VIRGINIA DEPARTMENT OF ENVIRONMENT QUALITY

WASTE DIVISION

OFFICE OF REMEDIATION PROGRAMS

STATEMENT OF BASIS

DUPONT SPRUANCE

RICHMOND, VIRGINIA

EPA ID NO. VAD009305137

JULY 2, 2012

Contents

1.0 INTRODUCTION 1

1.1 FACILITY NAME 1
1.2 PROPOSED DECISION 1
1.3 IMPORTANCE OF PUBLIC INPUT 2

2.0 FACILITY BACKGROUND 2

3.0 SUMMARY OF CORRECTIVE ACTION AND INTERIM MEASURES 2

3.1 CORRECTIVE MEASURES 2
3.2 SUMMARY OF ENVIRONMENTAL HISTORY AND MILESTONES 3
3.3 SUMMARY OF INTERIM MEASURES 4
3.3.1 Site Groundwater 4
3.3.2 SWMU 3 – Former Site Landfill, North 5
3.3.3 SWMU 50 – Aramid Fibers Plant II - Former Solvent Recovery and Waste Storage Area 5
3.3.4 East Ditch 5

4.0 GROUNDWATER 5

5.0 PFOA INVESTIGATION 7

6.0 SUMMARY OF HUMAN HEALTH RISK 7

6.1 SOIL EXPOSURE PATHWAYS 7
6.2 GROUNDWATER EXPOSURE PATHWAYS 8
6.3 POTENTIAL VAPOR INTRUSION INTO INDOOR AIR 9
6.4 SURFACE WATER PATHWAYS 9

7.0 CORRECTIVE ACTION OBJECTIVES 10

7.1 SOILS 10
7.2 GROUNDWATER 10

8.0 SUMMARY OF PROPOSED REMEDY 11

8.1 SOILS 11
8.2 GROUNDWATER 11
8.3 LONG TERM GROUNDWATER AND SURFACE WATER MONITORING 11
8.4 INSTITUTIONAL AND ENGINEERING CONTROLS 12
8.5 REPORTING 13
8.6 DEVELOPMENT AND IMPLEMENTATION OF A MATERIALS MANAGEMENT PLAN 13

9.0 EVALUATION OF PROPOSED REMEDY 14

9.1 THRESHOLD CRITERIA 15
9.1.1 Overall Protection of Human Health and the Environment 15
9.1.2 Ability to Attain Media Clean-up Objectives 15
9.1.3 Source Control 16

10.0 FINANCIAL ASSURANCE 16

11.0 PUBLIC PARTICIPATION 17

List of Figures

Figure 1-1 Site Location Map and SWMUs
Figure 1-2 Groundwater wells and extraction wells

1.0 INTRODUCTION

1.1 Facility Name

The Virginia Department of Environmental Quality (VDEQ) in cooperation with the United States Environmental Protection Agency (EPA) has prepared this Statement of Basis for the DuPont Spruance Plant located at 5401 Jefferson Davis Highway in Richmond, Virginia 23218 (hereinafter referred to as the Facility).

The Facility is subject to the Corrective Action Program under the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, and the Hazardous and Solid Waste Amendments (HSWA) of 1984, 42 U.S.C. Sections 6901 to 6992k. The Corrective Action Program is designed to ensure that certain facilities subject to RCRA have investigated and cleaned up any releases of hazardous waste and waste constituents that have occurred at their property.

On January 29, 2000, Virginia received authorization from EPA for the Corrective Action Program under Section 3006 of RCRA. EPA retained the lead for this Facility under a work share agreement with VDEQ. Information on the Corrective Action program as well as a fact sheet for the DuPont Spruance Facility can be found by navigating http://www.epa.gov/reg3wcmd/correctiveaction.htm.

VDEQ has reviewed all available Facility data and has determined that remediation is necessary for the Facility to satisfy its RCRA Corrective Action obligations. VDEQ proposes its final remedy for the Facility in this Statement of Basis and is providing the opportunity for public comment and review on its proposal and the associated permit modification.

1.2 Proposed Decision

This Statement of Basis explains VDEQ's proposed decision that further actions to remediate soil and groundwater, also known as corrective measures, are necessary to protect human health and the environment given current and reasonably anticipated future land use. VDEQ's proposed decision requires the Facility to expand the existing groundwater recovery and treatment system (GWTS), perform long term groundwater monitoring, and maintain certain property mechanisms known as Institutional Controls (ICs) and Engineering Controls (ECs). ICs are generally non-engineered mechanisms such as administrative and/or legal controls that minimize or eliminate the potential for human exposure to contamination and/or protect the integrity of a remedy. Engineering Controls are generally engineered mechanisms such as a landfill cap or construction requirements. The proposed corrective measures are discussed in Section 8.0 and the proposed controls are discussed in Section 8.4 below.

This Statement of Basis summarizes information that can be found in greater detail in the work plans and reports reviewed by VDEQ and EPA, which can be found in the Administrative Record. Figures are included following the text showing the Facility layout and the locations of each solid waste management unit (SWMU) (Figure 1), site-wide groundwater wells and extraction well locations (Figure 2).

1.3 Importance of Public Input

The purpose of this document is to solicit public comment on VDEQ's proposed remedy prior to VDEQ completing its remedy selection for the Facility. The public may participate in the remedy selection process by reviewing this Statement of Basis and documents contained in the Administrative Record in support of VDEQ's proposed decision and by submitting written comments to VDEQ during the public comment period. The information presented in this Statement of Basis can be found in greater detail in the work plans and reports submitted by the Facility to VDEQ and EPA. To gain a more comprehensive understanding of the RCRA activities that have been conducted at the Facility, VDEQ encourages the public to review these documents, which are found in the Administrative Record. A copy of the Administrative Record is available for public review, in electronic format, from the VDEQ contact person, for whom the address and telephone number is provided in Section 11.0.

VDEQ will make a final decision after considering all comments received during the comment period, consistent with applicable RCRA requirements and regulations. If the decision is substantially unchanged from the one proposed, VDEQ will issue a final decision and inform all persons who submitted written comments or requested notice of VDEQ's final determination. If the final decision is significantly different from the one proposed, VDEQ will issue a public notice explaining the new decision and will reopen the comment period. Each person who has submitted written comments will receive a written response from VDEQ. VDEQ will incorporate the remedy selection in its modification of the Facility's Hazardous Waste Management Permit for Site-Wide Corrective Action.

2.0 FACILITY BACKGROUND

The DuPont Spruance Facility is located in Chesterfield County, Virginia, along the southern border of the City of Richmond. The site property is approximately 525 acres. It is bordered on the west by Jefferson Davis Highway (U.S. Route 1) and on the east by the James River. The site is located just northwest of the I-95 and I-895 interchange. The site has been in continuous operation since 1929 as a manufacturing plant for textile fibers and sheet products. Manufacturing products have included Kevlar®, Nomex®, Nylon, Mylar®, Tyvek®, and Zytel®[i].

