzo(a)pyrene	3 / 3	2,400.000	0.000	500	ug/kg
SVOA	Benzo(b)fluoranthene	3 / 3	5,000.000	0.000	500	ug/kg
SVOA	Chrysene	3 / 3	1,600.000	0.000	500	ug/kg
SVOA	Fluoranthene	3 / 3	1,700.000	0.000	500	ug/kg
SVOA	Phenanthrene	3 / 3	1,200.000	0.000	500	ug/kg
SVOA	Pyrene	3 / 3	1,700.000	0.000	500	ug/kg
SVOA	Acenaphthene	1 / 3	350.000	0.000	500	ug/kg
SVOA	Benzo(k)fluoranthene	1 / 3	540.000	0.000	500	ug/kg
SVOA	Dibenz(a,h)anthracene	1 / 3	100.000	0.000	500	ug/kg
SVOA	Dibenzofuran	1 / 3	280.000	0.000	500	ug/kg
SVOA	Diethyl phthalate	1 / 3	260.000	0.000	500	ug/kg
SVOA	Fluorene	1 / 3	400.000	0.000	500	ug/kg
SVOA	Indeno(1,2,3-cd)pyrene	1 / 3	1,300.000	0.000	500	ug/kg
SVOA	Naphthalene	1 / 3	520.000	0.000	500	ug/kg
PPCB	PCB-1260	2 / 3	1,183.000	0.000	114	ug/kg
PPCB	Polychlorinated biphenyl	1 / 1	200.000	0.000	700	ug/kg
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	2 / 2	0.450	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	2 / 2	0.064	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	2 / 2	0.006	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2 / 2	0.007	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	2 / 2	0.009	0.000	0.003	ug/kg

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

Table 4.5. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 82 surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2 / 2	0.018	0.000	0.003	ug/kg
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	2 / 2	0.004	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	2 / 2	0.009	0.000	0.003	ug/kg
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	2 / 2	0.014	0.000	0.001	ug/kg
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	2 / 2	0.012	0.000	0.001	ug/kg
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	2 / 2	25.300	0.000	0.006	ug/kg
DI/FURA	Octachlorodibenzofuran	2 / 2	0.175	0.000	0.006	ug/kg
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzofuran	1 / 2	0.000	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	1 / 2	0.002	0.000	0.001	ug/kg
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	1 / 2	0.003	0.000	0.003	ug/kg
METAL		0 / 0				
RADS	Thorium-234	2 / 3	122.000	0.000	15	pCi/g
RADS	Uranium	2 / 2	46.700	0.000	1.69	pCi/g
RADS	Uranium-234	2 / 2	7.550	2.500	0.269	pCi/g
RADS	Uranium-238	2 / 2	38.500	1.200	1.37	pCi/g

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

Table 4.6. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 82 surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Acenaphthene	0	1	082012SA001	350.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	082003SA001	120.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	082009SA001	170.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	082012SA001	510.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	082003SA001	210.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	082009SA001	310.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	082012SA001	1,300.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	082003SA001	290.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	082009SA001	550.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	082012SA001	2,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	082003SA001	580.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	082009SA001	850.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	082012SA001	5,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	082009SA001	540.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	082003SA001	260.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	082009SA001	470.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	082012SA001	1,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenz(a,h)anthracene	0	1	082009SA001	100.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenzofuran	0	1	082012SA001	280.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Diethyl phthalate	0	1	082003SA001	260.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	082003SA001	560.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	082009SA001	810.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	082012SA001	1,700.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	082012SA001	400.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	082012SA001	1,300.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	082012SA001	520.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	082003SA001	410.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	082009SA001	560.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	082012SA001	1,200.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.6. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 82 surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Pyrene	0	1	082003SA001	370.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	082009SA001	680.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	082012SA001	1,700.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
PPCB	PCB-1260	0	1	082009SA001	292.000		X		0.000	112	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1260	0	1	082012SA001	1,183.000		X		0.000	114	ug/kg	ONSE	SW846-8082 M
PPCB	Polychlorinated biphenyl	0	1	082009SA001	200.000		X	NR	0.000	700	ug/kg	PGDP	SW846-8082
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	082009SA001	0.340		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	082012SA001	0.450		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	082009SA001	0.049		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	082012SA001	0.064		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	082009SA001	0.005		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	082012SA001	0.006		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	082009SA001	0.006		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	082012SA001	0.007		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	082009SA001	0.007		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	082012SA001	0.009		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	082009SA001	0.016		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	082012SA001	0.018		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	082009SA001	0.003		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	082012SA001	0.004		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	082009SA001	0.007		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	082012SA001	0.009		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzofuran	0	1	082009SA001	0.000	J	X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	0	1	082009SA001	0.002		X	NR	0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	0	1	082009SA001	0.003	J	X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	082009SA001	0.005		X	NR	0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	082012SA001	0.014		X		0.000	0.001	ug/kg	SWRI	SW846-8290

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.6. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 82 surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	0	1	082009SA001	0.006		X	NR	0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	0	1	082012SA001	0.012		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	082009SA001	12.600	E	X	NR	0.000	0.006	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	082012SA001	25.300	E	X		0.000	0.006	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	082009SA001	0.163		X	NR	0.000	0.006	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	082012SA001	0.175		X		0.000	0.006	ug/kg	SWRI	SW846-8290
RADS	Thorium-234	0	1	082009SA001	14.400	X	X		0.000	2.61	pCi/g	PGDP	RL-7124
RADS	Thorium-234	0	1	082012SA001	122.000		X		0.000	15	pCi/g	PARGN	DNT
RADS	Uranium	0	1	082009SA001	18.500		X		0.000	3	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	082012SA001	46.700		X		0.000	1.69	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	082009SA001	3.810		X		2.500	0.608	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	082012SA001	7.550		X		2.500	0.269	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	082009SA001	14.400		X		1.200	2.29	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	082012SA001	38.5		X		1.200	1.37	pCi/g	PGDP	RL-7124

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.7. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 82 subsurface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Subsurface Background	Detection Limit	Units
VOA		0 / 24				
SVOA	Di-n-butyl phthalate	3 / 20	1,600.000	0.000	490	ug/kg
SVOA	bis(2-Ethylhexyl)phthalate	1 / 20	540.000	0.000	500	ug/kg
PPCB		0 / 7				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS		0 / 24				

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all subsurface samples, including split and duplicate samples

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Table 4.8. Detections of organic compounds exceeding background values in SWMU 82 subsurface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Subsurface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	bis(2-Ethylhexyl)phthalate	3	6	082011SA006	540.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Di-n-butyl phthalate	3	6	082002SA006	590.000	B	X		0.000	470	ug/kg	PGDP	SW846-8270
SVOA	Di-n-butyl phthalate	3	6	082011SA006	1,600.000	B	X		0.000	460	ug/kg	PGDP	SW846-8270
SVOA	Di-n-butyl phthalate	33	36	082005SA036	1,600.000	B	X		0.000	490	ug/kg	PGDP	SW846-8270

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.9. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 82 storm water

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Background	Detection Limit	Units
VOA		0 / 3				
SVOA	bis(2-Ethylhexyl)phthalate	1 / 3	11.000	0.000	10	ug/L
SVOA	Di-n-butyl phthalate	1 / 3	6.000	0.000	10	ug/L
SVOA	Diethyl phthalate	1 / 3	9.000	0.000	10	ug/L
PPCB		0 / 3				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS	Technetium-99	1 / 2	23.400	0.000	14	pCi/L

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all storm water samples, including split and duplicate samples

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Table 4.10. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 82 storm water

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Bis(2-ethylhexyl)phthalate	0	0	082007WA000	11.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
SVOA	Di-n-butyl phthalate	0	0	082007WA000	6.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
SVOA	Diethyl phthalate	0	0	082007WA000	9.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
RADS	Technetium-99	0	0	082007WA000	23.400		X	NR	0.000	14	pCi/L	PARGN	DNT

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.11. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 82 groundwater

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Background	Detection Limit	Units
VOA	cis-1,2-Dichloroethene	1 / 1	0.200	0.000	1	ug/L
VOA	Trichloroethene	1 / 1	19.000	0.000	1	ug/L
SVOA		0 / 0				
PPCB		0 / 0				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS	Technetium-99	1 / 1	45.000	0.000	14	pCi/L

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all groundwater samples, including split and duplicate samples

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Table 4.12. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 82 groundwater

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Background	Detection Limit	Units	Laboratory	Analytical Method
VOA	cis-1,2-Dichloroethene	35	40	082008WA043	0.200	J	X		0.000	1	ug/L	ONSE	SW846-8021 M
VOA	Trichloroethene	35	40	082008WA043	19.000		X		0.000	1	ug/L	ONSE	SW846-8021 M
RADS	Technetium-99	35	40	082008WA043	45.000		X	NR	0.000	14	pCi/L	PARGN	DNT

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.13. Analytical groups tested by sample at SWMU 83

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Surface Soil Samples						
083002SA001		X	X			X
083006SA001		X	X			X
083009SA001		X	X			X
Subsurface Soil Samples						
083003SA006	X	X	X			
083003SA011	X	X	X		X	X
083003SA017	X	X	X			
083003SA030	X	X			X	X
083003SA033	X	X			X	X
083003SA041	X					
083008SA006	X	X	X		X	X
083008SA011	X	X	X		X	X
083008SA024	X	X			X	X
083008SA031	X	X			X	X
083008SA038	X	X				
083010SA006	X	X				
083010SA011	X	X	X		X	X
083010SA017	X	X	X		X	X
083010SA023	X	X			X	X
083010SA031	X					
083012SA006	X	X	X		X	X
083012SA011	X	X	X		X	X
083012SA017	X	X	X		X	X
083012SA023	X	X			X	X
083012SA031	X	X			X	X
Storm Water Samples						
083004WA000	X	X	X			X
083007WA000	X	X	X			X
083011WA000	X	X	X			
Groundwater Samples						
083003WA033	X	X				X
083003WA033-45						X
083003WA033-5						X

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Table 4.14. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 83 surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
VOA		0 / 0				
SVOA	Benzo(b)fluoranthene	2 / 3	850.000	0.000	500	ug/kg
SVOA	Benz(a)anthracene	1 / 3	190.000	0.000	500	ug/kg
SVOA	Benzo(a)pyrene	1 / 3	410.000	0.000	500	ug/kg
SVOA	Chrysene	1 / 3	250.000	0.000	500	ug/kg
SVOA	Fluoranthene	1 / 3	430.000	0.000	500	ug/kg
SVOA	Indeno(1,2,3-cd)pyrene	1 / 3	230.000	0.000	500	ug/kg
SVOA	Phenanthrene	1 / 3	250.000	0.000	500	ug/kg
SVOA	Pyrene	1 / 3	390.000	0.000	500	ug/kg
PPCB		0 / 3				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS		0 / 3				

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

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Table 4.15. Detections of organic compounds exceeding background values in SWMU 83 surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Benz(a)anthracene	0	1	083002SA001	190.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	083002SA001	410.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	083002SA001	850.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	083009SA001	170.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	083002SA001	250.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	083002SA001	430.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	083002SA001	230.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	083002SA001	250.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	083002SA001	390.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.16. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 83 subsurface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Subsurface Background	Detection Limit	Units
VOA		0 / 21				
SVOA		0 / 19				
PPCB		0 / 10				
DI/FURA		0 / 0				
METAL	Aluminum	3 / 15	17,500.000	12,000.000	20	mg/kg
METAL	Beryllium	2 / 15	0.760	0.690	0.5	mg/kg
METAL	Nickel	2 / 15	24.500	22.000	5	mg/kg
METAL	Vanadium	2 / 15	46.100	37.000	2	mg/kg
METAL	Iron	1 / 15	32,000.000	28,000.000	250	mg/kg
METAL	Magnesium	1 / 15	2,190.000	2,100.000	15	mg/kg
RADS		0 / 15				

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all subsurface samples, including split and duplicate samples

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Table 4.17. Detections of metals exceeding background values in SWMU 83 subsurface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Subsurface Background	Detection Limit	Units	Laboratory	Analytical Method
METAL	Aluminum	3	6	083008SA006	14,700.000	*NW	J		12,000.000	20	mg/kg	PGDP	SW846-6010A
METAL	Aluminum	3	6	083012SA006	17,500.000	*NW	J		12,000.000	20	mg/kg	PGDP	SW846-6010A
METAL	Aluminum	28	31	083012SA031	16,400.000	*NW	J		12,000.000	20	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	3	6	083012SA006	0.720		=		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	28	31	083012SA031	0.760		=		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Iron	28	31	083012SA031	32,000.000	*N	J		28,000.000	250	mg/kg	PGDP	SW846-6010A
METAL	Magnesium	3	6	083012SA006	2,190.000	N	J		2,100.000	15	mg/kg	PGDP	SW846-6010A
METAL	Nickel	3	6	083012SA006	23.400		=		22.000	5	mg/kg	PGDP	SW846-6010A
METAL	Nickel	28	31	083012SA031	24.500		=		22.000	5	mg/kg	PGDP	SW846-6010A
METAL	Vanadium	28	31	083008SA031	43.700	*N	=		37.000	2	mg/kg	PGDP	SW846-6010A
METAL	Vanadium	28	31	083012SA031	46.100		=		37.000	2	mg/kg	PGDP	SW846-6010A

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.18. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 83 storm water

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Background	Detection Limit	Units
VOA		0 / 3				
SVOA	bis(2-Ethylhexyl)phthalate	2 / 3	14.000	0.000	10	ug/L
SVOA	Di-n-butyl phthalate	2 / 3	7.000	0.000	10	ug/L
SVOA	Diethyl phthalate	2 / 3	8.000	0.000	10	ug/L
PPCB		0 / 3				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS	Technetium-99	2 / 2	17.400	0.000	14	pCi/L

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all storm water samples, including split and duplicate samples

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Table 4.19. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 83 storm water

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Bis(2-ethylhexyl)phthalate	0	0	083004WA000	10.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
SVOA	Bis(2-ethylhexyl)phthalate	0	0	083007WA000	14.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
SVOA	Di-n-butyl phthalate	0	0	083004WA000	7.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
SVOA	Di-n-butyl phthalate	0	0	083007WA000	6.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
SVOA	Diethyl phthalate	0	0	083004WA000	8.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
SVOA	Diethyl phthalate	0	0	083007WA000	8.000	J	X		0.000	10	ug/L	ONSE	SW846-8270 M
RADS	Technetium-99	0	0	083004WA000	17.400		X		0.000	14	pCi/L	PARGN	DNT
RADS	Technetium-99	0	0	083007WA000	14.600		X		0.000	14	pCi/L	PARGN	DNT

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.20. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 83 groundwater

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Background	Detection Limit	Units
VOA		0 / 1				
SVOA		0 / 1				
PPCB		0 / 0				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS	Technetium-99	1 / 1	25.900	0.000	12	pCi/L

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all groundwater samples, including split and duplicate samples

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Table 4.21. Detections of radioactive isotopes exceeding background values in SWMU 83 groundwater

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Background	Detection Limit	Units	Laboratory	Analytical Method
RADS	Technetium-99	30	33	083003WA033	25.900		X		0.000	12	pCi/L	PARGN	DNT

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4. 22. Analytical groups tested by sample at SWMU 84

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Surface Soil Samples						
084003SA001		X	X			X
084006SA001		X	X			X
084010SA001		X	X	X		X
084013SA001		X	X			X
084014SA001		X	X	X		X
084016SA001		X	X			X
Subsurface Soil Samples						
084001SA006	X	X	X			X
084001SA011	X	X	X			X
084001SA016	X	X	X			X
084001SA026	X					X
084004SA006	X	X	X			X
084004SA011	X	X	X			X
084004SA016	X	X	X			X
084004SA027	X	X				X
084004SA033	X	X				X
084005SA006	X	X	X			X
084005SA011	X	X	X			X
084005SA015	X	X	X			X
084005SA027	X	X				X
084005SA035	X	X				X
084005SA058	X	X				X
084009SA006	X	X	X			X
084009SA011	X	X	X			X
084009SA019	X	X	X			X
084009SA027	X	X				X
084009SA038	X	X				X
084009SA058	X	X				X
084015SA008	X	X	X			X
084015SA013	X					X
084015SA021	X	X				X
084015SA026	X	X				X
084015SA035	X	X				X
084015SA056	X	X				X
Storm Water Samples						
084007WA000	X	X	X			X
084011WA000	X	X	X			X
084012WA000	X	X	X			

Table 4. 22. Analytical groups tested by sample at SWMU 84

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Groundwater Samples						
084004WA060	X	X				X
084005WA058	X	X				X
084009WA058	X	X				X
084015WA056	X	X				X

Table 4.23. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 84 surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
VOA		0 / 0				
SVOA	Benz(a)anthracene	1 / 6	175.000	0.000	500	ug/kg
SVOA	Benzo(a)pyrene	1 / 6	270.000	0.000	500	ug/kg
SVOA	Benzo(b)fluoranthene	1 / 6	510.000	0.000	500	ug/kg
SVOA	Chrysene	1 / 6	240.000	0.000	500	ug/kg
SVOA	Fluoranthene	1 / 6	480.000	0.000	500	ug/kg
SVOA	Phenanthrene	1 / 6	290.000	0.000	500	ug/kg
SVOA	Pyrene	1 / 6	400.000	0.000	500	ug/kg
PPCB	PCB-1254	1 / 6	75.000	0.000	127	ug/kg
PPCB	PCB-1260	1 / 6	380.000	0.000	129	ug/kg
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	2 / 2	0.186	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	2 / 2	0.025	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	2 / 2	0.004	0.000	0.003	ug/kg
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2 / 2	0.010	0.000	0.003	ug/kg
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	2 / 2	0.005	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	2 / 2	0.006	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	2 / 2	0.001	0.000	0.001	ug/kg
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	2 / 2	0.002	0.000	0.003	ug/kg
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	2 / 2	0.001	0.000	0.001	ug/kg
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	2 / 2	6.790	0.000	0.007	ug/kg
DI/FURA	Octachlorodibenzofuran	2 / 2	0.061	0.000	0.007	ug/kg
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	1 / 2	0.002	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1 / 2	0.001	0.000	0.003	ug/kg
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	1 / 2	0.002	0.000	0.001	ug/kg

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

Table 4.23. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 84 surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
METAL		0 / 0				
RADS	Cesium-137	1 / 6	1.900	0.490	1.1	pCi/g

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

Table 4.24. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 84 surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Benz(a)anthracene	0	1	084014SA001	175.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	084014SA001	270.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	084014SA001	510.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	084014SA001	240.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	084014SA001	480.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	084014SA001	290.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	084014SA001	400.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
PPCB	PCB-1254	0	1	084014SA001	75.000	J	X		0.000	127	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1260	0	1	084010SA001	380.000		X		0.000	129	ug/kg	ONSE	SW846-8082 M
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	084010SA001	0.186		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	084014SA001	0.040		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	084010SA001	0.025		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	084014SA001	0.005		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	084010SA001	0.002	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	084014SA001	0.001	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	084010SA001	0.004		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	084014SA001	0.001	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	084010SA001	0.010		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	084014SA001	0.002	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	084010SA001	0.005		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	084014SA001	0.001	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	084010SA001	0.006		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	084014SA001	0.001	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	0	1	084010SA001	0.001	J	X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	0	1	084014SA001	0.001	J	X		0.000	0.001	ug/kg	SWRI	SW846-8290

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.24. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 84 surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	0	1	084010SA001	0.002	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	0	1	084014SA001	0.001	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	084010SA001	0.001		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	084014SA001	0.001	J	X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	0	1	084010SA001	0.002		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	084010SA001	6.790	E	X		0.000	0.007	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	084014SA001	2.680	E	X		0.000	0.006	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	084010SA001	0.061		X		0.000	0.007	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	084014SA001	0.011		X		0.000	0.006	ug/kg	SWRI	SW846-8290
RADS	Cesium-137	0	1	084010SA001	1.900		X		0.490	1.1	pCi/g	PARGN	DNT

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.25. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 84 subsurface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Subsurface Background	Detection Limit	Units
VOA	Acetone	8 / 27	4,200.000	0.000	250.000	ug/kg
SVOA	Bis(2-chloroethoxy)methane	1 / 25	240.000	0.000	500	ug/kg
SVOA	Bis(2-ethylhexyl)phthalate	1 / 25	240.000	0.000	500	ug/kg
SVOA	Di-n-butyl phthalate	1 / 25	3,800.000	0.000	410	ug/kg
PPCB		0 / 13				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS	Technetium-99	1 / 25	5.840	2.800	4.17	pCi/g

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all subsurface samples, including split and duplicate samples

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Table 4.26. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 84 subsurface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Subsurface Background	Detection Limit	Units	Laboratory	Analytical Method
VOA	Acetone	3	6	084001SA006	970.000	J	X		0.000	250	ug/kg	PORTS	SW846-8260A
VOA	Acetone	3	6	084005SA006	3,500.000		X	BL-T	0.000	250	ug/kg	PORTS	SW846-8260A
VOA	Acetone	3	6	084009SA006	760.000	J	X	BL-T	0.000	250	ug/kg	PORTS	SW846-8260A
VOA	Acetone	3	9	084004SA006	1,100.000		X	BL-T	0.000	250	ug/kg	PORTS	SW846-8260A
VOA	Acetone	8	11	084001SA011	480.000		X		0.000	250	ug/kg	PORTS	SW846-8260A
VOA	Acetone	10	13	084015SA013	530.000	J	X	BL-T	0.000	250	ug/kg	PORTS	SW846-8260A
VOA	Acetone	23	24	084001SA026	1,200.000	J	X		0.000	250	ug/kg	PORTS	SW846-8260A
VOA	Acetone	52	55	084009SA058	4,200.000	J	X	BL-T	0.000	250	ug/kg	PORTS	SW846-8260A
SVOA	bis(2-Chloroethoxy)methane	35	38	084009SA038	240.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	bis(2-Ethylhexyl)phthalate	35	38	084009SA038	240.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Di-n-butyl phthalate	13	16	084004SA016	3,800.000	B	X		0.000	410	ug/kg	PGDP	SW846-8270
RADS	Technetium-99	24	27	084009SA027	5.840		X		2.800	4.17	pCi/g	PGDP	RL-7116

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.27. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 84 storm water

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Background	Detection Limit	Units
VOA		0 / 3				
SVOA	bis(2-Ethylhexyl)phthalate	1 / 3	11.000	0.000	20	ug/L
SVOA	Diethyl phthalate	1 / 3	22.000	0.000	20	ug/L
PPCB		0 / 3				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS	Technetium-99	2 / 2	17.900	0.000	14	pCi/L

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all storm water samples, including split and duplicate samples

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Table 4.28. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 84 storm water

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	bis(2-Ethylhexyl)phthalate	0	0	084007WA000	11.000	J	X		0.000	20	ug/L	ONSE	SW846-8270 M
SVOA	Diethyl phthalate	0	0	084007WA000	22.000		X		0.000	20	ug/L	ONSE	SW846-8270 M
RADS	Technetium-99	0	0	084007WA000	17.900		X		0.000	14	pCi/L	PARGN	DNT
RADS	Technetium-99	0	0	084011WA000	14.500		X		0.000	14	pCi/L	PARGN	DNT

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.29. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 84 groundwater

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Background	Detection Limit	Units
VOA	1,1-Dichloroethene	1 / 4	0.100	0.000	1	ug/L
VOA	Acetone	1 / 1	88.000	0.000	10	ug/L
SVOA	bis(2-Ethylhexyl)phthalate	1 / 4	21.000	0.000	5	ug/L
PPCB		0 / 0				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS	Technetium-99	4 / 4	45.000	0.000	13	pCi/L

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all groundwater samples, including split and duplicate samples

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Table 4.30. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 84 groundwater

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Background	Detection Limit	Units	Laboratory	Analytical Method
VOA	1,1-Dichloroethene	55.5	55.5	084005WA058	0.100	J	X		0.000	1	ug/L	ONSE	SW846-8021 M
VOA	Acetone	53	56	084015WA056	88.000		X	BH-FB,&	0.000	10	ug/L	PGDP	SW846-8260
SVOA	Bis(2-ethylhexyl)phthalate	53	56	084015WA056	21.000	J	X		0.000	5	ug/L	PGDP	SW846-8270
RADS	Technetium-99	50.5	50.5	084004WA060	39.000		X		0.000	12	pCi/L	PARGN	DNT
RADS	Technetium-99	55	55	084009WA058	45.000		X		0.000	13	pCi/L	PARGN	DNT
RADS	Technetium-99	55.5	55.5	084005WA058	22.000		X		0.000	17	pCi/L	PARGN	DNT
RADS	Technetium-99	53	56	084015WA056	32.500		X		0.000	18.1	pCi/L	PGDP	RL-7100

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.31. Analytical groups tested by sample at SWMU 85

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Surface Soil Samples						
085003SA001		X	X			X
085008SA001		X	X	X		X
085010SA001		X	X			X
085014SA001		X	X			X
Subsurface Soil Samples						
085001SA006	X	X	X			X
085001SA013	X	X	X			X
085001SA030	X	X				X
085001SA041	X	X				X
085004SA006	X	X				X
085004SA013	X	X	X			X
085004SA030	X	X				X
085004SA041	X	X				X
085004SA053	X	X				X
085004SA060	X					
085007SA006	X	X	X			X
085007SA013	X	X	X			X
085007SA030	X	X				X
085007SA041	X	X				X
085007SA053	X					X
085007SA060	X					
085011SA006	X	X				X
085011SA013	X	X	X			X
085011SA030	X	X				X
085011SA040	X	X				X
085011SA051	X					X
085011SA060	X					
085013SA006	X	X	X			X
085013SA013	X	X	X			X
085013SA030	X	X				X
Storm Water Samples						
085005WA000	X	X	X			
085006WA000	X	X	X			
085012WA000	X	X	X			X
Groundwater Samples						
085001WA060	X					X
085004WA060	X					X

Table 4.31. Analytical groups tested by sample at SWMU 85

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Groundwater Samples (cont.)						
085007WA060	X					X
085011WA060	X					X

Table 4.32. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 85 surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
VOA		0 / 0				
SVOA	Benzo(b)fluoranthene	2 / 4	960.000	0.000	500	ug/kg
SVOA	Benz(a)anthracene	1 / 4	330.000	0.000	500	ug/kg
SVOA	Chrysene	1 / 4	390.000	0.000	500	ug/kg
SVOA	Fluoranthene	1 / 4	420.000	0.000	500	ug/kg
SVOA	Indeno(1,2,3-cd)pyrene	1 / 4	190.000	0.000	500	ug/kg
SVOA	Pyrene	1 / 4	460.000	0.000	500	ug/kg
PPCB	PCB-1260	1 / 4	71.000	0.000	119	ug/kg
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1 / 1	0.249	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	1 / 1	0.029	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	1 / 1	0.004	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1 / 1	0.004	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	1 / 1	0.004	0.000	0.003	ug/kg
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1 / 1	0.010	0.000	0.003	ug/kg
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	1 / 1	0.016	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1 / 1	0.007	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1 / 1	0.002	0.000	0.001	ug/kg
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	1 / 1	0.004	0.000	0.001	ug/kg
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	1 / 1	9.180	0.000	0.007	ug/kg
DI/FURA	Octachlorodibenzofuran	1 / 1	0.090	0.000	0.007	ug/kg
METAL		0 / 0				
RADS		0 / 4				

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

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Table 4.33. Detections of organic compounds exceeding background values in SWMU 85 surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Benz(a)anthracene	0	1	085003SA001	330.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	085003SA001	960.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	085010SA001	230.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	085003SA001	390.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	085003SA001	420.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	085003SA001	190.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	085003SA001	460.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
PPCB	PCB-1260	0	1	085008SA001	71.000	J	X		0.000	119	ug/kg	ONSE	SW846-8082 M
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	085008SA001	0.249		J		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	085008SA001	0.029		=		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	085008SA001	0.004		J		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	085008SA001	0.004		=		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	085008SA001	0.004		=		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	085008SA001	0.010		=		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	085008SA001	0.016		=		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	085008SA001	0.007		=		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0	1	085008SA001	0.002		=		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	085008SA001	0.004		=		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	085008SA001	9.180	E	J		0.000	0.007	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	085008SA001	0.090		J		0.000	0.007	ug/kg	SWRI	SW846-8290

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.34. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 85 subsurface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Subsurface Background	Detection Limit	Units
VOA		0 / 25				
SVOA		0 / 20				
PPCB		0 / 8				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS		0 / 22				

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all subsurface samples, including split and duplicate samples

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Table 4.35. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 85 subsurface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Subsurface Background	Detection Limit	Units	Laboratory	Analytical Method
No analytes detected in SWMU 85 subsurface soil													

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.36. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 85 storm water

Analytical Group	Analytical Compound	Number of Detects	/	Total Number of Samples (a)	Maximum Result (b)	Background	Detection Limit	Units
VOA	Methylene chloride	1	/	2	10.000	0.000	10	ug/L
SVOA		0	/	3				
PPCB		0	/	3				
DI/FURA		0	/	0				
METAL		0	/	0				
RADS	Technetium-99	1	/	1	16.200	0.000	14	pCi/L

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all storm water samples, including split and duplicate samples

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Table 4.37. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 85 storm water

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Background	Detection Limit	Units	Laboratory	Analytical Method
VOA	Methylene chloride	0	0	085005WA000	10.000	JU	J		0.000	10	ug/L	PGDP	SW846-8260
RADS	Technetium-99	0	0	085012WA000	16.200		X		0.000	14	pCi/L	PARGN	DNT

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.38. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in SWMU 85 groundwater

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Background	Detection Limit	Units
VOA	1,1-Dichloroethene	1 / 4	9.000	0.000	1	ug/L
VOA	Trichloroethene	1 / 4	1.000	0.000	1	ug/L
VOA	Vinyl chloride	1 / 4	0.150	0.000	1	ug/L
SVOA		0 / 0				
PPCB		0 / 0				
DI/FURA		0 / 0				
METAL		0 / 0				
RADS	Technetium-99	2 / 4	28.000	0.000	13	pCi/L

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all groundwater samples, including split and duplicate samples

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Table 4.39. Detections of organic compounds and radioactive isotopes exceeding background values in SWMU 85 groundwater

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Background	Detection Limit	Units	Laboratory	Analytical Method
VOA	1,1-Dichloroethene	56	58	085007WA060	9.000		X		0.000	1	ug/L	ONSE	SW846-8021 M
VOA	Trichloroethene	56	56	085011WA060	1.000		X		0.000	1	ug/L	ONSE	SW846-8021 M
VOA	Vinyl chloride	55	56	085004WA060	0.150	J	X		0.000	1	ug/L	ONSE	SW846-8021 M
RADS	Technetium-99	55	56	085004WA060	28.000		X		0.000	13	pCi/L	PARGN	DNT
RADS	Technetium-99	56	56	085011WA060	25.000		J		0.000	17.4	pCi/L	PGDP	RL-7100

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.40. Analytical groups tested by sample at C-340 Area

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Surface Soil Samples						
340001SA001		X	X		X	X
340002SA001		X	X	X	X	X
340003SA001		X	X	X	X	X
340005SA001		X	X		X	X
340006SA001		X	X	X	X	X
340008SA001		X	X		X	X
340010SA001		X	X	X	X	X
340011SA001		X	X	X	X	X
340012SA001C		X	X		X	X
340013SA001C		X	X		X	X
340014SA001C		X	X		X	X
340015SA001C		X	X		X	X
Subsurface Soil Samples						
340002SA011	X	X	X		X	X
340002SA023	X	X	X		X	X
340002SA026	X	X			X	X
340002SA033	X	X			X	X
340002SA047	X	X			X	X
340002SA060	X					X
340005SA011	X	X	X		X	X
340005SA025	X	X			X	X
340005SA033	X	X			X	X
340005SA040	X	X			X	X
340005SA056	X	X			X	X
340005SA060	X					X
340007SA011	X	X	X		X	X
340007SA023	X	X			X	X
340007SA036	X	X			X	X
340007SA044	X	X			X	X
340007SA054	X	X			X	X
340007SA060	X	X			X	X
340011SA011	X	X	X		X	X
340011SA024	X					X
340011SA030	X	X			X	X
340011SA035	X					X
340011SA047	X	X			X	X
340011SA060	X	X			X	X

Table 4.40. Analytical groups tested by sample at C-340 Area

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Storm Water Samples						
Media not sampled at C-340 Building Area						
Groundwater Samples						
Media not sampled at C-340 Building Area						

Table 4.41. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
VOA		0 / 0				
SVOA	Anthracene	11 / 12	45,000.000	0.000	500	ug/kg
SVOA	Benz(a)anthracene	11 / 12	90,000.000	0.000	500	ug/kg
SVOA	Benzo(a)pyrene	11 / 12	113,000.000	0.000	500	ug/kg
SVOA	Benzo(b)fluoranthene	11 / 12	121,000.000	0.000	500	ug/kg
SVOA	Benzo(k)fluoranthene	11 / 12	93,000.000	0.000	500	ug/kg
SVOA	Chrysene	11 / 12	86,000.000	0.000	500	ug/kg
SVOA	Fluoranthene	11 / 12	71,000.000	0.000	500	ug/kg
SVOA	Indeno(1,2,3-cd)pyrene	11 / 12	94,000.000	0.000	500	ug/kg
SVOA	Phenanthrene	11 / 12	72,000.000	0.000	500	ug/kg
SVOA	Pyrene	11 / 12	108,000.000	0.000	500	ug/kg
SVOA	Fluorene	10 / 12	16,000.000	0.000	500	ug/kg
SVOA	Acenaphthene	8 / 12	12,000.000	0.000	500	ug/kg
SVOA	Naphthalene	8 / 12	4,750.000	0.000	500	ug/kg
SVOA	Benzo(ghi)perylene	7 / 7	84,000.000	0.000	500	ug/kg
SVOA	Dibenzofuran	6 / 12	4,600.000	0.000	500	ug/kg
SVOA	Dibenz(a,h)anthracene	4 / 12	71,000.000	0.000	500	ug/kg
SVOA	2-Methylnaphthalene	1 / 12	300.000	0.000	500	ug/kg
SVOA	Acenaphthylene	1 / 12	770.000	0.000	500	ug/kg
SVOA	Bis(2-ethylhexyl)phthalate	1 / 12	540.000	0.000	500	ug/kg
PPCB	PCB-1254	6 / 12	83,600.000	0.000	9549	ug/kg
PPCB	PCB-1260	5 / 12	26,200.000	0.000	9549	ug/kg
PPCB	PCB-1248	3 / 12	1,076,381.000	0.000	191527	ug/kg
PPCB	PCB-1242	1 / 12	439.000	0.000	103	ug/kg

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

Table 4.41. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	5 / 5	0.711	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	5 / 5	0.145	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	5 / 5	0.021	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	5 / 5	0.010	0.000	0.003	ug/kg
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	5 / 5	0.045	0.000	0.003	ug/kg
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	5 / 5	0.394	0.000	0.003	ug/kg
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	5 / 5	0.023	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	5 / 5	0.105	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	5 / 5	0.008	0.000	0.001	ug/kg
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	5 / 5	0.029	0.000	0.003	ug/kg
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	5 / 5	0.021	0.000	0.001	ug/kg
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	5 / 5	0.032	0.000	0.001	ug/kg
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	5 / 5	10.100	0.000	0.006	ug/kg
DI/FURA	Octachlorodibenzofuran	5 / 5	0.255	0.000	0.006	ug/kg
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzofuran	3 / 5	0.001	0.000	0.003	ug/kg
DI/FURA	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2 / 5	0.006	0.000	0.001	ug/kg
DI/FURA	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1 / 5	0.002	0.000	0.001	ug/kg
METAL	Chromium	9 / 12	371.000	16.000	2	mg/kg
METAL	Zinc	9 / 12	272.000	65.000	15	mg/kg
METAL	Calcium	5 / 12	335,000.000	200,000.000	2500	mg/kg
METAL	Copper	4 / 12	158.000	19.000	2	mg/kg
METAL	Nickel	4 / 12	382.000	21.000	5	mg/kg
METAL	Beryllium	3 / 12	1.370	0.670	0.5	mg/kg
METAL	Lead	3 / 12	70.500	36.000	20	mg/kg
METAL	Magnesium	2 / 12	16,000.000	7,700.000	150	mg/kg
METAL	Aluminum	1 / 12	15,400.000	13,000.000	20	mg/kg

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

Table 4.41. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Near Surface Background	Detection Limit	Units
METAL	Mercury	1 / 12	0.430	0.200	0.2	mg/kg
METAL	Potassium	1 / 12	1,400.000	1,300.000	100	mg/kg
METAL	Sodium	1 / 12	421.000	320.000	200	mg/kg
RADS	Thorium-234	11 / 12	2,890.000	0.000	102	pCi/g
RADS	Uranium	9 / 9	3,160.000	0.000	13.7	pCi/g
RADS	Uranium-238	9 / 9	2,740.000	1.200	11.7	pCi/g
RADS	Uranium-234	8 / 9	379.000	2.500	1.63	pCi/g
RADS	Technetium-99	6 / 12	105.000	2.500	4.34	pCi/g
RADS	Plutonium-239/240	4 / 9	0.304	0.000	0.0506	pCi/g
RADS	Protactinium-234m	4 / 12	5,000.000	0.000	689	pCi/g
RADS	Uranium-235	3 / 12	49.000	0.140	19	pCi/g
RADS	Neptunium-237	1 / 9	0.165	0.100	0.109	pCi/g

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all surface samples, including split and duplicate samples

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Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	2-Methylnaphthalene	0	1	340003SA001	300.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthene	0	1	340001SA001	840.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthene	0	1	340003SA001	4,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthene	0	1	340006SA001	3,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthene	0	1	340008SA001	12,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthene	0	1	340010SA001	4,600.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthene	0	1	340012SA001C	4,100.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthene	0	1	340013SA001C	7,061.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthene	0	1	340014SA001C	1,650.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Acenaphthylene	0	1	340011SA001	770.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340001SA001	5,800.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340002SA001	140.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340003SA001	7,200.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340006SA001	6,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340008SA001	45,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340010SA001	12,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340011SA001	3,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340012SA001C	10,700.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340013SA001C	18,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340014SA001C	3,870.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Anthracene	0	1	340015SA001C	3,320.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340001SA001	4,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340002SA001	420.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340003SA001	17,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340006SA001	14,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340008SA001	90,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340010SA001	19,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340011SA001	5,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340012SA001C	22,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Benz(a)anthracene	0	1	340013SA001C	35,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340014SA001C	7,380.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benz(a)anthracene	0	1	340015SA001C	4,740.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340001SA001	8,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340002SA001	820.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340003SA001	30,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340006SA001	24,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340008SA001	113,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340010SA001	37,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340011SA001	3,200.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340012SA001C	28,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340013SA001C	18,300.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340014SA001C	13,940.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(a)pyrene	0	1	340015SA001C	8,770.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340001SA001	8,200.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340002SA001	1,900.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340003SA001	66,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340006SA001	50,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340008SA001	121,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340010SA001	34,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340011SA001	5,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340012SA001C	36,900.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340013SA001C	37,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340014SA001C	23,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	0	1	340015SA001C	13,100.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(ghi)perylene	0	1	340001SA001	3,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(ghi)perylene	0	1	340008SA001	84,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(ghi)perylene	0	1	340010SA001	13,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(ghi)perylene	0	1	340012SA001C	19,300.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Benzo(ghi)perylene	0	1	340013SA001C	25,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(ghi)perylene	0	1	340014SA001C	10,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(ghi)perylene	0	1	340015SA001C	4,060.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340001SA001	7,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340002SA001	260.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340003SA001	6,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340006SA001	5,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340008SA001	93,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340010SA001	31,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340011SA001	1,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340012SA001C	20,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340013SA001C	27,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340014SA001C	11,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(k)fluoranthene	0	1	340015SA001C	11,700.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	bis(2-Ethylhexyl)phthalate	0	1	340011SA001	540.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340001SA001	6,800.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340002SA001	540.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340003SA001	22,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340006SA001	17,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340008SA001	86,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340010SA001	28,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340011SA001	3,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340012SA001C	24,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340013SA001C	31,800.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340014SA001C	11,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Chrysene	0	1	340015SA001C	8,150.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenz(a,h)anthracene	0	1	340003SA001	7,200.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenz(a,h)anthracene	0	1	340006SA001	5,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenz(a,h)anthracene	0	1	340008SA001	60,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Dibenz(a,h)anthracene	0	1	340010SA001	71,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenzofuran	0	1	340001SA001	400.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenzofuran	0	1	340003SA001	1,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenzofuran	0	1	340006SA001	1,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenzofuran	0	1	340008SA001	4,600.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenzofuran	0	1	340010SA001	1,000.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Dibenzofuran	0	1	340013SA001C	3,640.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340001SA001	6,800.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340002SA001	740.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340003SA001	28,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340006SA001	26,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340008SA001	71,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340010SA001	26,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340011SA001	4,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340012SA001C	22,700.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340013SA001C	33,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340014SA001C	12,700.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluoranthene	0	1	340015SA001C	7,550.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340001SA001	930.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340003SA001	4,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340006SA001	3,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340008SA001	16,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340010SA001	5,100.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340011SA001	920.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340012SA001C	5,570.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340013SA001C	11,200.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340014SA001C	1,870.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Fluorene	0	1	340015SA001C	1,610.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340001SA001	4,300.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340002SA001	270.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340003SA001	13,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340006SA001	94,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340008SA001	93,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340010SA001	16,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340011SA001	2,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340012SA001C	19,300.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340013SA001C	26,700.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340014SA001C	11,100.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Indeno(1,2,3-cd)pyrene	0	1	340015SA001C	4,750.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	340001SA001	1,000.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	340003SA001	920.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	340006SA001	600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	340008SA001	3,500.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	340010SA001	1,200.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	340011SA001	320.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	340012SA001C	1,180.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Naphthalene	0	1	340013SA001C	4,750.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340001SA001	6,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340002SA001	450.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340003SA001	17,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340006SA001	15,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340008SA001	72,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340010SA001	25,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340011SA001	3,600.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340012SA001C	20,800.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340013SA001C	33,100.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340014SA001C	10,200.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Phenanthrene	0	1	340015SA001C	9,740.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
SVOA	Pyrene	0	1	340001SA001	7,800.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340002SA001	720.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340003SA001	24,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340006SA001	22,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340008SA001	108,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340010SA001	30,000.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340011SA001	5,400.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340012SA001C	23,900.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340013SA001C	41,500.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340014SA001C	15,900.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Pyrene	0	1	340015SA001C	6,480.000		X		0.000	500	ug/kg	ONSE	SW846-8270 M
PPCB	PCB-1242	0	1	340011SA001	439.000		X		0.000	103	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1248	0	1	340012SA001C	1,076,381.000		X		0.000	191527	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1248	0	1	340014SA001C	70,406.000		X		0.000	19666	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1248	0	1	340015SA001C	560,099.000		X		0.000	186700	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1254	0	1	340002SA001	547.000		X		0.000	96	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1254	0	1	340003SA001	6,148.000		X		0.000	112	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1254	0	1	340008SA001	83,600.000		X		0.000	9549	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1254	0	1	340010SA001	440.000		X		0.000	100	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1254	0	1	340011SA001	534.000		X		0.000	103	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1254	0	1	340013SA001C	8,100.000		X		0.000	1511	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1260	0	1	340001SA001	7,200.000		X		0.000	1223	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1260	0	1	340006SA001	256.000		X		0.000	104	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1260	0	1	340008SA001	26,200.000		X		0.000	9549	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1260	0	1	340010SA001	340.000		X		0.000	100	ug/kg	ONSE	SW846-8082 M
PPCB	PCB-1260	0	1	340011SA001	378.000		X		0.000	103	ug/kg	ONSE	SW846-8082 M
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	340002SA001	0.421		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	340003SA001	0.352		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	340006SA001	0.075		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	340010SA001	0.354		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0	1	340011SA001	0.711		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	340002SA001	0.067		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	340003SA001	0.067		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	340006SA001	0.038		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	340010SA001	0.062		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0	1	340011SA001	0.145		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	340002SA001	0.008		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	340003SA001	0.008		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	340006SA001	0.007		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	340010SA001	0.005		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0	1	340011SA001	0.021		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	340002SA001	0.009		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	340003SA001	0.007		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	340006SA001	0.003	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	340010SA001	0.009		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	1	340011SA001	0.010		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	340002SA001	0.014		X	NR	0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	340003SA001	0.016		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	340006SA001	0.016		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	340010SA001	0.005		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,4,7,8-Hexachlorodibenzofuran	0	1	340011SA001	0.045		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	340002SA001	0.021		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	340003SA001	0.013		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	340006SA001	0.003		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	340010SA001	0.026		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0	1	340011SA001	0.394		X		0.000	0.003	ug/kg	SWRI	SW846-8290

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	340002SA001	0.009		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	340003SA001	0.008		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	340006SA001	0.005		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	340010SA001	0.003		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,6,7,8-Hexachlorodibenzofuran	0	1	340011SA001	0.023		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	340002SA001	0.013		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	340003SA001	0.009		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	340006SA001	0.003		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	340010SA001	0.011		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0	1	340011SA001	0.105		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzofuran	0	1	340006SA001	0.000	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzofuran	0	1	340010SA001	0.000	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8,9-Hexachlorodibenzofuran	0	1	340011SA001	0.001	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0	1	340010SA001	0.006		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0	1	340011SA001	0.005		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	0	1	340002SA001	0.003		X	NR	0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	0	1	340003SA001	0.004		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	0	1	340006SA001	0.003		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	0	1	340010SA001	0.001	J	X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	1,2,3,7,8-Pentachlorodibenzofuran	0	1	340011SA001	0.008		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	0	1	340002SA001	0.014		X	NR	0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	0	1	340003SA001	0.003		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	0	1	340006SA001	0.007		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	0	1	340010SA001	0.001	J	X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,6,7,8-Hexachlorodibenzofuran	0	1	340011SA001	0.029		X		0.000	0.003	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	340002SA001	0.017		X	NR	0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	340003SA001	0.020		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	340006SA001	0.006		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	340010SA001	0.002		X		0.000	0.001	ug/kg	SWRI	SW846-8290

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
DI/FURA	2,3,4,7,8-Pentachlorodibenzofuran	0	1	340011SA001	0.021		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,7,8-Tetrachlorodibenzo-p-dioxin	0	1	340011SA001	0.002		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	0	1	340002SA001	0.016		X	NR	0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	0	1	340003SA001	0.032		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	0	1	340006SA001	0.012		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	0	1	340010SA001	0.004		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	2,3,7,8-Tetrachlorodibenzofuran	0	1	340011SA001	0.025		X		0.000	0.001	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	340002SA001	5.390	E	X	NR	0.000	0.005	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	340003SA001	10.100	E	X		0.000	0.006	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	340006SA001	7.080	E	X		0.000	0.006	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	340010SA001	3.600		X		0.000	0.005	ug/kg	SWRI	SW846-8290
DI/FURA	Octachloro-dibenzo[b,e][1,4]dioxin	0	1	340011SA001	3.410	E	X		0.000	0.005	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	340002SA001	0.150		X	NR	0.000	0.005	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	340003SA001	0.255		X		0.000	0.006	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	340006SA001	0.035		X		0.000	0.006	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	340010SA001	0.188		X		0.000	0.005	ug/kg	SWRI	SW846-8290
DI/FURA	Octachlorodibenzofuran	0	1	340011SA001	0.194		X		0.000	0.005	ug/kg	SWRI	SW846-8290
METAL	Aluminum	0	1	340001SA001	15,400.000	*NW	X		13,000.000	20	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	0	1	340003SA001	0.680		X		0.670	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	0	1	340008SA001	1.370		X		0.670	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	0	1	340012SA001C	1.000		X		0.670	0.5	mg/kg	PGDP	SW846-6010A
METAL	Calcium	0	1	340002SA001	239,000.000	*N	X		200,000.000	2500	mg/kg	PGDP	SW846-6010A
METAL	Calcium	0	1	340010SA001	281,000.000	J	X		200,000.000	500	mg/kg	PGDP	SW846-6010A
METAL	Calcium	0	1	340011SA001	335,000.000	*N	X		200,000.000	2500	mg/kg	PGDP	SW846-6010A
METAL	Calcium	0	1	340014SA001C	259,000.000	*N	X		200,000.000	2500	mg/kg	PGDP	SW846-6010A
METAL	Calcium	0	1	340015SA001C	291,000.000	*N	X		200,000.000	2500	mg/kg	PGDP	SW846-6010A
METAL	Chromium	0	1	340001SA001	20.700		X		16.000	2	mg/kg	PGDP	SW846-6010A
METAL	Chromium	0	1	340003SA001	22.600		X		16.000	2	mg/kg	PGDP	SW846-6010A

