

RCRA FACILITY INVESTIGATION PLAN

**DuPont Washington Works
Washington, West Virginia**

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DERS Project No. 7179

Prepared by

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CONTENTS

1.0 INTRODUCTION	1
1.1 Purpose.....	2
1.2 Facility Description.....	2
2.0 FACILITY CHARACTERIZATION - CURRENT CONDITIONS	4
2.1 Solid Waste Management Unit Current Conditions	4
2.1.1 SWMU A-3—Riverbank Landfill.....	4
2.1.2 SWMU B-4—Anaerobic Digestion Ponds.....	5
2.1.3 SWMU C-6—Polyacetal Waste Incinerator	6
2.1.4 SWMU H-14—Burning Ground.....	7
2.2 Regional Environmental Setting.....	7
2.2.1 Topographic Setting.....	7
2.2.2 Regional Geologic Setting.....	7
2.2.3 Regional Hydrogeology.....	8
2.2.4 Regional Groundwater and Surface Water Use.....	8
2.3 Site Conceptual Model Development.....	9
2.3.1 SWMU Impacts to Soil/Groundwater	10
2.3.2 Geology and Hydrogeology.....	11
2.3.2.1 Groundwater Flow Directions	12
2.3.2.2 Transmissivity, Hydraulic Conductivity and Groundwater Flow Velocity	13
2.3.3 Surface Water.....	14
2.3.4 Potential Air Emissions and Wind Direction	15
2.3.5 Potential Receptors Identification	15
2.4 Site Conceptual Model Summary.....	16
2.5 Potential Corrective Measure Technologies	17
3.0 RCRA FACILITY INVESTIGATION PLAN.....	19
3.1 Sitewide Hydrogeologic Investigation.....	19
3.1.1 Groundwater Flow Model Objective.....	19

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JSO019181

EID624916

CONTENTS
(Continued)

3.1.2 Groundwater Flow Model Management and Scope of Work	20
3.1.2.1 Groundwater Conceptual Model Development	21
3.1.2.2 Model Codes and Methods Selection	22
3.1.2.3 Model Setup and Input Estimation	22
3.1.2.4 Model Calibration and Sensitivity Analysis	23
3.1.2.5 Particle Tracking and Scenario Simulations	24
3.1.2.6 Model Field Verification	25
3.1.2.7 Final Groundwater Model Calibration	25
3.2 Site Conceptual Model Refinement	26
3.3 RCRA Facility Investigation Goals and Technical Approach	26
3.4 Application of Screening Concentrations	27
3.4.1 SWMU A-3—Riverbank Landfill	29
3.4.1.1 Application of Screening Criteria	29
3.4.1.2 Source and Release Characterization	30
3.4.2 SWMU B-4—Anaerobic Digestion Ponds	31
3.4.2.1 Application of Screening Criteria	31
3.4.2.2 Source and Release Characterization	31
3.4.3 SWMU C-6—Polyacetal Waste Incinerator	32
3.4.3.1 Application of Screening Criteria	32
3.4.3.2 Source and Release Characterization	32
3.4.4 SWMU H-14—Burning Ground	32
3.4.4.1 Application of Screening Criteria	32
3.4.4.2 Source and Release Characterization	33
3.5 RCRA Facility Investigation Field Investigation	34
3.5.1 Background Soil Sampling	34
3.5.2 SWMU Specific Soil and Groundwater Sampling	34
3.5.2.1 SWMU A-3—Riverbank Landfill and SWMU B-4—Anaerobic Digestion Ponds	35

CONTENTS (Continued)

3.5.2.2 SWMU C-6—Polyacetal Waste Incinerator.....	36
3.5.2.3 SWMU H-14—Burning Ground	36
3.5.3 Sitewide Monitor Well Installations and Closures.....	37
3.5.4 Soil Geotechnical Analysis	38
3.6 Site-Specific Risk-Based Action Levels.....	38
4.0 PROPOSED REVISED NOMENCLATURE FOR WELLS AND SOIL BORINGS.....	39
5.0 RFI REPORT PREPARATION	40
6.0 REFERENCES	41

FIGURES

Figure 1	Site Location Map
Figure 2	Solid Waste Management Unit Location Map
Figure 3	Monitor Well Location Map
Figure 4	Regional Stratigraphic Column
Figure 5	Cross Section Location Map
Figure 5A	Cross Section A-A'
Figure 5B	Cross Section B-B'
Figure 5C	Cross Section C-C'
Figure 5D	Cross Section D-D'
Figure 5E	Cross Section E-E'
Figure 5F	Cross Section F-F'
Figure 6	Schematic of Riverbank Slumping of Floodplain Deposits
Figure 7	Groundwater Elevation Contour Map—November 1991
Figure 8	Site Conceptual Model Cross Section Location Map

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JSO019183

EID624918

CONTENTS (Continued)

Figure 8A	Site Conceptual Model Cross Section $C_{cm}-C_{cm}'$
Figure 8B	Site Conceptual Model Cross Section $D_{cm}-D_{cm}'$
Figure 8C	Site Conceptual Model Cross Section $F_{cm}-F_{cm}'$
Figure 9	Proposed RFI Sample and Monitor Well Location Map
Figure 9A	Detail of Proposed RFI Sample and Monitor Well Location Map—Western Side
Figure 9B	Detail of Proposed RFI Sample and Monitor Well Location Map—Eastern Side
Figure 10	Revised Nomenclature for Wells and Soil Borings
Figure 10A	Detail of Revised Nomenclature for Wells and Soil Borings—Western Side
Figure 10B	Detail of Revised Nomenclature for Wells and Soil Borings—Eastern Side

TABLES

Table 1	Existing Well Information
Table 2	Background Surface Soil Sample Results
Table 3	Background Groundwater Sample Results
Table 4	Surface Soil Results from the Riverbank Landfill
Table 5	Subsurface Soil Results from the Riverbank Landfill
Table 6	Groundwater Results from the Riverbank Landfill Wells
Table 7	Results from the Riverbank Landfill Seeps
Table 8	Subsurface Soil Results from the Anaerobic Digestion Ponds
Table 9	Groundwater Results from the Anaerobic Digestion Ponds
Table 10	Surface Soil Results from the Polyacetal Waste Incinerator
Table 11	Surface Soil Results from the Burning Ground
Table 12	Subsurface Soil Results from the Burning Ground
Table 13	Groundwater Results from the Burning Ground

CONTENTS
(Continued)

APPENDIXES

- Appendix A Project Management Plan
- Appendix B Sampling and Analysis Plan
- Appendix C Quality Assurance Project Plan
- Appendix D Data Management Plan
- Appendix E Health and Safety Plan
- Appendix F Waste Management Plan
- Appendix G Community Relations Plan

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EID624920

1.0 INTRODUCTION

In response to the United States Environmental Protection Agency's (USEPA's) May 5, 1997, letter request and in accordance with the Resource Conservation and Recovery Act (RCRA) Corrective Action portion of RCRA Permit Number WVD 04-587-5291, DuPont Washington Works herein presents its RCRA Facility Investigation (RFI) Plan 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)

Per an agreement with the USEPA, SWMU A-1, Local Landfill, will not be included in the RFI as it is currently regulated under a State of West Virginia Division of Environmental Protection (WVDEP) Solid Waste/National Pollutant Discharge Elimination System (SW/NPDES) permit Number WV 0076538.

