Celanese
ACETATE

Celco Plant
PO Box 1000
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Narrows, VA 24124
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JHJ 12.06

October 25, 2006

Mr. Denis M. Zielinski, Senior RPM
Waste & Chemicals Management Division
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Re: Description of Current Conditions Report
RCRA Facility Lead Program
Celco Plant, Narrows, Virginia

Dear Mr. Zielinski:

On behalf of the Celanese Acetate LLC Celco Plant ("Celco"), I am pleased to submit the attached Description of Current Conditions ("DOCC") Report and Community Relations Plan. Both submittals track the Facility Lead Program Strategy and Schedule that we submitted on May 4.

You will see that the DOCC Report contains a description of each SWMU and AOC, and specifically identifies corrective measures that have been implemented or are ongoing. As discussed on March 16, we included separate categories in Section 7.1 of the DOCC Report for SWMUs and AOCs that are:

(1) eligible for No Further Action status; and

(2) being addressed under state-led regulatory programs that are consistent with applicable RCRA rules and objectives.

We understand that with EPA's concurrence, those SWMUs and AOCs in the first category will not require further investigation or remedial action under the Facility Lead Program, and that those in the second will be monitored by EPA until such time as the state-led corrective action is complete and they are eligible for No Further Action status.

We would welcome your comments and questions on these submittals. Following your approval, we will begin working on the next milestones in our Strategy and Schedule.

We are pleased to be a part of EPA's Facility Lead Corrective Action Program, and we are committed to working toward the goals and expectations of the Facility Lead Agreement. Please feel free to contact me if you have any questions or need any additional information to complete your review.

Sincerely,

Jason H. Johns
EHS Section Leader
Celanese Acetate LLC
540.921.6405

cc: Leslie Romanchik – VDEQ

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DESCRIPTION OF CURRENT CONDITIONS (DOCC) REPORT

Celanese Acetate, LLC

Celco Site

Narrows, Virginia

October 2006

ARCADIS

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Description of Current Conditions (DOCC) Report

Celco Site
Narrows, Virginia

Prepared for:
Celanese Acetate, LLC

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Our Ref.:
MD000925.0003

Date:
October 2006

TABLES

FIGURES

APPENDICES

1. Introduction

1.1 Purpose

In January 2006, Celanese Acetate, LLC (Celanese) entered into a U.S. Environmental Protection Agency, Region III (USEPA), Facility Lead Agreement (Agreement) under the Resource Conservation and Recovery Act (RCRA) and agreed to conduct environmental investigations and perform remediation at the Celco Site (Figure 1-1), as necessary, to meet RCRA Corrective Action Goals.

In March 2006, a Draft Final RCRA Site Visit Report was prepared by USEPA and the U.S. Army Corps of Engineers, which consolidated relevant information from the USEPA site visit conducted in October 2005. In March 2006, Celanese met with USEPA to present an overview of activities completed at the Celco Site. In May 2006 Celanese submitted a Workplan to USEPA and Virginia Department of Environmental Quality (VDEQ) to address Corrective Action at the facility, which included the preparation of a Description of Current Conditions (DOCC) Report to consolidate and present existing information.

1.2 Report Organization

This DOCC Report is divided into the following sections:

- Section 1 – *Introduction* discusses the approach and framework for this report and presents a summary of the historical environmental investigations performed at the Celco Site;

- Section 2 - *Facility Background* discusses general property information, hydrogeology, operational and manufacturing history, and regulatory history;

- Section 3 – *Solid Waste Management Units (SWMUs)/Areas of Concern (AOCs) Status* identifies and discusses the current status of the SWMUs and AOCs ;

- Section 4 – *Nature and Extent of Contamination* discusses the site monitoring well network, groundwater quality and major areas of known or suspected contamination;

- Section 5 – *Groundwater Modeling* presents, analyzes and draws conclusions regarding existing and predicted future groundwater flow and constituent transport;

- Section 6 – *Risk Analysis* presents, analyzes and draws conclusions regarding the potential human health and environmental risks posed by constituents detected at the site;

- Section 7 – *Conclusions and Recommendations* presents a summary of the findings and recommendations for future action at the site;

- Section 8 - *References* provides references for this document.

1.3 File Review

Celanese retains "Environmental Files" at a central location at the Celco Site. A review of these files was performed in June 2006 for the purpose of collecting information regarding environmental issues and to identify potential SWMUs and AOCs. The results of this review have been incorporated into this DOCC Report.

Celco Site Environmental Files contain reports of documented spills and leaks, corrective action taken, and correspondence with regulators about these incidences. These files were reviewed in preparation of this report. Overall, the majority of the documented incidences were isolated, minimal environmental impact was reported, and correction actions were completed and adjustments to operational practices were implemented to resolve the problem(s). The review of the documented spills and leaks did not lead to the development of additional SWMUs or AOCs specific to these incidences.

The 10 March 2006 USEPA Draft Final RCRA Site Visit Report identified several follow-up action items to be addressed by Celanese in the DOCC Report. Each of the action items required Celanese to provide additional information. The actions taken and the findings regarding each of the action items are summarized below:

- Celanese to submit additional information on SWMU #4 Pond B Closure Status:
    - The status of the closure of Pond B is discussed in Section 3.11.

- Celanese to submit additional information on Fly Ash Ponds #1 through #4 post closure status:
    - The status of Fly Ash Ponds #1 through #4 is discussed in Sections 3.13 through 3.17.

- Celanese to submit additional information on the Building 2 historical Polychlorinated Biphenyls (PCB) spill:
  - Available information regarding the Building 2 historical PCB spill is presented in Section 2.6.2.3.

- Celanese to submit additional information on the Form 2F VI 1998 Significant Spills within last 3 years:
  - Form 2F, Part VI referenced above is a form provided by Celanese with their past Virginia Pollutant Discharge Elimination System (VPDES) Permit Application(s). Form 2F, Part VI itemizes spills within the last 3 years and was last updated in 2002. Form 2F, Part VI is updated during each permit renewal process which is typically every five years. The information provided in Form 2F, Part VI includes a summary of significant spills occurring within the last three years and the information presented in the form is extracted from the Celanese environmental files. The Celanese environmental files include a written record of significant spills that have occurred, and the remedial actions taken in response to the spills including reporting to the appropriate regulatory authorities. The available information related to spills/releases was reviewed in preparation of this DOCC Report and in response to this action item. The files reviewed indicate that the majority of the documented spills were isolated, minimal environmental impact was reported, and corrective actions were completed and adjustments to operational practices were implemented to resolve the problem(s). The review of these documented spills and leaks did not lead to the development of additional SWMUs or AOCs specific to the spills reported in Form 2F, Part VI.

- Celanese to submit additional information regarding AOC#1 – February 1991 Benzene Release:
  - Available information regarding the February 1991 Benzene release is presented in Section 3.27.

- Celanese to submit additional information on the 12 June 1989 Methyl Ethyl Ketone (MEK) discharge to Outfall 001:
  - The 12 June 1989 incident report was reviewed and the following summary is offered. On 12 June 1989, approximately 750 gallons of MEK were discharged via Outfall 001. The source of the spill was the main stills cooling water discharge. Each of the stills utilized two condensers in the process. Testing revealed leaking tubes in one condenser of the first still and both condensers on the second still. The leaking tubes were repaired, the condensers were air tested, and the stills were returned to service.

- Celanese to submit additional information on the 8 May 1985 spill of ethyl acetate Outfall 001:
    - The 8 May 1985 incident report was reviewed and the following summary is offered. On 8 May 1985, approximately 1,200 gallons of ethyl acetate spilled while off-loading the chemical from a train car to a storage tank. During the filling of an underground storage tank from a rail car by gravity feed, and the subsequent pumping of the solvent from the tank to another underground tank, automatic shutoffs failed and the spill washed through Outfall 001. Procedures that resulted in the spill were modified to prevent future spills.

1.4 Historical Environmental Investigations

Since 1968, there have been numerous environmental investigations/projects performed at the Celco Site. These projects have been performed to investigate specific problem areas (e.g., benzene area release), for routine monitoring purposes (e.g., production well water quality) and/or more recently for site-wide characterization. Some activities were conducted for remediation purposes, such as the investigation and subsequent automated collection of petroleum product from the subsurface at the aboveground tank farm. As part of their overall facility environmental management strategy, most of the projects have been performed proactively by Celanese without regulatory participation or oversight. Some of the environmental activities have been performed under permit and/or in conjunction with regulatory oversight such as the Underground Storage Tanks (UST) closure, aeration/equalization basin RCRA closure and the ongoing Permit 207 landfill groundwater monitoring program.

In 1996, the Celco Site was assessed and ranked by the VDEQ and the USEPA Region III for the RCRA National Corrective Action Prioritization System (NCAPS). An NCAPS ranking was completed in 1996, which listed a total of 39 SWMUs. The NCAPS report concluded that there was the potential for release to groundwater associated with the Equalization /Aeration Basins at the wastewater treatment plant and from the Landfill Cells associated with Celco Landfill Permit No. 207. In light of the finalization of the NCAPS ranking and since Celanese had performed numerous environmental evaluations and corrective actions at the facility, Celanese proactively implemented a program to perform a comprehensive environmental evaluation covering the Plant Area and the Landfill Area.

In 1997, Celanese initiated a Site-Wide Groundwater Assessment to evaluate existing historical groundwater quality data, to collect additional data necessary to address data gaps, and to prioritize environmental issues at the site based on potential human health and environmental risk. An Internal Draft Report was issued in May 1999 that focused on several major areas of the facility; the Internal Draft Report was not finalized. In 2003, Celanese performed a subsequent site-wide groundwater sampling event and utilized the results to update the 1999 Internal Draft Site-Wide Assessment Report. In February 2005, an updated Site-Wide Groundwater Assessment Report was completed. Celanese utilized the results of this report to focus their continuing efforts to fully understand site conditions and to perform additional investigations and/or remedial activities where warranted.

As part of their overall facility environmental management strategy, Celanese has proactively pursued the characterization and remediation of the facility conditions with respect to groundwater which is protective of human health and the environment. This management strategy has the objective of evaluating impacts to the two major receptors at the facility; the onsite production wells and the adjacent New River. The onsite production wells serve as a containment field to significantly limit the migration of constituents within groundwater to the adjacent New River.

The risk management approach considers the entire facility or subsections of the facility as potential source areas. Risks to human health or the environment will occur only if receptors are exposed to contaminants above established action levels or risk-based concentrations. By taking a global approach (outside-in), Celanese has determined the constituent loading to the river and the representative risk posed by these conditions.

Using this Site-Wide Assessment approach, a site characterization has been completed from a global perspective which has determined:

1) the nature and extent of contamination,

2) the risk posed by constituents of concern to human health and the environment under the current production well containment strategy, and

3) quantitatively evaluated the risk posed by constituents of concern to human health and environment if the production wells were turned off (i.e., loss of hydraulic containment strategy).

The environmental projects performed at the Celco Site have included, but are not necessarily limited to, the following: chemical sewer upgrades, stormwater management improvements, basin closure, use of new technologies (e.g., Biohoch tanks, ketene processing), installation of groundwater monitoring wells, the collection of environmental samples from groundwater, surface water, soil and air, the measurement of groundwater and surface-water elevations across the site, fate and transport modeling, risk analysis, free-product collection, and bioremediation.

The following list of activities and/or reports representing environmental projects that have been completed by Celanese for the Celco Site were utilized in developing this DOCC Report:

- **1962** – Waste Control Status and Recommendations, Prepared by Roy F. Weston, Inc.
- **1968** – Thermal Groundwater Plume Investigation, Performed by Celanese personnel, no published report
- **1981** – Hydrogeologic Study, Prepared by Soil and Material Engineers
- **Jan. 87** – Landfill Operating and Closure Plan, Prepared by Anderson Associates
- **Jan. 90** – Fuel Oil Tank Area, Phase I Investigation, Prepared by Westinghouse
- **Feb. 90** – Industrial Waste Landfill, Part A Permit Application, Prepared by Anderson and Associates
- **Apr. 90** – Closed Process Sludge Landfill Area, Final Remedial Investigation Report, Volumes I and II, Prepared by Westinghouse
- **Phase I** – Installed LB1 – LB9, Wells B46 – B53, and coreholes HCNB1 – HCNB6
- **Phase II** – Installed LB10 – LB11, B54 – B57, and coreholes HCNB7 – HCNB9
- **Apr. 90** – Geology and Hydrogeology In and Around the Celco Landfill Facility Proposed Landfill Sites, Prepared by Westinghouse
- **Jul. 90** – Fuel Oil Tank Area, Site Characterization, Prepared by Westinghouse
- **Sep. 90** – Fuel Oil Tank Area, Corrective Action Plan, Prepared by Westinghouse
- **Jan. 91** – Hydrogeologic and Geotechnical Investigation, Landfill Relocation Site, Prepared by Westinghouse

- **Jun. 91** – Environmental Planning, Prepared by CH2M Hill
- **Sep. 91** – Aeration and Equalization Basin Part B Permit Application, Prepared by CH2M Hill
- **Jun. 92** – Leaking USTs, Site Characterization Report, Prepared by Westinghouse
- **Sep. 92** – Inventory, Assessment and Recommendations Concerning the Groundwater Program, Technical Memorandum No. 1, Prepared by SEC Donohue
- **Sep. 92** – Sampling and Analysis Plan, Technical Memorandum No. 2, Prepared by SEC Donohue
- **Sep. 92** – Truck Scales UST, Site Characterization Report, Prepared by SEC Donohue
- **Jan. 93** – Site Wide Sampling Event, Performed by RUST E&I to provide a broad database of groundwater chemical information for both the Landfill and Plant Areas.
- **Jan. 93** – UST Closure Investigation in Tank Farm Area, RUST E&I investigation revealed benzene in groundwater and soil in the Tank Farm Area.
- **May. 93 –** Tank Farm Hydrogeologic Assessment, Performed by RUST E&I
- **Jul. 93** – Phase I Site Wide Groundwater Assessment Report, Prepared by RUST E&I
- **Sep. 93** – Groundwater Program Implementation, Prepared by RUST E&I
- **Apr. 94** – Phase II Environmental Assessment, Prepared by ARCADIS
- **Oct. 95** – Assessment and Environmental Management Strategy for the Closed Benzene Underground Storage Tank Site, Prepared by ARCADIS
- **Oct. 96** – Equalization and Aeration Basin Closure, Environmental Sampling Report, Prepared by ARCADIS
- **Aug. 97** – Former Equalization and Aeration Basins, Closure and Post-Closure Plan, Prepared by ARCADIS

- **Jul. 00** – Summary of 1995-1999 Methane and Thermal Data, Prepared by ARCADIS
- **Jul. 00** – Summary of Remediation/Monitoring Data, Former Benzene UST Site, Prepared by ARCADIS
- **Dec. 00** – Statistical Evaluation of 1999/2000 Phase II Groundwater Quality Data, Permit 207 Landfill, Prepared by ARCADIS
- **Jan. 01** – Ammonia Discharge Remedial Evaluation, Stormwater Outfall 005, Prepared by ARCADIS
- **Mar. 01** – Summary of 2000 Remediation/Monitoring Data, Former Benzene UST Site, Prepared by ARCADIS
- **Mar. 01** – Thermal Plume Investigation Report, Prepared by ARCADIS
- **Mar. 01** – Geotechnical and Structural Integrity Analysis, Closed Process Sludge Landfill, Prepared by ARCADIS
- **Aug. 01** – Closure Plan for Lagoons 1, 2 and 4, Prepared by Draper Aden Associates
- **Oct. 01** – Area D Investigation, Celanese Industrial Landfill, Prepared by ARCADIS
- **Dec 01** – Potable Water Supply Risk Assessment, Prepared by ARCADIS
- **Jan. 02** – Statistical Evaluation of 2000/2001 Phase II Groundwater Quality Data, Permit 207 Landfill, Prepared by ARCADIS
- **Mar. 02** – Environmental Investigation/Remedial Alternative Analysis Report, Volumes 1 and 2, Closed Process Sludge Landfill, Prepared by ARCADIS
- **Apr. 02** – Summary of 2001 Remediation/Monitoring Data, Former Benzene UST Site, Prepared by ARCADIS
- **Sep. 02** – Stormwater Pipe 005, Video Inspection, Prepared by ARCADIS

- **Jan. 03** – Letter to VDEQ Proposing Groundwater Protection Standards/Alternate Concentration Limits, Prepared by ARCADIS/Celanese
- **Jan. 03** – Groundwater Sampling and Analysis Plan, Permit 207 Landfill, Prepared by ARCADIS
- **Feb. 03** – Summary of 2002 Groundwater Data, Permit 207 Landfill, Prepared by ARCADIS
- **May 03** – Baseline Environmental Due Diligence Report, Celanese Acetate LLC and Cinergy Solutions of Narrows LLC, Celco Plant, Prepared by ARCADIS
- **Sep. 03** – Proposed Remedial Plan, Amendment No. 1 – Environmental Investigation/Remedial Alternatives Assessment, Closed Process Sludge Landfill, Prepared by ARCADIS
- **Sep. 03** – Closure Plan – Pond B, Prepared by ARCADIS
- **Oct. 03** – Summary of 2002 Remediation/Monitoring Data, Former Benzene UST Site, Prepared by ARCADIS
- **Feb 04** – Summary of 2003 Groundwater Data, Permit 207 Landfill, Prepared by ARCADIS
- **May 04** – Summary of 2003 Benzene Monitoring Data, Prepared by ARCADIS
- **Feb 05** – Phase III Investigation Report – CPSL, Prepared by ARCADIS
- **Feb 05** – Summary of 2004 Groundwater Data, Permit 207 Landfill, Prepared by ARCADIS
- **May 05** – Permit 207 Corrective Action Plan – CPSL, Prepared by ARCADIS
- **May 05** – Permit 207 Corrective Action Monitoring Plan – CPSL, Prepared by ARCADIS
- **May 05** – Summary of Site-Wide Assessment – Celco, Prepared by ARCADIS

- **Mar 06 –** Fly Ash Ponds Groundwater Assessment and Monitoring Report (Year 1), Prepared by ARCADIS

- **May 06 –** USEPA RCRA Facility Lead Strategy Workplan, Prepared by ARCADIS

2. Facility Background

2.1 Site Description, Property Boundaries, and Land-Use

The Celco Site, located in southwestern Virginia, is less than three miles east of the town of Narrows in Giles County. This area lies within the Cumberland Mountains of the Valley and Ridge physiographic province. The Celco Site is bounded by the New River to the south and east and a local mountain known as Hemlock Ridge to the north. The plant entrance is near the intersection of the Route 460 and the New River.

The plant has manufactured cellulose acetate (CA) flake and fiber since December 1939 and employs approximately 700 people. The total Celco Site encompasses approximately 1332 acres, divided into two major areas (the Plant Area and Landfill Area), which are separated by Route 460. Collectively, the Plant Area and the Landfill Area are referred to as the "Celco Site" in this report.

The plant buildings are typically either administrative, process-contained, or warehouses. The Plant Area contains a wastewater treatment plant (WWTP), aboveground storage tanks (ASTs) for chemicals and/or fuel oils. Some tanks are located in a raised terraced Tank Farm. Several sedimentation ponds for settling fly ash generated from coal burners are located in the northwestern portion of the Plant Area. An internal road system connects the different portions of the Plant Area. A rail system borders the plant to the south for bulk transportation purposes. The Plant Area is shown in Figure 2-1.

Celanese Acetate LLC (Celanese) owns and operates the Celco Site, except for certain utilities infrastructure, which are owned and managed by Duke Energy Generation Systems of Narrows LLC (DEGS). DEGS was formerly Cinergy Solutions of Narrows, LLC. DEGS supplies the energy needs to the Celco Site from those utilities. Previously all utilities inside the Celco Site were directly owned, operated and managed by Celanese until 2003 when DEGS took over. DEGS's offices and management personnel associated with utilities are located inside the physical layout of the Celco Site itself.

North of Route 460, the Celco property is located on a mountainside of Hemlock Ridge. This area is referred to as the "Landfill Area" because it is used for landfilling of non-hazardous industrial waste in permitted landfills. The Appalachian Trail traverses through wooded areas between Route 460 and the landfills. The Landfill Area is shown in Figure 2-2.