3.0 SUMMARY OF CORRECTIVE ACTION AND INTERIM MEASURES

3.1 Corrective Measures

EPA issued a Corrective Action Permit to DuPont for the Spruance facility in September 1998. Prior to the Corrective Action Permit, DuPont had been voluntarily investigating groundwater as early as 1976. During a voluntary groundwater survey, DuPont discovered that trichloroflouromethane (TCFM) had apparently been released into the groundwater. Upon discovery, DuPont notified the State Water Control Board, Chesterfield County, and EPA of its preliminary findings. In 1987, Virginia's State Water Control Board issued a "Special Order" to investigate the groundwater contamination and consider, if appropriate, abatement alternatives for TCFM. A second Special Order was issued in July 1990 by the State Water Control Board for

[i] Kevlar, Nomex, Mylar, Teflon, Tyvek, and Zytel are registered trademarks of DuPont.

more studies dealing with offsite contamination. The second order also identified additional contaminants discovered in groundwater besides TCFM such as chloroform, carbon disulfide, hexamethylphosphoramide (HMPA) and zinc. Four extensive groundwater assessment studies were conducted at the site between 1987 and 1995. In these studies, DuPont installed and sampled nearly 250 monitoring wells and piezometers; surface water and soil samples were also collected. The studies indicate two significant sources of contamination at the Facility; the contaminated soils beneath the Nomex and Kevlar manufacturing areas and the former site landfill. In 1977, the landfill was closed in accordance with existing regulations and by 1978 a cap of compacted soil was in place. In 1994, a groundwater treatment system was installed to establish a facility wide collection system at the perimeter of the facility and within the source areas.

DuPont conducted a voluntary RCRA Facility Assessment (RFA) and submitted the report to EPA in 1996. The Report identified 63 Solid Waste Management Units (SWMUs). EPA reviewed the RFA, and concluded that 18 of the 63 SWMUs should be investigated under the Corrective Action Permit. EPA concluded that at 45 SWMUs there was no evidence of a release and therefore no further action was warranted at those SWMUs. DuPont submitted a Final Release Assessment Report in December 1998, which addressed the 18 SWMUs. EPA reviewed the 18 SWMUs in the Final Release Assessment Report, and recommended that 6 SWMUs be further evaluated under the RCRA Facility Investigation (RFI) (See Figure 1). The results of the RFI are provided in the Final RCRA Facility Investigation and Corrective Measures Study (RFI/CMS) Report, dated August 2011.

The voluntary investigations as well as the RFI determined that constituents were widely distributed in groundwater with only limited areas of impacted soil. Those areas of impacted soil are as follows: (1) SWMU 50 - The Former Solvent Recovery and Waste Storage Area North of the Nomex Plant; (2) SWMU 51 –Former Kevlar Market Development Facility No. 1 Loading Dock Drum Storage Area; and (3) SWMU 3 – Former Site Landfill North. In 1993, prior to the RFI, an interim measure was performed in the Former Solvent Recovery and Waste Storage Area North of the Nomex Plant (SWMU 50). The structural features of this area were demolished and capped with a geotextile liner, 2 feet of soil, and an asphalt cap to inhibit infiltration. The Former Site Landfill (SWMU 3) was closed prior to 1982, and covered with compacted soil. During the RFI, only arsenic exceeded applicable screening levels (industrial) in soil samples. However, arsenic concentrations did not exceed the regional background value published by Shacklette and Boerngen in 1984. The groundwater constituents of potential concern (COPCs) identified in RFI/CMS are carbon tetrachloride, chloroform, tetrachloroethylene, trichloroethylene, hexamethylphosphoramide (HMPA), trichlorofluoromethane (TCFM), vinyl chloride, and perfluorooctanoic acid (PFOA). Groundwater is not used on the site for drinking water, and no downgradient users of off-site groundwater exist between the site boundary and the James River. Based on the interim measures and the soil sampling results, the RFI/CMS Report concluded that only sitewide groundwater requires further remedial action.

3.2 Summary of Environmental History and Milestones

To date, the following RCRA Corrective Action milestones have been completed at the Facility:

a. In 1987, Virginia's State Water Control Board issues "Special Order" to DuPont, dated January 15, 1987, for investigation for groundwater on-site. An amendment to the initial Special Order was issued by the State Water Board on November 4, 1997.

b. DuPont performs groundwater investigation in four separate phases, from 1989 thru 1995.

c. In 1990, Virginia's State Water Control Board issues a second "Special Order" to DuPont, dated June 15, 1990, for addition groundwater investigation on-site and off-site.

d. DuPont installs a groundwater treatment system (GWTS) in 1993, and begins operation in 1994.

e. DuPont conducts RCRA Facility Assessment, contained in a Report dated July 1996.

f. EPA issues Corrective Action Permit to DuPont for the Spruance Plant in September 1998. VDEQ re-issued Corrective Action Permit in September 2009.

g. DuPont submits a Final RCRA Release Assessment Report in December 1998, which covers 18 SWMUs specified in the Corrective Action Permit.

h. DuPont submits "Evaluation of Reasonably Anticipated Future Land Use" document to EPA in December 1998.

i. DuPont submits an Interim Remedial Measures for Groundwater Extraction Report in January 1999, as required by the Corrective Action Permit.

j. EPA approves both the "Migration of Groundwater Under Control" and "Current Human Exposures Under Control" Environmental Indicators (CA750 and CA725, respectively) (2001 and 2002).

k. DuPont submits the PFOA Groundwater and Surface Water Sampling Results (Phase I - 2006).

l. DuPont submits the East Ditch Remedial Design (2006).

m. DuPont submits the PFOA Phase II Water Sampling Report (2007).

n. DuPont submits the Final RCRA Facility Investigation and Corrective Measures Study Report (2011).

3.3 Summary of Interim Measures

From 1987 thru 2010, remedial activities have occurred at the Facility to address impacts to human health and the environment. Some interim measures are the result of direct State Water Board Orders (i.e., Site Groundwater), while other interim measures have been implemented by DuPont (i.e., SWMU 3, SWMU 50, and East Ditch).

3.3.1 Site Groundwater

Starting with the 1987 State Water Control Board Order, which required investigation and abatement alternatives for trichloroflouromethane found in groundwater, DuPont has focused a great deal of effort on understanding site geology and groundwater .

The 1990 State Water Control Board Order required DuPont to remove contaminants found in groundwater under the Spruance site. By 1994, the GWTS was up and running. The GWTS was designed to handle 160 gallons per minute, with an air stripper, pH adjustment, and carbon treatment. Upgrades to the GWTS occurred in 1996 and additional upgrades occurred after a conceptual engineering assessment was completed in 2002 (See Figure 2).

