RCRA FACILITY INVESTIGATION REPORT
DUPONT WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA

JUNE 30, 1999 Project No. 0D6W7205

Prepared by

CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and The W-C Diamond Group

Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027

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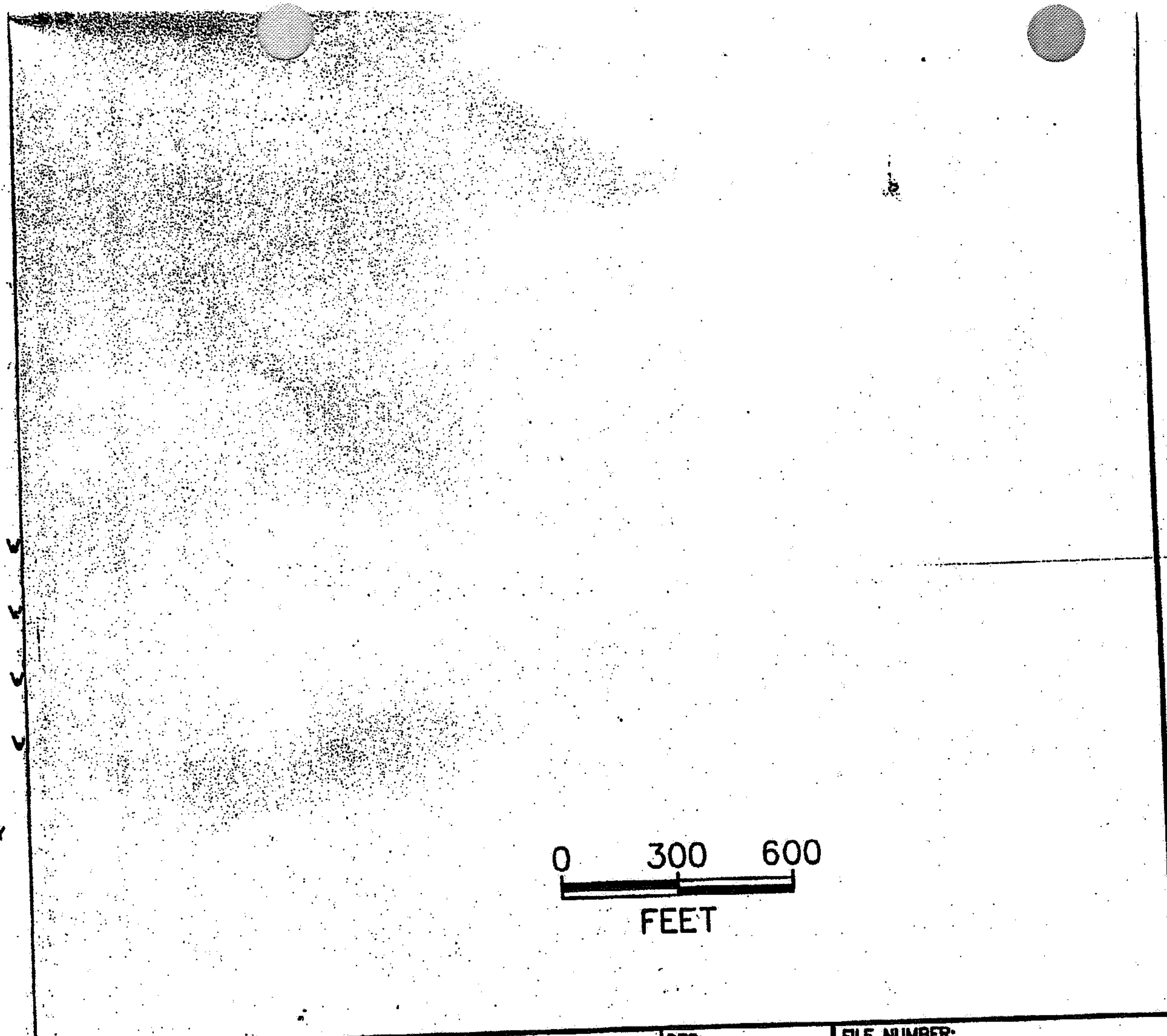

APPROXIMATE AERIAL EXTENT OF SOLID W
MANAGEMENT UNIT C-6

APPROXIMATE AERIAL EXTENT OF SOLID W
MANAGEMENT UNIT H-14

APPROXIMATE AERIAL EXTENT OF SOLID W
MANAGEMENT UNIT A-3

APPROXIMATE AERIAL EXTENT OF SOLID W
MANAGEMENT UNIT B-4

PERMITTED HAZARDOUS WASTE FACILITY

TITLE: RFI SOIL SAMPLING DuPONT WASHINGT WASHINGTON, WEST	DWN: DHE	DES.:	FILE NUMBER: 7205D002
	CHKD:	APPD:	FIGURE NO.: 3.1
	DATE: 05/24/99	REV.: 0	

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TUAL MODEL LOCATION MAP	FIGURE 8

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N WORKS
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Remediation Services

DUPONT

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DuPont
Washington Works
P. O. Box 1217
Parkersburg, WV 26102-1217

DUPONT

CERTIFIED MAIL –
RETURN RECEIPT REQUESTED

June 24, 1999

Mr. Martin Kotsch
Project Manager
U.S. EPA, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

RE: Permit WVD045875291

Dear Mr. Kotsch:

Please find enclosed the RCRA Facility Investigation (RFI) Report of Findings for your review and comment.

If you have any questions or comments, please contact me at (304) 863-4271.

Very truly yours,

R L Ritchey

R. L. Ritchey
Sr. Environmental Control Consultant
Washington Works

Attachment

CC: Mr. Mark Priddy
Office of Waste Management
WV-DEP
1356 Hansford Street
Charleston, WV 25301

Ms. Barbara Taylor, Chief*
Office of Water Resources
WV-DEP
1201 Greenbrier Street
Charleston, WV 25311

Mr. B. F. Smith, Chief*
Office of Waste Management
Charleston, WV 25301
1356 Hansford Street

* cover letter only

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EID090346

RCRA FACILITY INVESTIGATION REPORT
DUPONT WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA
USEPA PERMIT NUMBER WVD04-587-5291

June 30, 1999

Project No. 0D6W7205

DUPONT

CORPORATE REMEDIATION GROUP
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Wendel Latz
Chem Waste Landfill
Operator

ASH000254

EID090350

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RCRA FACILITY INVESTIGATION REPORT
ACRONYM LIST

ADP=	Anaerobic Digestion Ponds
ADQM=	Analytical Data Quality Management
AEL=	Allowable Exposure Level
ASTM=	American Society for Testing and Materials
BG=	Burning Ground
BGS=	Below Ground Surface
CED=	Corporate Environmental Database
CEG=	Community Exposure Guideline
CLP=	Contract Laboratory Program
COC=	Chain of Custody
CRG=	Corporate Remediation Group
CSR=	Code of State Regulations
CT=	Carbon Tetrachloride
DOT=	Department of Transportation
DQO=	Data Quality Objectives
DTW=	Depth to Water
ECD=	Electronic Capture Detector
ESI=	Environmental Standards, Inc.
FC-143=	Ammonium Perfluorooctanoate
FID=	Flame Ionization Detector
ft/sec=	Feet Per Second
GC=	Gas Chromatograph
GE=	General Electric Plastics
gpd/ft^2=	Gallons Per Day Per Square Foot
gpm=	Gallons Per Minute
HQ=	Hazard Quotient
HSWA=	Hazardous and Solid Waste Amendments
LLI=	Lancaster Laboratories, Inc.
MCL=	Maximum Contaminant Levels
MeCl=	Methylene Chloride Seep
mg/kg=	Milligrams Per Kilogram
MS=	Matrix Spike
MSD=	Matrix Spike Duplicate
MSL=	Mean Sea Level
ND=	Non-Detect
PCE=	Tetrachloroethene
PEF=	Particulate Emission Factor
PID=	Photo Ionization Detector
PPE=	Personal Protective Equipment
PSD=	Public Service District
PVC=	Polyvinyl Chloride
PWI=	Polyacetal Waste Incinerator
QA=	Quality Assurance
QAPP=	Quality Assurance Project Plan
QC=	Quality Control
RBC=	Risk-Based Concentrations
RBL=	River-Bank Landfill
RBLL1=	Methylene Chloride Seep
RCRA=	Resource Conservation and Recovery Act
RFI=	RCRA Facility Investigation
RTE=	Rare, Threatened or Endangered
SCM=	Site Conceptual Model
SL=	Screening Levels
SOP=	Standard Operating Procedure
SWMU=	Solid Waste Management Unit
TCE=	Trichloroethene
TCLP=	Toxicity Characteristic Leaching Procedure
µg/kg=	Micrograms Per Kilogram
µg/L=	Micrograms Per Liter
USEPA=	U.S. Environmental Protection Agency
USGS=	United States Geological Survey
VI=	Verification Investigation
VOC=	Volatile Organic Compound

Executive Summary

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted in the fall of 1998 on four Solid Waste Management Units (SWMUs) at the DuPont Washington Works to satisfy requirements of its RCRA Hazardous and Solid Waste Amendments (HSWA) Permit Number WVD 04-587-2591. The primary objectives of this investigation were to determine the nature and extent of waste constituent releases from these units into underlying soil, determine the rate of migration in groundwater and other media, and evaluate any potential impacts to human health or the environment from these releases.

The four SWMUs investigated were SWMU A-3 Riverbank Landfill (RBL), SWMU B-4 Anaerobic Digestion Ponds (ADP), SWMU C-6 Polyacetal Waste Incinerator, and SWMU H-14 Burning Ground (BG). The RFI was designed to fill data gaps remaining after completion of the 1992 Verification Investigation (VI), which determined that each of these units had potentially released waste constituents into underlying soil and groundwater.

The RFI scope of work included a major field effort entailing soil boring and monitoring well installation, soil and groundwater quality sampling, and field reconnaissance to identify potential human and ecological receptors. The RFI effort also included construction of a site-wide groundwater flow model to evaluate the impact of production well pumping on waste constituent migration from SWMU areas. The modeling was conducted to confirm that ongoing production well pumping prevented off-site migration of SWMU-impacted groundwater.

Soil and groundwater analytical results were compared to USEPA Region III Risk-Based Concentrations (RBCs) for industrial soil, or to Maximum Contaminant Levels (MCLs) or RBCs for drinking water. These results were evaluated in conjunction with the receptor identification results to determine if any significant exposure issues exist.

The key conclusions of the RFI are summarized as follows:

- The Riverbank Landfill (RBL) and Anaerobic Digestion Pond (ADP) SWMUs have released organic constituents to underlying soils. These impacts tend to occur below land surface, are limited in areal extent, and do not exceed USEPA Region III industrial soil RBCs.
- Several RBL/ADP-derived organic constituents were detected in site aquifer groundwater quality samples. However, in most instances, these constituents are at concentrations below the MCL or RBC for tapwater. This groundwater migrates to and is contained by on-site production wells.
- Two organic constituents, trichloroethene (TCE) and ammonium perfluoro-octanoate (i.e., FC-143), are present in production well groundwater, the former at concentrations exceeding its MCL, the latter at concentrations exceeding its calculated health-based screening level. This impacted groundwater does not present a human exposure risk as it is primarily used for non-contact industrial purposes.
- Ongoing production well pumping, as confirmed by the groundwater flow model, prevents off-site migration of SWMU-derived waste constituents. Although not planned,

this pumping could be reduced by as much as 65% while still maintaining site groundwater capture.

- No significant exposure pathways to SWMU-impacted soils or groundwater exist, because all soils are covered and rendered inaccessible by buildings, asphalt, or dense vegetation; and the site aquifer groundwater is either below health-based screening levels or is primarily utilized for non-contact industrial purposes.

- The active containment/treatment system for the methylene chloride seep (RBLL1), as constructed, effectively contains seepage and prevents off-site migration. The system is an effective final remedy.

Based on these conclusions, DuPont Washington Works believes that it meets applicable criteria under USEPA's Environmental Indicator program, specifically, CA-725 Human Exposures Under Control, and CA-750 Contaminated Groundwater Migration Under Control.

DuPont recommends the following current and future activities at Washington Works pursuant to its HSWA Permit/Corrective Action Program:

- Continue operation of the methylene chloride seep (RBLL1) collection/treatment system.

- Maintain production well pumping at or above 35% of present levels.

- Conduct long-term site aquifer potentiometric surface monitoring to continue to verify site groundwater capture.

- Conduct long-term groundwater quality monitoring to continue to ensure protection of human health and the environment.

In response to the United States Environmental Protection Agency (USEPA) letter of May 5, 1997, and in accordance with the Corrective Action portion of the Resource Conservation and Recovery Act (RCRA) Permit Number WVD 04-587-5291, DuPont Washington Works herein presents its RCRA Facility Investigation (RFI) findings for the following four Solid Waste Management Units (SWMUs):

- SWMU A-3—Riverbank Landfill (RBL)
- SWMU B-4—Anaerobic Digestion Ponds (ADP)
- SWMU C-6—Polyacetal Waste Incinerator (PWI)
- SWMU H-14—Burning Ground (BG)

1.1 SWMU DESCRIPTIONS

A brief description of each of the SWMUs is presented below. SWMU locations are shown on Figure 1.1.

- SWMU A-3, Riverbank Landfill (RBL): The RBL is about 4,500 feet long and lies along the northern edge of the site near the Ohio River. It was operated between 1948 and the late 1960s and received powerhouse ash, incineration ash, plastics, rubble, and plant trash. After closure, it was covered with 6 to 35 inches of soil. Currently, the RBL is covered with dense vegetation (on its slope) or by buildings and pavement in the manufacturing area.

- SWMU B-4, Anaerobic Digestion Ponds (ADPs): Three former ADPs are co-located with a portion of the RBL. One pond dates from the 1950s and two others from the 1970s. The ponds received waste from the fluorocarbon manufacturing process until 1988, when the pond contents and upper few feet of clay liner and pond berm material were removed and disposed of off site. The pond area was backfilled and capped with topsoil, and the area is currently vegetated with grass.

- SWMU C-6, Polyacetal Waste Incinerator (PWI): The former PWI consisted of two brick-lined pits in the western portion of the manufacturing area. The PWI operated between 1959 and 1990. The PWI has been excavated and backfilled with clean soil.

- SWMU H-14, Burning Ground (BG): The BG is located in the central portion of the manufacturing area and was operated between 1948 and 1965. Since 1990, the site has been leveled with clean fill and gravel and overlain by buildings and asphalt.

A previous Verification Investigation (VI) found evidence of releases of organic constituents and possibly metals to soil and groundwater at the RBL, ADP, and BG (DuPont 1992). Little evidence of contamination was found in soil at the site of the former PWI. Further investigations and evaluations were performed for this RFI, and are reported herein.

1.2 RFI PURPOSE AND INVESTIGATION TASKS

This RFI Report was prepared in accordance with the RCRA Facility Investigation Plan that was submitted to USEPA in 1997 (DuPont 1997). The purpose of the RFI Report is to:

- Summarize the nature and extent of releases of SWMU-related constituents and, if applicable, rate of migration.
- Provide a detailed geologic and hydrogeologic characterization of the area surrounding and underlying the SWMUs.
- Identify if potential releases are a concern for human health or the environment.
- Determine if further actions are warranted for the SWMUs.

The RFI tasks that were performed to meet these objectives include:

- Background soil sampling.
- SWMU-specific soil and groundwater sampling.
- Site-wide monitoring well installation and groundwater sampling, and closure of old monitoring wells determined by site-wide survey.
- Data evaluation and identification of sources of release and nature and extent of contamination.
- Hydrogeologic characterization and groundwater flow model development and calibration.
- Identification of potential receptors and a screening-level risk evaluation to assess whether releases from SWMUs pose a threat to human health or the environment.

1.3 GUIDANCE DOCUMENTS

The following documents were used in the preparation of this RFI.

RCRA Groundwater Monitoring: Draft Technical Guidance (USEPA Office of Solid Waste, November 1992); *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (USEPA, SW-846 Third Edition November 1986) *RCRA Facility Investigation Guidance* (USEPA 530/SW-89-031, May 1989); *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening* (USEPA Region III, 1993), and other guidance documents as cited in the report.

The 1,200-acre DuPont Washington Works site (also referred to as the plant or the Site) is located on the Ohio River in Washington, West Virginia, approximately seven miles southwest of Parkersburg, West Virginia (see Figure 2.1). Previously, the land was used for agriculture. The initial manufacturing units constructed at Washington Works were completed in 1948. The plant currently has 14 operating and service divisions that span nearly a mile along the Ohio River.

Products manufactured at the site include:

- Compounded engineering plastics
- Nylon molding pellets and filaments
- Acrylic molding compounds
- Polyvinyl butyral
- Acrylic resins
- Fluoropolymers
- Polyacetal products

Washington Works is located in an area of industrial and other land uses. Immediately adjacent to the western boundary of the plant site is the General Electric Plastics plant (GE) and two industrial warehouses (see Figure 2.2). The north side of the plant is bounded by the Ohio River, which flows west and is located hydraulically upgradient from the plant. A heavily wooded and hilly 250-acre closed solid waste landfill (i.e., Local Landfill), owned by Washington Works, is located contiguous to and immediately south of the site. The east side of the site is bound by a small stream and steep, wooded hills. Residential areas are located within one mile on the south, east, and west sides.

Other large manufacturing industries in the surrounding area include Amoco, Shell Chemicals, and Huntsman Chemicals, all being on the Ohio side of the Ohio River.

Washington Works also encompasses Blennerhassett Island, located in the Ohio River, upstream of the plant (Figure 2.1). One of several Washington Works groundwater well fields is located on the island.

2.1 TOPOGRAPHIC SETTING

The Washington Works plant rests on Quaternary alluvial terrace deposits in western West Virginia's Ohio River Valley. The alluvial terrace is topographically flat and lies approximately 50 feet above the Ohio River, which flows east to west past the site (see Figure 2.1). The alluvial terrace is underlain by a flat, river-scoured bedrock surface of the Dunkard Series that rises steeply and outcrops off the southern edge of the site to form the valley wall. The valley wall rises from an elevation of 630 feet above mean sea level (MSL) near the southern edge of the site to 860 feet above MSL at the Local Landfill (see Figure 2.2). This higher knob country south of the site is characterized by branching V-shaped valleys typical of a dissected plateau geomorphology.

2.2 REGIONAL GEOLOGIC SETTING

The Washington Works plant lies on the western edge of the Appalachian Geosynclinal basin. Valley fill Quaternary alluvium and Permian-age Dunkard Series bedrock highlands dominate the regional geologic setting. The Quaternary alluvium ranges from one to 100 feet in depth and consists of unconsolidated river deposits of poorly to well-sorted, brown and gray sand, silts, clay and gravel. The Dunkard Series bedrock consists primarily of red and varicolored sandy shale; gray, green and brown sandstone; and minor beds of coal, claystone, black carbonaceous shale, and limestone (see Figure 2.3).

2.3 REGIONAL HYDROGEOLOGY

The Quaternary alluvial terrace unconfined aquifer (i.e., alluvial aquifer) is the principal regional aquifer and is used locally for industrial, municipal, and rural water supplies. Wells in the region generally yield several hundred gallons per minute (gpm). Radial collector wells in the Ohio River yielding as much as 3,500 gpm have been reported (Schultz 1984). Natural recharge to the alluvial aquifer comes from various sources, including:

- Infiltration of precipitation falling directly on the alluvium
- Lateral movement of the river water through the alluvium via permeable sands and gravel zones
- Seepage from streams tributary to the Ohio River

The maximum amount of water available to the alluvium depends on the degree of hydraulic connection to the river. The degree of hydraulic connection is a function of the condition of the river bottom, permeability and thickness of the alluvium, and distance and hydraulic gradient between the wells and river. Pumping of on-site active well fields near and parallel to the river (i.e., the Ranney Well, the DuPont-Lubeck Well Field and the East Well Field shown in Figure 2.4) lowers the groundwater level to below river stage. This induces water from the river to flow into the alluvium toward the wells, which replaces water pumped from storage in the aquifer, and helps sustain high-yield pumping wells.

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2.4 REGIONAL GROUNDWATER AND SURFACE WATER USE

Regional groundwater supplies are obtained from the Dunkard Group bedrock and Ohio River alluvial terrace deposits. The saturated portion of the Ohio River alluvial terrace deposits comprises the principal regional aquifer used for water supply purposes. Production wells completed in this aquifer have been known to yield up to 500 gpm (Schultz, 1984). Based on these high yields, numerous industrial and commercial water supply companies obtain water from the alluvial aquifer. The yield from alluvial aquifer wells is related to the well's position with respect to the river, as well as formation grain size and thickness.

The groundwater quality in the alluvium in this region tends to be naturally poor, having the highest median chloride, sulfate, hardness (as calcium carbonate), iron, and manganese concentrations of all hydrogeologic units in the region (Schultz 1984). Water from the alluvium generally is a calcium bicarbonate type, with near neutral pH and high dissolved solids content.

The underlying Dunkard Group bedrock generally only yields enough water for domestic and farm use. Median yields for valley, hillside, and hilltop wells were 6.5, 2.0, and 3.0 gpm, respectively (Schultz 1984). Except for a few localized areas where fractures are plentiful, there is little potential for higher well yields. Waters in the Dunkard Group generally are a sodium bicarbonate type (Schultz 1984).

Regional surface water use is primarily satisfied by the Ohio River and Little Kanawha River near Parkersburg. These sources provide water to the cities of Parkersburg, West Virginia, and Belpre, Ohio. In less congested areas (i.e., near the DuPont site), the local communities receive water from small local water companies that obtain their water from production wells screened in the Quaternary river alluvium.

2.5 LOCAL GEOLOGY AND HYDROGEOLOGY

The uppermost geologic unit directly below the plant consists of Ohio River terrace deposits of Pleistocene age. The total thickness averages approximately 60 feet along the riverbank and approximately 100 feet to the south. Along the riverbank, this unit consists of silt, clay, and fine-grained sand to approximately 20 to 30 feet, followed by approximately 20 to 30 feet of coarse sand and gravel, which extends down to the top of the bedrock (part of the Permian-age Dunkard Group). To the south on the main plant area and above the riverbank, approximately 10 to 20 feet of silt, clay, and fine-grained sand overlie approximately 80 to 100 feet of sand and gravel to approximately 90 to 120 feet deep (the top of bedrock). These deposits are laterally continuous throughout the site.

Site geology is shown on six geologic cross sections developed during the April 1992 VI (DuPont, 1992) and revised based on additional findings from this investigation. The locations of the geologic cross sections are shown in Figure 2.5. Two east-west geologic cross sections, A-A' and F-F', are shown on Figures 2.5A and 2.5F. Four north-south cross sections, B-B', C-C', D-D', and E-E' are shown on Figures 2.5B, 2.5C, 2.5D and 2.5E, respectively. The cross sections were developed from detailed geologic logs obtained during the VI and RFI, and from less detailed historic geologic logs from test and production wells and geotechnical borings drilled in the late 1950s through the early 1980s.

The bedrock unit that underlies the Ohio River terrace deposits consists of interbedded sandstones, siltstones, claystones, shales, occasional limestones, and coal zones. This formation belongs to the Permian-age Dunkard Group. Soil borings drilled in the early 1970s at the northwest corner of the site indicate that the top of the bedrock zone, which immediately underlies the upper alluvial sand and gravel of the Ohio River terrace deposits, is shale at approximately 530 feet above MSL. To the south of the plant toward the edge of the Ohio River depositional valley, the Ohio River terrace deposits thin out. Bedrock of the Dunkard Group is present at the ground surface south of the site at the Local Landfill.

Due to riverbank undercutting, some slumping of clay and silt exists along the northern boundary of the property along the river's edge. An interpretation of the typical Ohio Riverbank stratigraphy is presented in Figure 2.6 (Carlston and Graeff 1955) and correlates well with the geologic data obtained from the borings completed along the riverbank. Seeps located along the riverbank appear to be precipitation that has infiltrated topsoil or fill and that flows along the top of the underlying shallow clay and discharges along the riverbank. Figure 2.5C shows an example of the relationship of fill and clay layers along the riverbank.

The Ohio River alluvial terrace deposits comprise the principal aquifer underlying the site, hereafter referred to as the "site aquifer." The water table occurs at a depth of about 60 to 70 feet bgs in the main plant area. The saturated zone is approximately 30 to 40 feet thick, extending to the surface of the underlying Dunkard Group. The on-site production water wells completed in the site aquifer yield 200 to 450 gpm. As discussed in Section 2.4, the underlying Dunkard Group is not a major aquifer. In fact, the upper zone of the Dunkard Group, primarily a shale and silt matrix, bounds the lower portion of the site aquifer and serves as a confining unit to underlying geologic units.

2.5.1 Groundwater Flow Directions

Groundwater flows to the south-southwest in the Washington Works site aquifer. However, groundwater elevations, flow directions, and flow rates on-site are strongly influenced by the Ohio River and by pumping of on-site production wells. The Ohio River is the primary source of recharge to the site aquifer. The on-site production wells are the Ranney Well, a radial collector well which pumps 800 to 1,000 gpm; the seven wells in the East Well Field, which pump a combined average rate of 2,000 gpm; and the five DuPont-Lubeck wells, which pump about 700 gpm combined.

Groundwater elevation contour maps developed from data collected in November 1998 and February 1999 are presented as Figure 2.7 and Figure 2.8, respectively. The direction of groundwater flow in the site aquifer is indicated by the flow arrows. As shown on the groundwater elevation contour maps, groundwater flow in the northeast part of the site is toward the East Well Field wells from the south and from the north. In the north-central portion of the site, groundwater flow is toward the Ranney Well. In the central and western portion of the site, groundwater flow is south-southwest towards the DuPont-Lubeck Well Field. Pumping of the production wells (Ranney Well, East Well Field, and the DuPont-Lubeck Well Field) eliminates off-site migration of groundwater which may emanate from the SWMU areas.

2.5.2 Transmissivity, Hydraulic Conductivity, and Groundwater Flow Velocity

In a 1990 hydrogeologic assessment, production well specific capacity testing of the DuPont-Lubeck Well Field ~~and~~ the East Well Field was conducted. The results were used to calculate the transmissivity of the site aquifer (DuPont 1990).

The results indicated that the transmissivity values for the site aquifer in the vicinity of the DuPont-Lubeck Well Field appear to be higher than the values calculated in the vicinity of the East Well Field. In the vicinity of the DuPont-Lubeck Well Field, transmissivity values ranged between 114,900 and 127,500 gallons per day per square foot (gpd/ft^2). In the vicinity of the East Well Field, the values ranged between 16,050 and 50,000 gpd/ft^2. The differences in the shape, depth, and extent of the cones of depression between these two areas support the transmissivity values calculated.

In the same 1990 hydrogeologic assessment, hydraulic conductivity values were calculated from the transmissivity values for the East Well Field. For Wells 335 and 337, the hydraulic conductivity values ranged from 0.00042 to 0.0018 feet/second (ft/sec) and from 0.00033 to 0.0016 ft/sec, respectively.

Using the hydraulic conductivity values from the 1990 study and the hydraulic gradient values determined from groundwater elevations measured in 1990 and assuming an effective porosity value for sand and gravel of 35 %, the groundwater flow velocity for several well pairs was calculated. The groundwater flow velocity was estimated at 5 feet/day (ft/d) between monitoring wells TW-24 and TW-27 in the southwest portion of the site. A groundwater flow velocity of 3 ft/d was estimated between monitoring wells TW-33 and TW-M4 in the western central portion of the site. In the eastern portion of the site, a groundwater flow velocity of 1.5 ft/day was estimated for the site aquifer between monitoring wells TW-M1 and TW-26.

2.6 SURFACE WATER

Surface water at the Washington Works facility is considered to be the Ohio River, drains and storm sewers, seeps at the riverbank, and drainage swales. The average river water elevation is about 580 feet above MSL and the elevation of the Ohio River terrace deposits under the main plant is about 630 feet above MSL. The Ohio River is the main recharge source to the site aquifer.

A large portion of the plant site is covered with asphalt and concrete. Therefore, much of the precipitation falling on site is routed toward drains and storm sewers, which ultimately discharge into the Ohio River. Precipitation falling on the riverbank slope either percolates into the soil or runs off to the river. In addition, the seeps that occur in places along the riverbank are probably caused by percolated water that accumulates above the slumped, low-permeability clay and silt of the Ohio River deposits that underlie topsoil and fill along the riverbank.

Precipitation falling on the unpaved southern portion of the site most likely migrates downward toward the unconfined water table, but may be limited by the shallow layers of clay and silt of the Ohio River terrace deposits.

Two drainage swales, one located in the facility's southwest corner, and the other located on the extreme eastern end of the facility, also convey surface runoff during rainy weather to the Ohio River. During dry weather, the drainage swales are dry.

2.7 KNOWN RELEASES FROM SITE SWMUs

Previous investigations presented in the VI Report (DuPont 1992) and summarized in the RFI Plan (DuPont 1997) found evidence of releases of organic constituents and possibly metals to soil and groundwater at the RBL, ADP, and BG. Little evidence of release was found in soil at the site of the former PWI.

At the RBL/ADP area (in the western portion of the RBL), several organic constituents and metals were detected in groundwater or seep samples that exceeded health-based screening criteria for drinking water. These constituents included methylene chloride, Freon-113, tetrachloroethene (PCE), trichloroethene (TCE), arsenic, cadmium, and lead. FC-143 and Triton-X were also detected in groundwater and seep samples in this area. Soil samples that were collected in the vicinity of the RBL/ADP during the VI did not have significant levels of site-related constituents, indicating that releases to groundwater and to surface seeps are the chief migration pathways from these SWMUs. The source of release may be the RBL, ADP, or both.

The main seep area (RBLL1) at the RBL/ADP, where methylene chloride is the primary constituent, has been controlled by a french drain and carbon adsorption treatment system since 1990 (see Figure 4.1). A key objective of the RFI was to determine if this containment system is effective at preventing off-site migration.

The BG ceased operation in 1965 and, since 1990, the site has been leveled with clean fill and gravel and overlain in part by buildings and asphalt. A potential release of organic constituents to groundwater was identified in the VI, in that carbon tetrachloride, PCE, and TCE were detected in concentrations above screening criteria for drinking water. FC-143 was also detected in groundwater. Arsenic, lead, and nickel were detected above MCLs in unfiltered samples but not in filtered samples, suggesting that the presence of these metals in groundwater is probably not due to leaching from soils at the BG. Soil samples did not have significant levels of site-related constituents, although barium and methylene chloride concentrations exceeded screening criteria for the soil-to-groundwater pathway (these constituents were not detected in groundwater above MCLs). An objective of the RFI was to determine if the BG was the source of the constituents identified in groundwater during the VI, or whether these constituents originated from the RBL.

The PWI was excavated (i.e., ash material was removed) and back filled with clean soil in early 1990. There is no evidence of significant releases to adjacent soil at the site of the former PWI because metals concentrations in soil samples did not exceed risk-based screening criteria or background levels (VI Report, DuPont 1992). Additional sampling for chromium is included in the RFI to confirm the conclusion, since chromium was omitted from the VI analytical list. Releases to groundwater are not a concern at this SWMU.

The RFI was designed to delineate the impact to soil and groundwater associated with potential releases from the four SWMUs, and to gain a better understanding of site geologic and hydrogeologic conditions so that constituent transport can be predicted. The RFI was also intended to identify potential exposure pathways and assess potential concerns for human health and the environment.

The field investigation was conducted in accordance with the RFI Plan (DuPont 1997) and included the following primary field activities:

- Site-wide monitoring well installation
- Site-wide groundwater sampling (2 rounds)
- Background soil sampling
- SWMU-specific soil sampling and groundwater sampling (2 rounds)

Site-wide monitoring well installation and soil sampling activities were conducted from August through October, 1998. Two comprehensive groundwater sampling events were conducted in November 1998 and February 1999 respectively, after all monitoring wells were installed and soil sampling was completed.

Soil and groundwater are the two environmental media that were sampled and analyzed during the RFI. The sections that follow provide detailed information on the sampling methods, locations, depths, and analytical parameters for each medium. Sampling locations and depths were selected to provide data representative of current site conditions. Analytical parameters were determined based on data collected at each unit during previous investigations. Table 3.1 describes the number and depth of borings at each investigation area. Table 3.2 summarizes the completed analytical parameters and test methods.

3.1 SOIL SAMPLING METHODS

Surface soil samples were collected from 0 to 2 feet below ground surface (BGS) using a stainless steel, hand-operated auger or split-spoon sampler. Borings were advanced using a truck-mounted drilling rig with hollow-stem augers. Continuous split-spoon samples were collected at 2-foot intervals per American Society for Testing and Materials (ASTM) methods, if a drill rig was used. In areas of the site which were inaccessible by a truck-mounted drilling rig or where sample locations were shallow, a stainless steel hand auger was used to collect the samples. Soil sampling locations are indicated on Figure 3.1.

During soil sampling activities, all intrusive work was monitored with a photoionization detector (PID) or a flame ionization detector (FID) as a means of screening spatial and vertical differences of volatile organic vapors at the various sampling locations. Monitoring was conducted to fulfill requirements of the Health and Safety Plan included in the RFI Work Plan and to assist in sample screening.

In general, samples were collected in the following order to reduce the loss of volatile components:

- Volatile organic compounds (VOCs)
- Extractable organics
- Metals
- Indicators (BOD, chloride, ethane, ethene, methane, nitrate, sulfate, sulfide, TOC)

Upon sample retrieval, the VOC sample containers were filled immediately by transferring soil from the sampling device with a stainless-steel scoop or trowel. The section representing soil from the 18-to-24-inch interval (BGS) was collected for VOC analysis because volatile organics in the deeper portion of the core are less likely to have volatilized to the atmosphere. The VOC sample containers were filled completely and packed to minimize sample headspace.

The remaining soil in the sample was screened for VOCs using a PID or FID. The soil was then transferred to the remaining sample containers using a stainless steel scoop or trowel. Collecting the sample for VOC analysis prior to performing headspace analysis minimizes the loss of VOCs from the sample prior to analysis. After the sample containers were filled, they were labeled and placed in a sample shuttle containing ice or ice packs. All samples were kept at approximately 4°C during storage and shipment. All equipment used to collect the soil sample was decontaminated prior to each use according to the general decontamination procedures discussed in Section 3.11 of this report.

During sample collection, a geologist recorded soil descriptions on the basis of visual observations in accordance with the Unified Soil Classification System (equivalent to ASTM D2487 69). Boring logs that provide a description of the penetrated soil profile were completed for each sample (see Appendix E). All PID/FID readings were noted on the boring logs. Upon completion of sampling, all borings were either tremmie grouted using an appropriate grouting mixture or filled with bentonite pellets if the location was sampled using a hand auger.

3.2 SITE-WIDE MONITORING WELL INSTALLATIONS

The RFI field investigation included installation of 24 site-wide monitoring wells to supplement the existing monitoring wells within or near the specific SWMUs being investigated. Monitoring well locations are indicated on Figure 3.2. In general, the new monitoring wells were installed to satisfy site aquifer hydrogeologic (i.e., piezometric head) data gaps. In addition, two wells were installed near the western plant boundary line (i.e., the boundary with GE) to determine piezometric head and groundwater quality.

The 24 new monitoring wells were installed at locations based on the Site Conceptual Model presented in the RFI Work Plan (DuPont 1997). A preliminary site-wide groundwater flow model was completed and presented to the USEPA Region III in August 1998. (RFI Work Plan:

Groundwater Model Update Report). There were no changes to the proposed sampling locations based on the preliminary model results.

All new wells ~~were~~ installed with a truck-mounted drilling rig with hollow-stem augers. The soil was continuously sampled with split spoons for lithologic logging if the monitoring well was associated with a SWMU. For background monitoring wells, as well as V06-MW01 and W05-MW01, lithologic logging was performed with split spoons samples collected approximately every 5 feet. During monitoring well drilling, soil samples were collected from various depths based on visual observations and PID/FID readings. The soil samples were analyzed for the specific parameters listed in Table 3.2. Lithologic logs were completed during the drilling activities. The lithologic logs and well construction diagrams are included as Appendix E and Appendix F, respectively.

3.2.1 Monitoring Well Construction

Monitoring wells were constructed according to West Virginia Monitoring Well Design Standards 47 CSR 60. No more than 20 feet of screen for each well were used during well construction activities. Soil borings were advanced until contact with the water table and then advanced another 10 to 15 feet. Well screens were installed to straddle the entire saturated thickness encountered in the borehole. All new monitoring wells were constructed with flush-jointed, Schedule 40, polyvinyl chloride (PVC), 2-inch diameter pipe. Each well was installed with a threaded PVC plug on the screen bottom.

The annular space around the screen was filled with gravel pack using an appropriate sand for the screen size. The gravel pack was extended 2 feet above the top of the screen. Gravel pack placement was confirmed by line measurements made through the annulus of the borehole to prevent sand bridging. A 2-foot-thick bentonite pellet seal was placed above the gravel pack. Seal placement was also confirmed by line measurements through the annulus of the borehole. Once in place, the bentonite seal was hydrated with water from the Blennerhassett Island pumping wells.

The remainder of the well annulus to ground surface was tremmie grouted with a cement/bentonite grout that was mixed according to one of the following specifications:

- Cement-bentonite—8 gallons of water to 5 pounds of bentonite dry mixed per 94-pound bag of cement
- Cement-bentonite—10 gallons of water per 8 pounds of bentonite water mixed with a 94-pound bag of cement

Protective 6-inch outer steel casing, locking cap, concrete pads, and traffic posts were installed for all wells in non-trafficked areas. Traffic bollards were installed for all stickup wells near roadways. Wells that were installed in heavily trafficked areas or roadways were completed with a Morrison-Dubuque type flushmount.

All RFI drilling was performed by a West Virginia licensed/certified well driller. Well logging and installation was supervised by a team of qualified geologists and engineers. All newly installed monitoring wells were registered by the driller within the state of West Virginia as per 47 CSR 60. All new wells have also been labeled by permanently affixing the West Virginia registration number to the protective casing or flushmount. Well construction information is summarized in Table 3.3.

3.2.2 Monitoring Well Development

The new wells were allowed to cure a minimum of 12 hours before being developed. Each new well was thoroughly developed by pumping and/or bailing to remove fines from the screened interval. Total well depths necessary to calculate the required purge volumes were tabulated after completion of the well installation and accompanied the sampling team in the field. All wells were developed for a minimum of one hour until at least ten well volumes had been purged and turbidity levels visibly decreased. All development water was contained and disposed of as described in Section 3.10 of this report. Well development information is summarized in Table 3.4.

3.3 SITE-WIDE GROUNDWATER SAMPLING

A total of 37 new and existing wells were sampled on two separate occasions during the RFI field investigation. These included one potable water well, four production wells, eight existing monitoring wells, and 24 newly installed monitoring wells. The first groundwater sampling event was conducted after all new monitoring wells had been installed and developed during the first and second weeks in November of 1998 (see Figure 3.2). The second groundwater sampling event was conducted during the first and second weeks in February of 1999. Well Q05-MW01 was not sampled during Round 2 because of insufficient water volume due to dry weather.

Field location maps were prepared from survey data for the newly installed monitoring wells. Prior to groundwater sampling, the depth to water was measured in each new and existing well that was accessible, and water level elevations were calculated for each sampling event based on new survey data (see Tables 3.5 and 3.6). This data was then used to prepare the water level contour maps depicting the groundwater gradient maps that are presented in Figures 2.7 and 2.8.

To minimize the potential for cross-contamination, monitoring wells were evacuated and sampled beginning from the well with the highest potential for contamination to the lowest. The sampling order of the wells from most to least contaminated was based on data from the VI (DuPont 1992).

Prior to sample acquisition, monitoring wells were purged a minimum of three volumes of water standing in the well casing by using a low-flow submersible pump. A few of the wells were purged and sampled with a disposable polyethylene bailer because the water column was not large enough to allow the use of a submersible pump. The depth of the purge pump intake depended on well yields. The ideal intake for the pump was at the static water level in the well. The pump intake was adjusted as the water column responded to pumping.

Measurements of pH, specific conductance, turbidity, dissolved oxygen, temperature, and salinity were collected by use of a Horiba U-10 instrument during well purging. Purging was completed when at least three well volumes had been evacuated and three consecutive readings of pH and specific conductance had stabilized to within 10 %. When purging was complete, the well was allowed to recharge and then sampled. All wells were sampled with a disposable polyethylene bailer and dedicated bailing twine. Dedicated, disposable tubing was used during well pumping. Proper decontamination was performed during well sampling to prevent cross-contamination within and between monitoring wells, as described in Section 3.11. Monitoring instruments and the submersible pump were cleaned with an Alconox detergent wash followed by a deionized water rinse. All purge and decontamination water was containerized and disposed of as described in Section 3.10 of this report.

3.4 SWMU-SPECIFIC SAMPLING

After review of VI data, SWMU-specific soil and groundwater sampling activities were planned and presented in the RFI Work Plan (DuPont 1997). The sampling programs described below allowed delineation of extent of migration of SWMU-specific constituents.

3.4.1 SWMU A-3—Riverbank Landfill (RBL) and SWMU B-4—Anaerobic Digestion Ponds (ADP)

Field investigation activities at the RBL and ADP SWMUs have been grouped together due to their close proximity. Soil boring and monitoring well sample locations are shown on Figures 3.1 and 3.2, respectively. In general, the sample locations were established to determine the vertical and lateral extent of waste constituents migrating from these units.

Three shallow soil borings and three monitoring well locations (well locations include both a soil boring and a monitoring well) were completed for the ADP to evaluate FC-143 concentrations in soil and groundwater and potential migration pathways. In addition to the new RFI soil borings and monitoring wells, the field investigation at the ADP included groundwater sample collection from Q04-MW01, Q05-MW01, P06-MW01, and P08-MW01, part of a series of six new monitoring wells installed in June 1997 that are situated within or near the ADP boundary.

A detailed investigation was conducted at the RBL seep area (RBLL1) (see Figure 4.1). An active French drain groundwater collection and carbon adsorption system has been in operation at RBLL1 since 1991. Six shallow soil borings and three shallow monitoring wells were installed in this area to determine the extent of methylene chloride impact to shallow soil and seep water. This investigation also helped to verify that the current collection and treatment system is effectively capturing the affected water at the RBLL1 seep area, and thus remains a successful ongoing corrective measure.

The rest of the RBL was investigated on a broader basis, with the objective being to determine whether impacts to shallow soil or groundwater have occurred, and, if so, determine the direction of constituent migration. Along the length of the north side of the RBL (i.e., riverside), 15 shallow soil borings were installed, approximately 100 to 140 feet apart. Shallow monitoring wells were installed at seven additional soil boring locations for a total of 22 soil sample sites.

The south side of the RBL was investigated along its entire length in a manner similar to the north side. Eight new monitoring wells were installed and two soil borings were completed along the south side of the RBL in an effort to supplement the existing well system. The wells were drilled just off the southern boundary of the RBL, since the SWMU area itself is inaccessible due to the presence of dense vegetation. Soil samples were collected from several depth intervals during the drilling investigation (see Table 3.1).

Six monitoring wells installed in June 1997 assisted in evaluating the potential migration of constituents from the RBL and ADP. As with all of the wells included in the RFI field investigation, these wells were sampled twice for the analytical parameters listed in Table 3.2.

3.4.2 SWMU C-6—Polyacetal Waste Incinerator (PWI)

Per USEPA Region III comments (EPA 1997) on the VI data from this SWMU, the field investigation at the PWI consisted of two soil samples collected with a hand auger at locations equivalent to the VI soil borings. Soil samples were collected from the surface (0 to 2 feet) and analyzed for chromium.

3.4.3 SWMU H-14—Burning Ground (BG)

The RFI field investigation included a comprehensive evaluation of soil and groundwater quality underneath and near the BG. Seventeen soil borings and five new monitoring wells were completed to determine the vertical and lateral extent of waste constituents migrating from this unit (see Figure 4.10). Soil boring locations were chosen within a statistically based 35-foot spaced grid. The locations were chosen based on the existence of numerous buildings in this area which prevented evenly spaced sampling points.

Soil borings included sample collection with depth to delineate vertical distribution of potential constituents of concern. The sampling frequency and analytical parameter list are provided in Table 3.1 and 3.2, respectively.

Based on the Site Conceptual Model, groundwater flow beneath the BG is mostly southwest toward the DuPont-Lubeck well field during pumping. The monitoring wells completed at the BG were designed to evaluate downgradient groundwater quality along this migration pathway. A separate monitoring well completed north of the BG and south of the RBL (AA05-MW01) was installed to aid in differentiating groundwater quality impacts between the two SWMU areas.

3.5 BACKGROUND SOIL SAMPLING

Twelve background soil samples were collected at ten borings at locations on the Washington Works site where, to the best of our knowledge, no manufacturing or waste management activities have been conducted. Background sample locations are listed in Table 3.1 and shown on Figure 3.1. All samples were collected from the same site-wide soil horizon that is present below or near the SWMUs being investigated. The background soil data set provides site-wide coverage of spatial variations in background metals concentrations, which may result from natural geologic processes. The background soil samples were analyzed for the following analytes: arsenic, barium, cadmium, chromium, lead, nickel, methylene chloride, tetrachloroethene, trichloroethene, and FC-143.