RFI requirements include hydrogeologic characterization of the facility, definition of the source of any release of hazardous waste or hazardous constituents, definition of the degree and extent of contamination, and identification of potential receptors. This plan was prepared using the following references: USEPA *Region IV, Standard Operating Procedures and Quality Assurance Manual*; the USEPA *Office of Solid Waste RCRA Groundwater Monitoring: Technical Guidance*; *Test Methods for Evaluating Solid Waste Physical/Chemical Methods-Third Edition*, USEPA document SW-846; RCRA *Facility Investigation Guidance*, USEPA document 530/SW-89-031; USEPA guidance for *Preparing the Perfect Project Plans*; USEPA checklist for *Quality Assurance Project Plan (QAPP)*; and USEPA guidance for *Common Deficiencies in RFI Plans*.

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EID624921

1.1 Purpose

The purpose of the RFI is to collect data of sufficient quality and quantity that:

- ☐ Characterizes the nature, extent of contamination from release sources, and, if applicable, rate of migration into groundwater, soil, or other media.
- ☐ Identifies any potential threat to human health or the environment.
- ☐ Provides a detailed geologic and hydrogeologic characterization of the area surrounding and underlying the SWMUs.
- ☐ Supports future corrective measures studies, if necessary.

1.2 Facility Description

The 1,200 acre DuPont Washington Works site is located in Washington, West Virginia, on the Ohio River approximately seven miles southwest of Parkersburg, West Virginia (see Figure 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 powders and filaments.
- ☐ Acrylic molding powders.
- ☐ Polyvinyl butyral.
- ☐ Acrylic resins.
- ☐ Fluoropolymers.
- ☐ Polyacetal products.

Washington Works is located in an industrial area. Immediately adjacent to the western boundary of the plant site is the General Electric Plastics plant and two industrial warehouses (see Figures 1 and 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

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EID624922

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 Shell Chemicals, Huntsman Chemicals, and Amoco.

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EID624923

2.0 FACILITY CHARACTERIZATION - CURRENT CONDITIONS

The following information has been compiled to meet the requirements of the Current Conditions section referenced in Attachment D of the May 5, 1997, letter from the USEPA (USEPA 1997):

- ☐ The general geographic location of the DuPont Washington Works is provided on Figure 1.
- ☐ A map of the site showing the property boundaries and identifying the current owners of adjacent properties is provided on Figure 2.
- ☐ The locations of all current permitted hazardous waste treatment, storage, or disposal areas are provided in Figure 2.
- ☐ The locations of all production and groundwater monitor wells are provided on Figure 3. Information addressing the location, the ground, top of casing and screened-interval elevations and construction data is provided on Table 1.

2.1 Solid Waste Management Unit Current Conditions

The locations and approximate aerial extent of the four SWMUs included in the RFI Plan are shown on Figure 2. The following subsections present known information on the SWMUs as developed from verification investigation (VI) results and historical information.

2.1.1 SWMU A-3—Riverbank Landfill

The RBL was operated from 1948 through the late 1960s. This landfill is approximately 4,500 feet long, 150 feet wide, and spans most of the northern edge of the site. The landfill was partially placed on top of the steep slope separating the main plant terrace and the lower-lying river floodplain. The downslope edge of the RBL is located approximately 125 feet from the Ohio River. The RBL was closed in the late 1960s, and 6 to 35 inches of soil were placed on top of the fill area. Currently, this area is covered with dense vegetation that includes grass, shrubs, and mature trees, making access extremely difficult.

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Since the closure of the RBL, several manufacturing operations, including the fluoropolymer manufacturing area, have been constructed or have expanded on top of the upslope landfill area (i.e., those landfill areas at main plant terrace level). These areas are now covered with asphalt and/or manufacturing facilities.

In the VI report (DuPont 1992), DuPont made the following recommendations for further action at the RBL:

- ☐ Perform additional monitoring of seep RBLL2.
- ☐ Conduct ongoing corrective action to treat seep RBLL1.
- ☐ Continue pumping from Ranney and DuPont-Lubeck water production wells.
- ☐ Install additional downgradient groundwater monitor wells to determine lateral extent and rate of migration of detected constituents.
- ☐ Sample the Ranney and DuPont-Lubeck wells for Triton® X-100, C-8 (i.e., ammonium perfluoro-octanoate), and the USEPA list of constituents.

Since the publication of the VI report, DuPont has conducted the following activities at the RBL:

- ☐ Continued pumping from the Ranney and DuPont-Lubeck water production wells.
- ☐ Installed monitor wells downgradient from the RBL and ADP to monitor C-8 migration in the groundwater.
- ☐ Continued operating the RBLL1 pump-and-treat system.
- ☐ Perform additional sampling of RBLL2 for volatiles and semivolatile organics, metals, toxicity, ammonia, and indicator parameters.

2.1.2 SWMU B-4—Anaerobic Digestion Ponds

The westernmost ADP was constructed in the mid-1950s. Two additional ponds built in the mid-1970s were constructed with 6- to 12-inch thick bentonite clay liners. A clay layer with polyethylene sheeting was used in the walls to restrict lateral seepage from the ponds. The combined capacity of the ponds was approximately three million gallons.

The ADP was closed in 1988. The liquid waste and sludge removed from the ponds was disposed off site. The upper few feet of clay underlying the ponds and pond berm

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material were also removed. Approximately 56,700 cubic feet, 43,900 cubic feet and 46,900 cubic feet of material was removed from ADPs 1, 2, and 3, respectively.

In the VI report, DuPont made the following recommendations for further action at the ADP:

- ☐ Install additional permanent downgradient groundwater monitor wells (to be done in conjunction with the additional RBL wells).
- ☐ Study in situ electrochemical techniques for C-8 stabilization.
- ☐ Continue to pump the DuPont-Lubeck wells.

Since the publication of the VI report, activities at the ADP have been linked with investigation and remediation activities at the RBL. DuPont did initiate an evaluation of in situ electrochemical techniques for C-8 stabilization; however, unfavorable preliminary results ceased further evaluations. In addition, six permanent downgradient monitor wells were installed in June 1997.

2.1.3 SWMU C-6—Polyacetal Waste Incinerator

The PWI consisted of two brick-lined pits that were operated between 1959 and 1990. The pits were approximately 10 feet deep, with 6 feet below grade. The pits were constructed of reinforced concrete lined with fire brick. Ash from the PWI was landfilled in the local and RBL landfills.

In the VI report, DuPont recommended that the PWI be closed in accordance with an approved closure plan. Since this time, the closure was completed by removing the fire brick to a depth of approximately 2 feet below grade and backfilling with clean soil. The surface was covered with gravel to match the surrounding area.

2.1.4 SWMU H-14—Burning Ground

The BG is located in the central part of the plant, south of the RBL. The BG was operated from 1948 to 1965. Since 1990, the BG has been leveled with clean fill and gravel. Buildings B-253 and B-256 have expanded to areas that overlay a portion of the

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BG. In addition, a drainage ditch has been constructed along the northern and western sides to promote surface drainage into site storm sewers. Those areas not covered by buildings are covered by asphalt (i.e., parking areas) or gravel.

In the VI report, DuPont recommended that additional groundwater monitor wells be installed in the vicinity of the BG to determine the lateral extent and rate of constituent migration. These activities will be conducted as part of the RFI field investigation and are discussed in Section 3.5.2.3.

2.2 Regional Environmental Setting

2.2.1 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 west past the site (see Figure 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. This higher knob country south of the site is characterized by branching V-shaped valleys typical of a dissected plateau geomorphology.

2.2.2 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 1 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 Paleozoic Dunkard Series bedrock consists primarily of red and varicolored sandy shale, gray, green and brown sandstone, minor beds of coal, claystone, black carbonaceous shale, and limestone (see Figure 4).