2.2 Topography

In the Plant Area which is adjacent to the New River, the topography is relatively flat as it is located on a New River terrace. The surrounding area on both sides of the New River is characterized by mountains with significant relief. The ground surface of the Plant Area is relatively level with surface elevations ranging from approximately 1580 to 1600 feet above mean sea level (ft msl).

The Landfill Area is located northeast of Route 460 on a mountainside overlooking the New River. Topographic relief in the Landfill Area increases steeply on the northeast side of Route 460 from 1600 ft msl to approximately 2600 ft msl along Hemlock Ridge.

2.3 Geology

The geologic information presented in this report is based upon interpretations developed from United States Geological Survey (USGS) and Virginia Division of Mineral Resources published literature, from Celanese-archives of historical environmental reports, and from numerous studies performed by ARCADIS on behalf of Celanese. The sources for this information are provided in Section 8 (References).

2.3.1 Regional Geology

Giles County lies within the southern Appalachian segment of the Valley and Ridge province. The geologic structure of this region includes long linear asymmetric folded rocks and major southeast dipping thrust faults, which are both complex and difficult to interpret. Major structural features in the area trend approximately North 65° East, including the major thrust faults referred to as the Pulaski, the Saltville, the Narrows, and the St. Clair. Each of the major regional thrust faults and folds have been deformed locally by numerous minor structures.

In Giles County, the New River follows a northeastward course, along strike, and then turns northwestward, past the Celco Site, and cuts across the grain of the Valley and Ridge province approaching the more gently deformed Allegheny Plateau province. The boundary between the Valley and Ridge province and the Allegheny Plateau province is known as the Allegheny Front.

Strata in Giles County form a relatively continuous succession of carbonate platform and clastic basinal deposits from the Lower Cambrian to the Upper Mississippian Systems, creating a composite thickness of about 15,000 ft. Overlying the various carbonate and clastic rock units in many places, particularly along the New River and its tributaries, are Quaternary unconsolidated deposits. Surface structures are well known from outcrops and mapping; however, structures at depth are more problematic and are subject to multiple interpretations.

Karst features, including sinkholes, caves and sinking or underground drainage, are common along the floors of valleys underlain by Cambrian-Ordovician limestone. Collapse of such features can occur, particularly where the water table has been lowered.

The Giles County area is of special interest, because the epicenter of the largest earthquake recorded in Virginia, which occurred in 1897, was near the town of Pearisburg (Campbell 1898; Hopper and Bollinger 1971, p. 54-66). Recent work has identified a seismogenic zone within Giles County that may be associated with that event (Bollinger and Wheeler 1980; 1983; Bollinger 1981). Minor earthquakes have persisted in Giles County. Although their origin is not well understood, they appear to originate at great depth in basement rocks (McDowell and Schultz 1989).

2.3.2 Local Geology of the Plant Area

The subsurface in the vicinity of the Plant Area is composed of seven distinct Paleozoic Era clastic rock units and an eighth Paleozoic Era rock unit, consisting of the Knox Group Dolomite. Surface deposits along the New River and its tributaries are composed of Quaternary unconsolidated deposits. The major stratigraphic groups, formations, and members within the area are illustrated on Figure 2-3. The relatively flat Plant Area is underlain by dolomite bedrock. As one moves north from the Plant Area toward the Landfill Area, the topography becomes steep and the bedrock geology changes from dolomite bedrock (which is intercepted by thrust faults) to folded, overturned, and faulted clastic units.

Overlying the various Paleozoic Era units in many places, particularly along the New River and its tributaries, are four types of Quaternary deposits including colluvium, fan deposits, alluvium, and terrace deposits. Colluvial deposits represent valley wall debris, which has been transported downslope by gravity slides or slump and are found at the base of relatively steep topographic relief. At the Celco Site, colluvial deposits occupy a small percentage of the area and are restricted to a few small areas to the northeast of the landfill and a larger band oriented northeast/southwest located farther up the hillside toward Hemlock Ridge. Fan deposits consist of gravels, sands, silts, and clays, which extend to a depth of less than 200 ft. Alluvial fan deposits are found just to the north of the Plant Area and the deposits continue upward following the relatively small surface channels up the hillside. Terrace deposits occupy areas immediately adjacent to the New River and represent materials deposited by the New River. The terrace deposits consist of gravels, sands, silts and clays and are similar to the alluvial deposits, although they were deposited at a topographically higher position.

The site geology is described in more detail in the following sections. The site geology is also illustrated on five hydrogeologic cross-sections that are presented as Figures 2-4 and 2-5.

2.3.2.1 Site Soils

The surface soils across the Celco Site vary and their properties are dependent primarily on the parent material from which they were formed. A mantle of residual soils up to 70 ft thick overlies the Knox Dolomite parent material areas. The residuum is formed from in-situ weathering of the original dolomitic rocks and is composed of brown, red-brown and yellow, stiff to hard, silts and clays. Relict bedding laminae and occasional thin layers of cherty gravel (in a clay matrix) are also present. At depths between 30 and 70 ft, the residuum becomes very hard, and the materials encountered are gray to tan, crumbly clay with silt to gravel-sized rock fragments. This material represents a transitional zone to the dolomite and indicates proximity of the bedrock surface (Westinghouse 1991). Colluvial soils consist of brown, red, and maroon, stiff to very hard, gravel-sized fragments of chert, dolomite and sandstone embedded in a silt and clay matrix. Residual soils formed over the clastic rock units consist of sands, silts, and clays and vary depending on the location and nature of the parent material. Residual soils formed from the Quaternary deposits consist of a mixture of gravels, sand, silts and clays. The proportion of each of these components varies and is dependent on the location and nature of the parent material.

2.3.2.2 Landfill Area Geology

Much of the hillside to the north of the Plant Area is underlain by folded clastic units including sandstones, siltstones, and shales. The clastic rock units form an overturned syncline trending northeast-southwest, where the southern limb of this fold makes up Hemlock Ridge. The clastic rock units are found in the subsurface from Hemlock Ridge to the south where they intersect with a northeast-southwest trending thrust fault referred to as the Narrows Fault. The northwestern part of Giles County is traversed by the Narrows Fault. The fault is exposed in a railroad cut along the New River, north of the town of Narrows. The Narrows Fault divides the clastic rocks to the north of the fault and dolomite limestone to the south of the fault.

Several branches of the Narrows Fault cross the Landfill Area, striking northeast-southwest. The reported strike is based on true north as opposed to plant north. The Narrows Fault reportedly has a southeast dip angle that ranges from 24° to 39° degrees with an average dip of 30.5° (Westinghouse 1991). Another fault branch is located approximately 500 to 700 ft to the southeast of the Narrows fault and runs roughly parallel to the strike of the Narrows Fault. The southern fault branch is reasonably expected to have a similar dip. This branch rejoins the Narrows Fault in the eastern portion of the site.

2.3.2.2.1 Narrows Fault Zone

The Narrows Fault Zone consists of a narrow region of highly broken, angular, and abraded (brecciated) rock fragments formed through the sliding movement of the opposing thrust blocks past one another. The northern fault branch forms a contact between the Knox Dolomite and various clastic units to the northwest, whereas the southern branch occurs entirely within the Knox Dolomite. The thickness of the fault zone of the northern Narrows Fault has been found to exceed 100 feet in width at a rock coring location in the vicinity of LF-56. The fault zone of the southern Narrows Fault was observed to be only a few feet thick, although the actual thickness is expected to be greater (Westinghouse 1991). Fault breccia consists of ½-inch to 3-inch angular, abraded clasts of chert and dolomite, which is distinguishable from other chert nodules and fragments weathered out of the Knox Dolomite. The brecciated fragments are contained in a red-orange clay matrix, which is different than the gray mottled clay produced by in-situ weathering of the dolomite.

2.3.2.3 Plant Area Geology

The geology of the Plant Area consists of fractured and karstified Knox Dolomite overlain by residual sediments and river terrace deposits. Some portions of the Plant Area are composed of fill materials. The surface deposits represent poorly-sorted deposits of cobbles, sands, silts, and clays. The unconsolidated material can be generally grouped into two categories: 1) sediments formed in-situ through the weathering of the underlying bedrock, and 2) river terrace deposits transported by the New River from upstream locations. The river terrace deposits extend from the New River up into the facility and thin with distance from the river.

Overlying the terrace deposits, numerous areas of the facility are covered with a veneer of reworked sand and silt materials utilized in historical regrading efforts at the facility. Recognizing distinctions between the residual soils and alluvial deposits in boring log descriptions from within the Plant Area is difficult. The thickness of the residual soils and alluvial deposits ranges from approximately 15 feet adjacent to the New River to approximately 85 feet located inward from the river, as indicated by bedrock surface elevations from borings logs for wells throughout the Plant Area. Plant Area monitoring wells installed in these units are referred to as "Quaternary" in the figures.

The Knox Dolomite is composed of a thick sequence of dolomite, much of it cherty, with minor amounts of sparsely fossiliferous limestone and sandstone (McDowell and Schultz 1990). The Knox Dolomite is characterized as a light- to medium-gray and fine- to medium-grained dolomite (McDowell and Schultz 1990). Chert is common in the Knox and occurs either as irregular beds in the dolomite or as concentrically banded white, gray or black nodules (McDowell and Schultz 1990).

The Knox Dolomite underlying the Plant Area is encountered between approximately 15 and 85 feet below land surface. Within the vicinity of Tank Farm, the Knox Dolomite is located approximately 40 to 45 ft below land surface (ft bls). Based on the evaluation of bedrock surface elevation, no significant slope to bedrock has been defined in this area. During drilling operations, significant fracture zones and voids were encountered, however, the pattern varies significantly between each hole location.

The Knox Dolomite is extremely weathered and fractured, and the bedrock surface is very irregular. Within the dolomite, bedrock fracturing extends to at least 275 ft, as described by the plant production well boring logs (e.g., PW-8). In addition, cavities and voids are present in the dolomite formed by groundwater dissolving the soluble calcium carbonate minerals along existing fractures. Some of the observed cavities are empty, while some appear to be filled with clay material. The irregularity of the bedrock surface and the presence of cavities are characteristic of carbonate bedrock terrain. This type of weathering is commonly referred to as "cutter and pinnacle" weathering. Cutters form due to solutional enlargement of fractures. Adjacent to cutters are pinnacles of more resistant, less fractured bedrock. Isolated sections of bedrock, or "floating boulders", are also a common feature.

2.4 Surface Hydrology

The New River forms the southern and eastern boundary of the Celco Site. The river is used for recreational purposes as well as industrial water supply. There are no known drinking water supply intakes from the New River within a three-mile radius of the facility. Celanese utilizes a river pump house for cooling water in the cellulose acetate manufacturing process. A typical withdrawal rate from the New River is 57 million gallons per day (MGD). The New River in the vicinity of the Celco Site has an average flow rate of 6000 cubic feet per second (3877.63 MGD) (U.S. Army Corps of Engineers [USACE 2006]) indicating it is a quick-moving river. Celanese discharges an average of 70.3 MGD from five outfalls to the New River (Figure 2-1) authorized under a Virginia Pollutant Discharge Elimination System Permit.

The 100-year floodplain is situated at an elevation of 1,564 ft msl, while the 25-year floodplain is situated at 1,555 ft msl according to USACE. The top of the equalization basin located on the south side of the Plant Area along the New River is at an elevation of approximately 1,555 ft msl, therefore, portions of the Plant Area lie within the 25- and 100-year floodplain.

There are two channels that carry water perennially (Figure 2-6); one channel originates as groundwater discharge on the mountain side above the Closed Process Sludge Landfill (CPSL). This perennial flow eventually infiltrates and dries up approximately 1000-feet downgradient of the Closed Process Sludge Landfill. The second channel originates offsite and upgradient of the Plant Area and is known as Stillhouse Branch. This stream channel flows west along the northside of Fly Ash Ponds 2, A, B, and C and then turns south and discharges to the New River.

2.5 Hydrogeology

The hydrogeologic information presented in this report is based upon interpretations developed from USGS and Virginia Division of Mineral Resources published literature, from Celanese-archives of historical environmental reports, and from numerous studies performed by ARCADIS on behalf of Celanese. The sources for this information are provided in Section 8 (References).

2.5.1 Regional Groundwater Flow

Groundwater flow regimes in northwestern Giles County are controlled primarily by the geologic structures, by local stratigraphic features such as bedding planes, and by the

New River which serves as a regional discharge boundary. Saturated conditions occur locally within the river terrace deposits located along the New River valley floor. Saturated conditions within the underlying Cambrian System carbonate rocks vary with depth based on the maturity of karst features within a particular section of the rock.

2.5.2 Regional and Local Groundwater Use

Within Giles County, the Celanese represents one of the largest users of groundwater resources for manufacturing, utilizing several production wells installed in the Knox Dolomite to depths up to 400 ft. Groundwater is also utilized as a source of potable water for the Celco Site and by nearby communities. The town of Narrows located to the southwest of the facility (approximately 3 miles) has two potable wells supplying drinking water to approximately 3,000 people. The town of Pearisburg is located approximately two miles to the southeast of the facility. Pearisburg, in conjunction with Bluff City, operates a total of four potable wells. In 1999, a new potable supply well was installed by Pearisburg across the New River from the facility. All of these major supply wells are within the Knox Group aquifer consisting of highly-productive Middle Ordovician limestone and dolomite. Supply wells extend to a minimum depth of 300 ft below land surface. Several privately owned domestic wells are located along Route 641 which traverses around the perimeter of the Landfill Area. These off-site potable wells are shown in Figure 2-7.

Until 1997, Celanese operated six on-site production wells. In 1997, the facility permit was modified to remove one of the wells (i.e., PW-10) from the list. The on-site wells used for plant manufacturing and/or potable supply currently include PW7, PW-8, PW9, PW11, and PW12 (Figure 2-6). Currently Well PW-7 is permitted for Potable Use and Well PW-9 is permitted as a back-up for Potable Use. In 2005, the cumulative total average pumping rate was approximately 2600 gallons per minute (gpm) as shown in the Table 2-1.

Celanese historically has operated three of its production wells for potable supply. In accordance with the Giles County Health Department requirements, water samples from each of these wells have been collected on a routine basis for a range of indicator and chemical-specific parameters. Chlorinated organics including tetrachloroethene (PCE), trichloroethene (TCE), carbon tetrachloride, 1,1-dichloroethane (11-DCA), 1,1-dichloroethene (11-DCE), and chloroethane have been detected in the production wells used for potable supply since the early 1990s. The facility water well permit was subsequently modified to eliminate the use of one of the production wells for potable use, and only Wells 7 and 9 are currently permitted for use. Chlorinated organics continue to be detected in these wells and water quality reports are required to be submitted to the Giles County Health Department. Production wells 7, 8, 9, 11 and 12 were transferred to DEGS on 30 June 2003, which now owns and operates these wells. Production wells are shown on Figures 2-6 and 2-7.

2.5.3 Site-Wide Groundwater Flow

Groundwater flow across the facility is controlled by geologic structures, by stratigraphic features such as bedding planes and solution cavities, and by the New River, which serves as the local and regional discharge boundary. In addition, groundwater flow across the facility is controlled in the vicinity of the Plant Area by relatively high pumping rates from plant production wells. During 2005, groundwater was withdrawn from five production wells at a cumulative rate of approximately 2600 gpm.

Groundwater elevations were measured in select site monitoring wells during 1994, 1997, 1998, 2003, and 2006 (Appendix A). Well specifications are shown in Appendix B. Groundwater elevations were plotted for the 04 June 2003 period, which was the last site-wide water-level survey and inferred groundwater contour elevations are presented on Figure 2-6. Inferred groundwater contour elevations indicate that the direction of groundwater flow in the vicinity of the Landfill Area is south/southeast toward the New River and the Plant Area. The inferred groundwater contours are relatively steep to the north of the southernmost Narrows Fault Branch and then flatten out to the south of the southernmost Narrows Fault Branch. There is a relatively large cone of depression that covers much of the Plant Area resulting from groundwater withdrawal from the production wells. Groundwater within the cone of depression and many areas outside of the cone of depression are ultimately captured by the production wells. Previous groundwater elevation data (October 1997) indicated that groundwater was mounding as a result of leakage in the vicinity of Fly Ash Ponds 1, 2 and 4. Since Fly Ash Pond 1 was closed and replaced with lined Fly Ash Ponds A, B and C in the early 2000s, groundwater mounding has been less pronounced.

Each of these groundwater elevation contour features is described in detail in the following discussion.

2.5.4 Local Groundwater Flow

2.5.4.1 Landfill Area Groundwater Flow

Groundwater monitoring wells in the area to the north of the northernmost Narrows Fault Branch are screened in the clastic rock zone. The hydrology of the clastic zone is composed of numerous water-bearing zones, which are either partially or completely isolated from one another. The Millboro Shale reportedly contains at least one, and probably more, water-bearing zones. Another major water-bearing unit in the clastic zone is the Rocky Gap Sandstone. This sandstone can be a productive aquifer due to its porous and weathered nature. Because the primary porosity of much of the clastic zone is low and groundwater flow is primarily by secondary porosity (i.e., fracture zones), the overall hydraulic conductivity of the clastic zone is relatively low. The relatively low hydraulic conductivity of the clastic zone is expressed in the steep inferred groundwater elevation contours presented on Figure 2-6.

Groundwater to the south of the northernmost Narrows Fault is either located in the clastic zone or slightly weathered Knox Dolomite, depending on the depth. Saturated conditions within the Knox Dolomite vary with depth based on the maturity of karst features within a particular section of rock. This hydrogeologic area has a somewhat higher hydraulic conductivity than the clastic zone to the north, but does not have as high a hydraulic conductivity as the more highly weathered dolomite that is located to the south and beneath much of the Plant Area along the New River valley floor. As a result, as the south/southeast flowing groundwater approaches the more highly weathered Knox Dolomite, the groundwater elevation contours flatten out as a result of the higher hydraulic conductivity.

2.5.4.1.1 New River Valley Floor Groundwater Flow

It has been postulated and further suggested by "old-timers" at the Celco Site, that an "underground river" exists and flows beneath much of the Plant Area. Given the physical setting and geology, it is possible that the Knox Dolomite has been highly weathered in this area and the resultant solution channels/cavities are highly connected and support a significant underground flow system. This hypothesis is supported by the fact that the New River valley floor throughout Giles County is composed of, and controlled by, highly weathered carbonaceous rock formations. Figure 2-6 illustrates that the New River bends to the south and then west, to flow around the Plant Area. The Plant Area is located within the New River valley floor and is situated on New River terrace deposits underlain by Knox Dolomite. It is therefore possible that in the geologic past, the Knox Dolomite beneath the Plant Area, which prevents the New River from flowing in a linear fashion, has became highly weathered and supports a significant underground flow in the direction of the force of the New River (i.e., through the Plant Area). The 04 June 2003 groundwater elevation contour map also supports this hypothesis (Figure 2-6). The dividing line between relatively steep groundwater contours (i.e., area of lower hydraulic conductivity) and relatively flat groundwater contours (i.e., area of higher hydraulic conductivity) creates a straight line through the Plant Area that connects the New River at points that lie to the north of the Plant Area and to the west of the Plant Area.

2.5.4.2 Plant Area Groundwater Flow

ARCADIS reviewed sample/core logs, well construction details (specifically screened intervals and depth of wells), water-level data, hydraulic head relationships, and used a two-dimensional, steady-state groundwater flow model to characterize the hydraulic conditions in the Plant Area (Geraghty & Miller, Inc. 1994). A discussion of hydrogeologic conditions in the Plant Area based on this comprehensive review is presented below.

Groundwater flow in the Plant Area is controlled by the geology, the New River, and active plant production wells (i.e., PW-7, PW-8, PW-9, PW-11 and PW-12). Saturated conditions exist within the alluvial deposits and bedrock. Saturated conditions exist intermittently within the unconsolidated deposits based on the degree and location of production well pumping. Even during production well pumpage, the water levels in the shallow Quaternary wells are similar to the water levels in adjacent wells screened in the dolomite. These similar water levels indicate that the two units are either highly connected or that the shallow zone is acting as a leaky unit and has reached steady-state conditions due to the continuous nature of the production well pumpage. These zones then collectively form a water-table aquifer.