3.6 SOIL GEOTECHNICAL ANALYSIS

During the RFI field investigation, soil samples were collected for laboratory geotechnical analysis from the RBL and BG SWMU areas. The geotechnical samples were collected via a 3-foot-long, 3-inch diameter, hydraulically advanced, Shelby tube sampler and analyzed for the following:

- Grain size (sieve analysis)
- Moisture content
- Atterberg limits
- Porosity
- Vertical permeability
- Horizontal permeability

The four Shelby tube soil samples, two from the BG and two from the RBL, were collected at locations already designated for soil boring/well installation. In general, the samples were collected from differing lithologies that represent the various soil types throughout the site.

3.7 SLUG TESTING

As a supplement to the permeability assessments conducted on the geotechnical samples, slug tests were performed on several newly installed wells throughout the site. Fifteen new wells were tested to provide hydraulic conductivity results throughout the site. The fifteen wells were slug tested during the first round of groundwater sampling in November 1998 after all wells had been properly developed.

In-situ permeability of the screened interval for each well was evaluated by the instantaneous removal and insertion of a well slug with a known volume. The response of the removal and insertion was measured in the well with pressure transducers and Hermit data loggers. Data was reduced using the Bouwer and Rice method for unconfined aquifers. Results of the slug tests were used in calibrating the groundwater model described in Section 5.

3.8 REVISED NOMENCLATURE

A site-wide alphanumeric coordinate system was developed to facilitate unique nomenclature for proposed and pre-existing wells and soil borings. This coordinate system allowed modification of the existing soil boring and monitoring well locations while maintaining an easily usable and understandable system of nomenclature.

A 200- by 200-foot grid was superimposed on the DuPont Coordinate System. Each column (from east to west) was assigned a letter from A to BE. Each row (from north to south) was assigned a number from 1 to 27. Hence each cell in the grid has a unique identifier (i.e., AP13, BA05).

All pre-existing wells and soil borings were then renamed according to the cell location and the type of sample. The following convention was used: MW for Monitoring wells, PW for production wells, and SB for soil borings. For example, two monitoring wells in cell AP13 were renamed AP13-MW01 and AP13-MW02.

After all preexisting wells and soil borings were renamed, RFI specific wells and soil boring locations were selected and named. Figure 3.2 shows the revised names for the preexisting wells and soil borings, as well as the completed RFI wells and soil borings.

3.9 SURVEYING

All sample locations were surveyed once the soil sampling and well installation program was completed. All well locations were surveyed and four measurements were recorded. The elevation of the ground surface and the top of the PVC casing was surveyed to the nearest 0.01 foot using the nearest convenient permanent surveyed benchmark. Horizontal locations (i.e., Northings and Eastings) of the wells were surveyed to the nearest 0.01 foot. Each of the new wells were marked on the top of the PVC riser pipe to identify the surveyor's reference point and to standardize the measuring point for depth to water measurements. Soil boring and hand auger locations were surveyed and three measurements were recorded for each point. Horizontal locations and ground surface elevations were recorded to assist in proper data analysis and cross-section representation.

3.10 WASTE MANAGEMENT

Waste management procedures are described in the Waste Management Plan (see Appendix F of the RFI workplan). Each waste stream produced during the RFI was handled in the appropriate manner as discussed in the following text. The typical wastes that were generated and managed during RFI activities included:

- Soil cuttings from drilling and augering activities
- Water from purging and development of monitoring wells
- Water from decontaminating sampling and drilling equipment

- Disposable sampling equipment
- Disposable personal protective equipment (PPE)
- General construction debris

Soil cuttings that were produced during the RFI drilling and augering programs were contained in 137 polyethylene, Department of Transportation (DOT) approved drums. All drums were labeled, dated, logged, and staged on-site to await characterization. Analytical samples from the associated soil borings were compiled to determine the status of the soil contained in each individual drum. Additional samples were collected and analyzed following the RFI program to further assess the status of individual drums. All drums were classified as non-hazardous and will be properly disposed of off site.

Development and decontamination water produced during the RFI activities was contained in a 21,000-gallon portable tank staged near the decontamination area. Approximately 3,500 gallons of waste water was produced during the sampling activities. A Toxicity Characteristic Leaching Procedure (TCLP) sample of the waste water was collected and analyzed following the RFI activities and results were compared to TCLP criteria for waste disposal classification. The waste water was classified as non-hazardous and pumped into an over-the-road tanker truck for transportation to the DuPont Chambers Works facility in Deepwater, New Jersey, for proper disposal.

Disposable PPE and sampling equipment were contained in drum liners at the end of each day. The drum liners were sealed after they were filled and deposited into an on-site waste dumpster for proper disposal.

3.11 DECONTAMINATION

Proper decontamination was performed during sample collection to prevent cross-contamination within and between sample locations. Prior to moving onto a new location, the drill rig and associated equipment were thoroughly cleaned at the decontamination pad constructed in the East Well Field area of the plant using a pressurized steam cleaner and Blennerhassett Island water.

Sampling equipment included drilling rigs with augers, hand augers, split-spoon samplers, trowels, spoons, mixing bowls, spatulas, bailers, tubing, and pumps. All of these items came into direct contact with the sample and had a potential to impact analytical results. Therefore, care was taken to ensure the cleanliness of all sampling equipment. When possible, laboratory-cleaned or disposable sampling equipment was used (e.g., bailers for sampling wells).

Sampling devices (i.e., split spoons, hand augers, and stainless steel sampling spoons) were cleaned, at a minimum, by an Alconox detergent scrub and a Blennerhassett Island water rinse after each use. All well riser pipe and screen used for well construction was certified cleaned and wrapped by the distributor. During drilling and well construction activities, vegetable oil and other nonpetroleum based products were used as lubricating oils to minimize potential contamination of the borehole and/or well. All excess soil cuttings and decontamination water were contained and will be disposed of as per Section 3.10.

All equipment in direct contact with the material to be sampled was decontaminated prior to sampling to prevent cross-contamination of the collected samples. In addition, care was taken so as not to allow anything to come into contact with a sample or sample area which could affect its composition.

In addition to the decontamination procedures outlined above, the person collecting the sample wore clean, disposable latex gloves and limited his/her contact with the samples. Sample bottles and containers were prepared by the contracted laboratory and were sealed to ensure cleanliness. Sample bottles were not cleaned or reused in the field. The drilling augers, well casings, well screens, and hoses were pressure washed prior to use, unless certified clean and wrapped prior to transport to the site. A personnel decontamination area was established at each sample location prior to start of sampling. Procedures for the decontamination of protective equipment and the removal of respiratory and personal protection clothing to avoid transfer of constituents from clothing to the body are discussed in the Health and Safety Plan (see Appendix E of the RFI workplan).

3.12 QUALITY ASSURANCE/QUALITY CONTROL

Several quality assurance/quality control (QA/QC) methods were conducted during the field activities to ensure quality data collection and analyses. Trip blanks, duplicate samples, matrix spike/matrix spike duplicates (MS/MSD) samples, and equipment blanks were collected during the field program to assure field procedure and laboratory quality.

A trip blank consisted of a sample container filled at the laboratory with analyte-free or deionized water. The trip blank traveled to the site with the empty sample bottles and back from the site with the collected samples in an effort to simulate sample handling conditions. Trip blanks were not opened in the field. Trip blanks were shipped and analyzed for each shuttle of VOC that was collected in a day's period. The trip blanks served as a check on sample contamination originating from container migration or from sample transport.

Duplicate soil and water samples were obtained by alternately filling sample containers from the same sampling device for each parameter. Media to be analyzed for VOCs were collected first. Duplicate samples were collected at a rate of one in twenty for each appropriate type of matrix and parameter. Duplicate samples were collected to evaluate the aggregate sampling and analytical precision.

MS/MSD samples were also collected at a level of one in twenty. MS/MSD samples were collected to provide a method of accuracy in a given matrix. The MS was performed by adding a predetermined quantity of stock solutions of certain analytes that are representative of test constituents to a sample matrix prior to the sample extraction/digestion and analysis. The concentration of the spike was at the regulatory standard level or above the method detection limit. The MSD was collected as a duplicate to the MS to further demonstrate analytical accuracy.

Equipment blanks (also called rinsate blanks) were used to evaluate equipment cleaning and decontamination procedures. At the sample location, analyte-free water or deionized water provided by the laboratory was poured over or through the sample collection device, collected in a sample container, and preserved as appropriate. One equipment blank was collected for every twenty samples.

All QA/QC samples were handled, transported, and analyzed in the same manner as actual field samples. Blanks were held on site for the minimum number of days. The temperature of the blanks was maintained at approximately 4°C while on site and during shipment. Holding times for individual parameters were dictated by the specific analytes being tested and the analytical method being used.

Samples collected were packaged in accordance with the Quality Assurance Project Plan (QAPP) and shipped under chain-of-custody to the laboratory using an overnight service (Federal Express) or laboratory courier.

3.13 SAMPLE PRESERVATION

All sample containers were received from the laboratory containing proper preservatives for the method analysis except for the dissolved metal sample containers. Field filtering for dissolved metals species in water samples was completed and the preservative was added to the sample aliquot once filtering was completed. Field filtering was performed using a 0.45-micron filter, a peristaltic pump, and dedicated Tygon tubing.

3.14 FIELD CUSTODY PROCEDURES

At the time of sample collection, the following field activities were performed and documented by the investigator:

- All procedures regarding preparation of reagents or supplies that were used in sample collection and/or sample preservation.
- Sample quantity, type (i.e., composite or grab), location, and depth was documented in the investigator's field log.
- Sample labels were prepared, and they included sample identification numbers, time and date of collection, proposed laboratory analyses, and name of sampler.

Samples collected in the field by a team of investigators were the responsibility of each sampler until the samples were transferred to a person designated as the field sample custodian. Chains of Custody (COC) forms were required and completed for each sample collected in the field.

Prior to sample transport to the laboratory, a COC form was completed by the field sample custodian. Sample locations, sample identification numbers, description of samples, number of samples collected, and specific laboratory analyses conducted on each sample were recorded on the COC forms. The field sample custodian signed and dated the COC form and retained a copy for the project records.

Prior to sample shuttle delivery to the courier, the sample shipping containers (e.g., cooler, box) were sealed with the signed COC forms inside. After shipping and arrival at the laboratory, the authorized laboratory custodian who received the samples signed the COC forms, thus terminating custody of the field sample custodian.

The following section presents the RCRA Facility Investigation results. It is organized as follows:

- Data Quality Review
- Soil Investigation
- Groundwater Investigation

In general, the results are presented and discussed on a SWMU by SWMU basis. To provide a qualitative guide to the level of observed impacts and to help assess their potential significance, all soil analytical results were compared to USEPA Region III Risk-Based Concentrations (RBCs) for industrial soil (USEPA Region III 1999). Groundwater results were compared to federal Maximum Contaminant Levels (MCLs) for drinking water or to RBCs for tapwater if no MCL was available. Concentrations of FC-143 were compared to preliminary health-based screening levels for soil and groundwater that are derived in Section 6.4.3. Tables in Appendices A, B, and C show all analytical results in comparison to these screening criteria.

Where relevant, the RFI results were discussed in relation to VI results to confirm consistency of findings or delineate migration pathways.

4.1 DATA QUALITY REVIEW

The groundwater and soil samples were collected, analyzed, and reviewed according to the QA/QC requirements stated in the QAPP, with the exceptions noted in Sections 4.1.2 and 4.1.3.

Sample custody at the analytical laboratory was maintained through systematic sample control procedures, including:

- Sample receipt
- Sample log in
- Sample storage
- Sample archival or disposal

The laboratory COC procedures were documented in the laboratory's quality assurance (QA) plan, which was provided as an attachment to the RFI workplan.

4.1.1 RFI Data Quality Objectives

The RFI data quality objectives (DQOs) were set based on RFI needs. The DQOs were stated in Section 3 and Table 1 of the QAPP in the RFI Work Plan.

Quantitative DQOs were established for completeness, accuracy, and precision. Completeness was calculated as usable data as a percentage of all analytical data generated. Results for individual metals were qualified as unusable (flagged R) for project purposes in one or more samples. The loss of these individual results as a result of data validation and evaluation did not materially affect the evaluation of the Washington Works site and did not change the conclusions reached in this report. Eleven sample results were found to be unusable out of 3,732 total results generated, for a completeness of greater than 99%. This value exceeds the completeness goals established in the QAPP. Precision and accuracy goals established in the QAPP were adopted from the associated analytical methods. Precision and accuracy results were evaluated and qualifiers applied as necessary for samples designated for full data validation.

4.1.2 RFI Analytical Protocol Deviations

All analytical procedures used by the laboratory for this investigation were USEPA-approved procedures with the exception of the surfactant ammonium perfluorooctoanate (FC-143), for which an USEPA-approved method was not identified. The analytical procedures used for the majority of the analyses were according to Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846, December 1996). The remaining analyses with the exception of FC-143 were conducted according to Methods for Chemical Analysis of Water and Wastes (USEPA 600/4-79-020, March 1988). The FC-143 analysis was performed according to a laboratory standard operating procedure (SOP) utilizing extraction, derivitization, and gas chromatograph (GC) electron capture detector (ECD) analysis.

Laboratory analysis was primarily performed by the DuPont partner laboratory Lancaster Laboratories, Inc. (LLI), Lancaster, Pennsylvania, as specified in the QAPP. LLI is evaluated, via periodic on-site audits, on an ongoing basis by DuPont to assess performance and to generate confidence in data obtained from sample analysis. Deviations from planned sample analysis are described below.

4.1.2.1 FC-143 Analysis

FC-143 analysis was performed for soil and first round groundwater samples by CH2M Hill (Quality Analytic), Montgomery, Alabama. Quality Analytic, however, ceased operation prior to second round groundwater sample collection. The FC-143 analytical SOP was subsequently provided to LLI and LLI performed all required analyses of second round groundwater samples.

A comparison of first and second round groundwater analysis results for FC-143 showed that many, but not all, second round results for FC-143 were higher than first round results. DuPont is investigating possible differences in the FC-143 standard used by the different laboratories for calibration and spiking in an attempt to explain the generally higher FC-143 results found during second round groundwater analysis. A third round of groundwater samples were collected from selected wells to verify this discrepancy (see Appendix D).

In addition, FC-143 analysis at each laboratory generally gave poor or imprecise spike recoveries as discussed in Section 4.1.3, resulting in qualification of validated FC-143 results as estimated. Two groundwater results and an equipment blank were qualified as unusable as discussed below.

4.1.2.2 Encore Sampling

Encore samplers were used to obtain and ship soil samples to the laboratory for methanol preservation according to USEPA Method 5035. Some sample weights were found upon methanol preservation to fall outside the recommended weight range of 4.5 to 5.5 grams. In all such cases the sample preparation and analysis was performed using the sample received at the laboratory and detection limits were adjusted accordingly.

4.1.3 RFI Data Usability Review and Data Validation

All of the analytical data (100%) was reviewed by the laboratory prior to reporting the data and by the DuPont Corporate Remediation Group (CRG) Analytical Data Quality Management (ADQM) team upon receipt of the data. Any major or minor QA/QC deficiencies are noted in the narrative portion of the laboratory data packages. In addition, full data validation was conducted on 10% of the RFI samples, as stated in the RFI Work Plan QAPP. Soil and groundwater sample results were validated by Environmental Standards, Inc. (ESI), Valley Forge, Pennsylvania. ESI performed the validation using the National Functional Guidelines (for organic and inorganic compounds) modified for use in USEPA Region III. The validation reports prepared by ESI, each including an executive summary, are available for inspection upon request.

Samples selected for validation represented data from all types of sampling conducted and parameter analyzed during the RFI. Laboratory generated Contract Laboratory Program (CLP)-like data packages were selected for validation at random in order to

- Evaluate approximately 10% of the total number of samples analyzed
- Preferentially select samples allowing validation of a more complete analytical list
- Minimize the number of data packages submitted for validation
- Allow complete data packages to be evaluated

As stated in Section 4.1.1, validation of the sample results by ESI resulted in assessment of individual target compounds/analytes in one or more samples as unusable for project purposes. Results were judged by the validator to be unusable (flagged R) primarily due to very low spike recoveries associated with non-detect FC-143 results and significant negative blank contamination associated with non-detect results for cadmium. The affected cadmium results may be considered usable at an elevated reporting level; however, this was not deemed necessary by users of the data.

Additional qualifiers were applied to the data by the validator to reflect samples where values may be considered to be estimated or to exhibit a high or low bias, such as where batch or sample spike recoveries fell outside QC criteria, or associated blank samples indicated an outside source (incomplete equipment cleaning, shipping, storage) of sample contamination.

Qualifiers provided by the data validators as well as those as well as those assigned upon further evaluation of analytical data were entered into DuPont's Corporate Environmental Database (CED) and are reflected in the tables and figures of this report.

4.2 SOIL INVESTIGATION

The sections below present soil sampling results obtained from the RFI. All results have been summarized in Appendix A. The tables include comparisons with USEPA Region III RBCs for industrial soil (or to a preliminary screening level for FC-143). Data results are also posted graphically on site maps.

The soil investigation was designed to fill data gaps remaining after the VI. In some instances, (i.e., SWMU H-14, Burning Ground) the soil investigation focused on near-surface (i.e., 0-2 foot) soil quality. In the following section, some comparisons between the VI data and the RFI data are presented.

4.2.1 Background Soil Sampling

Background soil samples were collected at ten locations near the upgradient perimeter of the property away from the main plant area (see Figure 3.1). Background soil samples were analyzed for the parameters listed in Table 4.1. Table 4.1 also presents a summary of background soil sample results. These summary concentrations were compared to SWMU area soil sample results to determine if the result exceeded background levels.

Based on the comparison of individual SWMU area soil sample results with background concentrations, the following key results are noted:

- The majority of individual metal results were less than or equivalent to the respective background concentration.
- FC-143 was present in several background, near-surface samples. This is attributed to deposition of airborne particulate originating from the Teflon process area.

4.2.2 SWMU A-3—Riverbank Landfill (RBL) and SWMU B-4—Anaerobic Digestion Ponds (ADP)

Results for the ~~ADP and~~ RBL are discussed together because the ADP is located within the RBL SWMU boundary. Samples collected within these two SWMU units were analyzed for the following organic parameters: methylene chloride (MeCl), Freon-113, PCE, TCE, and FC-143. All organic analytes were detected in the soil investigation in at least one soil sample.

Several soil borings were advanced downgradient of the RBLLI seep area to determine the horizontal and vertical extent of methylene chloride impact. These locations were M04-SB02, M04-SB03, and N04-SB02.

Figure 4.1 depicts the soil sample findings for this area. Mostly low levels of MeCl were found in four soil samples at depths ranging from 2 to 14 feet BGS from boreholes M04-SB05 and N05-SB01 in the soil around the seep area. The highest concentration of MeCl detected was from the 6- to 8-foot interval in M04-SB05 (320,000 μg/kg). This interval appears to be the only true hot spot found near the seep area because sampling intervals below and above display much lower concentrations (less than 700 μg/kg). Soil samples collected downgradient from M04-SB05 did not contain detectable MeCl, indicating limited horizontal movement away from the seep area. MeCl was not detected in samples from any other location at the site.

Freon-113 was detected in ten soil borings around the western section of the RBL/ADP. Figure 4.2 presents the results of analysis for Freon-113 in each of the sample locations. The Freon-113 soil concentrations ranged from nondetect to 9,700 μg/kg. In general, the Freon-113 was detected in subsurface soil samples (i.e., greater than 2 feet). These results confirm similar Freon-113 levels detected during the VI.

Low concentrations of both PCE and TCE were detected in soil samples collected near the RBL/ADP SWMU areas. Figures 4.3 through 4.6 present the sample locations and results. PCE was detected at concentrations up to 3,800 μg/kg and TCE was detected at concentrations up to 8,800 μg/kg. In general, these constituents were detected in subsurface soils (i.e., greater than 2 feet) in a random pattern throughout the limits of the RBL/ADP. No specific source area was identified. However, the highest concentrations appear to occur near the western portion of the RBL.

FC-143 was detected in a number of soil samples collected in the RBL/ADP SWMU area. Figures 4.7 through 4.9 present the soil sample locations and results of the analyses for FC-143. FC-143 was detected at concentrations ranging from 18 to 48,000 μg/kg. The highest results are associated with the ADP area and occur in soil samples collected from the 8- to 12-foot depth range. These results confirm similar results collected during the VI.

Samples collected in the RBL and ADP were also analyzed for five inorganic analytes: arsenic, barium, cadmium, lead and nickel. The detected concentrations of these inorganic parameters were similar to the mean level found in the background samples (see Section 4.2.1, Background Soil Sampling).

4.2.3 SWMU C-6 — Polyacetal Waste Incinerator (PWI)

Two soil samples, L08-SB02 and L09-SB02, were collected in the PWI and analyzed for chromium. The chromium results for these two samples were 10.8 and 9.6 mg/kg respectively. The chromium concentrations were equivalent to the background levels (4 to 120 mg/kg) at both locations.

4.2.4 SWMU H-14 — Burning Ground (BG)

Numerous soil samples were analyzed in the BG for two organic compounds: carbon tetrachloride (CT) and FC-143, which were detected during the VI in nearby groundwater samples. CT was detected at two locations at relatively low concentrations (180 to 840 µg/kg) within the BG area as indicated on Figure 4.10.

FC-143 was also detected in several of the samples collected in the BG at low concentrations (10 to 140 µg/kg). Figures 4.7 through 4.9 present the results of the analyses for FC-143.

Samples collected in the BG SWMU were also analyzed for five inorganic parameters: arsenic, barium, cadmium, lead, and nickel. The concentrations of these inorganic parameters were similar to the levels found in background samples (see Section 4.2.1, Background Soil Sampling).

4.2.5 Soil Investigation Summary

The RFI soil investigation's primary objective was to determine if constituents of interest identified during the VI were present in soils underlying or adjoining the RBL, ADP, PWI, and BG. In the RBLLI seep area, a more detailed investigation was conducted to determine the extent of MeCl impact to soils.

In addition, in order to assess qualitatively the level of observed impacts and their potential significance, all soil sample results were compared to USEPA Region III RBCs for industrial soil (USEPA Region III 1999) or to a preliminary health-based screening level for FC-143 (derived in Section 6.4.3). The soil investigation results are summarized as follows:

- Metal constituents detected in soil were comparable to background concentrations (see Table 4.1).
- PCE, TCE, and Freon-113 were detected throughout the RBL and ADP area soil, primarily in subsurface samples (depths greater than 2 feet). Concentrations were relatively low (typically 2,000 µg/kg or less). The maximum concentration of Freon-113 was 9,700 mg/kg at a depth of 10-12 feet.
- Extent of MeCl impacts at the RBLL1 seep area appear to be limited to a "hot spot" at about 8 to 10 feet BGS.

- The surfactant FC-143 was detected in soil throughout the RBL, ADP, and BG SWMU areas. The highest concentrations (up to 48,000 µg/kg) occurred in ADP area subsurface soils.
- None of the organic constituents detected in soil (i.e., PCE, TCE, MeCl, Freon-113, or FC-143) exceeded their respective RBCs (or preliminary screening level for FC-143).

Further discussion of the soil investigation results is provided in Section 6, Screening-Level Risk Evaluation.

4.3 GROUNDWATER INVESTIGATION

4.3.1 Plantwide Groundwater Sampling

Plantwide groundwater sampling was conducted during two separate monitoring events. The sampling events focused on existing and newly installed wells associated with the BG and RBL/ADP SWMUs. As per the VI results and the approved RFI workplan (DuPont 1997), groundwater was not investigated at the PWI. Table 4.1 lists the parameters that were analyzed at each specific SWMU. Following is a discussion that describes the findings for individual parameters. Results are summarized in Tables 4.2 to 4.6, and complete analytical results are shown in Appendices B and C.

Methylene Chloride (MeCl)

All plant wells were sampled and analyzed for MeCl except for those located within the BG. MeCl was not detected in any of the groundwater samples collected during either round of sampling. This includes M04-MW02 and N04-MW02, two monitor wells situated between the RBLL1 seep area and the Ohio River.

Carbon Tetrachloride (CT)

Five wells within and in close proximity to the BG were sampled for CT. CT was detected in samples from two of the wells. Table 4.2 presents the results from both rounds of sampling. Figures 4.11 (Round 1) and 4.12 (Round 2) show the well locations and CT sampling results within the BG SWMU. Detected concentrations ranged from 1 to 16 µg/L.

Tetrachloroethene (PCE)

All plant wells included in the two rounds were sampled for PCE except for the five wells within the BG boundary. PCE was detected in several wells on the plant site. All detections are associated with the RBL/ADP SWMUs. Figures 4.13 and 4.14 show the results and locations where PCE was detected in groundwater. Table 4.3 lists the results for both rounds of groundwater sampling and demonstrates consistency between rounds. Observed concentrations ranged from 1 to 240 µg/L.

Trichloroethene (TCE)

Wells that were included in the PCE sampling were also analyzed for TCE. Similar to PCE, TCE was detected ~~in~~ several wells on the plant site. Figures 4.15 and 4.16 show the results and well locations where TCE was detected. Like the PCE detections, TCE in groundwater occurs near the RBL/ADP SWMUs. Table 4.4 tabulates the results of the sample analyses for both groundwater sampling rounds. Observed concentrations ranged from 1 to 800 µg/L.

Freon-113

Freon-113 was analyzed for in samples associated with the RBL/ADP SWMUs. In both rounds, Freon-113 was detected in twelve of the wells sampled. Table 4.5 tabulates the results of the sample analyses. Well locations and sample results are presented in Figures 4.17 and 4.18. Observed concentrations ranged from non-detect to 7,100 µg/L.

FC-143

All plant wells were sampled for FC-143. Figures 4.19 and 4.20 depict the well locations and results for FC-143 detections. Table 4.6 presents the analytical results of the FC-143 sampling for both rounds. Observed concentrations ranged from 0.1 to 13,600 µg/L. Concentrations were below 40 µg/L in 28 of the 37 wells sampled; in the other 9 wells, maximum concentrations ranged from 380 to 13,600 µg/L. The highest concentrations were observed in monitoring wells P04-MW02 and R04-MW02, near the ADP area.

4.3.2 Groundwater Investigation Summary

Groundwater sample results were compared to MCLs for drinking water or a health-based screening level for FC-143 (see Tables 4.2 to 4.6). Several exceedances of the screening criteria for organic compounds occur mainly within the RBL/ADP SWMUs. In light of these findings, a thorough analysis of the site groundwater flow regime and the significant results of that analysis are discussed in Section 5.

Several total and dissolved inorganic parameters, specifically, barium, cadmium, lead, and nickel exceeded MCLs (see Appendices B and C). These exceedances occurred in samples taken at SWMU areas and in the background samples taken away from the manufacturing area. Based on the background levels, metals in groundwater are concluded to be naturally occurring and unrelated to SWMU releases.

The groundwater investigation results indicate:

- The seep collection and treatment system is effective at preventing off-site migration of seeps at RBLL1.
- The BG is not a significant source of constituents in the groundwater.
- The constituents of concern detected in groundwater are coming from the RBL/ADP SWMUs.

- Metals are naturally occurring and do not appear to be SWMU-related constituents of concern.

5.1 INTRODUCTION

In accordance with the September 24, 1997, DuPont Washington Works RCRA Facility Investigation Plan, Section 3.1.2, a mathematical model of groundwater flow at the site was constructed. A preliminary model was constructed in 1998, prior to the initiation of the RFI sampling activities, to assist in developing a more comprehensive list of field data needs. The results of the preliminary modeling were submitted to the USEPA Region III on August 18, 1998, in a letter report, *"RFI Work Plan: Groundwater Model Update Report."* The preliminary model has been refined based on data collected during the RFI, and the results presented herein.

Prior to beginning the mathematical modeling, new hydrogeologic data collected during the RFI were reviewed to confirm the site conceptual model. Since the model construction is based on the conceptual model, parameters such as river stage and hydraulic conductivity were refined in the mathematical model based on new information. The model was then calibrated to a recent data set, February 1, 1999, which included groundwater elevation data from a sufficient number of new and existing monitoring wells. After the model was calibrated, model parameters were independently increased and decreased relative to the value obtained during calibration to determine to which parameters the model is most sensitive. This helps to determine the degree of model uncertainty. The model was also verified against historic data sets. Then the calibrated model was used develop predictive runs under different pumping regimes.

5.2 CONCEPTUAL HYDROGEOLOGIC MODEL

As part of the hydrogeologic model development, all available hydrogeologic data for the Site were reviewed. All site-specific boring logs, groundwater elevation data, water supply well data, and regional hydrogeologic data were compiled and reviewed to determine the number of model layers, groundwater flow, boundary conditions, and the global water balance for the area to be modeled.

Previous studies show that the site is underlain by two primary geologic units: river terrace deposits and bedrock. The Pleistocene-age river terrace deposits are a fining upward sequence consisting of coarse sand and gravel deposits at the bottom grading up to finer sands, silts, and clays at the top. There are overbank deposits consisting of silt and clay along the Ohio River banks that are above the water-table aquifer. Fine-grained sediments may continue into the river bed in some areas due to bank slumping and low energy in the river, which creates a depositional environment for fines. In other areas of the river where energy is high, fines are eroded and coarser-grained sediments predominate (see cross sections in Figures 2.5A-2.5F). The alluvium is approximately 100 feet thick. Over the operating portion of the site, the contact between the alluvial deposits and the consolidated bedrock is relatively flat, at an elevation of approximately 530 feet above MSL. The bedrock is composed of Permian-age shale and sandstone of the Washington Formation which is part of the Dunkard Group. The bedrock permeability is very low compared to the overlying alluvial river terrace deposits (Schultz 1984). Just south of State Road 892, the Ohio River terrace ends and the bedrock outcrops at the surface.

Groundwater is encountered in the alluvium at the site at elevations ranging from approximately 570 to 554 feet MSL, with groundwater flow toward the process water supply wells at the site. The water level in the Ohio River adjacent to the site averages 582 feet MSL. Groundwater is recharged from rainfall, which averages around 35 inches a year (National Climatic Data Center and United States Geological Survey (USGS)), and river water infiltration. Since the bedrock permeability is much lower than the alluvium, there is not significant groundwater interaction between the bedrock and the alluvium. Surface water runoff from bedrock outcrop areas to the south is assumed to be carried away via surface water drainage ditches and therefore does not recharge groundwater.

5.3 GROUNDWATER FLOW MODEL DEVELOPMENT

A groundwater flow model of the site was constructed based on available data and the conceptual hydrogeologic model described above. The USGS model MODFLOW (McDonald and Harbaugh, 1988) was used to calculate groundwater elevations. MODFLOW is a three-dimensional, finite-difference groundwater flow model. The model MODFLOW was used because it is well documented and widely accepted by regulatory agencies and industry. The model pre- and post-processor Model Cad for Windows (Geraghty & Miller) was used to design the model grid, facilitate the building of input files for MODFLOW, and view the MODFLOW output files.

The model was set up as a one-layer, two-dimensional model. The model domain includes the following area (Figure 5.1 outlines the model domain on a USGS topographic map):

- North to South - North from the middle of the Ohio River Channel, and south to just below GE. The north to south domain totals 8,800 feet.
- East to West - East where the terrace deposits end at the valley wall, and west to the middle of the Ohio River channel. The east to west domain totals 15,500 feet.

The model was constructed by gridding the area into square regions called cells. The grid spacing or cell size is 50 feet by 50 feet over the entire model domain (see Figure 5.2). The cells were then grouped into zones based on parameters such as hydraulic conductivity and recharge. The areas of bedrock outcrop south of State Road 892 and northwest of the Ohio River were set as no-flow boundaries. No-flow boundary conditions are applied to cells that are outside of the model's computational domain.

A recharge rate of 11 inches a year was applied over the active flow cells in the model domain. Recharge was estimated to be about 1/3 of the annual rainfall of approximately 35 inches a year. Increased recharge along the bedrock outcrop south of the site was not simulated due to the presence of drainage ditches along State Road 892 that carry away runoff from the bedrock outcrop and prevent it from infiltrating into groundwater.

The Ohio River was modeled as a river with a stage of 584 feet MSL and a bottom of 553 feet MSL. River stage was modeled approximately two feet higher than average because of greater than average rainfall in February 1999 which caused a rise in river stage. The model-calibrated riverbed conductance was low. The latter is reasonable based on the presence of the fine-grained sediments which deposit along the low-energy reaches of the river found along much of the site boundary and along GE boundary. The bottom of the one-layer model was assigned an elevation of 525 feet MSL to approximate the bottom of the alluvial deposits. Figure 5.3 shows the location of the boundary conditions, including no-flow cells and river cells.

5.4 MODEL CALIBRATION

Once the model was constructed, it was calibrated to data collected from the site on February 1, 1999. This included extraction rate data from the site production wells and groundwater elevation data from 44 observation wells at the site. Elevations and pumping rates from a specific day were used rather than averages since pumping rates vary over time. Pumping rates can fluctuate daily in response to production needs for water and well maintenance issues. Since the fall of 1998, pumping rates have been monitored continuously, but in most cases flow meters record flow for a group of wells (e.g. DuPont-Lubeck Well Field, Blennerhassett Island, East Well Field, etc.) rather than individual wells. DuPont also obtained a June 1996 groundwater elevation map from GE, which borders the site to the southwest. This offsite information, including estimated groundwater extraction rates, was also included in the model setup.

Values for hydraulic conductivity and riverbed conductance were initially estimated based on grain size and hydraulic properties estimated from production well performance. The hydraulic conductivity and riverbed conductance were then varied independently to obtain a reasonable match between the model head and the target or measured heads. Recharge was not varied, as it was only 16% of the water into the model and some variation would not have significant impact. The hydraulic conductivity for the site in the calibrated model is 250 feet per day, with a hydraulic conductivity of 900 feet per day in the area of the DuPont-Lubeck Well Field, which coincides with a coarsening of the alluvium in that area (see cross sections in Figures 2.5A-2.5F). The calibrated hydraulic conductivity in the vicinity of the Ohio River was slightly less, at 200 feet per day. Figure 5.4 shows the location of the three different conductivity zones. Riverbed conductance is higher in the vicinity of Blennerhassett Island than in the rest of the river, but both are estimated by the model to be low, 13.1 feet^2 per day (ft ^{2}/d) and 2.3 ft ^{2}/d, respectively. The island is just off the cut bank or higher energy area of the Ohio River where coarser sediments are deposited. Riverbed conductance was calibrated at a somewhat lower value, 1.2 ft ^{2}/d, along the downstream portion of the site and along GE. This lower conductance coincides with the lower energy area of the Ohio River or fill bank, where finer sediments are deposited.

The groundwater elevation contours calculated by the model are shown on Figure 5.5, along with the residuals or the difference in the model heads and the target heads. To evaluate the difference between the target heads and the model heads, a calibration statistics program, CALSTATS (Geraghty & Miller, 1993), was used. CALSTATS calculates the range in heads, residual mean, residual standard deviation, and other statistical parameters, for the overall model. The residual standard deviation for the calibrated flow model is 1.6 feet. The observed range in heads (15.6 feet) and the residual standard deviation vary by 10.3 % of the total change in head across the model, indicating a reasonably good calibration for the model. In addition, target heads were plotted against model heads, and the resulting scatter plot shows that most of the residuals fall along a line of perfect fit (i.e., where the modeled head would exactly match the observed head). While scatter is observed along the line of best fit, the model shows little bias to modeling too high or too low. The CALSTATS results and the scatter plot for the calibrated model are included as Table 5.1 and Figure 5.6.

5.5 SENSITIVITY ANALYSIS

Sensitivity analyses were conducted using the calibrated flow model to determine the parameters that are most important in the model. Sensitivity analysis helps to quantify the degree of uncertainty in the model. Values for recharge, conductivity, riverbed conductance, river stage, and pumping were independently increased and decreased relative to the values obtained during calibration. The effect of increasing or decreasing a parameter was evaluated by comparing the best fit line for a data set to the perfect fit line (see Figure 5.7) and by reviewing the statistics provided by CALSTATS (see Table 5.2). In all cases the groundwater contours and the flow regime were very similar to the calibrated model and there was very similar capture.

The model seems to be most sensitive to conductivity and pumping rate. Conductivity is reasonably estimated in the model based on grain size and aquifer characteristics determined from the pumping wells. Decreasing the conductivity or increasing pumping increased the influence of the pumping wells. When conductivity was increased or pumping decreased, the flow regime and capture zone were very similar to the calibrated scenario as noted above.

The model is somewhat sensitive to riverbed conductance, river stage, and recharge. Riverbed conductance is a parameter that cannot be measured, only calibrated to. River stage was already modeled at a high, and it is unlikely that the stage would be two feet higher for any extended time, so the river stage was not increased for the sensitivity analysis. Lowering the river stage increased the influence of the pumping wells. Recharge is unlikely to be as high as 47% of the annual rainfall (16 inches per year = 47% of annual rainfall), and lower recharge enhanced the groundwater control provided by pumping (see Fig. 5-7).

Two additional data sets (piezometric elevations and estimated pumping rates) were available to verify the calibrated model. The pumping data and the observed heads from November 1, 1997, and November 9, 1998, were modeled using the more usual river stage of 582 feet. In both cases all the model heads fell along a line parallel to the line of perfect fit, but were about 6 feet lower than observed heads (see Figure 5.8). The discrepancy could be related to input values for river stage, conductivity, conductance, recharge, or pumping rates. Of these, the lower river stage was already accounted for, and conductivity and conductance should not vary seasonally. Rainfall in November 1997 and 1998 was likely lower than rainfall in the exceptionally wet February 1999, and lowering recharge would not help raise the model heads, even though there may be seasonal variations in rainfall that are not accounted for in the steady state model. Therefore, the most likely reason for the discrepancy is pumping. Pumping rates can vary greatly on a daily basis since they are process driven. A 20 % lowering of pumping rates shifted the November 1, 1997, and November 9, 1998, modeled heads up to levels closer to the observed heads, as shown on Figure 5.8. Due to the aforementioned variability in pumping rates, and the fact that individual wells do not have flow meters, a 20 % change from the rate estimated for one day is not unreasonable, given how much the rates can fluctuate and how they are recorded in groups, rather than individually, in some cases.

5.6 CONCLUSION OF GROUNDWATER MODELING

After the model was calibrated, it was used to simulate various pumping scenarios using the site's existing production wells with the objective of maintaining hydraulic control of groundwater on the site while decreasing overall pumping. Contour maps depicting groundwater elevations and flow lines for various pumping scenarios were constructed. These maps illustrated the area of groundwater capture for each scenario based on flow line convergence to recovery wells. Flow lines were calculated using MODPATH (Pollack 1994). The model shows that lowering February 1999 pumping rates by as much as 65% would still result in hydraulic control of groundwater at the site. The pumping distribution would have to be changed to approximately 660 gpm for the Ranney well, 500 gpm for the DuPont-Lubeck wells, 290 gpm for the East Well Field wells, and no pumping on Blennerhassett Island. Figure 5.9 illustrates the groundwater elevations and flow lines at these pumping rates.

The conclusion therefore is that the well pumping is containing SWMU-impacted groundwater and would continue to do so even with a significant reduction in pumping rates. The sensitivity results also indicate that groundwater is being contained even accounting for the uncertainty of the model input parameters, i.e., even if the hydraulic parameters input to the model are different from their true values, the sensitivity analysis results indicates that capture of SWMU-impacted groundwater is being maintained.

5.7 MODEL LIMITATIONS

Since this is a steady-state model, it simulates an average site condition rather than a fluctuating one. It cannot simulate the short-term changes in pumping rates, or seasonal fluctuations in river stage and recharge rates. The boundary conditions to the south of GE are uncertain, and GE water levels are based on a June 18-19, 1996, groundwater elevation map with pumping rates estimated based on these water levels. However, for the purpose of demonstrating current capture and capture under reduced pumping, these uncertainties do not change the conclusion that the pumping is containing the SWMU-impacted groundwater at the site.

6.1 OBJECTIVES AND APPROACH

The overall ~~objective of~~ this risk evaluation is to determine whether identified releases from the SWMUs are a potential concern for human health or the environment and whether further evaluation or action is warranted.

In the screening-level health risk evaluation, concentrations of constituents detected in soil and groundwater were compared to generic health-protective screening levels for soil and groundwater, in order to identify constituents and exposure pathways of potential concern. The ecological evaluation focused on characterizing the habitat within the RFI study area and identifying whether complete exposure pathways exist between SWMU releases and significant ecological resources or receptors. This approach allows identification of the constituents and exposure routes of concern early in the RFI/CMS process, and avoids expending effort on minor constituents and exposure routes that do not influence overall risk (USEPA Region III, 1993).

The risk evaluation has been prepared consistent with the screening-level approaches outlined in the following documents:

- RCRA Facility Investigation Plan, DuPont Washington Works (DuPont, 1997).
- RCRA Facility Investigation Requirements (included as Attachment D to the RCRA Facility Investigation Plan).
- USEPA Region III Technical Guidance Manual "Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening" (USEPA Region III, 1993).
- USEPA Region III Risk-Based Concentration Table (USEPA Region III, 1999).
- USEPA guidance for ecological risk assessment (USEPA 1997; 1998a; 1998b).

In keeping with the above guidance documents, the risk evaluation includes:

- Description of on-site and adjacent land use (Section 6.2).
- Evaluation of data used in risk screening (Section 6.3).
- Screening-level health risk evaluation, in which analytical data were compared to generic health-based screening levels for soil, to drinking water criteria for groundwater, or to background levels (Section 6.4).
- Identification of constituents and exposure pathways of concern screening step (Section 6.5).
- Ecological exposure evaluation (Section 6.6).
- Summary and conclusions (Section 6.7).

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6.2 SITE DESCRIPTION AND LAND USE

This section provides an overview of land use at the Washington Works site and identifies potential human ~~and~~ ecological receptors. Additional information on current and future land use is provided in Attachment 1, Land Use Report.

6.2.1 On-Site and Adjacent Land Use

The Washington Works facility has been the site of ongoing industrial activities since the initial plant was first constructed in 1948. It occupies 1,200 acres, extending about a mile along the Ohio River seven miles west of Parkersburg, WV. Most of the facility is developed for manufacturing purposes and is covered with paving, rail tracks, and buildings. Open areas include lawns, mowed fields, and a few areas of natural growth along portions of the riverbank. The developed portion of the property is fenced, and access is rigorously controlled by a security system. The riverbank itself lies outside the security fence, but is regularly patrolled. The riverbank adjacent to the facility is relatively inaccessible, due to its location and the regular security patrols, and there is little to attract casual visitors to the river's edge.

Adjacent land use is a mix of industrial, commercial, agricultural, residential, recreational, and open space. Adjacent industrial or commercial properties include GE Plastics and two warehouses to the west. Nearby residential areas include the unincorporated town of Washington, whose eastern extent is adjacent to the DuPont property, and individual homes and subdivisions within about a mile of the property to the east, south, and west.

Figure 2.2 show the Washington Works site and adjacent land use.

The Washington Works facility will continue to be used for industrial purposes in the future. Likewise, adjacent land use is expected to remain a mix of industrial, residential, and other uses. Land use issues are addressed in more detail in Attachment 1, Land Use Report.

6.2.2 Groundwater Uses

The alluvial terrace unconfined aquifer is the principal regional aquifer and is used locally for industrial, municipal, and rural water supplies. Depth to groundwater is approximately 60 to 70 feet in the main plant area, and the saturated zone is about 30 to 40 feet deep, extending to bedrock at roughly 100 feet BGS. As indicated in previous sections of this report, DuPont Washington Works operates several production well fields on the plant property that provide industrial process water and potable water to the plant (potable water is provided by Wells 331 (AO08, PW01), 332 (AQ09-PW01), and 336 (AM07-PW01), in the East Well Field).

Off-site well fields in the downstream direction include eleven industrial and five potable water wells on the GE Plastics site located just to the west of Washington Works and the Lubeck Public Service District (PSD) well field located about 2.3 miles south (downriver) of the plant. The Lubeck PSD provides water to nearly 99 % of the population in this portion of Wood County (Lubeck PSD, 1999). Other private wells or small community wells of unknown status were identified during a well search, but they are suspected of being inactive (see Section 4.3 of Attachment 1, Location of Wellhead Protection Areas and Drinking Water Wells).

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As discussed in Section 5, pumping of the Washington Works well fields controls groundwater flow, so that groundwater affected by SWMU releases is contained on-site.

6.2.3 Surface Water

Surface water of the Ohio River provides water to the cities of Parkersburg, West Virginia, and Belpre, Ohio, about seven miles upstream of the Washington Works facility. There are no permanent streams or surface water bodies on the main plant area at Washington Works. Precipitation in the main plant area is directed toward drains and storm sewers, which ultimately discharge to the Ohio River. Two drainage swales that convey surface runoff to the Ohio River during rainy weather are located on the property, one in the facility's southwest corner and the other on the extreme eastern (upgradient) end of the property.

The former BG and PWI have been excavated, backfilled, and resurfaced, so there are no surface water impacts from these SWMUs. The slopes of the RBL/ADP above the Ohio River are heavily vegetated, and the SWMUs have been covered with clean fill, so surface water impacts via surface runoff from these SWMUs are considered negligible. As indicated in the previous sections, SWMU-impacted groundwater does not discharge to surface water because of production well pumping.