3.3.2 SWMU 3 – Former Site Landfill, North

SWMU 3 was the primary landfill at the site. SWMU 3 was an approximately 50-acre landfill located on the northeastern site boundary. According to site records, the landfill is surrounded by compacted earthen berms and is unlined.
Based on waste disposal patterns, this SWMU is subdivided into four discrete landfill areas; trenches and open disposal pits were used for waste deposition in different portions of the landfill. As waste volume increased, the height of the earthen berms was increased to expand the landfill capacity. The landfill received waste until 1978, although the majority of waste disposal ceased by 1972.

The majority of the landfill was covered with 6 inches to 3 feet of compacted cover by 1979 and, currently, a vegetative cover remains in place over the majority of the landfill. The remainder of the landfill has been covered with impervious surfaces such as parking lots and buildings.

3.3.3 SWMU 50 – Aramid Fibers Plant II - Former Solvent Recovery and Waste Storage Area

This SWMU may have contributed constituents to groundwater in the past; HMPA and chloroform have been detected in off-site groundwater downgradient (both south and northeast) of the SWMU. However, an interim measures was implemented, removing contaminated surface soil to a depth of 2 feet below grade surface and installing an impermeable geotextile liner and asphalt cap after demolition of the unit. The groundwater under this SWMU is currently addressed as part of the operating groundwater treatment and extraction system.

3.3.4 East Ditch

The East Ditch is located directly east of the Polishing Pond. Surface water in the East Ditch is believed to be from groundwater under the Polishing Pond and Site Landfill North. When PFOA was discovered in the outfall of the ditch, an extensive investigation was conducted to determine the source of the PFOA. Since groundwater was found to discharge into the stream, DuPont decided to collect the surface water. In 2009, a well engineered collection system was installed to capture and collect the surface water in the East ditch and pump the water to the inlet side of the wastewater treatment system.

4.0 GROUNDWATER

Site wide groundwater is recognized as the transport medium for the soluble compounds associated with industrial processes at the site. The direction of groundwater flow in the shallow aquifer is complex. Groundwater at the site generally flows along preferential pathways to the northeast and southeast toward the James River. However, fluvial deposits and four specific areas of extraction wells have created multiple groundwater flow directions that are perpendicular to the general site wide flow. As an interim remedial measure, a GWTS consisting of 50 groundwater extraction wells was installed in 1993 and began operation in 1994. The groundwater recovery wells are located in four areas that are called alignments. One alignment is located in the main

plant area (10 wells), and there are three perimeter extraction well alignments: the northwest (14 wells), the northeast (12 wells), and the southern (14 wells). GWTS is described in greater detail in the Interim Measures Report for the Groundwater Extraction System (1999).

Groundwater at the site generally flows to the northeast and southeast toward the James River. However, several unlined impoundments on the site and a groundwater interceptor well system have created a shallow groundwater divide that is oriented diagonally from the Polishing Pond in the southeastern portion of the site toward the northwestern portion of the site. Groundwater flow is also influenced by withdrawals from an underdrain system beneath the Gypsum Acid Pond. Fluvial deposits and four specific areas of extraction wells have created multiple groundwater flow directions that are perpendicular to the general sitewide flow.

The diffuse sources of TCFM, HMPA, and chloroform in the western part of the site produce two major plumes. Both plumes appear to originate in the northern portion of the main plant area. One plume is oriented south-southeast and extends off of the site as far as Grindall Creek. The second plume extends northeast of the main plant area and continues off site to the James River. A separate HMPA plume originates in the closed landfill (SWMU 3) near the eastern portion of the northern perimeter, where HMPA-contaminated wastes were buried, and extends off site to the north-northeast. This plume extends to the James River and appears to merge with the northern plume from the main plant area.

A portion of the main southern HMPA plume also extends a short distance southwestward from the main plant area and likely discharges into Grindall Creek, which eventually discharges to the James River. Another HMPA plume extends southwestward from the closed landfill.

Carbon disulfide has been detected at a few discrete on-site locations, as well as at several isolated off-site locations; however, carbon disulfide is not present as a widespread plume.

Nonaqueous-phase carbon disulfide is present at the base of the shallow aquifer in the main plant area. There is no evidence of nonaqueous-phase carbon disulfide migrating beyond the source location in the main plant area.

DuPont has used a groundwater flow model, MODFLOW, to predict the direction of groundwater movement and the rate of constituent transport. This model has assisted in the development of the current interim measures that are employed to capture impacted groundwater. The placement of new wells and assessment of the efficacy of remedial measures are based upon the predictions of this model.

Annual groundwater elevations and the average weekly extraction rates during the monitoring period are used with the site's calibrated MODFLOW model to predict the potentiometric groundwater surface. The major groundwater flow paths from the northern site boundary are northeasterly via the abovementioned two high transmissivity zones toward the James River. Groundwater also leaves the site and flows to the James River at the southern and eastern boundaries, with flow rates greater along the southern boundary. Flow directly east between the Polishing Pond and the James River is quite slow because the aquifer associated with the terrace deposits has low permeability.

Spatial variability in aquifer properties causes the flow paths from the site to the river to be even more complex than the potentiometric surface would appear to indicate. Some groundwater from the site also reaches the river by discharging to the west to Grindall Creek and to the east to the East Ditch and the site's internal drainage ways, including the Outfall Ditch. The reservoir and the Polishing Pond recharge the aquifer and maintain locally high groundwater levels. In the past,

groundwater levels at the northern end of the manufacturing area were elevated due to leakage from buried sewer and water lines. The leaking lines have been repaired or replaced, and currently no known leaks exist.

5.0 PFOA INVESTIGATION

DuPont operated a Teflon® fibers production unit at the site from 1953 until 2004. In the manufacturing of Teflon® fiber, polytetrafluoroethylene (PTFE) dispersion (received as an off-site raw material) was mixed with viscose. The viscose was regenerated in an acid bath in spinning and acted as a matrix to bind the PTFE particles. PTFE dispersions contained low levels of PFOA, a surfactant used to prevent agglomeration of the particles.