Historical water-level data indicate that seasonal changes in groundwater elevations and their relation to the elevation of the New River can have a significant effect on flow directions. During periods where the New River is elevated, the direction of groundwater flow can be from the New River toward the Plant Area. During periods when the New River is low, the direction of groundwater flow can be from the New River into the Plant Area (due to production well pumpage) or from the Plant Area toward the New River, depending on the location. In the event that the amount of and/or configuration of pumping the plant production wells were altered, groundwater flow in the Plant Area would be affected. Under non-pumping conditions, groundwater flow would be expected to be towards the New River. A non-pumping production well scenario has been evaluated and is discussed in Section 5.0 (Groundwater Modeling).

2.5.4.2.1 Continuous Groundwater Elevation Data

During March 1998, continuous water-level elevation readings were collected at the New River (stream gauge SG-4), and monitoring well pairs MP-19 (residuum well) and MP-93 (bedrock well), and MP-20 (residuum well) and MP-94 (bedrock well). These data were collected to evaluate the relationship between the New River and the residuum and bedrock units in the Plant Area over time as they affect the direction of groundwater flow. The groundwater and surface-water elevation data indicate that the residuum and bedrock groundwater units adjacent to the New River respond relatively quickly and consistently to variations in the New River flow elevation.

2.5.4.2.2 Fly Ash Basin Area Groundwater Flow

Previous groundwater elevation data (October 1997) suggested that the Fly Ash Ponds 1, 2 and 4 may have been leaking water to the subsurface. The groundwater elevation contours showed that groundwater elevations immediately outside of the ponds were elevated and decreased rapidly in a somewhat radial pattern. Groundwater elevation contours indicated that groundwater from the ponds either flowed toward the production wells to the east or south toward the New River. The source of the mounding was not identified and could have been the result of one or a combination of several of the following potential sources:

- Leakage from Fly Ash Pond No. 2 and or No. 4;
- Leakage from the fly ash distribution lines;
- Leakage from the Cooling Tower; and/or,
- Leakage from other unidentified underground sources.

Previously, these ponds were unlined. In the early 2000s, Fly Ash Pond 1 was closed and replaced with three lined ponds (Fly Ash Ponds A, B, and C) in the footprint of Fly Ash Pond 1. Groundwater elevation contours from June 2003 (Figure 2-6) and February 2006 (Figure 2-8) indicate that the groundwater mounding has been less pronounced compared to historical elevation data. During the February 2006 survey, no pond seepage was observed and two shallow wells (P-1 and P-6) downgradient from the ponds were dry.

2.6 Site Operational and Manufacturing History

2.6.1 Manufacturing Processes

The Celco Site has been in operation since December 1939 and manufactures fiber-based products including cellulose-acetate fibers, which are used to make cigarette filters and textile fibers. Raw materials in the formulation of cellulose acetate are cellulose (wood pulp), acetic anhydride, acetic acid, sulfuric acid, and magnesium oxide. Historically, Celanese utilized benzene in the production process. Use of this chemical was terminated in the early 1990s with the startup of the Ketene process. Most of the raw materials are delivered to the site by rail or tanker truck. A schematic of the manufacturing process is presented as Figure 2-9.

The facility utilizes an on-site power plant that burns bituminous coal to produce steam and electricity. As of 2003, DEGS owns and operates this equipment. The waste streams are handled through the operation of permitted landfills across Route 460 and a 2.2 MGD capacity wastewater treatment facility.

2.6.2 Waste Storage, Handling, and Disposal

Celanese maintains a waste minimization program, which is an on-going process to identify opportunities where waste generation can be eliminated or prevented. Substitutions for certain chemicals and potential new methods that will decrease waste and/or decrease the use of chemicals are periodically evaluated. Plant area engineers are encouraged to minimize wastes in their area's processes and the potential for hazardous waste generation is assessed with each process.

As indicated above, a major success of the Celanese waste minimalization program was the elimination of benzene from the manufacturing process, through process changes and the construction of a new anhydride manufacturing facility as part of the Ketene process.

2.6.2.1 Solid Waste

Celanese manages its wastes in on-site landfills, wastewater treatment operations, surface impoundments, regeneration/recycling, and off-site treatment and disposal. DEGS manages the utilities including the fly ash ponds. Most of the Celanese solid waste is disposed of in on-site non-hazardous permitted landfills. A small portion of their solid waste is shipped off-site (for recycling, reuse as fuel, incineration, or landfilling).

Fly ash from the boiler operations is the largest waste stream generated, but is not currently disposed of at the Site. Fly ash from coal combustion is captured on electrostatic precipitators, sent to a dry ash handling system and trucked to Roanoke Cement as an ingredient, landfilled offsite and/or onsite. Sluiced bottom ash is pumped to fly ash settling basins located on the western side of the facility. The fly ash is periodically dredged from these basins and hauled to the ash landfills located on the Celco Site north of the Plant Area. Older areas of fly ash disposal exist at various locations through the Celco Site.

Other major waste streams include white sludge and brown sludge. White sludge consists of cellulose wood fibers and cellulose acetate fines that were historically disposed within basins adjacent to the New River. An improved method for handling this waste stream was developed so that the white sludge waste material can go directly to the landfill without being stored in ponds. This improvement has eliminated the need for White Sludge Pond B. White Sludge Pond B is currently being closed in accordance with a VDEQ approved closure plan. Clean closure is anticipated to be achieved in 2006. Brown Sludge is an acetic acid-based material generated from the cleaning of process vessels. Several areas were used for disposal of brown sludge within the Celco Site. These areas are discussed in more detail in Section 3 (SWMU/AOC Status).

Other smaller solid waste streams that go to the onsite permitted non-hazardous landfills include WWTP filter cake, filter tow, filter pads and filter dressings, scrap wood, paper, and plastic items. Asbestos waste generated from the removal of asbestos containing insulation material within the plant may be taken to on-site or off-site landfills depending on whether the asbestos is handled by plant or contract personnel. The majority of the asbestos waste is disposed of on-site in an asbestos permitted landfill.

The small portion of solid waste that is shipped off-site for disposal includes waste palletized carbon (generated from the biannual replacement of carbon in the solvent recovery absorbers), used oil, and miscellaneous RCRA hazardous wastes. Scrap metal (from equipment maintenance or change-outs) is sold.

2.6.2.1.1 Permitted Landfills

Celanese maintains two permitted landfills (Figure 2-2) managed under Virginia Solid Waste Regulations (Table 2-2), which are located north of Route 460. The Permit 207 landfill is an older unlined non-hazardous landfill with active, inactive, and closed cells. Active cells receive industrial waste and asbestos. Separate industrial and asbestos cells are inactive. Closed cells contain fly ash and processed sludge (i.e., the Closed Process Sludge Landfill [CPSL]).

A semi-annual groundwater monitoring program has been implemented for the Permit 207 Landfill. Remediation is ongoing at the CPSL. Both areas are further discussed in Section 3.0.

The Permit 550 landfill is a newer lined non-hazardous landfill with a leachate collection system, which became operational in 1993. This landfill receives industrial waste from plant operations. Virginia Department of Environment Quality does not require groundwater monitoring at this landfill because it was constructed with a double synthetic liner system with primary and secondary leachate collection.

The boundaries of the permitted landfills overlap as shown on Figure 2-2 to allow for sharing of access roads and borrow pits.

2.6.2.2 Hazardous Waste

The Celco Site was an existing facility when RCRA Subtitle C program became effective in November 1980, which addresses the treatment, storage, and disposal of hazardous waste. In November 1980, Celanese submitted a RCRA Part A Permit Application.

In March 1990, when USEPA promulgated the Toxic Characteristics rule, Celanese's process wastewater became a newly identified characteristic hazardous waste due to the presence of benzene. Later that year on 25 August 1990, USEPA provided notice to Celanese that the toxicity characteristics rule applies to the two surface water impoundments (Equalization and Aeration Basins) at the WWTP because they manage a characteristically toxic waste (benzene – D018) (USEPA 1996). The RCRA Permit Part A Application (Table 2-2) was subsequently amended on 25 September 1990 to reflect a classification of the plant wastewater as hazardous waste (Feuerbach

1990). On 27 September 1997, Celanese submitted a revised RCRA Part A Application.

On 24 September 1991, Celanese submitted a RCRA Part B Application to USEPA (Table 2-2). In the application, Celanese requested that the WWTP continue to operate under interim status because they intended to replace the surface impoundments with tanks rather than install new impoundments with liners (USEPA 1996; USEPA 1998). The WWTP continued to operate under RCRA interim status until 29 March 1994 when the impoundments ceased accepting waste (i.e., process water). In 1998, clean closure status was granted for the Equalization and Aeration Basins (USEPA 1996).

The Celco Site is a large quantity generator (LQR) (VA005007679) of hazardous waste (Table 2-2). Celanese does not have a permit to treat, store, or dispose of hazardous waste and is subject to the less than 90-day generator requirements. Since the late 1980s, Celanese has stored hazardous waste in drums in a curbed contained building located north of the Acetone Recovery Area and south of Fly Ash Pond 4 (Feuerbach 1988). Celanese also stores acetone waste contaminated with mesityl oxide (MEO) in a 3000-gallon AST on the southwestern side of Building 2 (Feuerbach 1988).

Previously, former less than 90-day hazardous waste accumulation areas with interim status were located east of the current accumulation area. These areas stopped receiving waste in the late 1980s. In August 1997, clean closure status was granted by Virginia Department of Environmental Quality for the interim status hazardous waste accumulation areas (Hopkins 1997). Closure of these areas is further discussed in Section 3 (SWMU/AOC Status).

2.6.2.3 PCB Phase-out Program

In the late 1970s, Celanese initiated a program to inventory equipment containing polychlorinated biphenyls (PCBs) such as transformers and capacitors. In the mid-1980s, Celanese began replacing and/or upgrading PCB equipment with non-PCB dielectric fluids and arranging off-site disposal for PCB-contaminated waste as needed.

USEPA finalized revisions to regulations on PCBs in 1990, which required (1) facilities with PCB equipment to submit a Notification of PCB Activity Form; (2) the use of manifest forms to document transport of PCBs to disposal facilities, and (3) expanded annual record keeping requirements for PCB equipment. Celanese submitted this form to USEPA in April 1990 and incorporated the regulation changes into their PCB phase-out program. By the late 1990s, Celanese had upgraded or replaced most of their PCB equipment. As of 2006, no equipment remained onsite, which contained PCBs (other than light ballasts).

There are two known historical spills/releases of PCBs. Both of these spills occurred predominantly over paved areas and impacted areas were decontaminated and/or removed. In November 1987, an overheated transformer leaked in the vicinity of the Building 12 causing a spill of approximately 75 to 100 gallons of 700,000 ppm Aroclor 1260. The spill was predominately to paved surfaces. An emergency cleanup team was onsite within 24 hours. The spill was contained with berms and samples were collected to delineate the impact area, which was then decontaminated. Some pavement was removed. This work was performed by BMS Technologies and the findings were documented in BMS (1987).

In September 1992, an historical spill of PCBs was discovered in Building 2 – Old Transformer Room. An oily substance on the floor of the Transformer Room contained PCBs at a concentration of 31,000 ppm. The investigation determined the former spill was contained within the room's boundaries and in soil underlying the northwest corner of the room where PCBs were detected at concentration of 300 ppm. A 63 square foot area of the concrete floor was removed and 2 feet of soil under concrete floor was excavated. The total soil volume excavated was approximately 5 cubic yards. These materials were disposed of off-site. This work was performed by EmTech Environmental Services and the findings were documented in EmTech (1992).

2.6.3 Wastewater Treatment, Effluent Discharge, and Fly Ash Settling

2.6.3.1 WWTP Operations

Wastewater in the Plant Area is collected through chemical process sewers that underlay the main production area and drain to the WWTP. Primary wastewater contributions are from cellulose acetate manufacturing, acetone recovery, acid recovery, anhydride manufacturing, and spill containment areas. Leachate from the Permit 550 Landfill cell(s) is gravity-fed through piping into the chemical process sewer system and is also treated at the WWTP.

Prior to 1996, Celanese operated two surface impoundments (aeration and equalization basins) as part of the waste treatment process. These units were closed under RCRA and replaced with BIOHOCH reactors, which are a biological wastewater treatment system.

River water is pumped from the New River and groundwater is pumped from a series of deep production wells for manufacturing operations (contact and non-contact) at the Celco Site. The average withdrawal rates are: river water (57 MGD) and groundwater (3.7 MGD). The average discharge rate from Outfalls 001 through 005 is 70.3 MGD. These rates should be considered estimates (Table 2-1) and are influenced by stormwater runoff from precipitation. The WWTP has a current capacity to treatment 2.2 MGD. Treated wastewater is discharged to the New River via Outfall 003.

2.6.3.2 Effluent Discharge

Celco Site operations pre-date state and federal regulations on effluent (pollutant) discharge. Virginia first promulgated its Water Control Law on 01 July 1946, which required certificates (i.e., permits) to discharge industrial and sanitary waste. On 01 October 1947, the Virginia State Water Control Board requested that Celanese submit plans for primary treatment of sanitary sewage and chlorination of treated sewage effluent. Subsequently, on 01 November 1947, the Virginia State Water Control Board issued Celanese certificates to discharge untreated industrial waste (WESTON 1962). In November 1949, Celanese began operation of a sanitary sewage plant. On 23 March 1954, the Virginia State Water Control Board issued Celanese a certificate to discharge fly ash into a settling lagoon (WESTON 1962). At the request of the Virginia State Water Control Board in the late 1960s, Celanese constructed a WWTP, which became operational in 1970.

USEPA promulgated regulations in November 1990 that required certain dischargers of stormwater to apply for a National Pollutant Discharge Elimination System (NPDES) permit for those discharges. The Commonwealth of Virginia is authorized to implement a NPDES program where the Virginia State Water Control Board serves as the permitting authority for Virginia Pollutant Discharge Pollutant Elimination System (VPDES) permits. Issued permits comply with both the VPDES Program and the State Water Control Law. Celanese applied for a VPDES permit in October 1991. In May 1992, a Special Consent Order from the Virginia State Water Control Board was issued to Celanese, which required that a schedule be established to meet new effluent requirements for the VPDES Permit. Currently, Celanese holds a VPDES Permit (VA00002999), which expires on 29 June 2008.

On 8 October 1999, a Special Consent Order from the Virginia State Water Control Board was issued to Celanese, which required that preventative actions be implemented to reduce unpermitted discharges to the New River (Table 2-3). Celanese was required to evaluate its current operations and maintenance procedures and implement any enhancements identified. In May 2001, Virginia Department of Environmental Quality canceled the Special Consent Order citing that all requirements had been met.

Outfall 002 receives boiler blowdown, coal pile runoff, chlorinated water treatment blowdown, wet bottom boiler seals, and some stormwater (Table 2-1). Until December 1993, partially stabilized sludge from the process manufacturing was conveyed into the fly ash settling ponds. Currently, sludge is dewatered and taken directly to the on-site landfill.

Outfall 001 receives non-contact cooling water, blowdown (from six cooling towers), steam condensate (from four electrodialysis recovery [EDR] units), and stormwater (from a 74-acre portion of the manufacturing area). Outfall 003 receives treated wastewater from the WWTP.

Outfalls 004 and 005 receive stormwater runoff from the landfill areas. Outfall 004 receives stormwater from the active and inactive industrial landfill areas. Only one sediment trap is in place, downgradient from the active industrial waste landfill. Stormwater passes through this trap then runs along the landfill access road and crosses route 460. The pipe appears on the plant side of Route 460 in a culvert which acts to trap additional sediment. Stormwater off of the borrow area and the CPSL crosses Route 460 at a different location and discharges on to the ground adjacent to railroad tracks on the northeast side of Fly Ash Pond 4. Elevated concentrations of ammonia have been detected at Outfall 005. Ammonia in Outfall 005 discharge is discussed in detail in Section 3.36 (AOC-8 Landfill Ammonia Flow).

2.6.3.3 Fly Ash Settling

Previously, three ponds (Fly Ash Ponds 1, 2, and 4) were used to settle fly ash from the boilers. These ponds have been closed or are in the process of being closed to address historical leakage concerns from the fly ash ponds. (Pond 3 was closed in 1975). In 2003, Fly Ash Pond 1 was closed and Fly Ash Ponds A, B, and C were constructed with a liner over the footprint of Fly Ash Pond 1. The respective volumes of these ponds are: Fly Ash Pond A (17.59 million gallons), Fly Ash Pond B (4.40 million gallons), and Fly Ash Pond C (8.80 million gallons). Closure of the remaining unlined ponds (Fly Ash Ponds 2 and 4) has been initiated and is scheduled to be completed in 2006.

The fly ash ponds also receive water from the Water Treatment Plant, boiler blowdown, coal pile runoff, and wet bottom boiler seals. Prior to 1993, partially stabilized sludge from the process WWTP was conveyed to the fly ash ponds.

In 2002, a post-closure monitoring plan was approved to monitor groundwater and surface water in the vicinity of the Fly Ash Ponds (Draper Aden 2002). The Year 1 post-closure monitoring effort performed in February and March 2006 indicated that (1) in the vicinity of the Fly Ash Ponds, the predominant direction of groundwater flow is southward toward the New River and/or the capture zone created by production well pumping activities and (2) the New River and Stillhouse Branch have not been adversely affected by the Fly Ash Ponds based on available water quality data.

2.6.4 Spill and Pollution Prevention and Contingency Planning

Celanese closed all known USTs at the facility in the early 1990s in accordance with VDEQ regulations. Many USTS were replaced with new ASTs, which are equipped with a secondary containment structure and/or spill containment system. In addition, several prevention and contingency-related plans have been prepared in accordance with state and federal regulations.

Celanese maintains a Stormwater Pollution Prevention Plan (SWPPP) (CH2MHill 1994). The SWPPP identifies potential sources of pollution; describes Celanese's stormwater management and control procedures; defines inspection, reporting, and plan revision procedures; identifies a pollution prevention team, and communicates Emergency Planning and Community Right-to-Know Act requirements.

Celanese maintains a Spill Prevention Control and Counter Measures and Oil Discharge Contingency Plan (SPCCP and ODCP) (Draper Aden 2004). The SPCCP provides information and guidance to personnel on how to prevent oil and fuel discharges and to safely respond to a spill incident, should one occur. The ODCP describes specific procedures for protecting environmentally sensitive areas; responding to potential oil discharges; and containing, remediating, and mitigating oil discharges within the shortest feasible time.

Storm sewers are located throughout the Plant Area and discharge to the 001 Outfall. Spill containment boxes, which are located throughout the Plant Area, include sandbags that can be used to block a spill from entering the storm sewers. If a spill enters a storm sewer, additional spill equipment is located at the 001 Outfall. If a spill enters the chemical process sewers, it would be contained in the equalization tank or routed to one of the two diversion tanks at the WWTP.

Celanese has an emergency response team, which is trained as well as plant personnel to respond to and contain oil spills with booms and other sorbent material. Spill equipment is located throughout the plant in strategic locations, which provide a means of protection for both chemical and storm sewers as well as the New River itself.

2.6.5 Environmental Programs

Environmental project work at the Celco Site is coordinated through two different groups: Celco Environmental, Health & Safety and Celco Project Engineering. The Environmental, Health & Safety Group develops the request for the project and provides technical advice, and Celco Project Engineering provides the project manager responsible for schedule and budget tracking. To minimize the impact of personnel changes on the continuity of individual projects, Celanese strives to integrate individual projects into the overall environmental strategy for the site through the Celanese Acetate Strategic Environmental, Health & Safety Project Planning process that is reviewed and updated annually.

2.6.6 Permits

Celanese maintains permits for pollutant discharge, potable well use, and equipment and tank operations with different state agencies. These permits are discussed throughout this report and have been tabulated in Table 2-2.

The Celco Site is a large quantity waste (LQW) generator; and as a result, they are still required to meet RCRA less than 90-day storage requirements.

