RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVES SELECTION

LCP-HOLTRACHEM SUPERFUND ALTERNATIVE SITE
RIEGELWOOD, COLUMBUS COUNTY, NORTH CAROLINA
OPERABLE UNIT 1

SEMS ID#: NCD991278631

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA, GEORGIA

SEPTEMBER 2017

PART 1: DECLARATION

1.0 SITE NAME AND LOCATION

The LCP-Holtrachem Superfund Alternative Site (Holtrachem) is located near John Riegel Road in Riegelwood, Columbus County, North Carolina. Honeywell International Inc. (Honeywell) is a Potentially Responsible Party (PRP) that currently owns the site property. The site's identification number in the Superfund Enterprise Management System (SEMS)[1] is NCD991278631. The site consists of only one Operable Unit (OU).

2.0 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) selects the remedial action to address the contamination and risks posed by the site. The remedy is selected in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP). EPA based its decision on the Administrative Record for the site. The State of North Carolina concurs with the selected remedy.

3.0 ASSESSMENT OF THE SITE

The response actions selected in this ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

4.0 DESCRIPTION OF SELECTED REMEDY

The remedial action selected in this ROD addresses contamination that poses unacceptable risks to human health and ecological receptors at the site. The wastes and contaminated media that poses unacceptable risks include soil, sediment, surface water, mercury wastes and Wastewater Treatment Solids (WWTS). The primary contaminants of concern are mercury and polychlorinated biphenyls (PCBs).

The selected remedy includes the following primary components:

- Treatment of mercury waste and contaminated soil, considered to be PTW, located beneath the former mercury cell building and former retort pad via In-Situ Stabilization (ISS)
- Capping of the areas treated by ISS in a manner that meets Resource Conservation and Recovery Act (RCRA) Subtitle C landfill final cover applicable or relevant and appropriate requirements (ARARs)
- Excavation of approximately 15,400 cubic yards (yd^3) of contaminated soil and sediment
- Capping approximately 1.7 acres of contaminated soil with a geosynthetic liner and vegetative cover

[1] In 2014, EPA replaced the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) database with SEMS. https://www.epa.gov/superfund/superfund-data-and-reports

- Construction, operation, closure, maintenance and monitoring of an on-site disposal unit that meets Toxic Substances Control Act (TSCA) chemical waste landfill ARARs in Title 40 Code of Federal Regulations (CFR) § 761.75
- Closure of the underground storm water conveyance system by cleaning and/or sealing off and solidifying the pipes/inlets in place using flowable grout
- Disposal of stockpiled WWTS, solids removed from the storm water conveyance system, and excavated contaminated soil and sediment that are not RCRA hazardous wastes in the constructed on-site TSCA disposal unit
- Treatment and/or disposal of RCRA hazardous wastes including soil that is considered RCRA characteristic waste or contains RCRA listed waste, if generated, at an off-site permitted RCRA treatment/disposal facility
- Decommissioning of the storm water treatment system and restoration of the site to natural drainage following completion of remedial action
- Disposal or recycling of demolition debris from the stormwater treatment system and other potentially dismantled structures. Disposition will be determined based on testing of the debris to determine if it is RCRA hazardous wastes.
- Monitoring and maintenance of the closed RCRA units (former surface impoundments) in accordance with RCRA ARARs for post-closure care of a hazardous waste surface impoundment
- Groundwater monitoring in accordance with ARARs to confirm TSCA disposal unit and closed RCRA units' integrity
- Engineering Controls (ECs) in the form of fencing, warning signs and erosion control measures to control sedimentation from stormwater runoff
- Implementation of Institutional Controls (ICs) in the form of a restrictive covenant and/or Notice of Contaminated Site in accordance with North Carolina statute
- Five-Year Reviews (FYRs)

5.0 STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action (unless justified by a waiver), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment). Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, EPA will conduct statutory FYRs beginning within five years after initiation of the remedial action to ensure that the remedy is protective of human health and the environment.

6.0 DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information is located in the Administrative Record file for this site.

Item	**Section Number**
Chemicals of concern and their respective concentrations.	**Section 5.6**
Baseline risk represented by the chemicals of concern.	**Section 7.0**
Cleanup levels established for chemicals of concern and their basis	**Section 12.4**
How source materials constituting principal threats are addressed.	**Section 11.0** and **Section 12.0**
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD.	**Section 6.0**
Potential land and groundwater use that will be available at the site because of the Selected Remedy.	**Section 12.4**
Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.	**Section 9.3.3** and **Section 12.3**
Key factors that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision).	**Section 12.1** and **Section 13.0**

7.0 AUTHORIZING SIGNATURE

This ROD documents the selection of the remedy for the LCP-Holtrachem Superfund Alternative Site. The EPA selected this remedy with concurrence from the North Carolina Department of Environmental Quality (NCDEQ).

Franklin E. Hill, Director
Superfund Division
U.S. Environmental Protection Agency, Region 4

9/29/17
Date

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

2L	Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (I5A NCAC 2L Standard)
ACM	asbestos-containing material
AMECFW	AMEC Foster Wheeler Environment & Infrastructure, Inc.
AOC	Administrative Order on Consent
App. Gamma	Approximate Gamma
AR	Administrative Record
ARAR	Applicable or Relevant and Appropriate Requirements
AST	above ground storage tank
AUF	area use factor
BAF	bioaccumulation factor
BERA	Baseline Ecological Risk Assessment
BG	background
BPT	Bleach Plant
CBP	Cell Building Pad
CCC	criterion continuous concentration
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Code of Federal Regulations
Cheb	Chebyshev Minimum Variance Unbiased Estimate of Upper Confidence Limit
Cheb-m	Chebyshev (mean, standard deviation) Uper Confidence Limit
cm/s	centimeter per second
COC	Chemical of Concern
COPC	Chemical of Potential Concern
COPEC	contaminant of potential ecological concern
CSF	cancer slope factor
CSM	Conceptual Site Model
CTA	CTA Environmental, Inc.
CTE	central tendency exposure
DDT	dichloro-diphenyltrichloroethane
DPT	direct push technology
DQO	data quality objective
DWQ	Division of Water Quality
EC	Engineering Control
ECBPA	East Cell Building Pad Area
EE/CA	Engineering Evaluation / Cost Analysis
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
EPDM	ethylene propylene diene-monomer
ERRB	Emergency Response and Removal Branch
ESI/RA	Expanded Site Inspection and Removal Assessment
ESP	Engineered Stockpile

ESV	ecological screening value
FEMA	Federal Emergency Management Agency
FIL	Fill Area
FS	Feasibility Study
ft^2	square feet
ft amsl	feet above mean sea level
ft bgs	feet below ground surface
ft/yr	feet per year
FYR	Five-Year Review
GPS	Global Positioning System
HCl	hydrochloric acid
HDPE	high density polyethylene
HEAST	Human Effects Assessment Summary Tables
Hg	mercury
HHRA	Human Health Risk Assessment
HI	hazard index
Honeywell	Honeywell International Inc.
HQ	hazard quotient
IC	Institutional Control
iESI/RA	Integrated Expanded Site Inspection / Removal Assessment
IP	International Paper
IRIS	Integrated Risk Information System
ISS	In-Situ Stabilization
IVMP	Inspection and Vapor Monitoring Plan
K_{ow}	octanol: water distribution coefficient
LC50	50 percent mortality
LCP	Linden Chemicals & Plastics, Inc.
LEL	lower effects level
LLTW	Low Level Threat Waste
LOAEL	Lowest Observed Adverse Effects Level
LOEC	lowest observed effect concentration
LTTD	low temperature thermal destruction
MCL	Maximum Contaminant Level
MESS	Mercury Elimination Sewer System
mg/kg	milligram per kilogram
mg/L	milligram per liter
MNAF	mercury not accounted for
MW	monitoring well
N/A	not applicable
NAVD 88	North American Vertical Datum of 1988
NAWQC	National Ambient Water Quality Criteria
NC	North Carolina
NCBPA	North Cell Building Pad Area

NCDENR	North Carolina Department of Environment and Natural Resources
NCDEQ	North Carolina Department of Environmental Quality
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Contingency Plan
ng/L	nanogram per liter
NGVD 29	National Geodetic Vertical Datum of 1929
NOAEL	No Observed Adverse Effects Level
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRB	North Retention Basin
NRWQC	National Recommended Water Quality Criteria
NUS	NUS Corporation
O&M	Operation and Maintenance
OA	Office Area
ONP	Old North Pond
OPA	Old Parking Area
OSC	On-Scene Coordinator
OSD	Old Salt Dock area
OSHA	Occupational Safety and Health Administration
OSP	Old South Pond
OU	Operable Unit
PA	Preliminary Assessment
PCB	polychlorinated biphenyl
pg/L	picograms per liter
POC	point of compliance
POLREP	pollution report
PPBV	parts per billion volume
ppm	part per million
PPRTV	Provisional Peer-Reviewed Threshold Value
PRG	preliminary remediation goal
PRD	Products Area
Premier	Premier Environmental Services, Inc.
PRP	Potentially Responsible Party
PTW	Principal Threat Waste
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RAGS	Risk Assessment Guidance for Superfund
RAL	Removal Action Level
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RET	Retort area
RfD	reference dose
RI	Remedial Investigation