6.2.4 Ecological Setting

The Washington Works site itself is largely developed and used for manufacturing activities, with manicured lawns, mowed fields, and a few areas of natural growth along portions of the river bank. These areas provide a narrow and intermittent terrestrial habitat for a variety of birds, small mammals, and other animals. The upper terraces upstream and downstream from the plant are kept in grassland with some small areas of trees and brush. A small chestnut grove is being developed by the facility's Wildlife Habitat Enhancement Program, in conjunction with the American Chestnut Foundation.

There are no known records of any federal or state listed species in the vicinity of the Washington Works Site (West Virginia Division of Natural Resources [WVDNR], 1999). In addition, no wetlands or critical terrestrial habitat were identified at the Washington Works facility during field observations conducted at the site. Section 6.6, Ecological Exposure Evaluation, provides additional site-specific information about ecological resources and exposures at the site.

6.3 DATA AND MEDIA EVALUATED

Soil and groundwater analytical data collected during the RFI were discussed in Sections 4.2 and 4.3. No quality assurance or quality control issues were identified that would affect data usability in risk assessment.

Tables 6.1 through 6.4 show the soil data included in the risk evaluation. These data were from samples collected between 0 and 20 feet BGS at the BG and RBL/ADP units. The depth of 20 feet is considered a conservative estimate of depth of excavation for future construction or utility work. Two soil intervals were evaluated: 0 to 2 feet (surface soil) and 2 to 20 feet (subsurface soil).

Table 6.5 shows the groundwater data included in the risk evaluation. These data were from water quality samples collected at the five production wells sampled during the RFI investigation: K16-PW01, L17-PW01, AM07-PW01, VO5-PW01, and LO4-PW01. Water from these wells is used to supply process water to the manufacturing area, and water from Wells AM07-PW01 (336) provides potable water to the plant. Therefore, groundwater drawn from these wells is representative of the exposure medium to which humans are or could be exposed.

6.4 SCREENING-LEVEL HEALTH RISK EVALUATION

The purpose of the screening-level health risk evaluation is to identify the constituents and exposure pathways that may be a concern for human health and that may warrant further evaluation or action. Constituents whose maximum concentrations do not exceed health-protective screening levels and environmental media that have no constituents exceeding screening levels are concluded to pose no concern for human health and can be eliminated from further evaluation. Potential exposure to multiple chemicals and multiple media also is considered in the risk evaluation, in order to strengthen conclusions drawn from the risk-based screen.

6.4.1 Potential Human Receptors

Human exposure to hazardous constituents released from the SWMUs is minimal or non-existent, because they have been removed and regraded or paved (BG, PWI, ADP) or covered and vegetated (RBL). However, for the risk evaluation it was assumed that potential on-site human receptors include site workers, occasional trespassers along the riverbank, and construction workers performing excavation work. Of these, the on-site worker is the most exposed individual, because he or she is assumed to be present on a daily basis for the duration of his/her career. Therefore, evaluating presumed on-site worker exposure to soil at the SWMUs is protective of construction workers and trespassers, whose exposure would be short-term and intermittent.

Likewise, workers are the only receptors who are exposed to production well water. Construction workers would not be exposed to groundwater during excavation because the water table is about 60 feet BGS.

6.4.2 Screening Levels Used in the Evaluation

Soil data were compared to the following screening levels:

- USEPA Region III RBCs for industrial soil (soil ingestion pathway) (USEPA Region III, 1999). The RBCs are based on a target excess cancer risk of 10^{-6} (1 in 1 million) and a noncancer hazard quotient (HQ) of one. These RBCs represent chemical concentrations in soil that would be expected to pose no adverse impacts to health under the exposure conditions evaluated. Industrial soil RBCs were used because the current and future use of the property is industrial (Section 6.2.1 and Attachment 1, Land Use Report).

- A screening level for lead in industrial soil of 1000 mg/kg. This level is a conservative (low) estimate for industrial soil screening purposes, because it is below typical screening levels calculated using USEPA's Adult Lead Exposure Model (1,200 to 1,800 mg/kg, using default parameters) (USEPA 1996a).

- Federal MCLs for drinking water or the federal action level for lead in tap water.

- USEPA Region III RBCs for tap water (in the absence of an MCL) (USEPA Region III, 1999).

- Preliminary screening levels for FC-143 in soil and groundwater (see Section 6.4.3).

Certain potential exposure pathways are not included in the derivation of the screening levels, namely:

- Inhalation: The inhalation pathway is not included in the derivation of the USEPA soil screening levels used in this evaluation. Nor are there USEPA-established "soil-to-air" screening levels for an industrial scenario. However, neglecting the inhalation pathway is not expected to significantly affect the results of the risk screening for the following reasons.

  — First, inhalation of non-volatile constituents (such as metals or FC-143) that are adhered to soil particulate matter usually does not contribute significantly to overall risk because air emissions from wind erosion are, on an annual average basis, relatively low. This is represented in USEPA's default Particulate Emission Factor (PEF) of 1.32 x 10^{+9} m^3/kg soil (USEPA 1996b). When applied in the denominator of an equation to estimate air concentrations of particulate matter, the resulting air particulate matter concentrations are negligible and usually do not contribute to overall risk.

  — Secondly, volatile constituents, such as methylene chloride or trichloroethylene, were relatively infrequently detected in soil (see Tables 6.1 through 6.4), and would not be expected to contribute to a significant inhalation hazard. Therefore, the industrial soil RBCs are considered sufficiently conservative (protective) for the screening-level risk evaluation. If constituent concentrations in soil exceed the RBCs, the inhalation pathway may warrant consideration in the future.

- Dermal absorption: The dermal absorption exposure route is not included in the derivation of the USEPA soil RBCs used in this evaluation. Although this adds a small uncertainty to the screening levels, it will not significantly affect the results of the screening. In cases where constituent concentrations in soil exceed RBCs, dermal absorption may warrant further consideration in the future.

- Migration to groundwater: Soil screening levels for protection of groundwater used as drinking water were not included in the risk screening evaluation because groundwater data were compared directly to drinking water criteria.

6.4.3 Derivation of Preliminary Screening Levels for FC-143

USEPA-established screening levels are not available for FC-143. Therefore, preliminary screening levels analogous to Region III RBCs for soil and groundwater were derived from a health-based Community Exposure Guideline (CEG) of 0.0003 mg/m^3 air (Haskell Laboratory 1991). The CEG was developed by Haskell Laboratory to be protective of public exposure via the inhalation pathway.

The CEG was derived from the DuPont Allowable Exposure Level (AEL) for workers of 0.01 mg/m^3. Both the AEL and the CEG are health-protective of the exposure conditions to which they apply. For example, the AEL for workers is 100 times lower than a No Observed Effect Level in a laboratory animal inhalation study and is 1,000 times lower than a Marginal Effect Level in a laboratory animal feeding study (Haskell Laboratory 1991). Therefore, the AEL is considered to be a safe level for workers potentially exposed for eight hours/day.

To derive a level protective of sensitive subpopulations (such as infants and the elderly) and to account for a 24-hour/day exposure time, the AEL was reduced further by a safety factor of ten to account for the presence of sensitive subpopulations in the community and again by a safety factor of three to account for a 24-hour/day exposure time, resulting in the CEG of 0.0003 mg/m^3. Therefore, the CEG is considered protective of general public exposures that could include sensitive subpopulations, exposed 24 hours/day.

Exposure to the CEG of 0.0003 mg/m^3 would result in an allowable daily intake of 0.006 mg/day, assuming an inhalation rate of 20 m^3/day (USEPA Region III default residential inhalation rate). From this allowable intake, preliminary screening levels for soil and groundwater can be calculated using USEPA default exposure assumptions for industrial soil ingestion and residential groundwater ingestion.

Table 6.6 shows the calculation of preliminary screening levels for FC-143 in industrial soil (120 mg/kg) and for groundwater used as drinking water (0.003 mg/L). These preliminary screening levels were used in evaluating site soil and production well water data for FC-143.

6.4.4 Results of Risk-Based Screening for Soil

Tables 6.1 through 6.4 show the sample analytical results for constituents detected in soil and groundwater and include the SLs for comparison. Table 6.7 summarizes the results of the risk-based screening for soil.

Table 6.7 shows that maximum observed concentrations of all constituents at all SWMUs and soil intervals were well below their respective screening levels, with the exception of arsenic (which is present at concentrations comparable to background levels). Therefore, it is concluded that constituents in soil do not pose a health concern for workers via the soil ingestion pathway.

Potential exposure via other routes (e.g., dermal absorption or inhalation) and possible additive effects of multiple noncarcinogens are also not a concern. Maximum observed concentrations of all site-related constituents were lower than screening levels by factors of ten to one million, except for FC-143 and methylene chloride in the 2- to-20-foot interval at the RBL/ADP, where maximum concentrations of these two constituents were lower than their respective screening levels by a factor of about 2.4.

Because maximum observed concentrations of site-related constituents are well below conservative health-protective screening levels, it is concluded that constituents in soil do not pose a health concern for workers or transient receptors.

6.4.5 Risk Screening for Production Well Water

Table 6.5 compares sample analytical results from production well samples to MCLs or other health-based screening levels for drinking water. Table 6.8 summarizes the risk-based screen for production well water.

In well AM07-PW01, which supplies potable water for the plant, maximum concentrations of all constituents were below their respective drinking water criteria. To confirm this conclusion, a third round of analysis for FC-143 was conducted in May, 1999 (see Appendix D). Therefore, no unacceptable health risk would be associated with the observed concentrations in the potable water well.

In production wells providing industrial process water, maximum concentrations of all constituents were also below health-based criteria for drinking water, with the exception of TCE in production well V05-PW01 and FC-143 in production wells K16-PW01, V05-PW01, and L04-PW01. Specifically, the maximum concentration of TCE (22 micrograms per liter (ug/L)) exceeded the MCL of 5 ug/L, and the maximum concentration of FC-143 (16.2 ug/L) exceeded its preliminary screening level for drinking water of 3 ug/L (Table 6.8). For both constituents, maximum concentrations exceeded their respective drinking water criteria by factors of four to five. Because water from these wells is not used for drinking, but rather for industrial processes such as non-contact cooling water or fire water where exposure is nonexistent or intermittent, it was concluded that the exceedances of the drinking water criteria by relatively small factors is not likely to pose health concern for workers who may be exposed to process water.

6.5 SUMMARY OF CONSTITUENTS AND PATHWAYS OF CONCERN (HUMAN HEALTH)

All constituents in all media evaluated were below health-protective criteria, with the exception of TCE and FC-143, whose maximum concentrations in industrial process well water exceeded drinking water criteria by factors of four to five (see Appendices B and C). However, average concentrations in process water at the point of use (which is a mixture of water from several production wells) will be lower than maximum concentrations detected in one well. Therefore, these exceedances are not considered a concern for worker health under exposure conditions typical for industrial process water.

As demonstrated in Section 5, SWMU-impacted groundwater is contained on-site by production well pumping and does not migrate off-site or to surface water.

In summary, the identified releases from the SWMUs are not a concern for human health. Site-related constituent concentrations in soil (0 to 20 feet) did not exceed screening levels. While TCE and FC-143 somewhat exceeded screening levels in production well water used for industrial process water (but not in potable well water), there is limited exposure to industrial process water. In addition, SWMU-impacted groundwater is contained on site.

These findings are summarized in Figure 6.1, Human Exposure Pathway Evaluation. The figure indicates that potential exposure routes for site receptors (workers, riverbank trespasser, and construction worker) are either incomplete or insignificant and that groundwater migration to surface water is an incomplete pathway due to pumping.

6.6 ECOLOGICAL EXPOSURE EVALUATION

The ecological evaluation focused on identifying whether significant ecological resources may be exposed to site-related constituents released from the SWMUs. According to USEPA guidance (USEPA 1997, 1998a, 1998b), valued ecological resources are those that either provide critical habitat (such as wetlands or fisheries), are critical to sustaining populations of species or habitat, are reflective of public concerns (e.g., wildlife habitat for game animals), or are federal or state listed species that could be exposed and susceptible to site-related constituents.

The study area for the ecological evaluation included the four SWMUs and surrounding terrestrial habitat. The ecological evaluation included a day and a half of field reconnaissance for habitat characterization (April 6 to 7, 1999), principally along the portion of the property adjacent to the river, which includes the RBL/ADP.

6.6.1 Exposure Areas and Media

Surface soil at the RBL/ADP is the only potential ecological exposure medium within the RFI study area. The PWI and BG SWMUs are covered with gravel, asphalt, or buildings and do not provide ecological habitat. Subsurface soil (greater than 2 feet) and groundwater are not exposure media of concern for ecological receptors, and groundwater does not discharge to surface water at the site.

6.6.2 Habitat Characterization at the RBL/ADP

The RBL/ADP lies in a narrow band between the river and the main manufacturing area. It runs approximately 4,500 feet and rises 30 feet above the floodplain, covering a portion of the alluvial terrace on which the main plant is located. A layer of clean fill 6 to 36 inches thick was placed over the RBL upon closure in the 1960s. The southern side of the RBL is within the active manufacturing area and is covered with gravel or buildings. The ADPs were closed in 1988 and removed. The ponds were filled and capped and are now covered with grassy vegetation.

The slope of the RBL/ADP is covered with hardwood trees, shrubs, grass, and other dense vegetation that has grown in the 30 years since the landfill was closed. The area between the RBL/ADL and the river is manicured grass, with a few trees and shrubs. At the upstream end of the RBL, the grassy area gives way to natural vegetation of trees and shrubs. Major vegetation species include beech, maples, oaks, ash, cottonwood, black willow, and sweetgum.

Wildlife observations, including tracks, burrows, and scat, included small mammals (woodchucks, cottontail rabbits, squirrels) and deer tracks along portions of the river. It can be assumed that other small animals such as mice, voles, raccoons, and various reptile and amphibian species would inhabit the area near the riverbank. Birds observed in the area were primarily bank swallows, crows, and redwing blackbirds. Other passerine birds will likely occur during different seasons. Hawks were observed hunting over the area and several species of waterfowl were observed on the river that might feed on vegetation on the riverbank. Ospreys, reintroduced by DuPont's Wildlife Habitat Enhancement Program, were reported by a plant employee to nest in the area. Bluebird and wood duck nesting boxes were placed near the river, but these species were not seen.

6.6.3 Identification of Significant Ecological Resources

While numerous plant and animal species were observed along the riverbank area, no significant ecological resources such as wetlands, game habitat, or threatened or endangered species were identified within the RFI study area. In addition, according to the WVDNR, Wildlife Resources Section, no rare, threatened, or endangered species are recorded for the vicinity of the Washington Works plant. Table 6.9 lists the terrestrial species that are listed as Rare, Threatened or Endangered (RTE) by both the U.S. Fish and Wildlife and the West Virginia Natural Heritage Program.

In conclusion, no significant ecological habitat or species of special concern were identified within the study area, and therefore potential ecological impacts from constituents in soil at the SWMUs are expected to be insignificant.

6.6.4 Ecological Exposure Pathway Evaluation

In conclusion, there appear to be no significant ecological resources or exposure pathways of concern related to soil at the SWMUs. Groundwater is not an exposure medium for ecological receptors, because there are no surface expressions of groundwater at the site (water table is about 60 feet BGS).

These findings are summarized in Figure 6.2, Ecological Exposure Pathway Evaluation. The figure indicates that potential soil exposure pathways are either incomplete or insignificant, primarily due to the absence of significant ecological resources in the study area.

6.7 SUMMARY AND CONCLUSIONS

Soil at all SWMUs is not a medium of concern for human health because maximum observed concentrations in soil were below health-protective screening levels. In the well supplying potable water (AM07-PW01), constituent levels were below MCLs or other health criteria, so the water is not a significant source of exposure for workers. In wells supplying industrial process water, maximum concentrations of two constituents somewhat exceeded MCLs or health criteria for drinking water, but the water is not ingested, and therefore, the production well water is not considered a health concern under exposure conditions typical for industrial process water.

SWMU - impacted groundwater is contained on site by production well pumping.

Ecological habitat in the study area is limited to a narrow band of woody or grassy vegetation along the river bank and slopes of the RBL/ADP, inhabited or visited by small mammals, birds, and other animals. No significant ecological resources were identified within the RFI study area, and no rare, threatened, or endangered species have been recorded for the vicinity of the Washington Works site. Because of the absence of significant ecological resources and the limited potential for exposure, ecological exposure pathways were concluded to be incomplete or insignificant.

Table 6.10 summarizes the findings of the screening-level risk evaluation and ecological exposure evaluation.

7.1 CONCLUSIONS

The main objectives ~~of~~ the Washington Works RFI were to determine the nature and extent of SWMU-derived waste constituents, and their rate of migration in groundwater and other media, and to identify whether or not potential releases are a concern for human health or the environment. The RFI field investigation, groundwater flow modeling, and a risk evaluation were conducted to meet these objectives. The primary conclusions reached through completion of these efforts are summarized as follows:

1. Concentrations of metals detected in soils underlying and adjacent to SWMU areas are comparable to background concentrations.
2. The organic constituents detected in groundwater appear primarily to be attributable to releases from the RBL and ADP SWMUs. The BG SWMU does not appear to be a source for organic constituents detected in groundwater.
3. The extent of horizontal impact (i.e., laterally away from the edge of a SWMU) of organic constituents to soils near the SWMUs appears to be minimal. In general, releases from SWMUs migrate vertically downward through the vadose zone to the site aquifer.
4. Concentrations of organic constituents detected in soils underlying and adjacent to SWMU areas do not exceed USEPA Region III RBCs for industrial soils. This includes shallow soils (0-2 feet deep) and subsurface soils (>2 feet deep).
5. Two organic waste constituents, TCE and FC-143, were detected in groundwater from production wells. Their concentrations exceeded health-based screening levels. However, this impacted groundwater does not present a human exposure risk as it is primarily used for non-contact industrial purposes.
6. In the methylene chloride seep area (i.e., RBLL1) the horizontal extent of impact (i.e., toward the river) is minimal. The active french drain collection system effectively contains seepage, prevents human exposure, and prevents off-site migration. This system is an effective final remedy as constructed.
7. No significant human or ecological exposure pathways to SWMU-impacted soils or groundwater exist. SWMU soils are covered and rendered inaccessible by overlying buildings, asphalt or dense vegetation. All but two organic constituents in site aquifer groundwater are below health-based screening levels; however, since the groundwater is primarily used for non-contact industrial purposes, it is deemed not a threat to human health.
8. The current groundwater flow model demonstrates complete capture of SWMU-impacted groundwater by the production well system and, although not planned, this capture would continue even with a 65% reduction in pumping rates.

7.2 USEPA ENVIRONMENTAL INDICATORS

The following summary is provided to address USEPA's newly implemented Environmental Indicator program. The primary objective is to present RFI conclusions that specifically pertain to CA 725-Human Exposure Under Control and CA 750-Contaminated Groundwater Migration Under Control evaluation criteria.

7.2.1 CA 725-Human Exposure Under Control

As noted in Section 6.5 and Section 7.1, there are currently no complete or significant exposure pathways to SWMU-impacted soils or groundwater.

7.2.2 CA 750-Contaminated Groundwater Migration Under Control

As demonstrated by the site-wide groundwater flow model, current production well pumping prevents off-site migration of SWMU-impacted groundwater.

7.3 RECOMMENDATIONS

DuPont recommends the following future activities at the Washington Works Plant site pertaining to the HSWA permit/Corrective Action Program:

- Continue operation of the methylene chloride seep collection and treatment system (RBLL1) as a final remedy.
- Maintain production well pumping at or above 35% of present levels.
- Conduct long-term groundwater quality and site aquifer potentiometric surface monitoring to ensure the continued protection of human health.
- Conduct long-term groundwater potentiometric surface monitoring to ensure the continued capture of site groundwater.

It is proposed that this monitoring occur semi-annually. A set of specific wells will be sampled for a parameter list consistent with currently identified groundwater quality impacts. Groundwater elevation measurements and samples would confirm the effectiveness of production well pumping as the means of preventing off-site migration of SWMU-derived waste constituents.

DuPont will prepare a long-term groundwater monitoring plan upon direction from USEPA Region III.

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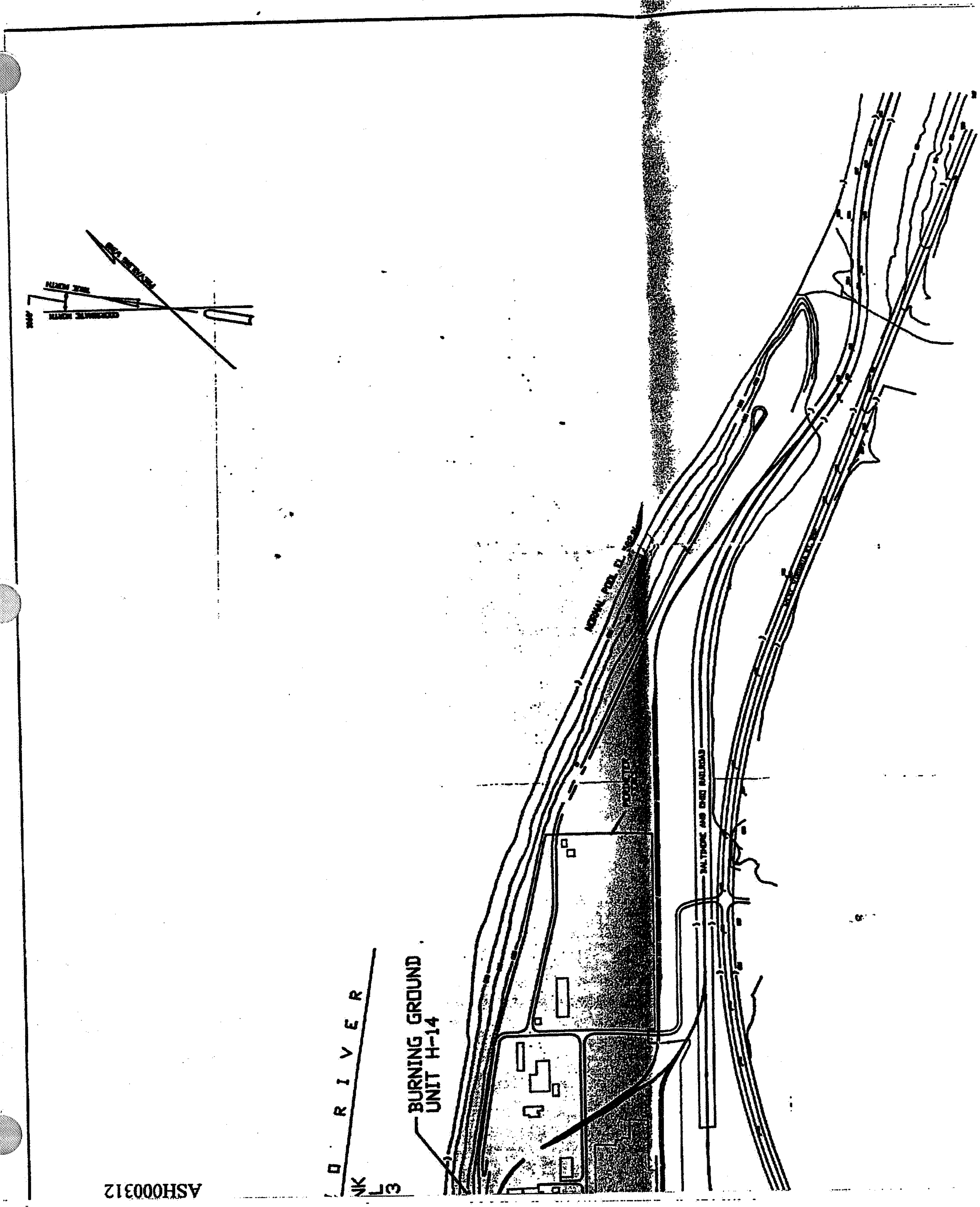

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FIGURES

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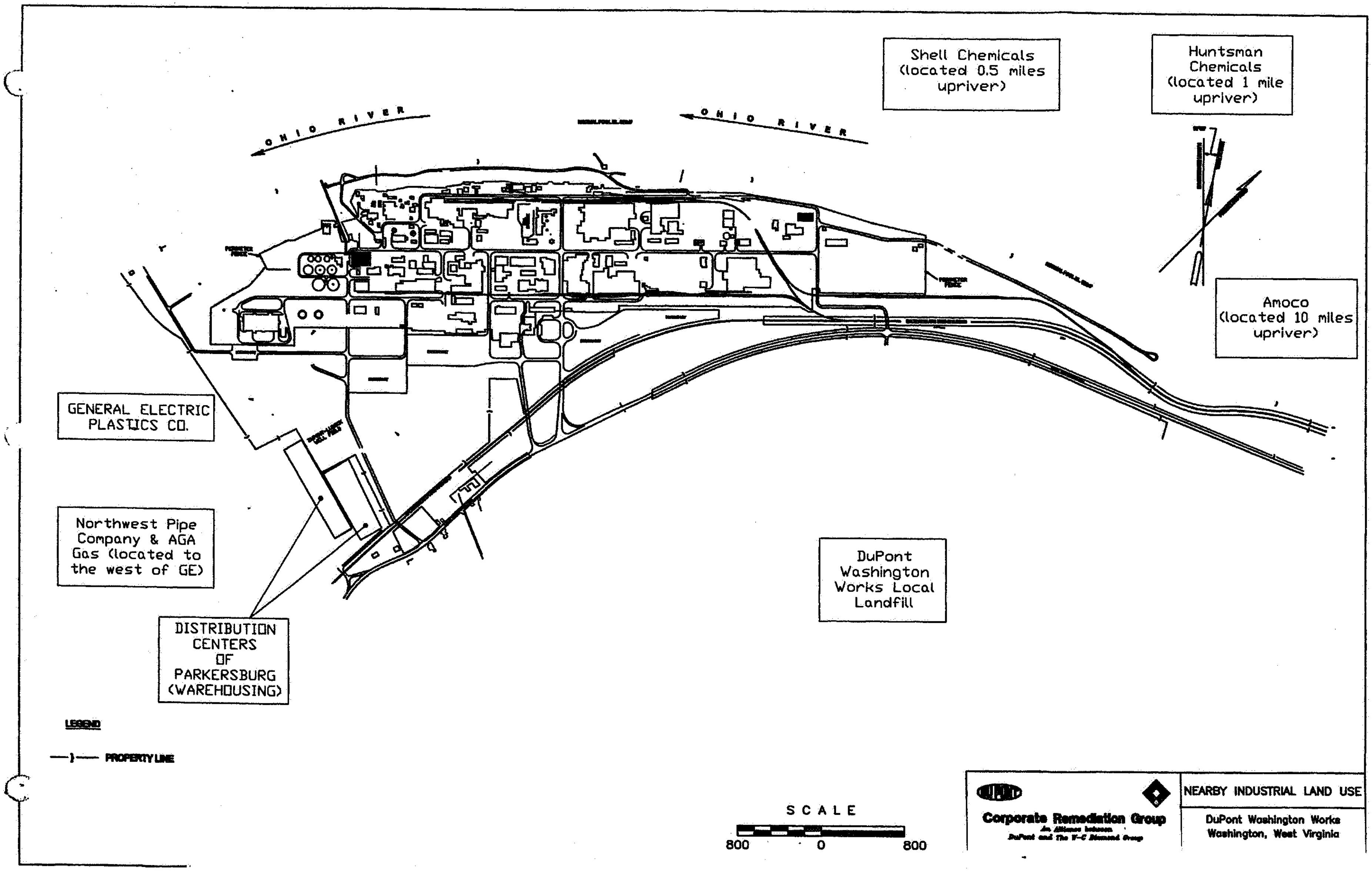
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Huntsman Chemicals (located 1 mile upriver)
OHIO RIVER
OHIO RIVER
Amoco (located 10 miles upriver)
GENERAL ELECTRIC PLASTICS CO.
Northwest Pipe Company & AGA Gas (located to the west of GE)
DISTRIBUTION CENTERS OF PARKERSBURG (WAREHOUSING)
DuPont Washington Works Local Landfill
LEGEND
PROPERTY LINE
SCALE
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Corporate Remediation Group
NEARBY INDUSTRIAL LAND USE
DuPont Washington Works
Washington, West Virginia

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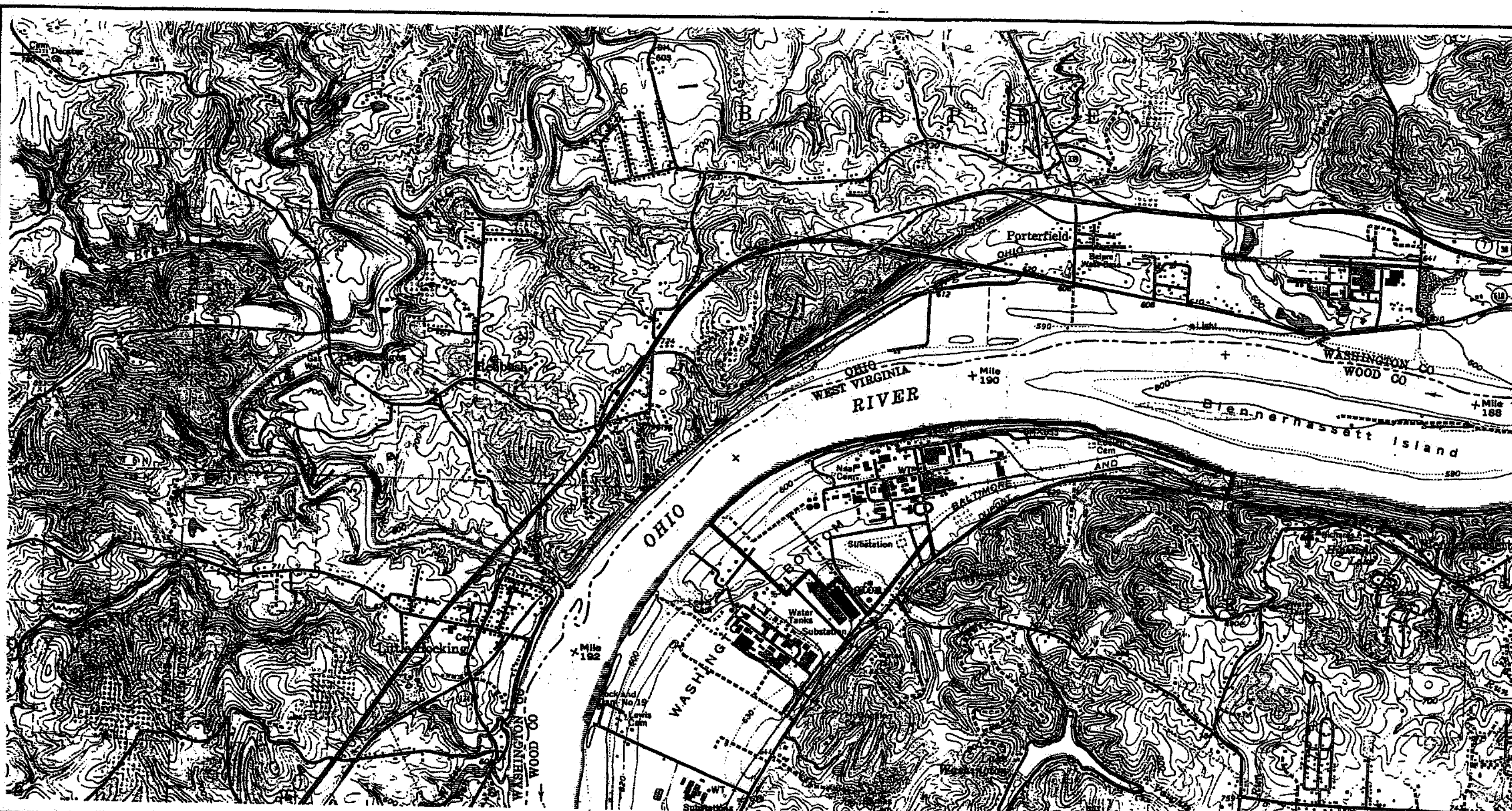
Figure 2.1



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DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

OHIO

SOURCE: USGS LITTLE HOCKING QUADRANGLE OHIO - WEST VIRGINIA
7.5 MINUTE SERIES (TOPOGRAPHIC)

SITE LOCATION MAP

FIGURE 2.1

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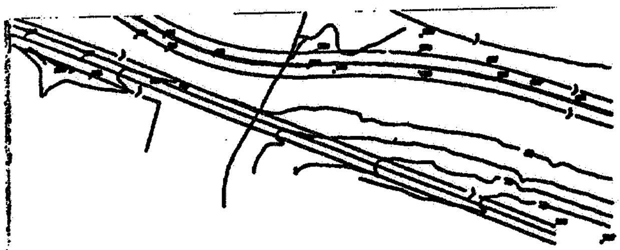
DATE	CHECKED	APPROVED	PROJECT NO
8/7/97		ASH	7179

E. I. DuPont de Nemours & Co. Inc.
WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA

DuPont Environmental Remediation Services

DUPONT



SCALE

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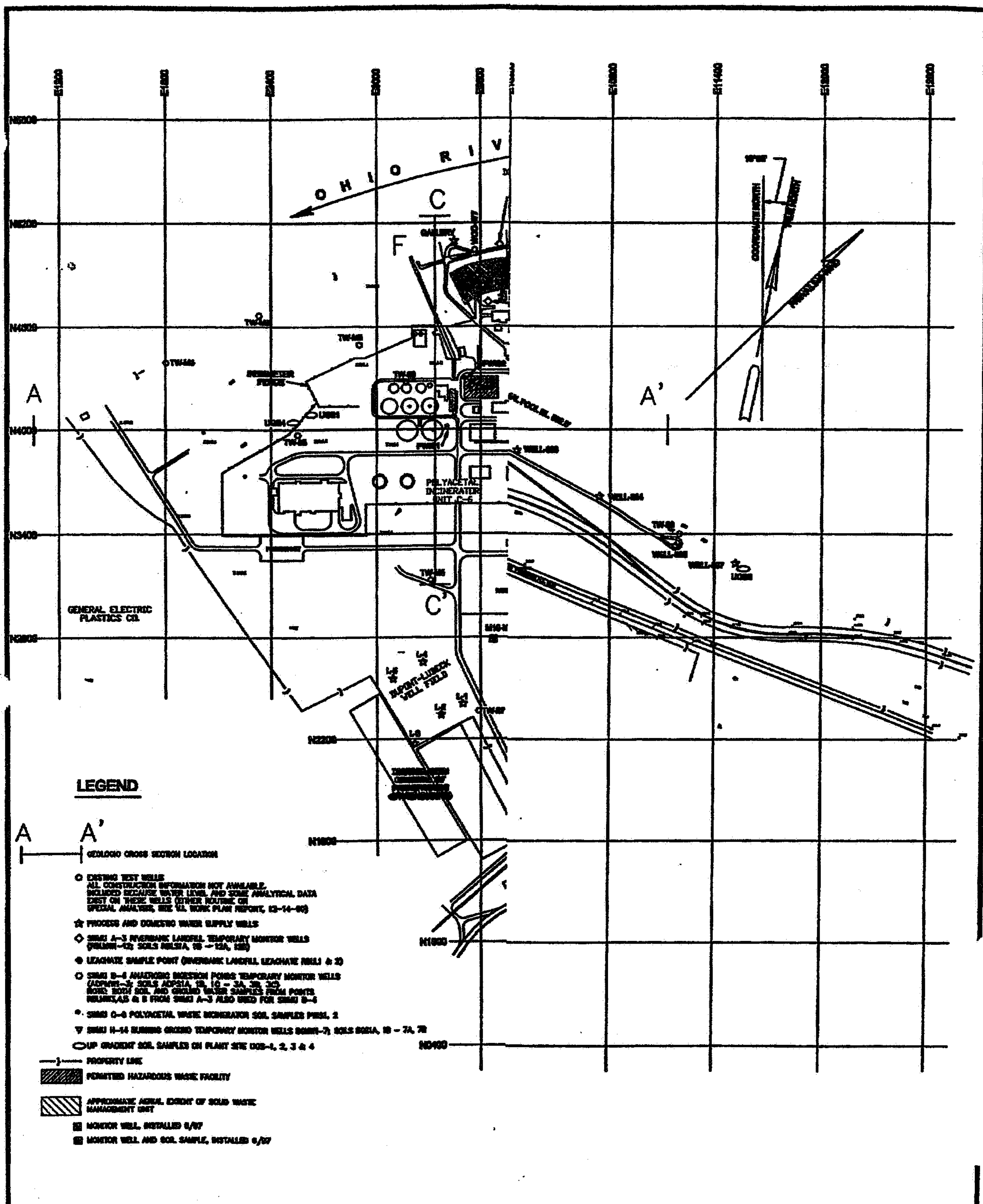

DUPONT **Corporate Remediation Group** *An Alliance between DuPont and The W-C Diamond Group* Barley Mill Plaza, Building 27 Wilmington, Delaware 19880-0027	TITLE: CROS DuPC WASI	DWN: DEL CHKD: SJO DATE: 6/25/99	DES.: APPD: REV.: 0
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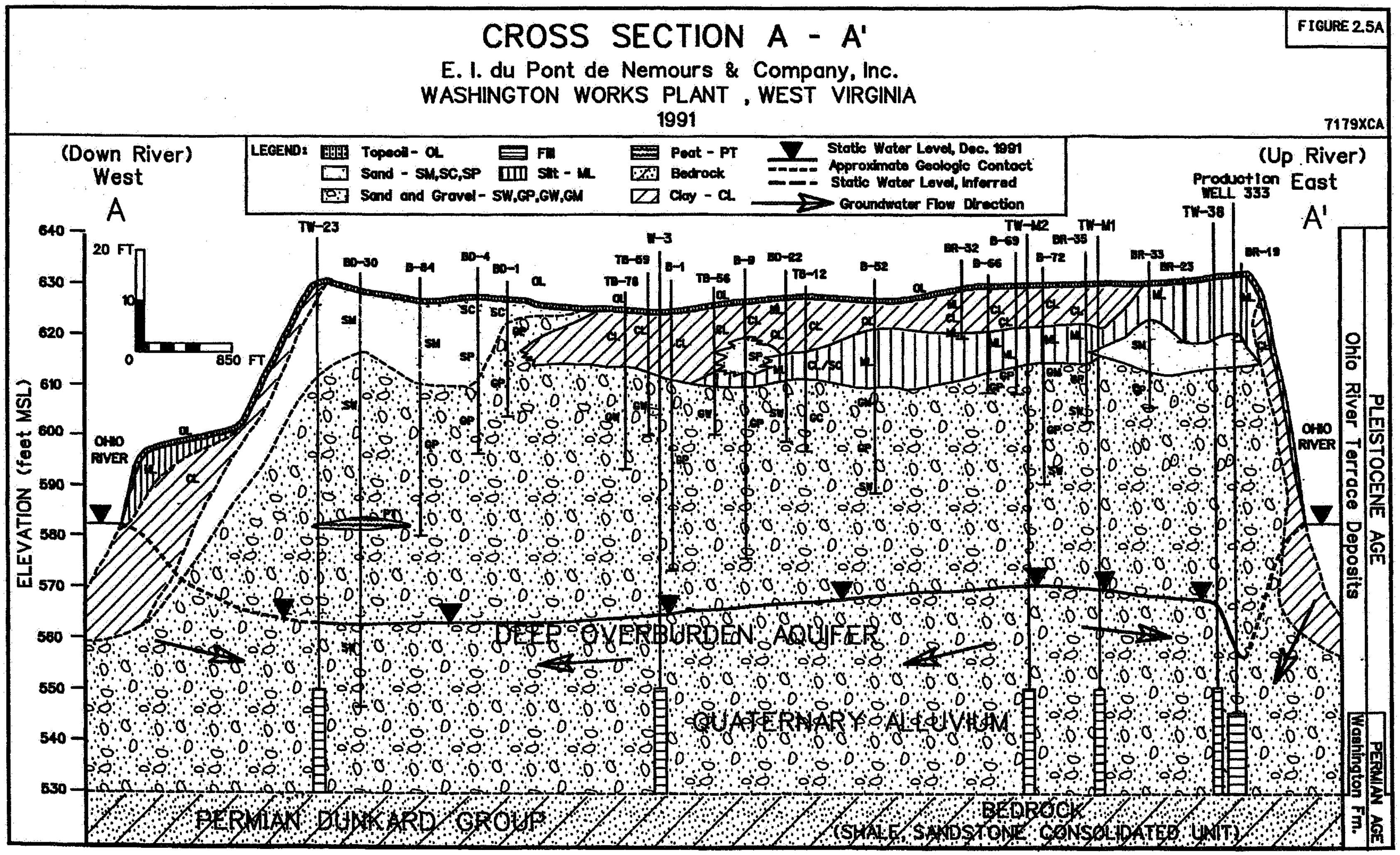

Figure 2.5A

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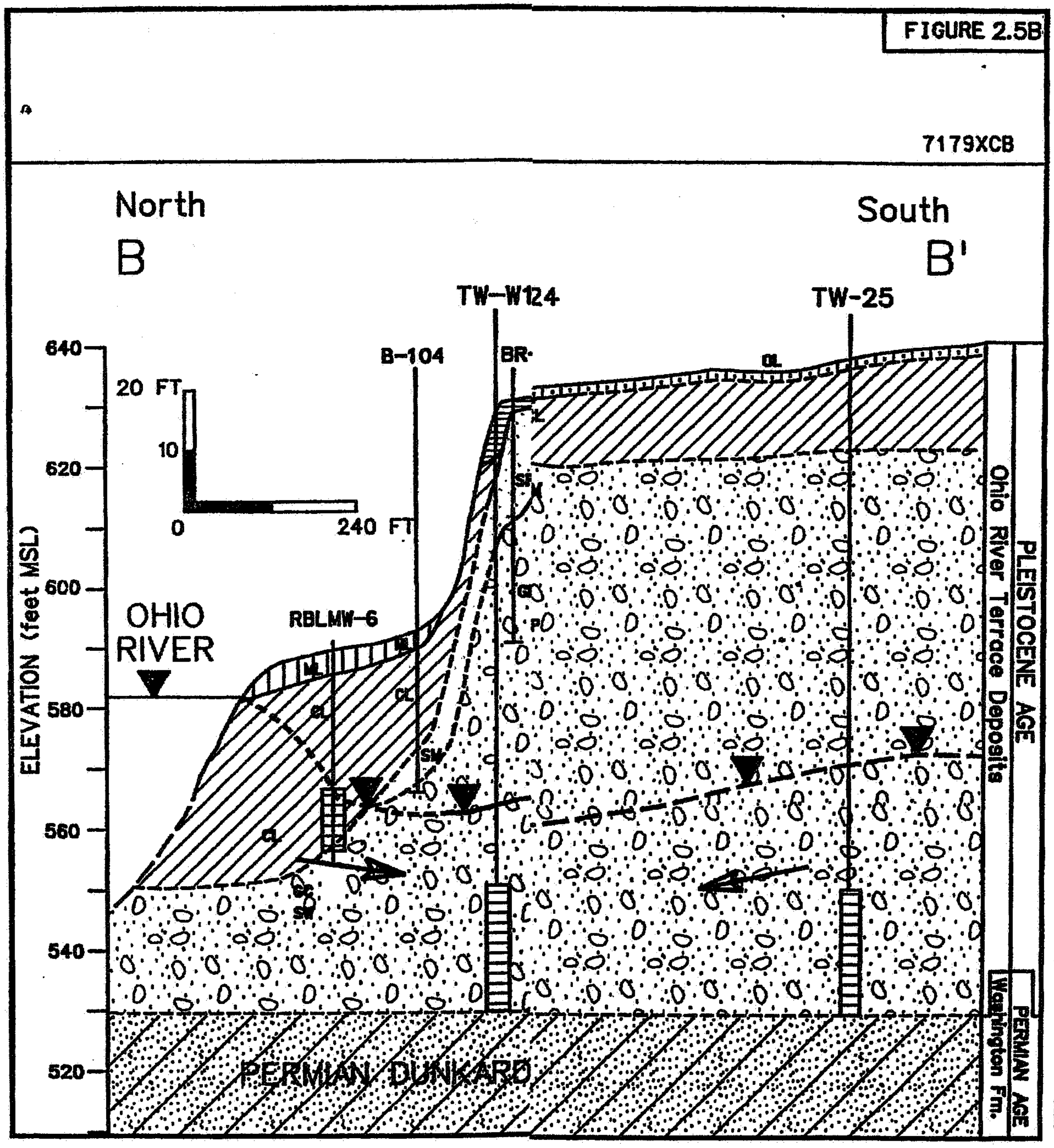