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
METAL	Chromium	0	1	340006SA001	18.800	*N	X		16.000	2	mg/kg	PGDP	SW846-6010A
METAL	Chromium	0	1	340008SA001	371.000		X		16.000	2	mg/kg	PGDP	SW846-6010A
METAL	Chromium	0	1	340010SA001	16.400		X		16.000	2	mg/kg	PGDP	SW846-6010A
METAL	Chromium	0	1	340012SA001C	104.000		X		16.000	2	mg/kg	PGDP	SW846-6010A
METAL	Chromium	0	1	340013SA001C	122.000		X		16.000	2	mg/kg	PGDP	SW846-6010A
METAL	Chromium	0	1	340014SA001C	48.100		X		16.000	2	mg/kg	PGDP	SW846-6010A
METAL	Chromium	0	1	340015SA001C	53.500		X		16.000	2	mg/kg	PGDP	SW846-6010A
METAL	Copper	0	1	340001SA001	30.100		X		19.000	2	mg/kg	PGDP	SW846-6010A
METAL	Copper	0	1	340008SA001	158.000		X		19.000	2	mg/kg	PGDP	SW846-6010A
METAL	Copper	0	1	340012SA001C	81.100		X		19.000	2	mg/kg	PGDP	SW846-6010A
METAL	Copper	0	1	340013SA001C	59.500		X		19.000	2	mg/kg	PGDP	SW846-6010A
METAL	Lead	0	1	340008SA001	66.100		X		36.000	20	mg/kg	PGDP	SW846-6010A
METAL	Lead	0	1	340012SA001C	70.500		X		36.000	20	mg/kg	PGDP	SW846-6010A
METAL	Lead	0	1	340013SA001C	55.100		X		36.000	20	mg/kg	PGDP	SW846-6010A
METAL	Magnesium	0	1	340005SA001	8,830.000	*NW	X		7,700.000	15	mg/kg	PGDP	SW846-6010A
METAL	Magnesium	0	1	340010SA001	16,000.000	N	X		7,700.000	150	mg/kg	PGDP	SW846-6010A
METAL	Mercury	0	1	340008SA001	0.430		X		0.200	0.2	mg/kg	PGDP	SW846-7471
METAL	Nickel	0	1	340001SA001	36.000		X		21.000	5	mg/kg	PGDP	SW846-6010A
METAL	Nickel	0	1	340008SA001	382.000		X		21.000	5	mg/kg	PGDP	SW846-6010A
METAL	Nickel	0	1	340012SA001C	111.000		X		21.000	5	mg/kg	PGDP	SW846-6010A
METAL	Nickel	0	1	340013SA001C	104.000		X		21.000	5	mg/kg	PGDP	SW846-6010A
METAL	Potassium	0	1	340008SA001	1,400.000	*N	X		1,300.000	100	mg/kg	PGDP	SW846-6010A
METAL	Sodium	0	1	340001SA001	421.000		X		320.000	200	mg/kg	PGDP	SW846-6010A
METAL	Zinc	0	1	340001SA001	132.000		X		65.000	15	mg/kg	PGDP	SW846-6010A
METAL	Zinc	0	1	340003SA001	78.800		X		65.000	15	mg/kg	PGDP	SW846-6010A
METAL	Zinc	0	1	340006SA001	65.100	*N	X		65.000	15	mg/kg	PGDP	SW846-6010A
METAL	Zinc	0	1	340008SA001	272.000		X		65.000	15	mg/kg	PGDP	SW846-6010A
METAL	Zinc	0	1	340010SA001	111.000		X		65.000	15	mg/kg	PGDP	SW846-6010A
METAL	Zinc	0	1	340012SA001C	252.000		X		65.000	15	mg/kg	PGDP	SW846-6010A

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
METAL	Zinc	0	1	340013SA001C	202.000		X		65.000	15	mg/kg	PGDP	SW846-6010A
METAL	Zinc	0	1	340014SA001C	124.000		X		65.000	15	mg/kg	PGDP	SW846-6010A
METAL	Zinc	0	1	340015SA001C	151.000		X		65.000	15	mg/kg	PGDP	SW846-6010A
RADS	Neptunium-237	0	1	340013SA001C	0.165		X		0.100	0.109	pCi/g	PGDP	RL-7124
RADS	Plutonium-239/240	0	1	340008SA001	0.304		X		0.000	0.0506	pCi/g	PGDP	RL-7120
RADS	Plutonium-239/240	0	1	340012SA001C	0.270		X		0.000	0.0541	pCi/g	PGDP	RL-7120
RADS	Plutonium-239/240	0	1	340013SA001C	0.116		X		0.000	0.0505	pCi/g	PGDP	RL-7120
RADS	Plutonium-239/240	0	1	340015SA001C	0.079		X		0.000	0.0651	pCi/g	PGDP	RL-7120
RADS	Protactinium-234m	0	1	340008SA001	5,000.000		X		0.000	689	pCi/g	PARGN	DNT
RADS	Protactinium-234m	0	1	340011SA001	186.000		X		0.000	95	pCi/g	PARGN	DNT
RADS	Protactinium-234m	0	1	340012SA001C	2,400.000		X		0.000	566	pCi/g	PARGN	DNT
RADS	Protactinium-234m	0	1	340015SA001C	880.000		X		0.000	319	pCi/g	PARGN	DNT
RADS	Technetium-99	0	1	340001SA001	8.300		X		2.500	4.34	pCi/g	PGDP	RL-7116
RADS	Technetium-99	0	1	340008SA001	105.000		X		2.500	4.34	pCi/g	PGDP	RL-7116
RADS	Technetium-99	0	1	340011SA001	6.340		X		2.500	4.32	pCi/g	PGDP	RL-7116
RADS	Technetium-99	0	1	340012SA001C	21.000		X		2.500	4.08	pCi/g	PGDP	RL-7116
RADS	Technetium-99	0	1	340013SA001C	20.700		X		2.500	4.08	pCi/g	PGDP	RL-7116
RADS	Technetium-99	0	1	340014SA001C	5.070		X		2.500	4.08	pCi/g	PGDP	RL-7116
RADS	Thorium-234	0	1	340001SA001	306.000		X		0.000	48	pCi/g	PARGN	DNT
RADS	Thorium-234	0	1	340002SA001	9.300		X		0.000	4.5	pCi/g	PARGN	DNT
RADS	Thorium-234	0	1	340003SA001	44.000		X		0.000	25	pCi/g	PARGN	DNT
RADS	Thorium-234	0	1	340006SA001	26.200		X		0.000	1.34	pCi/g	PGDP	RL-7124
RADS	Thorium-234	0	1	340008SA001	2,890.000		X		0.000	102	pCi/g	PARGN	DNT
RADS	Thorium-234	0	1	340010SA001	9.950		X		0.000	0.614	pCi/g	PGDP	RL-7124
RADS	Thorium-234	0	1	340011SA001	77.000		X		0.000	11	pCi/g	PARGN	DNT
RADS	Thorium-234	0	1	340012SA001C	1,320.000		X		0.000	73	pCi/g	PARGN	DNT
RADS	Thorium-234	0	1	340013SA001C	209.000		X		0.000	30	pCi/g	PARGN	DNT
RADS	Thorium-234	0	1	340014SA001C	52.000		X		0.000	16	pCi/g	PARGN	DNT

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
RADS	Thorium-234	0	1	340015SA001C	486.000		X		0.000	39	pCi/g	PARGN	DNT
RADS	Uranium	0	1	340001SA001	189.000		X		0.000	4.55	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	340006SA001	29.900		X		0.000	3.08	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	340008SA001	3,160.000		X		0.000	13.7	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	340010SA001	13.900		X		0.000	1.61	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	340011SA001	12.200		X		0.000	1.26	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	340012SA001C	1,170.000		X		0.000	8.96	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	340013SA001C	242.000		X		0.000	4.48	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	340014SA001C	63.200		X		0.000	2.12	pCi/g	PGDP	RL-7124
RADS	Uranium	0	1	340015SA001C	42.600		X		0.000	5.76	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	340001SA001	26.500		X		2.500	0.633	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	340006SA001	3.120		X		2.500	0.315	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	340008SA001	379.000		X		2.500	1.63	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	340010SA001	3.160		X		2.500	0.363	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	340012SA001C	158.000		X		2.500	1.2	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	340013SA001C	34.700		X		2.500	0.638	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	340014SA001C	10.500		X		2.500	0.348	pCi/g	PGDP	RL-7124
RADS	Uranium-234	0	1	340015SA001C	58.900		X		2.500	0.796	pCi/g	PGDP	RL-7124
RADS	Uranium-235	0	1	340008SA001	49.000		X		0.140	19	pCi/g	PARGN	DNT
RADS	Uranium-235	0	1	340012SA001C	36.000		X		0.140	15	pCi/g	PARGN	DNT
RADS	Uranium-235	0	1	340015SA001C	8.700		X		0.140	7.8	pCi/g	PARGN	DNT
RADS	Uranium-238	0	1	340001SA001	160.000		X		1.200	3.81	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	340006SA001	26.400		X		1.200	2.65	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	340008SA001	2,740.000		X		1.200	11.7	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	340010SA001	10.500		X		1.200	1.2	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	340011SA001	9.730		X		1.200	0.996	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	340012SA001C	994.000		X		1.200	7.56	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	340013SA001C	204.000		X		1.200	3.75	pCi/g	PGDP	RL-7124
RADS	Uranium-238	0	1	340014SA001C	51.800		X		1.200	1.72	pCi/g	PGDP	RL-7124

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.42. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area surface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Near Surface Background	Detection Limit	Units	Laboratory	Analytical Method
RADS	Uranium-238	0	1	340015SA001C	361.000		X		1.200	4.88	pCi/g	PGDP	RL-7124

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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Table 4.43. Frequency of detection of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area subsurface soil

Analytical Group	Analytical Compound	Number of Detects / Total Number of Samples (a)	Maximum Result (b)	Subsurface Background	Detection Limit	Units
VOA	Methylene chloride	5 / 24	7,800.000	0.000	1200	ug/kg
VOA	Chloromethane	1 / 24	3,400.000	0.000	1200	ug/kg
SVOA	Di-n-butyl phthalate	3 / 20	2,200.000	0.000	450	ug/kg
SVOA	Benzo(b)fluoranthene	2 / 20	367.000	0.000	500	ug/kg
SVOA	Bis(2-ethylhexyl)phthalate	1 / 20	360.000	0.000	500	ug/kg
SVOA	Diethyl phthalate	1 / 20	200.000	0.000	500	ug/kg
PPCB		0 / 5				
DI/FURA		0 / 0				
METAL	Beryllium	8 / 20	1.390	0.690	0.5	mg/kg
METAL	Vanadium	4 / 20	62.400	37.000	2	mg/kg
METAL	Aluminum	3 / 20	14,000.000	12,000.000	20	mg/kg
METAL	Chromium	2 / 20	74.300	43.000	2	mg/kg
METAL	Calcium	1 / 20	41,000.000	6,100.000	2500	mg/kg
METAL	Iron	1 / 20	35,900.000	28,000.000	5	mg/kg
METAL	Magnesium	1 / 20	2,620.000	2,100.000	15	mg/kg
RADS	Technetium-99	1 / 24	7.360	2.800	4.32	pCi/g

(a) Sample count exclusive of split and duplicate samples

(b) Maximum result for all subsurface samples, including split and duplicate samples

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Table 4.44. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area subsurface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Subsurface Background	Detection Limit	Units	Laboratory	Analytical Method
VOA	Chloromethane	8	11	340005SA011	3,400.000		X		0.000	1200	ug/kg	PGDP	SW846-8260
VOA	Methylene chloride	8	11	340005SA011	7,500.000	JX	X		0.000	1200	ug/kg	PGDP	SW846-8260
VOA	Methylene chloride	22	25	340005SA025	6,700.000	JX	X		0.000	1200	ug/kg	PGDP	SW846-8260
VOA	Methylene chloride	30	33	340005SA033	7,800.000	JX	X		0.000	1200	ug/kg	PGDP	SW846-8260
VOA	Methylene chloride	37	40	340005SA040	7,700.000	JX	X		0.000	1200	ug/kg	PGDP	SW846-8260
VOA	Methylene chloride	53	56	340005SA056	6,600.000	JX	X		0.000	1200	ug/kg	PGDP	SW846-8260
SVOA	Benzo(b)fluoranthene	26	32	340011SD030	57.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Benzo(b)fluoranthene	44	47	340011SA047	367.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	bis(2-Ethylhexyl)phthalate	22	25	340005SA025	360.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
SVOA	Di-n-butyl phthalate	20	23	340002SA023	1,400.000	B	X		0.000	360	ug/kg	PGDP	SW846-8270
SVOA	Di-n-butyl phthalate	37	40	340005SA040	1,200.000	B	X		0.000	450	ug/kg	PGDP	SW846-8270
SVOA	Di-n-butyl phthalate	57	60	340007SA060	2,200.000	B	X		0.000	450	ug/kg	PGDP	SW846-8270
SVOA	Diethyl phthalate	33	39	340007SA036	200.000	J	X		0.000	500	ug/kg	ONSE	SW846-8270 M
METAL	Aluminum	8	11	340002SA011	14,000.000	*NW	X		12,000.000	20	mg/kg	PGDP	SW846-6010A
METAL	Aluminum	8	11	340011SA011	12,500.000	*NW	X		12,000.000	20	mg/kg	PGDP	SW846-6010A
METAL	Aluminum	24	27	340002SA026	12,900.000	*NW	X		12,000.000	20	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	20	23	340007SA023	1.380		X		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	24	27	340002SA026	1.180		X		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	26	32	340011SD030	1.210		X		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	30	33	340002SA033	0.960		X		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	30	33	340005SA033	1.390		X		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	33	39	340007SA036	0.850		X		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	41	44	340007SA044	0.790		X		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Beryllium	44	47	340002SA047	0.800		X		0.690	0.5	mg/kg	PGDP	SW846-6010A
METAL	Calcium	33	39	340007SA036	41,000.000	*N	X		6,100.000	2500	mg/kg	PGDP	SW846-6010A

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.44. Detections of organic compounds, metals, and radioactive isotopes exceeding background values in C-340 Area subsurface soil

Analytical Group	Analytical Compound	Sample Interval (ft bgs) Top	Sample Interval (ft bgs) Bottom	Project Sample ID	Results (a)	Laboratory Qualifier	Validation Qualifier	Data Assessment Code	Subsurface Background	Detection Limit	Units	Laboratory	Analytical Method
METAL	Chromium	26	32	340011SD030	74.300		X		43.000	2	mg/kg	PGDP	SW846-6010A
METAL	Chromium	30	33	340005SA033	56.500		X		43.000	2	mg/kg	PGDP	SW846-6010A
METAL	Iron	30	33	340005SA033	35,900.000	*NW	X		28,000.000	5	mg/kg	PGDP	SW846-6010A
METAL	Magnesium	33	39	340007SA036	2,620.000		X		2,100.000	15	mg/kg	PGDP	SW846-6010A
METAL	Vanadium	20	23	340007SA023	46.100		X		37.000	2	mg/kg	PGDP	SW846-6010A
METAL	Vanadium	24	27	340002SA026	45.400		X		37.000	2	mg/kg	PGDP	SW846-6010A
METAL	Vanadium	26	32	340011SD030	39.900		X		37.000	2	mg/kg	PGDP	SW846-6010A
METAL	Vanadium	30	33	340005SA033	62.400		X		37.000	2	mg/kg	PGDP	SW846-6010A
RADS	Technetium-99	24	27	340002SA026	7.360		X		2.800	4.32	pCi/g	PGDP	RL-7116

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.45. Laboratory radiological error values for radionuclide detections above background levels

Site	Media	Analytical Compound	Project Sample ID	Results (a)	Laboratory Radiological Error (+/-)	Units
82	Surface Soil	Thorium-234	082009SA001	14.400	1.25	pCi/g
		Thorium-234	082012SA001	122.000	19	pCi/g
		Uranium	082009SA001	18.500	9.01	pCi/g
		Uranium	082012SA001	46.700	9.07	pCi/g
		Uranium-234	082009SA001	3.810	1.86	pCi/g
		Uranium-234	082012SA001	7.550	1.47	pCi/g
		Uranium-238	082009SA001	14.400	3.21	pCi/g
		Uranium-238	082012SA001	38.500	2.18	pCi/g
82	Storm Water	Technetium-99	082007WA000	23.400	9.1	pCi/L
82	Groundwater	Technetium-99	082008WA043	45.000	9.6	pCi/L
83	Storm Water	Technetium-99	083004WA000	17.400	8.9	pCi/L
		Technetium-99	083007WA000	14.600	8.7	pCi/L
83	Groundwater	Technetium-99	083003WA033	25.900	8.3	pCi/L
84	Surface Soil	Cesium-137	084010SA001	1.900	1.7	pCi/g
84	Subsurface Soil	Technetium-99	084009SA027	5.840	6.98	pCi/g
84	Storm Water	Technetium-99	084007WA000	17.900	8.9	pCi/L
		Technetium-99	084011WA000	14.500	8.7	pCi/L
84	Groundwater	Technetium-99	084004WA060	39.000	8.6	pCi/L
		Technetium-99	084005WA058	22.000	11	pCi/L
		Technetium-99	084009WA058	45.000	9.1	pCi/L
		Technetium-99	084015WA056	32.500	15.4	pCi/L
85	Storm Water	Technetium-99	085012WA000	16.200	8.8	pCi/L
85	Groundwater	Technetium-99	085004WA060	28.000	9.4	pCi/L
		Technetium-99	085011WA060	25.000	12.6	pCi/L
340	Surface Soil	Neptunium-237	340013SA001C	0.165	0.329	pCi/g
		Plutonium-239/240	340008SA001	0.304	0.047	pCi/g
		Plutonium-239/240	340012SA001C	0.270	0.0565	pCi/g
		Plutonium-239/240	340013SA001C	0.116	0.0306	pCi/g

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.45. Laboratory radiological error values for radionuclide detections above background levels

Site	Media	Analytical Compound	Project Sample ID	Results (a)	Laboratory Radiological Error (+/-)	Units
340	Surface Soil (Cont.)	Plutonium-239/240	340015SA001C	0.079	0.0519	pCi/g
		Protactinium-234m	340008SA001	5,000.000	801	pCi/g
		Protactinium-234m	340011SA001	186.000	86	pCi/g
		Protactinium-234m	340012SA001C	2,400.000	563	pCi/g
		Protactinium-234m	340015SA001C	880.000	278	pCi/g
		Technetium-99	340001SA001	8.300	3.46	pCi/g
		Technetium-99	340008SA001	105.000	7.13	pCi/g
		Technetium-99	340011SA001	6.340	3.62	pCi/g
		Technetium-99	340012SA001C	21.000	3.92	pCi/g
		Technetium-99	340013SA001C	20.700	3.9	pCi/g
		Technetium-99	340014SA001C	5.070	3.04	pCi/g
		Thorium-234	340001SA001	306.000	59	pCi/g
		Thorium-234	340002SA001	9.300	6.2	pCi/g
		Thorium-234	340003SA001	44.000	13	pCi/g
		Thorium-234	340006SA001	26.200	1.41	pCi/g
		Thorium-234	340008SA001	2,890.000	174	pCi/g
		Thorium-234	340010SA001	9.950	0.66	pCi/g
		Thorium-234	340011SA001	77.000	13	pCi/g
		Thorium-234	340012SA001C	1,320.000	109	pCi/g
		Thorium-234	340013SA001C	209.000	40	pCi/g
		Thorium-234	340014SA001C	52.000	18	pCi/g
		Thorium-234	340015SA001C	486.000	54	pCi/g
		Uranium	340001SA001	189.000	33.5	pCi/g
		Uranium	340006SA001	29.900	13.2	pCi/g
		Uranium	340008SA001	3,160.000	526	pCi/g
		Uranium	340010SA001	13.900	4.08	pCi/g
		Uranium	340011SA001	12.200	3.46	pCi/g
		Uranium	340012SA001C	1,170.000	195	pCi/g
		Uranium	340013SA001C	242.000	41.7	pCi/g
		Uranium	340014SA001C	63.200	11.7	pCi/g
		Uranium	340015SA001C	42.600	71.9	pCi/g
		Uranium-234	340001SA001	26.500	4.71	pCi/g
		Uranium-234	340006SA001	3.120	1.38	pCi/g
		Uranium-234	340008SA001	379.000	63.1	pCi/g
		Uranium-234	340010SA001	3.160	0.929	pCi/g
		Uranium-234	340012SA001C	158.000	26.4	pCi/g
		Uranium-234	340013SA001C	34.700	5.98	pCi/g
		Uranium-234	340014SA001C	10.500	1.94	pCi/g
		Uranium-234	340015SA001C	58.900	9.93	pCi/g

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

Table 4.45. Laboratory radiological error values for radionuclide detections above background levels

Site	Media	Analytical Compound	Project Sample ID	Results (a)	Laboratory Radiological Error (+/-)	Units
340	Surface Soil (Cont.)	Uranium-235	340008SA001	49.000	16	pCi/g
		Uranium-235	340012SA001C	36.000	15	pCi/g
		Uranium-235	340015SA001C	8.700	7.8	pCi/g
		Uranium-238	340001SA001	160.000	6.35	pCi/g
		Uranium-238	340006SA001	26.400	4.29	pCi/g
		Uranium-238	340008SA001	2,740.000	20.4	pCi/g
		Uranium-238	340010SA001	10.500	1.91	pCi/g
		Uranium-238	340011SA001	9.730	1.45	pCi/g
		Uranium-238	340012SA001C	994.000	12.8	pCi/g
		Uranium-238	340013SA001C	204.000	6.43	pCi/g
		Uranium-238	340014SA001C	51.800	2.81	pCi/g
		Uranium-238	340015SA001C	361.000	7.79	pCi/g
340	Subsurface Soil	Technetium-99	340002SA026	7.360	3.48	pCi/g

(a) Maximum result per sampled interval shown when split or duplicate analysis obtained

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5. RISK EVALUATION

This section evaluates the risk potential from the WAG 8 SE soil contamination by comparing the highest SWMU-specific concentrations of each detected contaminant to risk- and migration-based human health and ecological screening criteria (action levels). The evaluation follows the directions in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996) (i.e., Methods Document) for completing risk analyses during SEs. Consistent with agreements reached during meetings between regulatory agencies and DOE in November 1997, this risk evaluation is not a baseline risk assessment. Baseline risks for sites in WAG 8 will be compiled after consideration of the results contained in this SE report.

5.1 RISK SCREENING PROCESS

The purpose of this risk evaluation is to determine if hazards or risks at WAG 8 sites are *de minimis* or whether additional site-specific investigations are necessary to characterize the sites. The evaluation is carried out in three phases, the first of which (Phase I) employs risk- and regulatory-based guidance criteria (soil concentration benchmark values) as screens against which the maximally detected concentrations of SWMU-specific contaminants are compared. The risk evaluation uses flow charts (Figs. 5.1–5.4) to guide a reader through the process.

Where the Phase I findings point to the presence of SWMU-specific contaminant levels in excess of benchmarks, subsequent phases seek to reduce uncertainty by, in Phase II, determining the number of samples in which detected concentrations exceeded risk- or migration-based screening criteria, and by, in Phase III, determining the number of individual dioxin/furan and PAH congeners or mixtures of PCB congeners that exceed action levels and by what extent. Details of the three phases are provided in the following sections.

- Phase I represents the primary analytical phase of risk evaluation. In this phase the highest detected SWMU-specific concentrations of target contaminant list (TCL) and TAL compounds are compared to risk- or regulatory-based screening criteria (action levels). As specified in the Methods Document (DOE 1996), either an excess lifetime cancer risk (ELCR) of 1E-7 (1E-6 for radionuclides) or a hazard quotient of 0.1 was the trigger for calculating risk-based screening criteria (action levels). This approach is conservative and is designed to ensure that the risk associated with contaminants present at concentrations lower than these benchmarks are likely to be *de minimis*, even where several such contaminants are detected at a sampling location. Other screens include a site-wide background level screen for naturally occurring compounds, non-site-specific screening guidance values that may constitute applicable or relevant and appropriate requirements, and guidance values to protect ecological receptors. Identifying prevailing levels of contaminants in excess of benchmarks is the primary input in determining whether the SWMUs warrant (1) further characterization such as that performed during an RI or (2) no further action.

- In Phase II, compounds identified in excess of action levels in Phase I are evaluated on a sample-by-sample basis, comparing their frequency of detection and their frequency of exceedance (i.e., the number of samples in which a detected contaminant exceeded appropriate screening criteria). This essentially qualitative comparison determines whether the presence of a contaminant in excess of benchmarks is an isolated occurrence or more widespread. This helps to discriminate between those contaminants present as "hot spots" and those with a more pervasive pattern.

- In Phase III, maximally detected levels of dioxin/furan and PAH congeners and mixtures of PCB congeners are compared to congener- and PCB mixture-specific benchmarks. This analysis indicates the extent to which the Phase I findings of total dioxins/furans, PAHs, and PCBs in excess of screening criteria are due to dioxins/furans, PAHs, or PCBs "across-the-board," or whether such exceedances were driven by one or possibly a small number of components.

From analysis of the results of the three screening phases, Sect. 6 discusses the potential need for collecting additional site-specific data or whether a no further action recommendation is warranted.

5.1.1 Phase I—Determination of Contaminants in Excess of Screening Criteria

The Phase I screening criteria that are employed in this risk evaluation may be conveniently categorized into three groups: human health direct-contact screens, groundwater protection screens, and direct contact by ecological receptors screens. As noted in the following paragraphs, these screens implicitly address exposure to soil-borne contamination by, respectively, (1) an industrial worker, (2) hypothetical on- or off-site residents using PGDP groundwater as a source of drinking water, and (3) ecological receptors incidentally wandering onto the sites.

5.1.1.1 Human health direct-contact screen (industrial worker)

In the evaluation of risks to human health from direct contact with contaminated media, the focus is on direct contact with surface soil (0–1 ft bgs) by an industrial worker. Detected concentrations of constituents within each surface soil sample are compared to three screening criteria:

- Site-specific RBCs for the industrial worker, calculated following guidance in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996).

- Background surface soil concentrations for naturally occurring constituents obtained from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).

- KDEP screening levels for soil obtained from Appendix A of *Risk Assessment Guidance* (KDEP 1995).

The industrial RBCs used in this step of the risk evaluation were calculated based on the most current toxicity values and site-specific information and are, therefore, the most relevant to use in the risk screening process. The screening levels in the KDEP document are based on a residential exposure scenario, rather than industrial, and as such tend to be slightly more conservative. The KDEP guidance has not been updated since 1995, and at least some of the screening criteria may not reflect the most current toxicity values.

The process by which maximally detected contaminants at WAG 8 are compared to these benchmarks is illustrated in Fig. 1.

5.1.1.2 Groundwater protection screen (hypothetical future resident)

In evaluating the potential for prevailing levels of soil-borne contaminants to migrate to groundwater in sufficient quantities to represent a human health concern, detected concentrations of constituents in

both surface and subsurface soil (0–1 ft bgs and 0–15 ft bgs combined) were compared to two screening criteria, as illustrated in Fig. 2:

- Soil screening levels (SSLs) for the protection of a residential groundwater user calculated using current EPA guidance [*Soil Screening Guidance: Technical Background Document* (EPA 1996b)].

- Background subsurface soil concentrations for naturally occurring constituents obtained from Tables 4.2 and 4.4 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).

For the groundwater protection portion of the risk evaluation, detected constituent concentrations are compared to EPA SSLs that have been calculated using a dilution-attenuation factor (DAF) of 20. As noted in EPA (1996), a DAF of 20 is the default value selected by EPA because it is considered to provide SSLs that are protective of groundwater for all sites up to 0.5 acre in size and for most sites up to 30 acres in size. Generally, the default DAF is used for this risk evaluation because (1) each of the WAG 8 sites is small and (2) significant dilution and/or attenuation of soil leachate concentrations is expected to occur, because of the geology at PGDP, as leachate moves from WAG 8 sites to the uppermost potable aquifer at PGDP (i.e., the RGA). Salient geological issues supporting the use of the default value are that the depth to the RGA at PGDP ranges from 45 to 60 ft bgs (i.e., the aquifer is not in direct contact with the potentially contaminated soil) and that the hydraulic conductivity of the overlying UCRS tends to be very small, especially for the silty clay of the unit of the UCRS termed HU3. This unit is of special importance because it is at the bottom of the UCRS (i.e., directly above the RGA) and is up to 30 ft thick. Hence, HU3 forms an aquitard between the WAG 8 sites and the RGA.

5.1.1.3 Ecological receptor direct contact screen

In evaluating risks to ecological receptors from direct contact with contaminated media, the focus is on direct contact with surface soil. In this evaluation, detected concentrations of constituents within each soil sample are compared to three screening criteria (Fig. 3):

- RBCs obtained from *Preliminary Remediation Goals for Ecological Endpoints* (LMER 1997).

- Background surface soil concentrations for naturally occurring constituents obtained from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).

- Ecological screening values for soil obtained from EPA *Region 4 Risk Assessment Bulletins* available on the World Wide Web at http://www.epa.gov/region04/wastepgs/oftecser/ecobul.htm.

5.1.1.4 Data analyses considerations—toxicity equivalency factors

In accordance with EPA Region 4 guidance (EPA 1995) and the Methods Document, Phase I risk evaluation of the chlorinated dioxin and furan congeners is performed on "total dioxins/furans" using the toxicity equivalency approach. Toxicity equivalency factors (TEFs) are used to convert the concentration of each detected dioxin/furan congener to an equivalent concentration of 2,3,7,8-TCDD. The converted concentrations are then summed to obtain a toxicity equivalent (TEQ) that can be compared to the risk screening criterion for 2,3,7,8-TCDD.

A similar approach has been adapted for PAHs. The TEFs are based on the potency of each compound relative to benzo(a)pyrene (BaP). The concentration of each compound is multiplied by a

TEF, and then all are summed for a total BaP equivalent (BaPE). The BaPE is then compared to the risk screening criterion for BaP.

For PCBs, maximally detected concentrations of individual mixtures of congeners (PCBs-1248, -1254, etc) are summed for a total concentration of PCBs. Total PCBs are then compared to the toxicity benchmark for PCB-1260. This approach partially resembles the manner in which dioxins/furans and PAHs were assessed (e.g., comparing the sum of all PCB mixtures to the risk screening criterion of a single PCB, PCB-1260).

5.1.1.5 Summary of Phase I

In Phase I, the maximum detected concentration of each detected analyte for all samples at a location is compared to the following screening criteria:

- industrial use RBCs;
- residential SSLs;
- ecological RBCs (eco-RBCs);
- appropriate background concentrations (i.e., surface or subsurface); and
- KDEP or EPA Region 4 guidance values, whichever was appropriate.

Analytes that exceed background concentrations (where available) and one or more screening benchmark (i.e., RBCs, SSLs, eco-RBCs, and state or federal guidance) are marked as present at a site in excess of action levels in at least one sample. For inorganic chemicals and radionuclides with background concentrations available, an individual analyte must exceed both a screening benchmark and background concentration to be retained in this screen. Inorganic chemicals and radionuclides with no available risk benchmarks but with maximum detected concentrations exceeding background levels are retained unless noted otherwise (i.e., essential human nutrients). Analytes for which there are no risk-based benchmarks or background concentrations are considered to be in excess of operative benchmarks on a qualitative basis only. Illustrations of this approach using simplified hypothetical numbers and actual concentrations observed at site C-340 are shown in Exhibit 5.1.

After the Phase I screen, calcium, magnesium, potassium, and sodium are excluded from further human health evaluation because these substances are essential nutrients that are toxic only at extremely high concentrations (EPA 1995). However, these chemicals are retained for the Phase II evaluation of ecological risk if their concentration exceeds any Phase I benchmark. Other chemicals excluded from further evaluation are lithium and strontium (because these chemicals are not included on the EPA's TAL) and those substances identified in Phase I as qualitative analytes. Additional risk analysis of these substances is unlikely to be beneficial because their concentrations cannot be quantified in a baseline risk assessment.

5.1.2 Phase II—Frequency of Detection/Frequency of Exceedance

In Phase II, compounds in excess of screening criteria from Phase I are examined for exceedances of action levels on a sample-by-sample basis. As discussed, detected concentrations are compared to risk-based benchmarks and background concentrations for an indication of the number of samples in which an analyte exceeded screening benchmarks. A comparison of this incidence to the frequency with which the substance was detected at each site is used in this risk evaluation as an *a priori* indication of the SWMU-wide pervasiveness of the contamination in the surface and/or subsurface soil at a site. Thus, Phase II helps delineate the extensiveness of a detected compound at a site by distinguishing between a widespread pattern of occurrence versus hot spots.

5.1.3 Phase III—Breakout of Total Dioxins/Furans, Total PAHs, and Total PCBs into Congeners

As described in Sect. 5.1.1.4, Phase I features within-group comparisons of the sums of TEF-adjusted concentrations of dioxins/furans, PAHs, or PCBs to risk- and migration-based screening criteria for 2,3,7,8-TCDD (or furan), benzo(a)pyrene, or PCB-1260, respectively. The approach is used to take into account differences in systemic toxicity and carcinogenicity among congeners and (for PCBs) mixtures of congeners within the groups. However, in the Phase III analysis, uncertainty associated with a possible undue weighting of the evaluation by one or a few heavily represented components is evaluated by comparing the maximum detected concentration of each individual dioxin/furan, PAH, or PCB to its congener- (or compound-) specific industrial use RBC, residential SSL, or eco-RBC, as appropriate. The number of congeners or mixtures of congeners (for PCBs) with maximally detected concentrations in excess of component-specific benchmarks is a qualitative indication of whether the Phase I exceedance of benchmarks by total dioxins/furans, PAHs, or PCBs was driven predominantly by the presence of either a single or a large number of key components. The importance of this analysis is emphasized by the possibility that OCDD, the most heavily represented dioxin, may be "present" as a laboratory contaminant. If this congener emerges as both an *a priori* laboratory contaminant *and* the most heavily represented congener, any decision to undertake further investigations at a site ostensibly driven by dioxin contamination might need to be reconsidered in the light of the Phase III findings.

5.1.4 Summary of Phased Approach

Completion of Phase I provides a list of contaminants in excess of screening criteria for hypothetical receptors at each SWMU. Such contaminants are identified using very conservative criteria. For example, risk-based concentrations for individual analytes are based upon an ELCR of 1E-7 (1E-6 for radionuclides) for human receptors and a non-carcinogenic hazard index of 0.1 for human and ecological receptors, and the maximum detected concentration of each SWMU-specific analyte is used in the screening process. Such conservatism, employed to allow for cross-media contamination and the likely presence of more than six contaminants (Methods Document), is intended to ensure that potential human health risks associated with contaminant concentrations that are lower than the benchmark values developed therefrom are likely to be *de minimis*. This is expected to have the further effect that no potentially harmful substances are determined incorrectly to be present at lower concentrations than operative benchmarks.

The primary purpose for performing this risk evaluation in phases has been to supplement Phase I information on contaminants present in excess of action levels with (1) data indicative of the overall pervasiveness of contamination at each site and (2) the number and range of possible risk drivers. These additional analyses make an important contribution to reducing the uncertainty associated with the Phase I findings.

5.2 RISK SCREENING RESULTS

Because of their length, Tables 5.1 through 5.12 cited in the risk evaluation are presented in Appendix G. Tables located at the end of this section summarize the material presented in Appendix G.

Table 5.1 is a list of sampling stations by location. Table 5.2 is the data summary for all analytes by location and medium. Table 5.3 is the data summary for detected analytes by location and medium. Tables 5.4–5.6 are the Phase I comparisons of maximum detected concentrations and activities to site-specific industrial use RBCs, residential soil-to-groundwater screening criteria, ecological screening criteria, background concentrations, and federal or state risk screening guidance. Tables 5.7–5.9 are the sample-by-sample Phase II comparisons of detected concentrations and activities of contaminants that

were identified in Phase I as being present in excess of one or more screening criterion at one or more sampling locations. In Tables 5.10–5.12, individually detected dioxins/furans and PAH congeners, and PCBs in samples with total dioxins/furans, PAHs or PCBs in excess of group-specific benchmarks in Phase I, were screened against risk- or migration-specific benchmarks for the individual components, where available (Phase III). All the tables listed above are located in Appendix G.

As discussed previously, WAG 8 consists of five sites. These are SWMU 82—the C-531 Electrical Switchyard; SWMU 83—the C-533 Electrical Switchyard; SWMU 84—the C-535 Electrical Switchyard; SWMU 85—the C-537 Electrical Switchyard; and the C-340 Reduction and Metals Facility. Surface soil data from all sites are available for the direct-contact risk evaluations (industrial user and ecological receptors). Surface and subsurface soil data from all sites are available for groundwater protection risk evaluations. Although groundwater samples were collected at various locations in WAG 8, they are excluded from the risk evaluation because they were collected from the UCRS region, which is not a source of potable water at WAG 8 sites. Surface water samples, in the form of stormwater runoff collected from drainage ditches surrounding each site, are not included in the risk evaluation because stormwater does not constitute a permanent source of surface water at WAG 8 sites.

5.2.1 SWMU 82—C-531 Electrical Switchyard

5.2.1.1 Phase I—determination of contaminants present in excess of screening criteria

Table 5.2 (Appendix G) presents the data summary for all analytes that were detected and carried forward into the risk evaluation for SWMU 82. As shown in this table, results of analyses for organic compounds and radionuclides are available for both surface and subsurface soils. Results from three surface soil samples and up to 13 combined surface and subsurface soil samples are available for screening. Note that data aggregation techniques for evaluation of total dioxins/furans, total PAHs, and total PCBs result in different sample totals. The organic compounds and radionuclides detected at SWMU 82, their frequency of detection, detected range, non-detected range, distribution, and arithmetic mean are presented in Table 5.3 (Appendix G).

Table 5.13 summarizes the results of the Phase I comparison of contaminant-specific maximum detected concentrations to industrial use RBCs, background concentrations in surface soil, and KDEP screening criteria for surface soil samples collected at SWMU 82 (see also Table 5.4 in Appendix G). Of the organic compounds, total dioxins/furans, total PAHs, and total PCBs exceed one or more risk-based benchmarks. There are no background concentrations for organic compounds. The radionuclides thorium-234 and uranium-238 exceed one or more risk-based benchmarks and background activity (where available).

Table 5.14 summarizes the results of the Phase I comparison of maximum detected concentrations to residential soil-to-groundwater screening criteria and background concentrations for surface and subsurface soil samples collected at SWMU 82 (see also Table 5.5 in Appendix G). Of the organic compounds, total dioxins/furans exceed their SSL. While there are no SSLs for radionuclides, technetium-99, uranium-234, and uranium-238 exceed their respective background activities.

Table 5.15 summarizes the results of the Phase I comparison of maximum detected concentrations to eco-RBCs, background concentrations in surface soil, and EPA Region 4 ecological screening criteria for all surface soil samples collected at SWMU 82 (see also Table 5.6 in Appendix G). Of the organic compounds, anthracene, fluoranthene, naphthalene, phenanthrene, pyrene, total dioxins/furans, total PAHs, and total PCBs exceed one or more ecological risk-based benchmarks. There are no ecological screening criteria for radionuclides; however, plutonium-239, plutonium-239/240, uranium-234 and uranium-238 exceed their respective background activities.

5.2.1.2 Phase II—frequency of detection and frequency of exceedance

Contaminants found to exceed one or more risk- or migration-based screening criteria at SWMU 82 are listed in Table 5.16, which summarizes the results of identical screens to those of Phase I, but carried out on a sample-by-sample basis (Phase II) (see Tables 5.7–5.9 in Appendix G). Contaminants carried forward into Phase II are anthracene, fluoranthene, naphthalene, phenanthrene, pyrene, total dioxins/furans, total PAHs, total PCBs, plutonium-239/240, plutonium-239, technetium-99, thorium-234, uranium-234, and uranium-238. Table 5.16 gives the frequency with which these substances were detected at each site and the number of samples in which the analyte exceeds screening benchmarks. This comparison indicates the extent of contamination of the surface and/or subsurface soil at a site. Among the key findings to emerge from this analysis is that surface soil concentrations of total dioxins/furans, PAHs, and PCBs exceed industrial RBCs or KDEP-promulgated benchmarks in all samples in which these compounds were detected (2/4, 3/6, and 2/5 detects for total dioxins/furans, PAHs, and PCBs, respectively). Activities of some radionuclides are higher than background at SWMU 82 and at higher activities than industrial RBCs, where available (for example, uranium-238 in 2/2 detects). By contrast, only 1/11 technetium-99 detects in combined surface and subsurface soil exceeds the background activity of this isotope.

5.2.1.3 Phase III—comparison of concentrations of individual dioxins/furans, PAHs, and total PCBs with benchmarks

Table 5.10 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs in surface soil to their respective industrial use RBCs. These data are also summarized in Table 5.17, which, in addition, expresses the maximum concentration and action level as a ratio. Components with values for this ratio greater than unity are present in excess of industrial use risk-based screening criteria. Ten of 15 dioxins/furans fall into this category, most notably OCDD, with a maximum detected concentration exceeding its industrial use RBC 120-fold.

A subset of (mostly carcinogenic) PAH congeners evaluated as "total PAHs" in Phase I are considered individually in Phase III, with six of seven components exceeding their risk-based individual screening criteria [by approximately 900-fold for benzo(a)pyrene]. In a similar analysis, PCB-1260 exceeds its industrial use risk-based screening criterion approximately 30-fold.

Table 5.11 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs in surface and subsurface soil to their respective residential soil-to-groundwater SSLs, while Table 5.12 (Appendix G) compares the maximum detected concentration of individual congeners/compounds in surface soil to their respective ecological screening criteria. The only detected dioxin/furan and PAH congeners for which residential soil-to-groundwater screening criteria are available [1,2,3,7,8,9-hexaxhlorodibenzo-p-dioxin and benzo(a)pyrene] were detected at lower concentrations than their respective benchmarks (Table 5.18). Similarly, the maximum detected concentration of PCB-1260 is lower than its soil-to-groundwater soil screening level in available surface and subsurface soil samples. However, this mixture exceeds its compound-specific risk-based benchmark for the protection of ecological receptors (Table 5.19).

5.2.1.4 Summary of compounds present in excess of screening criteria at SWMU 82: An assessment of potential risk drivers

Of the 23 compounds that were hits at SWMU 82, 14 were detected in one or more samples in excess of Phase I compound-specific screening criteria (industrial risk-based, soil-to-groundwater screening levels, and/or risk-based benchmarks to protect ecological receptors). The identified compounds are phenanthrene, total dioxins/furans, total PAHs, total PCBs, dibenzofuran, anthracene,

fluoranthene, naphthalene, pyrene, and, among the radionuclides, thorium-234, neptunium-237, uranium-238, total alpha activity and total beta activity. Compounds retained by Phase I screens on a qualitative basis only (because of the absence of appropriate benchmarks) include technetium-99, plutonium-239, plutonium-239/240 and uranium-234.

As noted in Sect. 5.2.1.2, activities of some radionuclides are higher than background at SWMU 82 and at higher activities than industrial RBCs, where available (for example, uranium-238 in 2/2 detects). By contrast, only 1/11 technetium-99 detects in combined surface and subsurface soil exceeds background levels of radioactivity for this isotope. Surface soil concentrations of total dioxins/furans, PAHs, and PCBs exceed industrial RBCs or KDEP-promulgated benchmarks in all samples in which these compounds were detected (2/4, 3/6, and 2/5 detects for total dioxins/furans, PAHs, and PCBs, respectively).

From the Phase III analysis it is apparent that, of the 15 detected dioxin/furan congeners combined as "total dioxins/furans" in Phase I, OCDD is present far in excess of its industrial-use risk-based concentration (by a factor of approximately 120). Nine other dioxin/furan congeners were detected in concentrations that exceed their congener-specific benchmarks, though not to the same extent as OCDD (Table 5.17). Six of seven carcinogenic PAHs were detected in concentrations exceeding their industrial use risk-based concentrations [up to 900-fold for benzo(a)pyrene].

A comparison of soil concentrations of individual dioxins/furans, PAHs, or PCBs to soil-to-groundwater SSLs or ecological risk-based concentrations at SWMU 82 is constrained by the absence of suitable congener- or mixture-specific benchmarks. However, for PCB-1260, a mixture of congeners for which soil screening and ecological risk-based criteria *are* available, a maximum concentration/ecological risk-based screening value ratio close to 3 is obtained.

5.2.2 SWMU 83—C-533 Electrical Switchyard

5.2.2.1 Phase I—determination of contaminants present in excess of screening criteria

Table 5.2 (Appendix G) presents the data summary for all analytes that were detected and carried forward into the risk evaluation for SWMU 83. As shown in this table, results of analyses for inorganic chemicals, organic compounds, and radionuclides are available for both surface and subsurface soils. Results from three surface soil samples and up to 11 combined surface and subsurface soil samples are available for screening. Note that data aggregation techniques for evaluation of total dioxins/furans, total PAHs, and total PCBs result in different sample totals. The organic compounds and radionuclides detected at SWMU 83, their frequency of detection, detected range, non-detected range, distribution, and arithmetic mean are presented in Table 5.3 (Appendix G).

Table 5.20 summarizes the results of the Phase I comparison of contaminant-specific maximum detected concentrations to industrial use RBCs, background concentrations in surface soil, and KDEP screening criteria for surface soil samples collected at SWMU 83 (see also Table 5.4 in Appendix G). Of the organic compounds, only total PAHs exceed their RBC. No radionuclides exceed their respective RBCs and background activities (where available).

Table 5.21 summarizes the results of the Phase I comparison of maximum detected concentrations to residential soil-to-groundwater screening criteria and background concentrations for surface and subsurface samples collected at SWMU 83 (see also Table 5.5 in Appendix G). The inorganic chemicals aluminum and magnesium exceed their site-wide background concentrations. However, because there are no SSLs for these chemicals, and magnesium is an essential nutrient that is known to be toxic only at

extremely high concentrations, these substances are not assessed further in this risk evaluation. No radionuclides exceed background activities (where available).

Table 5.22 summarizes the results of the Phase I comparison of maximum detected concentrations to ecological screening criteria, background concentrations in surface soil, and EPA Region 4 ecological screening criteria for surface soil samples collected at SWMU 83 (see also Table 5.6 in Appendix G). Of the organic compounds, fluoranthene, phenanthrene, pyrene, and total PAHs exceed EPA Region 4 screening criteria.

5.2.2.2 Phase II—frequency of detection/frequency of exceedance

Contaminants found to exceed one or more risk- or migration-based screening criteria at SWMU 83 are listed in Table 5.23, which summarizes the results of identical screens to those of Phase I, but carried out on a sample-by-sample basis (Phase II) (see Tables 5.7–5.9 in Appendix G). Contaminants carried forward into Phase II are fluoranthene, phenanthrene, pyrene, and total PAHs. Table 5.23 lists the frequency with which each substance was detected at each site and the number of samples in which the analyte exceeds screening benchmarks. This comparison indicates the extent of contamination of the surface and/or subsurface soil at a site. Among the key findings to emerge from this analysis is that surface soil concentrations of total PAHs exceed industrial RBCs or KDEP-promulgated benchmarks in 2/2 samples in which the congeners were detected. Additionally, the levels of total PAHs and some non-carcinogenic PAHs considered individually in Phase I (fluoranthene, phenanthrene, and pyrene) exceed EPA Region 4 ecological screening values in 1/2 samples.

5.2.2.3 Phase III—comparison of concentrations of individual dioxins/furans, PAHs, and total PCBs with benchmarks

Table 5.10 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs in surface soil to their respective industrial use RBCs. These data are also summarized in Table 5.24, which, in addition, expresses the relationship between maximum concentration and action level as a ratio. Components with values for this ratio greater than unity are present in excess of industrial use risk-based screening criteria, with four of five PAH congeners falling into this category. Of these components, the maximally detected concentration of benzo(a)pyrene at SWMU 83 exceeded its congener-specific industrial use risk-based screening criterion 120-fold. By contrast, dioxins/furans and PCBs did not exceed risk- or migration-based screening criteria at SWMU 83.

Table 5.11 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective residential soil-to-groundwater SSLs. Table 5.12 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective ecological screening criteria. Of the detected congeners at SWMU 83, only benzo(a)pyrene has a residential soil-to-groundwater criterion available for screening, a value that is greater than the maximally detected concentration of this congener (Table 5.25).

No risk-based ecological benchmarks are available to screen detected dioxin/furan or PAH congeners (or PCB mixtures of congeners) at SWMU 83.

5.2.2.4 Summary of compounds present in excess of screening criteria at SWMU 83: An assessment of potential risk drivers

Of the 23 analytes detected at SWMU 83, 4 were detected in 1 or more samples in excess of Phase I compound-specific screening criteria (industrial risk-based, soil-to-groundwater screening levels, and/or

risk-based benchmarks to protect ecological receptors). The identified contaminants are total PAHs, fluoranthene, phenathrene, and pyrene. Surface soil concentrations of total PAHs exceed industrial RBCs or KDEP-promulgated benchmarks in the 2/5 samples in which these compounds were detected (Table 5.23).

From the Phase III analysis it is apparent that, of the five detected congeners combined as "total PAHs" in Phase I, benzo(a)pyrene is present in one surface soil sample 150-fold in excess of its industrial use RBC. Other PAH congeners detected in excess of their industrial use RBCs are benz(a)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene.

Fluoranthene, phenanthrene, pyrene, and total PAHs are retained from the Phase I ecological screen because they exceed EPA Region 4 ecological screening benchmarks (by 4.3, 2.5, and 3.9 times, respectively). However, when total PAHs are examined on a congener-specific basis, benzo(a)pyrene does not exceed this particular congener-specific benchmark (Table 5.25).

5.2.3 SWMU 84—C-535 Electrical Switchyard

5.2.3.1 Phase I—determination of contaminants present in excess of screening criteria

Table 5.2 (Appendix G) presents the data summary for all analytes that were detected and carried forward into the risk evaluation for SWMU 84. As shown in this table, results of analyses for organic compounds and radionuclides are available for both surface and subsurface soils. Results from 6 surface soil samples and up to 16 combined surface and subsurface soil samples are available for screening. Note that data aggregation techniques for evaluation of total dioxins/furans, total PAHs, and total PCBs result in different sample totals. The organic compounds and radionuclides detected at SWMU 84, their frequency of detection, detected range, non-detected range, distribution, and arithmetic mean are presented in Table 5.3 (Appendix G).

Table 5.26 summarizes the results of the Phase I comparison of maximum detected concentrations to industrial use RBCs, background concentrations in surface soil, and KDEP screening criteria for surface soil samples collected at SWMU 84 (see also Table 5.4 in Appendix G). Of the organic compounds, total dioxins/furans, total PAHs, and total PCBs exceed their respective RBCs and KDEP screening criteria. Of the radionuclides, cesium-137 exceeds both its RBC and background activity.