Previous reports (NCAPS, page 7; and RCRA Site Visit Report, page 11) identified the Celanese VPDES Permit No. as VA00050733. During the DOCC file review, the Celanese VPDES Permit No. was confirmed to be VA00000299.

2.6.7 Consent Orders

Several consent orders related to the Celco Site are discussed throughout this document (Table 2-3). In general, the consent orders were issued to comply with new and/or changing regulations and provided a legal framework for Celanese to comply with specific regulations within a specified time period. In each case, Celanese voluntarily entered into the consent order and worked jointly with the regulators to ensure compliance.

3. SWMU/AOC Status

In 1996, USEPA performed a National Corrective Action Prioritization System (NCAPS) ranking for the facility looking at specific waste management practices and disposal areas and potential threats to groundwater and surface water. USEPA identified 39 specific solid waste management units. USEPA issued a NCAPS ranking of the facility in July 1996 (USEPA 1996).

The USEPA has described and defined Solid Waste Management Units (SWMUs) as "any discernible unit in which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released." This definition is from the 61 Federal Register (19442) dated 1 May 1996.

USEPA recognizes there may be situations under Resource Conservation and Recovery Act (RCRA) where sites have known or suspected contamination, but do not clearly meet the definition of a SWMU. In these situations, classification as an "Area of Concern (AOC)" may be appropriate. An AOC is defined as any area where a release occurred, which warrants further investigation and/or remediation.

Beginning in 1997, Celanese initiated a comprehensive review of available site data to identify potential environmental areas across the site, which were synonymous with SWMUs and defined as potential areas of concern (AOCs). These environmental areas were subsequently evaluated with respect to current conditions and associated constituents of concern in order to develop recommendations regarding management or closure. The results of this evaluation were published in the May 2005 Site-Wide Groundwater Assessment Report (ARCADIS 2005).

In late 2005, Celanese Acetate LLC, entered into the Facility Lead Agreement for the Celco Site as part of the RCRA Corrective Action Program. A RCRA Site Visit was conducted in October 2005 by USEPA, USACE, and Virginia Department of Environmental Quality personnel. USACE subsequently issued the March 2006 Draft Final Site Visit Report, which identified 20 SWMUs and 2 AOCs based on the site visit and a file review (USACE 2006). This DOCC includes the SWMUs/AOCs that were identified in the March 2006 RCRA Site Visit Report and additional SWMUs/AOCs, which were identified in the May 2005 Site-Wide Groundwater Assessment and/or through additional file review/data evaluation by Celanese.

A total of 22 SWMUs and 8 AOCs have been identified at the Celco Site. These units are presented in Table 3-1 and Figure 2-1 and Figure 2-2 and discussed in detail below.

3.1 SWMU-1 (Building 37 Main Lab)

3.1.1 Status

Building 37 is located in the southeastern portion of the Plant Area. This building houses the main laboratory along with 10 satellite accumulation areas. Accumulated wastes include (currently or in the past): Karl Fisher debris, GC vials, sulfuric/nitric acid, waste oil with acetone and ethanol, finish oil, and liquid acid dope. Accumulated wastes are stored in drums and/or containers. All areas are inside the building and contained. The floor drains flow to the WWTP.

3.1.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. No further action is requested.

3.2 SWMU-2 (Building 1 & 2 Breezeway, 1st Floor)

3.2.1 Status

A covered breezeway, connecting Buildings 1 and 2 is used as a waste accumulation area. These buildings are located in the eastern portion of the Plant Area. Accumulated wastes may include (currently or in the past): fluorescent light bulbs, lead and alkaline batteries, polychlorinated biphenyl (PCB) bulb ballasts, and broken bulbs. These materials are stored in drums and/or containers. All areas are inside the building and contained. The building does not have floor drains.

3.2.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. No further action is requested.

3.3 SWMU-3 (Building 2, Jet Manufacturing Area, 3rd Floor)

3.3.1 Status

A satellite accumulation area is located on the 3rd floor of Building 2 (Jet Manufacturing Area). This area is located in the eastern portion of the Plant Area. Accumulated wastes may include (currently or in the past): chromic acid, hydrochloric acid, jet cleaning process rinse water, sulfuric/nitric mix from jet cleaning, isopropyl alcohol, and exchangeable resins. Accumulated wastes are stored in drums and/or containers. All areas are inside the building and contained. The floor drains flow to the WWTP.

3.3.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. This area is inspected weekly. No further action is requested.

3.4 SWMU-4 (Building 14, Shop Area)

3.4.1 Status

Building 14 (Shop Area) is located in the southwestern portion of the Plant Area. The shop contains a waste storage area for used oils and greases. All areas are inside the building and contained. The floor drains flow to the WWTP.

3.4.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. No further action is requested.

3.5 SWMU-5 (Building 13, Paint Shop)

3.5.1 Status

A satellite accumulation area is located in Building 13, which is located in the southern portion of the Plant Area. Accumulated wastes may include (currently or in the past): waste solvent paints. These wastes are stored in 55-gallon drums and smaller containers.

3.5.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. No further action is requested.

3.6 SWMU-6 (Multi-Dumpster Locations)

3.6.1 Status

This SWMU contains multiple dumpster locations across the Plant Area. The following wastes are stored in the dumpsters (currently or in the past): filter pads, scrap wood, waste tow, scrap cardboard, miscellaneous solid waste, and construction debris. Scrap metal is sold, while the remaining items are disposed of in the onsite landfills (USACE 2006).

3.6.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. No further action is requested.

3.7 SWMU-7 (Building 11, White Sludge, Awaiting Disposal)

3.7.1 Status

A temporary storage area for dewatered white sludge is located on the eastern side of Building 11, which is in the southern portion of the Plant Area. The dewatered white sludge is staged in a dumpster pending disposal in the Permit 550 Landfill. This area is paved and drains to the WWTP.

3.7.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. No further action is requested.

3.8 SWMU-8 (Building 5, Machine Shop, 1st Floor)

3.8.1 Status

A machine shop is located on the first floor of Building 5, which is in the southern portion of the Plant Area. The shop contains machine parts and metal shavings and uses various cutting oils (i.e., oils used to lubricate pipe cutting tools) and hydraulic fluids. The machine shop has a concrete floor which contains the area.

3.8.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. No further action is requested.

3.9 SWMU-9 (Less than 90 Day Accumulation Area)

3.9.1 Status

As a LQR, Celanese is subject to less than 90-day hazardous waste accumulation requirements under RCRA. A temporary hazardous waste accumulation area is located north of the Acetone Recovery Area and south of the Fly Ash Pond 4. This area is used to store hazardous waste for less than 90 days pending off-site disposal. The hazardous wastes are stored in drums and/or containers in a curbed container shed. This area has been used as the less than 90-day hazardous waste accumulation area since the late 1980s (Feuerbach 1988). Previously, Celanese stored hazardous waste at another location (SWMU-18), which is slightly east of SWMU-9. The former less than 90-day accumulation area stopped receiving hazardous waste in the late 1980s and was granted RCRA clean closure status in 1997 (Hopkins 1997).

3.9.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. This area is inspected in accordance with federal and/or state regulations. No further action is requested.

3.10 SWMU-10 (Wastewater Treatment Plant)

3.10.1 Status

Process wastewater generated as part of the manufacturing process is treated at the WWTP by an on-site biological treatment system. The WWTP receives wastewater from the cellulose acetate manufacturing and the acetone recovery processes; and from maintenance activities. The WWTP also receives cooling tower blowdown and condensate (from the Ketene process); still bottoms (from the distillation of carbon absorbers to recover acetone vapors); stormwater (from the industrial area); overflows from floor drains (in the power plant); and sanitary wastewater (after primary treatment and chlorine disinfection but prior to mixing with process wastewater and further biological treatment). The WWTP has been in operation since 1970. Treated wastewater is discharged to the New River via Outfall 003 which is regulated by VDEQ. Major upgrades were made to the WWTP in the 1990s. Prior to 1996, Celanese operated two surface impoundments (aeration and equalization basins) as part of the waste treatment process. These units were closed under RCRA and replaced with BIOHOCH reactors, which are a biological wastewater treatment system. The closed impoundments have been designated as SWMU-12.

Historical groundwater monitoring has detected few constituents in this area. The 1999/2003 risk assessment concluded that there was not an unacceptable risk to human health and/or the environment.

3.10.2 Corrective Action

SWMU-10 is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives. To avoid unnecessary duplication, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-10 is eligible for No Further Action status.

3.11 SWMU-11 (White Sludge, Pond B)

3.11.1 Status

A surface impoundment that was used for disposal of white sludge is located south of the railroad tracks in the Plant Area, between White Sludge Ponds A and C along the banks of the New River. White Sludge Pond B has an approximate capacity of 47,000 cubic yards and was lined with HDPE between 1990 and 1991.

As of 2003, Celanese no longer needed or utilized Pond B for the storage and management of white sludge and initiated clean closure plans. Virginia Department of Environmental Quality approved closure plans in April 2005. Sludge removal and earthwork is scheduled to be completed in 2006..

3.11.2 Corrective Action

SWMU-11 is scheduled for clean closure in 2006 in accordance with VDEQ regulations. This SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives. To avoid unnecessary duplication, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-11 is eligible for No Further Action status.

3.12 SWMU-12 (RCRA Closed WWTP Equalization/Aeration Basin)

3.12.1 Status

The original treatment system at the WWTP utilized an in-ground concrete-lined surface impoundment, designated as the Equalization Basin, and an unlined surface impoundment designated as the Aeration Basin. The Equalization Basin had a one-million gallon capacity and began operation in 1981. The Aeration Basin, which was used to biologically degrade organic wastewater, had a five-million gallon capacity and began operation in 1970.

When the Toxic Characteristics rule was promulgated in March 1990, Celanese's wastewater was considered a hazardous waste due to the presence of benzene, which was used in the manufacturing process. Both units stopped receiving waste in 1994 and were clean closed in accordance with federal RCRA guidelines in 1998.

Interim groundwater monitoring was conducted as part of the closure activities. Groundwater quality in monitoring wells in the vicinity of the equalization and aeration basin did not exhibit constituents above screening levels, with one exception chloroform (0.0092 mg/L) at MP-45 in 1997.

3.12.2 Corrective Action

This SWMU has been clean closed in accordance with RCRA. No further action is required.

3.13 SWMU-13 (Former Fly Ash Pond 1)

3.13.1 Status

Former Fly Ash Pond 1 was formerly located in the northwestern portion of the Plant Area. The unlined pond was used to settle fly ash and bottom ash from the boiler house. It operated from 1956 to 2004. Fly Ash Pond 1 was closed, in part, to address historical leakage concerns, including seep discharges from the walls of the pond. This closure was coincident with an enhancement to the dry fly ash process, which resulted in the generation of smaller volumes of fly ash. Leakage from Pond 1 was likely influencing groundwater mounding and seepage observed in the vicinity of the ponds. During a Fly Ash Basin Seep Evaluation conducted between 1996 and 1998, select metals (barium and arsenic) and chlorinated organics (11-DCE, chloroethane, cis-12-DCE, and vinyl chloride) were detected in seep water. In shallow groundwater near the seeps, several organics (11-DCE, chloroethane, vinyl chloride, acetone, and benzene) were also detected. The groundwater samples were collected from temporary wells installed in a perched zone by the seeps (ARCADIS 1998). A seep collection system was installed and operated to contain seep flow from the wall of the ponds. Prior to the installation of the seep collection system, seep flow was captured in onsite ditches that flowed to VPDES permitted outfalls. Pond 1 closure activities were performed by Celanese to comply with a Consent Order to address seep discharge (Table 2-3). Pond 1 has been closed, the seeps are no longer present, and the Consent Order has been met.

During previous site-wide groundwater sampling events in 1993/1997/2003, two organics (1,4-Dioxane, BEHP) and one metal (antimony) were detected from one or more samples at concentrations greater than risk-screening levels. These detections were from permanent monitoring wells near the fly ash ponds (ARCADIS 2005). These results indicated that the constituents detected in the temporary wells adjacent to the seeps were isolated and not migrating to other well locations. The 1993/1997/2003 groundwater quality data are presented in Appendix C.

When Fly Ash Pond 1 was closed, three new ponds (Fly Ash Ponds A, B, and C) were constructed with a liner over the footprint of Fly Ash Pond 1. The respective volumes of these ponds are: Fly Ash Pond A (17.59 million gallons), Fly Ash Pond B (4.40 million gallons), and Fly Ash Pond C (8.80 million gallons). The three new lined ponds (A, B, and C) are currently used and operated by Duke Energy Solutions of Narrows, LLC.

In February 2006, post-closure monitoring (ARCADIS 2006) was initiated in the vicinity of the fly ash ponds in accordance with a VDEQ-approved monitoring plan (Draper Aden 2002). The monitoring results, which were submitted to USEPA as part of the Facility Lead Program, are discussed below.

Groundwater and surface water sample locations are shown in Figure 2-8. In groundwater, cadmium, iron, manganese, and ammonia nitrogen were detected at concentrations greater than risk-screening criteria. No organics were detected in groundwater. Cadmium, iron, and manganese were also detected in the hydraulically upgradient well MP-116 at a concentration similar to the hydraulically downgradient wells indicating that the observed concentrations represent background water quality. These metal constituents are likely indicative of naturally-occurring ferromagnesian minerals found in clastic rock formations and alluvial deposits, which are present at the Site. In surface water, no constituents were detected at concentrations greater than risk-screening criteria.

The 2006 post-closure monitoring effort concluded that (1) in the vicinity of the Fly Ash Ponds, the predominant direction of groundwater flow is southward toward the New River and/or the capture zone created by production well pumping activities and (2) the New River and Stillhouse Branch have not been adversely affected by the Fly Ash Ponds. Also, the 1999/2003 risk assessment concluded that both during pumping and non-pumping scenarios that there was not an unacceptable risk to human health and/or the environment.

3.13.2 Corrective Action

This SWMU has been closed utilizing a VDEQ-approved closure plan. In addition, a VDEQ-approved monitoring plan is being implemented to monitor groundwater and surface water in the vicinity of the Fly Ash Ponds (Draper Aden 2002). The analytical results of Year 1 (February 2006) monitoring indicated that groundwater and surface water have not been adversely impacted (ARCADIS 2006).

Since this SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-13 is eligible for No Further Action status.

3.14 SWMU-14 (Fly Ash Pond 2)

3.14.1 Status

Fly Ash Pond 2 is located in the northern portion of the Plant Area between Ponds 3 and 4. The pond provides additional settling of ash prior to discharge to Outfall 002 (under the VPDES Permit). It has been in operation since 1964; however clean closure is currently scheduled to be completed in 2006 in accordance with the VDEQ-approved closure. Water quality in the vicinity of the Fly Ash Ponds was presented in Section 3.13.2. The 1999/2003 risk assessment concluded that both during pumping and non-pumping scenarios that there was not an unacceptable risk to human health and/or the environment.

3.14.2 Corrective Action

This SWMU is scheduled to be clean closed in 2006, utilizing a VDEQ-approved closure plan. In addition, a VDEQ-approved monitoring plan is being implemented to monitor groundwater and surface water in the vicinity of the Fly Ash Ponds (Draper Aden 2002). The analytical results of Year 1 (February 2006) monitoring indicated that groundwater and surface water have not been adversely impacted (ARCADIS 2006).

Since this SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-14 is eligible for No Further Action status.

3.15 SWMU-15 (Fly Ash Pond 3)

3.15.1 Status

Fly Ash Pond 3 is located in the northwestern portion of the Plant Area between Fly Ash Ponds 2 and C. The pond, which was also used for fly ash settling, was closed in 1975 with approximately 67,000 cubic yards of fly ash. Groundwater quality in the vicinity of the Fly Ash Ponds was presented in Section 3.13. The 1999/2003 risk assessment concluded that both during pumping and non-pumping scenarios that there was not an unacceptable risk to human health and/or the environment. In addition, a VDEQ-approved post-closure monitoring plan has been implemented to monitor groundwater and surface water in the vicinity of the Fly Ash Ponds (Draper Aden 2002). The analytical results of Year 1 (February 2006) monitoring indicated that groundwater and surface water have not been adversely impacted (ARCADIS 2006).

3.15.2 Corrective Action

This SWMU will be retained and managed under the RCRA Facility Lead Program.

3.16 SWMU-16 (Fly Ash Pond 4)

3.16.1 Status

Fly Ash Pond 4 is located in the northern portion of the Plant Area east of Fly Ash Pond 2. The pond has been used for fly ash settling. It has been in operation since 1973; however closure is planned in 2006. The pond has a capacity of 69,000 cubic yards. Groundwater quality in the vicinity of the Fly Ash Ponds was presented in Section 3.13. The 1999/2003 risk assessment concluded that both during pumping and non-pumping scenarios that there was not an unacceptable risk to human health and/or the environment.

3.16.2 Corrective Action

This SWMU is scheduled to be closed in 2006 in accordance with a VDEQ-approved closure plan. In addition, a VDEQ-approved post-closure monitoring plan has been implemented to monitor groundwater and surface water in the vicinity of the Fly Ash Ponds (Draper Aden 2002). The analytical results of Year 1 (February 2006) monitoring indicated that groundwater and surface water have not been adversely impacted (ARCADIS 2006).

Since this SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-16 is eligible for No Further Action status.

3.17 SWMU-17 (New Fly ash Ponds A, B, C)

3.17.1 Status

When Fly Ash Pond 1 was closed, three new ponds (Ponds A, B, and C) were constructed with a liner over the footprint of Fly Ash Pond 1. The respective volumes of these ponds are: Pond A (17.59 million gallons), Pond B (4.40 million gallons), and Fly Ash Pond C (8.80 million gallons). The three new lined fly ash ponds (A, B, and C) are currently used and operated by DEGS. Groundwater quality in the vicinity of the Fly Ash Ponds was presented in Section 3.13. The 1999/2003 risk assessment concluded that both during pumping and non-pumping scenarios that there was not an unacceptable risk to human health and/or the environment.

3.17.2 Corrective Action

The Fly Ash Ponds A, B, and C were constructed with a liner to prevent leakage and seep formation. Monitoring is being performed in the vicinity of the fly ash ponds in accordance with a VDEQ-approved monitoring plan (Draper Aden 2002), which will provide corollary information on groundwater quality.

Since this SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-17 is eligible for No Further Action status.

3.18 SWMU-18 (RCRA Closed Hazardous Waste Accumulation Areas)

3.18.1 Status

A former less than 90-day hazardous waste accumulation area was located north of the Acetone Recovery Area and south of the Fly Ash Ponds. This area is east of the current less than 90-day hazardous waste accumulation area. This former area was used to store hazardous waste pending off-site disposal. Drums periodically exceeded the 90-day storage limit. Materials stored in this area included miscellaneous RCRA hazardous wastes including volatile, semi-volatile, and metal compounds.

Prior to 1982, Celanese stored hazardous waste in two temporary tractor trailers, located south of Fly Ash Pond 4 (Nittany Geoscience 1997). In late 1982 or early 1983, Celanese constructed a new temporary hazardous waste accumulation area consisting of a small metal building with a concrete floor north of the trailers. Both the trailers and the building where hazardous waste was stored are referred to as the RCRA Interim Status Hazardous Waste Accumulation Area. In March 1989, the Virginia Department of Waste Management requested that Celanese submit a closure plan after it was determined on occasions in the past that hazardous waste was stored for more than 90 days. The closure plan was accepted in September 1990 and closure activities were conducted in 1990. Upon submittal of the closure report in February 1991, it was not approved by Virginia Department of Waste Management because low lead levels were detected in rinsate samples from decontamination fluids. At the time, Virginia Hazardous Waste Management Regulations required that background levels or non-detect levels be used as performance standards so the detection of low concentrations of lead in rinsate samples from decontamination fluids, which were above background levels prevented closure approval. This situation prompted Virginia Department of Waste Management to review its regulations, which were eventually changed to allow for risk-based performance standards to be utilized in closure plans. On 13 November 1996, a final closure plan incorporating a risk-based approach was approved. After the closure report was revised to address a risk-based approach, Virginia Department of Environmental Quality approved the clean closure of the RCRA Interim Status Hazardous Waste Accumulation Area on 29 August 1997 (Hopkins 1997).