RLS	registered land surveyors
RME	reasonable maximum exposure
ROD	Record of Decision
RP	Roberts Pond
RSL	Regional Screening Value
RYD	Rail Yard Area
SARA	Superfund Amendments and Reauthorization Act
SCBPA	South Cell Building Pad Area
SEMS	Superfund Enterprise Management System
Site	LCP-Holtrachem Superfund Site
SLERA	Screening-Level Ecological Risk Assessment
SMCL	Secondary Maximum Contaminant Level
SPLP	synthetic precipitation leaching procedure
SRB	South Retention Basin
SS	Sewer System
SVOC	semi-volatile organic compound
SW	surface water
SWDS	Solid Waste Disposal Site
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	to be considered
TCDD	Tetrachlorodibenzo-p-Dioxin
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEF	toxicity equivalent factor
TEQ	toxicity equivalent quotient
TIAS	Time Integrated Air Sampling
TIMVS	time-integrated mercury vapor sampling
TOC	total organic carbon
TRV	Toxicity Reference Value
TSCA	Toxic Substances Control Act
TSS	total suspended solid
UCL	upper confidence limit
UNPA	Upland Non-Process Area
UPA	Upland Process Area
URL	Uniform Resource Locator
US	United States
USGS	United States Geological Survey
µg/L	microgram per liter
$\mu g/m^3$	microgram per cubic meter
VI	vapor intrusion
VOC	volatile organic compound
WBA	Wooded Bottomland Area

WCBPA	West Cell Building Pad Area
Weston	Weston Solutions, Inc.
WHO	World Health Organization
WOE	weight of evidence
WWT	Wastewater Treatment
WWTS	Wastewater Treatment Solids
yd^3	cubic yard

PART 2: THE DECISION SUMMARY

The EPA prepared this ROD using information from documents in the Administrative Record, websites, and EPA guidance documents.

1.0 SITE NAME, LOCATION AND DESCRIPTION

The LCP-Holtrachem site (the site) is located at 636 John L. Riegel Road in Riegelwood, Columbus County, North Carolina. Riegelwood is about 20 miles west-northwest of Wilmington, North Carolina. The site consists of about 24.4 acres. The International Paper (IP) Riegelwood Mill facility surrounds the site on three sides and the Cape Fear River borders the fourth side. IP is an industrial pulp and paper manufacturing facility that opened in 1951 and occupies about 1,300 acres surrounding the site. The Cape Fear River is approximately 200 miles long and flows to the Atlantic Ocean. Near the site, the tidally influenced Cape Fear River is over 300 feet wide and up to 26 feet deep. **Figure 1** illustrates the general location of the site. **Figure 2** is an aerial view of the site and surrounding properties. **Figure 3** shows the property boundaries for the site and IP.

The site's identification number in the SEMS is NCD991278631. EPA is the lead agency for the site and the NCDEQ[2] is the support agency. The PRP, Honeywell, plans to implement the selected remedy with EPA and NCDEQ oversight.

In 1963, Allied Chemical Corporation developed the Holtrachem site as an industrial chlor-alkali manufacturing facility. Property ownership changed several times until the plant closed in November 2000. During operations, the facility produced various chemicals using a mercury electrolytic cell process. These chemicals included caustic liquid (sodium hydroxide), liquid chlorine, hydrogen gas, liquid bleach (sodium hypochlorite), and hydrochloric acid. The primary contaminants at the site are mercury and the polychlorinated biphenyl (PCB) known as Aroclor 1268. Both of these are hazardous to human health and the environment and were components of the mercury electrolytic cell process.

[2] On September 18, 2015, the North Carolina Department of Environment and Natural Resources (NCDENR)'s name changed to the North Carolina Department of Environmental Quality (NCDEQ). http://portal.ncdenr.org/web/guest/denr-blog/-/blogs/denr-has-a-new-name-n-c-dept-of-environmental-quality?_33_redirect=%2Fweb%2Fguest%2Fdenr-blog

Figure 1: General Site Location

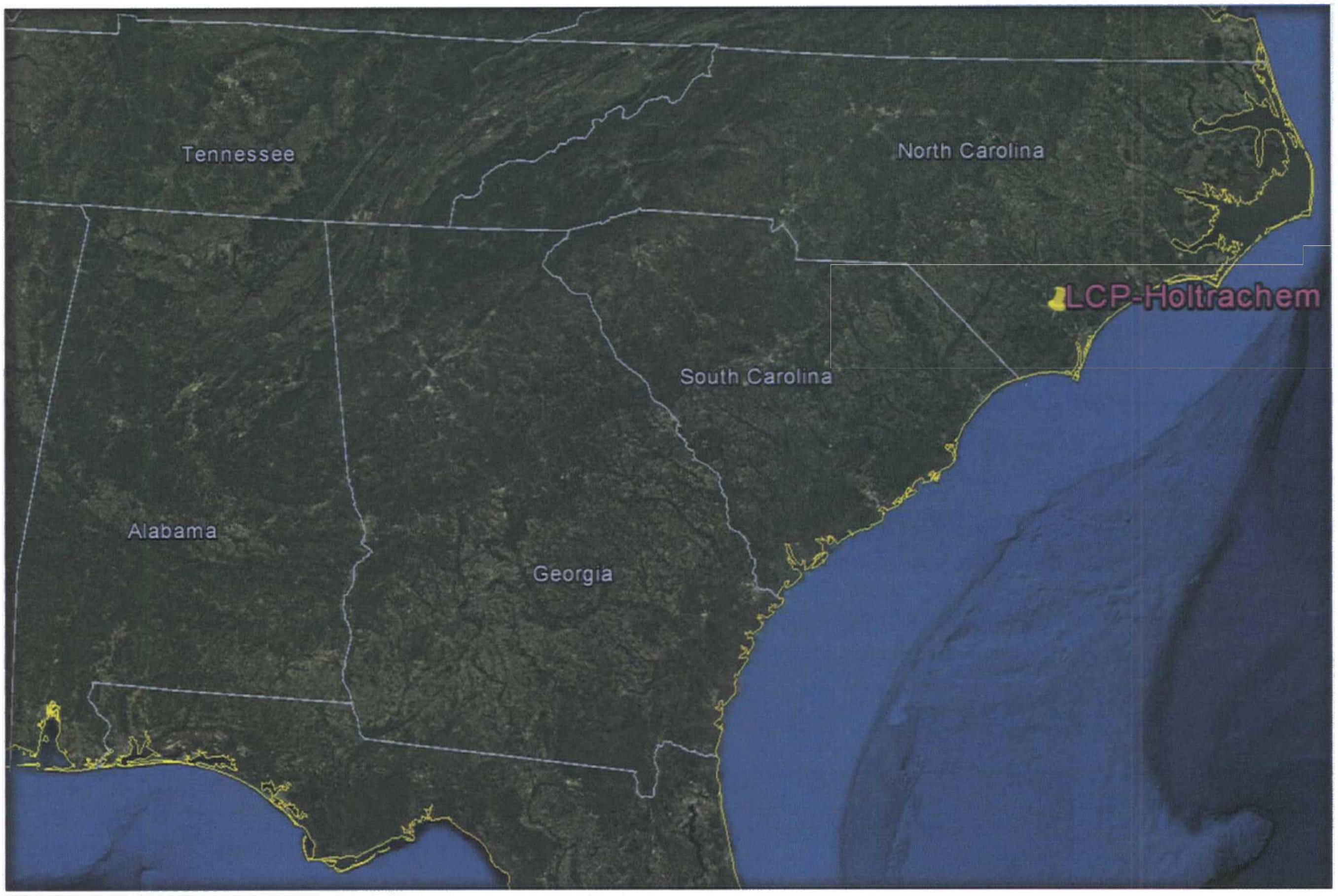
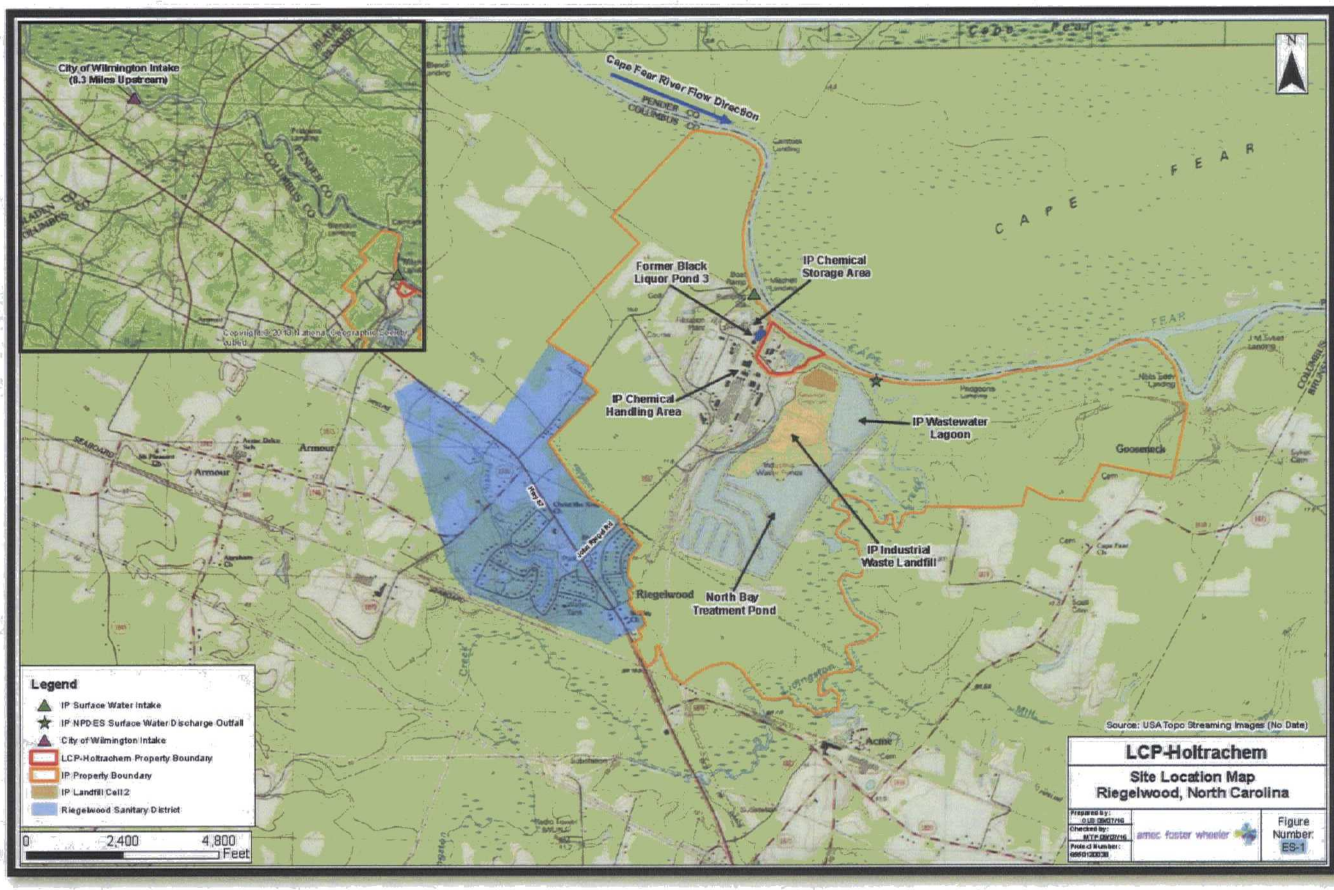