Table 5.27 summarizes the results of the Phase I comparison of maximum detected concentrations to residential soil-to-groundwater screening criteria and background concentrations in surface and subsurface soil samples at SWMU 84 (see also Table 5.5 in Appendix G). Of the organic compounds detected, total dioxins/furans exceed the soil-to-groundwater SSL. Of the radionuclides, cesium-137 and technetium-99 exceed their respective background activities.

Table 5.28 summarizes the results of the Phase I comparison of maximum detected concentrations to eco-RBCs, background concentrations in surface soil, and EPA Region 4 screening criteria for surface soil samples collected at SWMU 84 (see also Table 5.6 in Appendix G). Of the organic compounds, fluoranthene, phenanthrene, pyrene, total dioxins/furans, and total PCBs exceed their respective screening criteria.

5.2.3.2 Phase II—frequency of detection/frequency of exceedance

Contaminants found to exceed one or more risk- or migration-based screening criteria at SWMU 84 are listed in Table 5.29, which summarizes the results of identical screens to those in Phase I, but carried out on a sample-by-sample basis (Phase II) (see tables 5.7–5.9 in Appendix G). Contaminants retained

from the Phase I screens include fluoranthene, phenanthrene, pyrene, total dioxins/furans, total PAHs, total PCBs, cesium-137, and technetium-99. Table 5.29 gives the frequency with which each substance was detected at each site and the number of samples in which an analyte exceeds screening benchmarks. This comparison indicates the extent of contamination of the surface and/or subsurface soil at a site. Among the key findings to emerge from this analysis is that surface soil concentrations of total dioxins/furans, PAHs, and PCBs exceed industrial RBCs, KDEP-promulgated benchmarks, ecological RBCs, and EPA Region 4 ecological benchmarks in one or two samples. Activities of technetium-99 and cesium-137 are higher than site-wide background activities of these isotopes in one or two samples.

5.2.3.3 Phase III—breakout of total dioxins/furans, total PAHs, and total PCBs into congeners

Table 5.10 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective industrial use RBCs. These data are also summarized in Table 5.30, which, in addition, presents the maximum concentration and action level as a ratio. Contaminants with values for this ratio greater than unity are present in excess of industrial use risk-based screening criteria. Five of 14 dioxins/furans fall into this category, though most of these compounds display maximum concentration-RBC ratios close to unity. The exception to this general rule is OCDD, for which the maximum concentration exceeds its industrial-use RBC close to 30-fold.

A subset of (mostly carcinogenic) PAH congeners that are evaluated as "total PAHs" in Phase I were considered individually in Phase III, with three of four components exceeding their risk-based individual screening criteria [approximately 100-fold for benzo(a)pyrene]. In a similar analysis, PCB-1254 and PCB-1260 exceed their industrial use risk-based screening criteria 2- and 9-fold, respectively (Table 5.30).

Table 5.11 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective residential soil-to-groundwater SSLs, and Table 5.12 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective ecological screening criteria. The only detected dioxin/furan and PAH congeners for which residential soil-to-groundwater screening criteria are available [1,2,3,7,8,9-hexachlorodibenzo-p-dioxin and benzo(a)pyrene] were detected at lower concentrations than their respective benchmarks (Table 5.31). Similarly, the maximum detected concentrations of PCB-1254 and PCB-1260 in available surface and subsurface soil samples are lower than their soil-to-groundwater SSLs. However, PCB-1260 exceeds its compound-specific, risk-based benchmark for the protection of ecological receptors (Table 5.32).

5.2.3.4 Summary of compounds present in excess of screening criteria at SWMU 84: An assessment of potential risk drivers

Of the 11 compounds that are hits at SWMU 84, seven were detected in one or more samples in excess of Phase I compound-specific screening criteria (industrial risk-based, soil-to-groundwater screening levels, and/or risk-based benchmarks to protect ecological receptors). These are fluoranthene, phenanthrene, pyrene, total dioxins/furans, total PAHs, total PCBs, and cesium-237. Compounds retained on a qualitative basis only because of the absence of appropriate benchmarks include technetium-99 and alpha and beta radioactivity.

As noted above and in Sect. 5.2.3.2, activities of some radionuclides are higher than background at SWMU 84 (e.g., technetium-99). Activities of this isotope exceed background in 2/16 surface and subsurface samples combined. Surface soil concentrations of total dioxins/furans, PAHs, and PCBs exceed industrial RBCs or KDEP-promulgated benchmarks in all samples in which these compounds were detected (2/4, 1/7, and 2/8 detects for total dioxins/furans, PAHs, and PCBs, respectively).

From the Phase III analysis it is apparent that, of the 14 detected dioxin/furan congeners combined as "total dioxins/furans" in Phase I, OCDD is present in excess of its industrial-use risk-based concentration by a factor of approximately 30. Four other dioxin/furan congeners were detected in concentrations that exceed their congener-specific benchmarks, though not to the same extent as OCDD (Table 5.30). Three of four carcinogenic PAHs were detected in concentrations exceeding their industrial-use risk-based concentrations [up to 100-fold for benzo(a)pyrene].

A comparison of soil concentrations of individual dioxins/furans, PAHs, or PCBs to their soil-to-groundwater SSLs or ecological risk-based concentrations at SWMU 84 is constrained by the absence of suitable congener- or mixture-specific benchmarks. However, for PCB-1260, a mixture of congeners for which soil screening and ecological risk-based criteria *are* available, the maximum concentration/ ecological risk-based screening value ratio is close to unity.

5.2.4 SWMU 85—C-537 Electrical Switchyard

5.2.4.1 Phase I—determination of contaminants present in excess of screening criteria

Table 5.2 (Appendix G) presents the data summary for all analytes that were detected and carried forward into the risk evaluation for SWMU 85. As shown in this table, results of analyses for organic compounds and radionuclides are available for both surface and subsurface soils. Results from 4 surface soil samples and up to 16 combined surface and subsurface soil samples are available for screening. Note that data aggregation techniques for evaluation of total dioxins/furans, total PAHs, and total PCBs result in different sample totals. The organic compounds and radionuclides detected at SWMU 85, their frequency of detection, detected range, non-detected range, distribution, and arithmetic mean are presented in Table 5.3 (Appendix G).

Table 5.33 summarizes the results of the Phase I comparison of contaminant-specific maximum detected concentrations to industrial use RBCs, background concentrations in surface soil, and KDEP screening criteria for surface soil samples collected at SWMU 85 (see also Table 5.4 in Appendix G). Of the organic compounds, total dioxins/furans, total PAHs, and total PCBs exceed one or more risk-based benchmarks. No radionuclides exceed RBCs or background activities (where available).

Table 5.34 summarizes the results of the Phase I comparison of maximum detected concentrations to residential soil-to-groundwater screening criteria and background concentrations for surface and subsurface soil samples collected at SWMU 85 (see also Table 5.5 in Appendix G). Of the organic compounds detected, total dioxins/furans exceed the SSL. No radionuclides exceed background activities (where available).

Table 5.35 summarizes the results of the Phase I comparison of maximum detected concentrations to eco-RBCs, background concentrations in surface soil, and EPA Region 4 ecological screening criteria for surface soil samples collected at SWMU 85 (see also Table 5.6 in Appendix G). Of the organic compounds, fluoranthene, pyrene, total dioxins/furans, and total PCBs exceed one or more ecological risk-based benchmarks. There are no background concentrations for organic compounds. As mentioned above, there are no ecological screening criteria for radionuclides, and no background activities are available for comparison to the alpha and beta activities measured at SWMU 85.

5.2.4.2 Phase II—frequency of detection/frequency of exceedance

Contaminants found to exceed one or more risk- or migration-based screening criteria at SWMU 85 are listed in Table 5.36, which summarizes the results of identical screens to those in Phase I, but carried out on a sample-by-sample basis (Phase II) (see Tables 5.7–5.9 in Appendix G). Contaminants carried

forward into the Phase II analysis are fluoranthene, pyrene, total dioxins/furans, total PAHs, and total PCBs. Table 5.36 gives the frequency with which a substance was detected at each site and the number of samples in which an analyte exceeded screening benchmarks. This comparison indicates the extent of contamination of the surface and/or subsurface soil at a site. Findings to emerge from this analysis are that surface soil concentrations of total dioxins/furans, PAHs, and PCBs exceed industrial RBCs, KDEP-promulgated benchmarks, ecological RBCs, and EPA Region 4 ecological benchmarks in one or two samples.

5.2.4.3 Phase III—breakout of total dioxins/furans, total PAHs, and total PCBs into congeners

Table 5.10 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective industrial use RBCs. These data are also summarized in Table 5.37, which, in addition, compares the maximum concentration to its screening criterion as a ratio. Contaminants with values for this ratio greater than unity are present in excess of industrial-use risk-based screening criteria. Six of 12 dioxins/furans fall into this category, though most of these compounds display maximum concentration-RBC ratios close to unity. The exception to this general rule is OCDD, for which the maximum concentration exceeds its industrial-use RBC close to 45-fold.

A subset of (mostly carcinogenic) PAH congeners that are evaluated as "total PAHs" in Phase I are considered individually in Phase III, with three of four components exceeding their risk-based individual screening criteria [approximately 35-fold for benzo(a)pyrene]. In a similar analysis, PCB-1260 exceeds its industrial-use risk-based screening criterion twofold (Table 5.37).

Table 5.11 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective residential soil-to-groundwater SSLs, and Table 5.12 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective ecological screening criteria. The only detected dioxin/furan congener and PCB mixture of congeners for which residential soil-to-groundwater screening criteria are available (1,2,3,7,8,9-hexachlorodibenzo-p-dioxin and PCB-1260) were measured at lower concentrations than their respective benchmarks (Table 5.38). Similarly, the maximum detected concentration of PCB-1260 is lower than its ecological risk-based concentration in surface soil samples (Table 5.39).

5.2.4.4 Summary of compounds present in excess of screening criteria at SWMU 85: An assessment of potential risk drivers

Of the seven analytes detected at SWMU 85, five were detected in one or more samples in excess of Phase I compound-specific screening criteria (industrial risk-based, soil-to-groundwater screening levels, and/or risk-based benchmarks to protect ecological receptors). The contaminants are total dioxins/furans, total PAHs, total PCBs, fluoranthene, and pyrene. For four of the five detected contaminants, these exceedances occur in a single detect (out of a total number of detects of four, four, two, and five, for fluoranthene, pyrene, total dioxins/furans, and total PCBs, respectively). Surface soil concentrations of total PAHs exceed industrial RBCs or KDEP-promulgated benchmarks in two of the six samples in which these compounds were detected (Table 5.36).

From the Phase III analysis it is apparent that, of the 12 detected dioxin/furan congeners combined as "total dioxins/furans" in Phase I, OCDD is present in considerable excess of its industrial-use risk-based concentration (by a factor of approximately 45). Five other dioxin/furan congeners were detected in concentrations that exceeded their congener-specific benchmarks, though by factors ranging from four to close to unity (Table 5.37). Three of four carcinogenic PAH congeners (components of the "total PAH" parameter evaluated in Phase I) were detected in concentrations exceeding their industrial-use risk-

based concentrations [up to 35-fold for benzo(a)pyrene]. PCB-1260 exceeds its industrial-use risk-based concentration by a factor of two.

No individual dioxin/furan or PAH congener or PCB mixture of congeners was detected in excess of its soil-to-groundwater SSL or ecological risk-based screening criterion (Tables 5.38 and 5.39).

5.2.5 C-340 Reduction and Metals Facility

5.2.5.1 Phase I—determination of contaminants present in excess of screening criteria

Table 5.2 (Appendix G) presents the data summary for all analytes that were detected and carried forward into the risk evaluation for area C-340. As shown in this table, results of analyses for inorganic chemicals, organic compounds, and radionuclides are available from 12 surface soils and up to 16 combined surface and subsurface soils. Note that data aggregation techniques for evaluation of total dioxins/furans, total PAHs, and total PCBs result in different sample totals. The inorganic chemicals, organic compounds, and radionuclides detected at C-340, their frequency of detection, detected range, non-detected range, distribution, and arithmetic mean are presented in Table 5.3 (Appendix G).

Table 5.40 summarizes the results of the Phase I comparison of maximum detected concentrations to industrial use RBCs, background concentrations in surface soil, and KDEP screening criteria for surface soil samples collected from area C-340 (see also Table 5.4 in Appendix G). The inorganic chemicals aluminum, beryllium, chromium, lead, and nickel exceed one or more of their respective industrial use RBCs, background concentrations, and KDEP screening criteria. The essential nutrients calcium, magnesium, potassium, and sodium are present above background concentrations; however, as discussed in Sect. 5.3.1, these chemicals are known to be toxic only at extremely high concentrations and thus are not considered further in this risk evaluation. Of the organic compounds, anthracene, total dioxins/furans, total PAHs, and total PCBs exceed one or more risk-based benchmarks. Americium-241, cesium-137, cobalt-60, protactinium-234, thorium-234, uranium-234, uranium-235, and uranium-238 exceed one or more risk-based benchmarks and background activity (where available).

Table 5.41 summarizes the results of the Phase I comparison of maximum detected concentrations to residential soil-to-groundwater screening criteria and background concentrations for all surface and subsurface samples collected from C-340 (see Table 5.5 in Appendix G). Although soil-to-groundwater criteria for screening are not available, a number of inorganic chemicals exceed their respective background concentrations, including aluminum and lead, and the essential nutrients, calcium, magnesium, potassium, and sodium. However, the latter chemicals are known to be toxic only at extremely high concentrations and are not considered further in this risk evaluation. Of the organic compounds, chloromethane, methylene chloride, total dioxins/furans, total PAHs, and total PCBs exceed their respective SSLs, while among the radionuclides, cesium-137, technetium-99, uranium-234, uranium-235, and uranium-238 exceed their respective background activities.

Table 5.42 summarizes the results of the Phase I comparison of maximum detected concentrations to eco-RBCs, background concentrations in surface soil, and EPA Region 4 ecological screening criteria for all surface soil samples collected at C-340 (see also Table 5.6 in Appendix G). The inorganic chemicals aluminum, beryllium, chromium, copper, lead, mercury, nickel, and zinc exceeded one or more risk-based benchmarks and background concentrations. Calcium, magnesium, potassium, and sodium exceeded their respective background concentrations; however, there are no ecological screening criteria for these metals. Lithium slightly exceeded its eco-RBC and the EPA Region 4 screening criterion; however, as discussed in Sect. 5.3.1, lithium has not been further considered in this risk evaluation. Of the organic compounds, anthracene, fluoranthene, naphthalene, phenanthrene, pyrene, total dioxins/furans, total PAHs, and total PCBs exceeded one or more ecological risk-based benchmarks, while among the

radionuclides, cesium-137, neptunium-237, technetium-99, uranium-234, uranium-235, and uranium-238 exceed their respective background activities.

5.2.5.2 Phase II—frequency of detection and frequency of exceedance

Contaminants found to exceed one or more risk-based screening criteria at area C-340 are listed in Table 5.43, which summarizes the results of identical screens to those of Phase I, but carried out on a sample-by-sample basis (Phase II) (see Tables 5.7–5.9 in Appendix G). Contaminants carried forward to Phase II as a result of the Phase I screen include aluminum, beryllium, calcium, chromium, copper, lead, magnesium, mercury, nickel, potassium, sodium, zinc, anthracene, chloromethane, fluoranthene, methylene chloride, naphthalene, phenanthrene, pyrene, total dioxins/furans, total PAHs, total PCBs, americium-241, cesium-137, cobalt-60, neptunium-237, plutonium 239/240, protactinium-234m, technetium-99, thorium-234, uranium-235, and uranium-238.

Table 5.43 lists the frequency with which a substance was detected at each site and the number of samples in which each analyte exceeds benchmarks. This comparison gives an indication of the overall pervasiveness of contamination of the surface and/or subsurface soil at a site. A key finding to emerge from consideration of the extent of contamination of the inorganic hits is that 9 of 12 chromium and 9 of 12 zinc detects exceed their ecological RBCs and EPA Region 4 ecological benchmarks. Similarly, of the 4 of 12 lead detects in surface soil at area C-340, 3 exceed industrial-use and ecological risk-based screening criteria. By contrast, of the 12 aluminum hits (out of possible total of 12), only 1 sample contains the chemical in excess of industrial-use RBCs or ecological screening criteria.

Table 5.43 shows that not all detected organic contaminants are individually present in all surface and subsurface samples of soil collected at area C-340. For example, total dioxins/furans were detected only in five of nine surface soil samples at this location. However, overwhelmingly, where an organic contaminant was detected, its concentration is sufficient to exceed one or more risk-based screening criteria. Thus, all five of the total dioxin/furan detects exceed the industrial-use RBC, KDEP risk-based soil benchmark, soil-to-groundwater protective SSL, and ecological RBC for this analyte. Furthermore, this general pattern of pervasiveness is apparent for some other organic contaminants, most notably anthracene, fluoranthene, naphthalene, phenanthrene, pyrene, total PAHs, and total PCBs. Five of the seven americium-241 and five of seven of the cesium-137 detects exceed their industrial-use risk-based benchmarks, typifying the same pattern of pervasiveness and exceedances of benchmarks that was noted for organic and inorganic contaminants. Thus, while protactinium-234m was detected in 8 of 12 surface soil samples, the isotope is present in activities that are greater than its operative industrial-use RBC in all 8 samples Table 5.43 details the Phase II findings for all analytes retained by the Phase I screen.

5.2.5.3 Phase III—comparison of concentrations of individual dioxins/furans, PAHs, and total PCBs with benchmarks

Table 5.10 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective industrial use RBCs. These data are also summarized in Table 5.44, which, in addition, expresses the maximum concentration and action level as a ratio. Contaminants with values for this ratio greater than unity are present in excess of industrial-use risk-based screening criteria. Fifteen of 17 dioxins/furans fall into this category, most notably 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin (1,2,3,6,7,8-HCDD) and OCDD, with maximum detected concentrations exceeding their industrial use RBCs 65- and 50-fold, respectively.

A subset of (mostly carcinogenic) PAH congeners that are evaluated as "total PAHs" in Phase I is considered individually in Phase III, with seven of seven congeners exceeding their risk-based individual

screening criteria [greater than 40,000-fold for benzo(a)pyrene]. In a similar analysis, PCBs-1242, -1248, -1254, and -1260 exceed their respective industrial-use RBCs up to 26,000-fold.

Table 5.11 (Appendix G) compares the maximum detected concentration of individual dioxins/furans, PAHs, and PCBs to their respective residential soil-to-groundwater SSLs, while Table 5.12 (Appendix G) compares the maximum detected concentration of individual congeners/compounds in surface soil to their respective ecological screening criteria. The only detected dioxins/furans for which residential soil-to-groundwater screening values are available are 1,2,3,7,8,9-HCDD and 2,3,7,8-tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD), both of which were detected at concentrations that are lower than their respective SSLs (Table 5..45). By contrast, benzo(a)pyrene, PCB-1254, and PCB-1260 are present at concentrations in excess of their SSLs and, for the PCBs, at concentrations up to 3000 times greater than their ecological RBCs (Table 5.46).

5.2.5.4 Summary of compounds present in excess of screening criteria at area C-340: An assessment of potential risk drivers

Of the 50 analytes detected at C-340, 22 were measured in 1 or more samples in excess of Phase I compound-specific screening criteria (industrial risk-based, soil-to-groundwater SSLs, and/or risk-based benchmarks to protect ecological receptors). These are aluminum, beryllium, calcium, chromium, copper, lead, magnesium, mercury, nickel, potassium, sodium, zinc, anthracene, chloromethane, fluoranthene, methylene chloride, naphthalene, phenathrene, pyrene, total dioxins/furans, total PAHs, and total PCBs. Radionuclides retained as a result of Phase I screening include americium-241, cesium-137, cobalt-60, neptunium-237, plutonium-239/240, protactinium-234m, technetium-99, thorium-234, uranium-235, and uranium-238.

As discussed in Sect. 5.2.5.2, there is a clear distinction between those chemicals, such as zinc, that exceed benchmarks in most of the samples in which they were detected, and a chemical, such as aluminum, a ubiquitous soil component that, nonetheless, exceeds screening level benchmarks in only 1 of 12 hits. Most detected organic contaminants and radionuclides exceed one or more RBCs and other action levels in almost all samples in which they were detected (as detailed in Table 5.43).

From the Phase III analysis it is apparent that, of the 17 detected dioxin/furan congeners combined as "total dioxins/furans" in Phase I, 1,2,3,6,7,8-HCDD and OCDD were present in considerable excess of their industrial-use RBCs (65-fold and 50-fold, respectively). The maximum concentrations of 13 other dioxin/furan congeners exceeded industrial-use RBCs by factors ranging from 20 to unity. Seven of seven carcinogenic PAHs were detected at concentrations exceeding their industrial-use RBCs [up to approximately 41,000-fold for benzo(a)pyrene]. Four of four mixtures of PCB congeners displayed this same relationship to their industrial-use RBCs, with maximum concentration/RBC ratios ranging to values in excess of 25,000 for PCB-1248. Most PCBs exceeded their soil-to-groundwater SSLs and ecological RBCs in at least one sample.

5.3 UNCERTAINTY

In the baseline risk assessment section of a remedial investigation report, characterizing the cleanup unit employs statistically sufficient numbers of samples to determine realistic central tendency and reasonable maximum exposure estimates of unit-wide levels of contamination. This can then be used to estimate the degree of risk or hazard potentially impacting a receptor. By contrast, in a site evaluation, the (more preliminary) goal is to capture the degree of contamination related to past emissions and known spills ("hot spots") and to compare these levels directly to one or more risk-based and regulatory guidance values. Such information (benchmarks exceeded Y/N?) provides the input to a decision to either (1) take

no further action or (2) carry out further site investigations. Where the screening criteria have been developed from *de minimis* criteria, the resulting evaluation is likely to be conservative.

In the site evaluation described in this report, several risk-based and regulatory guidance values are employed to screen contaminants detected in soil samples, thereby increasing the likelihood that the detected levels of contamination at the SWMUs would exceed at least one of the operative benchmarks. In general, the justification for this (additionally) conservative approach is to minimize the possibility that a SWMU will be considered to warrant no further action when, in fact, significant amounts of contamination are present (false negative).

It could be argued that the underlying rationale for employing the conservative approach is based on the degree of uncertainty that is associated with many of the input parameters to the risk evaluation, including:

- how the action levels were derived,
- how the contaminants were measured,
- how the degree of toxicity associated with a particular contaminant was determined,
- how representative of the contaminated areas are the samples that were taken, and
- how relevant to actual site operations are the exposure assumptions that are built into the derivation of the action levels.

Recognizing and addressing these uncertainties may be important if, as a result of an overly conservative approach, comparatively benign cleanup units are incorrectly designated for further investigation where such activity is unwarranted (false positive).

Some of the uncertainties mentioned above can be recognized but not explicitly or quantitatively evaluated (e.g., the uncertainty potentially bounding the toxicity of a particular contaminant, or the relevance/applicability of default exposure assumptions). Others, such as the representativeness of the maximum detected concentration of a contaminant to its presence at the SWMU unit as a whole, are addressed in this risk evaluation by applying the Phase I screens to each sample individually, thereby offering an assessment of the site-wide pervasiveness of a particular contaminant, as described in Phase II of this risk evaluation.

The specific uncertainty addressed in Phase III arises from the recognition that, at all of the units under consideration, dioxins, furans, PAHs, and PCBs appear to be the primary risk drivers. The Phase III analysis addresses the potential for a single or (possibly) a very small number of individual dioxin/furan, PAH, or PCB components to overly weight the Phase I findings in circumstances that do not reflect a generalized pattern of contamination for these substances. This danger has been recognized in the present study for OCDD, a congener that (1) was found to be present at many-fold higher concentrations than the other dioxin/furan congeners and (2) may be a laboratory contaminant. If the concentrations of OCDD at WAG 8 are actually due to contamination resulting from laboratory processes, a remedial decision based on this finding would constitute a gross false positive, most likely resulting in unwarranted further investigation and/or cleanup activity.

Exhibit 5.2 summarizes the Phase II findings on representativeness in terms of (1) the frequency of detection of the analytes, (2) the number of contaminants with maximum detected concentrations in excess of screening criteria, and (3) the number of contaminants exceeding screening criteria in multiple samples. This evaluation is discussed in Sect. 5.3.1. Section 5.3.2 discusses the Phase III spectrum of dioxins/furans, PAHs, and PCBs that exceed congener- or mixture of congener-specific industrial-use RBCs, and the degree to which OCDD exceeds such benchmarks compared to other dioxin/furan

congeners. Key findings are summarized in Exhibit 5.3. The possibility that OCDD may represent a laboratory contaminant is addressed in Sect. 5.3.3.

The fact that one or more contaminants are present at each SWMU in excess of action levels in Phase I points to the need for further investigation at each cleanup unit, in line with decision rules routinely associated with the site evaluation process. However, there may be scope for professional judgement to endorse or temper such decisions, whether through the outcome of the Phase II analysis of representativeness, or through the Phase III analysis of the relevance of the OCDD measurements to the prevailing levels of dioxin contamination.

5.3.1 Summarizing the Representativeness Uncertainty (Phase II Data)

In analyzing the representativeness of the site-specific data (Phase II), Exhibit 5.2 illustrates the fact that, for surface soils at area C-340, 26 percent of all substances detected at this location are present in excess of one or more Phase I benchmarks (54 percent of detected analytes). Ninety-three percent of these substances exceed benchmarks in more than one surface soil sample. Taken together, these data suggest that exceedances of risk- and migration-based benchmarks at this particular location could be indicative of a general pervasiveness of contaminants in surface soil at area C-340. This information should be weighed when decisions on the need for further remedial activity are considered for this location. By contrast, only 7 percent of detected contaminants at SWMU 83 exceed any Phase I benchmarks (17 percent of all hits), with only 1/4 contaminants exceeding benchmarks in multiple samples. This finding may suggest that the exceedances of Phase I benchmarks at SWMU 83 are unlikely to indicate the same pervasive pattern of contamination such as that discerned at area C-340. Between the two extremes represented by area C-340 and SWMU 83, may be found variable rates of coverage and exceedances at the other SWMUs that, in each case, help to set the remedial decision-making process in the context of the representativeness of the Phase I analyses. Ultimately, the use of these data for remedial decision-making will depend on professional judgement, in light of the absence of formal decision rules for integrating the Phase II findings into the conclusions of the study.

5.3.2 Discerning the Relevance of Detected OCDD to the Overall Levels of Dioxin and Furan Congeners at WAG 8 (Phase III Data)

As illustrated in Exhibit 5.3, 15 of 17 dioxin/furan congeners were detected in surface soils at area C-340 at concentrations greater than congener-specific RBCs. OCDD was present at the highest concentration (1E-2 mg/kg) of all detected congeners and at 50 times greater than its industrial-use RBC. With the exception of SWMU 83, where no soil-borne dioxins/furans were detected, this pattern of exceedances of congener-specific industrial RBCs is repeated at the other SWMUs, with a range of dioxin/furan congeners exceeding their industrial-use RBCs, though to a lesser extent than OCDD. A number of PCBs and carcinogenic PAHs, including benzo(a)pyrene, were also detected in substantial excess of their industrial-use RBCs, most notably at area C-340, though evident to a more limited extent at the other SWMUs.

The maximum OCDD concentration at area C-340 is 25 times greater than the next most heavily represented congener, 1,2,3,6,7,8-hexachlorodibenzo(p)dioxin (3.94E-4 mg/kg). This disparity should be viewed in the context of whether there exist any recognized "fingerprints" of dioxin/furan congeners that may be typically present at contaminated sites as a result of industrial activity and releases to the environment. Also relevant is the extent to which OCDD is often the most heavily represented congener in releases of these components to the environment, for example, in combustion emissions.

As noted above, a parameter of interest to emerge from the Phase III assessment of OCDD is the ratio of its maximum detected concentration to its industrial-use RBC, as compared to equivalent ratios

for the other congeners. The value of this parameter for OCDD (50) is exceeded by that of 1,2,3,6,7,8-HCDD (65) at area C-340, with values for the other detected congeners ranging from 20 to 2. On their face, these data do not necessarily suggest the presence of OCDD at this location for any other reason than as a consequence of site-specific contamination as a result of past practices and spills.

In an example of a SWMU at the lower end of the contamination spectrum, 6/12 dioxin/furan congeners at SWMU 85 are present at levels in excess of congener-specific industrial-use RBCs in surface soils. The maximum concentration of OCDD (9.2E-3 mg/kg) was 36 times greater than that of the next most heavily represented component [1,2,3,4,6,7,8-heptachlorodibenzo(p)dioxin at 2.5E-4 mg/kg]. OCDD exceeds its congener-specific benchmark by a factor of 45, but none of the other congeners exceed their benchmarks more than 4-fold. In general terms, any differences in the "fingerprint" for the detected dioxins/furans in extracts of soils from area C-340 versus SWMU 85 might leave open the possibility that OCDD may have been present at the latter location as a result of processes other than past practices and spills.

5.3.3 Potential for OCDD Hits to be the Consequence of Laboratory Contamination

If the apparent presence of OCDD as an environmental contaminant at SWMU 85 is bounded by uncertainty, determining whether it should be unequivocally assigned to laboratory contamination can be addressed to some extent by data validation. This is because the OCDD value of 9.2E-3 mg/kg referred to above was determined in a surface soil sample (085008SA001), the results of which were validated during the quality assurance/quality control phase of data management. The OCDD data point was assigned "J" and "E" qualifiers because the response was outside the normal calibration range of the detection system. Of particular interest is the fact that, during the analytical run, trace amounts of a number of other dioxin/furan congeners were found to be present in the laboratory blanks, but not of OCDD. Such a finding provides no evidence that OCDD is present in this sample solely as a result of laboratory contamination, but it also cannot exclude the possibility. Accordingly, remedial decision-making based on the Phase I exceedances of screening criteria by "total dioxins/furans" must continue to weigh the false positive potential of these findings, especially in the absence of definitive evidence that can clarify whether OCDD is a laboratory contaminant.

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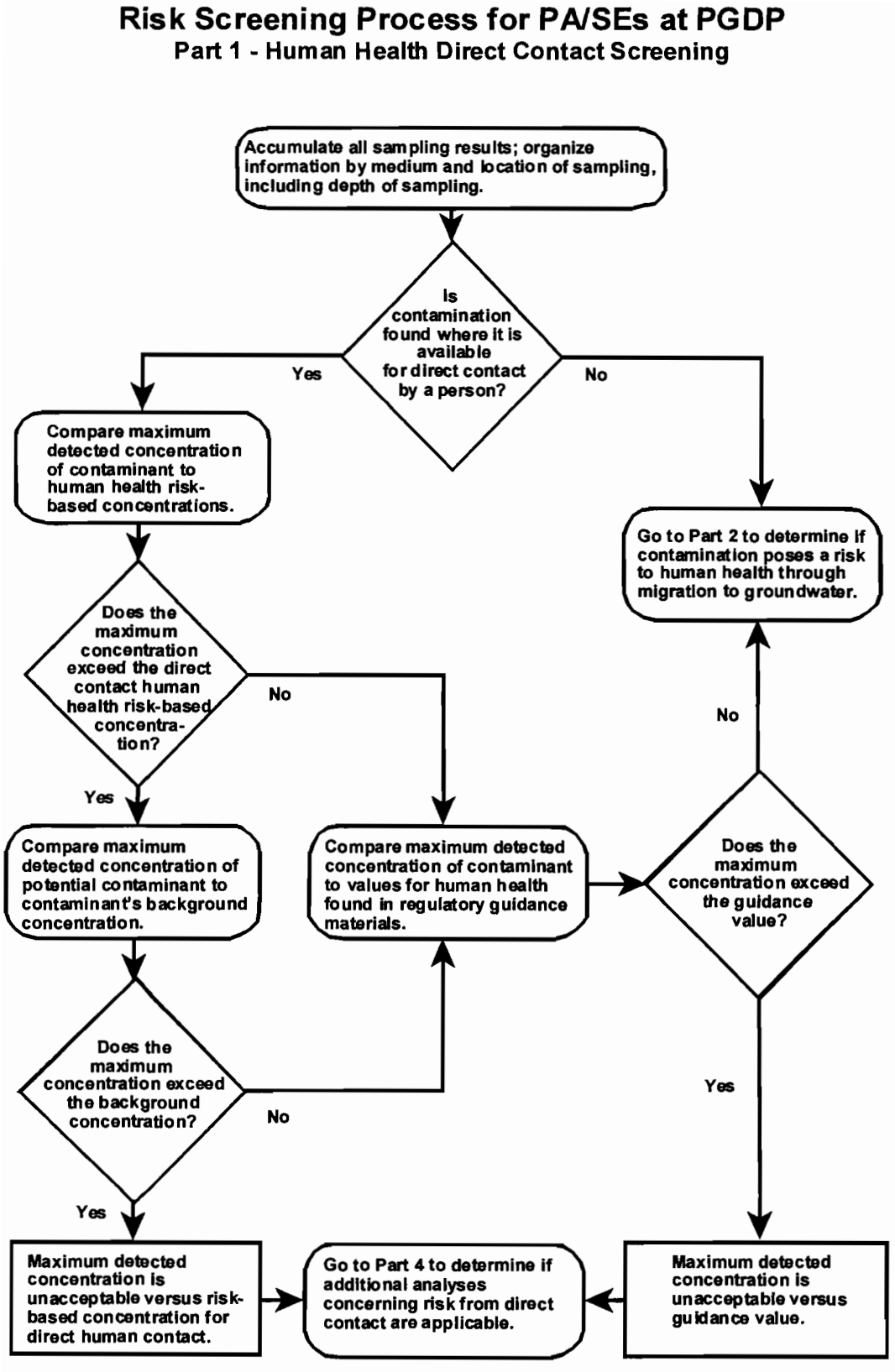

Fig. 5.1 Risk screening for direct contact risks to a human receptor

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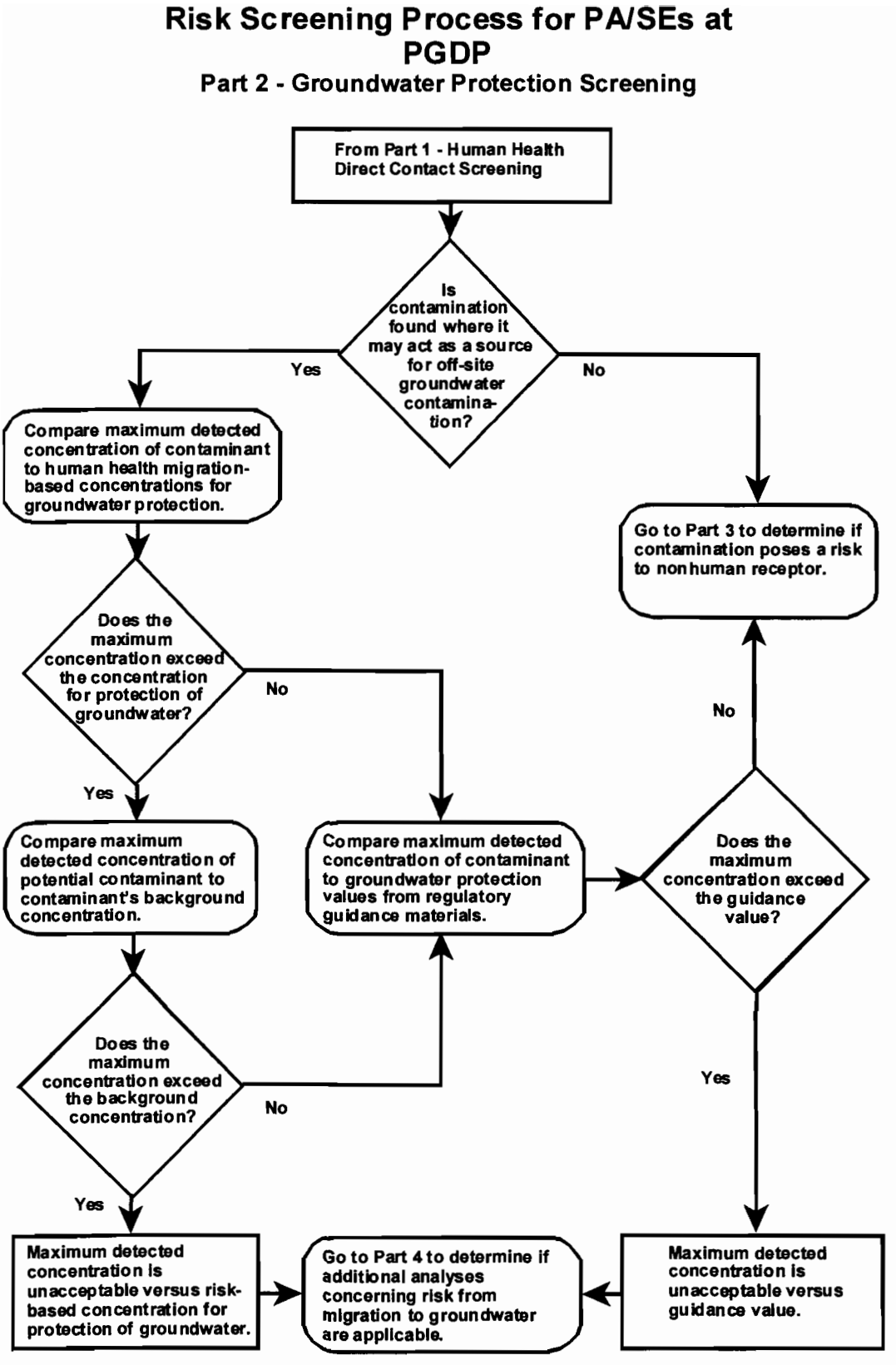

Fig. 5.2. Risk screening for protection of groundwater used by a resident

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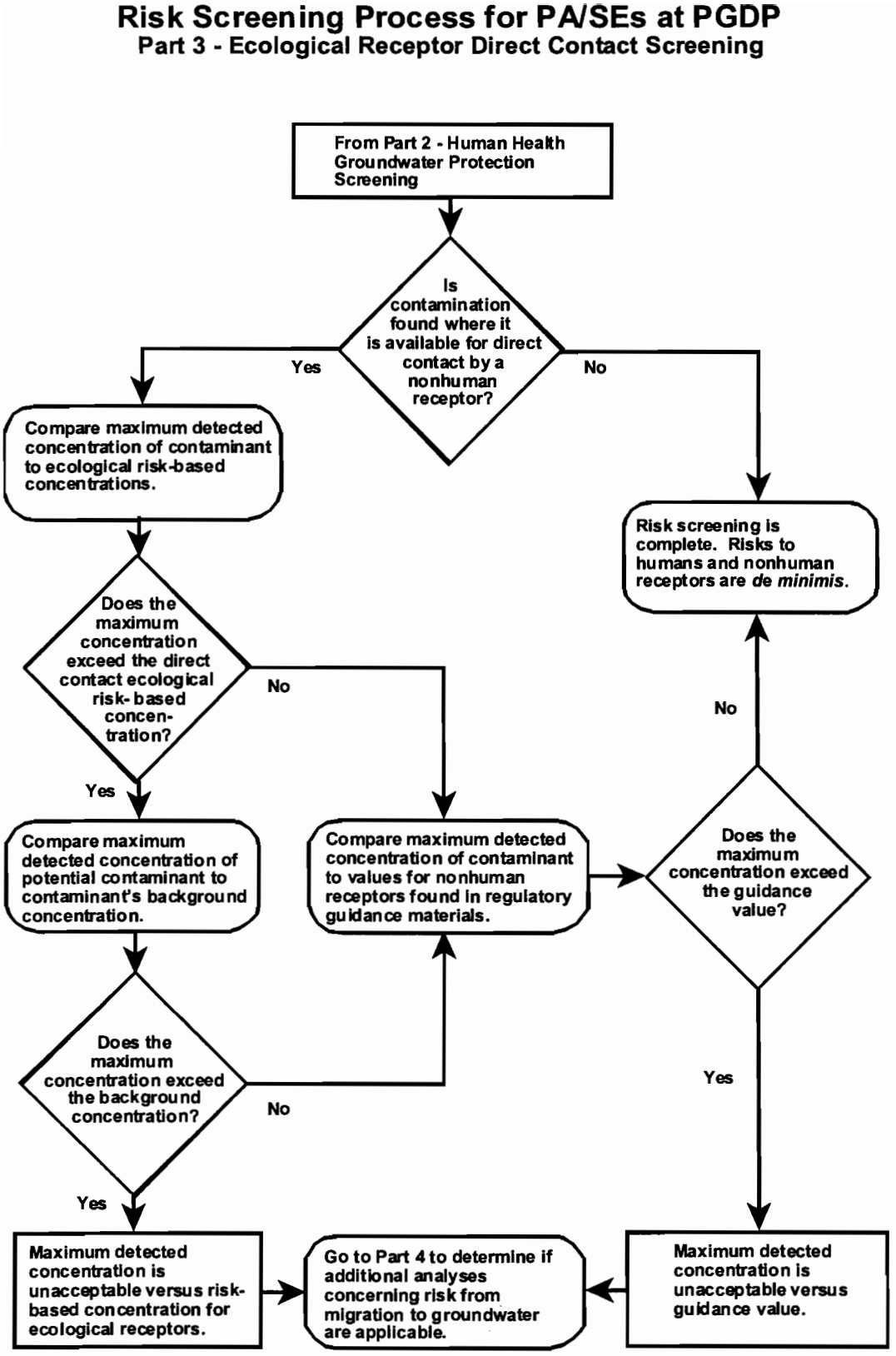

Fig. 5.3. Risk screening for direct contact risks to a nonhuman receptor

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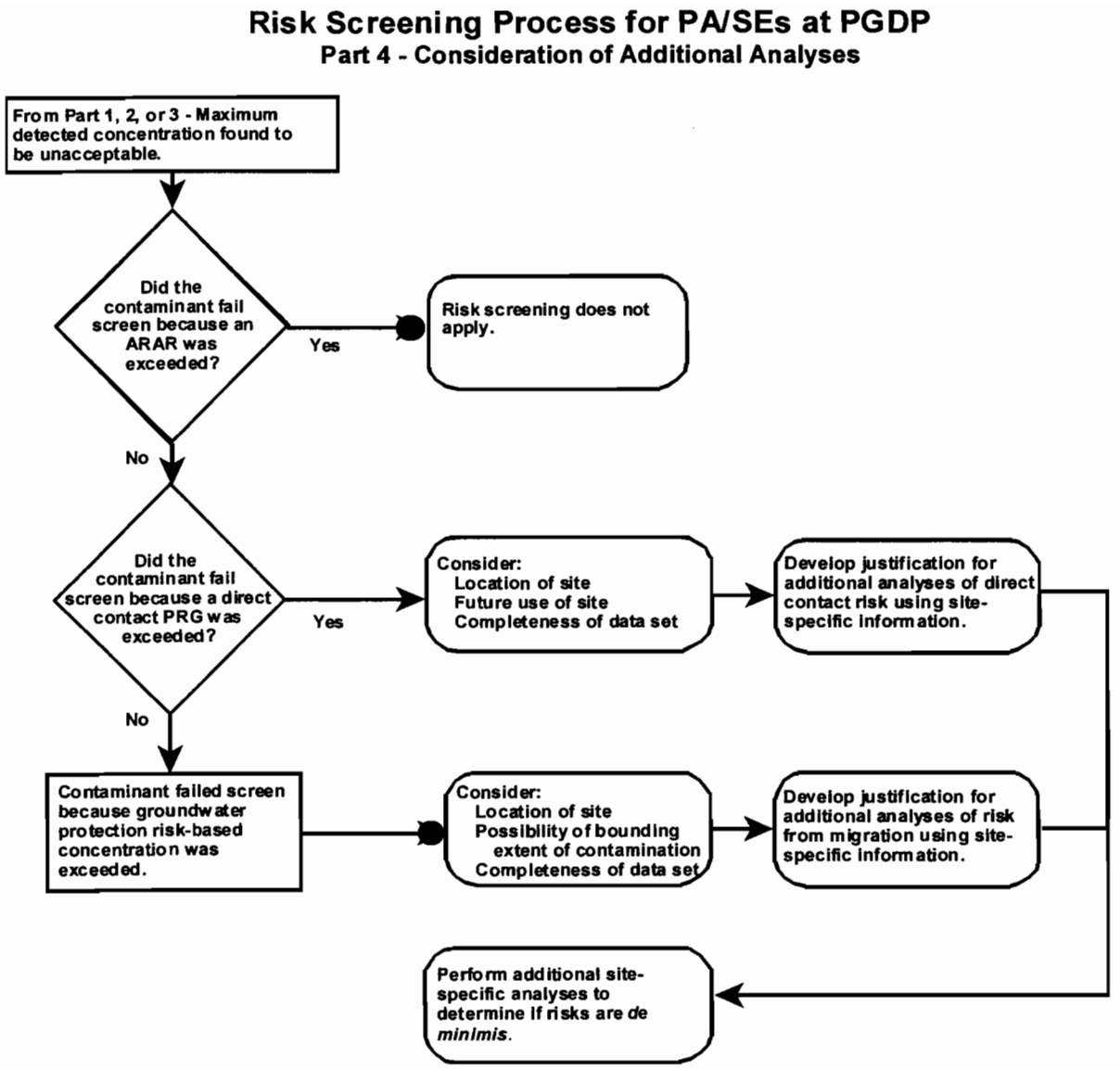

Fig. 5.4. Flow chart used to determine if additional risk analyses are justified

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Note: Tables 5.1 through 5.12 are located in Appendix G.

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Table 5.13. SWMU 82, Phase I—comparison of maximum detected concentrations in surface soil to risk-based screening criteria (industrial)

Constituent[a]	Maximum detected concentration[b]	Industrial-use risk-based concentration[c]		Background concentration[d]	KDEP screening value[e]	Exceed?/ basis
		Systemic toxicity	Cancer risk			
Organic compounds (mg/kg)						
Acenaphthene	3.50E-01	4.20E+02			3.60E+01	No
Anthracene	5.10E-01	4.90E+03			1.90E+00	No
Dibenzofuran	2.80E-01	4.40E+01			2.60E+01	No
Diethyl phthalate	2.60E-01	1.50E+04			5.20E+03	No
Fluoranthene	1.70E+00	2.80E+02			2.60E+02	No
Fluorene	4.00E-01	4.40E+02			3.00E+01	No
Naphthalene	5.20E-01	6.30E+01			8.00E+01	No
Phenanthrene	1.20E+00					Yes/Qual[f]
Pyrene	1.70E+00	2.10E+02			2.00E+02	No
Total dioxins/furans[g]	4.38E-05		6.20E-07[h]		3.80E-07[i]	Yes/P[j], K[k]
Total PAHs[l]	3.16E+00		2.70E-03[m]		6.10E-03[n]	Yes/P, K
Total PCBs[o]	1.18E+00		4.20E-02[p]		6.60E-03[q]	Yes/P, K
Radionuclides (pCi/g)						
alpha Activity	1.22E+02					Yes/Qual
beta Activity	2.18E+02					Yes/Qual
Neptunium-237	8.81E-03		4.50E-01	1.00E-01		No
Plutonium-239	2.75E-02		1.00E+01			No
Plutonium-239/240	4.38E-02		1.00E+01			No
Technetium-99	0.00E+00		2.30E+03	2.50E+00		No
Thorium-234	1.22E+02		4.50E+01			Yes/P
Uranium-234	7.55E+00		7.10E+01	2.50E+00		No
Uranium-238	3.85E+01		3.10E+00	1.20E+00		Yes/P, B[r]

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Risk-based concentrations (RBCs) were generated as described in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996). The target hazard index and cancer risk for non-radionuclides are 0.1 and 1×10^{-7}, respectively. The target cancer risk for radionuclides is 1E-6.
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Commonwealth of Kentucky Department of Environmental Protection (KDEP) screening values for residential exposure to surface soil are taken from Appendix A of *Risk Assessment Guidance* (KDEP 1995). All values presented in Appendix A were divided by 10 prior to use in this screening evaluation, as directed in the aforementioned guidance.
[f] Qual = qualitative analyte.
[g] Sum of TEF-converted dioxins/furans.
[h] RBC is for 2,3,7,8-TCDD.
[i] KDEP screening value is for 2,3,7,8-TCDD.
[j] P = > industrial-use RBC.
[k] K = > KDEP guidance.
[l] Sum of TEF-converted PAHs.
[m] RBC is for benzo(a)pyrene.
[n] KDEP screening value is for benzo(a)pyrene.
[o] Sum of PCB congeners.
[p] RBC is for PCB-1260.
[q] KDEP screening value is for total PCBs.
[r] B = > background concentration.

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Table 5.14 SWMU 82, Phase I—comparison of maximum detected concentrations in surface and subsurface soil to soil-to-groundwater screening criteria (residential)

Constituent[a]	Maximum detected concentration[b]	EPA soil screening level for protection of groundwater[c]	Background concentration[d]	Exceed?/ basis
Organic compounds (mg/kg)				
Acenaphthene	3.50E-01	6.30E+02		No
Anthracene	5.10E-01	1.30E+04		No
bis(2-Ethylhexyl)phthalate	5.40E-01	3.60E+03		No
Di-n-butyl phthalate	1.60E+00	5.00E+03		No
Dibenzofuran	2.80E-01			Yes/Qual[e]
Diethyl phthalate	2.60E-01	4.50E+02		No
Fluoranthene	1.70E+00	6.30E+03		No
Fluorene	4.00E-01	8.10E+02		No
Naphthalene	5.20E-01	6.10E+01		No
Phenanthrene	1.20E+00			Yes/Qual
Pyrene	1.70E+00	4.60E+03		No
Total dioxins/furans	4.38E-05	5.60E-06		Yes/S[f]
Total PAHs	3.16E+00	8.20E+00		No
Total PCBs	1.18E+00	6.20E+00		No
Radionuclides (pCi/g)				
alpha Activity	1.22E+02			Yes/Qual
beta Activity	2.18E+02			Yes/Qual
Neptunium-237	8.81E-03			Yes/Qual
Plutonium-239	2.75E-02			Yes/Qual
Plutonium-239/240	4.38E-02			Yes/Qual
Technetium-99	4.35E+00		2.80E+00	Yes/B[g]
Thorium-234	1.22E+02			Yes/Qual
Uranium-234	7.55E+00		2.40E+00	Yes/B
Uranium-238	3.85E+01		1.20E+00	Yes/B

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all soil samples.
[c] EPA SSLs for protection of groundwater were calculated using EPA's soil screening level guidance (see http://risk.lsd.ornl.gov/calc_start.htm on the World Wide Web for additional information).
[d] Background concentrations are taken from Tables 4.2 and 4.4 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Qual = qualitative analyte.
[f] S = > soil screening level.
[g] B = > background concentration.

