FINAL

REMEDIAL INVESTIGATION REPORT

AIR FORCE PLANT 59

APRIL 1996

VOLUME I - TEXT

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This document presents the results of the Remedial Investigation (RI) of Air Force Plant 59 (AFP 59), Johnson City, New York. The RI was conducted to accomplish the following objectives: confirm, characterize, and define the lateral and vertical extent of contamination at the site; supplement and refine the existing geological, hydrogeological, and chemical databases at the site; evaluate the chemical migration pathways and specific parameters affecting groundwater movement that influence the migration of contaminants; evaluate potential risks and hazards to public health and the environment; and identify applicable or relevant and appropriate requirements (ARARs).

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PREFACE

This Remedial Investigation (RI) Report was written by The Earth Technology Corporation (EARTH TECH) to document field and laboratory operations conducted for the RI of Air Force Plant 59 (AFP 59), Johnson City, New York. Field work was conducted in two phases (first phase in Summer 1994, second phase in fall and winter 1994) according to guidelines set forth in the Air Force Center for Environmental Excellence (AFCEE) "Handbook for the Installation Restoration Program (IRP), Remedial Investigations and Feasibility Studies (RI/FS)," September 1993. All work was completed under AFCEE Contract Number F41624-94-D-8055, Delivery Order 0004. The objectives were as follows:

1. To confirm, characterize, and define the lateral and vertical extent of contamination at the site;

2. To supplement and refine the existing geological, hydrogeological, and chemical data base for the site;

3. To evaluate the chemical migration pathways and specific parameters affecting groundwater movement that influence the migration of contaminants;

4. To evaluate potential risks and hazards to public health and the environment; and

5. To identify applicable or relevant and appropriate requirements (ARARs).

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LIST OF ACRONYMS

AA	Atomic Absorption
AFCEE	Air Force Center for Environmental Excellence
AFP 59	Air Force Plant 59
ARAR	Applicable or Relevant and Appropriate Requirement
ASC	Aeronautical Systems Center
AST	Aboveground Storage Tank
ASTM	American Society for Testing Materials
BEHP	Bis(2-ethylhexyl)phthalate
bgs	Below Ground Surface
BNA	Base, Neutral, and Acid Extractables
CDC	Centers for Disease Control
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CNS	Central Nervous System
COC	Chain-of-Custody
CRAVE	Carcinogen Risk Assessment Verification Endeavor
1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethene
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DoD	Department of Defense
DPM	Defense Priority Model
DPW	Deep Production Well
DQO	Data Quality Objectives
EBS	Environmental Baseline Survey
EIS	Environmental Impact Statement
EMI	Electromagnetic Imaging
EP	Extraction Procedure
FS	Feasibility Study
ft^2/day	Square Feet per Day
GC	Gas Chromatograph
GC/MS	Gas Chromatography/Mass Spectrometry
GE	General Electric
gpd	Gallons per Day
gpm	Gallons per Minute
GPR	Ground Penetrating Radar
HARM	Hazard Assessment Rating Methodology

LIST OF ACRONYMS

Continued

HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HSA	Hollow-Stem Auger
I.D.	Inside Diameter
IARC	International Agency for Research on Cancer
IRIS	Integrated Risk Information System
ICP	Inductively Coupled Plasma
IDL	Instrument Detection Limit
IEUBK	Integrated Exposure Uptake Biokinetic
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IRPIMS	IRP Information Management System
ISCST2	Industrial Source Complex-Short Term
ITIR	Informal Technical Information Report
LCS	Laboratory Control Samples
LOAEL	Lowest-Observed-Adverse-Effect Level
μg/kg	Micrograms per Kilogram
μg/dL	Micrograms per Deciliter
μg/L	Micrograms per Liter
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MF	Modifying Factor
m^3/day	Cubic Meters per Day
mg/kg	Milligram per Kilogram
mg/L	Milligrams per Liter
mg/m^3	Milligrams per Cubic Meter
mgd	Million Gallons per Day
mL/L	Milliliters per Liter
mm Hg	Millimeter Mercury
MOU	Memorandum of Understanding
MS	Matrix Spike
MSL	Mean Sea Level
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Technology
NOAEL	No-Observed-Adverse-Effect Level
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit

LIST OF ACRONYMS

Continued

NYSDEC	New York State Department of Environmental Conservation
NYSEG	New York State Electric and Gas
PAH	Polycyclic Aromatic Hydrocarbons
Pb-B	Blood-lead
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
POC	Principal Organic Contaminant
ppm	Parts per Million
PQL	Practical Quantitation Limit
PVC	Polyvinyl Chloride
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
Rd	Retardation Factor
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
RPF	Relative Potency Factors
SAP	Sampling and Analysis Plan
SARA	Superfund Amendment and Reauthorization Act
SCG	Standards Criteria and Guidance
SDI	Subchronic Daily Intake
SSI	Supplemental Site Inspection
SVOC	Semivolatile Organic Compound
1,1,1-TCA	1,1,1-Trichloroethane
TAL	Target Analyte List
TBC	To Be Considered
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TOC	Total Organic Carbon
TSD	Treatment, Storage, and Disposal
UCL	Upper Confidence Limit
UF	Uncertainty Factors

LIST OF ACRONYMS

Continued

USAF	United States Air Force
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
UTL	Upper Tolerance Limit
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WBV	Well Bore Volume
WHO	World Health Organization

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EXECUTIVE SUMMARY

This document is the *Remedial Investigation (RI) Report* for Air Force Plant 59 (AFP 59) in Johnson City, New York. The RI was performed in order to accomplish the following objectives:

- To confirm, characterize, and define the lateral and vertical extent of contamination at the site;
- To supplement and refine the existing geological, hydrogeological, and chemical data base for the site;
- To evaluate the chemical migration pathways and specifics of groundwater movement that influence the migration of contaminants;
- To evaluate potential risks and hazards to public health and the environment; and
- To identify Federal, State, and local applicable or relevant and appropriate requirements (ARARs).

ES.1 Site Location and Description

AFP 59 is located in south-central New York in the Westover area of the Town of Union, Broome County, immediately west of Johnson City (mailing address); the site is about 3 miles west of the central business district of the City of Binghamton and about 4 miles east of the center of the Village of Endicott (Figure ES-1). The plant occupies 29.6 acres (including Parking Lot #5, located north of Main Street) and is situated in a highly urbanized area (Figure ES-2). Parking Lot #5 was classified as a Category 1 site during the environmental baseline survey (EBS) conducted by EARTH TECH (EARTH TECH, 1995a), meaning it is an area where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas). Consequently, Parking Lot #5 was not investigated during the RI.

AFP 59 is a government-owned, contractor-operated facility. Remington Rand, Inc., the first manufacturer to occupy the plant, manufactured aluminum aircraft propellers at the plant from 1942 to 1945. The plant closed at the end of World War II and remained idle until April 1949, when it was reopened as an aircraft controls manufacturing facility. General Electric (GE) Aerospace was contracted to operate the facility and to direct manufacturing (primarily of parts for electro-mechanical aircraft control systems). Martin Marietta Aircraft Controls acquired GE Aerospace in 1993 and took over the operation of the facility and the manufacturing activities.

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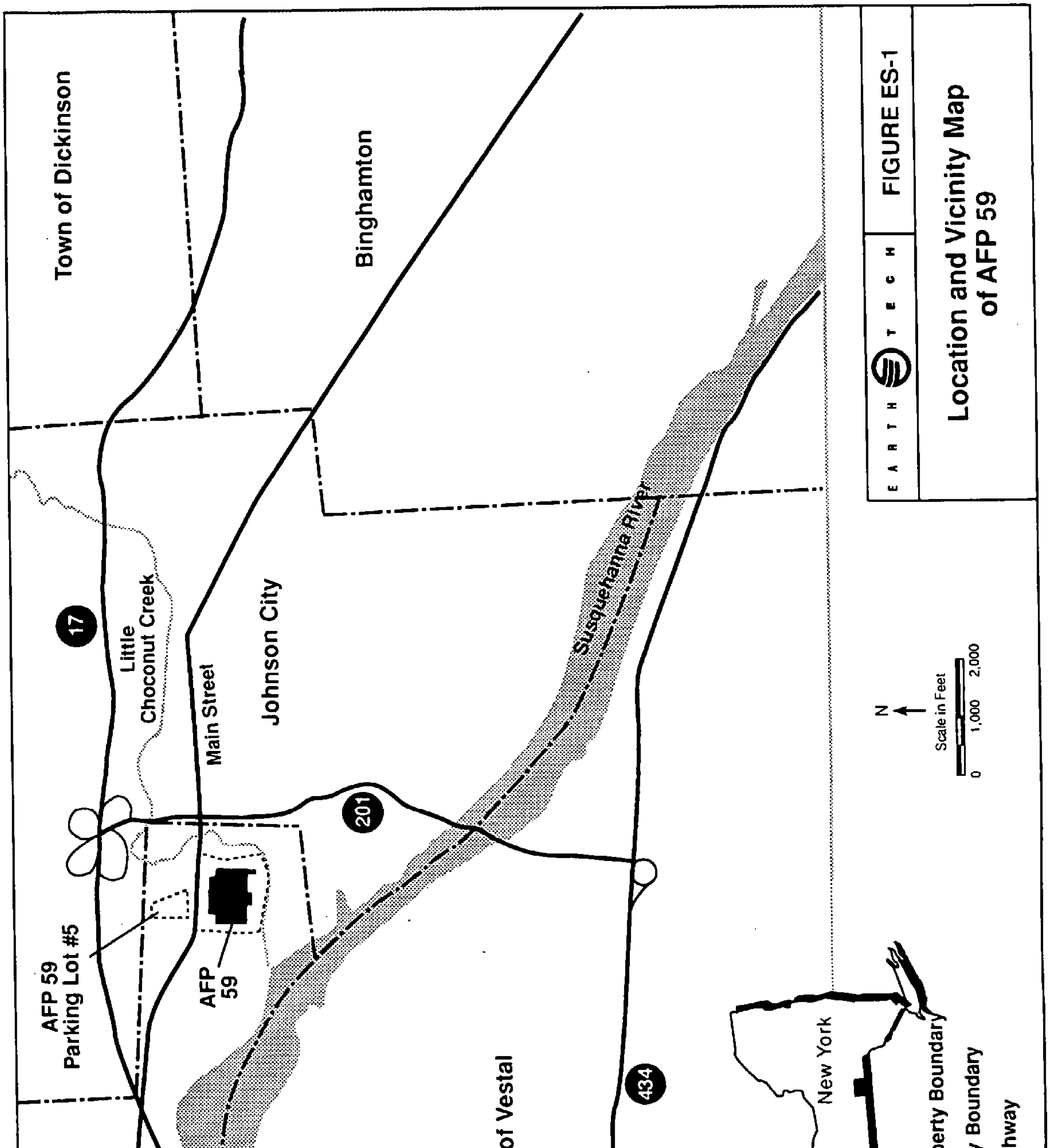

FIGURE ES-1

Location and Vicinity Map of AFP 59

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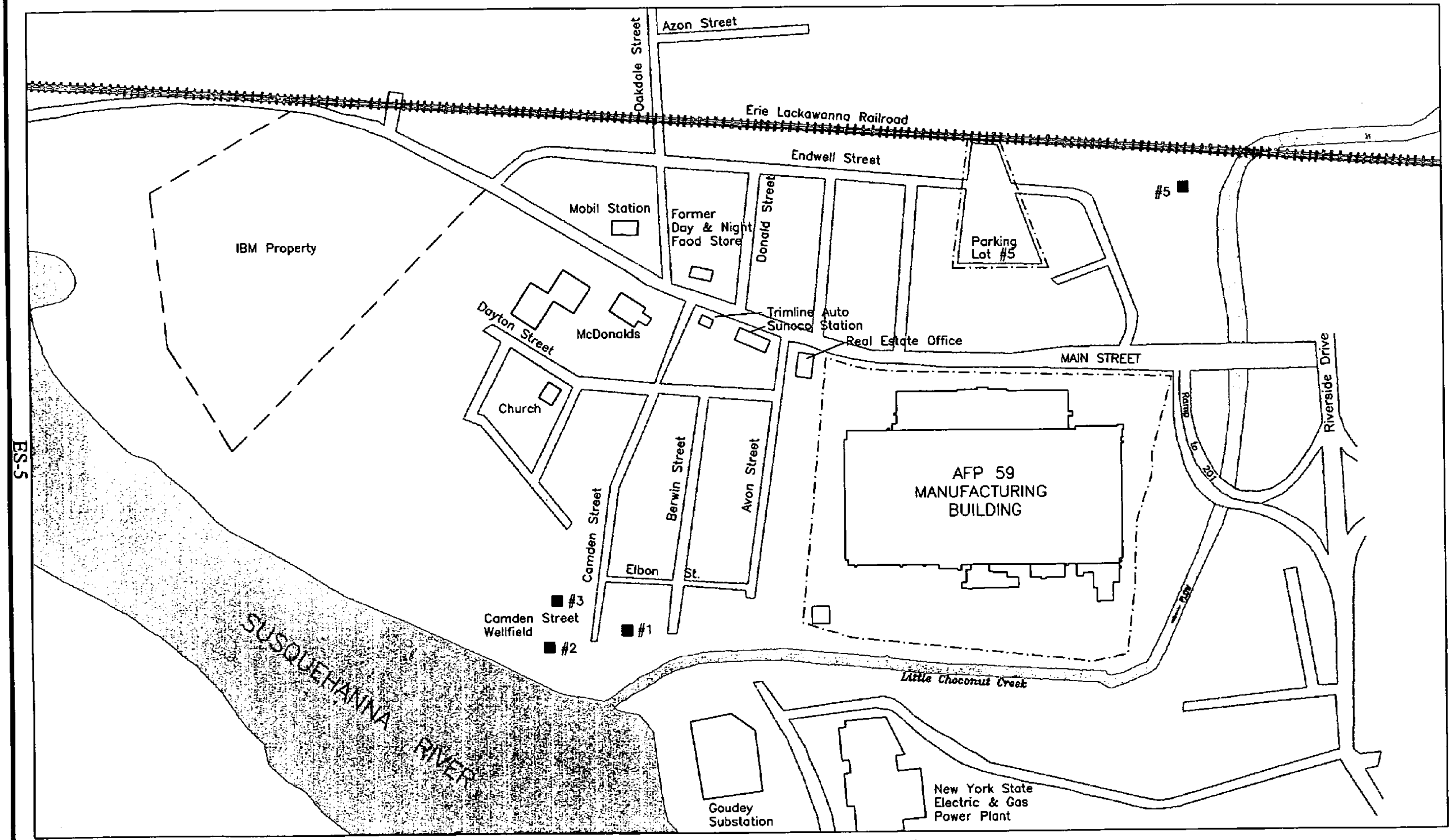

LEGEND

■ #1 – City Water Supply Well

—·—·— – AFP 59 Property Boundary

0 250 500

SCALE IN FEET

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FIGURE ES-2

LOCATION OF AFP 59 AND SURROUNDING LAND USE

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Lockheed Martin Control Systems currently manufactures flight control, laser, weapons control, internal navigation, and guidance systems at AFP 59.

Past and present activities at AFP 59 have generated a variety of waste products, including cutting, lubricating, and coolant oils; degreasing agents; plating acids, caustics, chromium, and cyanide solutions; and paint residues (United States Air Force [USAF], 1993b).

AFP 59 is listed as a Class 2 Site on the New York State Department of Environmental Conservation (NYSDEC) List of Inactive Hazardous Waste Disposal Sites (Site Code 7-04-020). A Class 2 Site is categorized as posing a "significant threat to the public health or environment." AFP 59 is not on the National Priorities List and is not under a Federal Facility Agreement.

Several Installation Restoration Program (IRP) sites and areas of concern have been identified at AFP 59 (see Figure ES-3) and investigated during the three previous IRP investigations, which include an IRP Phase I Records Search conducted by CH_2M Hill in 1984; a Phase II Stage I Confirmation/Quantification Study conducted by Fred C. Hart Associates, Inc., in 1988; and a Phase II Stage II Confirmation/Quantification Study conducted by Argonne National Laboratory in 1994. The potential source areas include the former underground waste oil storage tanks, the drum storage area, the plating operations building, the storage tank and settling pond, the former gasoline storage tank, the JP-4 piping area, and the abandoned oil/water separator.

Chlorinated hydrocarbons have been detected in the groundwater and soil at AFP 59 during the previous IRP investigations. Trichloroethene (TCE) was detected at a maximum concentration of 97 micrograms per liter (μg/L) in groundwater from well SW4 near the Plating Room, and 1,1,1-trichloroethane (1,1,1-TCA) was detected at a maximum concentration of 15.2 μg/L in groundwater from well SW9 near the southwestern corner of the property. Other chlorinated compounds detected in groundwater include 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), and tetrachloroethene. No semivolatile organic compounds (SVOCs), pesticides, or polychlorinated bipenyls (PCBs) were detected in groundwater samples. In addition, metals have been identified as exceeding background in both groundwater and soil samples at locations associated with some of the potential source areas.

Other than acetone and methylene chloride, the only volatile organic compounds (VOCs) detected in soil samples collected during the previous IRP investigations were TCE (maximum detection of 14 μg/L) and 1,1,1-TCA (maximum detection of 1 μg/L). Numerous SVOCs have been detected at many different soil sampling localities. Additionally, several metals have been identified as exceeding background in soil samples associated with some of the potential source areas.

Five additional soil investigations have been conducted at AFP 59 outside the IRP process related to the closure of the settling tank/storage pond and/or the Plating Room. These studies confirm the presence of VOCs and metals in the soil in the vicinity of the Plating Room.

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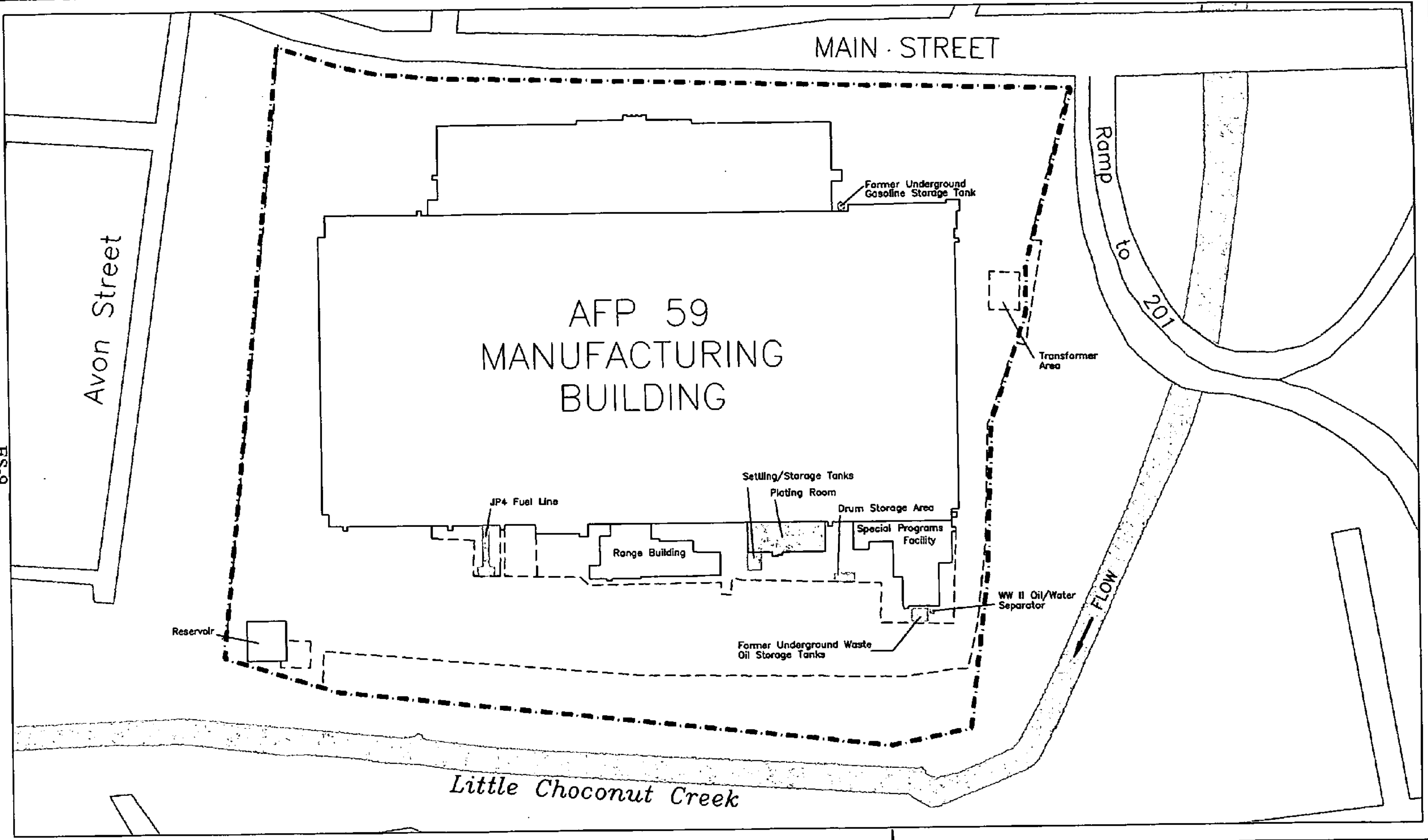

FIGURE ES-3

IRP SITES AND AREAS OF CONCERN

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At the Johnson City municipal wellfield (i.e., the Camden Street Wellfield), located approximately 1,000 feet southwest of AFP 59, 1,1,1-TCA has been detected in groundwater at concentrations exceeding the New York State drinking water standard. The aquifer has been designated a sole-source aquifer by the United States Environmental Protection Agency (USEPA) because it supplies drinking water to the area's 128,000 residents. The NYSDEC conducted a source investigation to determine potential sources of contamination, and an air stripper has been installed at the wellfield by Johnson City. The USAF has voluntarily entered into a Memorandum of Understanding (MOU) with Johnson City to provide partial financial support (subject to the availability of funds) for the operation of the air stripper. The MOU does not constitute a finding by the State of New York or Johnson City that AFP 59 is a source of the contamination (USAF, 1993b).

ES.2 Investigative Procedures and Time Sequence

Several types of investigative procedures were used during the RI to refine understanding of subsurface conditions, hydrogeology, and contaminant distribution in soils and the groundwater. The field investigation was conducted using a phased approach in order to efficiently characterize the site. The first phase of the investigation, a Reconnaissance Survey of AFP 59, was conducted between July 6 and July 17, 1994. The Reconnaissance Survey consisted of a geophysical clearance survey; soil and groundwater sampling; on-site analyses for screening; off-site analyses for site characterization; water level measurements in monitoring wells; and groundwater quality screening at selected monitoring wells.

A geophysical survey was conducted to locate subsurface utilities prior to sampling. Soil and groundwater samples were collected using a direct push sampling technique and analyzed at an on-site mobile laboratory for VOCs. A total of 33 groundwater and 56 soil samples were collected from 39 direct push locations for on-site analysis (see Figure ES-4). The screening data were used to locate potential source areas and delineate areas of contamination. Twenty-five soil samples were analyzed off-site for VOCs or metals at a fixed laboratory to provide data for site characterization, including definition of background. Twenty-six groundwater samples from on-site and off-site monitoring wells were also analyzed on-site during the first phase to obtain screening data on existing groundwater quality. Two of the 26 groundwater samples were split for off-site VOC analysis.

The data collected during the Reconnaissance Survey were analyzed to determine optimal locations to place monitoring wells and soil borings during the second phase of the investigation, which was initiated on October 17, 1994 and continued through December 9, 1994. The second phase of the investigation consisted of the installation of nine monitoring wells; soil and groundwater sampling; sediment and surface water sampling of Little Choconut Creek; and an aquifer test. Figure ES-5 shows locations sampled during the second phase of the investigation.

Four groundwater monitoring well clusters were installed during the second phase of the field program to define the extent of contamination, provide reproducible samples, and define the

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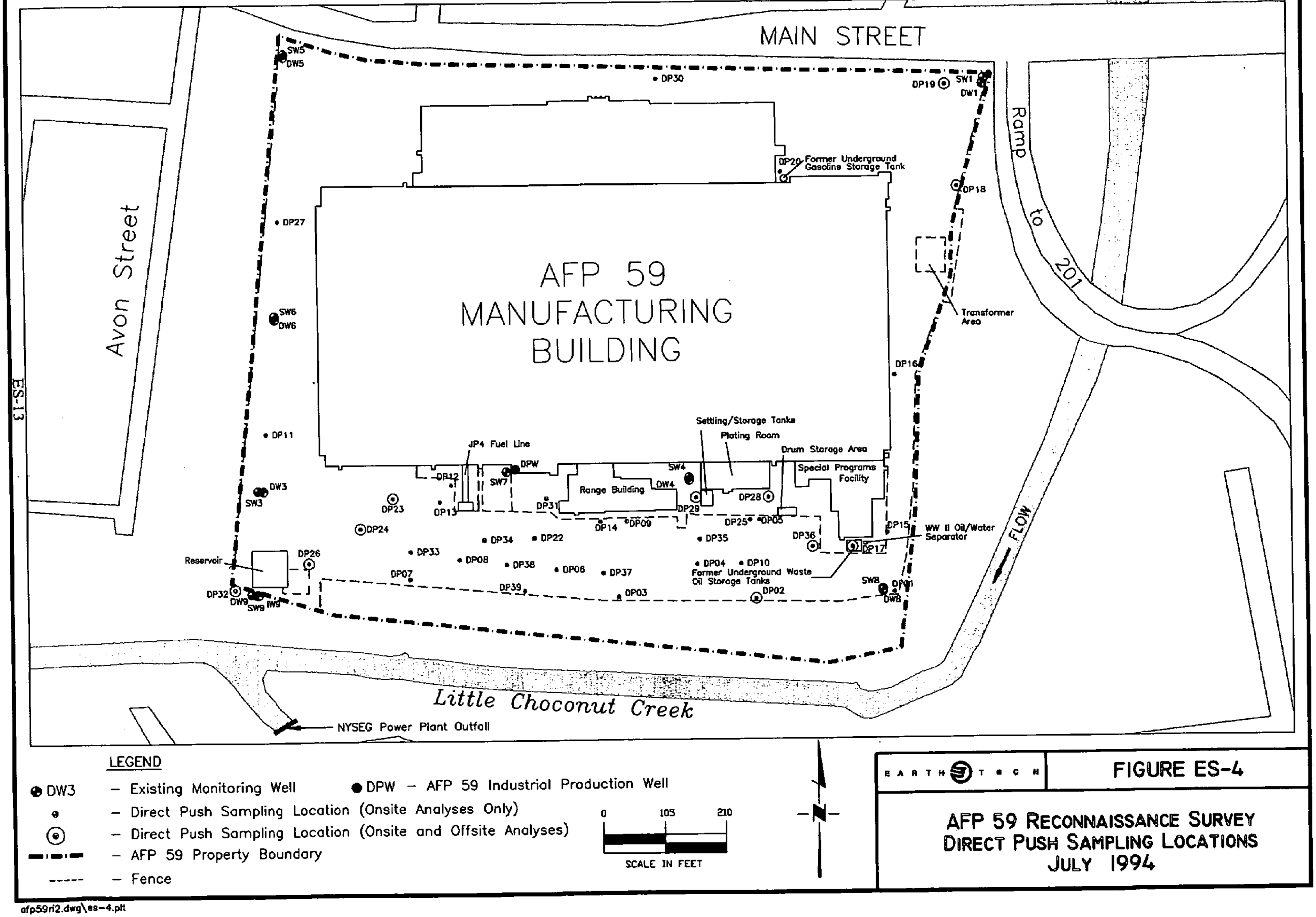
FIGURE ES-4

AFP 59 RECONNAISSANCE SURVEY
DIRECT PUSH SAMPLING LOCATIONS
JULY 1994



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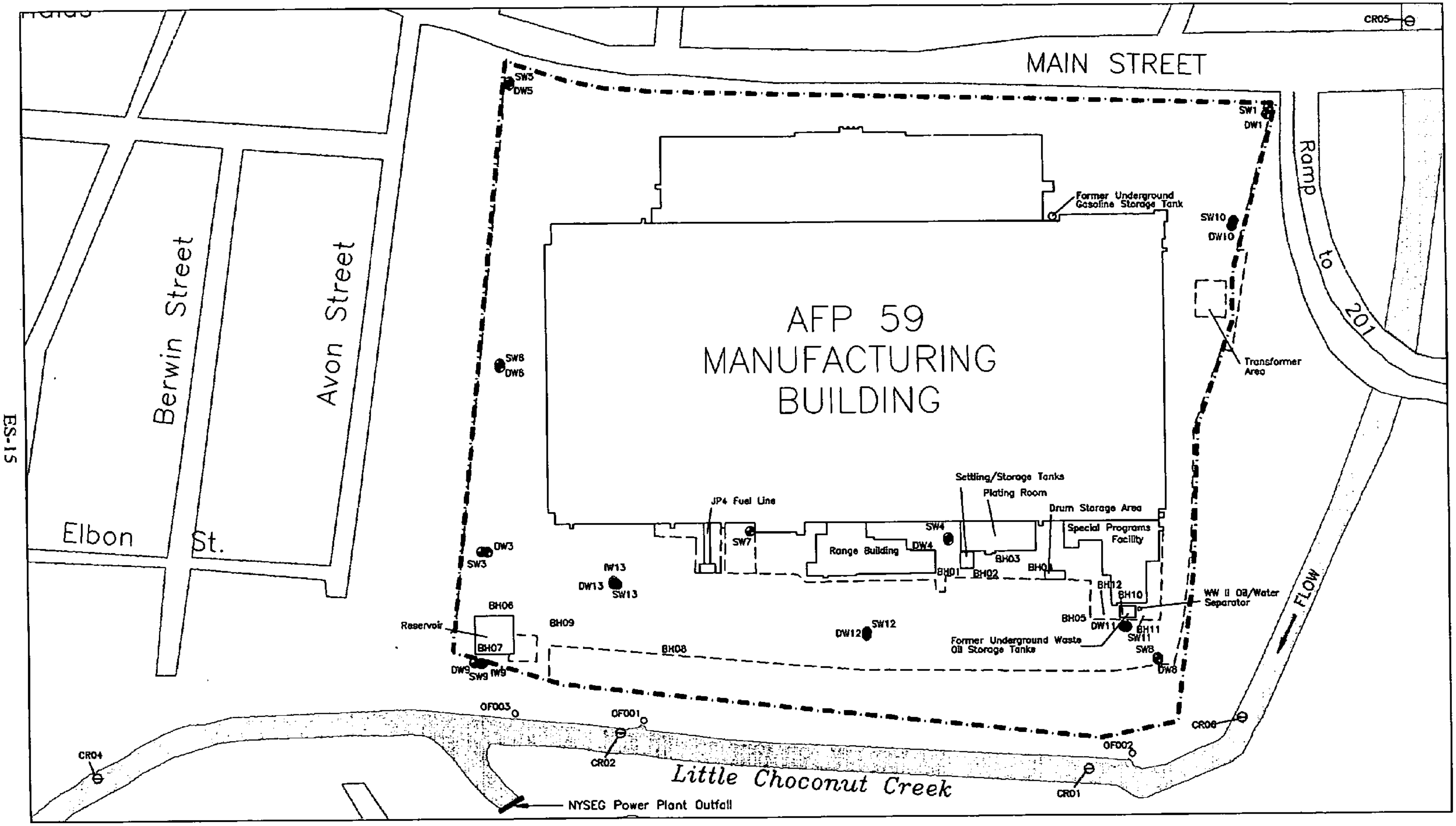

LEGEND

- ▬·▬·▬ – AFP 59 Property Boundary
- -------- – Fence
- ○ OF003 – AFP 59 Outfall
- ● DPW – AFP 59 Industrial Production Well
- ⊕ DW3 – Existing Monitoring Well
- ● DW12 – RI Monitoring Well
- ▲ BH8 – RI Soil Boring
- ⊖ CR04 – RI Surface Water/Sediment Sampling Location

0 115 230
SCALE IN FEET

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FIGURE ES-5

AFP 59 REMEDIAL INVESTIGATION SAMPLING LOCATIONS OCTOBER – DECEMBER 1994

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subsurface hydrogeology. Monitoring well clusters consisted of a shallow well screened across the water table and a deep well screened above the glacial till at the base of the aquifer. An intermediate well was installed at one cluster and screened immediately above the fine-grained glacial deposits that hydraulically separate the aquifer. In addition to the 9 monitoring wells, 12 soil borings were drilled and sampled to help define both the extent of contamination and the subsurface hydrogeology. Shallow and intermediate monitoring well boreholes and soil borings were drilled using hollow-stem auger (HSA) techniques, whereas deep monitoring well boreholes were drilled using both HSA and drive and wash techniques.

Groundwater samples were collected between November 28 and December 5, 1994 (the on-site production well was sampled on December 7, 1994 during the aquifer test) by bailing or using a combination of pumping and bailing. In total, 29 groundwater samples were collected during the second phase of the investigation, including 3 duplicate samples. The groundwater samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, and hardness.

Soil samples collected for chemical analysis were obtained at 5-foot intervals above the water table from the shallow monitoring well boreholes and the soil borings. A total of 53 soil samples (15 from monitoring well boreholes and 38 from soil borings) were collected, including 5 replicate samples. These samples were collected by driving split-spoon samplers lined with brass sleeves; the samples were sent to the laboratory in the brass sleeves for analysis. The soil samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, and total organic carbon (TOC). Soil samples collected to characterize the subsurface geology were obtained at varying intervals from the deep monitoring well boreholes by driving split-spoon samplers.

Sediment and surface water samples were collected from 5 locations in Little Choconut Creek to determine the impact of installation activities on the creek and to assess background conditions. Sediment samples were collected with a hand auger; surface water samples were collected by submerging laboratory sample bottles in the creek. Six sediment (including 1 replicate) and 6 surface water (including 1 duplicate) samples were collected. All samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, and cyanide. Additionally, sediment samples were analyzed for TOC, and surface water samples were analyzed for hardness.

An aquifer pumping test was conducted at the conclusion of the second phase of the field investigation between December 6 and December 8, 1994 by pumping the on-site deep production well. The pumping test continued for 24 hours and was followed by a recovery test of approximately 20 hours. Groundwater level measurements were obtained before, during, and after the pumping test from all on-site and several off-site wells. Groundwater level data were collected either through the use of dataloggers and pressure transducers or manually using an electric water level meter. The groundwater level data were used to calculate hydraulic properties of the aquifer, to determine the degree of interconnection between the upper and lower zones of the aquifer, and to generate potentiometric maps to determine groundwater flow directions. Water levels were also measured in Little Choconut Creek during the course of the pumping test using a Bubbler Portable Flow Meter. This information was used to determine the impact of pumping on the creek.

As part of the RI, a fish and wildlife impact analysis for AFP 59 and the surrounding area was performed through Step IIB (Criteria-Specific Analysis) under the guidance of the NYSDEC Division of Fish and Wildlife.

Table ES-1 provides a summary of activities conducted during both phases of the field investigation. Table ES-2 lists the total number of soil and groundwater samples collected during both phases of the field investigation. Table ES-3 lists the analytical methods used for all samples collected during both phases of the field investigation.

ES.3 Baseline Human Health Risk Assessment

A baseline human health risk assessment was conducted for the AFP 59 site to determine risks posed by the site under baseline conditions (without remediation) and the need for remediation. A summary of the baseline risk assessment follows. Several references provided guidance; they include:

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final.* United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., December 1989 (USEPA, 1989a).

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors, Interim Final.* United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., March 1991 (USEPA, 1991).

- *Guidance for Data Useability in Risk Assessment (Part A), Final.* United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., April 1992 (USEPA, 1992d).

- *Handbook for the Installation Restoration Program (IRP), Remedial Investigations and Feasibility Studies (RI/FS).* Air Force Center for Environmental Excellence, September 1993 (USAF, 1993a).

Risk assessment in toxicology is a process that combines exposure, dose-response, and relevant mechanistic data to produce a quantitative estimate of cancer or other adverse outcomes from a chemical exposure. Because of the numerous uncertainties associated with risk assessment, it is important that they be noted before reading the *RI Report* and the risk assessment. In many instances where risk estimates have been projected, the true value is somewhere between zero the projected upper bounds of risk.

Soil, groundwater, and surface water analytical data collected and validated by EARTH TECH during RI field activities were used for the risk assessment. In addition, soil analytical data collected by Martin Marietta in the vicinity of the Plating Room between July 1992 and December

TABLE ES-1
AFP 59 RI SUMMARY OF FIELD ACTIVITIES

Environmental Media	Field Activities	
	Reconnaissance Survey - Phase I	Phase II
Groundwater	Collected 33 groundwater samples using direct push sampling techniques for on-site VOC analysis.	Drilled and installed 4 monitoring well clusters with 1 deep and 1 shallow well each; at one well cluster an intermediate well was also installed.
	Collected groundwater samples from select existing monitoring wells and screened for VOCs (on-site analysis).	Collected groundwater samples from all new and existing monitoring wells; analyzed these for VOCs, SVOCs, pesticides/PCBs, inorganics, and hardness.
	Obtained a synoptic round of water level measurements.	Obtained a synoptic round of water level measurements. Conducted an aquifer pumping/recovery test.
Soil	Collected 56 soil samples using direct push sampling techniques from 32 locations for on-site VOC analysis.	Collected 3 to 4 soil samples from each shallow monitoring well and soil boring location; analyzed these for VOCs, SVOCs, pesticides/PCBs, inorganics, and TOC.
	Analyzed select soil samples from the direct push sampling at an off-site laboratory for metals and/or VOCs.	
Surface Water	None.	Collected surface water samples from 5 locations in Little Choconut Creek; analyzed these for VOCs, SVOCs, pesticides/PCBs, inorganics, and hardness.
Sediment	None.	Collected sediment samples from 5 locations in Little Choconut Creek; analyzed these for VOCs, SVOCs, pesticides/PCBs, inorganics, and TOC.

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TABLE ES-2
AFP 59 RI SAMPLE SUMMARY

Type of Sample	Number Collected
Direct push soil samples: on-site analysis	56
Direct push soil samples: off-site analysis	25
Groundwater samples: on-site analysis	59
Groundwater samples: off-site analysis	29
Hollow-stem auger soil boring soil samples: off-site analysis	38
Hollow-stem auger monitoring well soil samples: off-site analysis	15
Surface water samples: off-site analysis	6
Sediment samples: off-site analysis	6

Note: The numbers of samples collected include field replicates/duplicates.

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TABLE ES-3
SUMMARY OF SAMPLE ANALYSES

Analytical Method	Environmental Samples		Trip Blanks	Ambient Conditions Blanks	Equipment Blanks	Replicate/ Duplicate Samples	Total Analyses
	Phase I	Phase II					
SOIL ANALYSES							
SW8260 Volatile Organics	15	48	11	1	12	6	93
SW8270 Semivolatile Organics	0	48	---	---	8	5	61
SW8080 Pesticides/PCBs	0	48	---	---	8	5	61
SW6010, 7060, 7421, 7471, 7740, 7841 Metals	8	48	---	---	10	6	72
SW9012 Cyanide	0	48	---	---	7	5	60
SW9060 TOC	0	48	---	---	---	5	53
GROUNDWATER ANALYSES							
SW8260 Volatile Organics	2	26	8	1	8	3	48
SW8270 Semivolatile Organics	0	26	---	---	8	3	37
SW8080 Pesticides/PCBs	0	25	---	---	8	3	36
SW6010, 7060, 7421, 7470, 7740, 7841 Metals	0	26	---	---	8	3	37
SW9012 Cyanide	0	26	---	---	8	3	37
E130.1 Hardness	0	25	---	---	6	3	34
SEDIMENT ANALYSES							
SW8260 Volatile Organics	0	5	3(1)	1(2)	1	1	11

TABLE ES-3
SUMMARY OF SAMPLE ANALYSES

Continued

Analytical Method	Environmental Samples		Trip Blanks	Ambient Conditions Blanks	Equipment Blanks	Replicate/ Duplicate Samples	Total Analyses
	Phase I	Phase II					
SW8270 Semivolatile Organics	0	5	---	---	1	1	7
SW8080 Pesticides/PCBs	0	5	---	---	1	1	7
SW6010, 7060, 7421, 7471, 7740, 7841 Metals	0	5	---	---	1	1	7
SW9010 Cyanide	0	5	---	---	1	1	7
SW9060 TOC	0	5	---	---	---	1	6
SURFACE WATER							
SW8260 Volatile Organics	0	5	3[1]	1[2]	0[3]	1	10
SW8270 Semivolatile Organics	0	5	--	--	0	1	6
SW8080 Pesticides/PCBs	0	5	--	--	0	1	6
SW6010, 7060, 7421, 7470, 7740, 7841 Metals	0	5	--	--	0	1	6
SW9010 Cyanide	0	5	--	--	0	1	6
E130.1 Hardness	0	5	--	--	0	1	6

[1] Surface water and sediment VOC samples were shipped with soil VOC samples; therefore, the trip blanks associated with the surface water and sediment samples are also included in the total for the soil trip blanks.

[2] One ambient conditions blank was collected during sediment/surface water sampling.

[3] No equipment blanks were necessary during surface water sampling because none of the sampling equipment used required decontamination.

1994 and data collected by Argonne National Laboratory from two locations (DW1 and SW5) in November 1991 were used. Chemicals of potential concern were selected for soil, groundwater, surface water, and air. All organic analytes detected in soil, groundwater, and surface water were retained as chemicals of potential concern. All organic analytes in the 0- to 12-foot soil interval with a vapor pressure greater than 1 millimeter mercury (mmHg) at standard temperature and pressure were assumed to have volatile emission potential; these analytes were retained as volatile chemicals of concern in air.

For inorganic analytes in soil, groundwater, and surface water, a statistical comparison of site inorganic concentrations to background data was conducted. For inorganics in groundwater, site and background total metal concentrations were compared. The distribution of each analytical data set was determined using the Shapiro-Wilk test. For data sets with four or more analytical results, the Student's t test or the Wilcoxon Rank Sum test were used to statistically identify site inorganic concentrations that exceeded background concentrations. For data sets with less than four analytical results, the site and background maximum concentrations were compared to identify site inorganic concentrations that exceeded background concentrations. A qualitative comparison of site detections to background detection limits was performed for analytes that were detected in site samples but not in background samples.

Current and future human receptors were identified who could contact contaminated media at or migrating from AFP 59. The following specific receptors were identified:

- Current recreational users who wade and fish in Little Choconut Creek;
- Current on-site industrial workers at the Waste Oil Tank Area;
- Future on-site industrial workers;
- Future on-site construction workers; and
- Future off-site 30-year residents.

All potential exposure pathways were evaluated; complete exposure pathways were identified. The following complete exposure pathways were identified for evaluation of receptor intake:

- Dermal absorption of chemicals in surface water by current recreational users of Little Choconut Creek;

- Ingestion of contaminated fish by current recreational users of Little Choconut Creek;

- Inhalation of VOCs by current on-site industrial workers at the Waste Oil Tank Area;

- Incidental ingestion of chemicals in soil by future industrial or construction workers;

- Dermal absorption of chemicals in soil by future on-site industrial workers or on-site construction workers;

- Inhalation of contaminated, fugitive dust by future on-site industrial workers, on-site construction workers, and off-site 30-year residents;

- Inhalation of VOCs by future on-site industrial workers, on-site construction workers, or off-site 30-year residents;

- Ingestion of chemicals in drinking water by future on-site industrial workers or off-site 30-year residents;

- Inhalation of VOCs while showering by future off-site 30-year residents; and

- Dermal absorption of chemicals in shower water by future off-site 30-year residents.

Although current groundwater exposure pathways for off-site residents are considered complete, intake cannot be evaluated for the following reasons:

- Validated samples have not been collected from groundwater supplied by the Camden Street Wellfield;

- Groundwater is already being remediated through use of an air stripper; and

- The contribution of contaminants migrating from AFP 59 to the Camden Street Wellfield cannot be determined.

Receptor intake was calculated for all identified complete pathways, except for the groundwater exposure pathways for current off-site residents as explained above. The arithmetic mean and 95 percent upper confidence limit (UCL) of the arithmetic mean were calculated as exposure point concentrations for chemicals of potential concern in soil, surface water, and air. For groundwater pathways, mean and 95 percent UCL exposure point concentrations were calculated for pesticides and inorganics. For VOC and SVOC exposure point concentrations, maximum on-site groundwater concentrations in the shallow zone and deep zone were modeled separately to the Camden Street Wellfield using the Solute Model. Model results give the arrival time for migration from AFP 59 to the wellfield and maximum future chemical concentrations at the wellfield. A thorough description of the modeling effort is provided in Section 3.4.2.2.3.

Future dust and airborne VOC exposure point concentrations were calculated through the use of air emission and dispersion models. VOC emission rates were calculated using the Shen Model and the Hwang-Falco Model. The Shen Model was used for bulk samples where the contaminant concentration was greater than saturation, and the Hwang-Falco Model was used for bulk samples where the contaminant concentration was less than saturation. Fugitive dust emission rates were calculated using the USEPA "unlimited reservoir" fugitive dust model. For excavation scenarios, emissions were calculated from release of pollutants to the atmosphere when excavated soil is dumped onto a storage pile, from contaminated soil present in the excavation pit, and from contaminated soil in the storage pile. Excavation/dumping emissions were calculated using a pore space gas model. Diffusion emissions were calculated using a modified RTI Land Treatment model. The latest USEPA Air/Superfund Guidance document on estimating air impacts for the excavation of contaminated soil was used as the basis for these estimates. Both arithmetic mean and 95 percent UCL emission rates were calculated for each chemical of concern for each site. For excavation scenarios, ambient air contaminant concentrations were calculated by applying dilution factors calculated with the Industrial Source Complex-Short Term (ISCST2) model. For non-excavation scenarios, the SCREEN2 model was used. Concentrations were calculated for human receptors likely to receive significant exposure for both current and future scenarios.

Receptor intake estimates (i.e., exposure estimates) were calculated using receptor exposure point concentrations and USEPA acceptable intake models (i.e., formulas). USEPA standard default exposure factors were used where applicable. Reasonable assumptions were made to quantify site-specific exposure factors.

For the toxicity assessment, slope factors and reference doses (RfDs) were obtained from the USEPA's *Integrated Risk Information System (IRIS)* as a primary source (USEPA, 1995). If a slope factor or RfD was not available from IRIS, the *Health Effects Assessment Summary Tables (HEAST)* (USEPA, 1994c) were used as a secondary source. For chemicals that lacked an inhalation slope factor or RfD, the corresponding oral slope factor or RfD (if available) was applied. For some chemicals, no information was available in IRIS or HEAST, but a footnote in HEAST directed users to contact the Support Health Risk Technical Support Center. The Support Center issued provisional oral and/or inhalation slope factors and RfDs for some chemicals. If no provisional data were available and the data for appropriate surrogate compounds could not be located, ND (indicating "no data") was entered in the tables.

The use of mathematical models to extrapolate from high animal dose data to estimate human risk at low dose levels remains controversial. The most significant assumption in these models is that there is no threshold for carcinogenic and mutagenic effects. A second major constraint is a dose-response curve that assumes a specific shape at the lowest end of the response scale. Scientific debate continues about that low dose extrapolation model best fits the available experimental data. Another critical assumption is that when a chemical reaches a given target or site, the mechanism of action will be the same in both species. To date, no single mathematical model has described all the biological mechanisms involved in carcinogenesis.

Exposure intake values and toxicity values for chemicals of potential concern were integrated to obtain receptor risk estimates. In the case of lead exposure, a blood-lead concentration for future off-site resident children was estimated using the USEPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children (Version 0.99d).

In accordance with 40 Code of Federal Regulations (CFR) 300.430 (United States CFR, 1991), carcinogenic risk within the benchmark range of 10^{-4} (1 cancer case in 10,000) to 10^{-6} (1 cancer case in 1,000,000) is considered acceptable. The CFR states the following (United States CFR, 1991): "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6} using information on the relationship between dose and response. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure."

Table ES-4 presents a summary of the total human receptor cancer risk (i.e., risk exceeding 10^{-6}). The table shows that the total reasonable maximum case risk values exceed 10^{-6} risk as a benchmark for the following receptors (i.e., receptors are at potential risk):

- Current recreational users of Little Choconut Creek;
- Future off-site 30-year residents; and
- Future on-site industrial workers.

Reasonable maximum case risk for recreational users is 4×10^{-5}. Ingestion of contaminated fish drove total receptor risk. Chemicals driving risk for the fish ingestion pathway may not have migrated solely from AFP 59, but may have migrated from upstream locations. Consequently, risk was calculated for chemicals in the upstream, background samples. The chemicals that drive receptor risk were used to calculate background risk. Background risk (i.e., 1×10^{-5}) exceeded acceptable risk. Arsenic risk contributed 100 percent of background risk. If the arsenic risk of 1×10^{-5} is subtracted from site risk, the risk of 3×10^{-5} contributed by AFP 59 is still unacceptable. Exposure to bis(2-ethylhexyl)phthalate (BEHP) and p,p'-DDD drove site risk. These chemicals were only detected at CR04, which is located downstream of the New York State Electric and Gas (NYSEG) power plant outfall as well as the AFP 59 outfalls. The chemicals were not detected in samples collected immediately downstream of the AFP 59 outfalls or in background samples and, therefore, may have migrated from the NYSEG outfall and not AFP 59.

Table ES-4 provides the following additional risk information:

- For future off-site 30-year residents, the following groundwater pathways contributed to unacceptable risk:
    - Dermal absorption of beryllium, p,p'-DDE, TCE, and vinyl chloride in shower water.
    - Ingestion of 1,1-dichloroethene, beryllium, TCE, and vinyl chloride in drinking water.

TABLE ES-4
TOTAL HUMAN RECEPTOR CANCER RISK

Receptor	Total Cancer Risk Range			Factors Contributing to Risk > 1E-06		
	Average Case	Reasonable Maximum Case	Receptor at Risk (> 1E-06)	Pathway Contributing to Risk	Pathway Reasonable Maximum Case Risk	Chemical Contributing to Pathway Risk
CURRENT LAND USE						
Recreational Users of Little Choconut Creek	7E-05	4E-05	Yes	Ingestion of Contaminated Fish (from Little Choconut Creek)	4E-05	Arsenic bis(2-Ethylhexyl)phthalate p,p'-DDD
Recreational Users of Little Choconut Creek Background	1E-05	1E-05	Yes	Ingestion of Contaminated Fish (from Background for Little Choconut Creek)	1E-05	Arsenic
On-site Industrial Workers Impacted by the Waste Oil Tank Area	1E-08	1E-08	No	NA	NA	NA
FUTURE LAND USE						
Off-site 30-Year Residents	4E-05	2E-03(1)	Yes	Dermal Absorption of Chemicals in Shower Water	3E-05	Beryllium p,p'-DDE Trichloroethylene Vinyl Chloride
				Ingestion of Chemicals in Drinking Water	1E-04	1,1-Dichloroethene Beryllium Trichloroethylene Vinyl Chloride
				Inhalation of VOCs While Showering	2E-03	1,1-Dichloroethene Bromodichloromethane Carbon Tetrachloride Chloroform Methylene Chloride Trichloroethylene Vinyl Chloride

TABLE ES-4
TOTAL HUMAN RECEPTOR CANCER RISK

Continued

Receptor	Total Cancer Risk Range			Factors Contributing to Risk > 1E-06		
	Average Case	Reasonable Maximum Case	Receptor at Risk (> 1E-06)	Pathway Contributing to Risk	Pathway Reasonable Maximum Case Risk	Chemical Contributing to Pathway Risk
FUTURE LAND USE (CONTINUED)						
On-site Industrial Workers	3E-05	9E-05[1]	Yes	Plating Room - Dermal Absorption of Chemicals in Surface Soil	3E-05	Beryllium
				Ingestion of Chemicals in Drinking Water	6E-05	1,1-Dichloroethene Beryllium Trichloroethylene Vinyl Chloride
On-site Construction Workers Impacted by the Plating Room	2E-07	2E-07	No	NA	NA	NA
On-site Construction Workers Impacted by the Reservoir	2E-07	2E-07	No	NA	NA	NA
On-site Construction Workers Impacted by the Waste Oil Tanks	1E-06	8E-07	No	NA	NA	NA
On-site Construction Workers [2] Impacted by All Source Areas	1E-06	1E-06	No	NA	NA	NA

Key: NA = Not Applicable

[1] In calculating the reasonable maximum case risk, the shallow and deep groundwater pathway risks were combined by selecting the highest shallow or deep zone risk for each analyte.

[2] The same on-site construction workers were assumed to work at each source area for the full two month exposure duration. Consequently, risk from exposure at each source area was summed to determine total risk.

Note: For some of the receptors, the average case cancer risk exceeds the reasonable maximum case cancer risk. This is because of the frequency of non-detects and because one-half of the PQL is greater than the maximum detected value; therefore, the arithmetic mean concentration used to calculate average risk exceeds the one-sided 95% UCL of the arithmetic mean used to calculate reasonable maximum case cancer risk.

  - Inhalation of 1,1-dichloroethene, bromodichloromethane, carbon tetrachloride, chloroform, methylene chloride, TCE, and vinyl chloride while showering.

- For future on-site industrial workers, the following soil and groundwater pathways contributed to unacceptable risk:

  - Dermal absorption of beryllium in surface soil at the Plating Room Area.

  - Ingestion of 1,1-dichloroethene, beryllium, TCE, and vinyl chloride in drinking water.

There is a potential for adverse noncarcinogenic health effects when the hazard index exceeds 1 (USEPA, 1989a). As a rule, the more the hazard index exceeds unity, the greater the potential for adverse health effects.

Table ES-5 presents a summary of the total human receptor hazard indices. Table ES-5 shows that the total reasonable maximum case hazard index exceeds 1 for future off-site 30-year residents and future on-site industrial workers. Consequently, the potential exists for these receptors to experience adverse, noncarcinogenic health effects.

Table ES-5 provides the following risk information:

- For future off-site 30-year residents, the following groundwater pathways contributed to a hazard index greater than 1:

  - Ingestion of thallium in drinking water.

  - Inhalation of cis-1,2-dichloroethene and TCE while showering.

- For future on-site industrial workers, the following soil and groundwater pathways contributed to a hazard index greater than 1:

  - Dermal absorption of molybdenum, manganese, and total chromium in surface soil at the Plating Room Area.

  - Ingestion of thallium in drinking water.

Exposure to molybdenum does not induce the same noncarcinogenic health effects as exposure to manganese or total chromium. Consequently, their hazard quotients are not considered additive. Hazard quotients for dermal absorption of molybdenum, manganese, and total chromium in surface soil by future on-site industrial workers cannot be added for a total hazard index. Even though this is the case, the hazard quotient of 2 for molybdenum still exceeds 1, indicating the potential for adverse health effects.

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TABLE ES-5
TOTAL HUMAN RECEPTOR HAZARD INDEX

Receptor	Total Hazard Index Range			Factors Contributing to an Hazard Index > 1		
	Average Case	Reasonable Maximum Case	Receptor Hazard Index > 1	Pathway Contributing to the Hazard Index >1	Pathway Reasonable Maximum Case Hazard Index	Chemical Contributing to Pathway Hazard Index >1
CURRENT LAND USE						
Recreational Users of Little Choconut Creek	8E-01	8E-01	No	NA	NA	NA
Recreational Users of Little Choconut Creek Background	8E-02	1E-01	No	NA	NA	NA
On-site Industrial Workers Impacted by the Waste Oil Tank Area	1E-05	1E-05	No	NA	NA	NA
FUTURE LAND USE						
Off-site 30-Year Residents	3E+00	8E+01(1)	Yes	Ingestion of Chemicals in Drinking Water	7E+00	Thallium
				Inhalation of VOCs While Showering	7E+01	cis-1,2-Dichloroethylene Trichloroethylene
On-site Industrial Workers	3E+00	1E+01(1)	Yes	Plating Room - Dermal Absorption of Chemicals in Surface Soil	3E+00(3)	Molybdenum Manganese Total Chromium
				Ingestion of Chemicals in Drinking Water	6E+00	Thallium
On-site Construction Workers Impacted by the Plating Room	2E+00	1E+00	No	NA	NA	NA
On-site Construction Workers Impacted by the Reservoir	2E-01	2E-01	No	NA	NA	NA
On-site Construction Workers Impacted by the Waste Oil Tanks	2E-01	2E-01	No	NA	NA	NA
On-site Construction Workers (2) Impacted by All Source Areas	2E+00	1E+00	No	NA	NA	NA

Key: NA = Not Applicable

(1) In calculating the reasonable maximum case hazard index, the shallow and deep groundwater pathway hazard indexes were combined by selecting the highest shallow or deep zone hazard index for each analyte.

(2) The same on-site construction workers were assumed to work at each source area for the full two month exposure duration. Consequently, the hazard index from exposure at each source area was summed to determine a total hazard index.

(3) As a screening approach, the hazard quotients for molybdenum, manganese, and total chromium were considered additive. Molybdenum, manganese, and chromium do not induce the same noncarcinogenic health effects. Consequently, their hazard quotients are not considered additive for determination of a final HI. The hazard quotient of 2 for molybdenum still exceeds one. Manganese, with a hazard quotient for 0.4, and chromium, with a hazard quotient of 0.1, no longer contribute to a pathway HI which is greater than one.

Note: For some of the receptors, the average case hazard index exceeds the reasonable maximum case hazard index. This is because of the frequency of non-detects and because one-half of the PQL is greater than the maximum detected value; therefore, the arithmetic mean concentration used to calculate the average case hazard index exceeds the one-sided 95% UCL of the arithmetic mean used to calculate reasonable maximum case hazard index.

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The USEPA IEUBK Model demonstrated that the predicted blood-lead (Pb-B) level for the 0.5 to 1 year age group and consecutive yearly age groups to 6 to 7 years did not exceed 10 micrograms per deciliter (μg/dL). Blood-lead levels for the age groups range from 2.7 μg/dL to 4.5 μg/dL. A probability density plot shows that the geometric mean Pb-B concentration is 3.7 μg/dL; 98.44 percent of the children's Pb-B levels are below the cutoff of 10.0 μg/dL.

Thus, the model demonstrates that off-site resident children in the age range of 0.5 to 7 years are not at risk from exposure to lead.

ES.4 Conclusions and Recommendations

This section presents the conclusions and recommendations for the RI of AFP 59 as they relate to the risk to human health and to the comparison of site contaminants to ARARs. The conclusions are presented below by environmental medium. Although three source areas of soil contamination have been identified at AFP 59, the conclusions treat the plant as a single investigative site because of its small size and similar environmental characteristics. Recommendations follow the conclusions in Section ES.4.1. Tables ES-4 and ES-5 (in Section ES.3) present a summary of the human health risk assessment. Tables ES-6 through ES-9 present a comparison of site data to ARARs.

ES.4.1 Conclusions

This section presents the conclusions of the RI of AFP 59 by environmental medium. Only those analytes that contribute to unacceptable risk (i.e., carcinogenic risk exceeding 1×10^{-6} or hazard quotient exceeding 1) are included in the discussion of risk in this section.

ES.4.1.1 Soil

Carcinogenic and noncarcinogenic risk related to soil contamination at AFP 59 are discussed below.

CARCINOGENIC RISK. Carcinogenic risk due to soil contamination was identified for future on-site industrial workers (see Table ES-4). The only exposure pathway and analyte that contributed to unacceptable risk for on-site industrial workers was dermal absorption of beryllium in surface soil at the Plating Room Area. Beryllium was identified in 100 percent of the site surface soil samples collected in the Plating Room Area and in 100 percent of the background surface soil samples. Therefore, beryllium may represent an area-wide problem (potentially related to emissions from the NYSEG coal-burning power plant located south of AFP 59), not a site-specific one.

NONCARCINOGENIC RISK. Soil contamination due to the presence of molybdenum in surface soil near the Plating Room Area (see Table ES-5) was also identified as a noncarcinogenic risk for future on-site industrial workers. Because the hazard quotients for manganese (HQ=0.4) and total chromium (HQ=0.1) do not exceed 1, the potential for adverse noncarcinogenic health effects as

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TABLE ES-6
COMPARISON OF SITE ORGANIC SOIL DATA AND CLEANUP OBJECTIVES

Analyte	Plating Room		Waste Oil Tanks		Reservoir	
	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)
Acetone	0.03	**1.54**	NC	NA	NC	NA
Acenaphthene	21.5	0.15	43.7	0.29	NC	ND
Anthracene	50*	0.59	50*	0.42	50*	0.14
Benzo(a)anthracene	0.65	**2.7**	1.3	1.0	1.4	0.5
Benzo(a)pyrene	2.6	1.6	5.2	0.97	5.5	0.42
Benzo(b)fluoranthene	0.26	**2.9**	0.52	**1.3**	0.55	**0.78**
Benzo(g,h,i)perylene	NC	ND	50*	0.49	50*	0.15
Beta BHC	NC	ND	0.09	0.0043	NC	ND
Delta BHC	NC	ND	0.16	0.0021	0.17	0.0009
Gamma BHC	NC	ND	0.03	0.0006	0.028	0.0006
Bromomethane	--	0.016	--	ND	--	ND
n-Butylbenzene	--	ND	--	0.047	--	ND
sec-Butylbenzene	--	ND	--	0.011	--	ND
Bis(2-ethylhexyl)phthalate	50*	0.471	50*	0.97	50*	0.2
Chloroethane	NC	ND	0.88	0.0045	NC	ND
Chrysene	0.09	**2.6**	0.19	**1.0**	0.2	**0.5**
cis-1,2-Dichloroethene	--	ND	--	0.11	--	ND
p-Cymene	--	ND	--	0.053	--	ND
4,4'-DDD	1.8	0.0022	3.7	0.0056	4.1	0.0061
4,4'-DDT	NC	ND	1.2	0.008	1.3	0.0049
Dibenzofuran	NC	ND	2.9	0.36	NC	ND
Dibenz(a,h)anthracene	NC	ND	50*	0.11	NC	ND
1,1-Dichloroethane	NC	ND	0.07	0.011	NC	ND
Dieldrin	NC	ND	0.05	0.0039	0.06	0.0036
2,4-Dinitrotoluene	--	ND	--	0.41	--	ND

TABLE ES-6
COMPARISON OF SITE ORGANIC SOIL DATA AND CLEANUP OBJECTIVES

Continued

Analyte	Plating Room		Waste Oil Tanks		Reservoir	
	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)
Endosulfan I	0.19	0.0026	0.39	0.0028	NC	ND
Endosulfan II	NC	ND	NC	ND	0.42	0.0053
Endosulfan Sulfate	NC	ND	0.48	0.013	NC	ND
Endrin	NC	ND	0.04	0.0088	0.05	0.0024
Endrin Aldehyde	--	ND	--	0.043	--	0.014
Ethylbenzene	NC	ND	2.6	0.0013	NC	ND
Fluoranthene	50*	5.3	50*	2.7	50*	0.94
Fluorene	50*	0.11	50*	0.45	NC	ND
Heptachlor	NC	ND	NC	ND	0.06	0.0021
Heptachlor Epoxide	NC	ND	NC	ND	0.001	**0.0049**
Indeno(1,2,3-cd)pyrene	NC	ND	1.5	0.45	1.6	0.16
Isopropylbenzene	--	ND	--	0.0028	--	ND
Methoxychlor	10*	0.013	10*	0.025	10*	0.024
Methylene chloride	0.03	0.089	0.05	0.076	0.05	0.037
Methyl Ethyl Ketone	--	0.00454	--	ND	--	ND
2-Methylnaphthalene	NC	ND	17.3	0.6	NC	ND
Naphthalene	NC	ND	6.2	2.5	NC	ND
PCB-1254	0.41	0.17	0.83	0.17	NC	ND
PCB-1260	NC	ND	0.83	0.15	0.92	0.079
Phenanthrene	50*	2.7	50*	2.9	50*	0.61
n-Propylbenzene	--	ND	--	0.0078	--	ND
Pyrene	50*	4.2	50*	2.3	50*	0.8
Styrene	--	0.00124	--	ND	--	ND
1,2,3-Trichlorobenzene	--	ND	--	ND	--	0.0031
1,1,1-Trichloroethane	0.18	0.0087	NC	ND	0.38	ND

TABLE ES-6
COMPARISON OF SITE ORGANIC SOIL DATA AND CLEANUP OBJECTIVES

Continued

Analyte	Plating Room		Waste Oil Tanks		Reservoir	
	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)
Trichloroethene	0.15	0.071	0.30	0.015	0.32	0.07
1,2,4-Trimethylbenzene	--	ND	--	0.07	--	ND
1,3,5-Trimethylbenzene	--	ND	--	0.19	--	ND
Vinyl Chloride	NC	ND	0.05	0.015	NC	ND
m,p-Xylenes	0.281	0.00273(1)	0.57	0.0066	NC	ND
o-Xylenes	NC	ND	0.57	0.0062	NC	ND

Key:
ND = Not detected
NC = Not calculated
NA = Not analyzed
* = Calculated site-specific cleanup objective exceeds maximum value for group of contaminants; group maximum value is used.
-- = No cleanup objective available
(1) = Total Xylenes

Note: Concentrations exceeding cleanup objectives are shaded.

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TABLE ES-7
COMPARISON OF ORGANIC DATA AND NEW YORK STATE SCREENING CRITERIA FOR SEDIMENT

Analyte	CR01		CR02		CR04		CR05		CR06	
	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)
Anthracene	ND	--	0.34	--	ND	--	ND	--	ND	--
Benzo(a)anthracene	ND	NA	0.97	0.0039	0.21	0.011	ND	NA	0.12	0.0057
Benzo(a)pyrene	ND	NA	0.89	0.0039	0.17	0.011	ND	NA	0.097	0.0057
Benzo(b)fluoranthene	ND	NA	1.5	0.0039	0.29	0.011	ND	NA	0.17	0.0057
Benzo(g,h,i)perylene	ND	--	0.41	--	ND	--	ND	--	ND	--
BHCs (total)	ND	NA	0.016	0.0002	0.0003	0.0005	ND	NA	0.013	0.0003
Bis(2-ethylhexyl)phthalate	ND	NA	0.23	0.60	0.15	2.7	ND	NA	ND	NA
Chrysene	ND	NA	1	0.0039	0.22	0.011	ND	NA	ND	NA
Dibenzofuran	ND	--	0.12	--	ND	--	ND	--	ND	--
Endosulfan (I & II)	ND	NA	0.0028	9.0e-05	0.002	0.0004	0.0014	4.2e-05	0.0013	0.0001
Endrin	ND	NA	ND	NA	0.0025	0.01	0.0045	0.0011	ND	NA
Fluoranthene	ND	NA	1.9	3.0	0.28	13.7	0.11	1.4	0.2	4.5
Fluorene	ND	--	0.20	--	ND	--	ND	--	ND	--
Methoxychlor	ND	NA	ND	NA	0.019	0.008	ND	NA	ND	NA
Methylene Chloride	ND	--	0.022	--	0.019	--	ND	--	0.015	--
Naphthalene	ND	--	0.21	--	ND	--	ND	--	ND	--
PCBs (total)	ND	NA	ND	NA	ND	NA	0.16	1.1e-06	ND	NA
Phenanthrene	ND	NA	1.7	0.36	0.13	1.6	ND	NA	0.16	0.52
Pyrene	ND	--	1.4	--	0.33	--	0.11	--	0.16	--

Key: NA = Not Applicable　　ND = Not Detected
-- = No screening criteria

Note: Concentrations exceeding screening criteria are shaded.

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TABLE ES-8
COMPARISON OF INORGANIC DATA AND NEW YORK STATE SCREENING CRITERIA FOR SEDIMENT

Analyte	New York Sediment Criterion		Max. Site Sediment Conc. (mg/kg)	Impact	Max. Bkgd. Sediment Conc. (mg/kg)	Impact
	Lowest Effect Level (mg/kg)	Severe Effect Level (mg/kg)				
Aluminum	--	--	9,450	Unknown	6,840	Unknown
Arsenic	6.0	33.0	6.1	Moderate	5.2	None
Barium	--	--	71.3	Unknown	42.5	Unknown
Beryllium	--	--	0.47	Unknown	0.24	Unknown
Calcium	--	--	7,750	Unknown	32,100	Unknown
Chromium	26.0	110.0	16.2	None	9.9	None
Cobalt	--	--	9.4	Unknown	7.7	Unknown
Copper	16.0	110.0	28.8	Moderate	26.8	Moderate
Iron	20,000	40,000	20,100	Moderate	17,600	None
Lead	31.0	110.0	55.5	Moderate	19.5	None
Magnesium	--	--	5,100	Unknown	3,440	Unknown
Manganese	460.0	1100.0	410	None	584	Moderate
Mercury	0.15	1.3	0.22	Moderate	ND	None
Molybdenum	--	--	16.8	Unknown	15.0	Unknown
Nickel	16.0	50.0	21.1	Moderate	19.3	Moderate
Potassium	--	--	843	Unknown	NA	Unknown
Silver	1.0	2.2	0.59	None	ND	None
Vanadium	--	--	15.9	Unknown	11.5	Unknown
Zinc	120.0	270.0	383	Severe	138	Moderate

Key: ND = Not Detected
NA = Not Available
-- = No screening criteria

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TABLE ES-9
COMPARISON OF SITE DATA AND FEDERAL AND NEW YORK STATE CHEMICAL-SPECIFIC ARARS FOR GROUNDWATER AND SURFACE WATER

Analyte	Federal Primary MCL	New York Drinking Water Standard	New York Surface Water Standard	Max. Site Shallow Ground-water Conc.	Max. Site Deep Ground-water Conc.	Max. Site Surface Water Conc.
ORGANIC COMPOUNDS (μg/L)						
BHC (total)	---	5 (1)	0.01 (1)	0.01	0.011	**0.0155**
Bis(2-ethylhexyl) phthalate	6	50	0.6	ND	5.9	**3.0**
Bromodichloromethane	100 (2)	100	---	0.38	ND	0.60
Bromoform	100 (2)	100	---	ND	ND	1.1
Carbon Tetrachloride	5	5	---	0.6	ND	ND
Chlorodibromomethane	100 (2)	100	---	ND	ND	0.96
Chloroethane	---	5	---	4.2	ND	ND
Chloroform (Trichloromethane)	100 (2)	100	---	0.46	ND	0.33
Chloromethane	---	5	---	ND	0.38	ND
4,4'-DDE, 4,4'-DDD, 4,4'-DDT (total)	---	ND	0.001	ND	**0.166**	**0.018**
Dichlorodifluoromethane	---	5	---	ND	ND	0.38
1,1-Dichloroethane	---	5	---	**33**	2.4	ND
1,1-Dichloroethene	7	5	---	2.1	ND	ND
cis-1,2-Dichloroethene	70	5	---	**150**	**36**	ND
trans-1,2-Dichloroethene	100	5	---	0.30	ND	ND
Alpha Endosulfan (Endosulfan I)	---	---	0.009 (3)	ND	ND	**0.014**
Beta Endosulfan (Endosulfan II)	---	---	0.009 (3)	0.010	ND	0.0068
Ethylbenzene	700	5	---	0.68	0.40	ND
Heptachlor	0.4	0.4	0.001 (4)	**0.0095**	ND	ND
Isopropylbenzene	---	5	---	1.0	ND	ND
Methoxychlor	40	40	0.03	ND	0.090	ND
Methylene Chloride	5	5	---	**6.0**	ND	ND
Naphthalene	---	50	---	2.8	ND	ND
n-Propylbenzene	---	5	---	0.90	ND	ND
Toluene	1,000	5	---	1.3	ND	ND
1,2,4-Trichlorobenzene	70	5	5	2.7	ND	ND
1,1,1-Trichloroethane	200	5	---	**20**	1.2	ND

TABLE ES-9
COMPARISON OF SITE DATA AND FEDERAL AND NEW YORK STATE CHEMICAL-SPECIFIC ARARS FOR GROUNDWATER AND SURFACE WATER

Continued

Analyte	Federal Primary MCL	New York Drinking Water Standard	New York Surface Water Standard	Max. Site Shallow Ground-water Conc.	Max. Site Deep Ground-water Conc.	Max. Site Surface Water Conc.
ORGANIC COMPOUNDS ($\mu g/L$) (Continued)						
Trichloroethene	5	5	11 (5)	370	4.0	ND
Trichlorofluoromethane	---	5	---	2.8	ND	ND
1,2,4-Trimethylbenzene	---	5	---	15	ND	ND
1,3,5-Trimethylbenzene	---	5	---	36	0.78	ND
Vinyl chloride	2	2	---	6.2	0.28	ND
Xylenes (total)	10,000	5	---	6.9	0.54	ND
INORGANIC COMPOUNDS (mg/L)						
Aluminum	---	---	0.1 ionic	3.48	1.0	---
Arsenic	0.05	0.05	0.190 (6)	0.0063	0.0119	0.0029
Barium	2.0	2.0	---	0.344	0.222	0.064
Beryllium	0.004	0.003 (5)	1.1 (7)	0.0011	ND	ND
Calcium	---	---	---	260	157	93.9
Chromium (total)	0.1	0.1	0.35 (8)	0.0272	ND	0.0065
Copper	1.3 (9)	1.3 (10)	0.02 (11)	0.0455	ND	0.0133
Iron	---	0.3/0.5 (12)	0.3	10.4	4.46	0.665
Lead	0.015 (9)	0.015 (10)	0.007 (13)	0.0796	0.006	0.0032
Magnesium	---	35 (5)	---	58.3	38.3	16.7
Manganese	---	0.3/0.5 (12)	---	3.1	1.44	0.0345
Nickel	0.1	---	0.16 (14)	0.0475	ND	ND
Potassium	---	---	---	4.0	6.04	2.13
Silver	---	0.05	0.0001 ionic	0.010	ND	ND
Sodium	---	NDL (15)	---	60	94.3	38.3
Thallium	0.0005 (16)	0.004 (5)	0.008	ND	0.0468	ND

TABLE ES-9
COMPARISON OF SITE DATA AND FEDERAL AND NEW YORK STATE CHEMICAL-SPECIFIC ARARS FOR GROUNDWATER AND SURFACE WATER

Continued

Analyte	Federal Primary MCL	New York Drinking Standard	New York Surface Water Standard	Max. Site Shallow Ground-water Conc.	Max. Site Deep Ground-water Conc.	Max. Site Surface Water Conc.
INORGANIC COMPOUNDS (mg/L) (Continued)						
Vanadium	---	---	0.014	0.0124	0.006	ND
Zinc	---	0.3	0.14 (17)	ND	ND	0.0299

Key:
MCL = Maximum Contaminant Level
ND = Not Detected
NDL = No Designated Limit
--- = No ARAR

Note: Concentrations exceeding ARARs are shaded.

(1) Sum of alpha, beta, delta, and gamma BHC.
(2) Sum of trihalomethanes, including bromodichloromethane, dibromochloromethane, bromoform, and chloroform.
(3) Standard applies to Endosulfan (not distinguished I or II).
(4) Sum of Heptachlor and Heptachlor Epoxide.
(5) NY State groundwater guidance value (guidance values may be used where a standard has not been established) from the NY State Ambient Water Quality Standards and Guidance Values.
(6) Dissolved arsenic form.
(7) Standard = 1.1 mg/L when hardness is >75 ppm; acid-soluble form.
(8) Standard = exp(0.819[ln(ppm hardness)]+1.561)/1,000 mg/L, where average site surface water hardness = 191 ppm; acid-soluble form.
(9) Action level; applies to community water systems and non-transient, non-community water systems (i.e., at consumers' tap).
(10) The copper action level is exceeded if the concentration of copper in more than ten percent of one liter first draw tap water samples during any monitoring period exceeds 1.3 mg/l. The lead action level is exceeded if the concentration of lead in more than ten percent of one liter first draw top water samples collected during any monitoring period exceeds 0.015 mg/l.
(11) Standard = exp(0.8545[ln(ppm hardness)]-1.465)/1,000 mg/L, where average site surface water hardness = 191 ppm; dissolved form.
(12) The second standard applies to the sum of Iron and Manganese
(13) Standard = exp(1.266[ln(ppm hardness)]-4.661)/1,000 mg/L, where average site surface water hardness = 191 ppm; acid-soluble form.
(14) Standard = exp(0.76[ln(ppm hardness)]+1.06)/1,000 mg/L, where average site surface water hardness = 191 ppm; acid-soluble form.
(15) Water containing more than 20 mg/l of sodium should not be used for drinking by people on severely restricted sodium diets. Water containing more than 270 mg/l of sodium should not be used for drinking by people on moderately restricted sodium diets.
(16) Value provided is the Federal maximum contaminant level goal (MCLG). MCLGs are ARARs when greater than 0 and less than MCL.
(17) Standard = exp(0.85[ln(ppm hardness)]+0.50)/1,000 mg/L, where average site surface water hardness = 191 ppm; dissolved form.

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a result of manganese or chromium contamination is considered minimal. Although the hazard quotient for molybdenum (HQ=2) does exceed 1, the potential for adverse noncarcinogenic health effects as a result of molybdenum contamination is considered minimal for the following reasons: the contamination was detected in only 1 of the 16 soil samples collected at the Plating Room Area; it was detected in the replicate sample of a normal soil sample, but not in the normal sample; the replicate sample displayed elevated concentrations of most inorganics compared to the normal sample; the one site detect that drove risk (4,060 milligrams per kilogram [mg/kg] at the Plating Room Area) was greatly elevated compared to other site detects (22 mg/kg was the second highest detected concentration); and the other site detects did not drive risk at either the Waste Oil Tank Area or the Reservoir Area.

ARARs. Other than those analytes that contributed to unacceptable risk, the following analytes were detected in site soil samples above calculated soil cleanup objectives: acetone in the Plating Room Area; and heptachlor epoxide in the Reservoir Area (Table ES-6). Acetone is a common laboratory contaminant and, therefore, may not represent site contamination. The only heptachlor epoxide detected in the Reservoir Area was from a soil sample collected beneath the asphalt parking lot; therefore, no known source of heptachlor epoxide exists.

Background data were used for soil cleanup objectives for inorganic analytes. The following inorganic analytes exceeded background conditions: aluminum, barium, calcium, cadmium, copper, cyanide, selenium, and zinc. None of these inorganic analytes contributed to unacceptable risk.

ES.4.1.2 Sediment

A human health risk assessment was not conducted for sediment in Little Choconut Creek because no complete exposure pathway was identified. However, because New York State sediment screening criteria are risk-based, they do allow for a preliminary assessment of risk. The following organic analytes exceeded screening criteria in both site and background samples (see Table ES-7): benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, BHCs (total), and endosulfan (I and II). The organic analytes chrysene, methoxychlor, and phenanthrene exceeded screening criteria in site samples but not in background samples (see Table ES-7). Chrysene and phenanthrene are PAHs that represent possible area-wide contamination related to emissions from the NYSEG power plant. Methoxychlor was only detected in the replicate sediment sample (not the normal sample) collected at CR04, which is located downstream of both the NYSEG and AFP 59 outfalls. Methoxychlor was not detected at the two sediment sampling locations immediately downstream of the AFP 59 outfalls or at the background sediment sampling locations. Consequently, it may have migrated from the NYSEG outfall and not AFP 59. Additionally, none of the three analytes were detected during the sediment sampling conducted by Argonne National Laboratory (1994) during their investigation of AFP 59.

The inorganic analytes copper, nickel, and zinc exceeded screening criteria in both site and background samples (Table ES-8). The inorganic analytes arsenic, iron, lead, and mercury exceeded screening criteria in site samples but not in background samples (Table ES-8). Each of the four analytes was detected at a concentration only slightly above the "lowest effect level" established by the New York State screening criteria. Additionally, the presence of arsenic may be related to emissions from the NYSEG power plant, and the presence of mercury may be related to discharge from the NYSEG outfall (mercury was only detected at the sediment sampling location that is downstream of both the NYSEG and AFP 59 outfalls).

ES.4.1.3 Groundwater

Carcinogenic and noncarcinogenic risk related to groundwater contamination at AFP 59 are discussed below.

CARCINOGENIC RISK. Carcinogenic risk due to groundwater contamination was identified for future off-site 30-year residents and future on-site industrial workers (see Table ES-4). For future off-site 30-year residents, the following exposure pathways and analytes contributed to unacceptable risk:

- Dermal absorption of beryllium, p,p'-DDE, TCE, and vinyl chloride in shower water;
- Ingestion of 1,1-dichloroethene, beryllium, TCE, and vinyl chloride in drinking water; and
- Inhalation of 1,1-dichloroethene, bromodichloromethane, carbon tetrachloride, chloroform, methylene chloride, TCE, and vinyl chloride while showering.

For future on-site industrial workers, the following exposure pathway and analytes contributed to unacceptable risk:

- Ingestion of 1,1-dichloroethene, beryllium, TCE, and vinyl chloride in drinking water.

Although beryllium contributed to unacceptable risk, it was detected in groundwater monitoring wells at AFP 59 at concentrations below the New York State guidance value (no drinking water or ambient water quality standards exist for beryllium) and below the laboratory practical quantitation limit (PQL). Additionally, the presence of beryllium may be related to emissions from the NYSEG power plant rather than historical activities at AFP 59. The detection of the pesticide p,p'-DDE in the deep zone of the aquifer is probably unrelated to historical activities at AFP 59 because it was not detected in site soil samples or in the shallow zone of the aquifer. Therefore, no documented on-site source exists, and the p,p'-DDE is interpreted to have migrated to AFP 59 from an off-site, hydraulically upgradient source.

The VOCs detected in groundwater samples collected from on-site monitoring wells at AFP 59, especially the chlorinated hydrocarbons, were detected in past studies. As a result, one of the objectives of the RI was to substantiate the earlier detections and delineate the extent of groundwater contamination. While the VOCs did contribute to unacceptable risk, their presence in groundwater at AFP 59 is not of immediate concern because of the air stripper currently operating at the Camden Street Wellfield located downgradient of AFP 59. The air stripper, for which the USAF pays a portion of the operation and maintenance costs, removes any VOCs from the drinking water supplied to local residents.

Although VOC contamination has been detected in the past at the Camden Street Wellfield, it is not possible to document what portion of the contamination has migrated from AFP 59. Groundwater that underlies AFP 59 only accounts for a small fraction of the total volume of groundwater that is pumped at the wellfield. As a result, any contamination originating at AFP 59 would be greatly diluted by the time it reached the wellfield. Additionally, the United States Geological Survey has identified potential source areas other than AFP 59 that exist within the zone of influence of the wellfield.

NONCARCINOGENIC RISK. Noncarcinogenic risk due to groundwater contamination was also identified for future off-site 30-year residents and future on-site industrial workers (see Table ES-5). For future off-site 30-year residents, the following exposure pathways and analytes contributed to unacceptable risk:

- Ingestion of thallium in drinking water; and
- Inhalation of cis-1,2-dichloroethene and TCE while showering.

For future on-site industrial workers, the following exposure pathway and analyte contributed to unacceptable risk:

- Ingestion of thallium in drinking water.

No definable on-site source exists for thallium because it was not detected in site soil samples or in the shallow zone of the aquifer. Additionally, thallium was only detected in one of the nine groundwater samples collected from deep monitoring wells. Therefore, the thallium may have migrated to AFP 59 from an off-site, hydraulically upgradient source. The thallium may also be related to emissions from the NYSEG power plant. As discussed above, VOCs (in this case cis-1,2-dichloroethene and TCE) are not of immediate concern at AFP 59 because of the air stripper operating at the wellfield.

ARARS. In addition to those analytes that contributed to unacceptable risk, the following analytes (excluding VOCs) were detected in site groundwater samples above New York State groundwater standards (Table ES-9): BHC (total), heptachlor, iron, lead, magnesium, and sodium. No apparent source exists for the two pesticides because the majority of the plant property has been covered by impervious material (i.e., the plant and parking lots) since it was paved in 1959. Iron, magnesium, and sodium are common groundwater constituents, and lead did not contribute to unacceptable risk even using a conservative risk assessment model.

ES.4.1.4 Surface Water

Carcinogenic risk related to surface water contamination in Little Choconut Creek adjacent to AFP 59 is discussed below. No noncarcinogenic risk was identified.

CARCINOGENIC RISK. Current recreational users of Little Choconut Creek are potentially exposed to unacceptable risk due to ingestion of arsenic, BEHP, and p,p'-DDD in contaminated fish (see Table ES-4). Arsenic (possibly related to emissions from the NYSEG power plant) contributed to unacceptable risk for both site and background samples; therefore, exposure to BEHP and p,p'-DDD drove site risk. However, the two analytes were only detected in the surface water sample collected at CR04, which is located downstream of both the NYSEG and AFP 59 outfalls. They were not detected at the two surface water sampling locations immediately downstream of the AFP 59 outfalls (CR01 and CR02) or at the two background surface water sampling locations (CR05 and CR06). Consequently, they may have migrated from the NYSEG outfall and not AFP 59. Additionally, neither of the two analytes was detected in both the normal and duplicate samples collected at CR04, and neither was detected during previous surface water sampling conducted by Argonne National Laboratory (1994).

ARARS. Other than those analytes that contributed to unacceptable risk, the following analytes were detected in site surface water samples above surface water standards (Table ES-9): BHC (total), alpha endosulfan (endosulfan I), and iron. However, no apparent source exists for any of the three analytes detected above surface water standards. No apparent source exists for the two pesticides (BHC and alpha endosulfan) because the majority of the plant property has been covered by impervious material (i.e., the plant and parking lots) since it was paved in 1959.

ES.4.2 Recommendations

Based on the results of the RI of AFP 59, the following actions are recommended:

1) Perform additional groundwater sampling of select monitoring wells to verify or eliminate beryllium, thallium, and p,p'-DDE as chemicals of potential concern in groundwater at the site.

   All three analytes were detected in very few groundwater samples. Beryllium was detected in four groundwater samples (including a duplicate sample) collected from shallow monitoring wells (SW3, SW4, and SW11), and in none of the groundwater samples collected from deep monitoring wells. Although the percentage of detections is high in groundwater samples collected from shallow monitoring wells, the detections may be suspect because of the high number of samples that were unusable due to blank contamination. Nine of the groundwater samples collected from shallow monitoring wells and submitted for analysis of beryllium were unusable due to blank contamination. Consequently, additional groundwater sampling of SW3, SW4, and SW11 may eliminate beryllium as a chemical of potential concern.

Thallium was detected in none of the 15 groundwater samples collected from shallow monitoring wells and in 1 of the 12 groundwater samples collected from deep monitoring wells. The pesticide p,p'-DDE was detected in none of the 15 groundwater samples collected from shallow monitoring wells and in 2 of the 11 groundwater samples collected from deep monitoring wells. These detects may be considered suspect because of the low detection percentage. As a result, additional groundwater sampling may eliminate thallium and p,p'-DDE as chemicals of potential concern.

2) Collect additional site and background surface water samples to verify or eliminate arsenic, BEHP, and p,p'-DDD as chemicals of potential concern in Little Choconut Creek. As discussed above, arsenic shows risk for both the site and background surface water pathways. Additional sampling will allow for statistical comparisons between site and background contamination to determine whether site contamination is the result of background contamination migrating downstream from another source.

BEHP and p,p'-DDD were only detected in the surface water sample collected at CR04, which is located downstream of both the NYSEG and AFP 59 outfalls. Additional surface water sampling at locations immediately downgradient of the AFP 59 outfalls and upgradient of the NYSEG outfall may eliminate these analytes as chemicals of potential concern.

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SECTION 1.0

INTRODUCTION

This document is the *Remedial Investigation (RI) Report* for Air Force Plant 59 (AFP 59) in Broome County, New York. This RI report documents information gathered during the course of the RI and provides analysis and interpretation of the information to accomplish the following objectives:

- To confirm, characterize, and define the lateral and vertical extent of contamination at the site;
- To supplement and refine the existing geological, hydrogeological, and chemical data base for the site;
- To evaluate the chemical migration pathways and specific parameters affecting groundwater movement that influence the migration of contaminants;
- To evaluate potential risks and hazards to public health and the environment; and
- To identify applicable or relevant and appropriate requirements (ARARs).

The RI was conducted as part of the Installation Restoration Program (IRP). In 1980, the United States Department of Defense (DoD) developed the IRP to investigate hazardous material disposal sites on DoD facilities. Because of its primary mission in national defense, the United States Air Force (USAF) has long been engaged in a wide variety of operations that involve the use, storage, and disposal of hazardous materials.

The USAF initiated an IRP investigation at AFP 59 in March 1984. To date, three Phase I and Phase II investigations have been conducted under the IRP at AFP 59. These studies are summarized in the RI *Work Plan* (EARTH TECH, 1994c). Several other investigations have been conducted at AFP 59 outside of the IRP process and are also summarized in the *Work Plan*.

This report has been prepared in accordance with the United States Environmental Protection Agency (USEPA) document, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (1988). This report also follows the format and content requirements of the *Handbook for the Installation Restoration Program (IRP), Remedial Investigations and Feasibility Studies (RI/FS)* (USAF, 1993a).

This RI report contains four sections. Section 1 provides a description of the USAF IRP, information on the environmental setting of AFP 59, an inventory of IRP sites and areas of concern, and a summary of past remedial actions. Section 2 provides a description of project objectives; a summary of field activities; a summary of the laboratory analytical program; and descriptions of methods used to assess data quality, analyze data, and interpret data. Section 3 provides results of the RI, including identification of contaminants, discussion of site characteristics affecting contaminant migration, development of a baseline risk assessment, and identification of ARARs. Section 4 provides conclusions and recommendations.

1.1 The United States Air Force Installation Restoration Program

The objective of the USAF IRP is to assess past hazardous material disposal and spill sites at USAF installations and to develop remedial actions consistent with the National Contingency Plan (NCP) for sites that pose a threat to human health and the environment. This section presents information on the program origins, objectives, and organization.

1.1.1 Program Origins

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) known as the Superfund. CERCLA outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. CERCLA legislation identifies the USEPA as the primary policy and enforcement agency regarding contaminated sites.

To ensure compliance with CERCLA, the DoD developed the IRP to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated sites. The DoD issued Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP in June 1980 and implemented the policies outlined in this memorandum in December 1980. The DoD formally revised and expanded the existing IRP directives, and amplified all previous directives and memoranda concerning the IRP through DEQPPM 81-5, dated 11 December 1981. The memorandum was implemented by a USAF Message dated 21 January 1982.

Executive Order 12316, which was adopted in 1981, gave various Federal agencies, including the DoD, the responsibility to act as lead agencies to conduct investigations and implement remediation efforts when they are the sole or co-contributor to contamination on or off their properties.

In January 1987, Executive Order 12316 was revoked by Executive Order 12580. Executive Order 12580 delegates CERCLA functions vested in the President to the leads of various Federal agencies, including DoD.

The Superfund Amendment and Reauthorization Act (SARA) of 1986 extends the requirements of CERCLA and modifies CERCLA with respect to remediation goals and the process of remedy selection. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to actions that only contain or isolate the contaminant. SARA also provides for greater interaction with State agencies and the public and extends the role of the USEPA in evaluating health risks associated with contamination. Under SARA, early determination of ARARs is required, and the consideration of potential remedial alternatives is recommended at the initiation of an RI/feasibility study (FS). As amended by SARA, CERCLA is the primary Federal legislation governing remedial action at past hazardous waste disposal sites. The NCP was issued as a final rule on 8 March 1990 to provide the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

The IRP is the DoD's primary mechanism for response actions on USAF installations affected by the provisions of SARA. In November 1986, in response to SARA and other USEPA interim guidance, the USAF modified the IRP to provide for a RI/FS program. The IRP was modified so that RI/FS studies could be conducted as parallel activities rather than as serial activities. The program now includes ARAR determinations, identification and screening of technologies, and development of remedial alternatives. The IRP may include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure DoD compliance with Federal laws and regulations such as the Resource Conservation and Recovery Act (RCRA), the NCP, CERCLA, and SARA.

1.1.2 Program Objectives

The objectives of the IRP are as follows:

- To identify and evaluate DoD sites where contamination may be present because of past hazardous waste disposal practices, spills, leaks, or other activities;
- To control the migration of hazardous contaminants; and
- To control health hazards or hazards to the environment that may result from past DoD disposal operations.

The IRP was developed so these objectives could be met in accordance with CERCLA, the NCP, SARA, RCRA, and other applicable statutes. Solutions that are developed should protect public health and the environment, meet requirements of ARARs, and be technically feasible for the evaluated site.

To meet these IRP objectives, the following program tasks should generally be completed.

- Develop a project data base through literature search, field investigation, laboratory analysis, and data evaluation;

- Develop and implement a quality assurance/quality control (QA/QC) program to assure the collection of meaningful and defensible data;
- Develop and follow health and safety plans to protect the health and safety of personnel and to prevent the release of contaminants;
- Identify data gaps and implement appropriate additional or supplemental studies during the course of the IRP;
- Use a rigorous procedure to identify, evaluate, and select appropriate solutions;
- Conduct the IRP in compliance with applicable Federal and State regulations and guidance; and
- Provide information regarding the nature of identified contamination, potential effects of contamination on the community, the progress of the IRP, and the selected remedial alternative and its impact on the public and appropriate regulatory agencies.

1.1.3 Program Organization

IRP studies were originally organized in four phases: Phase I - Installation Assessment/Records Search; Phase II - Confirmation/Quantification; Phase III - Technology Base Development; and Phase IV - Remedial Action (Figure 1-1). Each phase is divided into different stages of study as knowledge of individual sites is improved and further investigations become necessary. The IRP has since been modified to be consistent with the CERCLA Response Action Process (Figure 1-2). A brief description of the formerly used phased IRP organization approach is presented below.

Phase I - Installation Assessment/Records Search studies are installation-wide studies to identify and assess past disposal sites. File material, site visits, and interviews provide information for initial assessments. The Phase I assessment considers whether or not each identified site poses hazards to public health or the environment. If a site presents little or no apparent hazard, it is not evaluated further. If a site presents an imminent threat to public health, an emergency response (a Phase IV action) is taken. If sampling and evaluation to confirm a suspected hazard are required, Phase II studies are initiated. Sites identified in Phase I are rated using the USAF Hazard Assessment Rating Methodology (HARM), a system that ranks a site for potential hazards to the public or the environment. The USAF also uses the Defense Priority Model to rank sites according to the potential risks they pose to human health and the environment.

Phase II - Confirmation/Quantification studies are performed to confirm the absence or presence of contamination, to assess the extent and degree of contamination, and to provide the basis for selecting appropriate remedial alternatives. During Phase II studies, groundwater, surface water, soil, and sediment samples are collected and analyzed as necessary. If Phase II studies do not reveal contamination threatening human health or the environment, the results are documented,

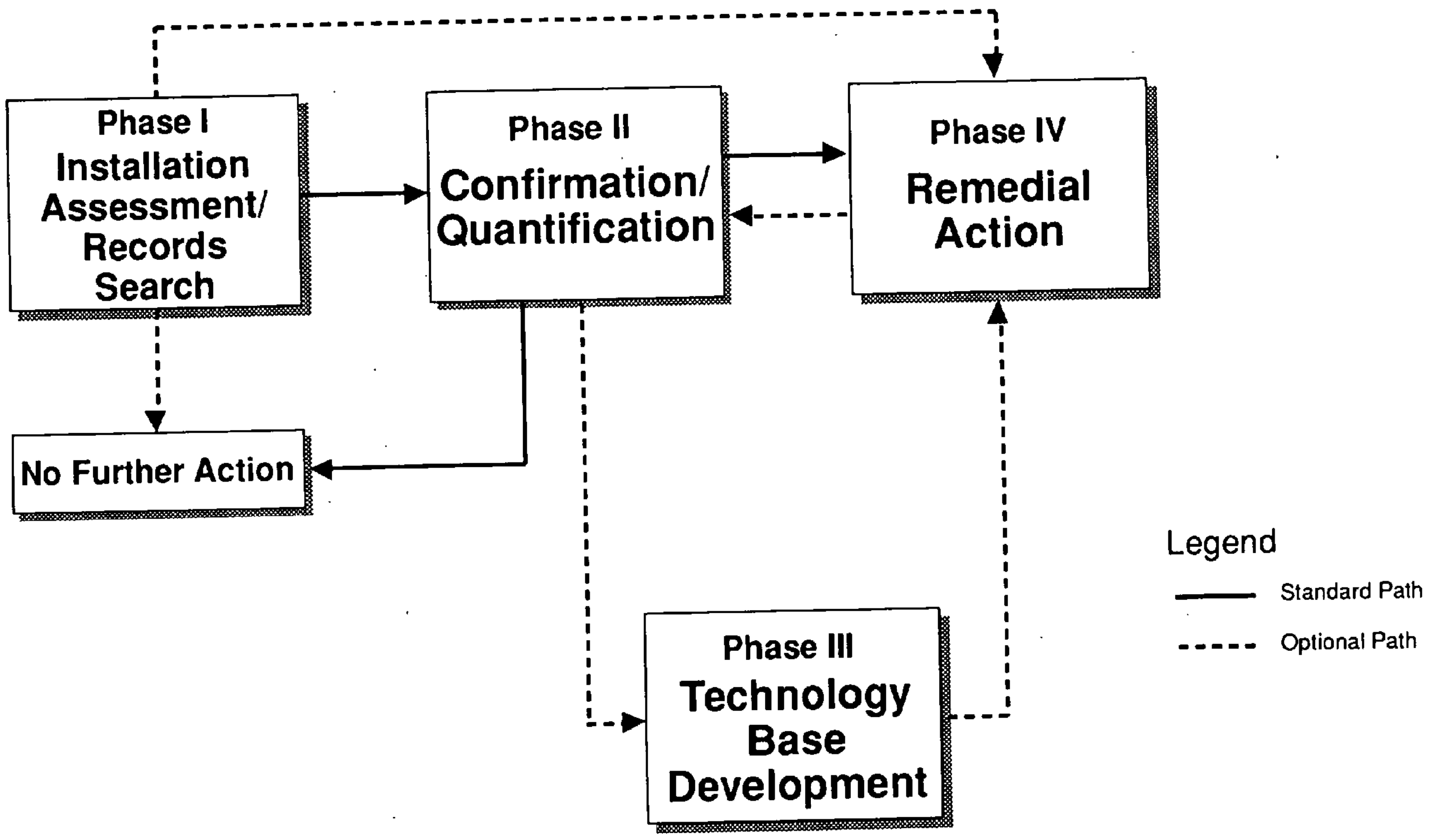

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FIGURE 1-1

Installation Restoration Program

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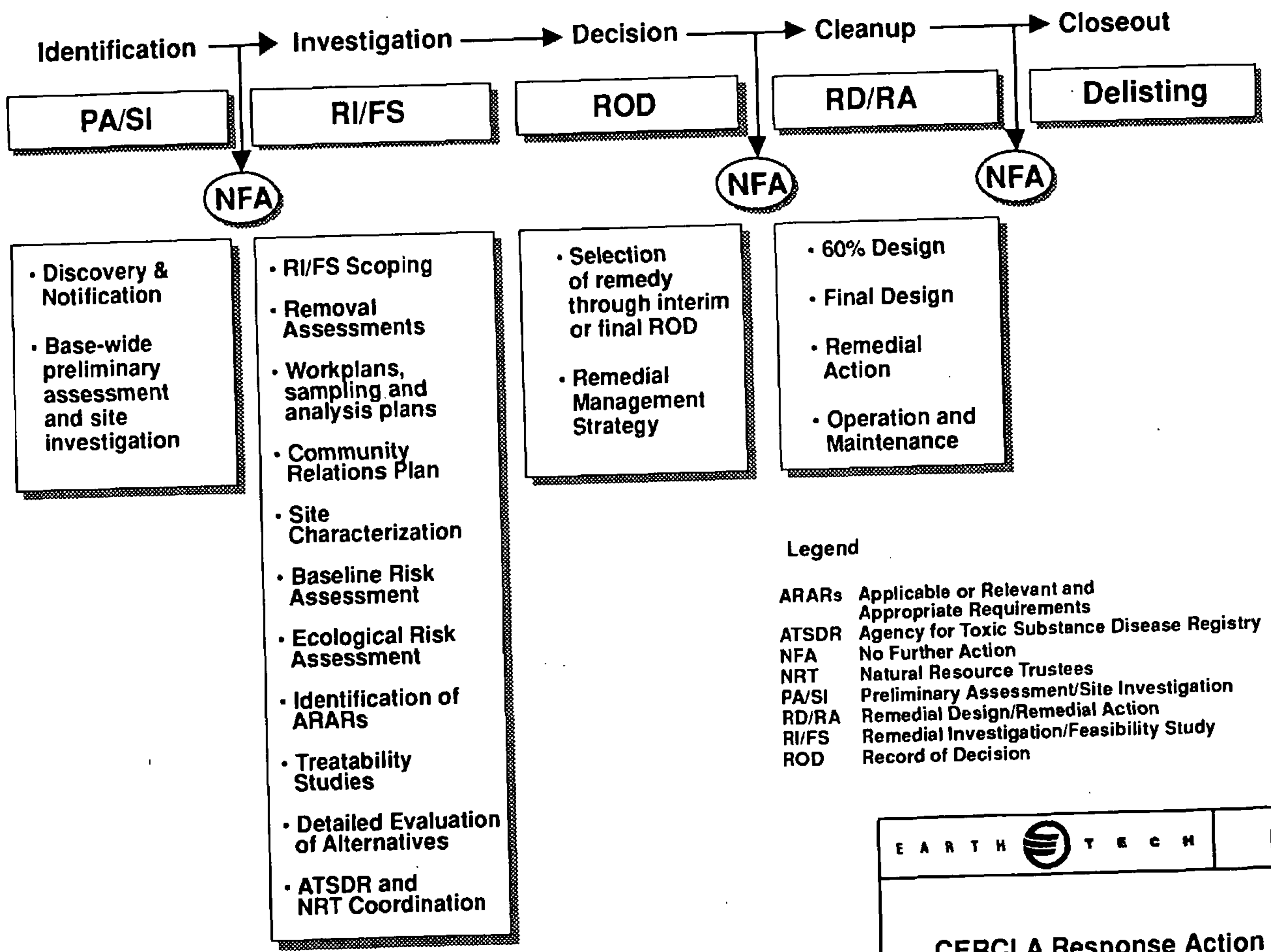

Legend

ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substance Disease Registry
NFA	No Further Action
NRT	Natural Resource Trustees
PA/SI	Preliminary Assessment/Site Investigation
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision

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FIGURE 1-2

CERCLA Response Action Process

Source: USAF, 1992

GF/AFP59/EBS/Car Res Act

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and no further action is recommended for the site. At some sites, Phase II sampling might not detect enough contamination to endanger human health or the environment, but future problems due to contaminant migration or transformation are still a possibility. Generally, the approach used for such sites is to further monitor water, soil, and/or sediment quality. If a Phase II study demonstrates that a site presents an imminent threat to public health, an emergency response (Phase IV) action generally is taken.

Phase III - Technology Base Development studies are not performed for every site but are intended to improve site investigation and remediation technology through research, development, and testing. Phase III studies are initiated for sites that cannot be controlled with a proven technology or for sites that are suitable for evaluating new technologies.

Phase IV - Remedial Actions are usually conducted in two stages. The first stage consists of developing Remedial Action Plans to document the development, evaluation, and selection of alternatives to control the hazards posed by a waste disposal site. Selection of the best remedial action alternative is based on engineering feasibility, cost, environmental effects, public health effects, and compliance with regulatory requirements. The second stage of the Phase IV study is the implementation of the selected alternative. Documentation for this stage includes design, construction, and management methods (nonstructural control measures). Long-term monitoring is often performed in association with site remediation to ensure compliance with contaminant standards or achievement of remediation goals.

An RI/FS encompasses the following key elements that are necessary to select an appropriate remedial action:

- Determining Federal and State ARARs;
- Developing data quality objectives (DQOs) necessary to allow evaluation of ARAR attainment and acceptable field and analytical procedures;
- Performing field RIs to examine water, soil, and sediment quality; to collect hydrogeologic and lithologic information to assess the extent and magnitude of contamination and movement of contamination at a site; and to support the development of potential remedial alternatives. The RI phase of work is described in CERCLA and the NCP;
- Performing risk assessments of potential hazards by assessing the impacts on various receptors through possible current or future exposure pathways as required under CERCLA, the NCP, and SARA, and as defined in the *Risk Assessment Guidance for Superfund* (USEPA, 1989a, 1989b);
- Evaluating sites where results of field investigations and risk analyses indicate no significant threat to human health, welfare, or the environment; and

- Developing potential alternatives (technologies) to address contamination or control contaminant migration. The alternatives should provide a range of reduction in the mobility, toxicity, or volume associated with contamination, and they should meet or exceed ARARs.

The initial screening of remedial alternatives is conducted using screening criteria for effectiveness, implementability, and cost. If necessary, field-scale or bench-scale studies are conducted to support the selection of a technology, and final ARARs are identified. A detailed analysis is then conducted to evaluate alternative technologies in terms of the nine criteria stipulated by the NCP: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of mobility, toxicity, or volume through treatment; short-term effectiveness; implementability; cost; State acceptance; and community acceptance. At the completion of the RI/FS, which is the functional equivalent of the selection of a remedy process as outlined in the NCP, USEPA guidance, or SARA, a remedial action alternative is selected. A Record of Decision for the site documenting the selected alternative can then be prepared using information and recommendations presented in the final RI/FS report.

The RI meets requirements of the NCP because the results identify potential contaminant receptors and delineate the extent and assess the migration of contaminants. The IRP is also consistent with USEPA guidance for conducting RI/FS investigations under SARA.

1.2 Installation Description

The following section describes the physical setting of AFP 59, including physiography, geology, hydrogeology, surface water features, drainage, and climatology.

1.2.1 Physiography and Topography

AFP 59 is located in south-central New York in the Westover area of the Town of Union, Broome County, immediately west of Johnson City (mailing address); the site is about 3 miles west of the Central Business District of the City of Binghamton and about 4 miles east of the center of the Village of Endicott (Figure 1-3). The plant occupies 29.6 acres (including Parking Lot #5 located north of Main Street) and is situated in a highly urbanized area (Figure 1-4). Parking Lot #5 was classified as a Category 1 site during the environmental baseline survey (EBS) conducted by EARTH TECH (EARTH TECH, 1995a), meaning it is an area where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas). Consequently, Parking Lot #5 was not investigated during the RI.

The plant is bounded on the east and south by Little Choconut Creek. South of AFP 59, beyond Little Choconut Creek, is a power plant owned by New York State Electric and Gas (NYSEG). Residential areas are located immediately west of the installation and also to the east, beyond Little Choconut Creek. Other nonresidential land around the plant is used for transportation, commercial enterprises, recreation, and industrial activity. The Camden Street Wellfield, an

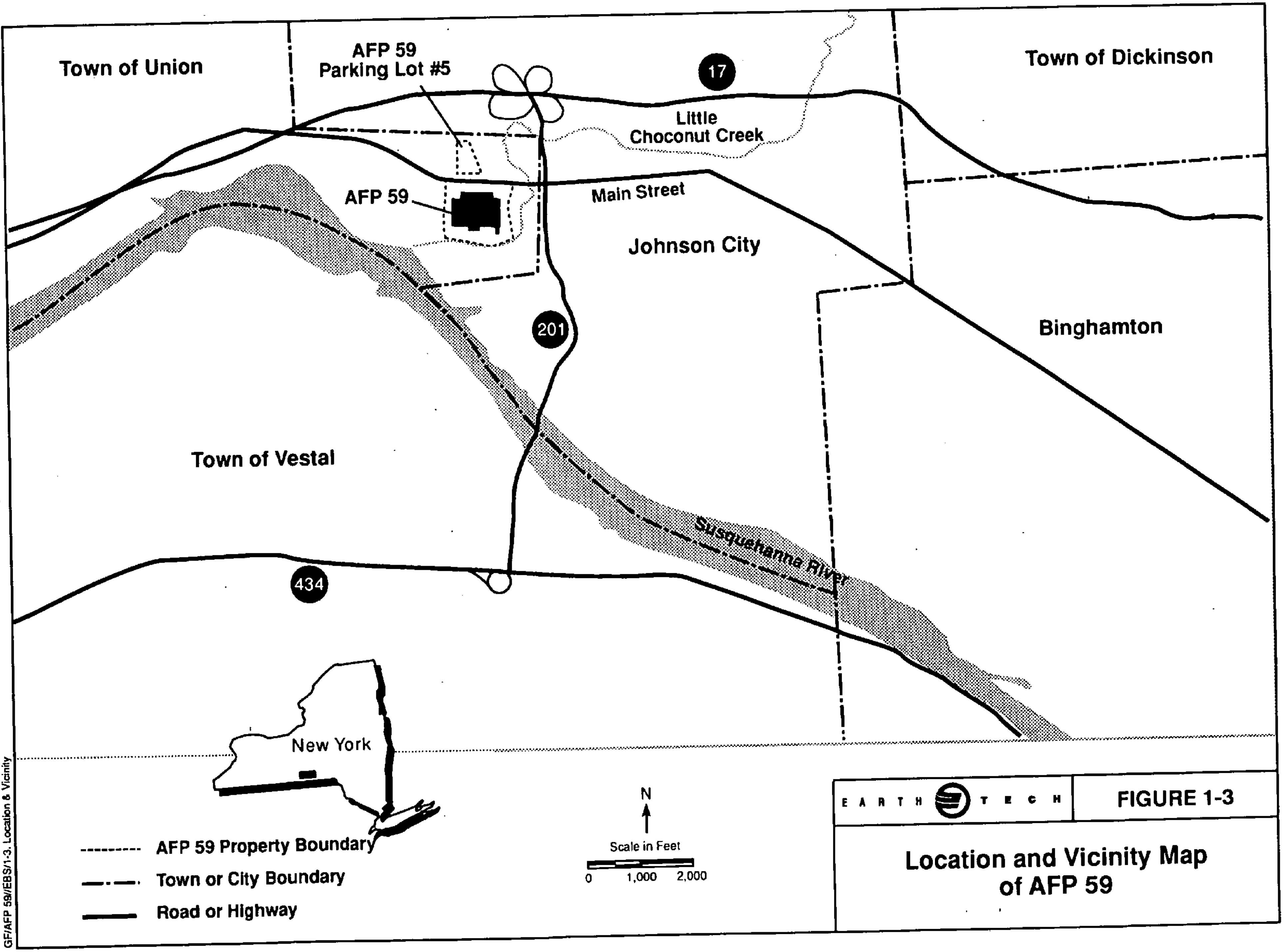

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FIGURE 1-3

Location and Vicinity Map of AFP 59

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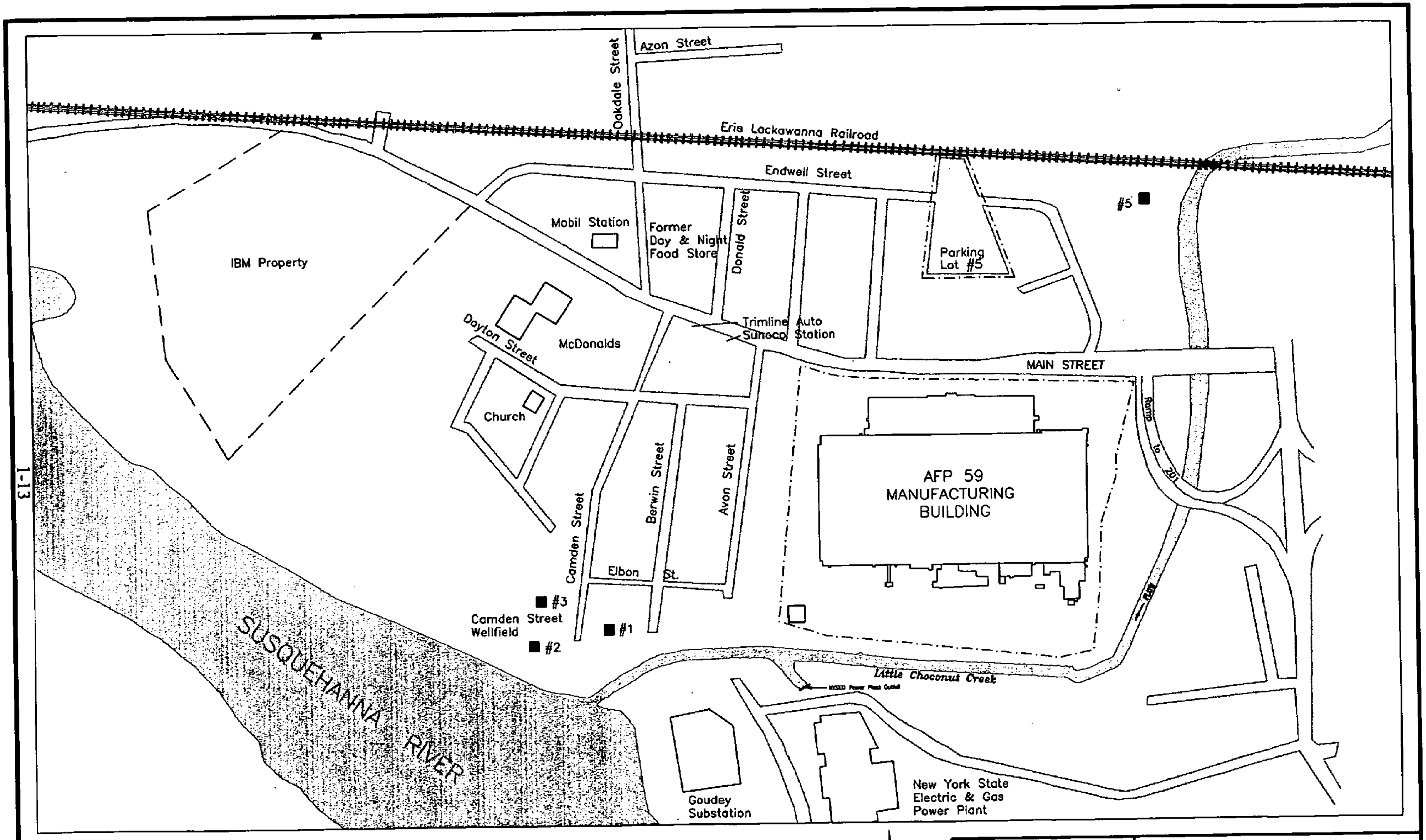

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FIGURE 1-4

LOCATION OF AFP 59 AND SURROUNDING LAND USE

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important source of water for Johnson City, is located approximately 1,000 feet southwest of the plant.

AFP 59 is located within the Appalachian Plateau physiographic province, which is characterized by relatively undisturbed, nearly horizontal sedimentary rocks bisected by stream and river valleys. The topography of the installation is nearly flat and ranges in elevation from 830 to 840 feet above mean sea level (MSL) (USAF, 1993b).

1.2.2 Geology

This section describes the geological setting, including glacial and bedrock geology, in the vicinity of AFP 59. Refer to Section 3.2.1 (Migration Potential) for a more detailed description of the site geology.

1.2.2.1 ***Regional Geology.*** Numerous geological studies have been conducted in the Susquehanna River basin in the vicinity of Johnson City and Binghamton, New York. The following section describes regional characteristics obtained from the New York State Department of Environmental Conservation (NYSDEC) Bulletin 73 (NYSDEC, 1977) and the United States Geological Survey (USGS) Water-Resources Investigations Report 85-4099 (USGS, 1986).

The Susquehanna River basin and vicinity are underlain by Pleistocene-age glacial deposits consisting of sand, gravel, silt, and clay. These deposits began forming approximately 18,000 years ago when the area was covered by glaciers. Figure 1-5 is an idealized cross-section that illustrates the geology in the vicinity of AFP 59.

A generalized diagram showing the sequence of stratified-drift deposition during deglaciation is provided in Figure 1-6. The advancing ice sheet widened stream-formed valleys and scoured the land surface, depositing glacial till. A warming climate caused ice in the uplands to melt rapidly while the valleys remained clogged with ice. The first stratified deposits began to form when meltwater from the uplands carried sediment to the valleys, depositing their sediment load on top of melting ice. Meltwater ponds that formed as the ice melted were rapidly filled with coarse-grained sediments that were interspersed with silt. Masses of debris slumped down into the ponds from adjacent slopes. These early deposits were derived from local bedrock (olive-gray shale and siltstone) and historically have been termed "drab." As the meltwater drainage system extended north, the presence of pebbles derived from distant regions increased. These first stratified deposits are called ice-contact deposits because they were laid down on top of ice. The thickness of the ice-contact deposits ranges from a few feet to between 50 and 100 feet. The thicker deposits tend to occur as "belts parallel to the valley axes" (USGS, 1986, p. 4).