Figure 2: Site surrounded by International Paper and the Cape Fear River

Figure 3: Site Location Map with Property Boundaries



2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Ownership History

On August 15, 1963, Riegel Paper Corporation transferred 26.26 acres of their property to Allied Chemical Corporation, most of which consists of the current LCP-Holtrachem site. Prior to that, aerial photographs show the property as an undeveloped wooded area. In 1985, the facility transferred back approximately two acres to Federal Paperboard Company, Inc. (formerly Riegel Paper Corporation and now known as International Paper Riegelwood Mill). Therefore, the site property is currently about 24.4 acres.

Ownership of the site property changed numerous times. Owners included Allied Chemical Corporation, LCP Chemicals – North Carolina, Hanlin Group, Inc., Holtrachem Manufacturing Company, LLC, and currently Honeywell.

2.2 Operational History

The site consisted of a chlor-alkali manufacturing facility from 1963 until 2000. **Figure 4** illustrates an aerial view of a portion of the plant in about 1965. The facility produced various chemicals using a mercury electrolytic cell process. These chemicals included caustic liquid (sodium hydroxide), liquid chlorine, hydrogen gas, liquid bleach (sodium hypochlorite), and hydrochloric acid. The facility transferred most of the caustic, chlorine, bleach, and hydrogen that it produced to the adjacent IP plant by pipeline. The facility sold the remaining chlorine, caustic, and acid to other companies. These products were transported by railcars and tanker trucks for distribution. The mercury cell operation shut down in April 1999, and the entire plant closed in November 2000. The mercury cell and chlorine processes are illustrated in **Figure 5** and **Figure 6**, respectively.