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Table 5.15. SWMU 82, Phase I—comparison of maximum detected concentrations in surface soil to ecological risk-based screening criteria

Constituent[a]	Maximum detected concentration[b]	Ecological risk-based concentration[c]	Background concentration[d]	EPA Region 4 ecological screening value for soil[e]	Exceed?/ basis
Organic compounds (mg/kg)					
Acenaphthene	3.50E-01	2.00E+01		2.00E+01	No
Anthracene	5.10E-01			1.00E-01	Yes/R[f]
Dibenzofuran	2.80E-01				Yes/Qual[g]
Diethyl phthalate	2.60E-01	1.00E+02		1.00E+02	No
Fluoranthene	1.70E+00			1.00E-01	Yes/R
Fluorene	4.00E-01			3.00E+01	No
Naphthalene	5.20E-01			1.00E-01	Yes/R
Phenanthrene	1.20E+00			1.00E-01	Yes/R
Pyrene	1.70E+00			1.00E-01	Yes/R
Total dioxins/furans[h]	4.38E-05	3.15E-06[i]			Yes/E[j]
Total PAHs[k]	3.16E+00			1.00E-01[l]	Yes/R
Total PCBs[m]	1.18E+00	3.71E-01[n]		2.00E-02[o]	Yes/E,R
Radionuclides (pCi/g)					
alpha Activity	1.22E+02				Yes/Qual
beta Activity	2.18E+02				Yes/Qual
Neptunium-237	8.81E-03		1.00E-01		No
Plutonium-239	2.75E-02		2.50E-02		Yes/B
Plutonium-239/240	4.38E-02		2.50E-02		Yes/B
Technetium-99	0.00E+00		2.50E+00		No
Thorium-234	1.22E+02				Yes/Qual
Uranium-234	7.55E+00		2.50E+00		Yes/B[p]
Uranium-238	3.85E+01		1.20E+00		Yes/B

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Ecological risk-based concentrations are taken from Table 4 in *Preliminary Remediation Goals for Ecological Receptors* (LMER 1997).
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 997).
[e] Ecological soil screening values are from *Region 4 Risk Assessment Bulletins* available on the World Wide Web at http://www.epa.gov/region04/wastepgs/oftecser/ecolbul.htm.
[f] R = > EPA Region 4 ecological screening value for soil.
[g] Qual = Qualitative analyte.
[h] Sum of TEF-converted dioxins/furans.
[i] Ecological risk-based concentrations is for 2,3,7,8-TCDD.
[j] E = > ecological risk-based concentration.
[k] Sum of TEF-converted PAHs.
[l] EPA Region 4 ecological screening value is for benzo(a)pyrene.
[m] Sum of PCB congeners.
[n] Risk-based concentration is for PCB-1260.
[o] EPA Region 4 ecological screening value is for total PCBs.
[p] B = > background concentration.

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Table 5.16. SWMU 82—frequency of detection and number of samples exceeding screening criteria or background concentrations

	Surface soil						Surface and subsurface soil combined		
Constituent*	Frequency of detection	Number of samples exceeding industrial RBCs	Number of samples exceeding KDEP benchmarks	Number of samples exceeding eco-RBCs	Number of samples exceeding EPA Region 4 benchmarks	Number of samples exceeding background/ no eco-RBC	Frequency of detection	Number of samples exceeding soil screening criteria	Number of samples exceeding background/ no SSL
Organic compounds									
Anthracene	3/3				3/3				
Fluoranthene	3/3				3/3				
Naphthalene	1/3				1/1				
Phenanthrene	3/3				3/3				
Pyrene	3/3				3/3				
Total dioxins/furans	2/4	2/2	2/2	2/2			2/4	2/2	
Total PAHs	3/6	3/3	3/3		3/3				
Total PCBs	2/5	2/2	2/2	2/2	2/2				
Radionuclides									
Plutonium-239/240	1/1					1/1			
Plutonium-239	1/1					1/1			
Technetium-99							11/11		1/11
Thorium-234	1/3	1/1							
Uranium-234	2/2					2/2	2/2		2/2
Uranium-238	2/2	2/2				2/2	2/2		2/2

*Only contaminants identified in Phase I as present in excess of action levels are listed.

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Table 5.17. SWMU 82, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria: Frequency of detection, maximum concentrations, and a comparison to industrial-use risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Industrial-use RBCs	Maximum concentration/ RBC ratio	Detected maximum > RBCs
Dioxins/furans (mg/kg)					
1,2,3,4,6,7,8-HCDD[a]	2/2	4.5E-4	6.2E-5	7	Yes
1,2,3,4,6,7,8-HCDF[b]	2/2	6.4E-5	6.2E-5	1	Yes
1,2,3,4,7,8,9-HCDF	2/2	5.9E-6	6.2E-5	<1	No
1,2,3,4,7,8-HCDD	2/2	6.6E-6	6.2E-6	1	Yes
1,2,3,4,7,8-HCDF	2/2	8.6E-6	6.2E-6	1	Yes
1,2,3,6,7,8-HCDD	2/2	1.8E-5	6.2E-6	3	Yes
1,2,3,6,7,8-HCDF	2/2	4.4E-6	6.2E-6	<1	No
1,2,3,7,8,9-HCDD	2/2	9.4E-6	5.1E-6	2	Yes
1,2,3,7,8,9-HCDF	1/2	4.2E-7	6.2E-6	<1	No
1,2,3,7,8-PCDF[c]	1/2	1.6E-6	4.2E-7	4	Yes
2,3,4,6,7,8-HCDF	1/2	2.8E-6	6.2E-6	<1	No
2,3,4,7,8-PCDF	2/2	1.4E-5	4.2E-6	3	Yes
2,3,7,8-TCDF[d]	2/2	1.2E-5	2.1E-6	6	Yes
OCDD[e]	2/2	2.5E-2	2.1E-4	120	Yes
OCDF[f]	2/2	1.8E-4	2.1E-4	<1	No
No. of congeners with maximum detected concentrations > RBCs					**10/15**
PAHs (mg/kg)					
Benz(a)anthracene	3/3	1.3E+0	2.7E-2	50	Yes
Benzo(a)pyrene	3/3	2.4E+0	2.7E-3	900	Yes
Benzo(b)fluoranthene	3/3	5.0E+0	2.7E-2	200	Yes
Benzo(k)fluoranthene	1/3	5.4E-1	2.7E-1	2	Yes
Chrysene	3/3	1.6E+0	2.7E+0	<1	No
Dibenzo(a,h)anthracene	1/3	1.0E-1	2.7E-3	40	Yes
Indeno(1,2,3-cd)pyrene	1/3	1.3E+0	2.7E-2	50	Yes
No. of congeners with maximum detected concentrations > RBCs					**6/7**
PCBs (mg/kg)					
PCB-1260	2/3	1.2E+0	4.1E-2	30	Yes
No. of PCBs with maximum detected concentrations > RBCs					**1/1**

[a] HCDD is heptachlorodibenzo-p-dioxin.
[b] HCDF is heptachlorodibenzofuran.
[c] PCDF is pentachlorodibenzofuran.
[d] TCDF is tetrachlorodibenzofuran.
[e] OCDD is octachlorodibenzo(b,e)(4)dioxin.
[f] OCDF is octachlorodibenzofuran.

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Table 5.18. SWMU 82, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria[a]: Frequency of detection, maximum concentrations, and a comparison to soil-to-groundwater soil screening levels

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration/ action level	Detected maximum > action levels
Dioxins/furans (mg/kg)					
1,2,3,7,8,9-HCDD[b]	2/2	9.4E-6	6.5E-2	<1	No
No. of congeners with maximum detected concentrations > action levels					**0/1**
PAHs (mg/kg)					
Benzo(a)pyrene	3/10	2.4E+0	8.2E+0	<1	No
No. of congeners with maximum detected concentrations > action levels					**0/1**
PCBs (mg/kg)					
PCB-1260	2/10	1.2E+0	2.5E+0	<1	No
No. of PCBs with maximum detected concentrations > action levels					**0/1**

[a] Congeners and mixtures of congeners without soil-to-groundwater screening values were excluded from this analysis.
[b] HCDD is hexachlorodibenzo-p-dioxin.

Table 5.19. SWMU 82, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria[a]: Frequency of detection, maximum concentrations, and a comparison to ecological risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration/ action level	Detected maximum > ecoRBCs
Dioxins/furans (mg/kg)					
2,3,7,8-TCDF[b]	2/2	1.2E-5	8.4E-4	<1	No
No. of congeners with maximum detected concentrations > RBCs					**0/1**
PCBs (mg/kg)					
PCB-1260	2/3	1.2E+0	3.7E-1	3	Yes
No. of PCBs with maximum detected concentrations > RBCs					**1/1**

[a] Congeners and mixtures of congeners without ecological risk-based concentrations were excluded from this analysis.
[b] TCDF is tetrachlorodibenzofuran.

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Table 5.20. SWMU 83, Phase I—comparison of maximum detected concentrations in surface soil to risk-based screening criteria (industrial)

Constituent[a]	Maximum detected concentration[b]	Industrial-use risk-based concentration[c]		Background concentration[d]	KDEP screening value[e]	Exceed?/ basis
		Systemic toxicity	Cancer risk			
Organic compounds (mg/kg)						
Fluoranthene	4.30E-01	2.80E+02			2.60E+02	No
Phenanthrene	2.50E-01					Yes/Qual[f]
Pyrene	3.90E-01	2.10E+02			2.00E+02	No
Total PAHs[g]	5.37E-01		2.07E-03[h]		6.10E-03[i]	Yes/P[j], K[k]
Radionuclides (pCi/g)						
alpha Activity	2.37E+01					Yes/Qual
beta Activity	3.38E+01					Yes/Qual

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Risk-based concentrations (RBCs) were generated as described in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996). The target hazard index and cancer risk for nonradionuclides are 0.1 and 1×10^{-7}, respectively. The target cancer risk for radionuclides is 1E-6.
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Commonwealth of Kentucky Department of Environmental Protection (KDEP) screening values for residential exposure to surface soil are taken from Appendix A of *Risk Assessment Guidance* (KDEP 1995). All values presented in Appendix A were divided by 10 prior to use in this screening evaluation, as directed in the aforementioned guidance.
[f] Qual = qualitative analyte.
[g] Sum of TEF-converted PAHs.
[h] Risk-based concentration is for benzo(a)pyrene.
[i] KDEP screening value is for benzo(a)pyrene.
[j] P = > industrial use risk-based concentration.
[k] K = > KDEP guidance.

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Table 5.21. SWMU 83, Phase I—comparison of maximum detected concentrations in surface and subsurface soil to soil-to-groundwater screening criteria

Constituent[a]	Maximum detected concentration[b]	EPA soil screening level for protection of groundwater[c]	Background concentration[d]	Exceed?/ basis
Inorganic chemicals (mg/kg)				
Aluminum	1.75E+04		1.20E+04	Yes/B[e]
Barium	1.26E+02	1.60E+03	1.70E+02	No
Beryllium	7.20E-01	6.30E+01	6.90E-01	No
Calcium	2.01E+03		6.10E+03	No
Chromium	2.19E+01	2.00E+09	4.30E+01	No
Cobalt	5.05E+00		1.30E+01	No
Copper	1.39E+01	1.10E+04	2.50E+01	No
Iron	1.86E+04		2.80E+04	No
Lithium	1.41E+01			Yes/Qual[f]
Magnesium	2.19E+03		2.10E+03	Yes/B
Manganese	3.23E+02	2.20E+03	8.20E+02	No
Nickel	2.34E+01	9.50E+02	2.20E+01	No
Potassium	7.59E+02		9.50E+02	No
Sodium	3.02E+02		3.40E+02	No
Strontium	1.94E+01	1.50E+04		No
Vanadium	2.41E+01	5.10E+03	3.70E+01	No
Zinc	5.65E+01	1.40E+04	6.00E+01	No
Organic compounds (mg/kg)				
Fluoranthene	4.30E-01	6.30E+03		No
Phenanthrene	2.50E-01			Yes/Qual
Pyrene	3.90E-01	4.60E+03		No
Total PAHs	5.37E-01	8.20E+00		No
Radionuclides (pCi/g)				
alpha Activity	2.37E+01			Yes/Qual
beta Activity	3.38E+01			Yes/Qual

Notes: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all soil samples.
[c] EPA SSLs for protection of groundwater were calculated using EPA's soil screening level guidance (see http://risk.lsd.ornl.gov/calc_start.htm on the World Wide Web for additional information).
[d] Background concentrations are taken from Tables 4.2 and 4.4 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] B = > background concentration.
[f] Qual = qualitative analyte.

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Table 5.22. SWMU 83, Phase I—comparison of maximum detected concentrations in surface soil to ecological risk-based screening criteria

Constituent[a]	Maximum detected concentration[b]	Ecological risk-based concentration[c]	Background concentration[d]	EPA Region 4 ecological screening value for soil[e]	Exceed?/ basis
Organic compounds (mg/kg)					
Fluoranthene	4.30E-01			1.00E-01	Yes/R[f]
Phenanthrene	2.50E-01			1.00E-01	Yes/R
Pyrene	3.90E-01			1.00E-01	Yes/R
Total PAHs[g]	5.37E-01			1.00E-01[h]	Yes/R
Radionuclides (pCi/g)					
alpha Activity	2.37E+01				Yes/Qual[i]
beta Activity	3.38E+01				Yes/Qual

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Ecological risk-based concentrations are taken from Table 4 in *Preliminary Remediation Goals for Ecological Receptors* (LMER 1997).
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Ecological soil screening values are from *Region 4 Risk Assessment Bulletins* available on the World Wide Web at http://www.epa.gov/region04/wastepgs/oftecser/ecolbul.htm.
[f] R = > EPA Region 4 ecological screening value for soil B = > background concentration.
[g] Sum of TEF-converted PAHs.
[h] EPA Region 4 ecological screening value is for benzo(a)pyrene.
[i] Qual = qualitative analyte.

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Table 5.23. SWMU 83—frequency of detection and number of samples exceeding screening criteria or background concentrations

	Surface soil						Surface and subsurface soil combined		
Constituent*	Frequency of detection	Number of samples exceeding industrial RBCs	Number of samples exceeding KDEP benchmarks	Number of samples exceeding eco-RBCs	Number of samples exceeding EPA Region 4 benchmarks	Number of samples exceeding background/ no eco-RBC	Frequency of detection	Number of samples exceeding soil screening criteria	Number of samples exceeding background/ no SSL
Organic compounds									
Fluoranthene	1/3				1/1				
Phenanthrene	1/3				1/1				
Pyrene	1/3				1/1				
Total PAHs	2/5	2/2	2/2		1/2				

*Only compounds identified in Phase I as present in excess of action levels are listed.

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Table 5.24. SWMU 83, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria*: Fequency of detection, maximum concentrations, and a comparison to industrial use risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Industrial use RBCs	Maximum concentration/ RBC ratio	Detected maximum > RBCs
PAHs (mg/kg)					
Benz(a)anthracene	1/3	1.9E-1	2.7E-2	7	Yes
Benzo(a)pyrene	1/3	4.1E-1	2.7E-3	150	Yes
Benzo(b)fluoranthene	2/3	8.5E-1	2.7E-2	30	Yes
Chrysene	1/3	2.5E-1	2.7E+0	<1	No
Indeno(1,2,3-cd)pyrene	1/3	2.3E-1	2.7E-2	9	Yes
No. of congeners with maximum detected concentrations > RBCs					**4/5**

*Congeners and mixtures of congeners without soil-to-groundwater screening values were excluded from this analysis.

Table 5.25. SWMU 83, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria*: Frequency of detection, maximum concentrations, and a comparison to soil-to-groundwater soil screening levels

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration/ action level	Detected maximum > action levels
PAHs (mg/kg)					
Benzo(a)pyrene	1/11	4.1E-1	8.2E+0	<1	No
No. of congeners with maximum detected concentrations > action levels					**0/1**

*Congeners and mixtures of congeners without soil-to-groundwater screening values were excluded from this analysis.

No risk-based ecological benchmarks were available to screen PAH congeners detected at SWMU 83.

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Table 5.26. SWMU 84, Phase I—comparison of maximum detected concentrations in surface soil to risk-based screening criteria (industrial)

Constituent[a]	Maximum detected concentration[b]	Industrial use risk-based concentration[c]		Background concentration[d]	KDEP screening value[e]	Exceed?/ basis
		Systemic toxicity	Cancer risk			
Organic compounds (mg/kg)						
Fluoranthene	4.80E-01	2.80E+02			2.60E+02	No
Phenanthrene	2.90E-01					Yes/Qual[f]
Pyrene	4.00E-01	2.10E+02			2.00E+02	No
Total dioxins/furans[g]	1.25E-05		6.20E-07[h]		3.80E-07[i]	Yes/P[j], K[k]
Total PAHs[l]	3.39E-01		2.70E-03[m]		6.10E-03[n]	Yes/P, K
Total PCBs[o]	3.80E-01		4.20E-02[p]		6.60E-03[q]	Yes/P, K
Radionuclides (pCi/g)						
alpha Activity	2.33E+01					Yes/Qual
beta Activity	2.96E+01					Yes/Qual
Cesium-137	1.90E+00		1.00E-01	4.90E-01		Yes/P, B[r]
Technetium-99	2.29E+00		2.30E+03	2.50E+00		No

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Risk-based concentrations (RBCs) were generated as described in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996). The target hazard index and cancer risk for nonradionuclides are 0.1 and 1×10^{-7}, respectively. The target cancer risk for radionuclides is 1E-6.
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Commonwealth of Kentucky Department of Environmental Protection (KDEP) screening values for residential exposure to surface soil are taken from Appendix A of *Risk Assessment Guidance* (KDEP 1995). All values presented in Appendix A were divided by 10 prior to use in this screening evaluation, as directed in the aforementioned guidance.
[f] Qual = qualitative analyte.
[g] Sum of TEF-converted dioxins/furans.
[h] Risk-based concentration is for 2,3,7,8-TCDD.
[i] KDEP screening values is for 2,3,7,8-TCDD.
[j] P = > industrial-use risk-based concentration.
[k] K = > KDEP guidance.
[l] Sum of TEF-converted PAHs.
[m] Risk-based concentration is for benzo(a)pyrene.
[n] KDEP screening value is for benzo(a)pyrene.
[o] Sum of PCB congeners.
[p] Risk-based concentration is for PCB-1260.
[q] KDEP screening value is for total PCBs.
[r] B = > background concentration.

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Table 5.27. SWMU 84, Phase I—comparison of maximum detected concentrations in surface and subsurface soil to soil-to-groundwater screening criteria (residential)

Constituent[a]	Maximum detected concentration[b]	EPA soil screening level for protection of groundwater[c]	Background concentration[d]	Exceed?/ basis
Organic compounds (mg/kg)				
Acetone	3.50E+00	1.50E+01		No
Fluoranthene	4.80E-01	6.30E+03		No
Phenanthrene	2.90E-01			Yes/Qual[e]
Pyrene	4.00E-01	4.60E+03		No
Total dioxins/furans	1.25E-05	5.60E-06		Yes/S[f]
Total PAHs	3.39E-01	8.20E+00		No
Total PCBs	3.80E-01	6.20E+00		No
Radionuclides (pCi/g)				
alpha Activity	2.33E+01			Yes/Qual
beta Activity	2.96E+01			Yes/Qual
Cesium-137	1.90E+00		2.80E-01	Yes/B[g]
Technetium-99	3.32E+00		2.80E+00	Yes/B

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all soil samples.
[c] EPA SSLs for protection of groundwater were calculated using EPA's soil screening level guidance (see http://risk.lsd.ornl.gov/calc_start.htm on the World Wide Web for additional information).
[d] Background concentrations are taken from Tables 4.2 and 4.4 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Qual = qualitative analyte.
[f] S = > soil screening level.
[g] B = > background concentration.

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Table 5.28. SWMU 84, Phase I—comparison of maximum detected concentrations in surface soil to ecological risk-based screening criteria

Constituent[a]	Maximum detected concentration[b]	Ecological risk-based concentration[c]	Background concentration[d]	EPA Region 4 ecological screening value for soil[e]	Exceed?/ basis
Organic compounds (mg/kg)					
Fluoranthene	4.80E-01			1.00E-01	Yes/R[f]
Phenanthrene	2.90E-01			1.00E-01	Yes/R
Pyrene	4.00E-01			1.00E-01	Yes/R
Total dioxins/furans	1.25E-05	3.15E-06			Yes/E[g]
Total PAHs[h]	3.39E-01			1.00E-01[i]	Yes/R
Total PCBs[j]	3.80E-01	3.71E-01[k]		2.00E-02[l]	Yes/E, R
Radionuclides (pCi/g)					
alpha Activity	2.33E+01				Yes/Qual[m]
beta Activity	2.96E+01				Yes/Qual
Cesium-137	1.90E+00		4.90E-01		Yes/B[n]
Technetium-99	2.29E+00		2.50E+00		No

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Ecological risk-based concentrations are taken from Table 4 in *Preliminary Remediation Goals for Ecological Receptors* (LMER 1997).
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Ecological soil screening values are from *Region 4 Risk Assessment Bulletins* available on the World Wide Web at http://www.epa.gov/region04/wastepgs/oftecser/ecolbul.htm.
[f] R = > EPA Region 4 ecological screening value for soil.
[g] E = > ecological risk-based concentration.
[h] Sum of TEF-converted PAHs.
[i] EPA Region 4 ecological screening value for total PAHs.
[j] Sum of PCB congeners.
[k] Risk-based concentration is for PCB-1260.
[l] EPA Region 4 ecological screening value is for benzo(a)pyrene.
[m] Qual = qualitative analyte.
[n] B = > background concentration.

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Table 5.29. SWMU 84—frequency of detection and number of samples exceeding screening criteria or background concentrations

	Surface soil						Surface and subsurface soil combined		
Constituent*	Frequency of detection	Number of samples exceeding industrial RBCs	Number of samples exceeding KDEP benchmarks	Number of samples exceeding eco-RBCs	Number of samples exceeding EPA Region 4 benchmarks	Number of samples exceeding background/ no eco-RBC	Frequency of detection	Number of samples exceeding soil screening criteria	Number of samples exceeding background/ no SSL
Organic compounds									
Fluoranthene	1/6				1/1				
Phenanthrene	1/6				1/1				
Pyrene	1/6				1/1				
Total dioxins/furans	2/4	2/2	2/2	2/2			2/4	1/2	
Total PAHs	1/7	1/1	1/1		1/1				
Total PCBs	2/8	2/2	2/2	1/2	2/2				
Radionuclides									
Cesium-137	1/6					1/1	1/15		1/1
Technetium-99							16/16		2/16

*Only those contaminants in excess of action levels in Phase I are considered in this evaluation.

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Table 5.30. SWMU 84, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria: Frequency of detection, maximum concentrations, and a comparison to industrial use risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Industrial-use RBCs	Maximum concentration/ RBC ratio	Detected maximum > RBCs
Dioxins/furans (mg/kg)					
1,2,3,4,6,7,8-HCDD[a]	2/2	1.9E-4	6.2E-5	3	Yes
1,2,3,4,6,7,8-HCDF[b]	2/2	2.5E-5	6.2E-5	<1	No
1,2,3,4,7,8,9-HCDF	1/2	2.2E-6	6.2E-5	<1	No
1,2,3,4,7,8-HCDD	1/2	1.3E-6	6.2E-6	<1	No
1,2,3,4,7,8-HCDF	2/2	3.6E-6	6.2E-6	<1	No
1,2,3,6,7,8-HCDD	2/2	9.9E-6	6.2E-6	2	Yes
1,2,3,6,7,8-HCDF	2/2	4.7E-6	6.2E-6	<1	No
1,2,3,7,8,9-HCDD	2/2	5.8E-6	5.1E-6	1	Yes
1,2,3,7,8-PCDF[c]	1/2	1.2E-6	4.2E-7	3	Yes
2,3,4,6,7,8-HCDF	1/2	1.7E-6	6.2E-6	<1	No
2,3,4,7,8-PCDF	2/2	1.4E-6	4.2E-6	<1	No
2,3,7,8-TCDF[d]	1/2	1.8E-6	2.1E-6	<1	No
OCDD[e]	2/2	6.8E-3	2.1E-4	30	Yes
OCDF[f]	2/2	6.1E-5	2.1E-4	<1	No
No. of congeners with maximum detected concentrations > RBCs					**5/14**
PAHs (mg/kg)					
Benz(a)anthracene	1/6	1.8E-1	2.7E-2	7	Yes
Benzo(a)pyrene	1/6	2.7E-1	2.7E-3	100	Yes
Benzo(b)fluoranthene	1/6	5.1E-1	2.7E-2	20	Yes
Chrysene	1/6	2.4E-1	2.7E+0	<1	No
No. of congeners with maximum detected concentrations > RBCs					**3/4**
PCBs (mg/kg)					
PCB-1254	1/6	7.5E-2	4.1E-2	2	Yes
PCB-1260	1/6	3.8E-1	4.1E-2	9	Yes
No. of PCBs with maximum detected concentrations > RBCs					**2/2**

[a] HCDD is heptachlorodibenzo-p-dioxin.
[b] HCDF is heptachlorodibenzofuran.
[c] PCDF is pentachlorodibenzofuran.
[d] TCDF is tetrachlorodibenzofuran.
[e] OCDD is octachlorodibenzo(b,e)(4)dioxin.
[f] OCDF is octachlorodibenzofuran.

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Table 5.31. SWMU 84, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria[a]: Frequency of detection, maximum concentrations, and a comparison to soil-to-groundwater soil screening levels

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration/ action level	Detected maximum > action levels
Dioxins/furans (mg/kg)					
1,2,3,7,8,9-HCDD[b]	2/2	5.8E-6	6.5E-2	<1	No
No. of congeners with maximum detected concentrations > action levels					**0/1**
PAHs (mg/kg)					
Benzo(a)pyrene	1/16	2.7E-1	8.2E+0	<1	No
No. of congeners with maximum detected concentrations > action levels					**0/1**
PCBs (mg/kg)					
PCB-1254	1/16	7.5E-2	1.7E+0	<1	No
PCB-1260	1/16	3.8E-1	2.5E+0	<1	No
No. of PCBs with maximum detected concentrations > action levels					**0/2**

[a] Congeners and mixtures of congeners without soil-to-groundwater screening values were excluded from this analysis.
[b] HCDD is hexachlorodibenzo-p-dioxin.

Table 5.32. SWMU 84, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria[a]: Frequency of detection, maximum concentrations, and a comparison to ecological risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration/ action level	Detected maximum > ecoRBCs
Dioxins/furans (mg/kg)					
2,3,7,8-TCDF[b]	1/2	1.8E-6	8.4E-4	<1	No
No. of congeners with maximum detected concentrations > RBCs					**0/1**
PCBs (mg/kg)					
PCB-1254	1/6	7.5E-2	3.7E-1	<1	No
PCB-1260	1/6	3.8E-1	3.7E-1	1	Yes
No. of PCBs with maximum detected concentrations > RBCs					**1/2**

[a] Congeners and mixtures of congeners without ecological risk-based concentrations were excluded from this analysis.
[b] TCDF is tetrachlorodibenzofuran.

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Table 5.33. SWMU 85, Phase I—comparison of maximum detected concentrations in surface soil to risk-based screening criteria (industrial)

Constituent[a]	Maximum detected concentration[b]	Industrial-use risk-based concentration[c]		Background concentration[d]	KDEP screening value[e]	Exceed?/ basis
		Systemic toxicity	Cancer risk			
Organic compounds (mg/kg)						
Fluoranthene	4.20E-01	2.80E+02			2.60E+02	No
Pyrene	4.60E-01	2.10E+02			2.00E+02	No
Total dioxins/furans[f]	1.89E-05		6.20E-07[g]		3.80E-07[h]	Yes/P[i], K[j]
Total PAHs[k]	1.48E-01		2.70E-03[l]		6.10E-03[m]	Yes/P, K
Total PCBs[n]	7.10E-02		4.20E-02[o]		6.60E-03[p]	Yes/P, K
Radionuclides (pCi/g)						
alpha Activity	2.39E+01					Yes/Qual[q]
beta Activity	2.99E+01					Yes/Qual

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Risk-based concentrations (RBCs) were generated as described in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996). The target hazard index and cancer risk for nonradionuclides are 0.1 and 1×10^{-7}, respectively. The target cancer risk for radionuclides is 1E-6.
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Commonwealth of Kentucky Department of Environmental Protection (KDEP) screening values for residential exposure to surface soil are taken from Appendix A of *Risk Assessment Guidance* (KDEP 1995). All values presented in Appendix A were divided by 10 prior to use in this screening evaluation, as directed in the aforementioned guidance.
[f] Sum of TEF-converted dioxins/furans.
[g] Risk-based concentration is for 2,3,7,8-TCDD.
[h] KDEP screening values is for 2,3,7,8-TCDD.
[i] P = > industrial use risk-based concentration.
[j] K = > KDEP guidance.
[k] Sum of TEF-converted PAHs.
[l] Risk-based concentration is for benzo(a)pyrene.
[m] KDEP screening value is for benzo(a)pyrene.
[n] Sum of PCB congeners.
[o] Risk-based concentration is for PCB-1260.
[p] KDEP screening value is for total PCBs.
[q] Qual = qualitative analyte.

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Table 5.34. SWMU 85, Phase I—comparison of maximum detected concentrations in surface and subsurface soil to soil-to-groundwater screening criteria

Constituent[a]	Maximum detected concentration[b]	EPA soil screening level for protection of groundwater[c]	Background concentration[d]	Exceed?/ basis
Organic compounds (mg/kg)				
Fluoranthene	4.20E-01	6.30E+03		No
Pyrene	4.60E-01	4.60E+03		No
Total dioxins/furans	1.89E-05	5.60E-06		Yes/S[e]
Total PAHs	1.48E-01	8.20E+00		No
Total PCBs	7.10E-02	6.20E+00		No
Radionuclides (pCi/g)				
alpha Activity	2.39E+01			Yes/Qual[f]
beta Activity	2.99E+01			Yes/Qual

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all soil samples.
[c] EPA SSLs for protection of groundwater were calculated using EPA's soil screening level guidance (see http://risk.lsd.ornl.gov/calc_start.htm on the World Wide Web for additional information).
[d] Background concentrations are taken from Tables 4.2 and 4.4 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] S = > soil screening level.
[f] Qual = qualitative analyte.

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Table 5.35. SWMU 85, Phase I—comparison of maximum detected concentrations in surface soil to ecological risk-based screening criteria

Constituent[a]	Maximum detected concentration[b]	Ecological risk-based concentration[c]	Background concentration[d]	EPA Region 4 ecological screening value for soil[e]	Exceed?/ basis
Organic compounds (mg/kg)					
Fluoranthene	4.20E-01			1.00E-01	Yes/R[f]
Pyrene	4.60E-01			1.00E-01	Yes/R
Total dioxins/furans[g]	1.89E-05	3.15E-06[h]			Yes/E[i]
Total PAHs[j]	1.48E-01			1.00E-01[k]	Yes
Total PCBs[l]	7.10E-02	3.71E-01[m]		2.00E-02[n]	Yes/R
Radionuclides (pCi/g)					
alpha Activity	2.39E+01				Yes/Qual[o]
beta Activity	2.99E+01				Yes/Qual

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Ecological risk-based concentrations are taken from Table 4 in *Preliminary Remediation Goals for Ecological Receptors* (LMER 1997).
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Ecological soil screening values are from *Region 4 Risk Assessment Bulletins* available on the World Wide Web at http://www.epa.gov/region04/wastepgs/oftecser/ecolbul.htm.
[f] R = > EPA Region 4 ecological screening value for soil.
[g] Sum of TEF-converted dioxins/furans.
[h] Ecological risk-based concentrations is for 2,3,7,8-TCDD.
[i] E = > ecological risk-based concentration.
[j] Sum of TEF-converted PAHs.
[k] EPA Region 4 ecological screening value for total PAHs.
[l] Sum of PCB congeners.
[m] Risk-based concentration is for PCB-1260.
[n] EPA Region 4 ecological screening value is for benzo(a)pyrene.
[o] Qual = qualitative analyte.

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Table 5.36. SWMU 85—frequency of detection and number of samples exceeding screening criteria or background concentrations

	Surface soil						Surface and subsurface soil combined		
Constituent*	Frequency of detection	Number of samples exceeding industrial RBCs	Number of samples exceeding KDEP benchmarks	Number of samples exceeding eco-RBCs	Number of samples exceeding EPA Region 4 benchmarks	Number of samples exceeding background/ no eco-RBC	Frequency of detection	Number of samples exceeding soil screening criteria	Number of samples exceeding background/ no SSL
Organic compounds									
Fluoranthene	1/4				1/1				
Pyrene	1/4				1/1				
Total dioxins/furans	1/2	1/1	1/1	1/1			1/2	1/1	
Total PAHs	2/6	2/2	2/2		1/2				
Total PCBs	1/5	1/1	1/1		1/1				

*Only those contaminants in excess of action levels in Phase I are considered in this evaluation.

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Table 5.37. SWMU 85, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria: Frequency of detection, maximum concentrations, and a comparison to industrial use risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Industrial-use RBCs	Maximum concentration/ RBC ratio	Detected maximum > RBCs
Dioxins/furans (mg/kg)					
1,2,3,4,6,7,8-HCDD[a]	1/1	2.5E-4	6.2E-5	4	Yes
1,2,3,4,6,7,8-HCDF[b]	1/1	2.9E-5	6.2E-5	<1	No
1,2,3,4,7,8,9-HCDF	1/1	3.9E-6	6.2E-5	<1	No
1,2,3,4,7,8-HCDD	1/1	3.8E-6	6.2E-6	<1	No
1,2,3,4,7,8-HCDF	1/1	3.6E-6	6.2E-6	<1	No
1,2,3,6,7,8-HCDD	1/1	1.0E-5	6.2E-6	2	Yes
1,2,3,6,7,8-HCDF	1/1	1.6E-5	6.2E-6	3	Yes
1,2,3,7,8,9-HCDD	1/1	7.1E-6	5.1E-6	1	Yes
1,2,3,7,8-PCDD[c]	1/1	2.0E-6	1.2E-6	2	Yes
2,3,4,7,8-PCDF[d]	1/1	3.5E-6	4.2E-6	<1	No
OCDD[e]	1/1	9.2E-3	2.1E-4	45	Yes
OCDF[f]	1/1	9.0E-5	2.1E-4	<1	No
No. of congeners with maximum detected concentrations > RBCs					**6/12**
PAHs (mg/kg)					
Benz(a)anthracene	1/4	3.3E-1	2.7E-2	12	Yes
Benzo(b)fluoranthene	2/4	9.6E-1	2.7E-2	35	Yes
Chrysene	1/4	3.9E-1	2.7E+0	<1	No
Indeno(1,2,3-cd)pyrene	1/4	1.9E-1	2.7E-2	7	Yes
No. of congeners with maximum detected concentrations > RBCs					**3/4**
PCBs (mg/kg)					
PCB-1260	1/4	7.1E-2	4.1E-2	2	Yes
No. of PCBs with maximum detected concentrations > RBCs					**1/1**

[a] HCDD is heptachlorodibenzo-p-dioxin.
[b] HCDF is heptachlorodibenzofuran.
[c] PCDD is pentachlorodibenzo-p-dioxin.
[d] PCDF is pentachlorodibenzofuran.
[e] OCDD is octachlorodibenzo(b,e)(4)dioxin.
[f] OCDF is octachlorodibenzofuran.

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Table 5.38. SWMU 85, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria[a]: Frequency of detection, maximum concentrations, and a comparison to soil-to-groundwater soil screening levels

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration / action level	Detected maximum > action levels
Dioxins/furans (mg/kg)					
1,2,3,7,8,9-HCDD[b]	1/1	7.1E-6	6.5E-2	<1	No
No. of congeners with maximum detected concentrations > action levels					**0/1**
PCBs (mg/kg)					
PCB-1260	1/12	7.1E-2	2.5E+0	<1	No
No. of PCBs with maximum detected concentrations > action levels					**0/1**

[a] Congeners and mixtures of congeners without soil-to-groundwater screening values were excluded from this analysis.
[b] HCDD is hexachlorodibenzo-p-dioxin.

Table 5.39. SWMU 85, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria[a]: Frequency of detection, maximum concentrations, and a comparison to ecological risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration / action level	Detected maximum > ecoRBCs
PCBs (mg/kg)					
PCB-1260	2/10	7.1E-2	3.7E-1	<1	No
No. of PCBs with maximum detected concentrations > RBCs					**0/1**

*Congeners and mixtures of congeners without ecological risk-based concentrations were excluded from this analysis.

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Table 5.40. C-340, Phase I—comparison of maximum detected concentrations in surface soil to risk-based screening criteria (industrial)

Constituent[a]	Maximum detected concentration[b]	Industrial-use risk-based concentration[c]		Background concentration[d]	KDEP screening value[e]	Exceed?/ basis
		Systemic toxicity	Cancer risk			
Inorganic chemicals (mg/kg)						
Aluminum	1.54E+04	4.60E+03		1.30E+04	7.70E+03	Yes/P[f], B[g], K[h]
Arsenic	5.19E+00	5.30E+00	3.30E-02	1.20E+01	3.20E-02	No
Barium	1.48E+02	2.30E+02		2.00E+02	5.30E+02	No
Beryllium	1.37E+00	9.50E-01	3.10E-04	6.70E-01	1.40E-02	Yes/P, B, K
Calcium	3.35E+05			2.00E+05		Yes*/B
Chromium	3.71E+02	3.60E+02		1.60E+01		Yes/P, B
Cobalt	9.65E+00	1.90E+03		1.40E+01		No
Copper	1.58E+02	5.30E+02		1.90E+01	2.80E+02	No
Iron	1.78E+04	2.10E+03		2.80E+04		No
Lead	7.05E+01	6.90E-04		3.60E+01	2.00E+01	Yes/P, B, K
Lithium	9.05E+00	6.40E+02			1.50E+02	No
Magnesium	1.60E+04			7.70E+03		Yes*/B
Manganese	5.94E+02	8.70E+01		1.50E+03	3.80E+01	No
Mercury	4.30E-01	8.10E-01		2.00E-01	2.30E+00	No
Nickel	3.82E+02	2.40E+02		2.10E+01	1.50E+02	Yes/P, B, K
Potassium	1.40E+03			1.30E+03		Yes*/B
Sodium	4.21E+02			3.20E+02		Yes*/B
Strontium	4.75E+02	5.50E+03			4.60E+03	No
Vanadium	2.91E+01	3.30E+00		3.80E+01	5.40E+01	No
Zinc	2.72E+02	2.70E+03		6.50E+01	2.30E+03	No
Organic compounds (mg/kg)						
2-Methylnapthalene	3.00E-01					Yes/Qual[i]
Acenaphthene	1.20E+01	4.20E+02			3.60E+01	No
Acenaphthylene	7.70E-01					Yes/Qual
Anthracene	4.50E+01	4.90E+03			1.90E+00	Yes/K
Benzo(ghi)perylene	8.40E+01					Yes/Qual
bis(2-Ethylhexyl)phthalate	5.40E-01	8.80E+01	8.80E-01		3.20E+00	No
Dibenzofuran	4.60E+00	4.40E+01				No
Fluoranthene	7.10E+01	2.80E+02			2.60E+02	No
Fluorene	1.60E+01	4.40E+02			3.00E+01	No
Naphthalene	4.75E+00	6.30E+01			8.00E+01	No
Phenanthrene	7.20E+01					Yes/Qual
Pyrene	1.08E+02	2.10E+02			2.00E+02	No
Total dioxins/furans[j]	9.15E-05		6.20E-07[k]		3.80E-07[l]	Yes/P, K
Total PAHs[m]	2.04E+02		2.70E-03[n]		6.10E-03[o]	Yes/P, K
Total PCBs[p]	1.08E+03		4.20E-02[q]		6.60E-03[r]	Yes/P, K

Table 5.40. (continued)

Constituent[a]	Maximum detected concentration[b]	Industrial-use risk-based concentration[c]		Background concentration[d]	KDEP screening value[e]	Exceed?/ basis
		Systemic toxicity	Cancer risk			
Radionuclides (pCi/g)						
alpha Activity	9.50E+03					Yes/Qual
Americium-241	3.30E+01		8.10E+00			Yes/P
beta Activity	1.74E+04					Yes/Qual
Cesium-137	2.60E+00		1.00E-01	4.90E-01		Yes/P, B
Cobalt-60	2.30E+00		2.20E-02			Yes/P
Neptunium-237	2.50E-01		4.50E-01	1.00E-01		No
Plutonium-239/240	3.04E-01		1.00E+01	2.50E-02		No
Protactinium-234m	5.00E+03		3.30E-02			Yes/P
Technetium-99	1.05E+02		2.30E+03	2.50E+00		No
Thorium-234	2.89E+03		4.50E+01			Yes/P
Uranium-234	3.79E+02		7.10E+01	2.50E+00		Yes/P, B
Uranium-235	4.90E+01		8.20E-01	1.40E-01		Yes/P, B
Uranium-238	2.74E+03		3.10E+00	1.20E+00		Yes/P, B

Notes: A blank cell indicates that a value does not exist within the particular screening category.
An asterisk indicates an essential human nutrient that was not further evaluated in Phases II and III.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Risk-based concentrations (RBCs) were generated as described in *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 1996). The target hazard index and cancer risk for nonradionuclides are 0.1 and 1×10^{-7}, respectively. The target cancer risk for radionuclides is 1E-6.
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Commonwealth of Kentucky Department of Environmental Protection (KDEP) screening values for residential exposure to surface soil are taken from Appendix A of *Risk Assessment Guidance* (1995). All values presented in Appendix A were divided by 10 prior to use in this screening evaluation, as directed in the aforementioned guidance.
[f] P = > industrial use risk-based concentration.
[g] B = > background concentration.
[h] K = > KDEP guidance.
[i] Qual = qualitative analyte.
[j] Sum of TEF-converted dioxins/furans.
[k] Risk-based concentration is for 2,3,7,8-TCDD.
[l] KDEP screening values is for 2,3,7,8-TCDD.
[m] Sum of TEF-converted PAHs.
[n] Risk-based concentration is for benzo(a)pyrene.
[o] KDEP screening value is for benzo(a)pyrene.
[p] Sum of PCB congeners.
[q] Risk-based concentration is for PCB-1260.
[r] KDEP screening value is for total PCBs.

Table 5.41. C-340, Phase I—comparison of maximum detected concentrations in surface and subsurface soil to soil-to-groundwater screening criteria (residential)

Constituent[a]	Maximum detected concentration[b]	EPA soil screening level for protection of groundwater[c]	Background concentration[d]	Exceed?/ basis
Inorganic chemicals (mg/kg)				
Aluminum	1.54E+04		1.20E+04	Yes/B[e]
Arsenic	5.19E+00	2.00E+02	7.90E+00	No
Barium	1.48E+02	1.60E+03	1.70E+02	No
Beryllium	1.37E+00	6.30E+01	6.90E-01	No
Calcium	3.35E+05		6.10E+03	Yes/B
Chromium	3.71E+02	2.00E+09	4.30E+01	No
Cobalt	9.65E+00		1.30E+01	No
Copper	1.58E+02	1.10E+04	2.50E+01	No
Iron	1.78E+04		2.80E+04	No
Lead	7.05E+01		2.30E+01	Yes/B
Lithium	1.16E+01			Yes/Qual[f]
Magnesium	1.60E+04		2.10E+03	Yes/B
Manganese	5.94E+02	2.20E+03	8.20E+02	No
Mercury	4.30E-01	2.10E+00	1.30E-01	No
Nickel	3.82E+02	9.50E+02	2.20E+01	No
Potassium	1.40E+03		9.50E+02	Yes/B
Sodium	4.21E+02		3.40E+02	Yes/B
Strontium	4.75E+02	1.50E+04		No
Vanadium	3.17E+01	5.10E+03	3.70E+01	No
Zinc	2.72E+02	1.40E+04	6.00E+01	No
Organic compounds (mg/kg)				
2-Methylnaphthalene	3.00E-01			Yes/Qual
Acenaphthene	1.20E+01	6.30E+02		No
Acenaphthylene	7.70E-01			Yes/Qual
Anthracene	4.50E+01	1.30E+04		No
Benzo(ghi)perylene	8.40E+01			Yes/Qual
bis(2-Ethylhexyl)phthalate	5.40E-01	3.60E+03		No
Chloromethane	3.40E+00	4.00E-02		Yes/S[g]
Dibenzofuran	4.60E+00			Yes/Qual
Fluoranthene	7.10E+01	6.30E+03		No
Fluorene	1.60E+01	8.10E+02		No
Methylene chloride	7.50E+00	2.30E-02		Yes/S
Napthalene	4.75E+00	6.10E+01		No
Phenanthrene	7.20E+01			Yes/Qual
Pyrene	1.08E+02	4.60E+03		No
Total dioxins/furans	9.15E-05	5.60E-06		Yes/S
Total PAHs	2.04E+02	8.2E+00		Yes/S
Total PCBs	1.08E+03	6.20E+00		Yes/S

Table 5.41. (continued)

Constituent[a]	Maximum detected concentration[b]	EPA soil screening level for protection of groundwater[c]	Background concentration[d]	Exceed?/ basis
Radionuclides (pCi/g)				
alpha Activity	9.50E+03			Yes/Qual
Americium-241	3.30E+01			Yes/Qual
beta Activity	1.74E+04			YesQual
Cesium-137	2.60E+00		2.80E-01	Yes/B
Cobalt-60	2.30E+00			Yes/Qual
Neptunium-237	2.50E-01			Yes/Qual
Plutonium-239/240	3.04E-01			Yes/Qual
Protactinium-234m	5.00E+03			Yes/Qual
Technetium-99	1.05E+02		2.80E+00	Yes/B
Thorium-234	2.89E+03			Yes/Qual
Uranium-234	3.79E+02		2.40E+00	Yes/B
Uranium-235	4.90E+01		1.40E-01	Yes/B
Uranium-238	2.74E+03		1.2E+00	Yes/B

Notes: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all soil samples.
[c] EPA SSLs for protection of groundwater were calculated using EPA's soil screening level guidance (see http://risk.lsd.ornl.gov/calc_start.htm on the World Wide Web for additional information).
[d] Background concentrations are taken from Tables 4.2 and 4.4 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] B = > background concentration.
[f] Qual = qualitative analyte.
[g] S = > soil screening level.

Table 5.42. C-340, Phase I—comparison of maximum detected concentrations in surface soil to ecological risk-based screening criteria

Constituent[a]	Maximum detected concentration[b]	Ecological risk-based concentration[c]	Background concentration[d]	EPA Region 4 ecological screening value for soil[e]	Exceed?/ basis
Inorganic chemicals (mg/kg)					
Aluminum	1.54E+04		1.30E+04	5.00E+01	Yes/B[f], R[g]
Arsenic	5.19E+00	9.90E+00	1.20E+01	1.00E+01	No
Barium	1.48E+02	2.83E+02	2.00E+02	1.65E+02	No
Beryllium	1.37E+00	1.00E+01	6.70E-01	1.10E+00	Yes/B, R
Calcium	3.35E+05		2.00E+05		Yes/B
Chromium	3.71E+02	4.00E-01	1.60E+01	4.00E-01	Yes/E[h], B, R
Cobalt	9.65E+00	2.00E+01	1.40E+01	2.00E+01	No
Copper	1.58E+02	6.00E+01	1.90E+01	4.00E+01	Yes/E, B, R
Iron	1.78E+04		2.80E+04	2.00E+02	No
Lead	7.05E+01	4.05E+01	3.60E+01	5.00E+01	Yes/E, B, R
Lithium	9.05E+00	2.00E+00		2.00E+00	Yes/E, R
Magnesium	1.60E+04		7.70E+03		Yes/B
Manganese	5.94E+02		1.50E+03	1.00E+02	No
Mercury	4.30E-01	5.10E-04	2.00E-01	1.00E-01	Yes/E, B, R
Nickel	3.82E+02	3.00E+01	2.10E+01	3.00E+01	Yes/E, B, R
Potassium	1.40E+03		1.30E+03		Yes/B
Sodium	4.21E+02		3.20E+02		Yes/B
Strontium	4.75E+02				Yes/Qual[i]
Vanadium	2.91E+01	2.00E+00	3.80E+01	2.00E+00	No
Zinc	2.72E+02	8.50E+00	6.50E+01	5.00E+01	Yes/E, B, R
Organic compounds (mg/kg)					
2-Methylnapthalene	3.00E-01				Yes/Qual
Acenaphthene	1.20E+01	2.00E+01		2.00E+01	No
Acenaphthylene	7.70E-01				Yes/Qual
Anthracene	4.50E+01			1.00E-01	Yes/R
Benzo(ghi)perylene	8.40E+01				Yes/Qual
bis(2-Ethylhexyl)phthalate	5.40E-01				Yes/Qual
Dibenzofuran	4.60E+00				Yes/Qual
Fluoranthene	7.10E+01			1.00E-01	Yes/R
Fluorene	1.60E+01			3.00E+01	No
Naphthalene	4.75E+00			1.00E-01	Yes/R
Phenanthrene	7.20E+01			1.00E-01	Yes/R
Pyrene	1.08E+02			1.00E-01	Yes/R
Total dioxins/furans[j]	9.15E-05	3.15E-06[k]			Yes/E
Total PAHs[l]	2.04E+02			1.00E-01[m]	Yes/R
Total PCBs[n]	1.08E+03	3.71E-01[o]		2.00E-02[p]	Yes/E, R

Table 5.42. (continued)

Constituent[a]	Maximum detected concentration[b]	Ecological risk-based concentration[c]	Background concentration[d]	EPA Region 4 ecological screening value for soil[e]	Exceed?/ basis
Radionuclides (pCi/g)					
alpha Activity	9.50E+03				Yes/Qual
Americium-241	3.30E+01				Yes/Qual
beta Activity	1.74E+04				Yes/Qual
Cesium-137	2.60E+00		4.90E-01		Yes/B
Cobalt-60	2.30E+00				Yes/Qual
Neptunium-237	2.50E-01		1.00E-01		Yes/B
Plutonium-239/240	3.04E-01		2.50E-02		Yes/B
Protactinium-234m	5.00E+03				Yes/Qual
Technetium-99	1.05E+02		2.50E+00		Yes/B
Thorium-234	2.89E+03				Yes/Qual
Uranium-234	3.79E+02		2.50E+00		Yes/B
Uranium-235	4.90E+01		1.40E-01		Yes/B
Uranium-238	2.74E+03		1.20E+00		Yes/B

Note: A blank cell indicates that a value does not exist within the particular screening category.