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2.2.3 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. Locally, active well fields near and parallel to the river (i.e., the Ranney Well, the DuPont-Lubeck Well Field and the East Field Wells shown in Figure 3), lower 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.

2.2.4 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 comprise the principal regional aquifer used for water supply purposes. Production wells completed in this aquifer have been known to yield up to 500 gpm. Based on these high yields, numerous industrial and commercial water supply companies obtain water from the alluvial aquifer. As noted earlier, the yield from alluvial aquifer wells is related to its 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 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 is generally a calcium-bicarbonate type, with a near neutral pH and high dissolved solids content.

The underlying Dunkard Group 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 are generally 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 localized water companies, who obtain their water from production wells screened in the Quaternary river alluvium.

2.3 Site Conceptual Model Development

This section presents the current Washington Works Site Conceptual Model (SCM) based on results from the VI and current (1997) information/data. Based on USEPA RFI guidance (USEPA 1994), the SCM is a comprehensive site description that includes the following conditions and information:

- ☐ Available sampling data related to the SWMUs and their impacts to soil/groundwater
- ☐ Geologic and hydrogeologic conditions
- ☐ Identified surface water bodies
- ☐ Potential air emissions and wind direction
- ☐ Identified receptors (known and potential)

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This information is used to develop a three-dimensional picture of site conditions that conveys what is known or suspected about the potential sources, releases and release mechanisms, contaminant fate and transport, exposure pathways and potential receptors, and risk.

The purpose of a SCM within the RFI framework is to define where releases from SWMUs have or have the potential to occur, identify potential migration pathways, and identify potential receptors to these releases. The SCM is initially developed prior to conducting an RFI to define and focus data needs. The current understanding of the SCM is used to establish a hypothesis about possible contaminant sources, contaminant fate and transport, exposure pathways, and potential receptors. The RFI data needs are then focused on verifying receptors so that risk-based corrective measure assessments can be pursued. The SCM will be continuously refined as the RFI and later phases are conducted.

2.3.1 SWMU Impacts to Soil/Groundwater

As noted previously, the VI determined that some waste constituents were detected in soil and groundwater within the RBL, ADP, and BG SWMUs. Detailed discussion of the type and quantity of site-related constituents found at the individual SWMUs is presented in Sections 3.4.1 through 3.4.4.

Based on the groundwater, surface water, and soil data collected from previous investigations, low concentrations of organic constituents detected in the western part of the RBL (and to a lesser extent in the central part) indicates a potential release. Within the area of the ADP, site-related constituents were detected in the underlying groundwater and soil. However, it is uncertain if the subsurface samples collected are representative of impact from the ADP, are representative of material within the RBL, or are representative of both SWMUs. Within the area of the PWI, no site-related constituents were detected, and metals concentrations were similar to background concentrations. Within the area of the BG trace concentrations of organic constituents in the soil indicates there has not been a significant release from this SWMU.

2.3.2 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 section developed during the VI. The locations of the geologic cross sections are shown in Figure 5. Two east-west geologic cross sections, A-A' and F-F', are shown on Figures 5A and 5F. Four north-south cross sections, B-B', C-C', D-D', and E-E' are shown on Figures 5B, 5C, 5D and 5E, respectively. The cross sections were developed from detailed geologic logs obtained during the VI and 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 on-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 6 (Carlston and Graeff 1955) and

correlates well with the geologic data obtained from the six borings completed along the riverbank, (RBLMW 1, 4, 6, 7, 10, and 11). Two seeps located along the riverbank to the northwest (RBLL1) and northeast (RBLL2) appear to be perched groundwater that flows along the top of the underlying shallow clay and discharges along the riverbank.

The Ohio River alluvial terrace deposits comprise the principal aquifer underlying the site, hereafter referred to as the "site aquifer". The saturated zone is approximately 30- to 40-feet thick and extends from the water table, which is approximately 60- to 70-feet deep in the main plant area, to bedrock, which is the underlying Dunkard Group. The on-site production water wells completed in the site aquifer yield 200 to 450 gpm. 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.

Groundwater elevations, flow directions, and flow rates on-site are influenced by on-site production wells and the Ohio River. The major groundwater flow direction is generally from the Ohio River on the north to the south-southwest toward the plant.

2.3.2.1 Groundwater Flow Directions

The direction of groundwater flow in the Washington Works site aquifer is generally from the north to the south-southwest. However, groundwater elevations, flow directions, and flow rates on-site are strongly influenced by the Ohio River and by on-site water production wells. The Ohio River is the primary source of recharge to the site aquifer. The on-site production wells include 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.

A groundwater elevation contour map developed from data collected in November 1991 is presented as Figure 7. The direction of groundwater flow in the site aquifer is indicated by the flow arrows. As shown on the groundwater elevation contour map, 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 parts of the site groundwater flow is south-southwest towards the DuPont-Lubeck Well Field. Pumping of the production wells (Ranney Well, East Field Wells, and the DuPont-Lubeck Well Field) eliminates potential off-site migration of groundwater.

2.3.2.2 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 calculated results indicate 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 gpd/ft². In the vicinity of the East Well Field, the values ranged between 16,050 and 50,000 gpd/ft². 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 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 and assuming an effective porosity value of 35 percent, representative of a sand and gravel, the groundwater flow velocity for several well pairs was calculated. The groundwater flow velocity was estimated at 5 ft/day between wells TW-24 and TW-27 in the southwest portion of the site. A groundwater flow velocity of 3 ft/day was

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estimated between 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 wells TW-M1 and TW-26.

2.3.3 Surface Water

Surface water at the Washington Works facility consists primarily of the Ohio River, drains and storm sewers, and drainage swales. As mentioned previously, the Ohio River bounds the Washington Works site on the north side. The average river water elevation is about 580 feet MSL and the elevation of the Ohio River terrace deposits under the main plant is about 630 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. Some precipitation falling onto the riverbank slope may either percolate into the RBL and soil or directly discharge into the Ohio River through surface runoff. Percolated water may form the seeps that exist at several locations on the western end of the RBL. These seeps are likely caused by the slumped, low-permeability, clay and silt of the Ohio River deposits underlying the RBL as well as the riverbank, which has allowed groundwater to accumulate.

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 precipitation runoff during rainy weather to Ohio River discharge points. During nonrainy periods, the drainage swales are dry.

2.3.4 Potential Air Emissions and Wind Direction

There are no known air emissions related to the SWMUs under investigation in this RFI. Air emissions from Washington Works manufacturing operations are regulated by permits obtained from the WVDEP. The prevailing wind direction at the site is from the southwest according to the current wind rose diagram developed by the site.

2.3.5 Potential Receptors Identification

The potential receptors to SWMU-specific constituents include humans and the environment. These receptors may be potentially exposed via the following pathways:

- ☐ Contact with surface soil
- ☐ Contact with or use of groundwater
- ☐ Contact with or use of surface water

The current site conditions and groundwater flow patterns prevent direct access with the SWMUs. A large portion of the RBL and ADP is fenced, including a chain-link fence along the entire southern side of the RBL. There is no fencing along the northern, downslope end of the RBL or ADPs; however, the dense vegetation and steep slope make access difficult. Much of the facility is covered by asphalt, concrete, or buildings; thus, direct contact with soil is eliminated as a potential exposure pathway.

Direct contact with surface soil and the BG and PWI are prevented by asphalt, buildings, or thick gravel coverings. As with the RBL, direct worker contact could only occur if excavations were conducted.