Figure 4: Site Aerial Photograph - circa 1965

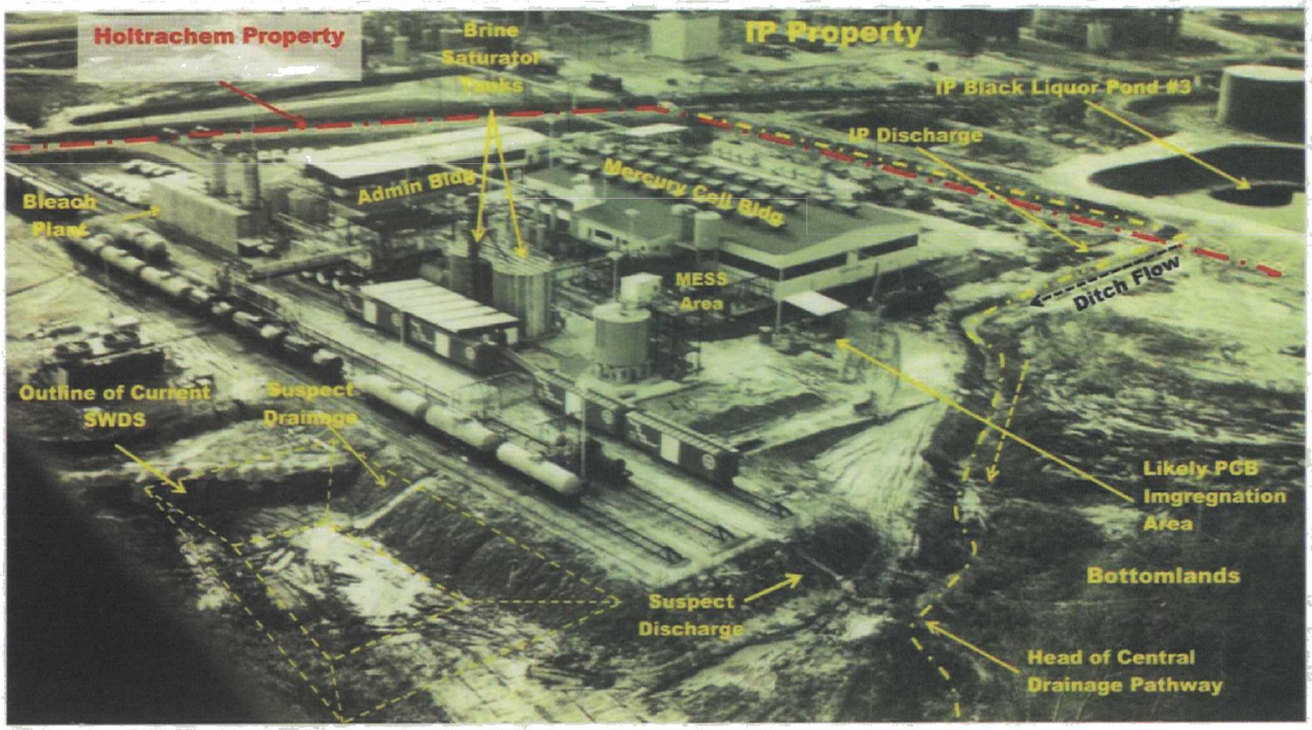


Illustration 1-3: Site Aerial Photograph - circa 1965

Figure 5: Mercury Cell Process

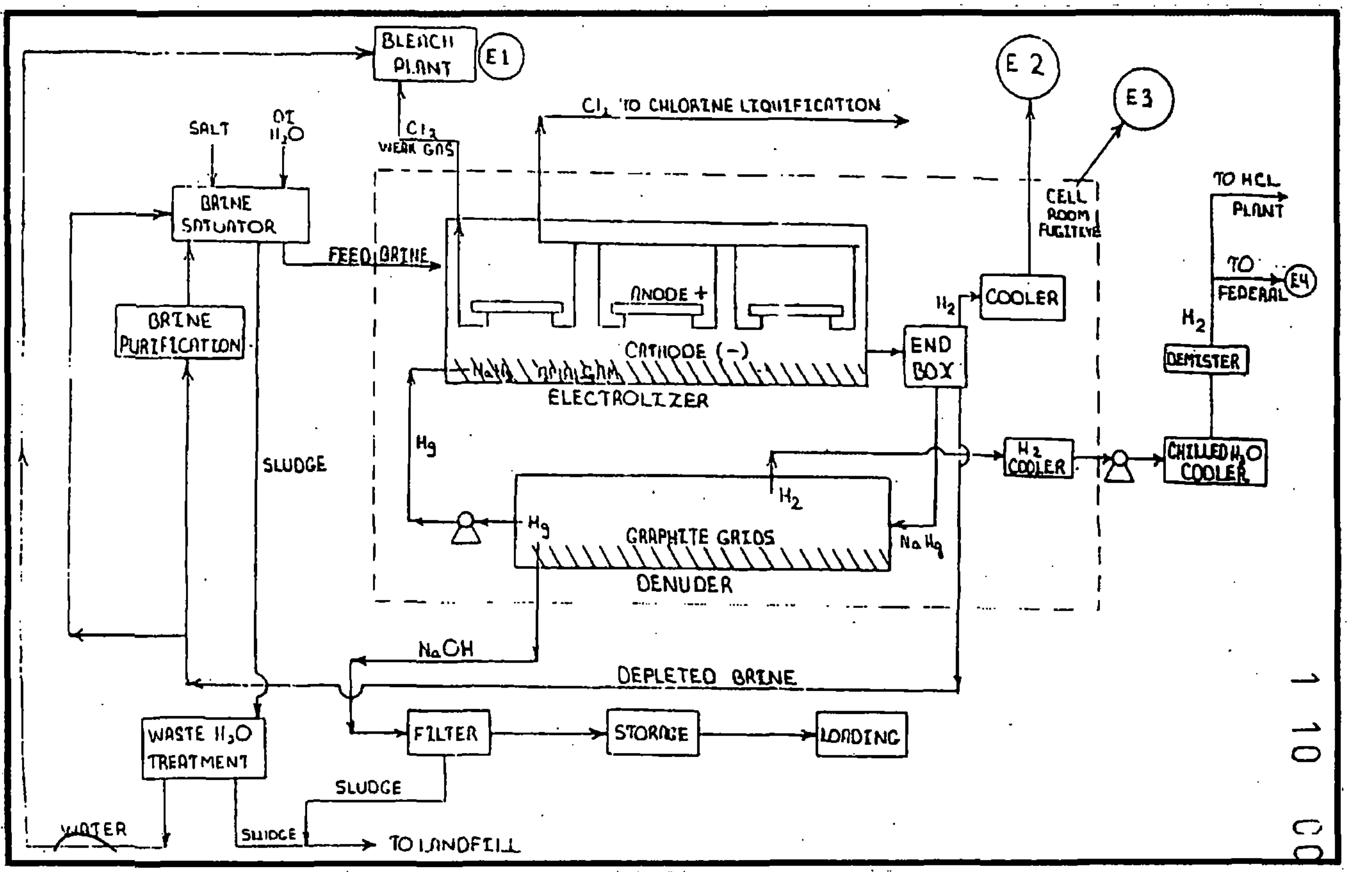
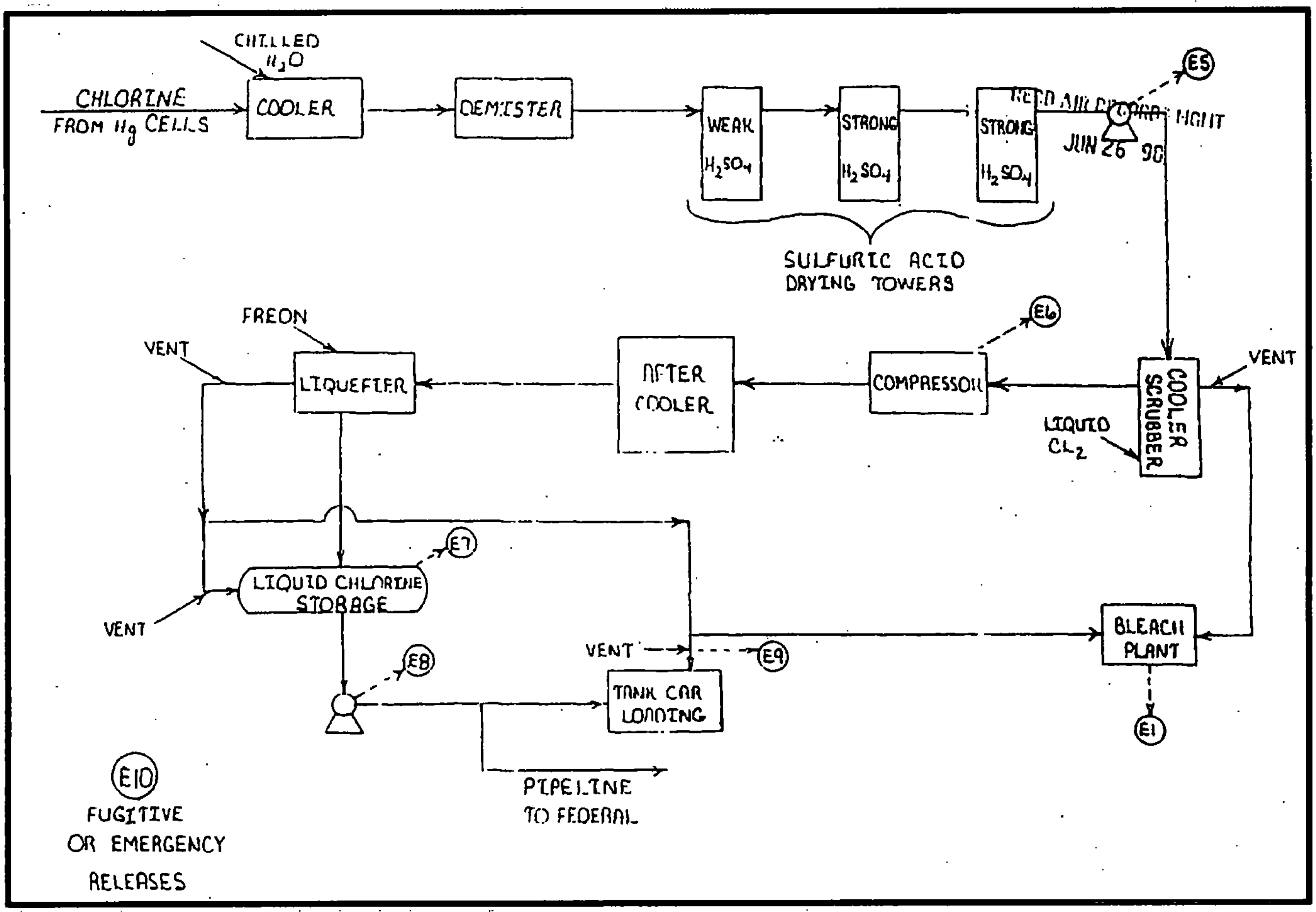


Figure 6: Chlorine Plant Process



2.3 Investigations, Actions and Violations under Authorities Other than CERCLA

While in operation, environmental evaluations at the facility focused on compliance with RCRA and the Occupational Safety and Health Administration (OSHA) regulations. Corrective action activities also occurred pursuant to the RCRA operating permit issued by NCDENR. A summary of the primary evaluations, actions and cited violations follow.

2.3.1 OSHA

In 1996, OSHA fined the facility $31,854 for an inadequate health and safety program. In December 1998, OSHA fined the facility $873,000, for failure to correct problems noted in 1996. OSHA reduced the fine to $100,000 after the plant's operator said the problems had been corrected.

2.3.2 RCRA

The facility operated under a RCRA Hazardous Waste permit. NCDENR issued permit number NCD991278631 to the facility on December 29, 1989. The permit became effective on June 28, 1991. The permit was modified on May 2, 1994, due to a change in the facility's ownership and operational control. In January 2002, after the facility ceased operations, NCDEQ RCRA Program referred the site to the Superfund program for further evaluation and remedial action under CERCLA.

2.3.2.1 Closed Surface Impoundments

Former facility operations included the creation and use of four surface impoundments: Solid Waste Disposal Site (SWDS), Roberts Pond, North Pond, and South Pond. The facility used these impoundments to treat and contain wastes generated during plant processes.

The SWDS, also known as the Allied Vault, received wastes including graphite anodes, stems, sludge, fly ash, concrete, sodium chloride, activated carbon, filter aid media, and mercury sludge generated from 1963 to 1980. The bottom liner of the SWDS included two feet of clay overlain by a polyvinyl chloride (PVC) liner overlain by another two feet of clay. The top cover of the SWDS consisted of a four-foot thick layer consisting of clay, marl, and asphalt. In 1985, the facility closed the SWDS with approximately 3,700 yd^3 of solidified wastes in place and capped with an asphalt cover graded to promote runoff toward the wooded bottomland area.

The Old South Pond was an ethylene propylene diene-monomer (EPDM) rubber lined surface impoundment that held about 1.06 million gallons of process wastewater and sludge. The Old North Pond had a PVC liner and functioned as an overflow basin with a capacity of 1.71 million gallons. These ponds received mercury-contaminated brine processing wastewater and sludge.