[a] Only detected constituents are listed.
[b] Maximum detected concentration across all surface soil samples.
[c] Ecological risk-based concentrations are taken from Table 4 in *Preliminary Remediation Goals for Ecological Receptors* (LMER 1997).
[d] Background concentrations are taken from Tables 4.1 and 4.3 in *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1997).
[e] Ecological soil screening values are taken from *Region 4 Risk Assessment Bulletins* available on the World Wide Web at http://www.epa.gov/region04/wastepgs/oftecser/ecolbul.htm.
[f] B = > background concentration.
[g] R = > EPA Region 4 ecological screening value for soil.
[h] E = > ecological risk-based concentration.
[i] Qual = qualitative analyte.
[j] Sum of TEF-converted dioxins/furans.
[k] Ecological risk-based concentrations is for 2,3,7,8-TCDD.
[l] Sum of TEF-converted PAHs.
[m] EPA Region 4 ecological screening value is for benzo(a)pyrene.
[n] Sum of PCB congeners.
[o] Risk-based concentration is for PCB-1260.
[p] EPA Region 4 ecological screening value is for total PCB

Table 5.43. C-340—frequency of detection and number of samples exceeding screening criteria or background concentrations

	Surface soil						Surface and subsurface soil combined		
Constituent*	Frequency of detection	Number of samples exceeding industrial RBC	Number of samples exceeding KDEP benchmarks	Number of samples exceeding eco-RBC	Number of samples exceeding EPA Region 4 benchmarks	Number of samples exceeding background/ no eco-RBC	Frequency of detection	Number of samples exceeding soil screening criteria	Number of samples exceeding background/ no SSL
Inorganic chemicals									
Aluminum	12/12	1/12	1/12		1/12		16/16		3/16
Beryllium	5/12	3/5	3/5	0/5	1/5				
Calcium	12/12					5/12			
Chromium	12/12	1/12		9/12	9/12				
Copper	11/12			2/11	3/11				
Lead	4/12	1/4	3/4	3/4	3/4		4/16		3/4
Magnesium	12/12					2/12			
Mercury	1/12			1/1	1/1				
Nickel	10/12	1/10	1/10	4/10	4/10				
Potassium	12/12					1/12			
Sodium	10/12					1/10			
Zinc	12/12			9/12	9/12				
Organic compounds									
Anthracene	11/16		10/11		11/11				
Chloromethane							1/4	1/1	
Fluoranthene	11/16				11/11				
Methylene chloride							1/4	1/1	
Naphthalene	8/16				8/8				
Phenanthrene	11/16				11/11				
Pyrene	11/16				11/11				
Total dioxins/furans	5/9	5/5	5/5	5/5			5/9	5/5	
Total PAHs	11/19	11/11	11/11		11/11		11/23	9/11	
Total PCBs	11/23	11/11	11/11	10/11	11/11		11/27	6/11	

Table 5.43. (continued)

Constituent*	Surface soil						Surface and subsurface soil combined		
	Frequency of detection	Number of samples exceeding industrial RBC	Number of samples exceeding KDEP benchmarks	Number of samples exceeding eco-RBC	Number of samples exceeding EPA Region 4 benchmarks	Number of samples exceeding background/ no eco-RBC	Frequency of detection	Number of samples exceeding soil screening criteria	Number of samples exceeding background/ no SSL
Radionuclides									
Americium-241	7/12	5/7							
Cesium-137	7/12	5/7				5/7	7/16		7/7
Cobalt-60	7/12	7/7							
Neptunium-237	9/9					2/9			
Plutonium-239/240	9/9					6/9			
Protactinium-234m	8/12	8/8							
Technetium-99	12/12					8/12	16/16		8/16
Thorium-234	11/12	7/11							
Uranium-234	9/9	2/9				8/9	9/9		8/9
Uranium-235	7/12	7/7				7/7	7/16		7/7
Uranium-238	9/9	9/9				9/9	9/9		9/9

*Only those contaminants in excess of action levels in Phase I were considered in this evaluation.

Table 5.44. C-340, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria: Frequency of detection, maximum concentrations, and a comparison to industrial use risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Industrial-use RBCs	Maximum concentration/ RBC ratio	Detected maximum > RBCs
Dioxins/furans (mg/kg)					
1,2,3,4,6,7,8-HCDD[a]	5/5	7.1E-4	6.2E-5	11	Yes
1,2,3,4,6,7,8-HCDF[b]	5/5	1.5E-4	6.2E-5	2	Yes
1,2,3,4,7,8,9-HCDF	5/5	2.1E-5	6.2E-5	<1	No
1,2,3,4,7,8-HCDD	5/5	1.0E-5	6.2E-6	2	Yes
1,2,3,4,7,8-HCDF	5/5	4.5E-5	6.2E-6	7	Yes
1,2,3,6,7,8-HCDD	5/5	3.9E-4	6.2E-6	65	Yes
1,2,3,6,7,8-HCDF	5/5	2.3E-5	6.2E-6	4	Yes
1,2,3,7,8,9-HCDD	5/5	1.1E-4	5.1E-6	20	Yes
1,2,3,7,8,9-HCDF	3/5	9.8E-7	6.2E-6	<1	No
1,2,3,7,8-PCDD[c]	2/5	5.6E-6	1.2E-6	5	Yes
1,2,3,7,8-PCDF[d]	5/5	7.8E-6	4.2E-7	20	Yes
2,3,4,6,7,8-HCDF	5/5	2.9E-5	6.2E-6	5	Yes
2,3,4,7,8-PCDF	5/5	2.1E-5	4.2E-6	5	Yes
2,3,7,8-TCDD[e]	1/5	2.4E-6	6.2E-7	4	Yes
2,3,7,8-TCDF[f]	5/5	3.2E-5	2.1E-6	15	Yes
OCDD[g]	5/5	1.0E-2	2.1E-4	50	Yes
OCDF[h]	5/5	2.6E-4	2.1E-4	1	Yes
No. of congeners with maximum detected concentrations > RBCs					**15/17**
PAHs (mg/kg)					
Benz(a)anthracene	11/12	9.0E+1	2.7E-2	3300	Yes
Benzo(a)pyrene	11/12	1.1E+2	2.7E-3	40800	Yes
Benzo(b)fluoranthene	11/12	1.2E+2	2.7E-2	4400	Yes
Benzo(k)fluoranthene	11/12	9.3E+1	2.7E-1	350	Yes
Chrysene	11/12	8.6E+1	2.7E+0	30	Yes
Dibenz(a,h)anthracene	4/12	7.1E+1	2.7E-3	26300	Yes
Indeno(1,2,3-cd)pyrene	11/12	9.4E+1	2.7E-2	3480	Yes
No. of congeners with maximum detected concentrations > RBCs					**7/7**
PCBs (mg/kg)					
PCB-1242	1/12	4.4E-1	4.0E-2	11	Yes
PCB-1248	3/12	1.1E+3	4.2E-2	26200	Yes
PCB-1254	6/12	8.4E+1	4.1E-2	2050	Yes
PCB-1260	5/12	2.6E+1	4.1E-2	640	Yes
No. of PCBs with maximum detected concentrations > RBCs					**4/4**

[a] HCDD is heptachlorodibenzo-p-dioxin.
[b] HCDF is heptachlorodibenzofuran.
[c] PCDD is pentachlorodibenzo-p-dioxin.
[d] PCDF is pentachlorodibenzofuran.
[e] TCDD is tetrachlorodibenzo-p-dioxin.
[f] TCDF is tetrachlorodibenzofuran.
[g] OCDD is octachlorodibenzo(b,e)(1,4)dioxin.
[h] OCDF is octachlorodibenzofuran.

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Table 5.45. C-340, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria: Frequency of detection, maximum concentrations, and a comparison to soil-to-groundwater soil screening levels

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration/ action level	Detected maximum > action levels
Dioxins/furans (mg/kg)					
1,2,3,7,8,9-HCDD[b]	5/5	1.1E-4	6.5E-2	<1	No
2,3,7,8-TCDD[c]	1/5	2.4E-6	5.6E-6	<1	No
No. of congeners with maximum detected concentrations > action levels					**0/2**
PAHs (mg/kg)					
B(a)P[d]	11/16	1.1E+2	8.2E+0	13	Yes
No. of congeners with maximum detected concentrations > action levels					**1/1**
PCBs (mg/kg)					
PCB-1242	1/16	4.4E-1	2.8E-1	2	Yes
PCB-1254	6/16	8.4E+1	1.7E+0	50	Yes
PCB-1260	5/16	2.6E+1	2.5E+0	10	Yes
No. of PCBs with maximum detected concentrations > action levels					**3/3**

[a] Congeners and mixtures of congeners without soil-to-groundwater screening values were excluded from this analysis.
[b] HCDD is hexachlorodibenzo-p-dioxin.
[c] TCDD is tetrachlorodibenzo-p-dioxin.
[d] benzo(a)pyrene

Table 5.46. C-340, Phase III—individual dioxins/furans, PAHs, and PCBs in excess of screening criteria[a]: Frequency of detection, maximum concentrations, and a comparison to ecological risk-based concentrations

Compound	Frequency of detection	Maximum concentration	Soil-to-groundwater action level	Maximum concentration/ action level	Detected maximum > ecoRBCs
Dioxins/furans (mg/kg)					
2,3,7,8-TCDD[b]	1/5	2.4E-6	3.2E-6	<1	No
2,3,7,8-TCDF[c]	5/5	3.2E-5	8.4E-4	<1	No
No. of congeners with maximum detected concentrations > RBCs					**0/2**
PCBs (mg/kg)					
PCB-1242	1/12	4.4E-1	3.7E-1	1	Yes
PCB-1248	3/12	1.1E+3	3.7E-1	2980	Yes
PCB-1254	6/12	8.4E+1	3.7E-1	230	Yes
PCB-1260	5/12	2.6E+1	3.7E-1	70	Yes
No. of PCBs with maximum detected concentrations > RBCs					**4/4**

[a] Congeners and mixtures of congeners without ecological risk-based concentrations were excluded from this analysis.
[b] TCDD is tetrachlorodibenzo-p-dioxin.
[c] TCDF is tetrachlorodibenzofuran.

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Exhibit 5.1. Hypothetical and compound-specific values as examples of Phase I acceptance/rejection criteria: How compounds are marked for retention in Phase II and Phase III screens

Hypothetical values for illustrative purposes				Examples from Phase I screens at C-340 Bldg. (mg/kg)					
Assumed maximum	Assumed benchmark	Assumed background	To Phase II ?	Compound	Screen	Maximum concentration	Benchmark	Background	To Phase II ?
10	20	40	No	Arsenic	eco-RBCs	5.19E+00	9.90E+00	1.20E+01	No
30	20	40	No	Iron	ind-RBCs	1.78E+04	2.10E+03	2.80E+04	No
50	20	40	Yes	Aluminum	ind-RBCs	1.54E+04	4.60E+03	1.30E+04	Yes
10	40	20	No	Barium	ind-RBCs	1.48E+02	2.30E+02	2.00E+02	No
30	40	20	No	Copper	ind-RBCs	1.58E+02	5.30E+02	1.90E+01	No
50	40	20	Yes	Chromium	ind-RBCs	3.71E+02	3.60E+02	1.60E+01	Yes
< 40	none	40	No	Cobalt	res SSLs	9.65E+00	none	1.30E+01	No
> 40	none	40	Yes	Magnesium	ind-RBCs	1.60E+04	none	7.70E+03	Yes
< 40	40	none	No	Strontium	ind-RBCs	4.75E+02	5.50E+03	none	No
> 40	40	none	Yes	Dioxin/furan	ind-RBCs	9.15E-05	6.20E-07	none	Yes
any	none	none	Yes	2-Methylnaphthalene	ind-RBCs	3.00E-01	none	none	Yes

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Exhibit 5.2. Phase II analysis: Representativeness of the Phase I exceedances of human health and ecological benchmarks by contaminants in surface soil at WAG 8

Location	No. of samples	No. of analytes	No. of detected analytes	No. of contaminants > benchmarks	Contaminants > benchmarks in >1 sample
Area C-340	12	102	50 (49)	27 (54)	25 (93)
SWMU 82	3	74	23 (31)	14 (61)	8 (57)
SWMU 84	6	72	11 (15)	8 (73)	2 (25)
SWMU 85	4	61	7 (11)	5 (71)	1 (20)
SWMU 83	3	59	23 (39)	4 (17)	1 (25)

Note: SWMUs are listed in descending rank order from the most to least contaminated.
Values in parentheses are percentages of the absolute values in the preceding columns.

Exhibit 5.3. Phase III analysis: Number of dioxins/furans, PAHs, and mixtures of PCB congeners in excess of industrial RBCs in surface soil at WAG 8

	Dioxins/furans			PAHs			PCBs	
Location	No. of congeners > industrial RBCs	Maximum concentration of OCDD[a] to industrial RBC ratio	Range of maximum concentrations of D/F[b] to industrial RBC ratios	No. of congeners > industrial RBCs	Maximum concentration of benzo(a)pyrene to industrial RBC ratio	Range of maximum concentrations of PAHs to industrial RBC ratios	No. of PCBs > industrial RBCs	Range of maximum concentrations of PCBs to industrial RBC ratios
Area C-340	15/17	50	2–65	7/7	40,800	30–26,300	4/4	11–26,200
SWMU 82	10/15	120	1–7	4/5	150	7–30	NA[d]	NA
SWMU 84	5/14	30	1–3	3/4	100	7–20	2/2	2–9
SWMU 85	6/12	45	1–4	3/4	NA[c]	7–35	1/1	2
SWMU 83	NA[e]	NA[e]	NA[e]	4/5	150	7–30	NA[d]	NA

Note: SWMUs are listed in descending order from the most to least contaminated.
NA not applicable.

[a] octachlorodibenzo(p)dioxin
[b] dioxins/furans
[c] benzo(a)pyrene was not detected in excess of industrial RBCs in surface soil at SWMU 85.
[d] PCBs were not detected in excess of industrial RBCs in surface soil at SWMUs 82 and 83.
[e] Dioxins/furans were not detected in excess of industrial RBCs in surface soil at SWMU 83.

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6. CONCLUSIONS AND RECOMMENDATIONS

NOTICE

EPA threshold levels have been used in this report to recommend possible future disposition of the units investigated. The reader should be aware that these recommendations are subject to review and change following the development and approval of chemical-specific action levels by the PGDP Core Team. These action levels, which will be used to determine whether a unit is a candidate for an early action, no further action, or further investigation, were not established at the time this report was prepared. After approval of the action levels, additional analyses to determine the future disposition of each unit may be performed at the direction of the Core Team.

Four electrical switchyards (SWMUs 82, 83, 84, and 85) and the C-340 Reduction and Metals Facility were investigated during the WAG 8 SE. The four switchyards are operating facilities containing high voltage transformers that supply power to a number of buildings within PGDP. The C-340 Reduction and Metals Facility is inactive and is currently scheduled for decommissioning and demolition. The following are the objectives of the WAG 8 SE:

- determine whether any of the sites are ongoing sources of off-site contamination,
- assess whether any site has released contaminants to the environment, and
- evaluate whether any site poses an unacceptable risk to on-site receptors.

To fulfill the objectives of the WAG 8 SE, surface soil, subsurface soil, storm water, and groundwater samples were collected along known or suspected migration pathways at each of the five sites. Due to health and safety concerns associated with conducting drilling activities inside active power supply facilities, sampling of SWMUs 82, 83, 84, and 85 was limited to the adjacent drainage ditches surrounding the sites. Because the interior of the switchyards could not be investigated during this study, a final determination as to whether contaminants have been released to the environment at any of these sites is not possible.

As stated, the WAG 8 SE sampling at the electrical switchyards focused on the peripheral drainage ditches. The constituents identified from these ditches include some contaminant groups (i.e., radionuclides) that are not process-related to the electrical switchyards. These were most likely derived from sources located outside the SWMU boundary.

The WAG 8 SE preliminary risk screening of impacts to human health and the environment for the switchyards was necessarily based on a limited data set collected from the ditches that contained contaminants from multiple sources. The use of this biased data and maximum contaminant concentrations has resulted in a very conservative risk analysis for the WAG 8 sites. Further, it should be recognized that although ecological risk benchmarks were exceeded at all sites, only minimal ecological habitat exists at the WAG 8 sites because of the large area overlain by gravel cover or concrete.

The following sections, organized by site, summarize the WAG 8 SE findings. Each site's section is divided into three parts: a description of the sampling results, a summary of preliminary risk screening, and conclusions and recommendations for the site.

6.1 SWMU 82

6.1.1 Sampling Results

Water samples collected from the drainpipes that direct runoff from SWMU 82 indicate that only a small quantity of technetium-99 (23.4 (±9.1) pCi/L) is currently being transported by storm water flow at the site. Technetium-99 is not a process-related contaminant at the electrical switchyards, and low levels of technetium-99 are known to be ubiquitous to PGDP.

Surface soil samples collected in the drainage ditches into which the storm water empties contained concentrations of several SVOAs, radionuclides, PCBs, and dioxin/furans. Detections of PCBs, at a maximum concentration of 1183 μg/kg, and dioxin/furans, at a maximum concentration of 25.3 μg/kg, may represent residual contaminants from historical leaks and spills that occurred at SWMU 82. However, low levels of SVOAs are known to be ubiquitous to PGDP, and radionuclides are not process-derived from electrical switchyards. The detected SVOAs and radionuclides found in the ditch at SWMU 82 are interpreted to have been introduced by over-land sheet flow, storm drain overflows during extreme rainfall events, or by aerial deposition. In general, both the concentration and number of contaminants within each of the analytical groups detected in the surface soil at WAG 82 were found to increase from north to south, reaching maximums at a location directly across the street from the C-340 Building. High concentrations of all analytical groups were detected at the C-340 Building during the WAG 8 SE. This observation supports the conclusions that contaminants have been introduced into the ditches at SWMU 82 from outside sources.

No site-derived contaminants were detected in the subsurface soil at SWMU 82, and only low levels of technetium-99 [maximum activity of 45 (±9.6) pCi/L] and TCE (maximum concentration of 19 μg/L) were found in a UCRS water sample. The technetium-99 and TCE in the groundwater are attributable to PGDP site-wide historical activities and are not related to SWMU 82 processes. The absence of site-derived contaminants in the subsurface of SWMU 82 indicates that leaching of contaminants from the soil to groundwater is not a significant contaminant migration pathway.

6.1.2 Risk Screening

An approximate indication of the level of risk associated with the maximum detected concentration of contaminants in soil may be obtained by comparison of their maximum concentration to screening criteria. The latter are derived from *de minimis* risk and systemic toxicity levels of 1E-7 and 0.1, respectively. Within this context, total dioxins/furans, total PAHs, total PCBs, thorium-234, anduranium-238 all exceeded their risk-based benchmarks for an on-site industrial worker at SWMU 82.

From the total set of analytes, 10 of 15 individual dioxin/furan congeners were present at concentrations that were greater than *de minimis* levels. The maximum observed concentration of OCDD exceeded its industrial use RBC by a factor of 120. Six PAHs and PCB-1260 exceeded their industrial use RBCs in at least one sample taken from SWMU 82. The maximum activities of thorium-234 and uranium-238 exceeded their industrial use RBCs by factors of 2.5 and 12, respectively.

Based on comparison of soil contaminant concentrations to EPA Region 4 SSLs, no individual compounds were detected at greater concentrations than their benchmarks. Total dioxins/furans, total PAHs, including five specific congeners, and total PCBs, including PCB-1260, exceeded their ecological risk-based and regulatory criteria.

6.1.3 Conclusions and Recommendations

Based on an evaluation of the results of the WAG 8 SE at SWMU 82, significant levels of contaminants are not currently being transported off site via storm water runoff from the electrical switchyard. Contaminant concentrations exceeding risk-based benchmarks are present in the surface soil of the ditch adjacent to the site, although not all contaminants present (e.g. thorium-234 and uranium-238) are derived from SWMU 82. Because the switchyards are in operation, WAG 8 SE sampling was confined to the periphery of the site. Based on the findings of this SE, further evaluation of the site may be necessary.

6.2 SWMU 83

6.2.1 Sampling Results

Samples collected from the drainpipes that direct runoff from SWMU 83 indicate that only a small quantity of technetium-99 (slightly above MDL) is currently being transported by the storm water flow. Technetium-99 is not a process-related contaminant at the electrical switchyards, and low levels of technetium-99 are known to be ubiquitous to PGDP.

Surface soil samples collected in the drainage ditches into which the storm water empties contained low concentrations of several SVOAs. The highest concentration for any single SVOA detected at SWMU 83 was only slightly above MDL. Low levels of SVOAs are known to be ubiquitous to PGDP, and it is probable that these contaminants are unrelated to SWMU 83. The SVOAs may have been introduced into the ditch by over-land sheet flow, by overflowing storm drains caused by extreme rainfall events, or by aerial deposition. The SVOA content of the surface soil at SWMU 83 is greatest in the sampling location closest to the C-340 Building. It is possible that the source for these contaminants is located at that facility, where some of the highest SVOA concentrations were detected during the WAG 8 SE.

Several metals were detected in the subsurface at concentrations that exceeded background levels. However, the metals were present at concentrations that were only slightly above background levels and are, therefore, considered within the range of expected variability for naturally occurring soil.

Low levels of technetium-99 [maximum activity of 25.9 (±8.3) pCi/L] that were found in UCRS water samples are attributable to PGDP site-wide historical activities and are not related to SWMU 83 processes.

6.2.2 Risk Screening

Maximum concentrations of "total PAHs" and the individual components benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded their industrial-use risk-based benchmarks for an on-site industrial worker in surface soil at SWMU-83. By contrast, comparison of soil contaminant concentrations to EPA SSLs did not indicate exceedances for any specific compounds for which such benchmarks are available. However, fluoranthene, phenathrene, pyrene, and total PAHs exceeded ecological screening benchmarks.

6.2.3 Conclusions and Recommendations

The general lack of contaminants in the runoff from SWMU 83 indicates that contaminants are not currently being transported off site via surface water flow. SVOAs are the only contaminants present in

the surface soil samples collected from the ditches adjacent to the site. The origin of these SVOAs is attributed to plant-wide processes and not to specific activities at SWMU 83. Because the switchyards are in operation, WAG 8 SE sampling was confined to the periphery of the site. Based on the findings of this SE, further evaluation of the site may be necessary.

6.3 SWMU 84

6.3.1 Sampling Results

Samples collected from the drainpipes that direct runoff from SWMU 84 indicate that only a small quantity of technetium-99 (slightly above MDL) is currently being transported by storm water flow. Technetium-99 is not a process-related contaminant at the electrical switchyards, and low levels of technetium-99 are known to be ubiquitous to PGDP.

Surface soil samples collected in the drainage ditches into which the storm water empties contained low concentrations of several SVOAs, cesium-137, PCBs, and dioxin/furans. The highest concentration for any single SVOA detected at SWMU 84 was only slightly above MDL, and low levels of SVOAs are known to be ubiquitous to PGDP. Because radionuclides are not process-derived from electrical switchyards, the cesium-137 in the surface soil at SWMU 84 has been derived from a source other than the electrical switchyard. Contaminants unrelated to SWMU 84 could have been introduced into the ditch by over-land sheet flow, by overflowing storm drains caused by extreme rainfall events, or by aerial deposition. The PCBs, at a maximum concentration of 380 μg/kg, and dioxin/furans, at a maximum concentration of 6.79 μg/kg, that were found in the surface soil within the ditch are interpreted to represent residual contaminants from historical leaks and spills that occurred at SWMU 84.

The only contaminant reported in the subsurface soil at SWMU 84 is a single detection of technetium-99 at a concentration 2.1 times background. This radionuclide is not a site-derived contaminant.

6.3.2 Risk Screening

Maximum concentrations and activities of total dioxins/furans, total PAHs, total PCBs, and cesium-137 detected in surface soil at SWMU-84 exceeded their industrial use RBCs, reflecting the potential for these compounds to exceed *de minimis* levels of risk or hazard at the appropriate locations. Five of 14 detected dioxins/furans exceeded their congener-specific RBCs—by a factor of 30 in the case of OCDD. Three of four detected PAHs exceeded their congener-specific RBCs, as typified by benzo(a)pyrene, which exceeded its benchmark 100-fold. PCBs-1254 and -1260 also displayed exceedances of their respective industrial use RBCs.

No contaminants were detected in surface or subsurface soil in excess of their soil-to-groundwater SSLs. However, fluoranthene, pyrene, phenanthrene, total PAHs, and total PCBs (including PCBs-1254 and -1260, individually) exceeded one or more risk-based or regulatory ecological screening criteria.

6.3.3 Conclusions and Recommendations

Evaluation of the results of the WAG 8 SE at SWMU 84 indicates that significant levels of contaminants are currently not being transported off site via storm water runoff from the electrical switchyard. However, contaminants at levels that exceed screening risk-based criteria are present in the surface soil of the ditch adjacent to the site. Because the switchyard is in operation, WAG 8 SE sampling

was confined to the periphery of the site. Based on the findings of this SE, further evaluation of the site may be necessary.

6.4 SWMU 85

6.4.1 Sampling Results

Water samples collected from the drainpipes that direct runoff from SWMU 85 indicate that only a small quantity of technetium-99 [16.2 (±8.8) pCi/L versus an MDL of 14 pCi/L] is currently being transported by storm water flow at the site. Technetium-99 is not a process-related contaminant at the electrical switchyards, and low levels of technetium-99 are ubiquitous to PGDP.

Surface soil samples collected in the drainage ditches into which the storm water empties contained low concentrations of several SVOAs, one detection of PCBs, and several dioxin/furans. Of the SVOA detections, only one exceeded the MDL, and low levels of SVOAs are known to be ubiquitous to PGDP. The single PCB detection (PCB-1260 at a concentration of 71 μg/kg) and the detected dioxin/furans (maximum concentration of 9.18 μg/kg) are interpreted to represent residual contaminants from historical leaks and spills that occurred at SWMU 85.

No contaminants were detected in the subsurface soil at SWMU 85.

6.4.2 Risk Screening

Maximally detected concentrations of total dioxins/furans, total PAHs, and total PCBs exceeded their respective industrial-use RBCs in at least one sample at SWMU-85. Six of 12 dioxin/furan congeners exceeded their congener-specific RBCs in one sample at this location, with OCDD exceeding its RBC by a factor of 45. Benzo(b)fluoranthene exceeded its benchmark by a factor of 35.

Fluoranthene, pyrene, total dioxins/furans, and total PCBs exceeded ecological risk-based and regulatory screening criteria.

6.4.3 Conclusions and Recommendations

Evaluation of the results of the WAG 8 SE at SWMU 85 indicates that significant levels of contaminants are not currently being transported off site via storm water runoff from the electrical switchyard. However, contaminants are present in the surface soil of the ditch adjacent to the site at concentrations that exceed risk-based screening levels. Because the switchyard is in operation, WAG 8 SE sampling was confined to the periphery of the site. Based on the findings of this SE, further evaluation of the site may be necessary.

6.5 C-340 REDUCTION AND METALS FACILITY

6.5.1 Sampling Results

Surface soils at the C-340 Building contain elevated levels of SVOAs, PCBs, dioxins/furans, metals, and radionuclides. PAHs represent a widely distributed group of contaminants at the C-340 Building site. Almost every surface soil sample contains a suite of PAHs, some in concentrations greater than 100,000 µg/kg. PCBs also occur site wide with concentrations for some congeners exceeding 500,000 µg/kg. Dioxin/furans are present throughout the site, and a suite of metals is found in excess of reference background concentrations. Radiological constituents are distributed throughout the site at particularly high activity levels for the thorium and uranium series radioisotopes.

Subsurface soil contained isolated occurrences of organic compounds that typically are found as laboratory contaminants. One detection of technetium-99 at an activity of 7.36 (±3.48) pCi/g and metals at maximum concentrations equal to or less than twice background levels were also detected in the subsurface soils. Because of the slow recharge rate of the shallow water-bearing sands at the site, groundwater could not be collected at the C-340 Building. However, only isolated occurrences of contaminants were found in the subsurface soil, indicating that infiltration of groundwater is not a significant contaminant migration pathway. The generally low mobility (under conditions similar to those at PGDP) of many of the compounds within the detected contaminant suites (metals, PAHs, PCBs, etc.) probably has contributed to the concentration of contaminants in the near surface soils.

Due to a lack of surface water at the C-340 Building, monitoring of surface water runoff could not be performed. Therefore, it is unknown whether the site is contributing to this migration pathway. However, the distribution of contaminants in the surface soil adjacent to SWMUs 82 and 83 suggests that areas adjacent to the C-340 Building may fall within the "contaminant halo" surrounding the C-340 Building and that these contaminants at SWMUs 82 and 83 may have been derived from the C-340 Building via surface water runoff.

6.5.2 Risk Screening

The maximum detected concentrations of metals such as aluminum, beryllium, chromium, lead, and nickel; organic compounds such as total dioxins/furans; total PAHs; and total PCBs; and the radionuclides americium-241, cesium-137, cobalt-60, protactinium-234m, thorium-234, and uranium isotopes, 234, 235 and 238 all exceeded analyte-specific industrial use RBCs. Fifteen of 17 detected dioxin/furan congeners exceeded their congener-specific benchmarks in at least one sample. 1,2,3,6,7,8-HCDD and OCDD exceeded their respective benchmarks by factors of 65 and 50. Seven PAH congeners exceeded their respective RBCs by factors ranging from 30 to close-to 41,000. Similar levels of exceedances were also observed for specific mixtures of PCB congeners.

Based on comparisons of surface and subsurface soil concentrations to contaminant-specific soil-to-groundwater SSLs, benzo(a)pyrene and the PCBs -1242, -1254 and -1260 exceeded their appropriate criteria in at least one sample. These same mixtures (plus PCB-1248) exceeded their respective risk- and regulatory-based ecological screening criteria by factors of up to 3000.

6.5.3 Conclusions and Recommendations

Because of the levels of contamination found at the C-340 Building, it is concluded that this facility has been a source for the release of contaminants into the environment. Contamination is generally confined to the surface soils surrounding the building. Risk to on-site workers from exposure by contact with SVOAs, PCBs, dioxins/furans, metals, and radionuclide-contaminated soil exists. It is suspected that

contaminants from the C-340 Building's surface soil were dispersed to peripheral areas of surrounding SWMUs via surface water sheet flow. However, monitoring of storm water runoff was not conducted at the C-340 Building during the WAG 8 SE, and it is not known whether the site is currently contributing to off-site receptors via the surface water migration pathway.

Leaching of contaminants to groundwater was determined to represent a potential migration pathway to off-site receptors. However, the lack of widespread contaminant levels in the subsurface soil indicates that this is not a significant migration pathway.

Concentration of contaminants in the surface and subsurface soil exceed risk- and regulatory-based ecological criteria. Exposure of ecological receptors to contaminants in the surface soil at the site is decreased because of the large area of the site that is covered by concrete. Therefore, the suitability of the site as a wildlife habitat is considerably reduced, which limits the exposure pathway to ecological receptors.

Soil at the C-340 Building contains contaminants at concentrations in excess of regulatory and ecological risk-based criteria. Additionally, this site may be a source of off-site contamination. The C-340 Building is currently scheduled for decommissioning and demolition. Based on the findings of this SE, further evaluation of the C-340 Building area may be necessary.

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Appendix A
WAG 8 Groundwater OU Data

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CIVIL SURVEY DATA
Converted to North/East Coordinates

Other Completed Borehole Locations			
Boring Code	**North Coordinate**	**East Coordinate**	**Elevation**
084-018/MW355	761.55	-4327.94	375.40
085-016/MW356	863.45	-1466.38	379.86

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WAG 8 Groundwater Operable Unit Data
Station 084-018

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CEMS TEAM
WAG 8 GROUNDWATER OU
DATA
LITHOLOGIC LOG

LITHOLOGIC LOG	BORING/WELL NO: 084-018/MW355	PAGE 1 of 2
FACILITY: PADUCAH GASEOUS DIFFUSION PLANT		SITE: WAG 8 SWMU 84
PROJECT NO.: 1999006	CLIENT/PROJECT: BECHTEL JACOBS	DRILLER: JACK MELTON
CONTRACTOR: TN & A	DRILL CONTRACTOR: MILLER DRILLING	BOREHOLE DIA: 5 1/4"
DRILL START: 7-22-99 0900	DRILL END: 7-24-99 0945	TOTAL DEPTH: 100' BGS
DRILL METHOD/ RIG TYPE: DWRC	COORDINATES: N 761.55 E -4327.94	PROTECTION LEVEL: D
LOGGED BY: TOM THORNBURGH		ELEVATION 375.40 FT AMSL

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NUMBER	RECOVERY (FT)	RAD CPM	H&S MONIT. VOC'S (ppm)	LITHOLOGIC DESCRIPTION	LITHOLOGY	COMMENTS
0	1		5	BKGD	0.0	CLAY, some fine grained gravel, soft, low plasticity, light olive brown (2.5Y5/3), moist		
5	2		0	NA	NA	No recovery		
10	3		5	BKGD	0.0	CLAY, soft to stiff, medium plasticity, light olive brown (2.5Y5/3), moist		
15	4		5	BKGD	0.0	SILT, some fine grained, subrounded to subangular gravel, light olive brown (2.5Y5/3)		
20	5		5	BKGD	0.0	Silty CLAY, trace fine grained sand, stiff, low plasticity, yellowish brown (10YR5/6), moist		
25	6		5	BKGD	0.0	SILT, trace very fine grained sand, brownish yellow (10YR6/8)		
30	7		5	BKGD	0.0	SILT, trace very fine grained sand, brownish yellow (10YR6/8)		
35	8		5	BKGD	0.0	SILT, some clay, trace very fine grained sand, brownish yellow (10YR6/6)		
40	9		5	BKGD	0.0	Silty CLAY, trace very fine grained sand, firm, medium to high plasticity, brownish yellow (10YR6/6)		
45	10		5	BKGD	0.0	SILT, trace fine grained subangular gravel and clay, yellowish brown (10YR5/6)		
50	11		5	BKGD	0.0	SAND & GRAVEL, some silt fine grained, subrounded to angular chert fragments, yellowish brown (10YR5/6)		
55	12		5	BKGD	0.0	GRAVEL, some very fine to very coarse grained sand, fine to coarse grained, rounded to subangular chert fragments, trace silt		
60								

U = SHELBY TUBE
S = SPLIT SPOON/ CONT. CORING
C = CUTTINGS
R = ROCK CORING
H = HYDROPUNCH
O = OTHER
FIELD G/C (MAKE/MOD.):
G/C OPER.:
COMMENTS:

CEMS TEAM
WAG 8 GROUNDWATER OU
DATA
LITHOLOGIC LOG

LITHOLOGIC LOG	BORING/WELL NO: 084-018/MW355	PAGE 2 of 2
FACILITY: PADUCAH GASEOUS DIFFUSION PLANT		SITE: WAG 8 SWMU 84
PROJECT NO.: 1999006	CLIENT/PROJECT: BECHTEL JACOBS	DRILLER: JACK MELTON
CONTRACTOR: TN & A	DRILL CONTRACTOR: MILLER DRILLING	BOREHOLE DIA: 5 1/4"
DRILL START: 7-22-99 0900	DRILL END: 7-24-99 0945	TOTAL DEPTH: 100' BGS
DRILL METHOD/ RIG TYPE: DWRC	COORDINATES: N 761.55 E -4327.94	PROTECTION LEVEL: D
LOGGED BY: TOM THORNBURGH		ELEVATION 375.40 FT AMSL

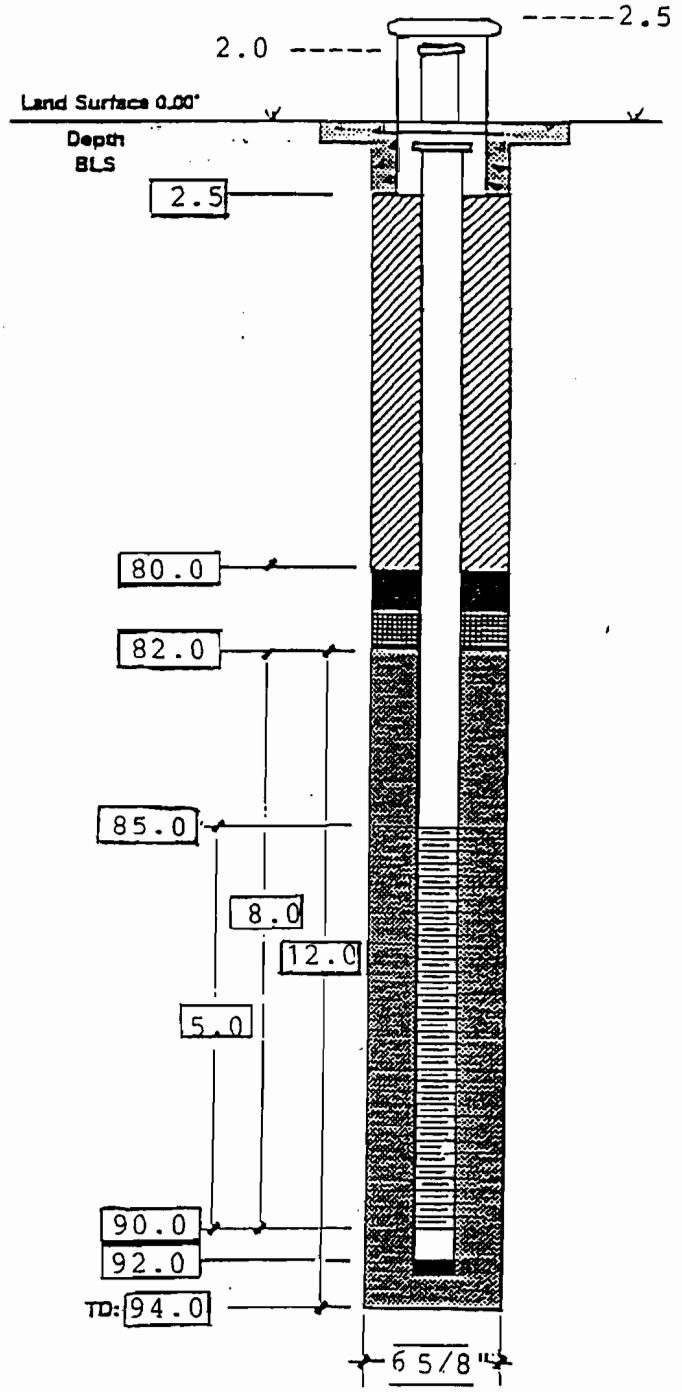
DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (FT)	RAD CPM	H&S MONIT. VOC'S (ppm)	LITHOLOGIC DESCRIPTION	LITHOLOGY	COMMENTS
60	13	084018 WA060 @ 62' BGS	5	BKGD	0.0	SAND & GRAVEL, some silt, very fine to very coarse grained sand, fine to coarse grained gravel, subrounded to subangular chert fragments, yellowish brown (10YR5/6)		Time: 1340 07/22/99
65	14	084018 WA065 @ 67' BGS	5	BKGD	0.0	SAND & GRAVEL, trace silt, very fine to very coarse grained sand, fine to coarse grained gravel, subrounded to angular chert, strong brown (7.5YR5/6)		Time: 1510
70	15	084018 WA070 @ 72' BGS	5	BKGD	0.0	SAND & GRAVEL, trace silt, very fine to very coarse grained sand, fine to coarse grained gravel, subrounded to subangular chert, yellowish brown (10YR5/8)		Time: 0820 07/23/99
75	16	084018 WA075 @ 77' BGS	5	BKGD	0.0	SAND & GRAVEL, trace silt, very fine to very coarse grained sand, fine to coarse grained gravel, subrounded to subangular chert, yellowish brown (10YR5/8)		Time: 0945
80	17	084018 WA080 @ 82' BGS	5	BKGD	0.0	SAND & GRAVEL, trace silt, very fine to very coarse grained sand, fine to coarse grained gravel, subrounded to subangular chert, yellowish brown (10YR5/8)		Time: 1050
85	18	084018 WA085 @ 87' BGS	5	BKGD	0.0	SILT, SAND & GRAVEL, very fine to very coarse grained sand, fine grained gravel, subrounded to subangular chert fragments, brownish yellow (10YR6/8)		Time: 1340
90	19	084018 WA090 @ 92' BGS	5	BKGD	0.0	SILT, trace clay, soft to firm, high plasticity, brownish yellow (10YR6/8) and grey (10YR5/1)		Time: 1500
95	20		5	BKGD	0.0	SILT, some soft, medium plasticity clay, olive yellow (2.5Y6/8) and light yellowish brown (2.5Y6/4)		
100								
105								
110								
115								
120								

U = SHELBY TUBE
S = SPLIT SPOON/ CONT. CORING
C = CUTTINGS
R = ROCK CORING
H = HYDROPUNCH
O = OTHER
FIELD G/C (MAKE/MOD.):
G/C OPER.:
COMMENTS:

MONITORING WELL CONSTRUCTION LOG

Well No. MW 355	Start Date: 7/28/99 | End Date: 7/29/99
Installation: Paducah Gaseous Diffusion Plant	Total Depth: 92.0
	Field Geologist: Tom Thornburgh
Site: Groundwater OU	Drilling Contractor: Miller MDC
Client/Project: WAG 8	Driller: G. Markgraff
Project No. NA	Coordinates: Northing: 761.55 Easting: -4327.94

All values are in feet, unless otherwise noted.



PROTECTIVE CASING
Material/Type: Steel
Diameter: 4" Depth BLS: 2.5'
Weep Hole: (yes) no

GUARD POSTS & SURFACE PAD
No. 4 Type: Steel
Composition & Size: Concrete 4x4

RISER PIPE
Type: Stainless Steel
Diameter: 2" Total Length:(TOC to TOS) 87.0
Weep Hole: yes (no)

GROUT
Composition: Bentonite 30% Solids
Interval BLS: 2.5-80 Tremied: (yes) no
Thickness: 2.5 to 80

CENTRALIZERS
Number: 3 Depths: 75', 50', 25' BGS

SEAL
Type: Bentonite Source: NA
Setup/Hydration Time: 8 hrs. Vol. Fluid Added 0
Tremied: yes (no) Thickness: 2'

CONTAINMENT SAND
Type: NA Source:
Amt. Used: Tremied: yes no
Grain Size Distribution:
Thickness:

FILTER PACK
Type: #1 Sand Source: NA
Amt. Used: 32156 (6.5) bg Tremied: (yes) no
Grain Size Distribution: NA
Thickness: 12.0'

SCREEN
Type: Stainless Steel Length: 5'
Diameter: 2" Interval BLS: 90.0'
Slot Size & Type: .010

SILT TRAP
Interval BLS: 90.0-92.0' Length: 2'
Bottom Cap: 92.0'

BACKFILL PLUG
Material: Sand
Setup/Hydration Time: Tremied: yes (no)

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WELL DEVELOPMENT FORM

Project Name and Number: WAG 8

Well Number and Location: MW355

Development Crew: Tom Thornburgh Driller: T. Neel

Water Levels/Time: Initial: 54.24 Pumping: NA Final: NA

Total Well Depth: Initial: 126' Final: _____

Date and Time: 9/21/99 Begin: 1421 Final: 1555

Development: Method(s): Pumping

Total Quantity of Water Removed: 220 gals

Date/Time and Pump Setting 9/21/99	Discharge Rates* and Measurement Method 4gal-2gal/min	Field Measurements				Remarks Including Sand Production
		Temp (F°)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
1421	Hydac	70.8	266	6.37	450	
1500		68.8	284	6.15	83	
1515		67.6	277	6.21	66	
1530		67.7	275	6.12	11	
1540		67.1	272	6.22	7.5	
1550		70.1	282	6.10	5.7	
1555		67.0	273	6.14	4.8	

* gallons per minute or bailer capacity

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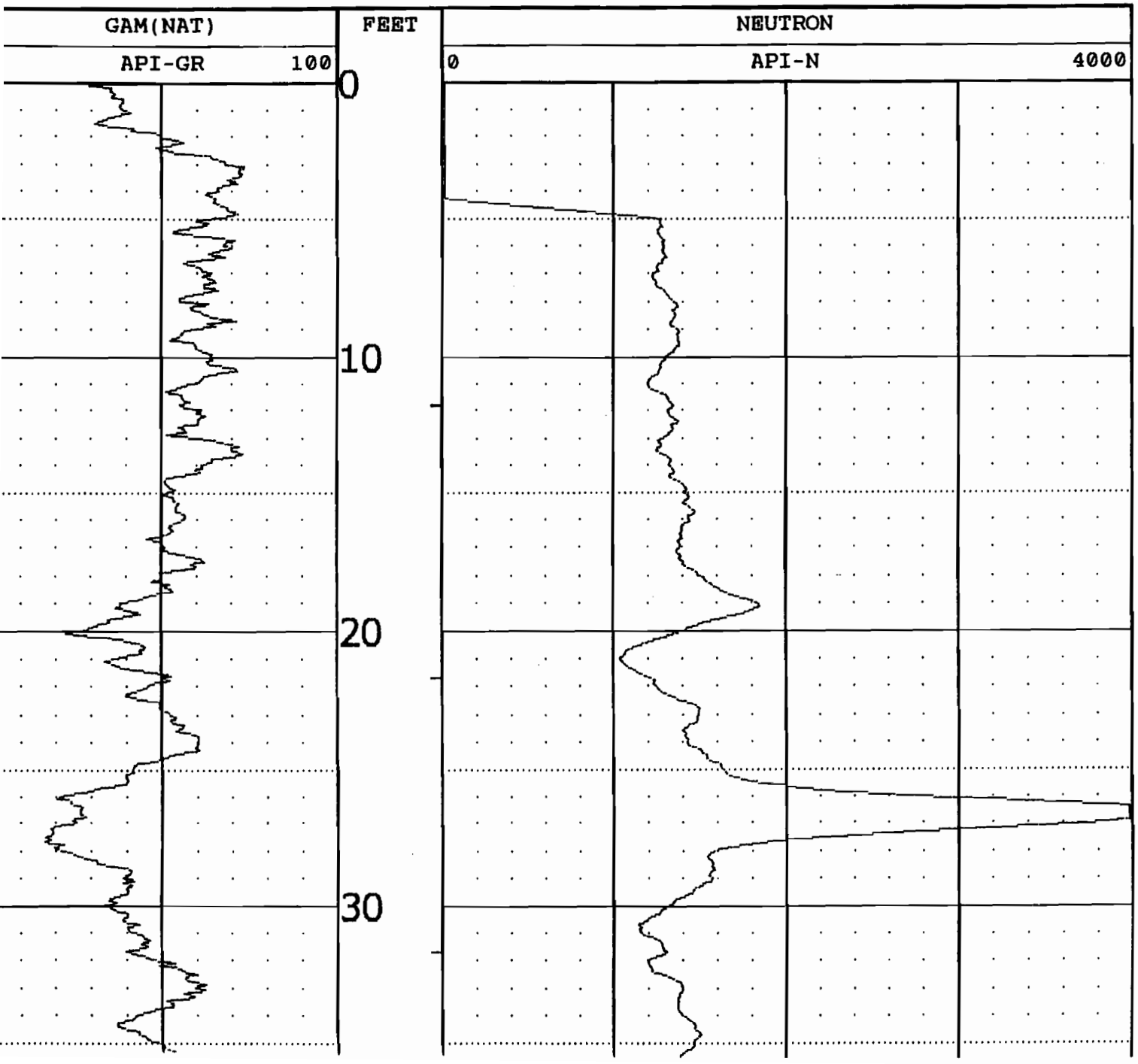
Century GEOPHYSICAL CORP.