As the ice surface lowered due to melting, the ice-contact deposits began to slump, and in some areas meltwater lakes were created. Fine-grained sediments composed of very fine sand, silt, and clay settled in the lakes on top of the ice-contact deposits. The meltwater streams then began to deposit coarse sand and gravel (outwash) originating from the Chenango Valley on top of the fine-

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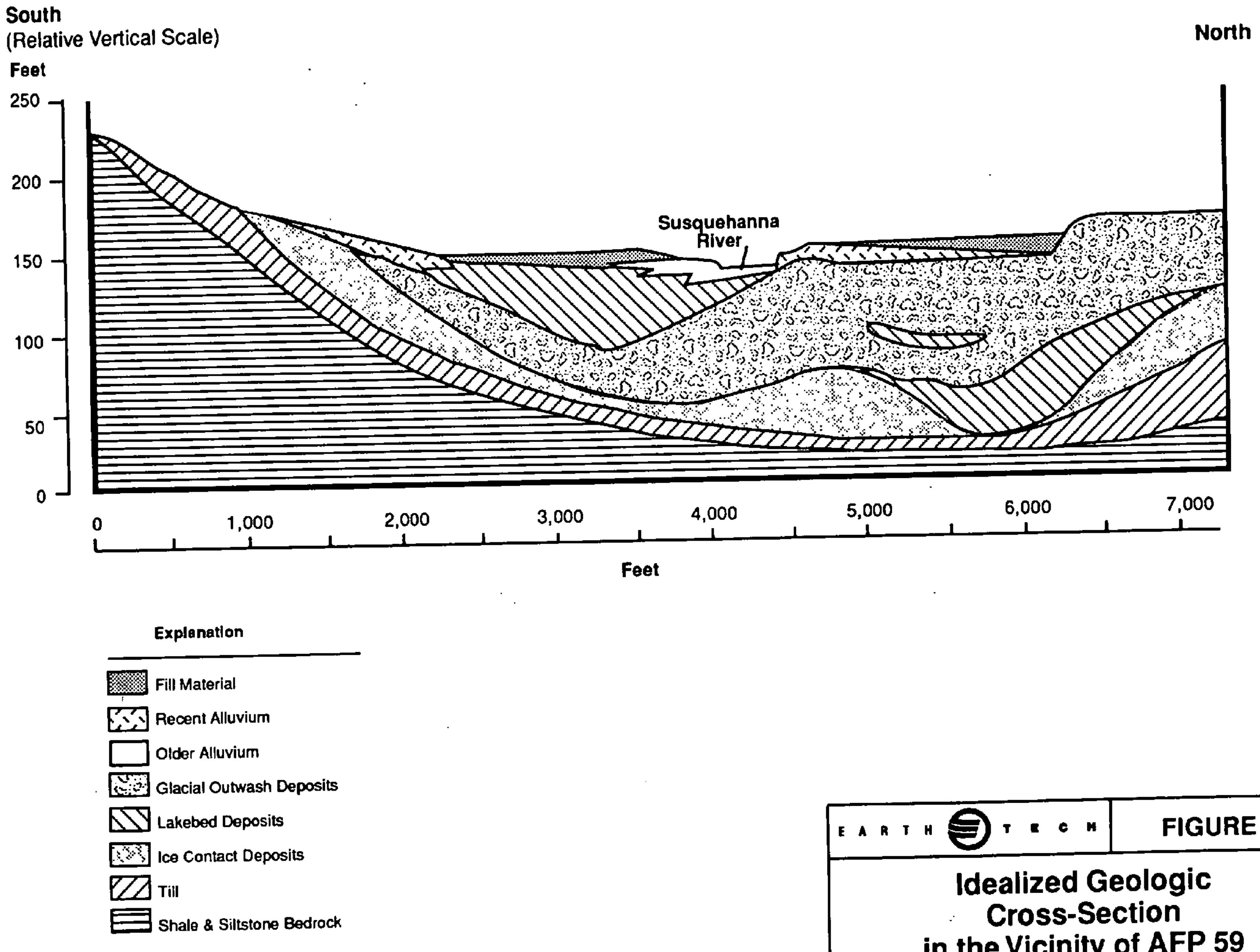

From: NYSDEC Bulletin 73, 1977

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FIGURE 1-5

Idealized Geologic
Cross-Section
in the Vicinity of AFP 59

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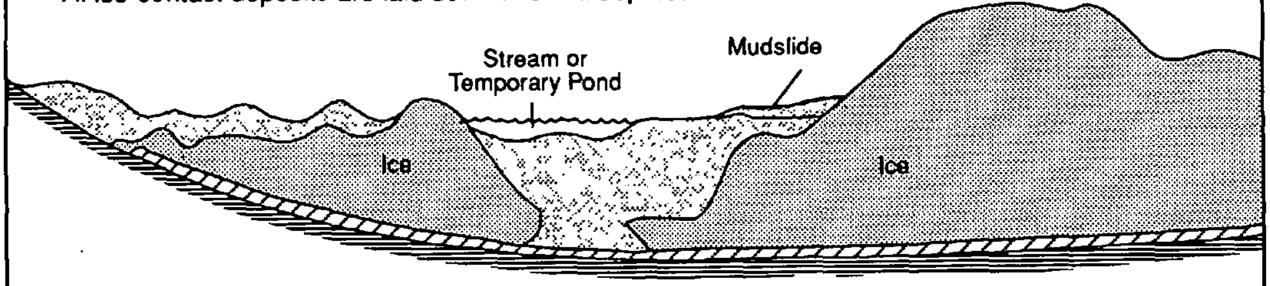
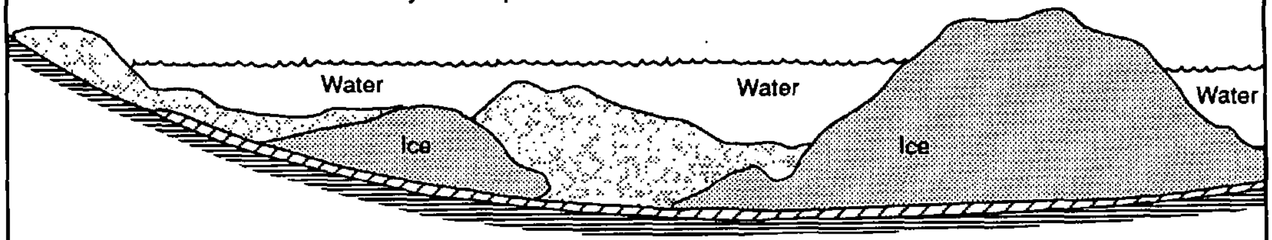
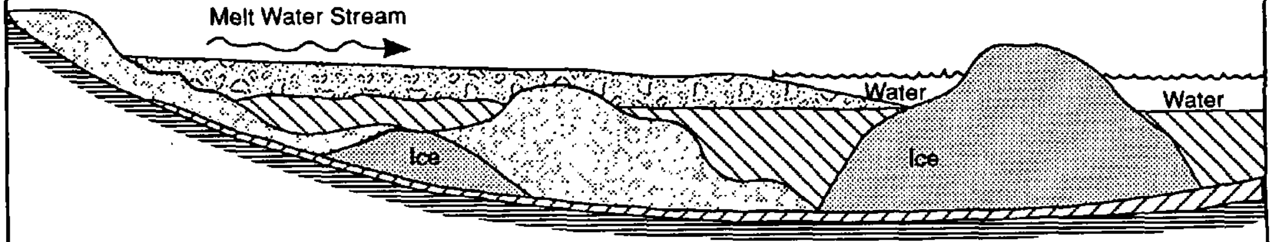
A. Ice-contact deposits are laid down in small depressions.



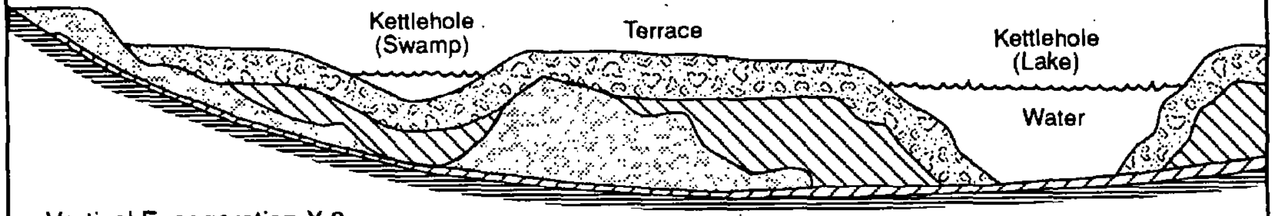
B. As ice surface lowers, ice-contact deposits slump, and a meltwater lake is formed in which silt and clay are deposited.



C. Outwash covers silt and clay deposits.



D. Remaining buried ice melts, causing nearby strata to collapse; this forms the modern surface. Postglacial sediments accumulate in depressions.



Vertical Exaggeration X 2

Explanation

- ▨ Glacial Outwash Deposits
- ▨ Lakebed Deposits
- ▨ Ice-Contact Deposits
- ▨ Glacial Till
- ▤ Shale Bedrock

From: USGS Water-Resources Investigations Report 85-4099

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FIGURE 1-6

Sequence of Stratified-Drift Deposition During Deglaciation

GF/AFP-59/EBS/1-6.Stratified Drift Deposition

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grained lake sediments in broad stream channels and deltas. These outwash deposits have historically been termed "bright" because the gravel is derived from more distant and colorful bedrock. The outwash deposits covered practically the entire width of the Susquehanna Valley, with thicknesses ranging from 10 to 100 feet.

When the buried ice blocks finally melted, the overlying deposits sagged and formed depressions called kettleholes. Sediments have been accumulating in these depressions for 15,000 years. Kettleholes that are near rivers have been filled primarily with silt, with occurrences of coarse-grained sediments from floods. Remote kettleholes formed peat swamps. Many kettleholes have been filled by man with trash and debris.

The most recent deposits in the area are alluvial fan and flood plain deposits that formed in postglacial streams and rivers. Silt, fine sand, and gravel make up these deposits.

The lithologic units found in the Susquehanna River basin are described in detail below in order from youngest to oldest. Figure 1-7 shows the surficial geology in the vicinity of AFP 59.

FILL. The fill is composed of garbage and ashes, in addition to some natural sand and gravel deposits. The fill has been placed into natural and excavated depressions at thicknesses of 5 to 20 feet.

ALLUVIUM. Alluvium occurs as flood plain deposits and alluvial fans. The flood plain deposits consist of approximately 15 feet of silt to fine sand that commonly overlie and are interbedded with 10 to 15 feet of a noncalcareous sandy pebble-cobble gravel. The alluvial fans are composed of 10 to 20 feet of silty, noncalcareous gravel. In some locations, older alluvial deposits interfinger with postglacial lakebeds.

POSTGLACIAL LAKEBEDS. Postglacial lakebeds formed in kettleholes and are scattered throughout the area. Water entering into the lakes from bordering streams and flood episodes deposited very fine sand, silt and clay. Sediment thicknesses in some postglacial lakebeds have been measured to be as much as 80 feet.

GLACIAL OUTWASH. Glacial outwash deposits are composed of 10 to 40 feet of sandy-pebble gravel and pebbly coarse to fine sand. Trace to moderate amounts of highly calcareous silts are also present. In some areas, the thickness of this deposit reaches 100 feet. The material for the coarse sediments was derived from the Chenango Valley and has been termed "bright" because 20 to 40 percent of these materials are colorful.

FINE-GRAINED GLACIAL DEPOSITS. Fine-grained glacial deposits are composed of silt, silty clay, and silty-fine sand and may be a significant barrier to vertical groundwater flow. The thickness of the fine-grained glacial deposits varies from 0 to 80 feet. The deposits, generally interpreted as glacial lakebed deposits, typically occur as lenses of limited areal extent; however, extensive deposits are present west of Johnson City. Fine-grained glacial deposits typically overlie ice-

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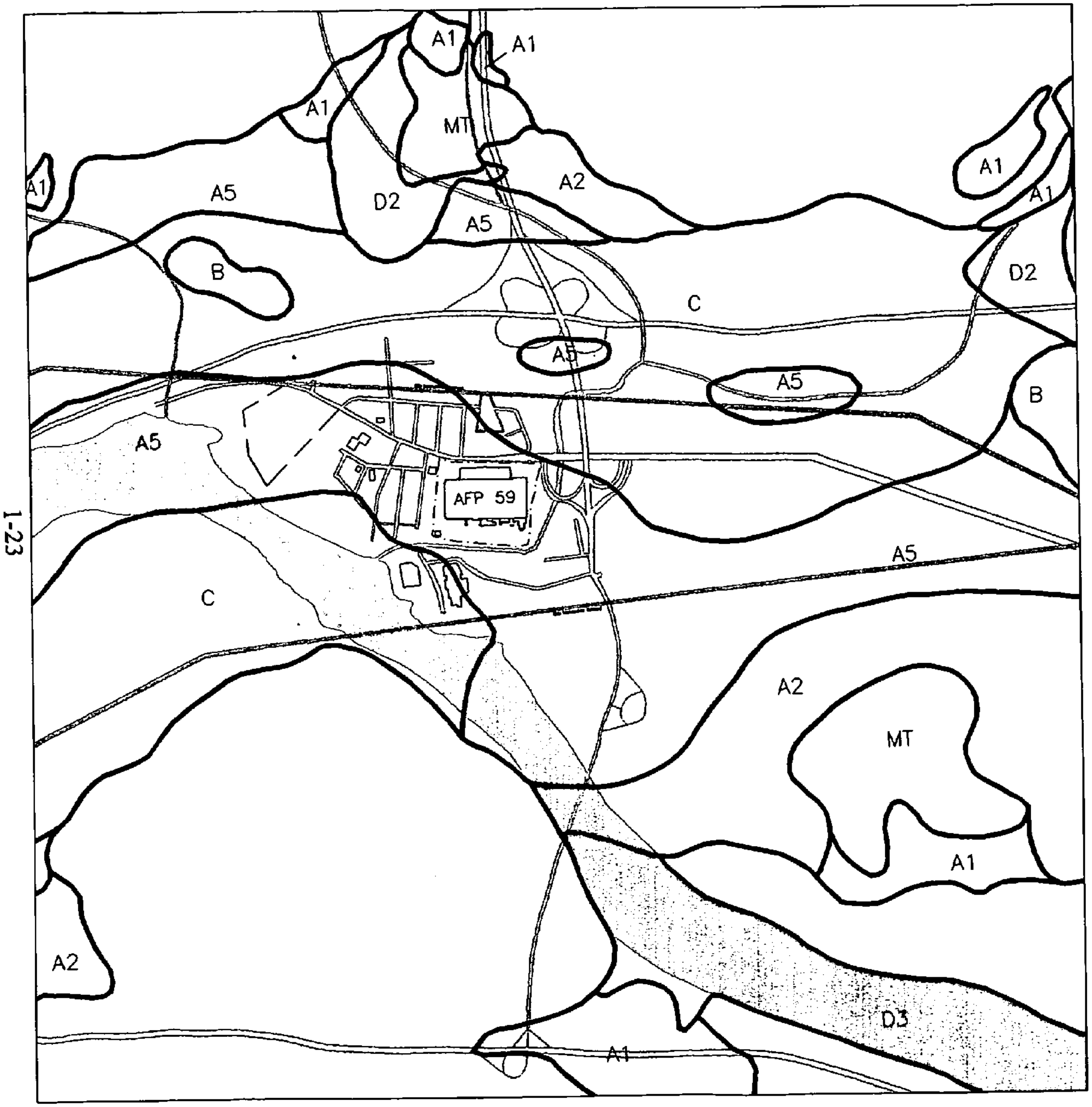

LEGEND

A1 – Ice-contact Deposits Along Valley Walls

A2 – Unsaturated Glacial Outwash Overlying Ice-contact Deposits

A5 – Glacial Outwash Overlying Ice-contact Deposits

B – Postglacial Lakebeds

C – Glacial Outwash Overlying Glacial Lakebeds

D2 – Alluvial Fans of Tributary System

D3 – Alluvium of Susquehanna River

MT – Morainal Till

–·– – AFP 59 Property Boundary

NOTE: Areas without labels represent Till.

Source: USGS Water Resources Investigations Report 85-4099

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FIGURE I-7

SURFICIAL GEOLOGY IN THE VICINITY OF AFP 59

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contact deposits, but have been found in some areas to interfinger with or overlie glacial outwash deposits.

ICE-CONTACT DEPOSITS. Ice-contact deposits in the Susquehanna River Valley are composed of sandy pebble to cobble gravel and pebbly sand with slight to abundant quantities of silt. The thickness of the ice-contact deposits varies from 0 to 100 feet. The ice-contact deposits are locally overlain by either glacial lakebed deposits or outwash deposits. The coarse sediments were derived from local olive-gray colored bedrock; therefore, the term "drab" has been applied.

GLACIAL TILL. The glacial till deposits are the oldest formation above bedrock and were deposited directly by glacial ice. These deposits range from 1 to 2 feet thick on steep slopes and are tens of feet thick beneath hillsides. The glacial till is a tough, compact, unsorted silt, clay, sand, and gravel.

BEDROCK. Shales and siltstones make up the bedrock material that underlies the glacial deposits throughout southern New York. These strata originated from the uplift of the Appalachian Range during the Acadian Orogeny (Devonian Period, 345 to 410 million years ago), with the clastic source area lying to the east. Large volumes of sediment eroded from the uplifted area were deposited in the shallow oceanic environment lying to the west of the growing mountain range. These sediments accumulated to form a thick sequence now known as the Catskill Clastic Wedge. Subsequent uplifting from a later orogenic event exposed the clastic bedrock to erosional forces, shaping the material to preglaciation form.

1.2.2.2 Site Geology. The subsurface geology at AFP 59 has been characterized through the evaluation of geologic borehole logs from monitoring wells and soil borings located across the site. The following section briefly describes the subsurface geology. Refer to Section 3.2.1 (Migration Potential) for a more detailed description of the site geology.

The subsurface geology at AFP 59 generally consists of approximately 75 to 100 feet of stratified, unconsolidated glacial deposits overlying glacial till and shale and siltstone bedrock. The stratigraphy generally consists of 2 to 5 feet of artificial fill, 3 to 34 feet of glacial outwash deposits, 0 to 54 feet of fine-grained glacial deposits, and 15 to 64 feet of ice-contact deposits. The maximum known thickness of the glacial till is 12 feet in the northeast corner of the property. The fine-grained glacial deposits are not present in the northeast portion of the site where glacial outwash deposits are in direct contact with ice-contact deposits. A thin layer of fine-grained alluvium overlies the glacial outwash deposits on the eastern portion of the site.

1.2.2.3 Soil. Soils in the vicinity of AFP 59 are composed of silty alluvial materials. The soils do not support heavy loads well and are subject to erosion. The materials were emplaced during the construction of the plant to elevate buildings above the flood plain. The western edge of AFP 59 is covered by disturbed or reworked loamy materials of glacial origin. Soils to the east of AFP 59 are gravelly and generally good for highways and building sites.

1.2.3 *Hydrogeology*

Numerous hydrogeological studies have been conducted in the Susquehanna River basin in the vicinity of Johnson City and Binghamton, New York. The following section summarizes aquifer characteristics described in these studies (NYSDEC, 1977; CH_2M Hill, 1984; USGS, 1986; Fred C. Hart Associates, Inc., 1988; URS Consultants, Inc., 1992; and Argonne National Laboratory, 1994). Refer to Section 3.2.1 (Migration Potential) for a detailed description of the site hydrogeology.

1.2.3.1 *Aquifer Identification*

BEDROCK AQUIFER. Groundwater is present in bedrock but generally provides limited quantities of water. Typically, wells completed in bedrock yield on average less than 10 gallons per minute (gpm). However, some bedrock wells that are completed several hundred feet deep into the bedrock have yielded 100 to 300 gpm (Argonne National Laboratory, 1994). The bedrock aquifer is generally considered a limited groundwater source.

CLINTON STREET-BALLPARK AQUIFER. The Clinton Street-Ballpark Aquifer is a highly productive aquifer, yielding 400 to 2,290 gpm, that underlies 3 square miles within the Greater Binghamton area (CH_2M Hill, 1984). It is associated with the Endicott-Johnson City Aquifer, but because of boundary conditions is considered a separate aquifer. The Clinton Street-Ballpark Aquifer's boundaries are the impermeable bedrock to the north, glacial till and impermeable bedrock to the south, the Chenango River to the east, and the Susquehanna River to the southwest (Figure 1-8). AFP 59 is located on the western edge of the aquifer.

The formations that make up the Clinton Street-Ballpark Aquifer are the glacial outwash deposits and the underlying ice-contact deposits, with occurrences of fine-grained glacial deposits that may locally restrict vertical groundwater movement. The aquifer is locally separated into two zones (shallow and deep) in areas where the fine-grained glacial deposits are present. In general, the shallow zone of the aquifer is comprised of glacial outwash deposits and the deep zone of the aquifer is comprised of ice-contact deposits. Section 3.2.1 (Migration Potential) describes the hydrogeology of the system in detail.

1.2.3.2 Groundwater Use and Well Inventory. Groundwater from the Clinton Street-Ballpark Aquifer is used for municipal and industrial purposes. Figure 1-9 displays the locations of observation wells and municipal and industrial production wells in the vicinity of AFP 59. In 1985, the USEPA designated the aquifer as a sole-source aquifer under the Safe Drinking Water Act (50 Federal Register 2025, January 14, 1985). To be designated as a sole-source aquifer, the act requires that the aquifer be the sole or principal drinking water source in the area and that contamination of the aquifer would create a significant public health hazard. The Clinton Street-Ballpark Aquifer serves approximately 128,000 people in the communities of Johnson City, Endicott, Nichols, Owego, Vestal, and Waverly.

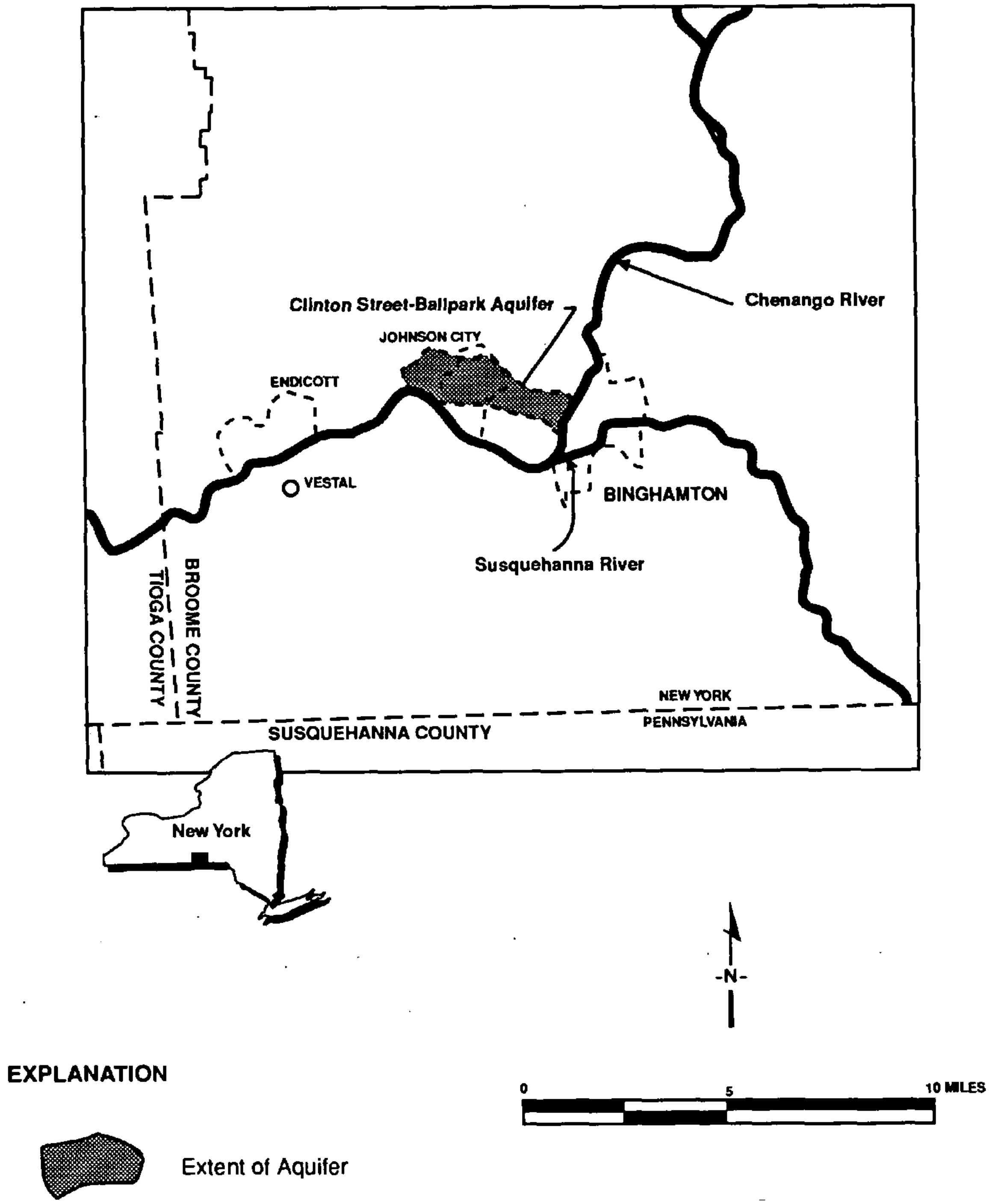

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FIGURE 1-8

Location of the Clinton Street-Ballpark Aquifer

Source: NYSDEC Bulletin 73, 1977

AFP-59/EBS/Clinton St.-Ballpark Aquife

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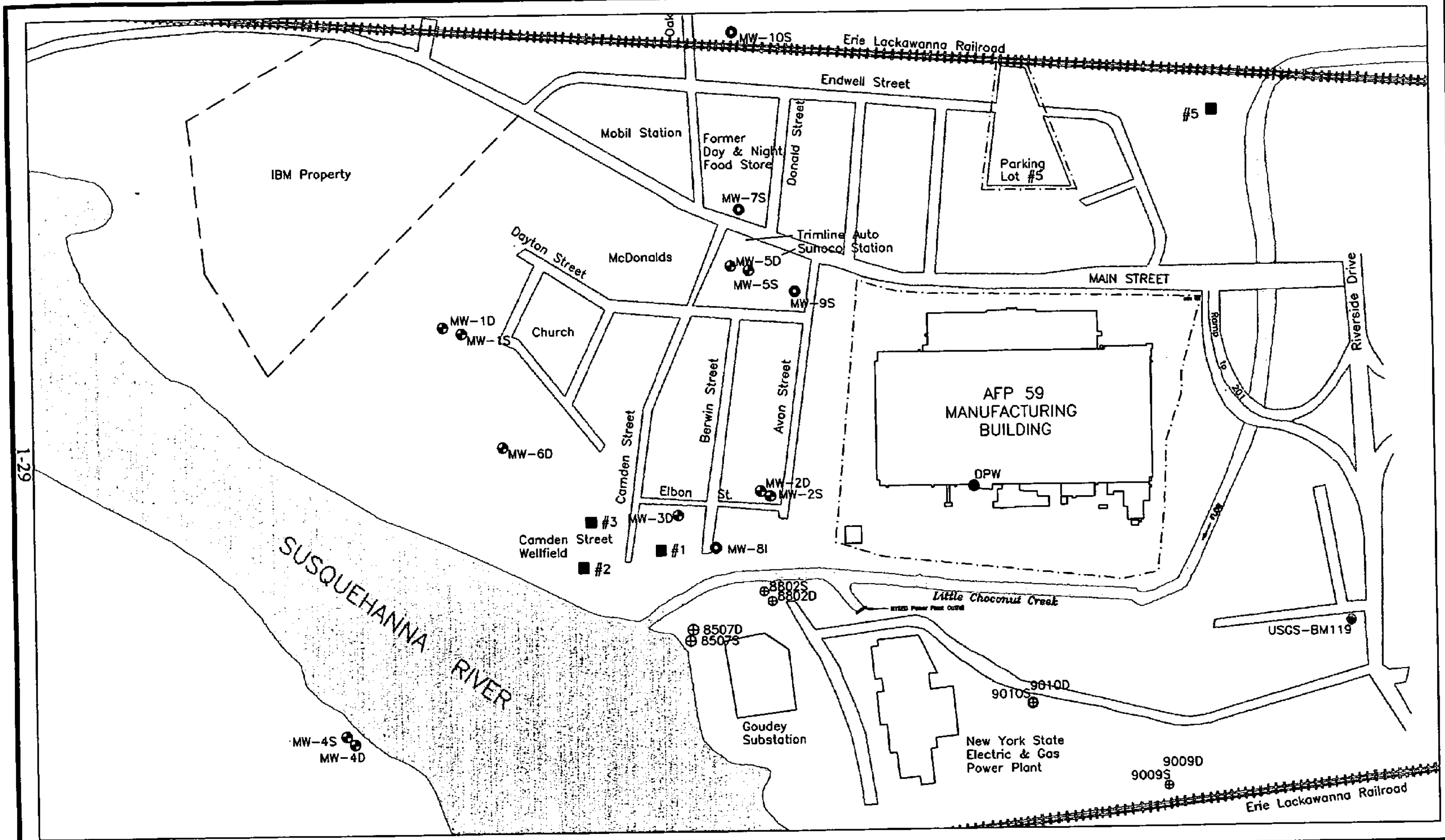

LEGEND

- ■ – Johnson City water supply wells
- ⊕ – NYSEG monitoring wells
- ⊕ – Monitoring Wells installed in 1991 for the Contaminant Source Investigation (URS, 1992)
- ○ – Monitoring Wells installed in 1992 for the Contaminant Source Investigation (URS, 1993)
- —·—·— – AFP 59 Property Boundary
- ● – AFP 59 Industrial Production Well
- ⊕ – USGS Monitoring Well

EARTH TECH

FIGURE I-9

LOCATION OF OBSERVATION WELLS AND MUNICIPAL AND INDUSTRIAL PRODUCTION WELLS IN THE VICINITY OF AFP 59

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The Johnson City Water Department maintains seven deep production wells (Production Wells 1 through 7) that supply potable water to the Village of Johnson City as well as to a portion of the Town of Union that lies north of the village (URS Consultants, Inc., 1992). Three of the Johnson City Water Department municipal production wells are located southwest of AFP 59 at the Camden Street Wellfield, and one municipal production well is located northeast of AFP 59 (see Figure 1-9). The overall capacity of the seven production wells is 8 million gallons per day (mgd). The current capacity of the 3 production wells at the Camden Street Wellfield is 3 mgd.

1.2.3.3 Aquifer Characteristics. The Clinton Street-Ballpark Aquifer ranges in thickness from 80 to 180 feet. Transmissivity of the aquifer generally ranges from 10,000 square feet per day (ft^2/day) to 50,000 ft /day and may reach values of 100,000 ft /day in certain areas (URS Consultants, Inc., 1992).

Figure 1-10 presents a regional groundwater flow net of the aquifer for October 6, 1967. Groundwater flow lines point in the direction of production wells that were in operation on or around October 6, 1967 (NYSDEC, 1977). Historic potentiometric surface maps portraying the groundwater flow directions prior to high volume pumping of the Clinton Street-Ballpark Aquifer have not been found. Therefore, no information is available on groundwater flow directions without the influence of production wells.

Figures 1-11 and 1-12 show potentiometric maps of the shallow and deep zones of the aquifer in the vicinity of AFP 59 that were created from groundwater level data collected in August 1994. The maps display groundwater flow directions very similar to 1967; the impact of pumping at the Camden Street Wellfield is illustrated, with contours becoming increasingly concentric as they get chosen to the wellfield. In addition, the August 1994 data show that groundwater flow patterns and response to pumping at the Camden Street Wellfield are similar in the shallow and deep zones of the aquifer.

1.2.3.4 Aquifer Discharge and Recharge. Prior to large-scale groundwater development, the Clinton Street-Ballpark Aquifer received water from precipitation and discharged groundwater into the Susquehanna and Chenango Rivers and their tributaries. Since the 1940s, the aquifer has been heavily used for Johnson City public water supply and industrial purposes. Studies have shown that groundwater no longer discharges into the Susquehanna and Chenango Rivers (NYSDEC, 1977; USGS, 1986). Instead, groundwater is discharged through pumped municipal and industrial production wells. The potentiometric surface has been lowered by as much as 23 feet in the Clinton Street-Ballpark Aquifer, causing the channels of Little Choconut Creek and the Susquehanna and Chenango Rivers to lie above the potentiometric surface (NYSDEC, 1977).

Today, sources of recharge to the aquifer include precipitation, infiltration from streams, runoff from upland areas, and underflow from adjacent aquifers (URS Consultants, Inc., 1992). Induced infiltration from the Susquehanna and Chenango Rivers resulting from high-volume pumping at wellfields is also a significant source of recharge to the aquifer. Based on water level and pumping information at the Camden Street Wellfield, the percentage of induced infiltration to total

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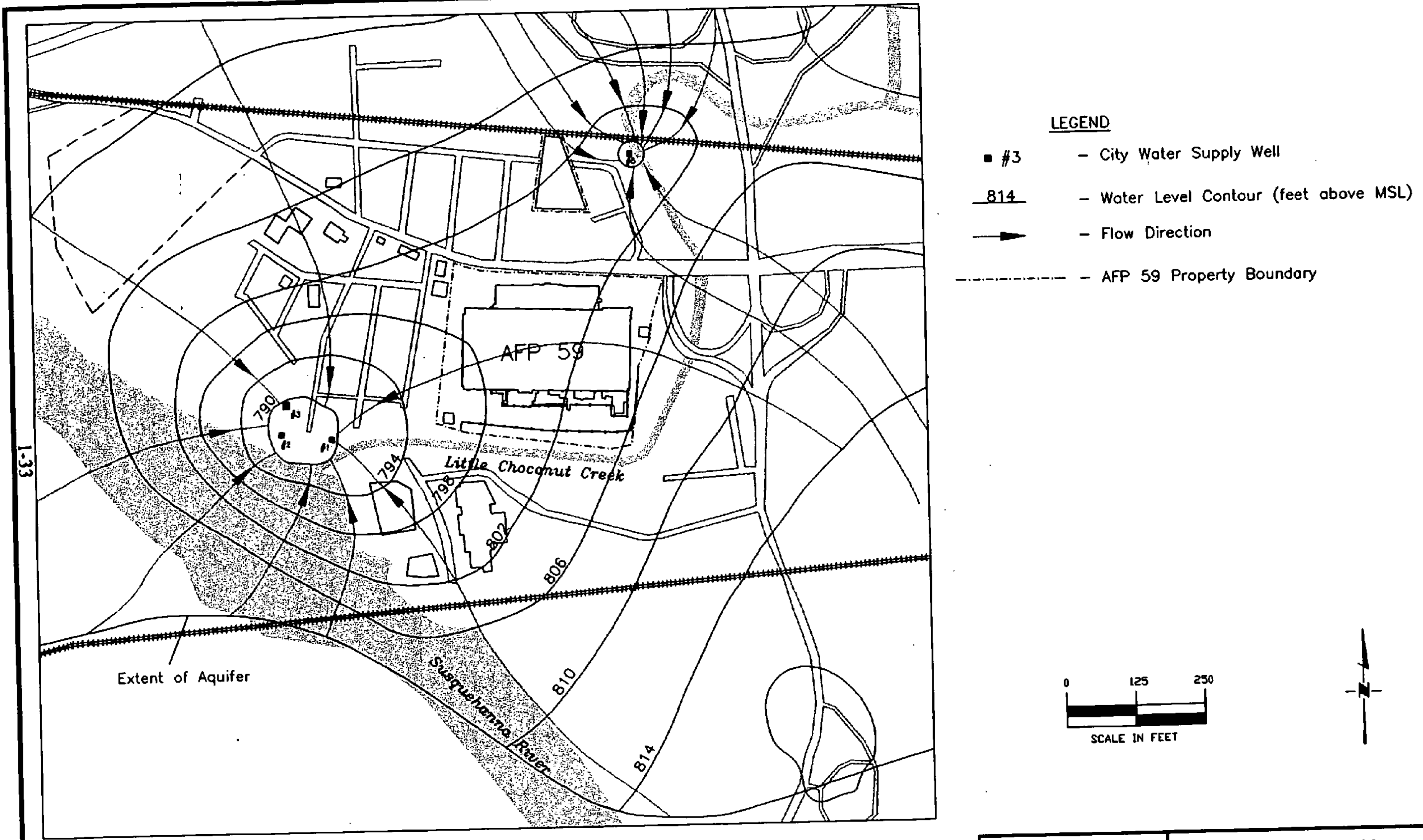

EARTH TECH

FIGURE 1-10

REGIONAL GROUNDWATER FLOW NET OF THE
CLINTON STREET – BALLPARK AQUIFER
OCTOBER 6, 1967

Source: NYSDEC Bulletin 73, 1977

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volume pumped at the wellfield is 57 percent (NYSDEC, 1977). Evidence for induced infiltration from streams has been documented on the following basis (NYSDEC, 1977): 1) the presence of coliform bacteria in a municipal well located several miles west of Johnson City; 2) fluctuating groundwater temperatures from 1°C to 22°C in the aquifer near rivers, whereas groundwater temperatures in deeper portions of the aquifer remain steady at 11°C; and 3) the aquifer is more mineralized in deeper portions of the aquifer than in portions of the aquifer near rivers where infiltration from river water occurs.

1.2.3.5 ***Groundwater Quality.*** According to a 1986 study, the groundwater temperature in the Clinton Street-Ballpark Aquifer ranges from 9°C to 11.5°C (USGS, 1986). Seasonal fluctuations occur in the aquifer within 20 feet of the land surface. The largest temperature fluctuations occur in the most permeable layers, especially when they are close to rivers. Temperatures have been reported to fluctuate from near 0°C in March to 22°C in September (NYSDEC, 1977). Groundwater temperatures have been used to locate induced infiltration in the aquifer.

The New York State Department of Health has monitored the sanitary quality of groundwater pumped from Johnson City Water Department municipal production wells. As of 1977, the presence of coliform bacteria had never been reported in Production Wells 1 through 3 (NYSDEC, 1977). It has been suggested that the bacteria are naturally filtered out of the water by fine-grained riverbed sediments and aquifer deposits (NYSDEC, 1977).

Coliform bacteria have been reported in a municipal well several miles west of Johnson City (NYSDEC, 1977). Riverbed excavation near the well, resulting in the removal of fine-grained sediments, may have allowed river water contaminated with coliform bacteria to enter the aquifer. Modern sewage treatment processes should decrease bacteria populations. However, penetration of bacteria into the aquifer may be expected under conditions of maximum groundwater development (NYSDEC, 1977).

Calcium and bicarbonate are the most abundant dissolved chemical constituents in the Clinton Street-Ballpark Aquifer. According to a 1972 study, the central portion of the aquifer is more mineralized and harder than at the outside edges (NYSDEC, 1977). Water hardness is mostly caused by calcium and magnesium ions. Hardness was found to be 300 milligrams per liter (mg/L) to 400 mg/L in the central portion of the aquifer and 150 mg/L to 210 mg/L near the borders of the aquifer near streams or rivers. The lower concentrations of dissolved solids at the borders of the Clinton Street-Ballpark Aquifer were due to infiltration of river water. Increased mineral content in the aquifer occurred during the late 1950s and 1960s. The increase in mineral content over time in the aquifer was attributed to human activities and development of the shallow zone of the aquifer. The shallow zone of the aquifer contains glacial outwash material with abundant quantities of limestone and dolomite, which are calcium- and magnesium-rich rocks.

1.2.4 Surface Water and Drainage

Two surface water bodies are within 1,000 feet of AFP 59: Little Choconut Creek and the Susquehanna River (see Figure 1-4). Little Choconut Creek borders the plant to the east and south. The creek flows to the west and converges with the Susquehanna River approximately 1,000 feet west of the southwest corner of the plant. The course of the northern branch of Little Choconut Creek was dramatically altered during the development of shopping malls in the area. The course of the creek has also been altered south of the plant; sometime between 1935 and 1968 the creek was moved north, most likely to accommodate trestle construction for the railroad. The U.S. Army Corps of Engineers considers Little Choconut Creek to be State waters for purposes of permitting under Section 404 of the Clean Water Act. The U.S. Fish and Wildlife Service classifies the stream as an upper perennial riverine wetland with unconsolidated bottom that is permanently flooded. In addition, there are areas of palustrine forested wetlands on islands and along the margins of the Susquehanna River downstream from the confluence with Little Choconut Creek.

No municipal users of surface water have been reported within 3 miles downstream of AFP 59 (CH_2M Hill, 1984). The City of Binghamton is the nearest municipal user of water from the Susquehanna River, and the surface water intakes are approximately 5 miles upstream of AFP 59.

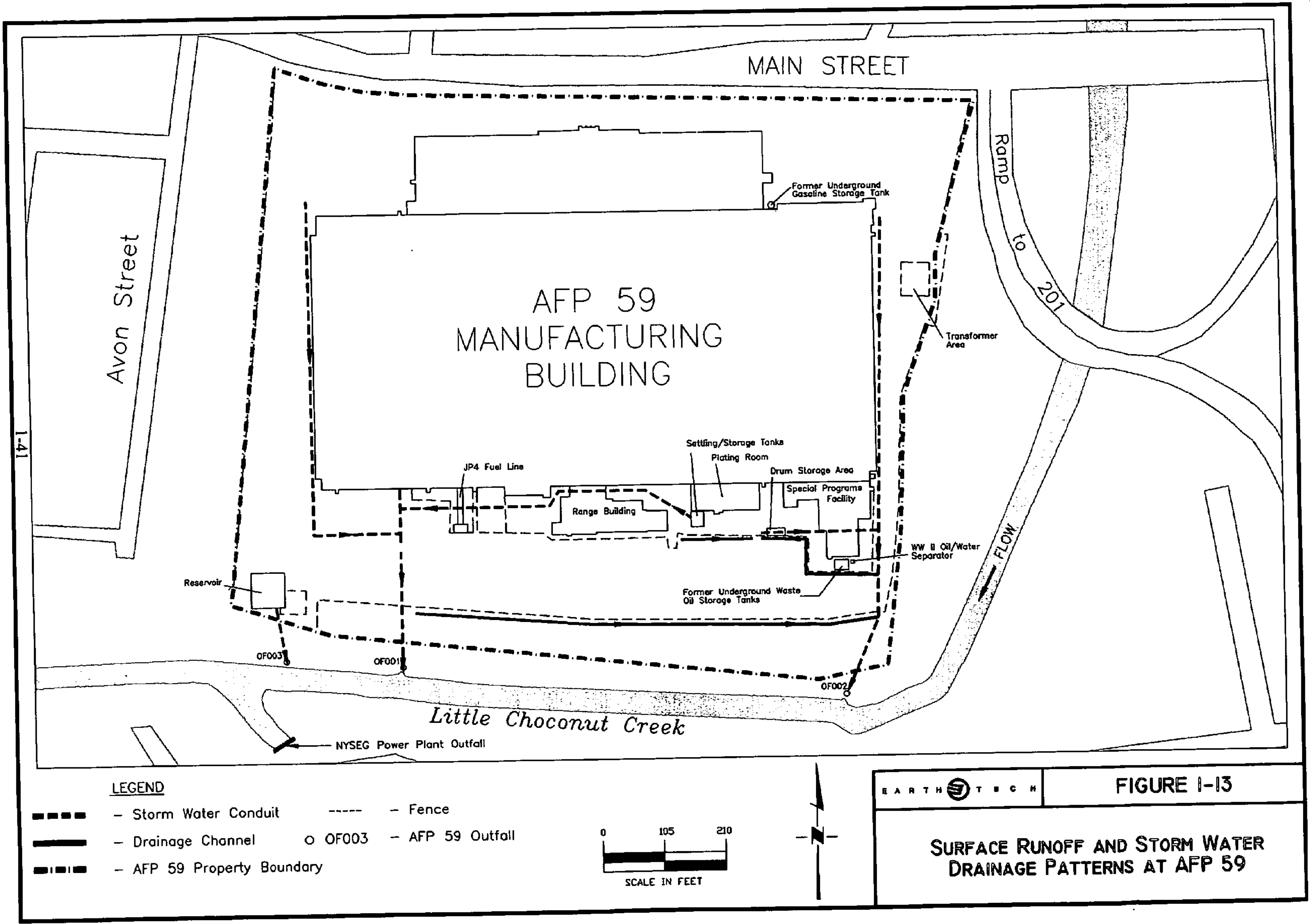
Surface runoff and storm water drainage patterns at AFP 59 are shown in Figure 1-13. Surface runoff from a large part of the southern portion of the plant discharges into Little Choconut Creek south of the plant through two permitted outfalls (001 and 002). A pump located on the flood control structure allows discharge during flood conditions. Much of the surface water from the hazardous waste storage areas, the back loading dock, and the work areas of the plant flows through a drain with an oil/water separator prior to discharge to Outfall 002. Noncontact cooling water drawn from the on-site production well is discharged through Outfall 003.

Although flow in Little Choconut Creek is seasonal, flow is also influenced by industrial stormwater and wastewater discharge. Industrial discharge along the course of the creek, including the AFP 59 outfalls, makes a quantitative evaluation of creek flow and recharge to the aquifer difficult. Municipal stormwater discharge to the creek further complicates the flow characteristics of Little Choconut Creek.

1.2.5 Climatology/Meteorology

The climate in the area is typically humid maritime, with mild summers and long, cold winters. The average annual temperature for nearby Binghamton is 46°F. Monthly mean temperatures vary from 22°F in January to 70°F in July (International Station Meteorological Climate Summary, 1990). The average daily minimum temperature in January is 15°F, whereas the average daily maximum temperature in July is 79°F. Freezing temperatures occur at Binghamton on the average of 147 days per year. The prevailing wind direction is west-southwest. Monthly mean temperature, precipitation, and wind speeds are presented in Table 1.2-1.

Mean annual precipitation in the vicinity of AFP 59 is 36.6 inches per year. The greatest average monthly precipitation occurs in June and July and the least in February. For the most part, precipitation is evenly distributed throughout the year. Snowfall accounts for a large portion of the total precipitation during the winter months, with an annual average of about 85 inches at the



EARTH TECH

FIGURE 1-13

SURFACE RUNOFF AND STORM WATER DRAINAGE PATTERNS AT AFP 59

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TABLE 1.2-1
METEOROLOGICAL DATA FOR BINGHAMTON (1949-1989)

Month	Mean Temperature (°F)	Mean Precipitation (inches)	Mean Wind Speed and Direction (knots)
January	22	2.4	11W
February	24	2.3	11W
March	32	2.8	11NW
April	45	3.2	10W
May	56	3.4	9S
June	65	3.6	9W
July	70	3.6	8W
August	68	3.4	7S
September	60	3.2	8S
October	49	2.8	9S
November	38	3.1	10S
December	27	2.8	10W
Annual	**46**	**36.6**	**9W**

Source: International Station Meteorological Climate Survey, 1990.

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Broome County airport. Mean annual lake evaporation, commonly used to estimate the mean annual evapotranspiration rate, is estimated to be 28 inches per year. Evapotranspiration over land areas may be greater or less than lake evaporation, depending on the amount and type of vegetation and the availability of moisture. Mean annual net precipitation (mean annual precipitation minus mean annual evapotranspiration) is approximately 9 inches per year (CH_2M Hill, 1984).

The background air quality or air attainment status at AFP 59 is designated by the county in which the facility is located (Broome County, New York). On the basis of a June 1993 report on AFP 59's compliance with the 1990 Clean Air Act Amendments, it was determined that AFP 59 is located in an ozone transportation region. This means that AFP 59 must comply with the same restrictions as a moderate nonattainment area for ozone (PRC Environmental Management, Inc., 1993). The report also indicated that AFP 59 did not meet any of the criteria of a major source as defined by the Clean Air Act Amendments of 1990 (PRC Environmental Management Inc., 1993). USEPA regulations designating areas for air quality planning are given in 40 Code of Federal Regulation (CFR) 81. The Broome County area had the following designations: total suspended particulate - better than national standards; carbon monoxide - unclassifiable/attainment; lead - not designated; and nitrogen dioxide - cannot be classified or better than national standards.

1.2.6 Biology

No plant or animal communities are present at AFP 59. Small strands of second growth hardwood forests are located adjacent to the property along Little Choconut Creek and the Susquehanna River; these include sycamores, elms, willows, and others. No endangered or threatened wildlife or plant species are known to occur in the vicinity of AFP 59.

1.3 Site Inventory

Nine sites or areas of concern where past activities at AFP 59 could have resulted in releases to the environment have been identified and are shown in Figure 1-14. The numbering of these sites has varied throughout the IRP process; therefore, the sites discussed below are identified by name, without reference to site numbers.

UNDERGROUND WASTE OIL STORAGE TANKS. This site is located south of the Special Programs Facility at the southeastern corner of the Manufacturing Building (see Figure 1-14). Two interconnected 1,000-gallon underground storage tanks (USTs) were used to store waste cutting oils on a temporary basis. Waste oils were collected from the various machining areas of the plant and then pumped into the USTs for storage pending removal and disposal by a private contractor. Prior to 1969, nonchlorinated, kerosene-based degreasing solvents were used at the plant and stored along with the waste oils. Halogenated solvents, such as trichloroethene, 1,1,1-trichloroethane, and freon, were introduced in 1969. These waste solvents were drummed and recycled on-site where possible or transported off-site by a contractor.

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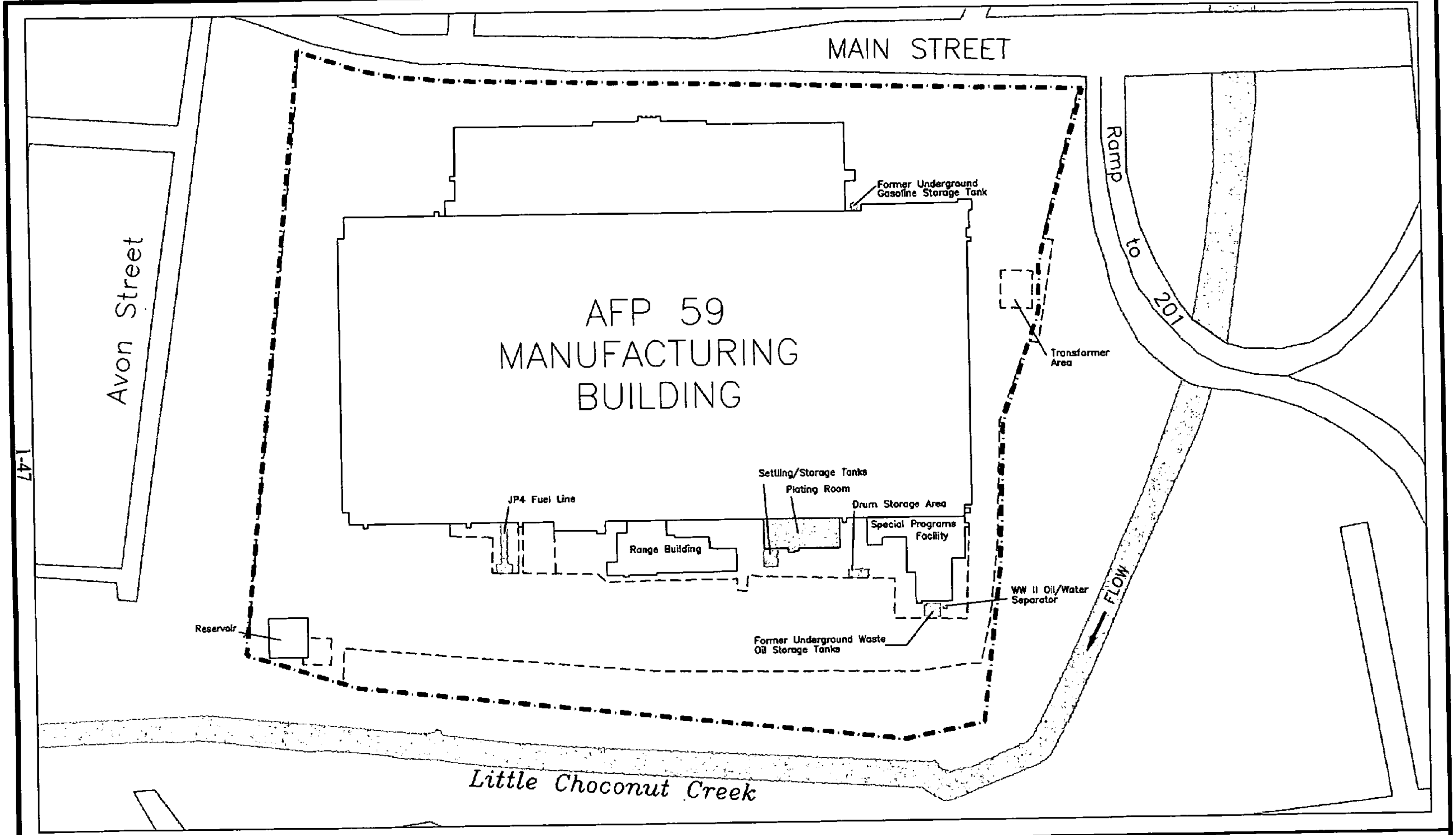

LEGEND

▬ ▪ ▬ – AFP 59 Property Boundary

----- – Fence

▨ – IRP Site or Area of Concern

0 100 200

SCALE IN FEET

EARTH TECH

FIGURE 1-14

IRP SITES AND AREAS OF CONCERN

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The USTs operated from 1953 to 1985, at which time they were removed (USAF, 1993b). The tanks were reportedly inspected daily to prevent overtopping. However, spills reportedly occurred during the removal of oils from the tanks by an outside contractor. During the tank removal, stained gravel and soil were found and determined to be contaminated. This soil was reportedly excavated to a depth of 12 feet (approximately 6 feet below the bottom of the tanks). Soil at the bottom of the excavation, below the removal area, was reportedly sampled and found to be nonhazardous (USAF, 1993b). The contaminated soil was then reportedly removed from the site. However, a tank removal report confirming this information has not been located by EARTH TECH.

Two soil samples from a soil boring were collected and analyzed during the *Supplemental Site Inspection* (SSI) to characterize potential contamination related to the waste oil storage tanks (Argonne National Laboratory, 1994). Both samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and pesticides/polychlorinated biphenyls (PCBs); the second sample was also analyzed for inorganics. The only VOC detected was methylene chloride (7 micrograms per kilogram [μg/kg]) in the shallow sample. A variety of SVOCs were detected at elevated concentrations (88 μg/kg to 9,900 μg/kg) in the shallow sample, whereas fewer SVOCs at lower concentrations were detected in the deep sample. The only pesticide detected was gamma chlordane (24 μg/kg) in the shallow sample. No elevated metals concentrations were detected, although cyanide was detected at 2.6 μg/kg.

Two additional soil samples were collected from 3 feet below ground surface (bgs) west of the former underground waste oil storage tanks, adjacent to the aboveground storage tank (AST), and screened for VOCs, SVOCs, and metals (Argonne National Laboratory, 1994). No VOCs, SVOCs, or elevated metals concentrations were detected.

DRUM STORAGE AREA. The Drum Storage Area is located in the maintenance area south of the Manufacturing Building, southeast of the former Plating Room, and west of the Special Programs Facility. The site has been used as a drum storage area from 1942 to the present. Waste paints, waste oils, and spent kerosene-based degreasers were stored at this area prior to off-site disposal by an outside contractor. The site is currently a less-than-90-day storage area. In 1963, the top 8 inches of soil were removed from the Drum Storage Area, and the site was paved (USAF, 1993b). Employees reported spills prior to the paving in 1963. The area was repaved in late 1970.

One soil sample was collected from 3 feet bgs immediately south of the Drum Storage Area during the SSI and screened for VOCs, SVOCs, and metals (Argonne National Laboratory, 1994). No VOCs, SVOCs, or elevated concentrations of metals were detected.

"SOUTHSIDE Z." Southside Z has been deleted from the list of IRP sites because of insufficient documentation regarding its location and use (USAF, 1993b).

LITTLE CHOCONUT CREEK. Little Choconut Creek is located on the plant's eastern and southern borders. It was placed on the IRP list because three wastewater outfalls enter the creek south of the plant. These outfalls are potential sources of contamination (USAF, 1993b).

Three sediment and surface water samples were collected from Little Choconut Creek during the SSI (Argonne National Laboratory, 1994). Water samples were also collected from Outfalls 001 and 002 during the investigation. The sediment and surface water sample pairs were collected in the following locations: one upstream of Johnson City near the source of the stream; one upstream of the three outfalls on the eastern side of the plant; and one downstream of the three outfalls. The only VOC detected in the three sediment samples was methylene chloride (8 μg/kg), which was detected in the sample downstream of the outfalls. SVOCs and aldrin were detected in two of the three sediment samples; copper and vanadium were detected at slightly elevated concentrations in the sediment. No VOCs, SVOCs, or pesticides/PCBs were detected in the surface water sample collected downstream of the outfalls; however, mercury was detected at 4.9 micrograms per liter (μg/L).

Trichloroethene (TCE) was detected in both outfall samples at concentrations of 0.3 μg/L at Outfall 001 and 4 μg/L at Outfall 002. At Outfall 001, 1,1,1-trichloroethane (1,1,1-TCA) and bromoform were also detected at concentrations less than 1 μg/L. Acetone and SVOCs were detected at Outfall 002.

PLATING BUILDING. The Plating Building is located south of the Manufacturing Building, between the Range Building and the Special Programs Facility. Operations in the Plating Room produced various wastes, including plating acids, caustic sludges, and chromium and cyanide solutions. The plating acid wastes were typically mixed sulfuric, nitric, muriatic, and chromic acids. Spent plating solutions included copper cyanide, nickel cyanide, and cadmium cyanide. The acid wastes were pumped to the plating waste storage tank and neutralized prior to removal by an outside contractor. The cyanide waste was drummed for off-site disposal (CH_2M Hill, 1984). Various degreasing activities also occurred in the Plating Room. Plating operations were discontinued in 1991, and the plating equipment was removed in 1992. At the time of closure, 89 tanks of various sizes, mostly less than 250 gallons, were located in the Plating Room. The Plating Room was decommissioned in 1992 and 1993 and is currently undergoing an NYSDEC-coordinated closure (USAF, 1993b).

Five Plating Room investigations were conducted between 1987 and 1994. In 1987, six soil samples were collected from three shallow soil borings (0 to 10 feet bgs) immediately south of the Plating Room and one shallow soil sample from below the Plating Room as part of the Stage 1 IRP investigation (Fred C. Hart Associates, Inc., 1988). The samples were analyzed for extraction procedure (EP) toxicity metals and total chromium. Two investigations were conducted that consisted of soil sampling in the Plating Room (OHM Remediation Services Corporation, 1993a, 1994). In 1993, 22 soil samples were collected, most of which were collected 6 inches below the concrete floor. In 1994, three additional soil samples were collected at a depth of 6 to 12 inches bgs. The 1993 soil samples were analyzed for VOCs, SVOCs, toxicity characteristic leachate procedure (TCLP) metals, and/or TCLP VOCs; the 1994 soil samples were analyzed for pesticides/PCBs, TCLP metals, SVOCs, and VOCs. In 1994, a monitoring well pair (SW4 and DW4) was installed immediately west of the Plating Room (Argonne National Laboratory, 1994). Two soil samples were collected from SW4 (6 to 8 feet bgs and 15.2 to 17.2 feet bgs), and groundwater samples were collected from both SW4 and DW4. Additionally, three hand auger soil samples and one soil boring sample were collected south of the Plating Room. With the exception of the hand auger samples, which were analyzed using field screening techniques, all samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and inorganics. During the final investigation, two soil samples were collected from two soil borings located in the Plating Room (Blasland, Bouck, and Lee, Inc., 1994).

TCE was detected in the groundwater sample from SW4 at 97 μg/L. Low levels of 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), methylene chloride, and 1,1,1-TCA were also detected at SW4. Low levels of TCE and 1,1,1-TCA were detected at DW4. No SVOCs or pesticides/PCBs were detected in the groundwater. Aluminum, barium, calcium, iron, lead, magnesium, manganese, potassium, and sodium were detected in all groundwater samples during two sampling rounds. The following inorganics were also detected at SW4: arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, silver, thallium, and zinc. Cadmium, silver, and thallium were also detected at DW4.

Three VOCs (methylene chloride, acetone, and TCE) have been detected in soil samples. The maximum TCE concentration detected was 6 μg/kg in the sample collected from 15.2 to 17.2 feet bgs at SW4. Twelve SVOCs and PCB-1260 were also detected (although 11 of them were detected in one sample). The metals analyses of the soil samples indicated the presence of antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, and cyanide.

STORAGE TANK AND SETTLING POND. The storage tank and settling pond are located adjacent to the southwestern corner of the Plating Building. The plating waste storage tank is an open-top, in-ground, rectangular tank. The walls of the tank are approximately 8 feet high. The tank is constructed of concrete, with an inner layer of acid brick and a fiberglass inner liner. The storage tank stored spent plating liquids prior to removal by an outside disposal contractor. Burnite was also stored in the tank from December 1990 to June 1991. Use of the storage tank was discontinued in June 1991 (USAF, 1993b).

The settling pond is a brick-lined, open-top, in-ground tank. From 1952 to 1969, plating rinsewater was discharged to the settling tank for metals precipitation and then discharged to Little Choconut Creek through Outfall 001. Between 1969 and 1984, ferrous sulfate was added to plating rinsewaters before entering the settling tank to reduce hexavalent chromium to trivalent chromium and precipitate the metals. The treated rinsewater was discharged to the creek through Outfall 001. The precipitate was periodically transferred to the adjoining storage tank for subsequent disposal by a contractor.

In July 1984, a new plating rinsewater treatment and reuse system was installed. The plating rinsewater passed through the settling tank and grease trap and was treated by anion and cation exchange columns. It was then stored in an underground tank for reuse. The brine generated during this process was placed in the storage tank and removed from the site by a contractor. In 1988, the treatment system became contaminated, and the system was abandoned. From 1988 to 1991, plating rinsewater was discharged into the sanitary sewer. Plating operations were discontinued in 1991, and the storage and settling tanks have not been used since then. The tanks are currently undergoing an NYSDEC-coordinated closure.

Soil samples were collected from the storage tank and settling pond area during five investigations from 1991 to 1994. In 1991, as part of the closure of plating operations, two composite samples were collected from locations immediately west of the storage tanks and settling pond (Marcor of New York, Inc., 1991). The samples were analyzed for TCLP metals and TCLP volatiles. Also in 1991, two soil samples were collected from soil borings located immediately west of the storage tank and settling pond; all samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and inorganics (Argonne National Laboratory, 1994). In 1992, three samples were collected immediately west, south, and east of the storage tank; the samples were analyzed for TCLP pesticides and herbicides, total metals, TCLP metals, TCLP SVOCs, VOCs, and TCLP volatiles. In 1993, four soil samples were collected from beneath the storage tank and settling pond; the samples were analyzed for metals and VOCs (OHM Remediation Services Corporation, 1993b). In 1994, one soil sample was collected from a soil boring through the bottom of the settling pond (Blasland, Bouck and Lee, 1994). The sample was analyzed for VOCs.

VOCs detected during the four investigations include methylene chloride, acetone, TCE, and tetrachloroethene. The only SVOC detected was bis(2-ethylhexyl)phthalate (91 μg/kg) from a soil sample located immediately west of the settling pond. The following metals were detected above NYSDEC soil cleanup levels: arsenic, cadmium, chromium, copper, lead, manganese, nickel, and zinc. No metals were found above the TCLP limit.

FORMER GASOLINE STORAGE TANK. A gasoline storage tank was located north of the Manufacturing Building and east of the office building (see Figure 1-14). The 1,000-gallon UST was removed in 1975. No other information on the history and condition of the site is available (USAF, 1993b).

One soil sample was collected from a depth of 10 to 14 feet bgs from a soil boring drilled during the SSI (Argonne National Laboratory, 1994). Analysis of the sample indicated the absence of VOCs, pesticides, and PCBs, but revealed the presence of dibenzofuran, bis(2-ethylhexyl)phthalate, and 14 polynuclear aromatic hydrocarbons (PAHs). No elevated concentrations of inorganic analytes were detected.

PIPING AREA. The Piping Area is located south of the Manufacturing Building. The underground pipeline leads from two 1,500-gallon ASTs containing JP-4 fuel to the Manufacturing Building. The fuel was used to test various aviation components. The tanks remain half full and are currently inactive.

Six soil samples collected from 3 feet bgs adjacent to the pipeline during the SSI were subjected to field screening for VOCs, SVOCs, and metals (Argonne National Laboratory, 1994). No organics were detected above the instrument detection limits, and no elevated metals concentrations were detected.

OIL/WATER SEPARATOR. The former oil/water separator is located near the southeast corner of the Special Programs Facility adjacent to the former waste oil storage tanks. Waste oils and kerosene-based degreasing solvents were discharged to the oil/water separator from 1942 to 1953. Effluent from the separator was discharged to the storm sewer system that emptied into Little Choconut Creek through Outfall 002. In the 1970s, the separator was filled with sand and capped with concrete (USAF, 1993b).

One soil sample located adjacent to the oil/water separator was collected from a depth of 10 to 14 feet bgs from a soil boring drilled during the SSI (Argonne National Laboratory, 1994). Analysis of the sample indicated the presence of one VOC (acetone) and 10 SVOCs. No elevated concentrations of inorganics were detected.

1.4 Remedial Actions

Several remedial actions have been taken at areas within the AFP 59 boundaries and at the Camden Street Wellfield.

1.4.1 On-site Remedial Actions

In the 1970s, the oil/water separator near the southeast corner of the Special Programs Facility was abandoned in place by filling it with sand and capping it with concrete. The former gasoline UST was removed in 1975. The two 1,000-gallon waste oil USTs were removed in 1985, and stained gravel was reportedly removed to a depth of 12 feet. In 1990, a concrete transformer pad in the courtyard of the building contaminated with PCB-containing oil was remediated by jackhammering successive layers of concrete until wipe samples indicated PCB concentrations were below the allowable concentration. Use of the Plating Room was discontinued in 1991, and all equipment was subsequently removed. The Plating Room was decontaminated in 1992 and 1993. Use of the storage tank and settling pond adjacent to the Plating Room has also been discontinued (USAF, 1993b).

1.4.2 Off-site Remedial Actions

In June 1992, an air stripper was installed by Johnson City at the Camden Street Wellfield to reduce concentrations of 1,1,1-TCA to below the New York maximum contaminant level (MCL) of 5 μg/L. The USAF has entered into a Memorandum of Understanding (MOU) with the Village of Johnson City to provide a cooperative effort to maintain the operation of the air stripper. Under the terms of the MOU, the USAF will provide partial financial support for the operation and maintenance costs associated with the air stripper. This support is subject to the availability of funds. The MOU is a voluntary undertaking by the USAF and does not constitute any finding by either Johnson City or the State of New York that AFP 59 is the source of 1,1,1-TCA at the wellfield. An investigation of potential sources in the vicinity of the wellfield is being conducted by the USGS.

SECTION 2.0

PROJECT ACTIVITIES

The following sections discuss project objectives, the field and laboratory programs, and data evaluation procedures for the RI.

2.1 Project Objectives

Project objectives for the AFP 59 RI were identified in the *Work Plan* (EARTH TECH, 1994c) as the following:

- To identify potential on-site sources of soil and/or groundwater contamination;
- To define the nature and extent of on-site groundwater contamination in the shallow and deep zones of the aquifer;
- To define the nature and extent of on-site soil contamination;
- To define background concentrations of the targeted project inorganic and organic analytes in soil, sediment, surface water, and groundwater to determine the potential contribution from upgradient sources of contamination and to evaluate naturally occurring (background) metals concentrations;
- To identify migration pathways, including the degree of interconnection between the shallow and deep zones of the aquifer;
- To determine the potential relationship of identified contamination at AFP 59 to identified contamination at municipal wells;
- To refine the conceptual site model presented in the *Work Plan* (EARTH TECH, 1994c), including source identification, contaminant migration, and evaluation of potential receptors;
- To complete a baseline human health risk assessment;
- To complete a Fish and Wildlife Impact Analysis in accordance with NYSDEC, Division of Fish and Wildlife guidance; and

- Meet the requirements of CERCLA 120(h) to allow transfer of the property.

In developing the objectives for the RI, previously collected data were reviewed and summarized, and data gaps were identified. This process was documented in the AFP 59 *Sampling and Analysis Plan (SAP)* (EARTH TECH, 1994a). Identified data gaps and objectives for filling the data gaps are given below.

GROUNDWATER:

- **Identified Data Gaps**
    - Source and extent of both chlorinated and petroleum hydrocarbon contamination,
    - Presence of metals contamination,
    - Background levels of inorganics and organics in groundwater,
    - Migration potential between the shallow and deep zones of the aquifer (vertical migration),
    - Off-site migration potential (horizontal migration),
    - Regional potentiometric surface and groundwater flow directions.
- **Objectives**
    - To install additional monitoring wells, especially in the vicinity of the former waste oil tanks and hydraulically upgradient of the plant;
    - To sample new and existing wells; and
    - To complete an aquifer pumping/recovery test.

SEDIMENT AND SURFACE WATER:

- **Identified Data Gaps**
    - Impact of installation activities on Little Choconut Creek,
    - Interconnection between the surface water and groundwater.
- **Objectives**
    - To collect sediment and surface water samples in Little Choconut Creek, including upgradient of the plant and downgradient of each of the outfalls; and
    - To measure water levels in on-site monitoring wells and the creek prior to and during the pumping test to determine the hydraulic connection between the surface water and groundwater.

SOIL:

- **Identified Data Gaps**
    - Nature and extent of subsurface soil contamination,
    - Source of any existing soil contamination,
    - Background levels of inorganics and organics in soil, and
    - Extent and continuity of lithologic units.

- **Objectives**
    - To conduct a reconnaissance survey using direct push sampling techniques;
    - To drill soil borings and collect soil samples for analysis; and
    - To install additional monitoring wells and collect soil samples for analysis and lithologic characterization.

2.2 Field Activities

The following sections discuss field activities, the chronology of field work, and field QA/QC activities.

2.2.1 Field Program

The field investigation was conducted in two phases. A reconnaissance survey was completed in July 1994 to provide screening-level data on the nature and extent of contamination and to determine optimal sampling locations for the second phase of the investigation. In October 1994, the Phase II sampling began and included soil boring and monitoring well installation, subsurface soil sampling, sediment and surface water sampling, groundwater sampling, and an aquifer pumping/recovery test. A summary of field activities completed during both phases is provided in Table 2.2-1, and a summary of samples collected is provided in Table 2.2-2. A brief overview of each activity is provided below.

2.2.1.1 Site Reconnaissance, Preparation, and Restoration Procedures. Prior to subsurface sampling during the Reconnaissance Survey, a subsurface geophysical survey was conducted for utility clearance (see Section 2.2.1.2). EARTH TECH personnel performing the geophysical survey were assisted through the use of utility maps provided by AFP 59 personnel. As a result of the survey, the ground surface above all underground utilities and the locations of all subsurface sampling localities were marked with spray paint.

Fieldwork associated with the RI was coordinated with the AFP 59 point of contact to minimize disruption of plant activities during the fieldwork. The point of contact offered the following support for the completion of the fieldwork:

(1) Provided site utility maps;

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TABLE 2.2-1
AFP 59 SUMMARY OF RI FIELD ACTIVITIES

Environmental Media	Field Activities	
	Reconnaissance Survey - Phase I	Phase II
Groundwater	Collected 33 groundwater samples using direct push sampling techniques for on-site VOC analysis.	Drilled and installed 4 monitoring well clusters with 1 deep and 1 shallow well each; at one well cluster an intermediate well was also installed.
	Collected groundwater samples from select existing monitoring wells and screened for VOCs (on-site analysis).	Collected groundwater samples from all new and existing monitoring wells; analyzed these for VOCs, SVOCs, pesticides/PCBs, inorganics, and hardness.
	Obtained a synoptic round of water level measurements.	Obtained a synoptic round of water level measurements. Conducted an aquifer pumping/recovery test.
Soil	Collected 56 soil samples using direct push sampling techniques from 32 locations for on-site VOC analysis.	Collected 3 to 4 soil samples from each shallow monitoring well and soil boring location; analyzed these for VOCs, SVOCs, pesticides/PCBs, inorganics, and TOC.
	Analyzed select soil samples from the direct push sampling at an off-site laboratory for metals and/or VOCs.	
Surface Water	None.	Collected surface water samples from 5 locations in Little Choconut Creek; analyzed these for VOCs, SVOCs, pesticides/PCBs, inorganics, and hardness.
Sediment	None.	Collected sediment samples from 5 locations in Little Choconut Creek; analyzed these for VOCs, SVOCs, pesticides/PCBs, inorganics, and TOC.

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TABLE 2.2-2
AFP 59 RI SAMPLE SUMMARY

Type of Sample	Number Collected
Direct push soil samples: on-site analysis	56
Direct push soil samples: off-site analysis	25
Groundwater samples: on-site analysis	59
Groundwater samples: off-site analysis	29
Hollow-stem auger soil boring soil samples: off-site analysis	38
Hollow-stem auger monitoring well soil samples: off-site analysis	15
Surface water samples: off-site analysis	6
Sediment samples: off-site analysis	6

Note: The numbers of samples collected include field replicates/duplicates.

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(2) Approved a location for an equipment decontamination pad;

(3) Approved accumulation points at AFP 59 where containerized decontamination fluids, drill cuttings, and development/purge water were stored prior to disposal;

(4) Provided EARTH TECH with engineering plans, drawings, diagrams, etc. relevant to the areas being investigated during the RI; and

(5) Arranged for EARTH TECH field personnel and subcontractors to have personnel identification badges; a secure staging area for storing equipment and supplies; and a potable water supply.

The objective of site restoration was to minimize disruption resulting from the field investigation. Accordingly, drill cuttings, unused monitoring well construction materials, stakes, flagging, etc. were removed after drilling the borings and installing and developing the monitoring wells. No disturbance of vegetation or increase in erosion potential resulted from this effort.

2.2.1.2 Subsurface Utility Clearance Surveys. Prior to subsurface sampling during the Reconnaissance Survey at AFP 59, EARTH TECH conducted a geophysical clearance survey to determine the locations of underground utilities or other objects buried beneath the ground surface. The geophysical methods used for the clearance were electromagnetic imaging (EMI), ground penetrating radar, and magnetic profiling. Site utility maps were used in conjunction with these three methods to locate buried utilities. [Refer to the SAP (EARTH TECH, 1994a) for details concerning equipment capabilities and calibration.]

2.2.1.3 Direct Push Soil and Groundwater Sampling. As part of the first phase of the field investigation, Target Environmental Services, located in Columbia, Maryland, performed soil and/or groundwater sampling at 39 locations using direct push techniques at AFP 59. These samples were collected along drains, next to the Plating Room and settling/storage tanks, near the former waste oil tanks, and along the perimeter of the plant. In general, the sampling grid was more closely spaced in areas where the greatest data resolution was required (i.e., suspected source areas). Details of the direct push soil and groundwater sampling are given in the *Reconnaissance Survey Summary Report* (EARTH TECH, 1994b).

2.2.1.4 Drilling. This section describes the drilling methods and associated activities used to drill, sample, and abandon soil borings, and to drill, sample, and install monitoring wells during the second phase of the field investigation. All drilling was performed by Parratt Wolff, Inc., located in East Syracuse, New York. Drilling and sampling methods followed procedures described in the *IRP Handbook* (USAF, 1993a) and the *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document* (USEPA, 1986a); these procedures are outlined in the SAP (EARTH TECH, 1994a).

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TABLE 2.2-3
AFP 59 RI SOIL BORING SUMMARY

Borehole ID	Date Drilled	Total Depth Drilled (feet)	Number of Samples Collected for Analysis
59BH01	10/18/94	15	2
59BH02	10/18/94	10	3
59BH03	10/19/94	10	3
59BH04	10/19/94	15	4
59BH05	10/19/94	15	3
59BH06	10/19/94	10	2
59BH07	10/19/94	5	2
59BH08	10/20/94	10	4
59BH09	10/20/94	15	5
59BH10	10/21/94	10	3
59BH11	10/21/94	10	3
59BH12	10/23/94	10	4

Note: Number of samples includes field replicates.

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SOIL BORINGS. A total of 12 soil borings were drilled to collect soil samples for chemical analysis using the HSA method. A summary of the drilling and sampling activities conducted during drilling of the soil borings is provided in Table 2.2-3. Soil boring logs are presented in Appendix C. Borings were sampled at 5-foot intervals above the water table using a 2-foot long, 3-inch diameter split-spoon sampler with brass liners. The first sampling interval for borings located in the parking lot was from 1 to 3 feet bgs to avoid collection of asphalt with the samples. Each boring was terminated at the water table and grouted to the surface. Sampling and borehole abandonment procedures are described in detail in the SAP (EARTH TECH, 1994a).

MONITORING WELLS. Nine monitoring wells were installed at four well cluster locations during the field investigation. Four shallow wells were screened across the water table in the glacial outwash deposits (shallow zone of the aquifer); four deep wells were screened immediately above glacial till in the ice-contact deposits (deep zone of the aquifer); and one intermediate well was screened just above the fine-grained glacial deposits in the glacial outwash deposits. Monitoring well borehole and construction logs are presented in Appendix C.

Two drilling methods were used to drill monitoring well boreholes during the RI: HSA and drive and wash. The drilling, sampling, and well construction activities were conducted in the following sequential order at each location.

(1) A pilot hole at each deep monitoring well borehole location was drilled using 6.25-inch inside diameter (I.D.) HSAs. During drilling of the pilot hole, soil samples were generally collected at 5-foot intervals using a 2-foot long, 3-inch diameter, split-spoon sampler until the fine-grained glacial deposits were encountered. When the borehole had advanced to within 5 feet of the estimated top of the fine-grained glacial deposits (generally 10 to 20 feet bgs), continuous sampling was conducted to accurately determine the depth of the top of the fine-grained unit. The fine-grained glacial deposits were present at DW11, DW12, and DW13, but not at DW10. Soil samples from the pilot boreholes were collected to characterize the stratigraphy only; no samples were collected for chemical analysis. Potable water was used during the drilling of DW10, DW12, and DW13 to prevent sands from heaving into the HSAs.

(2) Surface casing was set in the upper portion of the deep monitoring well borehole (at DW11, DW12, and DW13) to prevent cross-contamination between the upper and lower zones of the aquifer. The augers were pulled from the pilot borehole after intersecting the fine-grained glacial deposits, and the borehole was reamed with 10.25-inch I.D. HSAs to the previously determined depth of the fine-grained glacial deposits. The surface casing was constructed of 8-inch nominal I.D., schedule 80 polyvinyl chloride (PVC), and was set approximately 2 feet into the fine-grained glacial deposits. The casing was grouted with a Portland cement/bentonite grout and was allowed to set for a minimum of 24 hours.

(3) The deep portion of the deep monitoring well borehole (at DW11, DW12, and DW13) was then drilled inside the surface casing using rotary wash and temporary 6-inch steel drive casing until glacial till was encountered (between 78 and 83 feet bgs). Soil samples were

collected to characterize the stratigraphy only; no samples were collected for chemical analysis as specified in the SAP (EARTH TECH, 1994a). The sampling interval varied depending on the subsurface geology (as determined from drill cuttings) and ranged from 2 to 10 feet. Glacial till was confirmed by sampling a minimum of 5 feet into the unit. Bedrock was not encountered in any of the boreholes. The monitoring well was completed approximately 2 feet into till to monitor conditions at the base of the deep zone of the aquifer.

The fine-grained glacial deposits were not encountered at DW10 as anticipated from existing well logs; therefore, no surface casing was necessary. The pilot hole at DW10 was drilled to 37 feet. The augers were then pulled and the deep portion of the borehole was completed using drive and wash techniques. The deep portion of the borehole was sampled at 10-foot intervals to characterize the stratigraphy; no samples were collected for chemical analyses as specified in the SAP (EARTH TECH, 1994a). Till was encountered at 88.8 feet bgs and sampled to a depth of 95 feet bgs; bedrock was not encountered. The monitoring well was completed approximately 2 feet into till to monitor conditions at the base of the aquifer. Deep monitoring well completion details are described in Section 2.2.1.5.

(4) The intermediate monitoring well borehole was drilled adjacent to the deep monitoring well. Because of subsurface geologic conditions, the only intermediate monitoring well installed was at monitoring well location 13. No intermediate well was installed at well location 10 because of the absence of the fine-grained glacial deposits, and none were installed at locations 11 and 12 because of the shallow depth of the fine-grained glacial deposits (the shallow wells are screened into the fine-grained glacial deposits at both locations). The intermediate monitoring well borehole was drilled using 6.25-inch I.D. HSAs. Potable water was used during drilling to prevent sands from heaving into the HSAs. Soil sampling was conducted beginning 5 feet before the depth of fine-grained glacial deposits as determined from the deep well pilot borehole. Continuous split-spoon sampling was then conducted to accurately define the upper surface of the fine-grained glacial deposits. The well was installed approximately 2 feet into the fine-grained glacial deposits to monitor conditions at the base of the shallow zone of the aquifer. Intermediate monitoring well completion details are described in Section 2.2.1.5.

(5) The shallow monitoring well boreholes were drilled adjacent to the intermediate and deep monitoring wells using 6.25-inch I.D. HSAs. Sampling for chemical analysis was conducted above the water table at 5-foot intervals using 2-foot long, 3-inch diameter split-spoon samplers with brass liners. The first sampling interval was from 1 to 3 feet bgs to avoid collection of asphalt with the samples. No sampling took place below the water table because lithologic characterization had been determined when drilling the deep monitoring well pilot borehole. The shallow monitoring wells were installed approximately 10 feet below the water table, between 23.5 and 28.7 feet bgs. Shallow monitoring well completion details are described in Section 2.2.1.5.

Waste handling, soil sample collection procedures, decontamination procedures, well completion, record keeping, and health and safety procedures are provided in the SAP (EARTH TECH, 1994a).

2.2.1.5 Monitoring Well Installation. Monitoring well installation activities included monitoring well construction, development, and wellhead completion. These procedures followed methods described in the *IRP Handbook* (USAF, 1993a), the *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document* (USEPA, 1986a), and the SAP (EARTH TECH, 1994a). A summary of well construction and development details for all wells installed during the RI is provided in Table 2.2-4. Well construction logs are presented in Appendix C; well development logs are presented in Appendix D.

As described in Section 2.2.1.4, monitoring wells were installed in clusters. Typical monitoring well construction diagrams for the shallow and intermediate wells and the deep wells are provided in Figures 2-1 and 2-2, respectively.

MONITORING WELL CASING/SCREEN. All monitoring wells installed during the RI were constructed of new and unused 2-inch diameter, Schedule 40 PVC casing and screen. The surface casing for monitoring wells DW11, DW12, and DW13 was constructed of 8-inch diameter, Schedule 80 PVC. Filter pack and well screen design were based on soil sample lithologic descriptions and results of field sieve analyses. Based on these criteria, a slot size of 0.01-inches (factory slotted) was chosen for well completion. Stainless steel centralizers were placed at the top and bottom of the screened interval for the deep monitoring wells (greater than 50 feet). Fifteen feet of screen was installed in the shallow monitoring wells, 10 feet of screen in the intermediate monitoring well, and 20 feet of screen in the deep monitoring wells. Casing and screen joints were flush threaded. In order to prevent the introduction of contaminants into the monitoring wells, no glue-connected fittings were used. The bottom of the screen was capped using a threaded PVC end cap.

FILTER PACK. Once the monitoring well casing and screen were in place, filter pack was added to stabilize the borehole wall adjacent to the screened interval. The filter pack extended from the bottom of the borehole to a minimum of 2 feet above the screened interval. Based on soil sample classifications and field sieve analyses, Morie #0 silica was selected for all monitoring wells with the exception of SW11 and SW12. Morie #00 silica was chosen for these two wells because their screened intervals extend into the fine-grained glacial deposits. Therefore, a finer filter pack was selected to prevent pulling formation materials into the wells during development and sampling. To eliminate any bridging of the filter pack during emplacement, the wells were surged with a surge block, and additional filter pack material was added as required.

BENTONITE SEAL. A bentonite seal with a 2-foot minimum vertical thickness was emplaced in the annular space above the filter pack to separate the filter pack from the grout surface seal. The bentonite used for the seal was 100-percent sodium bentonite. Based on the formation lithology adjacent to the seal interval, the seal consisted of either a bentonite slurry or bentonite chips. Bentonite chips were used in coarse-grained intervals where there was concern that a slurry would penetrate the formation. When the seal interval was below the water table, bentonite chips were

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TABLE 2.2-4
AFP 59 RI MONITORING WELL SUMMARY

Monitoring Well ID	Depth to Till (Feet bgs)	Total Depth Drilled (Feet)	Screened Interval (Feet bgs)	Date Well Installed	Development Date	Development Method
SW10	NA	25.5	10.0-25.0	10/23/94	11/17-11/19/94	Surge and pump/bail
DW10	88.8	95.0	70.3-90.3	10/21/94	11/16/94	Surge and pump
SW11	NA	23.7	8.5-23.5	11/14/94	11/17-11/19/94	Surge and pump/bail
DW11	78.0	79.5	59.3-79.3	11/07/94	11/17/94	Surge and pump
SW12	NA	27.2	12.0-27.0	11/16/94	11/18/94	Surge and pump
DW12	83.0	85.0	64.8-84.8	11/03/94	11/15/94	Surge and pump
SW13	NA	29.5	13.7-28.7	11/15/94	11/18/94	Surge and pump
IW13	NA	36.0	25.8-35.8	11/08/94	11/18/94	Surge and pump
DW13	82.5	84.5	64.3-84.3	10/31/94	11/16/94	Surge and pump

Key: bgs = Below Ground Surface
NA = Not Encountered

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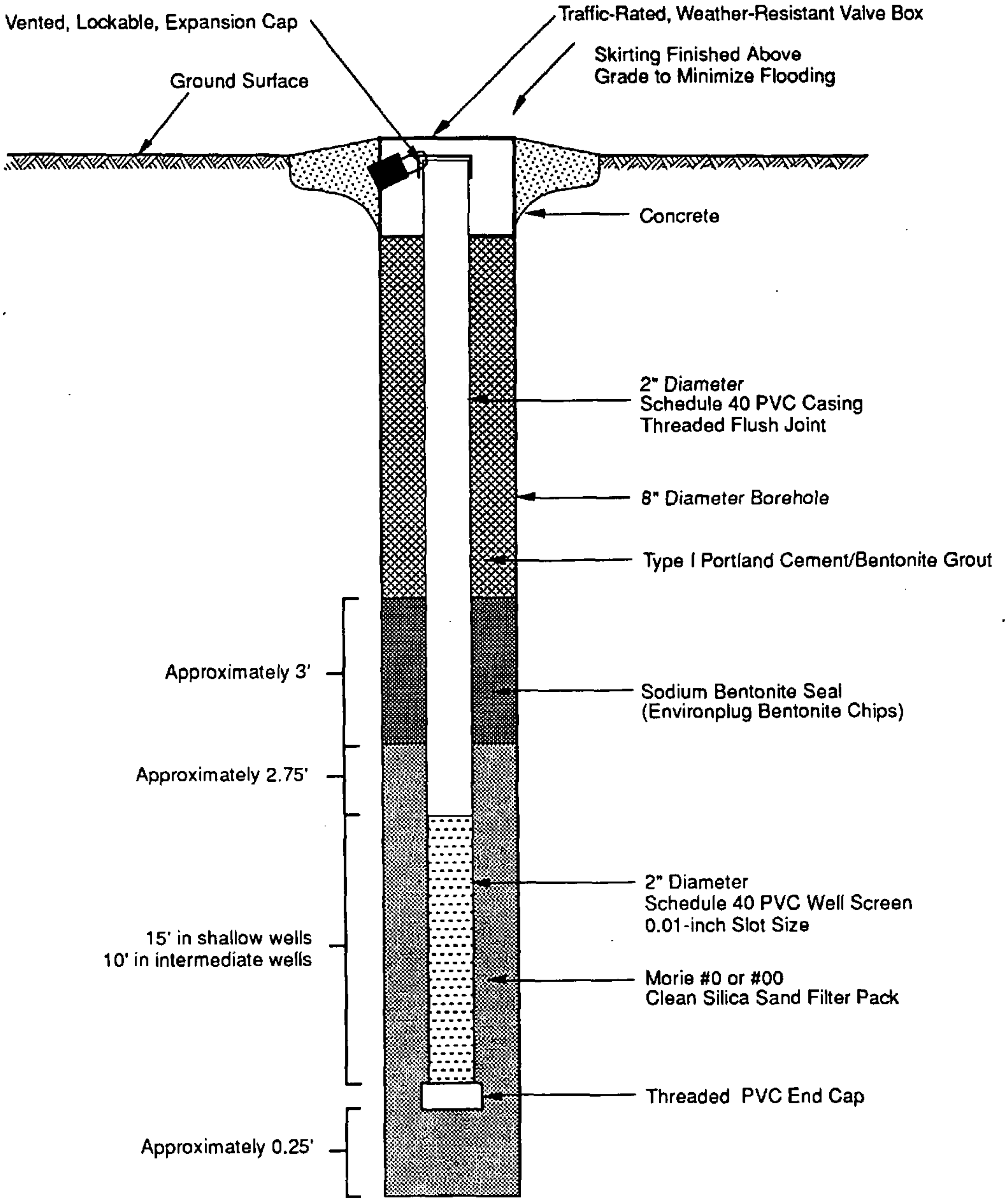

Not to Scale

AFP59/EBS/2-1.Typical Shallow

EARTH TECH

Figure 2-1

Typical Shallow and Intermediate Monitoring Wells with Flush-Mount Completion

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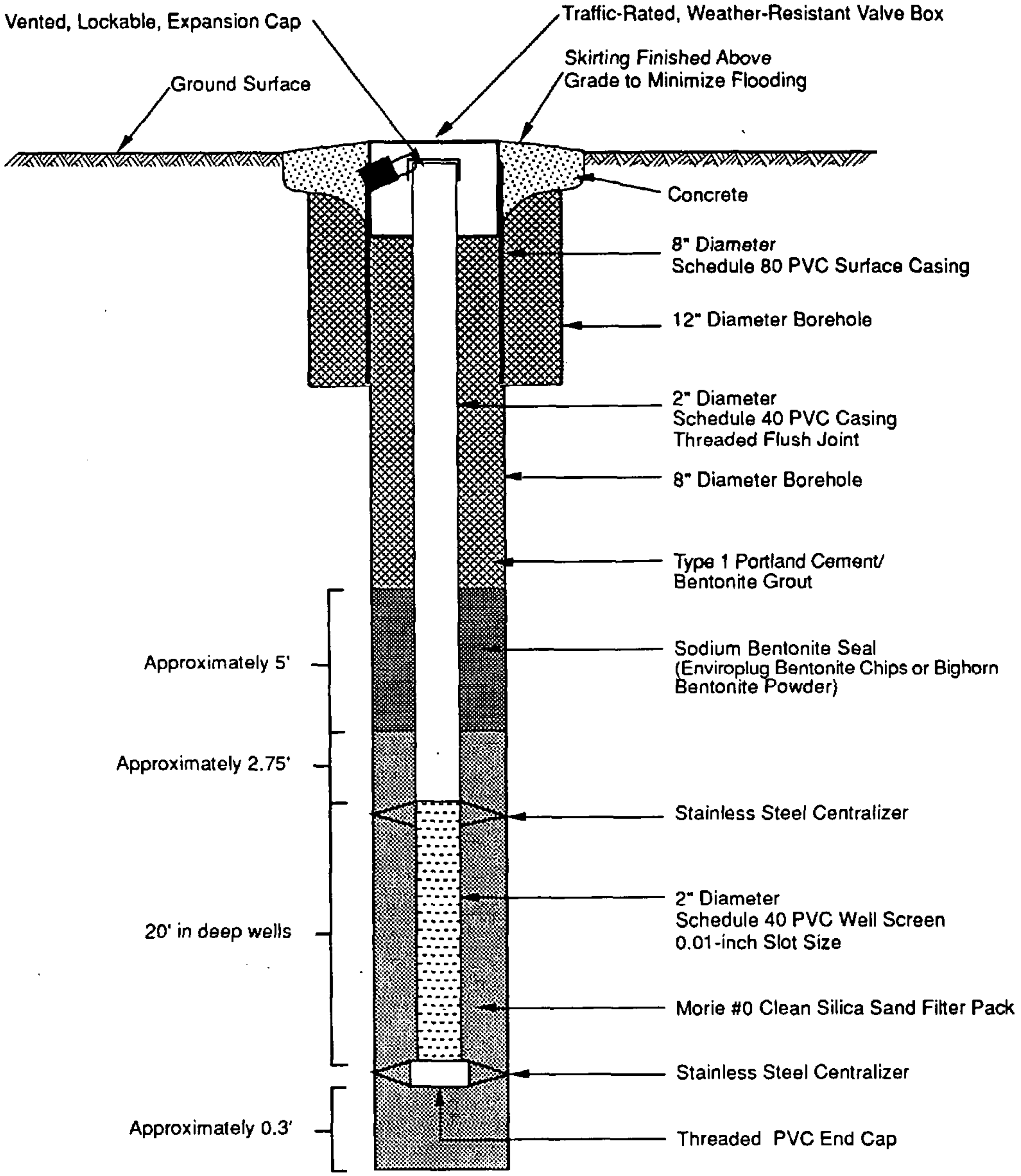

Not to Scale

EARTH TECH

Figure 2-2

Typical Double-Cased Deep Monitoring Well with Flush-Mount Completion

GF/AFP59/EBS/2-2 TYP DEEP MW

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slowly placed in the annular space between the monitoring well casing and the HSAs or drive casing to prevent bridging. Measurements were also taken throughout the emplacement process to assure that no bridging had occurred. If the seal interval was above the water table, the chips were hydrated with potable water and allowed to set for a minimum of 1 hour. If a slurry was chosen for the seal, the bentonite was hydrated before emplacement and then pump-tremied into the annular space between the monitoring well casing and the HSAs or drive casing. The seal was then allowed to set for a minimum of 30 minutes prior to emplacing the cement grout seal.

CEMENT GROUT. The cement grout mixture consisted of one 94-pound bag of Type I Portland cement, approximately 5 pounds of 100-percent sodium bentonite powder, and approximately 8 gallons of potable water. The mixture was mechanically blended and pump-tremied into the annular space between the monitoring well casing and the drill casing. Due to the shallow depth to the upper surface of the bentonite seal in the shallow and intermediate monitoring wells, the grout was not tremied in these wells.

SURFACE COMPLETION. All monitoring wells were installed with flush-mount surface completions. The well casing was capped with a ventilated, water-tight cap to prevent surface water from entering the monitoring well. A freely draining valve box was placed over the well casing and centered in a 3-foot diameter, 4-inch thick concrete pad that sloped away from the box. The identity of each monitoring well was clearly etched on the monitoring well valve box lid. A notch was cut in the top of each well casing; the elevation of this notch was later surveyed and used as a water level measuring point. All wells were padlocked for protection with corrosion-resistant locks as soon as possible after completion and were keyed alike.

MONITORING WELL DEVELOPMENT. All monitoring wells installed during the investigation were developed no sooner than 24 hours after completion of installation to allow for curing of the monitoring well grout. Surging and pumping or bailing was used to remove fines from the screened portion of the monitoring wells. A minimum of three times the well bore volume (WBV) was removed from each well during development. As defined in the SAP (EARTH TECH, 1994a), a WBV is the combined volume of water in the well and the saturated filter pack.

The temperature, specific conductance, suspended sediment, and turbidity of the groundwater being removed during development were measured using a calibrated temperature/conductivity meter, Imhoff cone, and turbidity meter.

Monitoring well development was considered complete when the following conditions were met:

(1) The suspended sediment content was < 0.75 milliliters per liter as measured in an Imhoff cone according to USEPA Method E160.5;

(2) Temperature and specific conductance were stable (temperature ± 1°C, specific conductance ± 5 percent of the previous reading);

(3) Turbidity readings remained within a 10 nephelometric turbidity unit (NTU) range for at least 30 minutes; and

(4) A minimum of three WBVs had been removed.

If these conditions were not met, then purging continued until six WBVs had been removed or physical parameters had stabilized, whichever came first.

The SAP (EARTH TECH, 1994a) calls for the measurement of pH during the development process; however, a faulty probe prevented pH measurements. After verbal communication with the NYSDEC, development continued based on the remaining physical parameters. The following factors suggest that the wells were adequately developed: the remaining physical parameters were stable; pH (and the remaining physical parameters) measured during well purging prior to groundwater sampling were stable; all wells showed a significant decrease in turbidity; and a minimum of six WBVs were removed from all wells except SW10, SW11, and SW12. Only three WBVs were purged from SW12 because all parameters stabilized and the development water visibly cleared. Slow recharge at SW10 and SW11 prevented purging six WBVs from these wells. SW10 was surged and bailed eight times over the course of 3 days before three WBVs were removed from the well.

2.2.1.6 Aquifer Tests. A constant-rate pumping test was conducted using the on-site deep production well (DPW) as the pumping well and existing on-site and off-site monitoring wells as observation wells. Little Choconut Creek was also monitored to determine the communication between the creek and the aquifer. The objective of the pumping test was to provide information on the hydraulic properties of the aquifer, the connection between the upper and lower zones of the aquifer, and the effect of pumping on Little Choconut Creek. Refer to Section 3.2.1 (Migration Potential) for more details concerning the aquifer test. The basic procedures that were used are described below.

(1) Static water levels were measured in all accessible on-site observation wells; depth of water was also measured in Little Choconut Creek. One stream gaging station was established in Little Choconut Creek to provide creek levels over the course of the pumping test. Johnson City Production Well 2 was pumping at a rate of approximately 3 mgd during the static water level measurements and the AFP 59 pumping test.

(2) The on-site production well was pumped at a constant discharge rate of approximately 145 gpm over a 24½-hour period. Water was discharged to the plant's noncontact cooling system. Discharge of the pumping test water was coordinated with the NYSDEC.

(3) Drawdown and recovery were measured in 17 on-site observation wells using electronic data loggers. The data loggers provided more accurate data and measured water levels at more frequent intervals. Drawdown and recovery in the remaining 14 on-site and off-site observation wells were measured manually.

(4) At the conclusion of the pumping phase, the pump was turned off and water level recovery was recorded in the observation wells for approximately 22 hours.

2.2.1.7 Surface Water and Sediment Sampling. Surface water and sediment sample pairs were collected from five locations in Little Choconut Creek during the RI. The field team sampled two background locations upstream of the facility: one from the portion of the creek that flows along the eastern boundary of the plant, and one from the creek north of Main Street. The other three sample pairs were collected downstream from each of Outfalls 001, 002, and 003. The location downstream of Outfall 003 was taken at the convergence of the creek and the Susquehanna River.

All sampling locations were marked with a pin flag and surveyed upon completion of the field program. Sample collection procedures are discussed in Section 2.2.1.12.

2.2.1.8 Fish and Wildlife Impact Analysis. As part of the RI at AFP 59, EARTH TECH performed a Fish and Wildlife Impact Analysis under the guidance of the NYSDEC Division of Fish and Wildlife (NYSDEC, 1991). The Fish and Wildlife Impact Analysis is a stepwise process requiring decisions at a number of points in its development. The five steps of the analysis include: a Site Description; a Contaminant-Specific Impact Analysis; an Ecological Effects of Remedial Alternatives; an Implementation of Selected Alternative in Design; and, a Monitoring Program. A complete analysis may not include all five steps, depending on whether certain criteria are met. The Fish and Wildlife Impact Analysis for AFP 59 and the surrounding areas was performed through Step IIB (Criteria-Specific Analysis) as recommended by the NYSDEC Division of Fish and Wildlife.

Step I (the Site Description) of the analysis included the creation of a topographic map showing the location of the site; any documented fish and wildlife resources; habitats supporting endangered, threatened, or rare species; species of concern; regulated wetlands; wild and scenic rivers; significant coastal zone areas; and streams, lakes, and other major resources within 2 miles of the perimeter of the site. A covertype map was also drawn for the site and an area within 0.5 miles of the perimeter. The map included major vegetative communities including wetlands, aquatic habitats, NYSDEC Significant Habitats, and areas of special concern. A qualified biologist performed the covertype identification during Phase II of the RI.

The objective of Step II is to determine the impact of site-related contaminants on fish and wildlife resources. Within Step II, additional steps assess the impact of site-related contaminants on fish and wildlife resources; these include pathway analysis, criteria-specific analysis, and analysis of toxicological effects. In the pathway analysis (Step IIA), fish and wildlife resources, contaminants of concern, sources of contaminants, and potential pathways of contaminant migration and exposure were identified. In Step IIB, the criteria-specific analysis, impact was assessed by comparing contaminant levels with numerical criteria such as ARARs; Standards, Criteria and Guidance; and To Be Considered (TBC) information. The results of the Fish and Wildlife Impact Analysis are presented in Appendix O.

2.2.1.9 Surveying. Upon completion of the field program, a third order survey of sampling locations was conducted by Purdy Engineering, a certified land surveyor located in Vestal, New York. The ground surface elevation, top of casing elevation, and horizontal location of all newly installed monitoring wells were surveyed, as were soil boring, surface water, and sediment sampling locations.

An xy-coordinate system was used to describe the horizontal location of each surveyed point, with the x-coordinate as the east-west axis and the y-coordinate as the north-south axis. All surveyed locations, benchmarks, and permanent markers were recorded on both unit-specific and facility maps. Horizontal locations were referenced to the New York State Plane Coordinate System. Ground surface elevation was referenced to mean sea level and measured to the nearest 0.01 foot. The elevation of the top of the monitoring well casing was surveyed from a notch in the casing, referenced to mean sea level, and surveyed to the nearest 0.01 foot.

The survey data for soil borings, all new monitoring wells, and surface water and sediment sampling locations are summarized in Table 2.2-5. All survey data are provided in Appendix E.

*2.2.1.10 **Equipment Decontamination**.* As designated by the AFP 59 point of contact, decontamination was performed at a temporary decontamination pad constructed in the rear parking lot south of the Drum Storage Area. The drill rig and associated equipment were steam cleaned before each borehole to prevent cross-contamination. Additionally, all equipment involved in soil sampling, monitoring well installation, development, purging and groundwater sampling, and sediment and surface water sampling was decontaminated prior to each use to assure the collection of representative samples. The decontamination procedures are outlined in the SAP (EARTH TECH, 1994a).

Decontamination fluids were containerized in 55-gallon drums and transported to the temporary storage area designated by the AFP 59 point of contact.

*2.2.1.11 **Waste Handling**.* The following section describes the procedures for handling and disposing of waste generated on-site during the field investigation. These wastes included soil cuttings, monitoring well development/purge water, and equipment decontamination fluids. All waste was containerized in 55-gallon drums and transported to the storage location (immediately west of the Drum Storage Area) designated by the AFP 59 point of contact. Waste characterization and disposal was completed by Northeast Environmental Services, Inc., located in Canastota, New York. All investigation-derived waste was disposed of in accordance with applicable State and Federal regulations at the Northeast Environmental Services, Inc., treatment, storage, and disposal (TSD) facility located in Wampsville, New York.

SOIL CUTTINGS. Soil cuttings generated during drilling were placed into labeled 55-gallon drums and sealed. The drums were then transported to the Drum Storage Area and stored pending characterization and disposal. All drums containing soil cuttings were disposed of in accordance with applicable State and Federal regulations at the Northeast Environmental Services, Inc., TSD facility located in Wampsville, New York.

MONITORING WELL DEVELOPMENT/PURGE WATER. Groundwater evacuated during monitoring well development and purging was discharged to the ground surface in a grass- or gravel-covered area nearest the monitoring well. The groundwater infiltrated into the ground and was discharged at a rate that would not allow drainage into the storm water system or the creek. Discharge of the development/purge water was coordinated with the NYSDEC.

TABLE 2.2-5
AFP 59 RI SURVEY DATA

Borehole ID	Northing	Easting	Ground Surface Elevation (Feet MSL)
59BH01	770504.7652849	665697.0473271	829.30
59BH02	770479.5469848	665729.3585010	829.03
59BH03	770497.4862481	665767.5283135	829.43
59BH04	770501.5455631	665828.7821322	829.32
59BH05	770417.2292920	665920.0549171	829.01
59BH06	770443.6279330	664942.4135177	829.31
59BH07	770378.9570836	664924.6542163	828.65
59BH08	770383.3566086	665220.7831427	828.74
59BH09	770416.3041077	665040.1969358	829.43
59BH10	770412.5120956	665977.9027177	829.00
59BH11	770414.2478066	665996.3792614	828.95
59BH12	770413.0014167	665947.8290488	829.14

Surface Water/ Sediment Sample ID	Northing	Easting	Creek Bed Elevation (Feet MSL)
59CR01	770181.048950	665922.827053	815.72
59CR02	770242.282098	665159.494070	814.43
59CR04	770176.377032	664307.163176	813.38
59CR05	771528.071011	666348.870651	820.37
59CR06	770258.069516	666164.011532	817.44

Monitoring Well ID	Northing	Easting	Top of Casing Elevation (Feet MSL)	Ground Surface Elevation (Feet MSL)
59DW10	771051.4709077	666161.4188267	830.57	830.90
59SW10	771059.6751327	666163.9875368	830.58	830.86
59DW11	770394.1921643	665978.5786721	828.90	829.17
59SW11	770393.8856914	665984.1829265	828.67	829.20
59DW12	770397.7488993	665563.5613218	829.17	829.46
59SW12	770403.6270490	665563.9030818	829.14	829.50
59DW13	770478.8601554	665153.2117839	828.42	828.78
59IW13	770476.3887595	665158.4168229	828.36	828.76
59SW13	770481.9133746	665158.3449657	828.32	828.75

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EQUIPMENT DECONTAMINATION FLUIDS. All fluids generated during equipment decontamination were initially contained at the temporary decontamination pad. The fluids were periodically pumped from the decontamination pad into labeled 55-gallon drums. The drums were then transported to the Drum Storage Area and stored pending characterization and disposal. All drums containing decontamination fluids were disposed of in accordance with applicable State and Federal regulations at Northeast Environmental Services, Inc., TSD facility located in Wampsville, New York.

2.2.1.12 Sample Collection Procedures. The procedures used for collecting environmental samples of groundwater, surface water, soil, and sediment are provided below. Methods for collecting field QA/QC samples are also discussed. Detailed descriptions are provided in the SAP (EARTH TECH, 1994a).

SUBSURFACE SOIL SAMPLING. Two drilling methods were used to drill monitoring well boreholes during the RI: HSA and drive and wash. As discussed in Section 2.2.1.4, no soil samples were collected for chemical analysis from the intermediate and deep monitoring well boreholes. During the drilling of the soil borings and shallow monitoring well boreholes, soil samples for potential chemical analysis were collected above the water table at 5-foot intervals. All soil samples were collected using split-spoon sampling techniques (American Society for Testing Materials [ASTM], 1988).

A photoionization detector (PID) was used to screen all soils during drilling. Soil samples from soil borings and shallow monitoring well boreholes were selected for chemical analysis based on field screening results regarding odor, discoloration, or elevated headspace readings. If no soil samples from a boring or borehole were identified for analysis based on the field screening results, the samples were selected at evenly spaced intervals from the ground surface to the water table. Up to three soil samples per borehole were selected for chemical analysis, except for several boreholes in which four samples were collected. The types of samples collected and the analytical methods used are summarized in Section 2.3.1.

A split-spoon sampling device was used to collect subsurface soil samples according to ASTM D1586 (ASTM, 1988). Each split-spoon sampler contained four, 6-inch long by 3-inch diameter brass liners. The first and second brass liners were collected for potential laboratory analysis. The liners were sealed at both ends using Teflon™ paper and covered with plastic end caps. The samples were then labelled, put in a plastic bag, and stored on ice in insulated coolers to cool the samples to 4°C. The third liner within the sample barrel was extruded into a glass sample jar and sealed with a Teflon™-lined lid. It was allowed to volatilize for approximately 30 minutes. A headspace measurement was taken from this sample for VOCs using a PID. The sample in the remaining liner was used for lithologic descriptions, including composition, color, stratification, and condition following the Unified Soil Classification System.

GROUNDWATER SAMPLING. The groundwater sampling program at AFP 59 included sampling all new and existing on-site monitoring wells. Section 2.3.1 lists the total number of samples collected for each sample type (e.g., environmental sample, duplicate) and the types of analyses. Groundwater samples were collected between November 28 and December 5, 1994 (the on-site production well was sampled on December 7, 1994 during the aquifer test). The on-site production well was inactive prior to and during groundwater sampling (the plant used water from the Johnson City Water Department between October 3 and December 6, 1996).

A total of 26 wells were sampled, with 3 duplicate samples. Groundwater samples were collected from the new monitoring wells no sooner than 3 days following development. This allowed the groundwater in the monitoring wells to return to equilibrium conditions. Groundwater samples were collected in order from least likely contaminated monitoring well locations to most likely contaminated monitoring well locations to lower the probability of cross-contamination. Groundwater sampling methods (discussed below) followed procedures described in the *IRP Handbook* (USAF, 1993a), the *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document* (USEPA, 1986a), and the SAP (EARTH TECH, 1994a).

All monitoring wells were purged, either through bailing or pumping, prior to sampling to obtain a representative groundwater sample. During purging, groundwater was collected after each WBV and tested for temperature, pH, specific conductance, and turbidity. Purging was considered complete when the parameters had stabilized using the following criteria: temperature ± 1°C, pH ± 0.1 units, conductivity ± 5 percent, and turbidity within 10 NTUs of the previous reading. A groundwater sample was then collected for laboratory analysis after the water level reached 80 percent of its static level or 16 hours after completion of purging, whichever occurred first.

If all the parameters did not stabilize after three WBVs were removed, then purging continued until six WBVs had been purged, or parameters had stabilized, whichever occurred first. Following NYSDEC direction, if water levels were steadily decreasing during purging, bailing/pumping was stopped to let the well recover before proceeding. This was only necessary at wells DW6 and SW11, and was done in an attempt to minimize volatilization of VOCs as groundwater flowed into the wells.

Monitoring wells SW5, IW9 and SW10 were bailed dry during purging due to very slow recharge rates. Groundwater samples were collected after allowing the wells to recover. IW9 was allowed to recover approximately 48 hours prior to sampling, and still had not fully recovered.

During the purging of wells sampled between November 28 and 30, 1994, the WBV definition from the SAP (EARTH TECH, 1994a) was used. These wells (SW1, SW5, SW7, SW8, SW10, SW12, and SW13) were purged of three times the combined volume of the water in the well casing and filter pack. Following NYSDEC direction, the remainder of the wells were purged using an alternative WBV definition: the volume of the entire borehole below the water table.

With the exception of samples collected for metals analysis, samples were collected in order of decreasing volatilization. Samples for metals analysis were collected first through the pump and were allowed to flow directly into the sample containers. The pump was not removed from the well between purging and sampling for metals to minimize turbidity.

After the metals sample was collected and the pump removed from the well, the remaining groundwater samples were collected in order of decreasing volatilization as follows: VOCs, SVOCs, pesticides/PCBs, cyanide, and hardness. These samples were collected with a teflon bailer rather than the pump to reduce potential volatilization.

In wells that were purged by bailing rather than pumping, the sampling order remained the same; metals samples were collected with a bailer instead of through a pump.

For each VOC groundwater sample, three pre-preserved 40 mL glass volatile organic analysis (VOA) vials were filled allowing no headspace. SVOCs, pesticides/PCBs, metals, cyanide, and hardness groundwater samples were placed in 1 liter plastic or glass containers, and then preserved as necessary.

Following sample collection, the sample containers were labeled, placed in plastic bags, and stored on ice in insulated coolers to cool the samples to 4°C. Samples were kept under strict chain-of-custody (COC).

SURFACE WATER SAMPLING. Surface water samples were collected from five locations in Little Choconut Creek. Samples were collected as follows.

(1) Surface water and sediment sample pairs were both collected from the same location in the stream. To avoid cross-contamination, the surface water sample was always collected prior to the sediment sample at each location. Sample pairs were collected first at the farthest downstream location, moving upstream for subsequent samples.

(2) Prior to collecting each surface water sample, the approximate sample location and depth were noted, as well as the temperature, pH, and conductivity of the creek water.

(3) Samples were collected in areas of similar environment at all locations. Samples were collected from active portions of the creek and from the side of the creek nearest the plant. A sample was collected by standing downstream of the sample location and submerging a spare laboratory-provided bottle into the water while positioning the bottle so the mouth faced upstream.

(4) The surface water was then transferred to laboratory-provided bottles. Each sample was analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, and hardness. The VOC sample was collected first in three pre-preserved 40 mL VOA vials. The remaining samples were collected in the following order: SVOCs, pesticides/PCBs, metals, cyanide, and hardness. Preservatives were added as appropriate for the analyses.

Following sample collection, the labeled sample containers were placed in plastic bags and stored on ice in insulated coolers to cool the samples to 4°C. Samples were kept under strict COC.

SEDIMENT SAMPLING. Sediment samples were collected as follows.

(1) A sediment sample was collected from 0 to 6 inches below the sediment-water interface with a hand auger. The sediment was removed from the hand auger with a stainless steel spoon and consolidated into a stainless steel bowl. Large rock pebbles were removed from the bowl before the sediment was placed in the sample jar.

(2) Each sediment sample was analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, and total organic carbon (TOC). The VOC sediment sample was packed as tightly as possible to avoid volatilization.

Following sample collection, the labeled sample containers were placed in plastic bags and stored on ice in insulated coolers to cool the samples to 4°C. Samples were kept under strict COC.

2.2.1.13 Record Keeping. Field records were maintained in sufficient detail to recreate all sampling and measurement activities and meet all IRP Information Management System (IRPIMS) data loading requirements. All information pertinent to the field program for the RI was recorded on appropriate data sheets and/or in the daily field logbook. Drilling records were kept in the daily field logbook for the investigation and on logs for each borehole.

In addition to the information entered into the logbook, the following data sheets were filled out and are maintained in the project files: Decontamination Record, Equipment Calibration Daily Log, Borehole Log, Monitoring Well Construction Log, Monitoring Well Development Log, Potentiometric Level Measurement Form, Groundwater Sampling Log, and Surface Water/Sediment Sampling Log.

2.2.1.14 Summary of Field Personnel. EARTH TECH field personnel and their responsibilities are described below. Ms. Reid Wellensiek, Project Manager and geologist, was responsible for project execution and support, coordination of support functions such as manpower requirements and field equipment requests, and review of laboratory and field data. Dave Parse assumed the role of Project Manager in June 1995.

On-site personnel responsible for installing monitoring wells and sampling soil, sediment, surface water, and groundwater included geologists Dave Parse, Donna Rios, and Robert Zapletal, and engineers Joan Biales and Keith Schenkel. Geophysical work was performed by Mark Saltz. Personnel involved in the aquifer test included Joan Biales, Dave Parse, Keith Schenkel, and Robert Zapletal.

Subcontractor support included the following: Target Environmental Services, Inc. (Columbia, Maryland) collected direct push soil and groundwater samples and provided on-site analytical testing during Phase I of the RI. Parratt-Wolff, Inc. (Syracuse, New York) provided HSA and drive and wash drill rigs for monitoring well installation and soil sampling. Parratt-Wolff, Inc., also helped in developing the wells. Northeast Environmental Services, Inc. (Canastota, New York) provided investigation-derived waste disposal services. Purdy Engineering (Vestal, New York) provided surveying of borehole, monitoring well, and surface water and sediment sample locations. CompuChem Environmental Corporation from Raleigh, North Carolina provided all off-site analytical services.

2.2.2 Chronology of Field Work

Tables 2.2-1 and 2.2-2 provide a summary of field activities conducted and the number of samples collected. The RI was divided into two phases of field work. The first phase of the field program began with a reconnaissance survey in July 1994. Soil and groundwater sampling was performed using direct push methods to determine the extent of contamination and potential source areas. A total of 56 soil samples were collected for on-site VOC analysis; 25 soil samples were sent off-site for analysis to confirm the screening results. Fifty-nine groundwater samples were collected and analyzed on-site for VOCs, and two were analyzed at the off-site laboratory. Phase II field work began in mid-October 1994 and included monitoring well installation, soil, groundwater, surface water, and sediment sampling, and an aquifer test. Twelve soil borings were installed in October 1994, and subsurface soil samples were collected for analysis. A total of nine monitoring wells were installed and developed in November 1994. Groundwater samples were collected between November 28 and December 5, 1994 (the on-site production well was sampled on December 7, 1994 during the aquifer test). A total of 53 soil samples, 29 groundwater samples, 6 surface water samples, and 6 sediment samples were collected (including the replicates and duplicates). The field work concluded with an aquifer test between December 6 and December 8, 1994.

2.2.3 Field Quality Assurance/Quality Control Program Description

The field QA/QC program included various activities. The review of field records, field instrument calibrations, collection of field blanks and replicate/duplicate samples, and COC procedure adherence were followed according to the *IRP Handbook* (USAF, 1993a) and planning documents (EARTH TECH, 1994a, 1994c). Record keeping of daily logs, equipment calibration, and COC forms is discussed in Section 2.2.1.13. As part of the soil, sediment, surface water, and groundwater sampling efforts, field QC samples were collected. Trip blanks, ambient conditions blanks, equipment blanks, and replicates/duplicates were collected to assess the variability, precision, accuracy, and interferences in sample shipment, sample collection, decontamination of sampling equipment, and sample matrix effects. In addition, a material blank sample was collected from the potable water source used in the equipment decontamination process. Equipment decontamination procedures were followed according to the SAP (EARTH TECH, 1994a) and are discussed in Section 2.2.1.10. The various types of field blanks, field replicates, and field duplicates collected during the sampling efforts are discussed below.

2.2.3.1 Trip Blanks. The trip blanks were prepared and handled as follows. A preacidified VOC sample bottle was filled in the laboratory with ASTM Type II water, transported to the site with empty sample bottles, and returned to the laboratory for analysis. Trip blanks were not opened in the field. One trip blank accompanied each cooler containing samples that were analyzed for VOCs by method SW8260. Analytical data were qualified based upon blank comparisons. Comparisons were calculated using USEPA protocols for blank contamination. Nineteen trip blanks were collected.

Chloroform, methylene chloride, and chloromethane were detected below the practical quantitation limit (PQL) in some of the trip blanks. The detection of these compounds may be attributed to laboratory contamination. Sample results were qualified as appropriate.

2.2.3.2 Ambient Conditions Blanks. The ambient conditions blanks were prepared and handled as follows. A preacidified VOC sample bottle was filled at a sampling site with ASTM Type II water. The ambient conditions blank was handled in the same way as other environmental samples and transported to the laboratory for analysis. One ambient conditions blank was collected at each sampling site during each VOC sampling round and analyzed for VOCs by method SW8260. Three ambient blanks were collected. No VOCs were detected in any of the ambient conditions blanks.

2.2.3.3 Equipment Blanks. An equipment blank is defined as ASTM Type II water that is poured through the sampling device, transferred to the sample bottle, and transported to a laboratory for analysis. An equipment blank was collected daily for each sampling device used by each sampling team. Twenty-one equipment blanks were collected.

Various metals were detected above the PQL in the equipment blanks, mainly zinc, sodium, iron, and aluminum. These analytes were detected in the associated laboratory blanks as well as the equipment blanks and may be an indication of trace contamination in the ASTM Type II water (see Section 2.3.3.3).

Methylene chloride and chloroform were detected in some of the equipment blanks. These compounds are also common laboratory contaminants and are considered to be artifacts of the laboratory environment and not the field conditions. The field QC results were used to qualify analytical results in the normal samples according to the "10 times rule" for blank contamination as discussed in Section 2.3.3.3.

Trace concentrations (below the laboratory PQL) of pesticide compounds were detected in the normal samples, the method blanks, and the equipment blanks. Trace values are considered artifacts of the laboratory environment and not the field conditions (see discussion in Section 2.3.3.3).

2.2.3.4 Material Blank (Potable Water Source). A water sample was initially collected as the material blank from a tap inside the building. The material blank was analyzed using the same methods as the normal environmental samples. This water source is part of the base potable water supply and is chlorinated. The water was used during the following field activities:

- Steam cleaning the drill rig and downhole equipment,
- Decontaminating sampling equipment,
- Preventing heaving sands during drilling, and
- Preparing grout for monitoring well installation and borehole abandonment.

The bromoform, chloroform, bromodichloromethane, and dibromochloromethane detected in the material blank are indicative of water chlorination. Various metals were detected above the PQL in the material blank. Results indicated elevated levels of copper, most likely from the copper pipes from which the water sample was collected. During drilling, potable water was taken from an on-site fire hydrant, and a second sample of potable water was taken from the hydrant and sent to CompuChem for metals analysis. Copper was not detected in this sample.

2.2.3.5 ***Field Replicates/Field Duplicates.*** Field replicates are single soil samples divided into two equal parts for analysis. Field replicates were labeled so that laboratory analysts were unable to distinguish them from normal samples. For split-spoon samples, the first and second brass liners from the bottom of the split-spoon were used as the sample and replicate, respectively. So that the normal and replicate samples were located as close together as possible, arrows were placed (by marker) on the liners pointing toward the interface where the liners met in the split-spoon sampler. Field replicates were collected at a 10 percent frequency and were analyzed for the same parameters as the normal samples. The target relative percent difference (RPD) between the field replicate and the normal environmental sample was 40 percent for soil/sediment samples as stated in the SAP (EARTH TECH, 1994a).