In the early 1970s, the facility constructed Roberts Pond. It was originally unlined and received mercury-contaminated wastes from the brine processing. In 1979, the facility installed a rubber liner. Site drawings from the late 1970s indicate a second pond (the old salt brine pit), to the west of Roberts Pond, was used to contain overflow from Roberts Pond. This second pond was reportedly backfilled and the area later used for salt storage prior to the construction of the membrane building.

In the 1980s, the facility closed Roberts Pond, the Old North Pond and the Old South Pond. Closure involved removal of materials from Roberts Pond and the Old North Pond, stabilization of the material with fly ash and dry cement, and placement into the Old South Pond. The PVC liners from Roberts Pond and the Old North Pond were sealed together, placed over the stabilized sludge, then bonded to the EPDM base liner and anchored in a trench. A compacted clay cap was then placed over the PVC liner to complete the closure of the South Pond.

Neither Roberts Pond nor the Old North Pond received official clean closure status under RCRA. The facility conducted groundwater monitoring for compliance purposes in general accordance with the post-closure care provisions set forth in the Hazardous Waste Management Part B Permit Application and the Hazardous Waste Management Permit, which became effective June 28, 1991.

2.3.2.2 RCRA Hazardous Waste

The facility operations generated four hazardous wastes identified as D009, F003, F005, and K106.

D009 is a solid waste that exhibits the characteristic of toxicity due to hazardous concentrations of mercury as defined in 40 CFR §261.24. The facility used a retort thermal reclamation process for mercury-contaminated solids. The residual ash created in this process was classified as D009 hazardous waste.

F003 and F005 are hazardous wastes from non-specific sources. They are defined in 40 CFR §261.31 as follows:

- F003: *The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent nonhalogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above nonhalogenated solvents, and a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.*
- F005: *The following spent nonhalogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above nonhalogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.*

K106 is a hazardous waste from a specific source. It is defined in 40 CFR §261.32 as, "*Wastewater treatment sludge from the mercury cell process in chlorine production.*" The facility generates K106 hazardous waste through its wastewater pretreatment system called the Mercury Elimination Sewer System (MESS). Wastewater is initially treated through the MESS to adjust pH, then sodium sulfide is added to form a mercury sulfide precipitate in a settling tank/clarifier. The settled mercury sulfide sludge is pumped to a filter press. The filter cake is stored and subsequently shipped off-site as a hazardous waste (K106).

2.3.2.3 RCRA Violations and Corrective Actions

A review of historical records indicated that between 1989 and 2001, there were five documented RCRA violations at the facility. These include:

- December 1989 – NCDENR issued a Notice of Violation (NOV) for
  - failure to use the correct hazardous waste code of K106 for disposal of the wastewater treatment sludge from the mercury cell process, and
  - failure to provide proper documentation of disposal.
- February 1996 – NCDENR issued a NOV for violations noted in a January 1995 inspection. The violations included:
  - a waste pile at the MESS,
  - unlabeled waste,
  - mercury waste accumulation of greater than 90 days,
  - leaking wastewater treatment tank,
  - employee training out of compliance, and
  - uncovered vat and floor sweepings at the MESS, which were unlabeled and not dated.
- May 2000 – NCDENR issued an Order for
  - failure to demonstrate clean closure equivalency of Robert's Pond and
  - plans to construct a building over Robert's Pond without agency approval.
- September 2000 – NCDENR required maintenance of the cap on the retort pad and removal of nearby debris.
- October 2001 – NCDENR issued an Imminent Hazard NOV for
  - failure to characterize waste,
  - failure to properly contain waste, and
  - accumulation of waste for greater than 90 days.

2.3.3 Water Quality History

From 1963 to 1978, spill containment and storm water management appear to be minimal at the site. The first documented release of hazardous substances to the adjacent Cape Fear river was in August 1978. This event involved a spill of approximately 400 gallons of brine solution that flowed into the river. The concentration of mercury in the brine solution was 3.6 milligrams per liter (mg/L).

Afterwards, the facility constructed a water management system that would prevent discharges to surface waters. By 1979, the facility had begun transferring wastewater collected by the water management system to IP's wastewater treatment system. Initially, the transfer was via an open ditch. In October 1989, a NCDENR inspection noted that water transference was by pipe instead of the open ditch.

In November 1993, a NCDENR inspection found mercury at a concentration of 0.035 mg/L in IP's discharge water. By 1999, mercury was a compliance issue for IP. Holtrachem and IP reached an agreement for reducing mercury contributions from products supplied by Holtrachem, and these provisions were included in IP's National Pollutant Discharge Elimination System (NPDES) Permit.

In April 1999, approximately 1,800 gallons of wastewater was unintentionally released. The concentrations of mercury in soil samples ranged from 1.96 to 13.7 milligrams per kilogram (mg/kg). The facility shut down the mercury cell operation two days later.

In May 1999, approximately 18,000 gallons of wastewater spilled from a storm water retention basin. The concentration of mercury in the water was 0.34 mg/L.

In September 1999, Hurricane Floyd caused a release of about 2.2 million gallons of storm water to the Cape Fear River. This event released about 5 pounds of mercury over a 19-hour period.

In October 1999, NCDENR issued a NOV and Assessment of Civil Penalty to the facility based on a review of the July 1999 discharge monitoring report. The violation was for exceeding permitted monthly average effluent limits for settleable solids.

2.3.4 Air Quality History

Air emissions history prior to 1979 is not documented. Beginning in the 1980s, Holtrachem operated under an air permit and provided annual air emissions inventory.

2.4 CERCLA Investigations and Actions

2.4.1 CERCLA Investigations

The "Discovery" date listed in SEMS is November 1, 1979. Two dates are currently in SEMS for Preliminary Assessments (PA): August 1, 1982 and November 2, 1987. The PA form located in the references of the integrated Expanded Site Inspection/Removal Assessment (iESI/RA) report is dated September 11, 1987.

On January 11, 2002, NCDENR sent a referral letter to EPA's Emergency Response and Removal Branch (ERRB). An EPA On-Scene Coordinator (OSC) visited the site on January 30, 2002, and February 20, 2002. In April 2002, EPA's contractor Weston Solutions, Inc. (Weston) conducted an iESI/RA in conjunction with NCDENR. Based on the findings of these inspections, EPA authorized a removal action.

In June 2004, Honeywell initiated an Engineering Evaluation/Cost Analysis (EE/CA) study with EPA oversight. Honeywell's contractors collected samples of air, surface water, groundwater, sediment, soil and biota. After Honeywell submitted the draft EE/CA report, EPA determined that it would be more appropriate to address the remaining contamination under remedial instead of removal authority. In September 2009, EPA converted the project from an EE/CA into a Remedial Investigation/Feasibility Study (RI/FS). EPA approved the Remedial Investigation (RI) report on July 29, 2014.

2.4.2 CERCLA Emergency Responses and Removal Actions

Two CERCLA emergency responses and two CERCLA removal actions have occurred. These include:
- 1999: Hurricane Floyd Emergency Response
- 2003-2004: Removal Action #1
- 2003: Hurricane Isabel Emergency Response
- 2008-2009: Removal Action #2 (IP Removal Action)

The PRP's contractors participated in all of these events. EPA provided contractor support during the two emergency responses and provided oversight activities during all events. A brief summary of each event is described in Sections 2.4.2.1 – 2.4.2.4.

2.4.2.1 Hurricane Floyd Emergency Response (1999)

In September 1999, Hurricane Floyd inundated the site with an estimated 24-inches of rain. The associated flooding caused a release of contaminated water from a storm water retention basin. The release flowed over land into the adjacent Cape Fear River. EPA and the Federal Emergency Management Agency (FEMA) responded. EPA personnel and contractors assisted facility personnel in sand-bagging to raise the berm height of the storm water collection basin and pumping water to IP.

2.4.2.2 Removal Action #1 (2002-2004)

In July 2002, EPA signed an Enforcement Action Memorandum for a time-critical removal action. EPA and Honeywell entered into an Administrative Order on Consent (AOC) for this removal action. The removal action began in January 2003. EPA issued the Final Pollution Report (POLREP) in October

2004, marking the completion of the removal action. During the removal action, workers dismantled the former mercury cell building and associated piping, encapsulated mercury-contaminated debris prior to off-site shipment/disposal, and collected over 34,000 pounds of mercury for reclamation/reuse. Workers also dismantled/disposed of other RCRA hazardous waste and non-hazardous waste/debris associated with some of the former facility operations. Southern Metal Recycling accepted over 1.5 million pounds of scrap metal, copper, aluminum, brass, titanium and stainless steel from the site for recycling. **Table 1** summarizes of the types of waste, disposition and quantities that were transported off-site associated with the removal action through March 2008.