84-18

COMPANY	: PGDP			OTHER SERVICES:	
WELL	: 84-18			UP	
LOCATION/FIELD	: PADUCAH				
COUNTY	: McCRACKEN			WL=60	
STATE	: KENTUCKY				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 07/23/99	NORTH COORD.	: 761.55	EAST COORD.	: -4327.94
DEPTH DRILLER	: 102			KB	:
LOG BOTTOM	: 95.70	LOG MEASURED FROM:		DF	:
LOG TOP	: -1.40	DRL MEASURED FROM:		GL	: 375.40
CASING DIAMETER	:	LOGGING UNIT	: TRLR		
CASING TYPE	:	FIELD OFFICE	: TULSA		
CASING THICKNESS	: .25	RECORDED BY	: T. NEAL		
BIT SIZE	: 6	BOREHOLE FLUID	: 0	FILE	: PROCESSED
MAGNETIC DECL.	: 0	RM	: 0	TYPE	: 9067A
MATRIX DENSITY	: 2.71	RM TEMPERATURE	: 0		
NEUTRON MATRIX	: Dolomite	MATRIX DELTA T	: 140		
				THRESH:	20000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FEET
0
10
20
30
NEUTRON
0
API-N
4000

40
50
60
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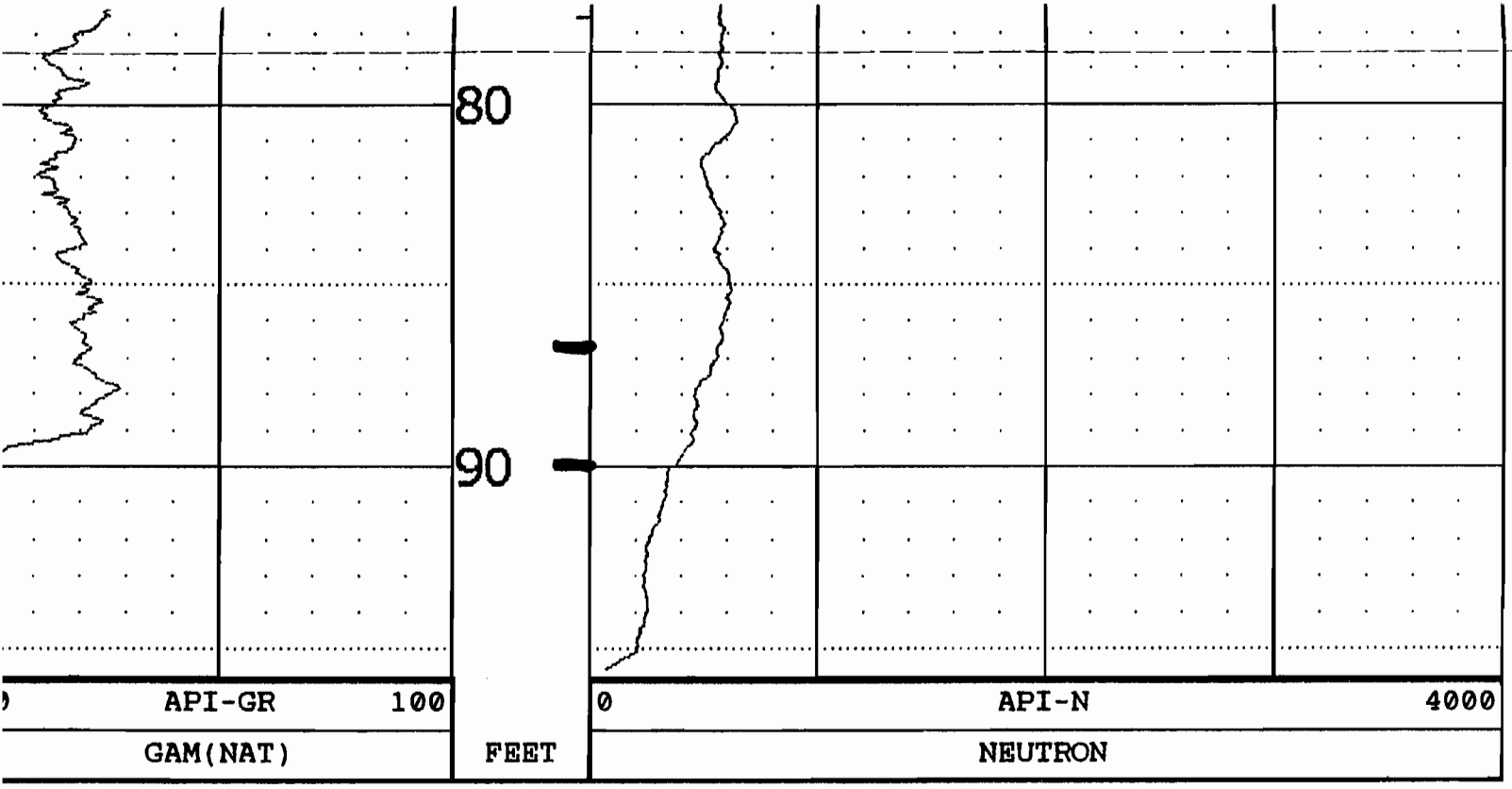

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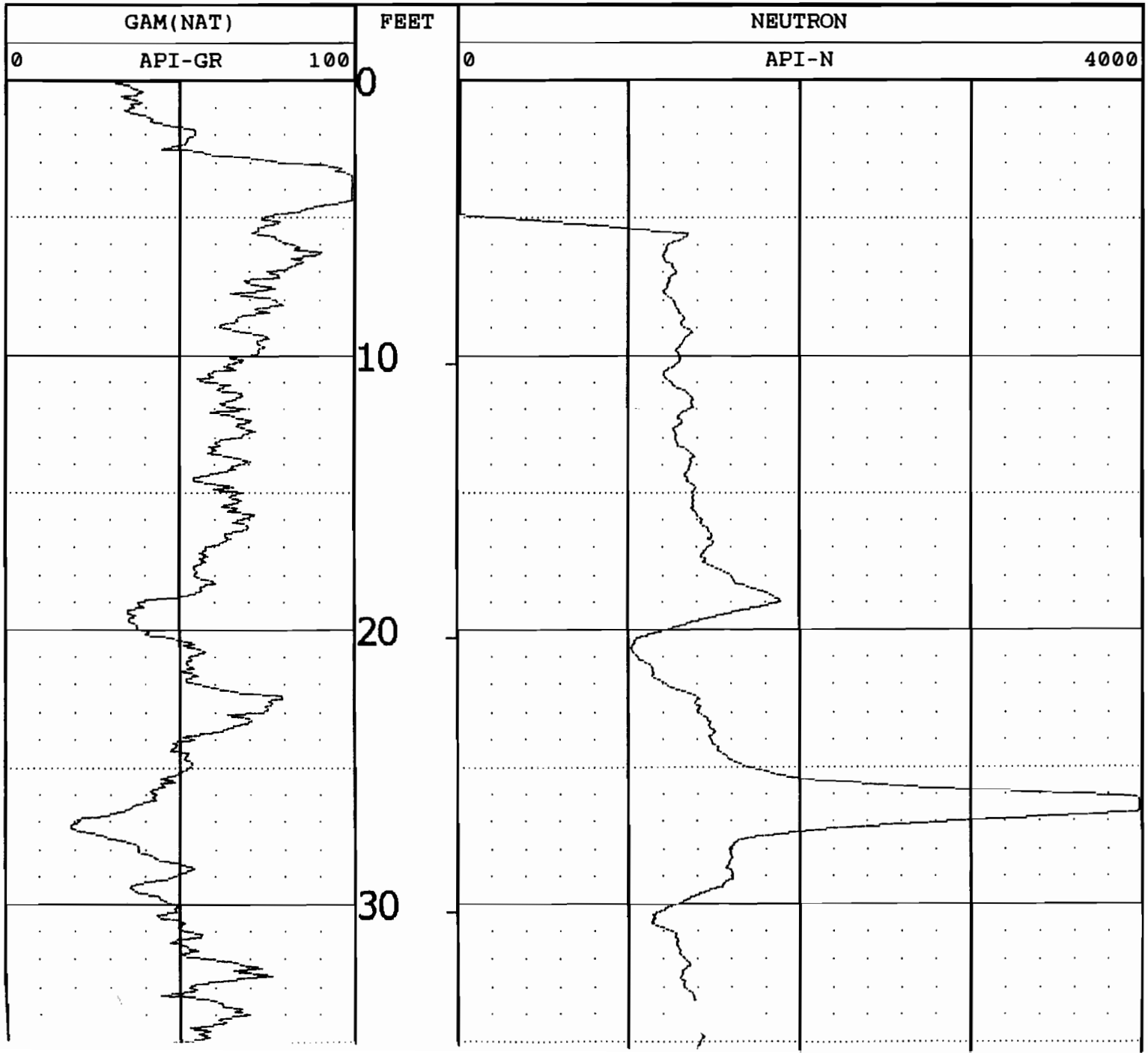
TOOL 9067A
SERIAL NUMBER 627

	DATE	TIME	SENSOR	STANDARD	RESPONSE
1	Mar24,99	08:00:59	GAM(NAT)	Default [API-GR]	Default [CPS]
	Mar24,99	08:00:59	GAM(NAT)	Default [API-GR]	Default [CPS]
2	Mar24,99	08:04:51	NEUTRON	Default [API-N]	Default [CPS]
	Mar24,99	08:04:51	NEUTRON	271.000 [API-N]	124 [CPS]

Century GEOPHYSICAL CORP.

84-18

COMPANY	: PGDP			OTHER SERVICES:	
WELL	: 84-18			DOWN	
LOCATION/FIELD	: PADUCAH				
COUNTY	: McCRACKEN			WL=60	
STATE	: KENTUCKY				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 07/23/99	NORTH COORD.	: 761.55	EAST COORD.	: -4327.94
DEPTH DRILLER	: 102			KB	:
LOG BOTTOM	: 96.00	LOG MEASURED FROM:		DF	:
LOG TOP	: -1.00	DRL MEASURED FROM:		GL	: 375.40
CASING DIAMETER	:	LOGGING UNIT	: TRLR		
CASING TYPE	:	FIELD OFFICE	: TULSA		
CASING THICKNESS:	.25	RECORDED BY	: T. NEAL		
BIT SIZE	: 6	BOREHOLE FLUID	: 0	FILE	: ORIGINAL
MAGNETIC DECL.	: 0	RM	: 0	TYPE	: 9067A
MATRIX DENSITY	: 2.71	RM TEMPERATURE	: 0		
NEUTRON MATRIX	: Dolomite	MATRIX DELTA T	: 140		
				THRESH:	20000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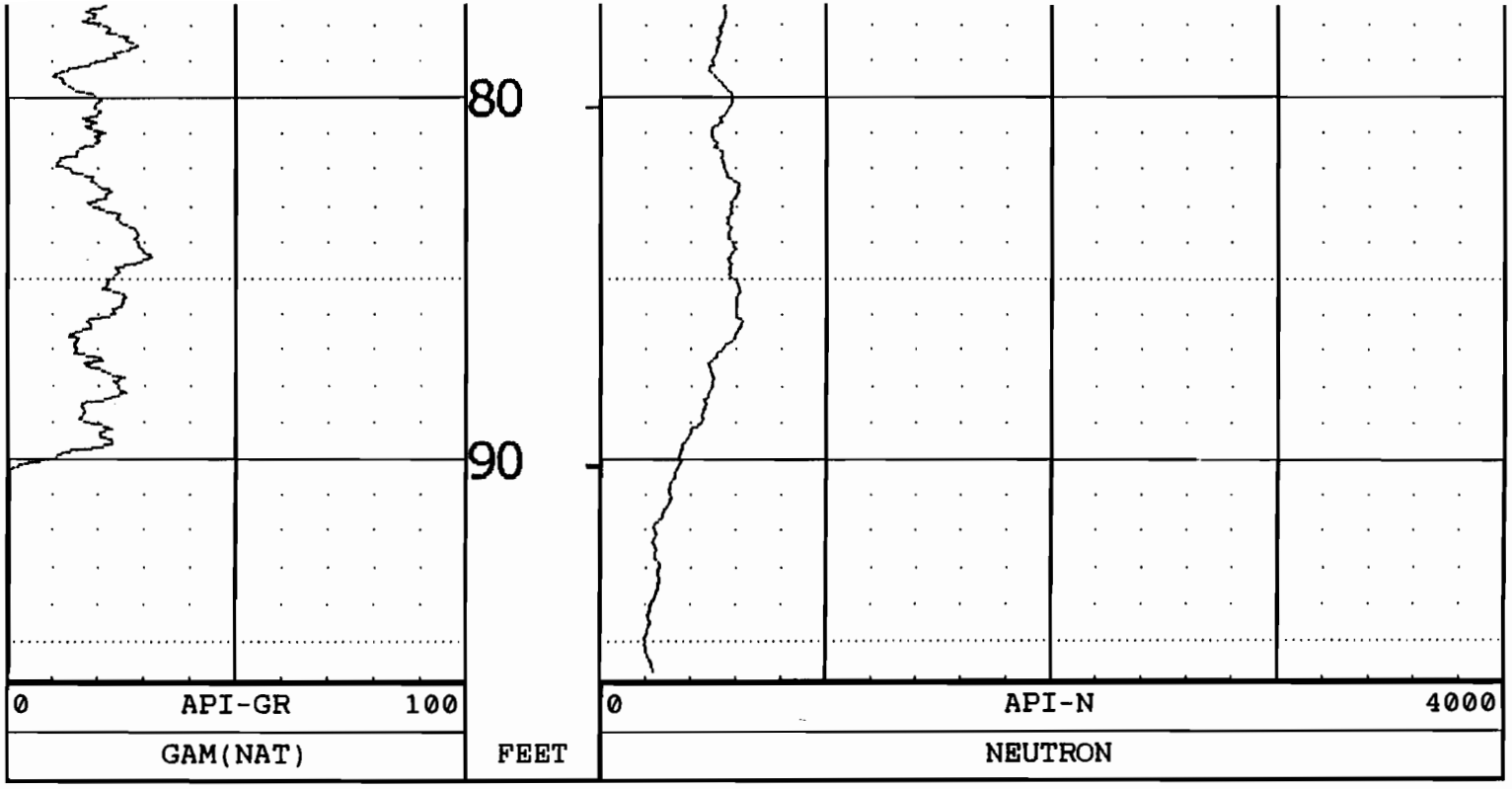
FEET
0
10
20
30
NEUTRON
0
API-N
4000

40
50
60
70



TOOL CALIBRATION 84-16 07/23/99 15:53
TOOL 9067A
SERIAL NUMBER 527

	DATE	TIME	SENSOR	STANDARD	RESPONSE
1	Mar24,99	08:00:59	GAM(NAT)	Default [API-GR]	Default [CPS]
	Mar24,99	08:00:59	GAM(NAT)	Default [API-GR]	Default [CPS]
2	Mar24,99	08:04:51	NEUTRON	Default [API-N]	Default [CPS]
	Mar24,99	08:04:51	NEUTRON	271.000 [API-N]	124 [CPS]

Analytical groups tested by sample at station 084-018

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Surface Soil Samples						
Media not sampled at station 084-018						
Subsurface Soil Samples						
Media not sampled at station 084-018						
Storm Water Samples						
Media not sampled at station 084-018						
Groundwater Samples						
084018WA060	X				X	X
084018WA060-45					X	
084018WA060-5					X	
084018WA065	X				X	X
084018WA065-45					X	
084018WA065-5					X	
084018WA070	X				X	X
084018WA070-45					X	
084018WA070-5					X	
084018WA075	X				X	X
084018WA075-45					X	
084018WA075-5					X	
084018WA080	X				X	X
084018WA080-45					X	
084018WA080-5					X	
084018WA085	X				X	X
084018WA085-45					X	
084018WA085-5					X	
084018WA090	X				X	X
084018WA090-45					X	
084018WA090-5					X	

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WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Sample ID: 084018WA060

Station: 084-018 **Media: WG** **Depth = 62 to 62 feet**

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
METAL				
Aluminum	SW846-6010A		43.1 mg/L	X/
Antimony	SW846-6010A	U	0.2 mg/L	X/
Arsenic	SW846-7060	U	0.005 mg/L	X/
Barium	SW846-6010A		0.349 mg/L	X/
Beryllium	SW846-6010A	B	0.008 mg/L	X/
Boron	SW846-6010A	NU	2 mg/L	X/
Cadmium	SW846-7131	U	0.005 mg/L	X/
Calcium	SW846-6010A		16.6 mg/L	X/
Chromium	SW846-6010A		0.125 mg/L	X/
Cobalt	SW846-6010A		0.069 mg/L	X/
Copper	SW846-6010A		0.062 mg/L	X/
Cyanide	SW846-9014	U	0.02 mg/L	X/
Iron	SW846-6010A		215 mg/L	X/
Lead	SW846-7421 E3	NUW	0.05 mg/L	X/
Lithium	SW846-6010A	U	0.05 mg/L	X/
Magnesium	SW846-6010A		7.43 mg/L	X/
Manganese	SW846-6010A		1.49 mg/L	X/
Mercury	SW846-7470	BUW	0.0002 mg/L	X/
Nickel	SW846-6010A		0.16 mg/L	X/
Potassium	SW846-6010A		4.94 mg/L	X/
Selenium	SW846-7740	U	0.005 mg/L	X/
Silver	SW846-6010A	U	0.05 mg/L	X/
Sodium	SW846-6010A		36.7 mg/L	X/
Strontium	SW846-6010A		0.097 mg/L	X/
Thallium	SW846-6010A	U	0.2 mg/L	X/
Vanadium	SW846-6010A		0.125 mg/L	X/
Zinc	SW846-6010A		0.295 mg/L	X/
RADS				
Alpha activity	SW846-9310		7 pCi/L	X/
Beta activity	SW846-9310		193 pCi/L	X/
Neptunium-237	RL-7124	A	-18.3 pCi/L	X/
Plutonium-239/240	RL-7120	A	-0.31 pCi/L	X/
Technetium-99	DNT		303 pCi/L	X/
Thorium-234	RL-7124	A	-159 pCi/L	X/
Uranium	RL-7124	A	pCi/L	X/
Uranium-234	RL-7124	A	pCi/L	X/
Uranium-235	AS7300		wt %	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	A	pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
Trichloroethene	SW846-8021 M		3.3 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/

Sample ID: 084018WA060-45

Station: 084-018 **Media: WG** **Depth = 62 to 62 feet**

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.102 mg/L	X/
Beryllium	SW846-6010A	BU	0.005 mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		16.6 mg/L	X/
Chromium	SW846-6010A	BU	0.05 mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Iron	SW846-6010A		0.351 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		6.26 mg/L	X/
Manganese	SW846-6010A		0.58 mg/L	X/
Nickel	SW846-6010A	U	0.05 mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	44.1 mg/L	X/R-C
Strontium	SW846-6010A		0.057 mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A	U	0.1 mg/L	X/
Zinc	SW846-6010A	U	0.2 mg/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
RADS				
Uranium	RL-7124	A	pCi/L	X/
Uranium-234	RL-7124	A	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	A	pCi/L	X/
Sample ID: 084018WA060-5				
Station: 084-018	**Media: WG**		**Depth = 62 to 62 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.095 mg/L	X/
Beryllium	SW846-6010A	U	0.005 mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		16.7 mg/L	X/
Chromium	SW846-6010A	U	0.05 mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Iron	SW846-6010A		0.487 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		6.25 mg/L	X/
Manganese	SW846-6010A		0.684 mg/L	X/
Nickel	SW846-6010A		0.054 mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	45.4 mg/L	X/R-C
Strontium	SW846-6010A		0.062 mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A	U	0.1 mg/L	X/
Zinc	SW846-6010A	U	0.2 mg/L	X/
RADS				
Uranium	RL-7124	A	pCi/L	X/
Uranium-234	RL-7124	A	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	A	pCi/L	X/
Sample ID: 084018WA065				
Station: 084-018	**Media: WG**		**Depth = 67 to 67 feet**	
METAL				
Aluminum	SW846-6010A		12.8 mg/L	X/
Antimony	SW846-6010A	U	0.2 mg/L	X/
Arsenic	SW846-7060		0.007 mg/L	X/
Barium	SW846-6010A		0.192 mg/L	X/
Beryllium	SW846-6010A	BU	0.005 mg/L	X/
Boron	SW846-6010A	NU	2 mg/L	X/
Cadmium	SW846-7131	U	0.005 mg/L	X/
Calcium	SW846-6010A		13.2 mg/L	X/
Chromium	SW846-6010A	U	0.05 mg/L	X/
Cobalt	SW846-6010A		0.018 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Cyanide	SW846-9014	U	0.02 mg/L	X/
Iron	SW846-6010A		76.4 mg/L	X/
Lead	SW846-7421 E3	NUW	0.05 mg/L	X/
Lithium	SW846-6010A	U	0.05 mg/L	X/
Magnesium	SW846-6010A		5.52 mg/L	X/
Manganese	SW846-6010A		0.266 mg/L	X/
Mercury	SW846-7470	BUW	0.0002 mg/L	X/
Nickel	SW846-6010A	U	0.05 mg/L	X/
Potassium	SW846-6010A		2.3 mg/L	X/
Selenium	SW846-7740	U	0.005 mg/L	X/
Silver	SW846-6010A	U	0.05 mg/L	X/
Sodium	SW846-6010A		32 mg/L	X/
Strontium	SW846-6010A	U	0.05 mg/L	X/
Thallium	SW846-6010A	U	0.2 mg/L	X/
Vanadium	SW846-6010A	U	0.1 mg/L	X/
Zinc	SW846-6010A	U	0.2 mg/L	X/
RADS				
Alpha activity	SW846-9310		4.2 pCi/L	X/
Beta activity	SW846-9310		120 pCi/L	X/
Neptunium-237	RL-7124	A	-3.29 pCi/L	X/
Plutonium-239/240	RL-7120	A	-0.202 pCi/L	X/
Technetium-99	DNT		159 pCi/L	X/
Thorium-234	RL-7124	A	103 pCi/L	X/
Uranium	RL-7124	A	pCi/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
Uranium-234	RL-7124	A	pCi/L	X/
Uranium-235	AS7300		wt %	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	A	pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
Trichloroethene	SW846-8021 M		2.5 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 084018WA065-45				
Station: 084-018	**Media: WG**		**Depth = 67 to 67 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Arsenic	SW846-7060	BNU	0.005 mg/L	X/
Barium	SW846-6010A		0.111 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		16.7 mg/L	X/R-C
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A	U	0.2 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		5.24 mg/L	X/
Manganese	SW846-6010A		0.077 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	34.5 mg/L	X/
Strontium	SW846-6010A		mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/
RADS				
Uranium	RL-7124	AX	pCi/L	X/
Uranium-234	RL-7124	AX	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	AX	pCi/L	X/
Sample ID: 084018WA065-5				
Station: 084-018	**Media: WG**		**Depth = 67 to 67 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Arsenic	SW846-7060	BNU	0.005 mg/L	X/
Barium	SW846-6010A		0.123 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		13.9 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A		0.244 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		5.33 mg/L	X/
Manganese	SW846-6010A		0.128 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	35.8 mg/L	X/R-C
Strontium	SW846-6010A		mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/
RADS				
Uranium	RL-7124	AX	pCi/L	X/
Uranium-234	RL-7124	AX	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	AX	pCi/L	X/
Sample ID: 084018WA070				
Station: 084-018	**Media: WG**		**Depth = 72 to 72 feet**	

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
METAL				
Aluminum	SW846-6010A		8.19 mg/L	X/
Antimony	SW846-6010A	U	0.2 mg/L	X/
Arsenic	SW846-7060	U	0.005 mg/L	X/
Barium	SW846-6010A		0.164 mg/L	X/
Beryllium	SW846-6010A	BU	0.005 mg/L	X/
Boron	SW846-6010A	NU	2 mg/L	X/
Cadmium	SW846-7131	U	0.005 mg/L	X/
Calcium	SW846-6010A		15.2 mg/L	X/
Chromium	SW846-6010A	U	0.05 mg/L	X/
Cobalt	SW846-6010A		0.022 mg/L	X/
Copper	SW846-6010A		0.078 mg/L	X/
Cyanide	SW846-9014	U	0.02 mg/L	X/
Iron	SW846-6010A		78.1 mg/L	X/
Lead	SW846-7421 E3	NUW	0.05 mg/L	X/
Lithium	SW846-6010A	U	0.05 mg/L	X/
Magnesium	SW846-6010A		5.98 mg/L	X/
Manganese	SW846-6010A		0.267 mg/L	X/
Mercury	SW846-7470	BUW	0.0002 mg/L	X/
Nickel	SW846-6010A	U	0.05 mg/L	X/
Potassium	SW846-6010A		2.15 mg/L	X/
Selenium	SW846-7740	U	0.005 mg/L	X/
Silver	SW846-6010A	U	0.05 mg/L	X/
Sodium	SW846-6010A		40.4 mg/L	X/
Strontium	SW846-6010A	U	0.05 mg/L	X/
Thallium	SW846-6010A	U	0.2 mg/L	X/
Vanadium	SW846-6010A	U	0.1 mg/L	X/
Zinc	SW846-6010A	U	0.2 mg/L	X/
RADS				
Alpha activity	SW846-9310	U	3.5 pCi/L	X/
Beta activity	SW846-9310		80.1 pCi/L	X/
Neptunium-237	RL-7124	A	-2.26 pCi/L	X/
Plutonium-239/240	RL-7120	A	-0.256 pCi/L	X/
Technetium-99	DNT		118 pCi/L	X/
Thorium-234	RL-7124	A	-98.2 pCi/L	X/
Uranium	RL-7124	A	pCi/L	X/
Uranium-234	RL-7124	A	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-235	AS7300		wt %	X/
Uranium-238	RL-7124	A	pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M		2.5 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	J	0.4 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
Trichloroethene	SW846-8021 M		4.6 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/

Sample ID: 084018WA070-45

Station: 084-018 **Media: WG** **Depth = 72 to 72 feet**

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.139 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		16 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Iron	SW846-6010A	U	0.2 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		6.16 mg/L	X/
Manganese	SW846-6010A		0.13 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	44 mg/L	X/
Strontium	SW846-6010A		mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/
RADS				
Uranium	RL-7124	A	pCi/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
Uranium-234	RL-7124	A	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	A	pCi/L	X/
Sample ID: 084018WA070-5				
Station: 084-018	**Media: WG**		**Depth = 72 to 72 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.14 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		16.3 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Iron	SW846-6010A		0.399 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		6.22 mg/L	X/
Manganese	SW846-6010A		0.151 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	45.3 mg/L	X/R-C
Strontium	SW846-6010A		mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/
RADS				
Uranium	RL-7124	A	pCi/L	X/
Uranium-234	RL-7124	A	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	A	pCi/L	X/
Sample ID: 084018WA075				
Station: 084-018	**Media: WG**		**Depth = 77 to 77 feet**	
METAL				
Aluminum	SW846-6010A		0.764 mg/L	X/
Antimony	SW846-6010A	U	0.2 mg/L	X/
Arsenic	SW846-7060	U	0.005 mg/L	X/
Barium	SW846-6010A		0.142 mg/L	X/
Beryllium	SW846-6010A	BU	0.005 mg/L	X/
Boron	SW846-6010A	NU	2 mg/L	X/
Cadmium	SW846-7131	U	0.005 mg/L	X/
Calcium	SW846-6010A		15.4 mg/L	X/
Chromium	SW846-6010A	U	0.05 mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Cyanide	SW846-9014	U	0.02 mg/L	X/
Iron	SW846-6010A		4.47 mg/L	X/
Lead	SW846-7421 E3	NUW	0.05 mg/L	X/
Lithium	SW846-6010A	U	0.05 mg/L	X/
Magnesium	SW846-6010A		6.01 mg/L	X/
Manganese	SW846-6010A	U	0.05 mg/L	X/
Mercury	SW846-7470	BUW	0.0002 mg/L	X/
Nickel	SW846-6010A	U	0.05 mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Selenium	SW846-7740	U	0.005 mg/L	X/
Silver	SW846-6010A	U	0.05 mg/L	X/
Sodium	SW846-6010A		37.7 mg/L	X/
Strontium	SW846-6010A	U	0.05 mg/L	X/
Thallium	SW846-6010A	U	0.2 mg/L	X/
Vanadium	SW846-6010A	U	0.1 mg/L	X/
Zinc	SW846-6010A	U	0.2 mg/L	X/
RADS				
Alpha activity	SW846-9310	U	1.2 pCi/L	X/
Beta activity	SW846-9310		52.8 pCi/L	X/
Neptunium-237	RL-7124	A	-27.6 pCi/L	X/
Plutonium-239/240	RL-7120	A	-0.209 pCi/L	X/
Technetium-99	DNT		90 pCi/L	X/
Thorium-234	RL-7124	A	117 pCi/L	X/
Uranium	RL-7124	AX	pCi/L	X/
Uranium-234	RL-7124	AX	pCi/L	X/
Uranium-235	RL-7124		wt %	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
Uranium-235	AS7300		wt %	X/
Uranium-238	RL-7124	AX	pCi/L	X/
VOA				
1,1,1-Trichloroethane	SW846-8260	U	5 ug/L	X/
1,1,2,2-Tetrachloroethane	SW846-8260	U	5 ug/L	X/
1,1,2-Trichloroethane	SW846-8260	U	5 ug/L	X/
1,1-Dichloroethane	SW846-8260	UX	5 ug/L	X/
1,1-Dichloroethene	SW846-8260		6 ug/L	X/
1,1-Dichloroethene	SW846-8021 M		5.6 ug/L	X/
1,2-Dichloroethane	SW846-8260	U	5 ug/L	X/
1,2-Dichloropropane	SW846-8260	U	5 ug/L	X/
1,2-Dimethylbenzene	SW846-8260	U	5 ug/L	X/
2-Butanone	SW846-8260	JU	10 ug/L	X/
2-Hexanone	SW846-8260	U	10 ug/L	X/
4-Methyl-2-pentanone	SW846-8260	U	10 ug/L	X/
Acetone	SW846-8260	JU	10 ug/L	X/
Benzene	SW846-8260	U	5 ug/L	X/
Bromodichloromethane	SW846-8260	U	5 ug/L	X/
Bromoform	SW846-8260	U	5 ug/L	X/
Carbon disulfide	SW846-8260	U	5 ug/L	X/
Carbon tetrachloride	SW846-8260	U	5 ug/L	X/
Chlorobenzene	SW846-8260	U	5 ug/L	X/
Chloroethane	SW846-8260	U	5 ug/L	X/
Chloroform	SW846-8260	U	5 ug/L	X/
Chloromethane	SW846-8260	U	5 ug/L	X/
cis-1,2-Dichloroethene	SW846-8260	UX	5 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		1 ug/L	X/
cis-1,3-Dichloropropene	SW846-8260	U	5 ug/L	X/
Dibromochloromethane	SW846-8260	U	5 ug/L	X/
Ethylbenzene	SW846-8260	U	5 ug/L	X/
m,p-Xylene	SW846-8260	U	10 ug/L	X/
Methylene chloride	SW846-8260	JU	10 ug/L	X/
Styrene	SW846-8260	U	5 ug/L	X/
Tetrachloroethene	SW846-8260	U	5 ug/L	X/
Toluene	SW846-8260	UY	5 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
trans-1,2-Dichloroethene	SW846-8260	U	5 ug/L	X/
trans-1,3-Dichloropropene	SW846-8260	U	5 ug/L	X/
Trichloroethene	SW846-8260		8 ug/L	X/
Trichloroethene	SW846-8021 M		8.4 ug/L	X/
Vinyl chloride	SW846-8260	U	5 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 084018WA075-45				
Station: 084-018	**Media: WG**		**Depth = 77 to 77 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.133 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		14.7 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A		mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A		0.482 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		5.77 mg/L	X/
Manganese	SW846-6010A		mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A		mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	36.9 mg/L	X/
Strontium	SW846-6010A		mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/
RADS				
Uranium	RL-7124	AX	pCi/L	X/
Uranium-234	RL-7124	AX	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	AX	pCi/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Sample ID: 084018WA075-5

Station: 084-018 **Media: WG** **Depth = 77 to 77 feet**

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.135 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		14.8 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A		mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A		0.537 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		5.78 mg/L	X/
Manganese	SW846-6010A		mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A		mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	37.6 mg/L	X/
Strontium	SW846-6010A		mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/
RADS				
Uranium	RL-7124	AX	pCi/L	X/
Uranium-234	RL-7124	AX	pCi/L	X/
Uranium-235	RL-7124		wt %	X/
Uranium-238	RL-7124	AX	pCi/L	X/

Sample ID: 084018WA080

Station: 084-018 **Media: WG** **Depth = 82 to 82 feet**

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
METAL				
Aluminum	SW846-6010A		12.5 mg/L	X/
Antimony	SW846-6010A	U	0.2 mg/L	X/
Arsenic	SW846-7060	U	0.005 mg/L	X/
Barium	SW846-6010A		0.168 mg/L	X/
Beryllium	SW846-6010A	BU	0.005 mg/L	X/
Boron	SW846-6010A	NU	2 mg/L	X/
Cadmium	SW846-7131	U	0.005 mg/L	X/
Calcium	SW846-6010A		12.8 mg/L	X/
Chromium	SW846-6010A	U	0.05 mg/L	X/
Cobalt	SW846-6010A		0.026 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Cyanide	SW846-9014	U	0.02 mg/L	X/
Iron	SW846-6010A		176 mg/L	X/
Lead	SW846-7421 E3	NUW	0.05 mg/L	X/
Lithium	SW846-6010A	U	0.05 mg/L	X/
Magnesium	SW846-6010A		5.44 mg/L	X/
Manganese	SW846-6010A		0.401 mg/L	X/
Mercury	SW846-7470	BUW	0.0002 mg/L	X/
Nickel	SW846-6010A	U	0.05 mg/L	X/
Potassium	SW846-6010A		2.07 mg/L	X/
Selenium	SW846-7740	U	0.005 mg/L	X/
Silver	SW846-6010A	U	0.05 mg/L	X/
Sodium	SW846-6010A		34.1 mg/L	X/
Strontium	SW846-6010A	U	0.05 mg/L	X/
Thallium	SW846-6010A	U	0.2 mg/L	X/
Vanadium	SW846-6010A	U	0.1 mg/L	X/
Zinc	SW846-6010A	U	0.2 mg/L	X/
RADS				
Alpha activity	SW846-9310		1.8 pCi/L	X/
Beta activity	SW846-9310		16.2 pCi/L	X/
Technetium-99	DNT		14.5 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M		5.8 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		1.6 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
Trichloroethene	SW846-8021 M		7.6 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/

Sample ID: 084018WA080-45

Station: 084-018 **Media: WG** **Depth = 82 to 82 feet**

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.105 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		11.9 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A	U	0.2 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		4.77 mg/L	X/
Manganese	SW846-6010A		0.068 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	34.4 mg/L	X/
Strontium	SW846-6010A		mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/

Sample ID: 084018WA080-5

Station: 084-018 **Media: WG** **Depth = 82 to 82 feet**

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.105 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		11.9 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A	U	0.2 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		4.76 mg/L	X/
Manganese	SW846-6010A		0.056 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	34.8 mg/L	X/
Strontium	SW846-6010A		mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/

Sample ID: 084018WA085

Station: 084-018 **Media: WG** **Depth = 87 to 87 feet**

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
ANION				
Fluoride	EPA-340.2		0.16 mg/L	X/
Sulfide	EPA-376.1	UX	2 mg/L	X/
METAL				
Aluminum	SW846-6010A		36.8 mg/L	X/
Antimony	SW846-6010A	U	0.2 mg/L	X/
Arsenic	SW846-7060	U	0.005 mg/L	X/
Barium	SW846-6010A		0.435 mg/L	X/
Beryllium	SW846-6010A	BU	0.005 mg/L	X/
Boron	SW846-6010A	NU	2 mg/L	X/
Cadmium	SW846-7131	U	0.005 mg/L	X/
Calcium	SW846-6010A		18.2 mg/L	X/
Chromium	SW846-6010A	U	0.05 mg/L	X/
Cobalt	SW846-6010A		0.029 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Cyanide	SW846-9014	U	0.02 mg/L	X/
Iron	SW846-6010A		143 mg/L	X/
Lead	SW846-7421 E3	NUW	0.05 mg/L	X/
Lithium	SW846-6010A	U	0.05 mg/L	X/
Magnesium	SW846-6010A		8.48 mg/L	X/
Manganese	SW846-6010A		0.476 mg/L	X/
Mercury	SW846-7470	BUW	0.0002 mg/L	X/
Nickel	SW846-6010A	U	0.05 mg/L	X/
Potassium	SW846-6010A		3.75 mg/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
Selenium	SW846-7740	U	0.005 mg/L	X/
Silver	SW846-6010A	U	0.05 mg/L	X/
Sodium	SW846-6010A		33.5 mg/L	X/
Strontium	SW846-6010A		0.143 mg/L	X/
Thallium	SW846-6010A	U	0.2 mg/L	X/
Vanadium	SW846-6010A	U	0.1 mg/L	X/
Zinc	SW846-6010A	U	0.2 mg/L	X/
PHYSC				
pH	SW846-9040		6.34 none	X/
RedOx	SM-2580 B		167 mV	X/
RADS				
Alpha activity	SW846-9310		2 pCi/L	X/
Beta activity	SW846-9310		9.7 pCi/L	X/
Technetium-99	DNT		19.6 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M		12 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		2.9 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
Trichloroethene	SW846-8021 M		12 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
WETCHEM				
Alkalinity	EPA-310.1		98 mg/L	X/
Ammonia	EPA-350.2	JU	0.2 mg/L	X/
Carbonate as CaCO3	SM-2320 B 17		93 mg/L	X/
Chemical Oxygen Demand (COD)	EPA-410.4 1978	U	25 mg/L	X/
Silica	EPA-370.1	J	6 mg/L	X/
Total Organic Carbon (TOC)	SW846-9060		2.4 mg/L	X/
Sample ID: 084018WA085-45				
Station: 084-018	**Media: WG**		**Depth = 87 to 87 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.157 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		16.8 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A		1.31 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		6.84 mg/L	X/
Manganese	SW846-6010A		0.247 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	34.4 mg/L	X/
Strontium	SW846-6010A		0.054 mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/
Sample ID: 084018WA085-5				
Station: 084-018	**Media: WG**		**Depth = 87 to 87 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.153 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		16.8 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A		1.06 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		6.74 mg/L	X/
Manganese	SW846-6010A		0.282 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
Sodium	SW846-6010A	N	35.3 mg/L	X/
Strontium	SW846-6010A		0.054 mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/
Sample ID: 084018WA090				
Station: 084-018	**Media: WG**		**Depth = 92 to 92 feet**	
METAL				
Aluminum	SW846-6010A		10.7 mg/L	X/
Antimony	SW846-6010A	U	0.2 mg/L	X/
Arsenic	SW846-7060	U	0.005 mg/L	X/
Barium	SW846-6010A		0.245 mg/L	X/
Beryllium	SW846-6010A	BU	0.005 mg/L	X/
Boron	SW846-6010A	NU	2 mg/L	X/
Cadmium	SW846-7131	U	0.005 mg/L	X/
Calcium	SW846-6010A		19.3 mg/L	X/
Chromium	SW846-6010A	U	0.05 mg/L	X/
Cobalt	SW846-6010A		0.011 mg/L	X/
Copper	SW846-6010A	U	0.05 mg/L	X/
Cyanide	SW846-9014	U	0.02 mg/L	X/
Iron	SW846-6010A		119 mg/L	X/
Lead	SW846-7421 E3	NUW	0.05 mg/L	X/
Lithium	SW846-6010A	U	0.05 mg/L	X/
Magnesium	SW846-6010A		8.26 mg/L	X/
Manganese	SW846-6010A		0.411 mg/L	X/
Mercury	SW846-7470	BUW	0.0002 mg/L	X/
Nickel	SW846-6010A	U	0.05 mg/L	X/
Potassium	SW846-6010A		2.95 mg/L	X/
Selenium	SW846-7740	U	0.005 mg/L	X/
Silver	SW846-6010A	U	0.05 mg/L	X/
Sodium	SW846-6010A		34.2 mg/L	X/
Strontium	SW846-6010A		0.082 mg/L	X/
Thallium	SW846-6010A	U	0.2 mg/L	X/
Vanadium	SW846-6010A	U	0.1 mg/L	X/
Zinc	SW846-6010A	U	0.2 mg/L	X/
RADS				
Alpha activity	EPA-900.0	A	2.79 pCi/L	X/
Alpha activity	SW846-9310		3.4 pCi/L	X/
Beta activity	EPA-900.0		14.96 pCi/L	X/
Beta activity	SW846-9310		14.7 pCi/L	X/
Technetium-99	RL-7100		20.6 pCi/L	X/
Technetium-99	DNT		21.1 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M		74 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		5.2 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.3 ug/L	X/
Trichloroethene	SW846-8021 M		19 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 084018WA090-45				
Station: 084-018	**Media: WG**		**Depth = 92 to 92 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.162 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		18.4 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A		0.353 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		7.46 mg/L	X/
Manganese	SW846-6010A		0.116 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	35.7 mg/L	X/
Strontium	SW846-6010A		0.055 mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 084-018 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
Sample ID: 084018WA090-5				
Station: 084-018	**Media: WG**		**Depth = 92 to 92 feet**	
METAL				
Aluminum	SW846-6010A	U	0.2 mg/L	X/
Antimony	SW846-6010A		mg/L	X/
Barium	SW846-6010A		0.162 mg/L	X/
Beryllium	SW846-6010A		mg/L	X/
Boron	SW846-6010A		mg/L	X/
Calcium	SW846-6010A		18.8 mg/L	X/
Chromium	SW846-6010A		mg/L	X/
Cobalt	SW846-6010A	U	0.01 mg/L	X/
Copper	SW846-6010A		mg/L	X/
Iron	SW846-6010A		1.62 mg/L	X/
Lithium	SW846-6010A		mg/L	X/
Magnesium	SW846-6010A		7.55 mg/L	X/
Manganese	SW846-6010A		0.182 mg/L	X/
Nickel	SW846-6010A		mg/L	X/
Potassium	SW846-6010A	U	2 mg/L	X/
Silver	SW846-6010A		mg/L	X/
Sodium	SW846-6010A	N	36.6 mg/L	X/
Strontium	SW846-6010A		0.057 mg/L	X/
Thallium	SW846-6010A		mg/L	X/
Vanadium	SW846-6010A		mg/L	X/
Zinc	SW846-6010A		mg/L	X/

*V/A = Validation / Assessment

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WAG 8 Groundwater Operable Unit Data
Station 085-016

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CEMS TEAM
WAG 8 GROUNDWATER OU
DATA
LITHOLOGIC LOG

LITHOLOGIC LOG	BORING/WELL NO: 085-016/MW356	PAGE 1 of 3
FACILITY: PADUCAH GASEOUS DIFFUSION PLANT		SITE: WAG 8 SWMU 85
PROJECT NO.: 1999006	CLIENT/PROJECT: BECHTEL JACOBS	DRILLER: DARREN HUNTER
CONTRACTOR: TN & A	DRILL CONTRACTOR: MILLER DRILLING	BOREHOLE DIA: 5 1/4"
DRILL START: 8-4-99 1310	DRILL END: 8-7-99 1230	TOTAL DEPTH: 138' BGS
DRILL METHOD/ RIG TYPE: DWRC	COORDINATES: N 863.45 E -1466.38	PROTECTION LEVEL: D
LOGGED BY: BRIAN JENKS		ELEVATION 379.86 FT AMSL

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (FT)	RAD CPM	H&S MONIT. VOC'S (ppm)	LITHOLOGIC DESCRIPTION	LITHOLOGY	COMMENTS
0	1		NA	BKGD	0.0	SILT, moderately plastic, yellowish brown (10YR5/6), dry to moist		Rad background = 300 cpm ,plus. Samples were surveyed outside the drill site because of elevated background. Background elevated due to cylinder yard adjacent to drill site.
5								
	2		NA	BKGD	0.0	SILT, trace very fine sand, yellowish brown (10YR5/6) to light olive brown (2-5Y5/3), damp to moist		
10								
15	3		NA	BKGD	0.0	SILT, trace very fine sand, yellowish brown (10YR5/6) to light olive brown (2-5Y5/3), damp to moist		
20	4		NA	BKGD	0.0	SILT, trace very fine grained sand, mottled yellowish brown (10YR5/6) and light olive brown (2-5Y5/3), wet		
25	5		NA	BKGD	0.0	SILT, trace very fine grained sand, yellowish brown (10YR5/6) moderately dense, plastic, damp		
30	6		NA	BKGD	0.0	No sample recovery		Cyclone clogged
35	7		NA	BKGD	0.0	No sample recovery		
40	8		NA	BKGD	0.0	SAND, well-sorted, fine to medium-grained, subangular to subrounded, light yellowish brown (10YR7/6)		
45	9		NA	BKGD	0.0	SILT/CLAY, yellowish brown (10YR7/6) to brownish yellow (5YR8/4), stiff, plastic, damp		
50	10		NA	BKGD	0.0	No sample recovery		Drill bit clogged, no circulation
55	11		NA	BKGD	0.0	No sample recovery		Drill bit clogged, no circulation
60								

U = SHELBY TUBE
S = SPLIT SPOON/ CONT. CORING
C = CUTTINGS
R = ROCK CORING _____
H = HYDROPUNCH _____
O = OTHER _____
FIELD G/C (MAKE/MOD.): _____
G/C OPER.: _____
COMMENTS: _____

CEMS TEAM
WAG 8 GROUNDWATER OU
DATA
LITHOLOGIC LOG

LITHOLOGIC LOG	BORING/WELL NO: 085-016/MW356	PAGE 2 of 3
FACILITY: PADUCAH GASEOUS DIFFUSION PLANT		SITE: WAG 8 SWMU 85
PROJECT NO.: 1999006	CLIENT/PROJECT: BECHTEL JACOBS	DRILLER: DARREN HUNTER
CONTRACTOR: TN & A	DRILL CONTRACTOR: MILLER DRILLING	BOREHOLE DIA: 5 1/4"
DRILL START: 8-4-99 1310	DRILL END: 8-7-99 1230	TOTAL DEPTH: 138' BGS
DRILL METHOD/ RIG TYPE: DWRC	COORDINATES: N 863.45 E -1466.38	PROTECTION LEVEL: D-MODIFIED
LOGGED BY: BRIAN JENKS		ELEVATION 379.86 FT AMSL

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (FT)	RAD CPM	H&S MONIT. VOC'S (ppm)	LITHOLOGIC DESCRIPTION	LITHOLOGY	COMMENTS
60	12		NA					
65	13		NA	BKGD	0.0	SAND, well sorted, fine grained, some 1/3" to 1/2" diameter gravel		TOP OF RGA @ 68 FT TIME: 0900 08/05/99
70	14	085016 WA070 @ 73' BGS	NA	BKGD	0.0	Silty GRAVEL, gravel range 1/8" to 1" diameter, subangular to subrounded, some very fine grained sand, yellowish brown (10YR 5/6)		
75	15	085016 WA075 @ 78' BGS	NA	BKGD	0.0	GRAVEL, angular chert, well-sorted 1/8" to 1" plus diameter		TIME: 1345
80	16	085016 WA080 @ 83' BGS	NA	BKGD	0.0	SAND, poorly-sorted, fine to coarse-grained, subangular to subrounded, some small gravel		TIME: 1430
85	17	085016 WA085 @ 88' BGS	NA	BKGD	0.0	Sandy GRAVEL, gravelly SAND, angular gravel, well sorted, subangular to rounded sand		TIME: 1515
90	18	085016 WA090 @ 93' BGS	NA	BKGD	0.0	GRAVEL, chert, angular to sub-angular, moderately well-sorted, 1/16" to 1 1/2" diameter		TIME: 1600
95	19	085016 WA095 @ 98' BGS	NA	BKGD	0.0	GRAVEL, chert, angular to sub-angular, moderately well-sorted, 1/16" to 1 1/2" diameter		TIME: 1650
100	20	085016 WA100 @ 103' BGS	NA	BKGD	0.0	Gravel, chert, moderately well sorted, 1/16" to 1/2" diameter, angular to subangular, slightly coarser than above, trace silt		TIME: 0900 08/06/99
105	21	085016 WA105 @ 108' BGS	NA	BKGD	0.0	Gravel, chert, moderately well sorted, 1/16" to 1/2" diameter, angular to subangular, slightly coarser than above, trace silt		TIME: 0945
110	22	085016 WA110 / 085016 WD110 @ 113' BGS	NA	BKGD	0.0	Silty GRAVEL, well-sorted, angular to subrounded, some fine grained sand		TIME: 1045 TIME: 1100
115	23	085016 WA115 @ 118' BGS	NA	BKGD	0.0	Silty, sandy GRAVEL, moderately well-sorted, subangular to subrounded, yellowish-brown (10YR5/6)		TIME: 1200
120								

U = SHELBY TUBE
S = SPLIT SPOON/ CONT. CORING
C = CUTTINGS
R = ROCK CORING
H = HYDROPUNCH
O = OTHER
FIELD G/C (MAKE/MOD.):
G/C OPER.:
COMMENTS:

CEMS TEAM
WAG 8 GROUNDWATER OU
DATA
LITHOLOGIC LOG

LITHOLOGIC LOG	BORING/WELL NO: 085-016/MW356	PAGE 3 of 3
FACILITY: PADUCAH GASEOUS DIFFUSION PLANT		SITE: WAG 8 SWMU 85
PROJECT NO.: 1999006	CLIENT/PROJECT: BECHTEL JACOBS	DRILLER: DARREN HUNTER
CONTRACTOR: TN & A	DRILL CONTRACTOR: MILLER DRILLING	BOREHOLE DIA: 5 1/4"
DRILL START: 8-4-99 1310	DRILL END: 8-7-99 1230	TOTAL DEPTH: 138' BGS
DRILL METHOD/ RIG TYPE: DWRC	COORDINATES: N 863.45 E 1466.38	PROTECTION LEVEL: D-MODIFIED
LOGGED BY: BRIAN JENKS		ELEVATION 379.86 FT AMSL

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (FT)	RAD CPM	H&S MONIT. VOC'S (ppm)	LITHOLOGIC DESCRIPTION	LITHOLOGY	COMMENTS
120	24	085016 WA120 @ 123' BGS	NA	BKGD	0.0	Silty GRAVEL, well-sorted, subangular to subrounded, some fine sand		TIME: 1430
125	25	085016 WA125 @ 128' BGS	NA	BKGD	0.0	Silty SAND and fine GRAVEL, well-sorted, subangular to subrounded, 1/16" to 1/4" diameter		TIME: 1515
130	26	085016 WA130 @ 133' BGS	NA	BKGD	0.0	Silty SAND and fine GRAVEL, well-sorted, subangular to subrounded, 1/16" to 1/4" diameter		TIME: 1630
135	27	085016 WA135 @ 138' BGS	NA	BKGD	0.0	CLAY, trace very fine grained sand, soft, plastic, bluish-grey (5B 5/1)		TIME: 0815 08/07/99
140								Top of McNairy @ 136' BGS
25								
30								
35								
40								
45								
50								
55								
60								

U = SHELBY TUBE
S = SPLIT SPOON/ CONT. CORING
C = CUTTINGS
R = ROCK CORING _____
H = HYDROPUNCH _____
O = OTHER _____
FIELD G/C (MAKE/MOD.): _____
G/C OPER.: _____
COMMENTS: _____

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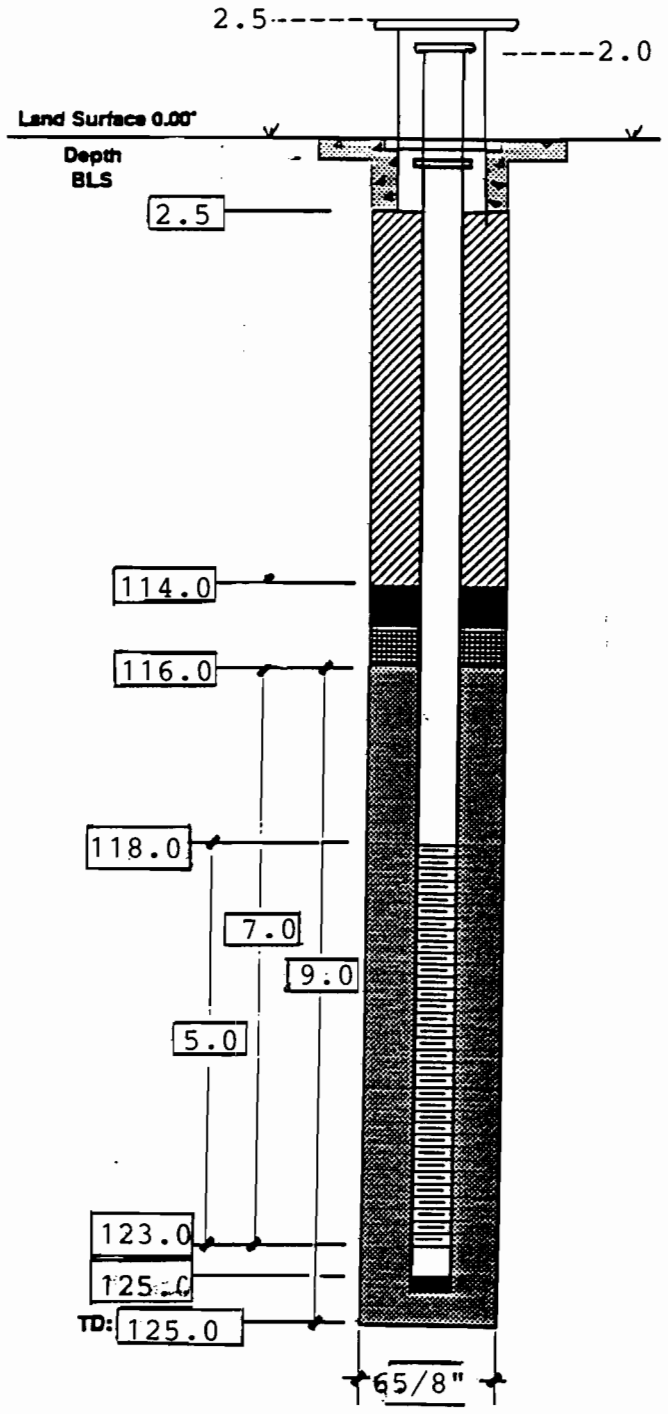
MONITORING WELL CONSTRUCTION LOG

Well No. MW 356	**Start Date:** 8/22/99 **End Date:** 8/23/99
Installation: PAducah Gaseous Diffusion Plant	**Total Depth:** 125 .0
	Field Geologist: Virginia Mullins
Site: Groundwater OU	**Drilling Contractor:** Miller MDC
Client/Project: WAG 8	**Driller:** Mark Miller (Jeff Brownfield)
Project No. NA	**Coordinates: Northing:** 863.45 **Easting:** -1466.38

All values are in feet, unless otherwise noted.