Groundwater flow patterns indicate that groundwater is contained on-site; therefore, no potential off-site groundwater receptors exist. Potential exposure to groundwater may occur at the East Field, Ranney, and DuPont-Lubeck production wells. All pumped production well water is used for process or noncontact cooling purposes; therefore, potential exposure to groundwater is unlikely. The only exception are the East field Wells 336 and 331, along with Well 332 (backup), which are used for the site's potable

water supply. All process and noncontact cooling water is eventually discharged to the Ohio River through NPDES permitted outfalls.

The Ohio River is the primary surface water resource for the plant and local community. The site extracts Ohio River water from its Gallery pumping station (see Figure 2) located on the northwest riverbank. This water is used on-site for production noncontact cooling water. Since the RBL is located adjacent to the Ohio River and the potential for seeps to discharge site-related constituents into the river exists, the Ohio River can be considered a potential receptor.

2.4 Site Conceptual Model Summary

Based on the information covered in Sections 2.3.1 through 2.3.5, the current SCM was developed and can be summarized as follows:

- ☐ Three of the four SWMUs to be investigated in the RFI have detectable concentrations of waste constituents.
- ☐ Under current site conditions, there is no exposure to SWMU impacted soil.
- ☐ On-site production wells control site aquifer flow directions and eliminate off-site migration. Potential exposure may occur at Wells 331, 332, and 336 which are used for site potable water supply.
- ☐ The Ohio River is the primary receptor for seeps and/or perched groundwater potentially discharging SWMU-related constituents.

Three SCM cross sections ($C_{CM}-C_{CM}'$, $D_{CM}-D_{CM}'$ and $F_{CM}-F_{CM}'$) were developed using the geologic cross sections (C-C', D-D' and F-F') as a framework. The location of the SCM cross sections are shown on Figure 8. Figures 8A, 8B, and 8C are the SCM cross sections $C_{CM}-C_{CM}'$, $D_{CM}-D_{CM}'$ and $F_{CM}-F_{CM}'$, respectively. In addition, the four SCM summary points listed above are depicted on $C_{CM}-C_{CM}'$, $D_{CM}-D_{CM}'$ and $F_{CM}-F_{CM}'$.

In the paved areas of the plant, precipitation may migrate by overland flow to storm sewers and drainage ditches that ultimately drain to the Ohio River. In unpaved areas, precipitation may infiltrate the Quaternary alluvium and migrate downward to the site

aquifer, flowing to the production wells where it is captured for noncontact process water. The noncontact process water is discharged into the Ohio River and is regulated by NPDES Permit WV0076538. In SWMU areas, any precipitation that may infiltrate and possibly be in contact with SWMU materials should migrate downward to the site aquifer and ultimately be captured as noncontact process water as described previously. In the riverbank areas, precipitation may migrate via overland flow down the riverbank and reach the Ohio River, which recharges the site aquifer. Alternatively, precipitation may infiltrate the landfill area and migrate via subsurface flow and either remain in a perched water table or reappear on the surface of the riverbank in the form of a seep.

2.5 Potential Corrective Measure Technologies

The VI report indicates that site-related constituents are present in soil and groundwater near the SWMUs (DuPont 1992). DuPont has reviewed the data generated by VI activities and believes that there is no immediate or imminent threat to human health or the environment created by conditions at Washington Works. Therefore, interim remedial measures are not currently warranted at the site.

Although DuPont believes that it is premature to make a judgment regarding the need for potential corrective measures at this time, the following is a description of technologies that may be appropriate for consideration as future soil remediation options:

- ❑ *Stabilization/solidification* involves mixing materials such as silicate, fly ash, lime, portland cement, or pozzolan with soil to immobilize and bind site-related constituents into a solidified matrix.
- ❑ *Phytoremediation* includes growing plants which uptake site-related constituents through the plant's root systems.
- ❑ *Aerobic treatment or in situ bioremediation* uses cultured or indigenous microorganisms to biodegrade organic compounds in soil. A sufficient supply of oxygen, nutrients, and substrate is necessary to sustain the microbial population.
- ❑ *Soil vapor extraction* consists of installing a network of vapor extraction wells screened in the contaminated region of the vadose zone. A vacuum induced in the extraction wells removes organic soil vapor from the vadose zone and brings it aboveground for treatment.

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- ❑ *Institutional controls* include deed restrictions, fencing of property, and maintenance of site security to minimize unauthorized access to the site.
- ❑ *Improved covers* that may include capping with impermeable materials and a soil cover.

Technologies that may be appropriate for consideration as future options include:

- ❑ *Air stripping* involves pumping groundwater through a packed column in a downflow configuration. An upward flow of air strips volatile organic compounds (VOCs) from the water and carries the VOCs into the atmosphere.
- ❑ *Carbon adsorption* uses activated carbon to adsorb the site-related constituents, removing them from groundwater.
- ❑ *Intrinsic bioremediation* is a process by which indigenous microbes break down organic compounds to form innocuous end products. This is a naturally occurring process, but is rate-limited by the available nutrients and substrate necessary to sustain the microbial population. Intrinsic bioremediation can occur aerobically (in the presence of oxygen) or anaerobically (absence of oxygen).
- ❑ *Enhanced bioremediation* is a process by which indigenous microbes break down organic compounds in the absence of oxygen. This process can be naturally occurring (intrinsic) or enhanced by amending groundwater conditions through nutrient and substrate addition to promote an increased rate of anaerobic biodegradation.
- ❑ *Zero valent iron treatment* relies on the ability of zero valent iron to dechlorinate chlorinated VOCs, breaks down compounds thus reducing concentrations. This technology can be implemented by installing a reactive wall containing metallic powder below ground through which groundwater will flow.
- ❑ *Institutional controls* include deed restrictions, fencing of property, and maintenance of site security to minimize unauthorized access to the site.

A complete evaluation of the potential remediation technologies for both soil and groundwater will be conducted (as part of a corrective measures study, if required) at a later date.

3.0 RCRA FACILITY INVESTIGATION PLAN

This section describes the RFI approach, along with rationales for application. The approach includes the application of risk-based screening criteria to the VI data in order to establish investigation analytical parameters, provide a detailed description of groundwater modeling activities to be conducted prior to the field investigation, and finally, provide a complete description of the RFI field investigation.

Descriptive details of the schedule and project management are presented in the Project Management Plan (see Appendix A). The physical sampling approach for conducting the RFI field investigation is presented in the Sampling and Analysis Plan (see Appendix B). Details on sampling and analytical procedures and quality assurance are presented in the Quality Assurance Project Plan (see Appendix C). Details on data management are provided in the Data Management Plan (see Appendix D). All aspects of the field program will be conducted in accordance with the Health and Safety Plan, the Waste Management Plan, and the Community Relations Plan provided as Appendices E, F, and G respectively.

3.1 Sitewide Hydrogeologic Investigation

The sitewide hydrogeologic investigation will initially consist of groundwater flow modeling. This effort will utilize hydrogeologic data obtained during the VI in combination with current conditions data in an effort to completely conceptualize and quantify site groundwater flow conditions.

3.1.1 Groundwater Flow Model Objective

The objective of the groundwater flow modeling is to construct a mathematical model of groundwater flow at Washington Works that will provide technical support for RFI field activities. The groundwater flow modeling will serve as a tool to define and focus RFI

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field work, sampling locations, and the need for future corrective measures evaluation by determining the following:

- ☐ Quantitative estimates of recharge, discharge, and groundwater flow rates in the site aquifer beneath the Washington Works plant area
- ☐ Groundwater flow directions and velocities near and around SWMUs
- ☐ Impact of the current and future production well system groundwater pumping as it relates to sitewide groundwater containment and SWMU corrective measures

The modeling effort will provide DuPont with a groundwater flow model (GFM) with proper documentation that will be technically defensible through formal peer/regulatory review processes. The GFM will facilitate completion of future RCRA program investigations and corrective measure evaluations, if required.