Table 1: Removal Action #1 Waste Disposal Summary as of March 10, 2008

Disposition	**Facility**	**Waste Stream**	**Quantity Shipped Off-site**	
Reuse	Goldsmith Evanston, IL	Reclaimed Elemental Mercury (for Reuse)	34,447	pounds
Recycling	Southern Metals Recycling Wilmington, NC	Scrap Metal	1,317,529	pounds
		Scrap Copper	183,177	pounds
		Scrap Aluminum	20,250	pounds
		Scrap Stainless Steel	14,650	pounds
		Scrap Titanium	4,280	pounds
		Scrap Brass	1,232	pounds
Hazardous Waste	Waste Management Emelle Treatment Facility Emelle, AL	Saturator Salt	1,008,180	pounds
		Hazardous - Variance Debris	761,972	pounds
		Hazardous - Macro (including hazardous asbestos-containing material (ACM))	99	boxes
		Non-Regulated Material - Directly Landfilled	80	boxes
		Hazardous - Micro	47	boxes
	EQ - Michigan Disposal Waste Treatment Belleville, MI	D009 - Wastewater Filter Cake	24	boxes
Non-Hazardous Waste	Anson Waste Management Facility Polkton, NC	Non-Hazardous ACM	22,040	pounds
	Sampson Co. Disposal Facility Roseboro, NC	Non-Hazardous Construction Debris	676,260	pounds

Notes:

ACM = asbestos-containing material

boxes = box sizes ranged from 20 to 30 yd^3

2.4.2.3 Hurricane Isabel Emergency Response (2003)

In September 2003, EPA signed an Emergency Response Action Memorandum to assist the facility with preparations for and responding to potential impacts from Hurricane Isabel. Activities included stabilization of tarps on roll-off boxes, movement of hazardous substance drums into warehouses, and strapping down loose items. Hurricane Isabel passed through the area on September 17, 2003. The PRP's contractor handled all water and reported that only minor damage occurred to the cell building metal sheeting. EPA contractors demobilized from the site on September 19, 2003.

2.4.2.4 Removal Action #2 (2008-2009)

In the early 2000s, IP planned to expand their landfill capacity by taking out of service one of their former wastewater treatment lagoons. **Figure 7** shows the lagoon that historically accepted wastewaters from the Holtrachem facility.

Figure 7: Google Earth photo from February 1993 with descriptions added

In September 2005, IP contracted with Premier Environmental Services, Inc. (Premier) to characterize the Landfill Cell No. 2 area. IP shared the results with EPA. The findings led to EPA issuing an Enforcement Action Memorandum and entering into an AOC with Honeywell and IP for the removal of WWTS containing PCBs. PCB concentrations equal to or greater than 50 mg/kg (or 50 ppm) are regulated for disposal as TSCA PCB waste and must be managed in accordance with TSCA regulations at 40 CFR 761 *et. seq.*

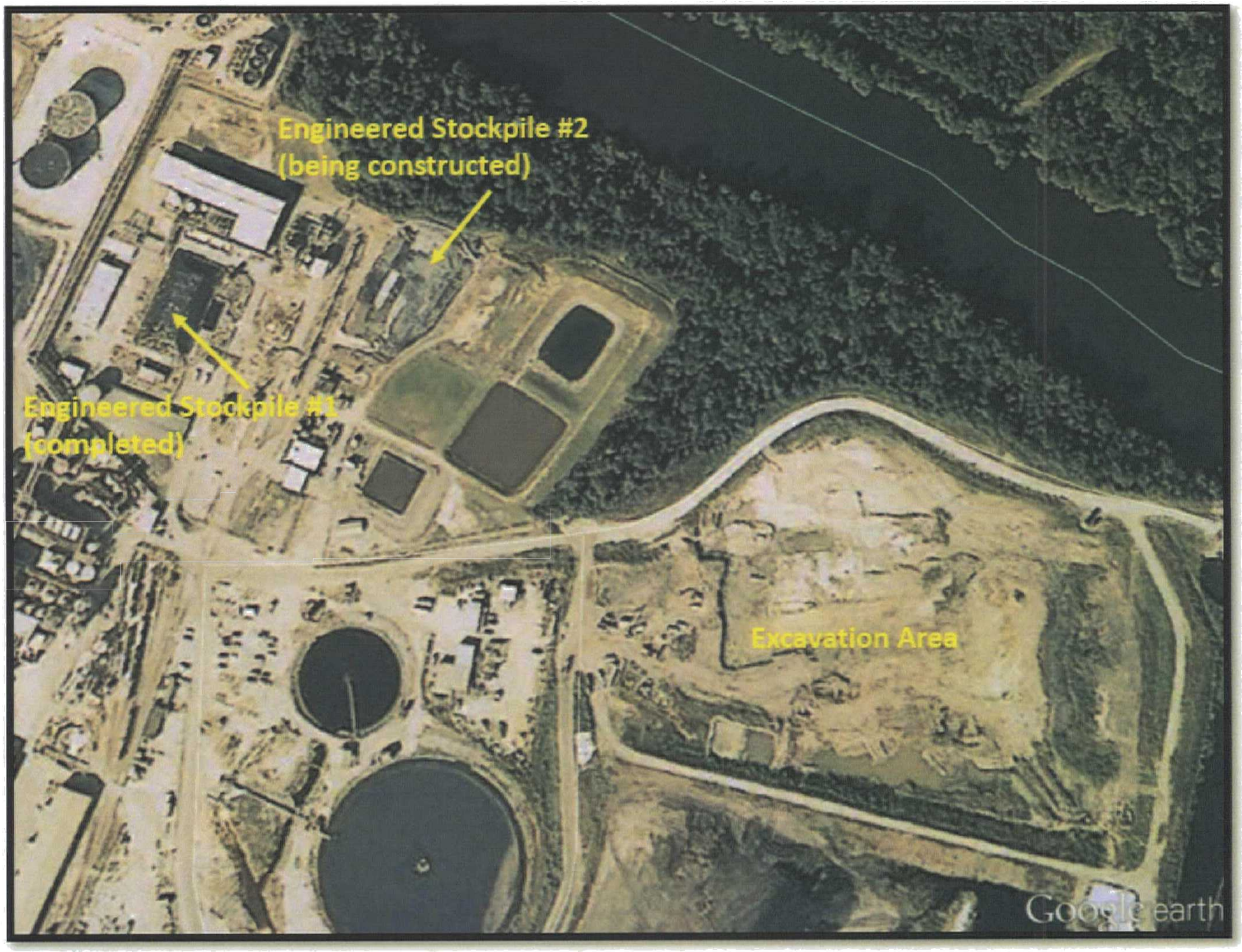
During 2008-2009, contractors performed the following activities:

- Construction of two engineered stockpiles on the Holtrachem property.
- Excavation and transportation of WWTS containing Aroclor 1268 at concentrations equal to or greater than 50 mg/kg from IP Landfill Cell No. 2 to the engineered stockpiles.
- Excavation and transportation of WWTS containing Aroclor 1268 at concentrations less than 50 mg/kg from IP Landfill Cell No. 2 to IP Landfill Cell No. 1.
- Removal of piping that reportedly transported wastewater from the Holtrachem facility to Landfill Cell No. 2 and associated impacted soil containing Aroclor 1268.
- Management of wastewater generated during the removal activities, including chemical treatment (using a flocculant and coagulant) prior to collection of water in two settling ponds; bag filtration; carbon filtration; and routine sampling to ensure that Aroclor 1268 concentrations were less than 3 micrograms per liter (μg/L) prior to discharge to IP's wastewater treatment system.
- Collection of confirmation samples to confirm achievement of cleanup goals.
- Collection of samples at a rate of approximately one per 1,000 yd^3 of material placed in the engineered stockpiles. An off-site laboratory analyzed the 19 samples for Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), metals, pesticides and dioxins.

Approximately 22,500 yd^3 of WWTS containing Aroclor 1268 at concentrations equal to or greater than 50 mg/kg were excavated and transported from IP Cell No. 2 and placed in the engineered stockpiles. Approximately 70,500 yd^3 of WWTS containing Aroclor 1268 at concentrations less than 50 mg/kg were excavated and transported from IP Cell No. 2 to IP Landfill Cell No. 1. More than 6.5 million gallons of water was pre-treated and discharged to IP's wastewater treatment system during the removal activities. **Figure 8** is a Google Earth aerial photograph from October 2008 that shows the removal action work in progress.

Honeywell's consultant incorporated weekly inspections of the engineered stockpiles into the pre-existing Post Removal Site Control Plan. Typically, wastes with concentrations of PCBs greater than or equal to 50 mg/kg are regulated for disposal as TSCA PCB waste and are disposed of in a TSCA chemical waste landfill. The engineered stockpiles were planned as temporary storage. The disposition of this waste material is included as part of the remedy selected in this ROD.

Figure 8: Google Earth aerial photo during the WWTS removal action (October 2008)



2.4.3 CERCLA Enforcement Actions

In April 2002, EPA sent a General Notice Letter to Honeywell. To date, EPA and Honeywell have entered into the four administrative orders listed in **Table 2**. IP is also a party in one of them. The PRPs have paid oversight bills in a timely manner. Informal discussions with Honeywell indicate that they will agree to implement the remedy selected in this ROD.