PROTECTIVE CASING
Material/Type: Steel
Diameter: 4" Depth BLS: 2.5'
Weep Hole: (yes) no

GUARD POSTS & SURFACE PAD
No. 4 Type: Steel
Composition & Size: Concrete 4'x4'

RISER PIPE
Type: Stainless Steel
Diameter: 2" Total Length:(TOC to TOS) _____
Weep Hole: yes no

GROUT
Composition: Bentonite 30% Solids
Interval BLS: 2.5-114.0 Tremied: (yes) no
Thickness: 2.5 to 114.0

CENTRALIZERS
Number: 3 Depths: 75', 50', 25'

SEAL
Type: Bentonite Source: NA
Setup/Hydration Time: 8 hrs. Vol. Fluid Added 0
Tremied: yes (no) Thickness: 114.0-116.0

CONTAINMENT SAND
Type: NA Source: _____
Amt. Used: _____ Tremied: yes no
Grain Size Distribution: _____
Thickness: _____

FILTER PACK
Type: #1 Sand Source: _____
Amt. Used: 6.6 bags(325lb) Tremied: (yes) no
Grain Size Distribution: NA
Thickness: 116.0-125.0

SCREEN
Type: Stainless Steel Length: 5.0'
Diameter: 2" Interval BLS: _____
Slot Size & Type: 0.10

SILT TRAP
Interval BLS: 123.0-125.0 Length: 2'
Bottom Cap: 12.0'

BACKFILL PLUG
Material: Sand
Setup/Hydration Time: _____ Tremied: yes (no)

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WELL DEVELOPMENT FORM

Project Name and Number: WAG 8

Well Number and Location: MW 356

Development Crew: Tom Thornburgh Driller T. Neel

Water Levels/Time: Initial: 55.56 Pumping: NA Final: NA

Total Well Depth: Initial: 125' Final: 125'

Date and Time: 9/21/99 Begin: 0917 Final: 1102

Development: Method(s): Pumping

Total Quantity of Water Removed: 250 gals

Date/Time and Pump Setting 9/21/99	Discharge Rates* and Measurement Method 4gal-2gal/min	Field Measurements				Remarks Including Sand Production
		Temp (F°)	Specific Conductivity (umhos/cm)	pH (Standard Units)	Turbidity	
0934	Hydac	64.8	374	6.35	809	
0946		64.9	367	6.17	191	
1028		66.5	358	6.12	62	
1042		67.5	365	6.14	6	
1052		67.3	362	6.11	7	
1102		66.9	357	6.10	10	

• gallons per minute or bailer capacity

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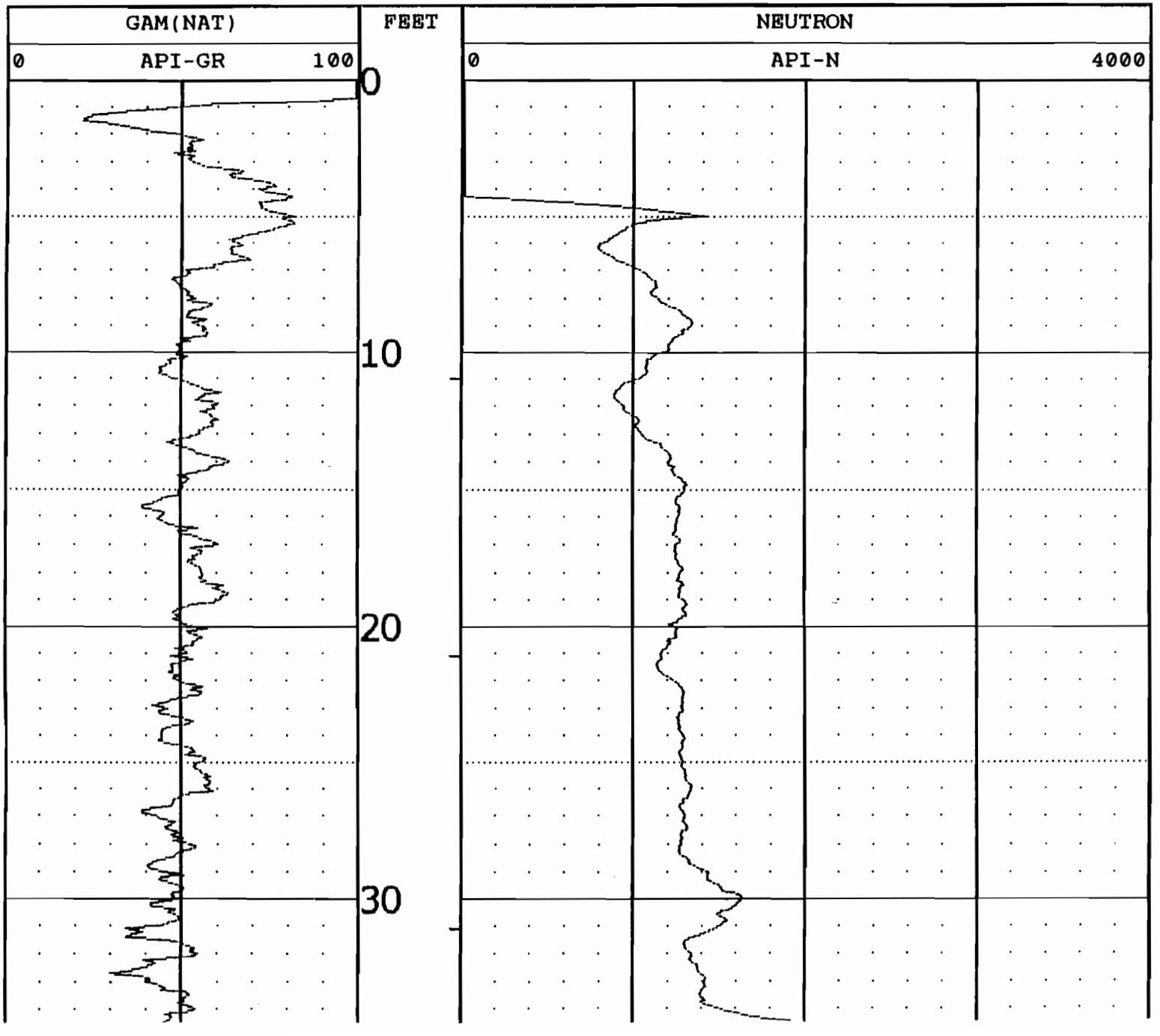
Century GEOPHYSICAL CORP.

85-16

COMPANY	: PGDP				OTHER SERVICES:		
WELL	: 85-16				UP		
LOCATION/FIELD	: PADUCAH						
COUNTY	: McCRACKEN				WL=112		
STATE	: KENTUCKY						
SECTION	:	TOWNSHIP	:		RANGE	:	
DATE	: 08/07/99	NORTH COORD.	: 863.45	EAST COORD.	:	-1466.38	
DEPTH DRILLER	: 138			KB	:		
LOG BOTTOM	: 136.00	LOG MEASURED FROM:		DF	:		
LOG TOP	: -1.40	DRL MEASURED FROM:		GL	:	379.86	
CASING DIAMETER	:	LOGGING UNIT	: TRLR				
CASING TYPE	:	FIELD OFFICE	: TULSA				
CASING THICKNESS:	.25	RECORDED BY	: T. NEAL				
BIT SIZE	: 6	BOREHOLE FLUID	: 0	FILE	:	ORIGINAL	
MAGNETIC DECL.	: 0	RM	: 0	TYPE	:	9067A	
MATRIX DENSITY	: 2.71	RM TEMPERATURE	: 0				
NEUTRON MATRIX	: Dolomite	MATRIX DELTA T	: 140				
				THRESH:		20000	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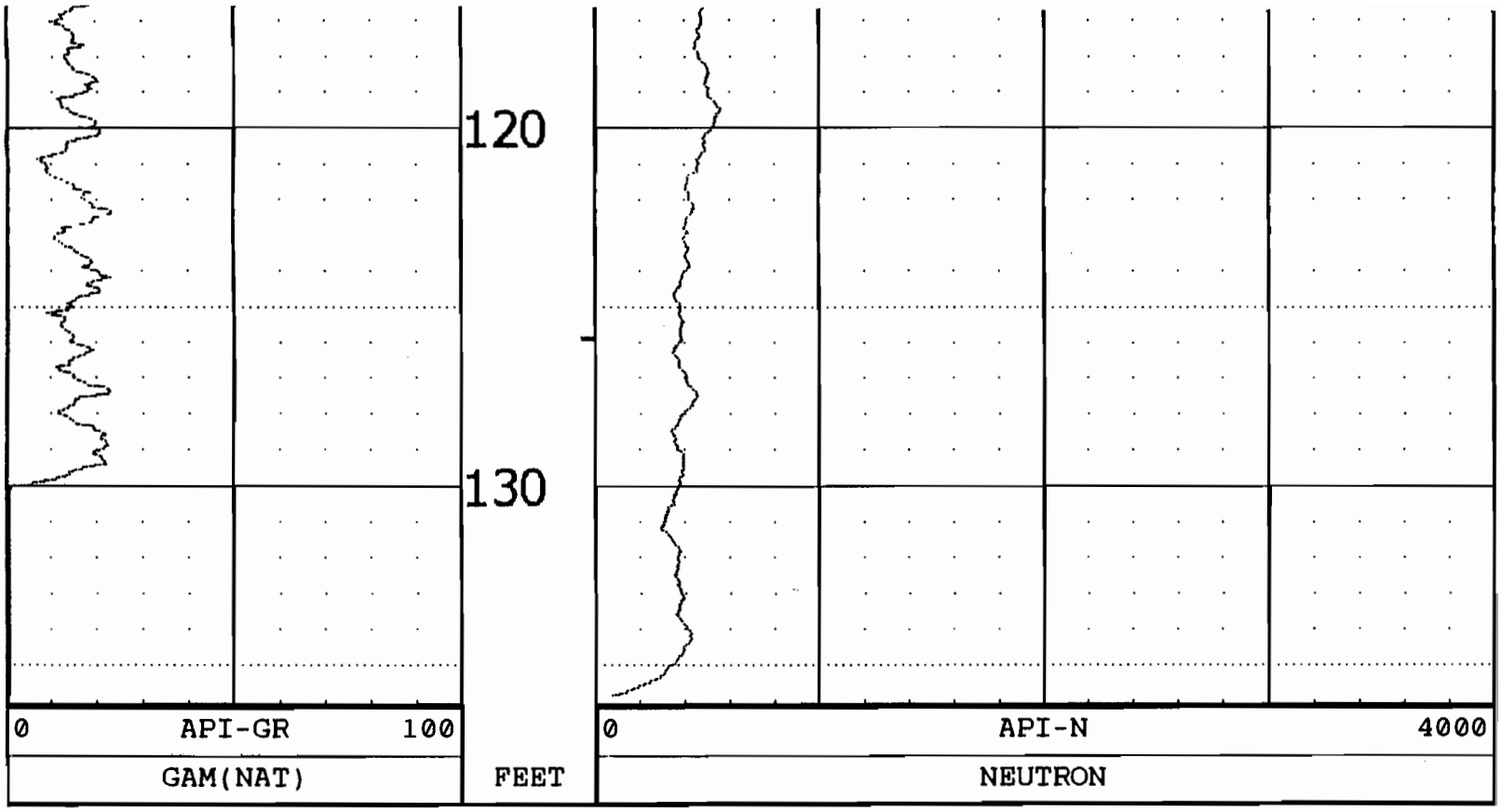

TOOL CALIBRATION 85-16 08/07/99 09:16
TOOL 9067A
SERIAL NUMBER 527

	DATE	TIME	SENSOR	STANDARD	RESPONSE
1	Mar24,99	08:00:59	GAM(NAT)	Default [API-GR]	Default [CPS]
	Mar24,99	08:00:59	GAM(NAT)	Default [API-GR]	Default [CPS]
2	Mar24,99	08:04:51	NEUTRON	Default [API-N]	Default [CPS]
	Mar24,99	08:04:51	NEUTRON	271.000 [API-N]	124 [CPS]

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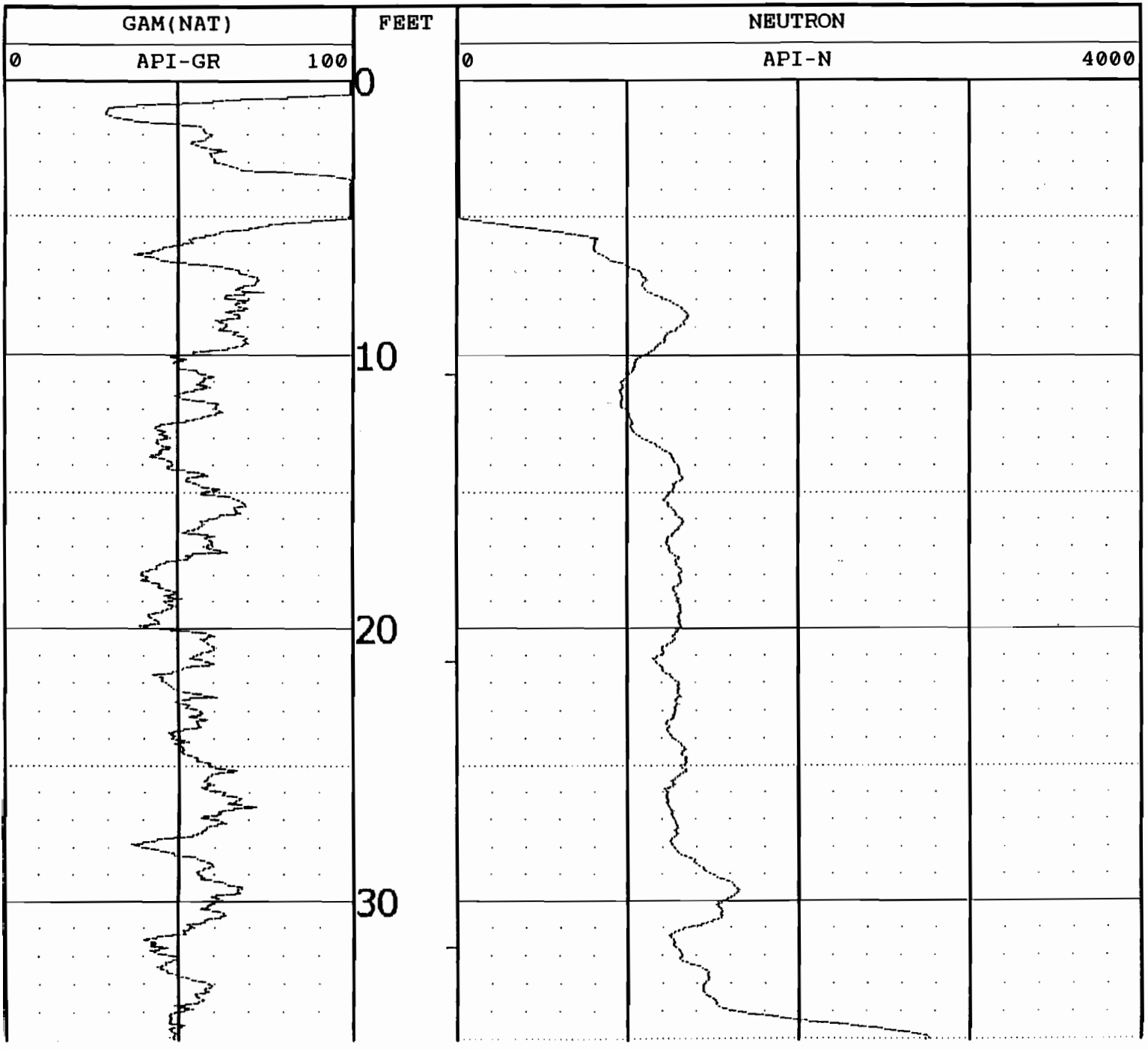
Century GEOPHYSICAL CORP.

85-16

COMPANY	: PGDP			OTHER SERVICES:	
WELL	: 85-16			DOWN	
LOCATION/FIELD	: PADUCAH				
COUNTY	: McCRACKEN			WL=112	
STATE	: KENTUCKY				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 08/07/99	NORTH COORD.	: 863.45	EAST COORD.	: -1466.38
DEPTH DRILLER	: 138			KB	:
LOG BOTTOM	: 136.10	LOG MEASURED FROM:		DF	:
LOG TOP	: -0.80	DRL MEASURED FROM:		GL	: 379.86
CASING DIAMETER	:	LOGGING UNIT	: TRLR		
CASING TYPE	:	FIELD OFFICE	: TULSA		
CASING THICKNESS	: .25	RECORDED BY	: T. NEAL		
BIT SIZE	: 6	BOREHOLE FLUID	: 0	FILE	: ORIGINAL
MAGNETIC DECL.	: 0	RM	: 0	TYPE	: 9067A
MATRIX DENSITY	: 2.71	RM TEMPERATURE	: 0		
NEUTRON MATRIX	: Dolomite	MATRIX DELTA T	: 140		
				THRESH:	20000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FEET
NEUTRON
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API-GR
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API-N
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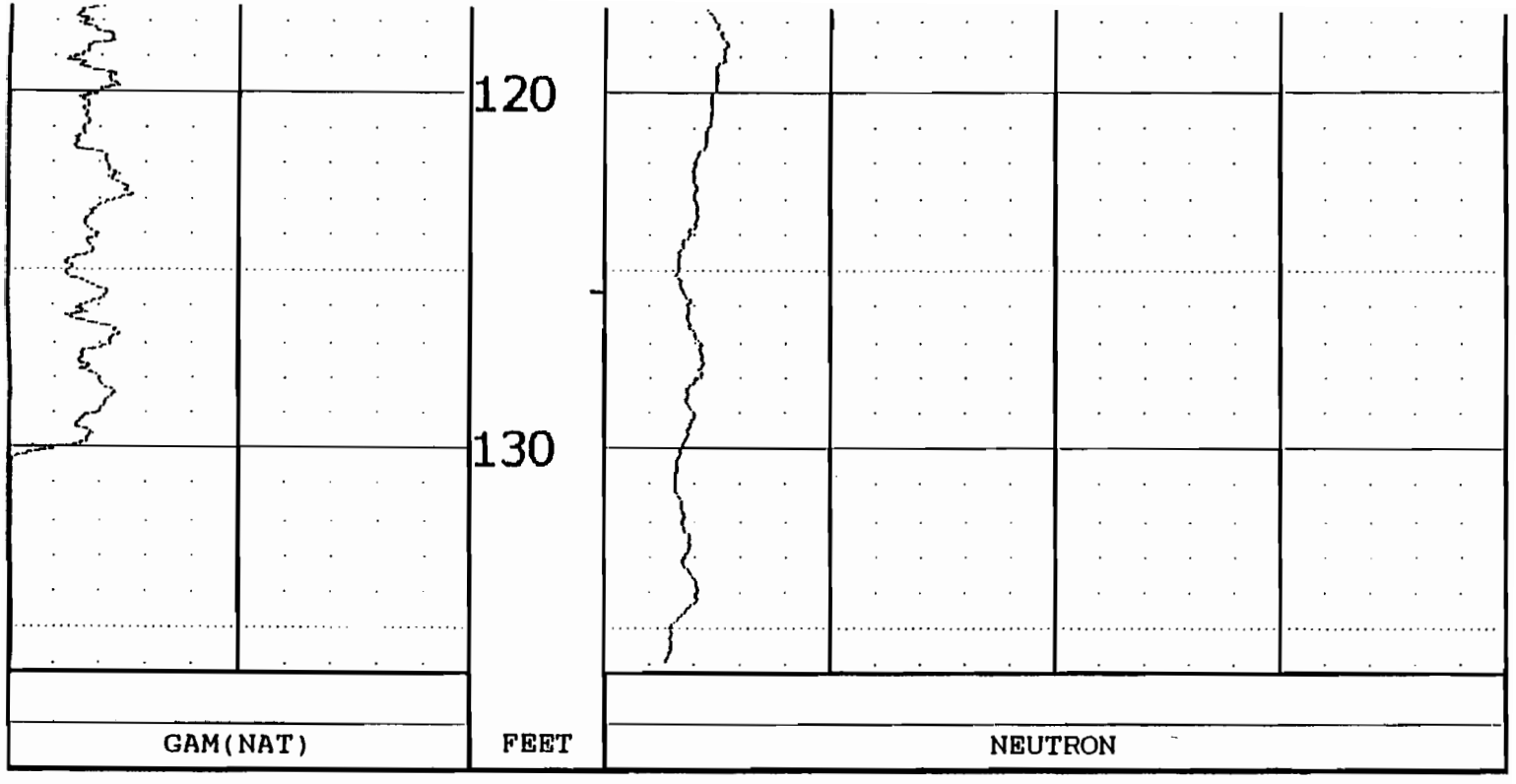
20
30

40
50
60
70

80
90
100
110



TOOL CALIBRATION 85-16 08/07/99 09:01
TOOL 9067A
SERIAL NUMBER 527

	DATE	TIME	SENSOR	STANDARD	RESPONSE
1	Mar24,99	08:00:59	GAM(NAT)	Default [API-GR]	Default [CPS]
	Mar24,99	08:00:59	GAM(NAT)	Default [API-GR]	Default [CPS]
2	Mar24,99	08:04:51	NEUTRON	Default [API-N]	Default [CPS]
	Mar24,99	08:04:51	NEUTRON	271.000 [API-N]	124 [CPS]

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Analytical groups tested by sample at station 085-016

Project Sample ID	Analytical Group					
	VOA	SVOA	PPCB	DI/FURA	METAL	RADS
Surface Soil Samples						
Media not sampled at station 085-016						
Subsurface Soil Samples						
Media not sampled at station 085-016						
Storm Water Samples						
Media not sampled at station 085-016						
Groundwater Samples						
085016WA070	X					X
085016WA075	X					X
085016WA080	X					X
085016WA085	X					X
085016WA090	X					X
085016WA095	X					X
085016WA100	X					X
085016WA105	X					X
085016WA110	X					X
085016WA115	X					X
085016WA120	X					X
085016WA125	X					X
085016WA130	X					X
085016WA135	X					X

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WAG 8 Groundwater Operable Unit Data - Station 085-016 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
Sample ID: 085016WA070				
Station: 085-016	**Media: WG**		**Depth = 73 to 73 feet**	
RADS				
Alpha activity	SW846-9310		1.68 pCi/L	X/
Beta activity	SW846-9310		2 pCi/L	X/
Technetium-99	DNT	U	2 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
Trichloroethene	SW846-8021 M	J	0.2 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA075				
Station: 085-016	**Media: WG**		**Depth = 78 to 78 feet**	
RADS				
Alpha activity	SW846-9310		3 pCi/L	X/
Beta activity	SW846-9310		5.7 pCi/L	X/
Technetium-99	DNT	U	6.7 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
Trichloroethene	SW846-8021 M	U	1 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA080				
Station: 085-016	**Media: WG**		**Depth = 83 to 83 feet**	
RADS				
Alpha activity	SW846-9310		4.2 pCi/L	X/
Beta activity	SW846-9310		5.1 pCi/L	X/
Technetium-99	DNT	U	6.9 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
Trichloroethene	SW846-8021 M	J	0.5 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA085				
Station: 085-016	**Media: WG**		**Depth = 88 to 88 feet**	
RADS				
Alpha activity	SW846-9310		3.4 pCi/L	X/
Beta activity	SW846-9310		8.6 pCi/L	X/
Technetium-99	DNT	U	12 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	J	0.4 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
Trichloroethene	SW846-8021 M		13 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA090				
Station: 085-016	**Media: WG**		**Depth = 93 to 93 feet**	
RADS				
Alpha activity	SW846-9310	U	2 pCi/L	X/
Beta activity	SW846-9310		10.1 pCi/L	X/
Technetium-99	DNT		14.6 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	J	0.7 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
Trichloroethene	SW846-8021 M		20 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA095				
Station: 085-016	**Media: WG**		**Depth = 98 to 98 feet**	
RADS				
Alpha activity	SW846-9310		6.9 pCi/L	X/
Beta activity	SW846-9310		9.8 pCi/L	X/
Technetium-99	DNT		18.1 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		1.3 ug/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 085-016 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
trans-1,2-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
Trichloroethene	SW846-8021 M		37 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA100				
Station: 085-016	**Media: WG**		**Depth = 103 to 103 feet**	
RADS				
Alpha activity	SW846-9310		4.9 pCi/L	X/
Beta activity	SW846-9310		12.3 pCi/L	X/
Technetium-99	DNT		17.7 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		3.4 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
Trichloroethene	SW846-8021 M		60 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA105				
Station: 085-016	**Media: WG**		**Depth = 108 to 108 feet**	
RADS				
Alpha activity	SW846-9310	U	3.6 pCi/L	X/
Beta activity	SW846-9310		12.6 pCi/L	X/
Technetium-99	DNT		19.5 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.3 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		5.4 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
Trichloroethene	SW846-8021 M		90 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA110				
Station: 085-016	**Media: WG**		**Depth = 113 to 113 feet**	
RADS				
Alpha activity	SW846-9310		4.6 pCi/L	X/
Beta activity	SW846-9310		11.5 pCi/L	X/
Technetium-99	DNT	U	13.1 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.3 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		7.1 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
Trichloroethene	SW846-8021 M		130 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA115				
Station: 085-016	**Media: WG**		**Depth = 118 to 118 feet**	
RADS				
Alpha activity	SW846-9310	U	1.6 pCi/L	X/
Beta activity	SW846-9310		8.3 pCi/L	X/
Technetium-99	DNT	U	8.1 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		7.7 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
Trichloroethene	SW846-8021 M		140 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA120				
Station: 085-016	**Media: WG**		**Depth = 123 to 123 feet**	
RADS				
Alpha activity	SW846-9310		2.6 pCi/L	X/
Beta activity	SW846-9310		6 pCi/L	X/
Technetium-99	DNT	U	14 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		8.5 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.3 ug/L	X/
Trichloroethene	SW846-8021 M		150 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA125				
Station: 085-016	**Media: WG**		**Depth = 128 to 128 feet**	
RADS				
Alpha activity	SW846-9310		2.3 pCi/L	X/
Beta activity	SW846-9310		7.2 pCi/L	X/
Technetium-99	DNT	U	6.3 pCi/L	X/

*V/A = Validation / Assessment

WAG 8 Groundwater Operable Unit Data - Station 085-016 Analytical Results

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		7.4 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.3 ug/L	X/
Trichloroethene	SW846-8021 M		120 ug/L	X/
Vinyl chloride	SW846-8021 M	J	0.1 ug/L	X/
Sample ID: 085016WA130				
Station: 085-016	**Media: WG**		**Depth = 133 to 133 feet**	
RADS				
Alpha activity	SW846-9310		2.5 pCi/L	X/
Beta activity	SW846-9310		3.4 pCi/L	X/
Technetium-99	DNT	U	9 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	J	0.8 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.1 ug/L	X/
Trichloroethene	SW846-8021 M		18 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WA135				
Station: 085-016	**Media: WG**		**Depth = 138 to 138 feet**	
RADS				
Alpha activity	SW846-9310		1.63 pCi/L	X/
Beta activity	SW846-9310		2.2 pCi/L	X/
Technetium-99	DNT	U	9.8 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	U	1 ug/L	X/
Trichloroethene	SW846-8021 M	J	0.4 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/
Sample ID: 085016WD110				
Station: 085-016	**Media: WG**		**Depth = 113 to 113 feet**	
RADS				
Alpha activity	SW846-9310		5 pCi/L	X/
Beta activity	SW846-9310		10.8 pCi/L	X/
Technetium-99	DNT		17.9 pCi/L	X/
VOA				
1,1-Dichloroethene	SW846-8021 M	J	0.3 ug/L	X/
cis-1,2-Dichloroethene	SW846-8021 M		7 ug/L	X/
trans-1,2-Dichloroethene	SW846-8021 M	J	0.2 ug/L	X/
Trichloroethene	SW846-8021 M		130 ug/L	X/
Vinyl chloride	SW846-8021 M	U	1 ug/L	X/

Analysis	Method	Lab Qual.	Results and Units	V/A* Codes

*V/A = Validation / Assessment

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Appendix B
Cone Penetrometer Test Logs

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FUGRO GEOSCIENCES, INC.

6105 Rookin
Houston, TX 77074
Phone : 713-778-5580
Fax : 713-778-5501

October 19, 1999
Report Number 0305-0034

TN & Associates, Inc.
101 N. Rutgers Ave., Suite 202
Oakridge, TN 37830

Attention: Mr. Doug Combs

REPORT FOR
CPT AND RELATED SERVICES
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KENTUCKY
SUBCONTRACT AGREEMENT: 1999006-FG

Dear Mr. Combs :

Please find attached the final results of the cone penetration tests conducted at the above referenced location. Also enclosed are diskettes containing the CPT electronic data.

Field investigation was carried out under the supervision of TN & Associate's field personnel. Cone penetration testing (piezocone and piezocone with conductivity sensor) was conducted according to ASTM D5778-95 methods and procedures.

For your information, the soil stratigraphy was identified using Campanella and Robertson's Simplified Soil Behavior Chart. Please note that because of the empirical nature of the soil behavior chart, the soil identification should be verified locally.

Fugro Geosciences, Inc. appreciates the opportunity to be of service to your organization. If you should have any questions, or if we can be of further assistance, please do not hesitate to contact us. We look forward to working with you in the future.

Very truly yours,
FUGRO GEOSCIENCES, INC.

Recep Yilmaz
President

RY/mdt

2 Diskettes Enclosed

Key to Soil Classification and Symbols

SOIL TYPE
(Shown in Symbol Column)

Fill | Sandy | Silty | Clayey

SAMPLE TYPE
(Shown in Samples Column)

Undisturbed | Rock Core | Split Spoon | No Recovery

Predominant type shown heavy

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (Major portion Retained on No. 200 Sieve)

Includes (1) clean gravels & sand described as fine, medium or course, depending on distribution of grain sizes (2) silty or clayey gravels & sands & (3) fine grained low plasticity soils (PI < 10) such as sandy silts. Condition is rated according to relative density, as determined by lab tests or estimated from resistance to sampler penetration.

Descriptive Term	Penetration Resistance*	Relative Density
Loose	0-10	0 to 40%
Medium Dense	10-30	40 to 70%
Dense	30-50	70 to 90%
Very Dense	Over 50	90 to 100%

*Blows/Ft., 140# hammer, 30" drop

FINE GRAINED SOILS (Major Portion Passing No. 200 Sieve)

Includes (1) inorganic & organic silts & clays, (2) sandy, gravelly or silty clays, & (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests for soils with PI $\geq$ 10.

Descriptive Term	Cohesive Shear Strength Tons/Sq. Ft.
Very Soft	Less Than 0.125
Soft	0.125 to 0.25
Firm	0.25 to 0.50
Stiff	0.50 to 1.00
Very Stiff	1.00 to 2.00
Hard	2.00 and Higher

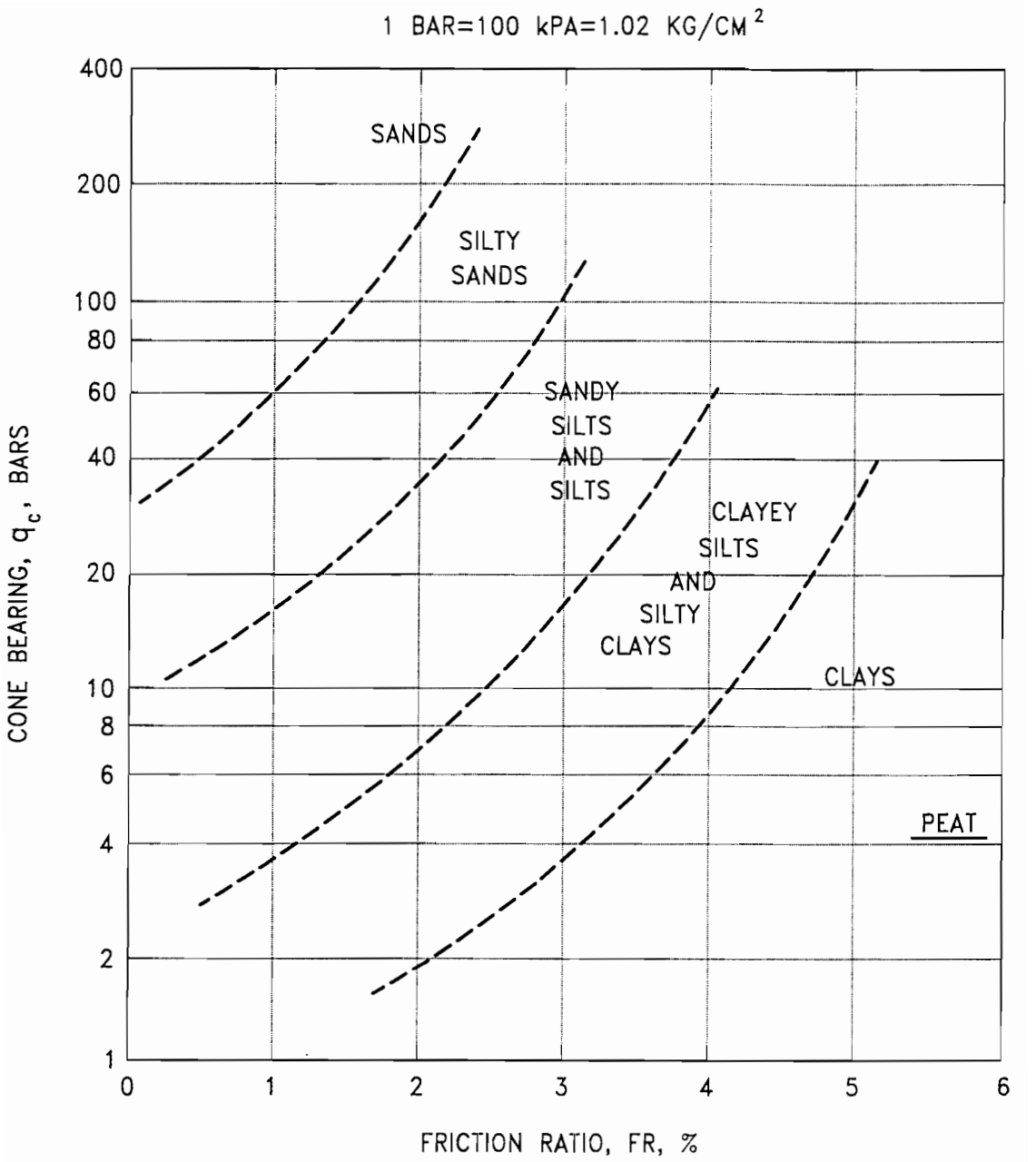
Note: Slickensided and fissured clay may have lower unconfined compressive strengths than shown above because of planes of weakness or shrinkage cracks; consistency ratings of such soils are based on hand penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

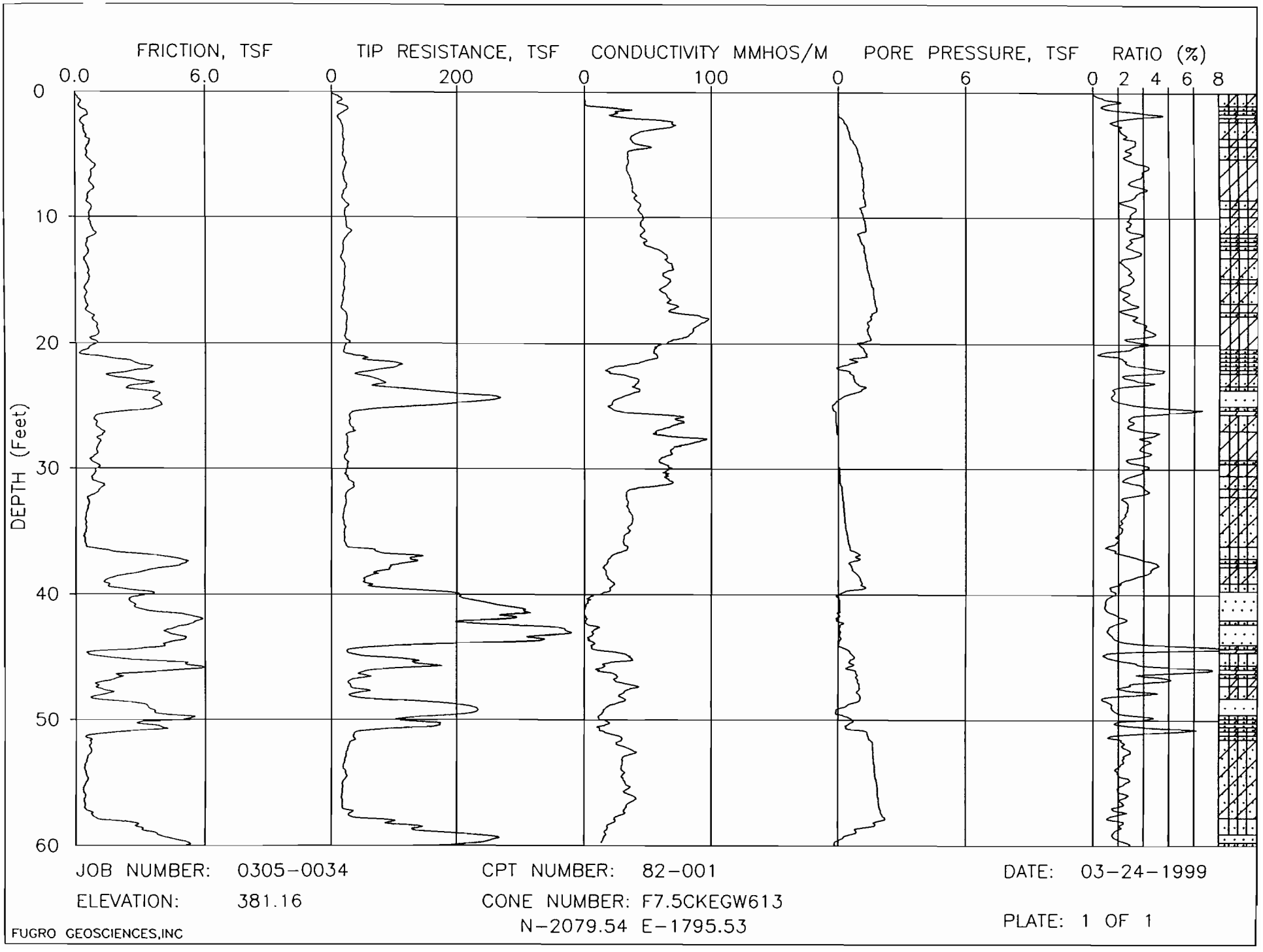
Parting:	paper thin in size
Seam:	1/8"-3" thick
Layer:	greater than 3"
Fissured:	containing shrinkage cracks, frequently filled with fine sand or silt, usually more or less vertical
Sensitive:	pertaining to cohesive soils that are subject to appreciable loss of strength when remolded
Interbedded:	composed of alternate layers of different soil types
Laminated:	composed of thin layers of varying color and texture
Calcareous:	containing appreciable quantities of calcium carbonate
Well Graded:	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Poorly Graded:	predominately of one grain size, or having a range of sizes with some intermediate size missing
Flocculated:	pertaining to cohesive soils that exhibit a loose knit or flakey structure
Slickensided:	having inclined planes of weakness that are slick and glossy in appearance.