3.1.2 Groundwater Flow Model Management and Scope of Work

Prior to beginning the GFM development, specific roles and responsibilities required to complete the modeling effort will be defined and the appropriate personnel (based on experience and education) will be identified as resources for the tasks. The roles identified include an individual responsible for management of the modeling effort; an individual(s) responsible for performing the model development, calibration, and scenario simulation; and an individual(s) to peer review the model development, the calibrated model, and the scenario simulations.

Specifically, the GFM scope of work will include a series of tasks completed in the following order:

- ☐ Groundwater conceptual model development
- ☐ Model codes and methods selection
- ☐ Model setup and input estimation
- ☐ Model calibration and sensitivity analysis
- ☐ Particle tracking and scenario simulations
- ☐ Model field verification
- ☐ Final groundwater model calibration

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Most tasks will be completed prior to RFI field work implementation, except for model field verification, which will be completed during field work implementation, and final calibration, which will be completed after field work. All modeling tasks will be documented in the RFI final report. A description of these tasks is described in detail in the following sections.

3.1.2.1 Groundwater Conceptual Model Development

Conceptual model development of both the local and regional hydrological system will include compilation of the data framework needed for model setup. This will include all applicable geologic, hydrogeologic, and SWMU construction data. Specific details pertinent to model development include:

- ☐ Geology and stratigraphy.
- ☐ Water budget .
- ☐ Aquifer and aquitard distribution and configuration.
- ☐ Hydrogeologic boundaries (i.e., groundwater and surface water).
- ☐ Piezometric head and hydraulic gradient.
- ☐ Hydraulic properties (i.e., hydraulic conductivity, porosity).
- ☐ Precipitation (i.e., infiltration).
- ☐ Groundwater pumping data (i.e., on-site and off-site production wells).

A large portion of this information was obtained during the VI and is readily available for use. Hence, the GFM development will be completed with minimal additional data gathering. Exceptions to this may include the need to acquire recent site and regional hydrogeologic data (i.e., off site) that will be required to establish model boundary conditions.

The GFM information sources and development results will be documented in the RFI report, including documentation of situations where specific data did not exist and assumptions were incorporated into the GFM and model setup.

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3.1.2.2 Model Codes and Methods Selection

The model proposed for use in the sitewide hydrological investigation is the United States Geological Survey (USGS) model MODFLOW (McDonald and Harbaugh 1988). MODFLOW is capable of simulating aerial or cross sectional and quasi-or fully three-dimensional transient or steady-state flow in anisotropic, heterogeneous, layered aquifer systems.

MODFLOW is a public domain model (not proprietary) that has wide public and regulatory acceptance for use in environmental applications. MODFLOW groundwater models have been developed by DuPont for numerous RCRA sites and several sites in USEPA Region III.

The model is based on a block-centered finite-difference approach, using variable grid spacing in the x, y, and z directions. Layers may be simulated as (semi-)confined, unconfined, or convertible between the two conditions. The model also allows pinch-out of aquifers, aquitards, or layers within an aquifer. The model can incorporate external influences such as time-varying wells, aerial recharge, drains, evapo-transpiration, and streams. Numerical solvers include the Strongly Implicit Procedure, the Slice-Successive Over-relaxation procedure and the Preconditioned Conjugate Gradient solver.

MODFLOW will likely be used to represent flow through the Washington Works aquifer system using a multilayer approach to evaluate sitewide groundwater migration patterns as well as groundwater flow details near the RBL, ADP, PWI, and BG SWMUs.

3.1.2.3 Model Setup and Input Estimation

A pre- and post-processor program will be used prior to running MODFLOW to facilitate grid design and data input and output. The model setup will begin with establishing a grid over the area to be modeled. Grid size will be based on the groundwater conceptual model considerations developed and generally accepted numerical convergence and accuracy criteria for finite difference calculations of

flow. Grid data entry will be consistent with the plant's state plane coordinate system.

Based on the groundwater conceptual model, the number, type [i.e., (semi-)confined, unconfined or convertible between the two conditions], area, and thickness of units required to accurately represent the actual hydrogeology of the site will be determined.

The top and bottom elevations for the aquifer and aquitard units will be defined using soil borings data and well logs. After the top and bottom elevations have been assigned to all units, the preprocessor program will be used to input properties including permeability, porosity, boundary conditions, infiltration rates, and production well flow rates.

3.1.2.4 Model Calibration and Sensitivity Analysis

Calibration is the most time-consuming and difficult process in developing a site-specific model. Steady-state calibrations will be performed to match the observed head distribution in all aquifer zones. Residuals (observed head minus modeled head at a well location) will be used to qualitatively evaluate calibration quality. Results of the model calibration task will be summarized and evaluated using graphs of actual monitor well piezometric head measurements versus model calculated heads and contour plots of modeled head versus observed heads and residuals.

Sensitivity analyses will be performed for order-of-magnitude changes on either side of best fit estimates for various input parameters to identify the more sensitive hydrogeologic parameters which may require further evaluation and/or field investigation studies.

3.1.2.5 Particle Tracking and Scenario Simulations

The calibrated model will be utilized to conduct groundwater particle tracking and scenario simulations. This effort will focus on current site conditions and pumping rates, as well as a range of production well pumping scenarios.

Particle tracking is an efficient and computationally quick method of evaluation of possible groundwater travel directions and velocities from SWMUs. Groundwater pathways will be calculated using the particle tracking analysis code MODPATH (Pollack 1989). MODPATH uses a semi-analytical particle tracking scheme based on the assumption that each directional velocity component varies linearly within a grid cell on its own coordinate direction. This assumption allows an analytical expression to be obtained describing the flow path within a grid cell. Given the position of a particle anywhere within the cell, MODPATH computes the coordinates of any other point along its pathline, either forward or reverse, within the cell and the time of travel between them, directly. MODPATH requires porosities, layer thickness of aquifers, and intervening aquitards, as well as head and flow data files generated by MODFLOW. The particle tracking routine then calculates groundwater pathlines and velocities from this data. As a result, the velocities calculated by MODPATH are based on a balanced system with respect to water mass, increasing the validity of the particle tracking analysis.

MODPATH is an advection model and does not compute solute concentrations in groundwater because the effects of retardation, mixing by dispersion, or degradation are not taken into account. This assumption affects constituent travel times but does not significantly affect the orientation of the particle migration pathlines calculated by the model. Particle tracking is an extremely valuable tool for evaluating groundwater flow directions and velocities and to aid in the understanding of possible solute migration pathways.

Pumping scenario simulations will be conducted to evaluate site flow conditions under variable pumping rates at each of the three pumping locations (i.e., East Well Field, Ranney Well, and DuPont-Lubeck Well Field). Because continuous pumping occurs at the site and is responsible for sitewide containment, this effort

will simulate site conditions if no, reduced, or more pumping occurs. Results from this evaluation will likely aid in the corrective measure decision-making process after RFI completion.

3.1.2.6 Model Field Verification

Field verification is conducted to determine if model results are accurate and to address hydrogeology data gaps. The model field verification task will be conducted during RFI field implementation and will consist of new monitor well installations throughout the facility where current data is not available (i.e., data gap locations). The new wells will allow comparison of model calculated heads with actual piezometric head measurements. Results of the field verification task will be summarized with graphs of actual monitor well piezometric head measurements versus model calculated heads. Minor variations in observed versus modeled head will indicate a good match and, thus, good model accuracy. Any large disparity in plotted points for a particular location may generate a need for additional model calibration.