The majority of the compounds that exceeded the 40 percent RPD limit were metals and pesticides. In most cases, the samples showed evidence of inhomogeneity between the samples, with differences in the metals results indicating mineralogic differences. Discrepancies in the moisture content may have been due to lithologic changes also. Generally, the results for organic compounds, especially pesticides, were low and too close to the reporting limit to yield reliable RPD calculations. In several samples, low concentrations were detected, but the replicate sample concentrations were below detection limits, thereby resulting in an RPD of 200 percent. The RPD comparisons that exceeded the target goal but were less than 200 were a result of wide variances in the detected compound. Because of the complex nature of chemical interactions within soil matrices, no data were qualified on the basis of the RPD results.

Field duplicates are two water samples collected independently at a sampling location during a single act of sampling. As with field replicates, field duplicates were labeled so that laboratory analysts were unable to distinguish them from normal samples. Field duplicates were collected at a 10 percent frequency and were also analyzed for the same parameters as the normal samples. The target RPD between the field duplicate and the normal environmental sample was 30 percent for water samples as stated in the SAP (EARTH TECH, 1994a).

The target RPD of 30 percent was met in most cases; RPD comparisons for a few metals, pesticides, and VOCs exceeded this target goal. As with field replicates, in several instances a compound was detected in either the normal sample or the field duplicate, but the other sample was below detection limit, thereby resulting in an RPD of 200 percent. No data were qualified on the basis of the results of the RPDs between the normal water samples and the field duplicates.

2.2.4 Problems Encountered and Corrective Actions Taken

During the field program, two surface water samples, a duplicate, and an equipment blank for cyanide analysis were initially preserved incorrectly due to a mislabelled preservative from the laboratory. The two surface water samples were recollected once the proper preservative was received in the field. The duplicate sample was inadvertently not recollected, however. The equipment blank could not be recollected, and therefore no cyanide analysis was performed.

During monitoring well development, the pH meter malfunctioned, and accurate pH readings could not be consistently obtained. As discussed in Section 2.2.1.5, however, this is not considered to have affected proper well development as supported by other stabilization parameters and pH readings obtained during well purging prior to groundwater sampling.

2.2.5 Field Quality Assurance Activities

To ensure that the QA objectives were achieved, a series of QC activities were performed. As discussed in Section 2.2.3, field blanks, replicates, and duplicates were collected. All field activities were documented in the field logbooks. Because several field team members made entries into the logbooks, the information was reviewed daily for correctness and completeness. The field team leader was responsible for this activity. Standard operating procedures for field record documentation are discussed in detail in Section 2.2.1.13.

2.3 Laboratory Analyses

All analytical data generated during the AFP 59 RI were reported as Air Force Center for Environmental Excellence (AFCEE) Level II (USEPA Level III) data. Data validation was required for 10 percent of the total number of samples collected during the RI. In addition, a data review of all the laboratory data collected for this effort was performed as part of EARTH TECH QC protocols. Holding times, blank contamination comparisons, completeness, spike recoveries, and RPDs were reviewed. Precision, accuracy, representativeness, completeness, and comparability were used to assess the laboratory data quality. The laboratory program and QA/QC activities are discussed below.

2.3.1 Analytical Program

Laboratory analyses were performed by CompuChem Environmental Corporation (Research Triangle Park, North Carolina). Analytical procedures concerning sample preparation, analysis, and reporting were in accordance with the specified method and guidelines given in the *IRP Handbook* (USAF, 1993a). Table 2.3-1 lists the number of analyses performed by method for soil, sediment, groundwater, and surface water. Table 2.3-2 lists the laboratory PQLs by analytical method.

Method detection limit (MDL) studies for Gas Chromatograph (GC) and Gas Chromatography/Mass Spectrometry (GC/MS) methods are performed by the laboratory according to 40 CFR 136 on an annual schedule. Instrument detection limit (IDL) studies for metals [Inductively Coupled Plasma (ICP) and Atomic Absorption] and wet chemistry methods are performed quarterly.

TABLE 2.3-1
SUMMARY OF SAMPLE ANALYSES

Analytical Method	Environmental Samples		Trip Blanks	Ambient Conditions Blanks	Equipment Blanks	Replicate/ Duplicate Samples	Total Analyses
	Phase I	Phase II					
SOIL ANALYSES							
SW8260 Volatile Organics	15	48	11	1	12	6	93
SW8270 Semivolatile Organics	0	48	—	—	8	5	61
SW8080 Pesticides/PCBs	0	48	—	—	8	5	61
SW6010, 7060, 7421, 7471, 7740, 7841 Metals	8	48	—	—	10	6	72
SW9012 Cyanide	0	48	—	—	7	5	60
SW9060 TOC	0	48	—	—	—	5	53
GROUNDWATER ANALYSES							
SW8260 Volatile Organics	2	26	8	1	8	3	48
SW8270 Semivolatile Organics	0	26	—	—	8	3	37
SW8080 Pesticides/PCBs	0	25	—	—	8	3	36
SW6010, 7060, 7421, 7470, 7740, 7841 Metals	0	26	—	—	8	3	37
SW9012 Cyanide	0	26	—	—	8	3	37
E130.1 Hardness	0	25	—	—	6	3	34
SEDIMENT ANALYSES							
SW8260 Volatile Organics	0	5	3(1)	1(2)	1	1	11

TABLE 2.3-1
SUMMARY OF SAMPLE ANALYSES

Continued

Analytical Method	Environmental Samples		Trip Blanks	Ambient Conditions Blanks	Equipment Blanks	Replicate/ Duplicate Samples	Total Analyses
	Phase I	Phase II					
SW8270 Semivolatile Organics	0	5	—	—	1	1	7
SW8080 Pesticides/PCBs	0	5	—	—	1	1	7
SW6010, 7060, 7421, 7471, 7740, 7841 Metals	0	5	—	—	1	1	7
SW9010 Cyanide	0	5	—	—	1	1	7
SW9060 TOC	0	5	—	—	—	1	6
SURFACE WATER							
SW8260 Volatile Organics	0	5	3(1)	1(2)	0(3)	1	10
SW8270 Semivolatile Organics	0	5	–	–	0	1	6
SW8080 Pesticides/PCBs	0	5	–	–	0	1	6
SW6010, 7060, 7421, 7470, 7740, 7841 Metals	0	5	–	–	0	1	6
SW9010 Cyanide	0	5	–	–	0	1	6
E130.1 Hardness	0	5	–	–	0	1	6

(1) Surface water and sediment VOC samples were shipped with soil VOC samples; therefore, the trip blanks associated with the surface water and sediment samples are also included in the total for the soil trip blanks.

(2) One ambient conditions blank was collected during sediment/surface water sampling.

(3) No equipment blanks were necessary during surface water sampling because no sampling equipment that required decontamination was used.

TABLE 2.3-2
ANALYTICAL PARAMETERS AND PRACTICAL QUANTITATION LIMITS FOR COMPUCHEM

Parameter	Practical Quantitation Limits	
	Soil (mg/kg)	Water (µg/L, unless otherwise indicated)
Semivolatile Organic Compounds (Method SW8270)		
Phenol	0.470	10
bis(2-Chloroethyl)ether	0.380	10
2-Chlorophenol	0.410	25
1,3-Dichlorobenzene	0.420	15
1,4-Dichlorobenzene	0.430	10
Benzyl Alcohol	0.430	15
1,2-Dichlorobenzene	0.400	15
2-Methylphenol	0.410	20
bis(2-Chloroisopropyl)ether	0.560	15
4-Methylphenol	2.900	120
N-Nitroso-Di-N-propylamine	0.410	10
Hexachloroethane	0.390	15
Nitrobenzene	0.510	10
Isophorone	0.430	10
2-Nitrophenol	0.320	30
2,4-Dimethylphenol	0.320	20
Benzoic Acid	2.900	45
bis(2-Chloroethoxy)methane	12.000	10
2,4-Dichlorophenol	0.300	30
1,2,4-Trichlorobenzene	0.390	10
Naphthalene	0.360	10
4-Chloroaniline	0.480	10
Hexachlorobutadiene	0.380	10
4-chloro-3-methylphenol	0.280	20
2-Methylnaphthalene	0.400	10
Hexachlorocyclopentadiene	0.360	10
2,4,6-Trichlorophenol	0.580	55
2,4,5-Trichlorophenol	0.710	65
2-Chloronaphthalene	0.430	10
2-Nitroaniline	1.500	15
Dimethyl phthalate	0.360	15
Acenaphthylene	0.340	10
3-Nitroaniline	0.920	15
4-Nitroaniline	1.0	20
Acenaphthene	0.370	10
2,4,-Dinitrophenol	0.590	90
4-Nitrophenol	0.890	35
Dibenzofuran	0.350	10
2,4-Dinitrotoluene	0.400	10

TABLE 2.3-2
ANALYTICAL PARAMETERS AND PRACTICAL QUANTITATION LIMITS FOR COMPUCHEM

Continued

Parameter	Practical Quantitation Limits	
	Soil (mg/kg)	Water (µg/L, unless otherwise indicated)
Semivolatile Organic Compounds (Method SW8270) (Continued)		
n-Nitrosodiphenylamine	0.860	10
Anthracene	0.420	10
Benzo(a)anthracene	0.400	15
Benzo(b)fluoranthene	0.320	15
Benzo(g,h,i)perylene	0.370	20
Benzo(a)pyrene	0.290	15
bis(2-ethylhexyl)phthalate	0.580	15
4-Bromophenyl phenyl ether	0.340	10
Butyl benzyl phthalate	0.290	15
4-Chlorophenyl phenyl ether	0.290	15
Chrysene	0.610	15
Dibenz(a,h)anthracene	0.410	20
Di-n-butylphthalate	0.910	40
3,3'-Dichlorobenzidine	0.400	15
Diethylphthalate	0.280	10
2,6-Dinitrotoluene	0.350	10
Di-n-octyl phthalate	0.380	20
Fluoranthene	0.290	15
Fluorene	0.330	10
Hexachlorobenzene	0.330	10
Indeno(1,2,3,-cd)pyrene	0.630	25
Phenanthrene	0.320	10
Pyrene	0.320	15
4,6-Dinitro-2-methylphenol	0.830	80
Pentachlorophenol	0.730	85
Organochlorine Pesticides & PCBs (Method SW8080)		
Aldrin	0.010	0.025
alpha-BHC	0.0025	0.025
beta-BHC	0.010	0.050
delta-BHC	0.00075	0.0010
gamma-BHC (Lindane)	0.0025	0.025
Chlordane	0.015	0.020
4,4'-DDD	0.010	0.050
4,4'-DDE	0.015	0.050
4,4'-DDT	0.010	0.075
Dieldrin	0.010	0.050
Endosulfan I	0.0050	0.025
Endosulfan II	0.020	0.025
Endosulfan sulfate	0.020	0.025
Endrin	0.010	0.050

TABLE 2.3-2
ANALYTICAL PARAMETERS AND PRACTICAL QUANTITATION LIMITS FOR COMPUCHEM

Continued

Parameter	Practical Quantitation Limits	
	Soil (mg/kg)	Water (µg/L, unless otherwise indicated)
Organochlorine Pesticides & PCBs (SW8080) (Continued)		
Endrin aldehyde	0.015	0.075
Heptachlor	0.0025	0.025
Heptachlor epoxide	0.015	0.050
Methoxychlor	0.030	0.25
Toxaphene	0.110	3.0
PCB-1016	0.050	0.50
PCB-1221	0.045	2.0
PCB-1232	0.040	1.0
PCB-1242	0.030	2.5
PCB-1248	0.160	0.75
PCB-1254	0.020	2.0
PCB-1260	0.060	0.50
Volatile Organics (Method SW8260 25mL purge)		
Dichlorodifluoromethane		
Benzene	0.010	1.0
Bromodichloromethane	0.015	0.75
Bromoform	0.015	0.50
Bromomethane	0.020	0.50
2,2-Dichloropropane	0.010	0.50
Carbon tetrachloride	0.015	0.50
Chlorobenzene	0.015	1.0
Chlorodibromomethane	0.015	0.50
Chloroethane	0.015	0.50
Trichlorofluoromethane	0.020	0.50
Chloroform	0.010	1.0
Chloromethane	0.015	0.75
1,1-Dichloroethane	0.015	1.0
1,2-Dichloroethane	0.015	0.75
1,1-Dichloroethene	0.020	0.75
trans-1,2-Dichloroethene	0.015	0.75
1,2-Dichloropropane	0.015	1.0
cis-1,3-Dichloropropene	0.015	0.75
trans-1,3-Dichloropropene	0.015	0.50
Ethylbenzene	0.015	0.50
cis-1,2-Dichloroethene	0.015	0.75
Methylene chloride	0.015	0.50
Bromochloromethane	0.035	15
Styrene	0.015	1.0
1,1,2,2-Tetrachloroethane	0.015	0.50
Tetrachloroethene	0.030	0.50
	0.015	0.75

TABLE 2.3-2
ANALYTICAL PARAMETERS AND PRACTICAL QUANTITATION LIMITS FOR COMPUCHEM

Continued

Parameter	Practical Quantitation Limits	
	Soil (mg/kg)	Water (µg/L, unless otherwise indicated)
Volatile Organics (Method SW8260 25 mL purge) (Continued)		
Toluene	0.015	0.75
1,1,1-Trichloroethane	0.015	0.75
1,1,2-Trichloroethane	0.020	0.75
Trichloroethene	0.015	0.75
1,1-Dichloropropene	0.015	1.0
Vinyl chloride	0.010	1.0
m,p-Xylenes	0.015	0.50
o-Xylenes	0.015	0.50
n-Propyl Benzene	0.015	0.75
Dibromomethane	0.020	0.75
1,3-Dichloropropane	0.010	0.75
1,2-Dibromoethane	0.020	0.75
1,1,1,2-Tetrachloroethane	0.015	0.75
Isopropyl Benzene	0.015	0.75
1,2,3-Trichloropropane	0.025	1.0
Bromobenzene	0.015	0.50
2-Chlorotoluene	0.015	0.50
4-Chlorotoluene	0.015	0.50
tert-Butyl Benzene	0.015	0.75
1,3,5-Trimethyl Benzene	0.015	0.50
1,2,4-Trimethyl Benzene	0.015	0.50
sec-Butyl Benzene	0.015	0.75
1,3-Dichlorobenzene	0.015	0.50
p-Isopropyl Toluene	0.015	0.75
1,4-Dichlorobenzene	0.015	0.75
1,2-Dichlorobenzene	0.020	0.50
n-Butyl Benzene	0.015	0.75
1,2-Dibromo-3-Chloropropane	0.030	1.5
1,2,4-Trichlorobenzene	0.025	0.50
Naphthalene	0.035	0.75
Hexachlorobutadiene	0.025	0.75
1,2,3-Trichlorobenzene	0.020	0.75
Total Organic Carbon (Method SW9060)		
TOC	50	NA
Cyanide, Total (Method SW9012)		
Cyanide, Total	0.90	0.01 mg/L

TABLE 2.3-2
ANALYTICAL PARAMETERS AND PRACTICAL QUANTITATION LIMITS FOR COMPUCHEM

Continued

Parameter	Practical Quantitation Limits	
	Soil (mg/kg)	Water (mg/L, unless otherwise indicated)
ICP Screen for Metals (Method SW6010)		
Aluminum	135	0.12
Antimony	7.0	0.180
Barium	0.65	0.0040
Beryllium	0.60	0.0025
Cadmium	1.5	0.019
Calcium	68.0	1.0
Chromium	2.5	0.019
Cobalt	2.0	0.020
Copper	3.0	0.010
Iron	38.5	0.12
Magnesium	52.0	0.058
Manganese	5.5	0.0035
Molybdenum	11.0	0.056
Nickel	8.5	0.050
Potassium	530	2.2
Silver	0.80	0.0080
Sodium	380	0.44
Vanadium	4.0	0.0065
Zinc	9.0	0.0095
Mercury (SW7470, SW7471)		
Mercury	0.30	0.00025
Arsenic (SW7060)		
Arsenic	0.85	0.018
Lead (SW7421)		
Lead	0.30	0.0075
Selenium (SW7740)		
Selenium	0.80	0.0075
Thallium (SW7841)		
Thallium	0.25	0.0035

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The laboratory reported as trace values any analytical results that were detected between the PQL and the MDL for organics and between the PQL and the IDL for inorganics. These values have been qualified as estimated (J) for use in the RI. The laboratory also reported values below the MDL in some instances. These results have been treated as nondetects during the RI because the accuracy of the values is unknown.

QC limits for percent recovery and RPD for matrix spike (MS) and laboratory control samples (LCS) are calculated statistically from at least 20 spiked samples analyzed in the laboratory for each matrix, analyte, and QC sample. Where historical data are not available for this determination, limits listed in the methods are used.

2.3.2 *Chronology of Laboratory Analyses*

Chemical analyses were performed between July 1994 and August 1994 for samples collected during the Reconnaissance Survey. A potable water sample was analyzed in September 1994. Samples collected during the RI were analyzed between October 1994 and January 1995. The dates of analyses for each sample are provided in Tables 3-1 through 3-20 of the *Analytical Data Informal Technical Information Report* (ITIR) (EARTH TECH, 1995b).

2.3.3 *Quality Assurance/Quality Control Program*

Laboratory QA/QC focused on ensuring that each chemical measurement had the highest probability of achieving method protocols for precision and accuracy. Data were reported according to AFCEE Level II requirements.

2.3.3.1 Types of Laboratory Quality Control Samples. QC samples such as method blanks, LCSs, and duplicate samples were evaluated and documented on a routine basis. Spike and surrogate recoveries were calculated as appropriate, and these QC data were compared on an ongoing basis to laboratory-established control limits. National Institute of Standards and Technology (NIST)-traceable standards were used for spiking compounds and surrogates. The various QC methods used to identify possible laboratory biases are discussed below.

Method Blanks. A method blank is an artificial sample used to monitor the analytical system for interferences and contamination from sources such as glassware or reagents. The method blank is taken through the entire sample preparation process and is included with each analytical lot of extractions/digestions prepared, regardless of method. Method blanks were analyzed for each method and each analytical batch.

Concentrations slightly above the PQLs were detected in the method blanks for metals, pesticides/PCBs, and the common volatile and semivolatile laboratory contaminants, (i.e., methylene chloride and phthalates). Method blank results were used to qualify associated normal environmental samples according to USEPA protocols for blank comparison.

Spikes. Spikes were used to evaluate matrix interferences and maintain method control. MS samples are normal environmental samples that are spiked with designated compounds of interest to determine whether the environmental matrix affects the ability to quantitate compounds of concern. MS samples were analyzed with each batch of soil, sediment, surface water, and groundwater samples analyzed using methods SW8260, SW8270, SW6010, SW9012, SW7060, SW7470, SW7421, SW7740, SW7841, and SW8080. The spiking levels and frequencies presented in Appendix A of the SAP (EARTH TECH, 1994a) according to the method and matrix were followed. Spiking compound percent recoveries were calculated and compared with the corresponding laboratory-established control limits.

LCSs were also used to maintain control of the analytical method. The LCS is comprised of ASTM Type II water spiked with the entire target compound list. The LCS is used to monitor the performance of the analytical method by matrix. Historical data of the LCSs were used to generate the control charts for which method trends were tracked by CompuChem. Percent recoveries of the spiked compounds were calculated and compared against the laboratory-established control limits. Samples associated with compounds for which the LCS percent recoveries were outside of the laboratory-established control limits were scrutinized to determine whether reanalysis was necessary.

Surrogate Compounds. For GC and GC/MS analyses, the analytical process included the addition, subsequent analysis, and recovery calculations of surrogate spiking compounds. Surrogate compounds were added to every normal and QC sample during sample preparation. The surrogate recovery was used to monitor matrix effects and sample preparation techniques. Compounds are considered suitable surrogate compounds if they meet the following criteria:

- They are not requested for analysis,
- They do not interfere with the determination of required analytes, and
- They are not naturally occurring yet are chemically similar to the required analytes.

As with the spiking compounds, the surrogate percent recoveries were calculated and compared with the corresponding laboratory-established control limits.

Duplicates. Duplicate sample determinations were used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analyses were also performed to generate data to determine the long-term precision of the analytical method on various matrices.

For inorganic methods, one duplicate sample was prepared and analyzed from each batch of samples with a similar matrix type (e.g., water, soil). A control limit of ± 20% for the RPD was used for original and duplicate sample values greater than or equal to 5 times the PQL. A control limit of ± the PQL was used if either the sample or duplicate value was less than 5 times the PQL. In the case where only one result was above five times the PQL and the other was below, the ± PQL control limit applied. If both sample values were nondetect, the RPD was not calculated.

The control limits as specified above (± 20% RPD and ± the PQL) are method requirements for duplicate samples, regardless of the sample matrix type. However, laboratory variability arising from the subsampling of nonhomogeneous soil samples was a common occurrence. Therefore, during data validation, the use of less restrictive criteria (e.g., ± 40% RPD, ± 2 times the PQL) were used to assess duplicate soil samples.

2.3.3.2 Frequency of QC Samples. Appendix A of the SAP (EARTH TECH, 1994a) lists the frequencies and acceptance criteria for method blanks, MSs/MS duplicates, LCSs, surrogate spikes, and duplicates for all methods used by CompuChem. Specific acceptance criteria for QC sample results are provided in the *Analytical Data ITIR* (EARTH TECH, 1995b).

2.3.3.3 Analytical Problems and Corrective Action. This section provides a discussion of laboratory problems encountered and corrective action procedures.

Holding Time Violations. All samples were analyzed within the required Air Force holding times specified in the *IRP Handbook* (USAF, 1993a) except for two equipment blanks. Samples EB1110994 and EB1111494 were extracted outside of the recommended holding time for method SW8270. The equipment blanks missing extraction holding times is considered to have minimal impact on the data because only trace amounts of SVOCs were detected in one of the seven samples associated with the equipment blanks.

The analyses of method SW8260 exceeded NYSDEC holding time requirements by 1 day for samples 59DP23S01, 59DP24S02, 59DP26S01, and 59DP26S02. In addition, holding times were exceeded by 2 days for samples 59SW3WG1, 59EB10713, 59EB10714, and TB1071494, and by 3 days for samples 59TB10712, 59EB10712, and 59TAP1WG1. Positive results for these samples have been qualified. Although NYSDEC holding times have been exceeded, the impact on the data is considered to be minimal because both Federal and Air Force holding time requirements were met.

Laboratory Corrective Action. Corrective action at the laboratory was performed by modifying laboratory worksheets to include holding time requirements for both the analytical method and the regulatory agency when they differed.

Laboratory Contamination. EARTH TECH evaluated blank analytical results from both field and laboratory blanks to determine the existence and magnitude of any contamination problems. Blank contaminants were evaluated, and the "5/10 times rule" established in the USEPA *Laboratory National Functional Guidelines for Organic Data Review* (USEPA, 1993a) and the USEPA *Laboratory National Functional Guidelines for Inorganic Data Review* (USEPA, 1994a) was applied. Sample results that were less than 5 times the concentration identified for the analyte in an associated blank (or 10 times, in the case of common laboratory contaminants) were determined to be blank contaminants; therefore, they were not considered to be positive detections.

Methylene chloride, chloromethane, bromomethane, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, naphthalene, m,p-xylenes, p-cymene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, hexachlorabutadiene, and chloroform were detected in method blanks at concentrations less than the PQL for the analyses of method SW8260. No SVOCs were detected in laboratory blanks for method SW8270.

Delta-BHC and 4,4'-DDD were detected slightly above the PQL in three method blanks for method SW8080. Delta-BHC was not detected in the associated samples; therefore, no corrective action was taken. Additional pesticide compounds were detected in the method blanks below the PQLs. Many of the method blank results were not confirmed on a second column because no associated samples required confirmation. A second column analysis may not have confirmed the presence of the pesticide compounds.

Iron, zinc, and sodium were detected above the PQL in the method blanks as well as the equipment blanks for the analyses of method SW6010. Environmental sample results that exceeded 5 times the amount detected in the associated blanks were considered valid, and no corrective action was taken. Sample results below 5 times the amount detected in the associated blank were qualified due to blank contamination.

Laboratory Corrective Action. The sample EP for pesticides/PCBs was examined for cross-contamination due to improperly cleaned glassware. The employees involved in the preparation and analyses of the samples were informed of the failing QC criteria and were provided with training to help ensure that this problem was not repeated.

The contaminants detected during analyses of method SW6010 may be attributed to the distillation process used by the laboratory. Deionized, distilled water was used for the preparation of all reagents and calibration standards and as dilution water for the analyses of method SW6010. The distillation process was closely examined by passing distilled water through a mixed bed of cation and anion exchange resins. This procedure ensured that the purity of the water was equivalent to ASTM Type II reagent-grade water and free of contaminants.

Consistent with the SAP (EARTH TECH, 1994a), corrective action was not required for target compounds detected in the associated blanks at concentrations less than or equal to the PQL.

2.3.3.4 Calculations of Completeness. All analytical methods met the target of 100 percent completion with the exception of method SW8080 for groundwater. The percent completion for the analyses of method SW8080 was 96.5 for groundwater. One groundwater sample was inadvertently omitted by the laboratory for this analysis. EARTH TECH received useable results from the laboratory for all other samples and each analysis requested. There was no breakage or sample loss due to handling or shipping procedures. Completeness was calculated by method and matrix using the following formula:

Number of samples sent for analysis/Number of valid samples × 100

2.3.3.5 QA Activities. As part of the QC activities, a complete review of all of the final COC forms was conducted by EARTH TECH. As the samples were relinquished from the field to the laboratory, the COC forms were properly signed by the relinquishing personnel and the receiving personnel.

An external laboratory audit was conducted by representatives from AFCEE. The audit was performed on August 17 and 18, 1994, at CompuChem. The CompuChem audit findings and responses are reported in Appendix P.

2.3.3.6 Data Management. As part of the EARTH TECH data management activities, a series of electronic QC programs were developed and used by EARTH TECH on the laboratory data generated for this effort. To ensure the accuracy of each program, a portion of the data was cross checked using hand calculations. CompuChem submitted analytical data in hardcopy and electronic form. AFCEE requires submission of the laboratory analytical results in the electronic IRPIMS format. The analytical methods used are submitted in the BCHTEST electronic file; the analytical results are submitted in the BCHRES electronic file. As part of AFCEE requirements, the IRPIMS files are checked by the laboratory and EARTH TECH using the AFCEE Quality Control Tool, prior to submitting the files to AFCEE.

2.4 Data Evaluation

This section provides a discussion of data validation and data review procedures.

2.4.1 Methodology for Data Quality Assessment

The process of generating data of known quality began in the planning stages when DQOs were established, continued during sample collection activities and laboratory analysis, and was completed by validating the analytical data. Validation of data required that appropriate QA/QC and documentation steps were performed in both the laboratory and the field. Chemists trained in validation procedures reviewed this information to assign data qualifiers. Qualifiers indicate data acceptance and potential limitations of data usage when QA/QC criteria were not met.

As specified in the SAP (EARTH TECH, 1994a), 10 percent of the total samples collected were validated in accordance with USEPA Level III requirements. Procedures for data validation were performed in accordance with the February 1993 *Laboratory National Functional Guidelines for Organic Data Review* (USEPA, 1993a) and the February 1994 *Laboratory National Functional Guidelines for Inorganic Data Review* (USEPA, 1994a). In addition, all data collected for this effort were reviewed for holding time conformance and field and laboratory blank contamination. Data were qualified as appropriate based on both the USEPA Level III data validation and the data review findings. The laboratory also flagged data in the data base as estimated in two situations: (1) when the first and second column RPD exceeded 20% for method SW8080; and (2) when the serial dilution failed the ± 10% criterion for method SW6010.

Two qualifiers were used in accordance with USEPA National Functional Guidelines. The definitions of those qualifiers are as follows:

- "U" Qualifier indicates that the compound is qualified as nondetect due to blank contamination.
- "J" Qualifier indicates that the compound is qualified as estimated.

Because no major problems were identified during the validation procedure of 10 percent of the data, it is concluded that all the data are of equal quality. The data validation summary is provided in Appendix N.

2.4.2 Data Analysis and Interpretation

All groundwater level data collected during the pumping and recovery tests were collected either through the use of data loggers and pressure transducers or by hand using an electric water level meter. The data were plotted on depth to water versus elapsed time hydrographs (Appendix D) to evaluate drawdown patterns at each well location. The hydrographs illustrated the presence of a rising trend in groundwater elevations prior to the pumping test and in data collected late in the recovery test. This trend is attributed to the rise in the Susquehanna River stage of approximately 6 feet, which occurred during the 24-hour period preceding the pumping test. Studies by the USGS (1986, 1996) have shown a direct correlation between rises in the Susquehanna River stage and rises in groundwater elevations as measured in monitoring wells in the area.

The pumping test data from all wells subjected to aquifer test analysis were corrected to account for the rising trend in the groundwater data. Similar corrections were required for the pumping test data collected during the 1992 *Contaminant Source Investigation* conducted by URS Consultants, Inc. (URS Consultants, Inc., 1992). For the RI pumping test data, the rate of groundwater elevation rise was calculated for each well subjected to analysis by evaluating the rate of rise recorded in the groundwater data collected prior to the pumping test and/or in data collected late in the recovery test. The rate of rise ranged from a minimum of 3×10^{-5} ft./min. at SW10 to a maximum of 3×10^{-4} ft./min. at DW3. The rate of rise calculated for each well was then subtracted from the observed drawdown data to arrive at the corrected drawdown data used in the pumping test analysis. The raw and corrected data are presented in Appendix D.

The corrected drawdown data were analyzed using the Geraghty and Miller software package AQTESOLV. Based on time-drawdown curves generated from the data and the subsurface geology at the site, the majority of the data were initially analyzed using two different solutions for leaky aquifers: one that accounts for storage from the aquitard (the fine-grained glacial deposits) and one that does not account for aquitard storage. Examination of the time-drawdown curves generated during the analysis demonstrated a more consistent fit with the type curves generated from the leaky aquifer solution that does not take into account aquitard storage (Hantush and Jacob, 1955). Therefore, this solution was used in the analysis of the pumping test data collected from most monitoring wells.

Unconfined aquifer conditions exist in the northeast portion of the property where no fine-grained glacial deposits are present. Therefore, the corrected drawdown data from SW10 and DW10 were analyzed using the Theis (1935) unconfined aquifer solution.

LEAKY AQUIFER SOLUTION. The aquifer test solution chosen to analyze the drawdown data from all wells located where the fine-grained glacial deposits are present solves for unsteady flow to a well in a leaky aquifer with no storage in the aquitard (Hantush and Jacob, 1955). The following set of assumptions are inherent in the solution:

- Aquifer has infinite areal extent;
- Aquifer is homogeneous, isotropic, and of uniform thickness;
- Aquifer potentiometric surface is initially horizontal;
- Pumping rate is constant;
- Pumping well is fully penetrating;
- Flow to well is horizontal;
- Aquifer is semi-confined;
- Flow is unsteady;
- Water is released instantaneously from storage with decline of hydraulic head;
- Diameter of the pumping well is small so that storage in the well can be neglected
- Confining bed has infinite areal extent, uniform vertical hydraulic conductivity, and uniform thickness;
- Confining bed is underlain by an infinite constant-head plane source; and
- Flow in the aquitard is vertical.

While all assumptions inherent in the solution are not satisfied, the Hantush and Jacob method represents the best solution for leaky aquifer conditions at AFP 59. The solution is given by the following equation:

$$s = \frac{Q}{4\pi T} W(u,r/B)$$

where:
s = drawdown (ft/min)
Q = constant pumping rate (ft^3/min)
T = aquifer transmissivity (ft^2/min)
W(u,r/B) = well function of Hantush

and:

$$u = \frac{r^2 S}{4Tt}$$

r = radius from pumping well to observation well (ft)
S = aquifer storativity (dimensionless)
t = time since pumping began (min)
B = $(Tb' / K')^{1/2}$ = the leakage factor

b' = aquitard thickness (ft)
K' = vertical hydraulic conductivity of aquitard (ft/min)

The solution was solved graphically in AQTESOLV by matching the field time-drawdown data to the type curves for the Hantush well function [W(u,r/B)]. The match point yields values of W(u,r/B), 1/u, t, and s. Transmissivity and storativity values can then be calculated using the following equations:

$$T = \frac{Q}{4\pi s} W(u,r/B)$$

and:

$$S = \frac{4uTt}{r^2}$$

UNCONFINED AQUIFER SOLUTION. The aquifer test solution chosen to analyze the drawdown data from SW10 and DW10, where unconfined aquifer conditions exist, solves for unsteady flow to a well in an unconfined aquifer (Theis, 1935). The following set of assumptions are inherent in the solution:

- Aquifer has infinite areal extent;
- Aquifer is homogeneous, isotropic, and of uniform thickness;
- Aquifer potentiometric surface is initially horizontal;
- Pumping rate is constant;
- Pumping well is fully penetrating;
- Flow to well is horizontal;
- Aquifer is unconfined;
- Flow is unsteady;
- Water is released instantaneously from storage with decline of hydraulic head; and
- Diameter of the pumping well is small so that storage in the well can be neglected.

While all assumptions inherent in the solution are not satisfied, the Theis method represents the best solution for unconfined conditions at AFP 59. The simplified Cooper and Jacob (1946) straight line method could not be used because the data violated the assumption that the value of u must be small (i.e., r is small and t is large). Neuman's (1975) method was not used because the time-drawdown data did not display the effects of delayed gravity drainage defined by this solution.

The solution is given by the following equation:

$$s = \frac{Q}{4\pi T} W(u)$$

where: s = drawdown (ft/min)
Q = constant pumping rate (ft^3/min)
T = aquifer transmissivity (ft^2/min)
W(u) = well function of Theis

and:

$$U = \frac{r^2 S}{4Tt}$$

r = radius from pumping well to observation well (ft)
S = aquifer storativity (dimensionless)
t = time since pumping began (min)

The solution was solved graphically in AQTESOLV by matching the field time-drawdown data to the type curves for the Theis well function [W(u)]. The match point yields values of W(u), 1/u, t, and s. Transmissivity and storativity values can then be calculated using the following equations:

$$T = \frac{Q}{4\pi s} W(u)$$

and:

$$S = \frac{4uTt}{r^2}$$

The similarity of the two solutions is illustrated in the equations that govern both solutions and by the fact that both solutions use the same graphical matching technique. The only difference between the two methods is the r/B value in the Hantush well function, which defines the leakage from the aquitard. As leakage (r/B) approaches zero, the Hantush type curves approach those of the Theis type curve.

2.4.3 Methodology for Risk Estimation

The methods used to estimate risks to human health and the environment included the following four basic procedures: data evaluation, exposure assessment, toxicity assessment, and risk characterization. These basic procedures included the following specific tasks:

- Selection of chemicals of potential concern in all media for human receptors;
- Identification of current and future receptors who may directly contact contaminated media or contact contaminated media that has migrated from a site;

- Identification of human exposure pathways;
- Quantification of human exposure;
- Assessment of human toxicity, including assessment of noncarcinogenic and carcinogenic health effects;
- Estimation of human risk by comparing potential exposure doses to doses known to cause toxic effects; and
- Evaluation of human health risk assessment uncertainties associated with all tasks with the risk assessment process.

Risk assessment methods are discussed in more detail in Section 3.4

SECTION 3.0

REMEDIAL INVESTIGATION

The results of the RI at AFP 59 are summarized in this section. The sampling and analysis results are presented, and potential migration pathways and receptors are identified to develop a conceptual site model for AFP 59. This information is used as the basis for the human health risk assessment. Results of the Fish and Wildlife Impact Analysis are presented in Appendix O.

3.1 Sampling and Analysis Results

To efficiently characterize the site, the field investigation at AFP 59 was conducted in two phases. In July 1994, a Reconnaissance Survey was conducted to locate potential source areas and to delineate areas of contamination. Soil and groundwater samples were collected using direct push methods and were analyzed for VOCs at an on-site, mobile laboratory. Using this screening data, soil samples were selected for off-site analysis to provide higher quality data for site characterization. Additionally, soil samples from background locations were collected and analyzed at an off-site laboratory. The data collected during the reconnaissance survey were presented in the *Reconnaissance Survey Summary Report* (EARTH TECH, 1994b).

The results of the Reconnaissance Survey were used to guide sampling during the second phase of the investigation, which was conducted between October and December 1994 to characterize the site. Soil boring and monitoring well locations were determined on the basis of results of the Reconnaissance Survey and previous investigations. Soil, groundwater, sediment, and surface water samples were collected during the second phase of the field investigation and analyzed at an off-site laboratory.

In addition to the sampling conducted by EARTH TECH, results from soil sampling completed by Martin Marietta as part of the Plating Room and settling/storage tank closure activities were used to characterize the site. These soil samples were collected between July 1992 and December 1994. Analytical results from soil samples collected from background locations during the SSI (Argonne National Laboratory, 1994) were also used to supplement background data collected during the RI.

This section summarizes the data collection activities completed during the RI field effort. Invalid data (identified in Section 2.4.1) are reviewed. Concentrations of analytes detected in site and background samples are presented, and site data are compared to background data to determine analytes present at concentrations exceeding naturally occurring, background levels. A trend analysis of identified contaminants is also presented, and potential sources contributing to identified contamination are discussed.

3.1.1 Review of Field And Laboratory Data

During the field investigation for the RI, soil, groundwater, sediment, and surface water samples were collected. All prescribed field procedures, sample handling documentation, laboratory procedures, and documentation specified in the approved planning documents (EARTH TECH, 1994a, 1994c) were followed. Ten percent of the data collected during the RI were validated by EARTH TECH in accordance with USEPA Level III requirements. Additionally, all of the data were reviewed for associated field and laboratory blank contamination and holding time conformance. Data qualifiers were applied as appropriate based on the results of both the data validation and review. The data validation and review process is described in Section 2.4.1, and the data validation summary report is provided in Appendix N. Data from samples not collected by EARTH TECH were not validated by EARTH TECH and were used as reported.

Two qualifiers were applied to the data as a result of the data validation and review processes and are defined below.

- U Analyte was detected in associated blank; sample result was considered a nondetect.
- J Analyte was detected but concentration is estimated.

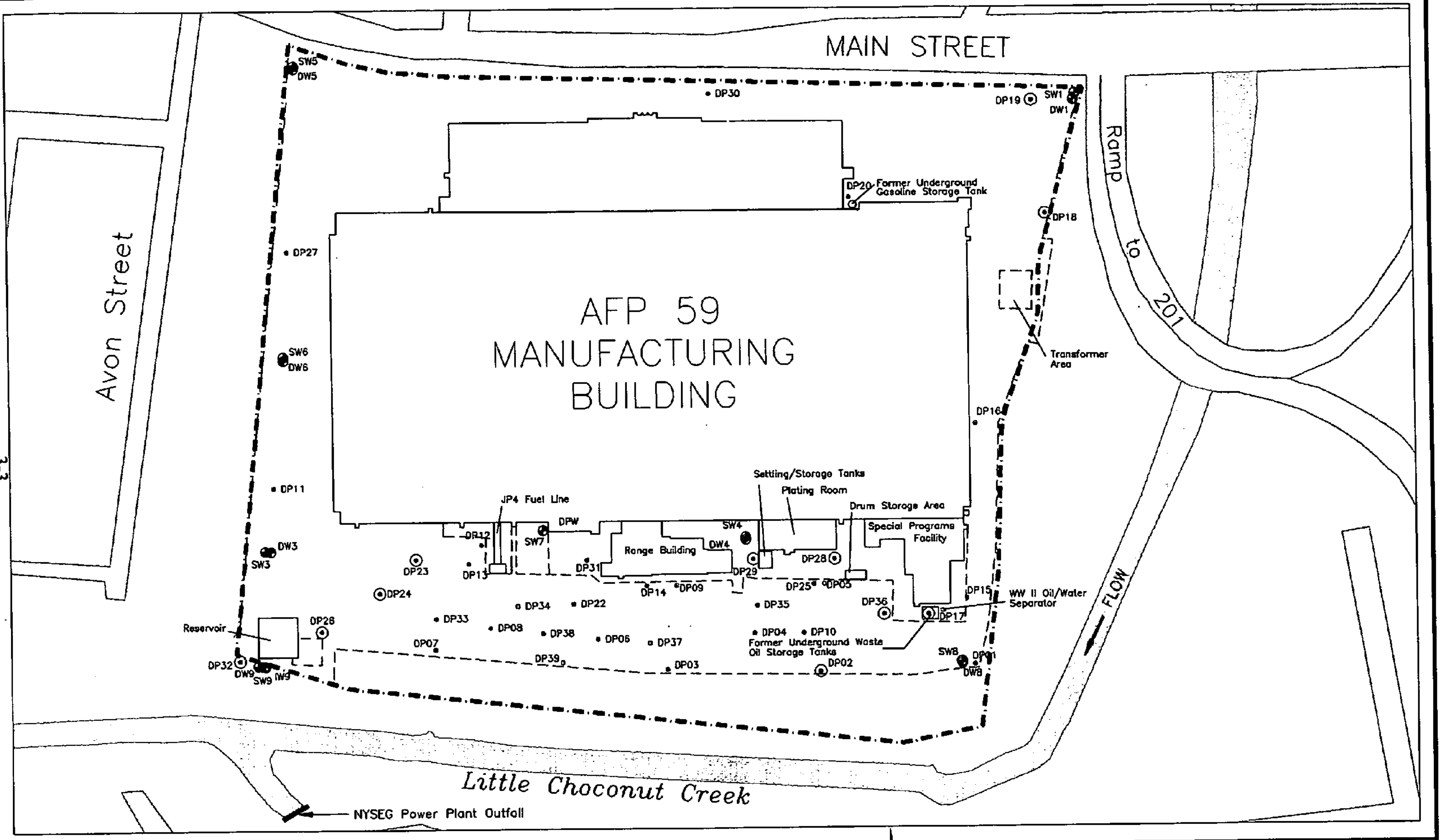
All data with "U" qualifiers are considered unusable. Data with "J" qualifiers (estimated) are considered useable. The most frequent uses of these qualifiers are discussed briefly. Refer to Sections 2.3 and 2.4.1 for a detailed discussion of the analytical program; refer to Appendix N for a discussion of the data validation conducted by EARTH TECH.

Low level methylene chloride contamination was detected in many environmental samples and laboratory QC samples. Methylene chloride is a common laboratory contaminant, and the results have been qualified to indicate blank contamination ("U") as appropriate. Other analytes detected in associated blanks have been qualified with a "U" as appropriate. Analytes detected below the PQL but above the MDL (for organics) or IDL (for inorganics) were qualified as estimated ("J"). Because numerous analytes were detected at low but quantifiable concentrations, J qualifiers are common throughout the data base.

3.1.2 Data Summary

The number of soil, groundwater, surface water, and sediment samples collected for chemical analysis during both phases of the RI at AFP 59 and the analyses performed are summarized below by media. Figures 3-1 and 3-2 present the locations of the samples collected by EARTH TECH during the RI, and Figure 3-3 presents the locations of samples from previous investigations conducted by Martin Marietta at AFP 59.

3.1.2.1 Soil. During the Reconnaissance Survey at AFP 59, 16 subsurface soil samples (including one replicate) collected from 12 locations using direct push methods were analyzed for VOCs at an off-site laboratory by method SW8260, and 9 subsurface soil samples (including one



LEGEND

● DW3 – Existing Monitoring Well ● DPW – AFP 59 Industrial Production Well
∘ – Direct Push Sampling Location (Onsite Analyses Only)
⊙ – Direct Push Sampling Location (Onsite and Offsite Analyses)
▬ · ▬ – AFP 59 Property Boundary
----- – Fence

0 105 210
SCALE IN FEET

EARTH TECH

FIGURE 3-1

AFP 59 RECONNAISSANCE SURVEY
DIRECT PUSH SAMPLING LOCATIONS
JULY 1994

afp59ri2.dwg\3-1.plt

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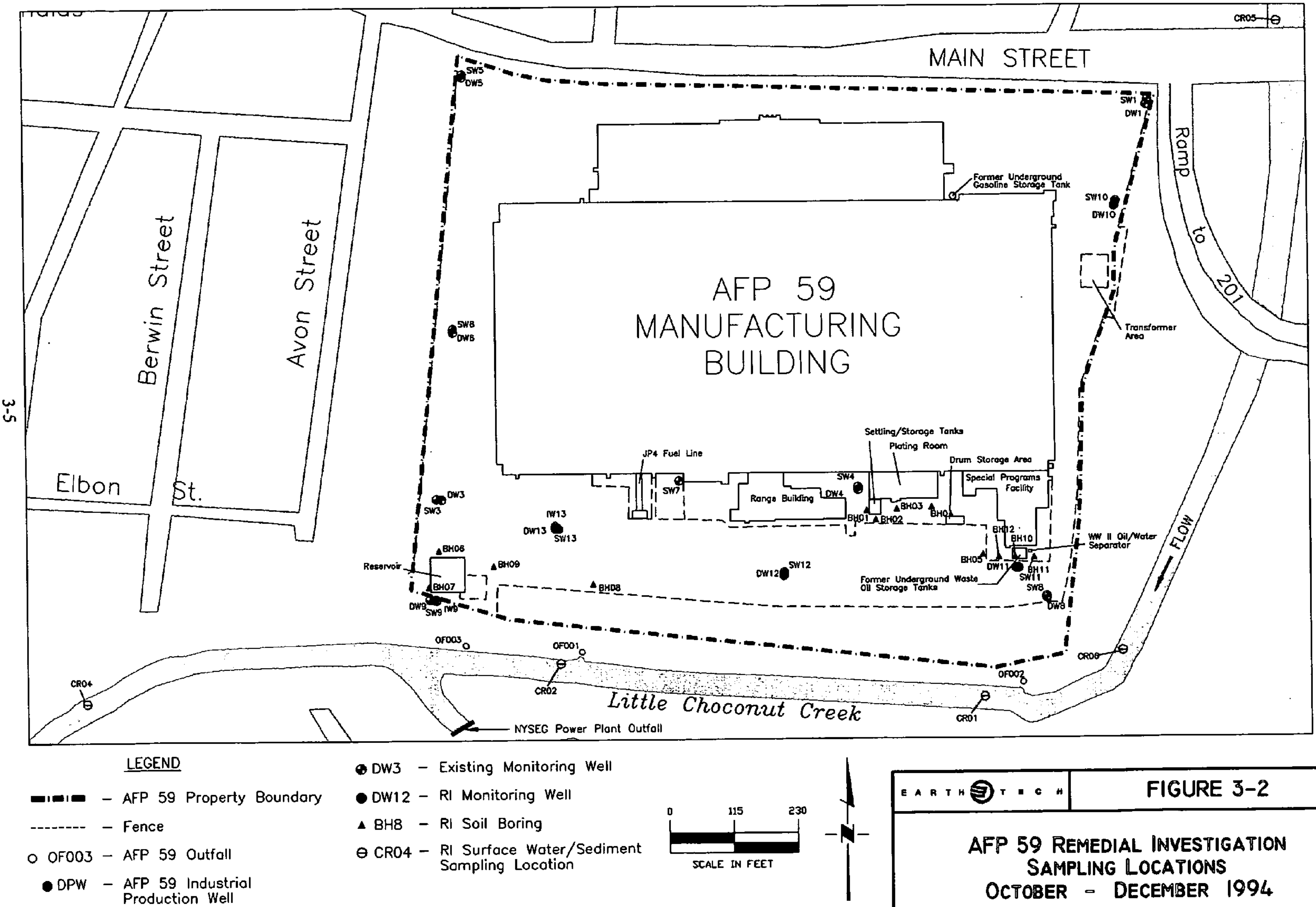

EARTH TECH

FIGURE 3-2

AFP 59 REMEDIAL INVESTIGATION SAMPLING LOCATIONS OCTOBER - DECEMBER 1994

afp59ri2.dwg\3-2.plt

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replicate) from five locations were analyzed for metals at an off-site laboratory by methods SW6010, SW7060, SW7421, SW7471, SW7740, and SW7841. Additional direct push samples collected during the Reconnaissance Survey were analyzed on-site for screening purposes only. Figure 3-1 shows the Reconnaissance Survey direct push sampling locations and the types of analyses conducted (i.e., on-site/off-site). All direct push sampling localities were located on the asphalt parking lot, with the following exceptions: DP17 was located on the gravel-covered area of the former waste oil tanks; DP31 was located on the grass-covered area south of the Manufacturing Building and west of the Range Building; and DP32 was located on the grass-covered area adjacent to the reservoir.

During the second phase of sampling that began in October 1994, subsurface soil samples were collected from 12 soil borings and the four boreholes that were completed as shallow monitoring wells. A total of 53 subsurface soil samples, including five replicates, were collected. Soil boring and monitoring well locations are shown in Figure 3-2. All sampling localities were located on the asphalt parking lot, with the following exceptions: BH07 was located on the grass-covered area adjacent to the reservoir, and BH10 and BH11 were located on the gravel-covered area of the former waste oil tanks. All soil samples were analyzed for VOCs (SW8260), SVOCs (SW8270), pesticides/PCBs (SW8080), ICP metals screen (SW6010), arsenic (SW7060), lead (SW7421), mercury (SW7471), selenium (SW7740), thallium (SW7841), cyanide (SW9012), and TOC (SW9060). Tables 3.1-1 through 3.1-6 summarize the analytical results for chemical analyses of soil samples at AFP 59. The tables list only those analytes that were detected in one or more sample. Complete analytical results are provided in the *Analytical Data ITIR* (EARTH TECH, 1995b).

Soil analytical data collected by Martin Marietta between July 1992 and December 1994 as part of the Plating Room closure activities were also used for site characterization. Figure 3-3 shows these soil sampling locations. During these investigations, soil samples were collected from 22 locations in the Plating Room. Eight additional samples were collected outside the Plating Room near the settling/storage tanks. Samples collected in July 1992 from the settling/storage tank area were analyzed for target analyte list (TAL) metals (SW6010/SW7471), cyanide (Contract Laboratory Program [CLP] 335.2), and VOCs (SW8240). Samples collected inside the Plating Room in September 1993 from locations 001 through 018 were analyzed for metals (SW6010/SW7471), cyanide (CLP 335.2), and VOCs (SW8240). Six samples (001, 004, 006, 009, 012, 015) were also analyzed for SVOCs (SW8270). Samples from the two degreaser pits (019/020 and 021/022) were analyzed for VOCs (SW8240) only. Soil samples collected beneath the settling/storage tanks in October 1993 were analyzed for TAL metals (ME20) and target compound list (TCL) VOCs (MV20). The three samples collected in the Plating Room in June 1994 were analyzed for pesticides/PCBs (GS05), TCL base neutrals/acids (BNAs) (MS22), and TCL VOCs (MV20). The two samples collected in November 1994 from the Plating Room were analyzed for TCL VOCs (MV20) only. The December 1994 sample from beneath the settling tank was analyzed for VOCs only. None of the data collected by Martin Marietta were validated by EARTH TECH. The analytical results are included with the EARTH TECH RI data in the summary tables (see Tables 3.1-1 through 3.1-5).

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TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7471, SW7740, SW7841)

		Environmental Samples (mg/kg) - Earth Tech										
		Field ID	59BH01SO1		59BH01SO2		59BH02SO1		59BH02SO2		59BH02SO3	
		Depth	1.00-3.00		5.00-7.00		1.00-3.00		5.00-7.00		10.00-12.0	
Parameters	PQL	Lab ID	648868		648881		648887		648893		648902	
Aluminum (Al)	135		7650	J	7980	J	8550	J	6590	J	7270	J
Arsenic (As)	0.85		9.8		8.7		10.0		8.0		8.5	
Barium (Ba)	0.65		37.9		44.1		49.7		39.4		48.8	
Beryllium (Be)	0.60		0.33	J	0.37	J	0.44	J	0.30	J	0.32	J
Calcium (Ca)	68.0		3440	J	3650	J	1570	J	2550	J	1690	J
Cadmium (Cd)	1.5		ND		ND		ND		ND		3.1	
Cobalt (Co)	2.0		9.4		9.4		10.3		7.4		8.8	
Chromium (Cr)	2.5		9.8		14.0		11.8		10.6		13.9	
Copper (Cu)	3.0		22.7	J	26.8	J	33.3	J	28.5	J	26.4	J
Iron (Fe)	38.5		18600	J	18000	J	21400	J	15900	J	17500	J
Mercury (Hg)	0.30		ND		ND		ND		ND		ND	
Potassium (K)	530		723		854		901		611		681	
Magnesium (Mg)	52.0		2890	J	3040	J	2850	J	3340	J	2960	J
Manganese (Mn)	5.5		416	J	486	J	625	J	566	J	797	J
Molybdenum (Mo)	11.0		ND		ND		ND		ND		ND	
Sodium (Na)	380		199	J	136	J	228	J	115	J	98.2	J
Nickel (Ni)	8.5		17.1		17.9		16.7		13.9		88.2	
Lead (Pb)	0.30		19.9		14.6		17.9		12.8		42.3	
Selenium (Se)	0.80		ND		ND		ND		ND		ND	
Vanadium (V)	4.0		11.9		12.8		14.1		10.7		11.5	
Zinc (Zn)	9.0		63.6	J	50.7	J	70.2	J	85.4	J	291	J

		Environmental Samples (mg/kg) - Earth Tech										
		Field ID	59BH03SO1		59BH03SO2		59BH03SO3		59BH04SO1		59BH04SO2	
		Depth	1.00-3.00		5.00-7.00		10.00-12.0		3.00-5.00		5.00-7.00	
Parameters	PQL	Lab ID	648908		648914		649273		649234		649261	
Aluminum (Al)	135		6640	J	3170	J	5660	J	11700	J	10900	J
Arsenic (As)	0.85		10.7		6.8		44.5		7.0		7.9	
Barium (Ba)	0.65		32.2		20.6		41.8		24.4		44.8	
Beryllium (Be)	0.60		0.28	J	0.17	J	0.27	J	0.48	J	0.46	J
Calcium (Ca)	68.0		4790		61300	J	1650	J	259	J	253	J
Cadmium (Cd)	1.5		ND		ND		2.3		ND		ND	
Cobalt (Co)	2.0		8.1		3.8		7.0		10.4		10.5	
Chromium (Cr)	2.5		8.7		4.3		8.0		13.7		13.2	
Copper (Cu)	3.0		25.4	J	13.3	J	22.2	J	17.8	J	20.8	J
Iron (Fe)	38.5		16100	J	7940	J	13700	J	20600	J	19800	J
Mercury (Hg)	0.30		ND		ND		ND		ND		ND	
Potassium (K)	530		620		379	J	700		922		689	
Magnesium (Mg)	52.0		2400	J	8860	J	2050	J	3560	J	3280	J
Manganese (Mn)	5.5		549	J	349	J	591	J	404	J	408	J
Molybdenum (Mo)	11.0		ND		ND		ND		ND		ND	
Sodium (Na)	380		150	J	128	J	79.2	J	116	J	96.1	J
Nickel (Ni)	8.5		13.9		6.6	J	45.0		21.5		19.7	
Lead (Pb)	0.30		10.6		9.1		17.2		11.0		13.9	
Selenium (Se)	0.80		ND		ND		ND		ND		ND	
Vanadium (V)	4.0		10.6		6.9		9.4		16.6		15.4	
Zinc (Zn)	9.0		55.9	J	55.9	J	656	J	103	J	112	J

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7471, SW7740, SW7841)

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59BH04SO9	59BH04SO3	59BH05SO1	59BH05SO2	59BH05SO3
		Depth 5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00	10.00-12.0
Parameters	PQL	Lab ID 649246	649318	649255	649267	649279
Aluminum (Al)	135	12700 J	9380 J	9890 J	13100 J	11200 J
Arsenic (As)	0.85	8.5	21.8	6.2	4.4	3.6
Barium (Ba)	0.65	31.3	61.8	46.1	93.7	38.0
Beryllium (Be)	0.60	0.52 J	0.68 J	0.40 J	0.59 J	0.47 J
Calcium (Ca)	68.0	220 J	924 J	1730 J	838 J	391 J
Cadmium (Cd)	1.5	ND	ND	ND	ND	ND
Cobalt (Co)	2.0	11.8	11.5	9.2	9.9	9.3
Chromium (Cr)	2.5	14.8	12.7	11.4	14.4	13.8
Copper (Cu)	3.0	45.7 J	54.3 J	20.0 J	14.7 J	14.2 J
Iron (Fe)	38.5	22400 J	28100 J	19000 J	18500 J	18900 J
Mercury (Hg)	0.30	ND	ND	ND	ND	0.12 J
Potassium (K)	530	829	910	635	890	782
Magnesium (Mg)	52.0	3700 J	2680 J	2980 J	3070 J	3480 J
Manganese (Mn)	5.5	484 J	553 J	321 J	376 J	298 J
Molybdenum (Mo)	11.0	ND	ND	ND	ND	ND
Sodium (Na)	380	113 J	94.6 J	124 J	117 J	106 J
Nickel (Ni)	8.5	22.7	20.2	17.9	17.6	21.4
Lead (Pb)	0.30	19.3	16.2	11.4	11.4	11.5
Selenium (Se)	0.80	ND	ND	ND	ND	ND
Vanadium (V)	4.0	17.8	19.0	14.3	17.3	16.0
Zinc (Zn)	9.0	325 J	204 J	75.9 J	111 J	126 J

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59BH06SO1	59BH06SO2	59BH07SO1	59BH07SO2	59BH08SO1
		Depth 1.00-3.00	5.00-7.00	3.00-5.00	5.00-7.00	1.00-3.00
Parameters	PQL	Lab ID 649305	649240	649285	649291	649827
Aluminum (Al)	135	4770 J	8390 J	7380 J	6920 J	13400 J
Arsenic (As)	0.85	3.6	7.5	6.0	8.8	5.4
Barium (Ba)	0.65	18.2 J	43.2	51.3	56.2	47.7 J
Beryllium (Be)	0.60	ND	0.42 J	0.40 J	0.32 J	0.44 J
Calcium (Ca)	68.0	68700 J	21700 J	10900 J	16000 J	932 J
Cadmium (Cd)	1.5	ND	ND	ND	ND	ND
Cobalt (Co)	2.0	5.0	7.9	7.5	7.4	9.3
Chromium (Cr)	2.5	6.5	10.6	10.6	8.9	15.6
Copper (Cu)	3.0	36.6	56.7 J	31.0 J	21.1 J	28.5
Iron (Fe)	38.5	10000 J	17500 J	14900 J	16100 J	20900 J
Mercury (Hg)	0.30	ND	0.11 J	ND	0.13 J	ND
Potassium (K)	530	458 U	788	799	782	938 U
Magnesium (Mg)	52.0	9760 J	4990 J	3690 J	13300 J	2910 J
Manganese (Mn)	5.5	281 J	479 J	552 J	849 J	320 J
Molybdenum (Mo)	11.0	17.0	ND	ND	ND	17.9
Sodium (Na)	380	112 U	136 J	113 J	131 J	226 J
Nickel (Ni)	8.5	9.5	16.3	13.1	15.3	19.9
Lead (Pb)	0.30	5.1	17.0	13.4	21.5	10.4
Selenium (Se)	0.80	ND	ND	ND	ND	ND
Vanadium (V)	4.0	6.1	13.2	12.1	10.9	14.9
Zinc (Zn)	9.0	46.8 J	203 J	86.4 J	96.0 J	82.6

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7471, SW7740, SW7841)

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59BH08SO2	59BH08SO9	59BH08SO3	59BH09SO1	59BH09SO2
		Depth 5.00-7.00	5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00
Parameters	PQL	Lab ID 649833	649845	649839	649859	649872
Aluminum (Al)	135	12100 J	11200 J	8730 J	6530	7010 J
Arsenic (As)	0.85	6.5	6.2	11.9	5.7	12.8 J
Barium (Ba)	0.65	79.0 J	57.0 J	70.1 J	32.7	50.6 J
Beryllium (Be)	0.60	0.40 J	0.36 J	0.35 J	0.30 J	0.27 J
Calcium (Ca)	68.0	593 J	6760 J	1330 J	43500	3030 J
Cadmium (Cd)	1.5	ND	ND	ND	ND	ND
Cobalt (Co)	2.0	10.5	10.3	9.7	6.8	7.2
Chromium (Cr)	2.5	14.5	14.3	11.1	8.0	9.7 J
Copper (Cu)	3.0	23.9	18.7	59.7	32.8	157 J
Iron (Fe)	38.5	22000 J	20300 J	22400 J	14200 J	16000 J
Mercury (Hg)	0.30	ND	ND	ND	ND	ND
Potassium (K)	530	846 U	416 U	947 U	496 J	713 U
Magnesium (Mg)	52.0	3420 J	3600 J	2850 J	5000	2520 J
Manganese (Mn)	5.5	529 J	600 J	1060 J	398	776 J
Molybdenum (Mo)	11.0	19.5	17.1	17.4	ND	12.2
Sodium (Na)	380	140 U	224 J	136 U	236 J	293 J
Nickel (Ni)	8.5	21.5	20.3	20.0	11.1	15.6
Lead (Pb)	0.30	14.3	12.5	32.1	8.8	12.3 J
Selenium (Se)	0.80	ND	ND	ND	ND	ND
Vanadium (V)	4.0	13.8	11.0	13.0	10.0	9.4
Zinc (Zn)	9.0	93.8 J	67.2 J	217 J	52.5	130 J

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59BH09SO9	59BH09SO3	59BH09SO4	59BH10SO1	59BH10SO2
		Depth 5.00-7.00	10.00-12.0	15.00-17.0	3.00-5.00	5.00-7.00
Parameters	PQL	Lab ID 649893	649878	649884	650126	650132
Aluminum (Al)	135	11600 J	6290 J	6040 J	7690 J	8530 J
Arsenic (As)	0.85	18.8	4.6	8.4	7.8	10.0
Barium (Ba)	0.65	125 J	36.1 J	56.6 J	34.3 J	40.5 J
Beryllium (Be)	0.60	0.81 J	ND	ND	0.23 J	0.29 J
Calcium (Ca)	68.0	11000 J	19100 J	24700 J	60500 J	32700 J
Cadmium (Cd)	1.5	ND	ND	ND	ND	ND
Cobalt (Co)	2.0	11.7	6.8	6.7	6.8	7.3
Chromium (Cr)	2.5	14.8	7.3	8.7	12.0	10.4
Copper (Cu)	3.0	78.8	42.7	39.9	22.1	32.6
Iron (Fe)	38.5	29700 J	15100 J	15600 J	16800 J	18800 J
Mercury (Hg)	0.30	0.40 J	ND	ND	ND	ND
Potassium (K)	530	1110 U	725 U	287 U	513 U	776 U
Magnesium (Mg)	52.0	4110 J	3290 J	3270 J	4310 J	5370 J
Manganese (Mn)	5.5	526 J	315 J	720 J	308 J	355 J
Molybdenum (Mo)	11.0	22.0	12.1	14.1	15.7	18.7
Sodium (Na)	380	706 J	93.1 U	106 U	119 U	105 U
Nickel (Ni)	8.5	27.5	11.6	12.4	16.3	18.6
Lead (Pb)	0.30	22.4	6.8	9.2	10.5	52.5
Selenium (Se)	0.80	0.56 J	ND	ND	ND	ND
Vanadium (V)	4.0	17.1	7.6	7.4	8.3	10.6
Zinc (Zn)	9.0	1090 J	67.0 J	136 J	51.0 J	63.6 J

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7471, SW7740, SW7841)

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59BH10SO3	59BH11SO1	59BH11SO2	59BH11SO3	59BH12SO1
		Depth 10.00-12.0	3.00-5.00	5.00-7.00	10.00-12.0	1.00-3.00
Parameters	PQL	Lab ID 650120	650108	650114	650102	650489
Aluminum (Al)	135	9830 J	12500 J	10700 J	11000 J	11500 J
Arsenic (As)	0.85	10.1	5.9	2.4	12.4 J	5.1
Barium (Ba)	0.65	62.4 J	60.5 J	32.7 J	79.7 J	74.9 J
Beryllium (Be)	0.60	0.35 J	0.45 J	0.39 J	0.39 J	0.41 J
Calcium (Ca)	68.0	986 J	653 J	499 J	855 J	2220 J
Cadmium (Cd)	1.5	ND	ND	ND	ND	ND
Cobalt (Co)	2.0	11.9	8.6	10.2	8.3	10.0
Chromium (Cr)	2.5	14.6	14.9	13.7	14.3 J	13.6
Copper (Cu)	3.0	41.4	78.3	16.7	58.8 J	40.1
Iron (Fe)	38.5	19900 J	20000 J	20800 J	19100 J	20800 J
Mercury (Hg)	0.30	ND	ND	ND	ND	ND
Potassium (K)	530	819 U	914 U	303 U	835 U	755 U
Magnesium (Mg)	52.0	2110 J	2950 J	2980 J	2390 J	2620 J
Manganese (Mn)	5.5	243 J	399 J	409 J	367 J	678 J
Molybdenum (Mo)	11.0	11.8 J	18.3	16.3	17.6	14.8
Sodium (Na)	380	94.8 U	83.9 U	80.7 U	87.1 U	96.9 U
Nickel (Ni)	8.5	28.7	20.5	19.8	24.4	20.2
Lead (Pb)	0.30	14.7	11.6	10.1	24.5 J	16.9
Selenium (Se)	0.80	ND	ND	ND	ND	ND
Vanadium (V)	4.0	11.0	14.9	11.8	13.2	12.4
Zinc (Zn)	9.0	78.5 J	142 J	55.1 J	128 J	79.3 J

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59BH12SO2	59BH12SO3	59BH12SO9		
		Depth 5.00-7.00	10.00-12.0	10.00-12.0		
Parameters	PQL	Lab ID 650495	650502	650542		
Aluminum (Al)	135	10900	11100	11000		
Arsenic (As)	0.85	5.6	3.8	3.5		
Barium (Ba)	0.65	82.9	58.5	54.1		
Beryllium (Be)	0.60	0.53 J	0.42 J	0.45 J		
Calcium (Ca)	68.0	7520	461	450		
Cadmium (Cd)	1.5	ND	ND	ND		
Cobalt (Co)	2.0	9.2	8.5	9.6		
Chromium (Cr)	2.5	12.8	12.5	12.3		
Copper (Cu)	3.0	39.3	11.1	10.6		
Iron (Fe)	38.5	19400 J	17700 J	18100 J		
Mercury (Hg)	0.30	ND	ND	ND		
Potassium (K)	530	716	509 J	449 J		
Magnesium (Mg)	52.0	3100	2830	2980		
Manganese (Mn)	5.5	646	282	417		
Molybdenum (Mo)	11.0	ND	ND	ND		
Sodium (Na)	380	137 J	91.8 U	101 U		
Nickel (Ni)	8.5	16.3	16.3	16.2		
Lead (Pb)	0.30	50.8	10.1	10.8		
Selenium (Se)	0.80	ND	ND	ND		
Vanadium (V)	4.0	15.9	14.8	14.1		
Zinc (Zn)	9.0	81.1	56.3	61.6		

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7471, SW7740, SW7841)

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59DP18S01	59DP18S03	59DP19S01	59DP19S03	59DP21S01
		Depth 0.00-2.00	5.00-7.00	0.00-2.00	5.00-8.00	0.00-2.00
Parameters	PQL	Lab ID 624933	624942	624939	624940	624941
Aluminum (Al)	135	8250	10200	9550	10600	8420
Arsenic (As)	0.85	55.4	18.2	1.6	5.0	5.3
Barium (Ba)	0.65	41.8	27.9	59.5	27.4	43.1
Beryllium (Be)	0.60	0.56 J	0.48 J	0.68	0.46 J	0.48 J
Calcium (Ca)	68.0	1230	229	12000	653	1520
Cadmium (Cd)	1.5	ND	ND	ND	ND	ND
Cobalt (Co)	2.0	8.9	8.5	11.9	10.0	8.3
Chromium (Cr)	2.5	10.5	12.3	13.0	12.5	10.9
Copper (Cu)	3.0	41.4	15.6	25.8	15.5	12.9
Iron (Fe)	38.5	20100	20300	22200	20200	16400
Mercury (Hg)	0.30	ND	ND	ND	ND	ND
Potassium (K)	530	888	617 J	1380	604 J	548 J
Magnesium (Mg)	52.0	2950	3080	5010	3190	2280
Manganese (Mn)	5.5	401	389	385	465	428
Molybdenum (Mo)	11.0	ND	ND	ND	ND	ND
Sodium (Na)	380	150 U	116 U	168 J	150 U	252 J
Nickel (Ni)	8.5	20.8	19.5	24.8	19.3	13.6
Lead (Pb)	0.30	18.0	12.3	31.3	12.7	19.5
Selenium (Se)	0.80	ND	ND	ND	ND	ND
Vanadium (V)	4.0	9.4	14.2	19.6	14.3	12.5
Zinc (Zn)	9.0	44.7	51.2	82.8	50.9	46.8

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59DP28S01	59DP28S09	59DP29S01	59DP29S02	
		Depth 0.00-2.00	0.00-2.00	0.00-2.00	5.00-7.00	
Parameters	PQL	Lab ID 625879	625877	625880	625878	
Aluminum (Al)	135	6500	6680	7030	8210	
Arsenic (As)	0.85	5.5	134	21.0	5.6	
Barium (Ba)	0.65	29.7	259	46.5	45.6	
Beryllium (Be)	0.60	0.29 J	0.80	0.38 J	0.40 J	
Calcium (Ca)	68.0	24300	57700	17500	1690	
Cadmium (Cd)	1.5	0.53 J	7.2	ND	ND	
Cobalt (Co)	2.0	6.3	31.7	7.6	10.1	
Chromium (Cr)	2.5	11.0	103	10.6	12.9	
Copper (Cu)	3.0	18.1	1040	25.4	19.8	
Iron (Fe)	38.5	13700	132000	16600	20000	
Mercury (Hg)	0.30	ND	ND	0.18 J	ND	
Potassium (K)	530	562 J	767	756	890	
Magnesium (Mg)	52.0	5630	3700	4660	3290	
Manganese (Mn)	5.5	359	1190	500	604	
Molybdenum (Mo)	11.0	ND	4060	ND	ND	
Sodium (Na)	380	151 U	534	112 U	140 U	
Nickel (Ni)	8.5	12.7	294	15.5	19.8	
Lead (Pb)	0.30	13.3	6990	34.2	12.2	
Selenium (Se)	0.80	ND	ND	ND	ND	
Vanadium (V)	4.0	10.1	54.5	11.3	13.1	
Zinc (Zn)	9.0	36.6	6500	53.5	53.2	

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7471, SW7740, SW7841)

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59SW10SO1	59SW10SO2	59SW10SO3	59SW11SO1	59SW11SO2
		Depth 1.00-3.00	5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00
Parameters	PQL	Lab ID 650548	650523	650554	655358	655373
Aluminum (Al)	135	8840	10600	9680	11000 J	10600 J
Arsenic (As)	0.85	5.0 J	5.5	6.7	4.7	7.4
Barium (Ba)	0.65	105	31.1	49.8	58.7	48.4
Beryllium (Be)	0.60	0.52 J	0.38 J	0.50 J	0.56 J	0.49 J
Calcium (Ca)	68.0	17800 J	454	295	12000 J	618 J
Cadmium (Cd)	1.5	ND	ND	ND	ND	ND
Cobalt (Co)	2.0	9.4	10.2	10.0	9.4	9.9
Chromium (Cr)	2.5	12.5	12.0	13.1	13.3	12.6
Copper (Cu)	3.0	132	14.7	17.5	41.4	56.4
Iron (Fe)	38.5	16000 J	18700 J	20200 J	20600 J	19400 J
Mercury (Hg)	0.30	ND	ND	ND	ND	ND
Potassium (K)	530	746	600 J	798	1140	825
Magnesium (Mg)	52.0	2890	3050	2920	4190	2820
Manganese (Mn)	5.5	743	425	317	498 J	649 J
Molybdenum (Mo)	11.0	ND	ND	ND	ND	ND
Sodium (Na)	380	183 J	96.4 U	171 J	229 J	162 J
Nickel (Ni)	8.5	19.1	16.8	16.9	17.8	17.5
Lead (Pb)	0.30	69.6 J	11.4	13.6	12.6	14.2
Selenium (Se)	0.80	0.92 J	ND	ND	ND	ND
Vanadium (V)	4.0	12.9	14.3	15.2	17.2	15.6
Zinc (Zn)	9.0	80.8	47.0	67.6	79.6 J	216 J

		Environmental Samples (mg/kg) - Earth Tech				
		Field ID 59SW11SO3	59SW12SO1	59SW12SO2	59SW12SO3	59SW12SO9
		Depth 12.00-14.0	1.50-2.50	6.00-7.00	11.50-12.5	12.50-13.0
Parameters	PQL	Lab ID 655379	658123	658127	658131	658142
Aluminum (Al)	135	8720 J	7040 J	8330 J	7430 J	6770 J
Arsenic (As)	0.85	6.4	6.3	6.9	5.3	6.2
Barium (Ba)	0.65	81.7	39.0	50.6	45.7	43.0
Beryllium (Be)	0.60	0.39 J	0.35 J	0.43 J	0.35 J	0.34 J
Calcium (Ca)	68.0	1000 J	10100 J	1590 J	3300 J	2900 J
Cadmium (Cd)	1.5	ND	ND	ND	ND	ND
Cobalt (Co)	2.0	8.5	7.4	9.6	8.6	8.7
Chromium (Cr)	2.5	13.0	9.9	11.4	12.7	10.8
Copper (Cu)	3.0	133	48.2	39.4	29.2	45.7
Iron (Fe)	38.5	17400 J	14700 J	19500 J	17300 J	16800 J
Mercury (Hg)	0.30	ND	ND	ND	ND	ND
Potassium (K)	530	896	736	910	971	800
Magnesium (Mg)	52.0	2520	3500	2770	2990	2640
Manganese (Mn)	5.5	579 J	397 J	586 J	527 J	577 J
Molybdenum (Mo)	11.0	ND	ND	ND	ND	ND
Sodium (Na)	380	157 J	139 J	124 J	123 J	124 J
Nickel (Ni)	8.5	18.0	13.9	18.3	16.2	15.4
Lead (Pb)	0.30	15.5	18.9	15.1	11.1	12.2
Selenium (Se)	0.80	ND	ND	ND	ND	ND
Vanadium (V)	4.0	15.4	12.2	14.3	13.5	11.9
Zinc (Zn)	9.0	145 J	66.3 J	101 J	67.7 J	84.1 J

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7471, SW7740, SW7841)

		Environmental Samples (mg/kg) - Earth Tech									
		Field ID 59SW12SO4		59SW13SO1		59SW13SO2		59SW13SO3		59SW13SO4	
		Depth 16.50-17.5		1.50-2.50		6.00-7.00		11.00-12.0		16.00-17.0	
Parameters	PQL	Lab ID 658135		657188		657176		657182		657194	
Aluminum (Al)	135	7230	J	6620	J	11000	J	5680	J	7210	J
Arsenic (As)	0.85	5.1		3.5		7.2		6.2		8.1	
Barium (Ba)	0.65	43.0		34.3		52.8		34.9		57.9	
Beryllium (Be)	0.60	0.37	J	0.35	J	0.50	J	0.41	J	0.35	J
Calcium (Ca)	68.0	3690	J	63100	J	1140	J	1240	J	2190	J
Cadmium (Cd)	1.5	ND		ND		ND		ND		ND	
Cobalt (Co)	2.0	8.1		5.3		9.8		7.1		7.7	
Chromium (Cr)	2.5	15.3		8.0		13.3		8.2		9.2	
Copper (Cu)	3.0	37.7		24.5		48.6		36.5		49.5	
Iron (Fe)	38.5	17100	J	11600	J	19700	J	14300	J	18300	J
Mercury (Hg)	0.30	ND		ND		ND		ND		ND	
Potassium (K)	530	1160		801		844		712		741	
Magnesium (Mg)	52.0	2820		6900		3180		2030		2830	
Manganese (Mn)	5.5	646	J	418	J	480	J	407	J	552	J
Molybdenum (Mo)	11.0	ND		ND		ND		ND		ND	
Sodium (Na)	380	122	J	219	J	301	J	150	J	115	J
Nickel (Ni)	8.5	16.3		10.9		18.6		12.3		14.2	
Lead (Pb)	0.30	10.0		9.9		13.3		11.0		19.9	
Selenium (Se)	0.80	ND		ND		ND		ND		ND	
Vanadium (V)	4.0	13.7		10.6		16.3		10.8		12.0	
Zinc (Zn)	9.0	74.5	J	51.3	J	221	J	179	J	167	J

Qualifiers: J = Estimated; U = Blank Contamination

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 001 Depth 0.50-1.00	002 0.50-1.00	003 0.50-1.00	004 0.50-1.00	005 0.50-1.00
Aluminum (Al)	5.00	2830	3080	2350	3830	3380
Arsenic (As)	5.00	ND	ND	ND	ND	ND
Barium (Ba)	1.00	24.5	17.5	25.8	35	47
Beryllium (Be)	1.00	ND	ND	ND	ND	ND
Calcium (Ca)	250	65600	41200	154000	39300	47100
Cadmium (Cd)	1.00	ND	ND	ND	1.24	ND
Cobalt (Co)	5.00	ND	ND	ND	ND	ND
Chromium (Cr)	1.00	4.85	8.05	3.43	16.5	7.75
Copper (Cu)	1.00	12.3	8.35	8.18	38.8	44.8
Iron (Fe)	6.25	8150	4250	6630	10200	8780
Mercury (Hg)	0.05	ND	ND	ND	ND	ND
Potassium (K)	50.0	328	283	333	345	402
Magnesium (Mg)	25.0	9550	4180	7400	5880	6080
Manganese (Mn)	1.00	260	121	265	330	320
Sodium (Na)	25.0	176	108	107	80.5	82.8
Nickel (Ni)	1.00	7.05	5.15	5.05	9.9	42.5
Lead (Pb)	2.00	8.63	3.4	4.88	7.55	8.08
Selenium (Se)	5.00	ND	ND	ND	ND	ND
Vanadium (V)	5.00	ND	ND	ND	5.17	ND
Zinc (Zn)	1.00	26.3	15	17.5	32.8	32.8

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 006 Depth 0.50-1.00	007 0.50-1.00	008 0.50-1.00	009 0.50-1.00	010 0.50-1.00
Aluminum (Al)	5.00	3880	3980	2380	3950	3330
Arsenic (As)	5.00	ND	ND	ND	ND	ND
Barium (Ba)	1.00	25.5	33.5	22.2	34.3	37.5
Beryllium (Be)	1.00	ND	ND	ND	ND	ND
Calcium (Ca)	250	51500	53800	65600	68800	115000
Cadmium (Cd)	1.00	6.33	84.3	ND	ND	ND
Cobalt (Co)	5.00	ND	ND	ND	ND	ND
Chromium (Cr)	1.00	410	305	18	38.5	5.83
Copper (Cu)	1.00	41.8	137	18.8	20.2	14.4
Iron (Fe)	6.25	8500	9050	7280	10400	8530
Mercury (Hg)	0.05	ND	ND	ND	0.071	ND
Potassium (K)	50.0	515	380	443	363	418
Magnesium (Mg)	25.0	7200	6380	11000	11000	5380
Manganese (Mn)	1.00	318	528	239	303	253
Sodium (Na)	25.0	163	132	133	205	86
Nickel (Ni)	1.00	295	78.5	6.35	11.9	7.28
Lead (Pb)	2.00	2350	15.1	8.23	12.2	4.58
Selenium (Se)	5.00	ND	ND	ND	ND	ND
Vanadium (V)	5.00	5.68	5.23	ND	5.85	ND
Zinc (Zn)	1.00	38	72.3	22.8	35.8	24.8

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 011 Depth 0.50-1.00	012 0.50-1.00	013 0.50-1.00	014 0.50-1.00	015 0.50-1.00
Aluminum (Al)	5.00	3380	4180	3180	2300	3200
Arsenic (As)	5.00	ND	ND	ND	ND	ND
Barium (Ba)	1.00	28.3	35.8	30.3	27.5	27.7
Beryllium (Be)	1.00	ND	ND	ND	ND	ND
Calcium (Ca)	250	54200	58300	54600	91900	48300
Cadmium (Cd)	1.00	ND	ND	ND	ND	ND
Cobalt (Co)	5.00	ND	ND	ND	ND	ND
Chromium (Cr)	1.00	5.17	6.08	3.9	4.88	5.53
Copper (Cu)	1.00	14.3	17.5	12.7	11.8	13.8
Iron (Fe)	6.25	9230	10500	8580	8750	8380
Mercury (Hg)	0.05	ND	ND	ND	ND	ND
Potassium (K)	50.0	383	345	253	219	278
Magnesium (Mg)	25.0	6500	7530	6500	32800	6000
Manganese (Mn)	1.00	273	318	213	303	273
Sodium (Na)	25.0	90	75.5	63.3	163	66
Nickel (Ni)	1.00	8.05	9.68	7.25	5.23	8.73
Lead (Pb)	2.00	5.83	6.65	3.85	3.98	6.55
Selenium (Se)	5.00	ND	ND	ND	ND	ND
Vanadium (V)	5.00	ND	5.95	ND	ND	ND
Zinc (Zn)	1.00	26.5	33.8	28.3	20.9	29.5

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 016 Depth 0.50-1.00	017 0.50-1.00	018 0.50-1.00	02 9.50-10.5	03 9.50-10.5
Aluminum (Al)	5.00	2340	3180	4030	5800	4980
Arsenic (As)	5.00	ND	ND	ND	ND	ND
Barium (Ba)	1.00	20.3	29.3	40.3	33.5	35.8
Beryllium (Be)	1.00	ND	ND	ND	ND	ND
Calcium (Ca)	250	41600	43900	55000	16300	6730
Cadmium (Cd)	1.00	ND	ND	ND	ND	5.8
Cobalt (Co)	5.00	ND	ND	ND	5.13	5.13
Chromium (Cr)	1.00	3.1	5.63	7.05	19.3	268
Copper (Cu)	1.00	9.55	14	14.9	13.3	111
Iron (Fe)	6.25	5230	7830	10400	15900	15800
Mercury (Hg)	0.05	ND	ND	ND	ND	ND
Potassium (K)	50.0	229	298	363	440	315
Magnesium (Mg)	25.0	3930	5800	6480	5950	4780
Manganese (Mn)	1.00	169	293	420	388	395
Sodium (Na)	25.0	56	87.3	109	70	56.3
Nickel (Ni)	1.00	5.15	6.87	8.3	25.5	108
Lead (Pb)	2.00	3.08	5.88	6.53	9.45	275
Selenium (Se)	5.00	ND	ND	ND	ND	ND
Vanadium (V)	5.00	ND	ND	5.38	7.58	6.5
Zinc (Zn)	1.00	18.4	26.5	34.3	37.5	77.3

TABLE 3.1-1
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR INORGANICS

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 05 Depth 9.50-10.5	06 9.50-10.5	GESS#1 10.00-10.5	GESS#2 9.80-10.3	GESS#3 9.50-10.0
Aluminum (Al)	5.00	5930	5050	6150	5050	5880
Arsenic (As)	5.00	ND	38.8	7.3	ND	ND
Barium (Ba)	1.00	36.8	48	31.3	26.3	33
Beryllium (Be)	1.00	ND	ND	ND	ND	ND
Calcium (Ca)	250	14600	12800	6800	3100	12000
Cadmium (Cd)	1.00	1.72	ND	ND	2.19	ND
Cobalt (Co)	5.00	5.55	ND	5.43	ND	5.43
Chromium (Cr)	1.00	43.8	19.4	21.1	265	12.4
Copper (Cu)	1.00	16	41.3	21.1	61.7	15.9
Iron (Fe)	6.25	16100	16500	16200	14800	15800
Mercury (Hg)	0.05	ND	0.065	ND	ND	ND
Potassium (K)	50.0	543	393	463	383	425
Magnesium (Mg)	25.0	4930	2980	2750	2600	2280
Manganese (Mn)	1.00	530	255	405	268	558
Sodium (Na)	25.0	103	36.3	66	88	61.5
Nickel (Ni)	1.00	74	30	19.1	68.8	14.3
Lead (Pb)	2.00	12.1	32.3	19	99	9.85
Selenium (Se)	5.00	ND	ND	ND	ND	ND
Vanadium (V)	5.00	7.92	9.5	8.05	7.28	8.3
Zinc (Zn)	1.00	43	143	35.8	53.8	34.3

Qualifiers: J = Estimated; U = Blank Contamination

Parameters	PQL	Environmental Samples (mg/kg) - Argonne National Laboratory				
		Field ID JCDW1AS Depth 8.00-10.0	JCDW1BS 8.00-10.0	JCDW1CS 18.00-20.0	JCSW5AS 10.00-12.0	JCSW5BS 23.00-27.0
Aluminum (Al)	40	9830	10200	5070	6270	12900
Arsenic (As)	2	5.2	5.5	3.2	3.6	7.9
Barium (Ba)	40	46.2	54.3	23.5	47.6	52.3
Beryllium (Be)	1	ND	ND	ND	ND	ND
Calcium (Ca)	1000	988	307	52200	44400	5740
Cadmium (Cd)	1	ND	ND	ND	ND	ND
Cobalt (Co)	10	10.5	10.9	6.9	6.9	13.3
Chromium (Cr)	2	14.6	16.4	8.3	10.6	18.6
Copper (Cu)	5	13.7	14.5	15	13	16.7
Iron (Fe)	20	22000	22800	13600	17100	27200
Mercury (Hg)	0.1	ND	ND	ND	ND	ND
Potassium (K)	1000	695	642	537	623	1520
Magnesium (Mg)	1000	3230	3280	5240	6330	5900
Manganese (Mn)	3	505	533	401	484	601
Sodium (Na)	1000	ND	ND	ND	ND	ND
Nickel (Ni)	8	19.2	20	13	13.2	24.5
Lead (Pb)	0.6	10.5	10.8	5.2	5.5	12.7
Selenium (Se)	1	ND	ND	ND	ND	ND
Vanadium (V)	10	12.9	14	11	11.8	17.3
Zinc (Zn)	4	60.8	73.5	41.8	45.6	65.4

TABLE 3.1-2
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR PCB/PESTICIDES

			Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH01SO1	59BH01SO2	59BH02SO1	59BH02SO2	59BH02SO3
		Action	Depth 1.00-3.00	5.00-7.00	1.00-3.00	5.00-7.00	10.00-12.0
Parameters	PQL	Levels (1)	Lab ID 648864	648880	648886	648892	648901
Aldrin	0.010	0.46-0.51	ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1	ND	ND	ND	ND	ND
delta-BHC	0.0007	0.08-0.17	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03	ND	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1	ND	0.0022 J	ND	ND	ND
4,4 -DDT	0.010	0.57-1.3	ND	ND	ND	ND	ND
Dieldrin	0.010	0.03-0.06	ND	ND	ND	ND	ND
Endosulfan I	0.0050	0.19-0.43	0.0011 J	0.0026 J	ND	ND	ND
Endosulfan II	0.020	0.19-0.42	ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53	ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05	ND	ND	ND	ND	ND
Endrin aldehyde	0.015		ND	ND	ND	ND	ND
Heptachlor epoxide	0.015	0.001	ND	ND	ND	ND	ND
Heptachlor	0.0025	0.03-0.06	ND	ND	ND	ND	ND
Methoxychlor	0.030	10	ND	0.013 J	ND	ND	ND
PCB-1254	0.020	0.41-0.83	ND	0.17	0.012 U	0.0098 U	0.0083 U
PCB-1260	0.060	0.83-0.92	ND	ND	ND	ND	ND

			Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH03SO1	59BH03SO2	59BH03SO3	59BH04SO1	59BH04SO2
		Action	Depth 1.00-3.00	5.00-7.00	10.00-12.0	3.00-5.00	5.00-7.00
Parameters	PQL	Levels (1)	Lab ID 648907	648913	649272	649233	649260
Aldrin	0.010	0.46-0.51	ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1	ND	ND	ND	ND	ND
delta-BHC	0.0007	0.08-0.17	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03	ND	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1	ND	ND	ND	ND	ND
4,4 -DDT	0.010	0.57-1.3	ND	ND	ND	ND	ND
Dieldrin	0.010	0.03-0.06	ND	ND	ND	ND	ND
Endosulfan I	0.0050	0.19-0.43	ND	ND	ND	ND	ND
Endosulfan II	0.020	0.19-0.42	ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53	ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05	ND	ND	ND	ND	ND
Endrin aldehyde	0.015		ND	ND	ND	ND	ND
Heptachlor epoxide	0.015	0.001	ND	ND	ND	ND	ND
Heptachlor	0.0025	0.03-0.06	ND	ND	ND	ND	ND
Methoxychlor	0.030	10	ND	ND	ND	ND	ND
PCB-1254	0.020	0.41-0.83	0.016 U	ND	ND	0.014 U	ND
PCB-1260	0.060	0.83-0.92	ND	ND	ND	ND	ND

TABLE 3.1-2
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR PCB/PESTICIDES

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH04SO9	59BH04SO3	59BH05SO1	59BH05SO2	59BH05SO3
			Depth 5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00	10.00-12.0
			Lab ID 649245	649317	649254	649266	649278
Aldrin	0.010	0.46-0.51	ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1	ND	ND	ND	ND	ND
delta-BHC	0.0007	0.08-0.17	ND	ND	0.0010 J	ND	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03	ND	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1	ND	ND	0.0056 J	ND	ND
4,4 -DDT	0.010	0.57-1.3	ND	ND	ND	ND	ND
Dieldrin	0.010	0.03-0.06	ND	ND	0.0039 J	ND	ND
Endosulfan I	0.0050	0.19-0.43	ND	ND	ND	ND	ND
Endosulfan II	0.020	0.19-0.42	ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53	ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05	ND	ND	ND	ND	ND
Endrin aldehyde	0.015		ND	ND	0.043	ND	ND
Heptachlor epoxide	0.015	0.001	ND	ND	ND	ND	ND
Heptachlor	0.0025	0.03-0.06	ND	ND	ND	ND	ND
Methoxychlor	0.030	10	ND	ND	ND	ND	ND
PCB-1254	0.020	0.41-0.83	0.046	ND	ND	ND	ND
PCB-1260	0.060	0.83-0.92	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH06SO1	59BH06SO2	59BH07SO1	59BH07SO2	59BH08SO1
			Depth 1.00-3.00	5.00-7.00	3.00-5.00	5.00-7.00	1.00-3.00
			Lab ID 649301	649239	649284	649290	649826
Aldrin	0.010	0.46-0.51	ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1	ND	ND	ND	ND	ND
delta-BHC	0.0007	0.08-0.17	ND	ND	0.0004 J	0.0005 J	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03	0.0006 J	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1	ND	ND	0.0017 J	0.0019 J	ND
4,4 -DDT	0.010	0.57-1.3	ND	ND	ND	ND	ND
Dieldrin	0.010	0.03-0.06	ND	ND	ND	ND	ND
Endosulfan I	0.0050	0.19-0.43	ND	ND	ND	ND	ND
Endosulfan II	0.020	0.19-0.42	ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53	ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05	ND	ND	ND	ND	ND
Endrin aldehyde	0.015		0.014 J	ND	ND	ND	0.0045 J
Heptachlor epoxide	0.015	0.001	0.0049 J	ND	ND	ND	ND
Heptachlor	0.0025	0.03-0.06	ND	ND	ND	0.0007 J	ND
Methoxychlor	0.030	10	ND	0.015 J	0.017 J	0.019 J	ND
PCB-1254	0.020	0.41-0.83	ND	ND	ND	ND	ND
PCB-1260	0.060	0.83-0.92	ND	ND	0.020 J	0.079 J	ND

TABLE 3.1-2
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR PCB/PESTICIDES

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech					
			Field ID Depth Lab ID	59BH08SO2 5.00-7.00 649832	59BH08SO9 5.00-7.00 649844	59BH08SO3 10.00-12.0 649838	59BH09SO1 1.00-3.00 649855	59BH09SO2 5.00-7.00 649871
Aldrin	0.010	0.46-0.51		ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1		ND	ND	ND	ND	ND
delta-BHC	0.0007	0.08-0.17		ND	ND	ND	0.0009	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03		ND	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1		ND	ND	ND	ND	ND
4,4 -DDT	0.010	0.57-1.3		ND	ND	ND	ND	ND
Dieldrin	0.010	0.03-0.06		ND	ND	ND	0.0036 J	ND
Endosulfan I	0.0050	0.19-0.43		ND	ND	ND	ND	ND
Endosulfan II	0.020	0.19-0.42		ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53		ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05		ND	ND	ND	ND	ND
Endrin aldehyde	0.015			0.0036 J	ND	0.0038 J	ND	ND
Heptachlor epoxide	0.015	0.001		ND	ND	0.0031 J	ND	ND
Heptachlor	0.0025	0.03-0.06		ND	0.0008 J	ND	0.0021 J	ND
Methoxychlor	0.030	10		ND	ND	ND	ND	ND
PCB-1254	0.020	0.41-0.83		ND	ND	ND	ND	ND
PCB-1260	0.060	0.83-0.92		ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech					
			Field ID Depth Lab ID	59BH09SO9 5.00-7.00 649892	59BH09SO3 10.00-12.0 649877	59BH09SO4 15.00-17.0 649883	59BH10SO1 3.00-5.00 650125	59BH10SO2 5.00-7.00 650131
Aldrin	0.010	0.46-0.51		ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1		ND	ND	ND	ND	ND
delta-BHC	0.0007	0.08-0.17		ND	0.0002 J	ND	ND	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03		ND	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1		ND	ND	ND	ND	ND
4,4 -DDT	0.010	0.57-1.3		ND	ND	ND	ND	ND
Dieldrin	0.010	0.03-0.06		ND	ND	ND	ND	ND
Endosulfan I	0.0050	0.19-0.43		ND	ND	ND	ND	ND
Endosulfan II	0.020	0.19-0.42		ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53		ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05		ND	ND	ND	ND	ND
Endrin aldehyde	0.015			ND	ND	ND	ND	ND
Heptachlor epoxide	0.015	0.001		ND	ND	ND	ND	ND
Heptachlor	0.0025	0.03-0.06		ND	ND	ND	ND	ND
Methoxychlor	0.030	10		ND	ND	ND	ND	ND
PCB-1254	0.020	0.41-0.83		ND	ND	ND	ND	ND
PCB-1260	0.060	0.83-0.92		ND	ND	ND	ND	ND

TABLE 3.1-2
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR PCB/PESTICIDES

			Environmental Samples (mg/kg) - Earth Tech					
			Field ID	59BH10SO3	59BH11SO1	59BH11SO2	59BH11SO3	59BH12SO1
			Depth	10.00-12.0	3.00-5.00	5.00-7.00	10.00-12.0	1.00-3.00
Parameters	PQL	Action Levels (1)	Lab ID	650119	650107	650113	650101 D	650488
Aldrin	0.010	0.46-0.51		ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1		0.0043 J	ND	ND	ND	ND
delta-BHC	0.0007	0.08-0.17		0.0021 J	ND	ND	ND	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03		ND	ND	0.0006 J	ND	ND
4,4 -DDD	0.010	1.8-4.1		ND	ND	ND	ND	ND
4,4 -DDT	0.010	0.57-1.3		0.0080 J	ND	ND	ND	ND
Dieldrin	0.010	0.03-0.06		ND	ND	0.0030 J	ND	ND
Endosulfan I	0.0050	0.19-0.43		0.0028 J	0.0017 J	ND	ND	ND
Endosulfan II	0.020	0.19-0.42		ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53		0.012 J	ND	ND	0.013 J	ND
Endrin	0.010	0.04-0.05		0.0082 J	0.0088 J	ND	ND	ND
Endrin aldehyde	0.015			ND	ND	ND	ND	0.0074 J
Heptachlor epoxide	0.015	0.001		ND	ND	ND	ND	ND
Heptachlor	0.0025	0.03-0.06		ND	ND	ND	ND	ND
Methoxychlor	0.030	10		ND	ND	ND	ND	ND
PCB-1254	0.020	0.41-0.83		ND	0.17 J	ND	ND	ND
PCB-1260	0.060	0.83-0.92		ND	ND	ND	ND	ND

			Environmental Samples (mg/kg) - Earth Tech					
			Field ID	59BH12SO2	59BH12SO3	59BH12SO9	59SW10SO1	59SW10SO2
			Depth	5.00-7.00	10.00-12.0	10.00-12.0	1.00-3.00	5.00-7.00
Parameters	PQL	Action Levels (1)	Lab ID	650494	650500	650541	650547	650518
Aldrin	0.010	0.46-0.51		ND	ND	ND	0.0051 J	ND
beta-BHC	0.010	0.04-0.1		ND	ND	ND	0.0028 J	ND
delta-BHC	0.0007	0.08-0.17		ND	ND	ND	0.0004 J	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03		ND	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1		ND	ND	ND	0.0025 J	ND
4,4 -DDT	0.010	0.57-1.3		ND	ND	ND	0.017 J	ND
Dieldrin	0.010	0.03-0.06		ND	ND	ND	ND	ND
Endosulfan I	0.0050	0.19-0.43		ND	ND	ND	0.0017 J	ND
Endosulfan II	0.020	0.19-0.42		ND	ND	ND	0.029 J	ND
Endosulfan sulfate	0.020	0.24-0.53		ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05		ND	ND	ND	0.015 J	ND
Endrin aldehyde	0.015			ND	ND	ND	0.017	ND
Heptachlor epoxide	0.015	0.001		ND	ND	ND	ND	ND
Heptachlor	0.0025	0.03-0.06		ND	ND	ND	ND	ND
Methoxychlor	0.030	10		ND	ND	ND	0.029 J	ND
PCB-1254	0.020	0.41-0.83		ND	ND	ND	ND	ND
PCB-1260	0.060	0.83-0.92		ND	ND	ND	ND	ND

TABLE 3.1-2
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR PCB/PESTICIDES

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59SW10SO3	59SW11SO1	59SW11SO2	59SW11SO3	59SW12SO1
			Depth 10.00-12.0	1.00-3.00	5.00-7.00	12.00-14.0	1.50-2.50
			Lab ID 650553	655355	655372	655378	658122
Aldrin	0.010	0.46-0.51	ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1	ND	0.0017 J	ND	ND	ND
delta-BHC	0.0007	0.08-0.17	ND	ND	0.0004 J	ND	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03	ND	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1	ND	0.0016 J	ND	ND	ND
4,4 -DDT	0.010	0.57-1.3	0.0055 J	ND	0.0053 U	0.0030 U	ND
Dieldrin	0.010	0.03-0.06	ND	ND	ND	ND	ND
Endosulfan I	0.0050	0.19-0.43	ND	ND	ND	ND	ND
Endosulfan II	0.020	0.19-0.42	ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53	ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05	0.0021 J	ND	ND	ND	ND
Endrin aldehyde	0.015		ND	0.010 J	ND	0.0068 J	ND
Heptachlor epoxide	0.015	0.001	ND	ND	0.0043 U	ND	ND
Heptachlor	0.0025	0.03-0.06	ND	ND	ND	ND	ND
Methoxychlor	0.030	10	ND	ND	ND	0.025 J	ND
PCB-1254	0.020	0.41-0.83	ND	ND	ND	ND	ND
PCB-1260	0.060	0.83-0.92	ND	ND	ND	0.15	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59SW12SO2	59SW12SO3	59SW12SO9	59SW12SO4	59SW13SO1
			Depth 6.00-7.00	11.50-12.5	12.50-13.0	16.50-17.5	1.50-2.50
			Lab ID 658111	658130	658141	658134	657187
Aldrin	0.010	0.46-0.51	ND	ND	ND	ND	ND
beta-BHC	0.010	0.04-0.1	ND	0.0018 J	0.0027 J	ND	ND
delta-BHC	0.0007	0.08-0.17	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	0.0025	0.01-0.03	ND	ND	ND	ND	ND
4,4 -DDD	0.010	1.8-4.1	0.0038 U	0.0029 U	0.0039 U	0.0022 U	ND
4,4 -DDT	0.010	0.57-1.3	ND	ND	ND	ND	ND
Dieldrin	0.010	0.03-0.06	ND	ND	ND	ND	ND
Endosulfan I	0.0050	0.19-0.43	ND	ND	ND	ND	ND
Endosulfan II	0.020	0.19-0.42	ND	ND	ND	ND	ND
Endosulfan sulfate	0.020	0.24-0.53	ND	ND	ND	ND	ND
Endrin	0.010	0.04-0.05	ND	ND	ND	ND	ND
Endrin aldehyde	0.015		ND	ND	ND	ND	ND
Heptachlor epoxide	0.015	0.001	0.0035 J	ND	ND	ND	0.0028 J
Heptachlor	0.0025	0.03-0.06	ND	ND	ND	ND	ND
Methoxychlor	0.030	10	ND	ND	ND	ND	ND
PCB-1254	0.020	0.41-0.83	ND	ND	ND	ND	ND
PCB-1260	0.060	0.83-0.92	ND	ND	ND	ND	ND

TABLE 3.1-2
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR PCB/PESTICIDES

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59SW13SO2 Depth 6.00-7.00 Lab ID 657175	59SW13SO3 11.00-12.0 657181	59SW13SO4 16.00-17.0 657193		
Aldrin	0.010	0.46-0.51	ND	ND	ND		
beta-BHC	0.010	0.04-0.1	ND	ND	ND		
delta-BHC	0.0007	0.08-0.17	ND	ND	ND		
gamma-BHC (Lindane)	0.0025	0.01-0.03	ND	ND	ND		
4,4 -DDD	0.010	1.8-4.1	0.0061 J	ND	ND		
4,4 -DDT	0.010	0.57-1.3	0.0024 J	0.0049 J	ND		
Dieldrin	0.010	0.03-0.06	0.0027 J	ND	ND		
Endosulfan I	0.0050	0.19-0.43	ND	ND	ND		
Endosulfan II	0.020	0.19-0.42	0.0053 J	ND	ND		
Endosulfan sulfate	0.020	0.24-0.53	ND	ND	ND		
Endrin	0.010	0.04-0.05	0.0024 J	ND	ND		
Endrin aldehyde	0.015		0.0032 J	ND	ND		
Heptachlor epoxide	0.015	0.001	ND	ND	ND		
Heptachlor	0.0025	0.03-0.06	0.0012 J	ND	ND		
Methoxychlor	0.030	10	0.024 J	ND	ND		
PCB-1254	0.020	0.41-0.83	ND	ND	ND		
PCB-1260	0.060	0.83-0.92	ND	ND	ND		

(1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, January 1994) using site-specific TOC values.

Qualifiers: J = Estimated; U = Blank Contamination

TABLE 3.1-2
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR PCB/PESTICIDES

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Martin Marietta				
			Field ID 025 Depth 0.50-1.00	026 0.50-1.00	027 0.50-1.00		
Aldrin	0.050	0.46-0.51	ND	ND	ND		
beta-BHC	0.050	0.04-0.1	ND	ND	ND		
delta-BHC	0.050	0.08-0.17	ND	ND	ND		
gamma-BHC (Lindane)	0.050	0.01-0.03	ND	ND	ND		
Dieldrin	0.050	0.03-0.06	ND	ND	ND		
Endosulfan sulfate	0.050	0.24-0.53	ND	ND	ND		
Endrin	0.050	0.04-0.05	ND	ND	ND		
Heptachlor epoxide	0.050	0.001	ND	ND	ND		
Heptachlor	0.050	0.03-0.06	ND	ND	ND		
Methoxychlor	0.050	10	ND	ND	ND		
PCB-1254	0.050	0.41-0.83	ND	ND	ND		
PCB-1260	0.050	0.83-0.92	ND	ND	ND		

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Argonne National Laboratory				
			Field ID JCDW1AS Depth 8.00-10.0	JCDW1BS 8.00-10.0	JCDW1CS 18.00-20.0	JCSW5AS 10.00-12.0	JCSW5BS 23.00-27.0
Aldrin	0.008	0.46-0.51	0.0076	0.0092	ND	ND	ND
a-BHC	0.008	0.04-0.1	ND	ND	ND	ND	ND
lta-BHC	0.008	0.08-0.17	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	0.008	0.01-0.03	ND	ND	ND	ND	ND
Dieldrin	0.016	0.03-0.06	ND	ND	ND	ND	ND
Endosulfan sulfate	0.016	0.24-0.53	ND	ND	ND	ND	ND
Endrin	0.016	0.04-0.05	ND	ND	ND	ND	ND
Heptachlor epoxide	0.008	0.001	ND	ND	ND	ND	ND
Heptachlor	0.008	0.03-0.06	ND	ND	ND	ND	ND
Methoxychlor	0.08	10	ND	ND	ND	ND	ND
PCB-1254	0.16	0.41-0.83	ND	ND	ND	ND	ND
PCB-1260	0.16	0.83-0.92	ND	ND	ND	ND	ND

(1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, January 1994) using site-specific TOC values.

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TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

			Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH01SO1	59BH01SO2	59BH02SO1	59BH02SO2	59BH02SO3
		Action	Depth 1.00-3.00	5.00-7.00	1.00-3.00	5.00-7.00	10.00-12.0
Parameters	PQL	Levels (1)	Lab ID 648861	648879	648885	648891	648900
Bromomethane	0.010		ND	0.016	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	ND	ND	0.079	ND	ND
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	0.0087 J	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

			Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH03SO1	59BH03SO2	59BH03SO3	59BH04SO1	59BH04SO9
		Action	Depth 1.00-3.00	5.00-7.00	10.00-12.0	3.00-5.00	5.00-7.00
Parameters	PQL	Levels (1)	Lab ID 648906	648912	649271	649232	649244
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	ND	ND	ND	ND	ND
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH04SO2	59BH04SO3	59BH05SO1	59BH05SO2	59BH05SO3
			Depth 5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00	10.00-12.0
			Lab ID 649259	649316	649253	649265	649277
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	0.011 J	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	0.022 J	0.038 J	ND	0.015 J	ND
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	0.015 J	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH06SO1	59BH06SO2	59BH07SO1	59BH07SO2	59BH08SO1
			Depth 1.00-3.00	5.00-7.00	3.00-5.00	5.00-7.00	1.00-3.00
			Lab ID 649298	649238	649283	649289	649825
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	ND	ND	0.021 J	0.020 J	0.037 J
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH08SO9	59BH08SO2	59BH08SO3	59BH09SO1	59BH09SO9
			Depth 5.00-7.00	5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00
			Lab ID 649843	649831	649837	649852	649891
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	0.014 J	0.015 J	0.014 J	0.019 J	0.024 J
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	0.0084 J	0.070
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH09SO2	59BH09SO3	59BH09SO4	59BH10SO1	59BH10SO2
			Depth 5.00-7.00	10.00-12.0	15.00-17.0	3.00-5.00	5.00-7.00
			Lab ID 649870	649876	649882	650129	650135
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	ND	ND	ND	0.014 U	ND
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	0.0074 J	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

			Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH10SO3	59BH11SO1	59BH11SO2	59BH11SO3	59BH12SO1
		Action	Depth 10.00-12.0	3.00-5.00	5.00-7.00	10.00-12.0	1.00-3.00
Parameters	PQL	Levels (1)	Lab ID 650123	650111	650117	650105	650487
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		0.0032 J	ND	ND	0.047	ND
sec-Butyl Benzene	0.015		0.0014 J	ND	ND	0.011 J	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	0.053	ND
1,1-Dichloroethane	0.015	0.07	ND	0.0042 J	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	0.029	ND	ND	0.013 J
Ethylbenzene	0.015	2.6	ND	ND	ND	0.0013 J	ND
Isopropyl Benzene	0.015		ND	ND	ND	0.0027 J	ND
Methylene chloride	0.035	0.03-0.05	ND	0.020 U	0.021 U	ND	ND
Naphthalene	0.035	6.2	0.0067 U	0.0022 U	ND	ND	0.0038 U
n-Propyl Benzene	0.015		ND	ND	ND	0.0078 J	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	0.0030 U
Trichloroethylene	0.015	0.15-0.32	ND	0.013 J	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		0.0092 J	ND	ND	0.070	0.0026 J
1,3,5-Trimethyl Benzene	0.015		0.025	ND	ND	0.19	0.0046 J
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	0.0018 J	ND	ND	0.0066 J	ND
o-Xylene	0.015	0.57	ND	ND	ND	0.0062 J	ND

			Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH12SO2	59BH12SO9	59BH12SO3	59DP02S02	59DP17S02
		Action	Depth 5.00-7.00	10.00-12.0	10.00-12.0	5.00-7.00	5.00-7.00
Parameters	PQL	Levels (1)	Lab ID 650493	650540	650499	624923	625882
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	0.0045 J	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	0.0041 J	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		0.11	ND	0.0064 J	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	0.020 U	0.023 U	0.019 U	ND	0.040
Naphthalene	0.035	6.2	ND	ND	ND	ND	0.0022 U
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	0.015	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59DP18S02	59DP18S04	59DP19S02	59DP19S04	59DP21S03
			Depth 2.00-4.00	7.00-8.00	2.00-5.00	8.00-9.00	4.00-6.00
			Lab ID 624926	624927	624928	624929	624932
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	ND	0.015 J	0.014 J	ND	0.025 J
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59DP23S01	59DP24S02	59DP26S01	59DP26S02	59DP28S09
			Depth 0.00-2.00	5.00-7.00	0.00-2.00	5.00-7.00	10.00-12.0
			Lab ID 625883	625881	625884	625885	626570
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	0.025 J	0.028 J	0.014 J	ND	0.089
Naphthalene	0.035	6.2	0.0021 U	0.0034 U	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	0.0031 J	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	0.0053 J	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59DP28S03 Depth 10.00-12.0 Lab ID 626569	59DP29S03 10.00-12.0 626571	59DP32S01 0.00-2.00 626572	59DP36S03 10.00-12.0 626573	59SW10SO1 1.00-3.00 650546
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	0.022 J	0.065	0.037 J	0.076	0.036 U
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59SW10SO2 Depth 5.00-7.00 Lab ID 650512	59SW10SO3 10.00-12.0 650552	59SW11SO1 1.00-3.00 655368	59SW11SO2 5.00-7.00 655376	59SW11SO3 12.00-14.0 655382
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	0.012 J
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	0.014 J
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	0.0013 J
Isopropyl Benzene	0.015		ND	ND	ND	ND	0.0028 J
Methylene chloride	0.035	0.03-0.05	0.023 U	ND	ND	ND	ND
Naphthalene	0.035	6.2	ND	0.0036 U	ND	ND	0.011 J
n-Propyl Benzene	0.015		ND	ND	ND	ND	0.0077 J
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	0.019
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	0.088
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	0.0020 J
o-Xylene	0.015	0.57	ND	ND	ND	ND	0.0036 J

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59SW12SO1 Depth 1.50-2.50 Lab ID 658109	59SW12SO2 6.00-7.00 658126	59SW12SO3 11.50-12.5 658114	59SW12SO9 12.50-13.0 658121	59SW12SO4 16.50-17.5 658115
Bromomethane	0.010		ND	ND	ND	ND	ND
n-Butyl Benzene	0.015		ND	ND	ND	ND	ND
sec-Butyl Benzene	0.015		ND	ND	ND	ND	ND
Chloroethane	0.020	0.88	ND	ND	ND	ND	ND
p-Cymene	0.015		ND	ND	ND	ND	ND
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	ND
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	ND
Isopropyl Benzene	0.015		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03-0.05	0.019 U	0.020 U	ND	0.024 J	ND
Naphthalene	0.035	6.2	ND	ND	ND	ND	ND
n-Propyl Benzene	0.015		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	ND
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	ND
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	ND
o-Xylene	0.015	0.57	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59SW13SO1 Depth 1.50-2.50 Lab ID 657191	59SW13SO2 6.00-7.00 657179	59SW13SO3 11.00-12.0 657185	59SW13SO4 16.00-17.0 657197	
Bromomethane	0.010		ND	ND	ND	ND	
n-Butyl Benzene	0.015		ND	ND	ND	ND	
sec-Butyl Benzene	0.015		ND	ND	ND	ND	
Chloroethane	0.020	0.88	ND	ND	ND	ND	
p-Cymene	0.015		ND	ND	ND	ND	
1,1-Dichloroethane	0.015	0.07	ND	ND	ND	ND	
cis-1,2-Dichloroethylene	0.015		ND	ND	ND	ND	
Ethylbenzene	0.015	2.6	ND	ND	ND	ND	
Isopropyl Benzene	0.015		ND	ND	ND	ND	
Methylene chloride	0.035	0.03-0.05	ND	ND	0.021 U	0.015 U	
Naphthalene	0.035	6.2	ND	ND	ND	ND	
n-Propyl Benzene	0.015		ND	ND	ND	ND	
1,1,1-Trichloroethane	0.015	0.18-0.38	ND	ND	ND	ND	
1,2,3-Trichlorobenzene	0.020		ND	ND	ND	ND	
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	
1,2,4-Trimethyl Benzene	0.015		ND	ND	ND	ND	
1,3,5-Trimethyl Benzene	0.015		ND	ND	ND	ND	
Vinyl chloride	0.010	0.05	ND	ND	ND	ND	
m,p-Xylene	0.015	0.57	ND	ND	ND	ND	
o-Xylene	0.015	0.57	ND	ND	ND	ND	

1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, January 1994) using site-specific TOC values.

Qualifiers: J = Estimated; U = Blank Contamination

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Martin Marietta				
			Field ID 001	002	003	004	005
			Depth 0.50-1.00	0.50-1.00	0.50-1.00	0.50-1.00	0.50-1.00
Acetone	0.025	0.03	0.071	0.042	0.205	1.54	0.183
Methyl Ethyl Ketone	0.01		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03	ND	ND	ND	ND	ND
Styrene	0.025		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	0.024	ND	ND	0.014	0.071
Xylenes, Total	0.025	0.57	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Martin Marietta				
			Field ID 006	007	008	009	010
			Depth 0.50-1.00	0.50-1.00	0.50-1.00	0.50-1.00	0.50-1.00
Acetone	0.025	0.03	0.235	1.37	0.997	0.936	0.461
Methyl Ethyl Ketone	0.01		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03	ND	ND	ND	ND	ND
Styrene	0.025		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	0.014	0.005	0.011	ND	ND
Xylenes, Total	0.025	0.57	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Martin Marietta				
			Field ID 011	012	013	014	015
			Depth 0.50-1.00	0.50-1.00	0.50-1.00	0.50-1.00	0.50-1.00
Acetone	0.025	0.03	0.079	0.059	0.313	0.073	0.094
Methyl Ethyl Ketone	0.01		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03	ND	ND	ND	ND	ND
Styrene	0.025		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	ND	ND
Xylenes, Total	0.025	0.57	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Martin Marietta				
			Field ID 016	017	018	019	020
			Depth 0.50-1.00	0.50-1.00	0.50-1.00	1.00-1.50	2.00-2.50
Acetone	0.025	0.03	0.085	0.049	0.059	0.037	0.029
Methyl Ethyl Ketone	0.01		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03	ND	ND	ND	ND	ND
Styrene	0.025		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	ND	0.006	0.022
Xylenes, Total	0.025	0.57	ND	ND	ND	ND	ND

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

			Environmental Samples (mg/kg) - Martin Marietta				
Parameters	PQL	Action Levels (1)	Field ID 021 Depth 1.00-1.50	022 2.00-2.50	025 0.50-1.00	026 0.50-1.00	027 0.50-1.00
Acetone	0.025	0.03	0.035	0.023	0.173	0.119	0.12
Methyl Ethyl Ketone	0.01		ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03	ND	ND	ND	0.008	0.008
Styrene	0.025		ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32	ND	ND	0.019	0.006	ND
Xylenes, Total	0.025	0.57	ND	ND	ND	ND	ND

			Environmental Samples (mg/kg) - Martin Marietta				
Parameters	PQL	Action Levels (1)	Field ID 02 Depth 9.50-10.5	03 9.50-10.5	05 9.50-10.5	06 9.50-10.5	RWT1 9.40-11.4
Acetone	0.025	0.03	0.047	0.059	0.045	0.081	0.0558
Methyl Ethyl Ketone	0.01		ND	ND	ND	ND	0.00454
Methylene chloride	0.035	0.03	0.006	0.006	ND	ND	0.00474
Styrene	0.025		ND	ND	ND	ND	0.00124
Trichloroethylene	0.015	0.15-0.32	0.02	ND	0.026	ND	0.00270
Xylenes, Total	0.025	0.57	ND	ND	ND	ND	0.00273

(1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, January 1994) using site-specific TOC values.

Qualifiers: J = Estimated; U = Blank Contamination

TABLE 3.1-3
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR VOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Martin Marietta				
			Field ID	GESS#1	GESS#2	GESS#3	PRSB-1	PRSB-25
			Depth	10.00-10.5	9.80-10.3	9.50-10.0	2.00-4.00	2.00-4.00
Acetone	0.025	0.03		ND	ND	ND	ND	0.027
Methyl Ethyl Ketone	0.01			ND	ND	ND	ND	ND
Methylene chloride	0.035	0.03		ND	ND	ND	ND	ND
Styrene	0.025			ND	ND	ND	ND	ND
Trichloroethylene	0.015	0.15-0.32		ND	ND	ND	0.07	0.009
Xylenes, Total	0.025	0.57		ND	ND	ND	ND	ND

(1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, January 1994) using site-specific TOC values.

Qualifiers: J = Estimated; U = Blank Contamination

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Argonne National Laboratory					
			Field ID	JCDW1AS	JCDW1BS	JCDW1CS	JCSW5AS	JCSW5BS
			Depth	8.00-10.0	8.00-10.0	18.00-20.0	10.00-12.0	23.00-27.0
Acetone	0.01	0.03		ND	ND	ND	ND	ND
Methyl Ethyl Ketone	0.01			ND	ND	ND	ND	ND
Methylene chloride	0.005	0.03		ND	ND	ND	ND	ND
Styrene	0.005			ND	ND	ND	ND	ND
Trichloroethylene	0.005	0.15-0.32		ND	ND	ND	ND	ND
Xylenes, Total	0.005	0.57		ND	ND	ND	ND	ND

(1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, January 1994) using site-specific TOC values.