Figure 2.5B

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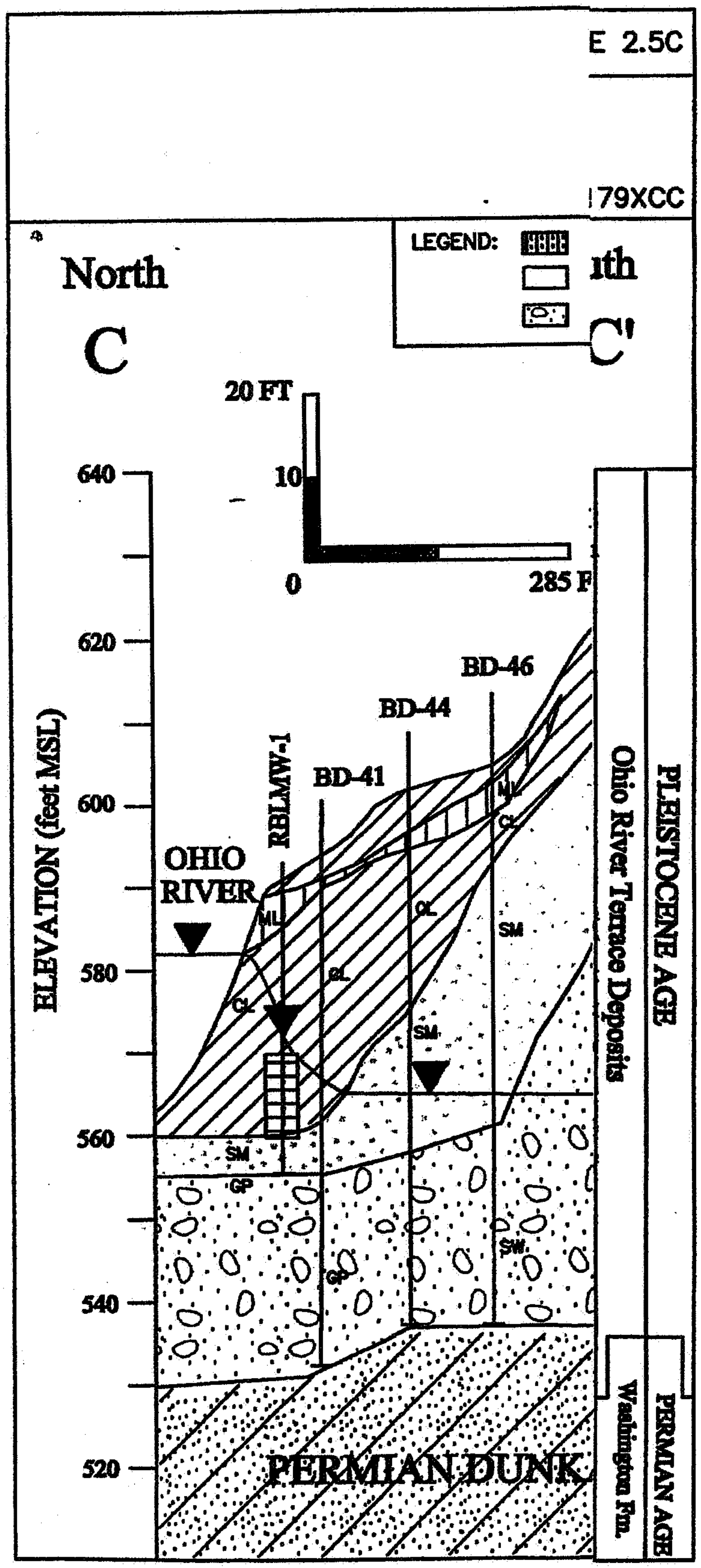


Figure 2.5C

ASH000318

EID090417

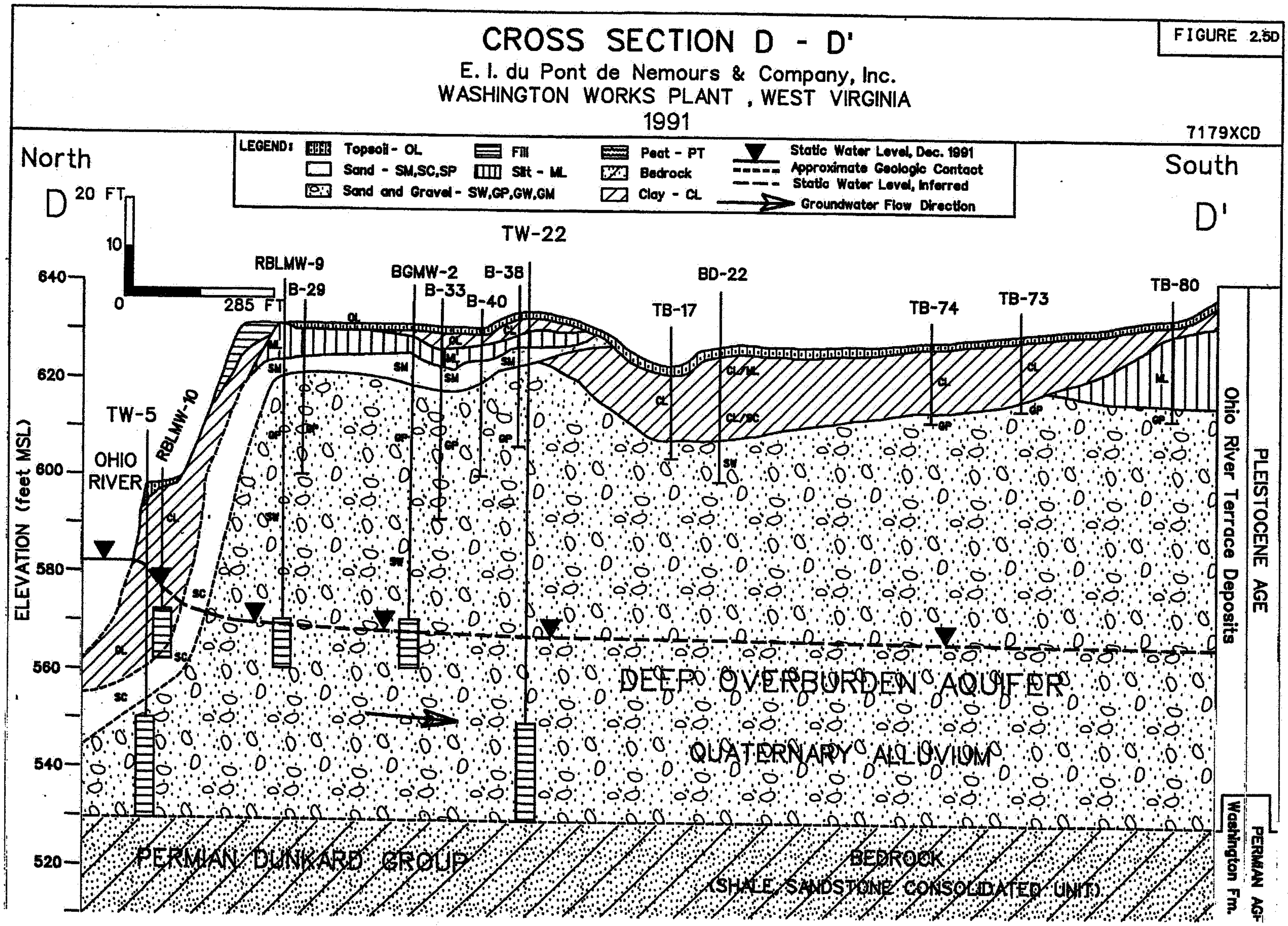

CROSS SECTION D - D'
E. I. du Pont de Nemours & Company, Inc.
WASHINGTON WORKS PLANT , WEST VIRGINIA
1991
FIGURE 2.5D
7179XCD
North
D
South
D'
LEGEND:
Topsoil - OL
Sand - SM,SC,SP
Sand and Gravel - SW,GP,GW,GM
Fill
Silt - ML
Peat - PT
Bedrock
Clay - CL
Static Water Level, Dec. 1991
Approximate Geologic Contact
Static Water Level, Inferred
Groundwater Flow Direction
20 FT
10
0
285 FT
ELEVATION (feet MSL)
640
620
600
580
560
540
520
TW-5
OHIO RIVER
RBLMW-10
RBLMW-9
B-29
BGMW-2
B-33
B-40
B-38
TW-22
TB-17
BD-22
TB-74
TB-73
TB-80
DEEP OVERBURDEN AQUIFER
QUATERNARY ALLUVIUM
PERMIAN DUNKARD GROUP
BEDROCK
(SHALE, SANDSTONE CONSOLIDATED UNIT)
PLEISTOCENE AGE
Ohio River Terrace Deposits
PERMIAN AGE
Washington Fm.

Figure 2.5D

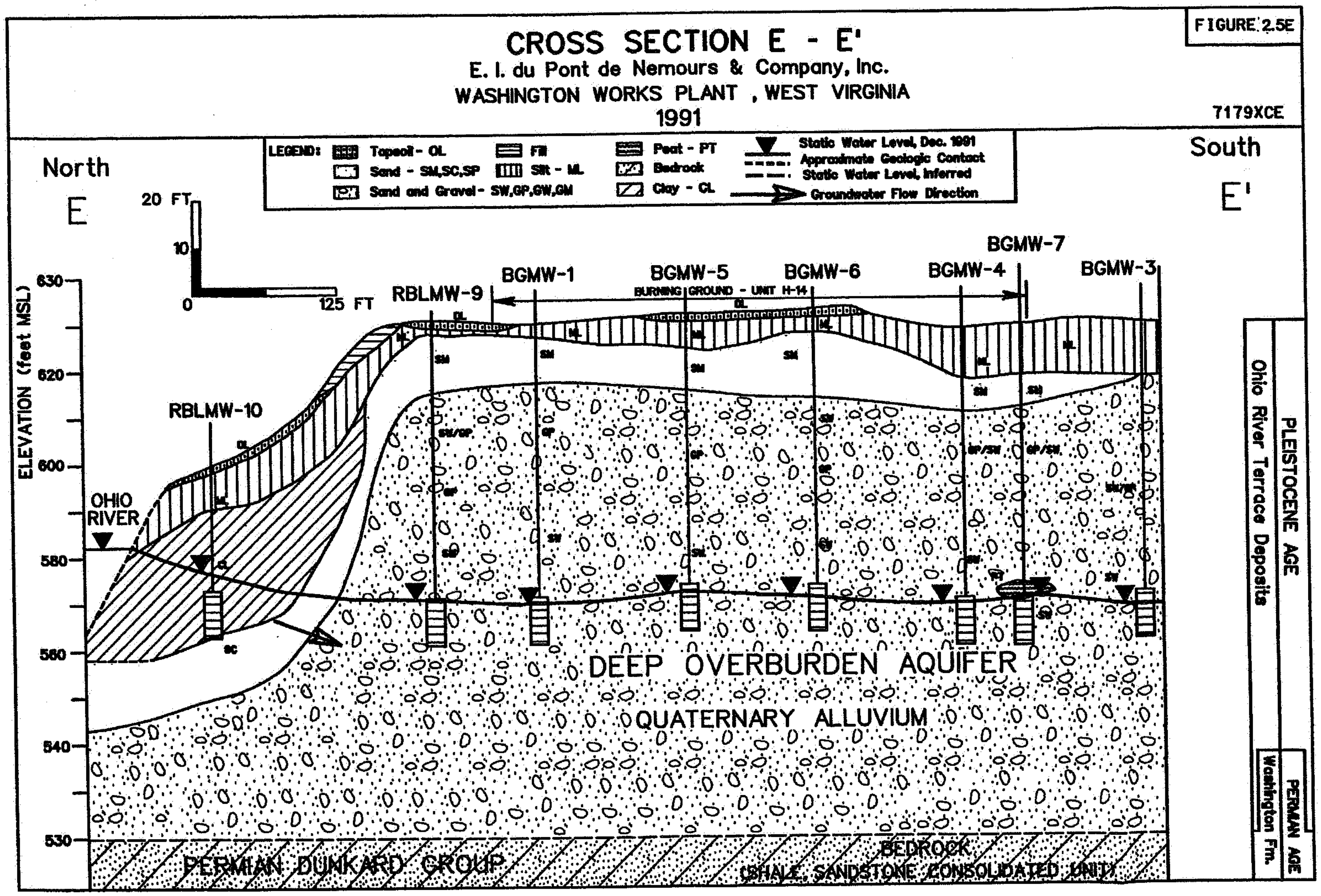

CROSS SECTION E - E'
E. I. du Pont de Nemours & Company, Inc.
WASHINGTON WORKS PLANT , WEST VIRGINIA
1991
FIGURE 2.5E
7179XCE
LEGEND: Topsoil - OL
Sand - SM,SC,SP
Sand and Gravel - SW,GP,GW,GM
Fill
Silt - ML
Peat - PT
Bedrock
Clay - CL
Static Water Level, Dec. 1991
Approximate Geologic Contact
Static Water Level, Inferred
Groundwater Flow Direction
North
E
South
E'
20 FT
10
0
125 FT
ELEVATION (feet MSL)
630
620
600
580
560
540
530
OHIO RIVER
RBLMW-10
RBLMW-9
BGMW-1
BGMW-5
BGMW-6
BGMW-4
BGMW-7
BGMW-3
BURNING GROUND - UNIT H-14
DEEP OVERBURDEN AQUIFER
QUATERNARY ALLUVIUM
PERMIAN DUNKARD GROUP
BEDROCK
(SHALE, SANDSTONE CONSOLIDATED UNIT)
PLEISTOCENE AGE
Ohio River Terrace Deposits
PERMIAN AGE
Washington Fm.

Figure 2.5E

Figure 2.5F

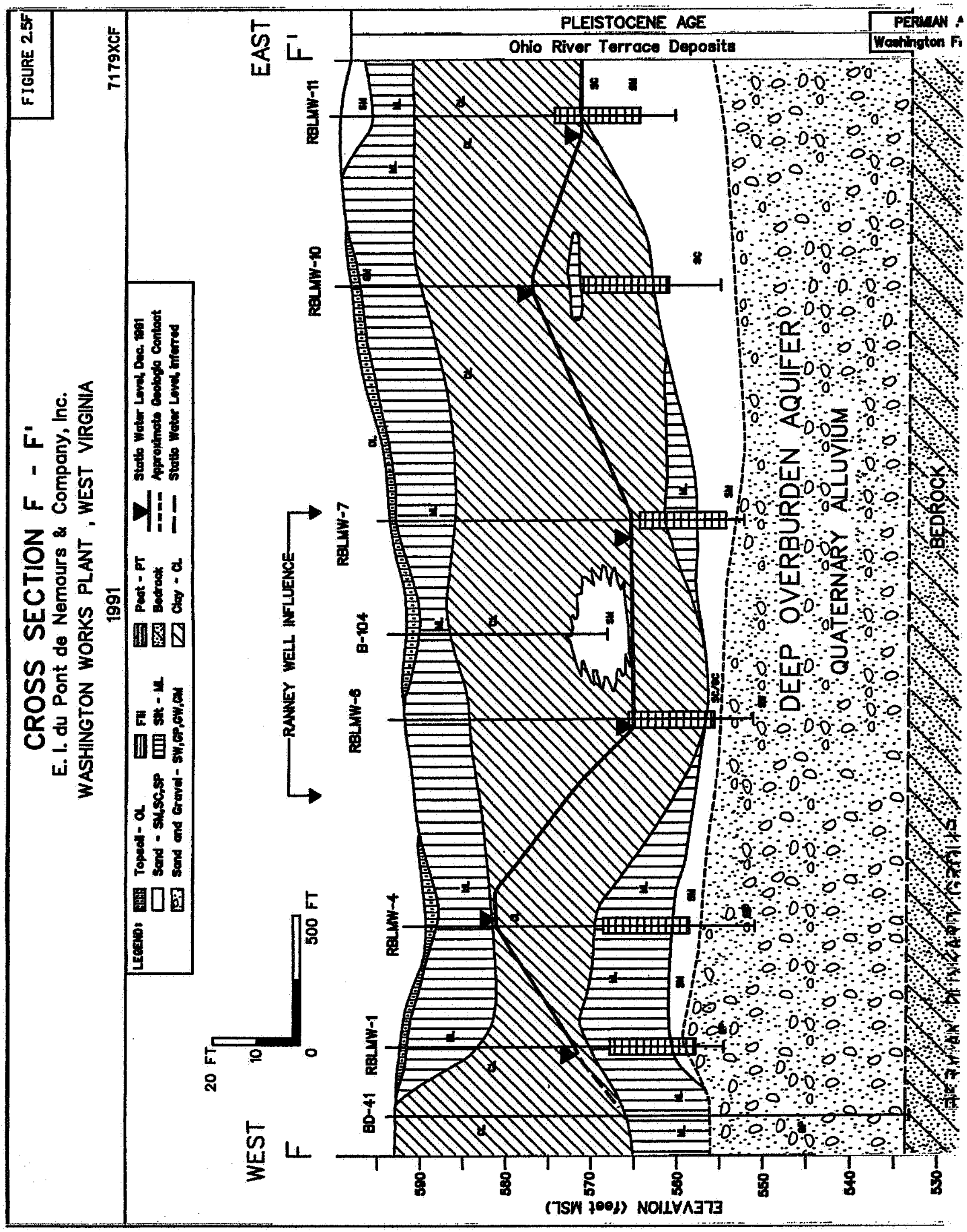


FIGURE 2.5F
7179XCF
CROSS SECTION F - F'
E. I. du Pont de Nemours & Company, Inc.
WASHINGTON WORKS PLANT , WEST VIRGINIA
1991
LEGEND:
Topsoil - OL
Sand - SM,SC,SP
Sand and Gravel - SW,GP,GW,GM
Fill
Silt - ML
Peat - PT
Bedrock
Clay - CL
Static Water Level, Dec. 1991
Approximate Geologic Contact
Static Water Level, Inferred
20 FT
10
0
500 FT
RANNEY WELL INFLUENCE
WEST
F
EAST
F'
BD-41
RBLMW-1
RBLMW-4
RBLMW-6
B-104
RBLMW-7
RBLMW-10
RBLMW-11
PLEISTOCENE AGE
Ohio River Terrace Deposits
PERMIAN
Washington F
DEEP OVERBURDEN AQUIFER
QUATERNARY ALLUVIUM
BEDROCK
ELEVATION (feet MSL)
590
580
570
560
550
540
530

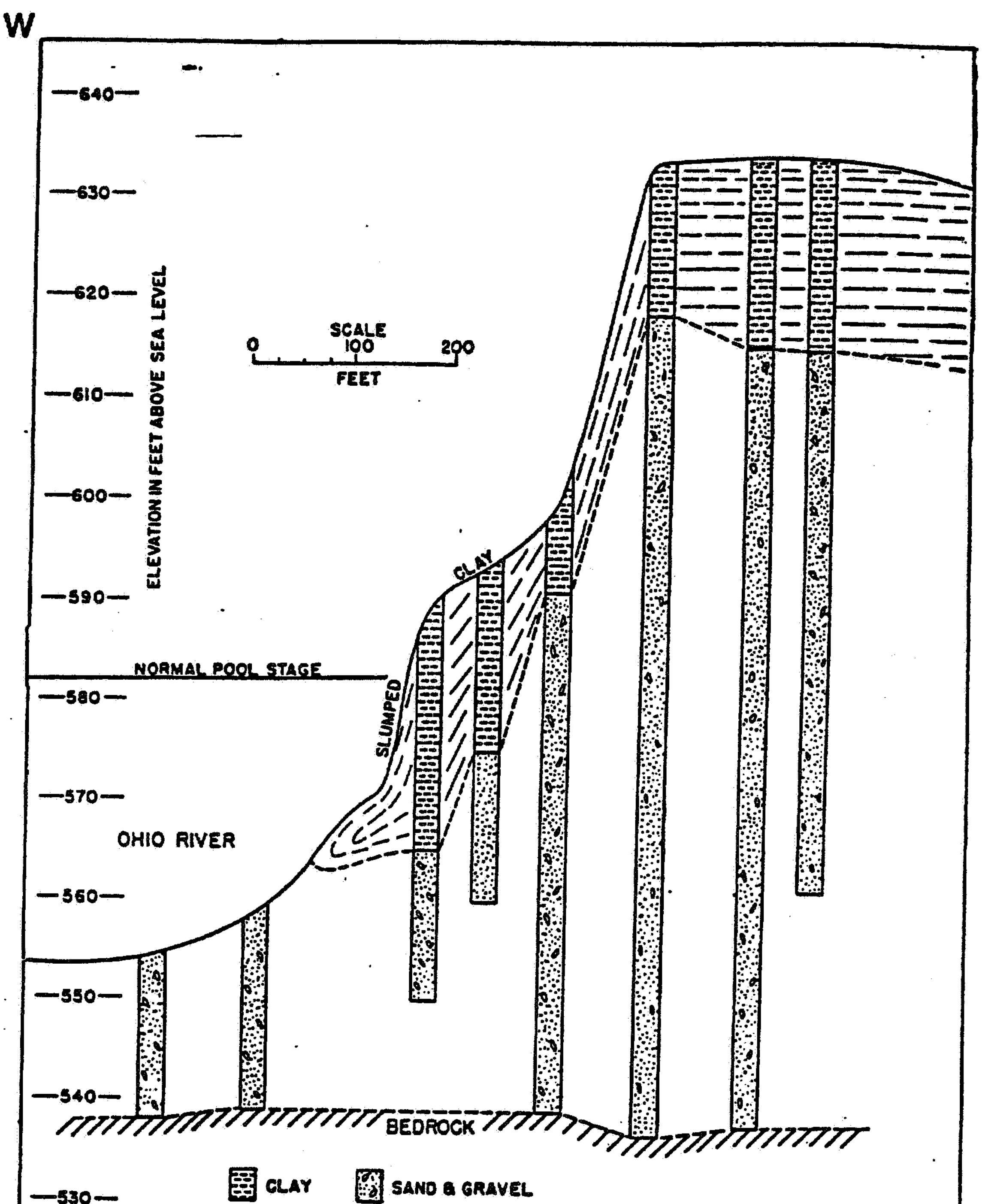


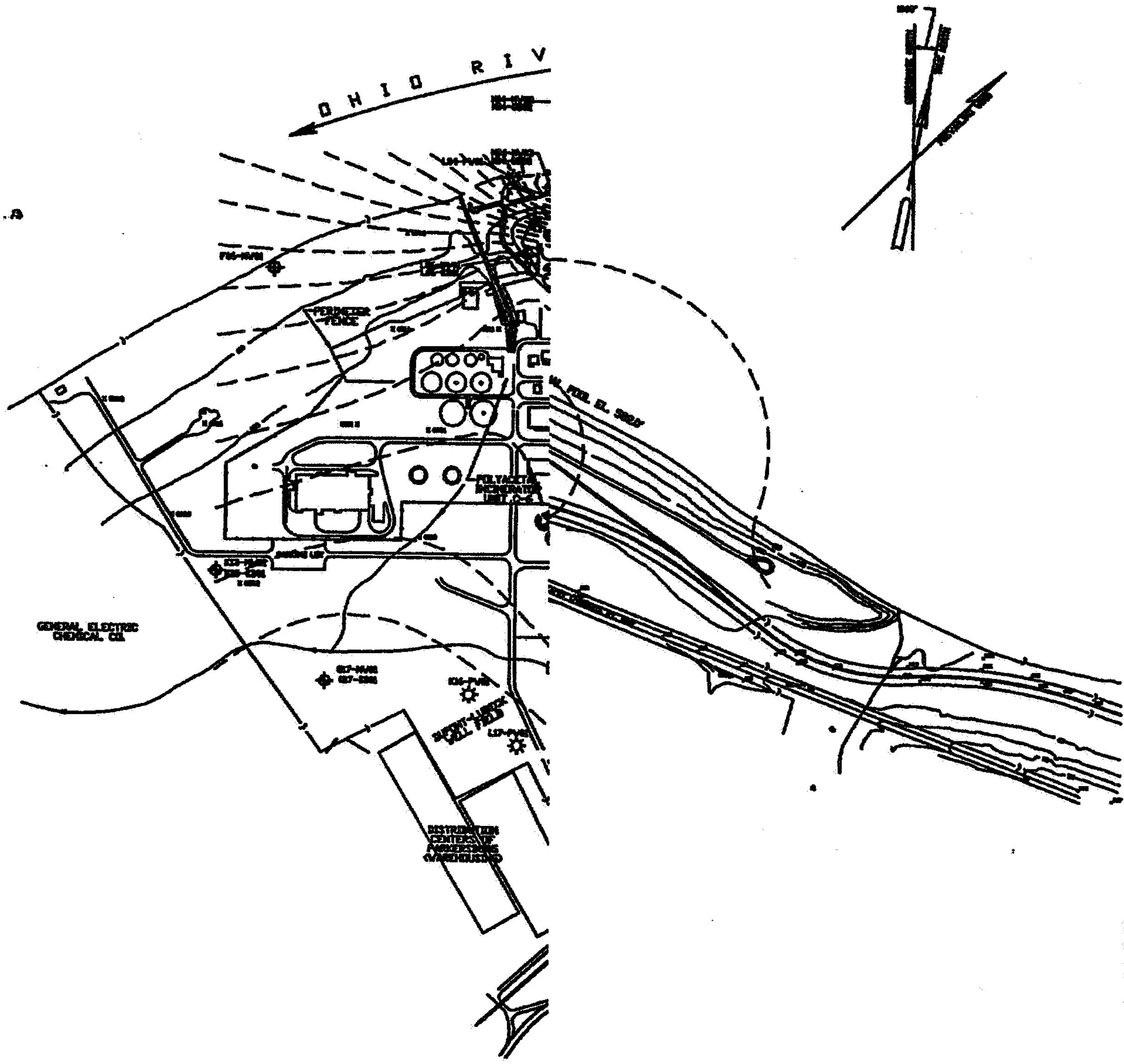
FIGURE 2.6

CROSS SECTION BASED ON TEST BORINGS AT E. I. du PONT de NEMOURS, POLY-CHEMICALS DIVISION, WASHINGTON BOTTOM, SHOWING RIVERBANK SLUMPING OF FLOOD-PLAIN CLAY.

Source: Carlston and Graeff 1955.

ASH000322

Figure 2.6



LEGEND

- = EXISTING WELL
- = PRODUCTION WELL
- = C-8 WELL
- = RFI WELL
- 564 - - - = GROUNDWATER CONTOUR ELEVATION

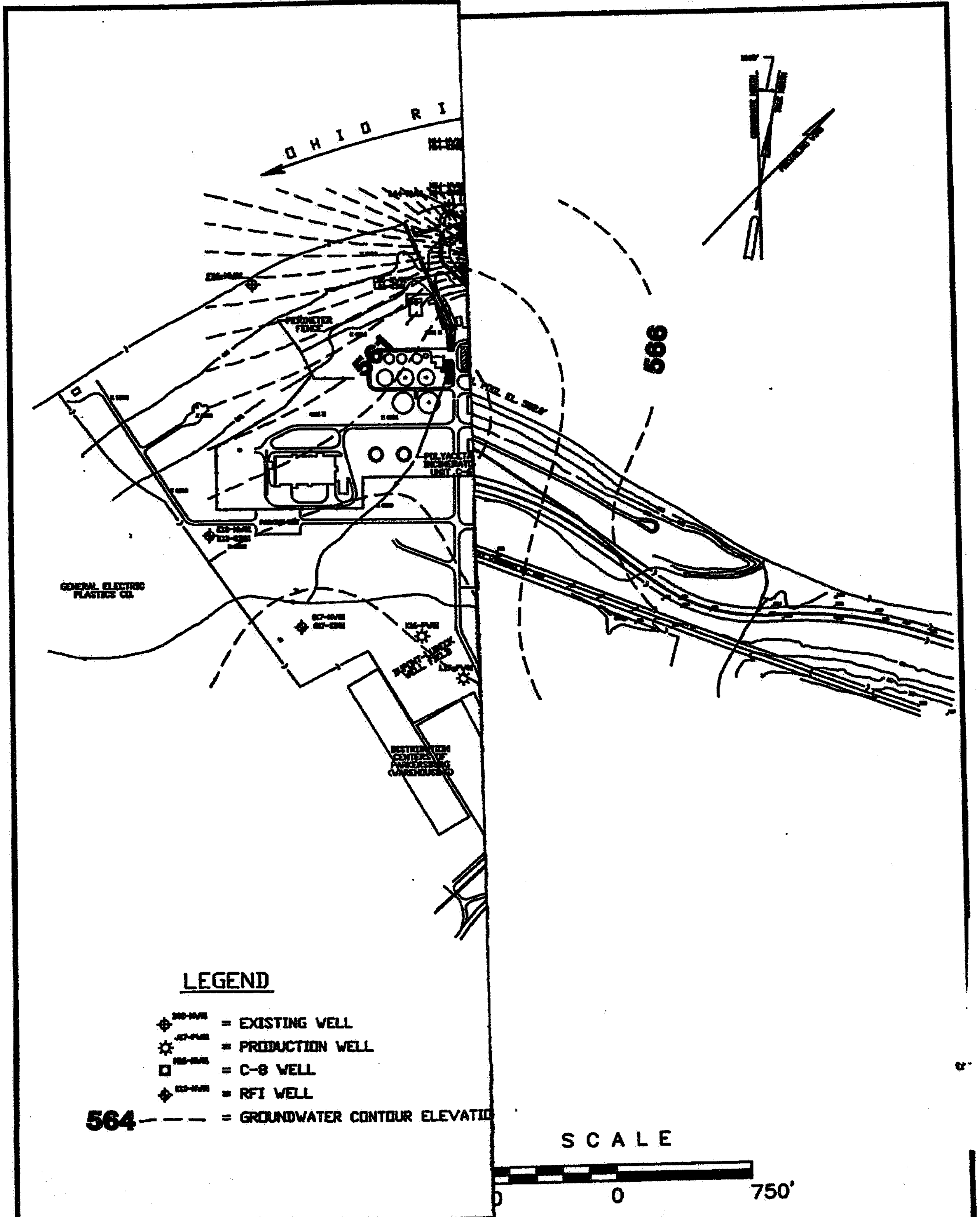
SCALE

0 0 750'

Corporate Remediation Group An Alliance between DuPont and The W-C Diamond Group Barley Mill Plaza, Building 27 Wilmington, Delaware 19880-0027	TITLE: GRC DuP WAS	DWN: DHE CHKD: SJO DATE: 05/24/99	DES.: APPD: REV.: 0	FILE NUMBER: 7205C003 FIGURE NO.: 2.7

Figure 2.7

ASH000323



DUPONT

Corporate Remediation Group

An Alliance between DuPont and The W-C Diamond Group

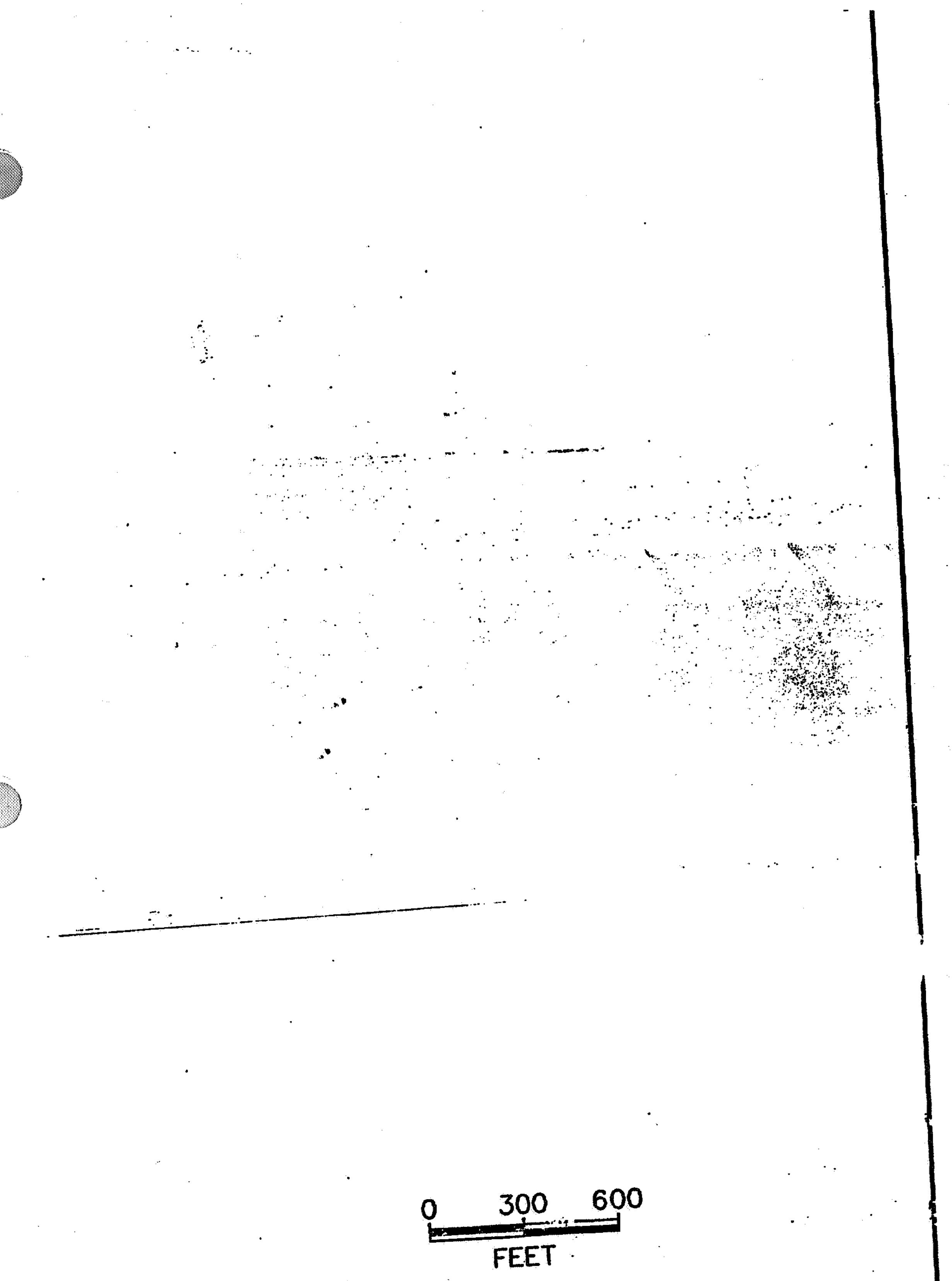
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027

TITLE:	DWN:	DES.:	FILE NUMBER:
GR	DHE		7205C004
Du	CHKD: SJO	APPD:	FIGURE NO.: 2.8
WA	DATE: 05/24/99	REV.: 0	

Figure 2.8

ASH000324

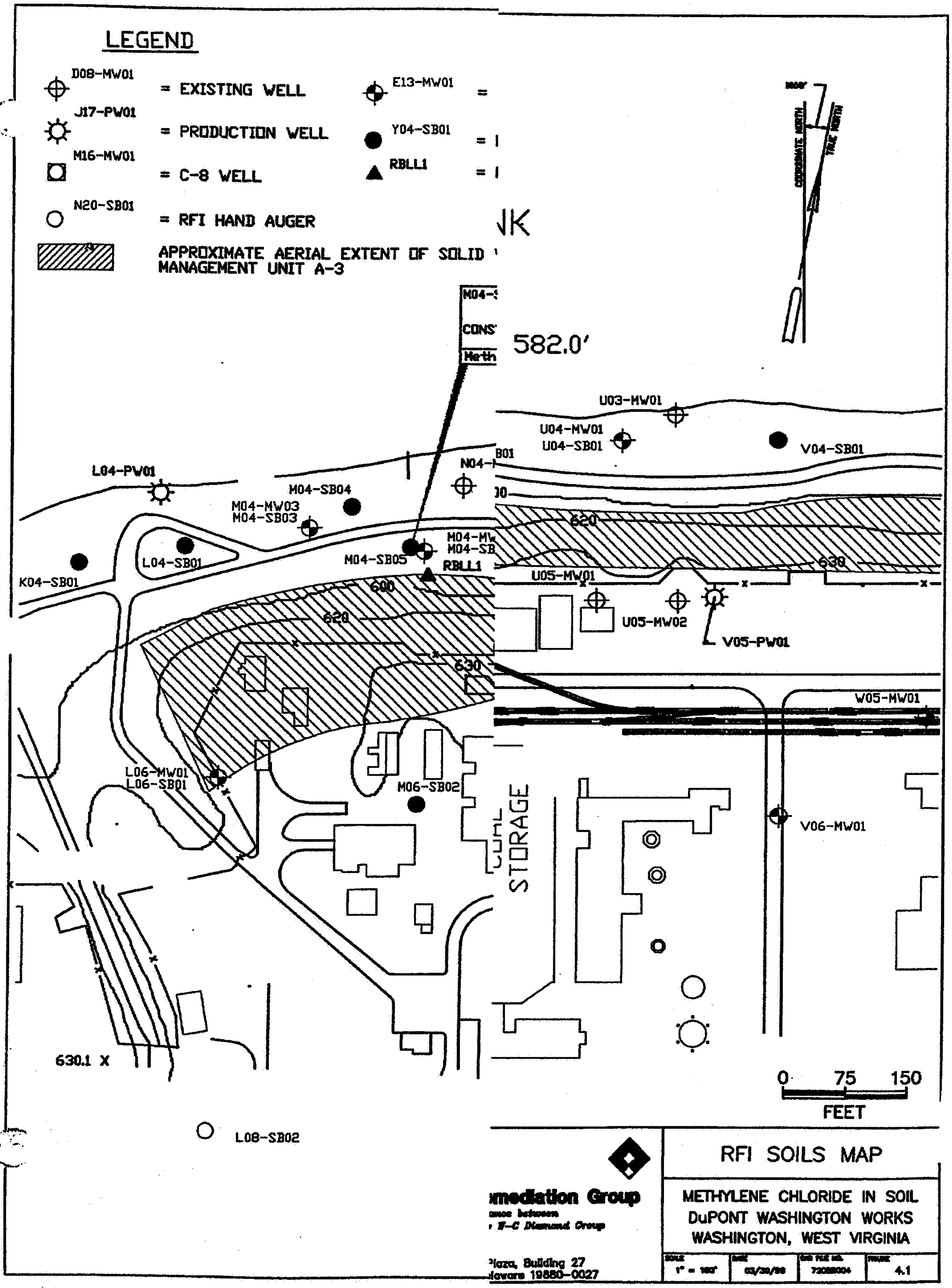
EID090423



DWN:	DES.:	FILE NUMBER:
DHE		7205D003
CHKD.:	APPD:	FIGURE NO.:
DATE: 05/24/99	REV.: 0	3.2

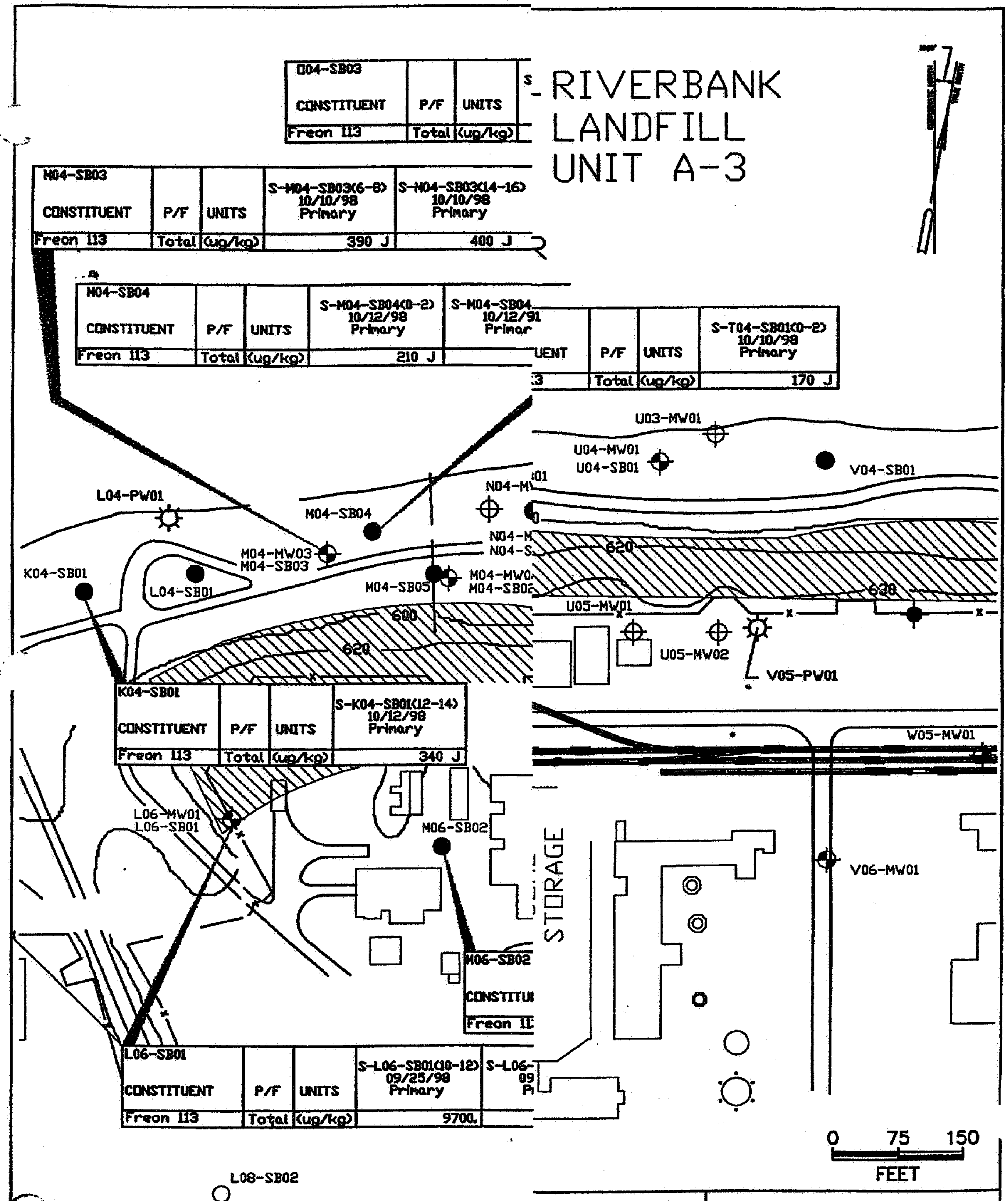
ASH000325

EID090424



ASH000326

EID090425



LEGEND

D08-MW01 = EXISTING WELL

J17-PW01 = PRODUCTION WELL

E13-MW01 = RF

Y04-SB01 RFI

nediation Group
ure between
W-C Diamond Group

aza, Building 27
ware 19880-0027

RFI SOILS MAP

FREON 113 IN SOIL
DuPONT WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA

SCALE	DATE	CAD FILE NO.	FIGURE
1" = 150'	03/30/99	7200FRE	4.2

ASH000327

EID090426

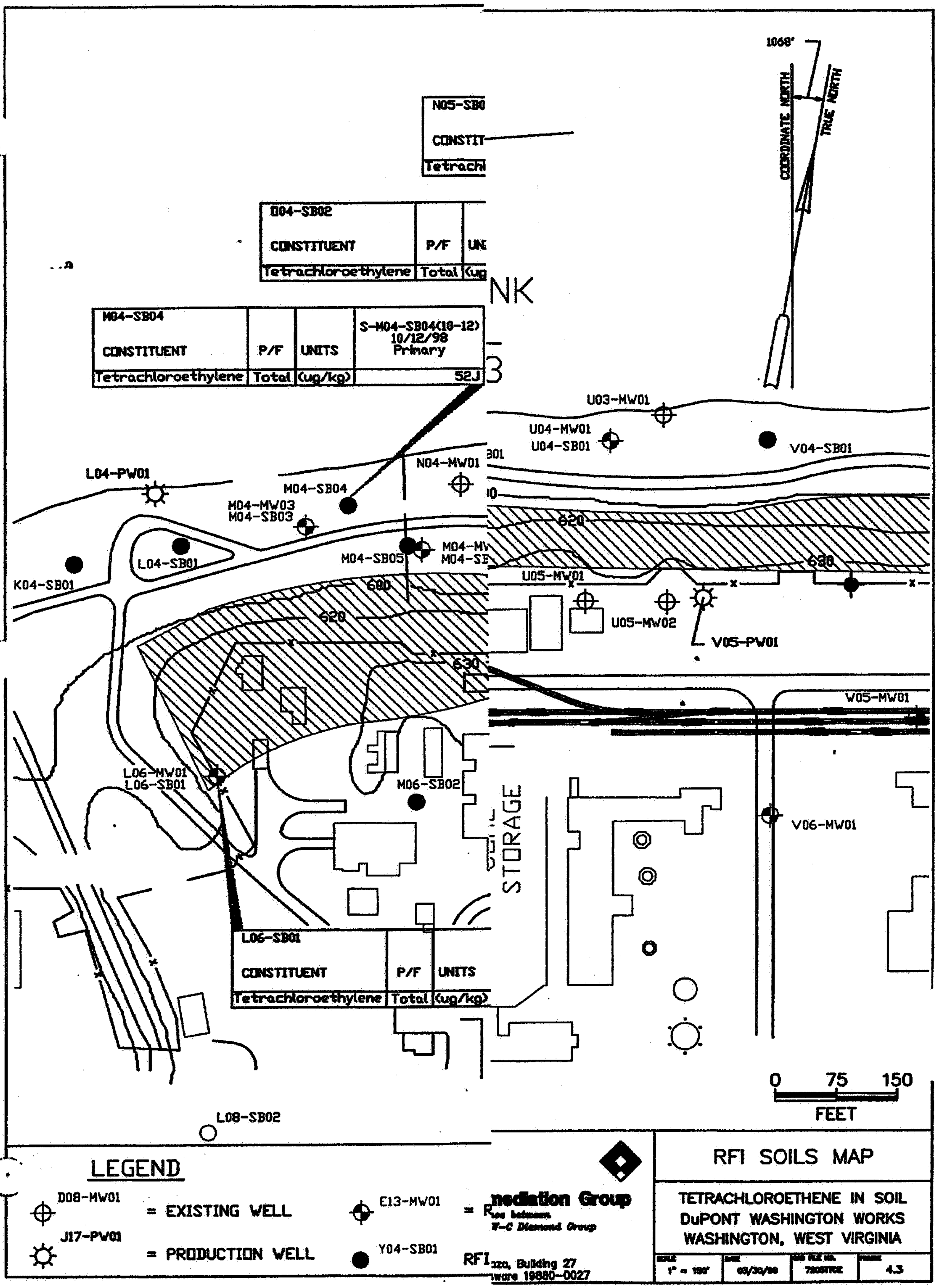
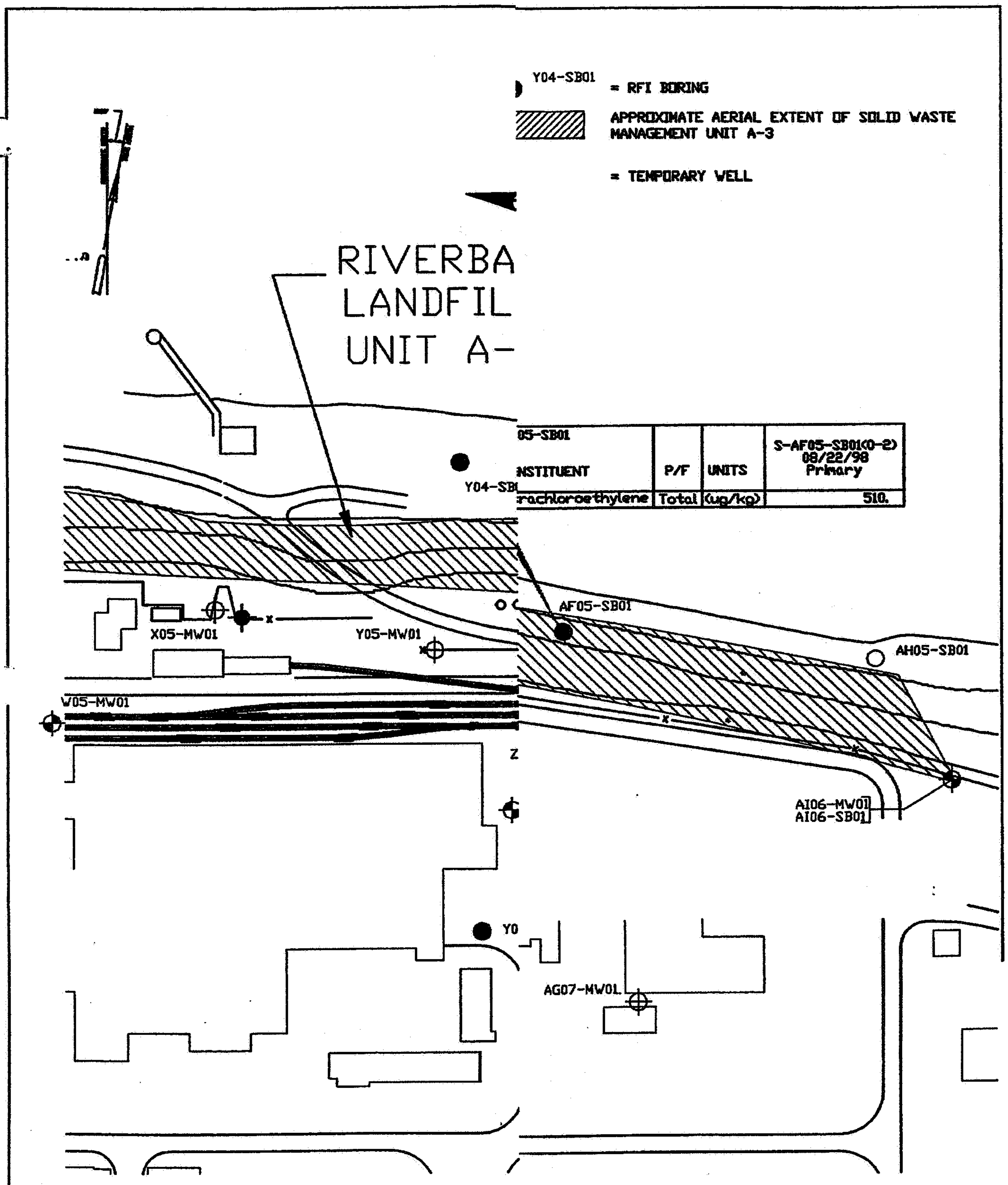