Degree of Slickensided Development

Slightly Slickensided:	slickensides present at intervals of 1'-2', soil does not easily break along these planes
Moderately Slickensided:	slickensides spaced at intervals of 1'-2', soil breaks easily along these planes
Extremely Slickensided:	continuous and interconnected slickensides spaced at intervals of 4"-12", soil breaks along the slickensides into pieces 3"-6" in size
Intensely Slickensided:	slickensides spaced at intervals of less than 4", continuous in all directions; soil breaks down along planes into nodules 1/4"-2" in size



CAMPANELLA AND ROBERTSON CLASSIFICATION CHART (1983)



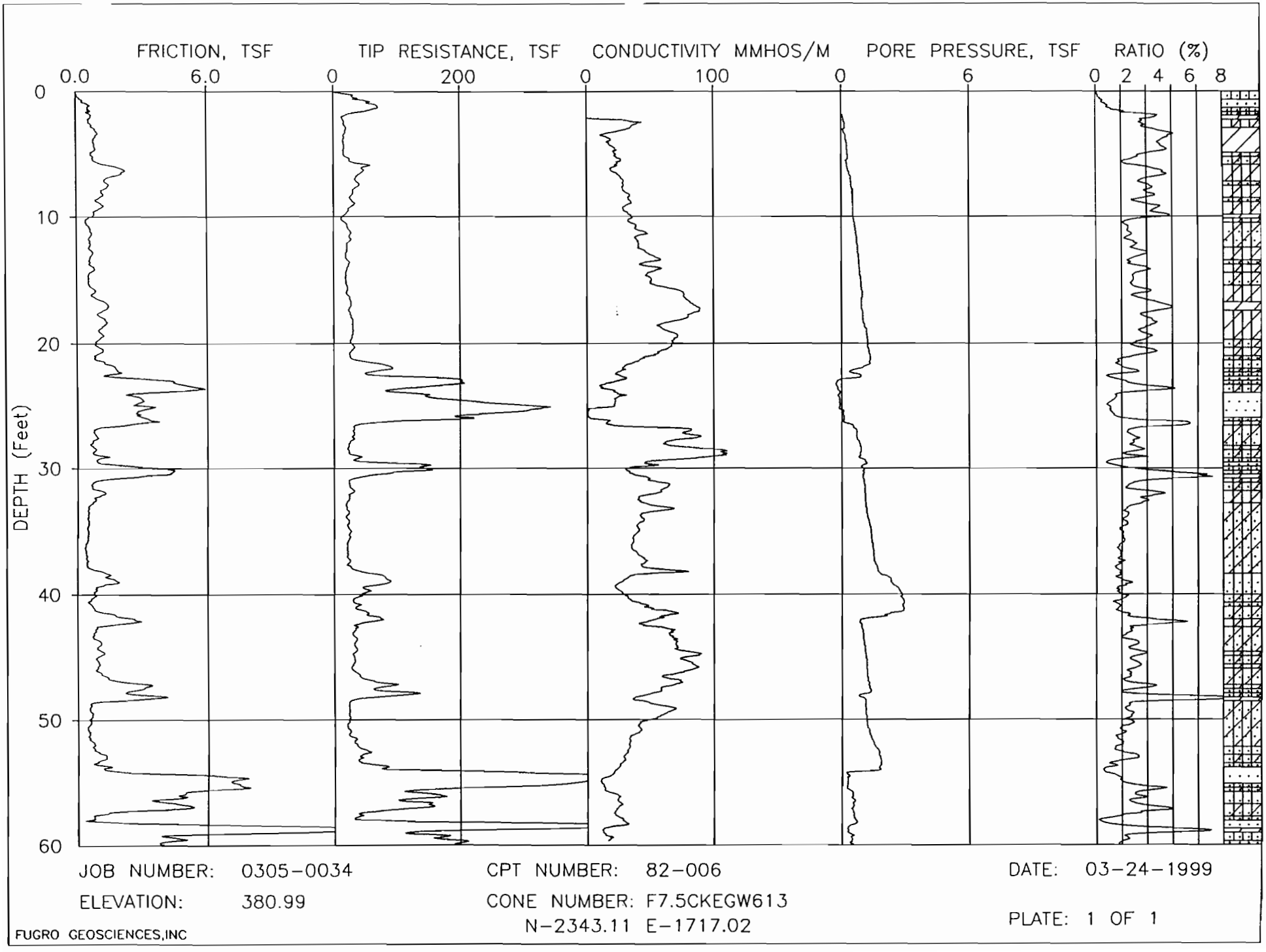
JOB NUMBER: 0305-0034
ELEVATION: 381.16

CPT NUMBER: 82-001
CONE NUMBER: F7.5CKEGW613
N-2079.54 E-1795.53

DATE: 03-24-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



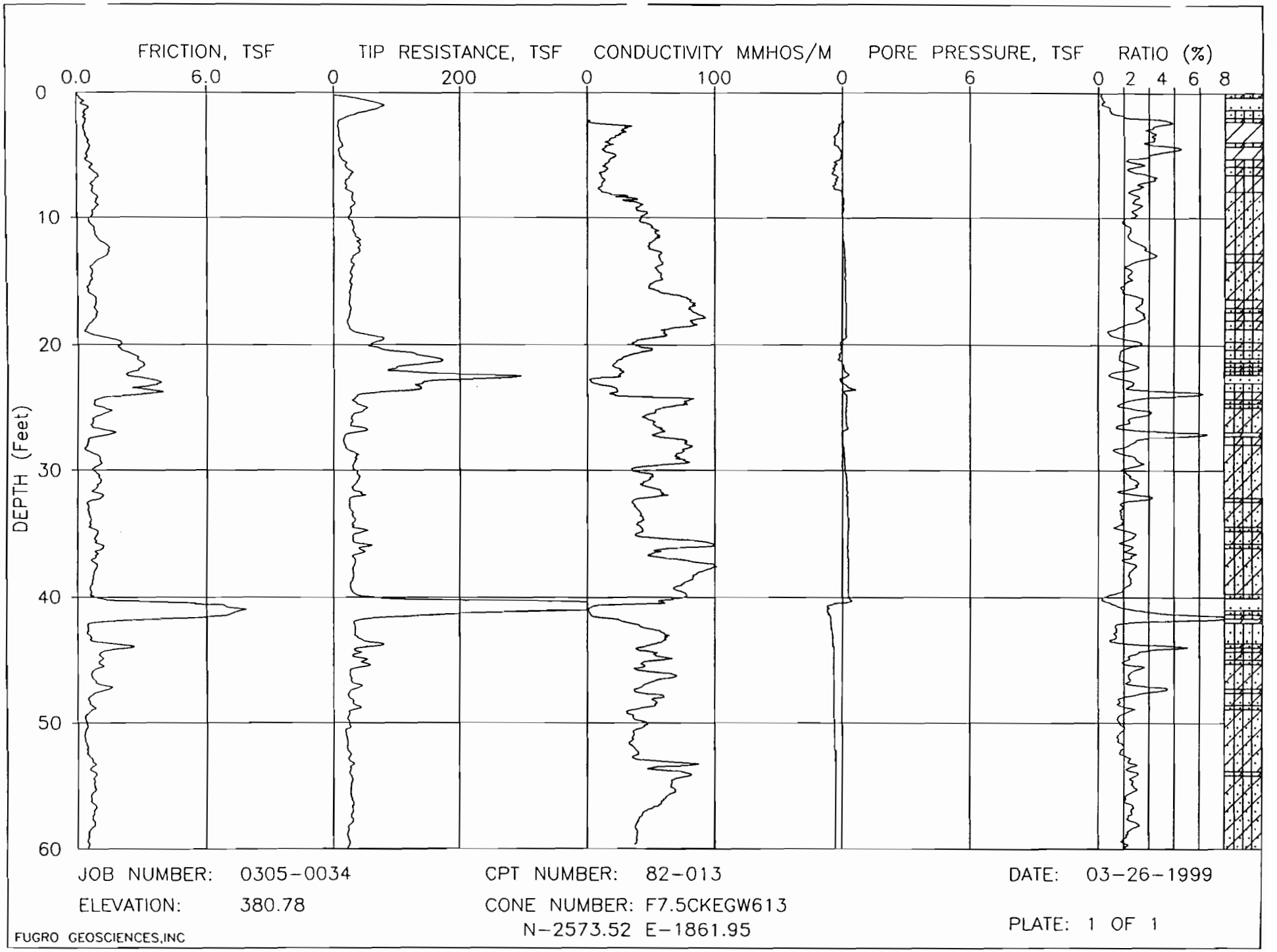
JOB NUMBER: 0305-0034
ELEVATION: 380.99

CPT NUMBER: 82-006
CONE NUMBER: F7.5CKEGW613
N-2343.11 E-1717.02

DATE: 03-24-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC

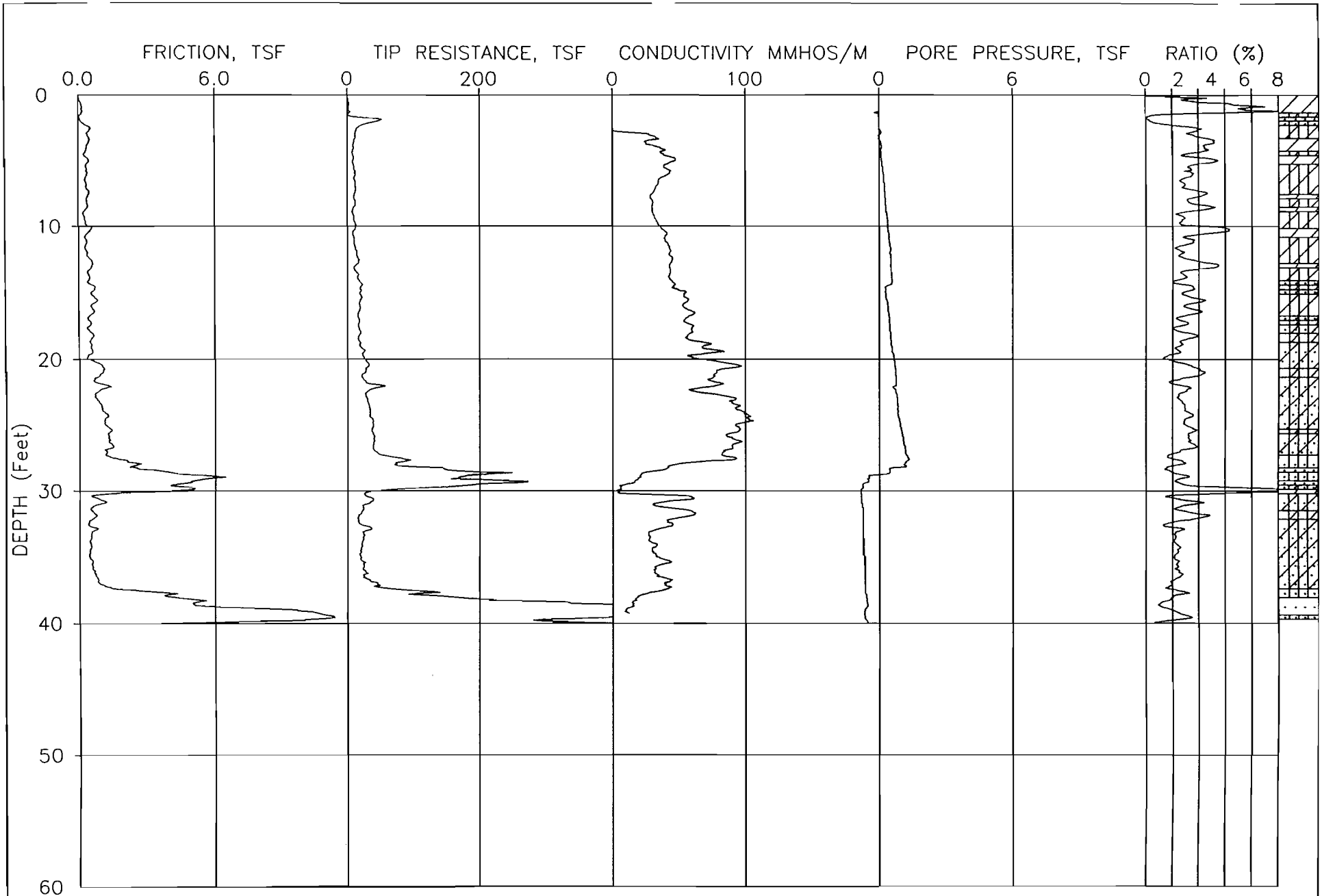


JOB NUMBER: 0305-0034
CPT NUMBER: 82-013
DATE: 03-26-1999

ELEVATION: 380.78
CONE NUMBER: F7.5CKEGW613
N-2573.52 E-1861.95

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0034

ELEVATION: 379.74

CPT NUMBER: 83-001

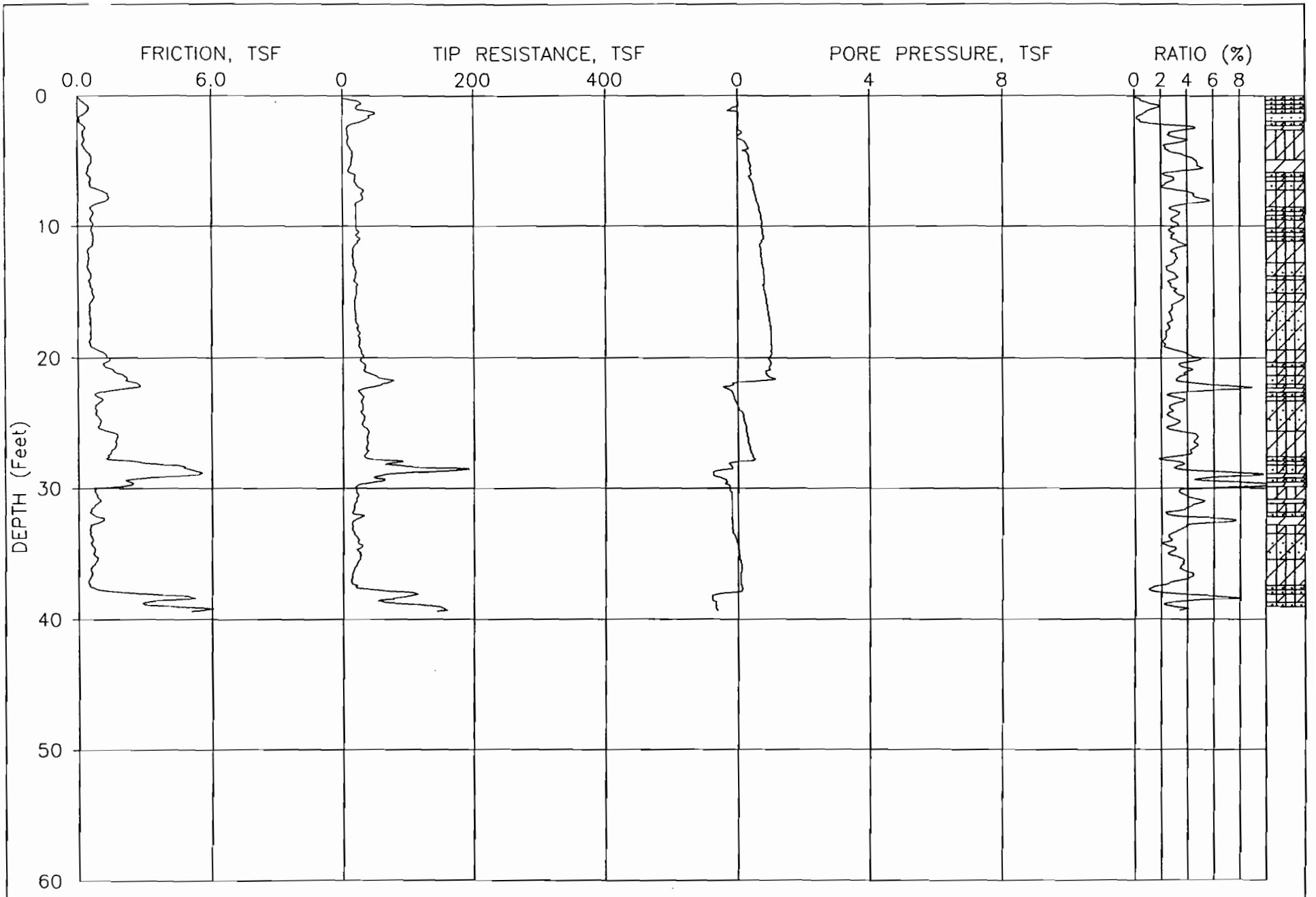
CONE NUMBER: F7.5CKEGW613

N-3091.83 E-1773.83

DATE: 03-23-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



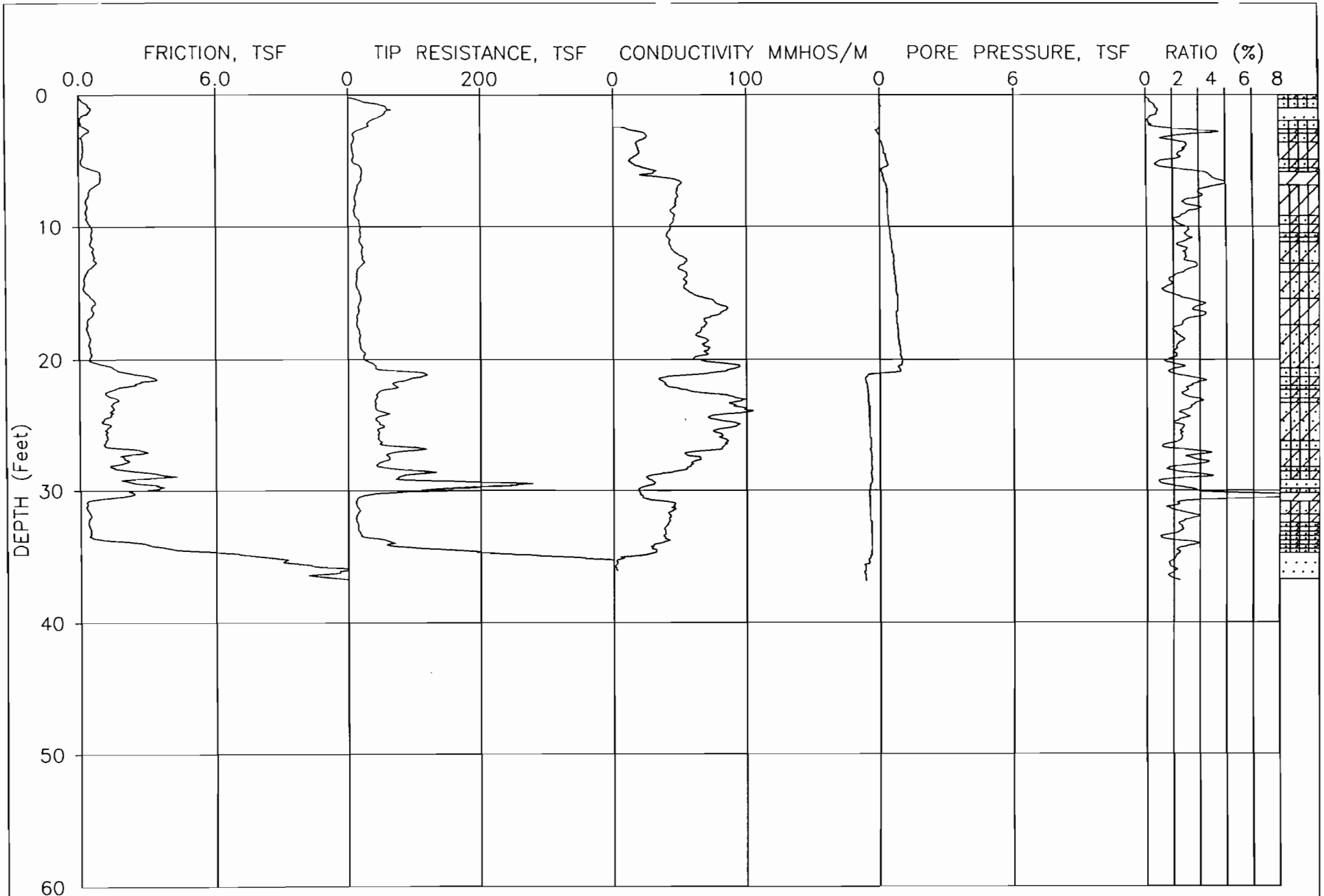
JOB NUMBER: 0305-0034
ELEVATION: 379.74

CPT NUMBER: 83-001A
CONE NUMBER: F7.5CKEW480
N-3091.83 E-1773.83

DATE: 03-23-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



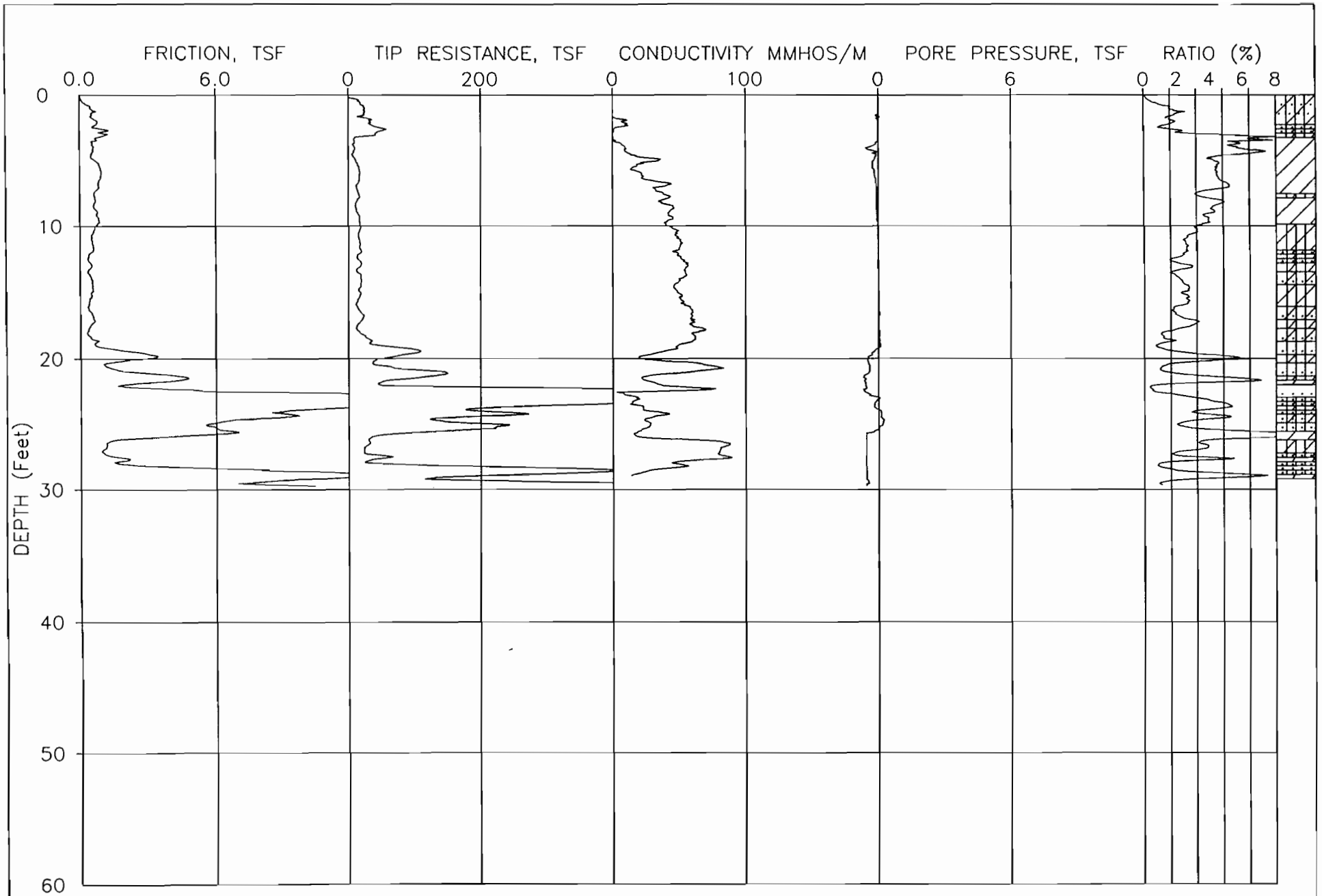
JOB NUMBER: 0305-034
ELEVATION: 379.68

CPT NUMBER: 83-005
CONE NUMBER: F7.5CKEGW613
N-3237.93 E-1716.91

DATE: 03-23-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0034

ELEVATION: 379.28

CPT NUMBER: 83-013

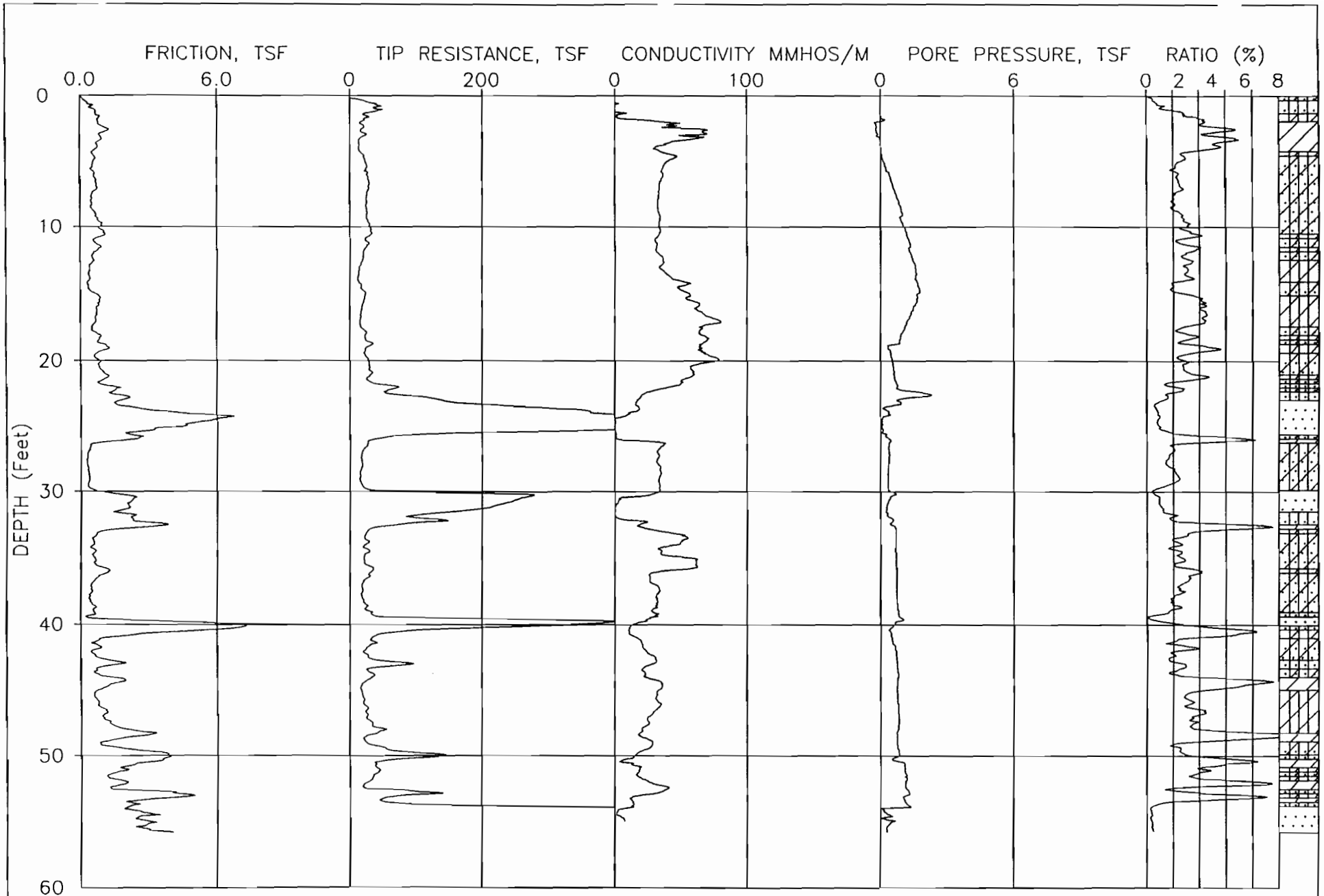
CONE NUMBER: F7.5CKEGW613

N-3894.58 E-1896.52

DATE: 04-07-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0034

ELEVATION: 0.00

CPT NUMBER: 84-002

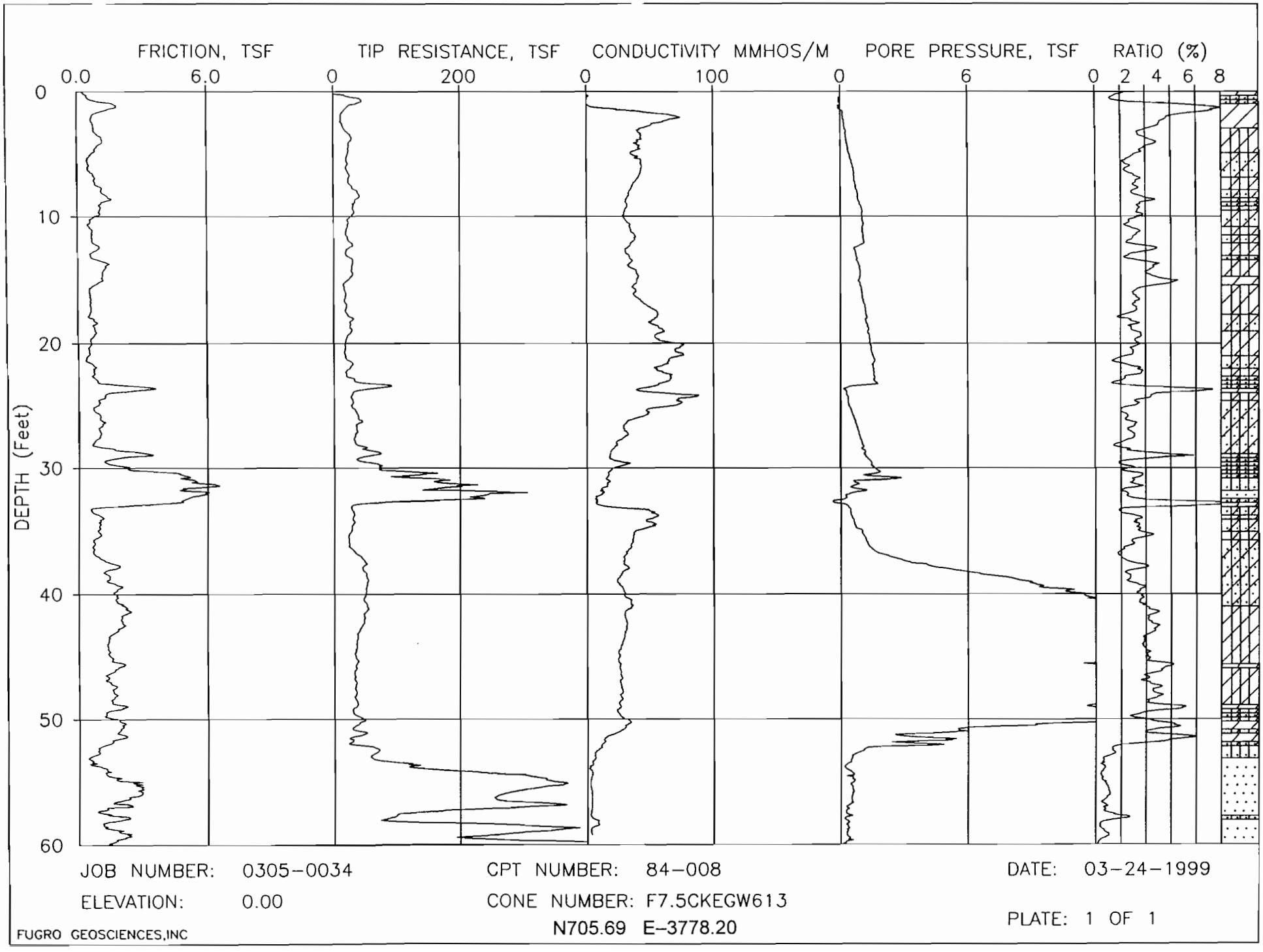
CONE NUMBER: F7.5CKEGW613

N643.12 E-4065.02

DATE: 03-24-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0034

ELEVATION: 0.00

CPT NUMBER: 84-008

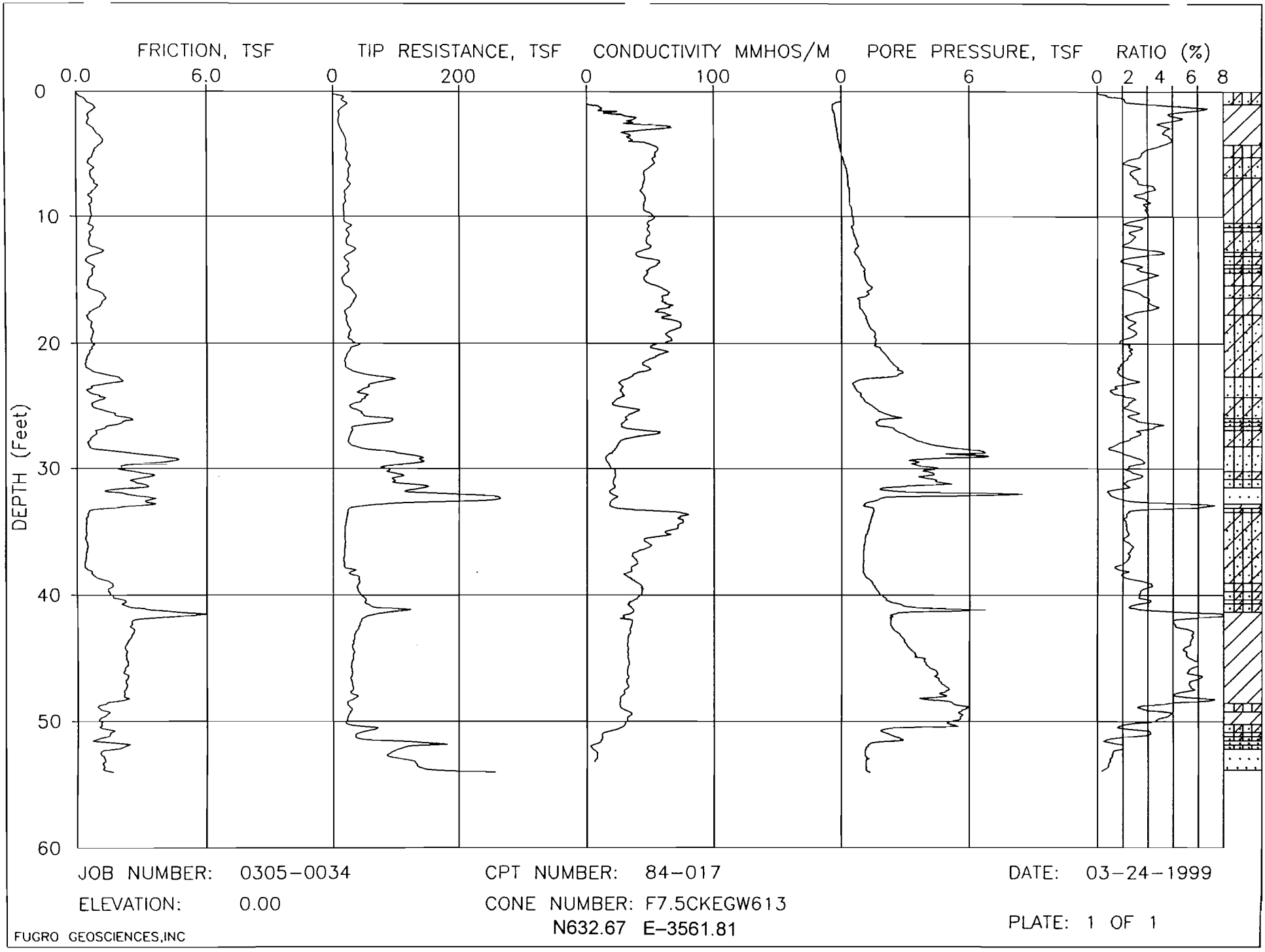
CONE NUMBER: F7.5CKEGW613

N705.69 E-3778.20

DATE: 03-24-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0034

ELEVATION: 0.00

CPT NUMBER: 84-017

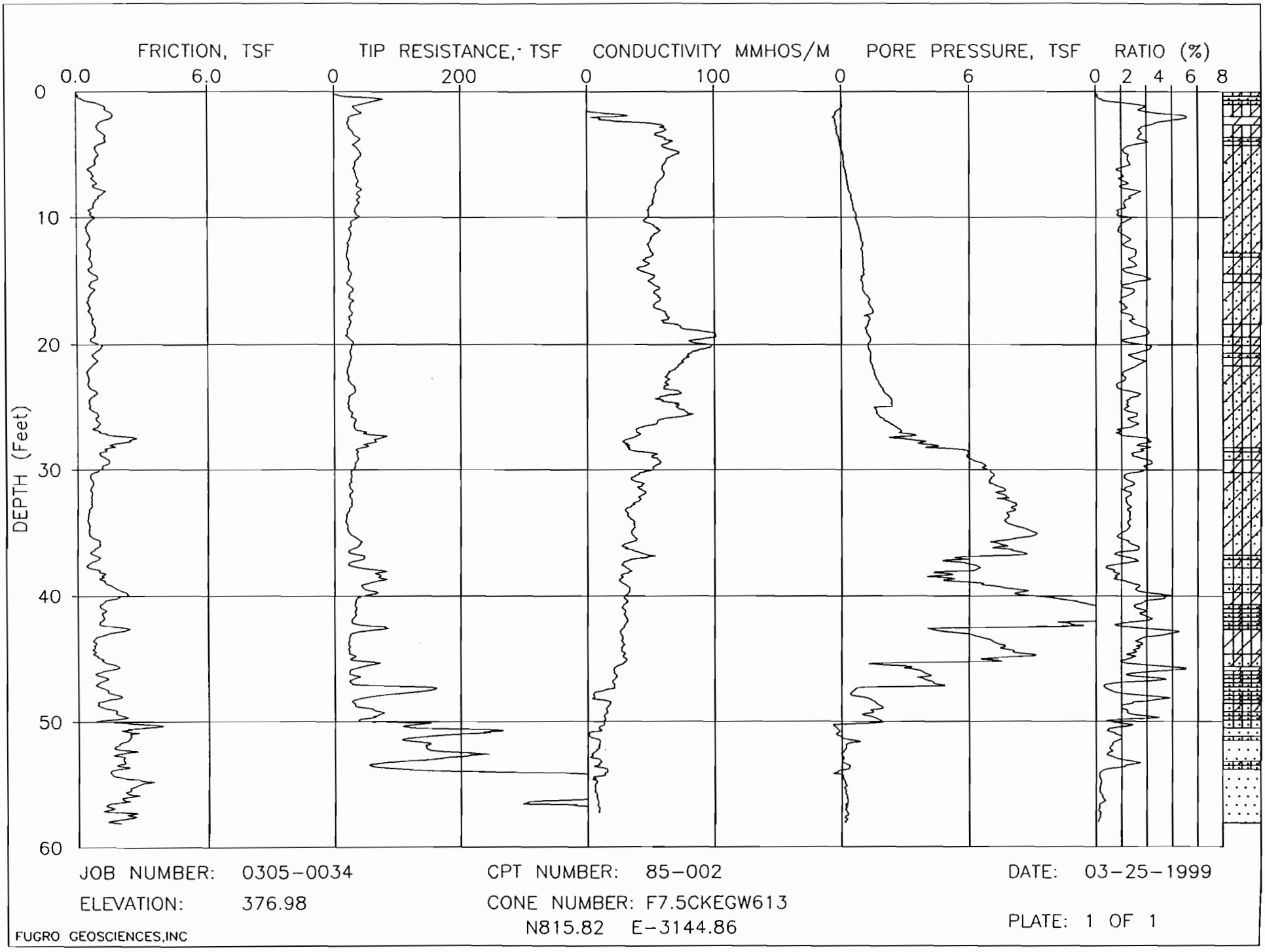
CONE NUMBER: F7.5CKEGW613

N632.67 E-3561.81

DATE: 03-24-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



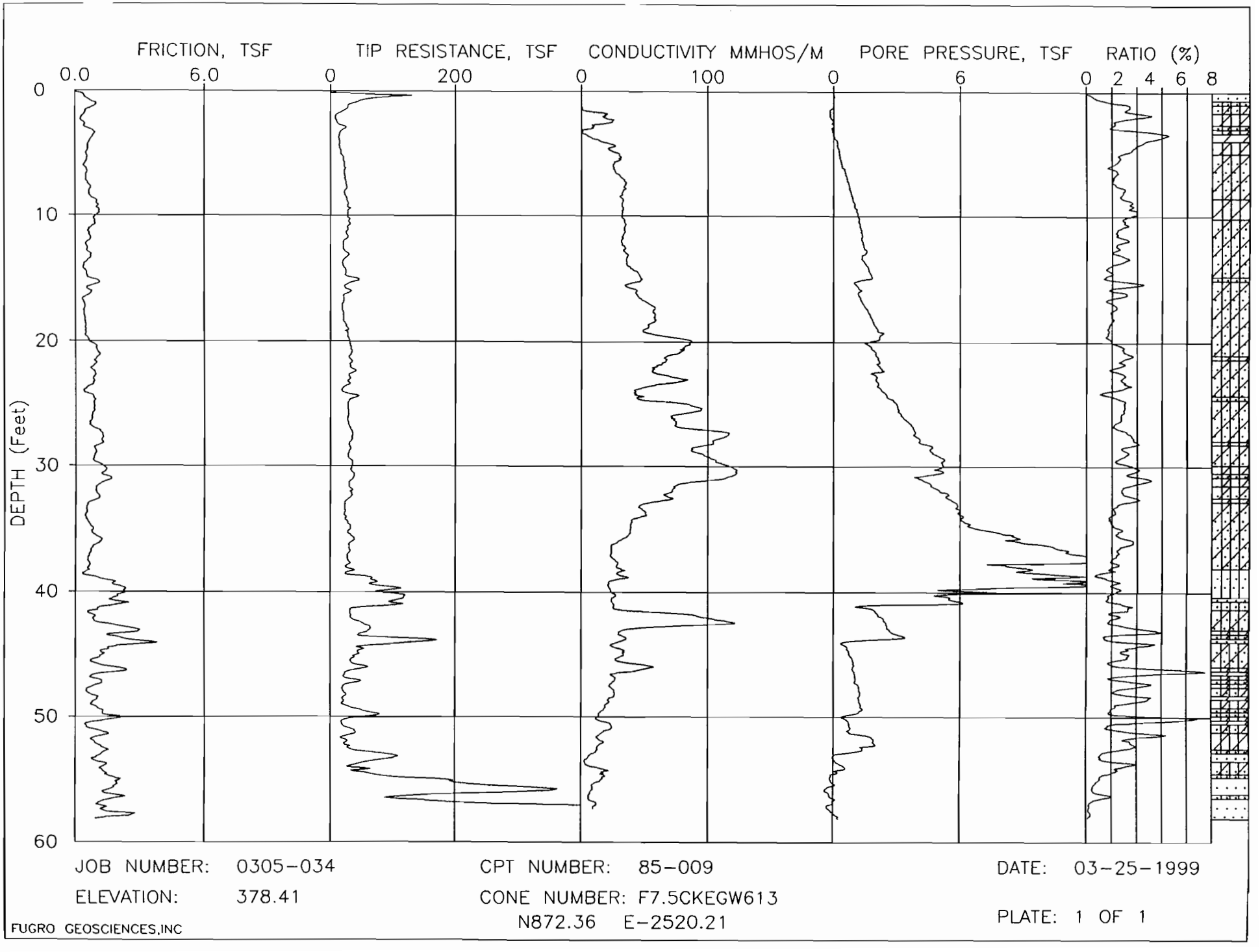
JOB NUMBER: 0305-0034
ELEVATION: 376.98

CPT NUMBER: 85-002
CONE NUMBER: F7.5CKEGW613
N815.82 E-3144.86

DATE: 03-25-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



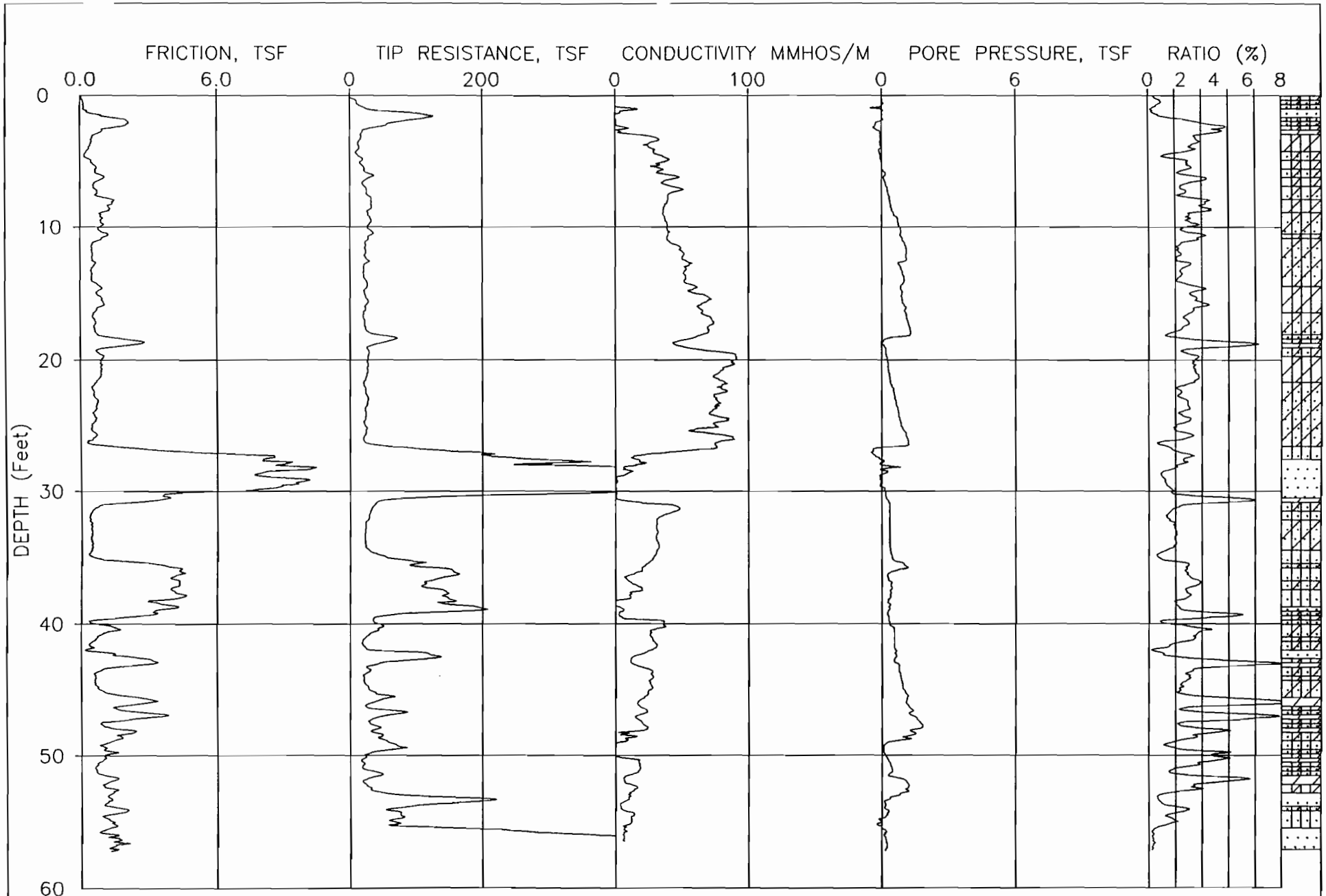
JOB NUMBER: 0305-034
ELEVATION: 378.41

CPT NUMBER: 85-009
CONE NUMBER: F7.5CKEGW613
N872.36 E-2520.21

DATE: 03-25-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0034

ELEVATION: 378.60

CPT NUMBER: 85-015

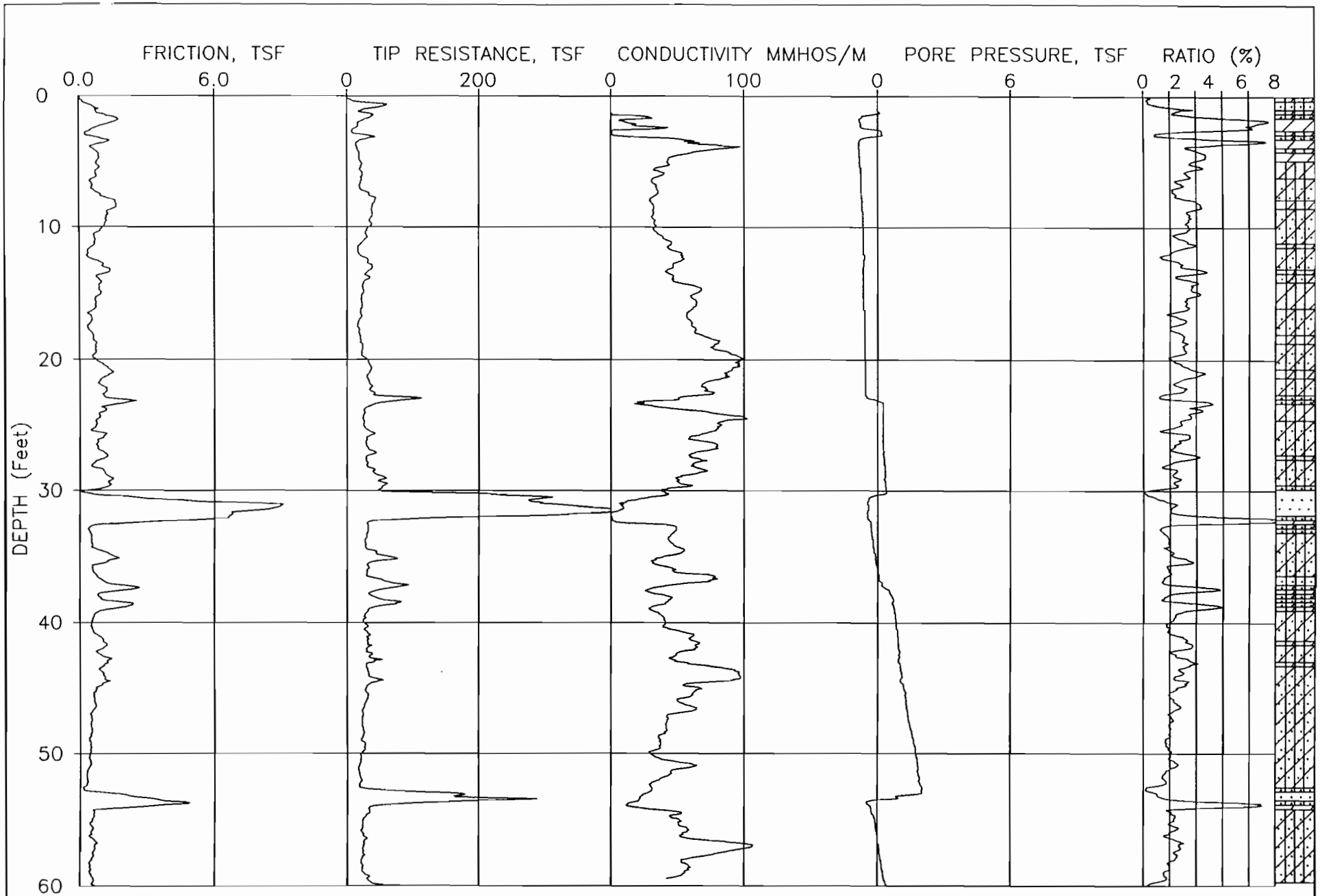
CONE NUMBER: F7.5CKEGW613

N827.27 E-2278.07

DATE: 03-25-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



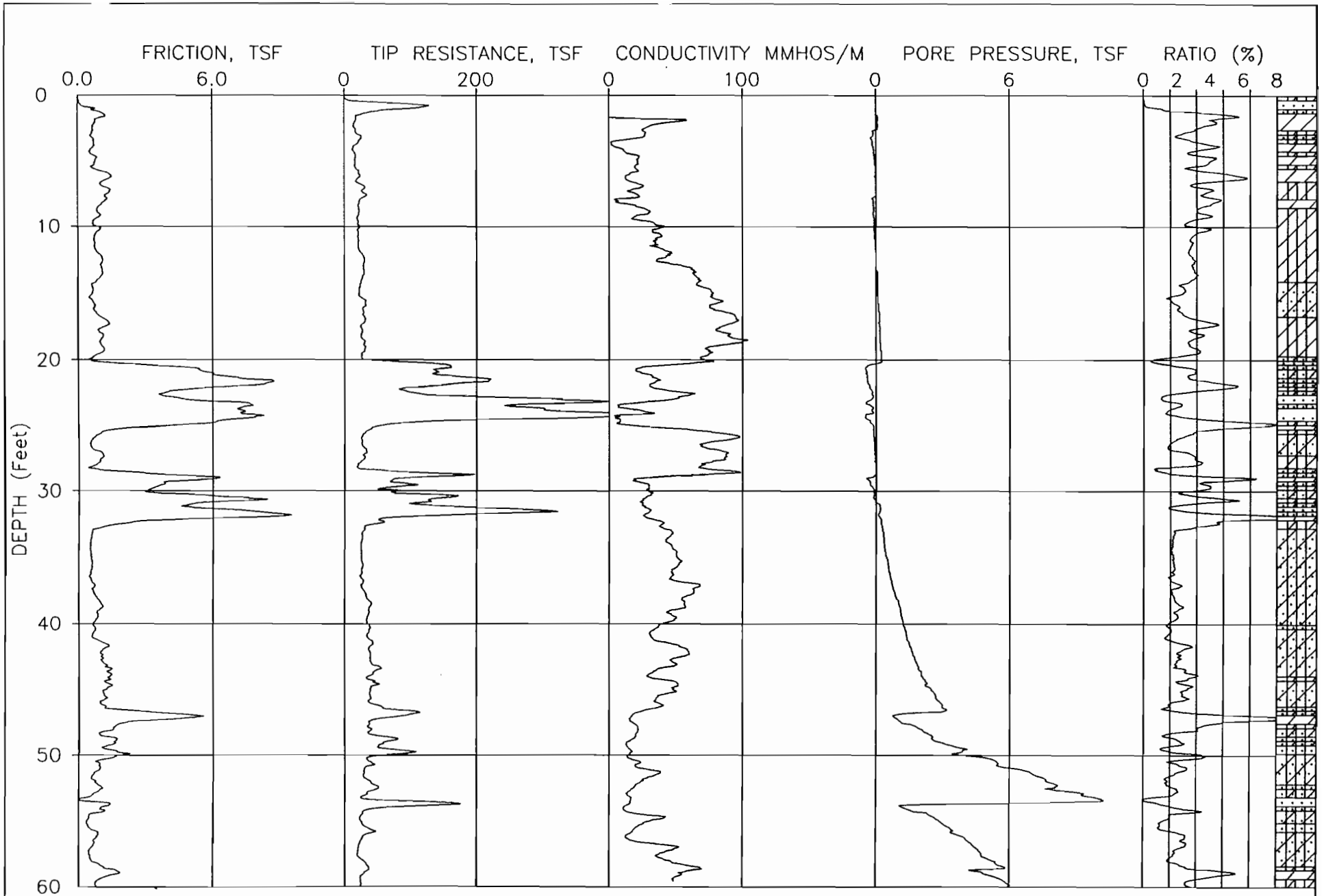
JOB NUMBER: 0305-0034
ELEVATION: 380.65

CPT NUMBER: 340-004
CONE NUMBER: F7.5CKEGW613
N-2809.43 E-1712.24

DATE: 03-26-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC



JOB NUMBER: 0305-0034
ELEVATION: 0.00

CPT NUMBER: 340-009
CONE NUMBER: F7.5CKEGW613
N-2811.06 E-1996.02

DATE: 03-25-1999

PLATE: 1 OF 1

FUGRO GEOSCIENCES,INC