3.18.2 Corrective Action

This SWMU has been clean closed in accordance with RCRA. No further action is required.

3.19 SWMU-19A (Permit 550 Landfill)

3.19.1 Status

The Permit 550 Landfill is north of Route 460 in the Landfill Area. It is adjacent to and north of the Permit 207 landfill (an older unlined landfill with active and closed cells) that Celanese has used to dispose of wastes. Celanese expanded its landfill operations in the early 1990s through the permitting and construction of a new Subtitle D landfill, which contains cells with liners and leachate collection systems. This new landfill is referred to as Permit 550 Landfill and receives non-hazardous industrial waste from the Plant Area.

The landfill Permit 550 was issued on 21 January 1993 by the Virginia Department of Waste Management and includes two landfill areas: main disposal area (25.5 acres) and asbestos disposal area (1.4 acres). The permit states that the main landfill may receive general trash, paper products, cardboard, wood, sawdust, filter pads, cellulose acetate flake, plastics, fiberglass installation, steel bands, wire, pipe light metal, scrap metal, fibrets, crushed coal, masonry waste, construction debris, waste yarn, filter rods, bottom ash, fly ash, chemical wastewater treatment sludge, white sludge, domestic sewage sludge, spill containment media (absorbents, sand, kitty litter), and special waste (petroleum) if approved before disposal. The disposal of drums, regulated hazardous wastes, and unstabilized sludge with free product are forbidden.

Since new cells have been installed with liners and leachate collection systems, Virginia Department of Environmental Quality currently does not require groundwater monitoring. An equalization tank has been installed at the landfill to containerize collected leachate and this fluid is conveyed by gravity flow to the Celanese WWTP for treatment. The boundaries of the permitted landfills (i.e., 207 and 550) overlap as shown on Figure 2-2 to allow for sharing of access roads and borrow pits.

3.19.2 Corrective Action

The Permit 550 Landfill was constructed as part of an effort to eventually phase out the use of the unlined Permit 207 Landfill. Because the Permit 550 Landfill cells were constructed with liners and leachate collection systems, groundwater monitoring is not required for this landfill. No known releases to the environment have occurred and no past remedial activities have been required, conducted nor are they expected. Since this SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-19A is eligible for No Further Action status.

3.20 SWMU-19B (Permit 207 Landfill)

3.20.1 Status

The Permit 207 landfill is an older unlined non-hazardous landfill with active, inactive, and closed cells. The boundaries of the permitted landfills overlap as shown on Figure 2-2 to allow for sharing of access roads and borrow pits.

Active cells receive industrial waste and fly ash. Specifically, these active cells include (1) a 21-acre industrial waste landfill that is permitted to receive demolition waste, brush, tree trimmings, stumps, and industrial waste (filter pads, waste paper, metal bands, fibers, asbestos, and ash) and (2) an 11-acre fly ash landfill that is permitted to receive fly ash and waste activated sludge from the Plant Area sedimentation ponds.

Closed cells include an industrial waste landfill, two asbestos landfills, and two fly ash landfills. The industrial waste landfill was used to dispose of demolition waste, brush, tree trimmings, stumps, and industrial waste (filter pads, waste paper, metal bands, fibers, asbestos, and ash). The fly ash landfills (which are 5-acres and 9 acres, respectively) received fly ash from the Plant Area Fly Ash sedimentation ponds. The Permit 207 Landfill also includes a closed cell known as the Closed Process Sludge Landfill (CPSL), which received process sludge from the production areas. The CPSL has been identified as SWMU-19C in this report and discussed in the following section.

Landfill Permit 207 was first granted on 15 June 1976 by the Virginia Department of Health for on-site disposal of industrial waste. The permit did not specify the actual landfill size, but instead referenced a plan by Anderson & Associates, which indicated that the landfill was 98.68 acres; of which 40.3 acres were actively being used at the time. In January 1984, the permit was reissued to include 20.87 additional acres. In 1989, the permit was revised to include a notice of corporate reorganization.

Since the initial issuance of the landfill permit, Celanese has performed routine groundwater monitoring in accordance with state requirements. Due to statistically significant increases for specific conductance over calculated background, Celanese entered into VDEQ-required Phase II monitoring in July 1996. Due to geological complexities affecting water quality, Celanese proposed and VDEQ subsequently approved the installation of a new monitoring well network to establish water quality conditions solely within the dolomite bedrock at the landfill. Quarterly sampling and statistical evaluations were implemented including the first year establishment of background water-quality conditions within the new monitoring well network.

At the end of 2000, Celanese submitted Phase II results indicating that it was appropriate to revert to the Phase I parameter program. Celanese proposed to VDEQ to allow the performance of a modified Phase I program utilizing alternative statistical techniques. Celanese continued with Phase II monitoring and reporting pending a response from VDEQ. In January 2003, Celanese submitted a letter to VDEQ proposing groundwater protection standards. Celanese also submitted a revised permit 207 Groundwater Monitoring Plan to VDEQ. VDEQ requested that Celanese amend

Permit 207 to include this information as Modules I, X and XI. This was considered a Major Permit Amendment. VDEQ reissued the permit in January 2006.

During the 1993/1997/2003 site-wide groundwater sampling events, groundwater samples were collected from monitoring wells in the Landfill Area for a comprehensive list of constituents including metals, organics, volatile organics, and field parameters.

During the 1993 and 1997 events, two organics (BEHP, benzene) and four inorganics (antimony, arsenic, iron, and manganese) were detected at concentrations greater than risk-screening criteria in one or more locations. The organic constituents were non – detect during subsequent verification sampling events. During the 2003 monitoring event, no groundwater constituents were detected at concentrations greater than risk screening criteria. Celanese has invested substantially in redeveloping many of the Landfill Area monitoring wells so that they can produce low-turbidity representative groundwater samples. As a result, the only constituents that are routinely detected in the Landfill Area wells are low concentrations of naturally occurring metals such as zinc and manganese.

The CPSL has been designated as a separate SWMU although it is located within the Permit 207 Landfill boundary and is discussed in detail in the following section. Several groundwater monitoring wells in the vicinity of the CPSL have detected constituents that have migrated from the CPSL. The extent of these constituent concentrations is limited to the shallow discontinuous water-bearing zone immediately downgradient of the CPSL. Celanese has defined the lateral and horizontal extent of this plume and is currently implementing a VDEQ approved Corrective Action Groundwater Monitoring Program to address these constituents. Because the CPSL constituents are limited in their extent and are being monitored and assessed under a specific VDEQ-regulated program, they have not been included in the general water-quality discussion above.

3.20.2 Corrective Action

Celanese is performing groundwater monitoring at the Permit 207 Landfill in accordance with VDEQ solid waste regulations. No known releases to the environment have occurred and no past remedial activities have been required or conducted other than the CPSL and Ammonia Flow, which are designated as SWMU-19C and AOC-8, respectively. Since this SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-19B is eligible for No Further Action status.

3.21 SWMU-19C (Closed Process Sludge Landfill)

3.21.1 Status

The Closed Process Sludge Landfill (CPSL) is an inactive landfill cell located in the southwestern portion of the Permit 207 Landfill (Figure 2-1 and 3-1). Historically, the CPSL was used for landfilling of waste process sludge from production operations. The CPSL is approximately one acre in size and was built in a topographic low coincident with an old streambed. The unit was constructed in 1943 and was closed in 1968. The CPSL was constructed in stages by building a toe berm and disposing of sludge until capacity was reached. The toe berm was then raised and the process was repeated. The sludge within the cell ranges up to 40 feet thick with a total volume of approximately 20,000 cubic yards. The cell was closed in 1968 and a two-foot earth fill cover layer was installed. In the 1980s, a clay soil cap was placed on the cell to control surface erosion and limit surface water infiltration. Based on the detection of seep outbreaks located on the face of the CPSL berm, an HDPE composite cap was placed on the cell and surface water was diverted to swales located along the perimeter of the landfill. These swales converge at the toe of the CPSL. A perennial groundwater discharge/stream channel flows adjacent to and along the west side of the CPSL. This stream flow turns abruptly east in the vicinity of the toe of the CPSL and enters a channel that conveys this water south toward the New River. However, this flow infiltrates and dries up completely approximately 1000-ft south of the toe of the CPSL.

In 1999, bacterial blooms were observed during a routine inspection and subsequent sampling efforts indicated the presence of high chemical oxygen demand (COD) within the surface water immediately downstream from the CPSL. Celanese initiated a Phase I evaluation of conditions at the CPSL including rudimentary surface water balance calculations, installation of piezometers within and outside of the CPSL, and collection of surface water and groundwater samples for characterization. It was determined that the sludge within the CPSL is saturated, and contaminated fluids are migrating beneath the toe berm within a 15 foot-thick permeable zone, mixing with groundwater and "day lighting" at the toe of the CPSL and/or along the course of the ditch. A surface water sample was collected approximately 100 feet downstream from the toe of the CPSL that contained acetic acid and an elevated COD detection (30 mg/L). Fluids within the CPSL contained acetic acid, MEK, benzene, acetone and COD concentrations approached 300,000 mg/L. At the toe of the CPSL, COD was detected at a concentration of 30,000 mg/L in surface water.

Celanese entered into discussions with VDEQ concerning these observations and a Consent Order was negotiated and signed in 2000, which required Celanese to perform an investigation into the causes for the observed conditions and to implement corrective actions to mitigate environmental impairment. Celanese submitted a workplan to VDEQ in November 2000 for supplemental field investigation activities and the performance of a human health and ecological risk assessment. VDEQ approved this workplan and the fieldwork commenced in spring 2001. The fieldwork was completed and an Environmental Investigation/Remedial Alternative Analysis Report was submitted to VDEQ in March 2002. The risk analysis concluded that the existing constituent concentrations do not result in an unacceptable risk to human health or the environment. However, exposure to the naturally occurring bacteria could induce temporary gastrointestinal distress in humans. Therefore, exposure to surface water containing the bacteria should be controlled. The report also presented a recommended remedial alternative for implementation, which included stream realignment; stormwater management improvements; channel improvements; and, groundwater investigations/monitoring.

In August 2003, VDEQ verbally accepted Celanese's recommended remedial approach and requested a written addendum to the March 2002 report. An addendum summarizing the proposed remediation plan was submitted in September 2003. During a 21 January 2004 conference call, VDEQ agreed to approve the proposed remediation plan if Celanese would commit to the remediation of the CPSL being managed within Permit 207 and the Solid Waste Regulations. In January 2006, a revised permit was issued which included Corrective Actions for the CPSL and required the corrective actions be addressed in accordance with VDEQ solid waste regulations. Celanese agreed to this approach and has implemented the process of remediating the CPSL within VDEQ solid waste regulations. Construction plans illustrating the stream realignment; stormwater management improvements; channel improvements; and, groundwater investigations/monitoring are presented as Figures 3-1, 3-2 and 3-3.

3.21.2 Corrective Action

The Permit 207 Landfill permit was revised in January 2006 to include Corrective Action of the CPSL in accordance with the VDEQ Solid Waste Corrective Action Regulations. The CPSL is currently being remediated under the VDEQ solid waste regulations.

Remedial construction activities are scheduled to be completed in 2006; environmental monitoring is scheduled to continue.

Since this SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-19C is eligible for No Further Action status.

3.22 SWMU-19D (Area D Waste Disposal Pit)

3.22.1 Status

The Area D Waste Disposal Pit is a small area (less than one acre in size) that was located in the eastern portion of the Permit 207 Landfill (Figures 2-2 and 3-4). This landfill was reportedly used for disposal of oily wastes.

This area has been investigated because it was identified as a potential source for low ppb-levels of chlorinated organic constituents detected in deep production wells located downgradient in the Plant Area. Specifically, Celanese initiated an assessment as to the potential source(s) of the chlorinated organic constituents detected in the deep production wells. All of the 60+ monitoring wells located within the Plant Area are installed to a depth of less than 100 feet and no chlorinated organics have been detected (except for MP-28 and MP-43). A groundwater modeling effort was utilized to "back-calculate" the potential location of a source area. This analysis suggested that a potential source could exist in the Landfill Area. Through records review and interviews, it was determined that a small basin or trench (referred to as Area D) had existed in the 1950 through 1970s where "liquid" wastes had been disposed. Disposed liquids may have included lubricants and oils. The identified location of Area D was consistent with the model predicted results.

During the 2006 DOCC file review, additional information was gathered from Celanese records, which also supports the previous assessment. This information indicated that a portion of the Permit 207 landfill was formerly used by the Virginia Power and Railroad as a landfill. The landfill was primarily used to dispose of fly ash from their power plant. Celanese purchased the land from Virginia Power and Railroad in the late 1950s or early 1960s after they went out of business. A file report indicated that around the same time period, the Virginia Garage disposed of old car parts and miscellaneous material in the same area.

During 2001, Celanese completed a soil and groundwater investigation within Area D to determine whether chlorinated organics, representing a continuing source, still exist. Soil gas samples were collected/analyzed, soil borings were installed and soil samples were collected/analyzed, and monitoring wells were installed and groundwater samples were collected/analyzed (ARCADIS 2001). Sample locations are shown on Figure 3-4. Organic constituents (1,1-DCA, 1,1-DCE, cis-1,2-DCE, PCE, TCE, chloroform and methylene chloride) were detected at low levels in the environmental samples analyzed. These same constituents have also been detected in the production wells. However, the investigations did not identify "high" constituent concentrations in the vicinity of the former disposal pit that would account for the constituent concentrations detected in the Plant Area Production Wells. However the results provided evidence that Area D may have been used for disposal of organic wastes. The results suggest that any organic and/or oily wastes that were reportedly disposed within Area D have likely migrated vertically downward within a relatively small area and that lateral migration was limited. The constituent concentrations observed within Area D environmental media were not great enough to account for dilution and attenuation that will occur during migration to support the low level detections at the production wells. Additional investigations such as soil borings and groundwater monitoring wells would not likely intercept the actual disposal pit and/or identify areas of separate phase organic and /or hydrocarbon liquids and were therefore deemed not warranted.

3.22.2 Corrective Action

Since this SWMU is being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and SWMU-19D is eligible for No Further Action status.

3.23 SWMU-20 (RCRA Less than 90-Day Accumulation Tank – Building 2 MEO)

3.23.1 Status

Celanese stores acetone waste contaminated with mesityl oxide (MEO) in a 3000-gallon AST on the southwestern side of Building 2.

3.23.2 Corrective Action

No known releases to the environment have occurred and no past remedial activities have been required or conducted. This tank is designed with secondary containment. No further action is requested.

SWMU-21 (Former 1950s Era Disposal Areas)

3.23.3 Status

Plant records indicate that several disposal areas utilized in the 1950s are located in the area south of Fly Ash Pond 2 and north of the railroad tracks in the western portion of the Plant Area (Figure 2-1). The records indicate that the main portion of this SWMU was used for disposal of white sludge and fly ash. These areas were closed between 1954 and 1960. The southern portion of this SWMU was used for disposal of white/brown sludge, flake, bands, and burnable trash and was closed in 1955. In the western portion of this SWMU, a former sedimentation pond was used for disposal of fly ash and refuse and was filled in and closed between 1967 and 1968 (Westinghouse Environmental and Geotechnical Services [Westinghouse] 1989).

Groundwater has been characterized in several wells located adjacent to this SWMU. The 1999/2003 risk assessment concluded that there was not an unacceptable risk to human health and/or the environment. A VDEQ-approved post-closure fly ash monitoring plan has been implemented to monitor groundwater and surface water in the vicinity of the Fly Ash Ponds, which is adjacent to SWMU-22 (Draper Aden 2002). The analytical results of Year 1 (February 2006) monitoring indicated that groundwater and surface water have not been adversely impacted (ARCADIS 2006).

In the vicinity of the eastern portion of this SWMU, groundwater constituents were not detected at concentrations greater than risk-screening levels except for a detection of chloroform in one sample (MP-45) in 1997.

3.23.4 Corrective Action

This SWMU will be retained and managed under the RCRA Facility Lead Program.

3.24 SWMU-22 (White Sludge Pond A)

3.24.1 Status

A surface impoundment that was used for disposal of white sludge is located south of the railroad tracks in the Plant Area. This area is between White Sludge Pond B (SWMU-11) and White Sludge Disposal Area B/C (SWMU-25) between the railroad tracks and the New River. White Sludge Pond A contains approximately 20,000 to 30,000 cubic yards of white sludge with some fly ash. The pond operated from 1965 to 1967, was abandoned in 1967, and closed one to two years later, in approximately 1969 (Westinghouse 1989).

During previous site-wide groundwater sampling events in 1993/1997/2003, six organics (acetone, acetonitrile, 1,2-dichloroethane, benzene, styrene, and BEHP) and four inorganics (antimony, arsenic, barium, and nickel) were detected in one or more groundwater samples at concentrations greater than risk-screening criteria. These detections were from monitoring wells near SWMU-24. The 1999/2003 risk assessment concluded that there was not an unacceptable risk to human health and/or the environment. The 1993/1997/2003 groundwater quality data are presented in Appendix C.

3.24.2 Corrective Action

This SWMU will be retained and managed under the RCRA Facility Lead Program.

3.25 SWMU-23 (White Sludge Disposal Area B/C)

3.25.1 Status

This SWMU was used for disposal of white sludge and is located south of the railroad tracks in the Plant Area, east of White Sludge Pond A (SWMU-24) between the railroad tracks and the New River. White Sludge Disposal Area B/C contains approximately 100,000 cubic yards of white sludge solids removed from White Sludge Ponds B & C. This disposal area was covered in 1965(Westinghouse 1989).

In the vicinity of White Sludge Pond A (SWMU-26) and White Sludge Disposal Areas B/C (SWMU-27), several organic and inorganic constituents were detected at concentrations above risk-screening criteria as discussed above. The 1999/2003 risk assessment concluded that there was not an unacceptable risk to human health and/or the environment.

3.25.2 Corrective Action

This SWMU will be retained and managed under the RCRA Facility Lead Program.

3.26 AOC-1 (Untreated Wastewater Discharge – February 1991)

3.26.1 Status

On 1 February 1991, approximately 55,000 gallons of untreated wastewater with an approximate benzene concentration of 5 ppm accidentally discharged to the New River from Outfall 001. The release occurred when the wastewater overflowed an influent bar screen, and eventually discharged from a drainage ditch to Outfall 001. At the time, Celanese's wastewater was classified as a hazardous waste because it contained benzene. Since a large volume of non-contact cooling water was discharging at the time, benzene concentrations were predicted to be diluted to 0.05 ppm (Feuerbach 1991). The bank of the river below the outfall was inspected after the release and showed no evidence of environmental impact. Soil samples from the drainage ditch were determined to be non-hazardous.

3.26.2 Corrective Action

This AOC will be retained and managed under the RCRA Facility Lead Program.

3.27 AOC-2 (Isopropyl Alcohol Overflow – December 1991)

3.27.1 Status

On 5 December 1991, approximately 500 gallons of isopropyl alcohol accidentally overflowed at a pumping station east of Building 10. The release occurred from a pump seal failure during material transfer. The spill was contained to a gravel area by the pumping station. The March 2006 Site Visit Report (USACE 2006) stated that the spill occurred on 6 December 1991, but a review of the Celanese files confirmed that the spill occurred on 5 December 1991 (CVLC 1992).

Celanese retained CVLC to investigate the spill. Soil sampling and organic vapor screening was performed from 6 December to 7 December 1991 to determine whether the soil was contaminated and to delineate the extent of the contamination. From 8 December to 11 December 1991, approximately 60 cubic yards of soil and gravel were excavated and containerized in drop-off trailers. The area was backfilled with crusher run, tampered, and covered with a few inches of gravel.

Letter correspondence from the Virginia State Water Control Board to Virginia Department of Waste Management states that isopropyl alcohol is not a hazardous substance and not regulated under Virginia Underground Storage Tank Regulations (Miles 1991).

3.27.2 Corrective Action

This AOC has been investigated and remediated. No further action is requested.