Table 2: List of Administrative Orders

Acronym	Title	Docket #	Parties Involved	Effective Date
AOC 1	Administrative Order on Consent for Removal Action	CER-04-2002-3771	EPA Honeywell International Inc.	7/1/2002
AOC 2	Administrative Order on Consent for Removal Action	CER-04-2004-3781	EPA Honeywell International Inc.	7/8/2004
AOC 3	Administrative Settlement Agreement and Order on Consent for Removal Action	CERCLA-04-2008-3769	EPA Honeywell International Inc. International Paper Company	5/20/2008
AOC 4	Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study	CERCLA-04-2009-3980	EPA Honeywell International Inc.	9/15/2009

3.0 COMMUNITY PARTICIPATION

In accordance with Section 300.430(f)(3) of the NCP, the EPA performed community participation activities related to selecting the cleanup action described in this ROD. EPA updated the Administrative Record (AR) for the site by adding documents that EPA used in selecting the cleanup plan. These documents include, among others, the Community Involvement Plan, RI Report, Ecological Risk Assessment, Baseline Human Health Risk Assessment, Feasibility Study (FS) and Proposed Plan.

EPA maintains the AR file at the EPA Region 4 office and at the East Columbus Public Library. EPA published a notice of the availability of these documents in the Star News on August 15, 2016. EPA held a public comment period from August 15, 2016 to September 14, 2016. In addition, EPA hosted a public meeting on August 23, 2016, at Riegelwood Community Center, in Riegelwood, NC to present the Proposed Plan to community members. At this meeting, representatives from EPA, NCDEQ, Honeywell and AMEC Foster Wheeler Environment & Infrastructure, Inc. (AMECFW) answered questions about the site and the remedial alternatives. A transcript of the meeting and EPA's response to comments received during the public comment period is included in this ROD in Part 3, the Responsiveness Summary. EPA did not receive any written comments from community members on the Proposed Plan.

Just prior to the start of the public meeting, NCDEQ verbally informed EPA and the PRP that some of their approved language changes on the draft FS were not included in the July 2015 version. The PRP's consultant acknowledged the oversight and submitted a revised FS on September 7, 2016. EPA and NCDEQ have approved the September 2016 FS and EPA has added it to the AR.

4.0 SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

Under EPA oversight, the PRPs previously conducted two removal actions at the site. The first removal action addressed the immediate threats of spilled and containerized wastes. As described in Section 2.4.2, Honeywell's contractors dismantled the former cell building and associated structures and transported wastes to off-site disposal facilities. In the second removal action, the PRPs contractors excavated WWTS from the adjacent IP property and transported WWTS that contained concentrations of Aroclor 1268 above 50 mg/kg to the site. The WWTS is sealed inside two engineered stockpiles.

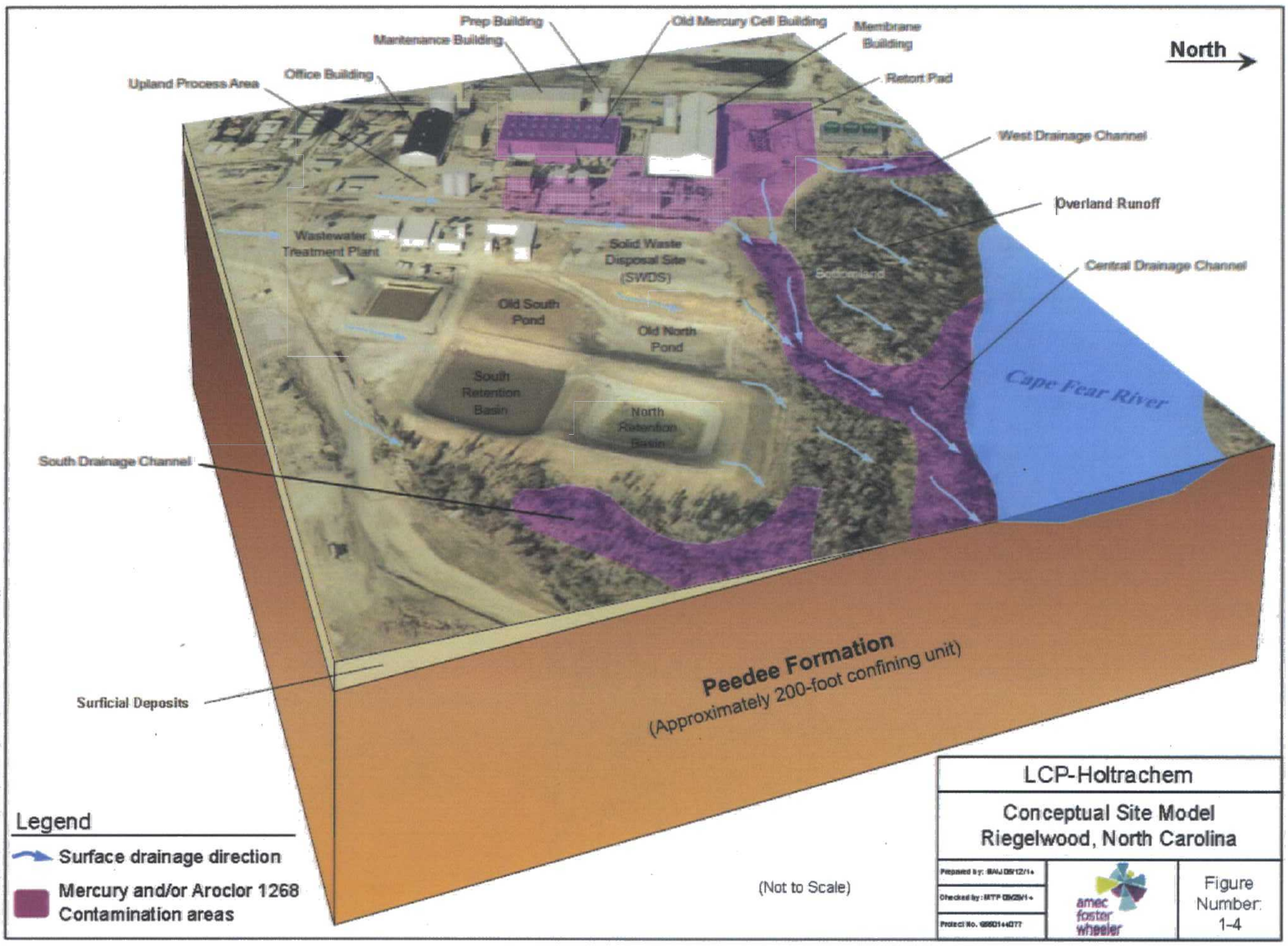
EPA is selecting the final remedy for the site and the remedial action is under one OU. The remedial action selected in this ROD addresses the following contaminated media and wastes: soil, sediment, surface water, former RCRA units, mercury wastes and the on-site stored WWTS. The response actions for the selected remedy include a variety of components that are described in **Sections 9.1.3** and **9.1.9**. Groundwater contamination is limited to the uppermost aquifer unit, which has insufficient yield for drinking water use. Based on multiple criteria, the aquifer is characterized as an EPA Class III, Subclass IIIA, not suitable as a potential source of drinking water and of limited beneficial use per "Guidelines for Ground-Water Classification Under the EPA Groundwater Protection Strategy", and the human health and ecological pathways for exposure to contaminated groundwater are incomplete. Data indicates that detected constituents in groundwater are not migrating and are not causing detriment to human health or the environment.

5.0 SITE CHARACTERISTICS

5.1 Conceptual Site Model

The Conceptual Site Model (CSM) is illustrated in **Figure 9**. Historical manufacturing operations resulted in the release of contaminants into the environment. The primary sources of contamination are from the historical mercury cell operations, retort operations, Aroclor 1268 graphite impregnation operations, spills and leaks. These operations and releases resulted in contaminated soil, sediment and surface water by overland flow (i.e., stormwater runoff) and atmospheric deposition.