Figure 4.3

ASH000328



emediation Group
liance between
e W-C Diamond Group
Plaza, Building 27
elaware 19880-0027

RFI SOILS MAP

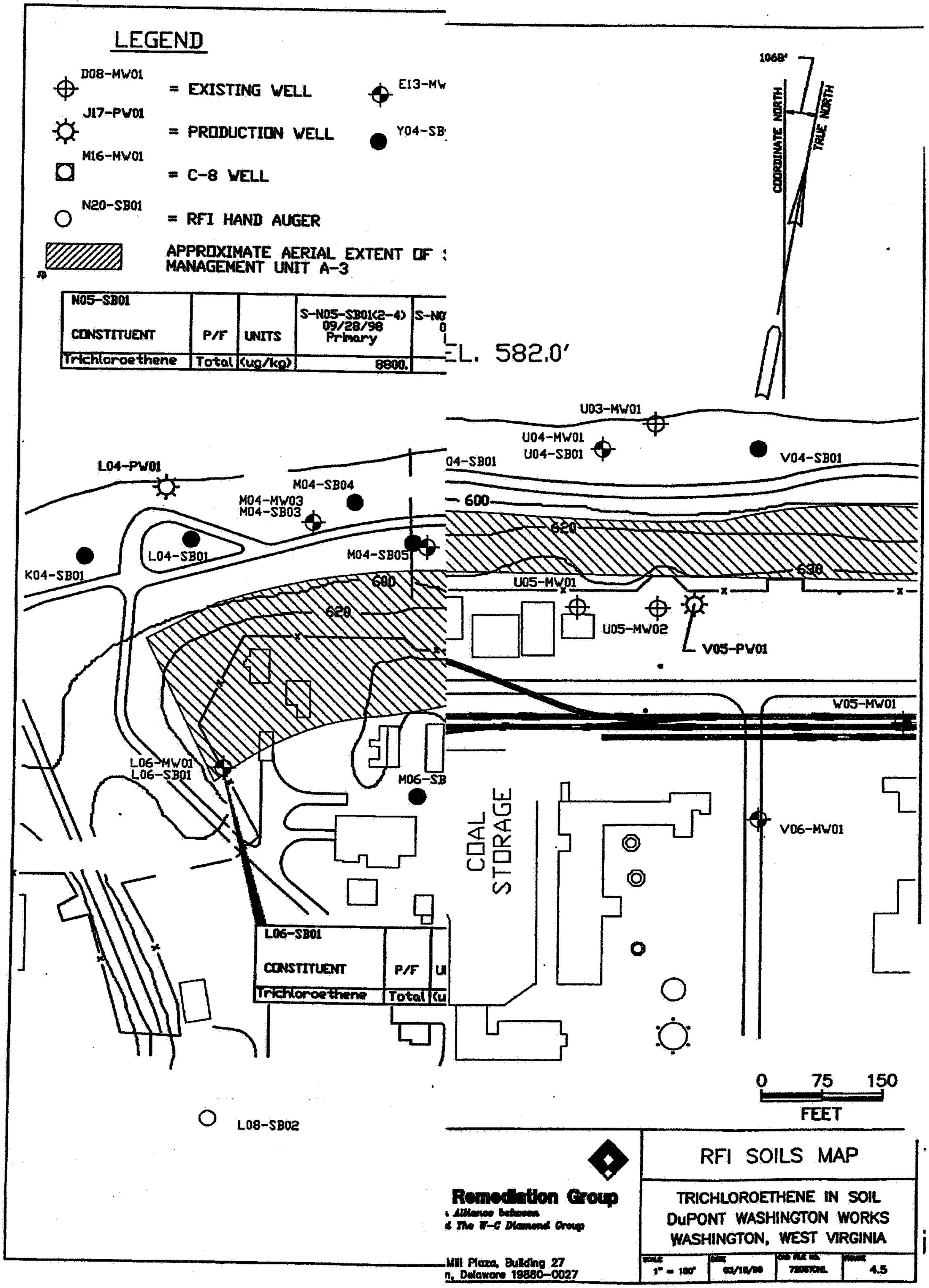
TETRACHLOROETHENE IN SOIL
DuPONT WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA

1" = 180'

4.4

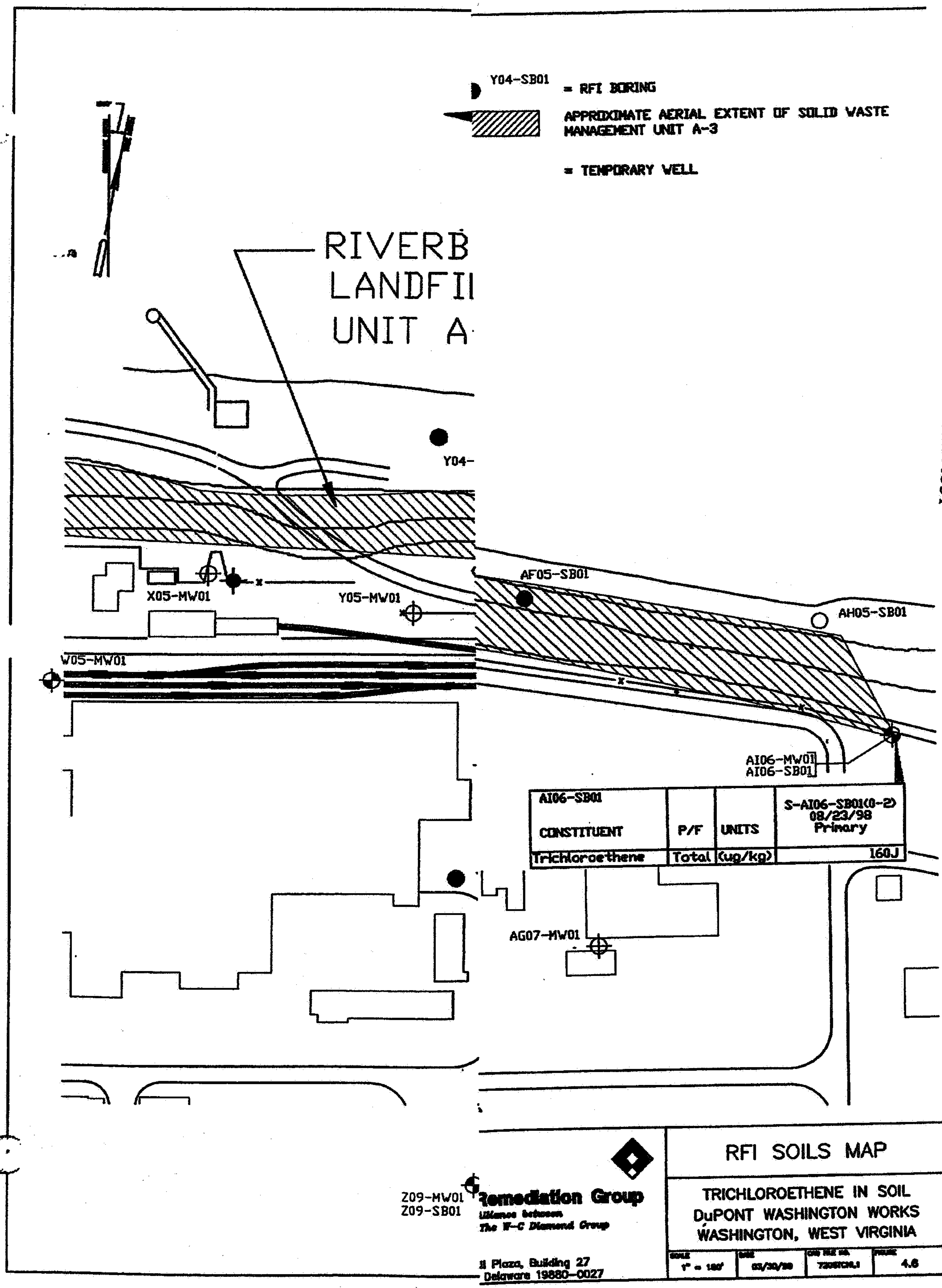
ASH000329

EID090428



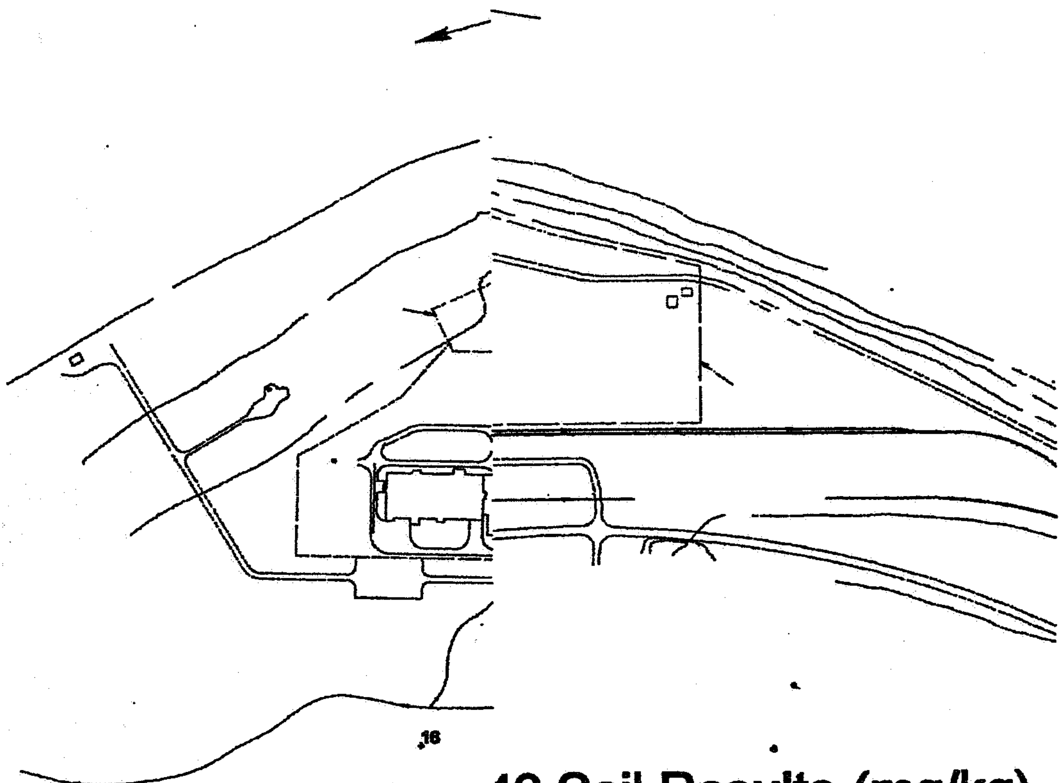
N05-SB01 CONSTITUENT	P/F	UNITS	S-N05-SB01(2-4) 09/28/98 Primary	S-N0
Trichloroethene	Total	(ug/kg)	8800.	

L06-SB01 CONSTITUENT	P/F	U
Trichloroethene	Total	(u



ASH000331

EID090430



43 Soil Results (mg/kg)
10 - 220
221 - 1000
1001 - 2400
2401 - 11000
11001 - 48000

ɔle results for one sample
on indicates that multiple
ample were collected for
ɔil depth range

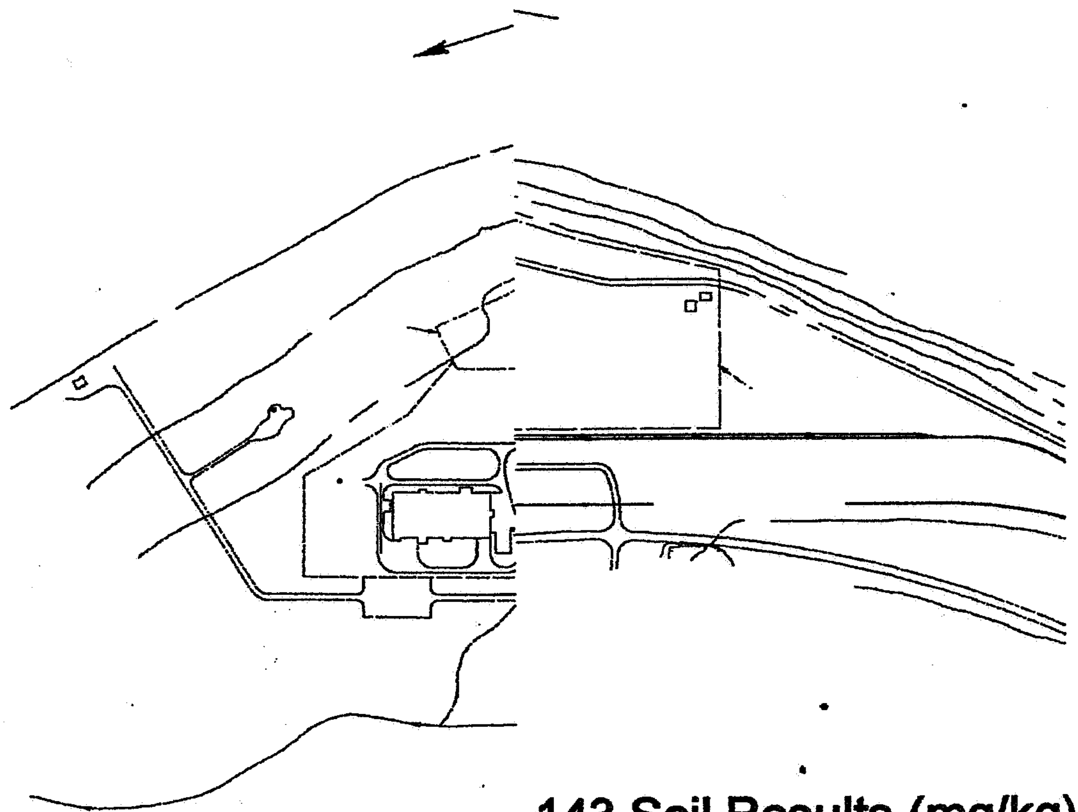
DUPONT Corporate Remediation Group
An Alliance between
Dupont and The W-C Diamond Group
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027

IH	DES.: SO	FILE NUMBER: Wash.apr
)	APPD.: SO	FIGURE NO.: 4.7
1/99	REV.: 1	

Figure 4.7

ASH000332

EID090431



-143 Soil Results (mg/kg)
10 - 60
61 - 170
171 - 600
601 - 1200
1201 - 9500

/ultiple results for one sample ›cation indicates that multiple ;oil sample were collected for he soil depth range

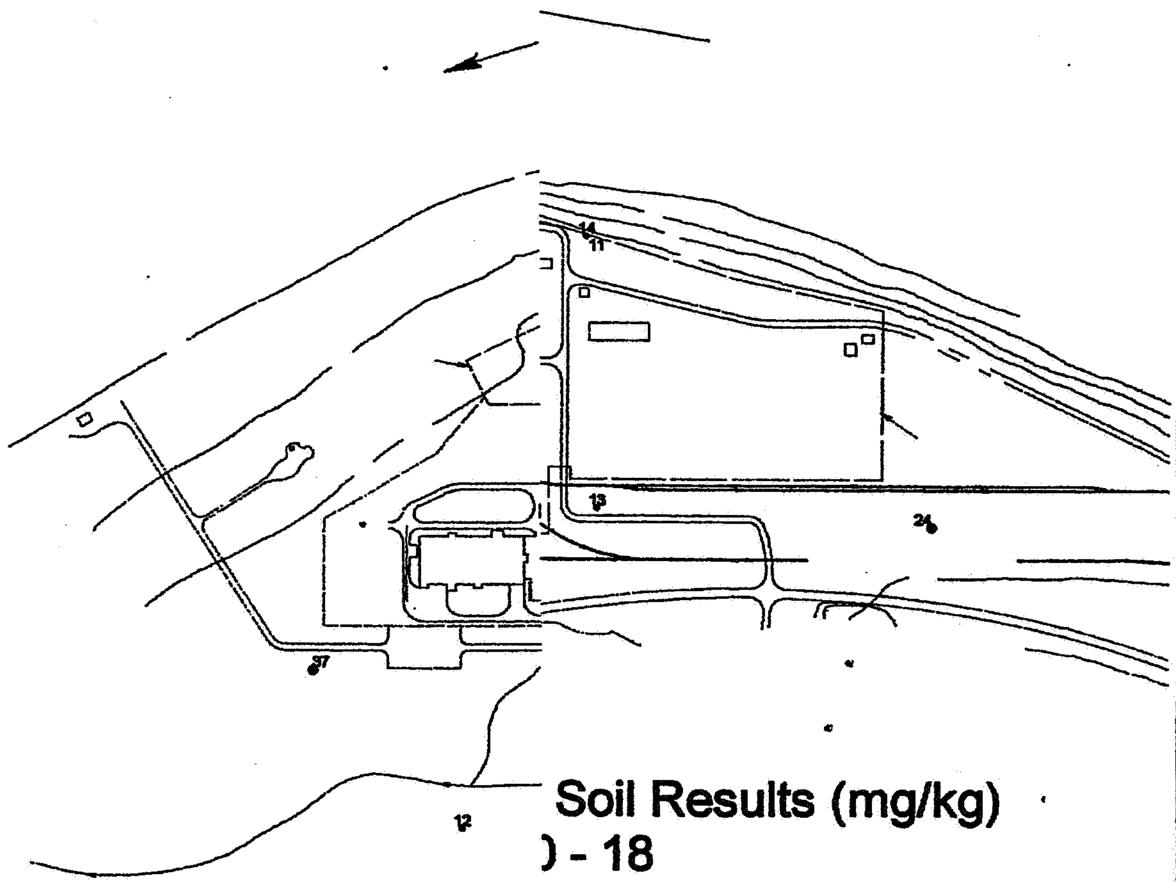
DU PONT **Corporate Remediation Group**
An Alliance between
Dupont and The W-C Diamond Group
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027

JH	DES.: SO	FILE NUMBER: Wash.apr
O	APPD.: SO	FIGURE NO.: 4.8
31/99	REV.: 1	

ASH000333

Figure 4.8

EID090432



Soil Results (mg/kg)

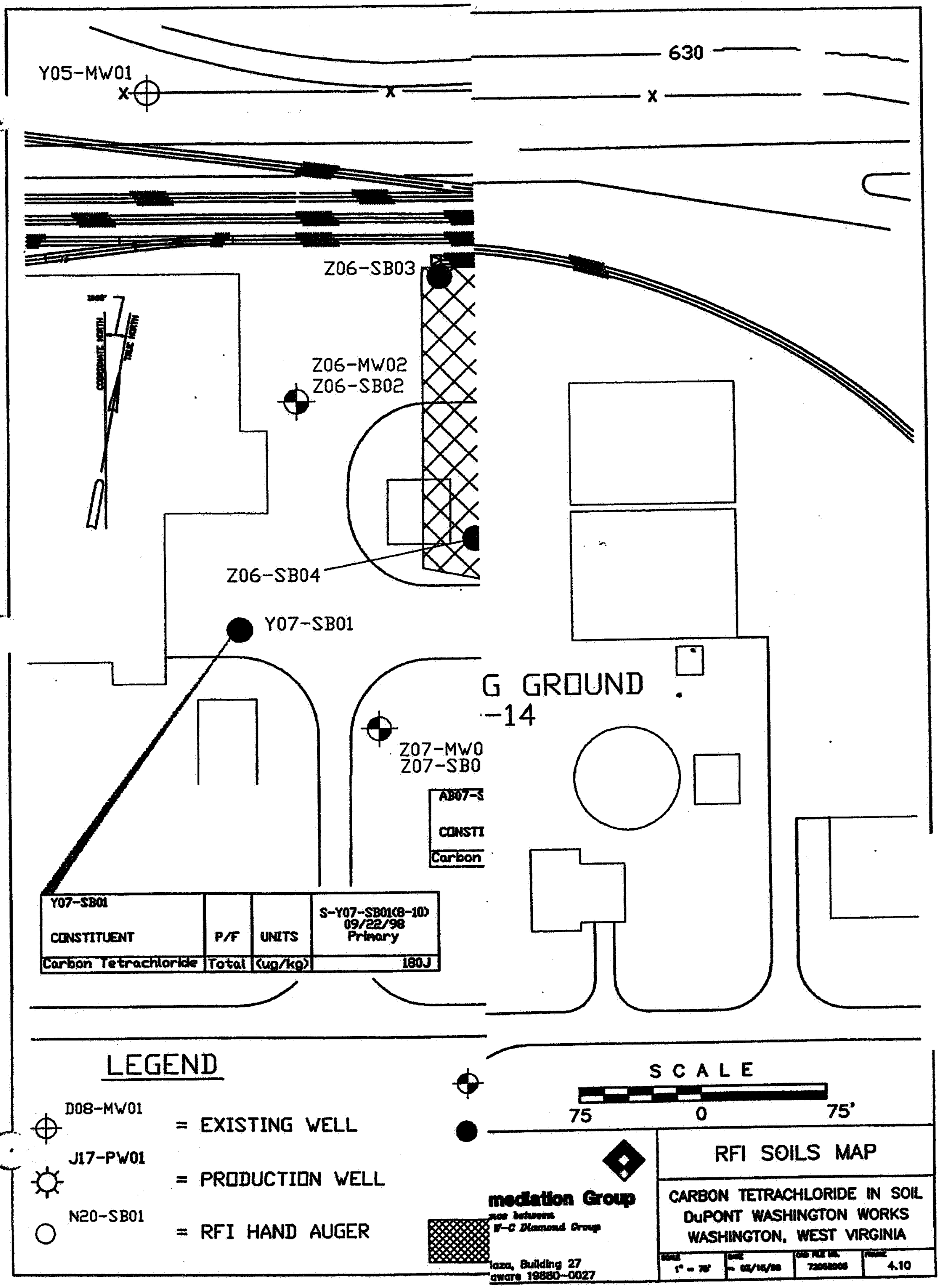
) - 18
) - 44
5 - 110
11 - 280
31 - 1800

results for one sample
indicates that multiple
ple were collected for
depth range

DUPONT **Corporate Remediation Group** *An Alliance between Dupont and The W-C Diamond Group Barley Mill Plaza, Building 27 Wilmington, Delaware 19880-0027*	RJH	DES.: SO	FILE NUMBER: Wash.apr
	SO	APPD.: SO	FIGURE NO.: 4.9
	3/31/99	REV.: 1	

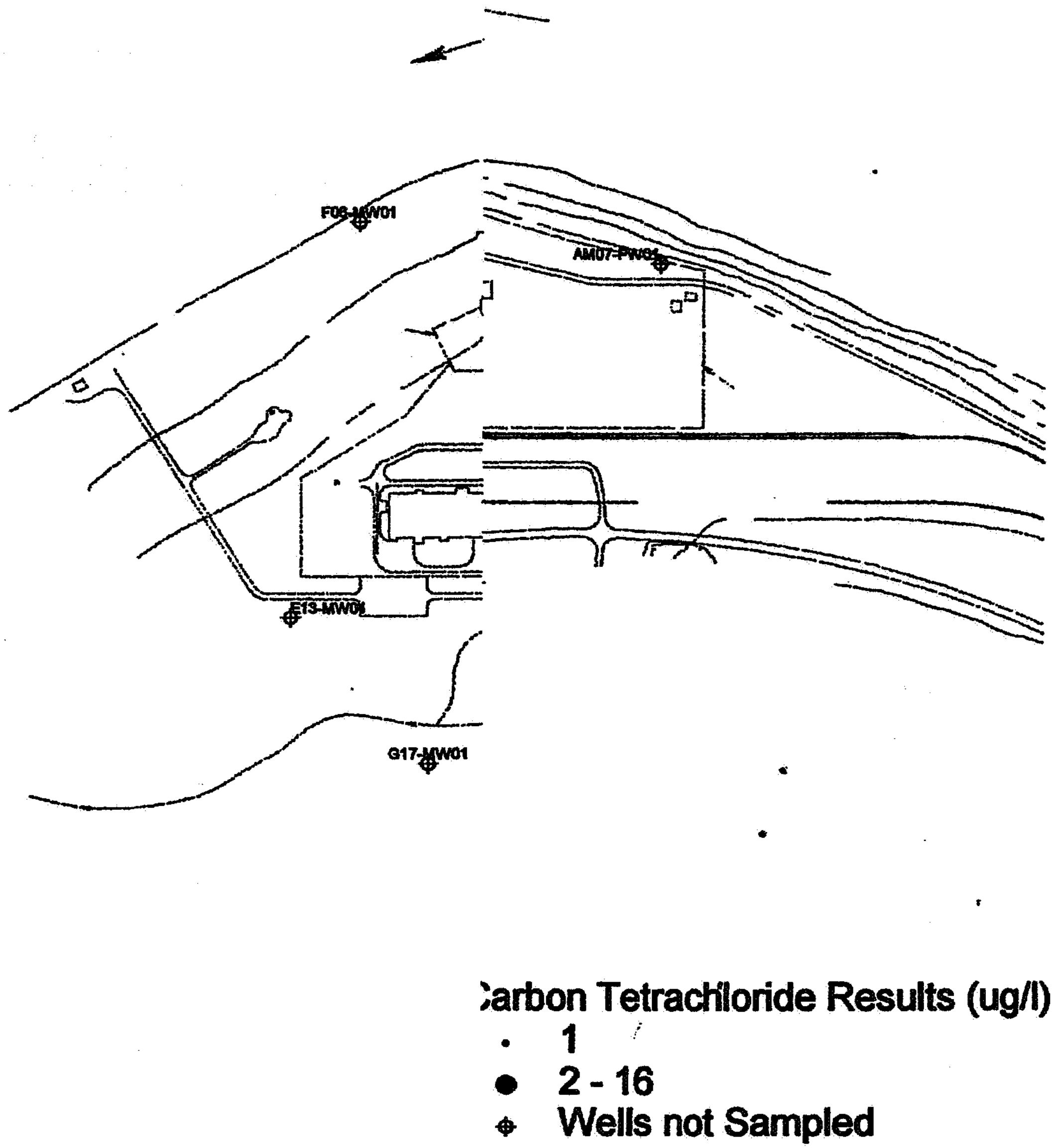
ASH000334

EID090433



ASH000335

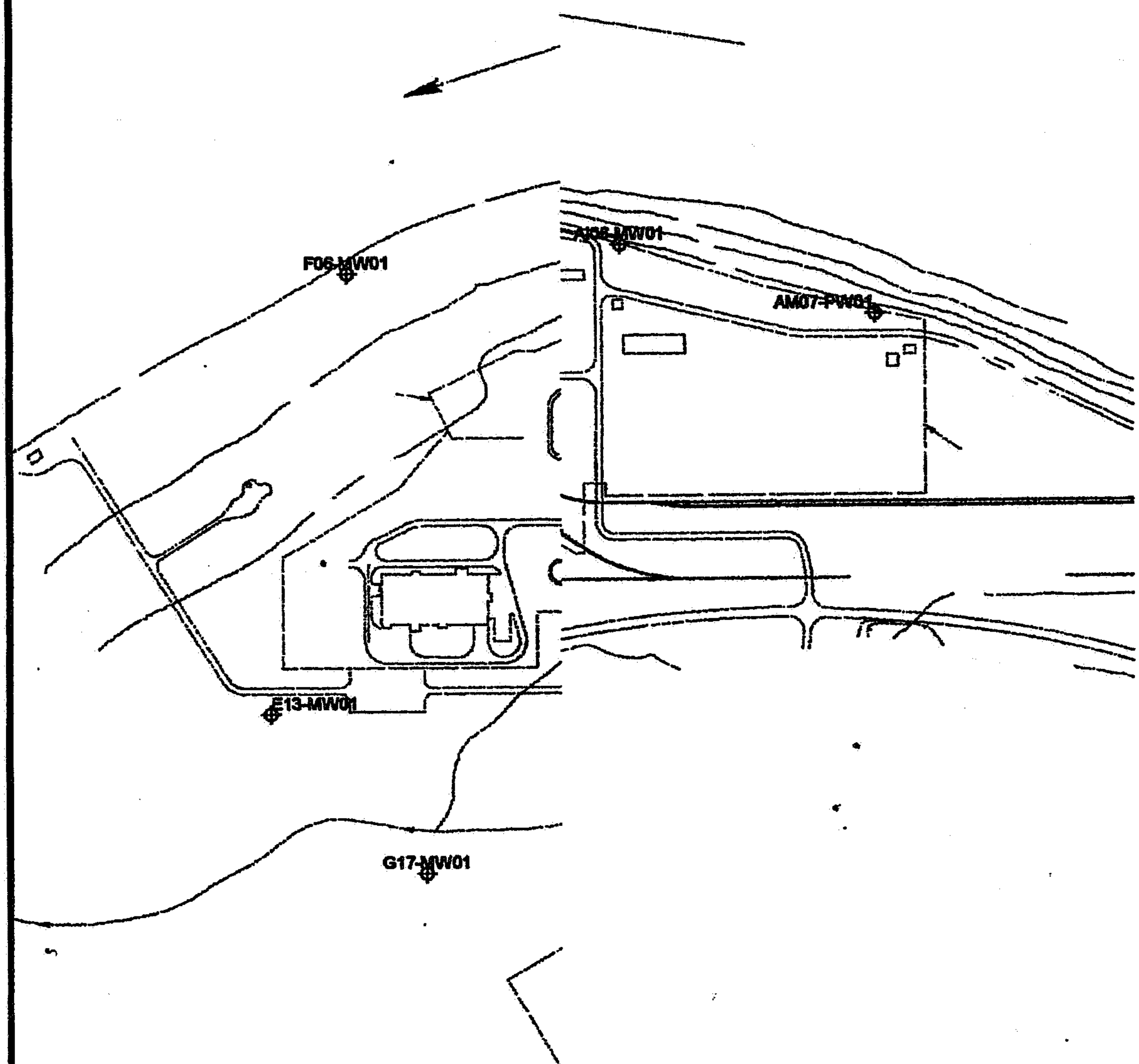
EID090434



DUPONT Corporate Remediation Group *An Alliance between Dupont and The W-C Diamond Group Barley Mill Plaza, Building 27 Wilmington, Delaware 19880-0027*	RJH	DES.: GB	FILE NUMBER: Acid.apr
	GB	APPD.: GB	FIGURE NO.: 4.11
	/19/99	REV.: 1	

ASH000336

Figure 4.11



bon Tetrachloride Results (ug/l)

1

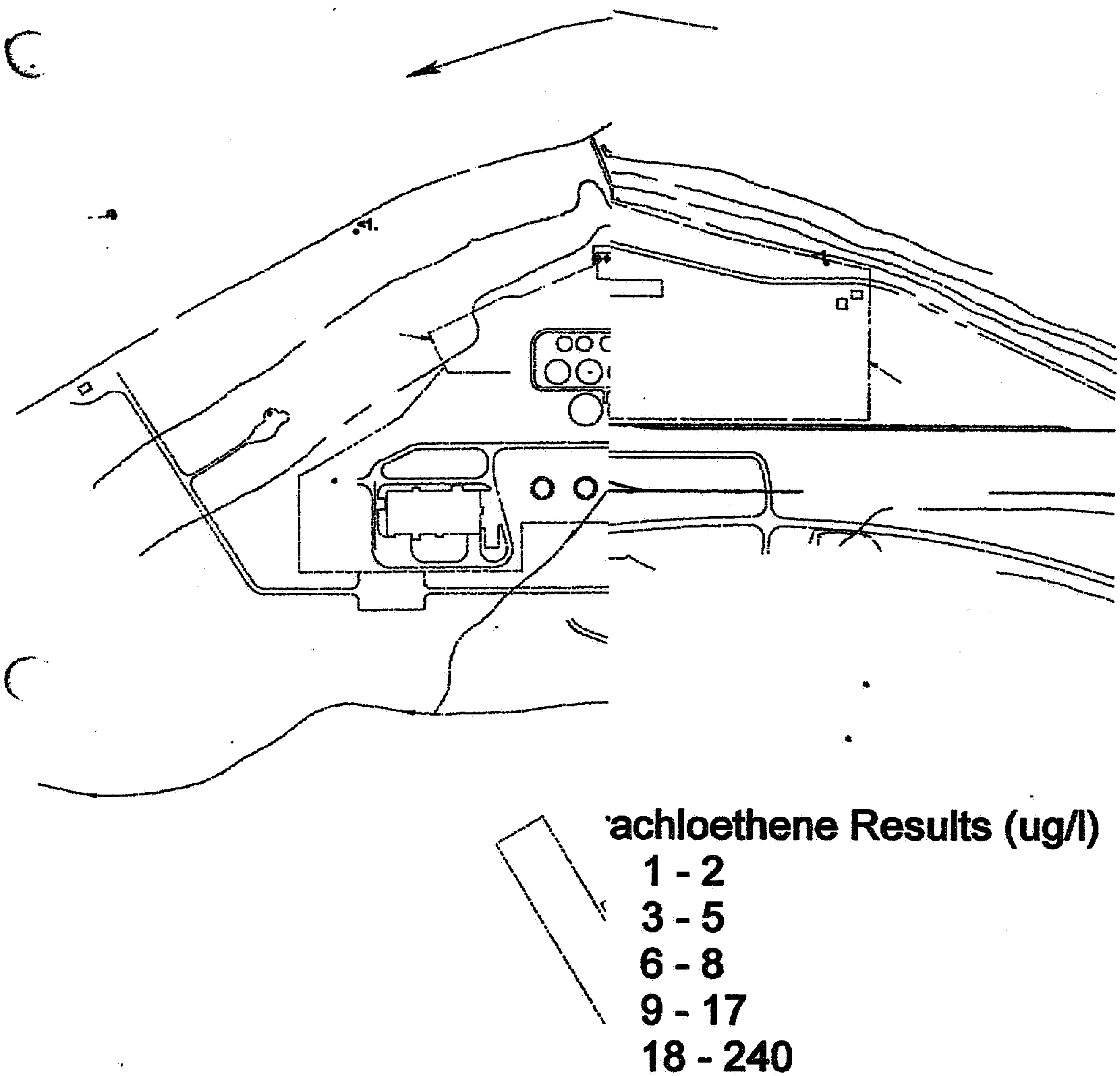
2 - 15

Wells not Sampled

ASH000337

DU PONT Corporate Remediation Group An Alliance between Dupont and The W-C Diamond Group Barley Mill Plaza, Building 27 Wilmington, Delaware 19880-0027	RJH	DES.: SO	FILE NUMBER: Wash.apr
	SO	APPD.: SO	FIGURE NO.: 4.12
	/19/99	REV.: 1	

EID090436

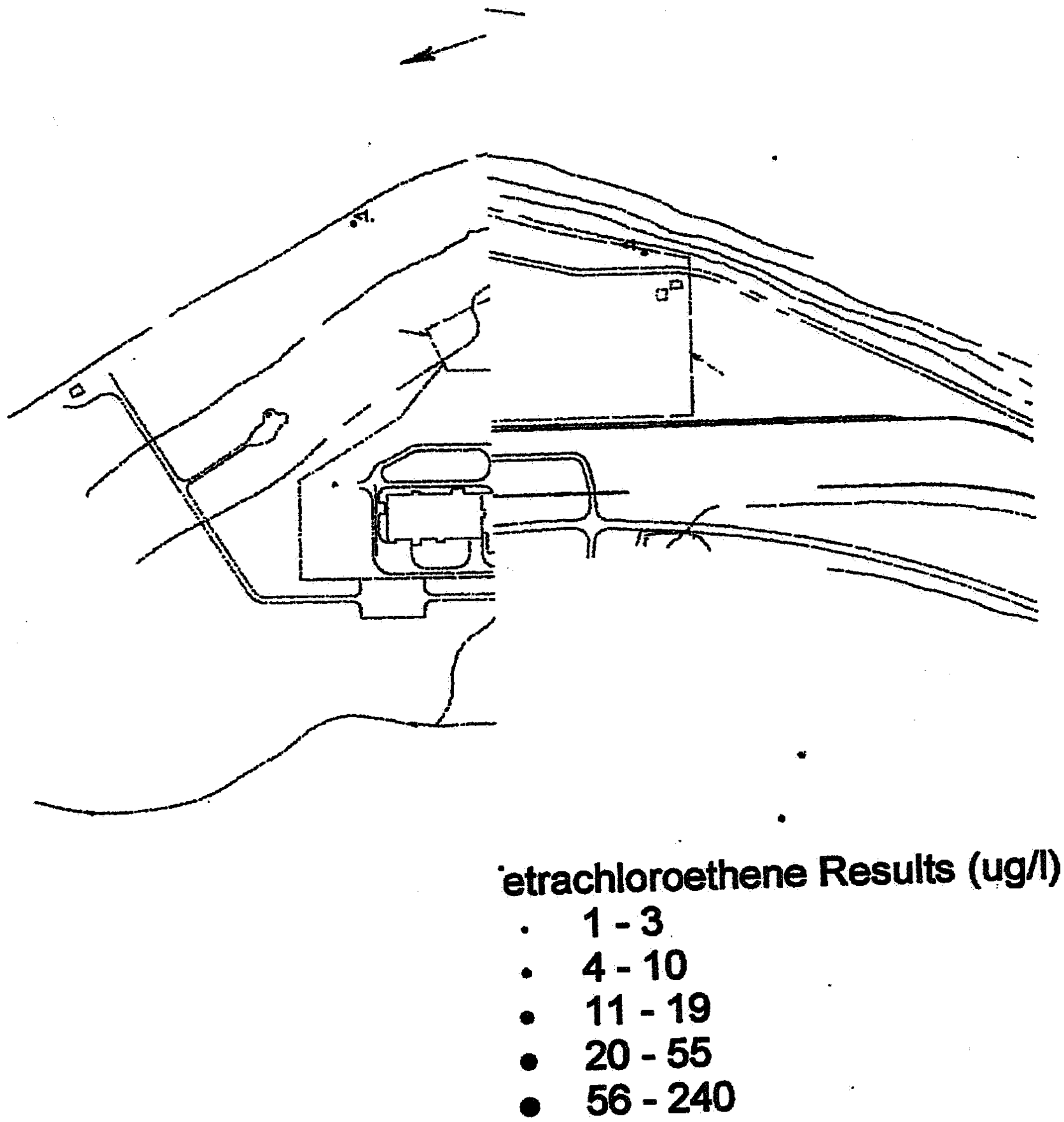


Corporate Remediation Group
An Alliance between
Dupont and The W-C Diamond Group
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027

JH	DES.: GB	FILE NUMBER: Acid.apr
F 3	APPD.: GB	FIGURE NO.: 4.13
'99	REV.: 1	

ASH000338

EID090437



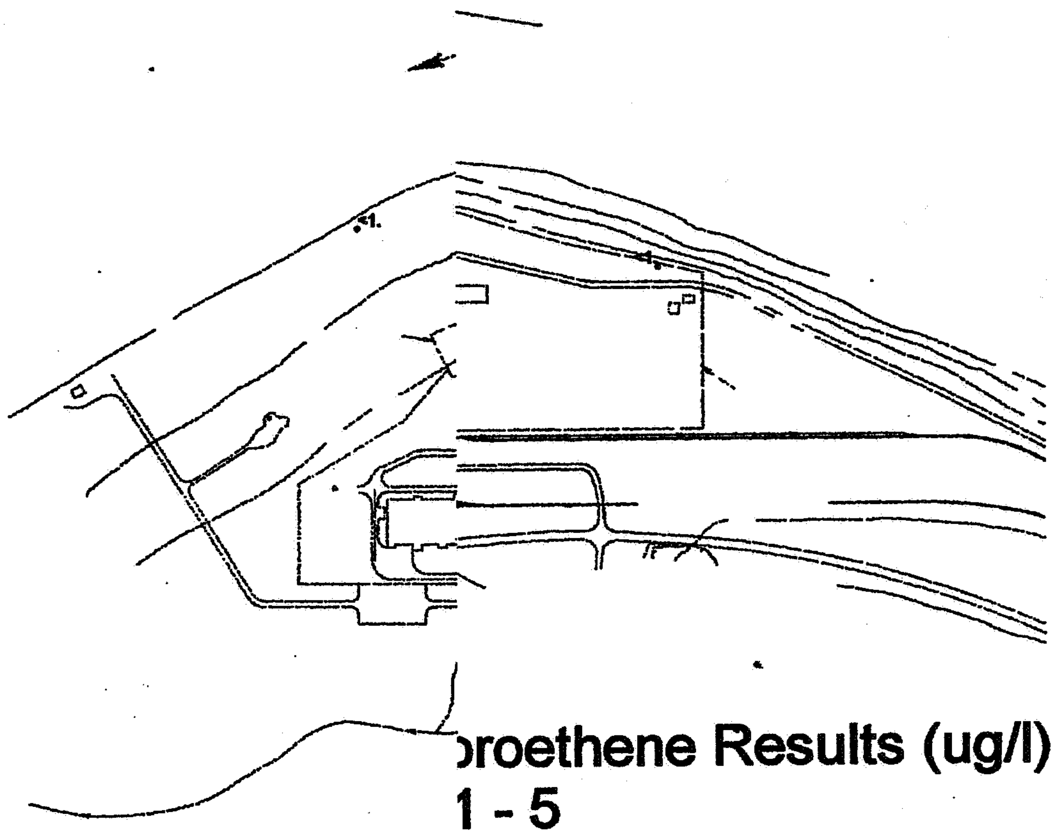
ASH000339

Figure 4.14

DUPONT

Corporate Remediation Group
An Alliance between
Dupont and The W-C Diamond Group
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027