3.28 AOC-3 (Production Wells 7 & 9)

3.28.1 Status

A series of deep on-site production wells extract groundwater from the carbonate bedrock at depths up to 400 feet below land surface for potable and industrial use. Currently, these wells are managed by Duke Energy Solutions of Narrows, LLC. Per requirements of the Giles County Health Department, groundwater samples have been collected over the past 15 years.

Several organic constituents have been detected in the Plant Area production wells in concentrations approaching risk-based criteria. These constituents include bromodichloromethane, chlorodibromomethane, chloroethane, chloroform, PCE, TCE, 11-DCE, and methylene chloride. It is possible that the first four constituents listed above, which are common to most of the production wells, but not any other Plant Area monitoring wells, are the result of disinfecting the production wells. These compounds are commonly found in wells that are disinfected. The chlorinated volatile organic compounds were also commonly found in the production wells, but were found in only two other (MP-28 and MP-43) Plant Area monitoring wells. Benzene has been detected in several monitoring wells in the Plant Area east of PW-8 and PW-11. In these production wells, benzene was detected at very low concentrations (< 2 ppb) on only a few occasions.

Based on these detections, Celanese initiated routine periodic monitoring of water-quality at the wells in accordance with the potable well permit conditions. Several of these chlorinated organic constituents are at concentrations approaching groundwater standards. Celanese currently utilizes this water for restrooms, sinks, and showers. During 2001, Celanese performed an evaluation of water quality conditions at the points of exposure throughout the plant, which at the time included fountains, ice machines, sinks, showers and soda fountains. A human health risk assessment was performed in December 2001 to ascertain site-specific risks to Celanese workers. Based on the results of the risk assessment, under 2001 conditions and using the USEPA defined target risk range of 1×10^{-4} to 1×10^{-6}, adverse health effects would not be expected from the long-term exposure to the potable water supply at the Celanese Site. Celanese is in the process of updating the 2001 Potable Well Risk Assessment utilizing data collected between 2001 and 2006.

Celanese initiated an assessment to determine the potential source(s) of the chlorinated organic constituents detected in the deep production wells. All of the 60+ monitoring wells located within the manufacturing area are installed to a depth of less than 100 feet and no chlorinated organics have been detected (except for MP-28 and MP-43). A groundwater modeling effort was utilized to "back-calculate" the potential location of a source area. This analysis suggested that a potential source existed in the Landfill Area. Through records review and interviews, it was determined that a small basin or trench (referred to as Area D) had existed in the 1950 through 1970s where "liquid" wastes had been disposed. Disposed liquids may have included lubricants and oils. The identified location of Area D was consistent with the model predicted results.

3.28.2 Corrective Action

Celanese has completed the Area D investigation. No further activities were recommended based on the results of the Area D Investigations to identify a potential source for low-level chlorinated organic constituents in the deep production wells. For the potable water supply, a monitoring program was implemented to collect water samples at specific exposure points (fountains, ice machines, etc.) within the Plant Area for chemical analysis. A human health risk assessment was performed in 2001 to evaluate the risks associated with human exposure to the water. Celanese also identified and removed all of the drinking water fountains at the Site; bottled water is provided. Sampling data from 2001 to 2006 is currently being evaluated to repeat and confirm that the results of the 2001 potable water supply risk analysis remain valid. Although the operation of the production wells has been transferred to DEGS, Celanese continues to monitor the constituent concentrations in the production wells and the associated human health risk factors.

3.29 AOC-4 (Building 10/11 Area, Thermal Plume/Sewers)

3.29.1 Status

Elevated groundwater temperatures were observed in the Building 10 & 11 Area during routine groundwater monitoring in 1995. This area is located in the southern portion of the Plant Area. In 1995, elevated groundwater temperatures were observed during an investigation in the Former Benzene UST Area (AOC-6) (ARCADIS 2001) where groundwater beneath the adjacent Tank Farm was initially observed as high as 125°F. A review of historical records revealed that during the installation of production well PW-4 elevated groundwater temperatures were observed in the late 1960s. This production well was later abandoned in part because the groundwater was too warm to be used as process water for plant operations. Celanese plant personnel collected additional groundwater temperatures in the vicinity of the Building 10 & 11 chemical process sewers and detected groundwater temperatures up to 98°F in 1968. No report was published and no additional information is known. The 1968 groundwater temperatures are shown on Figure 3-5.

In 2000, a soil and groundwater investigation within the raised Tank Farm & Building 10 & 11 Area was performed to establish the nature and extent of the thermal plume conditions (ARCADIS 2001). The thermal plume is illustrated in Figure 3-5. The assessment indicated that groundwater temperatures had decreased since 1995 but remained as much as 40°F above natural temperature values for groundwater. Elevated temperatures were detected throughout the Building 10 & 11 Area.

The 2000 investigation also identified detections of three organic constituents (acetic acid, acetone, and MEK) in the groundwater (Figure 3-5). (This figure also shows several detections of benzene to the north in the Former Benzene UST Area). Previously, acetic acid, acetone, and MEK constituents were stored in USTs in this area, yet these constituents are also components of the wastewater stream. Celanese closed all known USTs in the early 1990s. Currently, these constituents are stored and processed in ASTs and related equipment in the area. The March 2006 RCRA Site Visit Report (USACE 2006) identified a 5 December 1991 historical release of isopropyl alcohol (approximately 500 gallons) east of Building 10. A total of 60 cubic yards of soil and gravel were excavated in December 1991 (CVLC 1992). This area has been identified as AOC-2 and is discussed in more detail in Section 3.30.

These same groundwater constituents are also being discharged in hot process wastewater effluent collected in chemical sewers located in this same area. Many sections of the chemical sewer were very old and constructed of vitrified clay.

3.29.2 Corrective Action

Previous investigations concluded that it was likely that leakage of hot process wastewater from the chemical process sewers contributed to the elevated groundwater temperatures. Since the late 1990s, several corrective actions have been implemented to reduce groundwater temperatures, which are discussed below:

Underground Acetic Anhydride Pipeline Upgrade: An underground acetic anhydride pipeline existed on site that connected the aboveground storage tanks to the manufacturing process area. Pressure testing performed in 1999, indicated that the underground line was not leaking. However, because this line could not be visually inspected and continued to be a potential source of releases to the soil, an aboveground line was installed. The underground line was emptied, cleaned, isolated, and abandoned in place. The project was completed during September 2001.

The underground acetic anhydride pipeline also had an abandoned section, which branched off from the active pipe at an aboveground valve before it returned underground for about 30 ft. The end of the branch had been cut and blinded years ago. The valve between the active pipe and the inactive branch was in the closed position. The 2000 thermal investigation results suggested that this closed valve was leaking acetic anhydride into the inactive branch. Since the integrity of the abandoned branch could not be visually inspected, it was suspected that the branch could also be leaking.

Further investigation in April 2001 was performed on the closed valve and the 30-ft abandoned section. The valve may have been bleeding acetic anhydride into the abandoned section of pipe because the abandoned section was filled with product when the branch was disconnected from this valve. The valve was then removed and replaced with blinds on both ends of the piping, no longer allowing a connection between the active and inactive pipes. A pressure test performed on the 30-ft section of abandoned pipeline (to determine if acetic anhydride could have leaked from the pipe and contributed to the thermal plume) indicated that the section had not been leaking.

Chemical Sewer and Pipe Relining: The chemical sewer carries process waste flows to the waste treatment plant at elevated temperatures that can exceed 180° F. A section of the chemical sewer was relined in 1997. Samples collected since 1997 from the monitoring wells located near the relined section indicated a reduction in groundwater temperatures. A video inspection was conducted on another section of the chemical sewer system and identified cracks and areas that needed repairs. It was concluded that leaks from the sewer system could be contributing to the elevated groundwater temperatures.

Celanese implemented a project to reline and repair a second section of the chemical sewer which was completed in September 2001. Celanese has continued to improve the chemical sewer system by systematically relining and/or replacing pipe sections and manholes (Figures 3-6 and 3-7). Additional projects to install two manholes, line approximately 675 feet of underground pipe and eleven manholes and reline approximately 270 feet of trench was completed between 2003 and 2005. Figure 3-6 shows the locations of recently completed chemical sewer upgrades and future planned upgrades which are anticipated to be completed by early 2007. These remedial actions are anticipated to substantially reduce and control the leakage from the chemical sewer system. These remedial activities have been reported to the VDEQ annually.

Groundwater temperatures have continued to decline since 1998 (Figure 3-7), but remain above natural groundwater temperatures, which typically range from 55°F to 60°F. Current temperatures are in the mid 60 °F range. The declining groundwater temperatures indicate that relining of the chemical sewer system has had and will likely continue to have a positive effect on reducing wastewater leakage to the subsurface.

3.30 AOC-5 (Fuel Oil Remediation Area)

3.30.1 Status

This area is the location of a former UST which is suspected of leaking fuel oil since free product has been detected. Celanese closed all known USTs in the early 1990s. Within the raised tank farm area, separate phase No. 6 fuel oil was detected at MW-35 in 1995. This area is currently being remediated using absorbent socks and manual removal of fuel oil as necessary.

3.30.2 Corrective Action

Previously, Celanese installed an automated system to recover free product. However, water table fluctuations periodically exceed the elevation range of the recovery system and excessive water and/or no oil was recovered. Consequently, remediation using absorbent socks and manual removal of fuel oil was implemented. Minimal amounts of separate phase oil have been recovered.

3.31 AOC-6 (Former Benzene UST Area)

3.31.1 Status

The former Benzene UST Area is located at the raised terrace northeast of the Ketene process area and includes the closed benzene underground storage tanks (USTs). The location of this activity area is illustrated on Figure 2-1 and 3-8. The Benzene USTs were properly closed and during closure a substantial volume of contaminated soil was removed. Subsequent investigations conducted within the vicinity of two closed USTs indicated the presence of benzene in both soil and groundwater media. Of particular concern was the proximity of production well PW-8, located less than 300 feet to the east of the former benzene USTs. As a result of this concern, various investigative/monitoring activities were completed by ARCADIS (beginning in 1995) to provide an overall evaluation of the nature and extent of the benzene contamination and to develop an appropriate remediation strategy should conditions so require.

ARCADIS initiated field activities in August 1995, which included the installation of additional monitoring wells for use in the collection of soil, vapor, and groundwater samples. As part of this assessment, down-hole instrumentation was utilized to collect water quality data related to the evaluation of intrinsic bioremediation of the benzene contamination. In addition, a pilot vapor extraction test was performed to evaluate the effectiveness of this technology and to determine the off-gases produced. Detailed methodology, results, and conclusions regarding the 1995 investigation were submitted to Celanese in October 1995 in a report entitled Assessment and Environmental Management Strategy for the Closed Benzene Underground Storage Tank Site.

Between August 1995 and 1997 groundwater was sampled and analyzed for volatile organic constituents from a select few wells within the Former Benzene UST Site. A biogeochemical evaluation was performed and indicated that anaerobic conditions prevailed and that degradation of the benzene was occurring through reductive processes. Acetate intermediates, which are present in the groundwater, are the primary carbon food source for the microbial population. This limits the amount of available oxygen and maintains anaerobic or reducing conditions in the soils around the former USTs.

Based on decreasing concentration trends and the analysis of biogeochemical conditions contributing to benzene biodegradation, Celanese adopted a monitored natural attenuation (MNA) approach to the observed soil and groundwater conditions. Routine sampling has been performed since 1996 and concentrations are continuing to decrease. The investigation results are shown in Figure 3-8.

One consequence of the anaerobic degradation of benzene is the formation of methane, which is evident both in terms of aqueous chemistry as well as soil gas chemistry. Methane concentrations have been measured and monitored in the shallow vadose zone in the vicinity of the former benzene UST area.

The existing information suggests that the presence of acetate intermediates is acting as the primary carbon source for microbes. The acetate intermediate substrate is an excellent substrate for microbial growth, and is being utilized as a food source for the anaerobic degradation of benzene. Given these methanogenic (fermentive) conditions, benzene is transformed into carbon dioxide and methane. As long as there is a continuous source of acetate intermediates, the in-situ biodegradation process will likely remain anaerobic and methane will continue to be produced.

3.31.2 Corrective Action

Previous investigations demonstrated that in-situ biodegradation of benzene is occurring and that MNA has reduced the size and controlled the migration of the benzene plume. MNA monitoring is scheduled to continue.

3.32 AOC-7 (Tank Farm)

3.32.1 Status

The Tank Farm is located in the southern portion of the Plant Area, near the parking lots and main entrance to the plant. This area is a raised terrace that contains ASTs, which hold chemicals used in the manufacturing process. These chemicals include acidic acid, glacial acetic acid, and acidic anhydride. Historically, chemicals were stored in USTs within the raised terraced Tank Farm. Celanese closed all known USTs in the early 1990s. The Tank Farm contains ASTs with secondary containment. There is some history of incidental spills within the Tank Farm; however, no major environmental impacts from the Tank Farm ASTs have been identified.

3.32.2 Corrective Action

Known contamination within the Tank Farm Area, identified at two former UST areas (Former Fuel Oil UST Area and former Benzene UST Area) are being remediated separately (AOC-5 and AOC-6).

3.33 AOC-8 (Landfill Ammonia Flow)

3.33.1 Status

The Landfill Ammonia Flow Area is on the eastern boundary of the Permit 207 Landfill north of Route 460. This AOC consists of a stormwater conveyance pipe located beneath Permit 207 landfill cells which discharges (i.e., Outfall 005) to an earthen ditch below the landfill sedimentation pond. This 24-inch diameter conveyance pipe was installed in the 1950s and was constructed of sections of corrugated metal pipe and reinforced concrete pipe. Elevated concentrations of ammonia were measured in the discharge water at Outfall 005. In July 2000, VDEQ issued a Landfill Compliance Inspection Report that stated that the presence of ammonia in water at Outfall 005 was considered leachate. The July 2000 report also stated that leachate from a solid waste management unit shall not be allowed to discharge or drain into surface water except when authorized under a VPDES permit. The July 2000 report also required Celanese to submit a Plan of Action to address the discharge of ammonia within 30 days. Celanese conducted numerous evaluations to determine whether the source of the ammonia in the stormwater outfall flow was from infiltrating surface water or intruding groundwater. These findings were presented to VDEQ on 19 July 2005, with subsequent consensus that the water from the pipe is impacted subsurface groundwater flow and not leachate. Celanese has initiated corrective actions to address the discharge of ammonia to the New River. These actions are discussed below.

3.33.2 Corrective Action

Previously, Celanese submitted a multi-step plan to VDEQ to implement corrective actions to identify and evaluate potential remedial alternatives that would reliably and effectively control and manage the ammonia discharge. Most of these corrective actions have been completed and are summarized here.

Celanese evaluated the integrity of the storm pipe which runs beneath the landfill through use of a video camera. The camera was only able to access pipe in small sections, which suggested the pipe integrity is compromised. A study of the ammonia flow discharge was performed to compare the flows against infiltrating precipitation. In order to reduce the quantity of storm water flowing through the underdrain pipe, a project was initiated to cap the entrance to the upstream pipe inlets and divert upstream flow around the landfill through surface water channels at the perimeter of the landfill. This project was completed in 2004.

After the diversion project was completed, an additional study was performed to determine the effects of the diversion. The average flow amounts were substantially higher. Modeling was performed of potential infiltration through the landfill to establish the potential flows which could be generated through infiltration. The results of this study indicated that the flow from the pipe exceeded potential infiltration. It was concluded, with VDEQ concurrence, that the pipe discharge was the result of intruding groundwater.

Additional surface water monitoring at three locations was performed, which suggested that ammonia concentrations are significantly reduced with distance from the outfall. Celanese is working with VDEQ to remedy this issue.

4. Nature and Extent of Contamination

Celanese has proactively performed dozens of environmental investigations, which were described in Section 1.4 (Historical Environmental Investigations). In Section 3 (SWMU/AOC Status), the nature and extent of contamination at individual sites was described based on data collected during previous investigations.

The intent of this section is to describe the nature and extent of contamination from a site-wide or global perspective. As part of this discussion, the existing monitoring well network is described, the robustness of chemical data and potential impacts to media of concern are evaluated, potential pathways of contaminant migration are introduced, and major areas of focus are defined.

4.1 Monitoring Well Network

Over 100 monitoring wells have been installed during previous Celanese investigations (Figure 2-6). There are at least 50 different wells in both the Plant Area (Figure 2-1) and Landfill Area (Figure 2-2). Well construction details are presented in Appendix B.

In the Plant Area, groundwater monitoring wells are either screened in the alluvial/residuum material or in the deeper dolomite aquifer; some of the well screens extend across both units. As discussed in Section 2.5.4 (Local Groundwater Flow), these units are hydraulically connected and function as a water-table aquifer. In the Landfill Area, groundwater monitoring wells are either installed in clastic rock, dolomite rock or the Narrows fault zone. A shallow discontinuous water-bearing zone has been identified in the vicinity of the CPSL. A few landfill area monitoring wells are screened in the water-bearing portion of this colluvium/alluvium material.

Some of the site groundwater monitoring wells have either been abandoned or are no longer in use; these wells are noted in Appendix B and are shaded gray in the figures.

4.2 Media of Concern

4.2.1 Groundwater Quality

Groundwater quality samples have been and are currently being collected from various monitoring wells at the Celco Site. For example, there is a routine groundwater monitoring program associated with the Permit 207 Landfill. Also, there is routine monitoring of the plant production wells. In addition, Celanese has conducted three site-wide groundwater monitoring events to evaluate water quality; the first in 1993, the second in 1997, and the third in 2003.

In 1993, RUST collected groundwater samples from Plant Area and Landfill Area wells and analyzed samples for indicator parameters, total metals, dissolved metals and organic constituents. In 1997 and in 2003 groundwater samples were collected from select Plant Area and Landfill Area wells and analyzed for indicator parameters, total metals, dissolved metals and organic constituents. The 1993/1997/2003 groundwater data reflect water quality in the Plant Area from approximately 45 monitoring wells and water quality in the Landfill Area from approximately 22 wells. The basic constituents groups that were analyzed for included:

- Indicator Parameters;
- Metals;
- Volatile Organics; and,
- Semi-Volatile Organics.

Data from the 1993/1997/2003 data set have been used to develop a site-wide profile of groundwater quality. The RUST 1993 total metals data were determined to be non-representative of actual groundwater quality at the site and were, therefore, excluded from the site-wide screening process. This determination was based on the following information. The acid used to preserve the groundwater samples digests metals associated with sediment in the samples. The sampling techniques used in 1993 did not minimize turbidity in the samples, and a comparison of total versus dissolved metals concentrations indicated a significant disparity between these analyses. For the 1997 and 2003 site-wide sampling event, low-flow sampling techniques were used which properly minimize turbidity in samples.

The water-quality data for the 1993/1997/2003 sampling events, as well as other sampling events, have been tabulated and are presented in Appendix C. These tables' present values for those constituents that were detected in each of the groundwater monitoring wells sampled. If a particular constituent is not present in the summary table, that constituent was either not detected or in some cases not analyzed for. Much of the 1993 data has "J" flags attached to the constituent concentrations. A "J" flag attached to a constituent concentration indicates that the value reported is considered an estimate. It appears that much of the 1993 has "J" flags because many of the values were reported at values less than the method detection limit, which is considered an estimated value. These "J" flag data are useable qualitatively, but are not considered as reliable as data without "J" flags. Data reported at less than the method detection limit are often subject to being false positive.

The 1993/1997/2003 sampling data have been reviewed and summarized to present a comparison between sampling events of those constituents that were detected for the Plant Area and the Landfill Area, segregated as organic and inorganic constituents (Table 4-1). Those constituents that were detected at concentrations exceeding the screening level as defined above were bolded. Table 4-1 clearly illustrates that substantially fewer constituents were detected in 2003 compared to the 1993/1997 sampling events and fewer constituents were detected at concentrations exceeding the screening levels. Data posting maps of organic and inorganic detections including concentrations greater than risk-screening levels are presented in Figure 4-1 (Organics) and Figure 4-2 (Inorganics).