3.1.2.7 Final Groundwater Model Calibration

If necessary, final model calibration based on the field verification task will be conducted using the RFI field implementation results. The scope of this task will be driven by the data results obtained. As mentioned previously, if the field results are significantly different from the original model predictions, then additional calibration may be conducted until an accurate match has been achieved.

Results of final model calibration will be presented in the RFI final report along with all other model construction documentation, including model setup, calibration, particle tracking, and scenario simulations.

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3.2 Site Conceptual Model Refinement

The SCM previously described in Section 2.4 will be refined based on results from the sitewide groundwater flow modeling. The SCM refinement will primarily focus on site characteristics that are most important to defining final SWMU field investigation activities (i.e., data needs), such as migration pathways and receptors identification. The sitewide groundwater flow model results, specifically the SWMU to receptor groundwater flow path evaluation, will be used to finalize RFI soil and groundwater data needs.

The current SCM has provided the basis for proposing soil and groundwater sampling locations (see Section 3.5). In general, the SCM refinement step will determine whether sample/well locations should change, stay the same, or be added.

When the final data needs (i.e., sampling locations) are determined, DuPont will submit a technical memorandum summarizing all changes relative to the work plan proposed herein to the USEPA for approval. DuPont will not initiate any field activities proposed in this memorandum until the USEPA has approved the technical memorandum.

3.3 RCRA Facility Investigation Goals and Technical Approach

The primary goals of the RFI are to delineate soil and/or groundwater contamination associated with potential releases from four SWMUs and to gain a better understanding of site geology and hydrogeology so that constituent transport can be predicted. Other goals of the RFI are to identify the potential for adverse impact on surface water, identify potential exposure pathways, and assess potential risks to human health and the environment.

The technical approach reflected in this RFI Plan focuses on using previously collected data and constructing a site groundwater flow model to define the RFI field investigation scope of work. The following chronologically ordered steps represent the RFI Plan technical approach:

- ☐ Apply risk-based screening criteria to VI data to define SWMU-specific and sitewide sampling analytical lists.

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- ☐ Develop comprehensive sitewide groundwater flow model to fully define groundwater migration pathways and receptors.
- ☐ Use results from the first two steps to refine the SCM and determine final RFI field investigation scope.
- ☐ Conduct RFI field investigation.
- ☐ Develop site-specific risk-based action levels to evaluate VI and RFI data. If action levels are exceeded, the need for corrective measures stabilization or further monitoring will be evaluated.

3.4 Application of Screening Concentrations

One objective of the VI was to investigate whether a release of hazardous waste or hazardous constituent occurred to the soil and/or groundwater from five SWMUs (DuPont 1990). Soil data collected from the VI investigation was screened against background soil concentrations and screening levels (USEPA 1990) to determine whether a release occurred and if further investigation was necessary. While the number of background samples was limited, the data still provides useful quantitative information on local background concentrations. Chromium was not analyzed for in on-site samples and background samples. Soil sampling for chromium and other metals are proposed for the background soil samples.

In general, the VI concluded that most of the soil concentrations were below proposed action levels (PALs) and/or background concentrations, indicating no further action was necessary. The groundwater data indicated concentrations exceeding PALs for various constituents. To further evaluate these groundwater exceedences, additional soil and groundwater characterization is necessary.

The sampling proposed in this RFI plan will supplement existing site data. As an initial screening, data will be compared to risk-based concentrations (RBCs) and impact to groundwater concentrations presented in *EPA Region III RBC Table: Residential Soil Ingestion, Transfer From Soil To Groundwater, And Tap Water* (Smith 1995). For noncarcinogens, one tenth of the indicated RBC will be used as a screening concentration. Maximum concentration limits (MCLs) will be used where available rather than RBCs for tap water. Because direct daily contact with subsurface soil (greater than 2 feet) is

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unlikely, subsurface soil will only be screened for potential transfer from soil to groundwater.

Toxicity values for C-8 and Triton® X-100 have not been developed by the USEPA; therefore, screening concentrations could not be calculated. DuPont will develop a screening level for these compounds for both soil and groundwater. DuPont will consult with the USEPA and have the USEPA's concurrence prior to submitting the final RFI report.

Site soil data will also be screened against background concentrations for metals to eliminate those metals that may naturally occur at concentrations which exceed RBCs. As indicated in the USEPA's letter dated May 5, 1997 (USEPA 1997), the RBC for arsenic in soil (0.43 mg/kg) was exceeded in both the background (see Table 2) and site samples collected. In evaluating all of the on-site soil samples, arsenic concentrations in the surface soil (20 samples) ranged from 1.9 to 9.0 mg/kg (average 6.3 mg/kg). Subsurface soil samples (29 samples) ranged from 2.7 to 11 mg/kg (average 6.2 mg/kg). While the number of background samples are limited, evaluating all of the soil samples indicates a relatively narrow concentration range across the site with no obvious hotspot concentrations. Based on this semi-quantitative analysis, the concentrations of arsenic detected at the site are representative of background concentrations.

For each of the four SWMUs investigated, the VI data was rescreened against the RBCs indicated above to evaluate the need for further investigation at the site. The results of this evaluation were similar to those presented in the VI. However, based on the constituents detected in the groundwater and the limited number of background groundwater samples (see Table 3), further groundwater evaluation may need to consider a holistic site approach, rather than a SWMU-by-SWMU basis.

3.4.1 SWMU A-3—Riverbank Landfill

3.4.1.1 Application of Screening Criteria

Six sample boring locations were collected along the north side of the landfill and six along the south side to determine if a release from the RBL has occurred. Soil

and groundwater were collected from each location, and leachate samples were collected from two seep areas. Drilling within the landfill was not proposed due to the potential to create vertical conduits for contaminant migration and due to the great difficulty of this task.

A total of ten surface soil samples (0 to 2 feet) were collected. Arsenic (maximum 9 mg/kg) and benzo(a)pyrene were the only constituents which exceeded the residential RBC (see Table 4). As discussed above, the arsenic concentration is considered representative of background concentrations. Benzo(a)pyrene was detected only in one sample at 0.23 mg/kg. Barium and methylene chloride exceeded the impact to groundwater RBC. Since these compounds were not detected in the groundwater at concentrations exceeding MCLs, barium and methylene chloride were not considered a potential concern for surface soil.

The 14 subsurface soil samples had similar barium and methylene chloride results; both constituents exceeded the impact to groundwater RBC (see Table 5). As mentioned above, these compounds were not detected in the groundwater at concentrations exceeding MCLs.

Groundwater samples indicated the presence of several constituents that exceeded the MCLs or tap water RBCs (see Table 6):

- ☐ 1,1,2-trichloro-1,2,2-trifluoroethane
- ☐ Tetrachloroethene
- ☐ Trichloroethene
- ☐ Arsenic
- ☐ Cadmium
- ☐ Lead
- ☐ Nickel

C-8 and Triton® X-100 was also detected in the groundwater (maximum concentration 7.1 and 1.0 mg/l, respectively).