RJH	DES.: GB	FILE NUMBER: Acid.apr
'B	APPD.: GB	FIGURE NO.: 4.14
'19/99	REV.: 1	



broethene Results (ug/l)

1 - 5

6 - 61

62 - 150

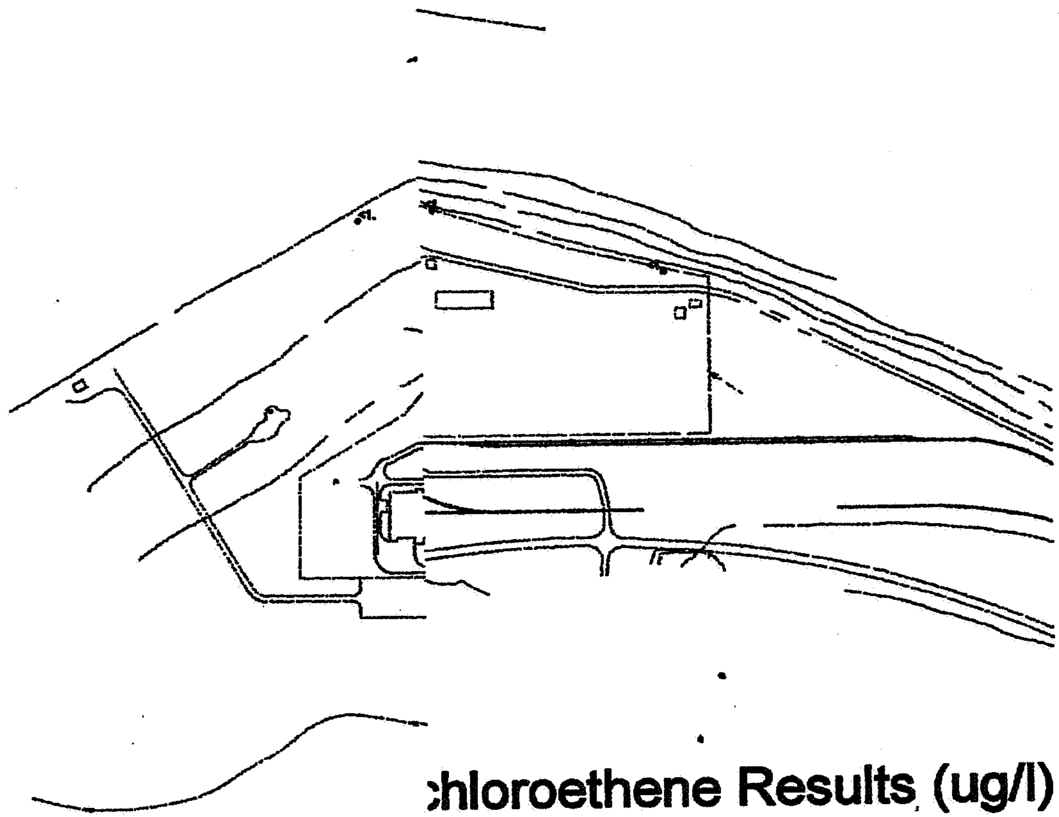
151 - 400

401 - 800

ASH000340

Figure 4.15

DUPONT **Corporate Remediation Group** *An Alliance between Dupont and The W-C Diamond Group Barley Mill Plaza, Building 27 Wilmington, Delaware 19880-0027*	RJH	DES.: GB	FILE NUMBER: Acid.apr
	GB	APPD.: GB	FIGURE NO.: 4.15
	5/19/99	REV.: 1	



:hloroethene Results (ug/l)

1 - 5

6 - 36

37 - 63

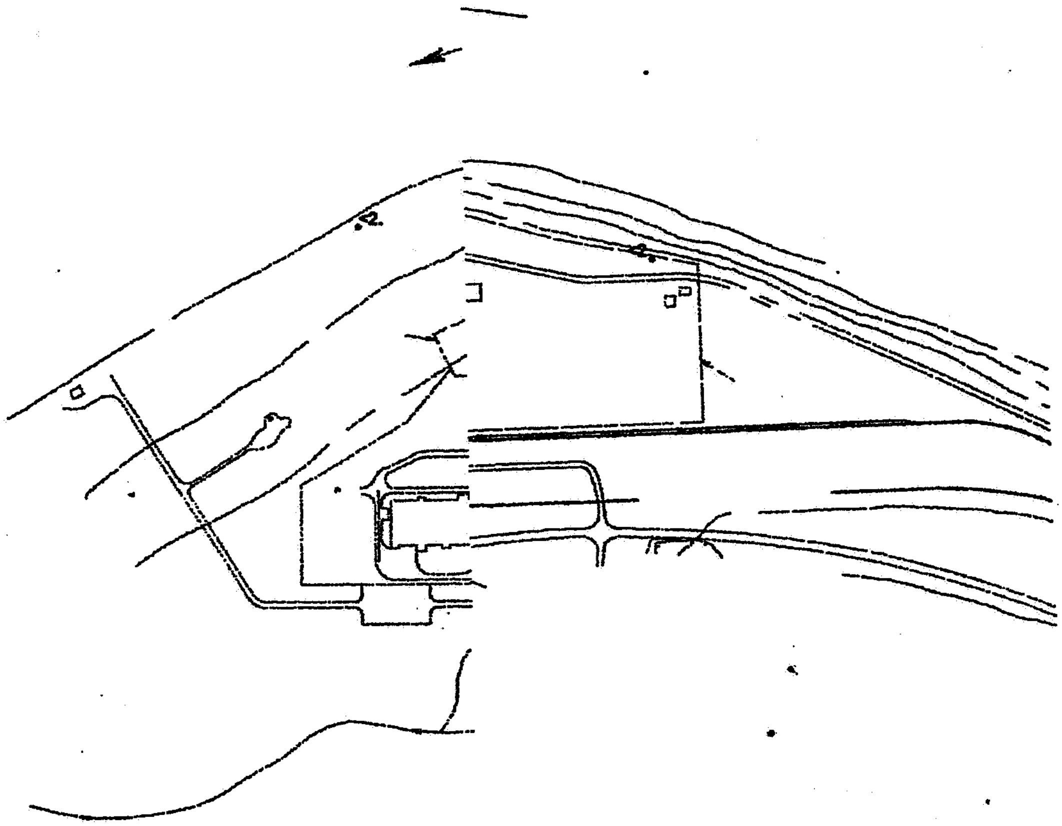
64 - 150

151 - 670

ASH000341

DUPONT **Corporate Remediation Group** *An Alliance between Dupont and The W-C Diamond Group Barley Mill Plaza, Building 27 Wilmington, Delaware 19880-0027*	WN.: RJH	DES.: GB	FILE NUMBER: Acid.apr	
	HKD.: GB	APPD.: GB	FIGURE NO.: 4.16	
	ATE: 5/19/99	REV.: 1		

EID090440



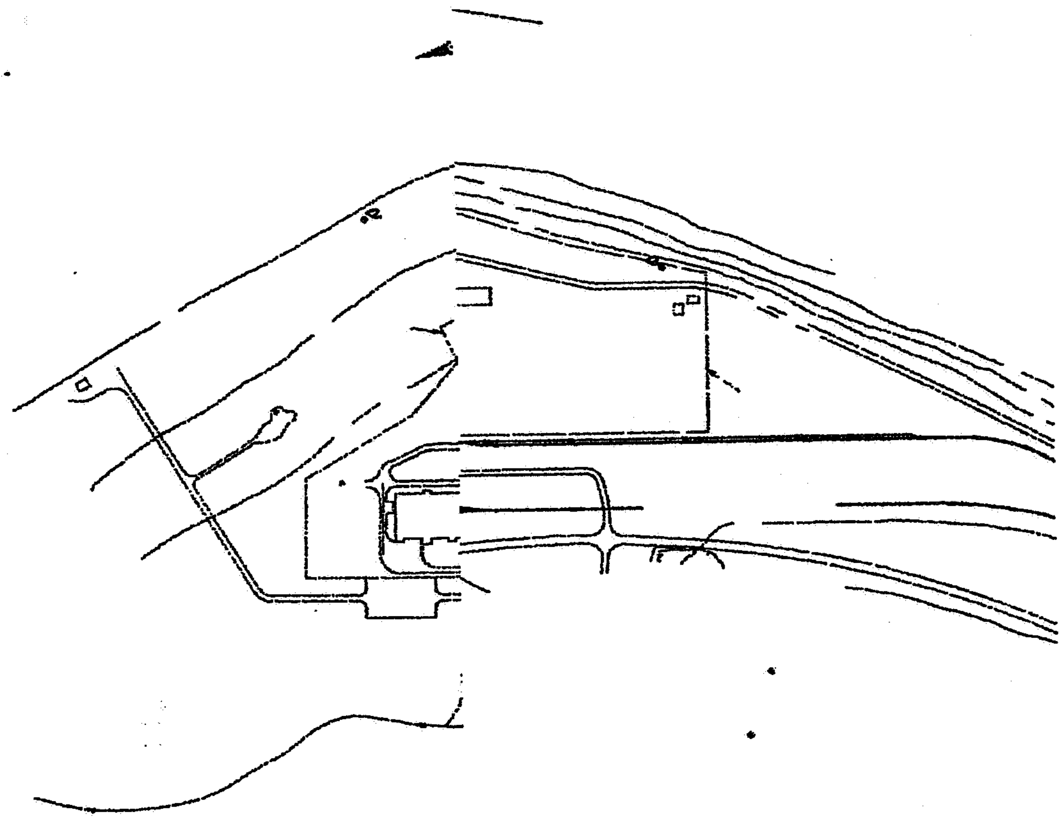
ound 1: Freon 113 Results (ug/l)

- 2 - 130
- 131 - 860
- 861 - 2200
- 2201 - 3700
- 3701 - 7100

DUPONT **Corporate Remediation Group** *An Alliance between* *Dupont and The W-C Diamond Group* *Barley Mill Plaza, Building 27* *Wilmington, Delaware 19880-0027*	RJH	DES.: GB	FILE NUMBER:	Acid.apr
	GB	APPD.: GB	FIGURE NO.:	4.17
	5/19/99	REV.: 1		

ASH000342

EID090441



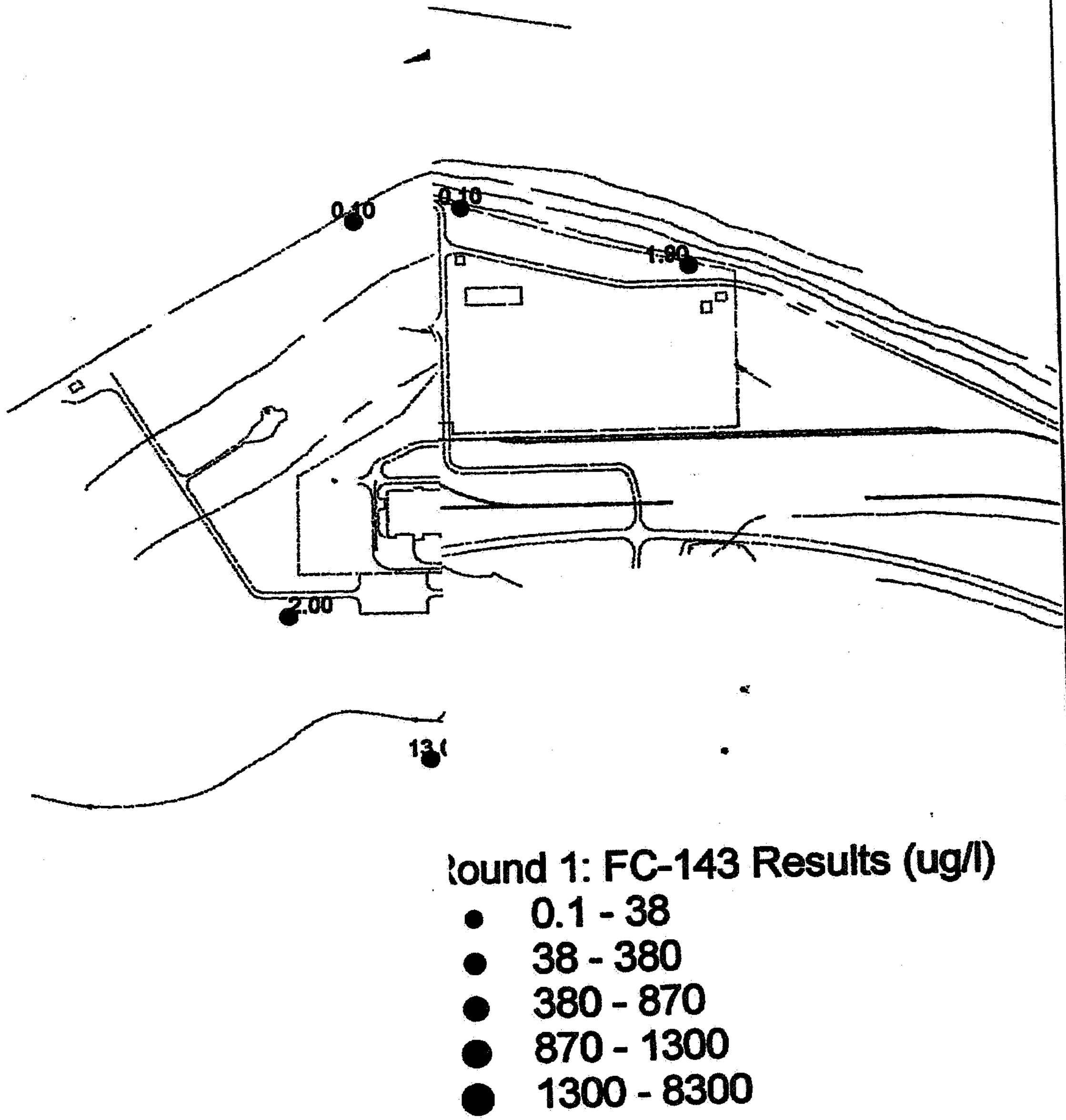
Round 2: Freon 113 Results (ug/l)

- 2 - 80
- 81 - 380
- 381 - 890
- 891 - 2200
- 2201 - 3600

ASH000343

DUPONT **Corporate Remediation Group** *An Alliance between Dupont and The W-C Diamond Group Barley Mill Plaza, Building 27 Wilmington, Delaware 19880-0027*	RJH	DES.: GB	FILE NUMBER: Acid.apr
	GB	APPD.: GB	FIGURE NO.: 4.18
	5/19/99	REV.: 1	

EID090442



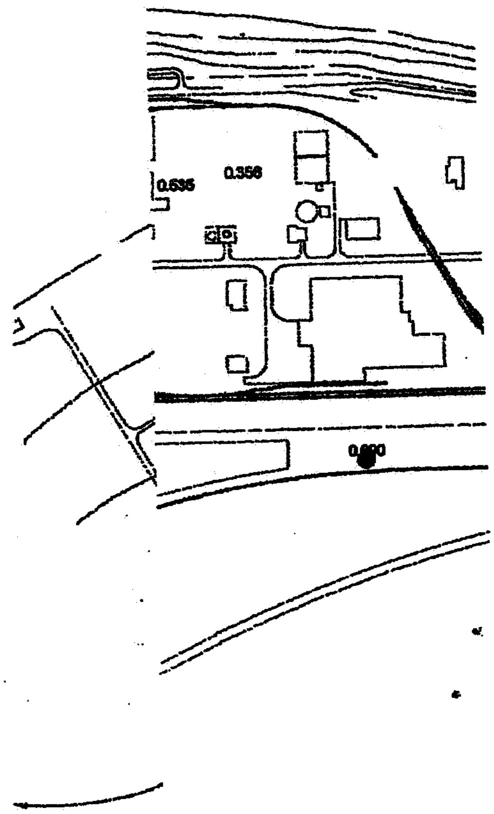
DU PONT **Corporate Remediation Group**

An Alliance between
Dupont and The W-C Diamond Group
Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027

RJH	DES.: SO	FILE NUMBER:	Wash.apr
SO	APPD.: SO	FIGURE NO.:	4.19
5/20/99	REV.: 1		

ASH000344

EID090443



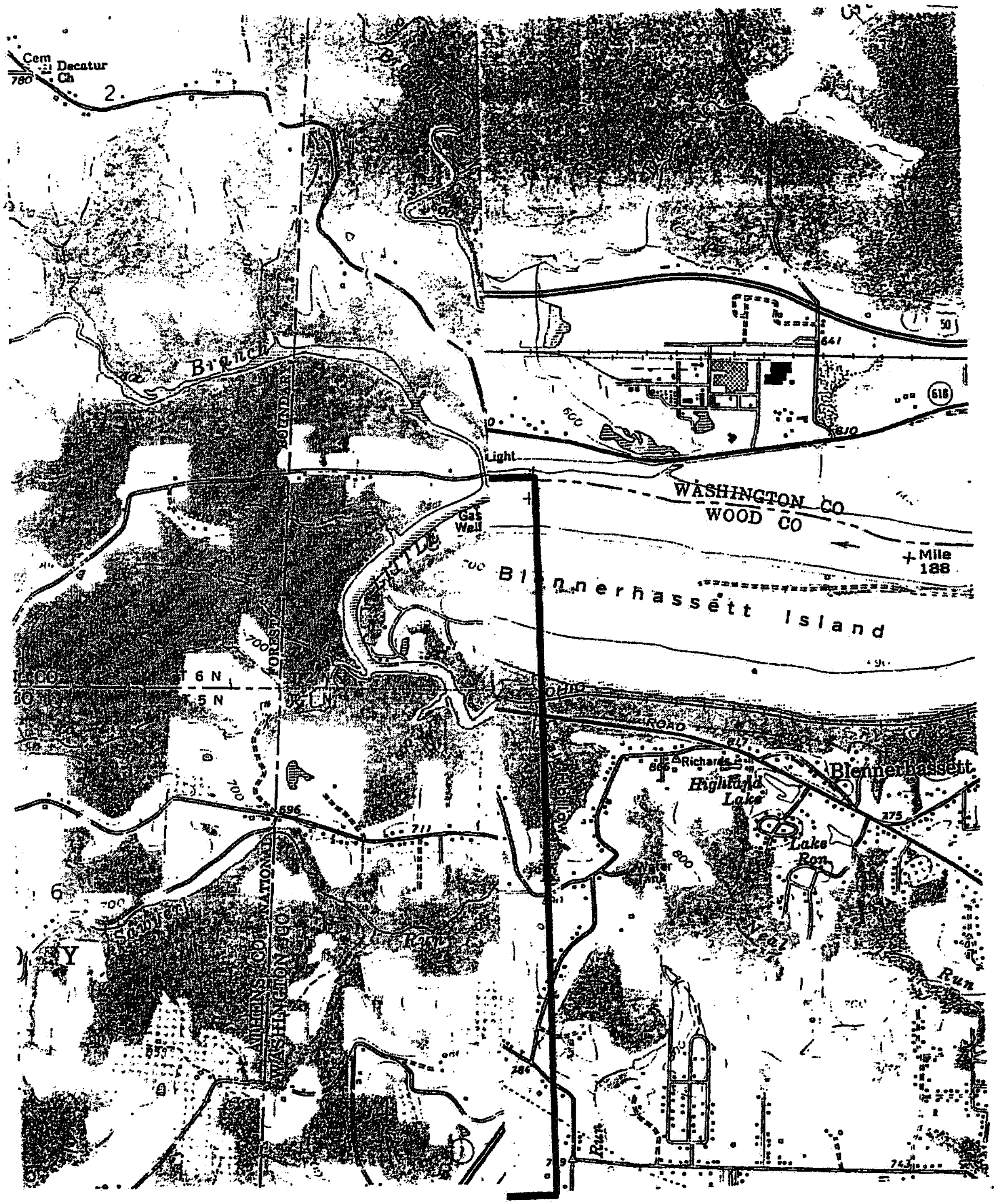
R

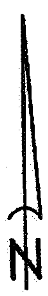
DUPONT Co
D

DW
CH
DA

ASH000345

EID090444





SOURCE: USGS LITTLE HOCKING QUAI
7.5 MINUTE SERIES (TOPOGRAPHIC)

emediation Group
liance between
he F-C Diamond Group
Plaza, Building 27
Delaware 19880-0027

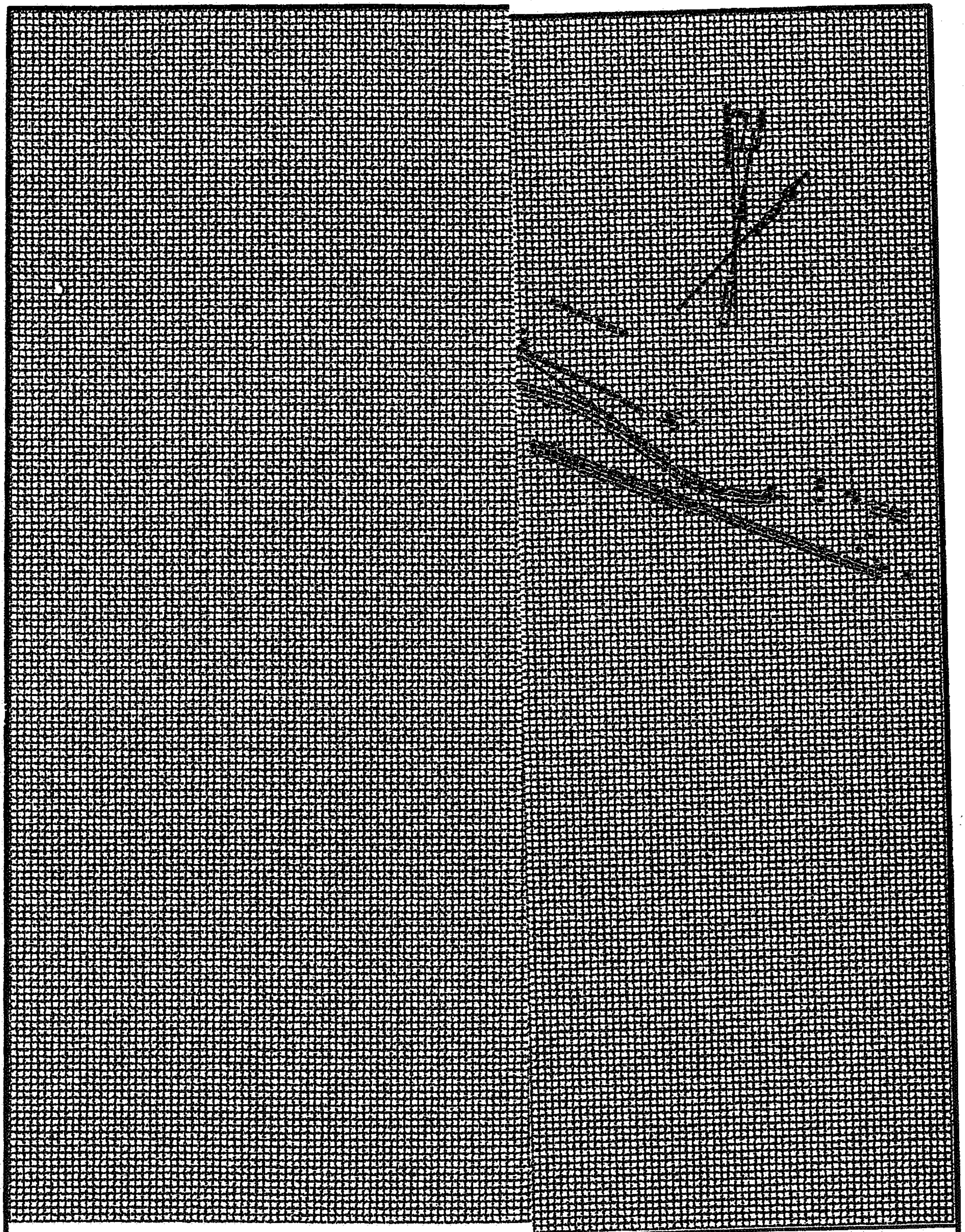
MODEL DOMAIN

E. I. DuPont de Nemours & Co.
DuPont Washington Works
Washington, West Virginia

As Shown	6/23/98	72058006	5.1

ASH000346

EID090445



MODEL GRID

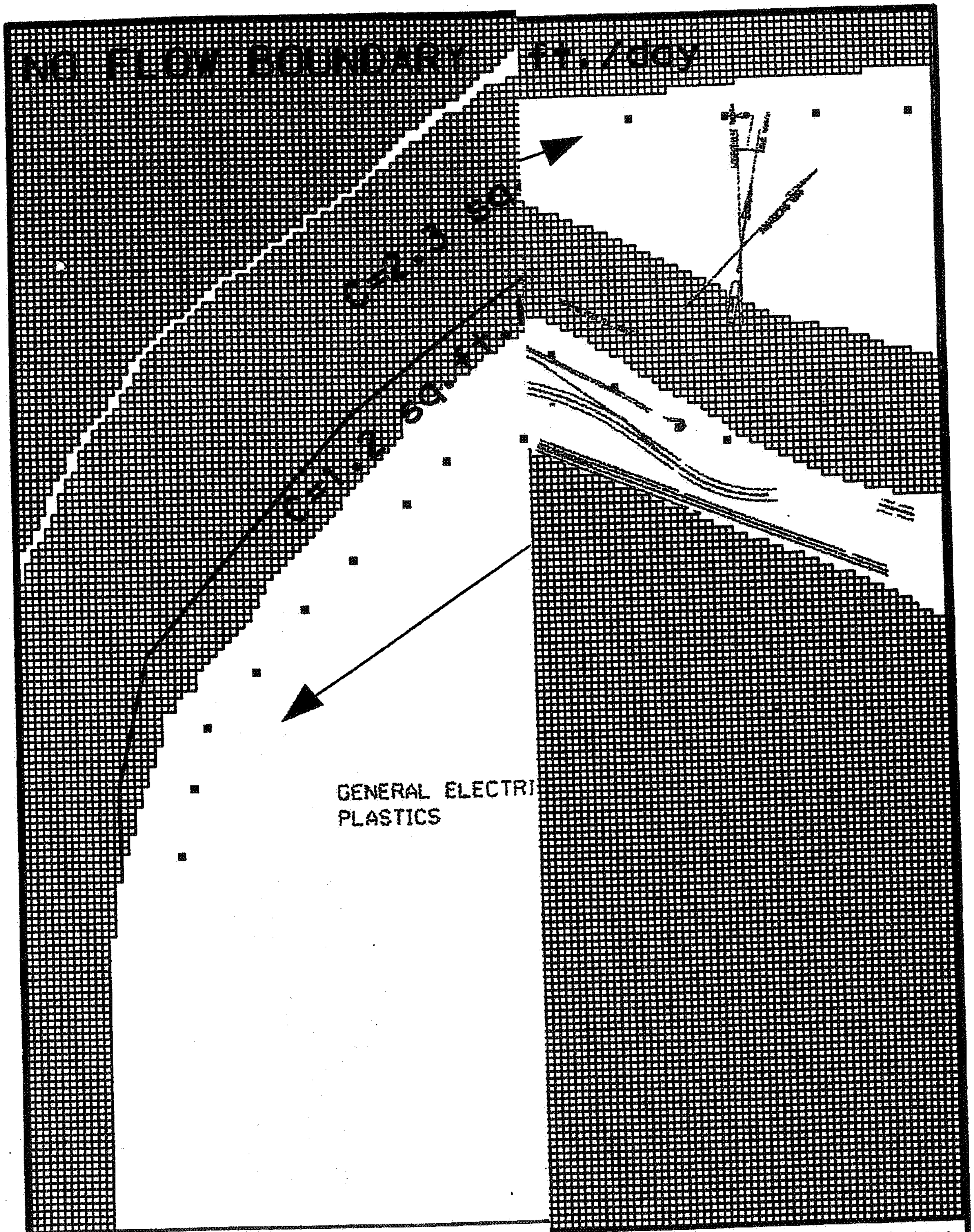
FIGURE	SCALE	DRAWN BY	CAD DRAWING NO
5.2	1000'=1"	MEV	grid.dgn
DATE 5-24-99	CHECKED CLB	APPROVED ASH	PROJECT NO 44D06W720599

Groundwater Flow Model
DUPONT WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA

Figure 5.2

ASH000347

EID090446



MODEL BOUNDARY CONDITIONS

FIGURE	SCALE	DRAWN BY	CAD DRAWING NO
5.3	1000'=1"	MEV	boundaries.dgn
DATE	**CHECKED**	**APPROVED**	**PROJECT NO**
5-24-99	CLB	ASH	44D06W720599

Groundwater Flow Model
DUPONT WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA

Figure 5.3

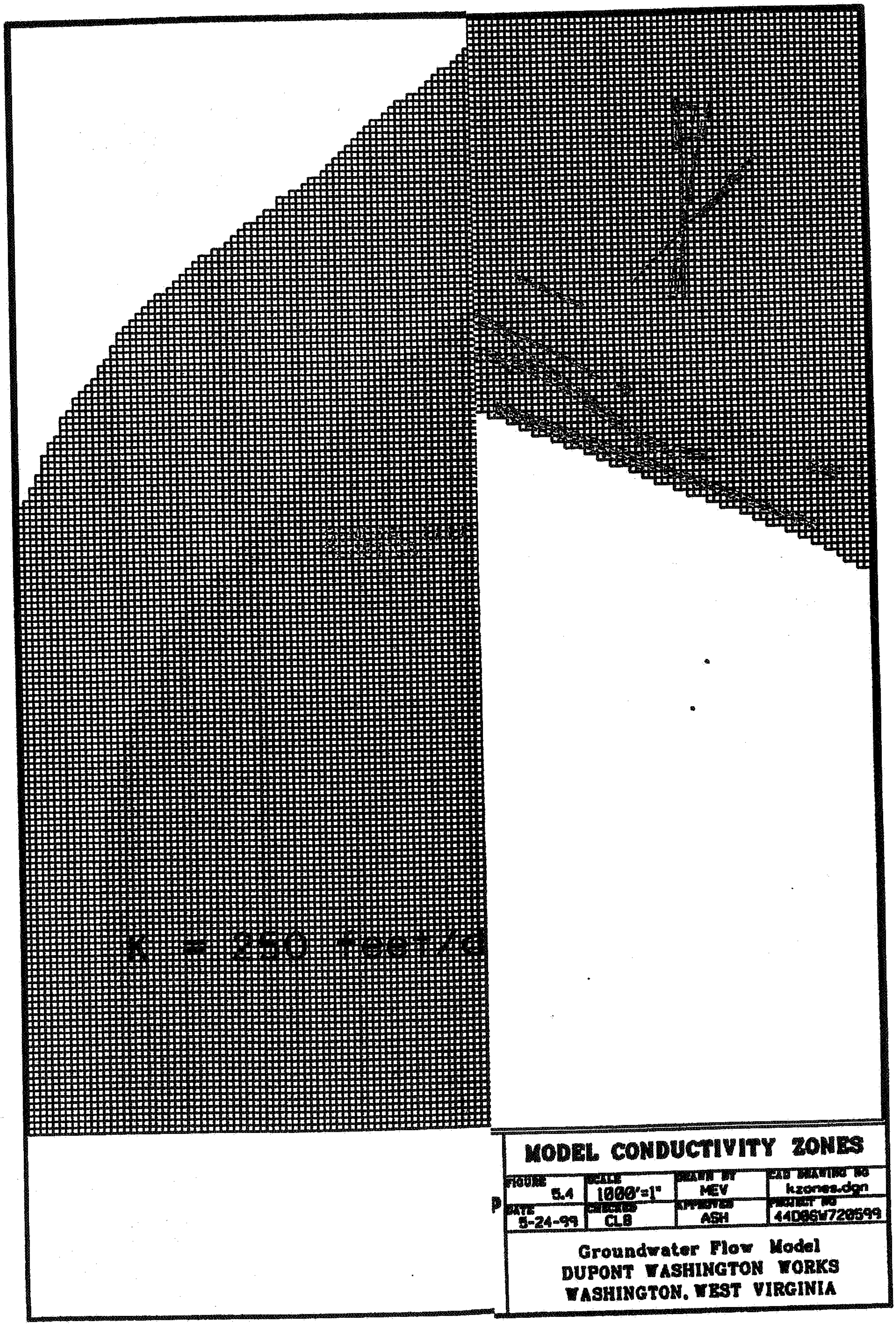
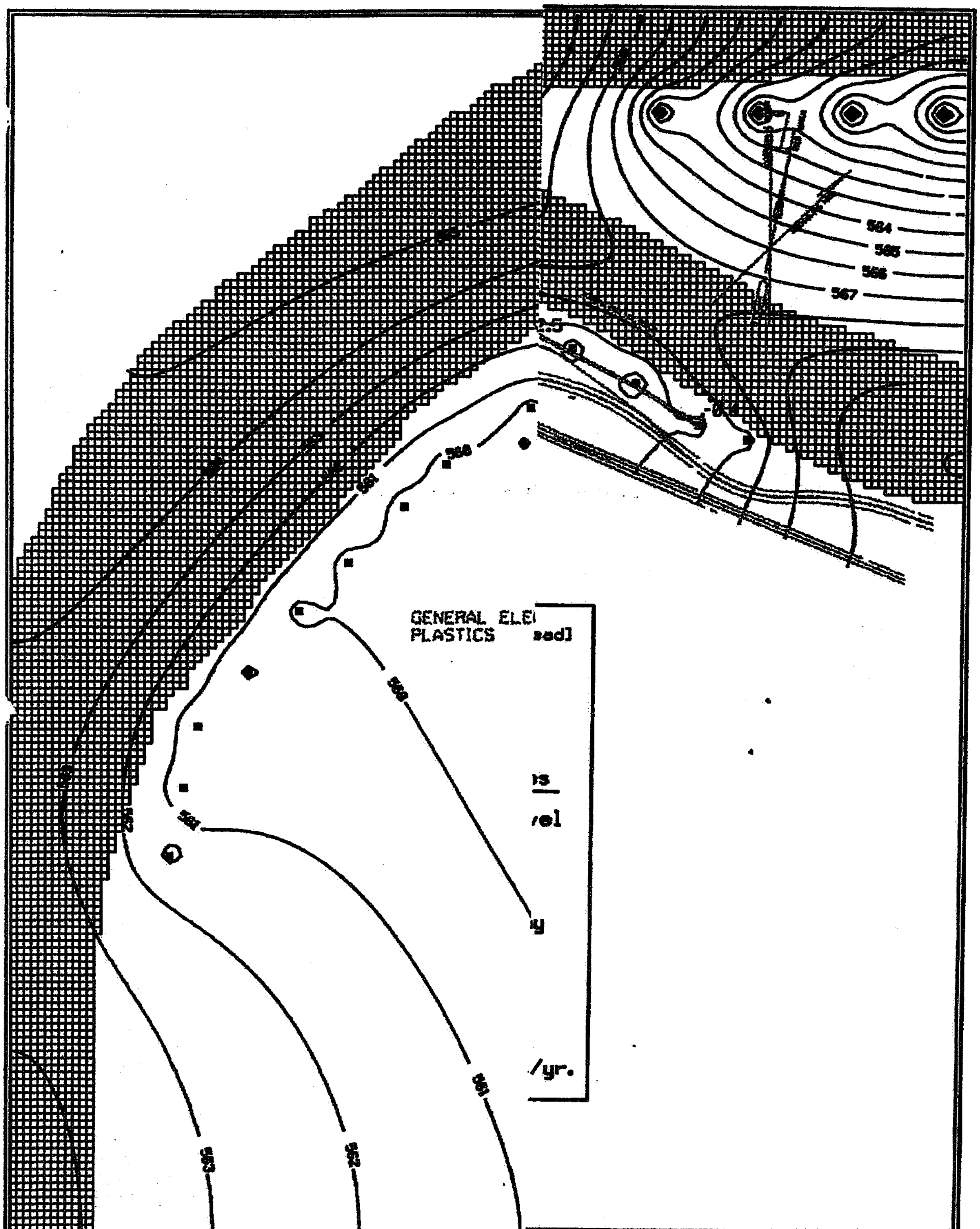


Figure 5.4

ASH000349



CALIBRATED MODEL GROUNDWATER POTENTIOMETRIC SURFACE WITH RESIDUALS

FIGURE	SCALE	DRAWN BY	CAD DRAWING NO
5.5	1000'=1"	MEV	out.dgn
DATE	CHECKED	APPROVED	PROJECT NO
5-24-99	CLB	ASH	44D06W720599

Groundwater Flow Model
DUPONT WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA

Figure 5.5

ASH000350

EID090449

ASH000351

Figure 5.6
Groundwater Model Summary
DuPont Washington Works
Parkersburg, West Virginia

Calibrated Groundwater Model - February 1, 1999 Data Set

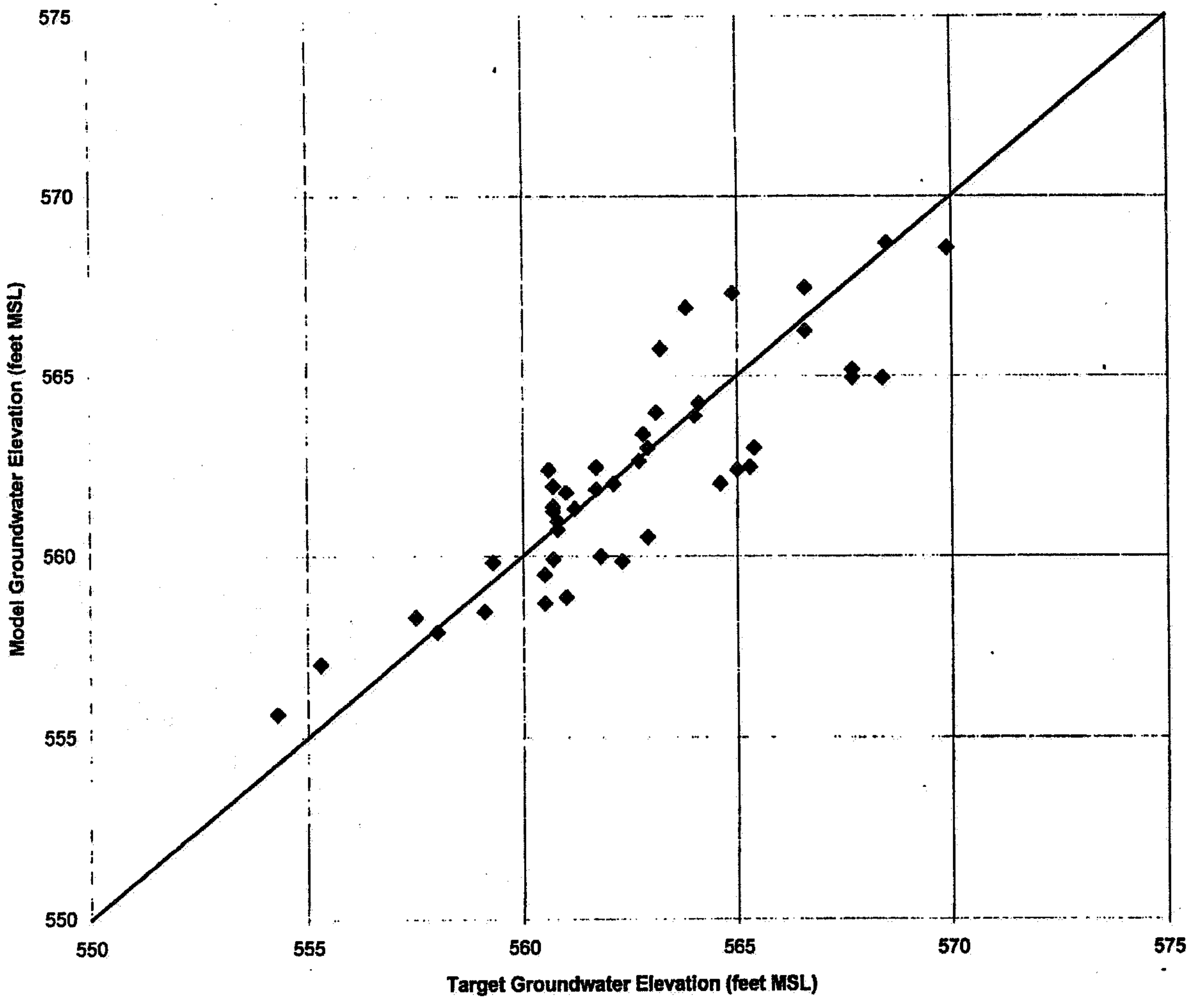
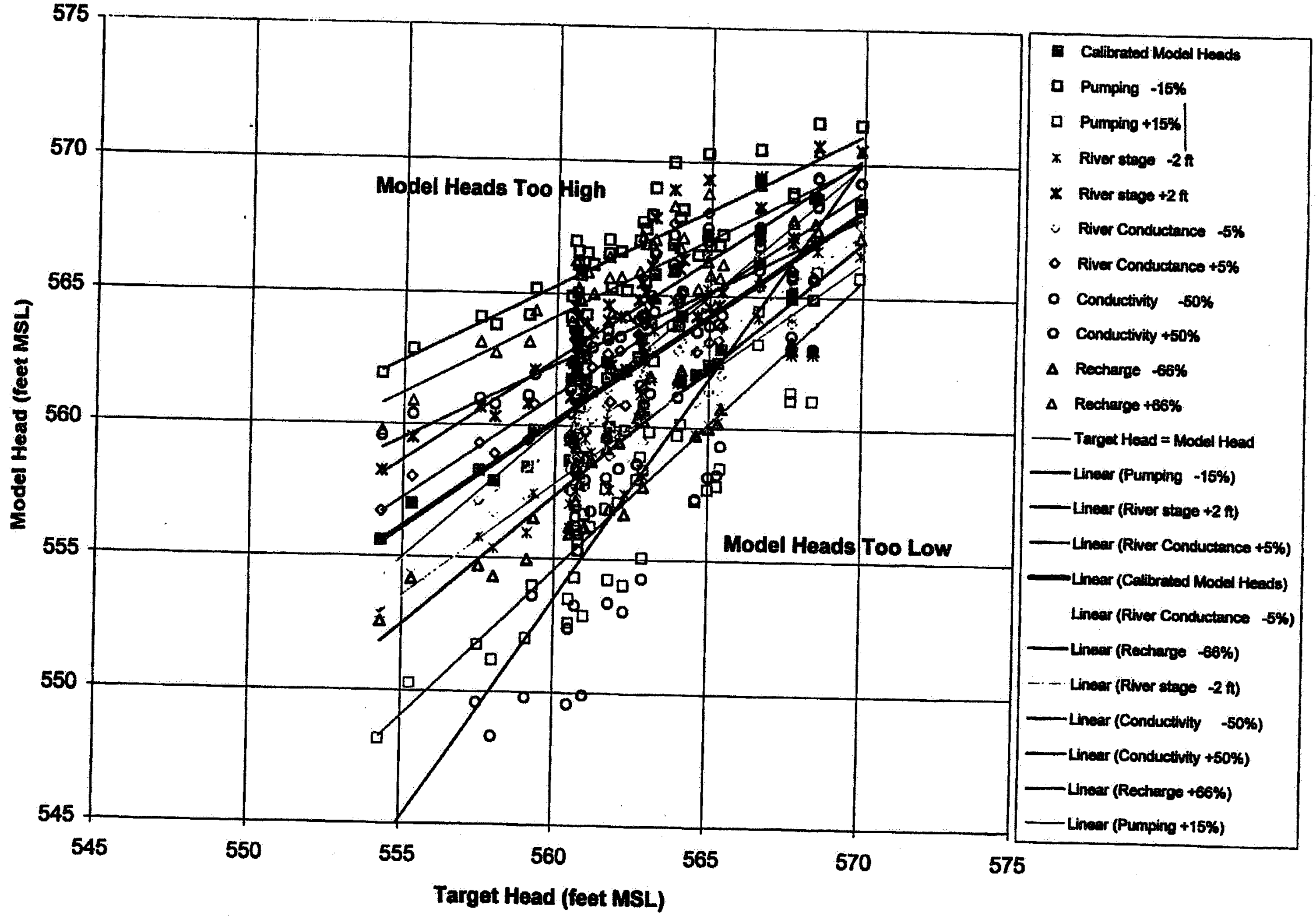


Figure 5.6

EID090450

. .gure 5.7
Groundwater Model Summary
DuPont Washington Works
Parkersburg, West Virginia

SENSITIVITY ANALYSES



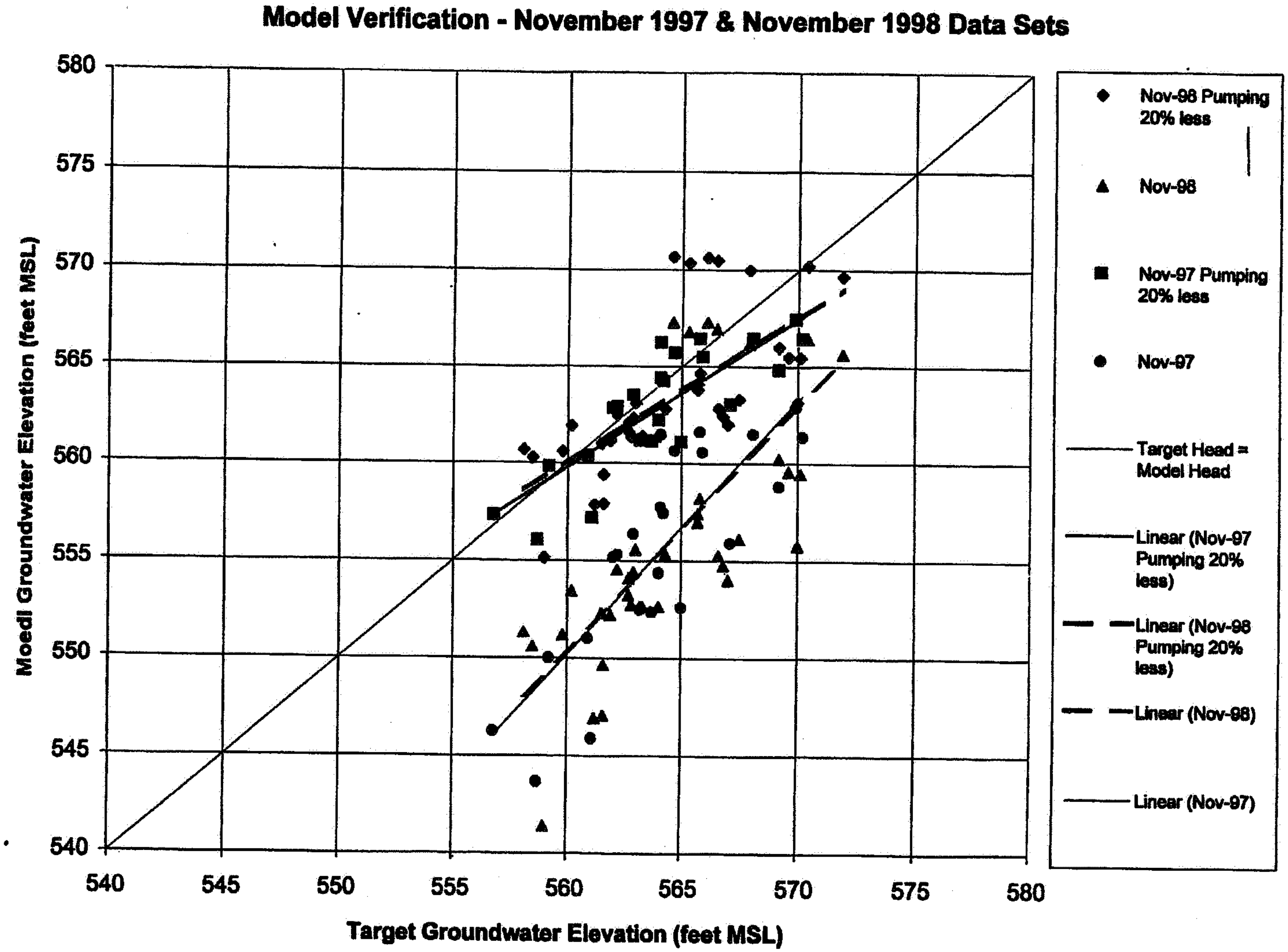
ASH000352

Note: Best fit line based on linear regression of data set.