The groundwater quality data were screened so that an analysis of risk related to human health and the environment could be performed for those constituents most likely to present a potential risk. The fate and transport and potential impact associated with the constituent concentrations that were detected is discussed in Section 5 (Groundwater Modeling). The risk analysis procedures and findings are presented in Section 6 (Risk Analysis).

4.2.2 Surface Water/Sediment Quality

Individual surface water sampling events have been conducted for investigations related to the CPSL, the closure of Fly Ash Ponds 1, 2 &4 and Outfall 005. Analytical results were discussed in Section 3, where applicable. Discharge to the New River is regulated through the VPDES Permit. Samples are collected at VPDES Permit regulated outfall locations on a routine basis.

4.2.3 Soil Quality

Individual soil sampling events have been conducted. Analytical results were discussed in Section 3, where applicable. Most of the Plant Area is paved, which limits the potential for soil quality to be impacted.

4.2.4 Air Quality

No site-wide air sampling events have been performed as part of the site-wide assessment work performed by Celanese. However, air emissions and air quality is regulated and permitted by USEPA/VDEQ.

4.3 Potential Pathways of Migration of Contamination

4.3.1 Groundwater

In the Plant Area, most areas are paved reducing the potential for surface spills to migrate in the subsurface. Historically, USTs were used at the site and several historical releases have impacted groundwater quality as discussed above. Celanese closed all known USTS in the early 1990s, which significantly reduces the potential for future releases to impact groundwater quality.

Deep groundwater is being used for industrial and potable supply in the Main Plant Area. Chlorinated organic constituents have been detected at low levels and site-specific analysis of these concentrations following USEPA guidelines concluded that the exposure scenarios evaluated do not represent an unacceptable risk. The source of the chlorinated organics has not been identified. Continued monitoring of the production well water and potable supply is being performed by DEGS.

From a global perspective, long-term pumping in the Plant Area has created a large cone of depression (Figure 2-6) that captures and prevents off-site migration of constituents in groundwater. Several off-site potable wells are located in the vicinity of the Celco Site as shown in Figure 2-7 and discussed in Section 2.5.2 (Regional and Local Groundwater Use). The nearest off-site potable well is at least 0.5 miles away. There are no off-site potable wells downgradient from the Celco Site, in part, because the New River serves as a regional discharge for groundwater.

4.3.2 Surface Water

In the Plant Area, surface water discharges to the New River, an unnamed tributary of the New River, or Still-house Branch through permitted outfalls regulated under the VPDES Permit. The majority of historical releases reviewed tended to flow toward permitted outfalls by way of drainage ditches and/or stormwater sewers (USACE 2006). A Stormwater Pollution Prevention Plan, Spill Prevention and Countermeasures Plan, and Oil Discharge Contingency Plan are in place and have resulted in increased engineering controls and personnel training to reduce the potential for surface water migration of contaminants.

Celanese discharges approximately 70.3 MGD (average) to the New River, which is a relatively quick-moving river with flows reported at 6000 cubic feet per second (3878 MGD) by USACE (2006).

4.3.3 Soil

In the Plant Area, the majority of the exposed areas are either paved or covered with gravel or grass. Therefore, the potential for contaminated soil and day to day exposure to surface soil is minimal. The majority of historical releases tended to flow toward a permitted outfall by way of storm pipes or drainage ditches (USACE 2006). The Plant Area is not in close proximity to residential areas and fencing restricting public access surrounds the property.

In the Landfill Area, solid wastes are disposed of in permitted landfills. Landfill caps and engineering controls minimize the potential for soil migration and exposure.

4.3.4 Air

Because air emissions and air quality is successfully regulated and permitted by USEPA/VDEQ, there is limited potential for contaminants to migrate from the air pathway.

4.4 Major Areas of Environmental Investigation/Remediation

The following areas were identified historically as major areas of environmental concern. Investigations have been performed and remediation has been performed and/or is ongoing for each of these areas.

- SWMU-19c Closed Process Sludge Landfill
- AOC-4 Building 10 & 11 – Thermal Area/Chemical Sewers
- AOC-5 Fuel Oil Remediation Area
- AOC-6 Former Benzene UST Area
- AOC-8 Landfill Ammonia Flow

5. Groundwater Modeling

The 1993/1997/2003 environmental data evaluated indicates that several constituents are present in the groundwater at concentrations that are greater than human health screening criteria. Groundwater withdrawal from the production wells is creating a relatively large cone of depression that serves to provide hydraulic containment for constituents in the subsurface for much of the Plant Area. If the production wells were turned off, groundwater flow and discharge would be south to the New River. In order to assess the potential impact associated with human health and environmental exposure scenarios, a groundwater flow model was constructed in 1997 to simulate fate and transport of the constituents in the subsurface under both pumping and non-pumping conditions.

The following objectives and/or goals were developed and served to guide the construction and utility of the groundwater model:

- Simulate groundwater flow conditions observed in October 1997;
- Simulate groundwater flow conditions with Plant Area production wells not pumping;
- Simulate pathway flow lines for constituents in groundwater with and without the Plant production wells pumping;
- Calculate projected constituent concentrations at the discharge point (i.e., New River) along the simulated flow lines for specific constituents with and without the Plant production wells pumping;
- Evaluate whether constituents entering the groundwater in the Landfill Area could potentially migrate to the production wells located in the Plant Area.

The data base indicates that fewer constituents were detected during the 2003 sampling event compared to previous sampling events in 1993 and 1997 and detections were generally at lower concentrations. This observation is illustrated on Table 4-1 Figures 4-1 and 4-2 and discussed in Section 4, Nature and Extent of Contamination. This analysis indicates that the assumptions that were used in 1997 to develop predicted constituent concentrations in the New River with the Production Wells Off remain valid for the 2003 data. Therefore, the predicted constituent concentrations presented in Section 5.2.5 would be expected to be the same and/or lower using the 2003 data and as such were not recalculated.

5.1 Groundwater Model Construction

The USGS program MODFLOW was used to simulate groundwater flow rates and water-table elevations at the Celco Site, assuming steady state conditions. MODFLOW uses the block-centered finite difference method, which converts the governing differential equations based on Darcy's Law into a series of algebraic equations by dividing the spatial domain into a grid of discrete blocks within which all parameters are assumed constant. The grid used for the Celco Site model had 50-foot spacing in the north and south directions and included two layers. The water-table aquifer exists throughout the model in Layer One, which includes all of the subsurface above a bottom elevation of 1486 ft msl (approximately 90 feet). Layer Two extends the model down to 1236 ft msl (approximately 250 feet) to account for the deeper flow system.

Groundwater is allowed to enter and leave a model through cells with specified boundary conditions. Sources of groundwater recharge in the Celco Site model included infiltration from precipitation on the land surface, the fly ash ponds, and some areas of the New River upstream of the plant. Groundwater discharged to the New River and into the production wells. The model parameters (e.g., hydraulic conductivity) were calibrated to site conditions by matching the simulated water-table elevations with 52 point measurements from monitoring wells located in the Plant and Landfill Areas.

5.2 Model Simulations

5.2.1 Simulated Water Levels

The water levels simulated by the calibrated groundwater flow model are shown in Figure 5-1 for Layers One and Two. The water elevations in Layer One represent the water table, whereas the Layer Two elevations represent head levels in the deeper flow system. The shape of the water table is controlled by boundary conditions and the zonation of hydraulic conductivity. Steepened gradients occur where hydraulic conductivity is low and groundwater drains away slowly, while relatively flat areas occur where hydraulic conductivity is high and faster flow occurs. Figure 5-1 does not show water-level contours above 1550 ft msl because the water-table gradient is so steep that the contours would be too close together above this elevation.

5.2.2 Pathline Analysis

Low concentrations of chlorinated organic constituents have been detected in Plant Area production wells. One potential source for these organic constituents that was investigated was the Area D Disposal Pit (SWMU-19D) in the Landfill Area. Therefore, one purpose for developing this groundwater flow model was to evaluate whether constituents entering the groundwater in the Landfill Area could potentially migrate to the production wells located in the Plant Area. In order to quantitatively answer this question with solute transport modeling, a particle-tracking simulation was conducted to illustrate the simulated direction of flow from Landfill Area. Particles were started in a circle at the water table centered at the Area D Disposal Pit. The simulations illustrate that the resulting pathlines, all ultimately discharge into PW7 during both pumping and non-pumping conditions (Figure 5-2). All pathlines descend from Layer One into Layer Two approximately half way along their trajectories. It can be concluded from this pathline analysis that constituents entering the water table at the suspected source area within the landfill do have the potential to impact the production wells.

5.2.3 Advective Transport Simulation

Pathlines from the particle tracking analysis illustrate groundwater flow directions. However, because of dispersion, dilution from recharge, and variations in flow velocity, pathlines provide only a qualitative picture of solute transport. Thus, a steady-state advective transport simulation was employed to assess whether the chlorinated organic constituents observed in the production wells could be due to transport of constituents dissolved in groundwater from the Landfill Area. A proprietary steady-state transport code was used for this simulation, which began with a reverse advective transport analysis. Given the flow field produced by the groundwater flow model, this analysis provided for each model cell the fraction of groundwater discharging to a particular well that also passes through that cell.

The analysis was applied to four of the production wells (PW7, PW9, PW11 and PW12). Well PW8 was utilized intermittently and therefore was excluded from this simulation. Groundwater from the cell representing the suspected source area (i.e., Area D Disposal Pit) constituted 6×10^{-4} of the discharge into PW7. This was the highest fraction among the four production wells. Second was PW9, with roughly 2×10^{-4} of its flow originating in the source area cell. The fraction of discharge originating in the source area cell was more than an order of magnitude lower for PW11 and PW12, because these cells ultimately derive most of their production from the New

River. A dilution factor of 6 x 10^{-4} for groundwater traveling from the suspected source area to PW7 indicates, for example, that the maximum observed PCE concentration of 0.0031 mg/L in PW7 would require a modeled source area concentration of 5.2 mg/L . Section 3.22, SWMU-19D, Area D Waste Disposal Pit presents the results of the Area D Investigations and discusses the conclusion that Area D is not a continuing source large enough to be the cause of the chlorinated organic concentrations observed in the plant production wells.

5.2.4 Simulation With Production Wells Off

The groundwater flow model was run with the production wells turned off to predict the fate and transport of constituents under non-pumping conditions. Figure 5-1 illustrates the resulting head contours at a one-foot interval up to 1550 ft msl for Layers One and Two. Turning the production wells off had a minimal effect on the simulated water levels in the low-conductivity zones near the western and northern model boundaries (where contours are not shown because they are too close together). However, the simulation allowed head levels to increase in the high-conductivity region (especially in Layer Two) so that groundwater discharges to the river throughout the model domain.

A new particle tracking analysis was applied to the flow model with the production wells turned off to illustrate groundwater flow directions in the absence of pumping. Figure 5-2 shows the resulting pathlines, which all travel more-or-less directly from the suspected source area (where particles were started at the water table) to the river south of PW7.

The advective solute transport code was applied to the model with the production wells turned off to predict the fate and transport of constituents under non-pumping conditions. This yielded the fraction of groundwater in each model cell that originated in a single cell representing the suspected source area. These volume fractions can be interpreted as dilution factors for calculating a simulated concentration at a given point in the model grid based on an assumed source concentration. For example, the highest simulated PCE concentration in the Layer One cells discharging to the river under non-pumping conditions would be approximately 0.0052 mg/L given a modeled source area concentration of 5.2 mg/L

5.2.5 Simulation of Constituent Discharges to the River

Constituents in groundwater at the Site can enter the New River through natural groundwater discharge and potentially impact river water quality. In general, impacts to surface water from constituents in discharging groundwater are rare and seldom significant because of the large dilution of groundwater discharge by surface water flowing from upstream. Nevertheless, the groundwater flow model was used to quantitatively simulate the incremental concentrations in the New River resulting from discharge of constituents known to exceed criteria in groundwater on the Site.

The first step in this analysis was to divide the New River into four reaches or discharge panels along the border of the Site. This was based on the directions of groundwater flow and the observed distribution of constituents in groundwater, such that each panel had distinctive discharge quantity and quality properties. Figure 5-2 shows the locations of the four panels, which are numbered one through four from upstream to downstream. A proprietary post-processing code was used to extract from the MODFLOW output files the total volume rate of groundwater discharge through each panel.

The concentration of each constituent in this discharge was assumed to equal the highest measured concentration among the monitoring wells on pathlines discharging through that panel. This approach represents a hypothetical screening scenario that, is most conservative for two reasons: (1) natural attenuation of constituent concentrations between the monitoring wells and the discharge points is not considered, and (2) all the groundwater discharging through a panel is assumed to contain each constituent at the highest concentration found anywhere in the region of the Celco Site that discharges groundwater through the panel.

Both pumping and non-pumping scenarios were considered in this analysis. Forward pathlines starting at all the monitoring wells where measured constituent concentrations exceeded criteria are shown on Figure 5-2 for pumping and non-pumping conditions.

Under pumping conditions, groundwater flows along pathlines from monitoring wells to the production wells when they are pumping, indicating that none of these pathlines discharge to the New River. Therefore, with the production wells on, the mass loading to the river and thus the incremental concentrations in the river is zero for constituents in all four panels.

Under non-pumping conditions, groundwater flows along pathlines from monitoring wells and discharges to the river along the southern shore of the Plant Area when the production wells are not pumping. No pathlines from monitoring wells discharge to Panel One (upstream along the eastern shore of the Plant Area and the steep hillside beneath the Landfill Area. Therefore, the simulated mass loading to the river is zero for all constituents in Panel One. Panel Two receives discharge from the southeast corner of the Plant Area, in the vicinity of production wells PW8, PW11, and PW12. Panel Three receives discharge from the center of the Plant Area (in the vicinity of PW7). All pathlines from the Landfill Area monitoring wells also discharge through Panel Three. Pathlines from PW9 and the other wells at the western end of the Plant Area discharge through Panel Four.

An incremental concentration in the river water due to discharge of groundwater for each constituent greater than groundwater criteria beneath the Celco Site was calculated. The parameters used in this calculation and the resulting projected river water concentrations are shown in Table 5-1. The first step was to calculate a loading rate, in units of constituent mass per time, for each constituent in each panel. This was accomplished by multiplying the highest concentration observed in the panel by the volumetric discharge rate from the panel. Then, for a given constituent, the loading rates from all panels were added to give a total loading rate to the river for that constituent. This loading rate was divided by the volumetric flow rate of the river at the site to provide a concentration in river water.

The 7Q10 river flow was estimated to be 777 cubic feet per second (cfs) or 1.9 x 109 liters/day based on data from the USGS gauging stations on the New River at Glen Lyn, Virginia and Wolf Creek, Virginia. Glen Lyn is the nearest station downstream of the site, with an average flow of 800 cfs. Wolf Creek is the only tributary between the site and Glen Lyn, with an average flow of 23 cfs. Thus, subtracting the Wolf Creek flow of 23 cfs from the downstream New River flow of 800 cfs provided the 777 cfs value for the flow of the New River past the Celco Site.

The only constituents whose projected incremental concentrations in river water due to groundwater discharge from the Site are greater than one μg/L are iron and manganese (Table 5-1).

Tables 4-1 and Figures 4-1 and 4-2 illustrate data that indicate that fewer constituents were detected during 2003 compared to 1993/1997 and generally at lower concentrations. Therefore, the assumptions that were used in 1997 to develop predicted constituent concentrations in the New River with the Production Wells Off remain valid for the 2003 data. Also, the predicted constituent concentrations would be expected to be the same and/or lower using the 2003 data and as such were not recalculated.

6. Risk Analysis

During the period 1997 through 1999, Celanese prepared a site-specific quantitative risk assessment that addressed human health and environmental risk across the entire Celco Site utilizing site-wide data collected in 1993 and 1997. The risk assessment was qualitatively evaluated and updated in February 2005 utilizing site-wide data collected in 2003. The results of the risk assessment(s) are presented in this DOCC Report. It should be recognized that the risk assessment was prepared using USEPA/VDEQ guidance that was current and available during the 1997/1999 time period. Celanese recognizes that regulatory guidance and methodologies for preparing risk assessments has been updated since 1997/1999 and therefore, the existing risk assessment needs to be updated. However, the overall approach to assessing risk at the Celco Site remains unchanged and the results of the existing risk assessment and not expected to change substantially, based on review of the existing database, when current guidance and methodologies are applied.

The 1993/1997/2003 environmental data evaluated indicates that several constituents are present in the groundwater at concentrations that are greater than human health screening criteria. In order to assess the potential health risks, a site-specific quantitative risk assessment was constructed utilizing 1993/1997 data. The results of the risk assessment were originally presented in detail in the Draft May 1999 Site-Wide Groundwater Assessment. A summary of the 1999 risk assessment was presented in the May 2005 Site-Wide Groundwater Assessment (ARCADIS 2005) and is presented again in this DOCC Report. Specifically, this section summarizes the risk assessment methodology and assumptions used to evaluate potential risks posed by constituents detected in groundwater at the Celco Site.

As discussed in Section 7, Conclusions and Recommendation, Celanese has proposed to update the risk assessment utilizing more recent site-wide data to be collected as part of the RFI process and the current regulatory guidance available at that time.

The risk assessment considered potential human health and screening-level ecological risks posed by constituents detected in groundwater. The risk assessment was conducted to evaluate whether constituent concentrations in environmental media pose a threat to human health, and to establish human health risk-based concentrations (RBCs) for constituents that potentially pose a threat to human health. Included in the risk assessment was an evaluation of the potential risks to ecological receptors at the Celco Site.

The risk assessment methodology was based on USEPA guidance for baseline risk assessments (USEPA 1989a; 1991a; 1991b; 1992a; 1992b; and 1992c). Earlier sections of the report describe the Celco Site and surrounding area, the site history, geology, hydrogeology, and data collected during the various site investigation activities; that information is not repeated in this section.

6.1 Constituent Characterization

The selection of constituents of potential concern (COPCs) for the human health risk assessment was based on the comparison of the maximum detected concentrations in the 1993/1997 data set with the appropriate screening level. The purpose of the COPC selection process was to focus the risk assessment calculations on the constituents that might pose a potential threat to human receptors, eliminating detected constituents that are unlikely to pose a threat. Constituents that were detected at concentrations exceeding the selected screening levels were retained as COPCs for the human health risk assessment, which are those constituents, included in the site-specific risk assessment calculations.

The 1993/1997/2003 groundwater data were compared with one-tenth the USEPA Region III (1998) RBC for tap water or the federal Maximum Contaminant Level (MCL) if the MCL was lower than the RBC for non-carcinogens. For carcinogenic compounds, the RBC was used to screen the data. A summary of constituent concentrations greater than risk screening levels for wells within the Plant Area (1993/1997/2003 data) are presented in Table 6-1. For 2003 data, only those constituents detected at concentrations greater than screening levels during that year, have concentrations from 1993/1997 presented in Table 6-1. No constituent concentrations were detected during the 2003 sampling event that were greater than risk screening levels for wells in the Landfill Area, exclusive of the CPSL.

6.2 Toxicity Assessment

Toxicity values for potential non-carcinogenic and carcinogenic effects were determined from available databases. When compared to or multiplied by the calculated exposure doses (or exposure-weighted air concentrations for inhalation exposure), these values yield an estimate of the potential risk to human health.

6.3 Exposure Assessment

An exposure assessment was conducted as part of the risk assessment to evaluate the potential human and ecological exposure pathways at the Celco Site. An exposure pathway is defined by the following four elements: (1) a source and mechanism of constituent release to the environment; (2) an environmental transport medium for the released constituent; (3) a point of potential contact with the contaminated medium (the exposure point); and (4) an exposure route at the exposure point. The purpose of the exposure assessment is to estimate the way(s) a population may potentially be exposed to constituents at the Celco Site. This typically involves projecting concentrations along potential pathways between sources and receptors. The projection usually is accomplished using site-specific data and, when necessary, mathematical modeling. Exposure can occur only when the potential exists for a receptor to directly contact released constituents or when there is a mechanism for released constituents to be transported to a receptor. Without exposure there is no risk; therefore, the exposure assessment is a critical component of the risk assessment.