In 2006, DuPont submitted a workplan to address whether PFOA was in the environment as a result of the former Teflon® fiber manufacturing. In August 2006, DuPont sampled groundwater and surface water at and around the Spruance facility. The results of that investigation indicated low levels of PFOA (less than 7.5 part per billion) in groundwater wells in areas of known manufacturing, wastewater processing, or waste disposal. (In 2006, EPA used a screening value of 1 part per billion (ppb) for PFOA, which at the time was the consensus value. In 2009, EPA's Office of Water developed a Provisional Health Advisory for PFOA of 0.4 ppb) concentrations of PFOA found in surface waters in the James River, Grindall Creek, and Falling Creek were also low, below 0.025 ppb. PFOA was not quantifiable (detected at levels so low it could not be accurately measured) at the public water intake for City of Hopewell. A second round of sampling was conducted in 2007, focusing on five potable water locations, twenty-seven groundwater monitoring wells and four springs. The results of the second sampling effort found no PFOA in the potable water locations and low levels of PFOA (less than 6.2 ppb) in the springs on the eastern side of the site. For the twenty-seven groundwater wells, 16 were found to contain PFOA at 1 ppb or less, and the remaining 11 wells had PFOA concentration in ground water ranging from 1 ppb to 25 ppb at well MW-225.

DuPont has continued to perform an annual groundwater and select surface water/spring sampling at and near the DuPont Spruance facility. A total of 46 monitoring wells are sampled along with four surface water/spring locations. In the 2010 Annual Report, DuPont commented that the concentrations in some wells appear to be decreasing and in other wells increasing, overall, concentrations of PFOA detected in 2010 are not significantly different than results of sampling performed in 2006, 2007, 2008 and 2009.

6.0 SUMMARY OF HUMAN HEALTH RISK

6.1 Soil Exposure Pathways

The Facility's future land use evaluation and feasible use of the property in the foreseeable future supported an industrial land use scenario as the reasonable scenario. DuPont supported the future land use assumption by submitting a Report in December 1998, "Evaluation of Reasonably Anticipated Future Land Use "for the site. In that December 1998 Report, DuPont provided supporting information for their argument that the site should be used for industrial purposes in the future. EPA agreed with that determination, and during the RFI soil contaminant concentrations were evaluated using industrial screening levels rather than residential screening levels. In accordance with EPA direction, industrial screening levels were obtained from EPA

regional screening levels (RSLs) for industrial soil ingestion at a Hazard index (HI) of 0.1 or a cancer risk level of 1×10^{-6}. Soil data collected during the RFI did not exceed the industrial screening criteria for any constituent, except arsenic. However, arsenic concentrations did not exceed the regional background value published by Shacklette and Boerngen in 1984. Since the current land use and anticipated future land use will be for industrial purposes, and there were no exceedances of any COPCs above EPA's industrial screening concentrations for soils or regional background level (arsenic), a human health risk assessment for current and future workers was not warranted.

In accordance with the DuPont Spruance internal procedures, all industrial workers employed at the site have received special OSHA-required and site-specific health and safety training to prevent exposures to COPCs and to protect against other health and safety hazards. In addition, all activities are required to be performed in accordance with a site-specific health and safety plan (HASP) that includes extensive procedures and mandated personal protective equipment (PPE). These in place procedures would preclude any industrial workers as well as construction workers from being exposed to COPCs.

The DuPont Spruance site is an industrial property surrounded by chain-linked security fence. The Facility has 24-hour security with armed guards and cameras to prevent trespassers from entering the site; therefore, that exposure potential pathway was not evaluated as a potential risk.

6.2 Groundwater Exposure Pathways

Groundwater is not used on the site for drinking water, and no downgradient users of off-site groundwater exist between the site boundary and the James River. Recognizing that Virginia has an antidegradation policy for groundwater, DuPont, EPA, and VDEQ agreed that screening values selected for each constituent detected in groundwater would be based upon drinking water criteria.

A hierarchical approach was used to select screening criteria based primarily on water supply standards. Upon the Facility's request, Virginia Groundwater Quality Standards were used; however, no site COPCs were listed in this standard. Next, Federal Maximum Contaminant Levels (MCLs) if established, were selected as screening criteria. For constituents that lack criteria from these sources, EPA drinking water health advisories and provisional toxicity criteria that have been approved by the EPA were selected as screening levels. For HMPA, the screening level is based on a provisional toxicity criterion approved by EPA Region III. For PFOA, the screening value is equivalent to the provisional health advisory from the EPA Office of Water. Finally, if a standard was not available, a screening criterion from the RSLs for tap water was selected. The RSLs are based on a cancer risk of 1×10^{-6} and a hazard quotient (HQ) of 1.0 (for noncarcinogens). In addition, an assessment of toxicological endpoints for RSL-based screening criteria was performed to determine if COPCs were detected with common toxicological endpoints within a given SWMU. In the event COPCs with a shared endpoint were detected, these constituents were screened using RSLs based on a HQ of 0.1.

A risk calculation was not performed for current exposures to groundwater at the Facility or for current exposures to groundwater offsite because there is no current exposure pathway for groundwater. Contaminated groundwater that has migrated offsite and under neighboring properties eventually discharges to the James River. Off-site groundwater contamination underlying neighboring properties will need to be addressed in the final decision for the site

through institutional or engineering controls. In the interim, DuPont has made efforts to alert property owners of the contaminated groundwater under their properties.

With the installation of the GWTS in 1994, significant reduction in contamination levels has occurred. Most of the groundwater contamination related to the Facility is prevented from migrating offsite and eventually to the James River by the GWTS.

6.3 Potential Vapor Intrusion into Indoor Air

Potential volatilization from groundwater to indoor air was assessed to evaluate the potential vapor intrusion pathway. To address potential vapor intrusion from groundwater, all VOC data collected in 2007 and 2008 were evaluated. VOC detections are sporadic in groundwater, and, based on area land use, the only existing buildings that could be affected by VOCs from impacted groundwater are used for industrial or commercial purposes. The Occupational Safety and Health Administration (OSHA) and EPA have agreed that OSHA generally will take the lead role in addressing vapor intrusion in occupational settings for all workers and all chemicals. Because of the industrial use, the OSHA permissible exposure levels (PELs) and the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLVs) were used to develop appropriate indoor air target concentrations for potential on-site exposure.

Site-related constituents HMPA and PFOA were not included in the vapor intrusion evaluation, as both constituents lack sufficient volatility (defined as a Henry's Law Constant greater than 10^{-5} atm-m^3/mol and a vapor pressure greater than 1 mm Hg at room temperature) to result in potentially significant vapor intrusion.

In the event that a well was sampled in both 2007 and 2008, the most recent data were used for the assessment. VOCs were detected in groundwater at 30 locations. The four off-site buildings and two on-site buildings located in the main plant area are the only existing buildings that could be influenced by VOCs in impacted groundwater. None of the VOCs detected in 2007 or 2008 exceeded screening levels based on an industrial exposure scenario. Therefore, this potential exposure pathway is not considered to be significant and no further evaluation of potential vapor intrusion from groundwater into on- and off-site buildings is warranted.