Figure 5.7

EID090451

Figure 5.8
Groundwater Model Summary
DuPont Washington Works
Parkersburg, West Virginia

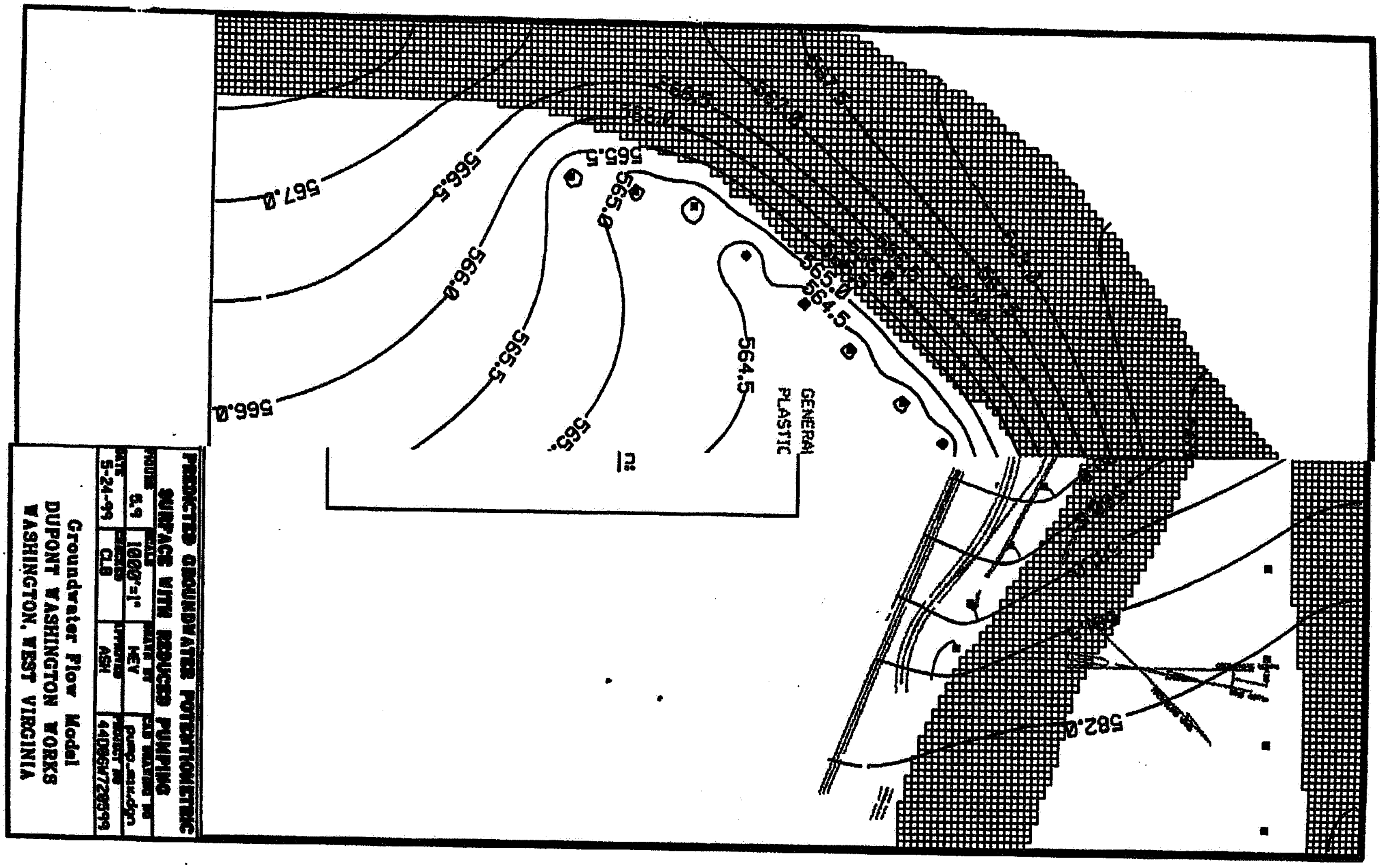


Note: Best fit lines based on linear regression of data set.

ASH000353

Figure 5.8

EID090452



PREDICTED GROUNDWATER POTENTIOMETRIC SURFACE WITH REDUCED PUMPING
FIGURE 5.9
SCALE 1000'=1"
DRAWN BY MEV
CAD DRAWING NO pump_mix.dgn
DATE 5-24-99
CHECKED CLB
APPROVED ASH
PROJECT NO 44D86W728599
Groundwater Flow Model
DUPONT WASHINGTON WORKS
WASHINGTON, WEST VIRGINIA
GENERAL
PLASTIC
582.0
564.5
565.0
565.5
566.0
566.5
567.0

Figure 5.9

SOURCE

WAY STATUS

ECEPTORS	FUTURE RECEPTOR
Riverbank Trespasser	Construction Worker
	O
	O
	O
O	O
O	O
O	O

MATERIALS IN FORMER BG AND RBL/ADP

NOTES:

◆ Potentially Complete and S

O Potentially Complete but In

Blank Indicates an Incomp

DUPONT WASHINGTON WORKS RFI
WASHINGTON, WEST VIRGINIA

WN		DATE: 5-20-99	FILE NO.
		DATE: 5-20-99	44d06W720599

RIVER BANK LANDFILL AND
ANAEROBIC DIGESTION PONDS
MAN EXPOSURE PATHWAY EVALUATION

FIGURE 6.1

Figure 6.1

ASH000355

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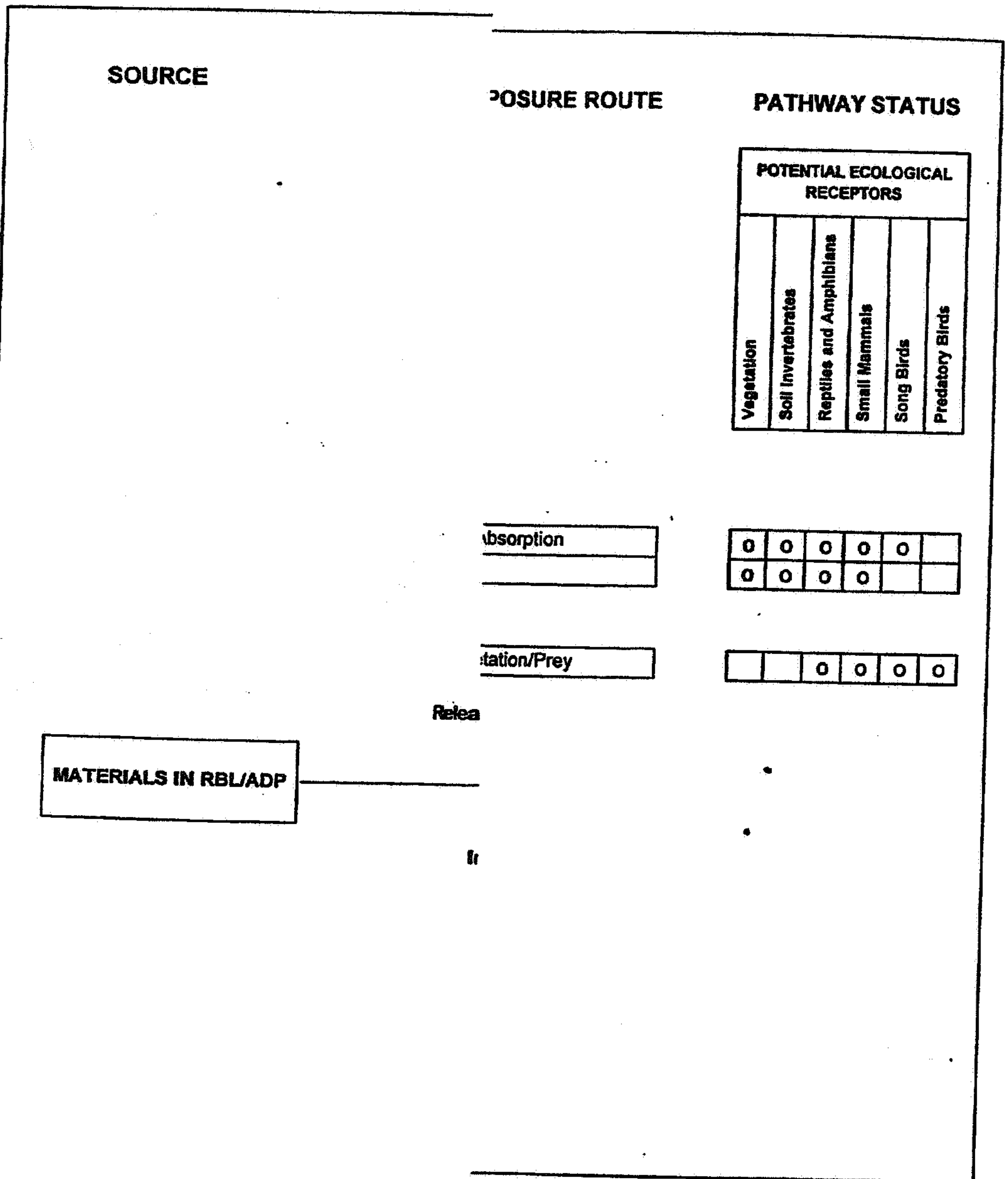
EID090454



NOTES:

- ◆ Potentially Complete and Significant Pathway
- O Potentially Complete but Insignificant Pathway
- Blank Indicates an Incomplete Pathway; Receptor Does

DUPONT WASHINGTON WORKS RFI
WASHINGTON, WEST VIRGINIA

DRN BY: LKR	DATE: 5-20-99	FILE NO.
CHECKED BY: PW	DATE: 5-20-99	44409W72099
RIVER BANK LANDFILL AND ANAEROBIC DIGESTION PONDS ꞮICAL EXPOSURE PATHWAY EVALUATION		FIGURE 6.2

Figure 6.2

ASH000356

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EID090455

TABLES

TABLE 3.1

BORING AND SAMPLE LOCATIONS BY SWMU
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Background	AE11-SB01	0	2	10/6/98
		59	61	10/6/98
	AI10-SB01	0	2	10/14/98
	AP10-SB01	0	2	10/14/98
	E13-SB01	0	2	10/7/98
	G17-SB01	0	2	10/14/98
	N20-SB01	0	2	10/14/98
	P14-SB01	0	2	10/14/98
	T14-SB01	0	2	10/5/98
	Y14-SB01	0	2	10/5/98
		76	78	10/5/98
	Z11-SB01	0	2	10/5/98
Burning Ground	AA06-SB01	0	2	9/2/98
		6	8	9/2/98
		14	16	9/2/98
		20	22	9/2/98
		40	48	9/2/98
		64	66	9/2/98
	AA07-SB01	0	2	9/16/98
	AA07-SB02	0	2	9/27/98
		4	6	9/27/98
	AA08-SB01	0	2	9/27/98
		4	6	9/27/98
	AA08-SB02	0	2	9/27/98
	AC06-SB03	0	2	8/31/98
		6	8	8/31/98
		12	14	8/31/98
		34	36	8/31/98
		48	50	8/31/98
		62	64	8/31/98
	AC06-SB04	0	2	9/1/98
		6	8	9/1/98
		14	16	9/1/98
		34	36	9/1/98
		54	56	9/1/98
		62	64	9/1/98
	AC06-SB05	0	2	9/9/98
		6	8	9/9/98
		12	14	9/9/98
		18	20	9/9/98
		40	42	9/9/98
		62	64	9/9/98

ASH000358

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BORING AND SAMPLE LOCATIONS BY SWMU
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Burning Ground (cont)	AC07-SB02	0	2	9/9/98
		18	20	9/9/98
		62	64	9/10/98
	AC07-SB03	0	2	9/14/98
		8	10	9/14/98
		20	22	9/14/98
		64	66	9/15/98
	AC07-SB04	0	2	9/14/98
		10	12	9/14/98
		20	22	9/14/98
		60	62	9/14/98
	AC08-SB01	0	2	9/27/98
		8	10	9/27/98
		58	60	9/27/98
	AC08-SB02	0	2	8/24/98
		10	12	8/24/98
		20	22	8/24/98
		30	32	8/24/98
		40	42	8/24/98
		50	52	8/24/98
		56	58	8/24/98
	Y07-SB01	0	2	9/22/98
		8	10	9/22/98
		22	24	9/22/98
		62	64	9/22/98
	Z06-SB02	2	4	9/22/98
		8	10	9/22/98
		62	64	9/22/98
	Z06-SB03	0	2	9/15/98
		10	12	9/15/98
		60	62	9/15/98
	Z06-SB04	0	2	9/11/98
		10	12	9/11/98
		64	66	9/11/98
	Z07-SB01	0	2	9/10/98
		10	12	9/10/98
		20	22	9/10/98
		62	64	9/11/98
	Z09-SB01	2	4	9/3/98
		8	10	9/3/98
		14	16	9/3/98
		20	22	9/3/98
		40	42	9/3/98

ASH000359

BORING AND SAMPLE LOCATIONS BY SWMU
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Burning Ground (cont)	Z09-SB01(cont)	60	62	9/3/98
River Bank Landfill	AA04-SB01	0	2	8/20/98
		6	8	8/20/98
		14	16	8/20/98
		30	32	8/20/98
	AA05-SB01	0	2	9/23/98
		8	10	9/23/98
		20	22	9/23/98
		60	62	9/23/98
	AB06-SB01	4	6	9/1/98
		10	12	9/1/98
		18	20	9/1/98
		40	42	9/1/98
		58	60	9/1/98
	AB06-SB02	2	4	9/8/98
		10	12	9/8/98
		18	20	9/8/98
		40	42	9/8/98
		62	64	9/8/98
	AB07-SB02	0	2	9/4/98
		4	6	9/4/98
		10	12	9/4/98
		14	16	9/4/98
		20	22	9/4/98
		40	42	9/4/98
		60	62	9/4/98
	AB08-SB02	0	2	9/27/98
		4	6	9/27/98
	AC04-SB01	0	2	8/21/98
		20	22	8/21/98
		28	30	8/21/98
	AE05-SB02	0	2	8/22/98
		34	36	8/22/98
		58	60	8/22/98
	AF05-SB01	0	2	8/22/98
		30	32	8/22/98
	AH05-SB01	0	2	10/14/98
		4	6	10/14/98
	AI06-SB01	0	2	8/23/98
		18	20	8/23/98
		36	38	8/23/98
		48	50	8/23/98
		60	62	8/23/98

ASH000360

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BORING AND SAMPLE LOCATIONS BY SWMU
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

River Bank Landfill(cont)	K04-SB01	0	2	10/12/98
		12	14	10/12/98
	L04-SB01	0	2	10/12/98
		8	10	10/12/98
	L06-SB01	0	2	9/25/98
		10	12	9/25/98
		22	24	9/25/98
		66	68	9/25/98
	M04-SB02	0	2	10/10/98
		8	10	10/10/98
		14	16	10/10/98
	M04-SB03	0	2	10/10/98
		6	8	10/10/98
		14	16	10/10/98
	M04-SB04	0	2	10/12/98
		10	12	10/12/98
	M04-SB05	2	4	10/12/98
		6	8	10/12/98
		12	14	10/12/98
	M06-SB02	2	4	9/28/98
		8	10	9/28/98
		20	22	9/29/98
		66	68	9/29/98
	N04-SB01	0	2	10/12/98
		12	14	10/12/98
	N04-SB02	0	2	10/9/98
		8	10	10/9/98
		14	16	10/9/98
	N05-SB01	2	4	9/28/98
		8	10	9/28/98
		20	22	9/28/98
		70	72	9/28/98
	O04-SB02	0	2	10/11/98
		6	8	10/11/98
		14	16	10/11/98
	O04-SB03	0	2	10/12/98
		10	12	10/12/98
		14	16	10/12/98
	Q04-SB03	0	2	10/11/98
		8	10	10/11/98
	S04-SB02	0	2	10/11/98
		8	10	10/11/98
		18	20	10/11/98

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EID090460

BORING AND SAMPLE LOCATIONS BY SWMU
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

River Bank Landfill(cont)	S05-SB02	2	4	9/26/98
		10	12	9/26/98
		40	42	9/26/98
		66	68	9/26/98
	T04-SB01	0	2	10/10/98
		10	12	10/10/98
		16	18	10/10/98
	U04-SB01	0	2	9/30/98
		4	6	9/30/98
		16	18	9/30/98
	V04-SB01	0	2	9/29/98
		4	6	9/29/98
		18	20	9/29/98
	YO4-SB01	0	2	8/20/98
		10	12	8/20/98
		30	32	8/20/98
Anearobic Digestion Ponds	P04-SB02	0	2	10/9/98
		8	10	10/9/98
		14	16	10/9/98
	PO5-SB02	2	4	9/24/98
		22	24	9/24/98
		42	44	9/24/98
		68	70	9/24/98
	R04-SB02	0	2	10/9/98
		10	12	10/9/98
		18	20	10/9/98

ASH000362

EID090461

TABLE 3.2

ANALYTICAL PARAMETERS BY SWMU
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

River Bank Landfill/	**Soil**	**Methylene chloride**	**SW-846 8240**
Anaerobic Digestion Pits		**Tetrachloroethene**	**SW-846 8240**
		Trichloroethene	**SW-846 8240**
		Freon-113	**SW-846 8240**
		FC-143	
		Arsenic	**7060**
		Barium	**6010**
		Cadmium	**6010**
		Lead	**7421**
		Nickel	**6010**
	Groundwater	Methylene chloride	SW-846 8240
		Tetrachloroethene	SW-846 8240
		Trichloroethene	SW-846 8240
		FC-143	
		Arsenic (dissolved/total)	7060
		Barium (dissolved/total)	6010
		Cadmium (dissolved/total)	6010
		Lead (dissolved/total)	7421
		Nickel (dissolved/total)	6010
		pH (field)	---
		Temperature (field)	---
		Specific conductivity (field)	---
		Dissolved oxygen (field)	---
		Redox (field)	---
Polyacetal Waste Incinerator	Soil	Chromium	6010
Burning Ground	Soil	Carbon Tetrachloride	SW-846 8240
		FC-143	
		Arsenic	7060
		Barium	6010
		Cadmium	6010
		Lead	7421
		Nickel	6010

RBL = Riverbank landfill (SWMU A-3)
ADP = Anaerobic digestion ponds (SWMU B-4)
BG = Burning ground (SWMU H-14)
PWI = Polyacetal waste incinerator (SWMU C-6)

ASH000363

TABLE 3.2

ANALYTICAL PARAMETERS BY SWMU
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Burning Ground (cont)	Groundwater	Carbon Tetrachloride	SW-846 8240
		Arsenic (dissolved/total)	7060
		Barium (dissolved/total)	6010
		Cadmium (dissolved/total)	6010
		Lead (dissolved/total)	7421
		Nickel (dissolved/total)	6010
		FC-143	
		pH (field)	---
		Temperature (field)	---
		Specific conductivity (field)	---
		Dissolved oxygen (field)	---
		Redox (field)	---
Background	Soil	Methylene chloride	SW-846 8240
		FC-143	SW-846 8240
		Arsenic	7060
		Barium	6010
		Cadmium	6010
		Chromium	6010
		Lead	7421
		Nickel	6010
	Groundwater	Methylene chloride	SW-846 8240
		Tetrachloroethene	SW-846 8240
		Trichloroethene	SW-846 8240
		Freon 113	SW-846 8240
		FC-143	
		Arsenic (dissolved/total)	7060
		Barium (dissolved/total)	6010
		Cadmium (dissolved/total)	6010
		Chromium (dissolved/total)	6010
		Lead (dissolved/total)	7421
		Nickel (dissolved/total)	6010
		pH (field)	---
		Temperature (field)	---
		Specific conductivity (field)	---
		Dissolved oxygen (field)	---
		Redox (field)	---

RBL = Riverbank landfill (SWMU A-3)
ADP = Anaerobic digestion ponds (SWMU B-4)
BG = Burning ground (SWMU H-14)
PWI = Polyacetal waste incinerator (SWMU C-6)

ASH000364

TABLE 3.3

NEW WELL CONSTRUCTION INFORMATION
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Borehole ID	Well ID	Depth to Bottom	Well Diameter	Slot Size	Screen Length	Screen From	Screen To	Sandpack From	Sandpack To	[illegible]	[illegible]	[illegible]	[illegible]
AA04-MW01, SB01	TW-70	43	2"	10	10	43	33	43	31	31	28.5	28.5	surface
AA05-MW01,SB01	TW-71	70	2"	10	10	70	60	70	58	58	56	56	surface
AB07-MW02,SB02	TW-72	72	2"	10	10	72	62	72	60	60	58	58	surface
AC07-MW02,SB02	TW-73	74	2"	10	10	74	64	74	62	62	60	60	surface
AE11-MW01,SB01	TW-74	72	2"	10	10	72	62	72	58	58	56	56	surface
AI06-MW01	TW-75	72	2"	10	10	72	62	72	60	60	58	58	surface
E13-MW01,SB01	TW-76	74	2"	10	10	74	64	74	60	60	58	58	surface
G17-MW01,SB01	TW-77	80	2"	10	10	80	70	80	68	68	66	66	surface
L06-MW01,SB01	TW-78	77	2"	10	10	77	67	77	65	65	63	63	surface
M04-MW02,SB02	TW-79	25	2"	10	10	25	15	25	13	13	11	11	surface
M04-MW03,SB03	TW-80	26	2"	10	10	26	16	26	14	14	12	12	surface
N04-MW02,SB02	TW-81	26	2"	10	10	26	16	26	14	14	12	12	surface
N05-MW01,SB01	TW-82	82	2"	10	10	82	72	82	70	70	68	68	surface
P04-MW02,SB02	TW-83	28	2"	10	10	28	18	28	16	16	14	14	surface
P05-MW02-SB02	TW-84	80	2"	10	10	80	70	80	68	68	66	66	surface
R04-MW02,SB02	TW-85	28	2"	10	10	28	18	28	16	16	14	14	surface
S05-MW02,SB02	TW-86	78	2"	10	10	78	68	78	66	66	64	64	surface
U04-MW01,SB01	TW-87	27	2"	10	10	27	17	27	15	15	13	13	surface
V06-MW01	TW-88	77	2"	10	10	77	67	77	65	65	63	63	surface
W05-MW01	TW-89	76	2"	10	10	76	66	76	64	64	62	62	surface
Y14-MW01,SB01	TW-90	90	2"	10	10	90	80	90	73	73	71	71	surface
Z06-MW02,SB02	TW-91	72	2"	10	10	72	62	72	60	60	58	58	surface
Z07-MW01,SB01	TW-92	74	2"	10	10	74	64	74	62	62	60	60	surface
Z09-MW01,SB01	TW-93	70	2"	10	10	70	60	70	58	58	56	56	surface

TABLE 3.4

WELL DEVELOPMENT INFORMATION
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Borehole ID	Well ID	Design	Date	Depth to Bottom	DTW	Volume	Gallons Developed	Volume Developed	[illegible]	Comments
AA04-MW01, SB01	TW-70	Stickup(2.6')	10/7/98	45.40	30.85	2.37	30	12 6	Bailed	Grey to brown, silty
AA05-MW01,SB01	TW-71	Stickup(2.6')	10/7/98	73.45	64.30	1.49	20	13.4	Pump/Bail	Dark brown, cloudy, silty
AB07-MW02,SB02	TW-72	Stickup(2.5')	10/11/98	75.35	64.25	1.81	30	16.6	Pump/Bail	Brown, cloudy, some silt
AC07-MW02,SB02	TW-73	Flushmount	10/12/98	73.60	62.60	1.79	30	16.7	Pump/Bail	Brown, cloudy, silty
AE11-MW01,SB01	TW-74	Flushmount	10/8/98	71.90	60.30	1.89	20	10.6	Pump/Bail	Dark brown, cloudy, silty
AI06-MW01	TW-75	Flushmount	10/7/98	71.90	62.10	1.60	20	12.5	Pump/Bail	Brown, cloudy, silty
E13-MW01,SB01	TW-76	Stickup(2.15')	10/9/98	76.80	63.50	2.17	25	11.5	Pump/Bail	Dark grey to brown, some silt
G17-MW01,SB01	TW-77	Stickup(2.5')	10/9/98	83.10	72.35	1.75	25	14.3	Bailed	Brown, cloudy, silty
L06-MW01,SB01	TW-78	Flushmount	10/9/98	78.25	68.20	1.64	20	12.2	Pump/Bail	Brown, cloudy, some silt
M04-MW02,SB02	TW-79	Stickup(2.15')	10/12/98	25.50	14.55	1.78	25	14.0	Pump	Light brown, cloudy, trace silt
M04-MW03,SB03	TW-80	Stickup(2.05')	10/12/98	28.45	14.45	2.28	25	11.0	Pump	Brown, cloudy, trace silt
N04-MW02,SB02	TW-81	Stickup(2.35')	10/12/98	28.85	14.80	2.29	25	10.9	Pump	Light brown, cloudy, trace silt
N05-MW01,SB01	TW-82	Flushmount	10/9/98	82.40	71.35	1.80	25	13.9	Bailed	Light brown, cloudy, some silt
P04-MW02,SB02	TW-83	Stickup	10/12/98	30.30	27.10	0.52	10	19.2	Bailed	Dark brown, cloudy, some silt
P05-MW02-SB02	TW-84	Flushmount	10/9/98	80.25	69.00	1.83	25	13.6	Bailed	Dark brown, cloudy, some silt
R04-MW02,SB02	TW-85	Stickup(2.00')	10/12/98	30.40	14.45	2.60	30	11.5	Pump	Brown, cloudy, silty
S05-MW02,SB02	TW-86	Flushmount	10/13/98	76.85	66.70	1.65	20	12.1	Pump/Bail	Brown, cloudy, silty
U04-MW01,SB01	TW-87	Stickup(2.5')	10/7/98	29.85	11.45	3.00	30	10.0	Bailed	Brown, cloudy, silty
V06-MW01	TW-88	Flushmount	10/8/98	75.65	65.95	1.58	20	12.6	Pump/Bail	Dark brown, cloudy, silty
W05-MW01	TW-89	Flushmount	10/11/98	76.20	65.10	1.81	20	11 1	Pump/Bail	Brown, cloudy, some silt
Y14-MW01,SB01	TW-90	Stickup(2.5')	10/8/98	93.85	77.75	2.62	30	11.4	Bailed	Dark brown, cloudy, silty
Z06-MW02,SB02	TW-91	Flushmount	10/8/98	71.40	61.65	1.59	20	12.6	Pump/Bail	Brown, cloudy, silty
Z07-MW01,SB01	TW-92	Stickup(2.45')	10/11/98	77.05	65.45	1.89	30	15.9	Pump/Bail	Brown, slightly cloudy, some silt
Z09-MW01,SB01	TW-93	Flushmount	10/13/98	70.10	57.90	1.99	20	10.1	Pump/Bail	Dark brown, cloudy, silty

TABLE 3.5

GROUNDWATER ROUND 1 DEPTH TO WATER MEASUREMENTS
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

AA04-MW01	TW-70	11/9/98	1117	44.44	31.7	12.74	0.163	2.08	6.23
AA05-MW01	TW-71	11/9/98	1505	73.11	65.13	7.98	0.163	1.30	3.90
AB07-MW02	TW-72	11/9/98	1445	75.01	64.83	10.18	0.163	1.66	4.98
AC07-MW02	TW-73	11/9/98	1438	73.14	63.12	10.02	0.163	1.63	4.90
AE11-MW01	TW-74	11/9/98	1134	71.52	60.33	11.19	0.163	1.82	5.47
AI06-MW01	TW-75	11/9/98	1427	71.61	62.11	9.5	0.163	1.55	4.65
AM07-PW01	336					na	na	na	na
E13-MW01	TW-76	11/9/98	1224	76.58	63.33	13.25	0.163	2.16	6.48
F06-MW01	TW-M6	11/9/98	1215	62.8	36.53	26.27	0.653	17.15	51.46
G17-MW01	TW-77	11/9/98	1205	82.49	72.4	10.09	0.163	1.64	4.93
K16-PW01	L4 (354)					na	na	na	na
L04-PW01	Gallery					na	na	na	na
L06-MW01	TW-78	11/13/98	1048	77.96	66.8	11.16	0.163	1.82	5.46
L17-PW01	L1 (351)					na	na	na	na
M04-MW02	TW-79	11/9/98	1051	26.86	15.02	11.84	0.163	1.93	5.79
M04-MW03	TW-80	11/9/98	1049	28.28	15.19	13.09	0.163	2.13	6.40
M16-MW01	TW-55	11/9/98	1155	71.57	67.32	4.25	0.163	0.69	2.08
N04-MW02	TW-81	11/9/98	1055	28.51	15.39	13.12	0.163	2.14	6.42
N05-MW01	TW-82	11/13/98	1200	82.15	70.55	11.6	0.163	1.89	5.67
N13-MW01	TW-54	11/9/98	1417	70.48	64	6.48	0.163	1.06	3.17
P04-MW02	TW-83	11/9/98	1059	30.02	23.64	6.38	0.163	1.04	3.12
P05-MW02	TW-84	11/13/98	1402	79.86	68.95	10.91	0.163	1.78	5.33
P06-MW02	TW-52	11/13/98	1130	73.2	68.15	5.05	0.163	0.82	2.47
P08-MW01	TW-53	11/9/98	1539	72.19	66.46	5.73	0.163	0.93	2.80
Q04-MW02	TW-50	11/9/98	1045	41.9	35.54	6.36	0.163	1.04	3.11
Q05-MW01	TW-51	11/13/98	1019	69.88	67.88	2	0.163	0.33	0.98
R04-MW02	TW-85	11/9/98	1104	29.98	19.79	10.19	0.163	1.66	4.98
S05-MW02	TW-86	11/13/98	1534	76.65	69.61	7.04	0.163	1.15	3.44
T13-MW01	TW-24	11/9/98	1148	98.36	69.5	28.86	1.469	42.40	127.19
U04-MW01	TW-87	11/9/98	1109	29.38	11.96	17.42	0.163	2.84	8.52
V05-PW01	Ranney					na	na	na	na
V06-MW01	TW-88	11/9/98	1519	75.75	68.7	7.05	0.163	1.15	3.45
V09-MW01	TW-3	11/9/98	1525	100	na		2.611		
W05-MW01	TW-89	11/9/98	1510	75.8	68.64	7.16	0.163	1.17	3.50
Y14-MW01	TW-90	11/9/98	1140	93.42	77.89	15.53	0.163	2.53	7.59
Z06-MW02	TW-91	11/9/98	1459	71.13	62.79	8.34	0.163	1.36	4.08
Z07-MW01	TW-92	11/9/98	1456	76.68	66.39	10.29	0.163	1.68	5.03
Z09-MW01	TW-93	11/9/98	1450	70.25	58.57	11.68	0.163	~~1.90~~	5.71

RFITABLS.xls

ASH000367

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TABLE 4.4

TRICHLOROETHENE RESULTS FOR GROUNDWATER SAMPLING
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Groundwater Results for November Sampling

AA05-MW01	11/11/98	23.	UG/L	1.	5	
L04-PW01	11/18/98	5.	UG/L	1.	5	
L06-MW01	11/13/98	61.	UG/L	1.	5	
M04-MW03	11/12/98	1.	UG/L	1.	5	J
N04-MW02	11/12/98	39.	UG/L	1.	5	
N05-MW01	11/13/98	800.	UG/L	25.	130	
P05-MW02	11/13/98	110.	UG/L	2.	10	
P06-MW02	11/13/98	400.	UG/L	10.	50	
P08-MW01	11/13/98	35.	UG/L	1.	5	
Q04-MW02	11/13/98	3.	UG/L	1.	5	J
Q05-MW01	11/13/98	130.	UG/L	5.	25	
V05-PW01	11/18/98	22.	UG/L	1.	5	
V06-MW01	11/16/98	150.	UG/L	1.	5	
W05-MW01	11/17/98	27.	UG/L	1.	5	

Groundwater Results for February Sampling

AA05-MW01	2/4/99	5.	UG/L	1.	5	
L04-PW01	2/7/99	5.	UG/L	1.	5	J
L06-MW01	2/5/99	25.	UG/L	1.	5	
M04-MW02	2/7/99	36.	UG/L	1.	5	
N04-MW02	2/7/99	30.	UG/L	1.	5	
N05-MW01	2/5/99	670.	UG/L	10.	50	
P05-MW02	2/5/99	150.	UG/L	1.	5	
P06-MW02	2/5/99	480.	UG/L	5.	25	
P08-MW01	2/4/99	63.	UG/L	1.	5	
V05-PW01	2/7/99	22.	UG/L	1.	5	
V06-MW01	2/4/99	120.	UG/L	1.	5	
W05-MW01	2/6/99	28.	UG/L	1.	5	

MCL= 5 UG/L

TABLE 4.5

FREON-113 RESULTS FOR GROUNDWATER SAMPLING
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Groundwater Results for November Sampling

L06-MW01	11/13/98	3700.	UG/L	50.	250
M04-MW03	11/12/98	1500.	UG/L	2.	10
N04-MW02	11/12/98	270.	UG/L	2.	10
N05-MW01	11/13/98	7100.	UG/L	50.	250
P05-MW02	11/13/98	1400.	UG/L	40.	200
P06-MW02	11/13/98	1900.	UG/L	20.	100
P08-MW01	11/13/98	270.	UG/L	4.	20
Q04-MW02	11/13/98	860.	UG/L	20.	100
Q05-MW01	11/13/98	2200.	UG/L	50.	250
S05-MW02	11/13/98	130.	UG/L	2.	10
U04-MW01	11/12/98	13.	UG/L	2.	10
V05-PW01	11/18/98	64.	UG/L	2.	10

MCL= 59,376 UG/L

Groundwater Results for February Sampling

L04-PW01	2/7/99	270.	UG/L	2.	10
L06-MW01	2/5/99	2900.	UG/L	50.	250
M04-MW02	2/7/99	380.	UG/L	4.	20
M04-MW03	2/7/99	3000.	UG/L	50.	250
N04-MW02	2/7/99	210.	UG/L	2.	10
N05-MW01	2/5/99	3600.	UG/L	100.	500
P05-MW02	2/5/99	1600.	UG/L	40.	200
P06-MW02	2/5/99	2200.	UG/L	50.	250
P08-MW01	2/4/99	890.	UG/L	10.	50
Q04-MW02	2/4/99	76.	UG/L	2.	10
S05-MW02	2/5/99	80.	UG/L	2.	10
V05-PW01	2/7/99	56.	UG/L	2.	10

TABLE 4.6

FC-143 RESULTS FOR GROUNDWATER SAMPLING
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Groundwater Results for November Sampling

AA04-MW01	11/12/98	0.1	UG/L		0.1	
AA05-MW01	11/11/98	0.77	UG/L		0.1	
AB07-MW02	11/16/98	0.2	UG/L		0.2	I
AC07-MW02	11/16/98	0.79	UG/L		0.1	
AE11-MW01	11/10/98	0.41	UG/L		0.1	
AI06-MW01	11/16/98	0.1	UG/L		0.1	
AM07-PW01	11/18/98	1.9	UG/L		0.1	
E13-MW01	11/11/98	2	UG/L		0.1	
F06-MW01	11/11/98	0.1	UG/L		0.1	
G17-MW01	11/11/98	13	UG/L		2	
K16-PW01	11/18/98	0.46	UG/L		0.1	
L04-PW01	11/18/98	7.9	UG/L		1	
L06-MW01	11/13/98	870	UG/L		50	
L17-PW01	11/18/98	0.33	UG/L		0.1	
M04-MW02	11/12/98	0.2	UG/L		0.1	
M04-MW03	11/12/98	0.1	UG/L		0.1	
M16-MW01	11/10/98	0.86	UG/L		0.1	
N04-MW02	11/12/98	380	UG/L		20	
N05-MW01	11/13/98	13	UG/L		2	
N13-MW01	11/11/98	0.1	UG/L		0.1	
P04-MW02	11/12/98	8300	UG/L		800	
P05-MW02	11/13/98	1200	UG/L		100	
P06-MW02	11/13/98	31	UG/L		2	
P08-MW01	11/13/98	36	UG/L		5	
Q04-MW02	11/13/98	660	UG/L		50	
Q05-MW01	11/13/98	38	UG/L		2	
R04-MW02	11/12/98	1300	UG/L		100	
S05-MW02	11/13/98	690	UG/L		50	
T13-MW01	11/17/98	0.1	UG/L		0.1	
U04-MW01	11/12/98	1.6	UG/L		0.1	
V05-PW01	11/18/98	0.66	UG/L		0.1	
V06-MW01	11/16/98	1.7	UG/L		0.2	

Groundwater Results for February Sampling

AA04-MW01	2/6/99	5.43	UG/L	0.028	0.095	
AA05-MW01	2/4/99	1.46	UG/L	0.032	0.11	
AB07-MW02	2/4/99	0.535	UG/L	0.030	0.099	
AC07-MW02	2/4/99	0.356	UG/L	0.028	0.095	
AE11-MW01	2/2/99	0.69	UG/L	0.030	0.1	
AI06-MW01	2/3/99	0.13	UG/L	0.030	0.1	
AM07-PW01	2/3/99	0.082	UG/L	0.030	0.1	J
E13-MW01	2/2/99	0.59	UG/L	0.030	0.1	
F06-MW01	2/2/99	0.35	UG/L	0.030	0.1	
G17-MW01	2/2/99	2.11	UG/L	0.030	0.1	
K16-PW01	2/9/99	16.2	UG/L	0.29	1	
L04-PW01	2/7/99	5.89	UG/L	0.028	0.094	
L06-MW01	2/5/99	4.91	UG/L	0.028	0.095	
L17-PW01	2/9/99	2.76	UG/L	0.029	0.098	
M04-MW02	2/7/99	17.0	UG/L	0.14	0.47	
M04-MW03	2/7/99	21.1	UG/L	0.16	0.53	
M16-MW01	2/3/99	3.66	UG/L	0.030	0.1	
N04-MW02	2/7/99	329.	UG/L	3.1	10	
N05-MW01	2/5/99	815.	UG/L	28.	95	
N13-MW01	2/2/99	29.6	UG/L	0.60	2	
P04-MW02	2/6/99	13600.	UG/L	320.	1100	
P05-MW02	2/5/99	434.	UG/L	2.8	9.5	
P06-MW02	2/5/99	414.	UG/L	3.1	10	
P08-MW01	2/4/99	43.4	UG/L	0.70	2.3	
Q04-MW02	2/4/99	994.	UG/L	6.1	20	
R04-MW02	2/6/99	9420.	UG/L	280.	950	
S05-MW02	2/5/99	174.	UG/L	3.1	10	
T13-MW01	2/3/99	0.64	UG/L	0.030	0.1	
U04-MW01	2/6/99	4.20	UG/L	0.033	0.11	
V05-PW01	2/7/99	12.4	UG/L	0.14	0.47	
V06-MW01	2/4/99	1.91	UG/L	0.029	0.095	

.BLE 4.6

FC-143 RESULTS FOR GROUNDWATER SAMPLING
RCRA FACILITY INVESTIGATION
DUPONT WASHINGTON WORKS PLANT

Groundwater Results for November Sampling

W05-MW01	11/17/98	0.31	UG/L		0.1	
Y14-MW01	11/10/98	12	UG/L		2	
Z06-MW02	11/16/98	4.5	UG/L		0.5	
Z07-MW01	11/16/98	3.8	UG/L		0.5	
Z09-MW01	11/17/98	0.1	UG/L		0.1	

Preliminary Screening Level (SL): 3 ug/L

Groundwater Results for February Sampling

W05-MW01	2/6/99	0.729	UG/L	0.028	0.095	
Y14-MW01	2/2/99	4.95	UG/L	0.030	0.1	
Z06-MW02	2/4/99	0.803	UG/L	0.029	0.097	
Z07-MW01	2/4/99	2.05	UG/L	0.028	0.095	
Z09-MW01	2/6/99	2.74	UG/L	0.029	0.095	

TABLE 5.1
Groundwater Model Summary
DuPont Washington Works
Parkersburg, West Virginia

CALSTATS --- Version 1.3
Calibration Statistics

MODFLOW BCF File Name....: mod.bcf
MODFLOW BAS File Name....: mod.bas
Target Information in....: mod.trg
Model-Computed Heads in..: mod.hds

Well Name	Target Head	Model Head	Residual
J08-MW01	561.00	561.73	-0.73
Z07-MW02	565.40	562.97	2.43
T13-MW01	561.80	559.97	1.83
U16-MW01	562.30	559.83	2.47
AO09-MW01	564.90	567.30	-2.40
L18-MW01	558.00	557.87	0.13
V09-MW01	562.90	560.49	2.41
AR09-MW01	563.20	565.76	-2.56
AX12-MW01	566.60	566.26	0.34
AJ06-MW01	568.50	568.68	-0.18
AO08-MW01	563.80	566.89	-3.09
Q04-MW02	561.20	561.29	-0.09
Q05-MW01	560.80	560.93	-0.13
P06-MW02	560.70	561.20	-0.50
P08-MW01	560.80	560.69	0.11
N13-MW01	560.50	559.45	1.05
M16-MW01	559.10	558.42	0.68
AA04-MW01	564.00	563.85	0.15
AA05-MW01	563.10	563.95	-0.85
AB07-MW02	564.10	564.21	-0.11
AC07-MW02	568.40	564.92	3.48
AE11-MW01	567.70	564.93	2.77
AI06-MW01	569.90	568.54	1.36
E13-MW01	559.30	559.80	-0.50
G17-MW01	557.50	558.26	-0.76
L06-MW01	560.60	562.36	-1.76
N05-MW01	560.70	561.90	-1.20
P04-MW02	562.10	561.97	0.13
P05-MW02	561.70	561.82	-0.12
S05-MW02	560.70	559.88	0.82
V06-MW01	560.50	558.66	1.84
W05-MW01	561.00	558.82	2.18
Y14-MW01	560.70	561.35	-0.65
Z06-MW02	565.30	562.44	2.86
Z07-MW01	562.70	562.61	0.09
Z09-MW01	565.00	562.36	2.64
Y05-MW01	564.60	561.99	2.61
AC05-MW01	567.70	565.15	2.55
AL10-MW01	566.60	567.45	-0.85
I07-MW01	561.70	562.42	-0.72
D08-MW01	562.90	562.97	-0.07
F06-MW01	562.80	563.34	-0.54
U03-MW01	555.30	556.97	-1.67
U05-MW02	554.30	555.60	-1.30

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----- **Summary Statistics For Entire Model** -----

Number of Targets	= 44
Residual Mean	= 0.321549
Residual Standard Dev.	= 1.599567
Residual Sum of Squares	= 117.128311
Absolute Residual Mean	= 1.266028
Minimum Residual	= -3.089648
Maximum Residual	= 3.480383
Observed Range in Head	= 15.600000
Res. Std. Dev./Range	= 0.102536

ASH000378

TABLE 5.2
Groundwater Model Summary
DuPont Washington Works
Parkersburg, West Virginia

Sensitivity Anlayses

	Residual Mean	Residual Standard Deviation	Residual Sum of Squares	Absolute Residual Mean	Minimum Residual	Maximum Residual
Calibrated Model	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Recharge + 66%	-3.1	1.7	556	3.1	-5.6	0.7
Recharge - 66%	2.7	1.9	480	3.0	-2.1	5.6
Conductivity + 50%	-1.2	1.8	202	1.8	-5.3	2.8
Conductivity - 50%	4.7	3.8	1658	5.1	-2.3	14.5
Conductance + 5%	-0.6	1.6	128	1.5	-3.9	2.7
Conductance - 5%	1.3	1.6	193	1.7	-2.2	4.4
River Stage + 2 feet	-1.9	1.6	270	2.1	-5.1	1 4
River Stage - 2 feet	2.6	1.6	408	2.7	-1.0	5.6
Pumping + 15 %	5.2	2.0	1358	5.2	0.0	8.3
Pumping - 15 %	-4.2	1.7	913	4.2	-7.6	-0.3

Residual = Observed Head minus Modeled Head
- residual = modeled heads too high
+ residual = modeled heads too low

	Calibrated Value	Varied Up To:	Varied Down To:
Recharge	0.0025	0.00375	0.00165
Conductivity	200	300	100
	250	375	125
	900	1350	450
Conductance	13.1	13.76	12.45
	2.3	2.42	2.19
	1.2	1.26	1.14
River Stage	584	586	582
Pumping (total)	5563	6398	4729

Note: Model units are in feet and days.