6.3.1 Mechanisms of Migration

There are several potential mechanisms by which constituents may migrate through environmental media. Migration into the air can occur by volatilization; migration into groundwater can occur by percolation of infiltrating rain water; and, following groundwater discharge into surface water, constituents may migrate with the surface water. The mechanisms of migration were considered and incorporated into the risk analysis process for the Celco Site.

At the Celco Site, COPCs dissolved in groundwater would likely discharge into the New River if the active production wells were not controlling groundwater flow. The assessment considered that the pumping wells were not active. In this situation, COPCs dissolved in the groundwater would then likely reach the river and groundwater discharge would occur to the river. Once the constituents migrate into the surface water, substantial dilution would occur, given the volume of water in the river.

6.3.2 Potential Exposure Scenarios

The most likely routes of potential human or ecological exposure to constituents detected at the Celco Site are through direct contact with groundwater or surface water, should constituents reach the New River. Under current conditions, the potential for human and ecological exposure to COPCs at the Celco Site is relatively low. However, the New River is used for recreational purposes and individuals may use the river for fishing or swimming. Therefore, each of these exposure pathways was considered further.

Groundwater at the site is used for production purposes. A portion of the water from the production wells also is used as a water supply. Direct exposure through the ingestion route was not evaluated in the 1999 risk assessment. However, this potential exposure scenario was considered separately in 2001 in a report entitled, Potable Water Supply Risk Assessment, ARCADIS 10 December 2001. Based on the results of the 2001 Potable Water Supply risk assessment, under 2001 conditions and using the USEPA defined target risk range of $1x10^{-4}$ to $1x10^{-6}$, adverse health affects were not expected from the long-term exposure to the potable water supply at the Celco Site. Celanese is currently updating the 2001 Potable Water Supply Risk Assessment using data collected between 2001 and 2006 to verify that adverse health affects are not expected from the long-term exposure to the potable water supply at the Celco Site.

6.3.3 Exposure Assumptions

The following exposure scenarios were included in the 1999 risk assessment:

- Adults ingesting fish caught in the New River;
- Older children ingesting fish caught in the New River; and,
- Older children swimming in the New River.

A conservative assumption underlying all calculations is that the constituent concentrations remain constant over the entire period of exposure. The effects of attenuation processes which would reduce the concentrations over time were not considered. For cancer risk, doses were averaged over a lifetime (70 years). Doses for non-cancer risk were averaged over the exposure period (USEPA 1989a).

6.4 Risk Characterization

This section presents the methodology used to develop the site-specific RBCs that are calculated to be protective of human health associated with exposure to constituents present at the Celco Site. If the maximum concentration from the landfill area, plant area, or production wells is below the calculated RBC, the constituent concentrations do not pose a threat to human health under the assumed exposure conditions.

Risks to human health can be evaluated quantitatively by combining exposure and hazard data. A distinction is made between non-carcinogenic and carcinogenic effects, and two general criteria are used to describe risk: the hazard quotient (HQ) for non-carcinogenic effects; and excess lifetime cancer risk (ELCR) for constituents thought to be potential human carcinogens.

Imbedded within the RBC calculation is the calculated exposure dose. Exposure doses are averaged over the expected exposure period to evaluate non-carcinogenic effects. The HQ is the ratio of the estimated exposure dose and the RfD for oral and dermal exposures, and the ratio of the estimated exposure-weighted air concentration and the RfC for inhalation exposures. An HQ greater than 1 indicates that the estimated exposure for that constituent exceeds the RfD or RfC. This ratio does not provide the probability of an adverse effect as does the ELCR. Although an HQ greater than 1 indicates that the estimated exposure for that constituent exceeds acceptable levels for protection against non-carcinogenic effects, it does not necessarily imply that adverse health effects will occur. The RBC was calculated based on an HQ of 1.

The ELCR is an estimate of the increased risk of cancer which results from lifetime exposure, at specified average daily dosages, to constituents detected in media at the facility. Estimated doses, or intakes, for each constituent are averaged over the expected lifetime of 70 years. It is assumed that a large dose received over a short period is equal to a smaller dose received over a longer period, as long as the total doses are equivalent. The ELCR, equal to the product of the exposure dose and the CSF (for oral or dermal exposure) or the product of the exposure-weighted air concentration and the URi (for inhalation exposure) is estimated for each Class A, B, and C carcinogenic COPC in each medium. The RBCs were calculated based on a target risk of 1×10^{-6} (one in 1,000,000).

6.4.1 Exposure of Adults through the Ingestion of Fish

The New River is used for recreational purposes. Fishing occurs on the river near the Celco Site. Therefore, it is possible for adults to catch fish and ingest the fish as there is no catch and release policy for the river. A source contribution term of 0.5 was used in the calculation under the assumption that 50 percent of the fish ingested by the individual would be caught in the New River.

6.4.2 Exposure of Older Children through the Ingestion of Fish

Older children (ages 7 to 16) also were assumed to fish along the banks of the river. Young children under the age of 7 were not assumed to fish in the river. Adults eat more fish than children do, and young children are not expected to eat as much fish as do older children (USEPA 1997b).

6.4.3 Exposure of Older Children Swimming

The New River may be used for swimming or boating. Individuals boating are not expected to have the same level of contact as are those swimming. Therefore, only the swimming exposure scenario was evaluated quantitatively. It was assumed that individuals ages 7 through 16 years would be the most likely to swim in the river. It was assumed that these children would swim in the river 5 days a week over the 12-week summer (assumed to be June through August).

6.4.4 Comparison of Site-Specific RBCs to Site-Related Concentrations

A comparison of the calculated RBCs with the projected river concentrations calculated using the groundwater model is presented in Table 6-1. None of the projected river concentrations exceed the calculated RBC; therefore, there is not a risk to human health from the exposure scenarios evaluation. Some of the maximum detected groundwater concentrations exceed the calculated RBCs; however, these concentrations would be substantially reduced once groundwater discharges into the river; therefore, this comparison is not appropriate.

Comparison of the calculated RBCs (Table 6-1) to the projected river concentrations (based on 1993/1997 maximum detected groundwater concentrations) shows that the projected river concentrations in most cases are several orders of magnitude below the site-specific RBCs. Table 6-1 also presents the maximum detected groundwater concentration for 2003 compared to the 1993/1997 groundwater data. The results of the 2003 site-wide groundwater sampling demonstrate that overall substantially fewer constituents were detected in 2003 compared to 1993/1997, which in general, were at the same or lower concentration.

The major assumptions utilized in the 1997 groundwater model and the risk assessment remains valid. Therefore, the 2003 groundwater constituent sampling results are consistent with and support the conclusions developed and presented in the

1999 risk analysis. As such a detailed quantitative re-analysis of the risk using the 2003 data set was not performed.

6.5 Ecological Evaluation

The objective of the 1999 screening-level ecological risk assessment (ERA) was to determine whether constituents detected at the Celco Site had the potential to adversely affect the ecosystem at the Celco Site or surrounding areas.

6.5.1 Exposure Assessment

Groundwater from the Celco Site would likely discharge into the New River if the active production wells were not controlling groundwater flow. The assessment considered that the pumping wells were not active. The New River provides a habitat for aquatic life. Aquatic organisms and benthic macro invertebrates may be exposed to constituents through direct contact with surface water, sediment and associated pore water, direct or ancillary ingestion of sediment, or indirectly through ingestion of prey. However, given the very low concentrations predicted to reach the river (during production well non-pumping conditions), there is not expected to be any risk to aquatic organisms from exposure to constituents discharging to the New River.

6.5.2 Comparison to USEPA Region III BTAG Screening Values

The USEPA Region III Biological Technical Assistance Group (BTAG) (1995c) issued conservative screening values to evaluate potential risks to ecological receptors. These values are very conservative (USEPA 1995c), but can be used to identify areas of potential concern. The USEPA Region III BTAG screening values were compared with the predicted river concentrations, and all of the predicted concentrations were below the screening values. Therefore, there was not expected to be any risk to flora or fauna in the river.

6.5.3 Comparison to Water Quality Criteria

The projected river concentrations modeled using on-site groundwater concentrations were all less than state and federal criteria, and USEPA Region IV screening values. USEPA Region IV values were used because at the time USEPA Region III did not have applicable screening values available. Therefore, there was no risk to aquatic life from the potential release of constituents from the Celco Site.

6.5.4 Occurrence of Threatened and Endangered Species

The Virginia Department of Natural Resources Heritage Trust and the United States Fish and Wildlife Service (USFWS) were requested to search each of their databases for the occurrence of special status species at and surrounding the Celco Site (within a 3-mile radius). No threatened and/or endangered species were identified.

6.6 Risk Analysis Conclusions

The human health and screening level ecological risk assessments evaluated potential risks to human health and the environment. Groundwater on the Celco Site is used for production purposes and for potable water supply. Potential human exposure to the potable water supply was considered separately in 2001 in a report entitled, Potable Water Supply Risk Assessment, ARCADIS 10 December 2001. Based on the results of the 2001 Potable Water Supply risk assessment, under 2001 conditions and using the USEPA defined target risk range of $1x10^{-4}$ to $1x10^{-6}$, adverse health affects were not expected from the long-term exposure to the potable water supply at the Celco Site. Celanese is currently updating the 2001 Potable Water Supply Risk Assessment using data collected between 2001 and 2006 to verify that adverse health affects are not expected from the long-term exposure to the potable water supply at the Celco Site.

Groundwater discharges to the New River were evaluated under the production well non-pumping scenario. As a result, potential off-site exposures were considered in the risk assessment. The risk assessment indicates that there is no risk to human health from the potential release of constituents into the river. Recreational users of the river could contact site-related concentrations. Exposure of individuals fishing or swimming in the river was also evaluated. RBCs were developed for these exposure scenarios. The RBCs were compared with both maximum on-site groundwater concentrations and projected river concentrations using the groundwater model. All of the projected concentrations were below the RBCs. Several of the maximum concentrations detected at the Celco Site exceeded the RBCs, but it is highly unlikely that these concentrations would ever reach the river. Therefore, there is no risk to human health from the potential release of constituents into the river.

A qualitative, screening level ecological risk assessment was conducted as part of the risk assessment. The assessment indicates that there is no risk to environmental receptors from the potential release of site-related constituents into the river.

The projected river concentrations were compared with the USEPA Region III conservative screening levels for flora and fauna, USEPA Region IV aquatic criteria, and Commonwealth of Virginia and federal water quality criteria. None of the projected concentrations were greater than levels protective of aquatic life. Therefore, there is no risk to environmental receptors from the potential release of site-related constituents into the river.

The results of the 2003 site-wide groundwater sampling demonstrate that substantially fewer constituents were detected in 2003 compared to 1993/1997, which in general, were at the same or lower concentration. The major assumptions utilized in the 1999 groundwater model and the risk assessment remains valid. Therefore, the 2003 groundwater constituent sampling results are consistent with and support the conclusions developed and presented in the 1999 risk analysis. As such a detailed quantitative re-analysis of the risk using the 2003 data set was not performed.

7. Conclusions and Recommendations

7.1 Conclusions

The Celco Site has been divided into two separate areas, which include the Landfill Area and the Plant Area. The Landfill Area is located on the hillside to the north of the Plant Area and is underlain predominantly by dolomite. The Narrows Fault runs northeast to southwest just to the north of the Landfill Area. The Narrows Fault divides the clastic rocks to the north of the fault and dolomite to the south of the fault. The Plant Area consists of fractured and karstified dolomite overlain by residual sediments and river terrace deposits. Many portions of the Plant Area surface are covered with fill material.

Groundwater flow across the Celco Site is controlled by geologic structures, by stratigraphic features such as bedding planes and solution cavities and by the New River, which serves as the local and regional discharge boundary. The primary direction of groundwater flow is southerly toward the New River (i.e., in the absence of production well pumping). Groundwater flow across the Plant Area is controlled by relatively high pumping rates (e.g., 2600 gpm) from plant production wells. There is a relatively large cone of depression that covers much of the Plant Area resulting from groundwater withdrawal from the production wells.

In the mid-1990s Celanese began to prepare a comprehensive site-wide evaluation (global perspective) of groundwater and potential impacts to the water-supply wells and the New River. The global risk management approach considers the entire facility or subsections of the facility as potential source areas and considered groundwater, surface water, soil and air. Risks to human health or the environment will occur only if receptors are exposed to contaminants above established action levels or risk-based concentrations. By taking a global approach (outside-in), Celanese has determined the constituent loading to the river and the representative risk posed by these conditions.

The groundwater monitoring well network (more than 100 wells) located in both the Landfill Area and the Plant Area provides comprehensive coverage of the subsurface hydrogeologic environment. A subset of these monitoring wells, which are representative of the Celco Site, have been sampled on three occasions (i.e., 1993, 1997 and 2003). Site-wide conditions were initially summarized in 1999 using data from 1993 and 1997, and site-wide conditions were again summarized in 2005 utilizing data collected across the site in 2003. The data present a comprehensive understanding of the groundwater quality and the resultant fate and transport of the constituents that were detected since 1993. The results of the groundwater modeling in conjunction with the risk assessment, indicates that the constituents detected in the subsurface in both the Landfill Area and the Plant Area do not present an unacceptable risk to human health or the environment.

The data indicate that constituent concentrations in the groundwater are disperse and are found at relatively low levels, particularly in the Landfill Area. Chlorinated organic constituents were detected in the Plant Area Production wells; the source of these constituents has not been identified. The data also indicate that groundwater quality has improved across the site between 1993 and 2003 and that the constituents detected and the relative concentrations have decreased.

All of the modeled human exposure constituent concentrations were below the RBCs. Therefore, there is no risk to human health from the potential migration of constituents into the New River. A qualitative, screening level ecological risk assessment was conducted as part of the risk assessment. The modeled surface water concentrations were compared with the USEPA Region III conservative screening levels for flora and fauna, USEPA Region IV aquatic criteria, and Commonwealth of Virginia and federal water quality criteria. None of the modeled constituent concentrations exceed levels protective of aquatic life. Therefore, there is no risk to environmental receptors from the potential release of site-related constituents into the river.

Withdrawal of groundwater by the production wells is creating a relatively large cone of depression that serves to provide hydraulic containment for constituents in the subsurface for much of the Plant Area. However, even if the plant were to turn off the production wells, the modeling in conjunction with the risk analysis indicates that constituent concentrations, upon reaching the New River, would still not pose an unacceptable risk to human health or the environment.

A comprehensive review of site data regarding past and current plant operations and waste management practices was performed to develop a list of SWMUs and AOCs. The existing levels of groundwater contamination observed at the Celco Site have originated primarily from historical underground sources such as USTs and chemical distribution systems. Celanese has closed all USTs and all underground chemical distribution systems to eliminate these potential continuing sources of contamination. There is some history of incidental spills and/or releases, but Celanese has proactively implemented spill containment and cleanup measures to address these incidences. Based on the comprehensive review of site data and existing environmental conditions, SWMUs and AOCs were identified. A total of 23 SWMUs and 8 AOCs were identified at the Celco Site. The SWMUs and AOCs are listed on Table 3-1 and illustrated on Figures 2-1 and 2-2.

Group #1 SWMUs/AOCs: No Further Action Status Requested

Many of the SWMUs and AOCs are well understood and do not pose an actual or future potential threat to human health or the environment. As such, Celanese requests that the status of the following SWMUs and AOCs be updated to No Further Action:

SWMU-1	Bldg. 37, Main Lab
SWMU-2	Bldg. 1 & 2, Breezeway, 1st Floor
SWMU-3	Bldg. 2, Jet Manufacturing Area, 3rd Floor
SWMU-4	Bldg. 14, Shop Area
SWMU-5	Bldg. 13, Paint Shop
SWMU-6	Multi-Dumpster Locations
SWMU-7	Bldg. 11, White Sludge, Awaiting Disposal
SWMU-8	Bldg. 5, Machine Shop, 1st Floor
SWMU-9	RCRA Less than 90 Day Accumulation Area
SWMU-12	RCRA Closed WWTP Equalization & Aeration Basin
SWMU-18	RCRA Closed Hazardous Waste Accumulation Area
SWMU-20	Bldg. 2, MEO Tank Accumulation
AOC-1	Untreated Wastewater Discharge – February 1991
AOC-2	Isopropyl Alcohol Overflow – December 1991

Group #2 SWMUs/AOCs: Currently Managed under State-Lead Programs

Some SWMUs/AOCs are being addressed under a state-lead regulatory program that is consistent with applicable RCRA rules and objectives. To avoid unnecessary duplication, Celanese requests that USEPA monitor relevant activities under the state-lead regulatory program until such time as corrective action is complete and the following SWMUs/AOCs are eligible for No Further Action status:

SWMU-10	Wastewater Treatment Plant
SWMU-11	White Sludge, Pond B
SWMU-13	Former Fly Ash Pond 1
SWMU-14	Fly Ash Pond 2

SWMU-16	Fly Ash Pond 4
SWMU-17	New Fly Ash Ponds A, B and C
SWMU-19A	Permit 550 Landfill
SWMU-19B	Permit 207 Landfill
SWMU-19C	Closed Process Sludge Landfill
SWMU-19D	Area D Waste Disposal Pit
AOC-8	Ammonia Flow

Group #3 SWMUs/AOCs – Retain for RCRA Facility Lead Program

The remaining SWMUs/AOCs will be evaluated further in conjunction with the existing database during the RFI process to determine whether additional investigations and/or characterization are warranted.

SWMU-15	Fly Ash Pond 3
SWMU-21	Former 1950s Era Disposal Areas
SWMU-22	White Sludge Pond A
SWMU-23	White Sludge Disposal Area B/C
AOC-3	Production Wells 7 & 9
AOC-4	Building 10/11Area, Thermal Plume, Sewers
AOC-5	Fuel Oil Remediation Area
AOC-6	Former Benzene UST Areal
AOC-7	Tank Farm

7.2 Recommendations

Celanese recommends that a RCRA Facility Investigation (RFI) Workplan be prepared following acceptance of this DOCC by USEPA/VDEQ. The RFI Workplan should evaluate and address additional data that may be appropriate/necessary to supplement existing conditions described in this DOCC. Celanese further recommends that the RFI specifically address the following issues:

1) Groundwater quality has been characterized across the Celco Site on several occasions (i.e., 1993, 1997, and 2003). However, there are several areas located hydraulically downgradient of the identified SWMUs/AOCs where existing groundwater monitoring wells, which have historically provided groundwater quality data, have either been destroyed and/or damaged. Therefore, Celanese recommends that the groundwater monitoring well

system be evaluated with respect to the DOCC list of SWMUs/AOCs and additional wells be installed, as necessary, to supplement and bolster the existing groundwater monitoring network. This evaluation would be performed and presented in a RFI Workplan.

2) The existing data presents a comprehensive understanding of the groundwater quality and the resultant fate and transport of the constituents that have been detected since 1993. The data indicate that constituent concentrations in the groundwater are disperse and are found at relatively low levels, particularly in the Landfill Area. The data also indicate that groundwater quality has improved across the site between 1993 and 2003 and that the constituents detected and the relative concentrations have decreased. However, it has been three (3) years since groundwater quality was evaluated site-wide and additional wells are proposed to be installed (associated with Group #3 SWMUs/AOCs identified above). Therefore, Celanese recommends that the RFI Workplan include the collection of groundwater samples from monitoring wells representative of site-wide conditions.

3) Many of the existing environmental issues at the Celco Site are being addressed through the implementation of closure activities (e.g., Closure of Pond B, Fly Ash Ponds 2 and 4) and remedial activities (e.g., CPSL Corrective Action) that are ongoing and being reviewed and approved by other regulatory programs and agencies (e.g., VDEQ, USACE). The results of the groundwater modeling in conjunction with the risk assessment, indicates that the constituents detected in the subsurface in both the Landfill Area and the Plant Area do not present an unacceptable risk to human health or the environment. The existing risk assessment was prepared following available and applicable USEPA and VDEQ guidance at that time (i.e., 1999/2003). Risk assessment guidance has changed since that time and new information is available and applicable. Therefore, Celanese recommends that the RFI Workplan include provisions for preparing an updated site-wide risk assessment utilizing current USEPA/VDEQ guidance.

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