6.4 Surface Water Pathway

The James River is classified by the State of Virginia as a public water supply (9 VAC 25-260-450) and as a recreational water body. However, the nearest downstream public water intake is located on the Appomattox River in the City of Hopewell, Virginia, approximately 18 miles downstream of the site. To protect the classified use of surface water in the James River, surface water concentrations collected from seeps adjacent to the James River were compared to the lower of Virginia water quality standards (9 VAC 25-260-140) for the protection of public water supplies and the National Ambient Water Quality Criteria (AWQC) (40 CFR Part 131). The EPA Region III freshwater benchmark criteria were used when Virginia or federal criteria were unavailable. If criteria were not available from any source, concentrations were compared to the groundwater screening criteria selected using the same hierarchical approach employed for the groundwater screening.

The residential-based criteria used in the exposure assessment are protective of off-site industrial or construction workers who have incidental contact with seep water. Of the COPCs present at the site, carbon tetrachloride, chloroform, tetrachloroethylene, trichloroethylene, vinyl chloride, and TCFM are recognized as VOCs that will preferentially partition to air. The same COPCs present in surface water have physical and chemical properties that preclude COPCs from

accumulating in fish. Therefore, potential exposure through fish consumption is not a significant pathway. A series of acute and chronic aquatic bioassays testing HMPA and PFOA in relevant species indicate that neither of these compounds would produce toxicity to aquatic organisms at the levels encountered in any perennial surface water at the site (i.e., Grindall Creek, Falling Creek, and the James River).

Surface water monitoring of constituents in the James River adjacent to the site and downstream has demonstrated that concentrations in the river are well below applicable regulatory criteria. In addition, the GWTS interim measure has resulted in a decrease in concentrations in the groundwater and the river.

7.0 CORRECTIVE ACTION OBJECTIVES

VDEQ has identified the following Corrective Action Objectives for soils and groundwater at the Facility:

7.1 Soils

The Corrective Action Objective for Facility soils is to control human and environmental exposure to the hazardous wastes and hazardous constituents that remain in place at the Facility. VDEQ has determined that EPA Region 3's Screening Levels for Industrial Soils for direct contact with soils are protective of human health and the environment for individual contaminants at this Facility, provided that the Facility is not used for residential purposes. Therefore, VDEQ's Corrective Action Objective for Facility soils is to control exposure to the hazardous constituents remaining in soils by requiring the compliance with and maintenance of land use restrictions at the Facility.

7.2 Groundwater

The Corrective Action Objective for contaminated groundwater at the Facility is to restore groundwater to drinking water standards. These standards are established by the Maximum Contaminant Levels (MCLs) promulgated at 40 CFR 141, pursuant to Section 1412 of the Safe Drinking Water Act (SDWA), 42 USC Section 300g-1. For contaminants of concern without an applicable MCL, EPA's RSL for tap water will be used. For constituents that lack criteria from these sources, EPA drinking water advisories, EPA provisional health advisories, and provisional toxicity criteria that have been approved by VDEQ were selected. Thus, the groundwater cleanup standards for the Facility are as follows:

Carbon tetrachloride	0.005 mg/l	MCL
Chloroform	0.00019 mg/l	RSL
Tetrachloroethylene	0.005 mg/l	MCL
Trichloroethylene	0.005 mg/l	MCL
Hexamethylphosphoramide (HMPA)	0.002 mg/l	See Note 1
Trichlorofluoromethane (TCFM)	1.1mg/l	RSL
Vinyl chloride	0.002 mg/l	MCL
Perfluorooctanoic acid (PFOA).	0.0004 mg/l	See Note 2

Units - milligrams per Liter (mg/L)

Note 1: HMPA - For HMPA, the screening level is based on a provisional toxicity criterion approved by EPA Region III.

Note 2: PFOA – On January 9, 2009, EPA's Office of Water (OW) developed Provisional Health Advisories for PFOA and PFOS to protect against potential risk from exposure to these chemicals through drinking water. Provisional Health Advisories (PHA) serve as informal technical guidance to assist Federal, State and local officials in response to an urgent or rapidly developing drinking water contamination. They reflect reasonable, health-based hazard concentrations above which action should be taken to reduce exposure to these contaminants in drinking water. The PHA values are 0.4 µg/L for PFOA and 0.2 µg/L for PFOS. These values may be used to assess contamination and exposure at other sites. Provisional Health Advisories are not to be construed as legally enforceable federal standards and are subject to change as new information becomes available.

Further information can be found at EPA's website: **www.epa.gov/oppt/pfoa/**

8.0 SUMMARY OF PROPOSED REMEDY

Based on the findings set forth in the RFA and RFI/CMS reports, VDEQ has determined that past operations at the Facility have resulted in soil and groundwater contamination. The proposed remedy for the Facility emphasizes source control through improving the existing GWTS as well as maintaining existing capping of soils with concentrations of contaminants above remedial goals. VDEQ additionally proposes to continue long term groundwater and surface water monitoring be conducted to ensure clean up goals are met and for remedial effectiveness. Finally, VDEQ will require institutional and engineering controls be implemented as necessary to prevent current and potential future exposure to contamination. VDEQ's proposed remedy is

8.1 Soils

Based on the available information, there are currently no unacceptable risks to human health and the environment via the soil or vapor intrusion pathways for the present and anticipated use of the property (industrial use). Because soil contaminant concentrations were evaluated using industrial screening levels rather than residential screening levels, the proposed remedy for soils is institutional controls (See Section 8.4) to restrict the Facility to non-residential uses. Also, the Facility will be required to maintain existing asphalt cap over SWMU 50 and existing soil cap over SWMU 3 where applicable. Improvements or integration of the soil cap should be made when existing buildings or structures are removed on SWMU 3.

8.2 Groundwater

The interim measures GWTS operating since 1994 has been effective in reducing concentrations in groundwater and surface water; however, expanding the groundwater treatment system and optimizing groundwater capture at the site boundary should result in improvement of the entire containment system, particularly from the northeast alignment wells. The exact details of where and how to optimize groundwater capture and the GWTS will be developed during the remedial design.

8.3 Long Term Groundwater and Surface Water Monitoring

Long term groundwater and surface water monitoring has been an active component of the existing groundwater treatment system. The existing groundwater and surface water monitoring

will continue to be conducted at the Facility until it is demonstrated that long term cleanup goals/drinking water standards are met and maintained. Changes to the long-term groundwater monitoring program may be proposed by the facility based on results from groundwater sampling and will be implemented via the existing Groundwater Monitoring Plan.