TABLE 3.1-4
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR SVOCS

			Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH01SO1	59BH01SO2	59BH01SO2D	59BH02SO1	59BH02SO2
			Depth 1.00-3.00	5.00-7.00	5.00-7.00	1.00-3.00	5.00-7.00
Parameters	PQL	Action Levels (1)	Lab ID 648857	648878	648878	648884	648890
Acenaphthene	0.370	21.5-43.7	ND	0.15 J	0.17 J	ND	ND
Acenaphthylene	0.340		ND	ND	ND	ND	ND
Anthracene	0.420	50	ND	0.59	0.59 J	ND	ND
bis(2-ethylhexyl)phthalate	0.580	50	ND	ND	ND	ND	ND
Benzo(a)anthracene	0.400	0.65-1.4	ND	2.7	3.3	ND	ND
Benzo(a)pyrene	0.290	2.6-5.5	ND	1.6	2.0	ND	ND
Benzo(b)fluoranthene	0.320	0.26-0.55	ND	2.9	3.8	ND	ND
Benzo(g,h,i)perylene	0.370	50	ND	ND	0.18 J	ND	ND
Chrysene	0.610	0.09-0.2	ND	2.6	3.2	ND	ND
Dibenz(a,h)anthracene	0.410	50	ND	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9	ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400		ND	ND	ND	ND	ND
Fluorene	0.330	50	ND	0.11 J	0.14 J	ND	ND
Fluoranthene	0.290	50	0.11 J	6.1 J	5.3	ND	ND
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6	ND	ND	ND	ND	ND
2-Methylnaphthalene	0.400	17.3	ND	ND	ND	ND	ND
Naphthalene	0.360	6.2	ND	ND	ND	ND	ND
Phenanthrene	0.320	50	ND	2.7	3.1	ND	ND
Pyrene	0.320	50	ND	4.2	5.7	ND	ND

			Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH02SO3	59BH03SO1	59BH03SO2	59BH03SO3	59BH04SO1
			Depth 10.00-12.0	1.00-3.00	5.00-7.00	10.00-12.0	3.00-5.00
Parameters	PQL	Action Levels (1)	Lab ID 648899	648905	648911	649270	649231
Acenaphthene	0.370	21.5-43.7	ND	ND	ND	ND	ND
Acenaphthylene	0.340		ND	ND	ND	ND	ND
Anthracene	0.420	50	ND	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.580	50	ND	ND	ND	ND	ND
Benzo(a)anthracene	0.400	0.65-1.4	ND	ND	ND	ND	ND
Benzo(a)pyrene	0.290	2.6-5.5	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	0.320	0.26-0.55	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.370	50	ND	ND	ND	ND	ND
Chrysene	0.610	0.09-0.2	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	0.410	50	ND	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9	ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400		ND	ND	ND	ND	ND
Fluorene	0.330	50	ND	ND	ND	ND	ND
Fluoranthene	0.290	50	ND	ND	ND	ND	ND
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6	ND	ND	ND	ND	ND
2-Methylnaphthalene	0.400	17.3	ND	ND	ND	ND	ND
Naphthalene	0.360	6.2	ND	ND	ND	ND	ND
Phenanthrene	0.320	50	ND	ND	ND	ND	ND
Pyrene	0.320	50	ND	ND	ND	ND	ND

TABLE 3.1-4
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR SVOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH04SO2 Depth 5.00-7.00 Lab ID 649258	59BH04SO9 5.00-7.00 649243	59BH04SO3 10.00-12.0 649315	59BH05SO1 1.00-3.00 649252	59BH05SO2 5.00-7.00 649264
Acenaphthene	0.370	21.5-43.7	ND	ND	ND	ND	ND
Acenaphthylene	0.340		ND	ND	ND	ND	ND
Anthracene	0.420	50	ND	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.580	50	ND	ND	ND	ND	ND
Benzo(a)anthracene	0.400	0.65-1.4	ND	ND	ND	ND	ND
Benzo(a)pyrene	0.290	2.6-5.5	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	0.320	0.26-0.55	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.370	50	ND	ND	ND	ND	ND
Chrysene	0.610	0.09-0.2	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	0.410	50	ND	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9	ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400		ND	ND	ND	ND	ND
Fluorene	0.330	50	ND	ND	ND	ND	ND
Fluoranthene	0.290	50	ND	ND	ND	ND	ND
Indeno(1;2,3,-cd)pyrene	0.630	1.5-1.6	ND	ND	ND	ND	ND
2-Methylnaphthalene	0.400	17.3	ND	ND	ND	ND	ND
Naphthalene	0.360	6.2	ND	ND	ND	ND	ND
Phenanthrene	0.320	50	ND	ND	ND	ND	ND
Pyrene	0.320	50	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH05SO3 Depth 10.00-12.0 Lab ID 649276	59BH06SO1 1.00-3.00 649294	59BH06SO2 5.00-7.00 649237	59BH07SO1 3.00-5.00 649282	59BH07SO2 5.00-7.00 649288
Acenaphthene	0.370	21.5-43.7	ND	ND	ND	ND	ND
Acenaphthylene	0.340		ND	ND	ND	ND	ND
Anthracene	0.420	50	ND	ND	ND	0.12 J	0.14 J
bis(2-ethylhexyl)phthalate	0.580	50	ND	0.20 J	ND	ND	ND
Benzo(a)anthracene	0.400	0.65-1.4	ND	ND	ND	0.50	0.50
Benzo(a)pyrene	0.290	2.6-5.5	ND	ND	ND	0.42	0.38
Benzo(b)fluoranthene	0.320	0.26-0.55	ND	ND	0.098 J	0.78	0.62
Benzo(g,h,i)perylene	0.370	50	ND	ND	ND	ND	0.15 J
Chrysene	0.610	0.09-0.2	ND	ND	ND	0.50 J	0.45 J
Dibenz(a,h)anthracene	0.410	50	ND	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9	ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400		ND	ND	ND	ND	ND
Fluorene	0.330	50	ND	ND	ND	ND	ND
Fluoranthene	0.290	50	ND	ND	ND	0.85	0.94
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6	ND	ND	ND	ND	0.16 J
2-Methylnaphthalene	0.400	17.3	ND	ND	ND	ND	ND
Naphthalene	0.360	6.2	ND	ND	ND	ND	ND
Phenanthrene	0.320	50	ND	ND	ND	0.47	0.61
Pyrene	0.320	50	ND	ND	ND	0.80	0.78

TABLE 3.1-4
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR SVOCS

			Environmental Samples (mg/kg) - Earth Tech					
			Field ID	59BH08SO1	59BH08SO2	59BH08SO9	59BH08SO3	59BH09SO1
		Action	Depth	1.00-3.00	5.00-7.00	5.00-7.00	10.00-12.0	1.00-3.00
Parameters	PQL	Levels (1)	Lab ID	649819	649830	649842	649836	649848
Acenaphthene	0.370	21.5-43.7		ND	ND	ND	ND	ND
Acenaphthylene	0.340			ND	ND	ND	ND	ND
Anthracene	0.420	50		ND	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.580	50		ND	ND	ND	ND	ND
Benzo(a)anthracene	0.400	0.65-1.4		ND	ND	ND	ND	0.20 J
Benzo(a)pyrene	0.290	2.6-5.5		ND	ND	ND	ND	0.14 J
Benzo(b)fluoranthene	0.320	0.26-0.55		ND	ND	ND	ND	0.29 J
Benzo(g,h,i)perylene	0.370	50		ND	ND	ND	ND	ND
Chrysene	0.610	0.09-0.2		ND	ND	ND	ND	0.20 J
Dibenz(a,h)anthracene	0.410	50		ND	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9		ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400			ND	ND	ND	ND	ND
Fluorene	0.330	50		ND	ND	ND	ND	ND
Fluoranthene	0.290	50		ND	ND	0.078 J	0.100 J	0.30 J
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6		ND	ND	ND	ND	ND
2-Methylnaphthalene	0.400	17.3		ND	ND	ND	ND	ND
Naphthalene	0.360	6.2		ND	ND	ND	ND	ND
Phenanthrene	0.320	50		ND	ND	ND	ND	ND
Pyrene	0.320	50		ND	ND	ND	ND	0.29 J

			Environmental Samples (mg/kg) - Earth Tech					
			Field ID	59BH09SO2	59BH09SO9	59BH09SO3	59BH09SO4	59BH10SO1
		Action	Depth	5.00-7.00	5.00-7.00	10.00-12.0	15.00-17.0	3.00-5.00
Parameters	PQL	Levels (1)	Lab ID	649869	649890	649875	649881	650124
Acenaphthene	0.370	21.5-43.7		ND	ND	ND	ND	ND
Acenaphthylene	0.340			ND	ND	ND	ND	ND
Anthracene	0.420	50		ND	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.580	50		ND	ND	ND	ND	ND
Benzo(a)anthracene	0.400	0.65-1.4		ND	ND	ND	ND	ND
Benzo(a)pyrene	0.290	2.6-5.5		ND	ND	ND	ND	ND
Benzo(b)fluoranthene	0.320	0.26-0.55		ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.370	50		ND	ND	ND	ND	ND
Chrysene	0.610	0.09-0.2		ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	0.410	50		ND	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9		ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400			ND	ND	ND	ND	ND
Fluorene	0.330	50		ND	ND	ND	ND	ND
Fluoranthene	0.290	50		ND	ND	ND	ND	ND
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6		ND	ND	ND	ND	ND
2-Methylnaphthalene	0.400	17.3		ND	ND	ND	ND	ND
Naphthalene	0.360	6.2		ND	ND	ND	ND	ND
Phenanthrene	0.320	50		ND	ND	ND	ND	ND
Pyrene	0.320	50		ND	ND	ND	ND	ND

TABLE 3.1-4
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR SVOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH10SO2 Depth 5.00-7.00 Lab ID 650130	59BH10SO3 10.00-12.0 650118	59BH11SO1 3.00-5.00 650106	59BH11SO2 5.00-7.00 650112	59BH11SO3 10.00-12.0 650100
Acenaphthene	0.370	21.5-43.7	0.29 J	ND	ND	ND	ND
Acenaphthylene	0.340		ND	ND	ND	ND	ND
Anthracene	0.420	50	0.42 J	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.580	50	ND	0.89 J	ND	ND	0.97 J
Benzo(a)anthracene	0.400	0.65-1.4	1.0	ND	ND	ND	ND
Benzo(a)pyrene	0.290	2.6-5.5	0.97	ND	ND	ND	ND
Benzo(b)fluoranthene	0.320	0.26-0.55	1.3	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.370	50	0.49	ND	ND	ND	ND
Chrysene	0.610	0.09-0.2	1.0	ND	ND	ND	ND
Dibenz(a,h)anthracene	0.410	50	0.11 J	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9	0.36 J	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400		0.41 J	ND	ND	ND	ND
Fluorene	0.330	50	0.45	ND	ND	ND	ND
Fluoranthene	0.290	50	2.7	ND	ND	ND	ND
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6	0.45 J	ND	ND	ND	ND
2-Methylnaphthalene	0.400	17.3	0.12 J	0.55 J	ND	ND	0.60 J
Naphthalene	0.360	6.2	0.34 J	1.4 J	ND	ND	2.5 J
Phenanthrene	0.320	50	2.9	0.84 J	ND	ND	0.96 J
Pyrene	0.320	50	2.3	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech				
			Field ID 59BH12SO1 Depth 1.00-3.00 Lab ID 650486	59BH12SO2 5.00-7.00 650492	59BH12SO3 10.00-12.0 650498	59BH12SO9 10.00-12.0 650539	59SW10SO1 1.00-3.00 650545
Acenaphthene	0.370	21.5-43.7	ND	ND	ND	ND	0.095 J
Acenaphthylene	0.340		ND	ND	ND	ND	0.100 J
Anthracene	0.420	50	ND	ND	ND	ND	0.51 J
bis(2-ethylhexyl)phthalate	0.580	50	ND	ND	ND	ND	0.24 J
Benzo(a)anthracene	0.400	0.65-1.4	ND	ND	ND	ND	5.9
Benzo(a)pyrene	0.290	2.6-5.5	ND	ND	ND	ND	5.2
Benzo(b)fluoranthene	0.320	0.26-0.55	ND	ND	ND	ND	10 J
Benzo(g,h,i)perylene	0.370	50	ND	ND	ND	ND	2.1
Chrysene	0.610	0.09-0.2	ND	ND	ND	ND	5.8
Dibenz(a,h)anthracene	0.410	50	ND	ND	ND	ND	0.57 J
Dibenzofuran	0.350	1.4-2.9	ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400		ND	ND	ND	ND	ND
Fluorene	0.330	50	ND	ND	ND	ND	0.12 J
Fluoranthene	0.290	50	ND	ND	ND	ND	8.1
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6	ND	ND	ND	ND	2.1
2-Methylnaphthalene	0.400	17.3	ND	ND	ND	ND	ND
Naphthalene	0.360	6.2	0.15 J	ND	ND	ND	ND
Phenanthrene	0.320	50	ND	ND	ND	ND	2.3
Pyrene	0.320	50	ND	ND	ND	ND	6.9

TABLE 3.1-4
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR SVOCS

			Environmental Samples (mg/kg) - Earth Tech				
Parameters	PQL	Action Levels (1)	Field ID 59SW10SO2 Depth 5.00-7.00 Lab ID 650510	59SW10SO3 10.00-12.0 650551	59SW11SO1 1.00-3.00 655352	59SW11SO2 5.00-7.00 655371	59SW11SO3 12.00-14.0 655377
Acenaphthene	0.370	21.5-43.7	ND	ND	ND	ND	ND
Acenaphthylene	0.340		ND	ND	ND	ND	ND
Anthracene	0.420	50	ND	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.580	50	ND	ND	ND	ND	0.94
Benzo(a)anthracene	0.400	0.65-1.4	ND	ND	ND	ND	ND
Benzo(a)pyrene	0.290	2.6-5.5	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	0.320	0.26-0.55	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.370	50	ND	ND	ND	ND	ND
Chrysene	0.610	0.09-0.2	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	0.410	50	ND	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9	ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400		ND	ND	ND	ND	ND
Fluorene	0.330	50	ND	ND	ND	ND	ND
Fluoranthene	0.290	50	ND	ND	ND	ND	ND
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6	ND	ND	ND	ND	ND
2-Methylnaphthalene	0.400	17.3	ND	ND	ND	ND	0.16 J
Naphthalene	0.360	6.2	ND	ND	ND	ND	0.49
Phenanthrene	0.320	50	ND	ND	ND	ND	0.14 J
Pyrene	0.320	50	ND	ND	ND	ND	ND

			Environmental Samples (mg/kg) - Earth Tech				
Parameters	PQL	Action Levels (1)	Field ID 59SW12SO1 Depth 1.50-2.50 Lab ID 658103	59SW12SO2 6.00-7.00 658104	59SW12SO3 11.50-12.5 658105	59SW12SO9 12.50-13.0 658107	59SW12SO4 16.50-17.5 658106
Acenaphthene	0.370	21.5-43.7	ND	ND	ND	ND	ND
Acenaphthylene	0.340		ND	ND	ND	ND	ND
Anthracene	0.420	50	ND	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.580	50	ND	ND	0.63 J	0.61 J	0.16 J
Benzo(a)anthracene	0.400	0.65-1.4	0.28 J	ND	ND	ND	ND
Benzo(a)pyrene	0.290	2.6-5.5	0.25 J	ND	ND	ND	ND
Benzo(b)fluoranthene	0.320	0.26-0.55	0.35 J	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.370	50	ND	ND	ND	ND	ND
Chrysene	0.610	0.09-0.2	0.32 J	ND	ND	ND	ND
Dibenz(a,h)anthracene	0.410	50	ND	ND	ND	ND	ND
Dibenzofuran	0.350	1.4-2.9	ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.400		ND	ND	ND	ND	ND
Fluorene	0.330	50	ND	ND	ND	ND	ND
Fluoranthene	0.290	50	0.30 J	ND	ND	ND	ND
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6	ND	ND	ND	ND	ND
2-Methylnaphthalene	0.400	17.3	ND	ND	ND	ND	ND
Naphthalene	0.360	6.2	ND	ND	ND	ND	ND
Phenanthrene	0.320	50	0.089 J	ND	ND	ND	ND
Pyrene	0.320	50	0.31 J	ND	ND	ND	ND

TABLE 3.1-4
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR SVOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Earth Tech Field ID 59SW13SO1 Depth 1.50-2.50 Lab ID 657186	59SW13SO2 6.00-7.00 657174	59SW13SO3 11.00-12.0 657180	59SW13SO4 16.00-17.0 657192	
Acenaphthene	0.370	21.5-43.7	ND	ND	ND	ND	
Acenaphthylene	0.340		ND	ND	ND	ND	
Anthracene	0.420	50	ND	ND	ND	ND	
bis(2-ethylhexyl)phthalate	0.580	50	ND	ND	ND	ND	
Benzo(a)anthracene	0.400	0.65-1.4	ND	ND	ND	ND	
Benzo(a)pyrene	0.290	2.6-5.5	ND	ND	ND	ND	
Benzo(b)fluoranthene	0.320	0.26-0.55	ND	ND	ND	ND	
Benzo(g,h,i)perylene	0.370	50	ND	ND	ND	ND	
Chrysene	0.610	0.09-0.2	ND	ND	ND	ND	
Dibenz(a,h)anthracene	0.410	50	ND	ND	ND	ND	
Dibenzofuran	0.350	1.4-2.9	ND	ND	ND	ND	
2,4,-Dinitrotoluene	0.400		ND	ND	ND	ND	
Fluorene	0.330	50	ND	ND	ND	ND	
Fluoranthene	0.290	50	ND	ND	ND	ND	
Indeno(1,2,3,-cd)pyrene	0.630	1.5-1.6	ND	ND	ND	ND	
2-Methylnaphthalene	0.400	17.3	ND	ND	ND	ND	
Naphthalene	0.360	6.2	ND	ND	ND	ND	
Phenanthrene	0.320	50	ND	ND	ND	ND	
Pyrene	0.320	50	ND	ND	ND	ND	

(1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup (NYSDEC, January 1994) using site-specific TOC values.

Qualifiers: J = Estimated; U = Blank Contamination

TABLE 3.1-4
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR SVOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Martin Marietta Field ID 001 Depth 0.50-1.00	004 0.50-1.00	006 0.50-1.00	009 0.50-1.00	012 0.50-1.00
Acenaphthene	0.33	21.5-43.7	ND	ND	ND	ND	ND
Acenaphthylene	0.33		ND	ND	ND	ND	ND
Anthracene	0.33	50	ND	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.33	50	ND	ND	0.471	0.471	0.471
Benzo(a)anthracene	0.33	0.65-1.4	ND	ND	ND	ND	ND
Benzo(a)pyrene	0.33	2.6-5.5	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	0.33	0.26-0.55	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	0.33	50	ND	ND	ND	ND	ND
Chrysene	0.33	0.09-0.2	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	0.33	50	ND	ND	ND	ND	ND
Dibenzofuran	0.33	1.4-2.9	ND	ND	ND	ND	ND
2,4,-Dinitrotoluene	0.33		ND	ND	ND	ND	ND
Fluorene	0.33	50	ND	ND	ND	ND	ND
Fluoranthene	0.33	50	ND	ND	ND	ND	ND
Indeno(1,2,3,-cd)pyrene	0.33	1.5-1.6	ND	ND	ND	ND	ND
2-Methylnaphthalene	0.33	17.3	ND	ND	ND	ND	ND
Naphthalene	0.33	6.2	ND	ND	ND	ND	ND
Phenanthrene	0.33	50	ND	ND	ND	ND	ND
Pyrene	0.33	50	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Martin Marietta Field ID 015 Depth 0.50-1.00	025 0.50-1.00	026 0.50-1.00	027 0.50-1.00	
Acenaphthene	0.33	21.5-43.7	ND	ND	ND	ND	
Acenaphthylene	0.33		ND	ND	ND	ND	
Anthracene	0.33	50	ND	ND	ND	ND	
bis(2-ethylhexyl)phthalate	0.33	50	0.471	ND	ND	ND	
Benzo(a)anthracene	0.33	0.65-1.4	ND	ND	ND	ND	
Benzo(a)pyrene	0.33	2.6-5.5	ND	ND	ND	ND	
Benzo(b)fluoranthene	0.33	0.26-0.55	ND	ND	ND	ND	
Benzo(g,h,i)perylene	0.33	50	ND	ND	ND	ND	
Chrysene	0.33	0.09-0.2	ND	ND	ND	ND	
Dibenz(a,h)anthracene	0.33	50	ND	ND	ND	ND	
Dibenzofuran	0.33	1.4-2.9	ND	ND	ND	ND	
2,4,-Dinitrotoluene	0.33		ND	ND	ND	ND	
Fluorene	0.33	50	ND	ND	ND	ND	
Fluoranthene	0.33	50	ND	ND	ND	ND	
Indeno(1,2,3,-cd)pyrene	0.33	1.5-1.6	ND	ND	ND	ND	
2-Methylnaphthalene	0.33	17.3	ND	ND	ND	ND	
Naphthalene	0.33	6.2	ND	ND	ND	ND	
Phenanthrene	0.33	50	ND	ND	ND	ND	
Pyrene	0.33	50	ND	ND	ND	ND	

(1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, January 1994) using site-specific TOC values.

Qualifiers: J = Estimated; U = Blank Contamination

TABLE 3.1-4
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR SVOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg) - Argonne National Laboratory				
			Field ID JCDW1AS Depth 8.00-10.0	JCDW1BS 8.00-10.0	JCDW1CS 18.00-20.0	JCSW5AS 10.00-12.0	JCSW5BS 23.00-27.0
Anthracene	0.33	50	0.017	ND	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.33	50	ND	ND	ND	ND	0.530
Di-n-butylphthalate	0.33	3.8-4.0	0.220	0.26	ND	ND	0.200
Fluoranthene	0.33	50	0.140	0.065	ND	ND	ND
Phenanthrene	0.33	50	0.16	ND	ND	ND	ND
Pyrene	0.33	50	0.11	0.052	ND	ND	ND

(1) Action Levels are based on NYSDEC guidance for the Determination of Soil Cleanup Objectives and Cleanup Levels (NYSDEC, January 1994) using site-specific TOC values.

TABLE 3.1-5
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR CYANIDE

Parameters	PQL	Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59BH01SO1	59BH01SO2	59BH02SO1	59BH02SO2	59BH02SO3
		Depth	1.00-3.00	5.00-7.00	1.00-3.00	5.00-7.00	10.00-12.0
		Lab ID	648871	648882	648888	648894	648903
Cyanide, Total	0.90		ND	ND	ND	ND	0.64

Parameters	PQL	Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59BH03SO1	59BH03SO2	59BH03SO3	59BH04SO1	59BH04SO9
		Depth	1.00-3.00	5.00-7.00	10.00-12.0	3.00-5.00	5.00-7.00
		Lab ID	648909	648915	649274	649235	649247
Cyanide, Total	0.90		ND	ND	ND	ND	ND

Parameters	PQL	Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59BH04SO2	59BH04SO3	59BH05SO1	59BH05SO2	59BH05SO3
		Depth	5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00	10.00-12.0
		Lab ID	649262	649319	649256	649268	649280
Cyanide, Total	0.90		ND	ND	ND	ND	ND

Parameters	PQL	Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59BH06SO1	59BH06SO2	59BH07SO1	59BH07SO2	59BH08SO1
		Depth	1.00-3.00	5.00-7.00	3.00-5.00	5.00-7.00	1.00-3.00
		Lab ID	649308	649241	649286	649292	649828
Cyanide, Total	0.90		ND	ND	ND	ND	ND

Parameters	PQL	Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59BH08SO9	59BH08SO2	59BH08SO3	59BH09SO1	59BH09SO9
		Depth	5.00-7.00	5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00
		Lab ID	649846	649834	649840	649862	649894
Cyanide, Total	0.90		ND	ND	ND	ND	ND

Parameters	PQL	Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59BH09SO2	59BH09SO3	59BH09SO4	59BH10SO1	59BH10SO2
		Depth	5.00-7.00	10.00-12.0	15.00-17.0	3.00-5.00	5.00-7.00
		Lab ID	649873	649879	649885	650127	650133
Cyanide, Total	0.90		ND	ND	ND	ND	ND

Parameters	PQL	Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59BH10SO3	59BH11SO1	59BH11SO2	59BH11SO3	59BH12SO1
		Depth	10.00-12.0	3.00-5.00	5.00-7.00	10.00-12.0	1.00-3.00
		Lab ID	650121	650109	650115	650103	650490
Cyanide, Total	0.90		ND	ND	ND	ND	ND

TABLE 3.1-5
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR CYANIDE

		Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59BH12SO2	59BH12SO9	59BH12SO3	59SW10SO1	59SW10SO2
		Depth	5.00-7.00	10.00-12.0	10.00-12.0	1.00-3.00	5.00-7.00
Parameters	PQL	Lab ID	650496	650543	650504	650549	650535
Cyanide, Total	0.90		ND	ND	ND	ND	ND

		Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59SW10SO3	59SW11SO1	59SW11SO2	59SW11SO3	59SW12SO1
		Depth	10.00-12.0	1.00-3.00	5.00-7.00	12.00-14.0	1.50-2.50
Parameters	PQL	Lab ID	650555	655361	655374	655380	658124
Cyanide, Total	0.90		ND	ND	ND	ND	ND

		Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59SW12SO2	59SW12SO3	59SW12SO9	59SW12SO4	59SW13SO1
		Depth	6.00-7.00	11.50-12.5	12.50-13.0	16.50-17.5	1.50-2.50
Parameters	PQL	Lab ID	658128	658132	658143	658136	657189
Cyanide, Total	0.90		ND	ND	ND	ND	ND

		Environmental Samples (mg/kg) - Earth Tech					
		Field ID	59SW13SO2	59SW13SO3	59SW13SO4		
		Depth	6.00-7.00	11.00-12.0	16.00-17.0		
Parameters	PQL	Lab ID	657177	657183	657195		
Cyanide, Total	0.90		ND	ND	ND		

TABLE 3.1-5
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR CYANIDE

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 001 Depth 0.50-1.00	002 0.50-1.00	003 0.50-1.00	004 0.50-1.00	005 0.50-1.00
Cyanide, Total	1.0	ND	ND	ND	ND	ND

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 006 Depth 0.50-1.00	007 0.50-1.00	008 0.50-1.00	009 0.50-1.00	010 0.50-1.00
Cyanide, Total	1.0	ND	ND	2.12	ND	ND

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 011 Depth 0.50-1.00	012 0.50-1.00	013 0.50-1.00	014 0.50-1.00	015 0.50-1.00
Cyanide, Total	1.0	ND	ND	1.11	ND	ND

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID 016 Depth 0.50-1.00	017 0.50-1.00	018 0.50-1.00		
Cyanide, Total	1.0	ND	1.03	ND		

Parameters	PQL	Environmental Samples (mg/kg) - Martin Marietta				
		Field ID GESS#1 Depth 10.00-10.5	GESS#2 9.80-10.3	GESS#3 9.50-10.0		
Cyanide, Total	1.0	ND	ND	ND		

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TABLE 3.1-6
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR TOC (SW9060)

Parameters	PQL		Environmental Samples (mg/kg)				
		Field ID	59BH01SO1	59BH01SO2	59BH02SO1	59BH02SO2	59BH02SO3
		Depth	1.00-3.00	5.00-7.00	1.00-3.00	5.00-7.00	10.00-12.0
		Lab ID	648874	648883	648889	648895	648904
TOC	50		1300	1940	7360	615	1380

Parameters	PQL		Environmental Samples (mg/kg)				
		Field ID	59BH03SO1	59BH03SO2	59BH03SO3	59BH04SO1	
		Depth	1.00-3.00	5.00-7.00	10.00-12.0	3.00-5.00	
		Lab ID	648910	648918	649275	649236	
TOC	50		4940	3560	1270	1150	

Parameters	PQL		Environmental Samples (mg/kg)				
		Field ID	59BH04SO2	59BH04SO9	59BH04SO3	59BH05SO1	59BH05SO2
		Depth	5.00-7.00	5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00
		Lab ID	649263	649248	649320	649257	649269
TOC	50		1890	786	1880	1960	5480

Parameters	PQL		Environmental Samples (mg/kg)				
		Field ID	59BH05SO3	59BH06SO1	59BH06SO2	59BH07SO1	59BH07SO2
		Depth	10.00-12.0	1.00-3.00	5.00-7.00	3.00-5.00	5.00-7.00
		Lab ID	649281	649311	649242	649287	649293
TOC	50		1310	2830	5020	4680	12200

Parameters	PQL		Environmental Samples (mg/kg)				
		Field ID	59BH08SO1	59BH08SO2	59BH08SO9	59BH08SO3	59BH09SO1
		Depth	1.00-3.00	5.00-7.00	5.00-7.00	10.00-12.0	1.00-3.00
		Lab ID	649829	649835	649847	649841	649865
TOC	50		3860	1850	6770	1530	1470

Parameters	PQL		Environmental Samples (mg/kg)				
		Field ID	59BH09SO2	59BH09SO9	59BH09SO3	59BH09SO4	59BH10SO1
		Depth	5.00-7.00	5.00-7.00	10.00-12.0	15.00-17.0	3.00-5.00
		Lab ID	649874	649895	649880	649886	650128
TOC	50		2710	16700	1400	645	3540

Parameters	PQL		Environmental Samples (mg/kg)				
		Field ID	59BH10SO2	59BH10SO3	59BH11SO1	59BH11SO2	59BH11SO3
		Depth	5.00-7.00	10.00-12.0	3.00-5.00	5.00-7.00	10.00-12.0
		Lab ID	650134	650122	650110	650116	650104
TOC	50		1300	8280	18500	1120	9930

TABLE 3.1-6
AIR FORCE PLANT 59
SOIL DATA SUMMARY FOR TOC (SW9060)

Parameters	PQL	Environmental Samples (mg/kg)					
		Field ID	59BH12SO1	59BH12SO2	59BH12SO3	59BH12SO9	59SW10SO1
		Depth	1.00-3.00	5.00-7.00	10.00-12.0	10.00-12.0	1.00-3.00
		Lab ID	650491	650497	650509	650544	650550
TOC	50		3030	3120	1480	1270	31600

Parameters	PQL	Environmental Samples (mg/kg)					
		Field ID	59SW10SO2	59SW10SO3	59SW11SO1	59SW11SO2	59SW11SO3
		Depth	5.00-7.00	10.00-12.0	1.00-3.00	5.00-7.00	12.00-14.0
		Lab ID	650538	650556	655364	655375	655381
TOC	50		635	743	4850	2910	7920

Parameters	PQL	Environmental Samples (mg/kg)					
		Field ID	59SW12SO1	59SW12SO2	59SW12SO3	59SW12SO9	59SW12SO4
		Depth	1.50-2.50	6.00-7.00	11.50-12.5	12.50-13.0	16.50-17.5
		Lab ID	658125	658129	658133	658144	658137
TOC	50		29200	4660	3480	529	1240

Parameters	PQL	Environmental Samples (mg/kg)					
		Field ID	59SW13SO1	59SW13SO2	59SW13SO3	59SW13SO4	
		Depth	1.50-2.50	6.00-7.00	11.00-12.0	16.00-17.0	
		Lab ID	657190	657178	657184	657196	
TOC	50		16800	2340	1770	2310	

Soil samples collected during the SSI from two locations (DW1 and SW5) were also used to characterize background conditions (see Figure 3-2). A total of five samples, including one replicate, were collected in November 1991. The soil samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and metals. The results are summarized with the RI data in Tables 3.1-1 through 3.1-5. Data validation was completed during the SSI (Argonne National Laboratory, 1994).

3.1.2.2 Groundwater. A total of nine groundwater monitoring wells were installed in October and November 1994 as part of the RI field effort. In December 1994, a round of groundwater samples was collected from all new and existing monitoring wells at AFP 59. Twenty-six groundwater samples and three duplicates were collected. Figure 3-2 shows the locations of the sampled monitoring wells. All groundwater samples were analyzed for VOCs (SW8260), SVOCs (SW8270), pesticides/PCBs (SW8080), ICP metals screen (SW6010), arsenic (SW7060), lead (SW7421), mercury (SW7470), selenium (SW7740), thallium (SW7841), cyanide (SW9012), and hardness (E130.1). All groundwater samples were unfiltered; therefore, the metals results represent total metals concentrations. Tables 3.1-7 through 3.1-11 summarize the analytical results for chemical analyses of groundwater samples at AFP 59. The tables list only those analytes that were detected in one or more samples. Complete analytical results are provided in the *Analytical Data ITIR* (EARTH TECH, 1995b).

3.1.2.3 Surface Water and Sediment. Surface water and sediment sample pairs were collected at five locations from Little Choconut Creek. One replicate sediment sample and one duplicate surface water sample were also collected and analyzed. Three sample pairs were collected at locations downstream from each of Outfalls 001, 002, and 003, and two samples were collected upstream from the plant's outfalls. Figure 3-2 shows the surface water and sediment sampling locations. Samples were analyzed for VOCs (SW8260), SVOCs (SW8270), pesticides/PCBs (SW8080), ICP metals screen (SW6010), arsenic (SW7060), lead (SW7421), mercury (SW7470/SW7471), selenium (SW7740), thallium (SW7841), and cyanide (SW9012).

In addition, all sediment samples were analyzed for TOC (SW9060), and all surface water samples were analyzed for hardness (E130.1). Tables 3.1-12 through 3.1-16 and Tables 3.1-17 through 3.1-21 summarize the analytical results for chemical analyses of sediment and surface water samples, respectively. The tables list only those analytes that were detected in one or more sample. Complete analytical results are provided in the *Analytical Data ITIR* (EARTH TECH, 1995b).

3.1.3 Background Levels

This section discusses the soil, groundwater, sediment, and surface water background results for AFP 59. Table 3.1-22 lists the background samples and the analyses completed.

3.1.3.1 Background Sampling and Analysis

SOIL. Background subsurface soil samples were collected from four locations on AFP 59 property that were believed to be unaffected by past plant activities. Subsurface soil samples were

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TABLE 3.1-7
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7470, SW7740, SW7841, SW9012)

				Environmental Samples (ug/L)									
Parameters	PQL	Action Levels		Field ID 59SW1WG1 Lab ID 660976		59DW1WG1 662310		59SW3WG1 663589		59SW3WG9 663611		59DW3WG1 663235	
Silver (Ag)	8.0	50	(2)	ND		ND		ND		ND		ND	
Aluminum (Al)	120			1260		113	U	106	U	113	U	117	U
Arsenic (As)	18	50	(2)	ND		ND		3.5	J	3.4	J	ND	
Barium (Ba)	4	2000	(2)	174		123		37.6	J	39.0	J	222	
Beryllium (Be)	2.5	3	(3)	0.91	U	0.79	U	0.57	J	ND		ND	
Calcium (Ca)	1000			199000		132000		84400		88800		138000	
Chromium (Cr)	19	100	(2)	ND		ND		ND		ND		ND	
Copper (Cu)	10	200	(2)	17.4		ND		2.9	U	3.3	U	ND	
Iron (Fe)	120	300	(2)	692		ND		71.0	U	53.3	U	538	
Potassium (K)	2,200			2500	U	1510	U	2310		2570		1970	U
Magnesium (Mg)	58	35,000	(2)	38500		29200		13800		14400		32000	
Manganese (Mn)	3.5	300	(2)	720		1.1	U	2.7	U	3.6	U	619	
Sodium (Na)	440	20,000	(2)	331000		116000		37500		39600		42700	
Nickel (Ni)	50	100	(1)	ND		ND		ND		ND		ND	
Lead (Pb)	7.5	15	(2)	58.8	J	ND		ND		ND		ND	
Thallium (Tl)	3.5	2	(1)	ND		ND		ND		ND		ND	
Vanadium (V)	6.5			ND		ND		ND		ND		ND	
Zinc (Zn)	9.5	500	(2)	31.6	U	24.8	U	30.4	U	31.0	U	13.4	U

				Environmental Samples (ug/L)									
Parameters	PQL	Action Levels		Field ID 59SW4WG1 Lab ID 664237		59DW4WG1 664254		59SW5WG1 661561		59DW5WG1 662298		59SW6WG1 663203	
Silver (Ag)	8.0	50	(2)	ND		ND		ND		ND		ND	
Aluminum (Al)	120			988		1000		5020		285	U	2470	
Arsenic (As)	18	50	(2)	ND		ND		10.5	J	ND		2.2	J
Barium (Ba)	4	2000	(2)	84.4	J	79.9	J	161		84.1		209	
Beryllium (Be)	2.5	3	(3)	0.23	J	ND		0.57	U	ND		0.45	U
Calcium (Ca)	1000			90200		138000		165000		116000		234000	
Chromium (Cr)	19	100	(2)	27.2		ND		11.8	J	ND		9.8	J
Copper (Cu)	10	200	(2)	11.6	U	5.4	U	52.9		ND		17.0	
Iron (Fe)	120	300	(2)	2290	J	3050	J	15300		426		2440	
Potassium (K)	2,200			2070	J	1890	J	2860		1670	U	3580	
Magnesium (Mg)	58	35,000	(2)	15800	J	32700	J	34300		28000		58300	
Manganese (Mn)	3.5	300	(2)	216		678		4000		802		1220	
Sodium (Na)	440	20,000	(2)	40400		26400		84200		29500		60000	
Nickel (Ni)	50	100	(1)	47.5	J	ND		23.2	J	ND		ND	
Lead (Pb)	7.5	15	(2)	8.6		6.0	J	50.4		ND		35.0	
Thallium (Tl)	3.5	2	(1)	ND	U	ND		ND		ND		ND	
Vanadium (V)	6.5			ND		3.4	J	10.9		ND		ND	
Zinc (Zn)	9.5	500	(2)	24.3	U	25.4	U	90.5	U	8.2	U	42.0	U

TABLE 3.1-7
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7470, SW7740, SW7841, SW90

Parameters	PQL	Action Levels		Environmental Samples (ug/L)									
				Field ID 59DW6WG1 Lab ID 663223		59SW7WG1 662304		59DPWWG1 665951		59SW8WG1 661563		59SW8WG9 661562	
Silver (Ag)	8.0	50	(2)	ND		ND		ND		10.0		ND	
Aluminum (Al)	120			376	U	2470		106	J	3480		3050	
Arsenic (As)	18	50	(2)	11.9	J	3.7	J	ND		3.1	J	3.9	J
Barium (Ba)	4	2000	(2)	144		330		87.4	J	143		131	
Beryllium (Be)	2.5	3	(3)	ND		0.38	U	ND		0.60	U	0.57	U
Calcium (Ca)	1000			86900		260000		135000		125000		108000	
Chromium (Cr)	19	100	(2)	ND		5.8	J	ND		8.7	J	8.3	J
Copper (Cu)	10	200	(2)	2.9	U	17.0		4.1	U	45.5		38.5	
Iron (Fe)	120	300	(2)	923		1460		284		6730		8320	
Potassium (K)	2,200			6040		2500	U	1860	J	2130	U	2070	U
Magnesium (Mg)	58	35,000	(2)	24800		53600		30100		26700		21500	
Manganese (Mn)	3.5	300	(2)	316		928		447		3090		3100	
Sodium (Na)	440	20,000	(2)	25300		29900		49600		22700		24500	
Nickel (Ni)	50	100	(1)	ND		ND		ND		ND		ND	
Lead (Pb)	7.5	15	(2)	3.2	J	57.0		1.8	J	33.9		79.6	
Thallium (Tl)	3.5	2	(1)	ND		ND		46.8		ND		ND	
Vanadium (V)	6.5			ND		ND		ND		10.5		12.4	
Zinc (Zn)	9.5	500	(2)	19.9	U	38.8	U	31.6	U	39.0	U	49.8	U

Parameters	PQL	Action Levels		Environmental Samples (ug/L)									
				Field ID 59DW8WG1 Lab ID 663215		59SW9WG1 663822		59IW9WG1 664217		59DW9WG1 663605		59SW10WG1 660971	
Silver (Ag)	8.0	50	(2)	ND		ND		ND		ND		ND	
Aluminum (Al)	120			151	U	904		1420		102	U	4350	
Arsenic (As)	18	50	(2)	ND		ND		ND		ND		2.8	J
Barium (Ba)	4	2000	(2)	45.5		47.3	J	369	J	36.8	J	339	
Beryllium (Be)	2.5	3	(3)	ND		ND		ND		ND		0.60	U
Calcium (Ca)	1000			148000		98200		178000		154000		120000	
Chromium (Cr)	19	100	(2)	ND		ND		ND		ND		8.9	J
Copper (Cu)	10	200	(2)	ND		6.2	U	10.3	U	ND		33.1	
Iron (Fe)	120	300	(2)	213	U	2060		1190		4460		4820	
Potassium (K)	2,200			2320	U	2520		47200		1950	J	3040	
Magnesium (Mg)	58	35,000	(2)	37800		18800		588		26900		20100	
Manganese (Mn)	3.5	300	(2)	669		294		85.2		1440		3940	
Sodium (Na)	440	20,000	(2)	94300		31600		61500		25700		231000	
Nickel (Ni)	50	100	(1)	ND		ND		ND		ND		21.3	J
Lead (Pb)	7.5	15	(2)	ND		5.4	J	7.6		1.7	J	51.8	J
Thallium (Tl)	3.5	2	(1)	ND		ND		ND		ND		ND	
Vanadium (V)	6.5			ND		3.8	J	ND		ND		4.6	J
Zinc (Zn)	9.5	500	(2)	8.8	U	30.3	U	45.3	U	32.3	U	48.5	U

TABLE 3.1-7
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7470, SW7740, SW7841, SW9012)

				Environmental Samples (ug/L)									
Parameters	PQL	Action Levels		Field ID 59DW10WG1 Lab ID 662316		59SW11WG1 664225		59SW11WG9 664231		59DW11WG1 664243		59SW12WG1 660959	
Silver (Ag)	8.0	50	(2)	ND		ND		ND		ND		ND	
Aluminum (Al)	120			108	U	216	U	317	U	133	U	3400	
Arsenic (As)	18	50	(2)	ND		4.2	J	3.2	J	ND		2.6	J
Barium (Ba)	4	2000	(2)	68.6		344	J	330	J	56.1	J	70.3	
Beryllium (Be)	2.5	3	(3)	0.23	U	1.1	J	0.34	J	ND		0.26	U
Calcium (Ca)	1000			141000		110000		109000		133000		89400	
Chromium (Cr)	19	100	(2)	ND		ND		ND		ND		ND	
Copper (Cu)	10	200	(2)	ND		4.5	U	5.0	U	3.7	U	31.8	
Iron (Fe)	120	300	(2)	ND		10400		8850		272	U	7410	
Potassium (K)	2,200			1950	U	3490		3230		2950		1760	U
Magnesium (Mg)	58	35,000	(2)	32200		16500		16300		35000		18000	
Manganese (Mn)	3.5	300	(2)	93.3		2790		2810		668		595	
Sodium (Na)	440	20,000	(2)	114000		28400		28100		69900		13900	
Nickel (Ni)	50	100	(1)	ND		ND		ND		ND		ND	
Lead (Pb)	7.5	15	(2)	ND		ND		4.8	J	ND		30.6	
Thallium (Tl)	3.5	2	(1)	ND		ND		ND		ND		ND	
Vanadium (V)	6.5			ND		4.2	J	ND		ND		7.3	
Zinc (Zn)	9.5	500	(2)	44.7	U	41.5	U	26.4	U	26.4	U	31.5	U

				Environmental Samples (ug/L)								
Parameters	PQL	Action Levels		Field ID 59DW12WG1 Lab ID 663811		59SW13WG1 661559		59IW13WG1 667053		59DW13WG1 663571		
Silver (Ag)	8.0	50	(2)	ND		ND		ND		ND		
Aluminum (Al)	120			114	U	3000		142	U	381	U	
Arsenic (As)	18	50	(2)	ND		6.3	J	ND		ND		
Barium (Ba)	4	2000	(2)	41.6	J	66.4		73.9	J	172		
Beryllium (Be)	2.5	3	(3)	ND		0.30	U	ND		0.45	U	
Calcium (Ca)	1000			157000		183000		221000		135000		
Chromium (Cr)	19	100	(2)	ND		7.8	J	ND		ND		
Copper (Cu)	10	200	(2)	2.9		12.4	U	3.7	U	4.1	U	
Iron (Fe)	120	300	(2)	272	U	4360		124	U	568		
Potassium (K)	2,200			1900	J	4000		3770		2110	U	
Magnesium (Mg)	58	35,000	(2)	38300		30400		34600		29400		
Manganese (Mn)	3.5	300	(2)	786		2460		6710		372		
Sodium (Na)	440	20,000	(2)	62400		59400		75400		29800		
Nickel (Ni)	50	100	(1)	ND		ND		ND		ND		
Lead (Pb)	7.5	15	(2)	ND		28.2		ND		ND		
Thallium (Tl)	3.5	2	(1)	ND		ND		47.0		ND		
Vanadium (V)	6.5			ND		5.3	J	ND		6.0	J	
Zinc (Zn)	9.5	500	(2)	33.9	J	34.9		46.0	U	13.4	U	

(1) Federal Primary MCL
(2) NY Drinking Water Standard
(3) NY Ambient Water Quality Guidance Value
Qualifiers: J = Estimated; U = Blank Contamination

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TABLE 3.1-8
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR PCB/PESTICIDES (SW8080)

			Environmental Samples (ug/L)					
Parameters	PQL	Action Levels (1)	Field ID Lab ID	59SW1WG1 660975	59DW1WG1 662309	59SW3WG1 663585	59SW3WG9 663610	59DW3WG1 663232
alpha-BHC	0.025	5		ND	ND	ND	ND	ND
beta-BHC	0.050	5		ND	ND	ND	ND	ND
delta-BHC	0.001	5		ND	ND	0.0004 J	0.0070	0.0022
gamma-BHC (Lindane)	0.025	5		ND	0.0035 J	ND	ND	ND
4,4 -DDD	0.050	ND		ND	ND	ND	ND	ND
4,4 -DDE	0.050	ND		ND	ND	ND	ND	ND
4,4 -DDT	0.075	ND		ND	ND	ND	ND	ND
Endosulfan II	0.025			ND	ND	ND	ND	ND
Heptachlor	0.025	0.4		ND	ND	ND	ND	ND
Methoxychlor	0.25	40		ND	ND	ND	ND	ND

			Environmental Samples (ug/L)					
Parameters	PQL	Action Levels (1)	Field ID Lab ID	59SW4WG1 664236	59DW4WG1 664253	59SW5WG1 661556	59DW5WG1 662297	59SW6WG1 663201
alpha-BHC	0.025	5		ND	ND	ND	0.0051 J	ND
beta-BHC	0.050	5		ND	ND	ND	ND	ND
delta-BHC	0.001	5		ND	ND	ND	ND	0.0032
mma-BHC (Lindane)	0.025	5		ND	ND	ND	ND	ND
4,4 -DDD	0.050	ND		ND	ND	ND	0.021 U	ND
4,4 -DDE	0.050	ND		ND	0.022 J	ND	ND	ND
4,4 -DDT	0.075	ND		ND	ND	ND	ND	ND
Endosulfan II	0.025			ND	ND	ND	ND	ND
Heptachlor	0.025	0.4		ND	ND	ND	ND	ND
Methoxychlor	0.25	40		ND	ND	ND	ND	ND

			Environmental Samples (ug/L)					
Parameters	PQL	Action Levels (1)	Field ID Lab ID	59DW6WG1 663221	59SW7WG1 662303	59SW8WG1 661558	59SW8WG9 661557	
alpha-BHC	0.025	5		ND	ND	ND	ND	
beta-BHC	0.050	5		0.0089 J	0.010 J	ND	ND	
delta-BHC	0.001	5		0.0016	ND	ND	ND	
gamma-BHC (Lindane)	0.025	5		ND	ND	0.0043 J	ND	
4,4 -DDD	0.050	ND		ND	ND	ND	ND	
4,4 -DDE	0.050	ND		ND	ND	ND	ND	
4,4 -DDT	0.075	ND		0.013 J	ND	ND	ND	
Endosulfan II	0.025			ND	ND	ND	ND	
Heptachlor	0.025	0.4		ND	ND	ND	ND	
Methoxychlor	0.25	40		ND	ND	ND	ND	

TABLE 3.1-8
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR PCB/PESTICIDES (SW8080)

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L) Field ID 59DW8WG1 Lab ID 663213	59SW9WG1 663821	59IW9WG1 664213	59DW9WG1 663604	59SW10WG1 660970
alpha-BHC	0.025	5	ND	ND	ND	ND	ND
beta-BHC	0.050	5	ND	ND	ND	ND	ND
delta-BHC	0.001	5	0.011 J	0.0022	ND	0.0031 J	ND
gamma-BHC (Lindane)	0.025	5	ND	ND	ND	ND	ND
4,4 -DDD	0.050	ND	ND	ND	ND	ND	ND
4,4 -DDE	0.050	ND	ND	ND	ND	ND	ND
4,4 -DDT	0.075	ND	ND	ND	ND	ND	ND
Endosulfan II	0.025		ND	ND	ND	ND	ND
Heptachlor	0.025	0.4	ND	ND	ND	ND	ND
Methoxychlor	0.25	40	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L) Field ID 59DW10WG1 Lab ID 662315	59SW11WG1 664224	59SW11WG9 664230	59DW11WG1 664242	59SW12WG1 660956
alpha-BHC	0.025	5	ND	ND	ND	ND	ND
beta-BHC	0.050	5	ND	ND	0.010 J	ND	ND
delta-BHC	0.001	5	ND	ND	ND	0.0011 U	0.0017
gamma-BHC (Lindane)	0.025	5	ND	ND	ND	ND	ND
4,4 -DDD	0.050	ND	ND	ND	ND	ND	ND
4,4 -DDE	0.050	ND	ND	ND	ND	ND	ND
4,4 -DDT	0.075	ND	ND	ND	ND	ND	ND
Endosulfan II	0.025		ND	ND	ND	ND	ND
Heptachlor	0.025	0.4	ND	ND	0.0095 J	ND	ND
Methoxychlor	0.25	40	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L) Field ID 59DW12WG1 Lab ID 663810	59SW13WG1 661554	59IW13WG1 667052	59DW13WG1 663570	
alpha-BHC	0.025	5	ND	ND	ND	ND	
beta-BHC	0.050	5	ND	ND	ND	ND	
delta-BHC	0.001	5	ND	ND	ND	0.0021	
gamma-BHC (Lindane)	0.025	5	ND	ND	ND	0.0049 J	
4,4 -DDD	0.050	ND	ND	ND	ND	ND	
4,4 -DDE	0.050	ND	0.15	ND	0.022 J	ND	
4,4 -DDT	0.075	ND	0.016 J	ND	0.014 J	ND	
Endosulfan II	0.025		ND	0.010 J	ND	ND	
Heptachlor	0.025	0.4	ND	ND	ND	ND	
Methoxychlor	0.25	40	0.090 J	ND	0.12 J	ND	

(1) NY Drinking Water Standard
Qualifiers: J = Estimated: U = Blank Contamination

TABLE 3.1-9
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR VOCS (SW8260)

			Environmental Samples (ug/L)				
Parameters	PQL	Action Levels (1)	Field ID 59SW1WG1 Lab ID 661547	59DW1WG1 662307	59SW3WG1 663579	59SW3WG9 663608	
Bromodichloromethane	0.50	100	ND	ND	0.34 J	0.38 J	
Benzene	0.75	5	ND	ND	ND	ND	
Toluene	0.75	5	ND	ND	ND	ND	
Chloroethane	0.50	5	ND	ND	ND	ND	
Chloromethane	1.0	5	ND	ND	ND	ND	
Carbon tetrachloride	1.0	5	ND	ND	ND	ND	
Chlorodibromomethane	0.50	100	ND	ND	ND	ND	
1,1-Dichloroethane	0.75	5	ND	ND	ND	ND	
1,1-Dichloroethene	0.75	5	ND	ND	ND	ND	
cis-1,2-Dichloroethylene	0.5	5	ND	1.8	ND	ND	
trans-1,2-Dichloroethene	1.0	5	ND	ND	ND	ND	
Ethylbenzene	0.75	5	ND	ND	ND	ND	
Trichlorofluoromethane	1.0	5	ND	ND	ND	ND	
Isopropyl Benzene	0.75	5	ND	ND	ND	ND	
Methylene chloride	15	5	ND	1.8 U	3.1 U	ND	
Naphthalene	0.75	50	ND	ND	ND	ND	
n-Propyl Benzene	0.75	5	ND	ND	ND	ND	
Bromoform	0.50	100	ND	ND	ND	ND	
1,1,1-Trichloroethane	0.75	5	ND	ND	0.36 J	0.50 J	
1,2,3-Trichlorobenzene	0.75	5	ND	ND	ND	ND	
1,2,4-Trichlorobenzene	0.50	5	ND	ND	ND	ND	
Trichloroethylene	0.75	5	ND	ND	1.2	1.8	
Chloroform	0.75	7	ND	ND	0.46 J	0.44 J	
1,2,4-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	
1,3,5-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	
Vinyl chloride	1.0	2	ND	ND	ND	ND	
m,p-Xylene	0.5	5	ND	ND	ND	ND	
o-Xylene	0.5	5	ND	ND	ND	ND	

TABLE 3.1-9
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR VOCS (SW8260)

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L)				
			Field ID 59DW3WG1 Lab ID 663175	59DW3WG1RE 663175 (4)	59SW4WG1 664234 (3)	59SW4WG1RE 664234 (2)	59DW4WG1 664251
Bromodichloromethane	0.50	100	ND	ND	ND	ND	ND
Benzene	0.75	5	ND	ND	ND	ND	ND
Toluene	0.75	5	ND	ND	ND	ND	ND
Chloroethane	0.50	5	ND	ND	ND	ND	ND
Chloromethane	1.0	5	ND	ND	ND	ND	ND
Carbon tetrachloride	1.0	5	ND	ND	ND	ND	ND
Chlorodibromomethane	0.50	100	ND	ND	ND	ND	ND
1,1-Dichloroethane	0.75	5	0.26 J	ND	8.5	7.5 J	ND
1,1-Dichloroethene	0.75	5	ND	ND	2.1 J	ND	ND
cis-1,2-Dichloroethylene	0.5	5	40 J	36	19	16	0.28 J
trans-1,2-Dichloroethene	1.0	5	ND	ND	ND	ND	ND
Ethylbenzene	0.75	5	ND	ND	ND	ND	ND
Trichlorofluoromethane	1.0	5	ND	ND	2.8 J	ND	ND
Isopropyl Benzene	0.75	5	ND	ND	ND	ND	ND
Methylene chloride	15	5	ND	ND	ND	ND	2.4 U
Naphthalene	0.75	50	ND	ND	ND	ND	ND
n-Propyl Benzene	0.75	5	ND	ND	ND	ND	ND
Bromoform	0.50	100	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.75	5	ND	ND	20	17	ND
1,2,3-Trichlorobenzene	0.75	5	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	0.50	5	ND	ND	2.7 J	ND	ND
Trichloroethylene	0.75	5	ND	ND	370 J	370	1.2
Chloroform	0.75	7	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	ND
Vinyl chloride	1.0	2	0.28 J	ND	ND	ND	ND
m,p-Xylene	0.5	5	ND	ND	ND	ND	ND
o-Xylene	0.5	5	ND	ND	ND	ND	ND

TABLE 3.1-9
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR VOCS (SW8260)

			Environmental Samples (ug/L)				
Parameters	PQL	Action Levels (1)	Field ID 59SW5WG1 Lab ID 661544	59DW5WG1 662295	59SW6WG1 663164	59DW6WG1 663169	
Bromodichloromethane	0.50	100	ND	ND	ND	ND	
Benzene	0.75	5	ND	ND	ND	ND	
Toluene	0.75	5	ND	ND	ND	ND	
Chloroethane	0.50	5	ND	ND	ND	ND	
Chloromethane	1.0	5	ND	0.54 U	ND	ND	
Carbon tetrachloride	1.0	5	ND	ND	0.33 J	ND	
Chlorodibromomethane	0.50	100	ND	ND	ND	ND	
1,1-Dichloroethane	0.75	5	ND	ND	1.6	ND	
1,1-Dichloroethene	0.75	5	ND	ND	ND	ND	
cis-1,2-Dichloroethylene	0.5	5	ND	ND	10	ND	
trans-1,2-Dichloroethene	1.0	5	ND	ND	ND	ND	
Ethylbenzene	0.75	5	ND	ND	ND	ND	
Trichlorofluoromethane	1.0	5	ND	ND	ND	ND	
Isopropyl Benzene	0.75	5	ND	ND	ND	ND	
Methylene chloride	15	5	ND	ND	1.7 J	ND	
Naphthalene	0.75	50	ND	ND	ND	ND	
n-Propyl Benzene	0.75	5	ND	ND	ND	ND	
Bromoform	0.50	100	ND	ND	ND	ND	
1,1,1-Trichloroethane	0.75	5	ND	ND	2.3	ND	
1,2,3-Trichlorobenzene	0.75	5	ND	ND	ND	ND	
1,2,4-Trichlorobenzene	0.50	5	ND	ND	ND	ND	
Trichloroethylene	0.75	5	ND	ND	1.8	ND	
Chloroform	0.75	7	ND	ND	ND	ND	
1,2,4-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	
1,3,5-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	
Vinyl chloride	1.0	2	ND	ND	ND	ND	
m,p-Xylene	0.5	5	ND	ND	ND	ND	
o-Xylene	0.5	5	ND	ND	ND	ND	

TABLE 3.1-9
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR VOCS (SW8260)

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L)				
			Field ID 59SW7WG1 Lab ID 662301	59SW7WG1RE 662301 (3)	59DPWWG1 665948	59SW8WG1 661546	59SW8WG9 661545
Bromodichloromethane	0.50	100	ND	ND	ND	ND	ND
Benzene	0.75	5	ND	ND	ND	ND	ND
Toluene	0.75	5	ND	ND	ND	ND	ND
Chloroethane	0.50	5	4.2	4.6	ND	ND	ND
Chloromethane	1.0	5	ND	ND	ND	ND	ND
Carbon tetrachloride	1.0	5	0.60 J	ND	ND	ND	ND
Chlorodibromomethane	0.50	100	ND	ND	ND	ND	ND
1,1-Dichloroethane	0.75	5	30 J	33	2.4	ND	ND
1,1-Dichloroethene	0.75	5	1.0	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.5	5	110 J	150	13	0.75	0.84
trans-1,2-Dichloroethene	1.0	5	0.30 J	ND	ND	ND	ND
Ethylbenzene	0.75	5	ND	ND	ND	ND	ND
Trichlorofluoromethane	1.0	5	ND	ND	ND	ND	ND
Isopropyl Benzene	0.75	5	ND	ND	ND	ND	ND
Methylene chloride	15	5	ND	20 J	ND	ND	ND
Naphthalene	0.75	50	ND	ND	ND	ND	ND
n-Propyl Benzene	0.75	5	ND	ND	ND	ND	ND
Bromoform	0.50	100	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.75	5	4.6	5.2 J	1.2	ND	ND
1,2,3-Trichlorobenzene	0.75	5	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	0.50	5	ND	ND	ND	ND	ND
Trichloroethylene	0.75	5	15	18	4.0	0.47 J	0.65
Chloroform	0.75	7	0.28 J	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	ND
Vinyl chloride	1.0	2	6.2	6.4 J	ND	ND	ND
m,p-Xylene	0.5	5	ND	ND	ND	ND	ND
o-Xylene	0.5	5	ND	ND	ND	ND	ND

TABLE 3.1-9
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR VOCS (SW8260)

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L)				
			Field ID 59DW8WG1 Lab ID 663168	59SW9WG1 663819	59IW9WG1 664211	59DW9WG1 663601	59SW10WG1 660952
Bromodichloromethane	0.50	100	ND	ND	ND	ND	ND
Benzene	0.75	5	ND	ND	0.29 J	ND	ND
Toluene	0.75	5	ND	ND	ND	ND	ND
Chloroethane	0.50	5	ND	ND	0.51	ND	ND
Chloromethane	1.0	5	ND	ND	ND	ND	ND
Carbon tetrachloride	1.0	5	ND	ND	ND	ND	ND
Chlorodibromomethane	0.50	100	ND	ND	ND	ND	ND
1,1-Dichloroethane	0.75	5	ND	0.62 J	13	ND	2.2
1,1-Dichloroethene	0.75	5	ND	ND	ND	ND	2.0
cis-1,2-Dichloroethylene	0.5	5	ND	0.67	5.4	ND	ND
trans-1,2-Dichloroethene	1.0	5	ND	ND	ND	ND	ND
Ethylbenzene	0.75	5	ND	ND	ND	0.40 J	ND
Trichlorofluoromethane	1.0	5	ND	ND	ND	ND	ND
Isopropyl Benzene	0.75	5	ND	ND	ND	ND	ND
Methylene chloride	15	5	ND	ND	ND	ND	ND
Naphthalene	0.75	50	ND	ND	ND	ND	ND
n-Propyl Benzene	0.75	5	ND	ND	ND	ND	ND
Bromoform	0.50	100	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.75	5	ND	1.8	ND	ND	10
1,2,3-Trichlorobenzene	0.75	5	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	0.50	5	ND	ND	ND	ND	ND
Trichloroethylene	0.75	5	ND	2.4	20	ND	21
Chloroform	0.75	7	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	ND
Vinyl chloride	1.0	2	ND	ND	1.0	ND	ND
m,p-Xylene	0.5	5	ND	ND	ND	0.29 J	ND
o-Xylene	0.5	5	ND	ND	ND	0.25 J	ND

TABLE 3.1-9
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR VOCS (SW8260)

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L)				
			Field ID 59DW10WG1 Lab ID 662313	59SW11WG1 664222	59SW11WG1R 664222 (5)	59SW11WG9 664228	59SW11WG9R 664228 (5)
Bromodichloromethane	0.50	100	0.35 J	ND	ND	ND	ND
Benzene	0.75	5	ND	ND	ND	ND	ND
Toluene	0.75	5	ND	1.1	1.3	1.3	1.5
Chloroethane	0.50	5	ND	0.67	0.66 J	0.72	0.62 J
Chloromethane	1.0	5	ND	ND	ND	ND	ND
Carbon tetrachloride	1.0	5	ND	ND	ND	ND	ND
Chlorodibromomethane	0.50	100	0.78	ND	ND	ND	ND
1,1-Dichloroethane	0.75	5	ND	6.0	5.9	6.7	5.9
1,1-Dichloroethene	0.75	5	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.5	5	ND	2.6	2.5	3.1	2.8
trans-1,2-Dichloroethene	1.0	5	ND	ND	ND	ND	ND
Ethylbenzene	0.75	5	ND	0.67 J	0.71 J	0.68 J	0.67 J
Trichlorofluoromethane	1.0	5	ND	ND	ND	ND	ND
Isopropyl Benzene	0.75	5	ND	1.0	1.0 J	1.0	0.89 J
Methylene chloride	15	5	ND	ND	ND	3.1 J	ND
Naphthalene	0.75	50	ND	2.5	3.4	2.8	2.4
n-Propyl Benzene	0.75	5	ND	0.90	0.93 J	0.88	0.78 J
Bromoform	0.50	100	1.5	ND	ND	ND	ND
1,1,1-Trichloroethane	0.75	5	0.35 J	9.1	8.9	9.2	7.9
1,2,3-Trichlorobenzene	0.75	5	ND	ND	0.72 J	ND	ND
1,2,4-Trichlorobenzene	0.50	5	ND	ND	ND	0.27 J	ND
Trichloroethylene	0.75	5	ND	0.34 J	ND	0.35 J	ND
Chloroform	0.75	7	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.50	5	ND	15	15	13	13
1,3,5-Trimethyl Benzene	0.50	5	ND	34 J	36	31 J	31
Vinyl chloride	1.0	2	ND	0.36 J	ND	0.44 J	ND
m,p-Xylene	0.5	5	ND	2.7	2.9	2.7	2.7
o-Xylene	0.5	5	ND	4.2	4.4	3.9	4.1

TABLE 3.1-9
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR VOCS (SW8260)

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L)				
			Field ID 59DW11WG1 Lab ID 664240	59SW12WG1 660949	59DW12WG1 663808	59SW13WG1 661542	59IW13WG1 667042
Bromodichloromethane	0.50	100	ND	ND	ND	ND	ND
Benzene	0.75	5	ND	ND	ND	ND	ND
Toluene	0.75	5	ND	ND	ND	ND	ND
Chloroethane	0.50	5	ND	ND	ND	ND	ND
Chloromethane	1.0	5	0.38 J	ND	ND	ND	ND
Carbon tetrachloride	1.0	5	ND	ND	ND	ND	ND
Chlorodibromomethane	0.50	100	ND	ND	ND	ND	ND
1,1-Dichloroethane	0.75	5	ND	ND	ND	ND	ND
1,1-Dichloroethene	0.75	5	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	0.5	5	ND	0.50	ND	ND	ND
trans-1,2-Dichloroethene	1.0	5	ND	ND	ND	ND	ND
Ethylbenzene	0.75	5	ND	ND	ND	ND	ND
Trichlorofluoromethane	1.0	5	ND	ND	ND	ND	ND
Isopropyl Benzene	0.75	5	ND	ND	ND	ND	ND
Methylene chloride	15	5	ND	ND	ND	ND	2.6 J
Naphthalene	0.75	50	ND	ND	ND	ND	ND
n-Propyl Benzene	0.75	5	ND	ND	ND	ND	ND
Bromoform	0.50	100	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	0.75	5	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	0.75	5	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	0.50	5	ND	ND	ND	ND	ND
Trichloroethylene	0.75	5	ND	ND	ND	ND	ND
Chloroform	0.75	7	ND	ND	ND	ND	ND
1,2,4-Trimethyl Benzene	0.50	5	ND	ND	ND	ND	ND
1,3,5-Trimethyl Benzene	0.50	5	0.78	ND	ND	ND	ND
Vinyl chloride	1.0	2	ND	0.30 J	ND	ND	ND
m,p-Xylene	0.5	5	ND	ND	ND	ND	ND
o-Xylene	0.5	5	ND	ND	ND	ND	ND

TABLE 3.1-9
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR VOCS (SW8260)

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L)				
			Field ID 59DW13WG1 Lab ID 663567				
Bromodichloromethane	0.50	100	ND				
Benzene	0.75	5	ND				
Toluene	0.75	5	ND				
Chloroethane	0.50	5	ND				
Chloromethane	1.0	5	ND				
Carbon tetrachloride	1.0	5	ND				
Chlorodibromomethane	0.50	100	ND				
1,1-Dichloroethane	0.75	5	ND				
1,1-Dichloroethene	0.75	5	ND				
cis-1,2-Dichloroethylene	0.5	5	ND				
trans-1,2-Dichloroethene	1.0	5	ND				
Ethylbenzene	0.75	5	ND				
Trichlorofluoromethane	1.0	5	ND				
Isopropyl Benzene	0.75	5	ND				
Methylene chloride	15	5	ND				
Naphthalene	0.75	50	ND				
n-Propyl Benzene	0.75	5	ND				
Bromoform	0.50	100	ND				
1,1,1-Trichloroethane	0.75	5	ND				
1,2,3-Trichlorobenzene	0.75	5	ND				
1,2,4-Trichlorobenzene	0.50	5	ND				
Trichloroethylene	0.75	5	ND				
Chloroform	0.75	7	ND				
1,2,4-Trimethyl Benzene	0.50	5	ND				
1,3,5-Trimethyl Benzene	0.50	5	ND				
Vinyl chloride	1.0	2	ND				
m,p-Xylene	0.5	5	ND				
o-Xylene	0.5	5	ND				

(1) NY Drinking Water Standard
(2) Sample diluted by a factor of 20.8
(3) Sample diluted by a factor of 7.1
(4) Sample diluted by a factor of 2.3
(5) Sample diluted by a factor of 1.7
Qualifiers: J = Estimated; U = Blank Contamination

TABLE 3.1-10
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR SVOCS (SW8270)

Parameters	PQL	Action Levels	Environmental Samples (ug/L)				
			Field ID 59SW1WG1 Lab ID 660974	59DW1WG1 662308	59SW3WG1 663581	59SW3WG9 663609	59DW3WG1 663231
bis(2-ethylhexyl)phthalate	15	6 (1)	ND	ND	ND	ND	ND
Phenol	10	50 (2)	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels	Environmental Samples (ug/L)				
			Field ID 59SW4WG1 Lab ID 664235	59DW4WG1 664252	59SW5WG1 661551	59DW5WG1 662296	59SW6WG1 663190
bis(2-ethylhexyl)phthalate	15	6 (1)	ND	ND	ND	ND	ND
Phenol	10	50 (2)	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels	Environmental Samples (ug/L)				
			Field ID 59DW6WG1 Lab ID 663219	59SW7WG1 662302	59DPWWG1 665949	59SW8WG1 661553	59SW8WG9 661552
bis(2-ethylhexyl)phthalate	15	6 (1)	ND	ND	ND	ND	ND
Phenol	10	50 (2)	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels	Environmental Samples (ug/L)				
			Field ID 59DW8WG1 Lab ID 663211	59SW9WG1 663820	59IW9WG1 664212	59DW9WG1 663603	59SW10WG1 660969
bis(2-ethylhexyl)phthalate	15	6 (1)	ND	ND	ND	ND	ND
Phenol	10	50 (2)	ND	ND	3.0 J	ND	ND

Parameters	PQL	Action Levels	Environmental Samples (ug/L)				
			Field ID 59DW10WG1 Lab ID 662314	59SW11WG1 664223	59SW11WG9 664229	59DW11WG1 664241	59SW12WG1 660953
bis(2-ethylhexyl)phthalate	15	6 (1)	ND J	ND	ND	5.9 J	ND J
Phenol	10	50 (2)	ND	ND	ND	ND	ND

Parameters	PQL	Action Levels	Environmental Samples (ug/L)				
			Field ID 59DW12WG1 Lab ID 663809	59SW13WG1 661549	59IW13WG1 667048	59DW13WG1 663569	
bis(2-ethylhexyl)phthalate	15	6 (1)	4.2 J	ND	ND	ND J	
Phenol	10	50 (2)	ND	ND	ND	ND	

(1) Federal Primary MCL
(2) NY Drinking Water Standard
Qualifiers: J = Estimated

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TABLE 3.1-11
AIR FORCE PLANT 59
GROUNDWATER DATA SUMMARY FOR HARDNESS (E130.1)

	Environmental Samples (mg/L)					
	Field ID	59SW1WG1	59DW1WG1	59SW3WG1	59SW3WG9	59DW3WG1
Parameters	Lab ID	660977	662311	663593	663612	663237
Hardness as CaCO3		759	558	335	348	637

	Environmental Samples (mg/L)					
	Field ID	59SW4WG1	59DW4WG1	59SW5WG1	59DW5WG1	59SW6WG1
Parameters	Lab ID	664238	664255	661566	662299	663206
Hardness as CaCO3		387	577	728	522	875

	Environmental Samples (mg/L)					
	Field ID	59DW6WG1	59SW7WG1	59DPWWG1	59SW8WG1	
Parameters	Lab ID	662224	662305	665952	661568	
Hardness as CaCO3		454	625	551	425	

	Environmental Samples (mg/L)					
	Field ID	59DW8WG1	59SW9WG1	59IW9WG1	59DW9WG1	59SW10WG1
Parameters	Lab ID	662217	663823	664218	663606	660972
Hardness as CaCO3		692	416	570	656	442

	Environmental Samples (mg/L)					
	Field ID	59DW10WG1	59SW11WG1	59SW11WG9	59DW11WG1	59SW12WG1
Parameters	Lab ID	662317	664226	664232	664244	660962
Hardness as CaCO3		667	459	441	587	351

	Environmental Samples (mg/L)					
	Field ID	59DW12WG1	59SW13WG1	59IW13WG1	59DW13WG1	
Parameters	Lab ID	663812	661564	667054	663576	
Hardness as CaCO3		693	802	858	578	

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TABLE 3.1-12
AIR FORCE PLANT 59
SEDIMENT DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7471, SW7740, SW7841, SW9012)

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg)				
			Field ID 59CR01SE1	59CR02SE1	59CR04SE1	59CR04SE9	59CR05SE1
			Depth 0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00
			Lab ID 649324	649330	648922	648928	649899
Silver (Ag)	0.80	1.0	ND	ND	ND	0.59 J	ND
Aluminum (Al)	135		7600 J	7340 J	1920 J	9450 J	6030 J
Arsenic (As)	0.85	6.0	5.4	6.1 J	4.4	5.5	5.2
Barium (Ba)	0.65		41.5 J	36.1 J	14.5	71.3	31.0 J
Beryllium (Be)	0.60		0.21 J	0.21 J	ND	0.47 J	0.21 J
Calcium (Ca)	68.0		7750 J	6700 J	2060 J	1630 J	17700 J
Cobalt (Co)	2.0		7.8	8.2	1.7 J	9.4	6.9
Chromium (Cr)	2.5	26.0	12.2	11.1 J	3.5 J	16.2	8.7
Copper (Cu)	3.0	16.0	24.1	21.4 J	5.7 J	28.8 J	12.2
Iron (Fe)	38.5	20,000	19500 J	19600 J	4070 J	20100 J	15800 J
Mercury (Hg)	0.30	0.15	ND	ND	0.22 J	0.17 J	ND
Potassium (K)	530		926 U	651 U	269 J	843	889 U
Magnesium (Mg)	52.0		2990 J	5100 J	577 J	2830 J	2840 J
Manganese (Mn)	5.5	460.0	410 J	394 J	60.5 J	302 J	397 J
Molybdenum (Mo)	11.0		15.5	16.8	ND	ND	14.0
Sodium (Na)	380		96.4 U	103 U	72.7 U	121 U	96.2 U
Nickel (Ni)	8.5	16.0	15.6	16.6	4.3 J	21.1	19.3
Lead (Pb)	0.30	31.0	11.6	23.6 J	55.5	54.1	15.3
Vanadium (V)	4.0		9.6	10.6	3.3 J	15.9	11.5
Zinc (Zn)	9.0	120.0	114 J	115 J	383 J	362 J	71.7 J

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg)				
			Field ID 59CR06SE1				
			Depth 0.00-1.00				
			Lab ID 649336				
Silver (Ag)	0.80	1.0	ND				
Aluminum (Al)	135		6840 J				
Arsenic (As)	0.85	6.0	ND				
Barium (Ba)	0.65		42.5 J				
Beryllium (Be)	0.60		0.24 J				
Calcium (Ca)	68.0		32100 J				
Cobalt (Co)	2.0		7.7				
Chromium (Cr)	2.5	26.0	9.9				
Copper (Cu)	3.0	16.0	26.8				
Iron (Fe)	38.5	20,000	17600 J				
Mercury (Hg)	0.30	0.15	ND				
Potassium (K)	530		661 U				
Magnesium (Mg)	52.0		3440 J				
Manganese (Mn)	5.5	460.0	584 J				
Molybdenum (Mo)	11.0		15.0				
Sodium (Na)	380		118 U				
Nickel (Ni)	8.5	16.0	14.1				
Lead (Pb)	0.30	31.0	19.5				
Vanadium (V)	4.0		9.5				
Zinc (Zn)	9.0	120.0	138 J				

(1) Sediment Criteria for Metals from Technical Guidance for Screening Contaminated Sediments (NYSDEC, November 1993)
Qualifiers: J = Estimated; U = Blank Contamination

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TABLE 3.1-13
AIR FORCE PLANT 59
SEDIMENT DATA SUMMARY FOR PCB/PESTICIDES (SW8080)

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg)				
			Field ID 59CR01SE1 Depth 0.00-1.00 Lab ID 649323	59CR02SE1 0.00-1.00 649329	59CR04SE1 0.00-1.00 648921	59CR04SE9 0.00-1.00 648927	59CR05SE1 0.00-1.00 649898
beta-BHC	0.010	2E-4 - 5E-4(2)	ND	0.016 J	ND	ND	ND
delta-BHC	0.0007	2E-4 - 5E-4(2)	ND	ND	0.0003 J	ND	ND
Endosulfan I	0.0050	4E-5 - 4E-4	ND	0.0028 J	0.0012 J	0.0020 J	0.0014 J
Endrin	0.010	0.001-0.01	ND	ND	ND	0.0025 J	0.0045 J
Methoxychlor	0.030	0.008	ND	ND	ND	0.019 J	ND
PCB-1254	0.020	1E-6	ND	ND	ND	ND	0.16

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg)				
			Field ID 59CR06SE1 Depth 0.00-1.00 Lab ID 649335				
beta-BHC	0.010	2E-4 - 5E-4(2)	0.013 J				
delta-BHC	0.0007	2E-4 - 5E-4(2)	ND				
Endosulfan I	0.0050	4E-5 - 4E-4	0.0013 J				
Endrin	0.010	0.001-0.01	ND				
Methoxychlor	0.030	0.008	ND				
PCB-1254	0.020	1E-6	ND				

(1) Sediment Criteria from Technical Guidance for Screening Contaminated Sediments (NYSDEC, November 1993). Criteria are sample-specific; ranges provided are based on TOC concentrations in samples where analyte was detected.

(2) Total BHCs

Qualifiers: J = Estimated

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TABLE 3.1-14
AIR FORCE PLANT 59
SEDIMENT DATA SUMMARY FOR VOCS (SW8260)

Parameters	PQL	Environmental Samples (mg/kg)				
		Field ID 59CR01SE1 Depth 0.00-1.00 Lab ID 649322	59CR02SE1 0.00-1.00 649328	59CR04SE1 0.00-1.00 648920	59CR04SE9 0.00-1.00 648926	59CR05SE1 0.00-1.00 649897
Methylene chloride	0.035	ND	0.022 J	0.019 J	ND	ND

Parameters	PQL	Environmental Samples (mg/kg)				
		Field ID 59CR06SE1 Depth 0.00-1.00 Lab ID 649334				
Methylene chloride	0.035	0.015 J				

Qualifiers: J = Estimated

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TABLE 3.1-15
AIR FORCE PLANT 59
SEDIMENT DATA SUMMARY FOR SVOCS

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg)				
			Field ID 59CR01SE1 Depth 0.00-1.00 Lab ID 649321	59CR02SE1 0.00-1.00 649327	59CR04SE1 0.00-1.00 648919	59CR04SE9 0.00-1.00 648925	59CR05SE1 0.00-1.00 649896
Anthracene	0.420		ND	0.34 J	ND	ND	ND
bis(2-ethylhexyl)phthalate	0.580	0.6-2.7	ND	0.23 J	ND	0.15 J	ND
Benzo(a)anthracene	0.400	0.004-0.01	ND	0.97	0.20 J	0.21 J	ND
Benzo(a)pyrene	0.290	0.004-0.01	ND	0.89	0.17 J	0.17 J	ND
Benzo(b)fluoranthene	0.320	0.004-0.01	ND	1.5	0.24 J	0.29 J	ND
Benzo(g,h,i)perylene	0.370		ND	0.41 J	ND	ND	ND
Chrysene	0.610	0.004-0.01	ND	1.0	0.20 J	0.22 J	ND
Dibenzofuran	0.350		ND	0.12 J	ND	ND	ND
Fluorene	0.330		ND	0.20 J	ND	ND	ND
Fluoranthene	0.290	1.4-13.7	ND	1.9	0.26 J	0.28 J	0.11 J
Naphthalene	0.360		ND	0.21 J	ND	ND	ND
Phenanthrene	0.320	0.36-1.6	ND	1.7	0.090 J	0.13 J	ND
Pyrene	0.320		ND	1.4	0.30 J	0.33 J	0.11 J

Parameters	PQL	Action Levels (1)	Environmental Samples (mg/kg)				
			Field ID 59CR06SE1 Depth 0.00-1.00 Lab ID 649333				
Anthracene	0.420		ND				
bis(2-ethylhexyl)phthalate	0.580	0.6-2.7	ND				
Benzo(a)anthracene	0.400	0.004-0.01	0.12 J				
Benzo(a)pyrene	0.290	0.004-0.01	0.097 J				
Benzo(b)fluoranthene	0.320	0.004-0.01	0.17 J				
Benzo(g,h,i)perylene	0.370		ND				
Chrysene	0.610	0.004-0.01	ND				
Dibenzofuran	0.350		ND				
Fluorene	0.330		ND				
Fluoranthene	0.290	1.4-13.7	0.20 J				
Naphthalene	0.360		ND				
Phenanthrene	0.320	0.36-1.6	0.16 J				
Pyrene	0.320		0.16 J				

(1) Sediment Criteria from Technical Guidance for Screening Contaminated Sediments (NYSDEC, November 1993). Criteria are sample-specific; ranges provided are based on TOC concentrations in samples where analyte was detected.

Qualifiers: J = Estimated; U = Blank Contamination

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TABLE 3.1-16
AIR FORCE PLANT 59
SEDIMENT DATA SUMMARY FOR TOC (SW9060)

		Environmental Samples (mg/kg)				
		Field ID 59CR01SE1 Depth 0.00-1.00	59CR02SE1 0.00-1.00	59CR04SE1 0.00-1.00	59CR04SE9 0.00-1.00	59CR05SE1 0.00-1.00
Parameters	PQL	Lab ID 649326	649332	648924	648930	649901
TOC	50	5520	2990	8350	13400	1410

		Environmental Samples (mg/kg)				
		Field ID 59CR06SE1 Depth 0.00-1.00				
Parameters	PQL	Lab ID 649338				
TOC	50	4370				

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TABLE 3.1-17
AIR FORCE PLANT 59
SURFACE WATER DATA SUMMARY FOR INORGANICS (SW6010, SW7060, SW7421, SW7470, SW7740, SW7841, SW9012)

			Environmental Samples (ug/L)				
Parameters	PQL	Action Levels (1)	Field ID 59CR01WS1 Lab ID 649347	59CR02WS1 649342	59CR04WS1 648844	59CR04WS9 648850	59CR05WS1 649816
Silver (Ag)	8.0	0.1	ND	ND	ND	ND	ND
Aluminum (Al)	120	100	110 U	93.4 U	108 U	110 U	57.8 U
Arsenic (As)	18	190	ND	2.9 J	2.3 J	1.7 J	2.1 J
Barium (Ba)	4		24.0	64.0	37.0	35.5	ND
Calcium (Ca)	1000		36100	93900	44300	42600	62.4 U
Chromium (Cr)	19	350	ND	ND	6.5 J	5.5 J	ND
Copper (Cu)	10	20	ND	13.3	ND	ND	ND
Iron (Fe)	120	300	63.4	665	63.4	127	ND
Potassium (K)	2,200		2130 J	1790 J	1340 J	1400 J	ND
Magnesium (Mg)	58		7460	16700	8100	7770	ND
Manganese (Mn)	3.5		3.5	34.5	13.0	12.3	ND
Sodium (Na)	440		28900	38300	16300	15500	573 U
Lead (Pb)	7.5	0.03	ND	3.2 J	ND	ND	ND
Zinc (Zn)	9.5	143	17.5	29.9	11.7	11.7	5.8 J

			Environmental Samples (ug/L)				
Parameters	PQL	Action Levels (1)	Field ID 59CR06WS1 Lab ID 649355				
Silver (Ag)	8.0	0.1	36.2				
Aluminum (Al)	120	100	65.4 U				
Arsenic (As)	18	190	2.2 J				
Barium (Ba)	4		20.1				
Calcium (Ca)	1000		30400				
Chromium (Cr)	19	350	ND				
Copper (Cu)	10	20	ND				
Iron (Fe)	120	300	84.5				
Potassium (K)	2,200		2360				
Magnesium (Mg)	58		6870				
Manganese (Mn)	3.5		4.4				
Sodium (Na)	440		28700				
Lead (Pb)	7.5	0.03	ND				
Zinc (Zn)	9.5	143	21.1				

(1) NY Water Quality Standard for Class C Surface Water
Qualifiers: J = Estimated; U = Blank Contamination

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TABLE 3.1-18
AIR FORCE PLANT 59
SURFACE WATER DATA SUMMARY FOR PCB/PESTICIDES (SW8080)

			Environmental Samples (ug/L)				
Parameters	PQL	Action Levels (1)	Field ID 59CR01WS1 Lab ID 649346	59CR02WS1 649341	59CR04WS1 648843	59CR04WS9 648849	59CR05WS1 649815
beta-BHC	0.050	0.01	ND	ND	0.022 U	ND	ND
delta-BHC	0.001	0.01	0.0042 U	ND	ND	0.0025	ND
gamma-BHC (Lindane)	0.025	0.01	0.0049 J	ND	0.013 J	ND	ND
4,4 -DDD	0.050	0.001	ND	ND	0.018 J	ND	ND
Endosulfan I	0.025	0.009	ND	0.014 J	ND	ND	ND
Endosulfan II	0.025	0.009	0.0068 J	ND	ND	ND	0.011 J

			Environmental Samples (ug/L)				
Parameters	PQL	Action Levels (1)	Field ID 59CR06WS1 Lab ID 649354				
beta-BHC	0.050	0.01	ND				
delta-BHC	0.001	0.01	0.0005 J				
gamma-BHC (Lindane)	0.025	0.01	ND				
4,4 -DDD	0.050	0.001	ND				
Endosulfan I	0.025	0.009	ND				
Endosulfan II	0.025	0.009	ND				

(1) NY Water Quality Standard for Class C Surface Water
Qualifiers: J = Estimated; U = Blank Contamination

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TABLE 3.1-19
AIR FORCE PLANT 59
SURFACE WATER DATA SUMMARY FOR VOCS (SW8260)

		Environmental Samples (ug/L)					
Parameters	PQL	Field ID 59CR01WS1 Lab ID 649344	59CR02WS1 649339		59CR04WS1 648841	59CR04WS9 648847	59CR05WS1 649813
Bromodichloromethane	0.50	ND	0.60		ND	ND	ND
Chlorodibromomethane	0.50	ND	0.96		ND	ND	ND
Dichlorodifluoromethane	1.0	ND	0.38	J	ND	ND	ND
Bromoform	0.50	ND	1.1	J	ND	ND	ND
Chloroform	0.75	ND	0.33	J	ND	ND	ND

		Environmental Samples (ug/L)				
Parameters	PQL	Field ID 59CR06WS1 Lab ID 649352				
Bromodichloromethane	0.50	ND				
Chlorodibromomethane	0.50	ND				
Dichlorodifluoromethane	1.0	ND				
Bromoform	0.50	ND				
Chloroform	0.75	ND				

Qualifiers: J = Estimated

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TABLE 3.1-20
AIR FORCE PLANT 59
SURFACE WATER DATA SUMMARY FOR SVOCS (SW8270)

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L)				
			Field ID 59CR01WS1 Lab ID 649345	59CR02WS1 649340	59CR04WS1 648842	59CR04WS9 648848	59CR05WS1 649814
bis(2-ethylhexyl)phthalate	15	0.6	ND	ND	ND	3.0 J	ND

Parameters	PQL	Action Levels (1)	Environmental Samples (ug/L)				
			Field ID 59CR06WS1 Lab ID 649353				
bis(2-ethylhexyl)phthalate	15	0.6	ND				

(1) NY Water Quality Standard for Class C Surface Water
Qualifiers: J = Estimated

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TABLE 3.1-21
AIR FORCE PLANT 59
SURFACE WATER DATA SUMMARY FOR HARDNESS (E130.1)

	Environmental Samples (mg/L)				
Parameters	Field ID 59CR01WS1 Lab ID 649348	59CR02WS1 649343	59CR04WS1 648845	59CR04WS9 648851	59CR05WS1 649817
Hardness as CaCO3	134	332	146	151	98

	Environmental Samples (mg/L)				
Parameters	Field ID 59CR06WS1 Lab ID 649356				
Hardness as CaCO3	124				

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TABLE 3.1-22
BACKGROUND SAMPLES AND ANALYSES

Sample ID	VOCs	SVOCs	Pesticides/ PCBs	Inorganics	Cyanide	TOC	Hardness
SOIL							
59DP18SO1				●			
59DP18SO2	●						
59DP18SO3				●			
59DP18SO4	●						
59DP19SO1				●			
59DP19SO2	●						
59DP19SO3				●			
59DP19SO4	●						
59DP21SO1				●			
59DP21SO3	●						
59SW10SO1	●	●	●	●	●	●	
59SW10SO2	●	●	●	●	●	●	
59SW10SO3	●	●	●	●	●	●	
JCDW1AS	●	●	●	●	●		
JCDW1BS	●	●	●	●	●		
JCDW1CS	●	●	●	●	●		
JCSW5AS	●	●	●	●	●		
JCSW5BS	●	●	●	●	●		
GROUNDWATER							
59SW1WG1	●	●	●	●	●		●
59SW5WG1	●	●	●	●	●		●
59SW10WG1	●	●	●	●	●		●
59DW1WG1	●	●	●	●	●		●
59DW5WG1	●	●	●	●	●		●
59DW10WG1	●	●	●	●	●		●
SEDIMENT							
59CR05SE1	●	●	●	●	●	●	
59CR06SE1	●	●	●	●	●	●	
SURFACE WATER							
59CR05WS1	●	●	●	●	●		●
59CR06WS1	●	●	●	●	●		●

Key: ● = Analytical method was completed for the sample
= Analytical method was not completed for the sample

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collected from 0 to 9 feet bgs by direct push methods at three locations (DP18, DP19, and DP21) in the northeastern and northwestern corners of the property (see Figure 3-1). Five soil samples were analyzed for metals (SW6010, SW7060, SW7421, SW7470, SW7740, and SW7841), and five soil samples were analyzed for VOCs (SW8260). Three other background soil samples were collected at depths ranging from 1 to 12 feet bgs from monitoring well borehole SW10. SW10 is located along the northeastern boundary of the property (see Figure 3-2). Background soil samples from monitoring well borehole SW10 were analyzed by the same methods as site samples: VOCs (SW8260), SVOCs (SW8270), pesticides/PCBs (SW8080), ICP metals screen (SW6010), arsenic (SW7060), lead (SW7421), mercury (SW7471), selenium (SW7740), thallium (SW7841), cyanide (SW9012), and TOC (SW9060).

Two locations sampled during the SSI (SW5 and DW1) are also in areas believed to be unaffected by past plant activities (see Figure 3-2). The analytical data obtained during the SSI are therefore included as background samples. A total of five soil samples were collected between 0 and 20 feet bgs and analyzed for VOCs, SVOCs, pesticides/PCBs, and inorganics. A summary of organic and inorganic analytical data for the background soil samples is provided in Tables 3.1-23 and 3.1-24, respectively.

Methylene chloride, a common laboratory contaminant, was the only VOC detected in the background soil samples. SVOCs were detected at concentrations less than 1 milligram per kilogram (mg/kg) at both DW1 and SW5. SVOCs were detected in the sample collected from 1 to 3 feet bgs in the SW10 borehole at concentrations ranging from 0.079 mg/kg to 10 mg/kg. Pesticides were also detected at SW10 from 1 to 3 feet bgs at concentrations ranging from 0.0004 mg/kg to 0.029 mg/kg. DDT and endrin were detected in trace amounts (below the PQL) at SW10 from 10 to 12 feet bgs at concentrations of 0.0055 mg/kg and 0.0021 mg/kg, respectively. At DW1, aldrin was the only pesticide detected. Pesticides were not detected at SW5. Because of the presence of organic contaminants in the soil samples from SW10, this location is not considered representative of background conditions. Therefore, the samples from SW10 are not included in the background data set for purposes of determining site concentrations in excess of background concentrations.

GROUNDWATER. Four monitoring wells located hydraulically upgradient of past plant activities and two wells located cross-gradient of areas affected by past plant activities were sampled to characterize background groundwater quality. These wells include three deep wells (DW1, DW5, and DW10) and three shallow wells (SW1, SW5, and SW10) (see Figure 3-2). All groundwater samples were collected in early December 1994. The groundwater samples were analyzed for VOCs (SW8260), SVOCs (SW8270), pesticides/PCBs (SW8080), ICP metals screen (SW6010), arsenic (SW7060), lead (SW7421), mercury (SW7470), selenium (SW7740), thallium (SW7841), cyanide (SW9012), and hardness (E130.1). Table 3.1-25 summarizes the analytical results for chemical analyses of background groundwater samples at AFP 59.

In the deep background monitoring wells, low concentrations (<2 μg/L) of VOCs were detected. The only VOC detected at DW1 was cis-1,2-dichloroethene at a concentration of 1.8 μg/L. At DW10, bromodichloromethane, bromoform, dibromochloromethane, and 1,1,1-TCA were

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TABLE 3.1-23
BACKGROUND ORGANIC CONCENTRATIONS IN SOIL

Analyte	CONCENTRATION (MG/KG)													
	59DP18SO2 2-4' bgs	59DP18SO4 7-8' bgs	59DP19SO2 2-5' bgs	59DP19SO4 8-9' bgs	59DP21SO3 4-6' bgs	59SW10SO1 1-3' bgs	59SW10SO2 5-7' bgs	59SW10SO3 10-12' bgs	JCDW1AS 8-10' bgs	JCDW1BS 8-10' bgs	JCDW1CS 18-20' bgs	JCSW5AS 10-12' bgs	JCSW5BS 23-27' bgs	Max Background[1]
Aldrin	NA	NA	NA	NA	NA	0.0051 J	ND	ND	0.0076	0.0092	ND	ND	ND	0.0092
Beta BHC	NA	NA	NA	NA	NA	0.0028 J	ND	ND	ND	ND	ND	ND	ND	ND
Delta BHC	NA	NA	NA	NA	NA	0.0004 J	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	NA	NA	NA	NA	NA	0.0025 J	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	NA	NA	NA	NA	NA	0.017 J	ND	0.0055 J	ND	ND	ND	ND	ND	ND
Alpha Endosulfan	NA	NA	NA	NA	NA	0.0017 J	ND	ND	ND	ND	ND	ND	ND	ND
Beta Endosulfan	NA	NA	NA	NA	NA	0.029 J	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	NA	NA	NA	NA	NA	0.015 J	ND	0.0021 J	ND	ND	ND	ND	ND	ND
Endrinald	NA	NA	NA	NA	NA	0.017	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	NA	NA	NA	NA	NA	0.029 J	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	NA	NA	NA	NA	NA	0.095 J	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	NA	NA	NA	NA	NA	0.100 J	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	NA	NA	NA	NA	NA	0.51 J	ND	ND	0.017	ND	ND	ND	ND	0.017
Benzo(a)anthracene	NA	NA	NA	NA	NA	5.9	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	NA	NA	NA	NA	NA	5.2	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	10 J	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	2.1	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)-phthalate	NA	NA	NA	NA	NA	0.24 J	ND	ND	ND	ND	ND	ND	0.53	0.53
Chrysene	NA	NA	NA	NA	NA	5.8	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	0.57 J	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	NA	NA	NA	NA	NA	0.079 J	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	NA	NA	NA	NA	NA	ND	ND	ND	0.22	0.26	ND	ND	0.20	0.26
Fluorene	NA	NA	NA	NA	NA	0.12 J	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	NA	NA	NA	NA	NA	8.1	ND	ND	0.14	0.065	ND	ND	ND	0.14
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	2.1	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	NA	NA	NA	NA	NA	2.3	ND	ND	0.16	ND	ND	ND	ND	0.16
Pyrene	NA	NA	NA	NA	NA	6.9	ND	ND	0.11	0.052	ND	ND	ND	0.11
Methylene Chloride	ND	0.015 J	0.014 J	ND	0.025 J	0.036 U	0.023 U	ND	ND	ND	ND	ND	ND	0.025
Total Organic Carbon	NA	NA	NA	NA	NA	31,600	635	743	NA	NA	NA	NA	NA	NA

Key:
bgs = Below ground surface
mg/kg = Milligrams per kilogram
NA = Not analyzed
ND = Not detected
J = Estimated concentration
U = Analyte detected in associated blanks. Data unusable

Note: Only analytes detected in one or more samples are included in this summary table.

[1] Maximum background concentrations exclude results from SW10.

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TABLE 3.1-24
BACKGROUND INORGANIC CONCENTRATIONS IN SOIL

Analyte	CONCENTRATION (MG/KG)													
	59DP18SO1 0-2' bgs	59DP18SO3 5-7' bgs	59DP19SO1 0-2' bgs	59DP19SO3 5-8' bgs	59DP21SO1 0-2' bgs	59SW10SO1 1-3' bgs	59SW10SO2 5-7' bgs	59SW10SO3 10-12' bgs	JCDW1AS 8-10' bgs	JCDW1BS 8-10' bgs	JCDW1CS 18-20' bgs	JCSW5AS 10-12' bgs	JCSW5BS 23-27' bgs	Max Background[1]
Aluminum	8,250	10,200	9,550	10,600	8,420	8,840	10,600	9,680	9,830	10,200	5,070	6,720	12,900	12,900
Barium	41.8	27.9	59.5	27.4	43.1	105	31.1	49.8	46.2	54.3	23.5	47.6	52.3	59.5
Beryllium	0.56 J	0.48 J	0.68	0.46 J	0.48 J	0.52 J	0.38 J	0.50 J	ND	ND	ND	ND	ND	0.68
Calcium	1,230	229	12,000	653	1,520	17,800 J	454	295	988	307	52,200	44,400	5,740	52,200
Cobalt	8.9	8.5	11.9	10.0	8.3	9.4	10.2	10.0	10.5	10.9	6.9	6.9	13.3	13.3
Chromium	10.5	12.3	13.0	12.5	10.9	12.5	12.0	13.1	14.6	16.4	8.3	10.6	18.6	18.6
Copper	41.4	15.6	25.8	15.5	12.9	132	14.7	17.5	13.7	14.5	15.0	13	16.7	41.4
Iron	20,100	20,300	22,200	20,200	16,400	16,000 J	18,700 J	20,200 J	22,000	22,800	13,600	17,100	27,200	27,200
Potassium	888	617 J	1,380	604 J	548 J	746	600 J	798	695	642	537	623	1,520	1,520
Magnesium	2,950	3,080	5,010	3,190	2,280 J	2,890	3,050	2,920	3,230	3,280	5,240	6,330	5,900	6,330
Manganese	401	389	385	465	428	743	425	317	505	533	401	484	601	601
Sodium	150 U	116 U	168 J	150 U	252 J	183 J	96.4 U	171 J	ND	ND	ND	ND	ND	252
Nickel	20.8	19.5	24.8	19.3	13.6	19.1	16.8	16.9	19.2	20.0	13.0	13.2	24.5	24.8
Vanadium	9.4	14.2	19.6	14.3	12.5	12.9	14.3	15.2	12.9	14.0	11.0	11.8	17.3	19.6
Zinc	44.7	51.2	82.8	50.9	46.8	80.8	47.0	67.6	60.8	73.5	41.8	45.6	65.4	82.8
Arsenic	55.4	18.2	1.6	5.0	5.3	5.0 J	5.5	6.7	5.2	5.5	3.2	3.6	7.9	55.4
Lead	18.0	12.3	31.3	12.7	19.5	69.6 J	11.4	13.6	10.5	10.8	5.2	5.5	12.7	31.3
Selenium	ND	ND	ND	ND	ND	0.92 J	ND	ND	ND	ND	ND	ND	ND	ND

Key:

bgs	=	Below ground surface
mg/kg	=	Milligrams per kilogram
ND	=	Not detected
J	=	Estimated concentration
U	=	Analyte detected in associated blanks. Data unusable.

Note: Only analytes detected in one or more samples are included in this summary table.

[1] Maximum background concentrations exclude results from SW10.

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TABLE 3.1-25
BACKGROUND ORGANIC AND INORGANIC CONCENTRATIONS IN GROUNDWATER

Analyte	59SW1WG1	59SW5WG1	59SW10WG1	59DW1WG1	59DW5WG1	59DW10WG1	Max Shallow Background(1)	Max Deep Background
INORGANIC COMPOUNDS (μg/L)								
Aluminum	1,260	5,020	4,350	113 U	285 U	108 U	5,020	NA
Barium	174	161	339	123	84.1	68.6	174	123
Calcium	199,000	165,000	120,000	132,000	116,000	141,000	199,000	141,000
Chromium	ND	11.8 J	8.9 J	ND	ND	ND	11.8	ND
Copper	17.4	52.9	33.1	ND	ND	ND	52.9	ND
Iron	692	15,300	4,820	ND	426	ND	15,300	426
Potassium	2,500 U	2,860	3,040	1,510 U	1,670 U	1,950 U	2,860	NA
Magnesium	38,500	34,300	20,100	29,200	28,000	32,200	38,500	32,200
Manganese	720	4,000	3,940	1.1 U	802	93.3	4,000	802
Sodium	331,000	84,200	231,000	116,000	29,500	114,000	331,000	116,000
Nickel	ND	23.2 J	21.3 J	ND	ND	ND	23.2	ND
Vanadium	ND	10.9	4.6 J	ND	ND	ND	10.9	ND
Zinc	31.6 U	90.5	48.5 U	24.8 U	8.2 U	44.7 U	90.5	NA
Arsenic	ND	10.5 J	2.8 J	ND	ND	ND	10.5	ND
Lead	58.8 J	50.4	51.8 J	ND	ND	ND	58.8	ND
Hardness (as $CaCO_3$)	759 mg/L	728 mg/L	442 mg/L	558 mg/L	522 mg/L	667 mg/L	759 mg/L	667 mg/L
ORGANIC COMPOUNDS (μg/L)								
Alpha BHC	ND	ND	ND	ND	0.0051 J	ND	ND	0.0051
Gamma BHC	ND	ND	ND	0.0035 J	ND	ND	ND	0.0035
cis-1,2-Dichloroethene	ND	ND	ND	1.8	ND	ND	ND	1.8
Bromodichloromethane	ND	ND	ND	ND	ND	0.35 J	ND	0.35
Bromoform	ND	ND	ND	ND	ND	1.5	ND	1.5
Dibromochloromethane	ND	ND	ND	ND	ND	0.78	ND	0.78
1,1-Dichloroethane	ND	ND	2.2	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	2.0	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	10	ND	ND	0.35 J	ND	0.35
Trichloroethene	ND	ND	21	ND	ND	ND	ND	ND

Key:

μg/L	=	Micrograms per liter
mg/L	=	Milligrams per liter
NA	=	Not available
ND	=	Not detected
J	=	Estimated concentration
U	=	Analyte detected in associated blanks. Data unusable.

Note: Only analytes detected in one or more samples are included in this summary table.

(1)Maximum concentrations in shallow background groundwater exclude results from SW10.

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detected at concentrations of 0.35 μg/L, 1.5 μg/L, 0.78 μg/L, and 0.35 μg/L, respectively (see Table 3.1-25). No VOCs were detected at DW5. No SVOCs were detected at any of the deep background groundwater locations. Pesticides were detected below the PQL at two deep background locations. Gamma BHC (0.0035 μg/L) was the only pesticide detected at DW1, and alpha BHC (0.0051 μg/L) the only pesticide detected at DW5. No pesticides were detected at DW10.

No organics were detected at SW1 or SW5. At SW10, VOCs detected include 1,1-DCA (2.2 μg/L), 1,1-DCE (2.0 μg/L), 1,1,1-TCA (10 μg/L), and TCE (21 μg/L). Because both TCE and 1,1,1-TCA were detected at concentrations exceeding the New York groundwater standard of 5 μg/L (see Section 3.5.1), and because organics were also detected in the soil samples from this location, SW10 is not considered representative of background conditions. The groundwater data from SW10 are therefore not included in the background data set. Although low concentrations (<2 μg/L) of organics were detected in upgradient wells in the deep zone of the aquifer (DW1 and DW10), these concentrations are consistent with regional levels of organic contamination that have been detected in the deep zone of the aquifer in the Johnson City area (URS Consultants, Inc., 1992; Argonne National Laboratory, 1994). Therefore, these samples were considered representative of background conditions and were retained in the background data set.

SURFACE WATER AND SEDIMENT. Two surface water and sediment sample pairs were collected from Little Choconut Creek at locations upstream from the AFP 59 outfalls. These samples were from locations that represent background conditions. The sample pair with the designation CR06 was collected upstream from the outfalls, along the eastern boundary of the plant (see Figure 3-2). The sample pair with the designation CR05 was collected upstream of the facility, north of Main Street (see Figure 3-2). These sample pairs were analyzed for VOCs (SW8260), SVOCs (SW8270), pesticides/PCBs (SW8080), ICP metals screen (SW6010), arsenic (SW7060), lead (SW7421), mercury (SW7470/SW7471), selenium (SW7740), thallium (SW7841), and cyanide (SW9012). Surface water samples were also analyzed for hardness (E130.1), and sediment samples were also analyzed for TOC (SW9060). Tables 3.1-26 and 3.1-27 summarize the analytical results for the background surface water and sediment samples, respectively.

No VOCs were detected in background surface water samples. Methylene chloride, the only VOC detected in the background sediment samples, is a common laboratory contaminant and was detected below the PQL. No SVOCs were detected in the background surface water, and only trace amounts of SVOCs (less than the PQL) were detected in background sediment samples at concentrations ranging from 0.097 mg/kg to 0.20 mg/kg (see Table 3.1-27). Trace concentrations of pesticides (less than the PQL) were detected in both surface water and sediment background samples. Pesticide concentrations in surface water ranged from 0.0005 μg/L to 0.011 μg/L (see Table 3.1-26). In sediment, pesticide concentrations ranged from 0.0013 mg/kg to 0.013 mg/kg. PCB-1254 was detected in sediment sample CR05 at a concentration of 0.16 mg/kg (see Table 3.1-27).

3.1.3.2 Comparison to Background. All organic analytes detected in site soil, groundwater, surface water, and sediment samples were considered to be present above background concentrations because they are not naturally occurring compounds. For inorganics, a comparison

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TABLE 3.1-26
BACKGROUND ORGANIC AND INORGANIC CONCENTRATIONS IN SURFACE WATER

Analyte	59CR05WS1	59CR06WS1
INORGANIC COMPOUNDS (μg/L)		
Silver	ND	36.2
Barium	ND	20.1
Calcium	62.4 U	30,400
Iron	ND	84.5
Potassium	ND	2,360
Magnesium	ND	6,870
Manganese	ND	4.4
Sodium	573 U	28,700
Zinc	5.8 J	21.1
Arsenic	2.1 J	2.2 J
Hardness (as $CaCO_3$)	98 mg/L	124 mg/L
ORGANIC COMPOUNDS (μg/L)		
Delta BHC	ND	0.0005 J
Beta Endosulfan	0.011 J	ND

Key:
μg/L = Micrograms per liter
mg/L = Milligrams per liter
ND = Not detected
J = Estimated concentration
U = Analyte detected in associated blanks. Data unusable.

Note: Only analytes detected in one or more samples are included in this summary table.

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TABLE 3.1-27
BACKGROUND ORGANIC AND INORGANIC CONCENTRATIONS IN SEDIMENT

Analyte	59CR05SE1	59CR06SE1
INORGANIC COMPOUNDS (MG/KG)		
Aluminum	6,030 J	6,840 J
Barium	31.0 J	42.5 J
Beryllium	0.21 J	0.24 J
Calcium	17,700 J	32,100 J
Cobalt	6.9	7.7
Chromium	8.7	9.9
Copper	12.2	26.8
Iron	15,800 J	17,600 J
Magnesium	2,840 J	3,440 J
Manganese	397 J	584 J
Molybdenum	14.0	15.0
Nickel	19.3	14.1
Vanadium	11.5	9.5
Zinc	71.7 J	138 J
Arsenic	5.2	ND
Lead	15.3	19.5
ORGANIC COMPOUNDS (MG/KG)		
Beta BHC	ND	0.013 J
Alpha Endosulfan	0.0014 J	0.0013 J
Endrin	0.0045 J	ND
PCB-1254	0.16	ND
Methylene Chloride	ND	0.015 J
Benzo(a)anthracene	ND	0.12 J
Benzo(a)pyrene	ND	0.097 J
Benzo(b)fluoranthene	ND	0.17 J
Fluoranthene	0.11 J	0.20 J
Phenanthrene	ND	0.16 J
Pyrene	0.11 J	0.16 J
Total Organic Carbon	1,410	4,370

Key:
mg/kg = Milligrams per kilogram
ND = Not detected
J = Estimated concentration
U = Analyte detected in associated blanks. Data unusable.

Note: Only analytes detected in one or more samples are included in this summary table.

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between site and background concentrations is necessary to determine which analytes are present above background concentrations. If an inorganic analyte was detected in both site and background samples, either the Student's t test or the Wilcoxon Rank Sum test was used to compare site concentrations to background concentrations provided that there was a sufficient number of samples in both the site and background sample groups to complete the tests.

The Students's t test is a parametric test that assumes the data being compared are normally distributed. Therefore, the Student's t test was applied only when the site inorganic concentrations and the background inorganic concentrations were both normally distributed. The Wilcoxon Rank Sum test is a nonparametric test that does not assume a distributional model for the data being compared. As such, this test was performed when either the site inorganic concentrations or the background concentrations were lognormally or nonnormally distributed.

If there are less than four samples in either the site or background sample group, the Student's t test and the Wilcoxon Rank Sum test cannot be applied. When data sets are small or otherwise do not meet the assumptions required for parametric statistics, then nonparametric statistics are more appropriate for comparisons of data sets. One nonparametric method recommended by the USEPA (USEPA, 1992h) for comparison of non-normal data sets when the assumptions of normality and lognormality cannot be justified is the nonparametric tolerance interval method. An upper tolerance limit (UTL) is established for each inorganic chemical in each medium based on the background data set for each medium, then the maximum site concentration for each chemical is compared to the UTL. If the maximum site value does not exceed the UTL for the chemical in background, then it is assumed that the site chemical concentrations do not exceed background and that the chemical is not a chemical of concern for the site.

The UTL in a nonparametric setting is usually chosen as an order statistic of the sample data, commonly the maximum value observed (USEPA, 1992h). Thus, for this RI the maximum background concentration for each chemical represents the UTL and is compared to the maximum site concentration to determine whether the site concentration exceeds background.

If an inorganic analyte is detected in site samples but not in background samples, there are no applicable statistical methods that can be used. Therefore, in these instances, the chemical was considered to be present above background conditions. To confirm the validity of this assumption, a qualitative review of the data was performed to determine whether the concentrations detected in the site samples were substantially greater than the detection limits of the background samples. If the maximum site detection for an inorganic analyte exceeded the laboratory PQL for that analyte, the analyte concentration was considered to be substantially greater than the detection limit and, therefore, above background conditions.

Site soil samples from all depths were statistically compared to background soil samples from all depths to determine site inorganics present above background levels. As described above, the statistical method used was based on the distribution of the data sets. For groundwater, surface water, and sediment, the background data sets were too small (less than four samples) to allow a statistical comparison between site and background data. Therefore, for these media, the maximum site concentration was compared to the maximum background concentration for each inorganic analyte. For groundwater, data from the shallow wells were compared to shallow background data (SW1 and SW5), and data from the deep wells were compared to deep background data (DW1, DW5, and DW10).

Appendix R provides the statistical comparison test results used to determine whether an inorganic analyte was considered to be present above background conditions.

3.1.4 Site Contaminants

This section discusses site contaminants by media.

3.1.4.1 Soil. Analytical results for soil samples collected during the RI are summarized in Tables 3.1-1 through 3.1-6. Figures 3-4 through 3-6 present concentrations of analytes in soil detected above background for VOCs and SVOCs. These figures illustrate that there are three distinct areas where soil contaminants were detected: the Plating Room Area, the Waste Oil Tank Area, and the Reservoir Area. Because the types of contaminants identified at each of these areas are also distinct, the results for each area are discussed separately below.

PLATING ROOM. A total of 18 soil samples associated with the Plating Room were collected and analyzed during the RI: twelve samples from boreholes BH01, BH02, BH03, and BH04; and six samples from direct push locations DP28 and DP29 (see Figures 3-1 and 3-2). Thirty-five soil samples from closure-related investigations in the Plating Room Area have also been collected by Martin Marietta (see Figure 3-3). These results were included in the evaluation of soil contamination during the RI to avoid a duplication of sampling efforts.

As discussed in Section 3.1.3.2, all organic compounds detected in soil are considered to be present above background levels. Table 3.1-28 summarizes the organics (and inorganics) detected in one or more soil samples in the Plating Room Area, the number of samples above the detection limit, the minimum and the maximum concentration detected, and the location of the maximum concentration.

Several VOCs were detected in the Plating Room Area soil samples (see Table 3.1-28). TCE was detected in 15 of 50 soil samples, with a maximum concentration of 0.071 mg/kg at location 005. 1,1,1-TCA was detected in only one soil sample from BH02 at a concentration of 0.0087 mg/kg. Acetone and methylene chloride were also detected in soil samples, but they are common laboratory contaminants. Other detected VOCs include bromomethane, methyl ethyl ketone, styrene, and xylenes; these analytes were each detected in only one sample in the Plating Room Area. SVOCs were detected primarily at BH01 from 5 to 7 feet bgs (see Figure 3-5). Bis(2-ethylhexyl)phthalate was detected at four locations, with a maximum concentration of 0.471 mg/kg. The following pesticides were detected below the PQL at only one location (BH01): alpha endosulfan, methoxychlor, and 4,4'-DDD. No other pesticides were detected in Plating Room soil samples. PCB-1254 was detected in two soil samples from 5 to 7 feet bgs (BH01 and BH04), with a maximum concentration of 0.17 mg/kg (see Table 3.1-28).

TABLE 3.1-28
ORGANICS AND INORGANICS DETECTED IN SOIL SAMPLES ASSOCIATED WITH THE PLATING ROOM

Parameter	Number of Samples Above Detection Limit[1]	Range (mg/kg)		Location of Maximum Detection	Depth of Maximum Detection (Feet bgs)
		Minimum Detected	Maximum Detected		
Alpha Endosulfan	2 of 12	0.0011	0.0026	BH01	5-7
Methoxychlor	1 of 15	0.013	0.013	BH01	5-7
4,4'-DDD	1 of 12	0.0022	0.0022	BH01	5-7
PCB-1254	2 of 10	0.046	0.17	BH01	5-7
1,1,1-Trichloroethane	1 of 50	0.0087	0.0087	BH02	5-7
Acetone	31 of 35	0.023	1.54	004	0.5-1.0
Bromomethane	1 of 50	0.016	0.016	BH01	5-7
Methylene Chloride	11 of 50	0.00474	0.089	DP28	10-12
Methyl Ethyl Ketone	1 of 35	0.00454	0.00454	RWT1	9.4-11.4
Styrene	1 of 50	0.00124	0.00124	RWT1	9.4-11.4
Trichloroethene	15 of 50	0.0027	0.071	005	0.5-1.0
Xylenes, Total	1 of 50	0.00273	0.00273	RWT1	9.4-11.4
Acenaphthene	1 of 21	0.15	0.15	BH01	5-7
Anthracene	1 of 21	0.59	0.59	BH01	5-7
Benzo(a)anthracene	1 of 21	2.7	2.7	BH01	5-7
Benzo(a)pyrene	1 of 21	1.6	1.6	BH01	5-7
Benzo(b)fluoranthene	1 of 21	2.9	2.9	BH01	5-7
bis(2-Ethylhexyl)phthalate	4 of 21	0.471	0.471	006/009/012/ 015	0.5-1.0
Chrysene	1 of 21	2.6	2.6	BH01	5-7
Fluoranthene	1 of 20	5.3	5.3	BH01	5-7
Fluorene	1 of 21	0.11	0.11	BH01	5-7
Phenanthrene	1 of 21	2.7	2.7	BH01	5-7
Pyrene	1 of 21	4.2	4.2	BH01	5-7
Aluminum	41 of 41	2,300	12,700	BH04	5-7
Arsenic	18 of 41	5.5	134	DP28	0-2

TABLE 3.1-28
ORGANICS AND INORGANICS DETECTED IN SOIL SAMPLES ASSOCIATED WITH THE PLATING ROOM

Continued

Parameter	Number of Samples Above Detection Limit[1]	Range (mg/kg)		Location of Maximum Detection	Depth of Maximum Detection (Feet bgs)
		Minimum Detected	Maximum Detected		
Barium	41 of 41	17.5	259	DP28	0-2
Beryllium	16 of 41	0.17	0.8	DP28	0-2
Cadmium	10 of 41	0.53	84.3	007	0.5-1.0
Calcium	41 of 41	220	154,000	003	0.5-1.0
Chromium	41 of 41	3.1	410	006	0.5-1.0
Cobalt	21 of 41	3.8	31.7	DP28	0-2
Copper	41 of 41	8.18	1,040	DP28	0-2
Cyanide	4 of 33	0.64	2.12	008	0.5-1.0
Iron	41 of 41	4,250	132,000	DP28	0-2
Lead	41 of 41	3.08	6,990	DP28	0-2
Magnesium	41 of 41	2,050	32,800	014	0.5-1.0
Manganese	41 of 41	121	1,190	DP28	0-2
Mercury	3 of 41	0.065	0.18	DP29	0-2
Molybdenum	1 of 16	4,060	4,060	DP28	0-2
Nickel	41 of 41	5.05	295	006	0.5-1.0
Potassium	41 of 41	219	922	BH04	3-5
Sodium	38 of 38	36.3	534	DP28	0-2
Vanadium	29 of 41	5.17	54.5	DP28	0-2
Zinc	41 of 41	15	6,500	DP28	0-2

Key: mg/kg = Milligrams per kilogram

(1) Samples with blank contamination were not included when determining the total number of samples for each analyte.

Note: Both existing soil data from Martin Marietta and EARTH TECH soil data collected during the RI are included in this table.

The method for determining whether site inorganic soil concentrations exceed background inorganic soil concentrations was discussed in Section 3.1.3.2. Table 3.1-29 lists the inorganic compounds detected in the Plating Room Area, the comparison method used, and whether the compounds exceed background levels. Cadmium, calcium, cyanide, and molybdenum were determined to exceed background levels. Cadmium, cyanide, and molybdenum were detected in Plating Room Area soil samples but not in background soil. Calcium was detected in all Plating Room samples, ranging in concentration from 220 mg/kg to a maximum at 003 of 154,000 mg/kg. Cadmium was detected in 10 samples, with a maximum concentration of 84.3 mg/kg at 007. Cyanide was detected in four samples, with a maximum concentration of 2.12 mg/kg at 008. Molybdenum was detected in only one soil sample at DP28 at a concentration at 4,060 mg/kg. Other metals detected in the Plating Room Area were determined to be within background levels (see Tables 3.1-28 and 3.1-29).

The replicate soil sample collected from 0-2 feet bgs at DP28 displayed elevated concentrations of most inorganic compounds compared to the normal soil sample collected at the same depth. On the basis of the analytical results from the normal soil sample and the other soil samples collected at the Plating Room Area, it appears as though the analytical results from the replicate soil sample (59DP28S09) can be discounted.

WASTE OIL TANKS. A total of 18 soil samples associated with the waste oil tanks were collected and analyzed during the RI: 13 samples from boreholes BH05, BH10, BH11, and BH12; two samples from direct push locations DP17 and DP36; and three samples from the SW11 borehole.

As discussed in Section 3.1.3.2, all organic compounds detected in soil were considered to be present above background levels. Table 3.1-30 summarizes the organics (and inorganics) detected in one or more soil samples in the Waste Oil Tank Area, the number of samples above the detection limit, the minimum and the maximum concentration detected, and the location of the maximum concentration.

Numerous VOCs were detected in soil samples associated with the Waste Oil Tank Area, with maximum concentrations generally detected between 5 to 12 feet bgs. Both chlorinated and petroleum hydrocarbons were detected in the Waste Oil Tank Area soil samples. Chlorinated hydrocarbons detected include 1,1-DCA, cis-1,2-DCE, TCE, and vinyl chloride, with maximum concentrations of 0.011 mg/kg, 0.11 mg/kg, 0.015 mg/kg, and 0.015 mg/kg, respectively (see Figure 3-4 and Table 3.1-30). Petroleum hydrocarbon compounds detected in the vicinity of the waste oil tanks include ethylbenzene, xylenes, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, isopropylbenzene, n-butylbenzene, n-propylbenzene, p-cymene, and sec-butylbenzene (see Table 3.1-30). Petroleum hydrocarbons were detected at concentrations less than 0.5 mg/kg and primarily in soil samples collected at depths greater than 10 feet bgs (see Figure 3-4).