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The groundwater seeps contained several organic constituents including (see Table 7)

- ☐ Methylene chloride
- ☐ Chloroform
- ☐ 1,1,2-trichloro-1,2,2-trifluoroethane
- ☐ Tetrachloroethene
- ☐ Trichloroethene
- ☐ C-8
- ☐ Toluene

3.4.1.2 Source and Release Characterization

The presence of low concentrations of organic constituents in the soil indicates a potential release from the RBL. However, the data indicates that the concentrations detected is not a potential concern for human health. The soil data indicates that there is the potential for the migration of barium, C-8, and methylene chloride to the groundwater, although the concentrations detected for each of these constituents does not indicate the soil sampled is a major source area. Additional groundwater samples are necessary to further evaluate both the soil and groundwater.

The presence of organic constituents in the seeps indicates a release from the RBL. Further evaluation of the seep areas is necessary to characterize the source and determine if there is potential impact to human health or the environment.

3.4.2 SWMU B-4—Anaerobic Digestion Ponds

3.4.2.1 Application of Screening Criteria

Nine subsurface soil samples were collected to better define the vertical distribution of postexcavation residual contamination in the soil. Barium and methylene chloride concentrations exceeded the impact to groundwater RBC (see Table 8). Both of these compounds were detected in the groundwater at

concentrations exceeding the groundwater RBC. C-8 was also detected at a maximum concentration of 101 mg/kg in the subsurface soil.

Riverbank samples RBLS-3, RBLS-4, RBLS-5, and RBLS-6 were collected to evaluate the impact to surface soil caused by flooding of the ADPs. The subsurface soil and groundwater samples were collected to examine the vertical and horizontal extent of contamination. Arsenic was the only constituent that exceeded the RBC, but the concentrations detected were considered background concentrations. Barium and methylene chloride exceeded the impact to groundwater RBC in both surface and subsurface soil; however, these compounds were not detected in the groundwater at concentrations exceeding MCLs. C-8 was also detected in sample 5 at 0.97 mg/kg. Triton® X-100 and C-8 were detected in the groundwater at riverbank samples RBLS-3, RBLS-4, RBLS-5, and RBLS-6.

Groundwater samples indicated the presence of several constituents that exceeded the MCLs or tap water RBCs: methylene chloride, arsenic, barium, cadmium, lead, and nickel (see Table 9). C-8 and Triton® X-100 was also detected in the groundwater (maximum concentration 38 and 16.48 mg/l, respectively).

3.4.2.2 Source and Release Characterization

Based on the sample depth of the VI data, it is uncertain if the subsurface soil samples collected are representative of the impact of the ADP or are representative of material within the RBL. Further inspection of the logs and sample depths will be evaluated as part of the RFI report.

It does not appear that the source of all of the groundwater exceedences has been fully defined. The soil data indicates that there is potential for the migration of barium, C-8, and methylene chloride to the groundwater. However, the concentrations detected for each of these constituents does not indicate that the soil sampled is a major source area. Additional groundwater samples are necessary to further evaluate both the soil and groundwater.

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3.4.3 SWMU C-6—Polyacetal Waste Incinerator

3.4.3.1 Application of Screening Criteria

Two surface soil samples were collected to determine if hazardous constituents have been emitted to the air from the PWI and deposited on nearby soil in concentrations which exceed action levels. Arsenic (5.9 mg/kg) was the only constituent that exceeded the RBC (see Table 10). As discussed above, this concentration is considered representative of background concentrations. Barium detected in both samples (64 and 67 mg/kg) exceeded the impact to groundwater RBC of 32 mg/kg. However, these concentrations of barium are considered representative of background concentrations (average 69.5 mg/kg).

3.4.3.2 Source and Release Characterization

Based on the sample results, surface soil is not a potential concern for human health. Metal concentrations are not elevated above background concentrations, however additional sampling and analysis for chromium will be conducted.

3.4.4 SWMU H-14—Burning Ground

3.4.4.1 Application of Screening Criteria

Seven surface soil samples were collected from around the BG area. Due to the presence of existing buildings, sample collection in the central portion of the original BG area was not feasible.

Arsenic (maximum 6.4 mg/kg) and benzo(a)pyrene were the only constituents that exceeded the residential RBC (see Table 11). As discussed above, the arsenic concentration is considered representative of background concentrations. Benzo(a)pyrene was only detected in one sample at 0.46 mg/kg. Barium and methylene chloride exceeded the impact to groundwater RBC. Since these compounds were not detected in the groundwater at concentrations exceeding MCLs, barium and methylene chloride are not considered a potential concern for surface soil.

The seven subsurface soil samples had similar barium and methylene chloride results; both constituents exceeded the impact to groundwater RBC (see Table 12). As mentioned above, these compounds were not detected in the groundwater at concentrations exceeding MCLs.

Groundwater samples indicated the presence of several constituents that exceeded the MCLs or tap water RBCs: carbon tetrachloride, tetrachloroethene, trichloroethene, total arsenic, total lead, and total nickel (see Table 13). Filtered metals concentrations did not exceed the MCLs or tap water RBCs. C-8 was also detected in the groundwater (maximum concentration 0.0055 mg/l).

3.4.4.2 Source and Release Characterization

The absence of organic constituents in the soil indicates that there has not been a release from the BG. The data indicates that the concentrations detected are not a potential concern for human health. The soil data indicates that there is the potential for migration of barium, C-8, and methylene chloride to the groundwater. However, the concentrations detected for each of these constituents does not indicate that the soil sampled is a major source area. C-8 was not analyzed in soil; however, it was detected in groundwater. Further characterization of C-8 in soil may be necessary. Groundwater has not been impacted; however, the source of all the groundwater exceedences has been fully defined. Additional groundwater samples are necessary to further evaluate both the soil and groundwater.

3.5 RCRA Facility Investigation Field Investigation

The sitewide field investigation will include the following primary activities:

- ☐ Background soil sampling
- ☐ SWMU specific soil and groundwater sampling
- ☐ Sitewide monitor well installation and closure
- ☐ Sitewide groundwater sampling

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The first three investigation activities will be conducted concurrently. Two sitewide groundwater sampling events will be conducted after all monitor well installations and closures have been completed. The detailed approach for conducting the field investigation is presented in the Sampling and Analysis Plan (see Appendix B) and all proposed soil sampling/well installation locations are displayed on Figures 9, 9A, and 9B.

3.5.1 Background Soil Sampling

Six background samples were collected during the VI. This data provided useful quantitative information, however, it was not sufficient for statistical analysis. Ten background soil sample locations have been defined so that a statistically significant data set is achieved. Background soil sampling will be conducted on the Washington Works site at locations where no manufacturing or waste management activities have been conducted. All samples will be collected from the same sitewide soil horizon present below or near the SWMUs being investigated. The background soil data set will provide sitewide coverage of spatial variations in background metals concentrations which may result from natural geologic processes. The background soil samples will be analyzed for the inorganic analytes listed in Appendix B, Table B-3.

3.5.2 SWMU Specific Soil and Groundwater Sampling

After review of VI data, SWMU-specific soil and groundwater sampling field activities were designed. The proposed sampling programs will achieve SWMU-specific constituent delineation.

3.5.2.1 SWMU A-3—Riverbank Landfill and SWMU B-4—Anaerobic Digestion Ponds

Field investigation activities at the RBL and ADP SWMUs have been grouped together due to their close proximity and similar VI-reported impacts. Proposed soil boring and monitor well locations are shown on Figures 9A and 9B. In general, the proposed sample locations are designed to determine the vertical and lateral extent of waste constituents migrating from these units. Based on VI data,

a substantially more comprehensive investigation is proposed near the ADP and RBL Seep 1 (RBLL1) locations where waste constituents have been detected.