8.4 Institutional and Engineering Controls

Institutional and engineering controls will be implemented in order to protect human health and the environment and to maintain the current and future integrity of the remedy. Given the nature and extent of impacted media left in place, more than one institutional control is necessary to prevent activities which could interfere with the integrity or protectiveness of the remedy. Therefore, VDEQ has determined that institutional and engineering controls are necessary to ensure the short and long term reliability of the remedy. Institutional controls to be utilized at the site will;

1) notify prospective buyers of the property of the environmental conditions at the Facility and of VDEQ's selected corrective measures as part of the remedy for the Facility under RCRA Corrective Action;
2) prohibit use of the property for residential purposes (including single family homes, multiple family dwellings, schools, day care facilities, child care centers, apartment buildings, dormitories, other residential style facilities, hospitals, and in-patient health care facilities) within the surveyed footprint of the property boundaries;
3) prohibit the use of groundwater beneath the property except for non-contact cooling water and purposes to support selected corrective measures;
4) require inspection and maintenance of the asphalt cap over SWMU 50;
5) require vapor mitigation be utilized in or beneath new, totally enclosed structures designed for occupation within the foot print of groundwater contaminated with volatile organic compounds identified during RFI above protective levels, unless it's demonstrated to VDEQ that it's not necessary to protect human health;
6) restrict activities that would interfere with or adversely impact the integrity of the remedy.
7) Maintain existing security fence around property to prevent trespassers from access to GWTS and any other areas of known contamination, such as SWMU 3 and 50.

Institutional controls described above will be implemented at the site through the following mechanisms;

- VDEQ anticipates that the above land and water use restrictions will be implemented through an environmental covenant to be entered pursuant to the Virginia Uniform Environmental Covenants Act (UECA), Va. Code, § 10.1-1238, *et seq.* and to be recorded with the deed for the DuPont Spruance facility. A declaration of restrictive covenant or similar instrument consistent with applicable requirements under the laws of the Commonwealth of Virginia will be recorded with the real property records for the Site such that prospective purchasers of the Site will have constructive notice of land use restrictions. The declaration of restrictive covenants will contain the land use controls described above and will be recorded with the land records in the office of the clerk of the circuit court for the jurisdiction in which the Site is located within ninety (90) days of executing the declaration. The current owner and future owners of the Site will be

obligated to comply with the recorded restrictive covenant since the covenant will run with the land;

- The existing Hazardous Waste Management Permit for Site-Wide Corrective Action will be modified to include the RCRA Corrective Action remedy decision after it is approved, and will be used as the controlling authority for implementation of the remedy through the VDEQ. The Permit will also be modified, as appropriate, to include land use restrictions as described above; and
- While groundwater beneath the site is not currently used as a drinking water source and there are no plans for such future use, to provide additional protection, the proposed remedy includes institutional controls to prohibit the development of wells for drinking water or other domestic uses at the Facility. A notification to prohibit well drilling under Virginia's Private Well Regulations, 12VAC 5-630-380 will be provided to the local health district (Chesterfield County and City of Richmond) in writing describing the nature and extent, including a map, of the contaminated groundwater located on the Facility property. The notice will be updated every three (3) years to reflect the latest contaminated groundwater plume boundary. A copy of the notification will be provided to VDEQ.

8.5 Reporting

DuPont will be required to submit annual reports containing, but not be limited to, annual groundwater monitoring data (as long as a requirement to sample annually exists), system O&M data, and evaluation of remedial effectiveness. DuPont will also be required to submit a remedy status evaluation report every three (3) years that evaluates the effectiveness of the corrective measures in meeting the human health and environmental protection objectives. This review may include, but not be limited to, review of DuPont's compliance with any potential covenant requirements, groundwater and land uses on the property, and zoning maps or planning documents that may affect future land use in the impacted area. The report will include progress of the remedial measures and of meeting the cleanup targets or remedial goals.

VDEQ will review the progress of the remedy activities to confirm that clean up targets and remedial goals have been met. If VDEQ determines that DuPont is not achieving clean up targets remedial goals, VDEQ may require DuPont to perform additional studies and/or to modify the existing corrective measures. If new contamination is discovered or if the proposed remedial options cannot adequately mitigate risk to human health or the environment, additional corrective measures will be developed and implemented. In the event that VDEQ requires DuPont to perform additional studies and/or to modify the existing corrective measures, an opportunity for public comment will be provided prior to the initiation of changes to the existing corrective measures, as necessary or appropriate.

8.6 Development and Implementation of a Materials Management Plan

VDEQ's proposed remedy requires the development and implementation of a Materials Management Plan to be approved by VDEQ before any earth moving activities, including construction and drilling, can be performed on SWMUs that contain COPCs above residential soil screening levels. The Materials Management Plan must also incorporate how groundwater known to contain COPCs above cleanup criteria will be handled and managed should earth moving

and/or construction and drilling require contact with groundwater. The Materials Management Plan will detail how soil and groundwater will be managed during any future subsurface activities conducted on these SWMUs and in groundwater. The Materials Management Plan will detail how all excavated soils from these SWMUs and groundwater will be handled and disposed. The Materials Management Plan will include analysis of constituents detected at the parcel if not previously identified.

In addition, all soils and groundwater that are to be disposed of will be sampled and disposed of in accordance with applicable State and Federal regulations. In addition, the Materials Management Plan will include soil stabilization requirements to minimize contact between storm water runoff and the parcel soils. Soil stabilization measures may include the construction of berms to prevent storm water from flowing onto certain areas as well as the construction of sumps with pumps to remove ponded water from low lying areas.

The Materials Management Plan will include a Health and Safety Plan, Sampling and Analysis Plan and Quality Assurance Project Plan. The Health and Safety Plan will, among other things, identify the SWMU locations at the Facility where contaminants remain in soils; detail how future on-site workers and contractors will be notified about such locations and about the presence of the contaminated soil and groundwater.

9.0 EVALUATION OF PROPOSED REMEDY

This section provides an evaluation of the proposed remedy using EPA's RCRA Corrective Action Program criteria. These criteria consist of three threshold criteria and seven balancing criteria. The criteria are applied in two phases. In the first phase, VDEQ evaluates three Threshold Criteria as general goals. In the second phase, if there is more than one remedy which meets the Threshold Criteria, VDEQ evaluates seven Balancing Criteria to determine which proposed remedy alternative provides the best relative combination of attributes.

In the RFI/CMS, DuPont evaluated nine alternatives for on-site groundwater as follows:

- No action
- Institutional controls
- Existing hydraulic containment and treatment
- Enhanced hydraulic containment (expand existing GWTS and optimize capture zone)
- Physical barrier wall
- In situ physical or chemical soil and/or groundwater treatment
- Bioremediation
- Phytoremediation
- Ex situ alternative groundwater treatment

In their evaluation, which is detailed in the RFI/CMS Report, DuPont selected "Enhanced hydraulic containment" of the nine alternatives. VDEQ agrees with the "Enhanced hydraulic containment" alternative proposed by DuPont for groundwater. Due to the unique combination of COPCs in groundwater at the site, the treatment options are very limited. For example, the only effective treatment for HMPA is sending the groundwater thru granular activated carbon to remove HMPA. Therefore, the proposed remedy of Enhanced hydraulic containment is the only alternative that meets the three Threshold Criteria, and an evaluation of the balancing criteria is unnecessary.