Numerous SVOCs were detected only at BH10 from 5 to 7 feet bgs, including 2,4-dinitrotoluene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, dibenzofuran, fluoranthene, fluorene,

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TABLE 3.1-29
COMPARISON BETWEEN BACKGROUND AND SOIL ASSOCIATED WITH THE PLATING ROOM FOR INORGANIC ANALYTES

Analyte	Comparison Method (1)	Exceeding Background?(2)
Aluminum	Wilcoxon Rank Sum Test	No
Arsenic	Wilcoxon Rank Sum Test	No
Barium	Wilcoxon Rank Sum Test	No
Beryllium	Wilcoxon Rank Sum Test	No
Cadmium	NA	Yes
Calcium	Wilcoxon Rank Sum Test	Yes
Chromium	Wilcoxon Rank Sum Test	No
Cobalt	Wilcoxon Rank Sum Test	No
Copper	Wilcoxon Rank Sum Test	No
Cyanide	NA	Yes
Iron	Wilcoxon Rank Sum Test	No
Lead	Wilcoxon Rank Sum Test	No
Magnesium	Wilcoxon Rank Sum Test	No
Manganese	Wilcoxon Rank Sum Test	No
Mercury	NA	No*
Molybdenum	NA	Yes
Nickel	Wilcoxon Rank Sum Test	No
Potassium	Wilcoxon Rank Sum Test	No
Sodium	Wilcoxon Rank Sum Test	No
Vanadium	Wilcoxon Rank Sum Test	No
Zinc	Wilcoxon Rank Sum Test	No

Key: NA = Not Applicable. Analyte detected at the site but not at background (see footnote 2).
* = Site concentrations are not considered above background because the detections do not substantially exceed background detection limits.

(1) The Wilcoxon Rank Sum Test was conducted as an upper one-tail test at the 0.05 significance level. Analytes were determined as statistically exceeding background if one-half the t or Z probability was less than 0.05 and the mean of the rank scores for the site data was greater than the mean of the rank scores for background data.

(2) In cases where the analyte was detected at the site but not at background, it was assumed that the site exceeded background.

Note: The comparison of Plating Room soil data to background included analytical data from the Remedial Investigation and existing soil data from Martin Marietta.

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TABLE 3.1-30
ORGANICS AND INORGANICS DETECTED IN SOIL SAMPLES ASSOCIATED WITH THE WASTE OIL TANKS

Parameter	Number of Samples Above Detection Limit(1)	Range (mg/kg)		Location of Maximum Detection	Depth of Maximum (Feet bgs)
		Minimum Detected	Maximum Detected		
Alpha Endosulfan	2 of 16	0.0017	0.0028	BH10	10-12
Beta BHC	2 of 16	0.0017	0.0043	BH10	10-12
Delta BHC	3 of 16	0.0004	0.0021	BH10	10-12
Dieldrin	2 of 16	0.0030	0.0039	BH05	1-3
Endosulfan Sulfate	2 of 16	0.012	0.013	BH11	10-12
Endrin	2 of 16	0.0082	0.0088	BH11	3-5
Endrin Aldehyde	4 of 16	0.0068	0.043	BH05	1-3
Gamma BHC	1 of 16	0.0006	0.0006	BH11	5-7
Methoxychlor	1 of 16	0.025	0.025	SW11	12-14
4,4'-DDD	2 of 16	0.0016	0.0056	BH05	1-3
4,4'-DDT	1 of 14	0.0080	0.0080	BH10	10-12
PCB-1254	1 of 16	0.17	0.17	BH11	3-5
PCB-1260	1 of 16	0.15	0.15	SW11	12-14
1,1-Dichloroethane	3 of 18	0.0041	0.011	BH05	5-7
1,2,4-Trimethylbenzene	4 of 18	0.0026	0.070	BH11	10-12
1,3,5-Trimethylbenzene	3 of 15	0.0046	0.19	BH11	10-12
Chloroethane	1 of 18	0.0045	0.0045	BH12	5-7
cis-1,2-Dichloroethene	7 of 18	0.0064	0.11	BH12	5-7
Ethylbenzene	2 of 18	0.0013	0.0013	SW11/BH11	12-14/10-12
Isopropylbenzene	2 of 18	0.0027	0.0028	SW11	12-14
Methylene Chloride	3 of 12	0.015	0.076	DP36	10-12
n-Butylbenzene	3 of 18	0.0032	0.047	BH11	10-12
n-Propylbenzene	2 of 18	0.0077	0.0078	BH11	10-12
p-Cymene	2 of 18	0.014	0.053	BH11	10-12
sec-Butylbenzene	2 of 18	0.0014	0.011	BH11	10-12
Trichloroethlene	2 of 18	0.013	0.015	BH05	5-7

TABLE 3.1-30
ORGANICS AND INORGANICS DETECTED IN SOIL SAMPLES ASSOCIATED WITH THE WASTE OIL TANKS

Continued

Parameter	Number of Samples Above Detection Limit[1]	Range (mg/kg)		Location of Maximum Detection	Depth of Maximum (Feet bgs)
		Minimum Detected	Maximum Detected		
Vinyl Chloride	1 of 18	0.015	0.015	BH12	5-7
m,p-Xylenes	3 of 18	0.0018	0.0066	BH11	10-12
o-Xylene	2 of 18	0.0036	0.0062	BH11	10-12
2,4-Dinitrotoluene	1 of 16	0.41	0.41	BH10	5-7
2-Methylnaphthalene	4 of 16	0.12	0.60	BH11	10-12
Acenaphthene	1 of 16	0.29	0.29	BH10	5-7
Anthracene	1 of 16	0.42	0.42	BH10	5-7
Benzo(a)anthracene	1 of 16	1.0	1.0	BH10	5-7
Benzo(a)pyrene	1 of 16	0.97	0.97	BH10	5-7
Benzo(b)fluoranthene	1 of 16	1.3	1.3	BH10	5-7
Benzo(g,h,i)perylene	1 of 16	0.49	0.49	BH10	5-7
bis(2-Ethylhexyl)phthalate	3 of 16	0.89	0.97	BH11	10-12
Chrysene	1 of 16	1.0	1.0	BH10	5-7
Dibenz(a,h)anthracene	1 of 16	0.11	0.11	BH10	5-7
Dibenzofuran	1 of 16	0.36	0.36	BH10	5-7
Fluoranthene	1 of 16	2.7	2.7	BH10	5-7
Fluorene	1 of 16	0.45	0.45	BH10	5-7
Indeno(1,2,3-cd)pyrene	1 of 16	0.45	0.45	BH10	5-7
Naphthalene	5 of 16	0.011	2.5	BH11	10-12
Phenanthrene	4 of 16	0.14	2.9	BH10	5-7
Pyrene	1 of 16	2.3	2.3	BH10	5-7
Aluminum	16 of 16	7,690	13,100	BH05	5-7
Arsenic	16 of 16	2.4	12.4	BH11	10-12
Barium	16 of 16	32.7	93.7	BH05	5-7
Beryllium	16 of 16	0.23	0.59	BH05	5-7
Calcium	16 of 16	391	60,500	BH10	3-5

TABLE 3.1-30
ORGANICS AND INORGANICS DETECTED IN SOIL SAMPLES ASSOCIATED WITH THE WASTE OIL TANKS

Continued

Parameter	Number of Samples Above Detection Limit[1]	Range (mg/kg)		Location of Maximum Detection	Depth of Maximum (Feet bgs)
		Minimum Detected	Maximum Detected		
Chromium	16 of 16	10.4	14.9	BH11	3-5
Cobalt	16 of 16	6.8	11.9	BH10	10-12
Copper	16 of 16	10.6	133	SW11	12-14
Iron	16 of 16	16,800	20,800	BH11	5-7
Lead	16 of 16	10.1	52.5	BH10	5-7
Magnesium	16 of 16	2,110	5,370	BH10	5-7
Manganese	16 of 16	243	678	BH12	1-3
Mercury	1 of 16	0.12	0.12	BH05	10-12
Molybdenum	7 of 16	11.8	18.7	BH10	5-7
Nickel	16 of 16	16.2	28.7	BH10	10-12
Potassium	9 of 9	449	1,140	SW11	1-3
Sodium	7 of 7	106	229	SW11	1-3
Vanadium	16 of 16	8.3	17.3	BH05	5-7
Zinc	16 of 16	51	216	SW11	5-7

Key: mg/kg = Milligrams per kilogram

(1) Samples with blank contamination were not included when determining the total number of samples for each analyte.

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indeno(1,2,3-cd)pyrene, and pyrene. SVOCs detected at other locations include 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, naphthalene, and phenanthrene, with maximum concentrations of 0.60 mg/kg, 0.97 mg/kg, 2.5 mg/kg, and 2.9 mg/kg, respectively.

Pesticides detected below the PQL in Waste Oil Tank Area soil samples include alpha endosulfan, beta BHC, delta BHC, dieldrin, endosulfan sulfate, endrin, endrin aldehyde, gamma BHC, methoxychlor, 4,4'-DDD, and 4,4'-DDT. Endrin aldehyde was the only pesticide detected above the PQL in the area, with a maximum concentration of 0.043 at BH05.

The method for determining whether inorganic concentrations in site soil samples exceed background levels was discussed in Section 3.1.3.2. Table 3.1-31 lists the inorganic compounds detected in soil samples from the Waste Oil Tank Area, the comparison method used, and whether the compounds exceed background levels. Aluminum, barium, copper, molybdenum, and zinc were detected at concentrations exceeding background. Molybdenum was detected in the site soils but not in background; it was detected in seven site samples, with concentrations ranging from 11.8 mg/kg to 18.7 mg/kg. Aluminum, barium, copper, and zinc were detected in all soil samples, with maximum concentrations of 13,100 mg/kg, 93.7 mg/kg, 133 mg/kg, and 216 mg/kg, respectively (see Table 3.1-30).

RESERVOIR AREA. A total of 22 soil samples were collected and analyzed in the vicinity of the reservoir during the RI: 13 samples from boreholes BH06, BH07, BH08, and BH09; five samples from direct push locations DP23, DP24, DP26, and DP32; and four samples from the SW13 borehole (see Figures 3-1 and 3-2).

As discussed in Section 3.1.3.2, all organic compounds detected in soil were considered to be present above background levels. Table 3.1-32 summarizes the organics (and inorganics) detected in one or more soil samples in the vicinity of the reservoir, the number of samples above the detection limit, the minimum and maximum concentrations detected, and the location of the maximum concentration.

TCE, 1,2,3-trichlorobenzene, and methylene chloride were the only VOCs detected in Reservoir Area soil samples (see Figure 3-4 and Table 3.1-32). TCE was detected in 4 of 22 samples, with a maximum concentration of 0.070 mg/kg at BH09 from 5 to 7 feet bgs. 1,2,3-Trichlorobenzene was detected in only one soil sample at DP24 at a concentration of 0.0031 mg/kg. Methylene chloride was detected below the PQL and is a common laboratory contaminant.

SVOCs were detected primarily at BH07; no SVOCs were detected at SW13, and SVOCs detected at BH06, BH08, and BH09 were at concentrations less than the PQL. Maximum concentration of anthracene (0.14 mg/kg), benzo(a)anthracene (0.50 mg/kg), benzo(a)pyrene (0.42 mg/kg), benzo(b)fluoranthene (0.78 mg/kg), benzo(g,h,i)perylene (0.15 mg/kg), chrysene (0.50 mg/kg), fluoranthene (0.94 mg/kg), indeno(1,2,3-cd)pyrene (0.16 mg/kg), phenanthrene (0.61 mg/kg), and pyrene (0.80 mg/kg) were detected at BH07.

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TABLE 3.1-31
COMPARISON BETWEEN BACKGROUND AND SOIL ASSOCIATED WITH THE WASTE OIL TANKS FOR INORGANIC ANALYTES

Analyte	Comparison Method (1)	Exceeding Background?(2)
Aluminum	Wilcoxon Rank Sum Test	Yes
Arsenic	Wilcoxon Rank Sum Test	No
Barium	Wilcoxon Rank Sum Test	Yes
Beryllium	Wilcoxon Rank Sum Test	No
Calcium	Wilcoxon Rank Sum Test	No
Chromium	Wilcoxon Rank Sum Test	No
Cobalt	Wilcoxon Rank Sum Test	No
Copper	Wilcoxon Rank Sum Test	Yes
Iron	Wilcoxon Rank Sum Test	No
Lead	Wilcoxon Rank Sum Test	No
Magnesium	Wilcoxon Rank Sum Test	No
Manganese	Wilcoxon Rank Sum Test	No
Mercury	NA	No*
Molybdenum	NA	Yes
Nickel	Wilcoxon Rank Sum Test	No
Potassium	Wilcoxon Rank Sum Test	No
Sodium	Wilcoxon Rank Sum Test	No
Vanadium	Wilcoxon Rank Sum Test	No
Zinc	Wilcoxon Rank Sum Test	Yes

Key:
NA = Not Applicable. Analyte detected at the site but not at background (see footnote 2).
* = Site concentrations are not considered above background because the detections do not substantially exceed background detection limits.

(1) The Wilcoxon Rank Sum Test was conducted as an upper one-tail test at the 0.05 significance level. Analytes were determined as statistically exceeding background if one-half the t or Z probability was less than 0.05 and the mean of the rank scores for the site data was greater than the mean of the rank scores for background data.

(2) In cases where the analyte was detected at the site but not at background, it was assumed that the site exceeded background.

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TABLE 3.1-32
ORGANICS AND INORGANICS DETECTED IN SOIL SAMPLES ASSOCIATED WITH THE RESERVOIR

Parameter	Number of Samples Above Detection Limit[1]	Range (mg/kg)		Location of Maximum Detection	Depth of Maximum (Feet bgs)
		Minimum Detected	Maximum Detected		
Beta Endosulfan	1 of 17	0.0053	0.0053	SW13	6-7
Delta BHC	4 of 17	0.0002	0.0009	BH09	1-3
Dieldrin	2 of 17	0.0027	0.0036	BH09	1-3
Endrin	1 of 17	0.0024	0.0024	SW13	6-7
Endrin Aldehyde	5 of 17	0.0032	0.014	BH06	1-3
Gamma BHC	1 of 17	0.0006	0.006	BH06	1-3
Heptachlor	4 of 17	0.0007	0.0021	BH09	1-3
Heptachlor Epoxide	3 of 17	0.0028	0.0049	BH06	1-3
Methoxychlor	4 of 17	0.015	0.024	SW13	6-7
4,4'-DDD	3 of 17	0.0017	0.0061	SW13	6-7
4,4'-DDT	2 of 17	0.0024	0.004	SW13	11-12
PCB-1260	2 of 17	0.02	0.079	BH07	5-7
Methylene Chloride	12 of 20	0.014	0.037	BH08	1-3
1,2,3-Trichlorobenzene	1 of 22	0.0031	0.0031	DP24	5-7
Trichloroethene	4 of 22	0.0053	0.070	BH09	5-7
Anthracene	2 of 17	0.12	0.14	BH07	5-7
Benzo(a)anthracene	3 of 17	0.2	0.50	BH07	3-5/5-7
Benzo(a)pyrene	3 of 17	0.14	0.42	BH07	3-5
Benzo(b)fluoranthene	4 of 17	0.098	0.78	BH07	3-5
Benzo(g,h,i)perylene	1 of 17	0.15	0.15	BH07	5-7
bis(2-Ethylhexyl)phthalate	1 of 17	0.20	0.20	BH06	1-3
Chrysene	3 of 17	0.20	0.50	BH07	3-5
Fluoranthene	5 of 17	0.078	0.94	BH07	5-7
Indeno(1,2,3-cd)pyrene	1 of 17	0.16	0.16	BH07	5-7
Phenanthrene	2 of 17	0.47	0.61	BH07	5-7
Pyrene	3 of 17	0.29	0.80	BH07	3-5
Aluminum	17 of 17	4,770	13,400	BH08	1-3
Arsenic	17 of 17	3.5	18.8	BH09	5-7
Barium	17 of 17	18.2	125	BH09	5-7
Beryllium	14 of 17	0.27	0.81	BH09	5-7
Calcium	17 of 17	593	68,700	BH06	1-3

TABLE 3.1-32
ORGANICS AND INORGANICS DETECTED IN SOIL SAMPLES ASSOCIATED WITH THE RESERVOIR

Continued

Parameter	Number of Samples Above Detection Limit[1]	Range (mg/kg)		Location of Maximum Detection	Depth of Maximum (Feet bgs)
		Minimum Detected	Maximum Detected		
Chromium	17 of 17	6.5	15.6	BH08	1-3
Cobalt	17 of 17	5.0	11.7	BH09	5-7
Copper	17 of 17	18.7	157	BH09	5-7
Iron	17 of 17	10,000	29,700	BH09	5-7
Lead	17 of 17	5.1	32.1	BH08	10-12
Magnesium	17 of 17	2,030	13,300	BH07	5-7
Manganese	17 of 17	281	1,060	BH08	10-12
Mercury	3 of 17	0.11	0.4	BH09	5-7
Molybdenum	9 of 17	12.1	22.0	BH09	5-7
Nickel	17 of 17	9.5	27.5	BH09	5-7
Potassium	8 of 8	496	844	SW13	6-7
Selenium	1 of 17	0.56	0.56	BH09	5-7
Sodium	12 of 12	113	706	BH09	5-7
Vanadium	17 of 17	6.1	17.1	BH09	5-7
Zinc	17 of 17	46.8	1,090	BH09	5-7

Key: mg/kg = Milligrams per kilogram

(1) Samples with blank contamination were not included when determining the total number of samples for each analyte.

Pesticides were detected below the PQL at all locations in the Reservoir Area. Delta BHC was detected above the PQL, at a concentration of 0.0009 mg/kg, at BH09 in the sample from 1 to 3 feet bgs. PCB-1260 was detected in two samples from BH07, with a maximum concentration of 0.079 mg/kg.

The method for determining whether inorganic concentrations in site soil samples exceed background levels was discussed in Section 3.1.3.2. Table 3.1-33 lists the inorganic compounds detected in soil samples collected near the reservoir, the comparison method used, and whether the compounds exceed background levels. Copper, molybdenum, selenium, sodium, and zinc all exceeded background levels. Molybdenum and selenium were detected in site samples but not in background samples. Molybdenum was detected in nine samples ranging in concentration from 12.1 mg/kg to 22.0 mg/kg. Selenium was only detected at BH09 from 5 to 7 feet bgs at a concentration of 0.56 mg/kg. Copper, sodium, and zinc were detected in all samples, with maximum concentrations of 157 mg/kg, 706 mg/kg, and 1,090 mg/kg, respectively.

*3.1.4.2 **Groundwater**.* Monitoring wells were installed at 13 locations at AFP 59 to monitor the shallow and deep zones of the aquifer. The analytical results for groundwater samples from the shallow and deep wells are discussed separately below. Intermediate-depth monitoring wells were installed at two locations; these analytical results are discussed with the shallow well data. The analytical results for all groundwater samples collected during the RI are summarized in Tables 3.1-7 through 3.1-11.

SHALLOW ZONE OF AQUIFER. VOCs detected in groundwater are illustrated in Figure 3-7. Table 3.1-34 summarizes all organics and inorganics detected in one or more groundwater sample from the shallow zone, the number of samples above the detection limit, the minimum and maximum concentrations detected, and the location of the maximum concentration. Chlorinated hydrocarbons were detected across the site in the shallow zone of the aquifer. The maximum concentrations were generally detected at SW4 and SW7, along the south-central edge of the plant and downgradient of the Plating Room Area. At SW4, the following maximum concentrations were detected: TCE at 370 μg/L; 1,1,1-TCA at 20 μg/L; 1,1-DCE at 2.1 μg/L; 1,2,4-trichlorobenzene at 2.7 μg/L; and trichlorofluoromethane at 2.8 μg/L. The following maximum concentrations were detected at SW7: cis-1,2-DCE at 150 μg/L; vinyl chloride at 6.2 μg/L; 1,1-DCA at 33 μg/L; trans-1,2-DCE at 0.30 μg/L; carbon tetrachloride at 0.6 μg/L; and chloroethane at 4.2 μg/L. The concentrations of chlorinated hydrocarbons decrease downgradient of these locations, along the western border of the plant. Maximum concentrations of TCE and 1,1,1-TCA along the western border are 2.4 μg/L at SW9 and 2.3 μg/L at SW6, respectively. The chlorinated hydrocarbons most frequently detected in the shallow zone were 1,1,1-TCA and its breakdown products (1,1-DCA, cis-1,2-DCE, 1,1-DCE, vinyl chloride, and chloroethane) and TCE and its breakdown products (cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, vinyl chloride, and chloroethane).

Petroleum hydrocarbon compounds were detected in the groundwater sample collected at SW11, near the former waste oil tanks (see Figure 3-7). Toluene (1.3 μg/L), ethylbenzene (0.68 μg/L), m,p-xylenes (2.7 μg/L), o-xylenes (4.2 μg/L), 1,2,4-trimethylbenzene (15 μg/L), 1,3,5-

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TABLE 3.1-33
COMPARISON BETWEEN BACKGROUND AND SOIL ASSOCIATED WITH THE RESERVOIR FOR INORGANIC ANALYTES

Analyte	Comparison Method (1)	Exceeding Background?(2)
Aluminum	Wilcoxon Rank Sum Test	No
Arsenic	Wilcoxon Rank Sum Test	No
Barium	Wilcoxon Rank Sum Test	No
Beryllium	Wilcoxon Rank Sum Test	No
Calcium	Wilcoxon Rank Sum Test	No
Chromium, Total	Wilcoxon Rank Sum Test	No
Cobalt	Wilcoxon Rank Sum Test	No
Copper	Wilcoxon Rank Sum Test	Yes
Iron	Wilcoxon Rank Sum Test	No
Lead	Wilcoxon Rank Sum Test	No
Magnesium	Wilcoxon Rank Sum Test	No
Manganese	Wilcoxon Rank Sum Test	No
Mercury	NA	No*
Molybdenum	NA	Yes
Nickel	Wilcoxon Rank Sum Test	No
Potassium	Wilcoxon Rank Sum Test	No
Selenium	NA	Yes
Sodium	Wilcoxon Rank Sum Test	Yes
Vanadium	Wilcoxon Rank Sum Test	No
Zinc	Wilcoxon Rank Sum Test	Yes

Key: NA = Not Applicable. Analyte detected at the site but not at background (see footnote 2).
* = Site concentrations are not considered above background because the detections do not substantially exceed background detection limits.

(1) The Wilcoxon Rank Sum Test was conducted as an upper one-tail test at the 0.05 significance level. Analytes were determined as statistically exceeding background if one-half the t or Z probability was less than 0.05 and the mean of the rank scores for the site data was greater than the mean of the rank scores for background data.

(2) In cases where the analyte was detected at the site but not at background, it was assumed that the site exceeded background.

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TABLE 3.1-34
ORGANICS AND INORGANICS DETECTED IN SHALLOW ZONE GROUNDWATER SAMPLES

Analyte	Number of Samples Above Detection Limit(1)	Range (µg/L)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
1,1,1-Trichloroethane	8 of 12	0.36	20	SW4
1,1-Dichloroethane	6 of 12	0.62	33	SW7
1,1-Dichloroethene	2 of 12	1.0	2.1	SW4
1,2,4-Trichlorobenzene	2 of 12	0.27	2.7	SW4
1,2,4-Trimethylbenzene	2 of 12	13	15	SW11
1,3,5-Trimethylbenzene	2 of 12	31	36	SW11
Bromodichloromethane	2 of 12	0.34	0.38	SW3
Carbon Tetrachloride	2 of 12	0.33	0.6	SW7
Chloroethane	3 of 12	0.67	4.2	SW7
Cis-1,2-dichloroethene	9 of 12	0.5	150	SW7
Ethylbenzene	2 of 12	0.67	0.68	SW11
Isopropylbenzene	2 of 12	1.0	1.0	SW11
Methylene Chloride	3 of 11	1.7	6.0	SW4
Naphthalene	2 of 12	2.5	2.8	SW11
n-Propylbenzene	2 of 12	0.88	0.90	SW11
Toluene	2 of 12	1.1	1.3	SW11
Trans-1,2-dichloroethene	1 of 12	0.30	0.30	SW7
Trichloroethene	10 of 12	0.34	370	SW4
Trichlorofluoromethane	1 of 12	2.8	2.8	SW4
Trichloromethane (Chloroform)	3 of 12	0.28	0.46	SW3
Vinyl Chloride	4 of 12	0.30	6.2	SW7
m,p-Xylenes	2 of 12	2.7	2.7	SW11
o-Xylene	2 of 12	3.9	4.2	SW11
Beta Endosulfan	1 of 12	0.010	0.010	SW13
Beta BHC	2 of 12	0.010	0.010	SW7/SW11
Delta BHC	5 of 12	0.0004	0.0070	SW3
Gamma BHC	1 of 12	0.0043	0.0043	SW8
Heptachlor	1 of 12	0.0095	0.0095	SW11
Aluminum	8 of 8	904	3,480	SW8
Arsenic	10 of 12	2.2	6.3	SW13

TABLE 3.1-34
ORGANICS AND INORGANICS DETECTED IN SHALLOW ZONE GROUNDWATER SAMPLES

Continued

Analyte	Number of Samples Above Detection Limit[1]	Range (µg/L)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
Barium	12 of 12	37.6	344	SW11
Beryllium	4 of 6	0.23	1.1	SW11
Calcium	12 of 12	84,400	260,000	SW7
Chromium	6 of 12	5.8	27.2	SW4
Copper	5 of 5	17.0	45.5	SW8
Iron	10 of 10	1,460	10,400	SW11
Lead	9 of 12	4.8	79.6	SW8
Magnesium	12 of 12	13,800	58,300	SW6
Manganese	10 of 10	216	3,100	SW8
Nickel	1 of 12	47.5	47.5	SW4
Potassium	8 of 8	2,070	4,000	SW13
Sodium	12 of 12	13,900	60,000	SW6
Silver	1 of 12	10.0	10.0	SW8
Vanadium	6 of 12	3.8	12.4	SW8

Key: µg/L = Micrograms per liter

(1)Samples with blank contamination were not included when determining the total number of samples for each analyte.

Note: This table does not include data from background wells SW1 and SW10.

trimethylbenzene (36 μg/L), isopropylbenzene (1.0 μg/L), and n-propylbenzene (0.90 μg/L) were detected at maximum concentrations at SW11. SVOCs were only detected in the groundwater sample from intermediate monitoring well IW9; phenol was detected at a concentration of 3.0 μg/L. Pesticides were detected below the PQL in groundwater samples from SW7, SW8, SW11, and SW13. No pesticides were detected at SW5. Delta BHC was detected above the PQL at SW3, SW6, SW9, and SW12, with a maximum concentration of 0.0070 μg/L at SW3.

The method for determining which inorganic analytes in the shallow zone of the aquifer were detected above background concentrations is presented in Section 3.1.3.2. Inorganics identified as exceeding background concentrations in the shallow zone of the aquifer are identified in Table 3.1-35. Barium, calcium, magnesium, and potassium were detected in 100 percent of the shallow groundwater samples.

DEEP ZONE OF AQUIFER. VOC concentrations detected in groundwater samples from the deep monitoring wells were consistently lower than VOC concentrations detected in the shallow monitoring wells (see Figure 3-7). Table 3.1-36 summarizes all organics and inorganics detected in one or more groundwater sample from the deep zone, the number of samples above the detection limit, the minimum and maximum concentrations detected, and the location of the maximum concentration. 1,1,1-TCA (1.2 μg/L), 1,1-DCA (2.4 μg/L), and TCE (4.0 μg/L) were all detected at maximum concentrations in the groundwater sample from the on-site DPW. Cis-1,2-DCE was detected at a maximum concentration of 36 μg/L at DW3. All other VOCs in the deep zone of the aquifer were detected at concentrations less than 1 μg/L (see Table 3.1-36).

Bis(2-ethylhexyl)phthalate was the only SVOC detected in groundwater samples from the deep wells, with a maximum concentration of 5.9 μg/L at DW11. Trace concentrations of pesticides (less than the PQL) were detected in groundwater samples from DW4 and DW5; no pesticides were detected at DW10 or DW11. Delta BHC was detected above the PQL at DW3, DW6, DW8, DW9, and DW13, with a maximum concentration of 0.011 μg/L at DW8. 4,4'-DDE was detected above the PQL in the groundwater sample from DW12 at a concentration of 0.15 μg/L.

Section 3.1.3.2 presents the method used for determining which inorganics detected in the deep zone of the aquifer exceed background levels. Table 3.1-37 presents the inorganics detected in the deep zone of the aquifer, the comparison method used, and whether the compound exceeds background levels. Aluminum, barium, calcium, iron, magnesium, manganese, and potassium were detected in 100 percent of the samples.

3.1.4.3 Sediment. Analytical results for sediment samples collected during the RI are summarized in Tables 3.1-12 through 3.1-16. A total of four site sediment samples, including one replicate, were collected from three locations: CR01, CR02, and CR04. Table 3.1-38 summarizes organic and inorganic contaminants detected in sediments, the number of samples above the detection limit, the minimum and maximum concentrations detected, and the location of the maximum detection.

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TABLE 3.1-35
COMPARISON BETWEEN BACKGROUND AND SHALLOW ZONE GROUNDWATER FOR INORGANIC ANALYTES

Analyte	Comparison Method	Exceeding Background
Aluminum	Maximum Comparison(1)	No
Arsenic	Maximum Comparison	No
Barium	Maximum Comparison	Yes
Beryllium	NA(2)	Yes
Calcium	Maximum Comparison	Yes
Chromium	Maximum Comparison	Yes
Copper	Maximum Comparison	No
Iron	Maximum Comparison	No
Lead	Maximum Comparison	No
Magnesium	Maximum Comparison	Yes
Manganese	Maximum Comparison	No
Nickel	Maximum Comparison	Yes
Potassium	Maximum Comparison	Yes
Silver	NA	Yes
Sodium	Maximum Comparison	No
Vanadium	Maximum Comparison	Yes

Key: NA = Not Applicable

(1) The maximum site and background concentrations are compared; if site maximum exceeds background maximum, analytes are determined to exceed background.

(2) Comparison not possible (either no valid background data or analyte not detected in background). Analyte is assumed to exceed background.

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TABLE 3.1-36
ORGANICS AND INORGANICS DETECTED IN DEEP ZONE GROUNDWATER SAMPLES

Analyte	Number of Samples Above Detection Limit(1)	Range (μg/L)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
1,1,1-Trichloroethane	1 of 9	1.2	1.2	DPW
1,1-Dichloroethane	2 of 9	0.26	2.4	DPW
1,3,5-Trimethylbenzene	1 of 9	0.78	0.78	DW11
Chloromethane	1 of 9	0.38	0.38	DW11
Cis-1,2-dichloroethene	3 of 9	0.28	36	DW3
Ethylbenzene	1 of 9	0.40	0.40	DW9
Trichloroethene	2 of 9	1.2	4.0	DPW
Vinyl Chloride	1 of 9	0.28	0.28	DW3
m,p-Xylenes	1 of 9	0.29	0.29	DW9
o-Xylene	1 of 9	0.25	0.25	DW9
Bis(2-ethylhexyl)phthalate	2 of 9	4.2	5.9	DW11
4,4'-DDE	2 of 8	0.022	0.15	DW12
4,4'-DDT	2 of 8	0.013	0.016	DW12
Alpha BHC	6 of 9	0.0003	0.0051	DW5
Beta BHC	1 of 8	0.0089	0.0089	DW6
Delta BHC	5 of 7	0.0016	0.011	DW8
Gamma BHC	1 of 8	0.0049	0.0049	DW13
Methoxychlor	1 of 8	0.090	0.090	DW12
Aluminum	1 of 1	1,000	1,000	DW4
Arsenic	1 of 9	11.9	11.9	DW6
Barium	9 of 9	36.8	222	DW3
Calcium	9 of 9	86,900	157,000	DW12
Iron	8 of 8	272	4,460	DW9
Lead	4 of 9	1.7	6.0	DW4
Magnesium	9 of 9	24,800	38,300	DW12
Manganese	9 of 9	316	1,440	DW9

TABLE 3.1-36
ORGANICS AND INORGANICS DETECTED IN DEEP ZONE GROUNDWATER SAMPLES

Continued

Analyte	Number of Samples Above Detection Limit[1]	Range (µg/L)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
Potassium	6 of 6	1,860	6,040	DW6
Sodium	9 of 9	25,300	94,300	DW8
Thallium	1 of 10	46.8	46.8	DPW
Vanadium	2 of 9	3.4	6.0	DW13

Key: µg/L = Micrograms per liter

(1)Samples with blank contamination were not included when determining the total number of samples for each analyte.

Note: This table does not include data from background wells DW1, DW5, and DW10.

TABLE 3.1-37
COMPARISON BETWEEN BACKGROUND AND DEEP ZONE GROUNDWATER FOR INORGANIC ANALYTES

Analyte	Comparison Method	Exceeding Background
Aluminum	NA(2)	Yes
Arsenic	NA	No*
Barium	Maximum Comparison(1)	Yes
Calcium	Maximum Comparison	Yes
Iron	Maximum Comparison	Yes
Lead	NA	No*
Magnesium	Maximum Comparison	Yes
Manganese	Maximum Comparison	Yes
Potassium	NA	Yes
Sodium	Maximum Comparison	No
Thallium	NA	Yes
Vanadium	NA	No*

Key: NA = Not Applicable
* = Site concentrations are not considered above background because the detections do not substantially exceed background detection limits.

(1) The maximum site and background concentrations are compared; if site maximum exceeds background maximum, analytes are determined to exceed background.

(2) Comparison not possible (either no valid background data or analyte not detected in background). Analyte is assumed to exceed background.

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TABLE 3.1-38
ORGANICS AND INORGANICS DETECTED IN SITE SEDIMENT SAMPLES

Analyte	Number of Samples Above Detection Limit[1]	Range (mg/kg)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
Alpha Endosulfan	3 of 4	0.0012	0.0028	CR02
Beta BHC	1 of 4	0.016	0.016	CR02
Delta BHC	1 of 4	0.0003	0.0003	CR04
Endrin	1 of 4	0.0025	0.0025	CR04
Methoxychlor	1 of 4	0.019	0.019	CR04
Methylene Chloride	2 of 4	0.019	0.022	CR02
Anthracene	1 of 4	0.34	0.34	CR02
Benzo(a)anthracene	3 of 4	0.2	0.97	CR02
Benzo(a)pyrene	3 of 4	0.17	0.89	CR02
Benzo(b)fluoranthene	3 of 4	0.24	1.5	CR02
Benzo(g,h,i)perylene	1 of 4	0.41	0.41	CR02
bis(2-ethylhexyl) phthalate	2 of 4	0.15	0.23	CR02
Chrysene	3 of 4	0.2	1.0	CR02
Dibenzofuran	1 of 4	0.12	0.12	CR02
Fluoranthene	3 of 4	0.26	1.9	CR02
Fluorene	1 of 4	0.2	0.2	CR02
2-Methylnaphthalene	1 of 4	0.067	0.067	CR02
Naphthalene	1 of 4	0.21	0.21	CR02
Phenanthrene	3 of 4	0.09	1.7	CR02
Pyrene	3 of 4	0.3	1.4	CR02
Total Organic Carbon	4 of 4	2,990	13,400	CR04
Aluminum	4 of 4	1,920	9,450	CR04
Arsenic	4 of 4	4.4	6.1	CR02
Barium	4 of 4	14.5	71.3	CR04
Beryllium	3 of 4	0.21	0.47	CR04
Calcium	4 of 4	1,630	7,750	CR01
Chromium	4 of 4	3.5	16.2	CR04
Cobalt	4 of 4	1.7	9.4	CR04
Copper	4 of 4	5.7	28.8	CR04
Iron	4 of 4	4,070	20,100	CR04
Lead	4 of 4	11.6	55.5	CR04
Magnesium	4 of 4	577	5,100	CR02
Manganese	4 of 4	60.5	410	CR01
Mercury	2 of 4	0.17	0.22	CR04
Molybdenum	2 of 4	15.5	16.8	CR02
Nickel	4 of 4	4.3	21.1	CR04
Potassium	2 of 2	269	843	CR04
Silver	1 of 4	0.59	0.59	CR04
Vanadium	4 of 4	3.3	15.9	CR04
Zinc	4 of 4	114	383	CR04

Key: mg/kg = Milligrams per kilogram

Note: Only analytes detected in one or more samples are included in this summary table.

(1) Samples with blank contamination were not included when determining the total number of samples for each analyte.

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The only VOC detected in sediment samples was methylene chloride; this analyte was detected at concentrations less than the PQL and is a common laboratory contaminant. No SVOCs were detected at CR01. SVOCs detected at both CR02 and CR04 include bis(2-ethylhexyl)phthalate, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene. SVOCs detected only at CR02 include anthracene, benzo(g,h,i)perylene, dibenzofuran, fluorene, and naphthalene. No PCBs were detected in site sediment samples. Trace concentrations of pesticides (less than the PQL) were detected at CR02 and CR04.

The methodology for determining which inorganic compounds detected in the site sediment samples exceed background levels is presented in Section 3.1.3.2. Table 3.1-39 lists the inorganic compounds detected in sediments, the comparison method used, and whether the compounds exceed background. Site sediment samples exceeded background for most inorganic analytes. Only calcium, manganese, mercury, and silver did not exceed background.

Potassium exceeded background because it was not detected in background sediment samples. Aluminum, arsenic, barium, cobalt, chromium, copper, iron, lead, magnesium, nickel, vanadium, and zinc were detected in all site samples. The maximum concentration of lead was detected at CR04 in the sample and its replicate, with concentrations of 55.5 mg/kg and 54.1 mg/kg, respectively.

3.1.4.4 Surface Water. Analytical results for surface water samples collected during the RI are summarized in Tables 3.1-17 through 3.1-21. A total of four site surface water samples, including one duplicate, were collected from three locations: CR01, CR02, and CR04. Table 3.1-40 summarizes organic and inorganic contaminants detected in surface water, the number of samples above the detection limit, the minimum and maximum concentrations detected, and the location of the maximum detection.

VOCs were only detected in the surface water sample from CR02. VOCs detected include bromodichloromethane, bromoform, chloroform, dibromochloromethane, and dichlorodifluoromethane. These analytes are typical of a chlorinated water source; therefore, the presence of these analytes may be due to the fact that Martin Marietta was using chlorinated water from the Johnson City Water Department (in the period preceeding the collection of the surface water samples) and discharged a portion of the water to plant outfalls. Bis(2-ethylhexyl)phthalate was detected at CR04 at a concentration of 3.0 μg/L in the duplicate sample; bis(2-ethylhexyl)phthalate was not detected in the normal sample. No other SVOCs were detected in surface water. Pesticides detected include delta BHC, gamma BHC, 4,4'-DDD, endosulfan I, and endosulfan II, with maximum concentrations of 0.0025 μg/L, 0.013 μg/L, 0.018 μg/L, 0.014 μg/L, and 0.0068 μg/L, respectively.

The method for determining which inorganic compounds detected in the site surface water samples exceed background levels is presented in Section 3.1.3.2. Table 3.1-41 lists the inorganics detected in surface water, the comparison method used, and whether the compounds exceed background. Inorganic analytes detected above background in site surface water samples include arsenic, barium, calcium, iron, magnesium, manganese, sodium, and zinc. Barium, calcium,

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TABLE 3.1-39
COMPARISON BETWEEN BACKGROUND AND SEDIMENT FOR INORGANIC ANALYTES

Analyte	Comparison Method	Exceeding Background?(2)
Aluminum	Maximum Comparison(1)	Yes
Arsenic	Maximum Comparison	Yes
Barium	Maximum Comparison	Yes
Beryllium	Maximum Comparison	Yes
Calcium	Maximum Comparison	No
Chromium	Maximum Comparison	Yes
Cobalt	Maximum Comparison	Yes
Copper	Maximum Comparison	Yes
Iron	Maximum Comparison	Yes
Lead	Maximum Comparison	Yes
Magnesium	Maximum Comparison	Yes
Manganese	Maximum Comparison	No
Mercury	NA(2)	No*
Molybdenum	Maximum Comparison	Yes
Nickel	Maximum Comparison	Yes
Potassium	NA	Yes
Silver	NA	No*
Sodium	Maximum Comparison	Yes
Vanadium	Maximum Comparison	Yes
Zinc	Maximum Comparison	Yes

Key: NA = Not Applicable
* = Site concentrations are not considered above background because the detections do not substantially exceed background detection limits.

(1) The maximum site and background concentrations are compared; if site maximum exceeds background maximum, analytes are determined to exceed background.

(2) Comparison not possible (analyte not detected in background). Analyte is assumed to exceed background.

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TABLE 3.1-40
ORGANICS AND INORGANICS DETECTED IN SITE SURFACE WATER SAMPLES

Analyte	Number of Samples Above Detection Limit[1]	Range (μg/L)		Location of Maximum Detection
		Minimum Detected	Maximum Detected	
Delta BHC	1 of 3	0.0025	0.0025	CR04
Endosulfan I	1 of 4	0.014	0.014	CR02
Endosulfan II	1 of 4	0.0068	0.0068	CR01
Gamma BHC	2 of 4	0.0049	0.013	CR04
4,4'-DDD	1 of 4	0.018	0.018	CR04
Bromodichloromethane	1 of 4	0.60	0.60	CR02
Bromoform	1 of 4	1.1	1.1	CR02
Chloroform	1 of 4	0.33	0.33	CR02
Dibromochloromethane	1 of 4	0.96	0.96	CR02
Dichlorodifluoromethane	1 of 4	0.38	0.38	CR02
Bis(2-ethylhexyl) phthalate	1 of 4	3.0	3.0	CR04
Arsenic	3 of 4	1.7	2.9	CR02
Barium	4 of 4	24	64	CR02
Calcium	4 of 4	36,100	93,900	CR02
Chromium	2 of 4	5.5	6.5	CR04
Copper	1 of 4	13.3	13.3	CR02
Iron	4 of 4	63.4	665	CR02
Lead	1 of 4	3.2	3.2	CR02
Magnesium	4 of 4	7,460	16,700	CR02
Manganese	4 of 4	3.5	34.5	CR02
Potassium	4 of 4	1,340	2,130	CR01
Sodium	4 of 4	15,500	38,300	CR02
Zinc	4 of 4	11.7	29.9	CR02

Key: μg/L = Micrograms per liter

Note: Only analytes detected in one or more sample are included in this summary table.

(1) Samples with blank contamination were not included when determining the total number of samples for each analyte.

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TABLE 3.1-41
COMPARISON BETWEEN BACKGROUND AND SURFACE WATER FOR INORGANIC ANALYTES

Analyte	Comparison Method	Exceeding Background?(2)
Arsenic	Maximum Comparison(1)	Yes
Barium	Maximum Comparison	Yes
Calcium	Maximum Comparison	Yes
Chromium	NA(2)	No*
Copper	NA	No*
Iron	Maximum Comparison	Yes
Lead	NA	No*
Magnesium	Maximum Comparison	Yes
Manganese	Maximum Comparison	Yes
Potassium	Maximum Comparison	No
Sodium	Maximum Comparison	Yes
Zinc	Maximum Comparison	Yes

Key:
NA = Not Applicable
* = Site concentrations are not considered above background because the detections do not substantially exceed background detection limits.

(1) The maximum site and background concentrations are compared; if site maximum exceeds background maximum, analytes are determined to exceed background.

(2) Comparison not possible (analyte not detected in background). Analyte is assumed to exceed background.

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TABLE 3.1-42
TREND ANALYSIS OF VOCs IN GROUNDWATER

Well ID	Date Sampled	Concentration of Analyte in Groundwater ($\mu g/L$)					
		TCA	TCE	VC	11DCE	12DCE	11DCA
SW1	Sept. 1986						
	Jan. 1992	0.5					
	Dec. 1994						
DW1	Jan. 1992	0.6					
	Dec. 1994					1.8 (c)	
SW3	Sept. 1986		6				
	Jan. 1992	12	9				5
	Dec. 1994	0.50	1.8				
DW3	Jan. 1992	0.3					0.3
	Dec. 1994			0.28		36 (c)	0.26
SW4	Jan. 1992	2	97		0.3		0.6
	Dec. 1994	20	370		2.1	19 (c)	8.5
DW4	Jan. 1992	0.9	0.2				
	Dec. 1994		1.2			0.28 (c)	
SW5	Jan. 1992	0.3					
	Dec. 1994						
DW5	Jan. 1992	2					
	Dec. 1994						
SW6	Jan. 1992	1	1				0.2
	Dec. 1994	2.3	1.8				1.6
DW6	Jan. 1992						
	Dec. 1994						
SW7	Jan. 1992	0.2	0.4				
	Dec. 1994	4.6	15	6.2	1	0.3(t)/ 150(c)	33

Table 3.1-42
Trend Analysis of VOCs in Groundwater

Continued

Well ID	Date Sampled	Concentration of Analyte in Groundwater (μg/L)					
		TCA	TCE	VC	11DCE	12DCE	11DCA
DPW	Sept. 1986	9	11			66 (t)	16
	Jan. 1992	3	7				3
	Dec. 1994	1.2	4				2.4
SW8	Jan. 1992		1.3				
	Dec. 1994		0.65			8.84 (c)	
DW8	Jan. 1992	0.6					
	Dec. 1994						
SW9	Jan. 1992	15.2	10				2
	Dec. 1994	1.8	2.4			0.67 (c)	0.62
DW9	Jan. 1992	0.2					
	Dec. 1994						

Key: μg/L = Micrograms per liter
(c) = cis-1,2-dichloroethene
(t) = trans-1,2-dichloroethene
TCA = 1,1,1-Trichloroethane
TCE = Trichloroethene
VC = Vinyl Chloride
11DCE = 1,1-Dichloroethene
12DCE = 1,2-Dichloroethene
11DCA = 1,1-Dichloroethane

Note: For 1992 data, the maximum value of either round A or B of sampling was used. A blank space indicates the analyte was not detected during the sampling event.

iron, potassium, magnesium, manganese, sodium, and zinc were detected in all site surface water samples.

3.1.5 Trend Analysis

Table 3.1-42 presents concentrations of the most frequently detected chlorinated hydrocarbons in groundwater at AFP 59 over time; only wells that were sampled two or more times are included in the table. Concentrations of chlorinated hydrocarbons at wells SW4, SW6, and SW7 have all increased between 1986 and 1994, whereas concentrations have tended to decrease at SW3 and SW9. There is no apparent trend at wells SW1, SW5, and SW8 because few contaminants have been detected and concentrations are generally low (<2 μg/L). In all the deep monitoring wells, the concentrations of chlorinated hydrocarbons have remained at low levels (DW1, DW3, DW4, DW5, DW6, and DW8) or decreased (DPW and DW9). At DW3, however, 1,2-DCE increased from nondetect in 1992 to 36 μg/L in 1994. Similar contaminants were detected across the site during all sampling events. Vinyl chloride, however, was not detected in any groundwater samples prior to 1994. Additionally, the presence of 1,2-DCE was more prevalent in groundwater samples collected in 1994. Although concentrations of 1,1,1-TCA and TCE increased at several shallow well locations, these compounds were not detected at increasingly elevated concentrations in the deep zone of the aquifer. These trend analysis data indicate that vertical migration of contaminants is not evident between 1986 and 1994.

Variations in soil and sediment contaminant concentrations over time may be due in large part to spatial variability in contamination, because different locations were sampled during each investigation. These data do not necessarily provide trends in contaminant concentrations and therefore are not included in this discussion. Historical surface water data are also not included because these data can be impacted by multiple and varied sources (e.g., discharges to the creek).

3.1.6 Sources

In Section 3.1.4, three areas of soil contamination were identified: the Waste Oil Tank Area, the Plating Room Area, and the Reservoir Area. Two of these areas (the Plating Room and Waste Oil Tank Areas) correspond to locations where hazardous materials have historically been used or stored. The source location, volume, hazardous constituents, and potential release are discussed below for each of these source areas.

A potential additional, or secondary, source of contamination is the subsurface storm drainage system. The subsurface storm drainage system collects surface runoff and discharges it to Little Choconut Creek through permitted outfalls. This system is described in Section 1.2.4. Any contamination in the storm water system could migrate to the surface water. Additionally, leaks of contaminated storm water from the subsurface drains could potentially impact subsurface soils.

WASTE OIL TANK AREA. The former underground waste oil storage tanks are an IRP site located south of the Special Programs Facility at the southeastern corner of the Manufacturing Building (see Figure 3-8). Two interconnected 1,000-gallon USTs were used to store waste cutting oils

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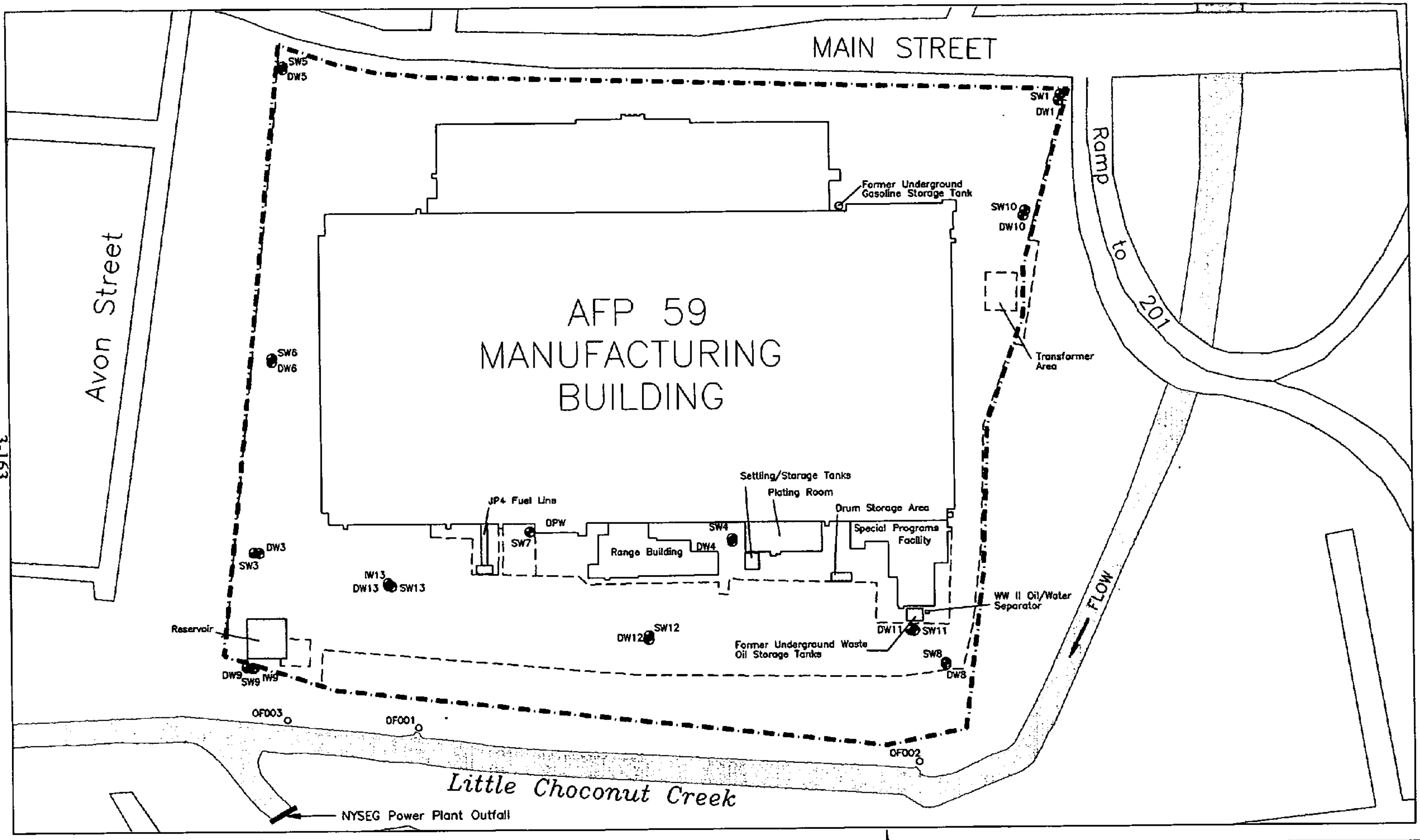

LEGEND

- ▬ · ▬ – AFP 59 Property Boundary
- ----- – Fence
- ○ OF003 – AFP 59 Outfall
- ● DW3 – AFP 59 Monitoring Well
- ● DPW – AFP 59 Industrial Production Well
- ☐ – Potential Source Area

EARTH TECH

FIGURE 3-8

POTENTIAL SOURCE LOCATIONS

afp59ri2.dwg\3-8.plt

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on a temporary basis. Prior to 1969, nonchlorinated, kerosene-based degreasing solvents were used at the plant and were stored along with the waste oils. The USTs were in operation from 1953 to 1985, at which time they were removed (USAF, 1993b). The tanks were reportedly inspected daily to prevent overtopping. However, spills reportedly occurred during the removal of oils from the tanks by an outside contractor.

A 3,000-gallon, double-walled AST was installed approximately 30 feet west of the former waste oil UST location to replace the USTs. A rain shield-covered diking system with a 3,500-gallon capacity was installed with the AST. All associated piping was aboveground, and the tank and piping were on a paved, asphalt surface. From 1985 to 1992, waste oils were collected in the aboveground tank and removed from the site by a contractor. In July 1992, the AST was drained, 2,400 pounds of sludge were removed, and the tank was steam-cleaned three times. The sludge was analyzed for disposal characterization, and 1,1,1-TCA was detected. Four soil samples were collected as part of the AST closure, and VOCs (including benzene, toluene, ethylbenzene, and xylenes) were below NYSDEC soil cleanup objectives. The AST was certified closed by the NYSDEC on February 2, 1994.

A former oil/water separator is also located near the Special Programs Facility (see Figure 3-8). Waste oils and kerosene-based degreasing solvents were discharged to the oil/water separator from 1942 to 1953. Effluent from the separator was discharged to the storm sewer system that emptied into Little Choconut Creek through Outfall 002. In the 1970s, the separator was filled with sand and capped with concrete (USAF, 1993b).

Contaminated soil in the vicinity of the waste oil tanks was identified during the RI (see Section 3.1.4). The soil could have been impacted by either spills or leaks at the Waste Oil Tank Area. The contaminated soil extends beyond the immediate area of the former tanks. As described in Section 3.1.4, the detected VOCs include chlorinated hydrocarbons and petroleum hydrocarbons. Chlorinated hydrocarbons were generally detected between 1 and 7 feet bgs, and petroleum hydrocarbons were generally detected between 10 and 14 feet bgs (see Figure 3-4). Additionally, SVOCs and pesticides were detected at low concentrations in the soil.

PLATING ROOM AREA. Three IRP sites are located in the vicinity of this source area: the Plating Room; the Storage Tank and Settling Pond; and the Drum Storage Area. These sites are located south of the Manufacturing Building (see Figure 3-8). Any past spills or leaks from these sources could potentially impact soil and/or groundwater in the area.

Operations in the Plating Room produced various wastes, including plating acids, caustic sludges, and chromium and cyanide solutions. The plating acid wastes were typically mixed sulfuric, nitric, muriatic, and chromic acids. Spent plating solutions included copper cyanide, nickel cyanide, and cadmium cyanide. The acid wastes were pumped to the plating waste storage tank and neutralized for removal by an outside contractor. The cyanide waste was drummed for off-site disposal (CH_2M Hill, 1984). Various degreasing activities also occurred in the Plating Room. Plating operations were discontinued in 1991, and the plating equipment was removed in 1992. At the time of closure, 89 tanks of various sizes, mostly less than 250 gallons, were located in the

Plating Room. The Plating Room was decommissioned in 1992 and 1993 and is currently undergoing an NYSDEC-coordinated closure (USAF, 1993b).

The storage tank and settling pond are located adjacent to the southwestern corner of the Plating Room. The storage tank stored spent plating liquids before removal by an outside disposal contractor. Burnite was also stored in the tank from December 1990 to June 1991. Use of the storage tank was discontinued in June 1991 (USAF, 1993b).

From 1952 to 1969, plating rinsewater was discharged to the settling tank for metals precipitation and then discharged to Little Choconut Creek through Outfall 001. Between 1969 and 1984, ferrous sulfate was added to the plating rinsewaters before entering the settling tank to reduce hexavalent chromium to trivalent chromium and precipitate the metals. The treated rinsewater was discharged to the creek through Outfall 001. The precipitate was periodically transferred to the adjoining storage tank for subsequent removal and disposal by a contractor. In July 1984, a new plating rinsewater treatment and reuse system was installed. The plating rinsewater then passed through the settling tank and grease trap and was treated by anion and cation exchange columns. It was then stored in an underground tank for reuse. The brine generated during this process was placed in the storage tank and removed from the site by an outside contractor. In 1988, the treatment system became contaminated, and the system was abandoned. From 1988 to 1991, plating rinsewater was discharged into the sanitary sewer. Plating operations were discontinued in 1991, and the storage and settling tanks have not been used since. The tanks are currently undergoing an NYSDEC-coordinated closure.

The Drum Storage Area is located in the maintenance area south of the Plating Room (see Figure 3-8). The site has been used as a drum storage area from 1942 to the present. Waste paints, waste oils, and spent kerosene-based degreasers were stored at this area prior to off-site disposal by an outside contractor. The site is a less-than-90-day storage area. Employees reported spills prior to the paving in 1963.

The extent of contaminated soil identified during the RI and closure-related sampling conducted by Martin Marietta is discussed in Section 3.1.4. Contaminated soil is present beneath the Plating Room and adjacent to the storage tank and settling pond; the soil could have been impacted by spills or leaks at either of these areas. TCE contamination of the soil in this area was detected most frequently at shallow depths (less than 7 feet bgs).

RESERVOIR AREA. Contaminated soil was also identified in the southwestern portion of the plant (see Figures 3-4 and 3-6). No IRP sites are present in this area, and no known previous storage or disposal activities took place in this area. A 500,000-gallon water reservoir is located in this area (see Figure 3-8). The water level in the reservoir is maintained by pumping groundwater from the on-site production well (DPW) directly to the reservoir. Chlorinated hydrocarbons have been detected in groundwater samples collected from the production well. Leaks of contaminated groundwater from the reservoir and/or the associated piping system are a potential source of soil contamination in this area. A 275-gallon diesel fuel AST, installed in 1943, is also present at the reservoir to fuel the emergency backup generator. The generator powers the backup water pumps that supply water for the emergency water systems.

An underground pipeline leading from two 1,500-gallon ASTs containing JP-4 fuel to the Manufacturing Building is also present in the southwest portion of the property (see Figure 3-8). The fuel was used to test various aviation components. The tanks remain half full and are currently inactive.

The extent of contaminated soil in the vicinity of the reservoir is discussed in Section 3.1.4 and could be related to leaks of contaminated groundwater or other, unknown sources (i.e., undocumented spills). TCE was detected in the soil at shallow depths (1 to 7 feet bgs).

3.2 Migration Pathways

The following sections evaluate the potential groundwater, surface water and air migration pathways for contaminant transport.

3.2.1 Migration Potential

Each potential migration pathway is evaluated below on the basis of relevant environmental characteristics. The potential migration pathways from the source areas identified in Section 3.1.6 are not addressed separately because the source areas are in the same vicinity and display similar environmental characteristics. The migration pathways discussed below apply to the entire southern zone of AFP 59.

3.2.1.1 Groundwater Pathway. Geologic and hydrogeologic information gathered during the RI and previous investigations has been integrated to evaluate the potential groundwater migration pathway.

GEOLOGY. This section describes the site geological setting, including both glacial and bedrock geology. Refer to Section 1.2.2.1 for a detailed discussion of the regional geology.

The subsurface geology at AFP 59 has been characterized through the evaluation of geologic borehole logs from monitoring wells and soil borings located across the site. The monitoring well construction and geologic logs of monitoring wells and soil borings completed during the RI are presented in Appendix C.

As discussed in Section 1.2.2.2, the subsurface geology at AFP 59 generally consists of approximately 75 to 100 feet of stratified, unconsolidated glacial deposits overlying shale and siltstone bedrock. Three geologic cross-sections depicting the complex subsurface stratigraphy at the site were created based on monitoring well borehole logs. Figure 3-9 shows the locations of each cross-section. Cross-sections A-A' and B-B' (Figures 3-10 and 3-11, respectively) run approximately north-south along the western and eastern sides of the site, respectively. Cross-section C-C' (Figure 3-12) runs approximately east-west across the southern portion of the site

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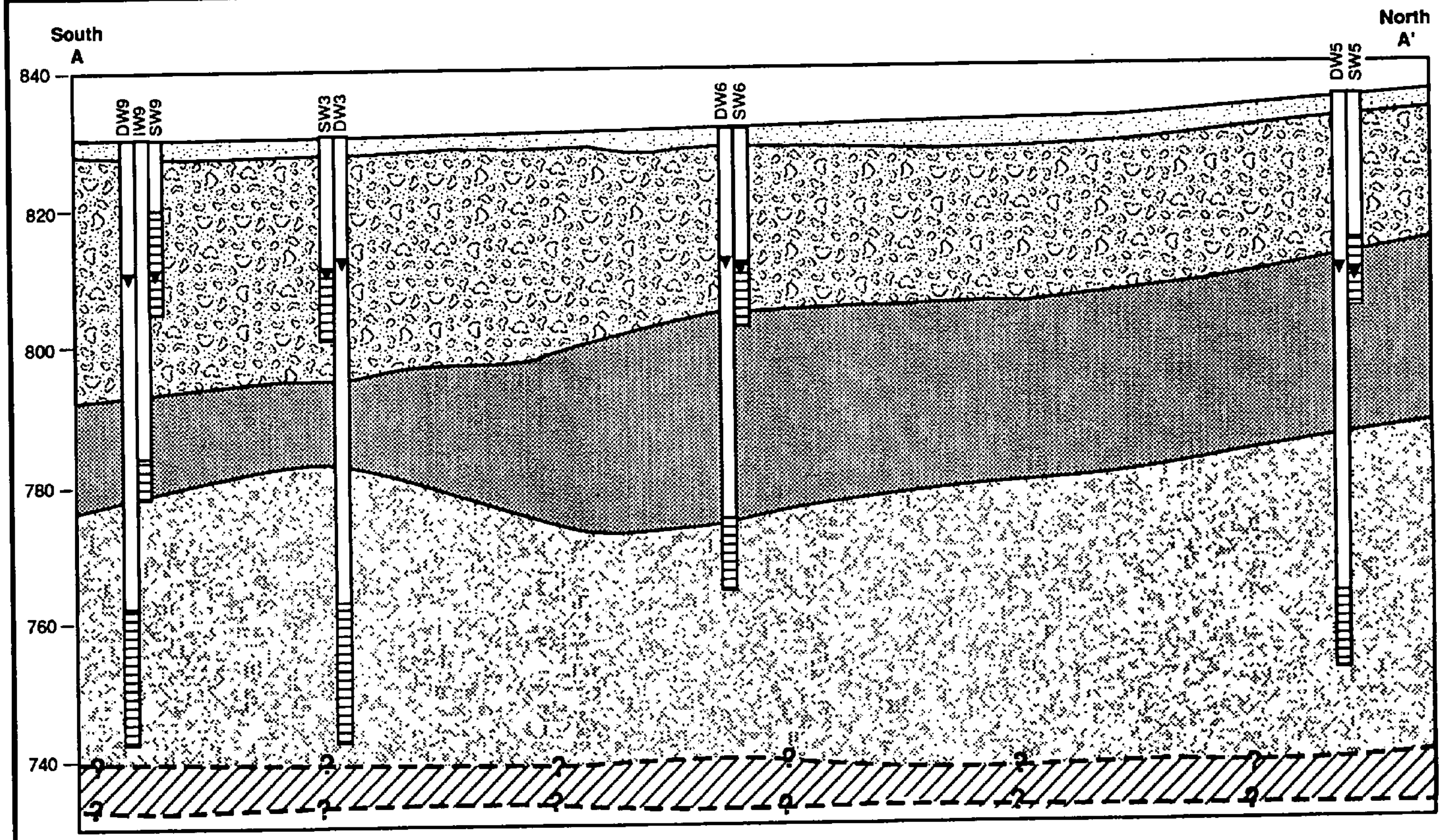

Explanation

- ░ Fill/Asphalt/Topsoil
- ▩ Fine-Grained Alluvium
- ▒ Glacial Outwash Deposits
- ▓ Fine-Grained Glacial Deposits
- ░ Ice-Contact Deposits
- ▨ Glacial Till
- ▼ Water Level Measured December 6, 1994

Vertical scale in feet above MSL

Vertical exaggeration = 5

100 50 0 100

Horizontal scale in feet

EARTH TECH

FIGURE 3-10

Cross-Section A-A'

AFP 59/X Sec c-c' 1.95

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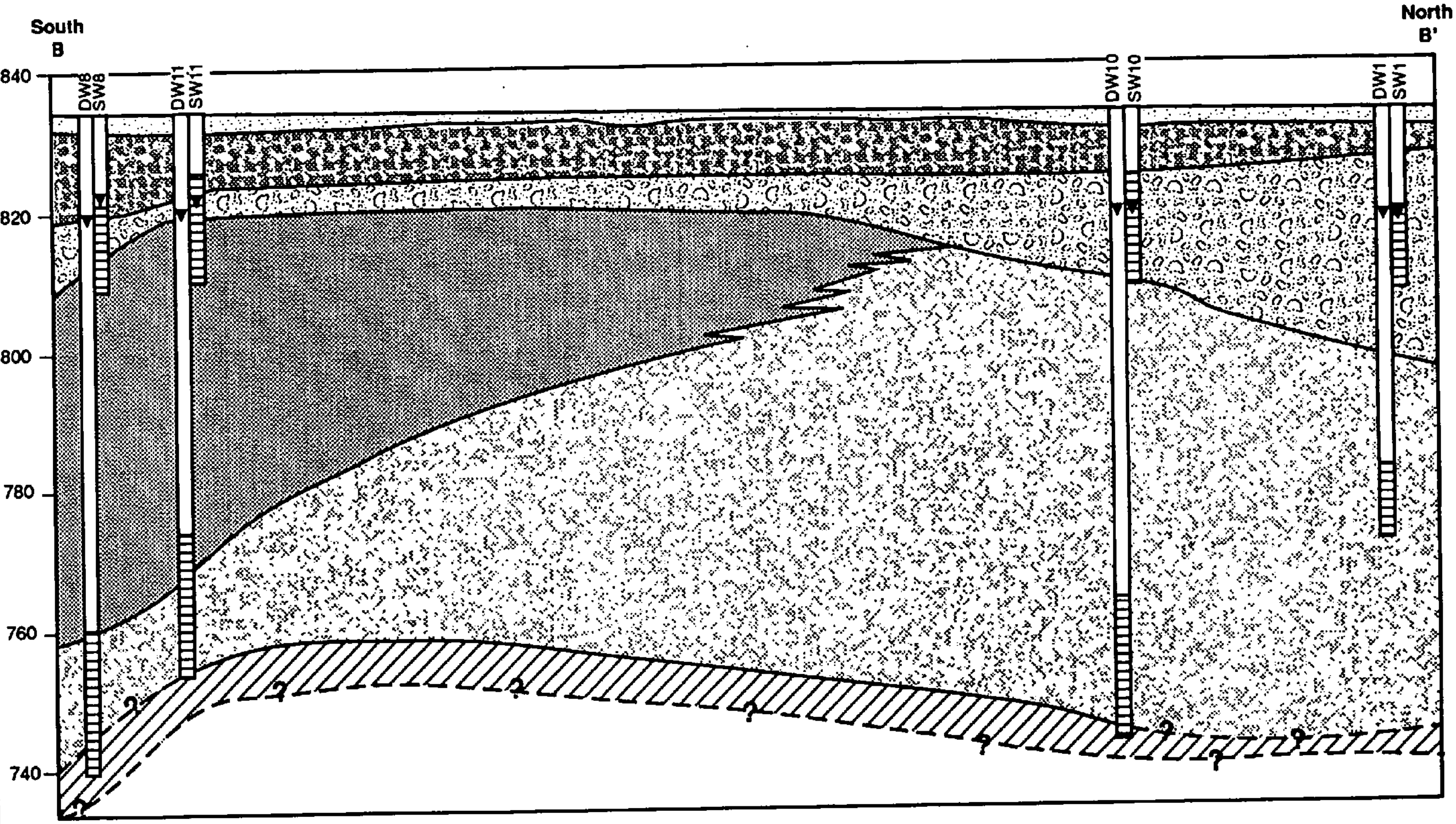

Explanation

- ░ Fill/Asphalt/Topsoil
- ▓ Fine-Grained Alluvium
- ▒ Glacial Outwash Deposits
- █ Fine-Grained Glacial Deposits
- ▒ Ice-Contact Deposits
- ▨ Glacial Till
- ▼ Water Level Measured December 6, 1994

Vertical scale in feet above MSL

Vertical exaggeration = 5

100 50 0 100

Horizontal scale in feet

FIGURE 3-11

Cross-Section B-B'

AFP 59/X Sec b-b' 1.95

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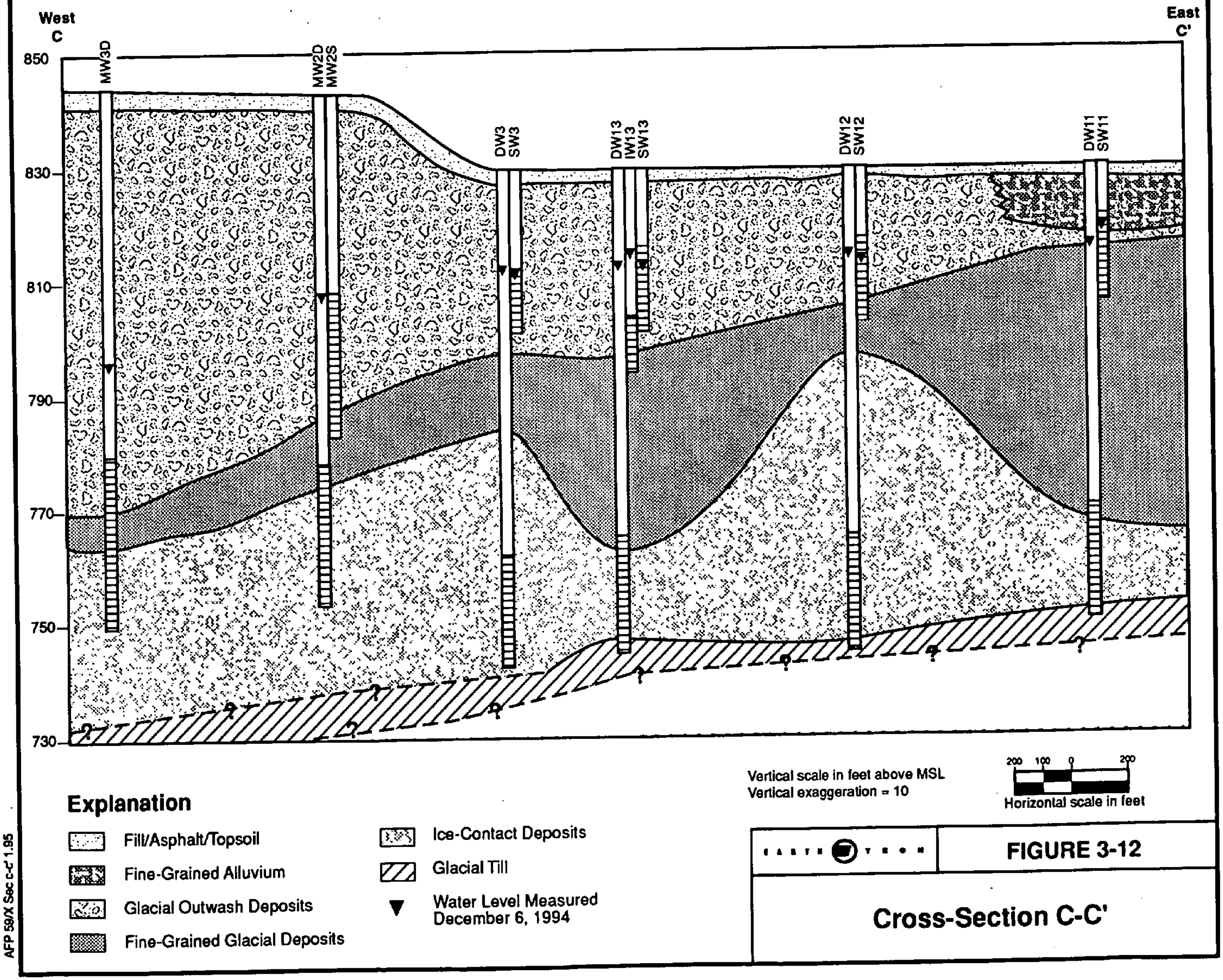

FIGURE 3-12

Cross-Section C-C'

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and continues off-site west of AFP 59 to include the NYSDEC monitoring wells MW-2D, MW-2S, and MW-3D.

The local glacial and postglacial stratigraphy is depicted in the geologic cross-sections (Figures 3-10, 3-11, and 3-12). The stratigraphy generally consists of 2 to 5 feet of artificial fill, 3 to 34 feet of glacial outwash deposits, 0 to 54 feet of fine-grained glacial deposits, and 15 to 64 feet of ice-contact deposits. As illustrated in cross-section B-B', the fine-grained glacial deposits are not present in the northeast portion of the site where glacial outwash deposits are in direct contact with ice-contact deposits. A thin layer of fine-grained alluvium overlies the glacial outwash deposits on the eastern portion of the site (cross-sections B-B' and C-C').

The glacial outwash deposits are composed of brown, fine to coarse sand and gravel. The thicknesses of the deposits range from less than 5 feet at DW11 to approximately 34 feet at DW3, DW9, and DW13. The glacial outwash is thinnest in the southeast corner of the property (see cross-sections B-B' and C-C') where the unit is overlain by approximately 10 feet of alluvium and underlain by approximately 50 feet of fine-grained deposits. Field sieve analyses of the glacial outwash from DW12 and DW13 were conducted during the RI; the results classify the samples as coarse sand and gravel, with less than 20 percent of the grains being finer than medium sand. A sample from a finer-grained interval (20 to 22 feet bgs) within the glacial outwash at DW10 was classified as fine sand with about 20 percent fines. Field sieve analysis forms and graphs are presented in Appendix D.

The lithology of the fine-grained glacial deposits, consisting of gray, very fine sand and silt with 5 to 15 percent clay, is consistent across the site. A field sieve analysis conducted on a sample from the fine-grained glacial deposits classifies the sample as 84 percent very fine sand, silt and clay, and 16 percent sand. The thickness of the unit, however, varies greatly across the site. Figure 3-13, an isopach map of the fine-grained glacial deposits, shows total thickness of the unit to be greatest in the southeast corner of the site. As illustrated in the geologic cross-sections and the isopach map, the fine-grained glacial deposits are present at most well locations, with the exceptions being SW1/DW1 and SW10/DW10 in the northeast corner of the property. The unit pinches out to the northeast beneath the plant, as interpreted in cross-section B-B'. Glacial outwash and ice-contact deposits are in direct contact only in the northeast corner of the site.

The ice-contact deposits display a high degree of heterogeneity throughout the site. Lithology ranges from brown, coarse sand and gravel in the northeast corner of the property, to gray, interbedded fine to coarse sand and very fine sand and silt. Field sieve analyses completed on samples of the ice-contact deposits from DW10 and DW12 classify the unit as fine to coarse sand with between 10 and 34 percent fines. No sieve analyses were completed on ice-contact deposits at DW11 and DW13 because of the interbedded nature of the unit at these locations. However, the very fine sand and silt content was approximately 50 percent at these locations based on the geologic borehole logs (Appendix C). In places the lithologic contact between the ice-contact deposits and the overlying fine-grained glacial deposits was not distinct, and the contact was assigned to the depth at which fine to coarse sand was first encountered. The thickness of the ice-contact deposits varies from 15 feet in the southeast corner of the property to 64 feet in the northeast corner of the property. The variable thickness of the unit is illustrated in the geologic cross-sections.

Glacial till, consisting of dark gray, highly compacted, unsorted silt, clay, sand, and gravel, was encountered between 78 and 90 feet bgs in the four deep monitoring well boreholes drilled during the RI. Geological information presented in the SSI (Argonne National Laboratory, 1994) indicates that the maximum known depth to glacial till at the site is 98 feet bgs in the northeastern corner of the property.

Bedrock was not encountered during drilling at any of the 13 on-site monitoring well locations. Therefore, thickness of the glacial till and depth to bedrock are unknown. However, sampling during the RI indicates a minimum till thickness of 5 to 6 feet at the deep well locations. In addition, New York Department of Transportation borings located adjacent to monitoring well DW1 indicate that till and bedrock were intersected at 98 and 110 feet bgs, respectively (Argonne National Laboratory, 1994).

HYDROGEOLOGY. This section describes the site hydrogeologic environment, illustrating the relationship between geology and hydrogeology. Refer to Section 1.2.3 for a detailed description of the regional hydrogeology.

The hydrogeologic conditions at AFP 59 have been evaluated primarily through groundwater elevation data obtained from monitoring wells located at and adjacent to the site. The following sections discuss the site hydrogeology as interpreted from data collected under static aquifer conditions and data collected during a pumping test conducted at the site. The complex, heterogeneous subsurface geology at the site makes interpretation of hydrogeologic data difficult. As discussed above, the lithology and thickness of the units vary greatly across the site.

Hydraulic heterogeneities related to the subsurface geology exist throughout the aquifer and are difficult to quantify in an evaluation of the hydrogeologic system at the site.

AFP 59 is located on the western edge of the Clinton Street-Ballpark Aquifer. Where present, the fine-grained glacial deposits separate the aquifer into a deep zone comprised of ice-contact deposits and a shallow zone comprised of glacial outwash deposits. Where absent, ice-contact and glacial outwash deposits are in direct hydraulic contact with one another, and no zonation of the aquifer exists. As discussed in the description of the site geology, the fine-grained glacial deposits pinch out beneath the plant and are absent in the northeast portion of the property.

Hydrogeologic conditions at AFP 59 were evaluated through data obtained from the 13 monitoring well clusters located across the site, in addition to several NYSDEC wells located west of the site. With the exception of monitoring well location 7, which only contains a shallow well, each AFP 59 monitoring well cluster consists of a deep well and a shallow well. Additionally, intermediate wells are installed at monitoring well locations 9 and 13.

Of the 13 monitoring well clusters, all but SW1/DW1 and SW10/DW10 are located in areas where fine-grained glacial deposits divide the aquifer into two zones. Where two zones are present, the shallow wells monitor water table hydrogeologic conditions in the shallow zone of the aquifer, and the deep wells monitor hydrogeologic conditions above till in the deep zone of the aquifer. SW1/DW1 and SW10/DW10 are located in the northeast portion of the site where the fine-grained glacial deposits are absent. The shallow and deep wells at these locations monitor hydrogeologic conditions at different depths within a continuous aquifer, with shallow wells monitoring the water table and deep wells monitoring the base of the aquifer immediately above till.

An industrial production well (DPW) used intermittently to obtain noncontact cooling water is located on the AFP 59 property. The capacity of the well is approximately 320 gpm. Monthly pumping rates supplied for the period May 1993 to May 1994 indicate that May through August were the peak pumping months, with rates ranging from 279,000 to 406,000 gallons per day (gpd) (average rate of 360,000 gpd). Although the pump was inoperable from late September to late January of the reported period, pumping for cooling purposes is typically not necessary during the winter months. This is illustrated by the fact that no pumping occurred in February, and the rate for March averaged only about 4,000 gpd.

In May 1994, a chemical treatment system was installed to reduce the volume of water required for cooling purposes. As a result, since May 1994, pumping of the production well has been limited to an average of approximately 39,000 gpd. This average value includes a 5-week period in September and early October 1994 during which the average rate exceeded 213,000 gpd. Excluding this peak pumping period, the average rate since May 1994 is only about 5,000 gpd.

Hydrogeology Under Static Aquifer Conditions. Because pumping records from the Camden Street Wellfield indicate that Production Well 2 is consistently pumped at approximately 3 mgd, static aquifer conditions are assumed to exist when only this well is in operation. If another production well in the vicinity of AFP 59, including the production well at AFP 59, is operating, the aquifer is considered to be under nonstatic conditions.

Static aquifer conditions have been evaluated through the use of groundwater elevation contour maps generated from groundwater level data collected from monitoring wells in the vicinity of AFP 59. The groundwater contour maps displayed in Figures 3-14 and 3-15 show the aquifer response to pumping at the Camden Street Wellfield in August 1994. The potentiometric surface and groundwater flow directions in both the shallow and deep zones of the aquifer indicate that groundwater flow is radial toward the wellfield in the vicinity of AFP 59 and that flow is generally in a westerly direction beneath AFP 59. The August 1994 data compare very closely to the 1967 data displayed in Figure 1-10 of Section 1.2.3.

Groundwater level data collected on December 6, 1994, immediately before the pumping test conducted at the site, were used to generate the groundwater contour maps shown in Figures 3-16 and 3-17. The potentiometric surface and groundwater flow directions in the two zones of the aquifer compare very closely to those from the August 1994 data. The maps from both sets of

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data show a general westerly flow in both the shallow and deep zones of the aquifer, with flow becoming southwesterly on the western side of the site. The December data also show a mounding of the potentiometric surface measured in the shallow wells in the southeastern portion of the site. This groundwater feature is not recorded in the August data, although the groundwater elevation at SW8 is 1.31 feet higher than the groundwater elevation at DW8 in August. The mounding may be related to precipitation in the area during early December.

In addition to defining groundwater flow patterns within the aquifer, the groundwater elevation data were used to evaluate the following: 1) vertical flow between the shallow and deep zones of the aquifer, 2) the hydraulic connection between the aquifer and Little Choconut Creek, and 3) fluctuations in groundwater elevations at the site.

Vertical groundwater flow between the two aquifer zones was evaluated by comparing groundwater elevations in the shallow and deep monitoring wells at each well cluster. Groundwater elevations from the August and December data indicate that, under static aquifer conditions, the vertical component of groundwater flow is generally upward. This is indicated by higher groundwater elevations in the deep wells at monitoring well clusters 3, 5, 6, 12 and 13. Monitoring well clusters 1, 4, 9, and 10 display very similar groundwater elevations, suggesting a weak component of vertical groundwater flow. This was expected at SW1/DW1 and SW10/DW10 due to the absence of the fine-grained glacial deposits at these locations. SW8/DW8 and SW11/DW11, located in the southeastern corner of the site, record shallow well groundwater levels up to 3.96 feet higher in elevation than the deep wells in December. As stated previously, the shallow well groundwater elevations may be related to infiltration of precipitation and may not represent typical static conditions.

Since the installation of the Camden Street Wellfield and the associated pumping-induced lowering of the groundwater table, both Little Choconut Creek and the Susquehanna River have become losing streams in the region. As shown in Figures 3-16 and 3-17, the potentiometric surface of both the shallow and deep zones of the aquifer are lower in elevation than the Little Choconut Creek bed. Consequently, surface water from the creek infiltrates down to recharge the aquifer (losing stream) rather than groundwater from the aquifer recharging the creek (gaining stream).

Figures 3-14 through 3-17 also allow for a temporal evaluation of fluctuations in the groundwater elevations. Comparison of the two sets of data indicates that groundwater elevations at AFP 59 were approximately 2 to 3 feet higher in August than in December. Large-scale fluctuations in groundwater elevations are related to several factors: 1) precipitation and infiltration in a region, which varies seasonally; 2) elevations of large bodies of surface water; and 3) pumping conditions within an aquifer. Under static conditions, the third factor remains constant and does not affect groundwater elevations. Infiltration of precipitation on a region affects groundwater elevations, although quantitative predictions of the effect are difficult. The final factor, elevation fluctuations of large bodies of surface water and how they affect aquifer elevations, is easier to predict by comparing groundwater elevations in monitoring wells with river stage as measured at gaging stations. Studies conducted by the USGS in 1986 and 1996 show a direct correlation between the Susquehanna River stage and groundwater elevations in the vicinity of AFP 59. The effect of the

Susquehanna River stage on groundwater elevations at AFP 59 is discussed further in the following section.

Hydrogeology Under Pumping Conditions. To evaluate hydraulic properties of the aquifer at AFP 59, a 24-hour pumping test was completed at the site on December 6 and 7, 1994, followed by a 24-hour recovery test on December 7 and 8, 1994. The goals of the pumping and recovery tests included defining aquifer parameters (i.e., transmissivity, storativity, hydraulic gradient, groundwater flow rate), determining the degree of hydraulic connection between the shallow and deep zones of the aquifer, and determining the impact of pumping on Little Choconut Creek. The on-site production well was pumped at a rate of approximately 145 gpm to stress the aquifer. The desired maximum flow rate of approximately 320 gpm could not be achieved because the flow was diverted through 2-inch piping in order to pass through a newly installed water meter. Groundwater level data were collected at all on-site and several off-site monitoring wells. The off-site wells included NYSDEC wells MW-2S, MW-2D, MW-3D, MW-7S, MW-8I and MW-9S. Water level data were also collected from a fixed location in Little Choconut Creek using a portable water level meter and datalogger.

Groundwater level data were collected either through the use of dataloggers and pressure transducers or manually using an electric water level meter. Three different dataloggers were used to record transducer data, including: 1) a Hermit datalogger at SW11/DW11; 2) Telog dataloggers at SW12/DW12 and SW13/IW13/DW13; and 3) CR10 dataloggers at SW3/DW3, SW4/DW4, SW6/DW6, SW7, and SW9/IW9/DW9. The remainder of the on-site and off-site water levels were obtained and recorded manually. The groundwater level data for each monitoring well are presented in Appendix D.

For each monitoring well, a hydrograph was created plotting depth to water versus elapsed time to evaluate the impact of the pumping on the aquifer. These hydrographs are contained in Appendix D. The wells can be separated into two groups based on whether or not they were affected by pumping. Those wells that responded to pumping include all deep wells, with the possible exception of the off-site well MW-3D; shallow wells located within 300 feet of the production well (SW4, SW7, SW12 and SW13); and SW1 and SW10, both of which are in the northeast portion of the property where no fine-grained glacial deposits exist. The remainder of the data from the shallow wells did not indicate an effect to the aquifer as a result of the pumping.

Response of the aquifer to pumping as monitored in the deep wells reflected conditions that were expected given the subsurface geology in the vicinity of AFP 59. All deep wells are screened in the deep zone of the aquifer at similar depths to the production well. Therefore, all deep wells are located in a zone of the aquifer that is hydraulically connected to the production well zone, and a response was anticipated. The fact that there was little or no response at MW-3D, which is located approximately 1,075 feet from the production well and only about 399 feet from Production Well 2 at the Camden Street Wellfield, suggests that pumping at Production Well 2 may mask the effect of pumping at the production well near the Camden Street Wellfield. Additionally, as discussed in the Aquifer Test Analysis section below, 1,075 feet is close to the radius of influence distances calculated for the AFP 59 production well when pumped at 145 gpm.

Response of the aquifer to pumping as observed in the shallow wells indicates that the fine-grained glacial deposits represent a significant barrier to vertical groundwater flow over the majority of the site. Most of the shallow wells showed no response to pumping (see Appendix D), indicating that the shallow and deep zones of the aquifer are hydraulically separated by the fine-grained glacial deposits at those locations. The fact that monitoring wells SW4, SW7, SW12 and SW13 did respond to pumping, even though fine-grained glacial deposits are present at these locations, indicates that the two zones of the aquifer are not hydraulically isolated. Leakage from the shallow zone to the deep zone of the aquifer through the fine-grained glacial deposits would be expected to be greatest in proximity of the pumping well. SW1 and SW10 also responded to pumping; but, since fine-grained glacial deposits are not present in the northeast portion of the property, such responses were anticipated.

The depth to water versus elapsed time hydrographs (Appendix D) were also used to evaluate a rising trend in groundwater elevations observed in data collected before the pumping test and in data collected late in the recovery test. This trend is attributed to the rise in the Susquehanna River stage of approximately 6 feet that occurred during the 24-hour period preceding the pumping test. Studies by the USGS (1986, 1996) have shown a direct correlation between rises in the Susquehanna River stage and rises in groundwater elevations as measured in monitoring wells in the region. Corrections made to the drawdown data to account for the rising trend in groundwater elevations are discussed in the Aquifer Test Analysis section.

The groundwater contour maps shown in Figures 3-18 and 3-19 were created to assess groundwater flow under pumping conditions. These maps were created by using data collected immediately before the conclusion of the pumping test. A comparison of groundwater elevations in the shallow and deep wells at each monitoring well cluster shows the vertical component of groundwater flow to be downward across most of the site under the conditions defining this pumping test. Monitoring well cluster 5 was the only cluster displaying higher elevations in the deep well, indicating that there was a slight upward component of flow at this well cluster. Elevations in the shallow and deep wells at well clusters 1, 6, and 10 differ by less than 0.17 feet, implying a weak vertical component of flow at these locations.

Figure 3-18 displays the potentiometric surface and groundwater flow directions in the shallow zone of the aquifer under pumping conditions. The contours in the vicinity of the production well show the impact of pumping on the shallow zone of the aquifer. The general groundwater flow direction remains westerly to southwesterly; however, flow lines are deflected toward the production well as a result of pumping. Although flow lines and the hydraulic gradient of the shallow zone of the aquifer are slightly altered, no groundwater divide is created in the shallow zone of the aquifer. Therefore, very little water from the shallow zone of the aquifer is captured through pumping of the production well at the flow rate and duration of this pumping test. The downward component of vertical flow created during pumping does result in some leakage through the fine-grained glacial deposits from the shallow zone to the deep zone of the aquifer.

Figure 3-19 displays the potentiometric surface and groundwater flow directions in the deep zone of the aquifer under pumping conditions. The effect of pumping is clearly evident, with

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concentrical contours defining the potentiometric surface around the production well. The hydraulic gradient is skewed in the vicinity of the production well, with the gradient being steeper upgradient and gentler downgradient of the production well. This skewing of the hydraulic gradient is the result of the regional southwesterly groundwater flow. Groundwater flow directions presented in Figure 3-19 show the development of a groundwater divide under pumping conditions along the western property boundary of AFP 59. Groundwater east of the divide is drawn to the production well, while groundwater west of the divide flows to the Camden Street Wellfield. The majority of groundwater flow in the deep zone of the aquifer along the southern portion of the site, including groundwater west of the production well, is captured by the production well when it is in operation. Groundwater flow in the northern portion of the site is affected by the production well but continues off-site to the Camden Street Wellfield.

Figures 3-20 and 3-21 display hydrographs that plot groundwater elevation versus radial distance from the production well for four monitoring wells and the city well, all of which lie west of the production well along a roughly east-west trend. Figure 3-20, which shows prepumping test data, defines the hydraulic gradient west of the production well under static aquifer conditions (i.e., no production wells in the area are in operation other than Production Well 2 at the Camden Street Wellfield). Figure 3-21, which shows elevations at the conclusion of the pumping test, illustrates how pumping of the production well creates a groundwater divide along the western edge of the site near DW3.

To monitor the depth of water in Little Choconut Creek during the pumping test, a Bubbler Portable Flow Meter (Model #4230) from Isco, Inc., was placed in the creek as close as possible to due south of the production well. This position was chosen because it represents the closest point in the creek to the production well, where any response to pumping would presumably be greatest. The creek was monitored continuously at 15-minute intervals from 2.5 hours before the pumping test began to 12 hours after the recovery test began. The depth of water data recorded by the flow meter are presented in Appendix D. Depth of water data, shown in Figure 3-22, show a linear decrease in the depth of Little Choconut Creek over the period monitored. Creek levels were high prior to the pumping test due to precipitation in the area and steadily decreased during the test. The data show no response to the production well being turned on or off, indicating that pumping of the production well does not affect flow in Little Choconut Creek. This response was predictable because the potentiometric surface of both zones of the aquifer are lower in elevation than the Little Choconut Creek bed.

Aquifer Test Analysis. Before analysis of the pumping test data, the data were corrected for the rising trend in groundwater elevations attributed to the rise in the Susquehanna River stage. Similar corrections were required for the pumping test data collected during the *Contaminant Source Investigation* (URS Consultants, Inc., 1992). For the RI pumping test data, the rate of groundwater elevation rise was calculated for each well subjected to analysis by evaluating the rate of rise recorded in the groundwater data collected prior to the pumping test and/or in data collected late in the recovery test. The rate of rise ranged from a minimum of 3×10^{-5} ft/min at SW10 to a maximum of 3×10^{-4} ft/min at DW3. The rate of rise calculated for each well was then subtracted from the observed drawdown data to arrive at the corrected drawdown data used in the

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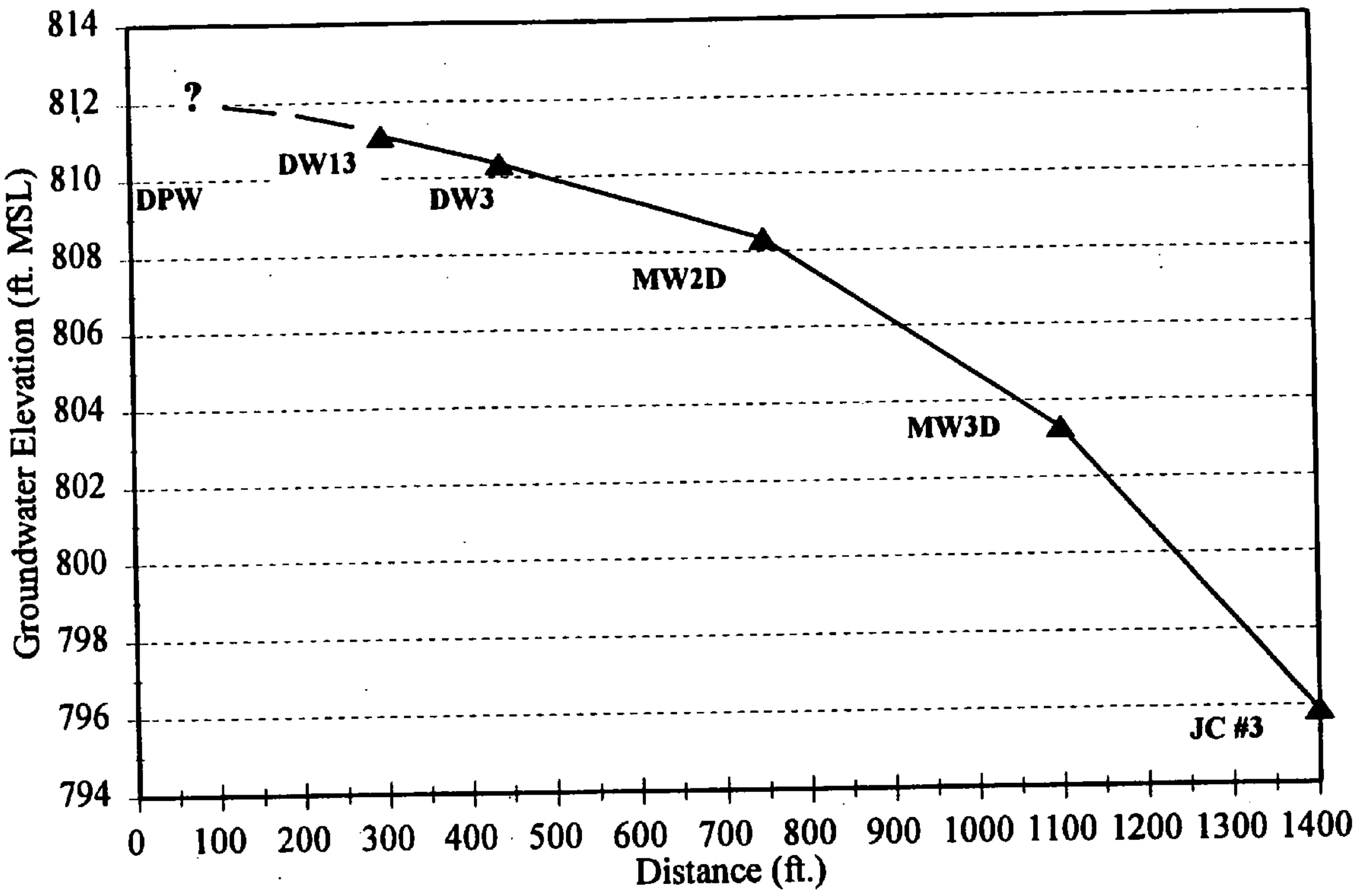

EARTH TECH

FIGURE 3-20

**Distance vs. Groundwater Elevation
Prior to Pumping Test**

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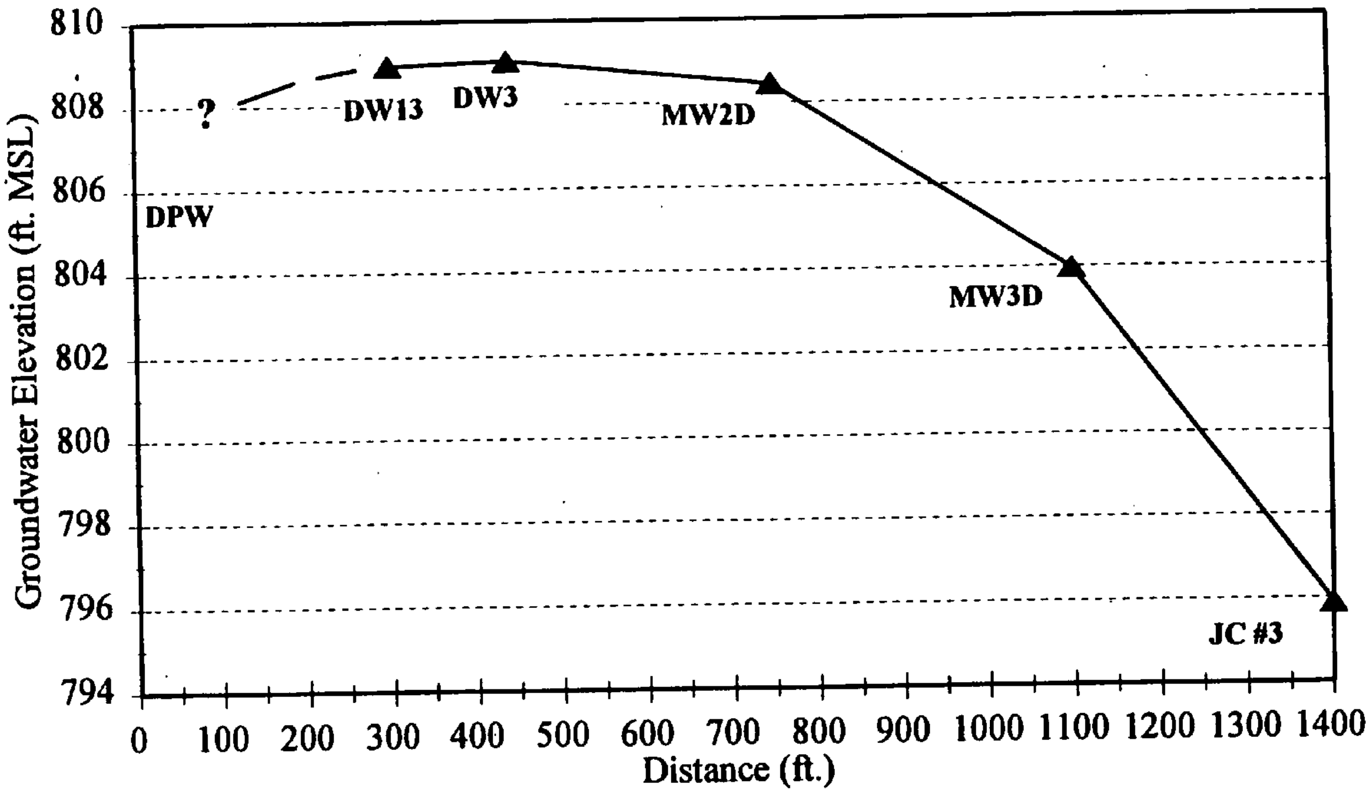

EARTH TECH

FIGURE 3-21

Distance vs. Groundwater Elevation
at End of Pumping Test

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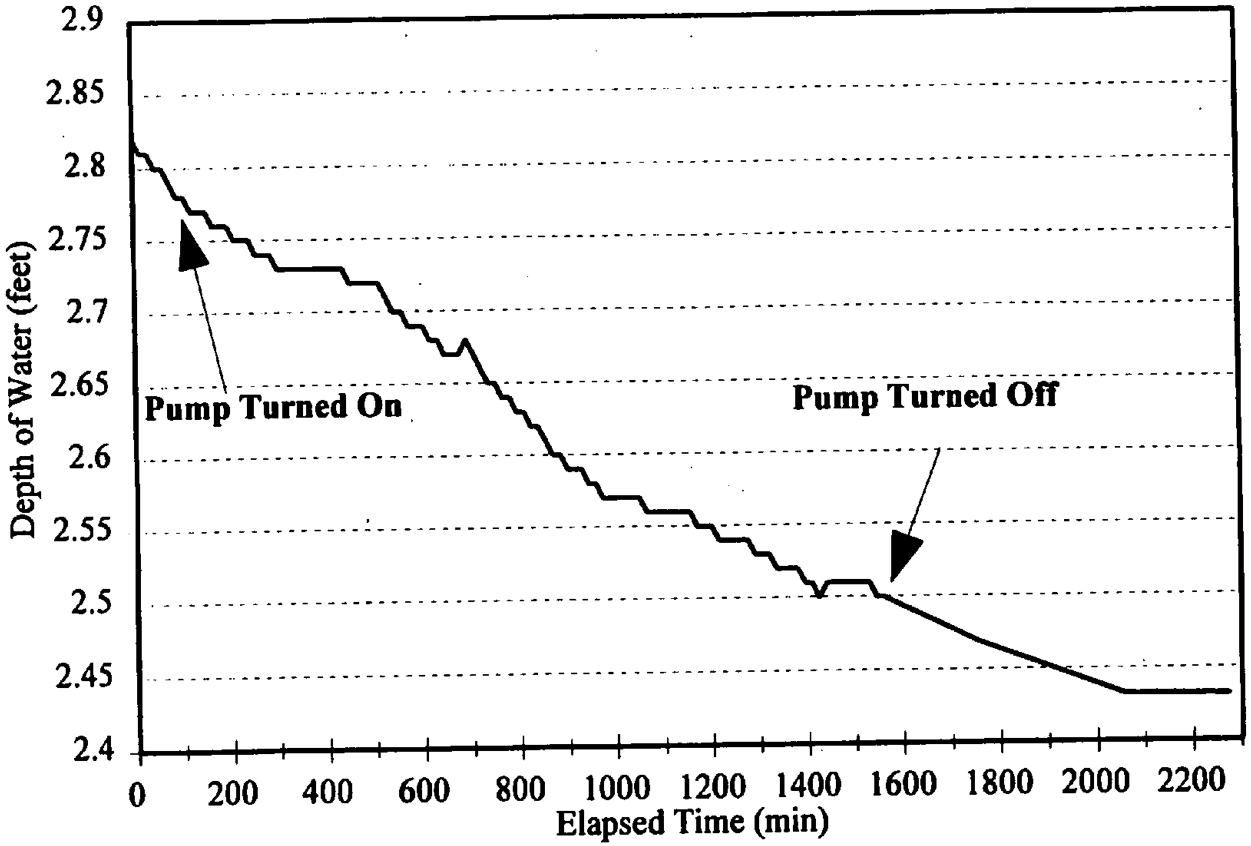

EARTH TECH

FIGURE 3-22

Depth of Water In
Little Choconut Creek
December 6-8, 1994

AFP-59/RI/FS/Fig 3-18 Dist DPW vs GW Elev

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pumping test analysis. Corrected drawdown was only calculated for those wells subjected to pumping test analysis. The raw and corrected data are presented in Appendix D.

The corrected drawdown data were analyzed using the Geraghty and Miller software package AQTESOLV. Based on time-drawdown curves generated from the data (see Appendix D) and the subsurface geology at the site, the majority of the data were initially analyzed using two different solutions for leaky aquifers: one that accounts for storage from the aquitard (the fine-grained glacial deposits) and one that does not account for storage from the aquitard. Examination of the time-drawdown curves demonstrated a more consistent fit with the type curves generated from the leaky aquifer solution, which does not take into account aquitard storage (Hantush and Jacob, 1955). Therefore, this solution was used in the analysis of the pumping test data collected from most monitoring wells. A detailed description of the solution is given in Section 2.4.2.

Because no fine-grained glacial deposits are present in the northeast portion of the property, SW10 and DW10 were analyzed using an unconfined aquifer solution (Theis, 1935). Data from SW1 and DW1 were not analyzed because they were too scattered to define time-drawdown curves that could be analyzed, and also because no data were available to account for the rising groundwater elevation trend related to the rise of the Susquehanna River. Results from the unconfined solution follow the discussion of the leaky aquifer solution. A detailed description of the unconfined solution is given in Section 2.4.2.

Time-drawdown data from all deep monitoring wells located on-site (except DW1) were analyzed. Data from the deep wells located off-site were not analyzed because the response to pumping was not strong enough to generate adequate drawdown at these wells.

With the exception of SW10, data from the shallow wells were not analyzed because of the hydraulic separation that exists between the shallow and deep zones of the aquifer. Any drawdown recorded in the shallow zone of the aquifer is the result of leakage through the fine-grained deposits to the deep zone of the aquifer due to pumping of the production well. Therefore, because drawdown is related to pumping in the deep zone and not the shallow zone of the aquifer, the drawdown in the shallow zone could not be analyzed to determine aquifer parameters.

The transmissivities and storativities computed by the AQTESOLV program are summarized in Table 3.2-1. Transmissivity values for the leaky aquifer solution ranged from 696 to 20,434 ft^2/day, with an average value of 8,151 ft^2/day. Storativity values ranged from 9.5×10^{-5} to 1.0×10^{-3}, with an average value of 8.2×10^{-4}. Hydraulic conductivity values were calculated for each well by dividing the transmissivity value by the saturated thickness of the aquifer at the well location. Hydraulic conductivities and saturated thicknesses are included in Table 3.2-1.

Transmissivity values calculated at AFP 59 are lower in general than the 10,000 to 50,000 ft^2/day range reported for the aquifer on a regional basis (URS Consultants, Inc., 1992). The lower values may be attributed to the subsurface geology at the site, which includes many locations

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TABLE 3.2-1
SUMMARY OF PUMPING TEST ANALYSIS

Well ID	T (FT^2/DAY)	S	Saturated Thickness (FT)	K (FT/DAY)
DW3	1,675	0.0001424	20	83.74
DW4	18,043	0.0006257	48.5	372.02
DW5	12,311	0.001015	35	351.74
DW6	696	0.0006258	10	69.62
DW8	14,904	0.0007967	17.5	851.66
DW9	759	0.0001456	20	37.94
DW11	20,434	0.0001930	10	2043.36
DW12	3,423	0.00009497	49	69.85
DW13	1,116	0.0002471	10	111.59
SW10	27,000	0.01037	71	380.28
DW10	22,018	0.003469	71	310.11

Key: T = Transmissivity
S = Storativity
K = Hydraulic Conductivity

Note: Transmissivities and storativities were computed using the AQTESOLV program.

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where the thickness of the lower zone of the aquifer (the ice-contact deposits) is very thin, thereby limiting transmissivity values. In addition, the regional range of transmissivity values is based on the assumption that the fine-grained glacial deposits are intermittent on a regional basis, and therefore the aquifer may be treated regionally as a continuous aquifer rather than two discrete zones. At AFP 59, however, the aquifer is treated as a zoned aquifer because of the presence of the fine-grained glacial deposits over the majority of the site. Consequently, saturated thicknesses used in the calculation of regional transmissivities are greater than those used for site transmissivities, resulting in higher regional transmissivity values.

Comparison of site and regional hydraulic conductivities support the fact that greater saturated thicknesses resulted in higher regional transmissivities. Hydraulic conductivity is a more suitable parameter to use in the comparison of data sets because it is not a function of saturated thickness as is transmissivity. Consequently, it is a function of a unit's ability to transmit water, regardless of aquifer thickness. Hydraulic conductivities at AFP 59 range from approximately 40 to 2,000 ft/day as compared to about 200 to 2,000 ft/day for reported regional conductivity values (URS Consultants, Inc., 1992). Therefore, when differences in saturated thickness are accounted for, site and regional hydraulic properties are similar.

In addition to the nine deep wells analyzed using the leaky aquifer solution, SW10 and DW10 were analyzed using AQTESOLV's Theis solution for unconfined aquifers, because no fine-grained glacial deposits are present at these locations. The time-drawdown curves are presented in Appendix D, and the results are summarized in Table 3.2-1. The transmissivity and storativity values are comparable to regional values, and the hydraulic conductivity values are comparable to both regional and site values.

Distance-drawdown analysis of the pumping test data was also conducted to determine aquifer transmissivity and the radius of influence of pumping and to verify results from the time-drawdown analysis. The corrected drawdown measured at the conclusion of the drawdown phase of the pumping test in 10 wells was plotted versus the radial distance from the production well on a semi-log plot (Figure 3-23). Wells DW1, MW-2D, and MW-3D were not included because of inadequate drawdown data.

The distance-drawdown plot presented in Figure 3-23 defines two straight-line trends in the data from which values of transmissivity have been calculated. Although distance-drawdown data typically result in only one linear trend, the complex subsurface geology at AFP 59 may explain the presence of the two trends. The fact that two linear trends exist suggests that site transmissivity varies over a range of values. The similarity of the distance-drawdown (2,527 to 6,824 ft^2/day) and time-drawdown (8,151 ft^2/day average value) transmissivity values support the results of the analyses. Additionally, the radius of influence of the production well when pumping 145 gpm is between 925 and 1,400 feet based on the distance-drawdown data. The radius of influence, as determined from distance-drawdown data, is equal to the value of the intercept of the line defining the trend in the data with the zero drawdown axis (see Figure 3-23).

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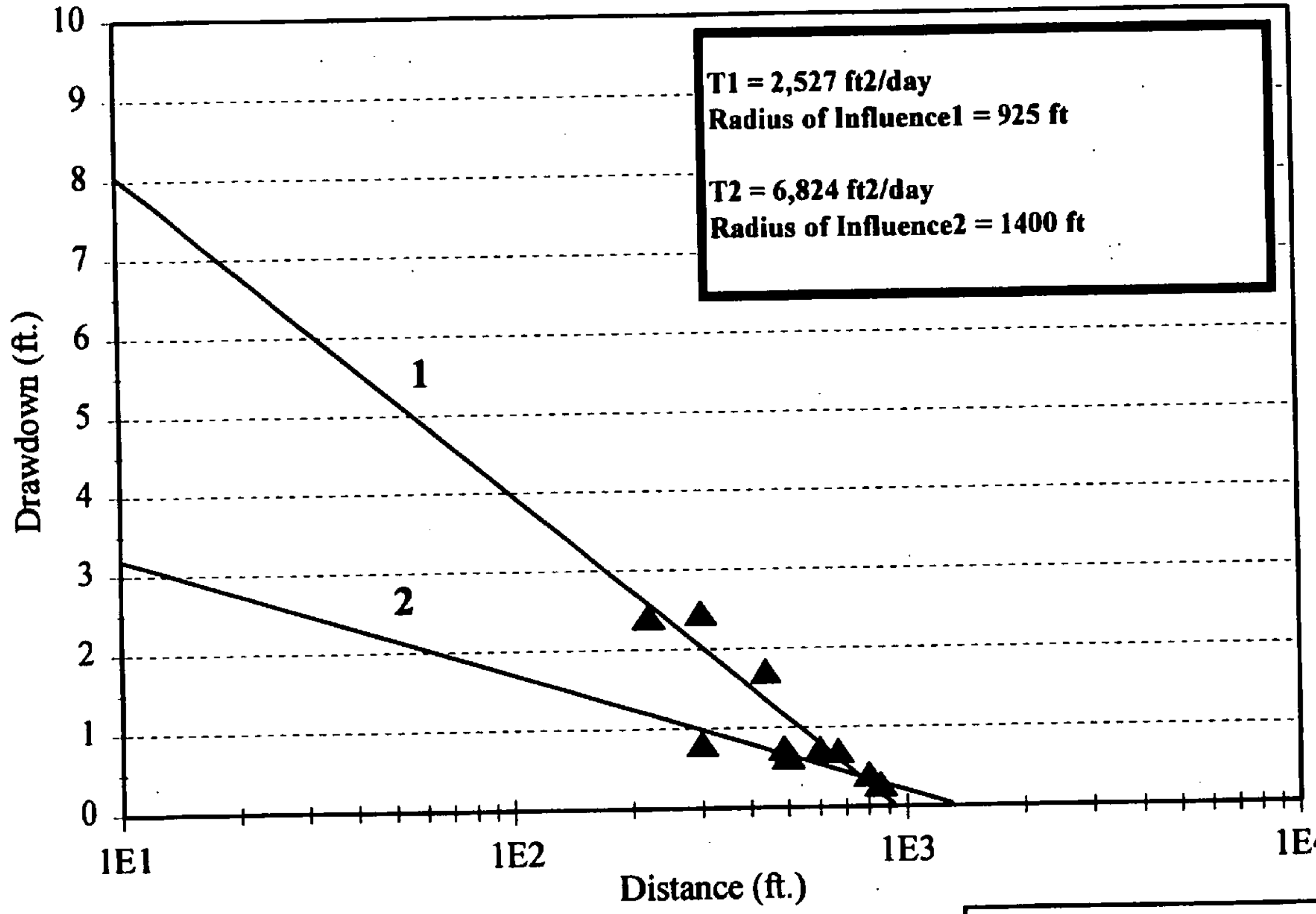

NOTE: Distance-drawdown line 1 corresponds to T1 and Radius of Influence 1; distance-drawdown line 2 corresponds to T2 and Radius of Influence 2.

EARTH TECH

FIGURE 3-23

Distance vs. Corrected Drawdown (Deep Wells)

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Based on groundwater elevations measured in December 1994 and the results of the pumping test analysis, a groundwater flow velocity has been calculated for the site. The groundwater seepage velocity, representing the travel speed of a particle of water, is estimated by Darcy's equation:

$$V = Ki/n_e$$

Where:
K = Hydraulic Conductivity
i = Hydraulic Gradient
n_e = Effective Porosity

Determination of the aquifer hydraulic conductivity was discussed previously (see Table 3.2-1). The hydraulic gradient represents the difference in groundwater elevation between two points along a flow line divided by the distance between the two points. A hydraulic gradient of 0.003 for the deep zone of the aquifer was calculated from the potentiometric map created using December 1994 groundwater elevation data from the deep wells (see Figure 3-17). An estimated effective porosity of 0.35 was used based on the geology of the ice-contact deposits. Given an average hydraulic conductivity of 454.97 ft/day, a hydraulic gradient of 0.003, and an effective porosity of 0.35, the estimated groundwater velocity at the site is 3.9 ft/day.

*3.2.1.2 **Surface Water Pathway**.* Refer to Section 1.2.4 for a detailed discussion of surface water bodies in the vicinity of AFP 59 and surface water and storm water runoff patterns at AFP 59. The following section discusses the potential surface water pathway.

As discussed in Section 1.2.4, two surface water bodies are within 1,000 feet of AFP 59: Little Choconut Creek and the Susquehanna River. Little Choconut Creek borders the plant to the east and south. The creek flows to the west and converges with the Susquehanna River approximately 1,000 feet west of the southwest corner of the plant. No municipal users of surface water have been reported within 3 miles downstream of AFP 59 (CH_2M Hill, 1984). The City of Binghamton is the nearest municipal user of water from the Susquehanna River, and the surface water intakes are approximately 5 miles upstream of AFP 59.

Both Little Choconut Creek and the Susquehanna River have become losing streams in the area since the installation of the Camden Street Wellfield. Consequently, surface water from the creek infiltrates down to recharge the aquifer rather than groundwater from the aquifer recharging the creek. Therefore, any site-derived contamination migrating through the groundwater pathway would be unable to affect Little Choconut Creek. Additionally, because groundwater within the zone of influence of the Camden Street Wellfield discharges to Production Well 2, including induced infiltration from the Susquehanna River, the river is also isolated from site-derived groundwater contamination.

Surface runoff and storm water drainage patterns at AFP 59 are shown in Figure 1-13. Surface water from a large part of the southern portion of the plant and noncontact cooling water drawn from the on-site production well is discharged to Little Choconut Creek through the three permitted outfalls. Potential use of Little Choconut Creek waters is restricted to recreational activities, including wading and fishing. Shallow depths of the creek, typically less than 1 foot, limit the potential for swimming in the creek.

3.2.1.3 ***Air Pathway***. Refer to Section 1.2.5 for a detailed discussion of the regional climate, including temperature, precipitation, evapotranspiration and wind characteristics, and air quality. Although contaminants have been identified in the soil at AFP 59, the surface is almost completely covered by the plant and surrounding paved parking lots. The only unpaved areas where soil contaminants were identified is the gravel area at the former waste oil tanks and the grass-covered area near the reservoir.

3.3 Conceptual Site Model

A conceptual site model under CERCLA is a written or pictorial representation of an environmental system and the biological, physical, and chemical processes that determine the transport of contaminants from sources through environmental media to receptors within the system. There are at least six basic activities associated with developing a conceptual site model:

- Determination of the limits of the study area or system boundaries;
- Identification of potential contaminants of concern;
- Identification and characterization of the source(s) of contaminants;
- Delineation of potential pathways of migration of contaminants through environmental media such as groundwater, surface water, soils, biota, and air;
- Establishment of background concentrations of contaminants for each contaminated medium; and
- Identification and characterization of potential human and ecological receptors.

The complexity of the conceptual site model should be consistent with the complexity of the site and the available data, and its development should be an ongoing, iterative process. Conceptual site models are used to integrate information from the site from various disciplines, identify data gaps, guide the risk assessment, and facilitate the selection of remedial designs.

The AFP 59 conceptual site model presented in this section provides a summary of the following: identification of contaminants in each environmental medium, source characterization, potential migration pathways for each medium, and identification of potential contaminant receptors.

3.3.1 Source Characterization and Identification of Contaminants

AFP 59 is a government-owned, contractor-operated facility. Remington Rand, Inc., was the first manufacturer to occupy the plant. Remington Rand manufactured aluminum aircraft propellers at the plant from 1942 to 1945. The plant closed at the end of World War II and remained idle until April 1949, when it was reopened as an aircraft controls manufacturing facility. GE Aerospace was contracted to operate the facility and the manufacturing process. The major process was the manufacturing of parts for electromechanical aircraft control systems. Martin Marietta Aircraft Controls acquired GE Aerospace in 1993 and took over the operation of the facility and the manufacturing activities. Lockheed Martin Control Systems currently manufactures flight control, laser, weapons control, internal navigation, and guidance systems at AFP 59.

Current and past activities at AFP 59 have generated a variety of waste products, including: cutting, lubricating, and coolant oils; degreasing agents; plating acids, caustics, chromium, and cyanide solutions; and paint residues (USAF, 1993b).

Three areas of soil contamination were identified during the field investigation: the Waste Oil Tank Area, the Plating Room Area, and the Reservoir Area (see Figure 3-8). Another potential (secondary) source of contamination is the subsurface storm drainage system. These multiple source areas may potentially impact groundwater quality. Because of the proximity of these source areas and the similar groundwater contamination found across the site, groundwater has been identified as a single investigative area (which includes both the shallow and deep zones of the aquifer). A summary of each source area is provided below. A more detailed discussion of these source areas is presented in Section 3.1.6.