ASH000379

TABLE 6.1
BURNING GROUND SOIL ANALYTICAL RESULTS: 0 - 2 FEET

SRCNAME	Depth		Date	Carbon Tetrachloride			FC-143			Arsenic		Barium		Cadmium			Lead		Nickel	
	From	To		ug/kg	Qual	PQL	ug/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual	mg/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual
AA06-SB01	0	2	9/2/98		ND	240		UI	24	8		167			ND	2.3	10.5		12.2	
AA07-SB01	0	2	9/16/98		ND	240		UI	25	7.4		108		0.59	J	2.6	11.6		12.6	
AA07-SB02	0	2	9/27/98		ND	240	82		12	5.6		142		0.67	J	2.2	11.5		12.8	
AA08-SB01	0	2	9/27/98		ND	240	32		11	9.8		112		1.04	J	2.2	26		16.7	
AA08-SB02	0	2	9/27/98		ND	240		U	12	8.7		106		1.99	J	2.3	19.6		13.2	
AB07-SB02	0	2	9/4/98		ND	240		U	12	9.4		72		1.2	J	2.2	10.5		15.5	
AB08-SB01								UI	37											
AB08-SB02	0	2	9/27/98		ND	270		U	12	10.2		79		0.92	J	2.3	14.8		17.3	
AC06-SB03	0	2	8/31/98		ND	240		U	10	3.7		43			ND	2	5.6		8.5	
AC06-SB04	0	2	9/1/98		ND	240	15		13	11.7		42			ND	2.2	10.5		13.1	
AC06-SB05	0	2	9/9/98		ND	240		U	11	8		41			ND	2.1	9.7		13.2	
AC07-SB02	0	2	9/9/98		ND	240	39		11	5.2		562		0.74	J	2.6	9.7		11.7	
AC07-SB03	0	2	9/14/98		ND	240	64		11	5.2		270			ND	2.2	11.4		12.4	
AC07-SB04	0	2	9/14/98		ND	240	29		12	6.2		131			ND	2.2	11.3		16.9	
AC08-SB01	0	2	9/27/98		ND	240		UI	21	7.5		139		0.71	J	2.2	10.2		13.2	
AC08-SB02	0	2	8/24/98		ND	240	53		11	6.9		142		0.59	J	2.2	12.8		14.7	
Y07-SB01	0	2	9/22/98		ND	240		U	11	4.9		212		0.65	J	2.3	3		2.6	J
Z06-SB03	0	2	9/15/98		ND	240		UI	26	10.2		78		0.89	J	2.3	9.4		14.4	
Z06-SB04	0	2	9/11/98		ND	240		UI	26	5.9		124			ND	2.3	12.9		13.9	
Z07-SB01	0	2	9/10/98		ND	240		UI	22	12.7		71			ND	2.2	14		17.3	
Maximum Concentration				ND			82			12.7		562.0		2.0			26.0		17.3	
Industrial Soil SL (CR = 10^{-6}; HQ = 1)				44000	c		120000	(1)		3.8	c	140000	n	1000	n		1000	(2)	41000	n
Maximum Conc. Exceeds SL?				No			No			Yes		No		No			No		No	

Legend:

c = Carcinogen.
CR = Target cancer risk for carcinogenic effects.
HQ = Target hazard quotient for noncancer effects.
J = Estimated concentration below the PQL.
n = Noncarcinogen.
ND = Not Detected.
PQL = Practical Quantitation Limit.
Qual = Laboratory data qualifier (J, U, UI) or Not Detected (ND).
SL = Screening Level. EPA Region III risk-based concentrations (RBCs) for industrial soil, based on 1 in 1 million (10^{-6}) excess cancer risk and noncancer hazard quotient of 1.
U = Not detected.
UI = Not detected.

Notes;
(1) Preliminary screening level; see Table 6.6 and Section 6.4.2
(2) Conservative SL for lead in industrial soil; see Section 6.4.1.

TABLE 6.2
BURNING GROUND SOIL ANALYTICAL RESULTS: 2 - 20 FEET

SRCNAME	Depth		Date	Carbon Tetrachloride			FC-143			Arsenic		Barium		Cadmium			Lead		Nickel	
	From	To		ug/kg	Qual	PQL	ug/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual	mg/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual
AA06-SB01	6	8	9/2/98		ND	240	140		14	12.3		52			ND	2.3	11.2		16.7	
AA06-SB01	14	16	9/2/98		ND	240	51		12	9.8		26			ND	2.2	7.2		9.4	
AA06-SB01	20	22	9/2/98		ND	240		U	11	9		28			ND	2.1	6		12.5	
AA07-SB02	4	6	9/27/98		ND	240	91		12	10.5		59		0.75	J	2.3	11.9		19	
AA08-SB01	4	6	9/27/98		ND	240		U	12	9.8		116		0.81	J	2.3	14.9		18.7	
AB06-SB01	4	6	9/1/98		ND	250		UI	24	9.7		43			ND	2.3	9.5		14.3	
AB06-SB01	10	12	9/1/98		ND	260		UI	22	10.3		35			ND	2.2	7.4		12.8	
AB06-SB01	18	20	9/1/98		ND	270		UI	21	6.1		23			ND	2.1	6		13.2	
AB06-SB02	2	4	9/8/98		ND	230		U	12	10.7		48			ND	2.2	9.1		14.4	
AB06-SB02	10	12	9/8/98		ND	270	17		11	10.1		37			ND	2.2	6.9		12.9	
AB06-SB02	18	20	9/8/98		ND	240		U	11	10.2		35			ND	2.1	4.8		11.1	
AB07-SB02	4	6	9/4/98	330		260		U	12	10		42			ND	2.3	10.3		15.3	
AB07-SB02	10	12	9/4/98	840		250	36		13	11.8		55			ND	2.4	9.7		14.3	
AB07-SB02	14	16	9/4/98	230	J	390	59		12	8.3		36			ND	2.3	7.9		11.1	
AB07-SB02	20	22	9/4/98		ND	290		U	11	4.4		30			ND	2.1	4.2		11.9	
AB08-SB02	4	6	9/27/98		ND	250	11		10	7		150		0.76	J	2.3	12.4		17.2	
AC06-SB03	6	8	8/31/98		ND	240	55		12	11.7		44			ND	2.4	11.2		15.6	
AC06-SB03	12	14	8/31/98		ND	240	12		12	12		63			ND	2.2	9.4		11.9	
AC06-SB04	6	8	9/1/98		ND	240	63		12	11.1		55			ND	2.4	10.9		16.6	
AC06-SB04	14	16	9/1/98		ND	240		UI	22	8.5		44			ND	2.1	9.8		17.8	
AC06-SB05	6	8	9/9/98		ND	240		U	12	10.5		46			ND	2.3	10.5		16.4	
AC06-SB05	12	14	9/9/98		ND	240		U	11	8		38			ND	2.3	6.6		11.9	
AC06-SB05	18	20	9/9/98		ND	240		U	11	5.9		21			ND	2.1	5.4		11.9	
AC07-SB02	18	20	9/9/98		ND	240		U	12	13		56			ND	2.5	13.1		15.3	
AC07-SB03	4	6	9/14/98					U	12											
AC07-SB03	8	10	9/14/98		ND	240		UI	23	11.4		76			ND	2.5	6.5		21.1	
AC07-SB03	14	16	9/14/98				18		13											
AC07-SB03	20	22	9/14/98		ND	240		U	11	8.8		43			ND	2.1	6.1		12.6	
AC07-SB04	4	6	9/14/98					U	13											
AC07-SB04	10	12	9/14/98		ND	240	13		11	7.8		45			ND	2.3	9.3		13	
AC07-SB04	14	16	9/14/98					U	12											
AC07-SB04	20	22	9/14/98		ND	240		U	12	6		39			ND	2.1	5.3		10.7	
AC08-SB01	4	6	9/27/98					UI	35											
AC08-SB01	8	10	9/27/98		ND	240		UI	25	10.9		90		0.88	J	2.5	13.2		20.8	
AC08-SB01	14	16	9/27/98					U	11											
AC08-SB01	20	22	9/27/98					UI	23											
AC08-SB02	10	12	8/24/98		ND	240		U	12	3.5		63			ND	2.4	10		19.9	
AC08-SB02	20	22	8/24/98		ND	240		U	10	5.9		48		0.23	J	2.1	5.4		14.3	

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TABLE 6.2

BURNING GROUND SOIL ANALYTICAL RESULTS: 2 - 20 FEET

SRCNAME	Depth		Date	Carbon Tetrachloride			FC-143			Arsenic		Barium		Cadmium			Lead		Nickel	
	From	To		ug/kg	Qual	PQL	ug/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual	mg/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual
Y07-SB01	4	6	9/22/98					U	11											
Y07-SB01	8	10	9/22/98	180	J	240		U	13	10.5		46		0.61	J	2.3	8.9		13.3	
Y07-SB01	14	16	9/22/98				78		11											
Z06-SB02	2	4	9/22/98		ND	240		U	12	12.2		71		0.71	J	2.4	12		14.2	
Z06-SB02	8	10	9/22/98		ND	240	23		13	6.7		50		0.54	J	2.4	8.4		12.5	
Z06-SB02	14	16	9/22/98					U	10											
Z06-SB02	20	22	9/22/98					U	12											
Z06-SB03	4	6	9/15/98					UI	21											
Z06-SB03	10	12	9/15/98		ND	240		UI	22	8.7		45		0.41	J	2.2	7.4			
Z06-SB03	14	16	9/15/98					UI	21											
Z06-SB03	20	22	9/15/98					UI	21											
Z06-SB04	10	12	9/11/98		ND	240	59		13	10		44			ND	2.3	11.7		15	
Z06-SB04	20	22	9/11/98					U	11											
Z07-SB01	10	12	9/10/98		ND	240		UI	24	9		43			ND	2.3	7.9		13.7	
Z07-SB01	20	22	9/10/98		ND	240		U	10	7		27			ND	2	4.4		10.5	
Z09-SB01	2	4	9/3/98		ND	240	34		12	12.5		65			ND	2.4	17		17.2	
Z09-SB01	8	10	9/3/98		ND	240		U	12	12		59			ND	2.5	11.7		19.8	
Z09-SB01	14	16	9/3/98		ND	240		U	12	10.4		65			ND	2.4	9.7		16.3	
Z09-SB01	20	22	9/3/98		ND	240		U	11	8.2		41			ND	2.2	9.1		14.7	
Maximum Concentration				840			140			13		150		0.88			17		21.1	
Industrial Soil SL (CR = 10-6; HQ = 1)				44000	c		120000	(1)		3.8	c	140000	n	1000	n		1000	(2)	41000	n
Maximum Conc. Exceeds SL?				No			No			Yes		No		No			No		No	

Legend:

c = Carcinogen.
CR = Target cancer risk for carcinogenic effects.
HQ = Target hazard quotient for noncancer effects.
J = Estimated concentration below the PQL.
n = Noncarcinogen.
ND = Not Detected.
PQL = Practical Quantitation Limit.
Qual = Laboratory data qualifier (J, U, UI) or Not Detected (ND).
SL = Screening Level. EPA Region III risk-based concentrations (RBCs) for industrial soil, based on 1 in 1 million (10^{-6}) excess cancer risk and noncancer hazard quotient of 1.
U = Not detected
UI = Not detected

Notes:

(1) Preliminary screening level: see Table 6.6 and Section 6.4.2.
(2) Conservative SL for lead in industrial soil; see Section 6.4 1.

1 .E 6.3

RIVER BANK LANDFILL/ ANAEROBIC DIGESTION

PONDS SOIL ANALYTICAL RESULTS: 0 - 2 FEET

SRCNAME	Depth		Date	FC-143			FREON 113			Methylene Chloride			Tetrachloroethene			Trichloroethene		
	From	To		ug/kg	Qual	PQL	ug/kg	Qual	PQL	ug/kg	Qual	PQL	ug/kg	Qual	PQL	ug/kg	Qual	PQL
AA04-SB01	0	2	8/20/98		U	12		ND	520		ND	260		ND	260	64	J	260
AA05-SB01	0	2	9/23/98		UI	27		ND	510		ND	260		ND	260		ND	260
AC04-SB01	0	2	8/21/98															
AE05-SB02	0	2	8/22/98	22		11		ND	530		ND	260		ND	260		ND	260
AF05-SB01	0	2	8/22/98		UI	22		ND	530		ND	270	510		270		ND	270
AH05-SB01	0	2	10/14/98	40		14		ND	590		ND	300		ND	300		ND	300
AI06-SB01	0	2	8/23/98	14		12		ND	500		ND	250		ND	250	160	J	250
K04-SB01	0	2	10/12/98	35		12		ND	520		ND	260		ND	260		ND	260
L04-SB01	0	2	10/12/98		UI	35		ND	440		ND	220		ND	220		ND	220
L06-SB01	0	2	9/25/98		UI	22		ND	470		ND	230		ND	230		ND	230
M04-SB02	0	2	10/10/98	55		12		ND	500		ND	250		ND	250		ND	250
M04-SB03	0	2	10/10/98		UI	24		ND	530		ND	270		ND	270		ND	270
M04-SB04	0	2	10/12/98	81		12	1600	J	470		ND	240		ND	240		ND	240
N04-SB01	0	2	10/12/98		UI	25		ND	560		ND	280		ND	280		ND	280
N04-SB02	0	2	10/9/98	79		13		ND	780		ND	390		ND	390		ND	390
O04-SB02	0	2	10/11/98	34		12		ND	600		ND	300	69	J	300		ND	300
O04-SB03	0	2	10/12/98	32		11		ND	480		ND	240		ND	240		ND	240
P04-SB02	0	2	10/9/98	50		13		ND	530		ND	270		ND	270		ND	270
Q04-SB03	0	2	10/11/98	170		13		ND	630		ND	320		ND	320		ND	320
R04-SB02	0	2	10/9/98	9500		1300		ND	560		ND	280		ND	280		ND	280
S04-SB02	0	2	10/11/98	1100		130		ND	650		ND	320		ND	320		ND	320
T04-SB01	0	2	10/10/98	60		11	170	J	600		ND	300		ND	300		ND	300
U04-SB01	0	2	9/30/98	140		13		ND	560		ND	280		ND	280		ND	280
V04-SB01	0	2	9/29/98	600		59		ND	610		ND	300		ND	300		ND	300
YO4-SB01	0	2	8/20/98	22		14		ND	540		ND	270		ND	270		ND	270
Maximum Concentration				9500			1600			ND			510			160		
Industrial Soil SL (CR = 10-6; HQ = 1)				120000	(1)		6.1E+10	n		760000	c		110000	c		520000	c	
Maximum conc. exceeds SL?				No			No			No			No			No		

Legend:

CR = Target cancer risk for carcinogenic effects.

HQ = Target hazard quotient for noncancer effects.

J = Estimated concentration below the PQL.

n = Noncarcinogen.

ND = Not Detected

PQL = Practical Quantitation Limit

Qual = Laboratory data qualifier (J, U, UI) or Not Detected (ND).

SL = Screening Level EPA Region III risk-based concentrations (RBCs) for industrial soil, based on 1 in 1 million (10^{-6}) excess cancer risk and noncancer hazard quotient of 1.

U = Not detected.

UI = Not detected.

Notes:

(1) Preliminary screening level; see Table 6 6 and Section 6.4.2.

(2) Conservative SL for lead in industrial soil; see Section 6.4.1.

.E 6.3

RIVER BANK LANDFILL/ ANAEROBIC DIGESTION
PONDS SOIL ANALYTICAL RESULTS: 0 - 2 FEET

SRCNAME	Depth		Date	Arsenic		Barium		Cadmium			Lead		Nickel	
	From	To		mg/kg	Qual	mg/kg	Qual	mg/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual
AA04-SB01	0	2	8/20/98	7.7		144			ND	2.4	19		20.8	
AA05-SB01	0	2	9/23/98	10.8		85		0.51	J	2.3	15.4		17.1	
AC04-SB01	0	2	8/21/98	9.4		92			ND	2.1	13.4		13.8	
AE05-SB02	0	2	8/22/98	5.9		972		4.5		2.1	33		12.1	
AF05-SB01	0	2	8/22/98	15		131		7.4		2.3	19		20.1	
AH05-SB01	0	2	10/14/98	7.9		85		2.34	J	2.4	26		19	
AI06-SB01	0	2	8/23/98	5.9		129		3.1		2.2	42		18.1	
K04-SB01	0	2	10/12/98	6.9		172			ND	2.2	26		26.2	
L04-SB01	0	2	10/12/98	6.4		135		0.7	J	2.3	20.1		20.8	
L06-SB01	0	2	9/25/98	9.6		123		0.91	J	2.3	16.2		14.1	
M04-SB02	0	2	10/10/98	7.8		224			ND	2.2	15.7		15.5	
M04-SB03	0	2	10/10/98	9.7		288			ND	2.4	24.2		32.6	
M04-SB04	0	2	10/12/98	10.2		157		0.36	J	2.4	60		32.1	
N04-SB01	0	2	10/12/98	7.8		104		0.3	J	2.3	33		22.2	
N04-SB02	0	2	10/9/98	9.7		161			ND	2.3	9.8		14.7	
O04-SB02	0	2	10/11/98	10.5		270		1	J	2.4	49		34.6	
O04-SB03	0	2	10/12/98	6.4		120			ND	2.2	13.5		12.8	
P04-SB02	0	2	10/9/98	9.50		175			ND	2.4	61		36	
Q04-SB03	0	2	10/11/98	10.1		127		0.42	J	2.4	77		41.3	
R04-SB02	0	2	10/9/98	7.50		150			ND	2.5	28		26.8	
S04-SB02	0	2	10/11/98	10.4		160		0.58	J	2.7	80		46.3	
T04-SB01	0	2	10/10/98	10		149			ND	2.4	50		32.2	
U04-SB01	0	2	9/30/98	8.2		139		3		2.2	29		29	
V04-SB01	0	2	9/29/98	6.7		153		3.3		2.3	32		32.4	
Y04-SB01	0	2	8/20/98	9.2		139			ND	2.3	50		24.5	
Maximum Concentration				15		972		7.4			80		46.3	
Industrial Soil SL (CR = 10-6; HQ = 1)				3.8	c	140000	n	1000	n		1000	(2)	41000	n
Maximum conc. exceeds SL?				Yes		No		No			No		No	

Legend:

CR = Target cancer risk for carcinogenic effects.
HQ = Target hazard quotient for noncancer effects.
J = Estimated concentration below the PQL.
n = Noncarcinogen.
ND = Not Detected.
PQL = Practical Quantitation Limit.
Qual = Laboratory data qualifier (J, U, UI) or Not Detected (ND)
SL = Screening Level. EPA Region III risk-based concentrati (RBCs) for industrial soil, based on 1 in 1 million (10^{-6}) excess cancer risk and noncancer hazard quotient of 1
U = Not detected.
UI = Not detected

Notes:
(1) Preliminary screening level; see Table 6 6 and Section 6 4 2.
(2) Conservative SL for lead in industrial soil; see Section 6.4 1

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RIVER BANK LANDFILL/AEROBIC DIGESTION PONDS
SOIL ANALYTICAL RESULTS: 2 - 20 FEET

SRCNAME	Depth		Date	FC-143			FREON 113			Methylene Chloride			Tetrachloroethene		
	From	To		ug/kg	Qual	PQL	ug/kg	Qual	PQL	ug/kg	Qual	PQL	ug/kg	Qual	PQL
AA04-SB01	6	8	8/20/98	32		11		ND	490		ND	240		ND	240
AA04-SB01	14	16	8/20/98		UI	24		ND	570		ND	290		ND	290
AA05-SB01	4	6	9/23/98	20		12									
AA05-SB01	8	10	9/23/98	39		12		ND	530		ND	260		ND	260
AA05-SB01	16	18	9/23/98		UI	21									
AA05-SB01	20	22	9/23/98	20		11		ND	630		ND	320	1400		320
AC04-SB01	10	12	8/21/98	18		12									
AC04-SB01	20	22	8/21/98		UI	13		ND	560		ND	280		ND	280
AE05-SB02	10	12	8/22/98		U	13									
AF05-SB01	10	12	8/22/98		U	13									
AF05-SB01	20	22	8/22/98		U	12									
AH05-SB01	4	6	10/14/98	34		15		ND	650		ND	330		ND	330
AI06-SB01	18	20	8/23/98		U	11		ND	480		ND	240		ND	240
K04-SB01	12	14	10/12/98		UI	24	340	J	520		ND	260		ND	260
L04-SB01	8	10	10/12/98		UI	24		ND	500		ND	250		ND	250
L06-SB01	10	12	9/25/98	280		66	340		580		ND	290		ND	290
M04-SB02	8	10	10/10/98		UI	25		ND	500		ND	250		ND	250
M04-SB02	14	16	10/10/98	26		13		ND	530		ND	260		ND	260
M04-SB03	6	8	10/10/98		U	12	1600	J	510		ND	260		ND	260
M04-SB03	14	16	10/10/98		UI	24	1600	J	490		ND	250		ND	250
M04-SB04	10	12	10/12/98	34		12	1600	J	500		ND	250	52	J	250
M04-SB05	2	4	10/12/98	86		12		ND	500	650		250		ND	250
M04-SB05	6	8	10/12/98	45		12		ND	500	320000		10000		ND	250
M04-SB05	12	14	10/12/98	43		12		ND	620	230	J	310		ND	310
M06-SB02	2	4	9/28/98	44		11	380	J	570		ND	280		ND	280
M06-SB02	8	10	9/28/98	32		11		ND	550		ND	280		ND	280
M06-SB02	20	22	9/29/98		U	11	580		510		ND	260		ND	260
N04-SB01	12	14	10/12/98		UI	25		ND	550		ND	280		ND	280
N04-SB02	8	10	10/9/98		U	12		ND	500		ND	250		ND	250
N04-SB02	14	16	10/9/98	220		12		ND	500		ND	250		ND	250
N05-SB01	2	4	9/28/98		U	11		ND	570	730		290	76	J	290
N05-SB01	8	10	9/28/98	110		11		ND	480		ND	240		ND	240
N05-SB01	20	22	9/28/98	1800		210	330	J	530		ND	270		ND	270
O04-SB02	6	8	10/11/98		UI	20	190	J	510		ND	250		ND	250
O04-SB02	14	16	10/11/98	28		13		ND	550		ND	280		ND	280
O04-SB03	10	12	10/12/98		U	12		ND	500		ND	250		ND	250
O04-SB03	14	16	10/12/98	24		12	140	J	520		ND	260		ND	260

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RIVER BANK LANDFILL/AEROBIC DIGESTION PONDS
SOIL ANALYTICAL RESULTS: 2 - 20 FEET

SRCNAME	Depth		Date	FC-143			FREON 113			Methylene Chloride			Tetrachloroethene		
	From	To		ug/kg	Qual	PQL	ug/kg	Qual	PQL	ug/kg	Qual	PQL	ug/kg	Qual	PQL
P04-SB02	8	10	10/9/98	11000		1300		ND	590		ND	290		ND	290
P04-SB02	14	16	10/9/98	10000		1300		ND	560		ND	280		ND	280
PO5-SB02	2	4	9/24/98	20		12		ND	510		ND	260	1200		260
Q04-SB03	8	10	10/11/98	48000		3800		ND	550		ND	280		ND	280
R04-SB02	10	12	10/9/98	7900		1300		ND	540		ND	270		ND	270
R04-SB02	18	20	10/9/98	11000		1300		ND	590		ND	290		ND	290
S04-SB02	8	10	10/11/98	44000		3800		ND	500		ND	250		ND	250
S04-SB02	18	20	10/11/98	11000		1300		ND	520		ND	260		ND	260
S05-SB02	2	4	9/26/98	28		11		ND	480		ND	240		ND	240
S05-SB02	10	12	9/26/98	140		13		ND	520		ND	260		ND	260
T04-SB01	10	12	10/10/98		U	12		ND	600		ND	300		ND	300
T04-SB01	16	18	10/10/98	54		13		ND	540		ND	270		ND	270
U04-SB01	4	6	9/30/98	95		12		ND	540		ND	270		ND	270
U04-SB01	16	18	9/30/98		U	13		ND	670		ND	330		ND	330
V04-SB01	4	6	9/29/98	170		13		ND	500		ND	250		ND	250
V04-SB01	18	20	9/29/98		UI	27		ND	580		ND	290		ND	290
YO4-SB01	10	12	8/20/98		UI	24		ND	560		ND	280		ND	280
Y04-SB01	18	20	8/20/98		U	13									
Maximum				48000			1600			320000			1400		
Industrial Soil SL (CR = 10-6; HQ = 1)				120000	(1)		6.1E+10	n		760000	c		110000	c	
Maximum conc. Exceeds SL?				No			No			No			No		

Legend:
CR = Target cancer risk for carcinogenic effects.
HQ = Target hazard quotient for noncancer effects.
J = Estimated concentration below the PQL.
n = Noncarcinogen.
ND = Not Detected.
PQL = Practical Quantitation Limit.
Qual = Laboratory data qualifier (J, U, UI) or Not Detected (ND).
SL = Screening Level. EPA Region III risk-based concentrations (RBCs) for industrial soil, based on 1 in 1 million (10^{-6}) excess cancer risk and noncancer hazard quotient of 1.
U = Not detected.
UI = Not detected.

Notes:
(1) Preliminary screening level; see Table 6.6 and Section 6.4.2
(2) Conservative SL for lead in industrial soil; see Section 6.4.1.

T. Ê 6.4

RIVER BANK LANDFILL/AEROBIC DIGESTION PONDS

SOIL ANALYTICAL RESULTS: 2 - 20 FEET

SRCNAME	Depth		Date	Trichloroethene			Arsenic		Barium		Cadmium			Lead		Nickel	
	From	To		ug/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual	mg/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual
AA04-SB01	6	8	8/20/98		ND	240	6.7		157			ND	2.4	19		23.4	
AA04-SB01	14	16	8/20/98		ND	290	5.2		106			ND	2.5	8.4		16.6	
AA05-SB01	4	6	9/23/98														
AA05-SB01	8	10	9/23/98		ND	260	7.9		27		0.23	J	2.2	7		9.7	
AA05-SB01	16	18	9/23/98														
AA05-SB01	20	22	9/23/98	2200		320	3.8		22		0.21	J	2.1	4.1		7	
AC04-SB01	10	12	8/21/98														
AC04-SB01	20	22	8/21/98		ND	280	7.4		155			ND	2.5	13.1		20.3	
AE05-SB02	10	12	8/22/98														
AF05-SB01	10	12	8/22/98														
AF05-SB01	20	22	8/22/98														
AH05-SB01	4	6	10/14/98		ND	330	13.4		145		1.94	J	2.6	91		44.6	
AI06-SB01	18	20	8/23/98		ND	240	7.9		62		2.7		2.2	13.7		16.8	
K04-SB01	12	14	10/12/98		ND	260	8.1		140			ND	2.5	17.4		23.3	
L04-SB01	8	10	10/12/98		ND	250	7.3		148			ND	2.5	15.9		22.4	
L06-SB01	10	12	9/25/98	1400		290	9		157		11.8		2.5	114		22.3	
M04-SB02	8	10	10/10/98		ND	250	8.7		233			ND	2.5	18.6		30.4	
M04-SB02	14	16	10/10/98		ND	260	6.7		142			ND	2.6	12.3		25.3	
M04-SB03	6	8	10/10/98		ND	260	6.4		136			ND	2.4	14.2		21.6	
M04-SB03	14	16	10/10/98		ND	250	7.4		130			ND	2.4	15.7		24.5	
M04-SB04	10	12	10/12/98		ND	250	6.8		146			ND	2.3	14.8		20.5	
M04-SB05	2	4	10/12/98		ND	250	22		122		0.33	J	2.3	19		13.7	
M04-SB05	6	8	10/12/98		ND	250	6.2		180			ND	2.5	17.5		26.7	
M04-SB05	12	14	10/12/98		ND	310	5.8		134			ND	2.5	14		22.6	
M06-SB02	2	4	9/28/98		ND	280	6		38		0.24	J	2.1	6.4		9.6	
M06-SB02	8	10	9/28/98		ND	280	8		35		0.28	J	2.2	8.7		12	
M06-SB02	20	22	9/29/98		ND	260	5.2		33		1.4	J	2.1	4.9		14.7	
N04-SB01	12	14	10/12/98		ND	280	5.8		137			ND	2.5	14.4		20.8	
N04-SB02	8	10	10/9/98		ND	250	7		229			ND	2.5	17.3		26.7	
N04-SB02	14	16	10/9/98		ND	250	5.9		102			ND	2.5	10.9		20.7	
N05-SB01	2	4	9/28/98	8800		290	8.2		147		0.7	J	2.3	99		17	
N05-SB01	8	10	9/28/98	78	J	240	7.8		43		0.29	J	2.2	8		12.2	
N05-SB01	20	22	9/28/98	340		270	5.2		32		0.33	J	2.2	6.1		10.4	
O04-SB02	6	8	10/11/98		ND	250	7.3		178			ND	2.4	18.7		27.1	
O04-SB02	14	16	10/11/98		ND	280	7.3		108		0.24	J	2.5	15.5		23.9	
O04-SB03	10	12	10/12/98		ND	250	6.9		146			ND	2.5	19.2		29.7	
O04-SB03	14	16	10/12/98		ND	260	6.8		144			ND	2.4	14.9		23.4	

T E 6.4

RIVER BANK LANDFILL/AEROBIC DIGESTION PONDS
SOIL ANALYTICAL RESULTS: 2 - 20 FEET

SRCNAME	Depth		Date	Trichloroethene			Arsenic		Barium		Cadmium			Lead		Nickel	
	From	To		ug/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual	mg/kg	Qual	PQL	mg/kg	Qual	mg/kg	Qual
P04-SB02	8	10	10/9/98		ND	290	6.80		172			ND	2.6	22		27.7	
P04-SB02	14	16	10/9/98		ND	280	8.60		170			ND	2.6	17.5		28.2	
PO5-SB02	2	4	9/24/98		ND	260	6.90		830					7.8			
Q04-SB03	8	10	10/11/98		ND	280	7.6		171			ND	2.5	18.1		23.5	
R04-SB02	10	12	10/9/98		ND	270	7.50		180			ND	2.5	16.1		25.1	
R04-SB02	18	20	10/9/98		ND	290	7.40		186			ND	2.6	15.6		27.7	
S04-SB02	8	10	10/11/98		ND	250	10.5		187			ND	2.4	18.7		27.4	
S04-SB02	18	20	10/11/98		ND	260	8.3		193			ND	2.5	16.4		27.4	
S05-SB02	2	4	9/26/98		ND	240	5.1		91		0.91	J	2.1	6.7		21.8	
S05-SB02	10	12	9/26/98		ND	260	7.8		30		0.53	J	2.3	7.7		12.4	
T04-SB01	10	12	10/10/98		ND	300	5.9		195			ND	2.5	17.9		30	
T04-SB01	16	18	10/10/98		ND	270	6.2		187			ND	2.5	13		27.2	
U04-SB01	4	6	9/30/98		ND	270	7.3		162		2.5		2.3	18		24.7	
U04-SB01	16	18	9/30/98		ND	330	6.6		155		2.55	J	2.6	14		26.6	
V04-SB01	4	6	9/29/98		ND	250	6.6		212		2.8		2.5	16.2		28.5	
V04-SB01	18	20	9/29/98		ND	290	7.1		128		2.35	J	2.6	14.4		22.1	
YO4-SB01	10	12	8/20/98		ND	280	6		117			ND	2.4	10.1		20	
Y04-SB01	18	20	8/20/98														
Maximum				8800			22		830		11 8			114		44.6	
Industrial Soil SL (CR = 10-6; HQ = 1)				520000	c		3.8	c	140000	n	1000	n		1000	(2)	41000	n
Maximum conc. Exceeds SL?				No			Yes		No		No			No		No	

Legend:
CR = Target cancer risk for carcinogenic effects.
HQ = Target hazard quotient for noncancer effects.
J = Estimated concentration below the PQL.
n = Noncarcinogen.
ND = Not Detected.
PQL = Practical Quantitation Limit.
Qual = Laboratory data qualifier (J, U, UI) or Not Detected (N
SL = Screening Level. EPA Region III risk-based concentrat (RBCs) for industrial soil, based on 1 in 1 million (10^{-6}) excess cancer risk and noncancer hazard quotient of 1.
U = Not detected.
UI = Not detected.

Notes:
(1) Preliminary screening level: see Table 6.6 and Section 6.4.
(2) Conservative SL for lead in industrial soil; see Section 6.4.1

TABLE 6.5
PRODUCTION WELL GROUNDWATER CONCENTRATIONS COMPARED TO MCLs OR OTHER SCREENING CRITERIA

SRCNAME	Date	Arsenic mg/L	Qual	PQL	Barium mg/L	Qual	PQL	Cadmium mg/L	Qual	PQL	Lead mg/L	Qual	PQL	Nickel mg/L	Qual	PQL
K16-PW01	11/18/98	0.0013	J	0.01	0.15		0.1	ND		0.01	ND		0.003	ND		0.05
K16-PW01	2/9/99	ND		0.01	0.14		0.1	ND		0.01	ND		0.003	ND		0.05
L17-PW01	11/18/98	0.0043	J	0.01	0.13		0.1	ND		0.01	0.0022	J	0.003	ND		0.05
L17-PW01	2/9/99	ND		0.01	0.13		0.1	ND		0.01	ND		0.003	ND		0.05
AM07-PW01 *	11/18/98	0.01		0.01	0.0672	J	0.1	ND		0.01	ND		0.003	ND		0.05
AM07-PW01 *	2/7/99	ND		0.01	0.0743	J	0.1	ND		0.01	ND		0.003	ND		0.05
V05-PW01	11/18/98	0.0025	J	0.01	0.0845	J	0.1	ND		0.01	ND		0.003	ND		0.05
V05-PW01	2/7/99	0.0017	J	0.01	0.0848	J	0.1	ND		0.01	ND		0.003	ND		0.05
L04-PW01	11/18/98	0.0068	J	0.01	0.16		0.1	ND		0.01	ND		0.003	ND		0.05
L04-PW01	2/7/99	0.0028	J	0.01	0.14		0.1	ND		0.01	ND		0.003	ND		0.05
Maximum Concentration		0.01			0.16			ND			0.0022			ND		
MCL or Other Criterion		0.05	MCL		2	MCL		0.005	MCL		0.015	(1)		0.14	MCL	
Maximum conc. Exceeds Criterion?		No			No			No			No			No		

SRCNAME	Date	FC-143 ug/L	Qual	PQL	PCE ug/L	Qual	PQL	TCE ug/L	Qual	PQL	MeCl ug/L	Qual	PQL	Freon 113 ug/L	Qual	PQL
K16-PW01	11/18/98	0.46		0.1							ND		5			
K16-PW01	2/9/99	16.2		1							ND		5			
L17-PW01	11/18/98	0.33		0.1							ND		5			
L17-PW01	2/9/99	2.76		0.098							ND		5			
AM07-PW01 *	11/18/98	1.9		0.1	ND		5	ND		5	ND		5	ND		10
AM07-PW01 *	2/7/99	0.082	J	0.1	ND		5	ND		5	ND		5	ND		10
V05-PW01	11/18/98	0.66		0.1	4	J	5	22		5	ND		5	64		10
V05-PW01	2/7/99	12.4		0.47	5		5	22		5	ND		5	56		10
L04-PW01	11/18/98	7.9		1	4	J	5	5		5	ND		5			
L04-PW01	2/7/99	5.89		0.094	4	J	5	5	J	5	ND		5	270		10
Maximum Concentration		16.2			5			22						270		
MCL or Other Criterion		3	(2)		5	MCL		5	MCL		5	MCL		59000	(3)	
Maximum conc. Exceeds Criterion?		Yes			No			Yes			No			No		

J = Estimated value below PQL.
MCL = Federal maximum contaminant Level for drinking water.
ND = Not detected.
PQL = Practical quantitation limit.
* Plant potable water supply (well 336). Observed concentrations did not exceed screening levels.
(1) Federal action level for lead in tap water.
(2) Preliminary screening level; see Table 6.6 and Section 6.4 2.
(3) Risk-based concentration for Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane) in tap water (USEPA Region III, 1999).

TABLE 6.6
CALCULATION OF PRELIMINARY SCREENING LEVELS FOR FC-143 IN SOIL AND DRINKING WATER

CEGair (1)	Inhalation Rate (2)	Allowable Daily Intake (3)	Water Ingestion Rate (4)	PSL water (5)	Soil Ingestion Rate (6)	Conversion Factor	PSL soil (7)
mg/m3	m3/day	mg/day	L/day	mg/L	mg/day	mg/kg	mg/kg
0.0003	20	0.006	2	0.003	50	1.E+06	120

Legend:
Allowable Daily Intake = CEGair x Inhalation Rate
PSL water = Preliminary Screening Level for drinking water = Allowable Daily Intake / Water Ingestion Rate
PSL soil = Preliminary Screening Level for industrial soil = Allowable Daily Intake x 10^{+6} mg/kg / Soil Ingestion Rate

Notes
(1) CEGair = Community Exposure Guideline for air exposures (Haskell Laboratory, 1991).
(2) USEPA Region III default residential inhalation rate (USEPA Region III, 1999).
(3) Allowable Daily Intake = CEGair x Inhalation Rate.
(4) USEPA Region III default residential groundwater ingestion rate (USEPA Region III, 1999).
(5) PSL water = Allowable Daily Intake / Water Ingestion Rate.
(6) USEPA default industrial soil ingestion rate (USEPA region III, 1999).
(7) PSL soil = Allowable Daily Intake x mg/kg / Soil Ingestion Rate.

Table 6.7
RISK-BASED SCREENING FOR SOIL

Constituent	Maximum Detected Concentration, mg/kg BG 0 - 2 ft	BG 2 - 20 ft	RBL/ADP 0 - 2 ft	RBL/ADP 2 - 20 ft	Industrial Soil SL (1) mg/kg	Max > Soil SL?
Arsenic	12 7	13	15	22	3.8	All SWMUs
Barium	562	150	972	830	140000	No
Cadmium	2	0.88	7.4	11.8	1000	No
Lead	26	17	80	114	1000 (2)	No
Nickel	17.3	22.6	46.3	44.6	41000	No
Carbon Tetrachloride	ND (<0.24)	0.84	-	-	44	No
FC-143	0.082	0.14	9.5	48	120 (3)	No
Freon 113	-	-	1.6	1.6	6.10E+07	No
Methylene Chloride	-	-	ND (<0.3)	320	760	No
Tetrachloroethylene	-	-	0.51	1.4	110	No
Trichloroethylene	-	-	0.16	8.8	520	No

Legend:
- Not analyzed.
na = not available.
BG = Burning Ground.
RBL/ADP = Riverbank Landfill and Anaerobic Digestion Ponds
SL = Screening Level

Notes:
(1) Industrial soil SL = Risk-based concentration (RBC) for industrial soil. USEPA Region III 1999.
(2) Conservative SL for lead in industrial soil; see Section 6.4.1.
(3) Preliminary screening level; see Table 6.6 and Section 6.4.2.

TABLE 6.8
HEALTH-BASED SCREENING FOR PRODUCTION WELL WATER

Constituent	Units	Potable Water Well (1)	Process Water Wells (2)	Screening Level	Type	Max > SL?
Arsenic	mg/L	0.01	0.0068	0.05	MCL	No
Barium	mg/L	0.07	0.16	2	MCL	No
Cadmium	mg/L	ND (<0.01)	ND (<0.01)	0.005	MCL	No
Lead	mg/L	ND (<0.003)	0.0022	0.015	MCL	No
Nickel	mg/L	ND (<0.05)	ND (<0.05)	0.14	MCL	No
FC-143	ug/L	1.9	16.2	3	PSL	Potable - No Process - Yes (3)
Tetrachloroethylene	ug/L	ND (<5)	5	5	MCL	No
Trichloroethylene	ug/L	ND (<5)	22	5	MCL	Potable - No Process - Yes (4)
Methyene Chloride	ug/L	ND (<5)	-	5	MCL	No
Freon 113	ug/L	ND (<10)	270	59000	RBC	No

Legend:
MCL = Maximum Contaminant Level for drinking water.
PSL = Preliminary Screening Level; see Table 6.6 and Section 6.4.2.
RBC = Risk-based concentration for tap water (USEPA Region III, 1999)
- = Not analyzed

Notes:
(1) Well 336 (AM07-PW01)
(2) Process Water Wells.
K16-PW01
K16-PW01
L17-PW01
L17-PW01
V05-PW01
V05-PW01
L04-PW01
L04-PW01

(3) Trichloroethylene exceeded the MCL in production well V05-PW01.
(4) FC-143 exceeded the preliminary SL in production wells K16-PW01, V05-PW01, and L04-PW01.

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TABLE 6.9
RARE, THREATENED, AND ENDANGERED TERRESTRIAL SPECIES (1)

Peregrine Falcon (*Falco peregrinus*)
Bald eagle (*Haliaeetus leucocephalus*)
Virginia big-eared bat (*Corynorhinus townsendii virginianus*)
Indiana bat (*Myotis sodalis*)
Gray bat (*M. grisescens*)
Northern flying squirrel (*Glaucomys sabrinus fuscus*)
Eastern cougar (*Felis concolor*)
Cheat Mountian salamander (*Plethodon nettingi*)
Flat-spired three-toothed land snail (*Triodopsis platysayoides*)
Shale barren rockcress (*Arabis serotina*)
Running buffalo clover (*Trifolium stoloniferum*)
Harperella (*Ptilimnium nodosum*)
Northeastern bulrush (*Scirpus ancistrochaetus*)
Virginia spiraea (*Spiraea virginiana*)

(1) Source: West Virginia Division of Natural Resources. These species are listed by both the U. S. Fish and Wildlife and the West Virginia Natural Heritage Program.

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TABLE 6.10
RISK EVALUATION RESULTS

	Do Constituent Levels Pose Potential Concern?		
Exposure Medium	Soil 0 – 2 ft	Soil 2 – 20 ft	Groundwater
BG Soil	No	No	
PWI Soil	No	No	
RBL/ADP Soil	No	No	
Potable Water Wells (2)			No
Process Water Wells (3)			No
SWMU Impacted Groundwater			Contained on site

(1) No = All constituent concentrations were below health screening levels or (for industrial process water) were below levels that would be expected to pose a concern under intermittent exposure during manufacturing operations. There were no significant ecological resources or listed species identified within the RFI study area.
(2) Potable water well = Well 336 (AM07-PW01).
(3) Process water wells = K16-PW01, L17-PW01, V05-PW01, L04-PW01.

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