While DuPont has some institutional and engineering controls in place, such as security fence, groundwater monitoring and asphalt cap for SWMU 50, VDEQ proposes that these and other controls be formalized thru the Permit and/or UECA for long-term protection of human health and the environment.

9.1 Threshold Criteria

9.1.1 Overall Protection of Human Health and the Environment

VDEQ's proposed remedies for soils are protective of human health and the environment. The extent of soil contamination is limited or present at depth (not at surface). Therefore, under current land use conditions, contaminated soil can be left in place with acceptable health risks. VDEQ proposes implementing institutional controls to prevent potential future exposure due to unanticipated land use change or construction activities that may deviate from the current exposure scenario. Interim measures activities undertaken for soil at SWMU 50 have already resulted in protection of human health and the environment. Existing engineering controls such as security fences, security personnel and security cameras provide controlled access to areas where soils are contaminated.

At the DuPont Spruance Facility, groundwater is not used on-site for drinking or other purposes. Public water is used for drinking water and general use and DuPont uses water from the James River for industrial processes. A domestic well survey conducted by DuPont extending 1 to over 2 miles from the Facility, found all wells either upgradient of the Facility or located far enough west or southwest of the Facility that could not be impacted by groundwater contamination. Property owners adjacent to the Facility where contaminated groundwater underlies have been alerted by DuPont of the conditions.

The annual groundwater monitoring reports over the last several years have shown COPC concentrations in on- and off-site groundwater monitoring wells declining since the GWTS was activated in 1994. Therefore, it is evident that the current GWTS is having a positive effect on groundwater quality at the site.

The current GWTS has some recognized limitations. Although the perimeter extraction wells are intended to intercept the three major plumes of impacted groundwater in the shallow aquifer, they do not prevent or control all off-site flow of contaminated groundwater. Additional hydrogeologic investigations conducted since the installation of the current GWTS indicate that the northeast alignment wells are not 100% effective in containing all contaminated mass flux from flowing through the alignment wells.

9.1.2 Ability to Attain Media Clean-up Objectives

VDEQ's proposed remedies meet the cleanup objectives based on assumptions regarding current and reasonably anticipated land and water resource use(s). For soils, the current and reasonably anticipated future use is industrial. The institutional controls and engineering controls required in VDEQ's proposed remedy provide the necessary safeguards to ensure the Facility maintains its industrial use.

For groundwater, the proposed remedy of expanding the GWTS and optimizing groundwater capture should result in improvement of the entire containment system, particularly from the northeast alignment wells. Generally, containment is most efficient in the northwestern and

southern alignment wells because these wells are able to achieve complete hydraulic capture of the COPC plumes. Estimated capture efficiencies were derived from the calibrated MODFLOW model, and model results indicate that capture efficiencies are not 100%. The lowest containment efficiencies occur in the eastern portion of the site along the eastern edge of the modeling domain because no extraction wells are present in the area. However, the MODFLOW model results predict that the mass of constituents migrating through the eastern portion of the site is negligible even without hydraulic control. Likewise, the contaminant flux is minimal at the northeast alignment wells for all of the COPCs except for HMPA. The northeast alignment wells were installed because of the presence of a HMPA plume in the area. Although these wells are not capable of complete hydraulic capture of the plume, they have been reducing the estimated HMPA flux substantially.

In summary, the GWTS expansion would improve the effectiveness of the current system by increasing the total groundwater recovery rate, thus reducing overall mass flux off site, and by improving groundwater capture in specific areas (e.g., the northeast alignment wells). Groundwater pumping and ex situ treatment is a proven technology that is readily implemented. DuPont has 15 years of operational experience with the existing GWTS at the site. To date, granular activated carbon is the only effective treatment method that has been identified for HMPA. The proposed expanded GWTS would continue to remove the COPCs from groundwater and meet the cleanup levels in Section 7.2.

9.1.3 Source Control

Extensive evaluations of potential remediation technologies for more than 15 years have not identified demonstrated technologies capable of in situ treatment or destruction of the extremely stable key compounds (i.e., HMPA and PFOA) at the site. Thus, the consideration of remedial alternatives focused on technologies that could address site-wide groundwater via containment.

Groundwater pump and treat is a proven technology that has been used at the site since 1994 as an interim measure with documented, measurable positive results. Based on this technology's established success in addressing COPC concentrations in groundwater, the recommended remediation alternative involves expanding the GWTS and optimizing capture performance.

10.0 FINANCIAL ASSURANCE

Assurances of financial responsibility for corrective action will be provided in accordance with the Facility's current Permit as follows. Within ninety (90) calendar days of final acceptance of the proposed determination and corrective measures remedy by the VDEQ via the Facility's Permit modification, the Permittee shall submit a cost estimate for completing the approved remedy(ies). The estimate may be based on the Corrective Measure Study, the approved remedy(ies), or any other available information. The cost estimate for completing the approved remedy(ies) shall be updated pursuant to the development of more detailed information (e.g., Corrective Measure Design or Implementation) and any modifications to the approved remedy(ies).

By March 31st following approval of the cost estimate for financial assurance, and each succeeding year, the Permittee shall demonstrate compliance with financial assurance to the Department for completing the approved remedies in accordance with 40 CFR § 264.101(b). By

March 31st following approval of any revised cost estimate, the Permittee shall demonstrate to the Department financial assurance for the updated cost estimates.

Financial assurance will be required by the Permit for ongoing operation and maintenance costs associated with the proposed determination including corrective/remedial measures, groundwater monitoring, and institutional/engineering controls during the Corrective Measures Implementation (CMI) period.

11.0 PUBLIC PARTICIPATION

Interested persons are invited to comment on VDEQ's proposed decision. The public comment period will last sixty (60) calendar days from the date the notice is published in a local newspaper. Comments may be submitted by mail, fax, e-mail, or phone to Ms. Laura Galli at the address listed below.