SVOCs were detected across the site, in the creek, and at background locations. Their widespread presence does not appear to be related to an individual source area. Two potential explanations for the widespread nature of the SVOC contamination have been identified. First, most of the SVOC contamination was detected in shallow soil samples (<5 feet bgs) collected beneath asphalt-covered areas. If small pieces of asphalt were inadvertently included in soil samples sent for laboratory analysis, elevated concentrations of SVOCs would be detected. Additionally, elevated SVOC concentrations may be related to long-term leaching of SVOCs from the asphalt into the soil.

Second, SVOC contamination at AFP 59 and the surrounding areas could be related to emissions from the NYSEG coal-burning power plant located immediately south of AFP 59. Combustion of fossil fuels results in the emission of various contaminants, including SVOCs. Because NYSEG has been in operation since at least 1935 (USGS, 1968), the SVOC contamination detected beneath the AFP 59 parking lots and in the surrounding areas may be related to NYSEG activities that predate the existence of AFP 59 and strict emissions regulations. The presence of arsenic, beryllium, and thallium may also be related to NYSEG emissions.

WASTE OIL TANK AREA. The former underground waste oil storage tanks are an IRP site located south of the Special Programs Facility (see Figure 3-8). Two interconnected 1,000-gallon USTs were used to store waste cutting oils on a temporary basis. Prior to 1969, nonchlorinated, kerosene-based degreasing solvents were used at the plant and were stored in the USTs along with the waste oils. Use of halogenated solvents such as TCE, 1,1,1-TCA, and freon was introduced in 1969. These waste solvents were drummed and recycled on-site (where possible) or transported off-site by a contractor. The USTs were in operation from 1953 to 1985, at which time they were removed (USAF, 1993b).

A 3,000-gallon, double-walled, AST and a former oil/water separator are located adjacent to the former waste oil UST location. The AST, installed approximately 30 feet west of the UST location to replace the USTs, was used to collect waste oil from 1985 to 1992. The AST was drained and cleaned in 1992 and certified closed by the NYSDEC in 1994. The oil/water separator, located immediately east of the UST location, was in operation from 1942 to 1953. Waste oils and kerosene-based degreasing solvents were discharged to the oil/water separator, and effluent was discharged to the storm sewer system that emptied into Little Choconut Creek through Outfall 002. In the 1970s, the separator was filled with sand and capped with concrete (USAF, 1993b).

Several VOCs were detected in the soil in the vicinity of the Waste Oil Tank Area, including both chlorinated and petroleum hydrocarbon compounds. Numerous SVOCs were also detected in soil samples. Only one pesticide was detected above the PQL in the area, and PCB-1254 and PCB-1260 were each detected at one sampling location. Aluminum, barium, copper, molybdenum, and zinc were the only inorganics that were detected in the soil at concentrations exceeding background.

PLATING ROOM AREA. Three IRP sites are located in the vicinity of this potential source area: the Plating Room; the Storage Tank and Settling Pond; and the Drum Storage Area. These sites are located south of the Manufacturing Building (see Figure 3-8).

Operations in the Plating Room produced various wastes, including plating acids, caustic sludges, and chromium and cyanide solutions. The plating acid wastes were typically mixed sulfuric, nitric, muriatic, and chromic acids. Spent plating solutions included copper cyanide, nickel cyanide, and cadmium cyanide. Various degreasing activities also occurred in the Plating Room. Plating operations were discontinued in 1991, and the plating equipment was removed in 1992. The Plating Room is currently undergoing an NYSDEC-coordinated closure (USAF, 1993b).

The storage tank and settling pond are located adjacent to the southwestern corner of the Plating Room. The storage tank stored spent plating liquids that were later removed by an outside disposal contractor. Burnite was also stored in the tank from December 1990 to June 1991. Use of the storage tank was discontinued in June 1991 (USAF, 1993b).

From 1969 to 1984, plating rinsewater was discharged to the settling pond for metals precipitation and then discharged to Little Choconut Creek through Outfall 001. In 1984, a new plating rinsewater treatment and reuse system was installed. The brine generated during this process was placed in the storage tank and removed from the site by a contractor. In 1988, the treatment system became contaminated and was abandoned. The tanks are currently undergoing an NYSDEC-coordinated closure.

The Drum Storage Area is located in the maintenance area southeast of the Plating Room (see Figure 3-8). The site has been used as a drum storage area from 1942 to the present. Waste paints, waste oils, and spent kerosene-based degreasers were stored at this area prior to off-site disposal by an outside contractor. In 1963, the top 8 inches of soil were removed from the Drum Storage Area, and the site was paved (USAF, 1993b); however, employees reported spills prior to the paving in 1963.

Data from the RI and data provided by Martin Marietta from closure-related sampling were used to characterize the Plating Room Area. The three most commonly detected VOCs in the soil were TCE, acetone, and methylene chloride. Several other VOCs and SVOCs were also detected in the soil. Three pesticides were detected below the PQLs at one location, and PCB-1254 was detected in two soil samples. Cadmium, calcium, cyanide, and molybdenum were the only inorganics that were detected in the soil at concentrations exceeding background.

RESERVOIR AREA. Contaminated soil was also identified in the southwest corner of the property. No existing IRP sites are present in this area, and no known previous storage or disposal activities have occurred in this area. A 500,000-gallon water reservoir is located in this area (see Figure 3-8). The water level in the reservoir is maintained by pumping groundwater from the on-site production well directly to the reservoir. Chlorinated hydrocarbons have been detected in groundwater samples collected from the production well. Leaks of contaminated groundwater from the reservoir and/or associated piping system are a potential source of soil contamination in this area.

The only VOCs detected in Reservoir Area soil samples were TCE, 1,2,3-trichlorobenzene, and methylene chloride. Several SVOCs were detected; benzo(a)anthracene and fluoranthene were the most common. Limited pesticide contamination was detected, and PCB-1260 was detected in two soil samples. Copper, molybdenum, selenium, sodium, and zinc were the only inorganics that were detected in the soil at concentrations exceeding background.

STORM DRAINAGE SYSTEM. The subsurface storm drainage system collects surface runoff and then discharges to Little Choconut Creek through Outfalls 001 and 002. Noncontact cooling water drawn from the on-site production well is discharged through Outfall 003. Any contamination in the storm water system could migrate to and impact sediment and surface water in the creek. Additionally, leaks of contaminated storm water from the subsurface drains could potentially impact subsurface soils.

The only VOC detected in creek sediment samples was methylene chloride, a common laboratory contaminant. Five VOCs were detected in the surface water sample from CR02, all of which are typical of a chlorinated water source. Several SVOCs were detected in sediment samples, whereas only one SVOC, bis(2-ethylhexyl)phthalate, was detected in surface water samples. Limited pesticide contamination was detected in both sediment and surface water samples. No PCBs were detected. Sediment samples exceeded background for all inorganic analytes except calcium, manganese, mercury, and silver. Surface water analyte concentrations exceeded background for all inorganic analytes except chromium, copper, lead, and potassium.

SHALLOW ZONE OF AQUIFER. Chlorinated hydrocarbons were detected across the site in the shallow zone of the aquifer, with maximum concentrations generally occurring at SW4 and SW7. Petroleum hydrocarbons were detected in the groundwater sample collected at SW11, near the former waste oil tanks. Limited pesticide and no SVOC or PCB contamination was detected in groundwater samples collected from the shallow zone of the aquifer. Shallow groundwater analyte concentrations exceeded background for the following inorganic analytes: barium, beryllium, calcium, chromium, magnesium, nickel, potassium, silver, and vanadium.

DEEP ZONE OF THE AQUIFER. VOC concentrations detected in groundwater samples from the deep monitoring wells were consistently lower than VOC concentrations detected in groundwater samples from the shallow monitoring wells. The maximum concentrations of 1,1,1-TCA, 1,1-DCA, and TCE in the deep zone of the aquifer were detected in the groundwater sample from the on-site production well (the on-site production well is screened in the deep zone of the aquifer). Cis-1,2-DCE was detected at a maximum concentration at DW3. Bis(2-ethylhexyl)phthalate was the only SVOC detected in groundwater samples from the deep wells. Two pesticides were detected above the PQLs, and several others were detected below the PQLs. No PCBs were detected in groundwater samples from the deep wells. Deep groundwater analyte concentrations exceeded background for all inorganic analytes except arsenic, lead, sodium, and vanadium.

3.3.2 Potential Migration Pathways

The following section evaluates the potential groundwater, surface water and air migration pathways for contaminant transport. Each potential migration pathway is evaluated on the basis of relevant environmental characteristics. The potential migration pathways from the source areas identified in Section 3.3.1 are not addressed separately because the source areas have similar environmental characteristics and are in proximity to one another. The migration pathways discussed below apply to the entire southern zone of AFP 59. Section 3.2.1 (Migration Potential) discusses the migration pathways in detail.

GROUNDWATER PATHWAY. Migration potential through the groundwater pathway is dictated by the geology and hydrogeology of the site and surrounding areas. Consequently, geologic and hydrogeologic information gathered during the RI and previous investigations has been integrated to evaluate the potential groundwater migration pathway.

The stratigraphy underlying AFP 59 generally consists of 2 to 5 feet of artificial fill, 3 to 34 feet of glacial outwash deposits, 0 to 54 feet of fine-grained glacial deposits, and 15 to 64 feet of ice-contact deposits. The fine-grained glacial deposits are not present in the northeast portion of the site where glacial outwash deposits are in direct contact with ice-contact deposits. A thin layer of fine-grained alluvium overlies the glacial outwash deposits on the eastern portion of the site.

AFP 59 is located on the western edge of the Clinton Street-Ballpark Aquifer. Where present, the fine-grained glacial deposits separate the aquifer into a deep zone comprised of ice-contact deposits and a shallow zone comprised of glacial outwash deposits. Vertical groundwater flow is restricted by the fine-grained glacial deposits in areas of aquifer zonation. Where absent, ice-contact and glacial outwash deposits are in direct hydraulic contact with one another, and no zonation of the aquifer exists. As discussed above, this occurs in the northeast portion of the property where there are no fine-grained glacial deposits.

Hydrogeologic conditions were evaluated primarily through the interpretation of groundwater level data collected from monitoring wells in the vicinity of AFP 59. Groundwater contour maps generated from groundwater level data indicate that groundwater flow is radial toward the Camden Street Wellfield in the vicinity of AFP 59 and that flow in both the shallow and deep zones of the aquifer is in a westerly to southwesterly direction beneath AFP 59 (see Figures 3-14 and 3-15).

Since the installation of the Camden Street Wellfield and the associated pumping-induced lowering of the groundwater table, both Little Choconut Creek and the Susquehanna River have become losing streams in the region. As shown in Figures 3-16 and 3-17, the potentiometric surface of both the shallow and deep zones of the aquifer are lower in elevation than the Little Choconut Creek bed. Consequently, surface water from the creek infiltrates down to recharge the aquifer (losing stream) rather than groundwater from the aquifer recharging the creek (gaining stream). Therefore, surface water contamination may impact groundwater, but groundwater contamination cannot impact Little Choconut Creek or the Susquehanna River.

Geological and hydrogeological data collected during the RI indicate that AFP 59 is within the capture zone of the Camden Street Wellfield. Contamination from both the shallow and deep zones of the aquifer has the potential to impact the Camden Street Wellfield. Because Production Well 2, the primary pumping well at the wellfield, is screened in both the shallow and deep zones of the aquifer, groundwater is supplied from both zones of the aquifer (Production Well 2 is screened primarily in the deep zone of the aquifer; therefore, the majority of the water is supplied by the deep zone of the aquifer). Additionally, the fine-grained glacial deposits, which act to hydraulically separate the two zones, are discontinuous both at AFP 59 and in the vicinity of the wellfield (URS Consultants, Inc., 1992). Therefore, cross-contamination between the shallow and deep zones of the aquifer is possible wherever there are no fine-grained glacial deposits.

SURFACE WATER PATHWAY. Two surface water bodies are within 1,000 feet of AFP 59: Little Choconut Creek and the Susquehanna River. Little Choconut Creek borders the plant to the east and south. The creek flows to the west and converges with the Susquehanna River approximately 1,000 feet west of the southwest corner of the plant. No municipal users of surface water have been reported within 3 miles downstream of AFP 59 (CH_2M Hill, 1984). The City of Binghamton is the nearest municipal user of water from the Susquehanna River, and the surface water intakes are approximately 5 miles upstream of AFP 59.

As discussed above, both Little Choconut Creek and the Susquehanna River have become losing streams in the area since the installation of the Camden Street Wellfield. Consequently, surface water from the creek/river infiltrates down to recharge the aquifer rather than groundwater from the aquifer recharging the creek/river. Therefore, Little Choconut Creek and the Susquehanna River are isolated from any site-derived contamination migrating through the groundwater pathway.

Surface runoff and storm water drainage patterns at AFP 59 are shown in Figure 1-13. Surface water from a large part of the southern portion of the plant and noncontact cooling water drawn from the on-site production well is discharged to Little Choconut Creek through the three permitted outfalls. Potential use of Little Choconut Creek waters is restricted to recreational activities, including wading and fishing. Shallow depths of the creek, typically less than 1 foot, limit the potential for swimming.

AIR PATHWAY. The climate in the area is typically humid maritime, with mild summers and long, cold winters. The average annual temperature for nearby Binghamton is 46°F. Monthly mean temperatures vary from 22°F in January to 70°F in July (International Station Meteorological Climate Summary, 1990). The prevailing wind direction is west-southwest, with an annual mean wind speed of 9 knots. Mean annual precipitation recorded in the vicinity of AFP 59 is 36.7 inches per year. Mean annual lake evaporation, commonly used to estimate the mean annual evapotranspiration rate, is estimated to be 28 inches per year. Mean annual net precipitation (mean annual precipitation minus mean annual evapotranspiration) is approximately 9 inches per year (CH_2M Hill, 1984).

Although contaminants have been identified in the soil at AFP 59, the surface is almost completely covered by the plant and surrounding parking lots (see Figure 3-24). The gravel-covered Waste Oil Tank Area represents the only complete air migration pathway that currently exists (i.e., migration of VOCs from subsurface soil to air). Future construction activities at the site exposing contaminated soil could also result in complete air migration pathways (either migration of VOCs from subsurface soil to air or migration of contaminated, fugitive dust).

3.3.3 Potential Receptors

Potential human receptors for the identified, complete migration pathways are presented below as part of the AFP 59 conceptual site model. Figure 3-25 presents a release, transport, and exposure diagram summarizing sources, release mechanisms, migration pathways, exposure pathways, and potential receptors; complete pathways are identified. A discussion of the potential receptors and exposure pathways is provided below.

Potential ecological receptors and exposure pathways are identified and discussed in the Fish and Wildlife Impact Analysis provided in Appendix O.

Figure 3-26 presents a zoning map that provides land use for property within 0.5 miles of AFP 59. As illustrated in the figure, the areas adjacent to AFP 59 include residential, industrial, and commercial properties. In general, areas immediately west and north of the plant are residential but include several commercial- and industrial-zoned properties. Immediately east of the plant are unzoned areas, areas zoned for conservation, and residential and commercial properties. Immediately south of the plant is the NYSEG power plant, which is zoned as heavy industrial.

The only school within 0.5 miles of AFP 59 is the C.F. Johnson Junior High School, which is located approximately 2,000 feet east-southeast of the plant. The nearest hospital is the Wilson Memorial Hospital, which is located approximately 3,000 feet east-southeast of the plant. School students and hospital patients have not been considered separately as potential receptors because

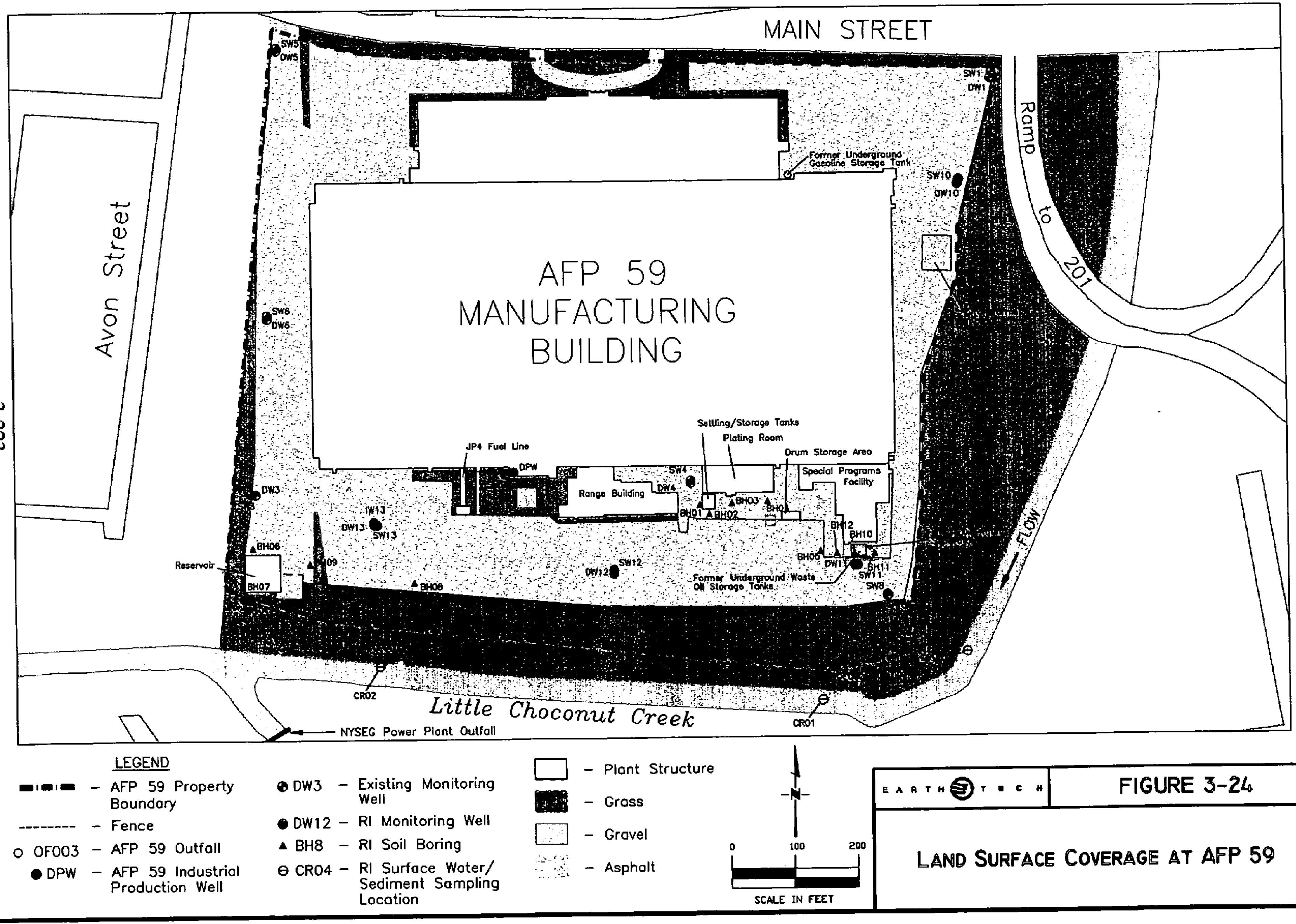

FIGURE 3-24

LAND SURFACE COVERAGE AT AFP 59

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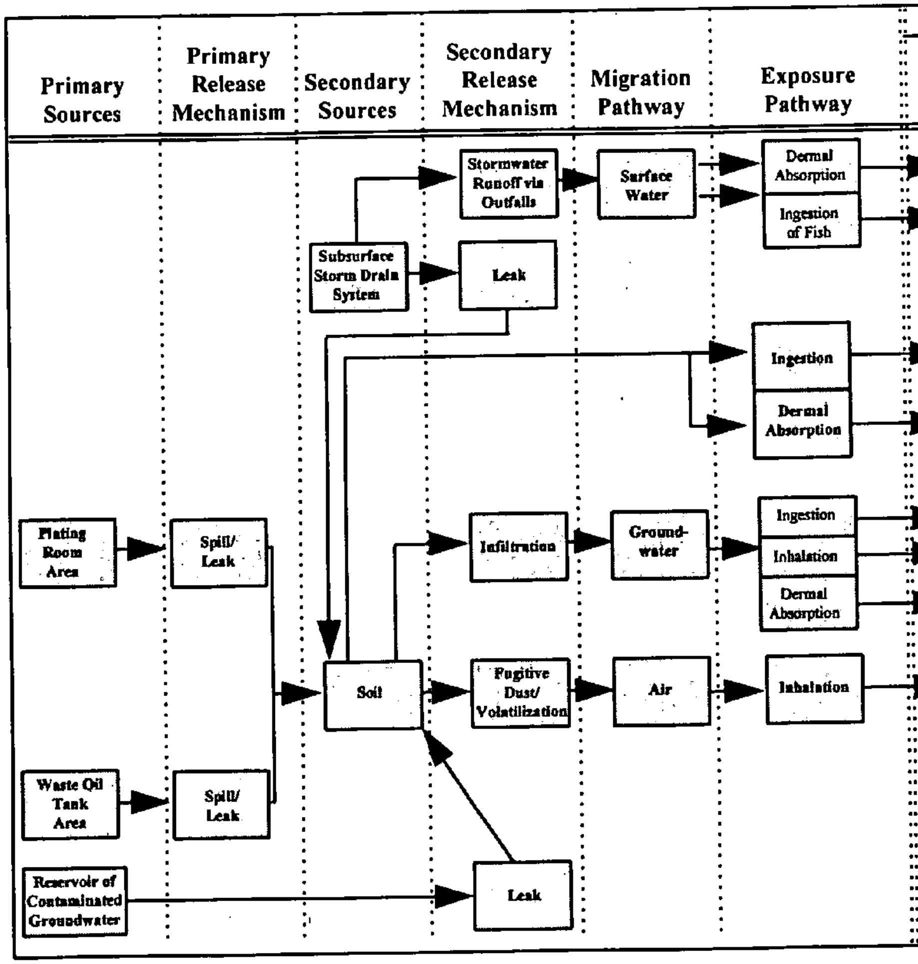

Exposure Pathway	Current Human Receptors: Industrial (Plant) Workers	Current Human Receptors: Recreational Users of Creek	Current Human Receptors: Offsite Residents	Future Human Receptors: Industrial Workers	Future Human Receptors: Construction Workers	Future Human Receptors: Offsite Residents
Dermal Absorption	NA	●	NA	NA	NA	NA
Ingestion of Fish	NA	●	NA	NA	NA	NA
Ingestion	X	NA	NA	●	●	NA
Dermal Absorption	X	NA	NA	●	●	NA
Ingestion	●	NA	●	●	NA	●
Inhalation	NA	NA	●	NA	NA	●
Dermal Absorption	NA	NA	●	NA	NA	●
Inhalation	●	NA	X	●	●	●

Explanation:
- ● Complete Pathway
- X Incomplete Pathway
- NA Not Applicable

#0510FIG.325

EARTH TECH

FIGURE 3-25

AFP 59

Release, Transport, and Exposure Diagram

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the maximally exposed receptor (residents living immediately adjacent to AFP 59) has been identified. Off-site residents are considered maximally exposed because they live adjacent to the site and their exposure periods are longer.

CURRENT RECEPTORS. Three potential on-site and off-site current human receptors have been identified: industrial workers (i.e., plant employees), recreational users of Little Choconut Creek, and off-site residents. For industrial workers, the complete exposure pathways identified are ingestion of groundwater and inhalation of VOCs migrating from soil to air in the vicinity of the Waste Oil Tank Area. The soil and air pathways are not complete pathways for the Plating Room Area and the Reservoir Area because they are predominantly covered by the Manufacturing Building, asphalt parking lots, and grass (see Figure 3-24).

Drinking water at the plant is supplied by the Johnson City municipal wellfield (i.e., the Camden Street Wellfield). While the groundwater pathway (ingestion) for industrial workers is complete, it is not possible to quantify risk because current concentrations at the Camden Street Wellfield, which are required to calculate current risk, are not available. Although groundwater contamination has been detected at the wellfield, an air stripper is in place to reduce concentrations to levels below ARARs. Additionally, reported contaminant concentrations in the groundwater at the wellfield have been below ARARs recently.

Recreational users of Little Choconut Creek have also been identified as potential current receptors. People fish and wade in the creek in the vicinity of AFP 59; therefore, dermal absorption of chemicals from surface water and ingestion of contaminated fish are considered complete exposure pathways for these receptors. Swimming, which might result in incidental ingestion of surface water, has not been considered because water levels in the creek are generally too shallow.

Finally, off-site residents in the vicinity of AFP 59 have been identified as potential current receptors. Ingestion of contaminated groundwater, inhalation of VOCs while showering, and dermal absorption of chemicals while showering are potential groundwater exposure pathways. As stated above, it is not possible to quantify risk for the current groundwater pathway. Although the groundwater exposure pathways are considered complete, groundwater from the Camden Street Wellfield currently meets ARARs.

Inhalation of contaminated fugitive dust and VOCs migrating from soil to air are considered incomplete exposure pathways for current off-site residents because the property is predominantly covered.

FUTURE RECEPTORS. In evaluating potential future receptors, several assumptions were made. First, it was assumed that the property will continue to be used as an industrial facility rather than for residential development. An agreement to transfer the property to Broome County has been approved, and Lockheed Martin intends to remain at the facility to continue similar industrial operations. Second, it was assumed that the potable water will continue to be supplied to the facility by the Camden Street Wellfield. No on-site drinking water wells are anticipated because of the plant's proximity to the existing wellfield and the status of the aquifer as a sole-source aquifer. Finally, it was assumed that contaminated soil at the facility might be exposed in the future, both at the surface and subsurface (i.e., during excavation for construction activities).

Three potential on-site and off-site future human receptors have been identified: industrial workers, on-site construction workers, and off-site residents. Exposure of future recreational users to contaminated surface water in Little Choconut Creek cannot be addressed because future concentrations of contaminants in the surface water are unknown. Assuming that contaminated surface soil could be exposed in the future, the soil ingestion and dermal absorption pathways are considered complete for future industrial workers. Additionally, inhalation of contaminated fugitive dust and VOCs migrating from soil to air are considered complete pathways. Ingestion of contaminated groundwater from the Camden Street Wellfield is also considered a complete exposure pathway for future industrial workers.

Future on-site construction workers could be exposed to subsurface soil (ingestion and dermal absorption of chemicals) during construction activities. Contact with groundwater during construction was not considered a complete pathway because of the depth to groundwater in the area (generally 12 to 25 feet bgs at AFP 59) and typical depths of excavation (0 to 12 feet bgs) during construction activities. Inhalation of contaminated fugitive dust and VOCs migrating from soil to air during construction activities are also complete pathways for future construction workers.

Future off-site residents in the vicinity of the plant could be exposed to contaminated groundwater through ingestion, inhalation of VOCs while showering, and dermal absorption while showering. Additionally, off-site migration of contaminated fugitive dust and VOCs in air could occur if the surface soil is exposed in the future. Therefore, off-site residents could be impacted by these exposure pathways.

3.4 Baseline Human Health Risk Assessment

Growing public awareness of the potential risks to humans from chemicals in the environment has led to concern over permissible exposure limits. This awareness has generated a demand for a means of estimating risk and for limiting exposure in cases where risk is judged to be excessive. One outcome of such growing public awareness is the emergence of the field of risk assessment, which evaluates available data on exposure and toxicity of chemicals to estimate associated risks to humans and the environment. The National Contingency Plan requires that a quantitative baseline risk assessment be performed to evaluate the potential risks to human health and the environment associated with current and future land use conditions in the absence of remedial activity. This section presents the baseline human health risk assessment for the RI of the AFP 59 site.

A baseline human health risk assessment consists of four basic steps: data evaluation, exposure assessment, toxicity assessment, and risk characterization. For completing each of these steps, several guidance documents were used as references. These documents include:

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final.* United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., December 1989 (USEPA, 1989a).

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors, Interim Final.* United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., March 1991 (USEPA, 1991).

- *Guidance for Data Useability in Risk Assessment (Part A), Final.* United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., April 1992 (USEPA, 1992d).

- *Handbook for the Installation Restoration Program (IRP), Remedial Investigations and Feasibility Studies (RI/FS).* Air Force Center for Environmental Excellence, September, 1993 (USAF, 1993a).

The risk assessment is divided into the following major sections: Section 3.4.1 - Selection of Chemicals of Potential Concern, Section 3.4.2 - Exposure Assessment, Section 3.4.3 - Toxicity Assessment, Section 3.4.4 - Risk Characterization, Section 3.4.5 - Risk Assessment Uncertainties, and Section 3.4.6 - Conclusions. Section 3.4.1 presents tables of chemicals of potential concern for all media that can be contacted by receptors and the selection methodology. Section 3.4.2 presents a potential exposure pathway table, tables of chemical concentrations at receptors (i.e., exposure point concentrations) with a discussion of the methodology used for calculation of concentrations, groundwater and air modeling methodology and results, exposure model tables, and exposure estimates. Section 3.4.3 presents tables of carcinogenic and noncarcinogenic toxicity values and the methodology used to select toxicity values. Section 3.4.4 presents the methodology used to estimate human health risk. Section 3.4.5 presents a discussion of the uncertainties associated with various steps in the risk assessment. Section 3.4.6 presents the conclusions of the risk assessment on the basis of the calculated carcinogenic and noncarcinogenic risk, as well as risk from exposure to lead. Summary tables of total human receptor cancer risk and hazard indices are also presented. The summary tables indicate which receptor risk values are unacceptable through benchmark comparisons and which exposure pathways and chemicals significantly contribute to unacceptable risk.

3.4.1 Selection of Chemicals of Potential Concern

The process used for selection of chemicals of potential concern in each medium (i.e., soil, groundwater, surface water, and air) for human receptors is described in this section. Contaminants identified as chemicals of potential concern in each medium are presented in tabular form.

The following references provided guidance for the selection process:

- *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final,* U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C., December, 1989 (USEPA, 1989a).

- *Handbook for the Installation Restoration Program (IRP), Remedial Investigations and Feasibility Studies (RI/FS),* Air Force Center for Environmental Excellence, September, 1993 (USAF, 1993a).

3.4.1.1 Data Useability. Analytical data compiled from environmental samples collected during the RI and selected additional investigations at AFP 59 were reviewed for usability in the human health risk assessment. Data sources included the following:

- Groundwater analytical data collected during the RI in December 1994;

- Soil analytical data collected during the RI in July, October, and November 1994;

- Soil analytical data collected by Martin Marietta in the vicinity of the Plating Room between July 1992 and December 1994;

- Soil analytical data collected by Argonne National Laboratory from two locations (DW1 and SW5) in November 1991; and

- Surface water data collected during the RI in October 1994.

The *Risk Assessment Guidance for Superfund, Volume I* (USEPA, 1989a) and the *Guidance for Data Useability in Risk Assessment* (USEPA, 1992d) provided guidance for data usability in the risk assessment. Ten percent of the data collected by EARTH TECH were validated to USEPA Level III. A data review of 100 percent of the data addressed holding times and blank contamination. Unqualified data and data assigned the "J" qualifier were judged usable for the risk assessment.

The "J" qualifier indicates that the associated value is estimated for analytes detected above the MDL. Data assigned "U" as a qualifier (i.e., blank contamination) were judged unusable for the risk assessment and were rejected from further consideration. The criteria used to identify blank contamination are discussed in Section 2.3.3.3.

3.4.1.2 Selection of Chemicals of Potential Concern in Site Soil. For each source area, chemicals of potential concern were selected for all sampled depths, the 0- to 3-foot soil interval (potential contact by future on-site industrial workers), and the 0- to 12-foot soil interval (potential contact by future on-site construction workers). The 0- to 3-foot surface soil interval was selected because the upper one foot of surface material was primarily asphalt and artificial fill; therefore, most surface soil samples were taken in the 1- to 3-foot bgs interval. A hypothetical 0-to 12-foot bgs interval was selected as a subsurface soil interval that could be contacted by future construction workers if excavation activities occurred during future land development.

All organic analytes detected in one or more site samples at each depth of concern were retained as chemicals of potential concern for that soil interval because they are not naturally occurring compounds.

Concentrations of inorganic analytes detected at each site were compared with inorganic concentrations for background data. As described in Section 3.1.3.2, the following sample locations were selected to provide background data:

- DP18
- DP19
- DP21
- JCDW1AS
- JCDW1BS
- JCDW5BS
- JCDW1CS
- JCDW5AS

Inorganic analytes that were not detected in any site samples from any sampled depth were deleted from further consideration for the site.

Figure 3-27 outlines the method used to compare site analytical data to background analytical data for inorganic analytes detected in site and background samples. For inorganic analytes having three or more analytical results, the Shapiro-Wilk statistical test was used to determine the data distribution of each analyte's concentrations. The Shapiro-Wilk test was conducted using the natural logarithms of the chemical concentrations. If the Shapiro-Wilk test did not reject a normal distribution for the natural logarithms of the concentrations, the distribution of concentrations was considered to be lognormal for that analyte. If the Shapiro-Wilk test rejected a normal distribution for the natural logarithms of the analyte's concentrations, the Shapiro-Wilk test was conducted on the untransformed analyte concentrations (i.e., the original analytical concentration reported by the laboratory). If the Shapiro-Wilk test did not reject a normal distribution for the untransformed analyte concentrations, the distribution of its concentrations was considered to be normal. If the Shapiro-Wilk test rejected a normal distribution for the untransformed analyte concentrations, the distribution of its concentrations was considered to be non-normal. Analytes with less than three analytical results were assumed to have lognormal distributions. Appendix Q provides the statistical distribution results for inorganic chemicals detected in site and background data.

For inorganic analytes with four or more analytical results in both site and background soil data sets (i.e., for the 0- to 12-foot interval and for all sample depths), either the Student's t test or the Wilcoxon Rank Sum test were used to statistically identify site inorganic concentrations that exceeded background levels. For a particular analyte, the Student's t test was used when both the site and background data sets were normally distributed. The Wilcoxon Rank Sum test was used if either the site or the background data set was not normally distributed.

The Student's t test is a parametric test that assumes the data being compared are normally distributed. Because false conclusions can result if this assumption is violated, the Student's t test was applied only when the site inorganic concentrations and the background concentrations were both normally distributed. The Wilcoxon Rank Sum test is a nonparametric test that does not

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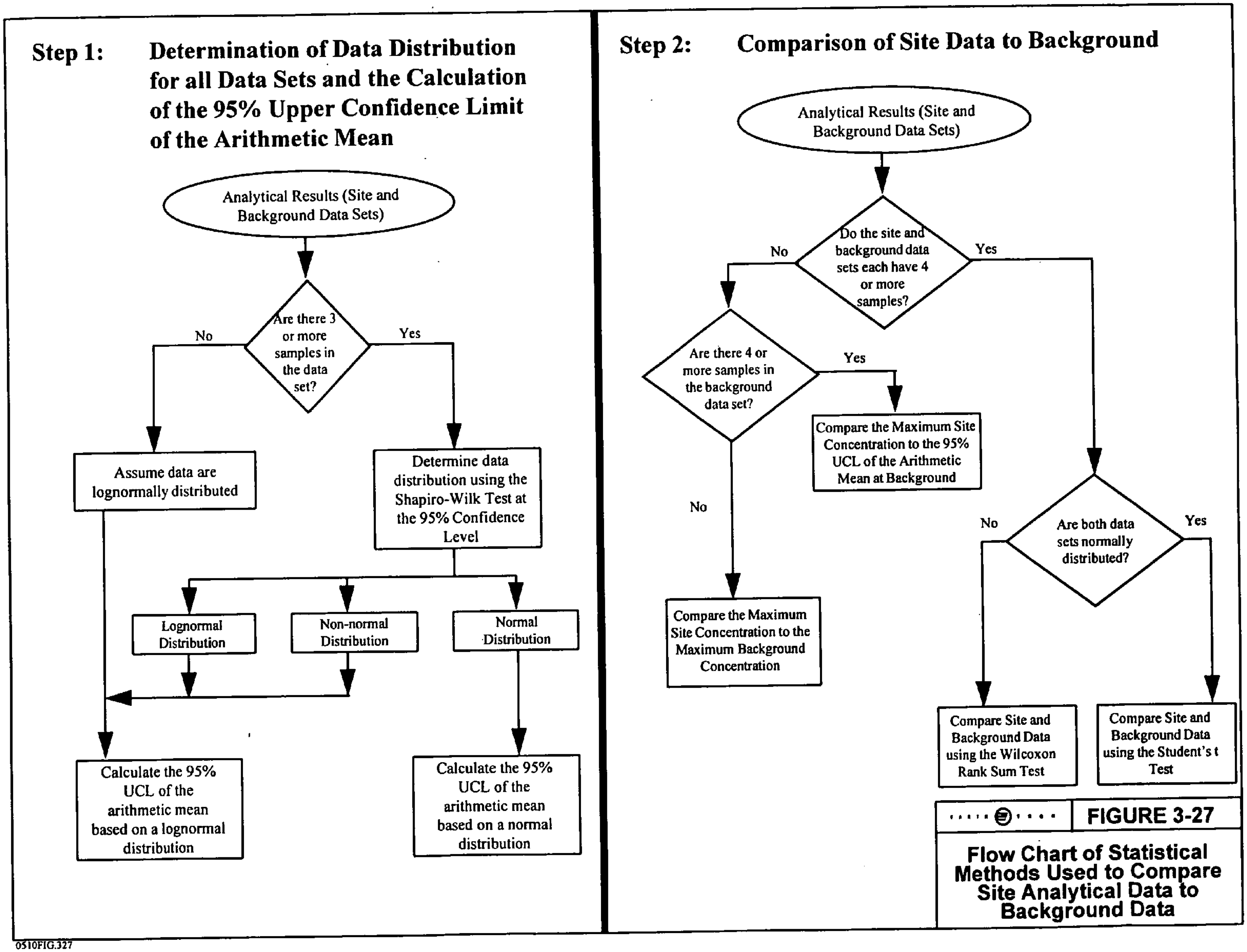

FIGURE 3-27

Flow Chart of Statistical Methods Used to Compare Site Analytical Data to Background Data

0510FIG.327

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assume a distributional model for the data being compared. As such, this test was only performed when either the site inorganic concentrations or background concentrations were lognormally or nonnormally distributed.

Both the Student's t and the Wilcoxon Rank Sum tests were conducted as upper one-sided tests at the 0.05 significance level (i.e., 95 percent confidence interval). The Student's t test produces a t statistic and a t probability. Analytes are determined to statistically exceed background if one-half of the t probability is less than 0.05 and the arithmetic mean for the site data is greater than the arithmetic mean for the background data. The Wilcoxon Rank Sum test produces a Z statistic and a Z probability. Analytes are determined to statistically exceed background if one-half the Z probability is less than 0.05 and the mean of the rank scores for the site data is greater than the mean of the rank scores for the background data.

For analytes having less than four analytical results for background (i.e., the 0- to 3-foot soil interval), the Student's t and Wilcoxon Rank Sum tests were not performed due to an insufficient number of background data points. One nonparametric method recommended by the USEPA (1992h) for comparison of non-normal data sets when data sets are small or otherwise do not meet the assumptions required for parametric statistics is the nonparametric tolerance interval method. A UTL is established for each inorganic chemical in the background data set, and the maximum site concentration for each chemical is compared to the UTL. If the maximum site value does not exceed the UTL for the chemical in background, then it is assumed that the site chemical concentrations do not exceed background and that the chemical is not a chemical of concern for the site.

The UTL in a nonparametric setting is usually chosen as an order statistic of the sample data, commonly the maximum value observed (USEPA, 1992h). For this RI, the maximum background concentration for each chemical represents the UTL, and it is compared to the maximum site concentration to determine whether the site concentration exceeds background. The inorganic was retained as a chemical of potential concern if its maximum concentration for the source area was greater than the maximum concentration for background.

A qualitative comparison was performed for inorganic analytes that were detected in site soil samples but not in background soil samples. Site detections were compared to background PQLs. If the maximum site detection for an inorganic analyte exceeded the laboratory PQL for that analyte, the analyte concentration was considered to be substantially greater than the detection limit and, therefore, above background conditions. Mercury detections in the 0- to 3-foot interval at the Plating Room Area and in the 0- to 12-foot interval and at all sampled depths at all source areas were found to be less than the maximum background PQLs. Consequently, mercury was eliminated as a chemical of potential concern for these soil intervals.

Appendix R provides the statistical comparison test results for each soil depth of concern to justify the retention or deletion of inorganic analytes as chemicals of potential concern for the particular soil depth of concern.

Table 3.4-1 presents a list (by source area) of chemicals of potential concern for all sampled soil depths. Table 3.4-2 presents a list (by source area) of chemicals of potential concern for the surface soil interval (0- to 3-foot interval). Table 3.4-3 presents a list (by source area) of chemicals of potential concern for the subsurface soil interval (the 0- to 12-foot interval).

3.4.1.3 Selection of Chemicals of Potential Concern in Surface Water. All organic analytes detected in site surface water samples were retained as chemicals of potential concern because they are not naturally occurring compounds. Concentrations of inorganic analytes detected in site surface water samples were compared with inorganic analyte concentrations detected in background samples. Because there are only three site and two background surface water sample locations, maximum site surface water concentrations were compared to maximum background concentrations. Inorganic analytes detected in the site samples with concentrations greater than the maximum concentrations found in background samples were retained as exceeding background. Appendix R provides the comparison test results for the surface water data to justify the retention or deletion of analytes as chemicals of potential concern.

A qualitative comparison was performed for inorganic analytes that were detected in site samples but not in background samples. Chromium, lead, and copper detections were found to be less than background PQLs; therefore, site concentrations for these analytes were considered to be within background levels and the analytes were eliminated as chemicals of potential concern for surface water.

Table 3.4-4 presents a list of the chemicals of potential concern for surface water.

3.4.1.4 Selection of Chemicals of Potential Concern in Groundwater. One round of unfiltered groundwater samples was collected in December 1994 as part of the RI field sampling effort. Three of the thirteen monitoring well locations (locations 1, 5, and 10) are believed to be unaffected by historic manufacturing activities and are considered to represent background locations. Monitoring wells DW1, DW5, and DW10 were used to characterize background conditions in the deep zone of the aquifer. Monitoring wells SW1 and SW5 were used to characterize conditions in the shallow zone of the aquifer (SW10 was not used because elevated levels of chlorinated hydrocarbons were detected).

As described in Section 3.2.1, the shallow and deep zones of the aquifer are hydraulically separated across most of the site. Additionally, groundwater contaminant concentrations are consistently higher in the shallow zone than in the deep zone. Because horizontal migration appears to be more predominant than vertical migration, the two zones were considered separately during the risk assessment. To determine chemicals of potential concern, inorganic analytical results from the shallow wells were compared to shallow inorganic background well results, and inorganic analytical results from the deep wells were compared to deep inorganic background well results.

The method described in Section 3.4.1.2 for determining inorganic chemicals of potential concern was applied to data from both the shallow and deep zones. Inorganic analytes that were not

TABLE 3.4-1
CHEMICALS OF POTENTIAL CONCERN IN SOIL (ALL SAMPLED DEPTHS)

PLATING ROOM

Organics		Inorganics
Acenaphthene Acetone Alpha Endosulfan Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene bis(2-Ethylhexyl)phthalate Bromomethane Chrysene Fluoranthene Fluorene Methoxychlor	Methylene Chloride Methyl Ethyl Ketone (2-Butanone) p,p'-DDD PCB-1254 (Arochlor 1254) Phenanthrene Pyrene Styrene 1,1,1-Trichloroethane Trichloroethylene (TCE) Xylene, Total	Cadmium Cyanide Molybdenum

RESERVOIR

Organics		Inorganics
Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g,h,i)perylene Beta Endosulfan bis(2-Ethylhexyl)phthalate Chrysene Delta BHC (Delta Hexachlorocyclohexane) Dieldrin Endrin Endrin Aldehyde Fluoranthene	Gamma BHC (Lindane) Heptachlor Heptachlor Epoxide Indeno(1,2,3-cd)pyrene Methylene Chloride Methoxychlor p,p'-DDD p,p'-DDT PCB-1260 (Arochlor 1260) Phenanthrene Pyrene Trichloroethylene (TCE) 1,2,3-Trichlorobenzene	Copper Molybdenum Selenium Zinc

WASTE OIL TANK

Organics		Inorganics
Acenaphthene Alpha Endosulfan Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g,h,i)perylene Beta BHC (Beta Hexachlorocyclohexane) bis(2-Ethylhexyl)phthalate Chloroethane Chrysene cis-1,2-Dichloroethylene Delta BHC (Delta Hexachlorocyclohexane) Dibenz(a,h)anthracene Dibenzofuran 1,1-Dichloroethane Dieldrin 2,4-Dinitrotoluene Endosulfan Sulfate Endrin Endrin Aldehyde Ethylbenzene Fluoranthene	Fluorene Gamma BHC (Lindane) Indeno(1,2,3-cd)pyrene Isopropylbenzene (Cumene) Methoxychlor Methylene Chloride 2-Methylnaphthalene n-Butylbenzene n-Propylbenzene Naphthalene p-Cymene *(p-isopropyltoluene)* p,p'-DDD p,p'-DDT PCB-1260 (Arochlor 1260) PCB-1254 (Arochlor 1254) Phenanthrene Pyrene sec-Butylbenzene Trichloroethylene (TCE) 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene (Mesitylene) Vinyl Chloride Xylenes, Total	Aluminum Barium Copper Molybdenum Zinc

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TABLE 3.4-2
CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL (0- TO 3-FOOT INTERVAL)

PLATING ROOM

Organics	Inorganics
Acetone Alpha Endosulfan bis(2-Ethylhexyl)phthalate Methylene Chloride Trichloroethylene (TCE)	Arsenic Barium Beryllium Cadmium Chromium, Total Cobalt Copper Cyanide Lead Manganese Molybdenum Nickel Vanadium Zinc

RESERVOIR

Organics	Inorganics
Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene bis(2-Ethylhexyl)phthalate Chrysene Delta BHC (Delta Hexachlorocyclohexane) Dieldrin Endrin Aldehyde Fluoranthene Gamma BHC (Lindane) Heptachlor Heptachlor Epoxide Methylene Chloride Pyrene Trichloroethylene (TCE)	Aluminum Chromium, Total Molybdenum

WASTE OIL TANK

Organics	Inorganics
Beta BHC (Beta Hexachlorocyclohexane) cis-1,2-Dichloroethylene Delta BHC (Delta Hexachlorocyclohexane) Dieldrin Endrin Aldehyde Naphthalene p,p'-DDD 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene (Mesitylene)	Aluminum Barium Chromium, Total Manganese Molybdenum

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TABLE 3.4-3
CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL (0- TO 12-FOOT INTERVAL)

PLATING ROOM

Organics		Inorganics
Acetone	Fluoranthene	Cadmium
Acenaphthene	Fluorene	Cyanide
Alpha Endosulfan	Methoxychlor	Molybdenum
Anthracene	Methylene Chloride	
Benzo(a)anthracene	Methyl Ethyl Ketone (2-Butanone)	
Benzo(a)pyrene	p,p'-DDD	
Benzo(b)fluoranthene	PCB-1254 (Arochlor 1254)	
bis(2-Ethylhexyl)phthalate	Phenanthrene	
Bromomethane	Pyrene	
Chrysene	Styrene	
	1,1,1-Trichloroethane	
	Trichloroethylene (TCE)	
	Xylenes, Total	

RESERVOIR

Organics		Inorganics
Anthracene	Gamma BHC (Lindane)	Copper
Benzo(a)anthracene	Heptachlor	Molybdenum
Benzo(a)pyrene	Heptachlor Epoxide	Selenium
Benzo(b)fluoranthene	Indeno(1,2,3-cd)pyrene	Zinc
Benzo(g,h,i)perylene	Methoxychlor	
Beta Endosulfan	Methylene Chloride	
bis(2-Ethylhexyl)phthalate	p,p'-DDD	
Chrysene	p,p'-DDT	
Delta BHC (Delta Hexachlorocyclohexane)	PCB-1260 (Arochlor 1260)	
Dieldrin	Phenanthrene	
Endrin	Pyrene	
Endrin Aldehyde	Trichloroethylene (TCE)	
Fluoranthene	1,2,3-Trichlorobenzene	

WASTE OIL TANK

Organics		Inorganics
Acenaphthene	Fluoranthene	Aluminum
Alpha Endosulfan	Fluorene	Barium
Anthracene	Gamma BHC (Lindane)	Molybdenum
Benzo(a)anthracene	Indeno(1,2,3-cd)pyrene	Zinc
Benzo(a)pyrene	Isopropylbenzene (Cumene)	
Benzo(b)fluoranthene	Methylene Chloride	
Benzo(g,h,i)perylene	2-Methylnaphthalene	
Beta BHC (Beta Hexachlorocyclohexane)	n-Butylbenzene	
bis(2-Ethylhexyl)phthalate	n-Propylbenzene	
Chloroethane	Naphthalene	
Chrysene	p-Cymene(p-Isopropyltoluene)	
cis-1,2-Dichloroethylene	p,p'-DDD	
Delta BHC (Delta Hexachlorocyclohexane)	p,p'-DDT	
Dibenz(a,h)anthracene	PCB-1254 (Arochlor 1254)	
Dibenzofuran	Phenanthrene	
1,1-Dichloroethane	Pyrene	
Dieldrin	sec-Butylbenzene	
2,4-Dinitrotoluene	Trichloroethylene (TCE)	
Endosulfan Sulfate	1,2,4-Trimethylbenzene	
Endrin	1,3,5-Trimethylbenzene (Mesitylene)	
Endrin Aldehyde	Vinyl Chloride	
Ethylbenzene	Xylenes, Total	

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TABLE 3.4-4
CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER

Organics	Inorganics
Alpha Endosulfan Beta Endosulfan Bis(2-ethylhexyl)phthalate Bromodichloromethane Bromoform Chloroform Delta BHC Dibromochloromethane Dichlorodifluoromethane Gamma BHC p,p'-DDD	Arsenic Barium Copper Manganese Zinc

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detected in any groundwater samples were deleted from further consideration. A qualitative comparison was performed for inorganic analytes that were detected in site samples but not in background samples. Arsenic, lead, and vanadium detections in groundwater samples from the deep zone were found to be less than background PQLs; therefore, deep zone concentrations for these analytes were considered to be within background levels and they were eliminated as chemicals of potential concern for the deep zone. All other inorganic analytes were compared to background data by comparing maximum site concentrations to maximum background concentrations as described in Section 3.4.1.2. Appendix R provides the comparison results for groundwater data to justify the retention or deletion of an inorganic analyte as a chemical of potential concern in groundwater.

All organic analytes detected in one or more groundwater samples were retained as chemicals of potential concern because they are not naturally occurring compounds.

Table 3.4-5 presents a list of the chemicals of potential concern for the shallow and deep groundwater zones.

3.4.1.5 Selection of Chemicals of Potential Concern in Air. For future industrial workers and 30-year residents, the chemicals of potential concern for fugitive dust are the same as the chemicals of potential concern for site surface soil. The method used for the selection of the chemicals of potential concern for soil is described in Section 3.4.1.2. Table 3.4-2 presents a list of the chemicals of potential concern for site surface soil. For future construction workers who may contact subsurface soil (i.e., the 0- to 12-foot interval), the chemicals of potential concern for fugitive dust are the same as the chemicals of potential concern for site subsurface soil. Table 3.4-3 presents a list of the chemicals of potential concern selected for site subsurface soil.

In addition to contaminated fugitive dust, organic soil contaminants may volatilize into soil air spaces and migrate to the soil surface, where they may potentially be emitted into the atmosphere. All chemicals of concern in the 0- to 12-foot interval with a vapor pressure greater than 1 millimeter mercury (mm Hg) at standard temperature and pressure were assumed to have volatile emission potential and, therefore, to be volatile chemicals of concern in air. The USEPA recommends a vapor pressure threshold of 10 mm Hg in the accidental release provisions of the Clean Air Act Amendments (Federal Register, 1994). Consequently, use of a volatile vapor pressure of 1 mm Hg is considered conservative. Table 3.4-6 presents a list of the volatile chemicals of potential concern for air.

3.4.1.6 Exclusion of Certain Inorganic Chemicals of Potential Concern. The concentrations of calcium, iron, magnesium, potassium, and sodium statistically exceeded background concentrations in some environmental media (i.e., soil, surface water, groundwater, or air) (see Appendix R). However, these metals were not selected as chemicals of potential concern in any medium because: (1) they are essential elements in the diet of living organisms, (2) their levels are normally under physiological control, (3) they were detected at levels only slightly above background, and (4) they are toxic only at very high doses. These inorganics were eliminated from further consideration in this risk assessment in accordance with USEPA guidance (USEPA, 1989a).

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TABLE 3.4-5
CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER: SHALLOW AND DEEP ZONE

SHALLOW ZONE	
Organics	**Inorganics**
Beta BHC	Barium
Beta Endosulfan	Beryllium
Bromodichloromethane	Chromium, Total
Carbon Tetrachloride	Nickel
Chloroform (Trichloromethane)	Silver
Chloroethane	Vanadium
cis-1,2-Dichloroethene	
Delta BHC	
1,1-Dichloroethane	
1,1-Dichloroethene	
Ethylbenzene	
Gamma BHC	
Heptachlor	
Isopropylbenzene (Cumene)	
Methylene Chloride	
n-Propylbenzene	
Naphthalene	
Toluene	
trans-1,2-Dichloroethene	
1,1,1-Trichloroethane	
1,2,4-Trichlorobenzene	
Trichloroethylene (TCE)	
Trichlorofluoromethane	
1,2,4-Trimethylbenzene	
1,3,5-Trimethylbenzene	
Vinyl Chloride	
Xylenes, Total	

TABLE 3.4-5
CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER: SHALLOW AND DEEP ZONE

Continued

DEEP ZONE	
Organics	**Inorganics**
Beta BHC Bis(2-ethylhexyl)phthalate Chloromethane cis-1,2-Dichloroethene Delta BHC 1,1-Dichloroethane Ethylbenzene Gamma BHC Methoxychlor p,p'-DDE p,p'-DDT 1,1,1-Trichloroethane Trichloroethylene (TCE) 1,3,5-Trimethylbenzene Vinyl Chloride Xylenes, Total	Aluminum Barium Manganese Thallium

TABLE 3.4-6
VOLATILE ORGANIC COMPOUNDS OF POTENTIAL CONCERN IN AIR

PLATING ROOM

Organics
Acetone
Bromomethane
Methylene chloride
Methyl Ethyl Ketone (2-Butanone)
1,1,1-Trichloroethane
Trichloroethylene (TCE)
Xylenes, Total

RESERVOIR

Organics
Methylene Chloride
Trichloroethylene (TCE)

WASTE OIL TANK

Organics
Chloroethane
cis-1,2-Dichloroethylene
Dibenzofuran
1,1-Dichloroethane
Ethylbenzene
Isopropylbenzene (Cumene)
Methylene Chloride
n-Propylbenzene
n-Butylbenzene
p-Cymene (p-isopropyltoluene)
sec-Butylbenzene
Trichloroethylene (TCE)
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene (Mesitylene)
Vinyl Chloride
Xylenes, Total

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TABLE 3.4-7
POTENTIAL PATHWAYS OF EXPOSURE TO CHEMICALS OF POTENTIAL CONCERN

CURRENT LAND USE CONDITIONS			
Medium	**Route of Exposure**	**Receptor**	**Complete Pathway**
Surface Water (off-site)	Dermal absorption while wading	Recreational users (i.e., 7 through 15 year age range) of Little Choconut Creek	Yes. Recreational users have been observed who are wading in the creek while fishing.
Surface Water (off-site)	Incidental Ingestion while swimming	Recreational users of Little Choconut Creek	No. Creek is too shallow to allow swimming.
Fish (off-site)	Ingestion	Recreational users of Little Choconut Creek	Yes. Recreational users have been observed fishing in the creek.
Soil (on-site)	Incidental Ingestion Dermal absorption	Industrial (plant) workers	No. Site soil is 98% covered by impermeable material (i.e., building material and the asphalt parking lot).
Air (on-site)	Inhalation of VOCs Inhalation of fugitive dust	Industrial (plant) workers at the Plating Room Area and the Reservoir Area	No. Site soil is 98% covered by impermeable material (i.e., building material and the asphalt parking lot).
Air (on-site)	Inhalation of VOCs	Industrial (plant) workers at the Waste Oil Tank Area	Yes. A substantial area of soil is covered with approximately 6" of gravel. VOCs could be emitted to air from soil below.
Air (on-site)	Inhalation of fugitive dust	Industrial (plant) workers at the Waste Oil Tank Area	No. Area is either covered with asphalt, or approximately 6" of gravel, which would suppress generation of fugitive dust.
Air (off-site)	Inhalation of VOCs Inhalation of fugitive dust	Residents	No. Site soil is 98% covered by impermeable material (i.e., building material and the asphalt parking lot).
Groundwater (on-site)	Ingestion	Industrial (plant) workers	No. Potable supply wells are not located on site.
Groundwater (off-site)	Ingestion Inhalation while showering Dermal absorption while showering	Residents; Industrial (plant) workers	Yes. The magnitude of exposure cannot be evaluated because validated samples have not been collected from groundwater supplied by the Camden Street Wellfield. Also groundwater contamination is already being remediated through use of an air stripper. Finally, the magnitude of exposure cannot be quantified because the contribution of contaminants migrating from AFP 59 cannot be determined.

TABLE 3.4-7
POTENTIAL PATHWAYS OF EXPOSURE TO CHEMICALS OF POTENTIAL CONCERN

Continued

FUTURE LAND USE CONDITIONS			
Medium	**Route of Exposure**	**Receptor**	**Complete Pathway**
Soil (on-site)	Dermal absorption Incidental ingestion	Industrial workers	Yes, assuming industrial development occurs on site and soil is exposed.
Soil (on-site)	Dermal absorption Incidental ingestion	Construction workers	Yes, assuming industrial development occurs on site which requires excavation.
Air (on-site)	Inhalation of VOCs Inhalation of fugitive dust	Industrial workers	Yes, assuming industrial development occurs on site and soil is exposed.
Air (on-site)	Inhalation of VOCs Inhalation of fugitive dust	Construction workers	Yes, assuming industrial development occurs on site which requires excavation.
Air (off-site)	Inhalation of VOCs Inhalation of fugitive dust	30-year residents	Yes, assuming industrial development occurs on site and soil is exposed.
Groundwater (off-site)	Ingestion	Industrial workers	Yes. Groundwater contamination could reach supply wells in the Johnson City Municipal Wellfield in the future.
Groundwater (off-site)	Ingestion Dermal absorption while showering Inhalation while showering	30-year residents	Yes. Groundwater contamination could reach supply wells in the Johnson City Municipal Wellfield in the future.
Groundwater (on-site)	Ingestion Dermal absorption while showering Inhalation while showering	Industrial workers; 30-year residents	No. It is highly unlikely that potable supply wells will be developed on site.
Vegetables, fruit (on-site)	Ingestion	30-year residents	No. Future development is assumed to be industrial.
Soil (on-site); air (on-site)	Incidental Ingestion Dermal absorption Inhalation of VOCs Inhalation of fugitive dust	30-year residents	No. Future development in assumed to be industrial.

3.4.2 Exposure Assessment

This section presents the following: a pathway analysis in Section 3.4.2.1; estimates of chemical concentrations at receptors and groundwater and air modeling methodologies in Section 3.4.2.2; and exposure model summaries and exposure estimates in Section 3.4.2.3. Results are presented in tabular formats accompanied by a discussion of the method used in each assessment.

3.4.2.1 Exposure Pathway Analysis. Potential current and future human receptors who could contact contaminated media either at or migrating from the site were identified in the Conceptual Site Model (Section 3.3). These receptors are current recreational users of Little Choconut Creek, current industrial workers at the Waste Oil Tank Area, current off-site residents, future on-site industrial workers, future on-site construction workers, and future off-site 30-year residents. The rationale and justification for identification of complete exposure pathways is presented in Section 3.3.3 of the Conceptual Site Model. Table 3.4-7 presents a summary of potential exposure pathways discussed in Section 3.3.3 for all identified receptors by contaminated media. Pathway completion is analyzed; justification for considering a potential pathway as complete or incomplete is provided.

3.4.2.2 Concentrations of Chemicals of Potential Concern at Points of Exposure. The arithmetic mean, 95 percent upper confidence limit (UCL) of the arithmetic mean, or the maximum value was used to represent chemical concentrations in soil, groundwater, surface water, and air at appropriate human receptors. The following formula was used to quantify the arithmetic mean exposure point concentration at a receptor for each chemical of potential concern:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} C_i$$

Where: $\bar{x}$ = Arithmetic mean concentration
n = Number of samples
C_i = Contaminant concentration.

The 95 percent UCL of the mean contaminant concentrations at receptors were quantified according to USEPA guidance (USEPA, 1992e). The 95 percent UCL of the arithmetic mean concentration for each chemical of potential concern was calculated on the basis of the distribution of the analytical results (i.e., normal, lognormal or non-normal). For chemicals having three or more analytical results, the Shapiro-Wilk distribution test was used to determine the distribution of analytical results for each chemical of potential concern. For chemicals having less than three analytical results, the concentration distribution was assumed to be lognormal. For all concentrations of chemicals of potential concern that were reported as nondetectable concentrations (i.e., the chemical concentration did not exceed the laboratory detection limit as represented by the PQL), a value of one-half the detection limit was used for calculating exposure concentrations in accordance with USEPA guidance (USEPA, 1989a).

The following formula was used to quantify the 95 percent UCL of the arithmetic mean concentration for normally distributed data at a receptor (USEPA, 1992e):

$$95\%\ UCL\ of\ the\ arithmetic\ mean = \bar{x} + \left(t_{0.95,\ n-1}\right)\left(\frac{s}{\sqrt{n}}\right)$$

Where:
$\bar{x}$ = Arithmetic mean concentration
$t_{0.95,\ n-1}$ = 95 percent t distribution value for n-1 degrees of freedom
s = Standard deviation
n = Number of samples.

The following formula was used to quantify the 95 percent UCL of the arithmetic mean concentration for lognormally or non-normally distributed data at a receptor (USEPA, 1992e):

$$95\%\ UCL\ of\ the\ arithmetic\ mean = e^{\left(\bar{x} + 0.5s^2 + sH/\sqrt{n - 1}\right)}$$

Where:
e = Base of natural log, approximately equal to 2.718
$\bar{x}$ = Mean of the natural logarithms of the analyte concentrations
s = Standard deviation of the natural logarithms of the analyte concentrations
H = H-statistic
n = Number of samples.

In those cases where the 95 percent UCL of the mean concentration exceeded the maximum detected concentration of a contaminant, the maximum detected concentration was used as the exposure concentration (USEPA, 1989a).

For some exposure point concentrations, the arithmetic mean concentration exceeded the maximum concentration that was substituted for the 95% UCL concentration. In this case, the maximum concentration was less than ½ the PQL. As a result, the maximum concentration (or 95% UCL concentration) was less than the arithmetic mean concentration.

Xylene isomers were reported by the analytical laboratory as o-xylene and m,p-xylene concentrations. Isomer concentrations were summed to quantify a total xylene concentration. This procedure was implemented because toxicity values do not exist for both m,p-xylene and o-xylene. Toxicity values do exist for total xylenes. If only one analyte was detected in a sample, the detected concentration and the detection limit of the other analyte were summed to estimate the concentration of total xylenes. If neither analyte was detected, one-half the detection limit of the analyte with the greatest detection limit was used to estimate the total xylene concentration.

If both analytes were detected in a sample, the concentrations were summed. By estimating a total xylene concentration, intake and risk could be quantified for applicable exposure pathways.

3.4.2.2.1 Soil. Future on-site industrial workers who may contact chemicals in surface soil (i.e., the 0- to 3-foot soil interval) were identified in the Conceptual Site Model. Table 3.4-8 presents concentrations of chemicals of potential concern in surface soil for these receptors at each source area. Future construction workers who may contact subsurface soil (i.e., the 0- to 12-foot soil interval) were also identified in the Conceptual Site Model. Table 3.4-9 presents concentrations of chemicals of potential concern in the subsurface soil for these receptors at each source area.

3.4.2.2.2 Surface Water. Concentrations of chemicals of concern at receptors were calculated using unfiltered surface water data. Two completed exposure pathways for current surface water users were identified in Table 3.4-7 based on field observation of current uses of Little Choconut Creek. Estimated concentrations of chemicals of potential concern in surface water at the receptor are provided in Table 3.4-10.

3.4.2.2.3 Groundwater. Concentrations of chemicals of potential concern at receptors were calculated using unfiltered groundwater data. The data from the shallow and deep zones of the aquifer beneath the plant were considered separately.

Groundwater modeling of VOCs and SVOCs was conducted to quantitatively evaluate the impact of groundwater contamination originating at AFP 59 on the Camden Street Wellfield. Future off-site concentrations of pesticides and inorganics were not modeled because these analytes are not susceptible to the contaminant fate mechanisms that affect VOC and SVOC concentrations. Instead, the mean and 95% UCL of the mean site concentrations were assumed to have migrated to the Camden Street Wellfield and were used in risk calculations. Estimated chemical concentrations of pesticides and metals in the shallow and deep zone are presented in Tables 3.4-11 and 3.4-12, respectively.

To evaluate the impact of groundwater contamination originating at AFP 59 on the Camden Street Wellfield, a model capable of predicting maximum concentrations and travel times at the wellfield was required. The Solute Model, developed by the International Ground Water Modeling Center in Golden, Colorado, was selected. The model is a simplified one-dimensional, analytical solute transport model that is based on the advection-dispersion-retardation equation. The partial differential equation from which the model was developed is the following:

$$D \frac{\delta^2 c}{\delta x^2} - V \frac{\delta c}{\delta x} = R \frac{\delta c}{\delta t}$$

Where: D = Coefficient of longitudinal dispersion
R = Retardation factor
x = Horizontal groundwater flow direction

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Table 3.4-8
Plating Room
Chemical Concentrations in Surface Soil (0 to 3 feet) at Receptors

Receptor: Future Onsite Industrial Workers		Arithmetic Mean Concentration (mg/kg)		95% UCL Concentration (mg/kg)	
Chemical Category	Chemical				
Inorganics	ARSENIC	9.83		10.52	
	BARIUM	41.55		47.38	
	BERYLLIUM	0.48		0.52	
	CADMIUM	4.6	(a)	3.7	
	CHROMIUM, TOTAL	42.3		60.6	
	COBALT	4.9		6.1	
	COPPER	67.4	(a)	67.1	
	CYANIDE	0.60		0.72	
	LEAD	398.0	(a)	331.6	
	MANGANESE	368.2		440.3	
	MOLYBDENUM	681.6		4060.0	(b)
	NICKEL	37.4		50.6	
	VANADIUM	7.3		9.7	
	ZINC	304.8	(a)	153.4	
Pesticides/PCBs	ALPHA ENDOSULFAN	0.0022	(a)	0.0011	(b)
Semi-Volatile Organics	bis(2-ETHYLHEXYL) PHTHALATE	0.30		0.42	
Volatile Organics	ACETONE	0.295		0.569	
	METHYLENE CHLORIDE	0.007		0.007	
	TRICHLOROETHYLENE (TCE)	0.009		0.013	

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, the arithmetic mean concentration exceeds the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean.

(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

Table 3.4-8
Reservoir
Chemical Concentrations in Surface Soil (0 to 3 feet) at Receptors

Receptor: Future Onsite Industrial Workers		Arithmetic Mean Concentration (mg/kg)		95% UCL Concentration (mg/kg)	
Chemical Category	Chemical				
Inorganics	ALUMINUM	7830		13400.0	(b)
	CHROMIUM, TOTAL	9.5		15.6	(b)
	MOLYBDENUM	11.7		17.9	(b)
Pesticides/PCBs	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0005		0.0009	(b)
	DIELDRIN	0.005	(a)	0.0036	(b)
	ENDRIN ALDEHYDE	0.009		0.014	(b)
	GAMMA BHC (LINDANE)	0.0012	(a)	0.0006	(b)
	HEPTACHLOR	0.0016		0.0021	
	HEPTACHLOR EPOXIDE	0.006	(a)	0.0049	(b)
Semi-Volatile Organics	BENZO(a)ANTHRACENE	0.21	(a)	0.2	(b)
	BENZO(a)PYRENE	0.15	(a)	0.14	(b)
	BENZO(b)FLUORANTHENE	0.20		0.29	(b)
	bis(2-ETHYLHEXYL) PHTHALATE	0.29	(a)	0.2	(b)
	CHRYSENE	0.30	(a)	0.2	(b)
	FLUORANTHENE	0.19		0.3	(b)
	PYRENE	0.20		0.29	(b)
Volatile Organics	METHYLENE CHLORIDE	0.024		0.034	
	TRICHLOROETHYLENE (TCE)	0.008		0.0084	

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, the arithmetic mean concentration exceeds the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean.
(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

Table 3.4-8
Waste Oil Tanks
Chemical Concentrations in Surface Soil (0 to 3 feet) at Receptors

Receptor: Future Onsite Industrial Workers

Chemical Category	Chemical	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)
Inorganics	ALUMINUM	10797	11500.0 (b)
	BARIUM	59.90	74.9 (b)
	CHROMIUM, TOTAL	12.8	13.6 (b)
	MANGANESE	499.0	678.0 (b)
	MOLYBDENUM	9.0	14.8 (b)
Pesticides/PCBs	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.004 (a)	0.0017 (b)
	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0006	0.001 (b)
	DIELDRIN	0.005 (a)	0.0039 (b)
	ENDRIN ALDEHYDE	0.020	0.043 (b)
	p,p'-DDD	0.004	0.0056 (b)
Semi-Volatile Organics	NAPHTHALENE	0.12	0.15 (b)
Volatile Organics	1,2,4-TRIMETHYLBENZENE	0.007 (a)	0.0026 (b)
	1,3,5-TRIMETHYLBENZENE (MESITYLENE)	0.007 (a)	0.0046 (b)
	cis-1,2-DICHLOROETHYLENE	0.010	0.013 (b)

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, the arithmetic mean concentration exceeds the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean.

(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

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Table 3.4-9
Plating Room
Chemical Concentrations in Subsurface Soil (0 to 12 feet) at Receptors

Receptor: Future Onsite Construction Workers

Chemical Category	Chemical	Arithmetic Mean Concentration (mg/kg)		95% UCL Concentration (mg/kg)	
Inorganics	CADMIUM	3.3	(a)	2.4	
	CYANIDE	0.51		0.59	
	MOLYBDENUM	259.5	(a)	167.9	
Pesticides/PCBs	ALPHA ENDOSULFAN	0.0027	(a)	0.0026	(b)
	METHOXYCHLOR	0.018	(a)	0.013	(b)
	p,p'-DDD	0.009	(a)	0.0022	(b)
	PCB-1254 (AROCHLOR 1254)	0.035		0.074	
Semi-Volatile Organics	ACENAPHTHENE	0.19	(a)	0.15	(b)
	ANTHRACENE	0.22		0.25	
	BENZO(a)ANTHRACENE	0.32		0.35	
	BENZO(a)PYRENE	0.23		0.26	
	BENZO(b)FLUORANTHENE	0.31		0.32	
	bis(2-ETHYLHEXYL) PHTHALATE	0.32		0.37	
	CHRYSENE	0.38		0.46	
	FLUORANTHENE	0.42	(a)	0.40	
	FLUORENE	0.18	(a)	0.11	(b)
	PHENANTHRENE	0.30		0.32	
	PYRENE	0.37	(a)	0.36	
Volatile Organics	1,1,1-TRICHLOROETHANE	0.018	(a)	0.0087	(b)
	ACETONE	0.240		0.412	
	BROMOMETHANE	0.018	(a)	0.014	
	METHYL ETHYL KETONE (2-BUTANONE)	0.045	(a)	0.00454	(b)
	METHYLENE CHLORIDE	0.026		0.036	
	STYRENE	0.018	(a)	0.00124	(b)
	TRICHLOROETHYLENE (TCE)	0.024		0.027	
	XYLENES, TOTAL	0.018	(a)	0.00273	(b)

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, *the arithmetic mean concentration* exceeds the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean.

(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

Table 3.4-9
Reservoir
Chemical Concentrations in Subsurface Soil (0 to 12 feet) at Receptors

Receptor: Future Onsite Construction Workers Chemical Category	Chemical	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)
Inorganics	COPPER	46.5	63.0
	MOLYBDENUM	11.9	16.2
	SELENIUM	0.7 (a)	0.56 (b)
	ZINC	178.9	277.2
Pesticides/PCBs	BETA ENDOSULFAN	0.011 (a)	0.0053 (b)
	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0005	0.0005
	DIELDRIN	0.006 (a)	0.0036 (b)
	ENDRIN	0.006 (a)	0.0024 (b)
	ENDRIN ALDEHYDE	0.008	0.010
	GAMMA BHC (LINDANE)	0.0014 (a)	0.0006 (b)
	HEPTACHLOR	0.0014	0.0016
	HEPTACHLOR EPOXIDE	0.008 (a)	0.0049 (b)
	METHOXYCHLOR	0.018	0.020
	p,p'-DDD	0.005	0.0061 (b)
	p,p'-DDT	0.006 (a)	0.0049 (b)
	PCB-1260 (AROCHLOR 1260)	0.04	0.04
Semi-Volatile Organics	ANTHRACENE	0.23 (a)	0.14 (b)
	BENZO(a)ANTHRACENE	0.27	0.32
	BENZO(a)PYRENE	0.20	0.24
	BENZO(b)FLUORANTHENE	0.26	0.34
	BENZO(g,h,i)PERYLENE	0.21 (a)	0.15
	bis(2-ETHYLHEXYL) PHTHALATE	0.3 (a)	0.2 (b)
	CHRYSENE	0.4	0.4
	FLUORANTHENE	0.27	0.39
	INDENO(1,2,3-c,d)PYRENE	0.4 (a)	0.16 (b)
	PHENANTHRENE	0.24	0.29
	PYRENE	0.28	0.36
Volatile Organics	1,2,3-TRICHLOROBENZENE	0.011 (a)	0.0031 (b)
	METHYLENE CHLORIDE	0.021	0.024
	TRICHLOROETHYLENE (TCE)	0.012	0.013

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, the arithmetic mean concentration exceeds the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean.

(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

Table 3.4-9
Waste Oil Tanks
Chemical Concentrations in Subsurface Soil (0 to 12 feet) at Receptors

Receptor: Future Onsite Construction Workers

Chemical Category	Chemical	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)
Inorganics	ALUMINUM	10703	11409
	BARIUM	57.69	68.41
	MOLYBDENUM	11.0	14.4
	ZINC	93.7	116.2
Pesticides/PCBs	ALPHA ENDOSULFAN	0.004 (a)	0.0028 (b)
	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.007 (a)	0.0043 (b)
	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0007	0.0009
	DIELDRIN	0.007 (a)	0.0039 (b)
	ENDOSULFAN SULFATE	0.01	0.01
	ENDRIN	0.008	0.0088 (b)
	ENDRIN ALDEHYDE	0.013	0.018
	GAMMA BHC (LINDANE)	0.002 (a)	0.0006 (b)
	p,p'-DDD	0.007 (a)	0.0056 (b)
	p,p'-DDT	0.008	0.008 (b)
	PCB-1254 (AROCHLOR 1254)	0.03	0.03
Semi-Volatile Organics	2,4-DINITROTOLUENE	0.5 (a)	0.41 (b)
	2-METHYLNAPHTHALENE	0.3	0.3
	ACENAPHTHENE	0.5 (a)	0.29 (b)
	ANTHRACENE	0.6 (a)	0.42 (b)
	BENZO(a)ANTHRACENE	0.6	0.9
	BENZO(a)PYRENE	0.4	0.7
	BENZO(b)FLUORANTHENE	0.5	0.8
	BENZO(g,h,i)PERYLENE	0.5 (a)	0.49 (b)
	bis(2-ETHYLHEXYL) PHTHALATE	0.4	0.5
	CHRYSENE	0.8	1.0 (b)
	DIBENZ(a,h)ANTHRACENE	0.5 (a)	0.11 (b)
	DIBENZOFURAN	0.5 (a)	0.36 (b)
	FLUORANTHENE	0.5	1.0
	FLUORENE	0.4	0.45 (b)
	INDENO(1,2,3-c,d)PYRENE	0.8 (a)	0.45 (b)
	NAPHTHALENE	0.3	0.6
	PHENANTHRENE	0.5	0.7
	PYRENE	0.6	1.0
Volatile Organics	1,1-DICHLOROETHANE	0.008	0.009
	1,2,4-TRIMETHYLBENZENE	0.012	0.015
	1,3,5-TRIMETHYLBENZENE (MESITYLENE)	0.022	0.029
	CHLOROETHANE	0.011 (a)	0.0045 (b)
	cis-1,2-DICHLOROETHYLENE	0.016	0.020
	ETHYLBENZENE	0.008 (a)	0.0013 (b)
	ISOPROPYLBENZENE (CUMENE)	0.009 (a)	0.0027 (b)
	METHYLENE CHLORIDE	0.027	0.035
	n-BUTYLBENZENE	0.011	0.013
	n-PROPYLBENZENE	0.009 (a)	0.0078 (b)
	P-CYMENE (p-ISOPROPYLTOLUENE)	0.011	0.013
	SEC-BUTYLBENZENE	0.009	0.011
	TRICHLOROETHYLENE (TCE)	0.009	0.010
	VINYL CHLORIDE	0.009	0.010
	XYLENES, TOTAL	0.010	0.011

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, the arithmetic mean concentration exceeds the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean.

(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

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Table 3.4-10
Little Choconut Creek
Chemical Concentrations in Surface Water at Receptors

Receptor: Current Recreational Users of Little Choconut Creek		Arithmetic Mean Concentration (ug/L)	95% UCL Concentration (ug/L)
Chemical Category	Chemical		
Inorganics	ARSENIC	4.6 (a)	2.9 (b)
	BARIUM	41.4	64.0 (b)
	CHROMIUM, TOTAL	8.3 (a)	6.0 (b)
	COPPER	7.8	13.3 (b)
	LEAD	3.6 (a)	3.2 (b)
	MANGANESE	16.9	34.5 (b)
	ZINC	19.7	29.9 (b)
Volatile Organics	BROMODICHLOROMETHANE	0.37	0.6 (b)
	BROMOFORM	0.53	1.1 (b)
	CHLOROFORM	0.36 (a)	0.33 (b)
	DIBROMOCHLOROMETHANE	0.49	0.96 (b)
	DICHLORODIFLUOROMETHANE	0.5 (a)	0.38 (b)
Pesticides/PCBs	ALPHA ENDOSULFAN	0.013	0.014 (b)
	BETA ENDOSULFAN	0.011 (a)	0.0068 (b)
	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0011	0.0018 (b)
	GAMMA BHC (LINDANE)	0.010	0.013 (b)
	p,p'-DDD	0.023 (a)	0.018 (b)
Semi-Volatile Organics	bis(2-ETHYLHEXYL) PHTHALATE	6 (a)	3.0 (b)

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, the arithmetic mean concentration exceeds the maximum detected concentration.

(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

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Table 3.4-11
Chemical Concentrations of Pesticides and Metals in the Shallow Groundwater Zone

Receptor: Future Offsite 30-year Residents; Future Onsite Industrial Workers		Arithmetic Mean Concentration (ug/L)		95% UCL Concentration (ug/L)	
Chemical Category	Chemical				
Inorganics	BARIUM	146.6		337.0	(b)
	BERYLLIUM	0.7		0.7	(b)
	CHROMIUM, TOTAL	10.8		14.7	
	NICKEL	27.5		31.8	
	SILVER	4.6		5.5	
	VANADIUM	5.0		7.1	
Pesticides/PCBs	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.022	(a)	0.01	(b)
	BETA ENDOSULFAN	0.012	(a)	0.01	(b)
	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0015		0.0037	(b)
	GAMMA BHC (LINDANE)	0.012	(a)	0.0043	(b)
	HEPTACHLOR	0.012	(a)	0.0095	(b)

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, the arithmetic mean concentration exceeds the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean.

(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

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Table 3.4-12
Chemical Concentrations of Pesticides and Metals in the Deep Groundwater Zone

Receptor: Future Offsite 30-year Residents; Future Onsite Industrial Workers		Arithmetic Mean Concentration (ug/L)		95% UCL Concentration (ug/L)	
Chemical Category	Chemical				
Inorganics	ALUMINUM	1000		1000	
	BARIUM	98.4		181.5	
	MANGANESE	666.1		950.7	
	THALLIUM	15.5		46.8	(b)
Pesticides/PCBs	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.023	(a)	0.0089	(b)
	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0030		0.011	(b)
	GAMMA BHC (LINDANE)	0.012	(a)	0.0049	(b)
	METHOXYCHLOR	0.12	(a)	0.09	(b)
	p,p'-DDE	0.040		0.071	
	p,p'-DDT	0.032	(a)	0.016	(b)

(a) Because of the frequency of non-detects and because one-half the Practical Quantitation Limit (PQL) is greater than the maximum detected value, the arithmetic mean concentration exceeds the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean.

(b) Since the one-sided 95% Upper Confidence Limit (UCL) of the Arithmetic Mean exceeded the maximum, the maximum is used.

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V = Seepage velocity in the x direction
c = Concentration of solute in groundwater
t = Travel time.

The model was developed for one-dimensional, nonreactive contaminant transport. Contaminant fate mechanisms, such as biodegradation and area-specific sorption and retardation factors, are not fully addressed by this model. Consequently, modeling results from the Solute Model represent a conservative, worst-case scenario. The following assumptions are inherent in the model:

- A homogeneous, isotropic aquifer;
- A uniform saturated thickness;
- A uniform velocity along the entire flowpath;
- Steady-state, uniform groundwater flow; and
- No degradation.

MODEL INPUT PARAMETERS. Table 3.4-13 presents the input parameters used for the model. Two types of input parameters are represented in this table: parameters based on actual field measurements and parameters based on literature data. The field-based parameters include hydraulic conductivity, hydraulic gradient, groundwater velocity, and retardation. Parameters selected from the literature include longitudinal dispersion and effective porosity.

Due to the hydraulic separation of the shallow and deep zones of the aquifer (see Section 3.2.1.1), the shallow and deep zones were modeled separately. During modeling of the two aquifer zones, it was assumed that contaminants in both the shallow and deep zones migrated laterally to the wellfield, with no vertical migration of contamination. However, as discussed in the Conceptual Site Model, it was not possible to determine aquifer parameters such as hydraulic conductivity for the shallow zone of the aquifer. Based on results of existing studies in the immediate area, aquifer parameters determined for the deep zone of the aquifer have been applied to the shallow zone during modeling. Results presented in the *Contaminant Source Investigation* (URS Consultants, Inc., 1992) show hydraulic conductivities to be very similar in the shallow and deep zones of the aquifer, supporting the application of deep zone parameters to the shallow zone.

The average hydraulic conductivity was determined using data from the RI pumping test conducted in December 1994. The analysis of the pumping test data is presented in Section 3.2.1.1 of the Conceptual Site Model. An average site hydraulic conductivity of 454.97 ft/day was calculated by averaging the hydraulic conductivities computed for those wells subjected to pumping test analysis.

The hydraulic gradient used in the model was based on groundwater measurements EARTH TECH collected from deep monitoring wells in the vicinity of AFP 59 on August 22-24, 1994. These measurements were used to generate the potentiometric map illustrated in Figure 3-15. The hydraulic gradient represents the difference in groundwater elevation between two points along

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TABLE 3.4-13
SOLUTE MODEL INPUT PARAMETERS

PHYSICAL AND CHEMICAL PARAMETERS FOR BOTH ZONES OF THE AQUIFER[1]		
Average Hydraulic Conductivity (feet/day)	454.97	
Hydraulic Gradient (dimensionless)	0.003	
Effective Porosity (dimensionless)	0.35	
Groundwater Velocity (feet/day)	3.9	
Longitudinal Dispersion (feet)	50	
Contaminant	**Partition Coefficient[2] (K_{oc}) (mL/g)**	**Retardation Factor (R_d) (Dimensionless)**
1,1,1-Trichloroethane	152	3.7
1,1-Dichloroethane	30	1.5
1,1-Dichloroethene	65	2.16
1,2,4-Trichlorobenzene	9200	165
1,2,4-Trimethylbenzene	6700[5]	107.1
1,3,5-Trimethylbenzene	6700[5]	107.1
Bis(2-ethylhexyl)phthalate	2E+09	>1000
Bromodichloromethane	61	2.1
Carbon Tetrachloride	439	8.8
Chloroethane	37[4]	1.6
Chloromethane	35	1.6
Cis-1,2-dichloroethene	49	1.8
Di-n-butylphthalate	162[4]	3.9
Ethylbenzene	1100	20
Isopropylbenzene	2818[6]	45.6
Methylene Chloride	21	1.33
Naphthalene	940[3]	17.8
n-Propylbenzene	676[6]	11.7
Toluene	250[3]	5.4
Trans-1,2-dichloroethene	59	2.0
Trichloroethene	126	3.2
Trichlorofluoromethane	159	3.84
Trichloromethane (Chloroform)	47	1.8
Vinyl Chloride	8.2[3]	1.1
Total Xylenes	268	5.8

Key: NA = Not Available

[1] Field-based parameters calculated from EARTH TECH data.
[2] Source: Sims, Sims, and Hansen (1991), *unless otherwise noted.*
[3] USEPA, 1989e.
[4] NYSDEC, 1994.
[5] K_{oc} *calculated from* K_{ow} *using the* following equation: $\log K_{oc} = 0.937 \log K_{ow} - 0.006$ (Lyman, Reehl, and Rosenblatt, 1982). K_{ow} for both 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene is 12,300 (ASTER, 1995).
[6] Hazardous Substances Data Bank (HSDB), 1995.

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a groundwater flow line divided by the distance between the two points. The site hydraulic gradient of 0.003 was calculated using the following equation:

$$i = H/l$$

Where:
i = Hydraulic gradient (dimensionless)
H = Groundwater elevation differential between two points along a flow line (feet)
l = Distance between the two points along a flow line (feet)

Effective porosity represents the percentage of the total volume of a given mass of soil that consists of interconnecting voids (Bates and Jackson, 1984). Geotechnical analyses are required to determine site-specific effective porosity values. Geotechnical analyses were not conducted during the RI at AFP 59. Therefore, a value of 0.35 was selected from the literature (Freeze and Cherry, 1979) based on the hydrogeology of the aquifer.

The groundwater velocity represents the travel speed of a particle of water. This value was estimated using Darcy's equation:

$$V = \frac{Ki}{n_e}$$

Where:
V = Groundwater velocity (feet/day)
K = Hydraulic conductivity (feet/day)
i = Hydraulic gradient (dimensionless)
n_e = Effective porosity (dimensionless).

Using the hydraulic conductivity, hydraulic gradient, and effective porosity values, the estimated groundwater velocity at the site is 3.9 feet/day.

Hydrodynamic dispersion includes both pore-scale microdispersion and bed-scale macrodispersion. This process causes some contaminants to arrive at downgradient well locations more rapidly than would be expected under advective conditions flow alone. Solute concentrations decrease with increased distance from the source area and greater lateral dispersion occurs parallel to flow (longitudinal dispersion) than perpendicular to flow (transverse dispersion) (Marquis, Copeland, and Holbrow, 1992). Previous field investigations of dispersion suggest that longitudinal dispersivity varies as a function of the scale of the field problem, with higher dispersivity values associated with greater transport distances and/or longer travel times. In the absence of detailed tracer test results, longitudinal dispersivity is generally estimated using a "rule of thumb" in which dispersivity is assigned a value equal to one-tenth the travel distance from the source area to the point where the concentration of the contaminant is estimated. For AFP 59, the average travel distance was set at 500 feet, significantly less than the actual transport distance of 964 feet to 2,018 feet, to maintain a conservative approach. The longitudinal dispersivity value used was 50 feet.

Retardation results from sorption of hydrophobic substances such as dissolved phase VOCs onto soil particles, chemical interactions between subsurface fluids in primary and secondary pores and the geologic media, and migration into discontinuous ("dead-end") pores by diffusion (Marquis, Copeland, and Holbrow, 1992). To determine site-specific retardation factors, organic carbon results from soil samples collected below 10 feet bgs during the RI were used. Total organic carbon content varied from less than 645 parts per million (ppm) to 3,480 ppm. To account for the slower movement of dissolved VOCs in the aquifer, a retardation factor (Rd) was determined for each contaminant (see Table 3.4-13) using the following equation (Bouwer, 1991).

$$R_d = 1 + K_d (1-n)\rho/\theta$$

$$K_d = (F_{oc}) (K_{oc})$$

Where:
R_d = Retardation factor
K_d = Distribution coefficient (contaminant specific)
F_{oc} = Fraction of organic carbon (field tested as 0.002 g/g by averaging all site TOC results from samples collected below 10 feet)
K_{oc} = Soil-water partition coefficient (contaminant specific)
n = Effective porosity (0.35) (dimensionless)
ρ = Mass density of aquifer sediments (2.65 g/cm^3) (Bouwer, 1991)
θ = Volumetric water content of aquifer (0.25 at 100 percent saturation).

MODEL RESULTS. Table 3.4-14 presents the following information: maximum on-site contaminant concentrations detected during RI sampling; the sampling location at which the maximum concentrations were detected; the distance to Johnson City Production Well 2 (the receptor point) from the sampling location; maximum modeled concentrations at the receptor point; and modeled arrival times for the maximum concentrations. Results from the shallow and deep zones of the aquifer were modeled separately and are therefore presented separately in Table 3.4-14.

Maximum analyte concentrations detected on-site were modeled, regardless of the well location. As a result, analyte concentrations from six different shallow wells and four different deep wells were used during the groundwater modeling (see Table 3.4-14). Monitoring well clusters 3 and 11 were the only locations where maximum contaminant concentrations were detected in both the shallow and deep zones of the aquifer. The variable distances from the different wells to Johnson City Production Well 2 were included in the model.

The objective of the modeling effort was to estimate the maximum concentration and time of arrival of each on-site contaminant at the receptor well (Johnson City Production Well 2) located downgradient of AFP 59. Table 3.4-14 presents a summary of the modeling results. Complete model runs are included in Appendix T.

Table 3.4-14
Chemical Concentrations in Groundwater at the Receptor Point Using Solute Model

Contaminant	Maximum Onsite Concentration (μg/L)	Location of Site Maximum	Distance to the Receptor Point Johnson City Well #2 (Feet)	Maximum Concentration at Receptor Point Johnson City Well #2 (μg/L)	Maximum Concentration Arrival Time (Years)
Shallow Zone					
Bromodichloromethane	0.38	SW3	999	0.26	2.0
Carbon Tetrachloride	0.6	SW7	1433	0.11	8.6
Chloroethane	4.2	SW7	1433	3.3	2.0
cis-1,2-dichloroethene	150	SW7	1433	106	2.0
1,1-Dichloroethane	33	SW7	1433	26.3	2.0
1,1-Dichloroethene	2.1	SW4	1747	1.28	2.8
Ethylbenzene	0.68	SW11	2018	0.04	26.5
Isopropylbenzene	1.0	SW11	2018	0.029	60.2
Methylene Chloride	3.1	SW11	2018	2.33	2.5
n-Propylbenzene	0.90	SW11	2018	0.106	15.4
Naphthalene	2.8	SW11	2018	0.21	24
1,1,1-Trichloroethane	20	SW4	1747	7.5	4.5
1,2,4-Trichlorobenzene	2.7	SW4	1747	0	>40
1,2,4-Trimethylbenzene	15	SW11	2018	0.186	144.6
1,3,5-Trimethylbenzene	36	SW11	2018	0.452	141.6
Toluene	1.3	SW11	2018	0.31	7.4
Total Xylenes	6.9	SW11	2018	1.78	8.2
Trans-1,2-dichloroethene	0.3	SW7	1433	0.20	3.9
Trichloroethene	370	SW4	1747	159	4.1
Trichlorofluoromethane	2.8	SW4	1747	1.0	4.9
Trichloromethane	0.46	SW3	999	0.37	1.64
Vinyl Chloride	6.2	SW7	1433	5.6	1.6
Deep Zone					
Bis(2-ethylhexyl)phthalate	5.9	DW11	2018	0	>40
Chloromethane	0.38	DW11	2018	0.25	2.4
1,1-Dichloroethane	2.4	DPW	1449	1.9	2.0
cis-1,2-dichloroethene	36	DW3	999	29.7	1.64
Ethylbenzene	0.40	DW9	964	0.04	11.9
1,1,1-Trichloroethane	1.2	DPW	1449	0.48	4.1
Total Xylenes	0.54	DW9	964	0.18	3.6
Trichloroethene	4.0	DPW	1449	1.8	3.2
Vinyl Chloride	0.28	DW3	999	0.26	1.23

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Results from the Solute Model indicate that the contaminant arrival times vary from 1.23 to more than 40 years. Contaminants with higher retardation values took a considerably longer time to reach the receptor well. Maximum contaminant concentrations at Johnson City Production Well 2 varied from 0 to 159 μg/L for the different contaminants.

Degradation processes and biodegradation would occur during the modeled time frame in the contaminant flow path, and inclusion of their effects in the modeling effort would have resulted in lower contaminant concentrations and longer travel time predictions. In addition, the one-dimensional model used for this effort does not account for dispersion, sorption, retardation, and biodegradation occurring in the transverse direction. Under these simulated conditions, the estimated contaminant concentrations predicted to reach the receptor well are presumed to be higher than expected under natural contaminant migration conditions.

3.4.2.2.4 Air. The methodology used for modeling of VOC and dust emissions for the undisturbed soil and construction scenarios is discussed in this section. This section also includes a discussion of the air dispersion modeling. Concentrations of chemicals of potential concern in air for each receptor are provided in Appendix V.

AIR EMISSIONS - UNDISTURBED SOIL SCENARIOS. Air emissions of VOCs will occur from soil *in-situ* as contaminant vapor migrates through the soil pore spaces to the surface of the site. Although emissions of VOCs are negligible under current conditions at AFP 59, where impermeable material (concrete, asphalt, buildings, etc) covers most of the site, future scenarios allow for the complete removal of such cover as a worst-case exposure.

Ideally, the concentration of a contaminant in the soil pore space gas is used to predict VOC emission rates. However, because soil gas concentrations were not available at AFP 59, the bulk concentration of each contaminant in the soil was used to model VOC emission rates. For each of the three source areas, the mean and 95 percent UCL concentration were calculated for each volatile contaminant in the 0 to 12 feet soil interval. (Concentrations at lower depths were assumed to have minimal impact on surface emissions due to both soil tortuosity considerations and generally lower concentrations.) A contaminant was assumed to be volatile if its vapor pressure at 25°F was greater than 1 mm Hg.

The Shen Model (USEPA, 1989c) was used to determine emission rates for VOC chemicals of potential concern from soil where the concentration of the contaminant in the soil is greater than the contaminant's saturation concentration.

Saturation concentration for a given contaminant is calculated as follows:

$$C_{sat} = K_d S n_{m,s} + S\ \theta_{m,s}$$

Where: C_{sat} = Saturation concentration, mg/kg
K_d = Soil/water partition coefficient, L/kg

S = Solubility of contaminant in water, mg/L-water
$n_{m,s}$ = Soil moisture content for site s, weight fraction
$\theta_{m,s}$ = Soil moisture content for site s, L-water/kg-soil

The Shen Model applies Raoult's law to relate contaminated material composition to emission rate. It assumes that the contaminated material is completely saturated with the constituent being analyzed.

The following form of the Shen Model is used in this analysis:

$$E_{i,s} = D_i C_{si} (P^{4/3}) \frac{M_{i,s}}{d_s} \; x \; 10^4 \; cm^2/m^2$$

Where:
$E_{i,s}$ = Mean or 95% UCL emission rate of volatile chemical of concern *i* for site s, g/sec-m^2
D_i = Diffusion coefficient of volatile chemical of concern *i* in air, cm^2/sec
C_{si} = Saturation vapor concentration of volatile chemical of concern *i*, g/cm^3
P = Soil porosity, dimensionless (assumed to be 0.375 for all sites)
$M_{i,s}$ = Mean or 95% UCL weight fraction of volatile chemical of concern *i* for site s, dimensionless
d_s = Effective depth of soil cover (conservatively assumed to be 1 foot or 30.5 cm), cm

This form of the Shen Model incorporates a worst-case porosity term representative of completely dry soil. The depth of clean soil cover was conservatively assumed to be 1 foot. The contaminant concentration in air at the surface was assumed to be equal to 0.

The Hwang-Falco Model (USEPA, 1992a) was used to determine emission rates for VOC chemicals of potential concern from soil where the concentration of the contaminant is less than the contaminant's saturation concentration. All contaminants are assumed to be in solution with the available soil moisture and adsorbed to soil particles within the soil matrix. This model accounts for depletion of the contaminant over time.

The following form of the Hwang-Falco Model is used in this analysis:

$$E_{i,s} = \frac{2 \, P^{1/3} \, D_i \, K_{as,i} \, C_{i,s}}{\sqrt{\pi \alpha t}} \times 10^4 \, \frac{cm^2}{m^2}$$

Where: $E_{i,s}$ = Mean or 95% UCL emission rate of component *i* for site s, g/s-m^2

P = Soil porosity, dimensionless (assumed to be 0.375 for all sites)

D_i = Effective diffusivity of component *i* in air, cm^2/sec

$K_{as,i}$ = Soil/air partition coefficient of chemical of concern i, g/cm^3

$C_{i,s}$ = Mean or 95% UCL soil concentration of contaminant *i* at site *s*, g/g

t = Exposure interval, sec (9.07×10^8 for 30 year exposure)

$$K_{as,i} = \frac{41\ H}{K_{d,i}}$$

Where: H = Henry's law constant of component *i*, atm - m^3/mole

K_d = Soil/water partition coefficient, mL/g

41 = Conversion factor to convert H to dimensionless form

$$\alpha = \frac{P^{4/3}\ D_i}{P + \rho(1 - P)/K_{as,i}}$$

Where: ρ = Particle density, g/cm^3 (2.65).

PM_{10} (i.e., respirable particulate matter with an aerodynamic diameter of 10 microns or less) contaminant emission rates were calculated for all source areas and chemicals of potential concern. Volatile, semivolatile, and nonvolatile chemicals of concern can be adsorbed to soil particles. Contaminated particles may be emitted from an area as particulate matter. Emissions at an undisturbed site may occur as fugitive dust caused by wind erosion. The following equation (USEPA, 1992a) was used to estimate contaminant particulate emissions:

$$E_{i,s} = (1 - V_s) \left(\frac{[u]}{u_{t,s}} \right)^3 F(x)(C_{i,s})$$

Where: $E_{i,s}$ = Mean or 95% UCL PM_{10} annual average emission rate of chemical of concern *i* for site *s*, g/m^2-sec

V_s = Fraction of site with continuous vegetative cover (equals 0 for bare soil; 0 was assumed for all sites as a worst case)

$[u]$ = Mean annual wind speed at 10 m height conservatively assumed to be 4.5 m/sec

$u_{t,s}$ = Equivalent threshold value of wind speed at 7m anemometer height for site, m/sec

x = $0.886\ u_{t,s}/[u]$ (Empirical value)
F = $0.18\ (8x^3 + 12x)e^{-x^2} \times 10^{-5}$ g/m²-sec (Empirical value)
$C_{i,s}$ = Mean or 95% UCL fractional percent by weight of chemical of concern *i* from bulk sample of surface material *s*

The threshold wind speed will depend on the mean soil particle size. A mean particle size of 0.475 mm, typical of sandy soil, was used for all sites. This form of the dust equation assumes an unlimited reservoir of erodible material. $E_{i,s}$ was calculated based on mean and 95 percent UCL statistics for the 0- to 3- feet soil interval at each source area.

Specific input parameters for these models are presented in Appendix U.

AIR EMISSIONS - CONSTRUCTION SCENARIO. Air emissions from construction occur from VOC emissions and from PM_{10} emissions during the excavation of the site source areas. The model used to calculate the VOC emissions from construction is found in *Estimation of Air Impacts for the Excavation of Contaminated Soil* (USEPA, 1992c). The model used to calculate the PM_{10} emissions is found in *Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites* (USEPA, 1993b). These two models calculate contaminant emission rates from bulk soil contaminant concentrations. Where available, field data were used to calculate the VOC and PM_{10} emission rates. For input parameters that were not known from field data, model default values were used.

The construction scenario used to determine emission rates is taken from the VOC emission model (USEPA, 1992c). This standard construction scenario is based on excavating a 10 m × 15 m × 1 m pit in 1 hour. The scoops from the backhoe are assumed to roughly maintain their shape (1 m × 2 m × 1 m) when added to a stockpile. This produces a pile with 140 m² of surface area that, when added to the 150 m² area of the pit, yields a total surface area of 290 m². From these values the emitting surface area, soil excavation rate, volume of soil moved, and time to excavate a given volume of soil are calculated.

The emission rate for the ith contaminant due to VOC emissions, $ER_{i,VOC}$, is calculated from the two terms, $ER_{i,PS}$, representing the emissions from the soil pore space, and $ER_{i,DIFF}$, representing the diffusion of the VOC from the excavated pit and the soil storage pile. The equations and the input parameters used in the VOC model are shown below.

Equation(1) $$ER_{i,VOC} = ER_{i,PS} + ER_{i,DIFF}$$

Where: $ER_{i,VOC}$ = Emission rate for contaminant i due to VOC emissions, g/sec

Equation(2) $$ER_{i,PS} = \frac{P_i \times MW_i \times 10^6 \times E_{i,a} \times Q}{R \times T}$$

Where: $ER_{i,PS}$ = Pore space emission rate for contaminant i, g/sec
P_i = Vapor pressure for contaminant i, mm Hg
MW_i = Molecular weight for contaminant i, g/g-mol
10^6 = Conversion factor, cm^3/m^3
$E_{i,a}$ = Air filled porosity for contaminant i, dimensionless
Q = Excavation rate, m^3/sec
ExC = Soil-gas to atmosphere exchange constant, dimensionless
R = Gas constant, mm Hg-cm^3 / g-mol °K
T = Ambient temperature, °K

If the porosity emission rate ($ER_{i,PS}$), Equation 2, yields a value that exceeds one-third the total mass of the contaminant in the pore space, $M_{i,G}$, then the following equation should be used to calculate the pore space emissions.

Equation(3)
$$ER_{i,PS} = \frac{M_{i,G}}{3 \times t_{sv}}$$

Where: $M_{i,G}$ = $C_i \times S_v \times 10^6$

And: $M_{i,G}$ = Total mass of contaminant i in soil, g
S_V = Volume of soil moved, m^3
t_{SV} = Time to excavate a given volume of soil, sec
C_i = Bulk soil concentration for contaminant i, g/cm^3

The diffusion term, $ER_{i,DIFF}$, is given by Equation (4).

Equation(4)
$$ER_{i,DIFF} = \frac{C_i \times 10{,}000 \times SA}{\frac{E_{i,a}}{K_{i,eq} \times k_g} + \left[\frac{\pi \times t}{D_{i,e} \times K_{i,eq}}\right]^{\frac{1}{2}}}$$

Where: $ER_{i,DIFF}$ = Diffusivity emission rate for contaminant i, g/sec
Ci = Bulk soil concentration for contaminant i, g/cm^3
SA = Emitting surface area, m^2
$E_{i,a}$ = Air filled porosity for contaminant i, dimensionless

And:

$$K_{i,eq} = \frac{P_i \times MW_i \times E_{i,a}}{R \times T \times C_i}$$

$K_{i,eq}$ = Relative saturation of soil-gas of contaminant i, dimensionless

k_g = Gas-phase mass transfer coefficient, cm/sec

t = Time increment for diffusivity emissions, sec (923 sec)

And:

$$D_{i,e} = \frac{D_{i,a} \times (E_{i,a})^{3.33}}{(E_T)^2}$$

$D_{i,e}$ = Effective diffusivity in air for contaminant i, cm^2/sec

$D_{i,a}$ = Diffusivity in air for contaminant i, cm^2/sec

E_T = Total soil porosity, dimensionless

The $K_{i,eq}$ term represents the relative saturation of the soil-gas with respect to contaminant i and can not realistically exceed 1.0. If the equation for $K_{i,eq}$ yields a value greater than 1.0, then 1.0 is used.

The $ER_{i,VOC}$ emission rate was averaged over the 1 hour excavation time and assumed to be constant for the hour. For simplicity, the time at which the average emission rate occurs was used to calculate the diffusivity term of the VOC emissions, $ER_{i,DIFF}$, to yield the average emission rate for the hour. Based on the emissions versus time curve provided in the reference (USEPA, 1992c), the time at which the average emission occurs was calculated to be approximately 923 seconds.

The pore space emissions and diffusivity emissions were added to obtain the overall emission rate, in g/sec, due to VOC emissions, $ER_{i,VOC}$. To obtain a flux (emission rate per unit area), the $ER_{i,VOC}$ term was divided by the sum of the surface areas of the pile and the pit.

The values that were not available from field data are presented below. These values are defaults obtained from the model's construction scenario.

INPUT VARIABLE DEFAULT/CONSTANT VALUES

Variable or Constant	Value	Unit
ExC	0.333	dimensionless
S_V	150	m^3
t_{SV}	3600	sec
Q	0.0416	m^3/sec
SA	290	m^2
T	298	°K
R	62,361	mm Hg-cm^3 / g-mol °K
k_g	0.15	cm/sec

The contaminant emission rate due to dust, $ER_{i,DUST}$, was calculated using the same construction scenario used by the VOC model. The equation (Equation 5) used in the dust model with the input parameters is shown below.

$$Equation(5) \qquad ER_{i,DUST} = C^*_i \times \frac{k \times 0.0016 \times M_{KG} \times \left[\frac{U}{2.2}\right]^{1.3}}{t_{sv} \times \left[\frac{X}{2.0}\right]^{1.4}}$$

Where: $ER_{i,DUST}$ = Emission rate for contaminant i due to dust emissions, g/sec

C^*_i = Weight fraction of contaminant i in soil, g/g

k = Particle size multiplier, dimensionless

0.0016 = Empirical constant, g/kg

M_{KG} = Mass of waste handled, kg

U = Mean wind speed, m/sec

X = Percent moisture, %

2.2 = Empirical constant, m/sec

2.0 = Empirical constant, %

t_{sv} = Time to excavate the soil containing$_{KG}$ M of contaminant i, sec

For the model construction scenario, the particle size considered for the dust emissions is PM_{10}. The particle size multiplier for PM_{10} that is used in Equation (5), k, is 0.35. The value used for the mean wind speed, U, is 1.75 m/sec.

As with the emission rate due to VOC emissions, the emission rate due to dust emissions is divided by the sum of the areas of the pit and the storage pile to yield a flux emission rate per unit area.

The mean and 95 percent UCL soil concentrations of each contaminant were available for each source area. From these concentrations, the above equations were used to calculate the emissions due to dust and, for the volatile compounds, the emissions due to VOCs. Each of these emission rates, ER_{VOC} and ER_{DUST}, were calculated for each area using both the mean and 95 percent UCL concentrations for each contaminant.

A standard construction scenario is used by the model to determine the mean and 95 percent UCL emission fluxes (g/sec-m^2) for each contaminant due both to VOC and dust for each site. These emission fluxes are then assumed to be constant during the time the site is excavated. As stated in the exposure models in Section 3.4.2.3, the construction scenario that applies to the AFP 59 source areas is assumed to last for 2 months. The emission fluxes calculated from the standard construction scenario, then, are assumed to occur during the entire time that the construction scenario is under way (2 months). Each area is assumed to be excavated to a depth of 12 feet over the entire area one time during the time of construction.

DISPERSION OF AIR CONTAMINANTS. Contaminant concentrations in air were calculated by multiplying the site/contaminant-specific emission rates described above by an appropriate dilution factor. The SCREEN2 dispersion model (USEPA, 1992f) was originally used to calculate a dilution factor for both construction and nonconstruction scenarios. The SCREEN2 model uses worst-case meteorological conditions, consequently overpredicting contaminant concentrations in air. It was run in the rural mode with no terrain adjustments. Risk was found acceptable for nonconstruction scenarios, but unacceptable for construction scenarios. Consequently, the Industrial Source Complex-Short-Term (ISCST2) model (USEPA, 1992g) was used to calculate more realistic dilution factors, air contaminant concentrations, and risk for the construction scenarios.

The ISCST2 model is a more site-specific dispersion model that uses site-specific meteorological conditions. One year of hourly surface weather data for Binghamton, New York was combined with upper air (mixing height) data from Albany, New York into an ISCST2-compatible (RAMMET) format to represent meteorological conditions at AFP 59. The ISCST2 model was run in rural mode with no terrain adjustments.

Both SCREEN2 and ISCST2 require that area sources be square. Because the extent of the subsurface contamination is not clearly defined, the emitting area of the sites could not be exactly represented. For nonconstruction scenarios, a square source area with area equal to the estimated extent of contamination was overlayed onto each site.

For the construction scenario, the emitting area was assumed to be of constant size and moving with the receptor (the construction worker). The emitting area was assumed to be square with a diagonal equal to 10 meters. This is the length of the trench dug over the 6 minute emitting period (the amount of time assumed to elapse before the excavated material is covered). The receptor was placed in the center of this area. The area was divided into 16 equal smaller squares to meet the ISCST2 model's restrictions on source-receptor proximity. The emission rate was assumed to be constant over all 16 area sources.

For nonconstruction scenarios, two receptors were modeled for each of the three AFP 59 source areas. One receptor, representing a resident in the residential area immediately to the west of the plant, was common to all three areas. To represent this receptor, the distance from the edge of each source area to the boundary of the plant adjacent to the residential area was modeled. (Because the SCREEN2 model assumes that the wind is blowing directly from the source area to the receptor, only the distance from the source area to the receptor is required as an input parameter.) The resulting concentrations were summed to obtain a total concentration at the residential receptor. Another receptor, representing an on-site worker, was placed as close to each source area as allowed by the model in order to obtain a maximum concentration from that source. The resulting three concentrations were summed to form a worst-case concentration to which any on-site worker potentially could be exposed.

To obtain a dilution factor, an emission rate of 1×10^{-6} g/sec-m^2 was modeled for each source area in a given site. The resulting modeled concentrations at receptors were used as dilution factors for those receptors. Actual concentrations due to site emissions for chemicals of potential concern for each human receptor are given by the following equation:

$$\chi_{i,s,r} = \left(\frac{\chi}{Q}\right)_{s,r} \times E_{i,s} \times 10^3 \ mg/g$$

Where:

$\chi_{i,s,r}$ = concentration of chemical of concern *i* due to site *s* at receptor *r*, mg/m^3

$(\chi/Q)_{s,r}$ = dilution factor for site *s* at receptor *r*, $\dfrac{g/m^3}{g/\sec - m^2}$

$E_{i,s}$ = emission rate for chemical of concern *i* from site *s*, g/sec-m^2

SCREEN2 analyzes a variety of hypothetical meteorological conditions to calculate a "worst case" 1-hour average concentration. For future *in situ* scenarios, the 1-hour average was multiplied by 0.1 to approximate an annual average concentration. The factor of 0.1 is a standard empirical factor for estimating annual average concentrations based on hourly concentrations. For construction scenarios, the 1-hour average concentration, obtained from ISCST2, was used for the 2 month exposure period. This is because the construction worker is assumed to be in the center of the emitting area thus negating the effect of wind direction variability.

Both an arithmetic mean and 95% UCL concentration are calculated from the appropriate emission rate. Chemical concentrations of fugitive dust at receptors are presented in Appendix V-2. Chemical concentrations of VOCs at receptors are presented in Appendices V-1 and V-3.

3.4.2.3 ***Intake Estimates.*** Intake values were estimated for completed exposure pathways identified in Table 3.4-7. EARTH TECH developed software programs to calculate receptor intake values for each identified exposure pathway.

Chronic Daily Intakes (CDIs) were estimated for current recreational users of Little Choconut Creek, current industrial workers at the Waste Oil Tank Area, future on-site industrial workers, and future off-site 30-year residents. Although the groundwater exposure pathways for current off-site residents are complete, the magnitude of exposure cannot be evaluated because of the following reasons: validated samples have not been collected from groundwater supplied by the Camden Street Wellfield, groundwater contamination is already being remediated at the wellfield, and the contribution of contaminants migrating from AFP 59 cannot be determined. Consequently, CDIs for groundwater intake by current off-site residents have not been estimated. Subchronic Daily Intakes (SDIs) were estimated for future on-site construction workers. In accordance with USEPA Guidance, CDIs were estimated for exposure of 7 years to a lifetime and SDIs were estimated for exposure of 2 weeks to 7 years (USEPA, 1989a).

The basic formula used to estimate CDI or SDI is the following:

$$CDI\ or\ SDI\ (mg/kg\text{-}day) = C \times \frac{CR \times EF \times ED}{BW} \times \frac{1}{AT},$$

Where: CDI or SDI = CDI or SDI by the receptor in mg/kg body weight-day
C = Chemical concentration; the arithmetic mean, 95 percent UCL of the mean, or maximum concentration contacted over the exposure period (e.g., mg/L)
CR = Contact Rate; the amount of contaminated media contacted per unit time or event (e.g., L/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body weight of receptor; the average body weight over the exposure period (kg)
AT = Averaging Time; period over which the exposure is averaged (days)

Tables 3.4-15 through 3.4-32 present formulas and assumptions used to model intake values for each complete exposure pathway. Standard default exposure factors were used to estimate intake where applicable. Guidance provided by the USEPA was used for selection of standard default exposure factors. Reasonable assumptions were made to quantify site-specific exposure factors.

For current industrial workers at the Waste Oil Tank Area, a worker was assumed to inhale VOCs emitted from soil through gravel for 8 hours/day and 250 days/year. For future industrial

TABLE 3.4-15
MODEL FOR ESTIMATING ABSORBED DOSE FOR CURRENT RECREATIONAL USERS OF LITTLE CHOCONUT CREEK THROUGH DERMAL ABSORPTION OF CHEMICALS IN SURFACE WATER

$$Absorbed\ Chronic\ Dose\ (mg/kg\text{-}day) = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

CW = Chemical concentration in surface water (mg/L).

SA = Skin surface area available for contact (cm^2).

PC = Chemical specific dermal permeability constant (cm/hr).

ET = Exposure time (hours/day).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

CF = Volumetric conversion factor for water (1 liter/1000 cm^3).

BW = Body weight (kg).

AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- Concentrations in surface water (CW) are represented by the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean.
- The exposed skin surface area (SA) of recreational users wading in Little Choconut Creek is 3800 cm^2/event (forearms, hands, lower legs, feet) (USEPA, 1989d). It is assumed that the exposed skin surface area is 30% of the total body surface area. The total body surface area was calculated as the average for boys and girls ages 7 through 15 for the 50th percentile.
- Chemical specific dermal permeability constants are presented in Table 3.4-16.
- The exposure time (ET) is 2.6 hours/day (USEPA, 1992b).
- A recreational user is assumed to be exposed (EF) for 64 days/year, or 4 days/week for the 16 warmest weeks of the spring and summer.
- The duration of exposure (ED) for a recreational user is 9 years (i.e., a child 7 through 15 years old).
- A child weighs 41.0 kg (BW) (USEPA, 1989d). This is an average of body weights for children in the age group (7 through 15 years old) that were assumed to be wading in Little Choconut Creek.
- The averaging time (AT) is 9 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-16
DERMAL PERMEABILITY CONSTANTS FOR CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER AND SURFACE WATER

Chemical	Permeability Constant (PC) (cm/hr)
1,1-Dichloroethane	8.9×10^{-3} (b)
1,1-Dichloroethene	1.6×10^{-2} (b)
1,1,1-Trichloroethane	1.7×10^{-2} (b)
1,2,4-Trichlorobenzene	1.0×10^{-1} (b)
1,2,4-Trimethylbenzene	1×10^{-3} (c)
1,3,5-Trimethylbenzene	1×10^{-3} (c)
Alpha Endosulfan	1.0×10^{-3} (c)
Aluminum	1×10^{-3} (c)
Arsenic	1×10^{-3} (c)
Barium	1×10^{-3} (c)
Beryllium	1×10^{-3} (c)
Beta BHC	1.0×10^{-3} (c)
Beta Endosulfan	1.0×10^{-3} (c)
Bis(2-ethylhexyl)phthalate	1×10^{-3} (c)
Bromodichloromethane	5.8×10^{-3} (b)
Bromoform	2.6×10^{-3} (b)
Carbon Tetrachloride	2.2×10^{-2} (b)
Chloroethane	8.0×10^{-3} (b)
Chloroform (Trichloromethane)	1×10^{-1} (a)
Chloromethane	4.2×10^{-3} (b)
Chromium (as Sodium Chromate)	2×10^{-3} (a)
cis-1,2-Dichloroethene	1×10^{-2} (b)
Copper	1×10^{-3} (c)
Delta BHC	1.0×10^{-3} (c)
Dibromochloromethane	1×10^{-3} (c)
Dichlorodifluoromethane	1.2×10^{-2} (b)
Ethylbenzene	1 (a)
Gamma BHC	1.0×10^{-3} (c)
Heptachlor	1.1×10^{-2} (b)
Isopropylbenzene (Cumene)	1×10^{-3} (c)
Manganese	1×10^{-3} (c)
Methoxychlor	1.0×10^{-3} (c)

TABLE 3.4-16
DERMAL PERMEABILITY CONSTANTS FOR CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER AND SURFACE WATER

Continued

Chemical	Permeability Constant (PC) (cm/hr)
Methylene Chloride	4.5×10^{-3} (b)
n-Propylbenzene	1.0×10^{-3} (c)
Naphthalene	6.9×10^{-2} (b)
Nickel	1×10^{-4} (a)
p,p'-DDD	2.8×10^{-1} (b)
p,p'-DDE	2.4×10^{-1} (b)
p,p'-DDT	4.3×10^{-1} (b)
Silver	6×10^{-4} (a)
Thallium	1×10^{-3} (c)
Toluene	1 (a)
trans-1,2-Dichloroethene	1×10^{-2} (b)
Trichloroethylene (TCE)	2×10^{-1} (a)
Trichlorofluoromethane	1.7×10^{-2} (b)
Vanadium	1×10^{-3} (c)
Vinyl Chloride	7.3×10^{-3} (b)
Xylenes, Total	1×10^{-3} (f)
Zinc	6×10^{-4} (a)

(a) Experimentally measured PC (Table 5-3 of USEPA, 1992b).

(b) Predicted PC (Table 5-7 of USEPA, 1992b).

(c) Experimentally measured PC value for water used in the absence of chemical-specific experimental or predicted PC values (Table 5-3 or 5-7, respectively, of USEPA, 1992b), unless otherwise noted.

(d) Endrin used as surrogate.

(e) Heptachlor used as surrogate.

(f) Toluene used as surrogate.