Four shallow soil borings and two groundwater monitor well locations (some locations include both soil boring and monitor well) are proposed for the ADP to evaluate C-8 and Triton® X-100 concentrations in soil and groundwater and potential migration pathways. In addition to the proposed soil borings and monitor wells, the field investigation at the ADP will include groundwater sample collection from Q04-MW01, a new monitor well installed in June 1997 that is situated within the ADP boundary.

A detailed investigation will be conducted at the RBL groundwater seep area (RBLL1). An active french drain groundwater collection and carbon adsorption system currently operates at RBLL1. Six shallow soil borings and three shallow monitor wells will be installed in this area to determine the extent of methylene chloride impact to shallow soil and groundwater. This investigation will also help verify that the current pump-and-treat system is effectively capturing the impacted area and thus remains an ongoing corrective measure.

The remaining RBL SWMU will be investigated on a broader basis. The primary objective of the proposed program is to determine whether any shallow soil or groundwater impact has occurred, and, if it has, determine its migration direction. Along the RBL length along the north side (i.e., riverside), shallow soil borings will be completed approximately every 100 to 140 feet. Shallow monitor wells will be installed at a number of the soil boring locations. Where obvious soil impact (i.e., high volatile organic vapor readings) is discovered during soil boring drilling, the field geologist may chose to install a monitor well.

The south side of the RBL will be investigated along its entire length in a manner similar to the north side. Seven new monitor wells will be installed along the south side of the RBL length in an effort to supplement the existing well system. The wells will be drilled just off the southern boundary of the RBL, since the

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SWMU area itself is inaccessible. Soil samples will be collected from several depth intervals during the monitor well drilling.

The six new monitor wells installed in June 1997 will aid 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 will be sampled twice for the analytical parameter lists provided in Appendix B.

3.5.2.2 SWMU C-6—Polyacetal Waste Incinerator

Per the USEPA's comments on the VI data from this SWMU, the field investigation at the PWI will consist of two soil samples drilled at locations equivalent to the VI soil borings. Soil samples will be collected from the surface (0 to 2 feet), as in the VI, and analyzed for chromium.

3.5.2.3 SWMU H-14—Burning Ground

The RFI field investigation will include a comprehensive evaluation of soil and groundwater quality underneath and nearby the BG. Twenty-two shallow soil borings and three monitor wells will be completed to find the source in the soil. Soil borings locations were chosen within a statistically based 35-foot spaced grid (see Figure 9B). The locations chosen were also based on the existence of numerous buildings in this area which prevented evenly spaced sampling points.

Soil borings will include sample collection with depth to delineate vertical distribution. The sampling frequency and analytical parameter list are provided in the Sampling and Analysis Plan (see Appendix B).

Based on the SCM, groundwater flow beneath the BG is mostly southwest toward the DuPont-Lubeck well field. The monitor wells proposed at the BG are designed to evaluate downgradient groundwater quality along this migration pathway. A separate monitor well proposed north of the BG and south of the RBL

will aid in differentiating groundwater quality impacts between the two SWMU areas.

3.5.3 Sitewide Monitor Well Installations and Closures

The RFI field investigation will include sitewide monitor well installations and closures in addition to the proposed monitor wells within or near the SWMUs being investigated. In general, the new monitor wells will be installed to satisfy site aquifer hydrogeologic (i.e., piezometric head) data gaps. In addition, two wells will be installed near the western plant boundary line (i.e., the boundary with General Electric Co.) to determine piezometric head and groundwater quality.

The proposed monitor well locations are based on the current SCM; however, the completion of the sitewide groundwater flow model may change or add to these proposed locations. Any changes will be communicated in the final RFI sampling locations technical memorandum submitted to the USEPA around April 1998.

As part of the field investigation, a number of old monitor wells with unknown construction (or observation wells) present at the site will be closed. The wells designated for closure will be determined during a sitewide well survey that will be conducted sometime during the fall 1997. The wells will be closed according to the State of West Virginia Guidelines for Monitor Well Closure (47 CSR 60). If it is determined that the piezometric head data provided by the well is critical for site flow monitoring, a new monitor well will be installed at a nearby location. The results of the well survey and a list of wells designated for closure will be communicated to the USEPA in the April 1998 technical memorandum.

3.5.4 Soil Geotechnical Analysis

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

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

Approximately four shelby tube soil samples will be collected from each SWMU at locations already designated for soil boring/well installation. In general, the samples will be collected from depth intervals that correlate with the depth of the bottom of the SWMU waste materials.

3.6 Site-Specific Risk-Based Action Levels

The site data generated during the RFI will be compared to site-specific, risk-based action levels to determine if any corrective action measures are required. Action levels will include MCLs, surface water quality standards, and health-based concentrations. The health-based concentration will be based on potential site-specific exposure and, therefore, will be less conservative than the initial screening concentrations (see Section 3.4). If the data does not exceed the action levels, no further action will be required.

4.0 PROPOSED REVISED NOMENCLATURE FOR WELLS AND SOIL BORINGS

A sitewide alphanumeric coordinate system has been developed to facilitate unique nomenclature for proposed and preexisting wells and soil borings. This coordinate system will allow modification of the proposed soil boring and monitor 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 preexisting wells and soil borings were then renamed according to the cell location and the type of sample. The following convention was used: MW for monitor wells, PW for production wells, SB for soil borings, L for leachate samples and SW for surface water. For example, two monitor wells in cell AP13 were renamed AP13-MW01 and AP13-MW02.

After all preexisting wells and soil borings were renamed, proposed wells and soil boring locations were selected and named. On Figures 9, 9A, and 9B the old nomenclature is used for pre-existing wells and soil borings. Figures 10, 10A, and 10B show the alphanumeric coordinate system, the revised names for the preexisting wells and soil borings, as well as the proposed RFI wells and soil borings.

5.0 RFI REPORT PREPARATION

Upon completion of the field activities specified in the approved RFI Plan, a RFI report will be written that documents field activities, discusses data collected during the investigation, and compares the data to appropriate risk-based screening levels. If additional data is required, the appropriate recommendations will be submitted to the USEPA.

The RFI report will include the following major components:

- ❑ **Introduction**
A brief discussion that references the work plan under which the work was completed, the administrative authority overseeing the investigation, and a listing of the investigation tasks completed.
- ❑ **Field Activities**
A complete discussion of the activities completed in the field, including deviations from the work plan and a justification for the deviations.
- ❑ **Data Discussion**
An overview of general site data collected to complete the site investigation, a SWMU-specific review of pertinent data, and a discussion of statistical approaches for data evaluation.
- ❑ **Quality Assurance/Quality Control (QA/QC)**
An analysis of the completeness, accuracy, and precision of the data collected.
- ❑ **Release Evaluation**
Based on the data that meet QA/QC requirements, SWMUs that have released hazardous constituents to the soil, groundwater, or other environmental media will be identified.
- ❑ **Risk Evaluation**
A risk evaluation that compares release data to appropriate action levels to determine if corrective action measures are required.
- ❑ **Conclusions**
A summary of the findings of the field investigation with recommendations for the future course of action at each SWMU.

6.0 REFERENCES

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FIGURES

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TABLES

JSO019228

EID624963

APPENDICES

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Appendix A

PROJECT MANAGEMENT PLAN

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Appendix B

SAMPLING AND ANALYSIS PLAN

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Appendix C

QUALITY ASSURANCE PROJECT PLAN

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Appendix D
DATA MANAGEMENT PLAN

JSO019233

EID624968

Appendix E
HEALTH AND SAFETY PLAN

JSO019234

EID624969

Appendix F
WASTE MANAGEMENT PLAN

JSO019235

EID624970

Appendix G

COMMUNITY RELATIONS PLAN

JSO019236

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