A public meeting will be held during the comment period with the date and location included in the public notice as published in a local newspaper. The Administrative Record contains all the information considered by VDEQ for its proposed remedy for the Facility. To receive a copy of the Administrative Record, contact Ms. Laura Galli at the address below:

Virginia Department of Environmental Quality
629 East Main Street
P.O. Box 1105
Richmond, VA 23218
Contact: Ms. Laura Galli
Phone: (804) 698 - 4218
Fax: (804) 698-4324
Email: laura.galli@deq.virginia.gov

N
W
E
S

SWMU-46
SWMU-2
SWMU-50
SWMU-51
SWMU-12
SWMU-64
SWMU-45
SWMU-61
SWMU-6
SWMU-49
SWMU-11
SWMU-10
SWMU-5
DEBRIS LANDFILL (SWMU 5)
SWMU-8
North / South Aeration Basins (SWMUs 8 and 9)
SWMU-9
SWMU-7
SWMU-14
SWMU-4
SWMU-3
LANDFILL AREA 1
LANDFILL AREA 2
LANDFILL AREA 3
LANDFILL AREA 4
East / West Cladfers (SWMUs 10 and 11)
Polishing Pond
95

SWMU Types

- Interim Measures
- No Further Action
- Pending Further Investigation

Base Map
Railroad
Highway
Surface Water
Plant Border
Site Structure

0 185 370 740 1,110 1,480
Feet

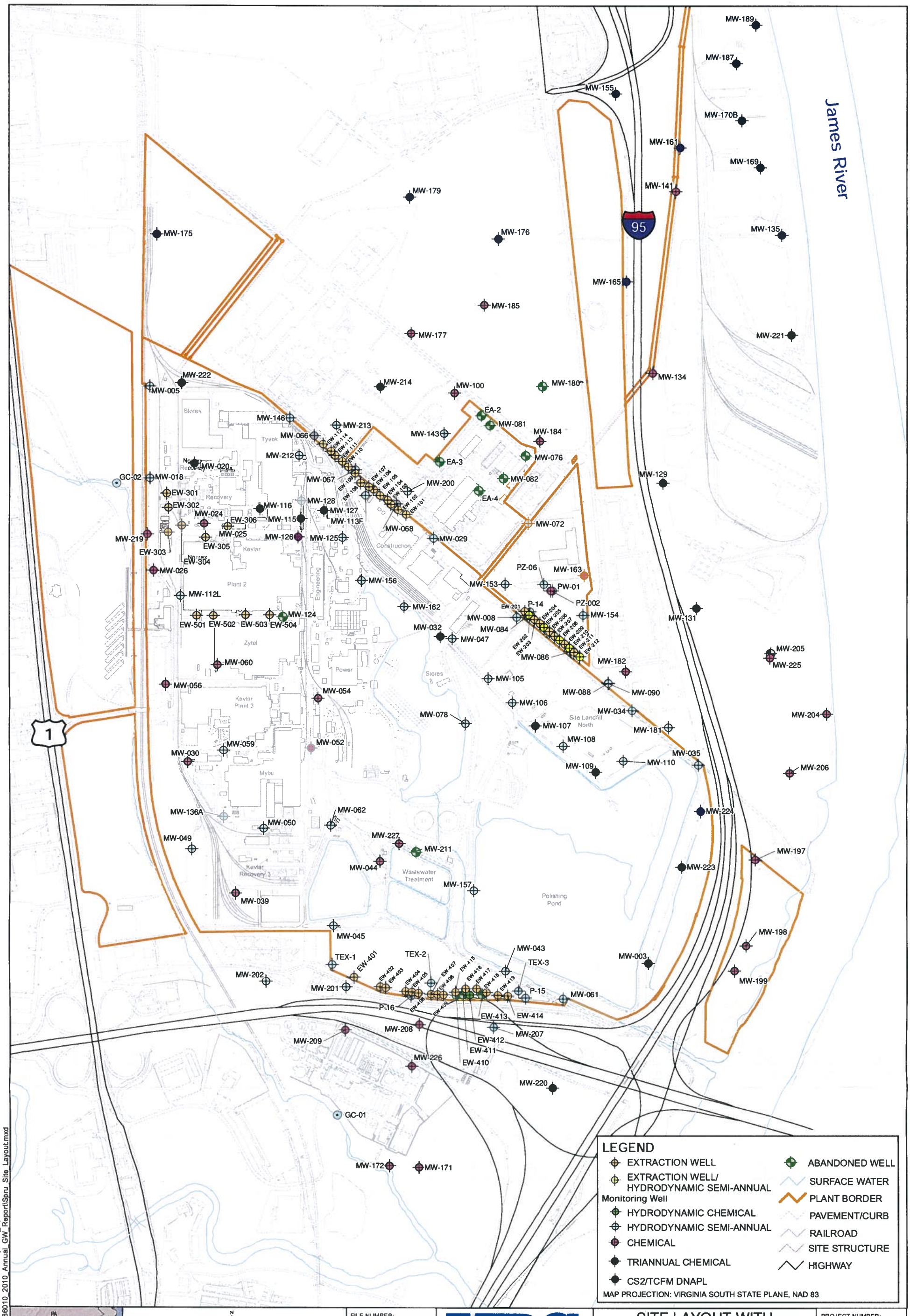
DUPONT

CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and URS Corporation - North Carolina
6324 Fairveiw Road
Charlotte, NC 28210

Title: SWMU Location Map
RFI CMS 2008 Report
DuPont Plant
Spruance, Virginia

Drawn:	Date:	DuPont Project Number:
C. Oneal	04/23/09	
Revision Number: 4	Figure Number: 3-1	URSD Project Number: 18985598

File Name: G:\Spruance\Gis\Project_figures\RFI_CMS_2008\Spru_SWMU.mxd



LEGEND

- EXTRACTION WELL
- EXTRACTION WELL/ HYDRODYNAMIC SEMI-ANNUAL
- Monitoring Well
- HYDRODYNAMIC CHEMICAL
- HYDRODYNAMIC SEMI-ANNUAL
- CHEMICAL
- TRIANNUAL CHEMICAL
- CS2/TCFM DNAPL
- ABANDONED WELL
- SURFACE WATER
- PLANT BORDER
- PAVEMENT/CURB
- RAILROAD
- SITE STRUCTURE
- HIGHWAY

MAP PROJECTION: VIRGINIA SOUTH STATE PLANE, NAD 83

N W E S

0 350 700 1,400

Feet

1:8,400

MAP FORMATED FOR "B" (11" X 17") SIZE SHEET.
SCALE NOT VALID FOR DIFFERENT PAGE SIZE.

FILE NUMBER:	
DESIGNED BY:	AB
DRAWN BY:	FND
DATA QUALITY CHECK BY:	MKL

URS

URS Corporation
Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713

SITE LAYOUT WITH MONITORING WELL LOCATIONS

2010 ANNUAL GROUNDWATER MONITORING REPORT
DUPONT SPRUANCE PLANT
RICHMOND, VIRGINIA

PROJECT NUMBER:	18985848
DATE:	01/24/2011
FIGURE NUMBER:	2

Printed: Monday, January 24, 2011 1:42:04 PM By: nick_dipaolo
U:\Spruance_GIS\Project\18986010_2010_Annual_GW_Report\Spru_Site_Layout.mxd