TABLE 3.4-17
MODEL FOR ESTIMATING INTAKE FOR CURRENT RECREATIONAL USERS OF LITTLE CHOCONUT CREEK THROUGH INGESTION OF CONTAMINATED FISH

$$CDI\ (mg/kg\text{-}day) = \frac{CF \times IR \times FI \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).

CF = Contaminant concentration in fish (mg/kg).

IR = Ingestion rate (kg/day).

FI = Fraction ingested from contaminated source (unitless).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

BW = Body weight (kg).

AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- Contaminant concentrations in fish (CF) are represented by SW × BCF where SW is the arithmetic mean or the 95% UCL of the measured surface water chemical concentration (mg/L) and BCF is the fish bioconcentration factor (L/kg) for that chemical. Chemical BCFs are presented in Table 3.4-18.
- The fish ingestion rate (IR) is 0.054 kg/day for a recreational user for fish caught on the Little Choconut Creek by a 7 to 15 year old recreational user. This ingestion rate is equivalent to about two 8-ounce servings of fish per week (USEPA, 1991).
- The fraction ingestion (FI) from fish is assumed to be 1.
- An adult recreational user is exposed (EF) for 350 days/year (USEPA, 1991).
- The duration of exposure (ED) for an adult recreational user is 30 years (USEPA, 1991).
- An adult recreational user weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 30 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-18
BIOCONCENTRATION FACTORS FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER

Chemical	Bioconcentration Factor (BCF)
Alpha Endosulfan	88 (i)
Arsenic	8.5 (a) (f)
Barium	100 (b)
Beta Endosulfan	88 (i)
Bis(2-ethylhexylphthalate)	851(l)
Bromodichloromethane	1 (j) (f)
Bromoform	37.4 (j)
Chloroform	7 (a) (f)
Copper	55 (e) (f)
p,p'-DDD	12,000 (d)
Delta BHC	319 (h)
Dibromochloromethane	1.1 (j) (f)
Dichlorodifluoromethane	26 (k)
Gamma BHC	319 (b)
Lead	42 (a)
Manganese	350 (b) (f)
Zinc	1,000 (d)

(a) ATSDR Toxicity Profile for Specified Compound, 1993.
(b) ATSDR Toxicity Profile for Specified Compound, 1992.
(d) ATSDR Toxicity Profile for Specified Compound, 1992 (Draft Report).
(e) ATSDR Toxicity Profile for Specified Compound, 1990.
(f) The mean value was calculated from a range of BCFs.
(h) Gamma BHC used as surrogate. See (a).
(i) Endosulfan used as surrogate. See (a).
(j) Retrieved from Hazardous Substances Data Bank (HSDB), 1993.
(k) Retrieved from Hazardous Substances Data Bank (HSDB), 1995.
(l) Howard, 1989.

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TABLE 3.4-19
MODEL FOR ESTIMATING INTAKE FOR FUTURE ONSITE INDUSTRIAL WORKERS THROUGH INCIDENTAL INGESTION OF CHEMICALS IN SURFACE SOIL

$$CDI\ (mg/kg\text{-}day) = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).
CS = Concentration in the surface soil (mg/kg) (i.e., 0 to 3 feet below land surface).
IR = Ingestion rate (mg/day).
CF = Conversion factor (10^{-6} kg/mg).
FI = Fraction ingested from contaminated source (unitless).
EF = Exposure frequency (days/year).
ED = Exposure duration (years).
BW = Body weight (kg).
AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- Contaminant concentrations in surface soil (CS) are represented by the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean.
- A soil ingestion rate (IR) of 50 mg/day is used for an industrial worker (USEPA, 1991).
- The fraction ingested from the contaminated source (FI) is assumed to be 1.
- An industrial worker is exposed (EF) for a total of 250 days/year, or 5 days/week for 50 weeks/year (USEPA, 1991). The industrial worker is assumed to be exposed to chemicals within each of three source areas for ⅓ of 250 days/year, or 83.3 days/year.
- The duration of exposure (ED) for an industrial worker is 25 years (USEPA, 1991).
- An industrial worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 25 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-20
MODEL FOR ESTIMATING ABSORBED DOSE FOR FUTURE ONSITE INDUSTRIAL WORKERS THROUGH DERMAL ABSORPTION OF CHEMICALS IN SURFACE SOIL

$$\text{Absorbed Chronic Dose } (mg/kg\text{-}day) = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS = Concentration in the surface soil (mg/kg) (i.e., 0 to 3 feet below land surface).
CF = Conversion factor (10^{-6} kg/mg).
SA = Skin surface area available for contact (cm^2/event).
AF = Soil to skin adherence factor (mg/cm^2 skin).
ABS = Absorption factor (unitless).
EF = Exposure frequency (events/year).
ED = Exposure duration (years).
BW = Body weight (kg).
AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- Concentrations in surface soil (CS) are represented by the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean.
- The exposed skin surface area (SA) is 4,370 cm^2/event (head, hands, forearms) (USEPA, 1989d, 1992b). The percentage of total body surface area (i.e., 23,000 cm^2) for head, hands, and forearms is 19%.
- Soil to skin adherence factor (AF) is 1.0 mg/cm^2; this is a reasonable upper value (USEPA, 1992b).
- The absorption factor (ABS) is 0.25 (25%) for VOCs, 0.10 (10%) for SVOCs and pesticides, and 0.01 (1%) for inorganics (Ryan, *et al.*, 1987).
- An industrial worker is exposed (EF) for a total of 250 events/year, 1 event/day, 5 events/week for 50 weeks/year. The industrial worker is assumed to be exposed to chemicals within each of three source areas for ⅓ of 250 events/year or 83.3 events/year.
- The duration of exposure (ED) for an industrial worker is 25 years (USEPA, 1991).
- An industrial worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 25 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-21
MODEL FOR ESTIMATING INTAKE FOR FUTURE ONSITE INDUSTRIAL WORKERS THROUGH INHALATION OF CONTAMINATED FUGITIVE DUST

$$CDI\ (mg/kg\text{-}day) = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).

CA = Dust contaminant concentration in air (mg/m^3).

IR = Inhalation rate (m^3/day).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

BW = Body weight (kg).

AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- The dust contaminant concentration in air (CA) is the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean. CA represents modeled outdoor air concentrations. It was assumed that the indoor air concentration inhaled by a worker is equal to the modeled outdoor concentration.
- The inhalation rate (IR) for an industrial worker is 20 m^3/8-hour day (USEPA, 1991).
- An industrial worker is exposed (EF) for 250 days/year, or 5 days/week for 50 weeks/year (USEPA, 1991).
- The duration of exposure (ED) for an industrial worker is 25 years (USEPA, 1991).
- An industrial worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 25 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-22
MODEL FOR ESTIMATING INTAKE FOR CURRENT AND FUTURE ONSITE INDUSTRIAL WORKERS THROUGH INHALATION OF VOLATILE ORGANIC COMPOUNDS

$$CDI\ (mg/kg\text{-}day) = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).

CA = Contaminant concentration in air (mg/m^3).

IR = Inhalation rate (m^3/day).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

BW = Body weight (kg).

AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- The airborne contaminant concentration in air (CA) is the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean. CA represents modeled outdoor air concentrations. It was assumed that the indoor air concentration inhaled by a worker is equal to the modeled outdoor concentration.
- The inhalation rate (IR) is 20 m^3/8-hour day (USEPA, 1991).
- An industrial worker is exposed (EF) for 250 days/year, or 5 days/week for 50 weeks/year (USEPA, 1991).
- The duration of exposure (ED) for an industrial worker is 25 years (USEPA, 1991).
- An industrial worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 25 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-23
MODEL FOR ESTIMATING INTAKE FOR FUTURE ONSITE INDUSTRIAL WORKERS THROUGH INGESTION OF CHEMICALS IN DRINKING WATER

$$CDI\ (mg/kg\text{-}day) = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).
CW = Contaminant concentration in groundwater (mg/L).
IR = Drinking water ingestion rate (L/day).
EF = Exposure frequency (days/year).
ED = Exposure duration (years).
BW = Body weight (kg).
AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- Concentrations in groundwater (CW) are represented by the maximum concentration of an analyte.
- The drinking water ingestion rate (IR) is 1 L/day (USEPA, 1991).
- An industrial worker is exposed (EF) for 250 days/year, or 5 days/week for 50 weeks/year (USEPA, 1991).
- The duration of exposure (ED) for an industrial worker is 25 years (USEPA, 1991).
- An industrial worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 25 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-24
MODEL FOR ESTIMATING INTAKE FOR FUTURE ONSITE CONSTRUCTION WORKERS THROUGH INCIDENTAL INGESTION OF CHEMICALS IN SUBSURFACE SOIL

$$SDI\ (mg/kg\text{-}day) = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where:

SDI = Subchronic Daily Intake (mg/kg-day).

CS = Concentration in subsurface soil (mg/kg) (i.e., 0-12 feet below land surface).

IR = Ingestion rate (mg/day).

CF = Conversion factor (10^{-6} kg/mg).

FI = Fraction ingested from contaminated source (unitless).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

BW = Body weight (kg).

AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- Contaminant concentrations in subsurface soil (CS) are represented by the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean.
- A soil ingestion rate (IR) of 480 mg/day is used for a construction worker (USEPA, 1991).
- The fraction ingested from the contaminated source (FI) is assumed to be 1.
- A construction worker is exposed (EF) for 250 days/year, or 5 days/week for 50 weeks/year (USEPA, 1991).
- The duration of exposure (ED) for a construction worker is 0.167 year (i.e., 2 months/year) at each source area.
- A construction worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 0.167 year × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-25
MODEL FOR ESTIMATING ABSORBED DOSE FOR FUTURE ONSITE CONSTRUCTION WORKERS THROUGH DERMAL ABSORPTION OF CHEMICALS IN SUBSURFACE SOIL

$$\text{Absorbed Subchronic Dose } (mg/kg\text{-}day) = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS = Concentration in subsurface soil (mg/kg) (i.e., 0-12 feet below land surface)
CF = Conversion factor (10^{-6} kg/mg).
SA = Skin surface area available for contact (cm^2/event).
AF = Soil to skin adherence factor (mg/cm^2 skin).
ABS = Absorption Factor (unitless).
EF = Exposure frequency (events/year).
ED = Exposure duration (years).
BW = Body weight (kg).
AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- Contaminant concentrations in subsurface soil (CS) are represented by the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean.
- The exposed skin surface area (SA) is 4,370 cm^2/event (head, hands, forearms) (USEPA, 1989d, 1992b). The percentage of total body surface area (i.e., 23,000 cm^2) for head, hands, and forearms is 19%.
- Soil to skin adherence factor (AF) is 1.0 mg/cm^2; this is a reasonable upper value (USEPA, 1992b).
- The absorption factor (ABS) is 0.25 (25%) for VOCs, 0.10 (10%) for SVOCs and pesticides, and 0.01 (1%) for inorganics (Ryan, *et al.*, 1987).
- A construction worker is exposed (EF) for 250 events/year, or 1 event/day, 5 events/week for 50 weeks/year (USEPA, 1991).
- The duration of exposure (ED) for a construction worker is 0.167 year (i.e., 2 months/year) at each source area.
- A construction worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 0.167 year × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-26
MODEL FOR ESTIMATING INTAKE FOR FUTURE ONSITE CONSTRUCTION WORKERS THROUGH INHALATION OF CONTAMINATED FUGITIVE DUST

$$SDI\ (mg/kg\text{-}day) = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Where:

SDI = Subchronic Daily Intake (mg/kg-day).

CA = Dust contaminant in air (mg/m^3).

IR = Inhalation rate (m^3/day).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

BW = Body weight (kg).

AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- The dust contaminant concentration in air (CA) is the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean. CA represents modeled outdoor air concentrations.
- The inhalation rate (IR) for a construction worker is 20 m^3/8-hour day (USEPA, 1991).
- A construction worker is exposed (EF) for 250 days/year or 5 days/week for 50 weeks/year (USEPA, 1991).
- The duration of exposure (ED) for a construction worker is 0.167 year (i.e., 2 months/year) at each source area.
- A construction worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 0.167 year × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-27
MODEL FOR ESTIMATING INTAKE FOR FUTURE ONSITE CONSTRUCTION WORKERS THROUGH INHALATION OF VOLATILE ORGANIC COMPOUNDS

$$SDI\ (mg/kg\text{-}day) = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Where:

SDI = Subchronic Daily Intake (mg/kg-day).

CA = Contaminant concentration in air (mg/m^3).

IR = Inhalation rate (m^3/day).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

BW = Body weight (kg).

AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- The airborne contaminant concentration in air (CA) used is either the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean. CA represents modeled outdoor air concentrations.
- The inhalation rate (IR) is 20 m^3/8-hour day (USEPA, 1991).
- A construction worker is exposed (EF) for 250 days/year, or 5 days/week for 50 weeks/year (USEPA, 1991).
- The duration of exposure (ED) for a construction worker is 0.167 year (i.e., 2 months/year) at each source area.
- A construction worker weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 0.167 year × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-28
MODEL FOR ESTIMATING INTAKE FOR FUTURE OFFSITE 30-YEAR RESIDENTS THROUGH INGESTION OF CHEMICALS IN DRINKING WATER

$$CDI\ (mg/kg\text{-}day) = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).
CW = Contaminant concentration in groundwater (mg/L).
IR = Drinking water ingestion rate (L/day).
EF = Exposure frequency (days/year).
ED = Exposure duration (years).
BW = Body weight (kg).
AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- Concentrations in groundwater (CW) are represented by the maximum concentration of an analyte.
- The drinking water ingestion rate (IR) is 2 L/day (USEPA, 1991).
- A resident is exposed (EF) for 350 days/year (USEPA, 1991).
- The duration of resident exposure (ED) is 30 years (USEPA, 1991).
- A resident weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 30 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-29
MODEL FOR ESTIMATING INTAKE FOR FUTURE OFFSITE 30-YEAR RESIDENTS THROUGH INHALATION OF VOLATILE ORGANIC COMPOUNDS WHILE SHOWERING

$$CDI\ (mg/kg\text{-}day) = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).
CA = Contaminant concentration in air (mg/m^3).
IR = Inhalation rate (m^3/day).
EF = Exposure frequency (days/year).
ED = Exposure duration (years).
BW = Body weight (kg).
AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- $CA\ (contaminant\ concentration\ in\ air,\ mg/m^3) = \frac{(CA_{max}\ /\ 2)t_1 + CA_{max}\ t_2}{t_1 + t_2}\ (1)$,

$$Where:\ CA_{max} = \frac{C_w\, f\, F_w\, t_1}{V_a}\quad (1)\ ,\ and$$

Where:

C_w = The arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean of the contaminant concentration in shower water (mg/L).
f = The fraction volatilized (unitless) is 0.7 (i.e., the mean of the range of 0.5 to 0.9) (Andelman, 1990).
F_w = The water flow rate (L/hr) is 750 L/hr (i.e., the mean of the range 500 to 1,000 L/hr) (Schaum, *et al.*, 1992).
t_1 = The duration period for showering (hr) is 0.2 hr (USEPA, 1992b).
t_2 = The duration period for the time after showering is 0.35 hr (i.e., the mean of the range of 0.2 to 0.5 hr) (Schaum, *et al.*, 1992).
V_a = The bathroom volume (m^3) is 11 m^3 (i.e., the mean of the range of 6 to 16 m^3) (Schaum, *et al.*, 1992).

(1) Reference: Schaum, *et al.*, 1992.

- The inhalation rate (IR) is 15 m^3/day (USEPA, 1991).
- A resident is exposed (EF) for 350 days/year (USEPA, 1991).
- The duration of exposure (ED) for a resident is 30 years (USEPA, 1991).
- A resident weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 30 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-30
MODEL FOR ESTIMATING ABSORBED DOSE FOR FUTURE OFFSITE 30-YEAR RESIDENTS THROUGH DERMAL ABSORPTION OF CHEMICALS IN SHOWER WATER

$$\textit{Absorbed Chronic Dose (mg/kg-day)} = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

CW = Chemical concentration in shower water (mg/L).
SA = Skin surface area available for contact (cm^2).
PC = Chemical-specific dermal permeability constant (cm/hr).
ET = Exposure time (hours/day).
EF = Exposure frequency (days/year).
ED = Exposure duration (years).
CF = Conversion factor (1 liter/1000 cm^3).
BW = Body weight (kg).
AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- The contaminant concentration in shower water (CW) is represented by the maximum concentration of an analyte.
- The exposed skin surface area (SA) is 23,000 cm^2, as an upperbound, whole-body value (USEPA, 1992b).
- Chemical-specific dermal permeability constants (PCs) are presented in Table 3.4-16.
- The exposure time (ET) is 12 minutes/day, or 0.2 hour/day (USEPA, 1992b).
- A resident is exposed (EF) for 350 days/year, or one shower/day for 7 days/week for 50 weeks/year (USEPA, 1992b).
- The duration of resident exposure (ED) is 30 years (USEPA, 1991).
- A resident weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 30 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-31
MODEL FOR ESTIMATING INTAKE FOR FUTURE OFFSITE 30-YEAR RESIDENTS THROUGH INHALATION OF CONTAMINATED FUGITIVE DUST

$$CDI\ (mg/kg\text{-}day) = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).

CA = Dust contaminant concentration in air (mg/m^3).

IR = Inhalation rate (m^3/day).

EF = Exposure frequency (days/year).

ED = Exposure duration (years).

BW = Body weight (kg).

AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- The dust contaminant concentration in air (CA) is the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean. CA represents modeled outdoor air concentrations. It was assumed that the indoor air concentration inhaled by a resident is equal to the modeled outdoor concentration.
- A resident inhales at the rate (IR) of 20 m^3/day (USEPA, 1991).
- A resident is exposed (EF) for 350 days/year (USEPA, 1991).
- The duration of resident exposure (ED) is 30 years (USEPA, 1991).
- A resident weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 30 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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TABLE 3.4-32
MODEL FOR ESTIMATING INTAKE FOR FUTURE OFFSITE 30-YEAR RESIDENTS THROUGH INHALATION OF VOLATILE ORGANIC COMPOUNDS

$$CDI\ (mg/kg\text{-}day) = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI = Chronic Daily Intake (mg/kg-day).
CA = Contaminant concentration in air (mg/m^3).
IR = Inhalation rate (m^3/day).
EF = Exposure frequency (days/year).
ED = Exposure duration (years).
BW = Body weight (kg).
AT = Averaging time (period over which exposure is averaged, in days).

Assumptions:

- The airborne contaminant concentration in air (CA) is the arithmetic mean or the 95% upper confidence limit (UCL) of the arithmetic mean. CA represents modeled outdoor air concentrations. It was assumed that the indoor air concentration inhaled by a resident is equal to the modeled outdoor concentration.
- The inhalation rate (IR) is 20 m^3/day (USEPA, 1991).
- A resident is exposed (EF) for 350 days/year (USEPA, 1991).
- The duration of resident exposure (ED) is 30 years (USEPA, 1991).
- A resident weighs 70 kg (BW) (USEPA, 1991).
- The averaging time (AT) is 30 years × 365 days/year for intake of a chemical when considering noncarcinogenic effects and 70 years × 365 days/year for a chemical when considering carcinogenic effects.

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workers, a worker was assumed to be exposed to contaminated soil in all three source areas within a single work year. Consequently, a hypothetical assumption was made that an industrial worker would be exposed to soil for one-third of a work year (i.e., 83.3 days/year) at each source area.

As described in Section 3.4.2.2.3, chemical data were modeled separately within the shallow and deep groundwater zones. Municipal wells in the Camden Street Wellfield that would supply potable water for future receptors are screened across both zones. Consequently, future exposure is due to a combination of exposure to analytes within both zones. Risk was quantified by selecting the highest risk value within one zone for an analyte detected in both zones. The risk value for the other zone was not used in quantifying pathway risk. Thus, risk was quantified by selecting the highest analyte risk value from either zone and totaling analyte risk to determine total pathway risk.

Using the exposure models and factors presented in Tables 3.4-15 through 3.4-32, chemical intake values (i.e., exposure values) were estimated for identified receptors. Estimated current and future intake values are presented in Appendix W.

3.4.3 Toxicity Assessment

This section provides a toxicity assessment of chemicals of potential concern identified in Section 3.4.1. Section 3.4.3.1 presents a discussion of the derivation and meaning of carcinogenic toxicity values, and Section 3.4.3.2 presents a discussion of non-carcinogenic toxicity values. Toxicity values for carcinogenic and non-carcinogenic effects of chemicals, plus other pertinent toxicity information, are summarized in tabular form. Section 3.4.3.4 presents dermal toxicity values that have been adjusted from oral values, and Section 3.4.3.4 includes a discussion of the blood-lead level of concern.

3.4.3.1 Carcinogenic Toxicity Values. In the first step of a carcinogenic toxicity assessment, the USEPA evaluates human and animal studies to determine the weight-of-evidence classification for carcinogenicity. The USEPA adjusts the weight-of-evidence classification upward or downward, based on other supporting carcinogenic evidence, such as metabolic and other pharmacokinetic studies, cell cultures or microorganism studies, or structure-activity studies. Table 3.4-33 gives the USEPA weight-of-evidence classification system for carcinogenicity. This system has been adapted from the system developed by the International Agency for Research on Cancer (IARC).

In the second step of a toxicity assessment, the USEPA assigns a toxicity value to a chemical that quantitatively defines the relationships between dose and response. This toxicity value is named the slope factor. The USEPA typically calculates slope factors for potential carcinogens with weight-of-evidence classifications of A, B1, and B2. Estimation of slope factors for chemicals in Class C proceeds on a case-by-case basis.

For carcinogens, the USEPA assumes that there is essentially no level of exposure to a chemical with carcinogenic effects that does not pose a finite probability of generating a carcinogenic

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TABLE 3.4-33
USEPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR CARCINOGENICITY

Class	Description
A	Human Carcinogen
B1 or B2	Probable Human Carcinogen B1 indicates that limited human data are available B2 indicates sufficient evidence in animals and inadequate or no evidence in humans
C	Possible Human Carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of non-carcinogenicity for humans

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response. Consequently, in evaluating cancer risks, a carcinogenic effect threshold cannot be estimated.

The slope factor is an upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime (i.e., risk per unit dose or risk per mg/kg-day). The USEPA uses mathematical models and procedures to extrapolate from carcinogenic responses observed at high doses to responses expected at low doses. After the data are fit to the appropriate model, the upper 95th percent confidence limit of the slope of the resulting dose-response curve is calculated. This value is the slope factor and is an upper 95th percent confidence limit of the probability of a response per unit intake of a chemical over a lifetime.

Tables 3.4-34 and 3.4-35 present the carcinogenic toxicity values for chemicals of potential concern in soil, surface water, groundwater, or air that are classified as A, B1, B2, or C carcinogens. The tables give the oral and inhalation slope factors for each chemical of potential concern, the weight-of-evidence classification, the type of cancer caused by each chemical, and the source of the slope factor.

Slope factors were obtained from the USEPA's Integrated Risk Information System (IRIS) as a primary source (USEPA, 1995). These slope factors have been verified by the USEPA Carcinogen Risk Assessment Verification Endeavor (CRAVE) work group. If a slope factor was not available from IRIS, the *Health Effects Assessment Summary Tables* (HEAST) (USEPA, 1994c) were used as a secondary source. For chemicals that lacked an inhalation slope factor, the corresponding oral slope factor, if available, was applied as an inhalation slope factor. For some chemicals, no information was available in IRIS or HEAST, but a footnote in HEAST directed users to contact the Superfund Health Risk Technical Support Center. The Support Center issued provisional oral and/or inhalation slope factors for some chemicals. If no provisional data were available and the data for appropriate surrogate compounds could not be located (see below), ND (indicating "no data") was entered in the tables.

Carcinogenicity data for surrogate chemicals were used for chemicals of potential concern when no other information was available. Specifically, dieldrin served as a surrogate compound for aldrin, and benzo(a)pyrene served as a surrogate compound for PAHs identified as chemicals of potential concern (Section 3.4.1) that are designated as carcinogens (i.e., B2 weight-of-evidence). These PAHs include:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Chrysene
- Dibenz(a,h)anthracene
- Indeno(1,2;3-cd)pyrene

For these PAHs, the only slope factor available is an oral slope factor for benzo(a)pyrene of 7.3 $(mg/kg\text{-}day)^{-1}$. Therefore, the benzo(a)pyrene oral slope factor was initially used as an inhalation slope factor for benzo(a)pyrene as well as surrogate oral and inhalation slope factors for the remaining carcinogenic PAHs. Footnotes in Tables 3.4-34 and 3.4-35 identify the use of surrogates as well as the source of carcinogenic toxicity data.

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TABLE 3.4-34
TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS (ORAL)

Chemical	Slope Factor (SF) $(mg/kg\text{-}day)^{-1}$	Weight-of-Evidence Classification	Type of Cancer
1,1-Dichloroethane	ND	C (a)	Hepatocellular carcinomas (mice)
1,1-Dichloroethene	6.1×10^{-1} (a)	C	Adrenal pheochromocytomas (rat)
Aldrin	1.6×10^{1} (a) (e)	B2	Liver (mouse)
Alpha BHC	6.3 (a)	B2	Hepatic nodules and hepatocellular carcinomas (male mouse)
Arsenic	1.8 (a)	A	Skin (human)
Benzo(a)anthracene	7.3 (b)	B2 (a)	Liver and lung (mouse)
Benzo(a)pyrene	7.3 (a)	B2	Forestomach (mouse)
Benzo(b)fluoranthene	7.3 (b)	B2 (a)	Lung, thorax, liver, skin (rat, mouse)
Beryllium	4.3 (a)	B2	*Tumors-all sites (rat); osteosarcoma* (rabbit); lung (human)
Beta BHC	1.8 (a)	C	Hepatic nodules and hepatocellular carcinomas (male mouse)
Bis(2-ethylhexyl)phthalate	1.4×10^{-2} (a)	B2	Liver (rat, mouse)
Bromodichloromethane	6.2×10^{-2} (a)	B2	Kidney, large intestine tumors (rat); kidney (male mouse), liver tumors (female mouse)
Bromoform	7.9×10^{-3} (a)	B2	Neoplastic lesions in the large intestine (female rat)
Cadmium	ND	There is inadequate evidence for carcinogenicity by the oral route. (a)	Seven studies in rats and mice where cadmium salts have been administered orally have shown no evidence of carcinogenic response. There are no positive studies of orally ingested cadmium suitable for quantitation (a).
Carbon Tetrachloride	1.3×10^{-1} (a)	B2	Hepatocellular carcinomas/ hepatomas (hamster, mouse, rat)
Chloroform (Trichloromethane)	6.1×10^{-3} (a)	B2	Kidney (rat)
Chloromethane	1.3×10^{-2} (c)	C	Kidney (mouse)
Chromium	ND	There is inadequate evidence for carcinogenicity by the oral route. (a)	ND
Chrysene	7.3 (b)	B2 (a)	Liver, lung tumors (mouse)

TABLE 3.4-34
TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS (ORAL)

Continued

Chemical	Slope Factor (SF) (mg/kg-day)$^{-1}$	Weight-of-Evidence Classification	Type of Cancer
Dibenz(a,h)anthracene	7.3 (b)	B2 (a)	Lung, skin (mouse)
Dibromochloromethane	8.4×10^{-2} (a)	C	Liver (mouse)
Dieldrin	1.6×10^{1} (a)	B2	Liver tumors (mouse)
Gamma BHC	1.3 (c)	B2-C	ND
Heptachlor	4.5 (a)	B2	Hepatocellular carcinomas (mouse)
Heptachlor Epoxide	9.1 (a)	B2	Hepatocellular carcinomas (mouse)
Indeno(1,2,3-cd)pyrene	7.3 (b)	B2 (a)	Lung, thorax, skin (rat, mouse)
Lead	ND	B2 (a)	Kidney (rat, mouse)
Methylene Chloride	7.5×10^{-3} (a)	B2	Hepetocellular adenomas or carcinomas and hepatocellular cancer and neoplastic nodules (mouse).
Nickel	ND	There is inadequate evidence for carcinogenicity by the oral route (a).	ND
p,p'-DDD	2.4×10^{-1} (a)	B2	Liver (male mouse)
p,p'-DDE	3.4×10^{-1} (a)	B2	Hepatocellular carcinomas, hepatomas (mouse, hamster)
p'p'-DDT	3.4×10^{-1} (a)	B2	Liver (mouse, rats)
Tetrachloroethene	5.2×10^{-2} (d)	C-B2	ND
Trichloroethene	1.1×10^{-2} (d)	C-B2	ND
Vinyl Chloride	1.9 (c)	A	Liver, Zymbal gland tumors (rat)

Key: ND = No Data

(a) Retrieved from USEPA, 1995.
(b) Oral slope factor for benzo(a)pyrene was used.
(c) Retrieved from USEPA, 1994c, Annual FY94.
(d) Retrieved from Superfund Health Risk Technical Support Center.
(e) Data for Dieldrin were used.

TABLE 3.4-35
TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS (INHALATION)

Chemical	Slope Factor (SF) (mg/kg-day)$^{-1}$	Weight-of-Evidence Classification	Type of Cancer
1,1-Dichloroethane	ND	C (a)	ND
1,1-Dichloroethene	1.8×10^{-1} (a) (b)	C	Kidney adenocarcinoma (mouse)
Aldrin	1.6×10^{1} (e)	B2	Liver (mouse)
Alpha BHC	6.3 (e)	B2	ND
Arsenic	1.5×10^{1} (a)(b)	A	Lung (male human)
Benzo(a)anthracene	7.3 (d)	B2 (a)	Liver and lung (mouse)
Benzo(a)pyrene	7.3 (e)	B2	ND
Benzo(b)fluoranthene	7.3 (d)	B2 (a)	Lung, thorax, liver, skin (rat, mouse)
Beryllium	8.4 (a) (b)	B2	Lung (rat, monkey), osteosarcomas (rabbits)
Beta BHC	1.8 (e)	C	ND
Bis(2-ethylhexyl)phthalate	1.4×10^{-2} (e)	B2 (a)	ND
Bromodichloromethane	6.2×10^{-2} (e)	B2	ND
Bromoform	3.9×10^{-3} (a) (b)	B2	Large intestine (rat)
Cadmium	6.3 (a) (b)	B1	Lung, trachea, bronchus (male human)
Carbon Tetrachloride	5.3×10^{-2} (a) (b)	B2	Hepatocellular carcinomas/ hepatomas (hamster, mouse, rat)
Chloroform (Trichloromethane)	8.1×10^{-2} (a)(b)	B2	Liver (mouse)
Chloromethane	6.3×10^{-3} (c)	C	Kidney (mouse)
Chromium, Total[f]	4.2×10^{1} (c)	A	Lung (human)
Chrysene	7.3 (d)	B2 (a)	Liver, lung tumors (mouse)
Dibenz(a,h)anthracene	7.3 (d)	B2 (a)	Mammary, skin (mouse)
Dibromochloromethane	8.4×10^{-2} (e)	C	ND
Dieldrin	1.6×10^{1} (a)	B2	Tumors (mouse)
Gamma BHC	1.3 (e)	B2-C	ND
Heptachlor	4.5 (e)	B2	ND
Heptachlor Epoxide	9.1 (e)	B2	ND
Indeno(1,2,3-cd)pyrene	7.3 (d)	B2 (a)	Lung, thorax, skin (rat, mouse)

TABLE 3.4-35
TOXICITY VALUES: POTENTIAL CARCINOGENIC EFFECTS (INHALATION)

Continued

Chemical	Slope Factor (SF) $(mg/kg\text{-}day)^{-1}$	Weight-of-Evidence Classification	Type of Cancer
Lead	ND	B2 (a)	ND
Methylene Chloride	1.6×10^{-3} (a)	B2	Combined ademonas and carcinomas (female mouse)
Nickel	8.4×10^{-1} (a) (b)	A	Respiratory tract
p,p'-DDD	2.4×10^{-1} (e)	B2	ND
p,p-DDE	3.4×10^{-1} (e)	B2	ND
p,p'-DDT	3.4×10^{-1} (e)	B2	ND
Tetrachloroethylene	2.0×10^{-3} (g)	C-B2	ND
Trichloroethylene	6.0×10^{-3} (g)	C-B2	ND
Vinyl Chloride	3.0×10^{-1} (c)	A	Liver (rat, human, mouse, hamster)

Key: ND = No Data

(a) Retrieved from USEPA, 1995.
(b) Inhalation slope factor converted from inhalation unit risk.
(c) Retrieved from USEPA, 1994c, Annual FY94.
(d) Oral slope factor for benzo(a)pyrene was used.
(e) Oral slope factor was used.
(f) Data for Cr+6 were used.
(g) Retrieved from Superfund Health Risk Technical Support Center.

The USEPA has proposed the use of relative potency factors (RPFs) for assessment of risk from oral and dermal exposure to potentially carcinogenic PAHs. An RPF has been assigned to the six PAHs that have been classified as carcinogens (i.e., B2 weight-of-evidence). The RPFs give an estimated order of magnitude potency compared to benzo(a)pyrene. Table 3.4-36 presents RPFs that have been assigned to potentially carcinogenic PAHs (USEPA, 1993c). As a screening process, all detected PAHs were initially assessed without applying RPFs. The slope factors for the potentially carcinogenic PAHs that initially drove unacceptable risk (i.e., chrysene, benzo(a)anthracene, and benzo(b)fluoranthene) were then modified using the appropriate RPFs during subsequent assessment.

3.4.3.2 Non-Carcinogenic Toxicity Values. A reference dose (RfD) is the toxicity value most often used to evaluate non-carcinogenic effects resulting from exposure to contaminants. A chronic RfD is defined as an estimate (with uncertainty spanning an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is unlikely to pose an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are used to evaluate potential non-carcinogenic effects for an exposure period of 7 years to a lifetime (i.e., 70 years). Chronic RfDs were used to evaluate potential non-carcinogenic effects for all identified human receptors, except future construction workers. Subchronic RfDs are used for receptor exposure of 2 weeks to 7 years; subchronic RfDs were used to evaluate potential non-carcinogenic effects for future construction workers with an assumed exposure duration of 2 months.

The USEPA has developed RfDs for the oral exposure route and reference concentrations (RfCs) for the inhalation exposure route. For the oral RfD, the USEPA examines all available animal and human toxicological studies for a chemical following exposure by the oral route. If adequate human data are available, this information is used. If adequate human data are not available, animal study data are used. If only animal study data are available, the USEPA selects the study on the most sensitive animal species as the critical study for the basis of the RfD. The most sensitive species is that species showing a toxic effect at the lowest administered dose.

Once the critical study and toxic effect have been selected, the USEPA identifies the no-observed-adverse-effect level (NOAEL) for the study. The NOAEL is the exposure level that represents the highest level tested at which no adverse effects, including the critical effect, were demonstrated. In some studies, only a lowest-observed-adverse-effect level (LOAEL) is available. The USEPA may use the LOAEL to determine the RfD, but this increases the uncertainty in the RfD value.

The RfD is calculated from the NOAEL (or LOAEL if a NOAEL is not available) by application of uncertainty factors (UFs) and a modifying factor (MF). UFs usually consist of multiples of 10. Each UF represents a specific area of uncertainty that the USEPA establishes in extrapolation from available data. The following UFs are applied to the extrapolated data:

- UF of 10 to account for variation in the general human population. This UF is intended to protect sensitive subpopulations, such as the elderly or children;

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TABLE 3.4-36
RELATIVE POTENCY FACTORS FOR CARCINOGENIC PAHs[(1)]

PAH	Classification	RPF
Benzo(a)anthracene	B2	0.1
Benzo(b)fluoranthene	B2	0.1
Benzo(a)pyrene	B2	1.0
Chrysene	B2	0.001
Dibenz(a,h)anthracene	B2	1.0
Indeno(1,2,3-cd)pyrene	B2	0.1

(1)USEPA, 1993c.

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- UF of 10 to account for extrapolation from animal studies to human studies;

- UF of 10 to account for a NOAEL that is derived from a subchronic rather than a chronic study; and

- UF of 10 to account for the use of a LOAEL rather than a NOAEL.

In addition to UFs, an MF ranging from greater than 0 to 10 is used to reflect a qualitative professional assessment of additional uncertainties in the critical study selected and in the entire data base applicable to the critical study.

The USEPA calculates a RfD by dividing the NOAEL (or LOAEL if a NOAEL is not available) by the products of all applicable UFs and the MF. RfDs are expressed in units of mg/kg-day. Most oral RfDs are based on administered doses rather than absorbed doses.

The same general extrapolation procedures are used by the USEPA to develop inhalation RfCs. The USEPA examines all available toxicological studies and selects the critical study and NOAEL (or LOAEL if a NOAEL is not available). The analysis of data is more complex, however, due to the dynamics of the respiratory system and the diversity across species, and the differences in the physicochemical properties of contaminants.

The same types of UFs that apply to oral RfDs are applied to RfCs. In addition to UFs, an MF of greater than 0 to 10 is also applied. As in the calculation of oral RfDs, the NOAEL (or LOAEL if a NOAEL is not available) is divided by the UFs and MF. A resulting RfC is usually reported in milligrams per cubic meter (mg/m^3) for continuous 24 hour/day exposure and can be converted to inhaled intake in mg/kg-day by adjusting for body weight in kilograms and an inhalation rate of 20 cubic meters per day (m^3/day). For this baseline risk assessment, RfCs were converted to inhalation RfDs.

Tables 3.4-37 and 3.4-38 present the toxicity values (RfDs) for potential non-carcinogenic effects of chemicals of potential concern in soil, surface water, groundwater, or air. The first source for RfDs and RfCs (which were converted to inhalation RfDs) was the USEPA's IRIS data base (USEPA, 1995). If RfDs or RfCs had not been published in IRIS, the USEPA's HEAST was used (USEPA, 1994c). For some chemicals, no information was available in IRIS or HEAST, but a footnote in HEAST directed users to contact the Superfund Health Risk Technical Support Center. The Support Center issued provisional RfDs and/or RfCs for some chemicals. If no information was available for a chemical, surrogate chemicals were used where appropriate. For example, toxicity data for PCB-1254 was used for PCB-1260, endrin for endrin aldehyde, etc. The use of surrogate data is footnoted in Tables 3.4-37 and 3.4-38. If no information was available for a chemical and the data for appropriate surrogate chemicals could not be located, ND (indicating "no data") was entered in the tables.

If a chemical lacked an inhalation RfD, the corresponding oral RfD, if available, was applied as an inhalation RfD. Because few RfC values were available, the oral RfD for a chemical

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TABLE 3.4-37
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (ORAL)

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
1,1-Dichloroethane	Chronic: 1×10^{-1} (c) Subchronic: 1 (c)	ND	No adverse effects observed	UF = 1,000 MF = 1
1,1-Dichloroethene	Chronic: 9×10^{-3} (b) Subchronic: 9×10^{-3} (c)	Medium	Hepatic lesions	UF = 1,000 MF = 1
1,1,1-Trichloroethane	Chronic: 2.5×10^{-1} (m) Subchronic: 2.5×10^{-1} (n)	ND	ND	ND
1,2,3-Trichlorobenzene	Chronic: 1×10^{-2} (q) Subchronic: 1×10^{-2} (q)	Medium	Increased adrenal weights; vacuolization of zona fasciculata in the renal cortex	UF = 1,000 MF = 1
1,2,4-Trichlorobenzene	Chronic: 1×10^{-2} (b) Subchronic: 1×10^{-2} (c)	Medium	Increased adrenal weights; vacuolization of zona fasciculata in the renal cortex	UF = 1,000 MF = 1
1,2,4-Trimethylbenzene	ND	ND	ND	ND
1,3,5-Trimethylbenzene	ND	ND	ND	ND
2-Methylnaphthalene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND
2,4-Dinitrotoluene	Chronic: 2×10^{-3} (b) Subchronic: 2×10^{-3} (c)	High	Neurotoxicity, Heinz bodies, biliary tract hyperplasia	UF = 100 MF = 1
Acenaphthene	Chronic: 6×10^{-2} (b) Subchronic: 6×10^{-1} (c)	Low	Hepatotoxicity	UF = 3,000 MF = 1
Acetone	Chronic: 1×10^{-1} (b) Subchronic: 1 (c)	Low	Increased liver and kidney weights and nephrotoxicity	UF = 1,000 MF = 1
Aldrin	Chronic: 3×10^{-5} (b) Subchronic: 3×10^{-5} (c)	Medium	Liver toxicity	UF = 1,000 MF = 1
Alpha BHC (Beta Hexachlorocyclohexane)(i)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-3} (c)	ND	ND	ND
Alpha Endosulfan(j)	Chronic: 6×10^{-3} (b) Subchronic: 6×10^{-3} (c)	ND	ND	ND
Aluminum	ND	ND	ND	ND
Anthracene	Chronic: 3×10^{-1} (b) Subchronic: 3 (c)	Low	No observed effects	UF = 3,000 MF = 1
Arsenic	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-4} (c)	Medium	Keratosis, hyperpigmentation, and possible vascular complications	UF = 3 MF = 1
Barium	Chronic: 7×10^{-2} (b) Subchronic: 7×10^{-2} (c)	Medium	Increased blood pressure	UF = 3 MF = 1
Benzo(a)anthracene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND
Benzo(a)pyrene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND

TABLE 3.4-37
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (ORAL)

Continued

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
Benzo(b)fluoranthene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND
Benzo(g,h,i)perylene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND
Beryllium	Chronic: 5×10^{-3} (b) Subchronic: 5×10^{-3} (c)	Low	No adverse effects observed	UF = 100 MF = 1
Beta BHC (Beta Hexachlorocyclohexane)(i)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-3} (c)	ND	ND	ND
Beta Endosulfan(j)	Chronic: 6×10^{-3} (b) Subchronic: 6×10^{-3} (c)	ND	ND	ND
Bis(2-ethylhexyl)phthalate	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-2} (a)	Medium	Increased relative liver weight	UF = 1,000 MF = 1
Bromodichloromethane	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-2} (c)	Medium	Renal cytomegaly	UF = 1,000 MF = 1
Bromoform	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-1} (c)	Medium	Hepatic lesions	UF = 1,000 MF = 1
Bromomethane	Chronic: 1.4×10^{-3} (b) Subchronic: 1.4×10^{-3} (a)	Medium	Epithelial hyperplasia of the forestomach	UF = 1,000 MF = 1
Cadmium	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (a)	High	Significant proteinuria	UF = 10 MF = 1
Carbon Tetrachloride	Chronic: 7×10^{-4} (b) Subchronic: 2×10^{-3} (h)	Medium	Liver lesions	UF = 1,000 MF = 1
Chloroethane	Chronic: 3 (m) Subchronic: 3 (n)	ND	ND	ND
Chloroform (Trichloromethane)	Chronic: 1×10^{-2} (b) Subchronic: 1×10^{-2} (c)	Medium	Fatty cyst formation in liver	UF = 1,000 MF = 1
Chloromethane	ND	ND	ND	ND
Chromium, Total(f)	Chronic: 5×10^{-3} (b) Subchronic: 2×10^{-2} (c)	Low	No effects reported	UF = 500 MF = 1
Chrysene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND
cis-1,2-Dichloroethene	Chronic: 1×10^{-2} (c) Subchronic: 1×10^{-1} (c)	ND	Decreased hematocrit and hemoglobin	UF = 3,000 MF = 1
Cobalt	ND	ND	ND	ND
Copper	Chronic: 3.7×10^{-2} (g) Subchronic: 3.7×10^{-2} (a)	ND	Local gastrointestinal irritation (acute effect)	ND
Cyanide	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-2} (c)	Medium	Weight loss, thyroid effects and myelin degeneration	UF = 100 MF = 5
Delta BHC (Beta Hexachlorocyclohexane)(i)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-3} (c)	ND	ND	ND

TABLE 3.4-37
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (ORAL)

Continued

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
Di-n-butyl phthalate	Chronic: 1×10^{-1} (b) Subchronic: 1 (c)	Low	Increased mortality	UF = 1,000 MF = 1
Dibenz(a,h)anthracene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND
Dibromochloromethane	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-1} (c)	Medium	Hepatic lesions	UF = 1,000 MF = 1
Dichlorodifluoromethane	Chronic: 2×10^{-1} (b) Subchronic: 9×10^{-1} (c)	Medium	Reduced body weight	UF = 100 MF = 1
Dieldrin	Chronic: 5×10^{-5} (b) Subchronic: 5×10^{-5} (c)	Medium	Liver lesions	UF = 100 MF = 1
Endosulfan Sulfate(j)	Chronic: 6×10^{-3} (b) Subchronic: 6×10^{-3} (c)	ND	ND	ND
Endrin Aldehyde(k)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-4} (c)	ND	ND	ND
Endrin	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-4} (c)	Medium	Mild histological lesions in liver, occasional convulsions	UF = 100 MF = 1
Ethylbenzene	Chronic: 1×10^{-1} (b) Subchronic: 1×10^{-1} (a)	Low	Liver and kidney toxicity	UF = 1,000 MF = 1
Fluoranthene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-1} (c)	Low	Nephropathy, increased liver weights, hematological alterations, and clinical effects	UF = 3,000 MF = 1
Fluorene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-1} (c)	Low	Decreased RBC count, packed cell volume and hemoglobin	UF = 3,000 MF = 1
Fluoride (Soluble, as Fluorine)	Chronic: 6×10^{-2} (b) Subchronic: 6×10^{-2} (c)	High	Objectionable dental fluorosis, a cosmetic effect	UF = 1 MF = 1
Gamma BHC (Lindane)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-3} (c)	Medium	Liver and kidney toxicity	UF = 1,000 MF = 1
Heptachlor	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	Low	Liver weight increase	UF = 300 MF = 1
Heptachlor Epoxide	Chronic: 1.3×10^{-5} (b) Subchronic: 1.3×10^{-5} (c)	Low	Increased liver to body weight ratio	UF = 1,000 MF = 1
Indeno(1,2,3-cd)pyrene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND
Isopropylbenzene (Cumene)	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-1} (c)	Low	Increased average kidney weight	UF = 3,000 MF = 1
Lead	ND	ND	ND	ND
Manganese	Chronic: 1.4×10^{-1} (b)(p) Subchronic: 1.4×10^{-1} (c)(p)	ND	Central nervous system effects	UF = 1 MF = 1

TABLE 3.4-37
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (ORAL)

Continued

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
Mercury	Chronic: 3×10^{-4} (c) Subchronic: 3×10^{-4} (c)	ND	Kidney effects	UF = 1,000 MF = 1
Methyl ethyl ketone	Chronic: 6×10^{-1} (b) Subchronic: 2 (c)	Low	Decreased fetal birth weight	UF = 3,000 MF = 1
Methoxychlor	Chronic: 5.3×10^{-3} (b) Subchronic: 5.3×10^{-3} (c)	Low	Excessive loss of litters	UF = 1,000 MF = 1
Methylene Chloride	Chronic: 6×10^{-2} (b) Subchronic: 6×10^{-2} (c)	Medium	Liver toxicity	UF = 100 MF = 1
Molybdenum	Chronic: 5×10^{-3} (b) Subchronic: 5×10^{-3} (c)	Medium	Increased uric acid levels	UF = 30 MF = 1
n-Butylbenzene	ND	ND	ND	ND
n-Propylbenzene	ND	ND	ND	ND
Naphthalene	Chronic: 4×10^{-2} (h) Subchronic: 4×10^{-2} (h)	ND	None observed	UF = 1,000 MF = 1
Nickel	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-2} (c)	Medium	Decreased body and organ weights	UF = 300 MF = 1
p-Cymene (p-Isopropyltoluene)	ND	ND	ND	ND
PCB-1254 (Arochlor 1254)	Chronic: 2×10^{-5} (b) Subchronic: 2×10^{-5} (a)	Medium	Ocular exudate, distorted growth of finger and toe nails, decreased antibody response to sheep erythrocytes, inflamed Meibomian glands	UF = 300 MF = 1
PCB-1260 (Arochlor 1260)(O)	Chronic: 2×10^{-5} (b) Subchronic: 2×10^{-5} (a)	ND	ND	ND
Phenanthrene	Chronic: 4×10^{-2} (d) Subchronic: 4×10^{-2} (e)	ND	ND	ND
p,p'-DDD(l)	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	ND	ND	ND
p,p'-DDE(l)	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	ND	ND	ND
p,p'-DDT	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	Medium	Liver lesions	UF = 100 MF = 1
Pyrene	Chronic: 3×10^{-2} (c) Subchronic: 3×10^{-1} (d)	Low	Kidney effects (renal tubular pathology, decreased kidney weights)	UF = 3,000 MF = 1
sec-Butylbenzene	ND	ND	ND	ND
Selenium	Chronic: 5×10^{-3} (b) Subchronic: 5×10^{-3} (c)	High	Clinical selenosis	UF = 3 MF = 1
Silver	Chronic: 5×10^{-3} (b) Subchronic: 5×10^{-3} (c)	Low	Argyria	UF = 3 MF = 1

TABLE 3.4-37
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (ORAL)

Continued

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
Styrene	Chronic: 2×10^{-1} (b) Subchronic: 2×10^{-1} (a)	Medium	Red blood cell and liver effects	UF = 1,000 MF = 1
Tetrachloroethylene	Chronic: 1×10^{-2} (b) Subchronic: 1×10^{-1} (c)	Medium	Hepatotoxicity; liver weight gain	UF = 1,000 MF = 1
Thallium (as thallium carbonate or thallium chloride)	Chronic: 8×10^{-5} (b) *Subchronic:* 8×10^{-4} (c)	Low	Increased SGOT and serum LDH levels, alopecia	UF = 3,000 MF = 1
Toluene	Chronic: 2×10^{-1} (b) Subchronic: 2 (c)	Medium	Changes in liver and kidney weights	UF = 1,000 MF = 1
trans-1,2-Dichloroethene	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-1} (c)	Low	Increased serum alkaline phosphatase	UF = 1,000 MF = 1
Trichloroethylene	Chronic: 6×10^{-3} (h) Subchronic: 6×10^{-3} (h)	Low	Increased relative liver weight	UF = 3,000
Trichlorofluoromethane	Chronic: 3×10^{-1} (b) Subchronic: 7×10^{-1} (c)	Medium	Survival and histopathology	UF = 1,000 MF = 1
Vanadium	Chronic: 7×10^{-3} (d) Subchronic: 7×10^{-3} (d)	ND	None observed	UF = 100 MF = 1
Vinyl Chloride	ND	ND	ND	ND
Xylenes, Total	Chronic: 2 (b) Subchronic: 2 (a)	Medium	Hyperactivity, decreased body weight, increased mortality	UF = 100 MF = 1
Zinc	Chronic: 3×10^{-1} (b) Subchronic: 3×10^{-1} (c)	Medium	47% decrease in erthrocyte superoxide dismutase (ESOD) concentration in adult female rats after 10 weeks of zinc exposure	UF = 3 MF = 1

Key:
ND = No Data
UF = Uncertainty Factor for chronic RfD
MF = Modifying Factor for chronic RfD

(a) Chronic RfD used as subchronic RfD.
(b) Retrieved from USEPA, 1995.
(c) Retrieved from USEPA, 1994c, Annual FY94.
(d) Provisional chronic RfD for naphthalene was used.
(e) Provisional subchronic RfD for naphthalene was used.
(f) Data for Cr^{+6}, rather than Cr^{+3}, were used because it is a more conservative assumption.
(g) USEPA Drinking Water Criteria Document "Concluded that toxicity data were inadequate for calculation of an RfD for copper." RfD converted from 1.3 mg/L drinking water standard.
(h) Retrieved from Superfund Health Risk Technical Support Center.
(i) Data for Gamma-BHC were used.
(j) Data for Endosulfan were used.
(k) Data for Endrin were used.
(l) Data for DDT were used.
(m) Chronic inhalation RfD were used.
(n) Subchronic inhalation RfD were used.
(o) Data for PCB-1254 were used.
(p) RfD values for food rather than for water were used (Valesquez, 1995).
(q) Data for 1,2,4-Trichlorobenzene were used.

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TABLE 3.4-38
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (INHALATION)

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
1,1-Dichloroethane	Chronic: 1×10-1 (d) (f) Subchronic: 1 (d) (f)	ND	Kidney damage	UF = 100 MF = 1
1,1-Dichloroethene	Chronic: 9×10^{-3} (b) Subchronic: 9×10^{-3} (c)	ND	ND	ND
1,1,1-Trichloroethane	Chronic: 2.5×10^{-1} (l) (f) Subchronic: 2.5×10^{-1} (a)	ND	ND	ND
1,2,3-Trichlorobenzene	Chronic: 1×10^{-2} (b) Subchronic: 1×10^{-2} (c)	ND	ND	ND
1,2,4-Trichlorobenzene	Chronic: 1×10^{-2} (b) Subchronic: 1×10^{-2} (c)	ND	ND	ND
1,2,4-Trimethylbenzene	ND	ND	ND	ND
1,3,5-Trimethylbenzene	ND	ND	ND	ND
2-Methylnaphthalene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
2,4-Dinitrotoluene	Chronic: 2×10^{-3} (b) Subchronic: 2×10^{-3} (c)	ND	ND	ND
Acenaphthene	Chronic: 6×10^{-2} (b) Subchronic: 6×10^{-1} (c)	ND	ND	ND
Acetone	Chronic: 1×10^{-1} (b) Subchronic: 1 (c)	ND	ND	ND
Aldrin	Chronic: 3×10^{-5} (b) Subchronic: 3×10^{-5} (c)	ND	ND	ND
Alpha BHC (Beta Hexachlorocyclohexane)(i)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-3} (c)	ND	ND	ND
Alpha Endosulfan(j)	Chronic: 6×10^{-3} (b) Subchronic: 6×10^{-3} (c)	ND	ND	ND
Aluminum	ND	ND	ND	ND
Anthracene	Chronic: 3×10^{-1} (b) Subchronic: 3×10^{-1} (c)	ND	ND	ND
Arsenic	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-4} (c)	ND	ND	ND
Barium	Chronic: 1×10^{-3} (d) (f) Subchronic: 1×10^{-4} (d) (f)	ND	Fetotoxicity	UF = 1,000 MF = 1
Benzo(a)anthracene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
Benzo(a)pyrene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
Benzo(b)fluoranthene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
Benzo(g,h,i)perylene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND

TABLE 3.4-38
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (INHALATION)

Continued

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
Beryllium	Chronic: 5×10^{-3} (b) Subchronic: 5×10^{-3} (c)	ND	ND	ND
Beta BHC (Beta Hexachlorocyclohexane)(i)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-3} (c)	ND	ND	ND
Beta Endosulfan(j)	Chronic: 6×10^{-3} (b) Subchronic: 6×10^{-3} (c)	ND	ND	ND
Bis(2-ethylhexyl)phthalate	Chronic: 2×10^{-2} (b) Subchronic: 6×10^{-2} (c)	ND	ND	ND
Bromodichloromethane	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-2} (c)	ND	ND	ND
Bromoform	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-1} (c)	ND	ND	ND
Bromomethane	Chronic: 1.4×10^{-3} (g) (f) Subchronic: 1.4×10^{-3} (a)	High	Degenerative and proliferative lesions of the olfactory epithelium of the nasal cavity	UF = 100 MF = 1
Cadmium	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	ND	ND	ND
Carbon tetrachloride	Chronic: 7×10^{-4} (b) Subchronic: 2×10^{-3} (c)	ND	ND	ND
Chloroform (Trichloromethane)	Chronic: 1×10^{-2} (b) Subchronic: 1×10^{-2} (c)	ND	ND	ND
Chloroethane	Chronic: 3 (g) (f) Subchronic: 3 (d) (f)	Medium	Delayed fetal ossification	UF = 300 MF = 1
Chloromethane	ND	ND	ND	ND
Chromium, Total(h)	Chronic: 1.1×10^{-6} (o) Subchronic: 1.1×10^{-6} (l)	ND	ND	ND
Chrysene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
cis-1,2-Dichloroethene	Chronic: 1×10^{-2} (b) Subchronic: 1×10^{-1} (c)	ND	ND	ND
Cobalt	ND	ND	ND	ND
Copper	Chronic: 3.7×10^{-2} (b) Subchronic: 3.7×10^{-2} (c)	ND	ND	ND
Cyanide	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-2} (c)	ND	ND	ND
Delta BHC (Beta Hexachlorocyclohexane)(i)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-3} (c)	ND	ND	ND
Di-n-butyl phthalate	Chronic: 1×10^{-1} (b) Subchronic: 1 (c)	ND	ND	ND

TABLE 3.4-38
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (INHALATION)

Continued

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
Dibenz(a,h)anthracene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND
Dibromochloromethane	Chronic: 2×10^{-2} (b) Subchronic: 2×10^{-1} (c)	ND	ND	ND
Dichlorodifluoromethane	Chronic: 5×10^{-1} (d) (f) Subchronic: 5×10^{-2} (d) (f)	ND	Liver lesions	UF = 10,000 MF = 1
Dieldrin	Chronic: 5×10^{-5} (b) Subchronic: 5×10^{-5} (c)	ND	ND	ND
Endosulfan Sulfate(j)	Chronic: 6×10^{-3} (b) Subchronic: 6×10^{-3} (c)	ND	ND	ND
Endrin Aldehyde(k)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-4} (c)	ND	ND	ND
Endrin	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-4} (c)	ND	ND	ND
Ethylbenzene	Chronic: 2.9×10^{-1} (g) (f) Subchronic: 2.9×10^{-1} (a)	Low	Developmental toxicity	UF = 300 MF = 1
Fluoranthene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-1} (c)	ND	ND	ND
Fluorene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-1} (c)	ND	ND	ND
Fluoride (Soluble, as Fluorine)	Chronic: 6×10^{-2} (b) Subchronic: 6×10^{-2} (c)	ND	ND	ND
Gamma BHC (Lindane)	Chronic: 3×10^{-4} (b) Subchronic: 3×10^{-3} (c)	ND	ND	ND
Heptachlor	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	ND	ND	ND
Heptachlor Epoxide	Chronic: 1.3×10^{-5} (b) Subchronic: 1.3×10^{-5} (c)	ND	ND	ND
Indeno(1,2,3-cd)pyrene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
Isopropylbenzene (Cumene)	Chronic: 3×10^{-3} (d) (f) Subchronic: 3×10^{-2} (d) (f)	ND	Central nervous system involvement	UF = 10,000 MF = 1
Lead	ND	ND	ND	ND
Manganese	Chronic: 1×10^{-5} (g) Subchronic: 1×10^{-5} (a)	Medium	Impairment of neuro-behavioral function	UF = 1,000 MF = 1
Mercury	Chronic: 9×10^{-5} (d) (f) Subchronic: 9×10^{-5} (d) (f)	ND	Nervous system neurotoxicity	UF = 30 MF = 1
Methyl Ethyl Ketone	Chronic: 2.9×10^{-1} (g)(f) Subchronic: 2.9×10^{-1} (d)(f)	Low	Decreased fetal birth weight	UF = 1,000 MF = 3
Molybdenum	Chronic: 5×10^{-3} (b) Subchronic: 5×10^{-3} (c)	ND	ND	ND

TABLE 3.4-38
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (INHALATION)

Continued

Chemical	RfD (mg/kg-day)	Confidence Level	Critical Effects	Uncertainty and Modifying Factors
Methoxychlor	Chronic: 5.3×10^{-3} (b) Subchronic: 5.3×10^{-3} (c)	ND	ND	ND
Methylene Chloride	Chronic: 9×10^{-1} (d) (f) Subchronic: 9×10^{-1} (d) (f)	Medium	Liver toxicity	UF = 100 MF = 1
n-Butylbenzene	ND	ND	ND	ND
n-Propylbenzene	ND	ND	ND	ND
Naphthalene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
Nickel	Chronic: 2×10^{-2} (c) Subchronic: 2×10^{-2} (d)	ND	ND	ND
p-Cymene (p-Isopropyltoluene)	ND	ND	ND	ND
PCB-1254(Arochlor 1254)	Chronic: 2×10^{-5} (b) Subchronic: 2×10^{-5} (c)	ND	ND	ND
PCB-1260 (Arochlor 1260) (m)	Chronic: 2×10^{-5} (b) Subchronic: 2×10^{-5} (c)	ND	ND	ND
p,p'-DDD (n)	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	ND	ND	ND
p,p'-DDE (n)	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	ND	ND	ND
p,p'-DDT	Chronic: 5×10^{-4} (b) Subchronic: 5×10^{-4} (c)	ND	ND	ND
Phenanthrene	Chronic: 4×10^{-2} (b) Subchronic: 4×10^{-2} (c)	ND	ND	ND
Pyrene	Chronic: 3×10^{-2} (b) Subchronic: 3×10^{-1} (c)	ND	ND	ND
sec-Butylbenzene	ND	ND	ND	ND
Selenium	Chronic: 5×10^{-3} (c) Subchronic: 5×10^{-3} (d)	ND	ND	ND
Silver	Chronic: 5×10^{-3} (b) Subchronic: 5×10^{-3} (c)	ND	ND	ND
Styrene	Chronic: 2.9×10^{-1} (g)(f) Subchronic: 8.6×10^{-1} (d)(f)	Medium	Central Nervous System effects	UF = 30 MF = 1
Tetrachloroethylene	Chronic: 1×10^{-2} (b) Subchronic: 1×10^{-1} (c)	ND	ND	ND
Thallium (as thallium carbonate or thallium chloride)	Chronic: 8×10^{-5} (b) Subchronic: 8×10^{-4} (c)	ND	ND	ND
Toluene	Chronic: 1×10^{-1} (g) (f) Subchronic: 1 (a)	Medium	Neurological and hematological effects; degeneration of nasal epithelium	UF = 300 MF = 1

TABLE 3.4-38
TOXICITY VALUES: POTENTIAL NON-CARCINOGENIC EFFECTS (INHALATION)

Continued

Chemical	RfD (mg/kg-day)			Confidence Level	Critical Effects	Uncertainty and Modifying Factors
trans-1,2-Dichloroethene	Chronic: Subchronic:	2×10^{-2} 2×10^{-1}	(b) (c)	ND	ND	ND
Trichloroethylene	Chronic: Subchronic:	6×10^{-3} 6×10^{-3}	(b) (c)	ND	ND	ND
Trichlorofluoromethane	Chronic: Subchronic:	3×10^{-1} 7×10^{-1}	(b) (c)	ND	ND	ND
Vanadium	Chronic: Subchronic:	7×10^{-3} 7×10^{-3}	(c) (d)	ND	ND	ND
Vinyl Chloride	ND			ND	ND	ND
Xylenes, Total	Chronic: Subchronic:	2 2	(b) (c)	ND	ND	ND
Zinc	Chronic: Subchronic:	3×10^{-1} 3×10^{-1}	(b) (c)	ND	ND	ND

Key:
ND = No Data
UF = Uncertainty Factor for chronic RfD
MF = Modifying Factor for chronic RfD

(a) Chronic RfD used as subchronic RfD.
(b) Chronic oral RfD was used.
(c) Subchronic oral RfD was used.
(d) Retrieved from USEPA, 1994c, Annual FY94.
(f) Inhalation RfD was converted from corresponding RfC.
(g) Retrieved from USEPA, 1995.
(h) Data for Cr^{+6}, rather than Cr^{+3}, were used because it is a more conservative assumption.
(i) Data for gamma-BHC were used.
(j) Data for endosulfan were used.
(k) Data for endrin were used.
(l) Retrieved from Superfund Health Risk Technical Support Center, 1995.
(m) Data for Arochlor 1254 were used.
(n) Data for DDT were used.
(o) Subchronic RfD used as chronic RfD.

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frequently served as its inhalation RfD, as footnoted in Tables 3.4-37 and 3.4-38. For two VOCs, chloroethane and 1,1,1-trichloroethane, the inhalation RfD served as the oral RfD.

The following PAHs were identified as chemicals of potential concern (Section 3.4.1):

- 2-Methylnaphthalene
- Acenaphthene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Chyrsene
- Dibenz(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Naphthalene
- Phenanthrene
- Pyrene

For the PAH chemical class, oral RfDs exist only for anthracene, fluoranthene, fluorene, and pyrene. A provisional oral RfD exists for naphthalene. Typically, the lowest RfD available is considered the most conservative: the oral RfD for pyrene is the lowest toxicity value available (3×10^{-2} mg/kg-day). However, naphthalene has a provisional chronic and subchronic RfD of 4×10^{-2} mg/kg-day, which is only slightly higher than pyrene. Because naphthalene has a higher vapor pressure, water solubility, and Henry's law constant, it can be considered to have a higher mobility. This could lead to greater exposure for a greater number of exposure pathways. Therefore, the naphthalene provisional oral RfD was considered to be more health protective as an evaluation point and was used as a surrogate for the PAHs lacking oral toxicity values. Inhalation RfCs are not available for any PAHs; the corresponding oral RfD was applied as a surrogate.

In addition to RfDs, Tables 3.4-37 and 3.4-38 list the confidence level assigned to the RfD by the USEPA, the critical effect selected by the USEPA, UFs and the MF, and the RfD source.

3.4.3.3 Adjustment of Oral Toxicity Values to Dermal Toxicity Values. For dermal exposure to chemicals in soil, groundwater, or surface water, it is necessary to adjust an oral toxicity value (i.e., RfD or slope factor) from an administered to an absorbed dose. Because the oral toxicity values for the chemicals are expressed as administered doses (i.e., intake-based), it was necessary to adjust both the RfDs and slope factors in estimating risk from dermal exposure. Thus, an estimated dermally absorbed dose may be appropriately compared with a toxicity value that has been adjusted to a dermal toxicity value.

In determining the extent of absorption of the chemical constituents, the available literature was searched for toxicokinetic data. Once the oral absorption efficiency (expressed as percent absorbed) was identified for a constituent, the factor was applied to the RfD and/or slope factor to arrive at the dermally adjusted toxicity value. RfD values were adjusted by multiplying by the oral absorption efficiency, whereas slope factors were adjusted by dividing by the oral absorption efficiency. Table 3.4-39 presents the RfDs and slope factors adjusted for dermal absorption of chemicals of potential concern.

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TABLE 3.4-39
TOXICITY VALUES ADJUSTED FOR DERMAL ABSORPTION OF CHEMICALS OF POTENTIAL CONCERN IN SOIL, GROUNDWATER, AND SURFACE WATER

Analyte	Oral Absorption Efficiency[(a)]	Adjusted Dermal Chronic RfD (mg/kg-day)	Adjusted Dermal Subchronic RfD (mg/kg-day)	Adjusted Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
1,1,1-Trichloroethane	0.94 (b)	2.4E-01	2.4E-01	N/A
1,1-Dichloroethane	1.00 (c)	1.0E-01	1.0E+00	ND
1,1-Dichloroethene	1.00	9.0E-03	9.0E-03	6.1E-01
1,2,3-Trichlorobenzene	1.00	1.0E-02	1.0E-02	N/A
1,2,4-Trichlorobenzene	1.00	1.0E-02	1.0E-02	N/A
1,2,4-Trimethylbenzene	1.00	ND	ND	N/A
1,3,5-Trimethylbenzene (Mesitylene)	1.00	ND	ND	N/A
2,4-Dinitrotoluene	1.00	2.0E-03	2.0E-03	N/A
2-Methylnaphthalene	0.48 (e)	1.9E-02	1.9E-02	N/A
Acenaphthene	0.48 (e)	2.9E-02	2.9E-01	N/A
Acetone	0.79 (f)	7.9E-02	7.9E-01	N/A
Aldrin	0.50 (g)	1.5E-05	1.5E-05	3.4E+01
Alpha BHC (Alpha Hexchlorocyclohexane)	0.97 (f)	2.9E-04	2.9E-03	6.5E+00
Alpha Endosulfan	0.78 (h)	4.7E-03	4.7E-03	N/A
Aluminum	0.04 (i)	ND	ND	N/A
Anthracene	0.64 (j)	1.9E-01	1.9E+00	N/A
Arsenic	0.95 (h)	2.9E-04	2.9E-04	1.9E+00
Barium	0.05 (i)	3.5E-03	3.5E-03	N/A
Benzo(a)anthracene	0.48 (e)	1.9E-02	1.9E-02	1.5E+01
Benzo(a)pyrene	0.48 (j)	1.9E-02	1.9E-02	1.5E+01
Benzo(b)fluoranthene	0.48 (e)	1.9E-02	1.9E-02	1.5E+01
Benzo(g,h,i)perylene	0.48 (e)	1.9E-02	1.9E-02	N/A
Beryllium	0.005 (h)	2.5E-05	2.5E-05	1.4E+03
Beta BHC (Beta Hexachlorocyclohexane)	0.91 (f)	2.7E-04	2.7E-03	2.0E+00
Beta Endosulfan	0.85 (h)	5.1E-03	5.1E-03	N/A
bis(2-Ethylhexyl)phthalate	0.23 (h)	4.6E-03	4.6E-03	6.1E-02
Bromodichloromethane	1.00	2.0E-02	2.0E-02	6.2E-02
Bromoform	1.00	2.0E-02	2.0E-01	7.9E-03

TABLE 3.4-39
TOXICITY VALUES ADJUSTED FOR DERMAL ABSORPTION OF CHEMICALS OF POTENTIAL CONCERN IN SOIL, GROUNDWATER, AND SURFACE WATER

Continued

Analyte	Oral Absorption Efficiency[a]	Adjusted Dermal Chronic RfD (mg/kg-day)	Adjusted Dermal Subchronic RfD (mg/kg-day)	Adjusted Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
Bromomethane	1.00	1.4E-03	1.4E-03	N/A
Cadmium	0.053 (h)	2.7E-05	2.7E-05	ND
Carbon Tetrachloride	0.96 (p)	6.7E-04	1.9E-03	1.4E-01
Chloroethane	1.00	3.0E+00	3.0E+00	N/A
Chloroform (Trichloromethane)	0.96 (h)	9.6E-03	9.6E-03	6.4E-03
Chloromethane	1.00	ND	ND	1.3E-02
Chromium, Total	0.013 (h)	6.5E-05	2.6E-04	N/A
Chrysene	0.24 (j)	9.6E-03	9.6E-03	3.0E+01
cis-1,2-Dichloroethene	1.00	1.0E-02	1.0E-01	N/A
Cobalt	0.31 (i)	ND	ND	N/A
Copper	0.50 (d)	1.9E-02	1.9E-02	N/A
Cyanide	0.47 (h)	9.4E-03	9.4E-03	N/A
Delta BHC (Delta Hexachlorocyclohexane)	0.92 (f)	2.8E-04	2.8E-03	N/A
Di-n-butyl phthalate	0.23 (k)	2.3E-02	2.3E-01	N/A
Dibenz(a,h)anthracene	0.10 (j)	4.0E-03	4.0E-03	7.3E+01
Dibenzofuran	0.90 (l)	ND	ND	N/A
Dibromochloromethane	1.00	2.0E-02	2.0E-01	8.4E-02
Dichlorodifluoromethane	1.00	2.0E-01	9.0E-01	N/A
Dieldrin	0.50 (h)	2.5E-05	2.5E-05	3.2E+01
Endosulfan Sulfate	0.82 (h)	4.9E-03	4.9E-03	N/A
Endrin	1.00	3.0E-04	3.0E-04	N/A
Endrin Aldehyde	1.00	3.0E-04	3.0E-04	N/A
Ethylbenzene	0.84 (m)	8.4E-02	8.4E-02	N/A
Fluoranthene	0.48 (e)	1.9E-02	1.9E-01	N/A
Fluorene	0.48 (e)	1.9E-02	1.9E-01	N/A
Fluoride	1.00(h)	6.0E-02	6.0E-02	N/A

TABLE 3.4-39
TOXICITY VALUES ADJUSTED FOR DERMAL ABSORPTION OF CHEMICALS OF POTENTIAL CONCERN IN SOIL, GROUNDWATER, AND SURFACE WATER

Continued

Analyte	Oral Absorption Efficiency(a)	Adjusted Dermal Chronic RfD (mg/kg-day)	Adjusted Dermal Subchronic RfD (mg/kg-day)	Adjusted Dermal Slope Factor (mg/kg-day)$^{-1}$
Gamma BHC (Lindane)	0.99(f)	3.0E-04	3.0E-03	1.3E+00
Heptachlor	0.77(h)	3.9E-04	3.9E-04	5.8E+00
Heptachlor Epoxide	0.77(h)	1.0E-05	1.0E-05	1.2E+01
Indeno(1,2,3-cd)pyrene	0.48(e)	1.9E-02	1.9E-02	1.5E+01
Isopropylbenzene (Cumene)	0.84(n)	3.4E-02	3.4E-01	N/A
Lead	0.087(h)	ND	ND	ND
Manganese	0.03(o)	1.5E-04	1.5E-04	N/A
Mercury (Inorganic)	0.15(i)	4.5E-05	4.5E-05	N/A
Methoxychlor	0.90(f)	4.8E-03	4.8E-03	N/A
Methy Ethyl Ketone (2-Butanone)	1.00	6E-01	2E+00	N/A
Methylene Chloride	0.98(h)	5.9E-02	5.9E-02	7.7E-03
Molybdenum	0.05	2.5E-04	2.5E-04	N/A
n-Butylbenzene	0.84(n)	ND	ND	N/A
n-Propylbenzene	0.84(n)	ND	ND	N/A
Naphthalene	0.48(e)	1.9E-02	1.9E-02	N/A
Nickel	0.055(h)	1.1E-03	1.1E-03	N/A
p,p'-DDD	0.08(f)	4.0E-05	4.0E-05	3.0E+00
p,p'-DDE	0.08(f)	4.0E-05	4.0E-05	4.3E+00
p,p'-DDT	0.08(f)	4.0E-05	4.0E-05	4.3E+00
p-Cymene (p-Isopropyltoluene)	0.84(n)	ND	ND	N/A
PCB-1254 (Arochlor 1254)	0.90(h)	1.8E-05	1.8E-05	N/A
PCB-1260 (Arochlor 1260)	0.90(h)	1.8E-05	1.8E-05	N/A
Phenanthrene	0.48(e)	1.9E-02	1.9E-02	N/A
Pyrene	0.75(j)	2.3E-02	2.3E-01	N/A
sec-Butylbenzene	0.84(n)	ND	ND	N/A
Selenium	0.94(b)	4.7E-03	4.7E-03	N/A
Silver	0.21(c)	1.1E-03	1.1E-03	N/A

TABLE 3.4-39
TOXICITY VALUES ADJUSTED FOR DERMAL ABSORPTION OF CHEMICALS OF POTENTIAL CONCERN IN SOIL, GROUNDWATER, AND SURFACE WATER

Continued

Analyte	Oral Absorption Efficiency[a]	Adjusted Dermal Chronic RfD (mg/kg-day)	Adjusted Dermal Subchronic RfD (mg/kg-day)	Adjusted Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$
Styrene	0.63	1.3E-01	1.3E-01	N/A
Tetrachloroethene	1.00 [h]	1.0E-02	1.0E-01	5.2E-02
Thallium	0.05	4.0E-06	4.0E-05	N/A
Toluene	0.84 [n]	1.7E-01	1.7E+00	N/A
trans-1,2-Dichloroethene	1.00	2.0E-02	2.0E-01	N/A
Trichloroethene	0.96 [h]	5.8E-03	5.8E-03	1.1E-02
Trichlorofluoromethane	1.00	3.0E-01	7.0E-01	N/A
Vanadium	0.026 [i]	1.8E-04	1.8E-04	N/A
Vinyl Chloride	1.00 [b]	ND	ND	1.9E+00
Xylenes, Total	0.895 [b]	1.8E+00	1.8E+00	N/A
Zinc	0.25 [f]	7.5E-02	7.5E-02	N/A

Key: ND = No Data
N/A = Not Applicable because the chemical is not classified a human carcinogen by USEPA.
RfD = Reference Dose.

Footnotes:

[a] Absorption assumed to be 5% for metals (USEPA, 1989a) and 100% for organics in absence of chemical specific information or information on appropriate surrogates.

[b] Agency for Toxic Substances and Disease Registry (ATSDR), 1994. Toxicological Profile for Specified Compound, Draft Report.

[c] Agency for Toxic Substances and Disease Registry (ATSDR), 1990, Toxicological Profile for Specified Compound.

[d] USEPA, 1987, Summary Review of the Health Effects Associated with Copper, Office of Health and Environmental Assessment, Washington, D.C.

[e] Benzo(a)pyrene used as a surrogate. See (j).

[f] Agency for Toxic Substances and Disease Registry (ATSDR), 1992, Toxicological Profile for Specified Compound, Draft Report.

[g] Dieldrin used as surrogate. See (h).

[h] Agency for Toxic Substances and Disease Registry (ATSDR), 1993, Toxicological Profile for Specified Compound.

[i] Agency for Toxic Substances and Disease Registry (ATSDR), 1992, Toxicological Profile for Specified Compound.

[j] Agency for Toxic Substances and Disease Registry (ATSDR), 1994. Toxicological Profile for PAHs, Draft Report.

[k] Bis(2-ethylhexyl)phthalate used as a surrogate. See (h).

[l] Chlorodibenzofuran used as surrogate. See (f).

[m] Agency for Toxic Substances and Disease Registry (ATSDR), 1989, Toxicological Profile for Specified Compound, Draft Report.

[n] Ethylbenzene used as surrogate. See (m).

[o] USEPA, 1984, Health Assessment Document (HAD) for Manganese, Final Report, Office of Health and Environmental Assessment, Cincinnati, Ohio.

[p] Chloroform used as surrogate. See (h)

3.4.3.4 ***Blood-Lead Level of Concern.*** Although lead has been assigned a weight-of-evidence classification of B2, the USEPA has not developed an oral or inhalation slope factor. Kidney cancer has been demonstrated in the rat and mouse. A slope factor was not developed because quantifying lead's cancer risk involves many uncertainties, and current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedure would not truly describe the potential risk. Also, the USEPA RfD Work Group considered the development of a verified oral and inhalation RfD inappropriate. They concluded that children's neurobehavioral development may be affected at blood-lead (Pb-B) levels without a threshold. An RfD was not developed even though lead toxicity is well known. In fact, exposure to lead affects many human systems or organs, such as the hematopoietic system, nervous system, kidney, gastrointestinal system, bone marrow cells, reproductive system, endocrine system, heart, and immune system.

Instead, a Pb-B level of concern was established to protect the health of children exposed to lead. The consensus on the Pb-B level that is considered toxic to children has changed in recent years. In 1975, the U.S. Centers for Disease Control (CDC) defined the toxic level in children's blood as 40 μg/deciliter (μg/dL). This value was reduced to 25 μg/dL by CDC in 1985. In 1986, the World Health Organization (WHO) recommended 20 μg/dL as the upper acceptable toxic limit. In the same year, the USEPA's Clean Air Scientific Advisory Committee indicated that levels of 10 to 15 μg/dL can be associated with adverse health effects (ATSDR, 1988). Consequently, the USEPA set the children's default Pb-B level of concern at 10 μg/dL for use in the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children (USEPA, 1994b). According to currently available data, children should not be considered at risk from exposure to lead if the Pb-B level remains below 10 μg/dL.

3.4.4 Risk Characterization

This section presents methods used to estimate human health risk. Receptor risk estimates are presented in tabular form.

For the risk estimate, the exposure assessment and the toxicity assessment are integrated into quantitative and qualitative expressions of risk. To characterize risk of potential carcinogenic effects, probabilities that a receptor will develop cancer over a lifetime of exposure are estimated from projected chronic chemical-specific intake or absorbed dose, and chemical-specific slope factors. Similarly, to characterize risk of potential chronic or subchronic non-carcinogenic effects, comparisons are made between estimated chronic or subchronic intake or absorbed dose, and RfDs.

To characterize carcinogenic risk and the potential for non-carcinogenic health effects for future groundwater exposure pathways, risk was first calculated separately for future receptor exposure to chemicals in both the shallow and deep groundwater zones. Future receptors can be exposed to chemicals in groundwater drawn from both zones. As a conservative approach, reasonable maximum case risk was calculated by selecting the highest shallow or deep zone risk value for each analyte. The highest appropriate risk values were summed for each groundwater pathway to determine risk from exposure to groundwater in both zones.

3.4.4.1 Carcinogenic Risk Estimates. For those chemicals that are potential carcinogens, risk has been estimated as the incremental probability of a receptor developing cancer over a lifetime as a result of exposure to a potential carcinogen via each identified exposure pathway. The slope factor converts estimated daily intakes to the incremental risk of a receptor developing cancer. The estimated chemical-specific intakes are low compared to intakes experienced by test animals or humans used to compute slope factors. Following USEPA guidance, it was assumed that the receptor dose-response relationship is linear in the low dose portion of the multistage model dose-response curve used to compute slope factors. Using this assumption, the slope factor is considered a constant and cancer risk is related to intake. Therefore, the following equation (i.e., the linear low-dose cancer risk equation) was used to compute chemical-specific cancer risk:

$$Risk = Chronic\ Daily\ Intake\ or\ Subchronic\ Daily\ Intake \times Slope\ Factor$$

To estimate risks due to incidental ingestion of contaminated soil, the daily intake is multiplied by the oral slope factor determined from administered dose toxicity studies. To estimate risk due to dermal absorption of chemicals from soil, the absorbed dose is multiplied by the oral slope factor adjusted for percent absorption (see Table 3.4-39).

The reasonable maximum case risk was quantified by using reasonable maximum exposure (RME) (intake) values in accordance with USEPA guidance. Average case risk was quantified using average exposure values. In accordance with USEPA guidance, total cancer risk for each exposure pathway was quantified by summing chemical-specific cancer risks (USEPA, 1989a).

3.4.4.2 Non-Carcinogenic Hazard Index Estimates. The potential for non-carcinogenic health effects due to chemical exposure is evaluated by comparing intake with a RfD. This comparison, or ratio, is called the hazard quotient and is expressed as the following formula:

$$Hazard\ Quotient\ (HQ) = \frac{Chronic\ Daily\ Intake\ (CDI)}{Chronic\ RfD}\ or\ \frac{Subchronic\ Daily\ Intake\ (SDI)}{Subchronic\ RfD}$$

As with cancer risk, the hazard quotient for ingestion and inhalation pathways was estimated by comparing intake with the oral RfD developed from administered dose toxicity studies. To determine the hazard quotient for dermal absorption pathways, the estimated absorbed dose intake was compared with the oral RfD adjusted for percent absorption (see Table 3.4-39).

The reasonable maximum case hazard quotients were quantified using RME (intake) values in accordance with USEPA guidance. Average case hazard quotients were quantified using average case exposure values.

In accordance with USEPA guidance, the hazard quotient for each chemical has been summed for each pathway, resulting in a pathway hazard index (USEPA, 1989a). This approach is conservative because health effects from exposure to different chemicals may result from a chemical effect on different organ systems.

3.4.4.3 ***Risk Summation.*** As stated previously, chemical-specific cancer risk estimates and hazard quotients were summed for each exposure pathway to estimate pathway cancer risk or a hazard index. Appropriate pathway risk estimates for completed receptor exposure pathways identified in Table 3.4-7 were summed to determine total receptor cancer risk or hazard index.

Receptor risk and hazard index estimate tables are presented in Appendix W.

3.4.4.4 ***Risk from Exposure to Lead.*** Future off-site resident children could be exposed to on-site lead in surface soil through inhalation of lead-contaminated, fugitive dust that has migrated from on-site.

Because USEPA-approved toxicity values do not exist for lead, the USEPA has developed an exposure uptake/biokinetic model for evaluating the potential impact of children exposed to lead. The latest model, the IEUBK Model for Lead, Version 0.99d, was used to estimate the off-site resident child's total exposure to lead. The model can estimate exposure for a 0.5 to 7 year old child. The 95 percent UCL concentration of lead dust (i.e., 4.33×10^{-9} mg/m^3) that was modeled to the receptor area was entered as site-specific data for the IEUBK Model. Because the dust concentration is minimal, the model default value of 0.1000 μg/m^3 replaced the modeled value. Default model data were used for all other exposure scenarios: drinking water ingestion, diet, soil and house dust exposure, paint intake, and maternal contribution. A summary of the IEUBK Model results is presented in Appendix X.

3.4.5 Risk Assessment Uncertainties

This section presents a discussion of uncertainties involved in the process of quantifying risk for human receptors. Uncertainties involved in the exposure assessment, toxicity assessment, and risk estimation are discussed separately.

3.4.5.1 ***Exposure Assessment.*** Uncertainty in the exposure assessment is a function of the completeness of site data, assumptions that simplify and approximate actual current or future site conditions, and professional judgment used in developing and evaluating various parameters. Assumptions and inferences that must be made to develop exposure scenarios introduce uncertainties into the exposure assessment.

For inorganic analytes with less than four analytical results, statistical comparisons with background data (i.e., the Student's t test or Wilcoxon Rank Sum test) could not be used. In these cases, an analyte's maximum site concentration was compared with its background 95% UCL of the mean concentration. If too few background data existed, the maximum site concentration was compared with its maximum background concentration. Using this type of background comparison, some inorganic analytes may have been excluded as chemicals of potential concern for exceeding background levels. Consequently, risk may have been underestimated.

Generally, the exposure scenarios and health protective exposure factors presented in this risk assessment are conservative and overestimate rather than underestimate exposure. Several conservative assumptions were made to compensate for uncertainties inherent in the exposure assessment.

It was assumed in the exposure assessment that chemical concentrations in site source areas or groundwater plumes would remain constant and that the transport mechanisms would operate at a steady state. This means that contaminant levels will not decrease due to the exhaustion of the contaminant sources or reach higher concentrations over the assumed exposure periods. This assumption was made when calculating exposure of future residents, industrial workers, and construction workers to site contaminants.

One result of this assumption may have been to overestimate exposure point concentrations near source areas because contaminant sources would likely decrease over time due to transport and fate mechanisms such as migration, photo-oxidation, biodegradation, etc. Conversely, the migration of some contaminants, for example, those leaching from soil to groundwater, may increase future exposure point concentrations; thus, in these cases, migration may cause future exposure intake values to be underestimated. Also, incomplete biodegradation of chlorinated hydrocarbons, such as perchloroethylene or TCE, in groundwater may increase the future concentration of more toxic compounds, such as vinyl chloride (a Class A carcinogen). An increase in future vinyl chloride concentrations would increase vinyl chloride intake values and risk.

Another assumption made in the exposure assessment is that chemicals of concern are uniformly distributed over the defined area, thus resulting in a uniform exposure level. Chemical analytical data were obtained from a directed sampling program, i.e., sampling locations were generally selected on the basis of where contaminants were expected to be present. Sampling zones found to be free of contamination received less investigation. This type of sampling scheme tends to overestimate the overall chemical concentrations at a site and resultant exposure and risk values.

As a screening approach for exposure and risk characterization, it was assumed that total chromium in soil and groundwater existed in the hexavalent state; intake, carcinogenic risk, and hazard indices were quantified with this assumption. Even if risk was overestimated, total risk due to exposure to chromium was not found unacceptable. Although carcinogenic risk may be overestimated, the screening approach proved beneficial for establishment of acceptable risk.

The model used to quantify exposure to VOCs while showering assumed constant volatilization and no ventilation within the bathroom. These assumptions are very conservative and are likely to overestimate actual airborne VOC concentrations (Schaum, *et al.*, 1992) and chemical-specific exposure.

Finally, the assumption is made that human exposure remains constant over the lifetime of an individual. In fact, lifestyle changes due to age and actual residence time will alter the projected exposure durations. Movement of individuals in and out of the potentially exposed community also affects exposure duration.

3.4.5.2 Groundwater Modeling. The Solute Model is the one-dimensional, nonreactive contaminant transport model used to estimate contaminant concentrations at receptors (i.e., Production Well 2 at the Camden Street Wellfield). The many assumptions inherent in this model create uncertainties in the exposure assessment and thus in the risk characterization. The assumptions include:

- A homogeneous, isotropic aquifer;
- A uniform saturated thickness;
- A uniform velocity along the entire flowpath;
- Steady-state, uniform groundwater flow; and
- No degradation.

Contaminant reduction or transformation due to biodegradation was not considered. This assumption may result in higher estimates of dissolved concentrations at the potential receptors than would naturally occur. In addition, other natural attenuation mechanisms, such as volatilization, were not considered, again presumably resulting in higher predicted contaminant concentrations than would actually occur.

Another assumption made in modeling contaminant transport in groundwater is that aquifer parameters determined for the deep zone are applicable to the shallow zone. Although URS Consultants, Inc., reported that hydraulic conductivities are similar for the shallow and deep zone (URS Consultants, Inc., 1992), this fact was not verified during the RI aquifer test analyses. Thus, exposure to groundwater contaminants in the shallow zone may be overestimated or underestimated, depending on the actual aquifer characteristics of the shallow zone.

The use of an estimated value for longitudal dispersivity also creates uncertainty. Because detailed tracer tests were not performed, longitudal dispersivity was estimated using a generally accepted "rule of thumb"; that is, dispersivity equals one-tenth the travel distance from the source area to the point where the concentration of the contaminant is estimated. This travel distance was set at 500 feet, resulting in a longitudal dispersitivity of 50 feet. If the actual travel distances, which range from 964 feet to 2,018 feet, had been used, the longitudal dispersivity value used in the Solute Model would have been approximately 2 to 4 times greater. Use of the artificially small longitudal dispersivity value in the model results in a higher estimation of contaminant levels at the receptor (i.e., the Camden Street Wellfield). This conservative approach could result in an overestimation of exposure, and thus risk.

A literature-based value for effective porosity (Freeze and Cherry, 1979) was used in the Solute Model because the geotechnical analyses required to determine a site-specific effective porosity value were not performed. Uncertainty in modeling is associated with the use of any literature-based parameters as a replacement for parameters derived from site data. However, the effective porosity value was selected from the literature based on the hydrogeological characteristics of the aquifer, and therefore the use of this value probably has little effect on the uncertainty associated with exposure and risk estimations.

*3.4.5.3 **Air Modeling***. A number of assumptions and various models were used to determine expected ambient air concentrations at receptors and receptor exposure. Some degree of uncertainty is associated with each assumption or model. Most decisions made for risk analyses tended to be conservative.

*3.4.5.3.1 **Uncertainties Involved in Air Emissions Modeling***. For exposure to VOCs, the Shen Model assumes that subsurface contamination is confined to a discrete layer of contaminated material. This model was designed to estimate emissions from landfills where the waste layer is covered by a layer of clean soil. It predicts air emissions more precisely for landfill sites than for sites with significant vertical contamination gradients. The Shen Model assumes that transport of a volatile compound through the soil cover layer is controlled by molecular diffusion; convective sweep due to internal gas generation and meteorological effects such as barometric pumping are not considered. The Shen Model assumes that Raoult's law applies. Raoult's law is applicable only to waste saturated with a constituent and ideal solutions. This will tend to overpredict emission rates (USEPA, 1989c). Dry soil is also assumed for all models. This increases the effective porosity of the soil and is therefore a conservative assumption.

The Hwang-Falco Model provides for decreasing emissions over time. Since a 30-year exposure period was assumed in the emission calculation, the actual average emission rate may be higher by perhaps a factor of 2 for other exposure scenarios. The soil/air partition coefficient (K_as) assumes that each contaminant will behave according to its Henry's law constant in multicomponent systems (i.e., activity coefficient = 1). If a contaminant's activity coefficient is less than 1, emissions will be less than calculated.

Dust emissions are heavily influenced by soil particle size. Since detailed soil surveys were not available, a mode particle size of 0.475 mm, typical of the soil type present at the site, was used. Field sieving of surface soil would provide more accurate estimates. Detailed data on nonerodible surface elements were not available. Therefore, a conservative correction factor of 1.2 was used. The "unlimited" dust model assumes no nonerodible surface crust and an unlimited reservoir of dust. The cumulative effect of these assumptions could result in an overprediction of the site dust emission rate.

Because neither the vertical nor areal extent of contamination is well defined, average emission rates were used for each site. A more complete understanding of the variation and extent of contamination would allow a better estimation of emission rate distribution within a site.

Under the construction scenario, only disturbed soil emissions are used to calculate ambient concentrations in the vicinity of the construction worker. Undisturbed soil emissions (diffusion and fugitive dust) are much smaller and are assumed to be negligible under this scenario.

Because the nature and extent of future construction on the AFP 59 site is poorly defined, many assumptions were required to develop model input parameters. The construction scenario is taken from the VOC model and assumes values for volume of soil excavated, the time to excavate that volume, and the area of the pit and storage pile; these values may not be representative of the actual construction. The excavation scenario also assumed the VOC emission rates to be zero after 1 hour from the time excavation started. Although the model was designed with the assumption that an infinite, homogeneous amount of contaminant-laden soil exists below a cap of clean soil, the construction scenario only considers the top 12 feet of the soil.

Uncertainties in the contaminant emission rates due to both VOC and dust emissions occur using Eklund's Model. The uncertainties caused from the VOC emission rate are due mainly to the assumptions about the pore space and diffusivity emission rates. The total pore space is assumed to be equal to the air filled pore space and is assumed to be saturated with the contaminant. The pore space emission rate is calculated from Equation (3) (see page 3-85) if the pore space emission rate calculated from Equation (2) (see page 3-284) yields a value larger than one-third of the amount of contaminant in the soil. Eklund's Model assumes the one-third "ceiling" on the pore space emissions as a conservative representation of the maximum amount of the contaminant in the soil that will be emitted from the pore space. The diffusivity emissions occur after the pore space emissions but use the original contaminant concentration. The contaminant concentration will actually be lower than the original due to the amount of contaminant emitted from the pore space.

The VOC emission rate was averaged over the time of excavation, 1 hour, to obtain the time at which the diffusivity term should be calculated. The average emission rate for the test case contaminant occurred at time $t=923$ seconds. This time was assumed to be the point at which the diffusivity emission rate for each contaminant was representative of the average emission rate during the hour of excavation. The diffusivity emission rate, therefore, was calculated at 923 seconds using Equation (4) (see pages 3-285 and 3-286).

The dust model makes the same assumptions regarding the construction scenario as does the VOC model. The model applies to a wide variety of material handling activities and is based on the premise that a certain percentage of the soil's surface area has a high erosion potential, and that the rest of the surface will not be emitted regardless of the time exposed. For in-place contaminated soil, overprediction of the emissions is possible as a soil crust tends to form, reducing the erosibility of the pile or field. The emission equation used is empirically based and was drawn from measurements at actual sites.

The construction emission rates are calculated on the premise that each entire site is excavated to a depth of 12 feet once during the period of construction. These emission calculations depend on the amount of soil removed and therefore will vary if the actual volume of soil excavated varies.

In addition, the dust model assumes that contaminant emission rates are related to dust emissions by the contaminant concentration in the soil. That is, the contaminant emission rate is found by multiplying the dust emission rate by the contaminant concentration in the soil.

3.4.5.3.2 Uncertainties Involved in Air Dispersion Modeling. Because the assumed areal extent of the AFP 59 source areas are irregularly shaped, the use of square area sources required by the both the ISCST2 model and the SCREEN2 model will necessarily introduce some error. This is particularly true for the construction scenario, where the emitting area is relatively small and ill-defined. Furthermore, the adequacy of the ISCST2 area source algorithm decreases for receptor distances less than one side-width (USEPA, 1992g). Although small area sources were defined whenever possible, some on-site receptors were located within one side-width of certain area sources. It is assumed that dilution factor contributions calculated by the ISCST2 model for these source-receptor pairs were more accurate than alternative approximation methods such as the simple box model (Baker and Mackay, 1985).

The meteorological data used in the ISCST2 modeling are believed to be representative of AFP 59, however, small differences in conditions may effect concentration estimates. Screening modeling using the SCREEN2 model, by its very nature, will tend to overpredict concentrations by using worst-case meteorological conditions.

Area sources are assumed to be at the same elevation as receptors. Actual differences between receptor and source elevations, although small, will have some small effect on concentration levels.

As stated in previous exposure model tables for estimating intake for the inhalation pathways (Section 3.4.2.2), the modeled contaminant concentration in air represents modeled outdoor air concentrations. It was assumed that indoor air concentrations equal modeled outdoor concentrations. For current and future on-site industrial workers, indoor concentrations of VOCs may far exceed outdoor concentrations due to migration of VOCs from the subsurface through cracks in a building foundation into indoor space. If the air exchange rate in the building is low, concentrations of VOCs could increase inside. Therefore, intake for on-site inhalation of VOCs may be underestimated.

For inhalation of contaminated fugitive dust, it is assumed that outdoor dust concentrations exceed indoor concentrations. This assumption is based on two references. The USEPA concluded that, at most sites, outdoor lead dust concentrations exceeded indoor concentrations (USEPA, 1986b). Cohen and Cohen concluded that indoor/outdoor lead dust concentration ratios ranged from 0.3 to 0.8 (Cohen and Cohen, 1980). Assuming on-site current and future industrial workers spend a reasonable amount of time inside buildings during dust exposure, dust inhalation intake values may be overestimated.

3.4.5.4 Toxicity Assessment. RfDs and RfCs developed by the USEPA are generally considered to have uncertainty spanning an order of magnitude or more. Consequently, total hazard indices for human receptors may be estimated high or low by an order of magnitude or more. The USEPA reports a "level of confidence" for each RfD and RfC value. Low confidence suggests a high degree of uncertainty in the accuracy of the toxicity value and indicates that the value may change in the future if additional toxicity data were to become available. Conversely, high confidence by the USEPA in an RfD or RfC indicates low uncertainty in the accuracy of the toxicity value. Quantitative uncertainty and modifying factors used to develop RfDs and RfCs are discussed in Section 3.4.3.1.

As stated in Table 3.4-37, the oral RfD for copper was developed from the drinking water standard of 1.3 mg/L. Although the oral RfD was developed, HEAST stated that the USEPA drinking water criteria document (USEPA, 1987) "concluded toxicity data were inadequate for calculation of an RfD for copper." Use of this oral RfD for copper increases the degree of uncertainty for the RfD, and therefore for the hazard quotients as well.

The USEPA calculates RfDs for inorganic chemicals (i.e., metals) based on the toxicity values obtained using a specific compound containing the metal (i.e., the metal is usually not administered in its elemental form). Because toxicities of metals are especially compound-specific, the RfD may or may not be applicable or appropriate for the inorganic species present at AFP 59. This may result in overestimation or underestimation of the chronic toxicity risks or hazards.

Slope factors developed by the USEPA are generally conservative, and as discussed in Section 3.4.3.1, represent the upper bound limit (i.e., upper 95th percent confidence limit) of the probability of a cancer response. Thus, the actual carcinogenic risk due to exposure to selected chemicals is likely to be lower than the estimated risk. Furthermore, there is uncertainty in the carcinogenic potential of chemicals classified as B1, B2, or C carcinogens. Only chemicals classified as A carcinogens are proven human carcinogens but risk was calculated identically for all chemicals classified as A, B1, B2, C carcinogen. Thus, it is possible for carcinogenic risk to be reported for chemicals that may not induce carcinogenesis.

The use of surrogate data in the toxicity assessment creates uncertainty. In many cases, oral RfDs served as inhalation RfDs, and in two cases the reverse was true. Because actual toxicity values may vary based on exposure route, the use of surrogate pathway RfDs may underestimate or overestimate risk. Similarly, applying oral inhalation RfDs from a surrogate chemical to a chemical of concern may ultimately underestimate or overestimate risk because it is not known whether the chemical-specific RfDs would be higher or lower than those of the surrogate chemical. The use of surrogate data in the toxicity assessment is footnoted in Tables 3.4-34, 3.4-35, 3.4-37, 3.4-38, and 3.4-39.

*3.4.5.5 **Risk Estimation.*** USEPA guidance indicates that carcinogenic risks and hazard indices resulting from various exposure scenarios that may or may not involve the same chemicals are additive (USEPA, 1989a). However, this approach ignores possible synergistic or antagonistic effects between chemicals and could overestimate or underestimate cancer risk or hazard indices for receptors.

For some chemicals, toxicological data were lacking, as were data for appropriate surrogate chemicals. Therefore, carcinogenic and noncarcinogenic risk associated with exposure to these chemicals could not be calculated. As a result, it is possible that overall risk to some receptors is underestimated.

The USEPA has proposed the use of relative potency factors (RPFs) for assessment of risk from oral exposure to potentially carcinogenic PAHs. An RPF has been assigned to the six PAHs detected at AFP 59 sites that have been classified as probable human carcinogens (i.e., B2 weight-of-evidence). The RPFs give an estimated order of magnitude potency compared to benzo(a)pyrene (see Table 3.4-36). The application of the potency factors to final carcinogenic risk estimates involving exposure to PAHs may underestimate or overestimate risk depending on the accuracy of the RPFs.

3.4.6 Conclusions

This section presents a summary of human health risk. Sections 3.4.6.1 and 3.4.6.2 provide a summary of receptor carcinogenic risk and non-carcinogenic hazard indices, respectively. Section 3.4.6.3 summarizes risk for resident children from exposure to lead. The criteria used to determine acceptable or unacceptable risk are presented. Receptor carcinogenic risk and non-carcinogenic hazard indices are summarized in tabular form. Risk values are compared to recommended benchmarks; receptor risk that exceeds a benchmark is discussed.

3.4.6.1 Carcinogenic Risk. In accordance with 40 CFR 300.430 (United States CFR, 1991), carcinogenic risk within the benchmark range of 10^{-4} (1 cancer case in 10,000) to 10^{-6} (1 cancer case in 1,000,000) is considered acceptable. The following statement is from 40 CFR 300.430 (United States CFR, 1991): "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6} using information on the relationship between dose and response. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure."

Table 3.4-40 presents a summary of the total human receptor cancer risk (i.e., risk exceeding 10^{-6}). This table also provides the following information:

- Receptors at risk,
- Exposure pathways that contribute to risk,
- Pathway reasonable maximum case risk, and
- Chemicals that contribute to pathway risk.

Table 3.4-40 shows that the total reasonable maximum case risk values exceed 10^{-6} risk as a benchmark for the following receptors (i.e., receptors are at potential risk):

- Current recreational users of Little Choconut Creek,
- Future off-site 30-year residents, and
- Future on-site industrial workers.

TABLE 3.4-40
TOTAL HUMAN RECEPTOR CANCER RISK

Receptor	Total Cancer Risk Range			Factors Contributing to Risk >1E-06		
	Average Case	Reasonable Maximum Case	Receptor at Risk (>1E-06)	Pathway Contributing to Risk	Pathway Reasonable Maximum Case Risk	Chemical Contributing to Pathway Risk
CURRENT LAND USE						
Recreational Users of Little Choconut Creek	7E-05	4E-05	Yes	Ingestion of Contaminated Fish (from Little Choconut Creek)	4E-05	Arsenic bis(2-Ethylhexyl)phthalate p,p'-DDD
Recreational Users of Little Choconut Creek Background	1E-05	1E-05	Yes	Ingestion of Contaminated Fish (from Background for Little Choconut Creek)	1E-05	Arsenic
On-site Industrial Workers Impacted by the Waste Oil Tank Area	1E-08	1E-08	No	NA	NA	NA
FUTURE LAND USE						
Off-site 30-Year Residents	4E-05	2E-03(1)	Yes	Dermal Absorption of Chemicals in Shower Water	3E-05	Beryllium p,p'-DDE Trichloroethylene Vinyl Chloride
				Ingestion of Chemicals in Drinking Water	1E-04	1,1-Dichloroethene Beryllium Trichloroethylene Vinyl Chloride
				Inhalation of VOCs While Showering	2E-03	1,1-Dichloroethene Bromodichloromethane Carbon Tetrachloride Chloroform Methylene Chloride Trichloroethylene Vinyl Chloride

TABLE 3.4-40
TOTAL HUMAN RECEPTOR CANCER RISK

Continued

Receptor	Total Cancer Risk Range			Factors Contributing to Risk > 1E-06		
	Average Case	Reasonable Maximum Case	Receptor at Risk (> 1E-06)	Pathway Contributing to Risk	Pathway Reasonable Maximum Case Risk	Chemical Contributing to Pathway Risk
FUTURE LAND USE (CONTINUED)						
On-site Industrial Workers	3E-05	9E-05[1]	Yes	Plating Room - Dermal Absorption of Chemicals in Surface Soil	3E-05	Beryllium
				Ingestion of Chemicals in Drinking Water	6E-05	1,1-Dichloroethene Beryllium Trichloroethylene Vinyl Chloride
On-site Construction Workers Impacted by the Plating Room	2E-07	2E-07	No	NA	NA	NA
On-site Construction Workers Impacted by the Reservoir	2E-07	2E-07	No	NA	NA	NA
On-site Construction Workers Impacted by the Waste Oil Tanks	1E-06	8E-07	No	NA	NA	NA
On-site Construction Workers [2] Impacted by All Source Areas	1E-06	1E-06	No	NA	NA	NA

Key: NA = Not Applicable

[1] In calculating the reasonable maximum case risk, the shallow and deep groundwater pathway risks were combined by selecting the highest shallow or deep zone risk for each analyte.
[2] The same on-site construction workers were assumed to work at each source area for the full two month exposure duration. Consequently, risk from exposure at each source area was summed to determine total risk.

Note: For some of the receptors, the average case cancer risk exceeds the reasonable maximum case cancer risk. This is because of the frequency of non-detects and because one-half of the PQL is greater than the maximum detected value; therefore, the arithmetic mean concentration used to calculate average risk exceeds the one-sided 95% UCL of the arithmetic mean used to calculate reasonable maximum case cancer risk.

Reasonable maximum case risk for recreational users is 4×10^{-5}. Ingestion of contaminated fish drove total receptor risk. Chemicals driving risk for the fish ingestion pathway may not have migrated solely from AFP 59 but may have migrated from upstream locations. Consequently, risk was calculated for chemicals in the upstream, background samples. Those chemicals that are driving receptor risk were used to calculate background risk. Background risk (i.e., 1×10^{-5}) exceeded acceptable risk. Arsenic risk contributed 100 percent of background risk. If the arsenic risk of 1×10^{-5} is subtracted from site risk, the risk of 3×10^{-5} contributed by AFP 59 still is unacceptable. Exposure to BEHP and p,p'-DDD drove site risk. These chemicals were only detected at CR04, which is located downstream of the NYSEG power plant outfall as well as the AFP 59 outfalls. The chemicals were not detected in samples collected immediately downstream of the AFP 59 outfalls and therefore may have migrated from the NYSEG outfall and not AFP 59.

Table 3.4-40 provides the following additional risk information:

- For future off-site 30-year residents, the following groundwater pathways contributed to unacceptable risk:
    - Dermal absorption of beryllium, p,p'-DDE, TCE, and vinyl chloride in shower water;
    - Ingestion of 1,1-dichloroethene, beryllium, TCE, and vinyl chloride in drinking water; and
    - Inhalation of 1,1-dichloroethene, bromodichloromethane, carbon tetrachloride, chloroform, methylene chloride, TCE, and vinyl chloride while showering.
- For future on-site industrial workers, the following soil and groundwater pathways contributed to unacceptable risk:
    - Dermal absorption of beryllium in surface soil at the Plating Room Area;
    - Ingestion of 1,1-dichloroethene, beryllium, TCE, and vinyl chloride in drinking water.

3.4.6.2 Non-Carcinogenic Health Effects. Per USEPA guidance, when the hazard index exceeds 1, there is a potential for adverse non-carcinogenic health effects (USEPA, 1989a). As a rule, the more the hazard index exceeds unity, the greater the potential for adverse health effects.

Table 3.4-41 presents a summary of the total human receptor hazard indices. This table identifies the following: receptors with hazard indexes greater than 1, exposure pathways that contribute to an hazard index greater than 1, pathway reasonable maximum case hazard index, and chemicals that contribute to a pathway hazard index greater than 1.

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TABLE 3.4-41
TOTAL HUMAN RECEPTOR HAZARD INDEX

Receptor	Total Hazard Index Range			Factors Contributing to an Hazard Index > 1		
	Average Case	Reasonable Maximum Case	Receptor Hazard Index > 1	Pathway Contributing to the Hazard Index > 1	Pathway Reasonable Maximum Case Hazard Index	Chemical Contributing to Pathway Hazard Index > 1
CURRENT LAND USE						
Recreational Users of Little Choconut Creek	8E-01	8E-01	No	NA	NA	NA
Recreational Users of Little Choconut Creek Background	8E-02	1E-01	No	NA	NA	NA
On-site Industrial Workers Impacted by the Waste Oil Tank Area	1E-05	1E-05	No	NA	NA	NA
FUTURE LAND USE						
Off-site 30-Year Residents	3E+00	8E+01[1]	Yes	Ingestion of Chemicals in Drinking Water	7E+00	Thallium
				Inhalation of VOCs While Showering	7E+01	cis-1,2-Dichloroethylene Trichloroethylene
On-site Industrial Workers	3E+00	1E+01[1]	Yes	Plating Room - Dermal Absorption of Chemicals in Surface Soil	3E+00[3]	Molybdenum Manganese Total Chromium
				Ingestion of Chemicals in Drinking Water	6E+00	Thallium
On-site Construction Workers Impacted by the Plating Room	2E+00	1E+00	No	NA	NA	NA
On-site Construction Workers Impacted by the Reservoir	2E-01	2E-01	No	NA	NA	NA
On-site Construction Workers Impacted by the Waste Oil Tanks	2E-01	2E-01	No	NA	NA	NA
On-site Construction Workers[2] Impacted by All Source Areas	2E+00	1E+00	No	NA	NA	NA

Key: NA = Not Applicable

[1] In calculating the reasonable maximum case hazard index, the shallow and deep groundwater pathway hazard indexes were combined by selecting the highest shallow or deep zone hazard index for each analyte.

[2] The same on-site construction workers were assumed to work at each source area for the full two month exposure duration. Consequently, the hazard index from exposure at each source area was summed to determine a total hazard index.

[3] As a screening approach, the hazard quotients for molybdenum, manganese, and total chromium were considered additive. Molybdenum, manganese, and chromium do not induce the same noncarcinogenic health effects. Consequently, their hazard quotients are not considered additive for determination of a final HI. The hazard quotient of 2 for molybdenum still exceeds one. Manganese, with a hazard quotient for 0.4, and chromium, with a hazard quotient of 0.1, no longer contribute to a pathway HI which is greater than one.

Note: For some of the receptors, the average case hazard index exceeds the reasonable maximum case hazard index. This is because of the frequency of non-detects and because one-half of the PQL is greater than the maximum detected value; therefore, the arithmetic mean concentration used to calculate the average case hazard index exceeds the one-sided 95% UCL of the arithmetic mean used to calculate reasonable maximum case hazard index.

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Table 3.4-41 shows that total reasonable maximum case hazard index exceeds 1 for the following receptors:

- Future off-site 30-year residents, and
- Future on-site industrial workers.

Consequently, the potential exists for these receptors to experience adverse, non-carcinogenic health effects.

Table 3.4-41 provides the following risk information:

- For future off-site 30-year residents, the following groundwater pathways contributed to a hazard index greater than one:
  - Ingestion of thallium in drinking water, and
  - Inhalation of cis-1,2-dichloroethene and TCE while showering.
- For future on-site industrial workers, the following soil and groundwater pathways contributed to an Hazard index greater than one:
  - Dermal absorption of molybdenum, manganese, and total chromium in surface soil at the Plating Room Area, and
  - Ingestion of thallium in drinking water.

As a screening-level approach, it was assumed that hazard quotients are additive. Consequently, hazard quotients for all chemicals were summed to determine the pathway hazard index. This concept would most properly apply if the chemicals induce the same noncarcinogenic health effects by the same mechanism of action. If the individual hazard quotient for a chemical exceeds 1, then the pathway hazard index exceeds 1. If two or more chemicals contribute to the pathway hazard index, addition of chemical hazard quotients may overestimate the potential for health effects if the chemicals do not induce the same health effects by the same mechanism of action.

Both cis-1,2-dichloroethene and TCE affect the Central Nervous System (CNS) cause CNS depression. Consequently, their hazard quotients are considered additive and the hazard index of 70 for inhalation of cis-1,2-dichloroethene and TCE while showering by future off-site 30-year residents is considered appropriate.

Exposure to molybdenum can affect the blood (i.e., causes anemia and elevated blood uric acid levels) and also cause musculoskeletal effects (i.e., gout-like symptoms, such as swelling, inflammation, and deformities of the joints). Exposure to manganese mainly affects the CNS. Exposure to chromium affects the skin and nasal septum (i.e., causes skin ulcers and perforation of the nasal septum). Consequently, their hazard quotients are not considered additive. Hazard quotients for dermal absorption of molybdenum (HQ = 2), manganese (HQ = 0.4), and chromium (HQ = 0.1) in surface soil by future on-site industrial workers cannot be added for a total hazard index. Even though this is the case, the hazard quotient of 2 for molybdenum still exceeds 1, indicating the potential for adverse health effects.

3.4.6.3 Risk from Exposure to Lead. The IEUBK Model demonstrated that the predicted blood-lead level for the 0.5- to 1-year age group and consecutive yearly age groups to 6 to 7 years did not exceed 10 μg/dL. Appendix X shows that Pb-B levels for these age groups range from 2.7 μg/dL to 4.5 μg/dL. The probability density plot shown in Appendix X shows that the geometric mean Pb-B concentration is 3.7 μg/dL; 98.44 percent of the children's Pb-B levels are below the cutoff of 10.0 μg/dL.

Thus, the model demonstrates that off-site resident children in the age range of 0.5 to 7 years are not at risk from exposure to lead migrating from the site in air.

3.5 Identification of Applicable or Relevant and Appropriate Requirements

Section 121 of CERCLA requires that site cleanups comply with Federal ARARs or State ARARs in cases where these requirements are more stringent than Federal requirements. ARARs are derived from both Federal and State laws. A requirement may be either "applicable" or "relevant and appropriate." "Applicable" requirements are those promulgated Federal or State substantive cleanup standards, standards of control, or requirements under Federal or State environmental laws or facility siting laws that meet all jurisdictional prerequisites of a requirement and fully address the circumstances at the site or the proposed remedial activity. Applicable requirements are identified on a site-specific basis by determining whether the jurisdictional prerequisites of a requirement fully address the circumstances at the site or the proposed remedial activity.

If not applicable, a requirement may nevertheless be "relevant and appropriate" if circumstances at the site, based on best professional judgment, are sufficiently similar to the problems or situations regulated by the requirement. Relevant and appropriate requirements are also determined on a site-specific basis by determining their jurisdictional prerequisites and comparing them to circumstances at the site. If there is sufficient similarity between the requirement and circumstances at the site, then determination of the requirement as relevant and appropriate may be made.

In addition to ARARs, nonpromulgated advisories or guidances, referred to as TBC materials, may also apply to the conditions found at a site. TBCs are not legally binding. However, they may be used to determine cleanup levels when ARARs do not exist or when ARARs alone would not be sufficiently protective of human health and the environment.

There are three types of ARARs: chemical-specific, location-specific, and action-specific. They are reviewed below.

3.5.1 Chemical-Specific ARARs

Chemical-specific ARARs include those environmental laws and regulations that regulate the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. These requirements generally set health- or risk-based concentration limits or discharge limits for specific hazardous substances. See Preamble to Proposed NCP, 53 Federal Register at 51437. Chemical-specific ARARs are triggered by the specific chemical contaminants found at a particular site.

This section presents a summary of Federal and State chemical-specific ARARs for groundwater and surface water and TBCs for soil and sediment. Chemical-specific ARARs and TBCs are listed, and comparisons are made between ARARs and maximum contaminant concentrations for each contaminant identified. Only TBCs are listed for soil and sediment because there are no chemical-specific ARARs for soil and sediment.

GROUND AND SURFACE WATER ARARS AND TBCS. Primary MCLs are enforceable standards for contaminants in public drinking water supply systems. MCLs are relevant and appropriate as groundwater cleanup standards where groundwater is a potential drinking water source. Groundwater is a potential drinking water source at AFP 59. For groundwater, Federal primary MCLs were obtained from 40 CFR 141 and are presented in Table 3.5-1.

The New York State chemical-specific groundwater standards presented in Table 3.5-1 were obtained from the New York State Sanitary Code, Chapter I, Subpart 5-1, Public Water Systems (New York State Department of Health, 1993). For those analytes not listed in the New York Sanitary Code, groundwater standards and guidance values were obtained from *Water Quality Regulations: Surface Water and Groundwater Classifications and Standards,* New York State Codes of Rules and Regulations, Title 6, Chapter X, Parts 700-705 (NYSDEC, 1992). A memorandum, Division of Water Technical and Operational Guidance Series (1.1.1), *Ambient Water Quality Standards and Guidance Values* (NYSDEC, 1993a), outlines the regulations in Title 6, Chapter X, Parts 700-705, and was used in preparing Table 3.5-1. Surface water standards were also obtained from Title 6, Chapter X, Parts 700-705. All analytes detected in site groundwater samples from the shallow and deep zones of the aquifer and site surface water samples from Little Choconut Creek are included in Table 3.5-1.

SOIL ARARS AND TBCS. Neither the Federal government nor the State of New York have developed a comprehensive list of cleanup standards for soil (the Toxic Substances Control Act does establish PCB soil cleanup levels for residential, industrial, and transformer substation scenarios). There are, however, various methodologies and guidelines for determining soil cleanup levels. These are considered TBCs. The methodology for determination of soil cleanup objectives is presented in a NYSDEC Division Technical and Administrative Guidance Memorandum entitled *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, 1994a). These generic soil cleanup objectives will "at a minimum, eliminate all significant threats to human health and/or the environment" (NYSDEC, 1994a). The cleanup objectives are intended to be protective of: (1) human health from exposure to carcinogens and systemic toxicants; and

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TABLE 3.5-1
COMPARISON OF SITE DATA AND FEDERAL AND NEW YORK STATE CHEMICAL-SPECIFIC ARARS FOR GROUNDWATER AND SURFACE WATER

Analyte	Federal Primary MCL	New York Drinking Water Standard	New York Surface Water Standard	Max. Site Shallow Ground-water Conc.	Max. Site Deep Ground-water Conc.	Max. Site Surface Water Conc.
ORGANIC COMPOUNDS (µg/L)						
BHC (total)	—	5 (1)	0.01 (1)	0.01	0.011	0.0155
Bis(2-ethylhexyl) phthalate	6	50	0.6	ND	5.9	3.0
Bromodichloromethane	100 (2)	100	—	0.38	ND	0.60
Bromoform	100 (2)	100	—	ND	ND	1.1
Carbon Tetrachloride	5	5	—	0.6	ND	ND
Chlorodibromomethane	100 (2)	100	—	ND	ND	0.96
Chloroethane	—	5	—	4.2	ND	ND
Chloroform (Trichloromethane)	100 (2)	100	—	0.46	ND	0.33
Chloromethane	—	5	—	ND	0.38	ND
4,4'-DDE, 4,4'-DDD, 4,4'-DDT (total)	—	ND	0.001	ND	0.166	0.018
Dichlorodifluoromethane	—	5	—	ND	ND	0.38
1,1-Dichloroethane	—	5	—	33	2.4	ND
1,1-Dichloroethene	7	5	—	2.1	ND	ND
cis-1,2-Dichloroethene	70	5	—	150	36	ND
trans-1,2-Dichloroethene	100	5	—	0.30	ND	ND
Alpha Endosulfan (Endosulfan I)	—	—	0.009 (3)	ND	ND	0.014
Beta Endosulfan (Endosulfan II)	—	—	0.009 (3)	0.010	ND	0.0068
Ethylbenzene	700	5	—	0.68	0.40	ND
Heptachlor	0.4	0.4	0.001 (4)	0.0095	ND	ND
Isopropylbenzene	—	5	—	1.0	ND	ND
Methoxychlor	40	40	0.03	ND	0.090	ND
Methylene Chloride	5	5	—	6.0	ND	ND
Naphthalene	—	50	—	2.8	ND	ND
n-Propylbenzene	—	5	—	0.90	ND	ND
Toluene	1,000	5	—	1.3	ND	ND
1,2,4-Trichlorobenzene	70	5	5	2.7	ND	ND
1,1,1-Trichloroethane	200	5	—	20	1.2	ND

TABLE 3.5-1
COMPARISON OF SITE DATA AND FEDERAL AND NEW YORK STATE CHEMICAL-SPECIFIC ARARS FOR GROUNDWATER AND SURFACE WATER

Continued

Analyte	Federal Primary MCL	New York Drinking Water Standard	New York Surface Water Standard	Max. Site Shallow Ground-water Conc.	Max. Site Deep Ground-water Conc.	Max. Site Surface Water Conc.
ORGANIC COMPOUNDS (µg/L) (Continued)						
Trichloroethene	5	5	11 (5)	370	4.0	ND
Trichlorofluoromethane	—	5	—	2.8	ND	ND
1,2,4-Trimethylbenzene	—	5	—	15	ND	ND
1,3,5-Trimethylbenzene	—	5	—	36	0.78	ND
Vinyl chloride	2	2	—	6.2	0.28	ND
Xylenes (total)	10,000	5	—	6.9	0.54	ND
INORGANIC COMPOUNDS (mg/L)						
Aluminum	—	—	0.1 ionic	3.48	1.0	—
Arsenic	0.05	0.05	0.190 (6)	0.0063	0.0119	0.0029
Barium	2.0	2.0	—	0.344	0.222	0.064
Beryllium	0.004	0.003 (5)	1.1 (7)	0.0011	ND	ND
Calcium	—	—	—	260	157	93.9
Chromium (total)	0.1	0.1	0.35 (8)	0.0272	ND	0.0065
Copper	1.3 (9)	1.3 (10)	0.02 (11)	0.0455	ND	0.0133
Iron	—	0.3/0.5 (12)	0.3	10.4	4.46	0.665
Lead	0.015 (9)	0.015 (10)	0.007 (13)	0.0796	0.006	0.0032
Magnesium	—	35 (5)	—	58.3	38.3	16.7
Manganese	—	0.3/0.5 (12)	—	3.1	1.44	0.0345
Nickel	0.1	—	0.16 (14)	0.0475	ND	ND
Potassium	—	—	—	4.0	6.04	2.13
Silver	—	0.05	0.0001 ionic	0.010	ND	ND
Sodium	—	NDL (15)	—	60	94.3	38.3
Thallium	0.0005 (16)	0.004 (5)	0.008	ND	0.0468	ND

TABLE 3.5-1
COMPARISON OF SITE DATA AND FEDERAL AND NEW YORK STATE CHEMICAL-SPECIFIC ARARS FOR GROUNDWATER AND SURFACE WATER

Continued

Analyte	Federal Primary MCL	New York Drinking Water Standard	New York Surface Water Standard	Max. Site Shallow Groundwater Conc.	Max. Site Deep Groundwater Conc.	Max. Site Surface Water Conc.
INORGANIC COMPOUNDS (mg/L) (Continued)						
Vanadium	---	---	0.014	0.0124	0.006	ND
Zinc	---	0.3	0.14 (17)	ND	ND	0.0299

Key:
MCL = Maximum Contaminant Level
ND = Not Detected
NDL = No Designated Limit
--- = No ARAR

Note: Concentrations exceeding ARARs are shaded.

(1) Sum of alpha, beta, delta, and gamma BHC.
(2) Sum of trihalomethanes, including bromodichloromethane, dibromochloromethane, bromoform, and chloroform.
(3) Standard applies to Endosulfan (not distinguished I or II).
(4) Sum of Heptachlor and Heptachlor Epoxide.
(5) NY State groundwater guidance value (guidance values may be used where a standard has not been established) from the NY State Ambient Water Quality Standards and Guidance Values (NYSDEC, 1993a).
(6) Dissolved arsenic form.
(7) Standard = 1.1 mg/L when hardness is >75 ppm; acid-soluble form.
(8) Standard = exp(0.819[ln(ppm hardness)]+1.561)/1,000 mg/L, where average site surface water hardness = 191 ppm; acid-soluble form.
(9) Action level; applies to community water systems and non-transient, non-community water systems (i.e., at consumers' tap).
(10) The copper action level is exceeded if the concentration of copper in more than ten percent of one liter first draw tap water samples during any monitoring period exceeds 1.3 mg/l. The lead action level is exceeded if the concentration of lead in more than ten percent of one liter first draw top water samples collected during any monitoring period exceeds 0.015 mg/l.
(11) Standard = exp(0.8545[ln(ppm hardness)]-1.465)/1,000 mg/L, where average site surface water hardness = 191 ppm; dissolved form.
(12) The second standard applies to the sum of Iron and Manganese
(13) Standard = exp(1.266[ln(ppm hardness)]-4.661)/1,000 mg/L, where average site surface water hardness = 191 ppm; acid-soluble form.
(14) Standard = exp(0.76[ln(ppm hardness)]+1.06)/1,000 mg/L, where average site surface water hardness = 191 ppm; acid-soluble form.
(15) Water containing more than 20 mg/l of sodium should not be used for drinking by people on severely restricted sodium diets. Water containing more than 270 mg/l of sodium should not be used for drinking by people on moderately restricted sodium diets.
(16) Value provided is the Federal maximum contaminant level goal (MCLG). MCLGs are ARARs when greater than 0 and less than MCL.
(17) Standard = exp(0.85[ln(ppm hardness)]+0.50)/1,000 mg/L, where average site surface water hardness = 191 ppm; dissolved form.

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(2) groundwater/drinking water quality. However, background values and/or MDLs may be used as the objectives if the calculated soil cleanup objectives are less than either of these values.

The cleanup objectives for protection of groundwater/drinking water are developed using the water/soil partitioning theory to predict the "maximum amount of contamination that may remain in soil so that leachate from the contaminated soil will not violate groundwater and/or drinking water standards" (NYSDEC, 1994a). A correction factor of 100 is also used to account for mechanisms that would hinder the migration of contamination from soil to groundwater that are not considered as part of the partitioning theory. In calculating the allowable soil concentration, the fraction of organic carbon in the site soil is used to develop site-specific cleanup objectives. Table 3.5-2 presents soil cleanup objectives for all analytes detected at each of the three areas identified during the RI. For each area, an average TOC concentration was determined from data collected during the RI and used to calculate site-specific cleanup objectives. If an analyte was not detected at a particular area, no cleanup objective was calculated. In addition to these calculated objectives, the following maximum values for groups of contaminants may not be exceeded.

Total VOCs $\leq$ 10 ppm
Total SVOCs $\leq$ 500 ppm
Individual SVOCs $\leq$ 50 ppm
Total pesticides $\leq$ 10 ppm.

Where the site-specific, calculated cleanup objective exceeded any of these criteria, the listed maximum value was considered the appropriate cleanup objective.

For cleanup values for metals, eastern United States or New York State soil background values may be used, although site-specific background data are preferable (NYSDEC, 1994a). A statistical comparison of site inorganic concentrations in soil to AFP 59 background is presented in Section 3.1.4, and inorganics exceeding background are identified.

SEDIMENT ARARS AND TBCS. There are no Federal or State standards for cleanup of contaminated sediments. New York State criteria for screening contaminated sediments for human health and environmental risk do, however, exist. The sediment criteria presented in Tables 3.5-3 and 3.5-4 were obtained from the *Technical Guidance for Screening Contaminated Sediments* (NYSDEC, 1993b). All analytes detected in site and background sediment samples are included in these tables. The sediment screening criteria were developed "to identify areas of sediment contamination and to make a preliminary assessment of the risk posed by the contamination to human health and the environment" (NYSDEC, 1993b). Different methods were used to develop screening criteria for two classes of contaminants (nonpolar organics and metals). The organic criteria are based on the USEPA equilibrium partitioning model and are tied to New York State surface water quality standards and guidance values and USEPA surface water criteria. The organic screening criteria are also based on the concentration of organic carbon in the sampled sediment; therefore, the screening criteria apply to specific sediment samples. Sediment criteria are developed for protection of human health from toxic effects of bioaccumulation; aquatic life

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TABLE 3.5-2
COMPARISON OF SITE ORGANIC SOIL DATA AND CLEANUP OBJECTIVES

Analyte	Plating Room		Waste Oil Tanks		Reservoir	
	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)
Acetone	0.03	1.54	NC	NA	NC	NA
Acenaphthene	21.5	0.15	43.7	0.29	NC	ND
Anthracene	50*	0.59	50*	0.42	50*	0.14
Benzo(a)anthracene	0.65	2.7	1.3	1.0	1.4	0.5
Benzo(a)pyrene	2.6	1.6	5.2	0.97	5.5	0.42
Benzo(b)fluoranthene	0.26	2.9	0.52	1.3	0.55	0.78
Benzo(g,h,i)perylene	NC	ND	50*	0.49	50*	0.15
Beta BHC	NC	ND	0.09	0.0043	NC	ND
Delta BHC	NC	ND	0.16	0.0021	0.17	0.0009
Gamma BHC	NC	ND	0.03	0.0006	0.028	0.0006
Bromomethane	--	0.016	--	ND	--	ND
n-Butylbenzene	--	ND	--	0.047	--	ND
sec-Butylbenzene	--	ND	--	0.011	--	ND
Bis(2-ethylhexyl)phthalate	50*	0.471	50*	0.97	50*	0.2
Chloroethane	NC	ND	0.88	0.0045	NC	ND
Chrysene	0.09	2.6	0.19	1.0	0.2	0.5
cis-1,2-Dichloroethene	--	ND	--	0.11	--	ND
p-Cymene	--	ND	--	0.053	--	ND
4,4'-DDD	1.8	0.0022	3.7	0.0056	4.1	0.0061
4,4'-DDT	NC	ND	1.2	0.008	1.3	0.0049
Dibenzofuran	NC	ND	2.9	0.36	NC	ND
Dibenz(a,h)anthracene	NC	ND	50*	0.11	NC	ND
1,1-Dichloroethane	NC	ND	0.07	0.011	NC	ND
Dieldrin	NC	ND	0.05	0.0039	0.06	0.0036
2,4-Dinitrotoluene	--	ND	--	0.41	--	ND

TABLE 3.5-2
COMPARISON OF SITE ORGANIC SOIL DATA AND CLEANUP OBJECTIVES

Continued

Analyte	Plating Room		Waste Oil Tanks		Reservoir	
	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)
Endosulfan I	0.19	0.0026	0.39	0.0028	NC	ND
Endosulfan II	NC	ND	NC	ND	0.42	0.0053
Endosulfan Sulfate	NC	ND	0.48	0.013	NC	ND
Endrin	NC	ND	0.04	0.0088	0.05	0.0024
Endrin Aldehyde	--	ND	--	0.043	--	0.014
Ethylbenzene	NC	ND	2.6	0.0013	NC	ND
Fluoranthene	50*	5.3	50*	2.7	50*	0.94
Fluorene	50*	0.11	50*	0.45	NC	ND
Heptachlor	NC	ND	NC	ND	0.06	0.0021
Heptachlor Epoxide	NC	ND	NC	ND	0.001	0.0049
Indeno(1,2,3-cd)pyrene	NC	ND	1.5	0.45	1.6	0.16
Isopropylbenzene	--	ND	--	0.0028	--	ND
Methoxychlor	10*	0.013	10*	0.025	10*	0.024
Methylene chloride	0.03	0.089	0.05	0.076	0.05	0.037
Methyl Ethyl Ketone	--	0.00454	--	ND	--	ND
2-Methylnaphthalene	NC	ND	17.3	0.6	NC	ND
Naphthalene	NC	ND	6.2	2.5	NC	ND
PCB-1254	0.41	0.17	0.83	0.17	NC	ND
PCB-1260	NC	ND	0.83	0.15	0.92	0.079
Phenanthrene	50*	2.7	50*	2.9	50*	0.61
n-Propylbenzene	--	ND	--	0.0078	--	ND
Pyrene	50*	4.2	50*	2.3	50*	0.8
Styrene	--	0.00124	--	ND	--	ND
1,2,3-Trichlorobenzene	--	ND	--	ND	--	0.0031
1,1,1-Trichloroethane	0.18	0.0087	NC	ND	0.38	ND

TABLE 3.5-2
COMPARISON OF SITE ORGANIC SOIL DATA AND CLEANUP OBJECTIVES

Continued

Analyte	Plating Room		Waste Oil Tanks		Reservoir	
	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)	Calculated New York Soil Cleanup Objective (mg/kg)	Maximum Site Concentration (mg/kg)
Trichloroethene	0.15	0.071	0.30	0.015	0.32	0.07
1,2,4-Trimethylbenzene	--	ND	--	0.07	--	ND
1,3,5-Trimethylbenzene	--	ND	--	0.19	--	ND
Vinyl Chloride	NC	ND	0.05	0.015	NC	ND
m,p-Xylenes	0.281	0.00273(1)	0.57	0.0066	NC	ND
o-Xylenes	NC	ND	0.57	0.0062	NC	ND

Key:
ND = Not Detected
NC = Not Calculated
NA = Not Analyzed
* = Calculated site-specific cleanup objective exceeds maximum value for group of contaminants; group maximum value is used.
-- = No cleanup objective available
(1) = Total Xylenes

Note: Concentrations exceeding cleanup objectives are shaded.

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TABLE 3.5-3
COMPARISON OF ORGANIC DATA AND NEW YORK STATE SCREENING CRITERIA FOR SEDIMENT

Analyte	CR01		CR02		CR04		CR05		CR06	
	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)	Sediment Conc. (mg/kg)	NY Sample-Specific Sediment Criterion (mg/kg)
Anthracene	ND	--	0.34	--	ND	--	ND	--	ND	--
Benzo(a)anthracene	ND	NA	0.97	0.0039	0.21	0.011	ND	NA	0.12	0.0057
Benzo(a)pyrene	ND	NA	0.89	0.0039	0.17	0.011	ND	NA	0.097	0.0057
Benzo(b)fluoranthene	ND	NA	1.5	0.0039	0.29	0.011	ND	NA	0.17	0.0057
Benzo(g,h,i)perylene	ND	--	0.41	--	ND	--	ND	--	ND	--
BHC (total)	ND	NA	0.016	0.0002	0.0003	0.0005	ND	NA	0.013	0.0003
Bis(2-ethylhexyl)phthalate	ND	NA	0.23	0.60	0.15	2.7	ND	NA	ND	NA
Chrysene	ND	NA	1	0.0039	0.22	0.011	ND	NA	ND	NA
Dibenzofuran	ND	--	0.12	--	ND	--	ND	--	ND	--
Endosulfan (I & II)	ND	NA	0.0028	9.0E-05	0.002	0.0004	0.0014	4.2E-05	0.0013	0.0001
Endrin	ND	NA	ND	NA	0.0025	0.01	0.0045	0.0011	ND	NA
Fluoranthene	ND	NA	1.9	3.0	0.28	13.7	0.11	1.4	0.2	4.5
Fluorene	ND	--	0.20	--	ND	--	ND	--	ND	--
Methoxychlor	ND	NA	ND	NA	0.019	0.008	ND	NA	ND	NA
Methylene Chloride	ND	--	0.022	--	0.019	--	ND	--	0.015	--
Naphthalene	ND	--	0.21	--	ND	--	ND	--	ND	--
PCBs (total)	ND	NA	ND	NA	ND	NA	0.16	1.1E-06	ND	NA
Phenanthrene	ND	NA	1.7	0.36	0.13	1.6	ND	NA	0.16	0.52
Pyrene	ND	--	1.4	--	0.33	--	0.11	--	0.16	--

Key:

NA	=	Not Applicable	ND	=	Not Detected
--	=	No screening criteria			

Note: Concentrations exceeding screening criteria are shaded.

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from acute toxicity; aquatic life from chronic toxicity; and wildlife from toxic effects of bioaccumulation. If the criteria for any of these categories is exceeded, a sediment is considered to be contaminated. Table 3.5-3 presents the minimum criteria for each sediment sample based on the organic carbon concentrations in each sample as determined during the RI.

The sediment screening criteria for metals are based on two levels of protection (lowest effect levels and severe effect levels). Background concentrations for metals are not used since naturally occurring concentrations could cause adverse ecological effects. Lowest effect levels indicate the "level of sediment contamination that can be tolerated by the majority of benthic organisms, but still causes toxicity to a few species" (NYSDEC, 1993b); severe effect levels indicate the "concentration at which pronounced disturbance of the sediment dwelling community can be expected" (NYSDEC, 1993b). The New York State lowest effect level is the lower of either the lowest effect level as described in the Ontario Ministry of the Environment guidelines for metals (Persaud, Jaagumagi, and Hayton, 1992), or the effect range-low as described by Long and Morgan (1990). The New York State severe effect level is the lower of either the severe effect level as described in the Ontario Ministry of the Environment guidelines for metals (Persaud, Jaagumagi, and Hayton, 1992), or the effect range-moderate as described by Long and Morgan (1990). A sediment is considered contaminated if either of these levels is exceeded. If only the lowest effect level is exceeded, the impact is considered moderate; if both criteria are exceeded, the sediment is considered to be severely impacted. The metals criteria are intended for screening only; if contaminants are identified exceeding these criteria, additional studies are needed to quantify risk and determine if remediation is necessary. Table 3.5-4 presents the New York State lowest effect level and severe effect level and indicates whether the sediment samples collected during the RI are considered contaminated and, if so, the level of impact.

3.5.2 Potential Location-Specific ARARs

Location-specific ARARs govern activities in certain environmentally sensitive areas. Potential location-specific ARARs that may be pertinent to remedial activities at AFP 59 are described below:

- **Endangered Species Act (50 CFR 200 and 402).** Endangered species and the critical habitats upon which they depend are protected under this statute. Threatened species are also identified.

- **Executive Order on Flood Plain Management (Executive Order No. 11988).** In furtherance of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321 *et seq.*), the National Flood Insurance Act (42 USC 4001 *et seq.*), and the Flood Disaster Protection Act (PL93-234, 87 Stat. 975), long- and short-term adverse impacts associated with the occupancy and modification of flood plains are regulated. Mandatory identification of flood plains, alternatives to activities conducted or planned in flood plains, and potentially an Environmental Impact Statement for activities that cannot be moved, are stipulated.

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TABLE 3.5-4
COMPARISON OF INORGANIC DATA AND NEW YORK STATE SCREENING CRITERIA FOR SEDIMENT

Analyte	New York Sediment Criterion		Max. Site Sediment Conc. (mg/kg)	Impact	Max. Bkgd. Sediment Conc. (mg/kg)	Impact
	Lowest Effect Level (mg/kg)	Severe Effect Level (mg/kg)				
Aluminum	--	--	9,450	Unknown	6,840	Unknown
Arsenic	6.0	33.0	6.1	Moderate	5.2	None
Barium	--	--	71.3	Unknown	42.5	Unknown
Beryllium	--	--	0.47	Unknown	0.24	Unknown
Calcium	--	--	7,750	Unknown	32,100	Unknown
Chromium	26.0	110.0	16.2	None	9.9	None
Cobalt	--	--	9.4	Unknown	7.7	Unknown
Copper	16.0	110.0	28.8	Moderate	26.8	Moderate
Iron	20,000	40,000	20,100	Moderate	17,600	None
Lead	31.0	110.0	55.5	Moderate	19.5	None
Magnesium	--	--	5,100	Unknown	3,440	Unknown
Manganese	460.0	1100.0	410	None	584	Moderate
Mercury	0.15	1.3	0.22	Moderate	ND	None
Molybdenum	--	--	16.8	Unknown	15.0	Unknown
Nickel	16.0	50.0	21.1	Moderate	19.3	Moderate
Potassium	--	--	843	Unknown	NA	Unknown
Silver	1.0	2.2	0.59	None	ND	None
Vanadium	--	--	15.9	Unknown	11.5	Unknown
Zinc	120.0	270.0	383	Severe	138	Moderate

Key:
ND = Not Detected
NA = Not Available
-- = No screening criteria

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- **National Historic Preservation Act (16 USC Section 470 et seq. 36 CFR Part 800).** This act requires Federal agencies to take into account the effect of any federally assisted undertaking or licensing on any district, site, building structure, or object that is included in or eligible for inclusion in the National Register for Historic Places.

- **Clean Water Act, Section 404(b)(1) and Executive Order 11990 "Protection of Wetlands" (40 CFR Section 230.10 and Executive Order 11990).** Section 404 of the Clean Water Act requires permits for the discharge of dredge or fill materials into wetlands. Executive Order 11990, in furtherance of the NEPA, requires action to minimize adverse impact, destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.

- **New York State Freshwater Wetlands Act and implementing regulations (Article 24 ECL, 6 NYCRR Parts 663 and 664).** The Act and implementing regulations require that wetlands be preserved, protected, and conserved consistent with the general welfare and beneficial economic, social and agricultural development of the State. Unavoidable adverse impacts on wetlands are addressed through a mitigation program.

- **Laws and regulations regulating streams and navigable water bodies (Article 15 ECL, 6 NYCRR Part 608).** The laws and regulations prohibit change, modification or disturbance of any protected stream, its bed, or banks without a permit. Placement of dams or docks and excavation or placement of fill in navigable waters is also regulated.

3.5.3 Potential Action-Specific ARARs

Action-specific ARARs are restrictions that define acceptable treatment and disposal procedures for hazardous substances. These ARARs generally set performance, design or other similar action-specific controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants, such as RCRA regulations for waste TSD. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. These requirements may include:

- **National Pretreatment Standards (40 CFR Part 403).** Standards are set to control pollutants that pass through or interfere with treatment processes in publicly owned treatment works or that may contaminant sewage sludge.

- **Clean Water Act (33 USC 1251-1376).** This act sets standards and requirements for pollutant discharge. **The National Pollutant Discharge Elimination System (NPDES) (40 CFR 122 and 125)** requires permits for the discharge of pollutants from any point source into waters of the United States.

- **New York Hazardous Waste Identification Rules (NYCRR, Title 6, Chapter 371).** These regulations establish criteria for identifying a hazardous waste.

- **New York Final Status and Interim Status Standards for Owners and Operators of Hazardous Waste Facilities (NYCRR, Title 6, Chapter IV, Subchapter B, Subpart 373-2 and 373-3).** Site remedies may include the operation of facilities for storage or treatment of groundwater and soils containing hazardous contaminant concentrations. Potential pertinent regulations include those regulating tank systems, waste piles, container storage, and generation of hazardous waste.

- **New York Land Disposal Restrictions (NYCRR, Title 6, Chapter IV, Subchapter B, Subpart 376).** These regulations prohibit the land disposal of any waste listed in the regulations and containing constituents exceeding published criteria. These regulations may be applicable to the disposal of soils and treatment residuals, if soils are treated and disposed of on-site.

SECTION 4.0

CONCLUSIONS AND RECOMMENDATIONS

This section presents the conclusions and recommendations for the RI of AFP 59 as they relate to the risk to human health and to the comparison of site contaminants to ARARs. The conclusions are presented below in Section 4.1 by environmental medium. Although Section 3 identifies three source areas of soil contamination at AFP 59, the conclusions treat the plant as a single investigative site because of its small size and similar environmental characteristics. Recommendations follow the conclusions in Section 4.2.

4.1 Conclusions

This section presents the conclusions for the RI of AFP 59 by environmental medium. Only those analytes that contribute to unacceptable risk (i.e., carcinogenic risk exceeding 1×10^{-6} or hazard quotient exceeding 1) are included in the discussion of risk in this section.

4.1.1 Soil

CARCINOGENIC RISK. Carcinogenic risk due to soil contamination was identified for future on-site industrial workers. The only exposure pathway and analyte that contributed to unacceptable risk for on-site industrial workers was dermal absorption of beryllium in surface soil at the Plating Room Area. Beryllium was identified in 100 percent of the site surface soil samples collected in the Plating Room Area and in 100 percent of the background surface soil samples. Therefore, beryllium may represent an area-wide problem (potentially related to emissions from the NYSEG coal-burning power plant located south of AFP 59), not a site-specific one.

NONCARCINOGENIC RISK. Soil contamination due to the presence of molybdenum in surface soil near the Plating Room Area was also identified as a noncarcinogenic risk for future on-site industrial workers. Because the hazard quotients for manganese (HQ=0.4) and total chromium (HQ=0.1) do not exceed 1, the potential for adverse noncarcinogenic health effects as a result of manganese and chromium contamination is considered minimal. Although the hazard quotient for molybdenum (HQ=2) does exceed 1, the potential for adverse noncarcinogenic health effects as a result of molybdenum contamination is considered minimal for the following reasons: the contamination was detected in only 1 of the 16 soil samples collected at the Plating Room Area; it was detected in the replicate sample of a normal soil sample, but not in the normal sample; the replicate sample displayed elevated concentrations of most inorganics compared to the normal sample; the one site detect that drove risk (4,060 mg/kg at the Plating Room Area) was greatly elevated compared to other site detects (22 mg/kg was the second highest detected concentration); and the other site detects did not drive risk at either the Waste Oil Tank Area or the Reservoir Area.

ARARs. Other than those analytes that contributed to unacceptable risk, the following analytes were detected in site soil samples above calculated soil cleanup objectives: acetone in the Plating Room Area; and heptachlor epoxide in the Reservoir Area. Acetone is a common laboratory contaminant and, therefore, may not represent site contamination. The only heptachlor epoxide detected in the Reservoir Area was from a soil sample collected beneath the asphalt parking lot; therefore, no known source of heptachlor epoxide exists.

Background data were used for soil cleanup objectives for inorganic analytes. The following inorganic analytes exceeded background conditions: aluminum, barium, calcium, cadmium, copper, cyanide, selenium, and zinc. None of these inorganic analytes contributed to unacceptable risk.

4.1.2 Sediment

A human health risk assessment was not conducted for sediment in Little Choconut Creek because no complete exposure pathway was identified. However, because New York State sediment screening criteria are risk-based, they do allow for a preliminary assessment of risk. The following organic analytes exceeded screening criteria in both site and background samples: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, BHCs (total), and endosulfan (I and II). The organic analytes chrysene, methoxychlor, and phenanthrene exceeded screening criteria in site samples but not in background samples. Chrysene and phenanthrene are PAHs that represent possible area-wide contamination related to emissions from the NYSEG power plant. Methoxychlor was only detected in the replicate sediment sample (not the normal sample) collected at CR04, which is located downstream of both the NYSEG and AFP 59 outfalls. Methoxychlor was not detected at the two sediment sampling locations immediately downstream of the AFP 59 outfalls or at the background sediment sampling locations. Consequently, it may have migrated from the NYSEG outfall and not AFP 59. Additionally, none of the three analytes were detected during the sediment sampling conducted by Argonne National Laboratory (1994) during their investigation of AFP 59.

The inorganic analytes copper, nickel, and zinc exceeded screening criteria in both site and background samples. The inorganic analytes arsenic, iron, lead, and mercury exceeded screening criteria in site samples but not in background samples. Each of the four analytes was detected at a concentration only slightly above the "lowest effect level" established by the New York State screening criteria. Additionally, the presence of arsenic may be related to emissions from the NYSEG power plant, and the presence of mercury may be related to discharge from the NYSEG outfall (mercury was only detected at CR04, which is located downstream of both the NYSEG and AFP 59 outfalls).

4.1.3 Groundwater

This section summarizes the carcinogenic and noncarcinogenic risk related to groundwater contamination at AFP 59 (Section 4.1.3.1) and evaluates the distribution of chlorinated hydrocarbons in groundwater in the vicinity of AFP 59 (Section 4.1.3.2).

Carcinogenic Risk. Carcinogenic risk due to groundwater contamination was identified for future off-site 30-year residents and future on-site industrial workers. For future off-site 30-year residents, the following exposure pathways and analytes contributed to unacceptable risk:

- Dermal absorption of beryllium, p,p'-DDE, TCE, and vinyl chloride in shower water;
- Ingestion of 1,1-dichloroethene, beryllium, TCE, and vinyl chloride in drinking water; and
- Inhalation of 1,1-dichloroethene, bromodichloromethane, carbon tetrachloride, chloroform, methylene chloride, TCE, and vinyl chloride while showering.

For future on-site industrial workers, the following exposure pathway and analytes contributed to unacceptable risk:

- Ingestion of 1,1-dichloroethene, beryllium, TCE, and vinyl chloride in drinking water.

Although beryllium contributed to unacceptable risk, it was detected in groundwater monitoring wells at AFP 59 at concentrations below the New York State guidance value (no drinking water or ambient water quality standards exist for beryllium) and below the laboratory PQL. Additionally, the presence of beryllium may be related to emissions from the NYSEG power plant rather than historical activities at AFP 59. The detection of the pesticide p,p'-DDE in the deep zone of the aquifer is probably unrelated to historical activities at AFP 59 because it was not detected in site soil samples or in the shallow zone of the aquifer. Therefore, no documented on-site source exists, and the p,p'-DDE is interpreted to have migrated to AFP 59 from an off-site, hydraulically upgradient source.

The VOCs detected in groundwater samples collected from on-site monitoring wells at AFP 59, especially the chlorinated hydrocarbons, were detected in past studies. As a result, one of the objectives of the RI was to substantiate the earlier detections and delineate the extent of groundwater contamination. While the VOCs did contribute to unacceptable risk, their presence in groundwater at AFP 59 is not of immediate concern because of the air stripper currently operating at the Camden Street Wellfield located downgradient of AFP 59. The air stripper, for which the USAF pays a portion of the operation and maintenance costs, removes any VOCs from the drinking water supplied to local residents.

Although VOC contamination has been detected in the past at the Camden Street Wellfield, it is not possible to document what portion of the contamination has migrated from AFP 59. Groundwater that underlies AFP 59 only accounts for a small fraction of the total volume of groundwater that is pumped at the wellfield. As a result, any contamination originating at AFP 59 would be greatly diluted by the time it reached the wellfield. Additionally, the USGS (1996) has identified potential source areas other than AFP 59 that exist within the zone of influence of the wellfield.

NONCARCINOGENIC RISK. Noncarcinogenic risk due to groundwater contamination was also identified for future off-site 30-year residents and future on-site industrial workers. For future off-site 30-year residents, the following exposure pathways and analytes contributed to unacceptable risk:

- Ingestion of thallium in drinking water; and
- Inhalation of cis-1,2-dichloroethene and TCE while showering.

For future on-site industrial workers, the following exposure pathway and analyte contributed to unacceptable risk:

- Ingestion of thallium in drinking water.

No definable on-site source exists for thallium because it was not detected in site soil samples or in the shallow zone of the aquifer. Additionally, thallium was only detected in one of the nine groundwater samples collected from deep monitoring wells. Therefore, the thallium may have migrated to AFP 59 from an off-site, hydraulically upgradient source. The thallium may also be related to emissions from the NYSEG power plant. As discussed above, VOCs (in this case cis-1,2-dichloroethene and TCE) are not of immediate concern at AFP 59 because of the air stripper operating at the wellfield.

ARARs. In addition to those analytes that contributed to unacceptable risk, the following analytes (excluding VOCs) were detected in site groundwater samples above New York State groundwater standards: BHC (total), heptachlor, iron, lead, magnesium, and sodium. No apparent source exists for the two pesticides because the majority of the plant property has been covered by impervious material (i.e., the plant and parking lots) since it was paved in 1959. Iron, magnesium, and sodium are common groundwater constituents, and lead did not contribute to unacceptable risk even using a conservative risk assessment model.

4.1.3.1 On-site and Off-site VOC Contamination. In order to evaluate the distribution of several chlorinated hydrocarbons of concern, including 1,1,1-TCA, TCE, and cis-1,2-DCE, the analytical results of groundwater samples collected by EARTH TECH and the USGS were plotted as illustrated in Figures 4-1 and 4-2. The figures include on-site data collected by EARTH TECH in December 1994 during the RI field investigation and off-site data collected by the USGS in August 1994. The analytical results from the USGS investigation have not been validated by

EARTH TECH. Additionally, the analyses run on the USGS samples did not differentiate between cis-1,2-DCE and trans-1,2-DCE. Consequently, the results are reported as the total of the two analytes.

Figure 4-1 shows the distribution of the three chlorinated hydrocarbons in the shallow zone of the aquifer. None of the three analytes were detected in any groundwater samples collected west and south of the Camden Street Wellfield. In addition to the sampling locations shown in Figure 4-1, two additional wells that are not included in the figure were sampled by the USGS. These include MW-4S, located southwest of AFP 59 on the southern side of the Susquehanna River, and MW-6, located northwest of the plant (see Figure 3-14).

Although the maximum concentrations of the chlorinated hydrocarbons in the shallow zone of the aquifer at AFP 59 exceed New York State drinking water standards, the concentrations of these contaminants decrease rapidly downgradient in the direction of the wellfield. As illustrated in Figure 4-1, the maximum concentrations of TCE (370 μg/L) and 1,1,1-TCA (20 μg/L) were detected at SW4, and the maximum concentration of cis-1,2-DCE (150 μg/L) was detected at SW7. In the short distance downgradient to the monitoring wells along the western boundary of AFP 59, the maximum concentrations of these contaminants decreased to 2.4 μg/L, 2.3 μg/L, and 10 μg/L, respectively. Therefore, the concentrations of TCE and 1,1,1-TCA are below New York State drinking water standards as groundwater migrates off-site. Cis-1,2-DCE is above State drinking water standards at only one monitoring well located along the western boundary of AFP 59.

In addition to showing the contamination detected in the shallow zone of the aquifer at AFP 59, Figure 4-1 indicates that AFP 59 is not the sole source of groundwater contamination in the area. All three chlorinated hydrocarbons were detected in groundwater samples collected north and northwest of the plant. These off-site detections include a maximum 1,1,1-TCA concentration (150 μg/L at MW-4 on Azon Street) that is 7.5 times higher than any 1,1,1-TCA detection at AFP 59. As shown in Figures 3-14 and 3-15, areas to the north and northwest of AFP 59 are hydraulically upgradient or cross-gradient of the plant. Therefore, these detections are not related to historical activities at AFP 59 and indicate that at least one additional source of contamination exists.

Figure 4-2 presents the distribution of the three chlorinated hydrocarbons in the deep zone of the aquifer. None of the three analytes were detected in any groundwater samples collected west and south of the Camden Street Wellfield. Only one off-site groundwater sample (MW-5D) was collected from the deep zone of the aquifer northwest of AFP 59; 1,1,1-TCA was detected in that sample. Because MW-5D is located cross-gradient of AFP 59, the contamination detected in that monitoring well could not be related to historical activities at AFP 59. Consequently, either a source of deep zone contamination exists north of AFP 59, or a source of shallow zone contamination is impacting the deep zone of the aquifer.

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4.1.4 Surface Water

Carcinogenic risk related to surface water contamination in Little Choconut Creek adjacent to AFP 59 is discussed below. No noncarcinogenic risk was identified.

CARCINOGENIC RISK. Current recreational users of Little Choconut Creek are potentially exposed to unacceptable risk due to ingestion of arsenic, BEHP, and p,p'-DDD in contaminated fish. Arsenic (possibly related to emissions from the NYSEG power plant) contributed to unacceptable risk for both site and background samples; therefore, exposure to BEHP and p,p'-DDD drove site risk. However, the two analytes were only detected in the surface water sample collected at CR04, which is located downstream of both the NYSEG and AFP 59 outfalls. They were not detected at the two surface water sampling locations immediately downstream of the AFP 59 outfalls (CR01 and CR02) or at the two background surface water sampling locations (CR05 and CR06). Consequently, they may have migrated from the NYSEG outfall and not AFP 59. Additionally, neither of the two analytes was detected in both the normal and duplicate samples collected at CR04, and neither was detected during previous surface water sampling conducted by Argonne National Laboratory (1994).

ARARS. Other than those analytes that contributed to unacceptable risk, the following analytes were detected in site surface water samples above surface water standards: BHC (total), alpha endosulfan (endosulfan I), and iron. However, no apparent source exists for any of the three analytes detected above surface water standards. No apparent source exists for the two pesticides (BHC and alpha endosulfan) because the majority of the plant property has been covered by impervious material (i.e., the plant and parking lots) since it was paved in 1959.

4.2 Recommendations

Based on the results of the RI of AFP 59, the following actions are recommended:

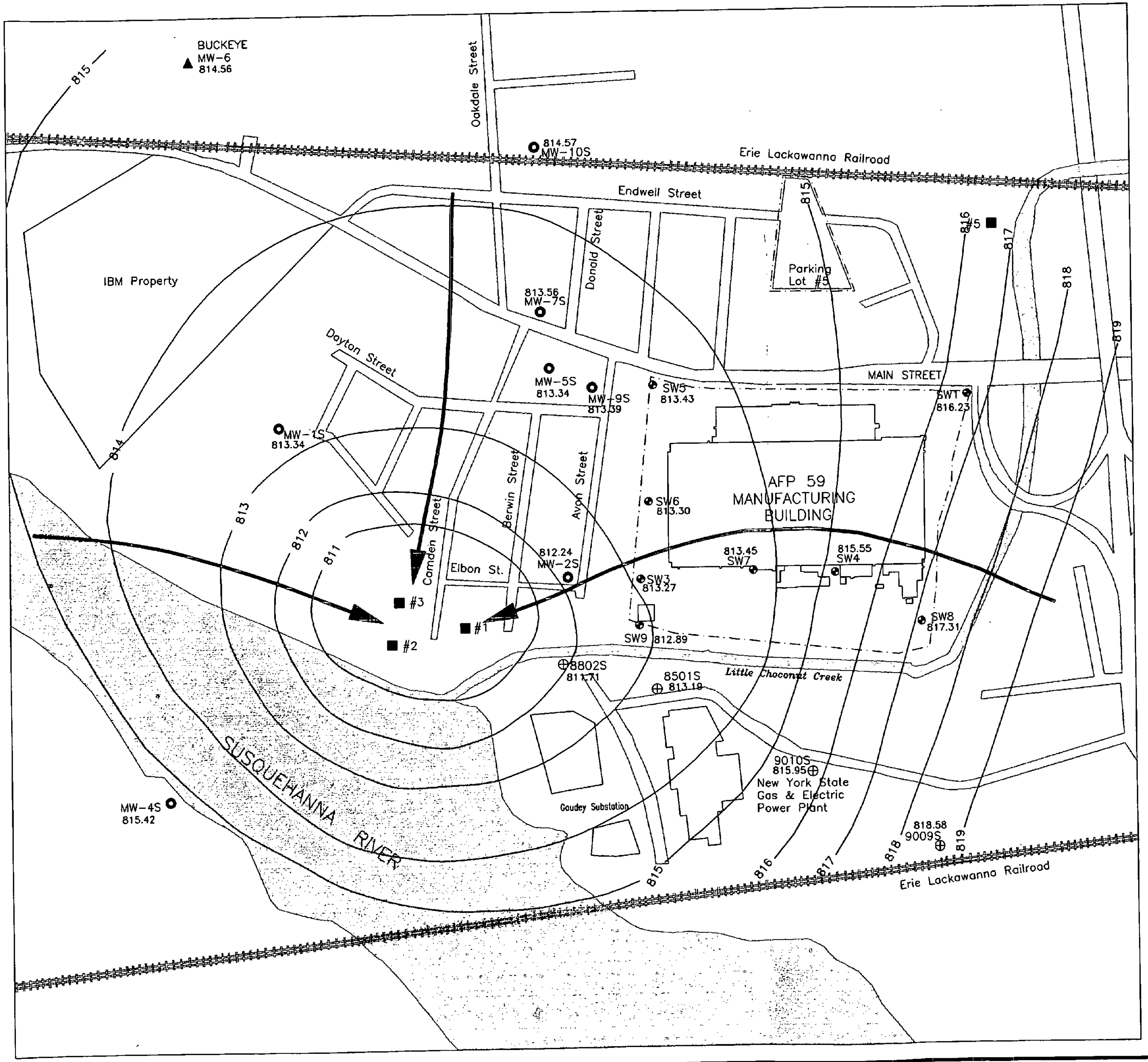
1) Perform additional groundwater sampling of select monitoring wells to verify or eliminate beryllium, thallium, and p,p'-DDE as chemicals of potential concern in groundwater at the site.

   All three analytes were detected in very few groundwater samples. Beryllium was detected in four groundwater samples (including a duplicate sample) collected from shallow monitoring wells (SW3, SW4, and SW11), and in none of the groundwater samples collected from deep monitoring wells. Although the percentage of detections is high in groundwater samples collected from shallow monitoring wells, the detections may be suspect because of the high number of samples that were unusable due to blank contamination. Nine of the groundwater samples collected from shallow monitoring wells and submitted for analysis of beryllium were unusable due to blank contamination. Consequently, additional groundwater sampling of SW3, SW4, and SW11 may eliminate beryllium as a chemical of potential concern.

Thallium was detected in none of the 15 groundwater samples collected from shallow monitoring wells and in 1 of the 12 groundwater samples collected from deep monitoring wells. The pesticide p,p'-DDE was detected in none of the 15 groundwater samples collected from shallow monitoring wells and in only 2 of the 11 groundwater samples collected from deep monitoring wells. These detects may be considered suspect because of the low detection percentage. As a result, additional groundwater sampling may eliminate thallium and p,p'-DDE as chemicals of potential concern.

2) Collect additional site and background surface water samples to verify or eliminate arsenic, BEHP, and p,p'-DDD as chemicals of potential concern in Little Choconut Creek. As discussed above, arsenic shows risk for both the site and background surface water pathways. Additional sampling will allow for statistical comparisons between site and background contamination to determine whether site contamination is the result of background contamination migrating downstream from another source.

BEHP and p,p'-DDD were only detected in the surface water sample collected at CR04, which is located downstream of both the NYSEG and AFP 59 outfalls. Additional surface water sampling at locations immediately downgradient of the AFP 59 outfalls and upgradient of the NYSEG outfall may eliminate these analytes as chemicals of potential concern.



LEGEND

◉SW4	AFP 59 MONITORING WELL
○MW-3S	NYSDEC MONITORING WELL
⊕8507S	NYSEG MONITORING WELL
▲MW-6	MONITORING WELL AT BUCKEYE PIPELINE CO.
■#2	JOHNSON CITY WATER SUPPLY WELL
819.23	GROUNDWATER ELEVATION (FEET MSL)
───	GROUNDWATER ELEVATION CONTOUR (FEET MSL)
←	GROUNDWATER FLOW DIRECTION
—·—·—	AFP 59 BOUNDARY

NOTE: GROUNDWATER ELEVATIONS WERE MEASURED FROM AUGUST 22-24, 1994

CONTOUR INTERVAL = 1FT.

0 200 400
SCALE IN FEET

EARTH TECH

FIGURE I-11

POTENTIOMETRIC SURFACE AND GROUNDWATER FLOW (SHALLOW WELLS) IN THE VICINITY OF AFP 59
AUGUST 22-24, 1994

afp59ri3.dwg\1-11.plt

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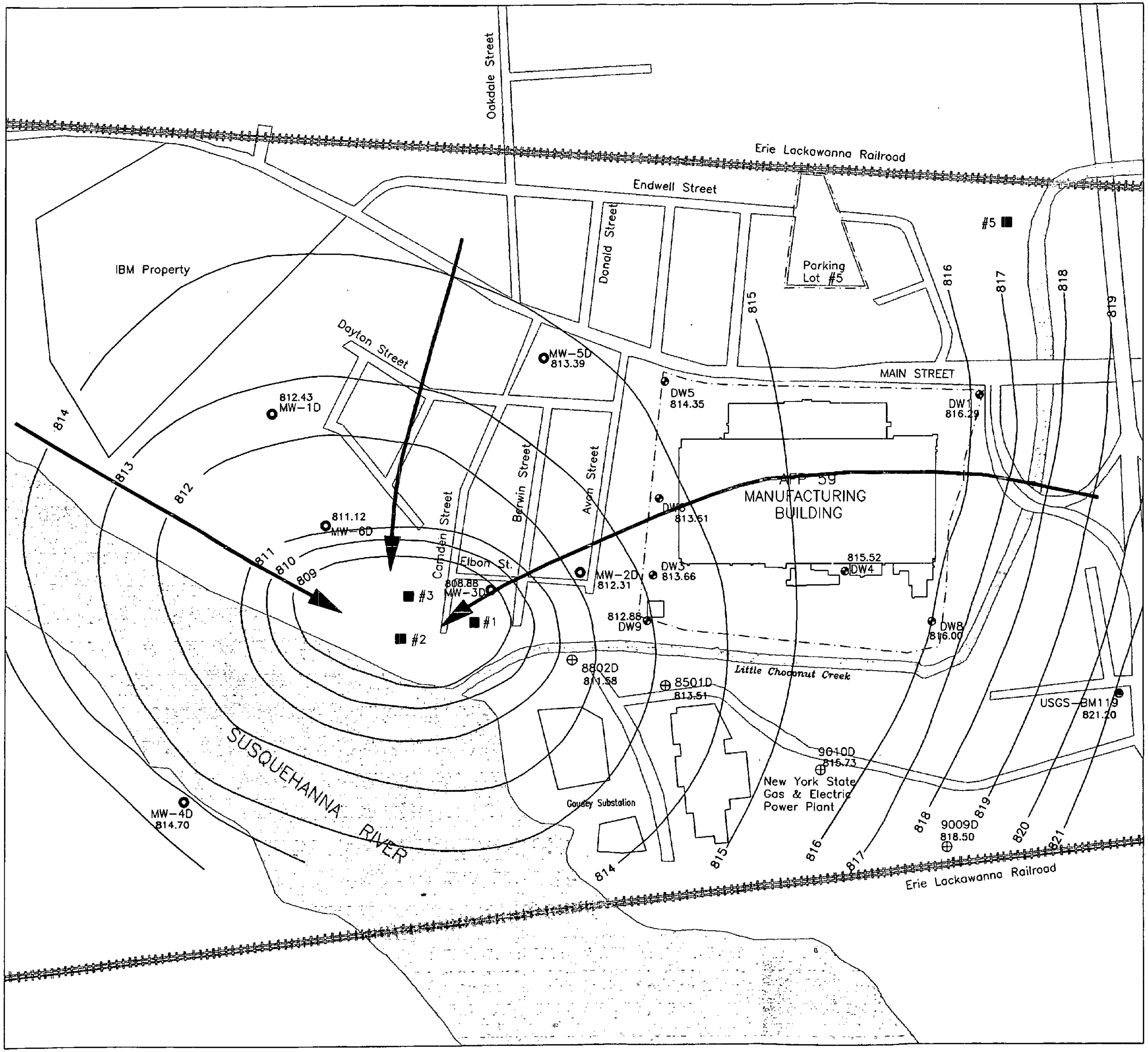

LEGEND

● DW4	AFP 59 MONITORING WELL
○ MW-3D	NYSDEC MONITORING WELL
⊕ 8507D	NYSEG MONITORING WELL
● BM 119	USGS MONITORING WELL
■ #2	JOHNSON CITY WATER SUPPLY WELL
819.23	GROUNDWATER ELEVATION (FEET MSL)
⌒	GROUNDWATER ELEVATION CONTOUR (FEET MSL)
←	GROUNDWATER FLOW DIRECTION
— · —	AFP 59 BOUNDARY

0 200 400
SCALE IN FEET

N

EARTH TECH

FIGURE 1-12

POTENTIOMETRIC SURFACE AND GROUNDWATER FLOW (DEEP WELLS) IN THE VICINITY OF AFP 59
AUGUST 22-24, 1994

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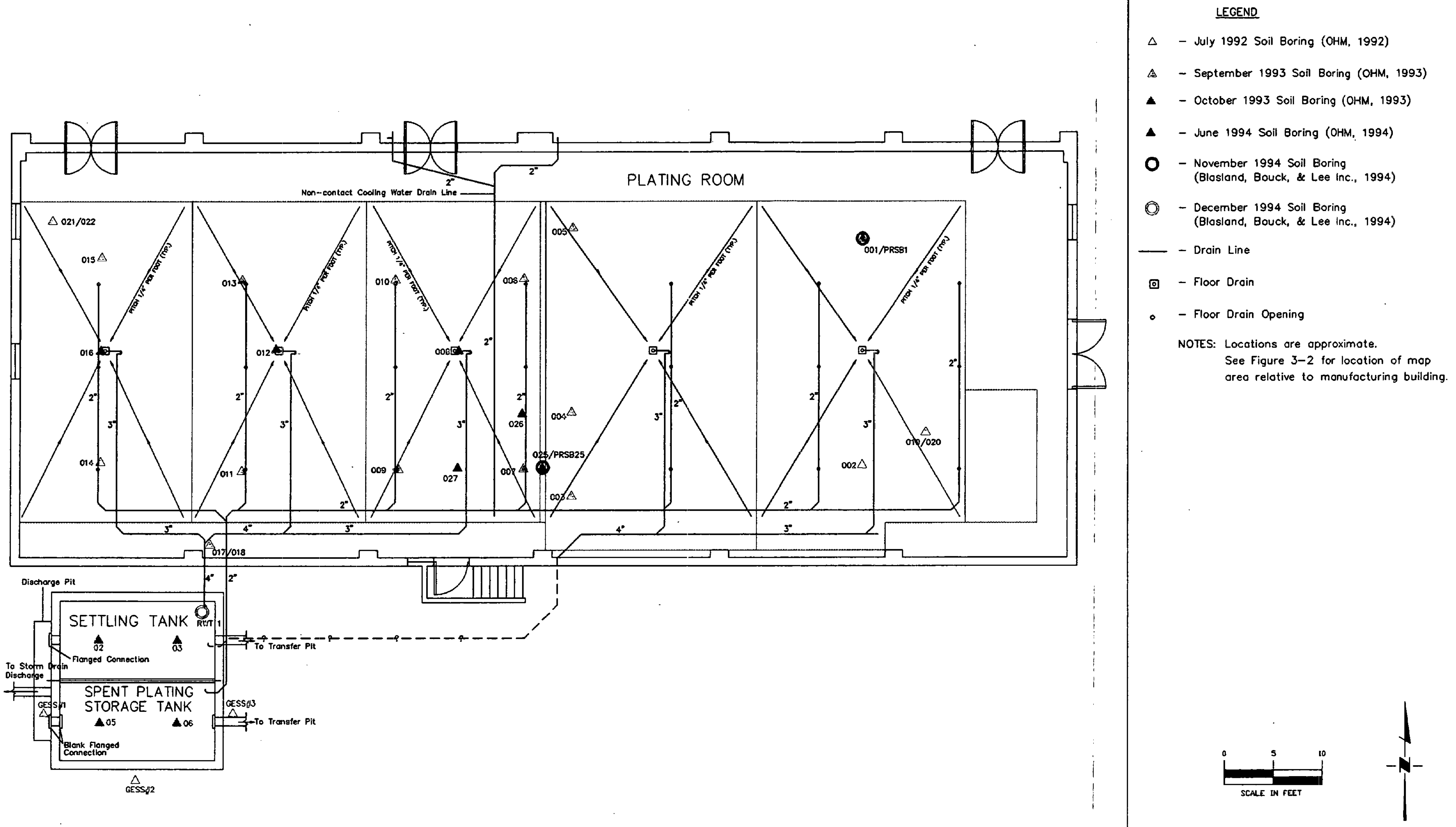

LEGEND

△ – July 1992 Soil Boring (OHM, 1992)

◬ – September 1993 Soil Boring (OHM, 1993)

▲ – October 1993 Soil Boring (OHM, 1993)

▲ – June 1994 Soil Boring (OHM, 1994)

○ – November 1994 Soil Boring (Blasland, Bouck, & Lee Inc., 1994)

◎ – December 1994 Soil Boring (Blasland, Bouck, & Lee Inc., 1994)

—— – Drain Line

▣ – Floor Drain

∘ – Floor Drain Opening

NOTES: Locations are approximate.
See Figure 3–2 for location of map area relative to manufacturing building.

EARTH TECH

FIGURE 3-3

MARTIN MARIETTA CLOSURE INVESTIGATION
SOIL SAMPLING LOCATIONS
JULY 1992 - DECEMBER 1994

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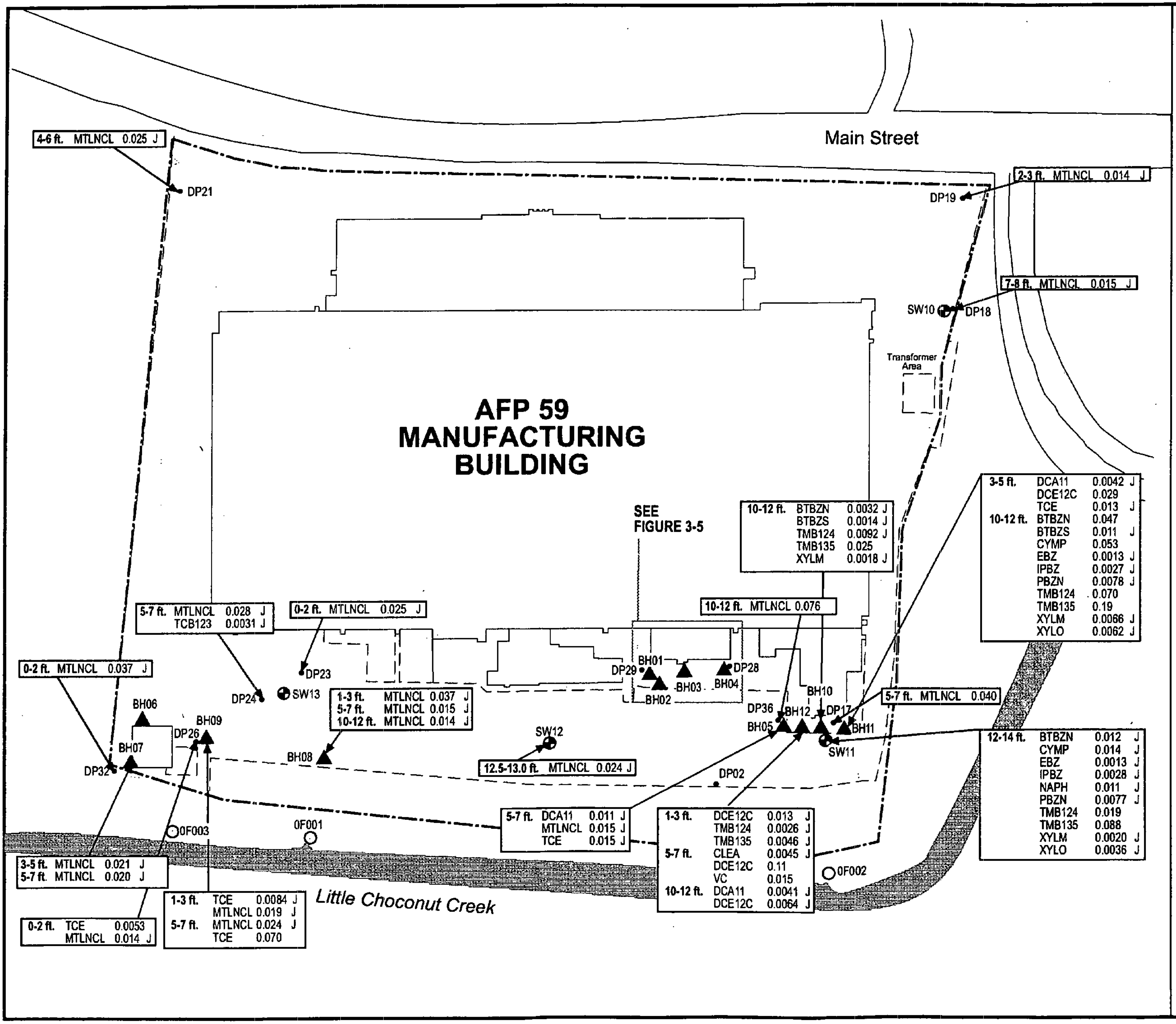

AFP59\Concentrations\VOCs detected in soil

—·—·—	Boundary
– – – –	Fence
⊕	Monitoring Well
○	Outfall
▲	Soil Boring
•	Direct Push Location

KEY

BTBZN = n-butylbenzene
BTBZS = sec-butylbenzene
CLEA = chloroethane
CYMP = p-cymene (p-isopropyl toluene)
DCA11 = 1,1-dichloroethane
DCE12C = cis-1,2-dichloroethene
EBZ = ethylbenzene
IPBZ = isopropylbenzene (cumene)
MTLNCL = methylene chloride
PBZN = n-propylbenzene
TCB123 = 1,2,3-trichlorobenzene
TCE = trichloroethene
TMB124 = 1,2,4-trimethylbenzene
TMB135 = 1,3,5-trimethylbenzene
VC = vinyl chloride
XYLM = m,p-xylene
XYLO = o-xylene

J = Estimated

Note: Concentrations are reported in mg/kg. Highest concentrations of replicate samples are reported. If no data are presented at a location, no VOCs were detected in the soil.

100 50 0 100
Scale in Feet

N

EARTH TECH

FIGURE 3-4

VOCs Detected in Soil

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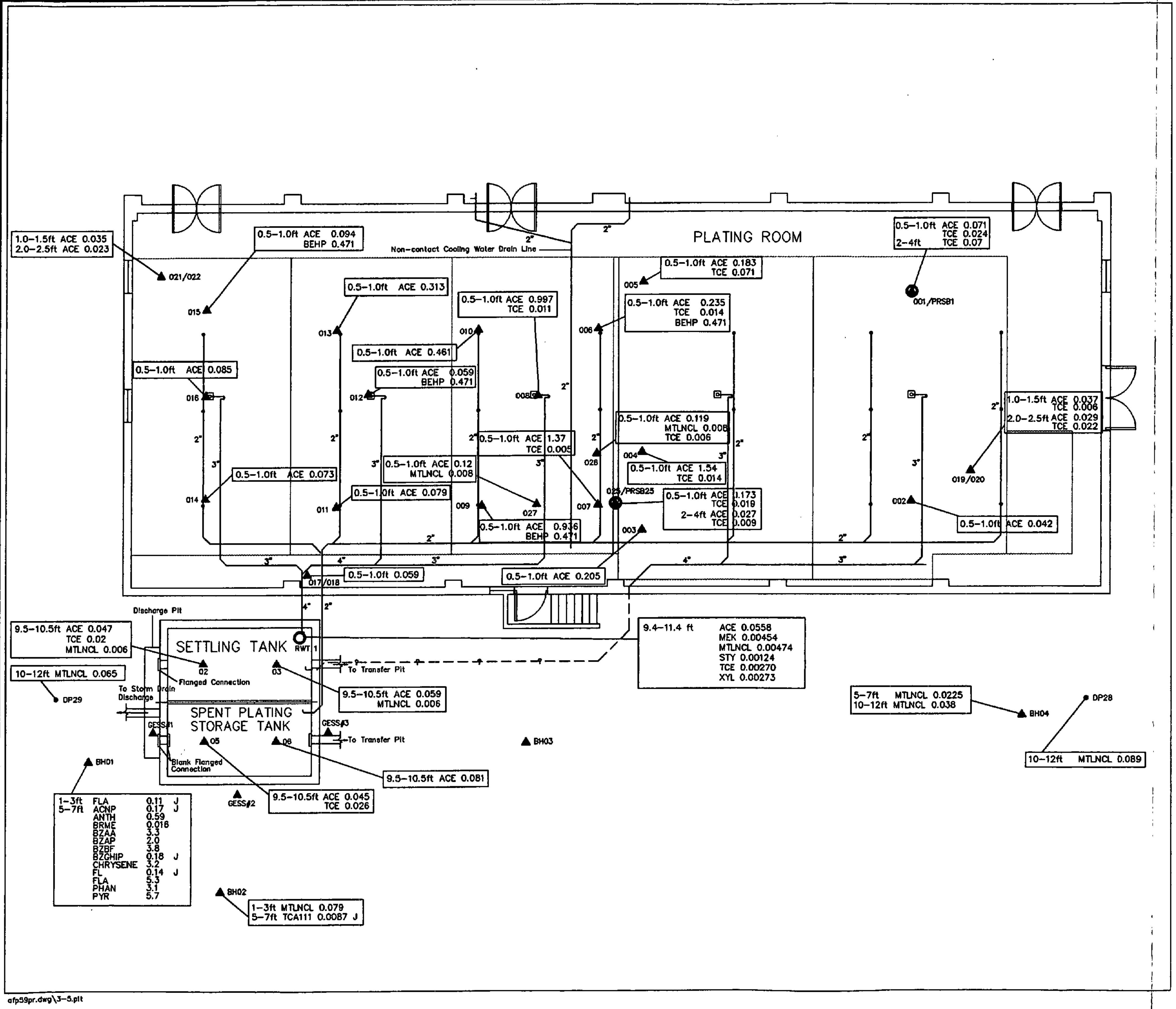


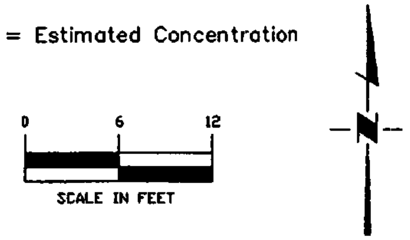
LEGEND

- ▲ – July 1992 Soil Boring (OHM, 1992)
- ▲ – September 1993 Soil Boring (OHM, 1993)
- ▲ – October 1993 Soil Boring (OHM, 1993)
- ▲ – June 1994 Soil Boring (OHM, 1994)
- ▲ – October 1994 Soil Boring (Earth Tech RI)
- ○ – November 1994 Soil Boring (Blasland, Bouck, & Lee Inc., 1994)
- ○ – December 1994 Soil Boring (Blasland, Bouck, & Lee Inc., 1994)
- ● – July 1994 Direct Push Sampling Location (Earth Tech RI)
- — – Drain Line
- ▣ – Floor Drain
- ∘ – Floor Drain Opening

ACE	ACETONE
ACNP	ACENAPHTHENE
ANTH	ANTHRACENE
BEHP	BIS (2–ETHYLHEXYL) PHTHALATE
BRME	BROMOMETHANE
BZAA	BENZO (a) ANTHRACENE
BZAP	BENZO (a) PYRENE
BZBF	BENZO (a) FLUORANTHENE
BZGHIP	BENZO (a) PERYLENE
FL	FLUORENE
FLA	FLUORANTHENE
MEK	METHY ETHY KETONE
MTLNCL	METHYLENE CHLORIDE
PHAN	PHERANTHRENE
PYR	PYRENE
STY	STYRENE
TCAIII	I,I,I – TRICHLOROETHANE
TCE	TRICHLOROETHENE
XYL	XYLENES (TOTAL)

NOTES:

- Locations are approximate. See Figure 3–2 for location of map area relative to manufacturing building.
- Concentrations are reported in mg/kg. Highest concentrations of replicate samples are reported. If no data are presented at a location, no VOCs/SVOCs were deteced in the soil.
- J = Estimated Concentration



EARTH TECH

FIGURE 3–5

VOCs AND SVOCs DETECTED IN SOIL – PLATING ROOM AREA

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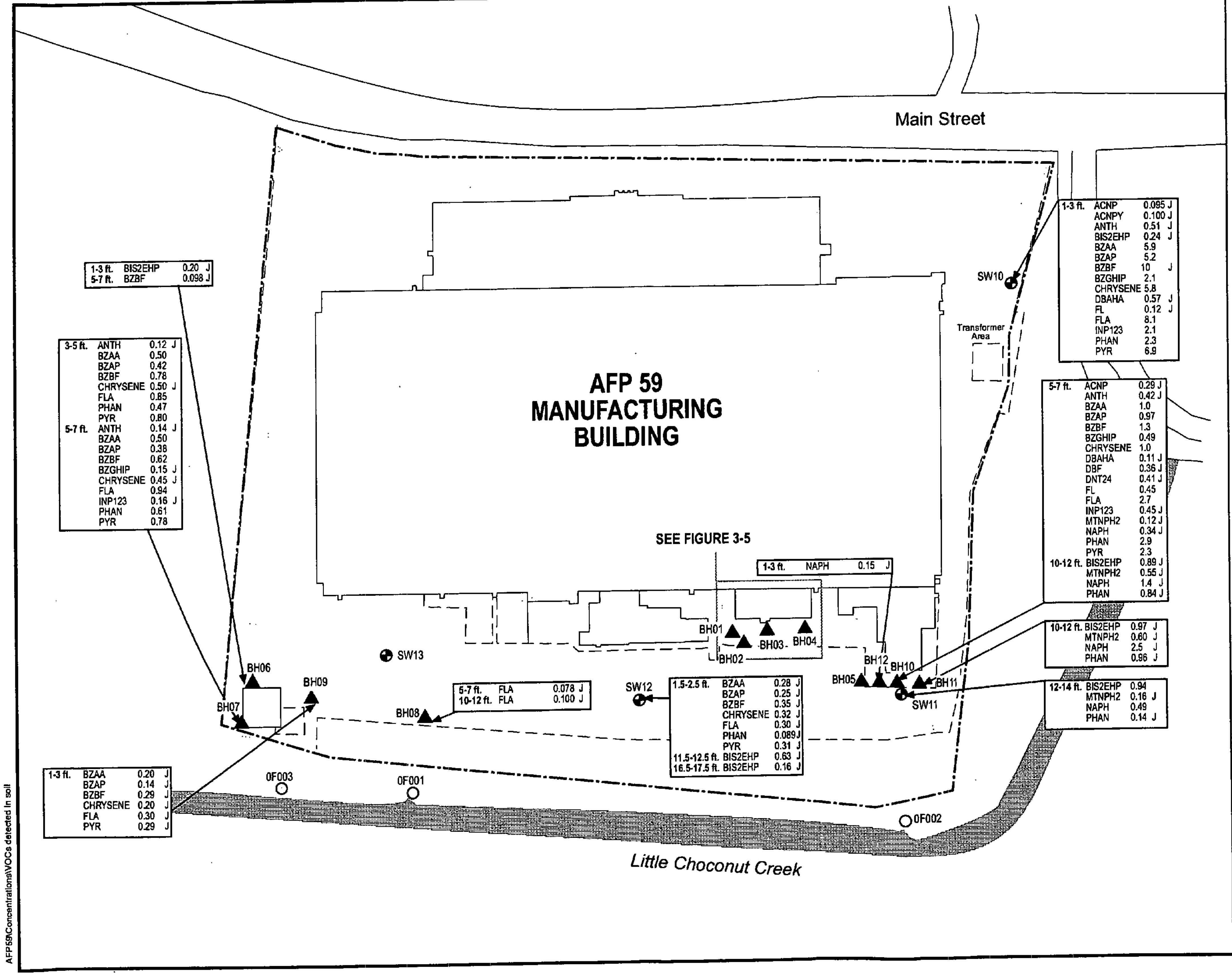

AFP59\Concentrations\VOCs detected in soil

—·—·— Boundary

– – – – Fence

⊕ Monitoring Well

○ Outfall

▲ Soil Boring

KEY

ACNP = acenaphthene
ACNPY = acenaphthylene
ANTH = anthracene
BIS2EHP = bis(2-ethylhexyl)phthalate
BZAA = benzo(a)anthracene
BZAP = benzo(a)pyrene
BZBF = benzo(b)fluoranthene
BZGHIP = benzo(g,h,i)perylene
CHRYSENE = chrysene
DBAHA = dibenz(a,h)anthracene
DBF = dibenzofuran
DNT24 = 2,4-dinitrotoluene
FL = fluorene
FLA = fluoranthene
INP123 = indeno(1,2,3-cd)pyrene
MTNPH2 = 2-methylnaphthalene
NAPH = naphthalene
PHAN = phenanthrene
PYR = pyrene

J = Estimated

Note: Concentrations are reported in mg/kg. Highest concentrations of replicate samples are reported. If no data are presented at a location, no SVOCs were detected in the soil.

100 50 0 100

Scale in Feet

N

EARTH TECH

FIGURE 3-6

SVOCs Detected in Soil

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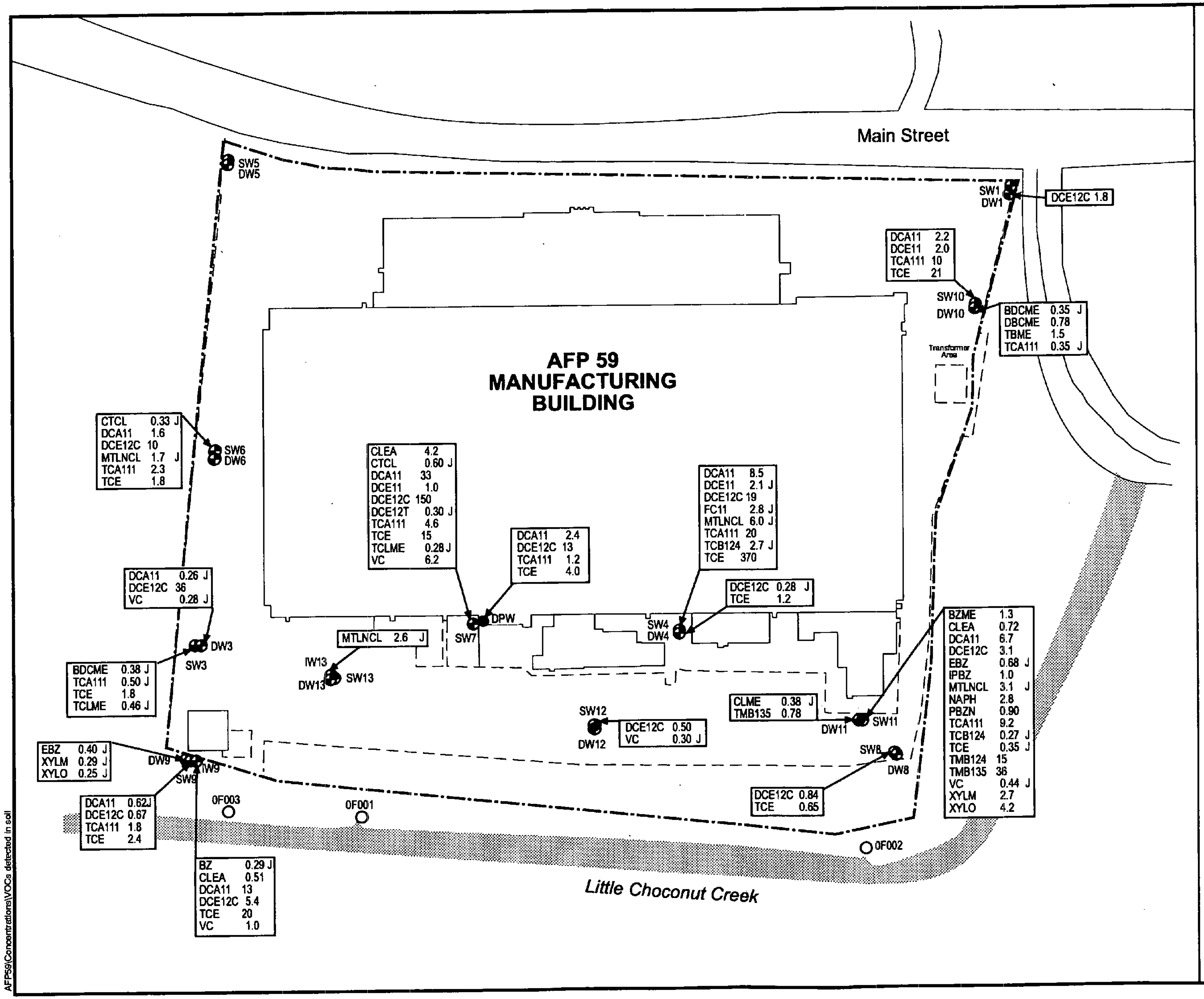

—·—·—	Boundary
— — —	Fence
●	Industrial Production Well
⊕	Monitoring Well
○	Outfall

KEY

BDCME	=	bromodichloromethane
BZ	=	benzene
BZME	=	toluene
CLEA	=	chloroethane
CLME	=	chloromethane
CTCL	=	carbon tetrachloride
DBCME	=	dibromochloromethane
DCA11	=	1,1-dichloroethane
DCE11	=	1,1-dichloroethene
DCE12C	=	cis-1,2-dichloroethene
DCE12T	=	trans-1,2-dichloroethene
EBZ	=	ethylbenzene
FC11	=	trichlorofluoromethane
IPBZ	=	isopropylbenzene
MTLNCL	=	methylene chloride
NAPH	=	naphthalene
PBZN	=	n-propylbenzene
TBME	=	bromoform
TCA111	=	1,1,1-trichloroethane
TCB124	=	1,2,4-trichlorobenzene
TCE	=	trichloroethene
TCLME	=	chloroform
TMB124	=	1,2,4-trimethylbenzene
TMB135	=	1,3,5-trimethylbenzene
VC	=	vinyl chloride
XYLM	=	m,p-xylene
XYLO	=	o-xylene

J = Estimated

Note: Concentrations are reported in μg/L. If no data are presented at a monitoring well location, no VOCs were detected in the groundwater.

At locations were duplicates were collected, the maximum concentration is presented.

100 50 0 100

Scale in Feet

N

EARTH TECH

FIGURE 3-7

VOCs Detected in Groundwater

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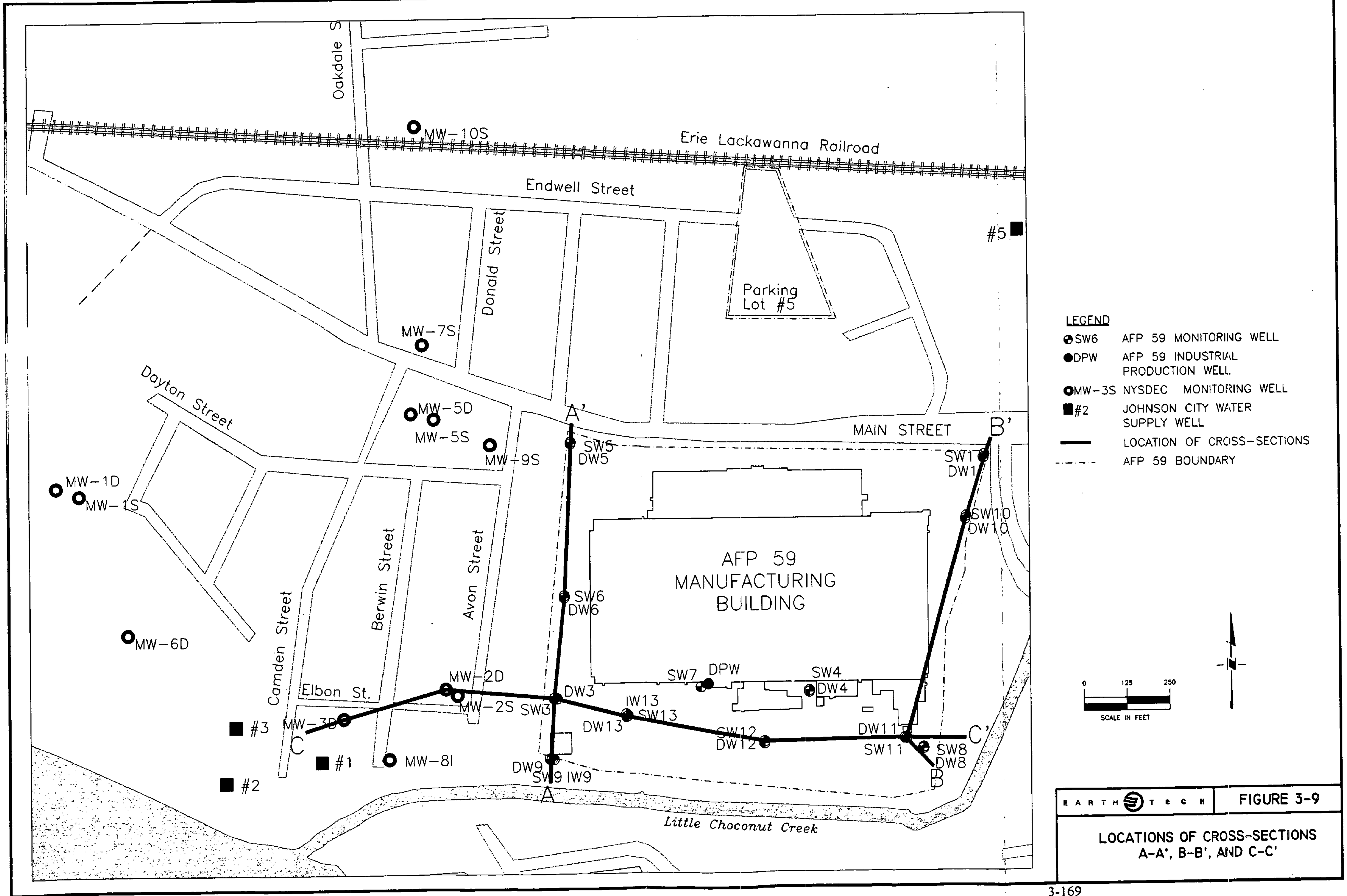

FIGURE 3-9

LOCATIONS OF CROSS-SECTIONS A-A', B-B', AND C-C'

afp59ri1.dwg\3-9.plt

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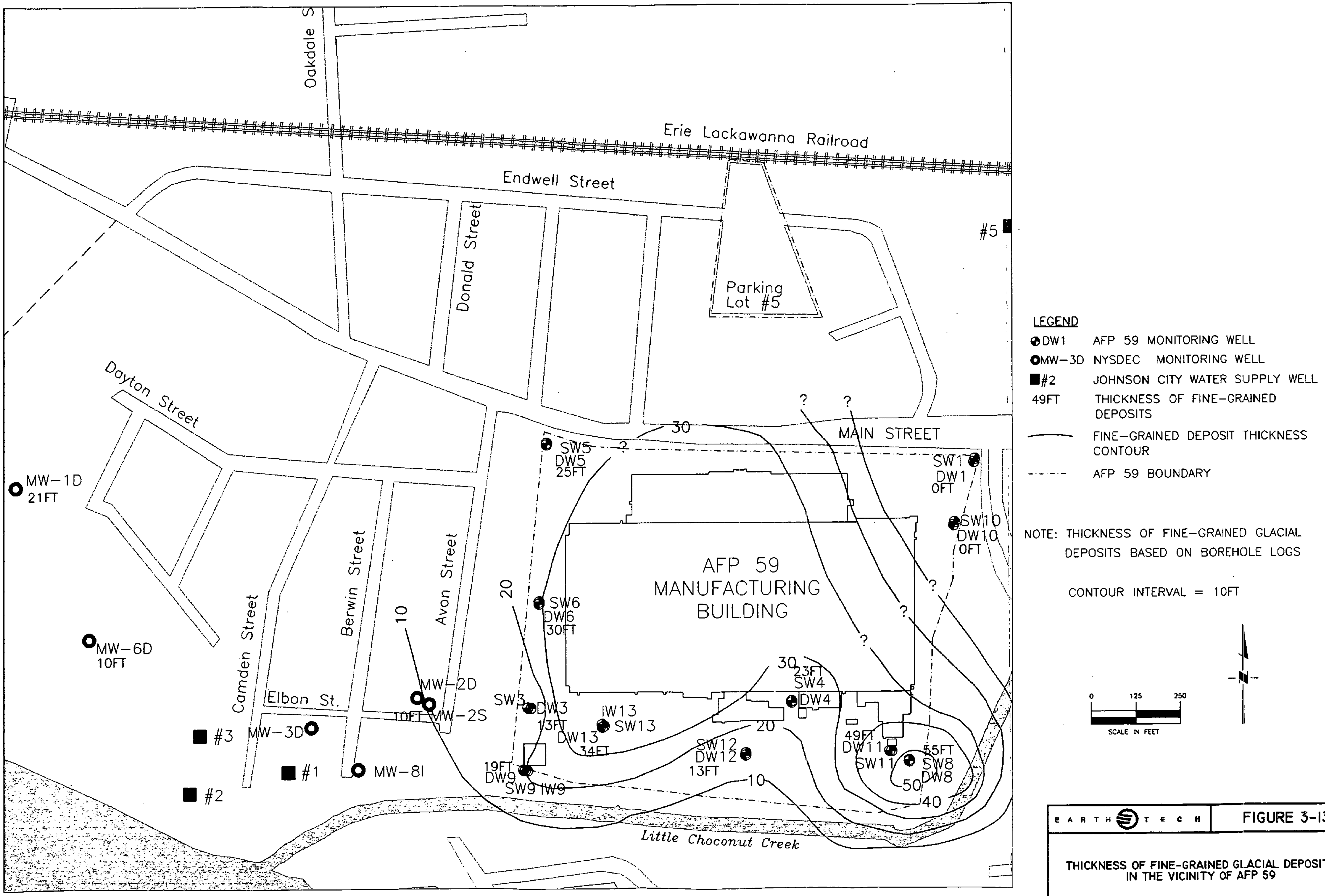

EARTH TECH

FIGURE 3-13

THICKNESS OF FINE-GRAINED GLACIAL DEPOSITS IN THE VICINITY OF AFP 59

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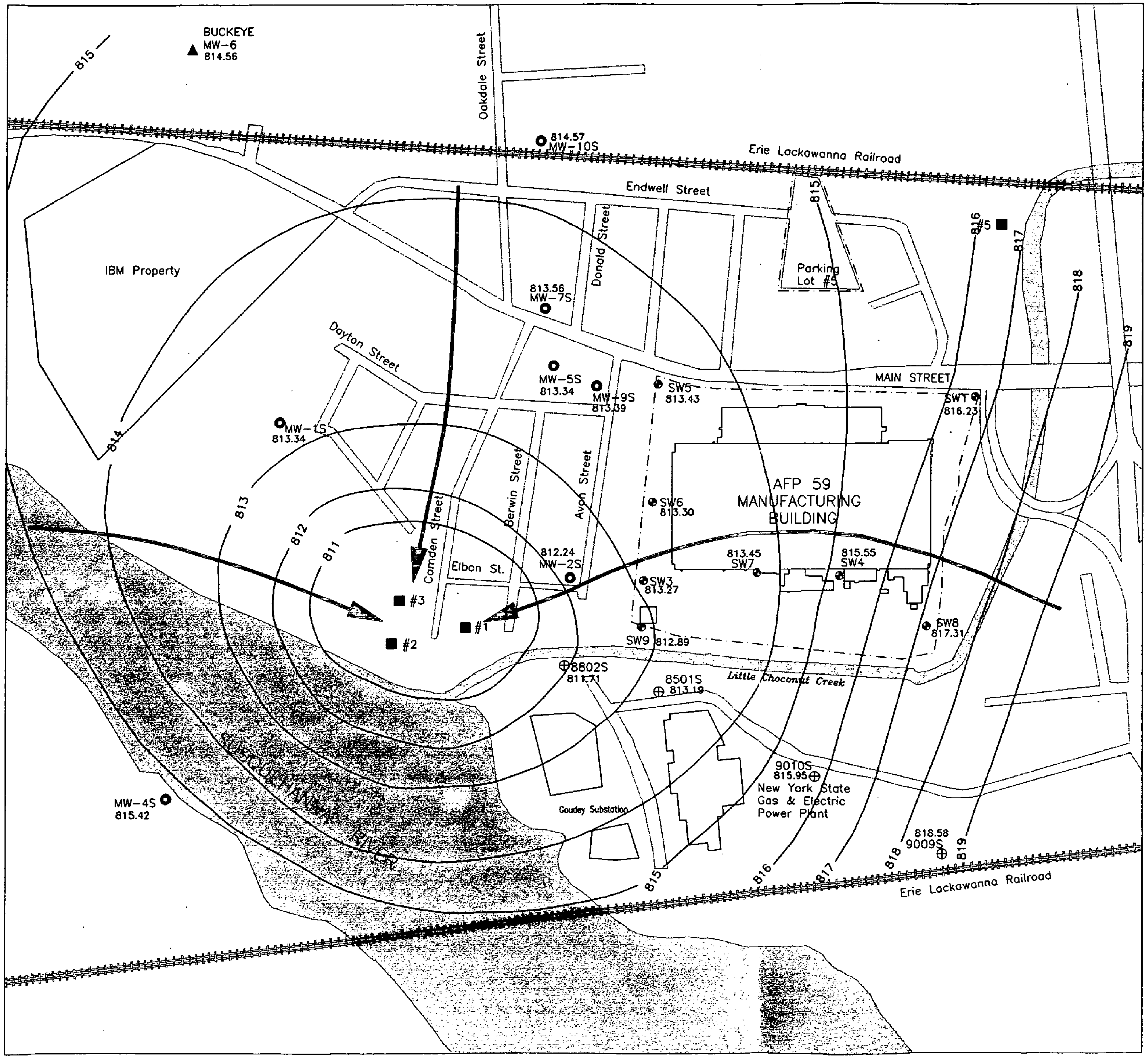

LEGEND

⊕SW4	AFP 59 MONITORING WELL
○MW-3S	NYSDEC MONITORING WELL
⊕8507S	NYSEG MONITORING WELL
▲MW-6	MONITORING WELL AT BUCKEYE PIPELINE CO.
■#2	JOHNSON CITY WATER SUPPLY WELL
819.23	GROUNDWATER ELEVATION (FEET MSL)
———	GROUNDWATER ELEVATION CONTOUR (FEET MSL)
⟵	GROUNDWATER FLOW DIRECTION
-·-·-	AFP 59 BOUNDARY

NOTE: GROUNDWATER ELEVATIONS WERE MEASURED FROM AUGUST 22-24, 1994

CONTOUR INTERVAL = 1FT.

0 200 400
SCALE IN FEET

N

EARTH TECH

FIGURE 3-14

POTENTIOMETRIC SURFACE AND GROUNDWATER FLOW (SHALLOW WELLS) IN THE VICINITY OF AFP 59 AUGUST 22-24, 1994

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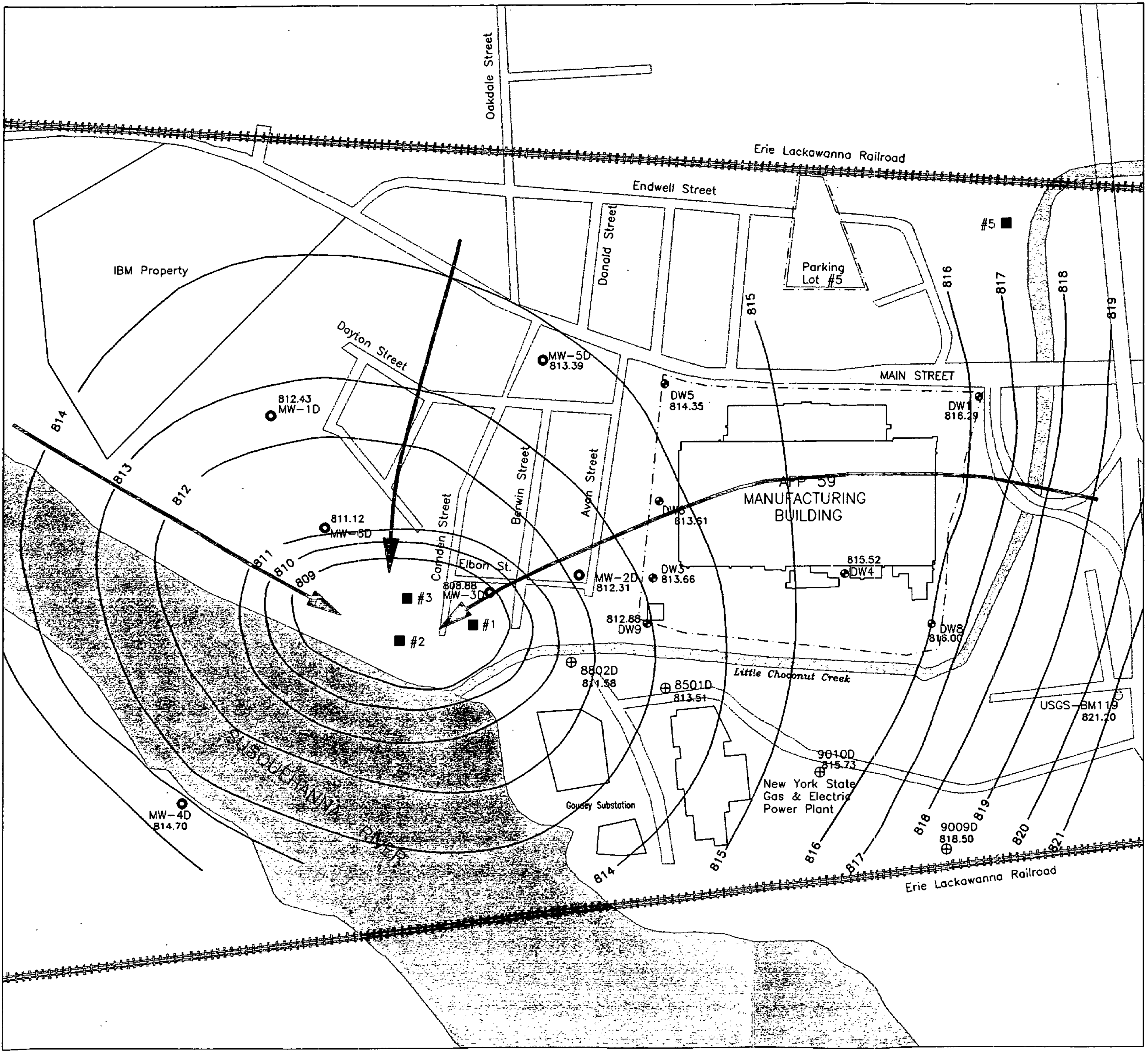

LEGEND

◉DW4	AFP 59 MONITORING WELL
●MW-3D	NYSDEC MONITORING WELL
⊕8507D	NYSEG MONITORING WELL
○BM 119	USGS MONITORING WELL
■#2	JOHNSON CITY WATER SUPPLY WELL
819.23	GROUNDWATER ELEVATION (FEET MSL)
—	GROUNDWATER ELEVATION CONTOUR (FEET MSL)
⇐	GROUNDWATER FLOW DIRECTION
-·-·-	AFP 59 BOUNDARY

NOTE: GROUNDWATER ELEVATIONS WERE MEASURED FROM AUGUST 22-24, 1994

CONTOUR INTERVAL = 1FT.

0 200 400
SCALE IN FEET

EARTH TECH

FIGURE 3-15

POTENTIOMETRIC SURFACE AND GROUNDWATER FLOW (DEEP WELLS) IN THE VICINITY OF AFP 59
AUGUST 22-24, 1994

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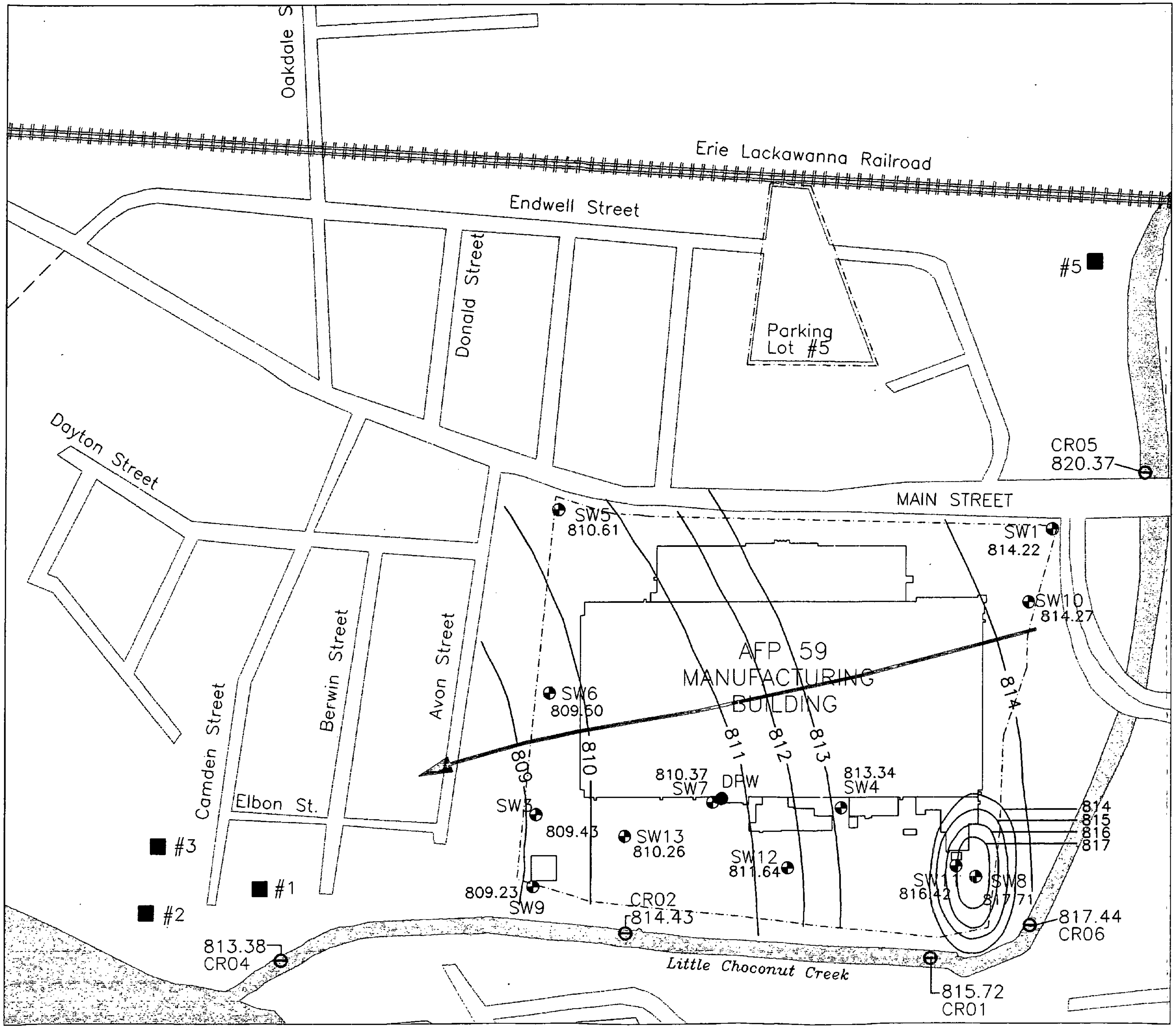

LEGEND

◉SW4	AFP 59 MONITORING WELL
●DPW	AFP 59 INDUSTRIAL PRODUCTION WELL
⊖815.72	CREEK BED ELEVATION (FEET MSL)
■#2	JOHNSON CITY WATER SUPPLY WELL
819.23	GROUNDWATER ELEVATION (FEET MSL)
———	GROUNDWATER ELEVATION CONTOUR (FEET MSL)
←	GROUNDWATER FLOW DIRECTION
-·-·-	AFP 59 BOUNDARY

NOTE: GROUNDWATER ELEVATIONS WERE MEASURED ON DECEMBER 6, 1994 PRIOR TO THE PUMPING TEST.

CONTOUR INTERVAL = 1FT.

0 125 250
SCALE IN FEET

N

EARTH TECH

FIGURE 3-16

POTENTIOMETRIC SURFACE AND GROUNDWATER FLOW AT AFP 59 (SHALLOW WELLS) PRIOR TO PUMPING TEST

afp59ri1.dwg\3-16.plt

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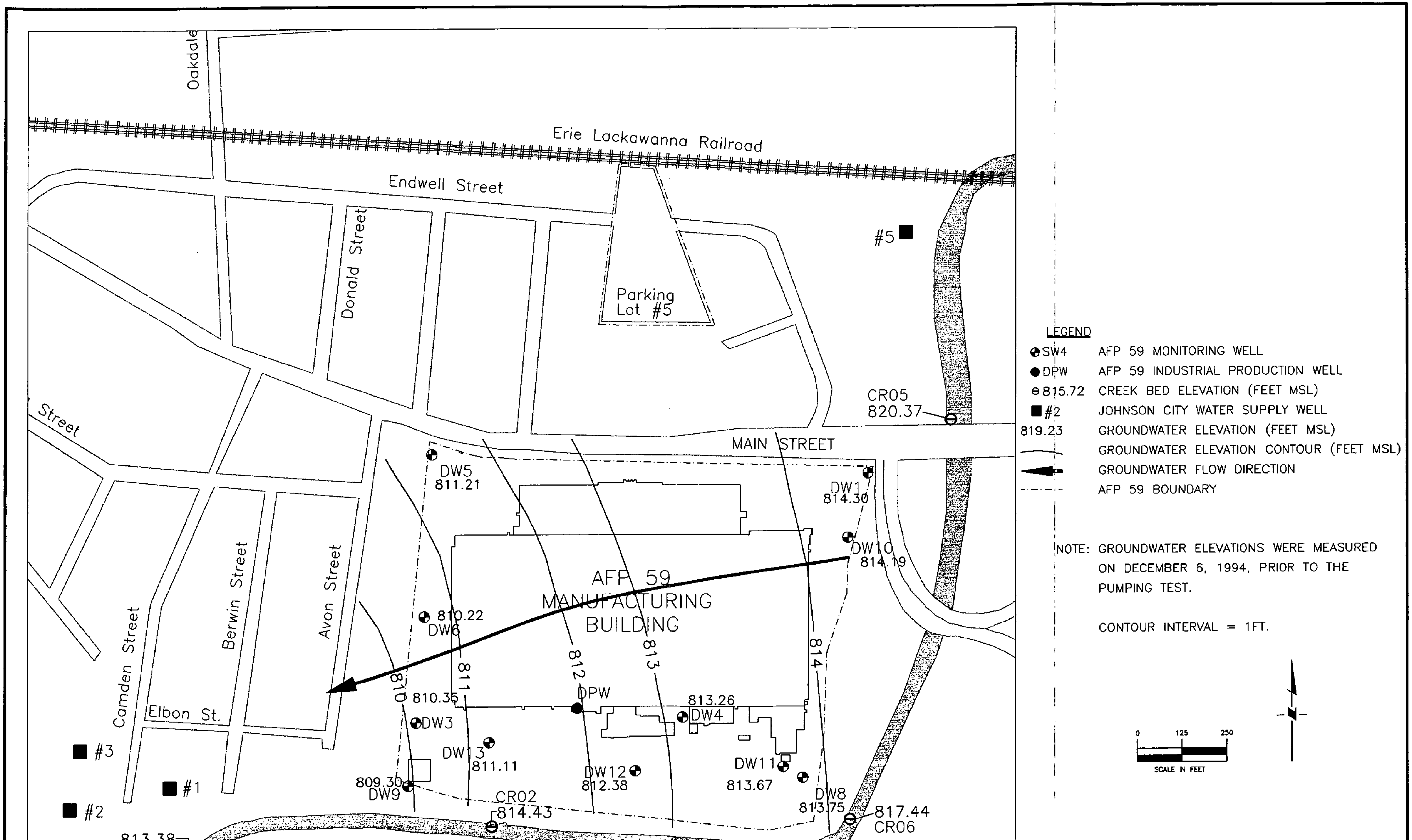

NOTE: GROUNDWATER ELEVATIONS WERE MEASURED ON DECEMBER 6, 1994, PRIOR TO THE PUMPING TEST.

CONTOUR INTERVAL = 1FT.

EARTH TECH

FIGURE 3-17

POTENTIOMETRIC SURFACE AND GROUNDWATER FLOW AT AFP 59 (DEEP WELLS) PRIOR TO PUMPING TEST

afp59ri1.dwg\3-17.plt

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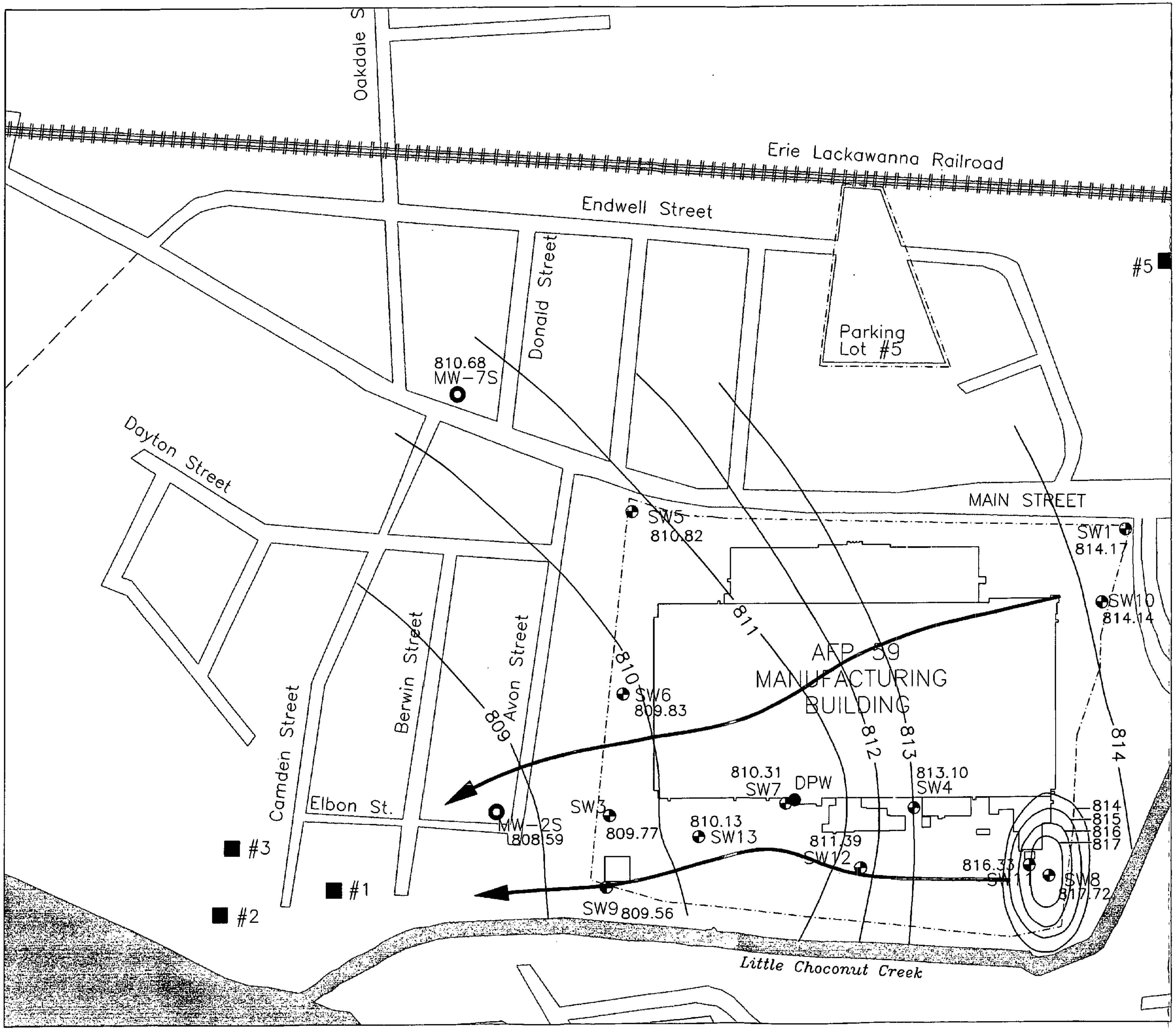
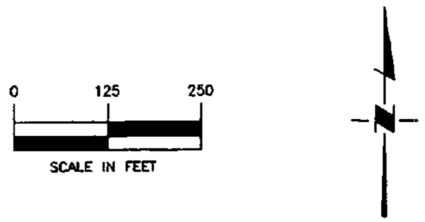


LEGEND

● SW4	AFP 59 MONITORING WELL
● DPW	AFP 59 INDUSTRIAL PRODUCTION WELL
○ MW-3S	NYSDEC MONITORING WELL
■ #2	JOHNSON CITY WATER SUPPLY WELL
819.23	GROUNDWATER ELEVATION (FEET MSL)
⁀	GROUNDWATER ELEVATION CONTOUR (FEET MSL)
←	GROUNDWATER FLOW DIRECTION
-·-·-	AFP 59 BOUNDARY

NOTE: GROUNDWATER ELEVATIONS WERE MEASURED ON DECEMBER 7, 1994 IMMEDIATLY PRIOR TO THE END OF THE PUMPING TEST.

CONTOUR INTERVAL = 1FT.



EARTH TECH

FIGURE 3-18

POTENTIOMETRIC SURFACE AND GROUNDWATER FLOW (SHALLOW WELLS) IN THE VICINITY OF AFP 59 AT THE END OF THE PUMPING TEST

afp59ri1.dwg\3-18.plt

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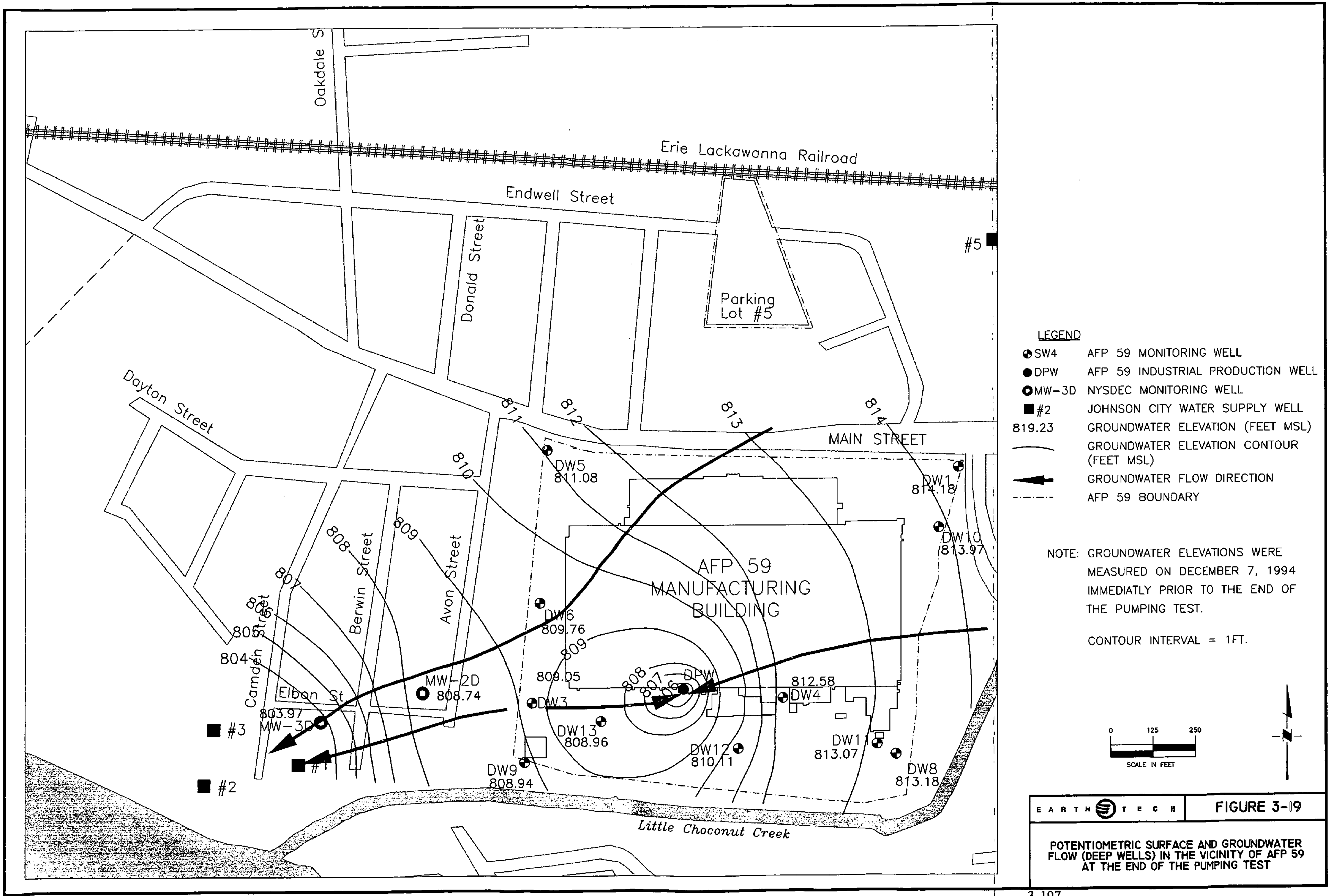

LEGEND

◐SW4	AFP 59 MONITORING WELL
●DPW	AFP 59 INDUSTRIAL PRODUCTION WELL
○MW-3D	NYSDEC MONITORING WELL
■#2	JOHNSON CITY WATER SUPPLY WELL
819.23	GROUNDWATER ELEVATION (FEET MSL)
⌒	GROUNDWATER ELEVATION CONTOUR (FEET MSL)
←	GROUNDWATER FLOW DIRECTION
-·-·-	AFP 59 BOUNDARY

NOTE: GROUNDWATER ELEVATIONS WERE MEASURED ON DECEMBER 7, 1994 IMMEDIATLY PRIOR TO THE END OF THE PUMPING TEST.

CONTOUR INTERVAL = 1FT.

EARTH TECH

FIGURE 3-19

POTENTIOMETRIC SURFACE AND GROUNDWATER FLOW (DEEP WELLS) IN THE VICINITY OF AFP 59 AT THE END OF THE PUMPING TEST

afp59ri1.dwg\3-19.plt

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LEGEND

- ▨ COMMERCIAL
- ▨ CONSERVATION
- ▨ INDUSTRIAL
- ☐ RESIDENTIAL
- – – – PROPERTY BOUNDARY
- +++++++ RAILROAD
- MAJOR BUILDINGS*

* SMALL COMMERCIAL BUILDINGS AND RESIDENTIAL STRUCTURES NOT SHOWN

SOURCES: JOHNSON CITY PLANNING DEPARTMENT
TOWN OF UNION PLANNING DEPARTMENT
VESTAL TOWN CLERKS OFFICE

0 300 600
SCALE IN FEET

EARTH TECH

FIGURE 3-26

ZONING CLASSIFICATION FOR PROPERTIES WITHIN 0.5 MILES OF AFP 59

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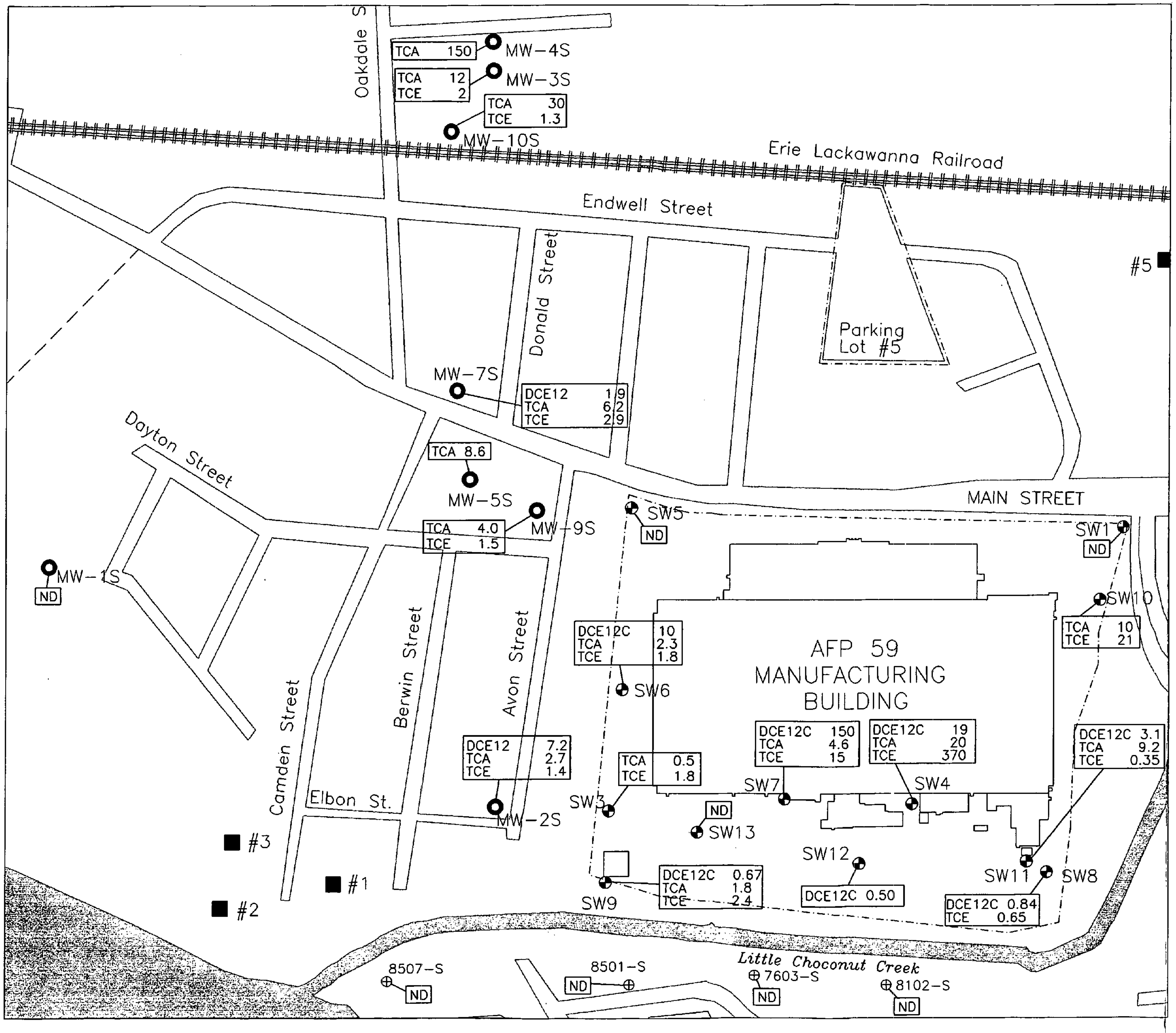

LEGEND

SW4	AFP 59 MONITORING WELL
MW-3S	NYSDEC MONITORING WELL
⊕ 8501-D	NYSEG MONITORING WELL
■ #2	JOHNSON CITY WATER SUPPLY WELL
-·-·-·-	AFP 59 BOUNDARY
DCE12C	CIS-1,2-DICHLOROETHENE
DCE12	TOTAL CIS- AND TRANS-1,2-DICHLOROETHENE
TCA	1,1,1-TRICHLOROETHANE
TCE	TRICHLOROETHENE
ND	NOT DETECTED

NOTES: ON-SITE SAMPLING WAS CONDUCTED BY EARTH TECH IN DECEMBER 1994. OFF-SITE SAMPLING WAS CONDUCTED BY THE USGS IN AUGUST 1994. CONCENTRATIONS ARE REPORTED IN ug/L

EARTH TECH

FIGURE 4-1

CONCENTRATIONS OF SELECT CHLORINATED HYDROCARBONS IN THE SHALLOW ZONE OF THE AQUIFER IN THE VICINITY OF AFP 59

afp59rl1.dwg\4-1.plt

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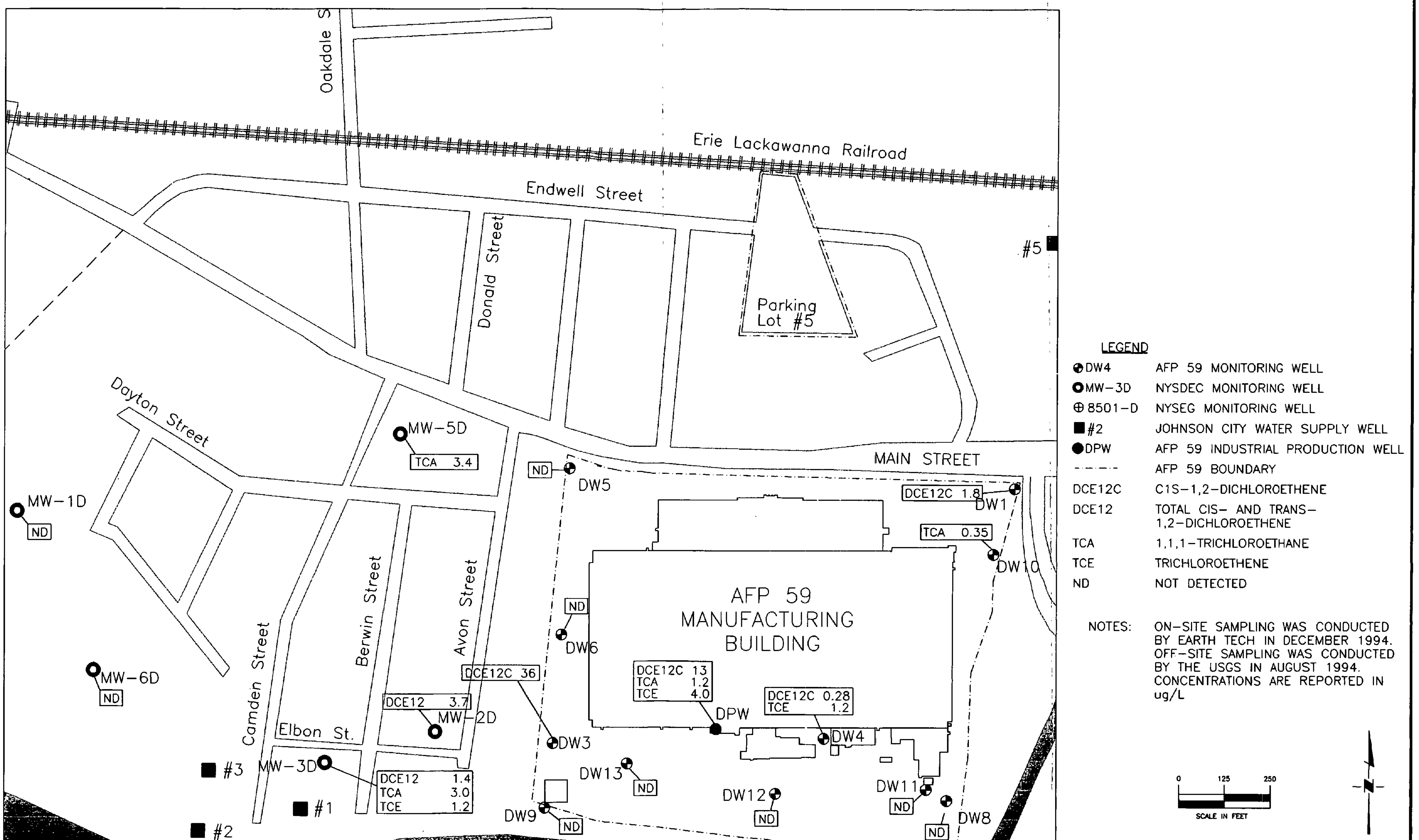

NOTES: ON-SITE SAMPLING WAS CONDUCTED BY EARTH TECH IN DECEMBER 1994. OFF-SITE SAMPLING WAS CONDUCTED BY THE USGS IN AUGUST 1994. CONCENTRATIONS ARE REPORTED IN ug/L

EARTH TECH

FIGURE 4-2

CONCENTRATIONS OF SELECT CHLORINATED HYDROCARBONS IN THE DEEP ZONE OF THE AQUIFER IN THE VICINITY OF AFP 59

afp59ri1.dwg\4-2.plt

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