Figure 9: Conceptual Site Model



5.2 Site Overview

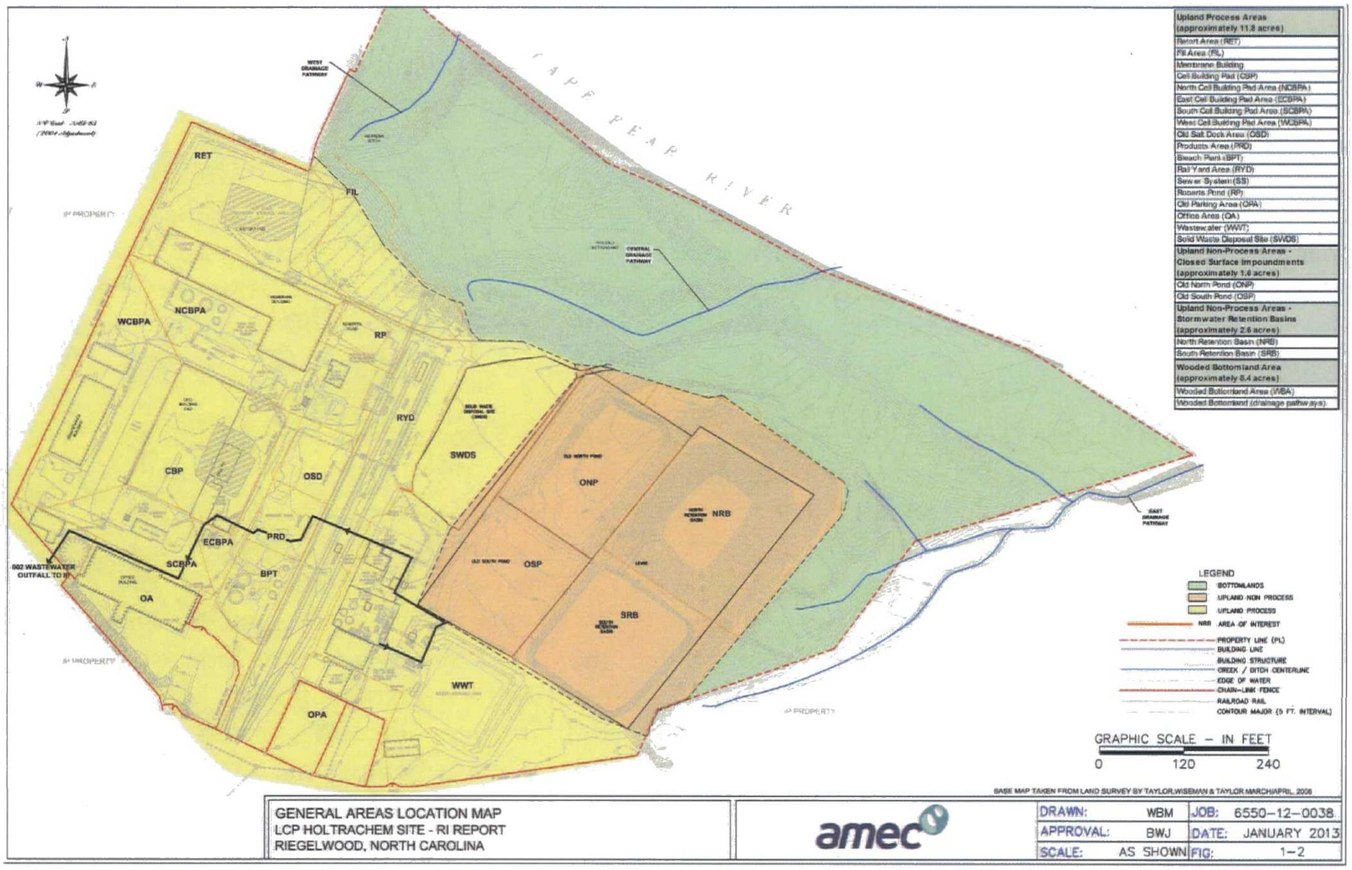
The site is approximately 24.4 acres. It is surrounded by IP on all sides, except where the site borders the Cape Fear River. The site is generally lower in elevation than the adjacent IP property (in some areas by 10 to 15 feet). The site was divided into three areas for purposes of the risk assessments. The areas are illustrated in **Figure 10**.

The Upland Process Area (UPA) is approximately 11.8 acres and consists of the former process and operational areas, and the wastewater treatment area. The majority of the UPA is relatively flat with ground surface elevations ranging from approximately 35 to 36 feet using the North American Vertical Datum of 1988 (NAVD 88). The eastern portion of the UPA slopes to the east with elevations ranging from 29 to 35 feet.

The Upland Non-Process Area (UNPA) is approximately 4.2 acres located in the east central portion of the site. This area contains two surface impoundments referred to as the Old North Pond and the Old South Pond, and two (north and south) retention basins surrounded by grassed areas.

The Wooded Bottomland Area (WBA) is approximately 8.4 acres located along the northern and eastern boundaries of the site. It consists of 7.3 acres of delineated wetlands, which are illustrated in **Figure 11**. This area is located within an alluvial floodplain between the Cape Fear River and the industrialized portions of the site. In general, the land slopes to the northeast, as the western half of the bottomland forest is higher than the eastern half with elevations ranging from 10 to 30 feet. The forest canopy is moderately dense. Trees, limbs, and persistent herbaceous plants that remain visible throughout the year dominate this area. The understory is thick on the western half with briars and more upland vegetation. The understory on the eastern half is less dense and contains lower-lying vegetation, including some that is more typical of wet environments. The bottomlands also consist of three primary drainage ditches: one to the west, one in the center bisecting the forest, and one to the south. A portion of the bottomlands is located within a 100-year floodplain zone, which is colored in blue in **Figure 12**.

Figure 10: General Area Location Map



Note: yellow is Upland Process Area, orange is Upland Non-Process Area, and green is Wooded Bottomland Area.

Figure 11: Wetland Delineation Map

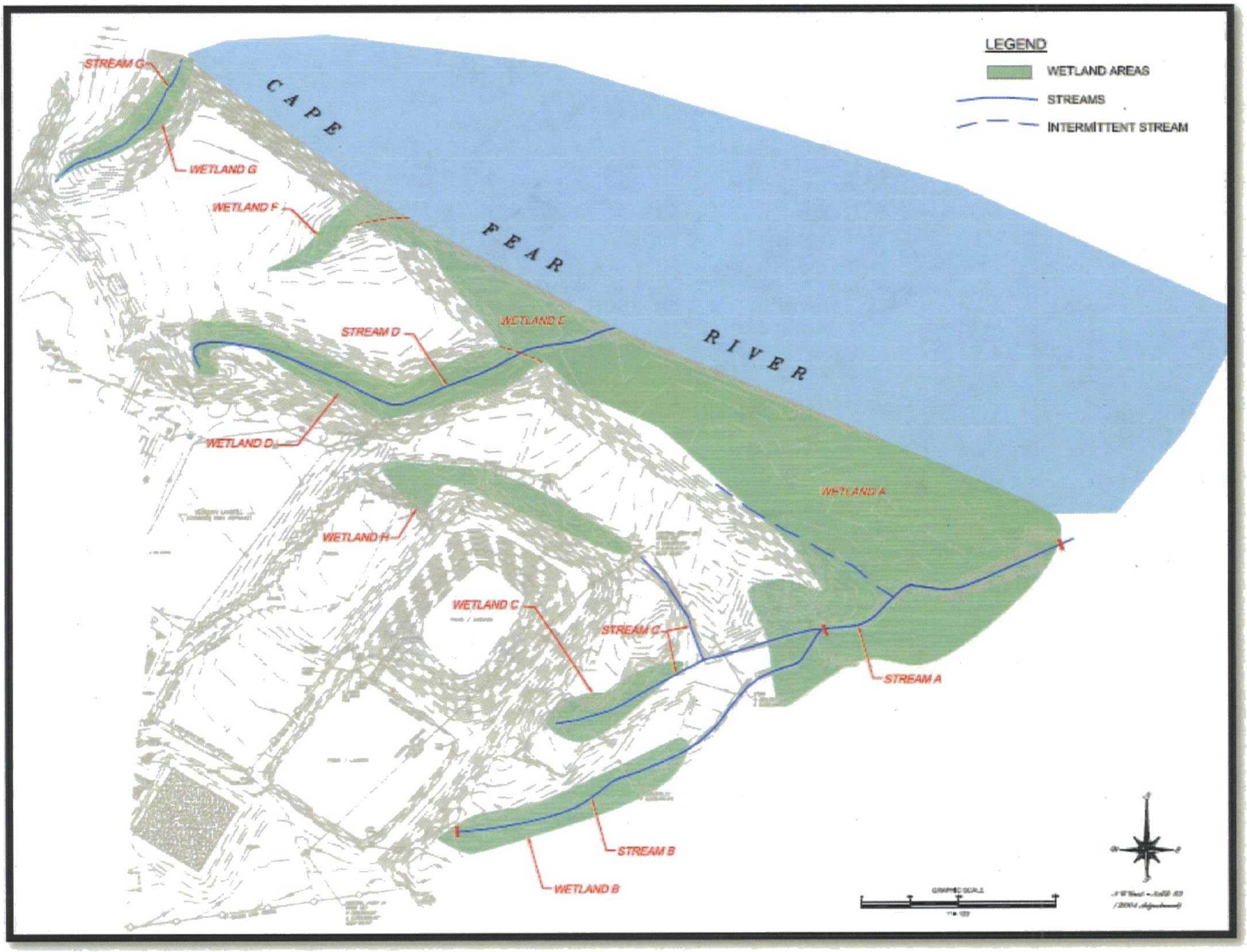


Figure 12: 100-year Flood Zone

5.3 Surface and Subsurface Features

5.3.1 Upland Process Area

The UPA currently contains perimeter fencing, several structures and buildings, nine above ground storage tanks (ASTs), several storm water collection basins connected to an underground piping system to capture storm water, paved and gravel roads, concrete foundations of former operational structures, a railroad spur, and a wastewater treatment system.

Access Structures

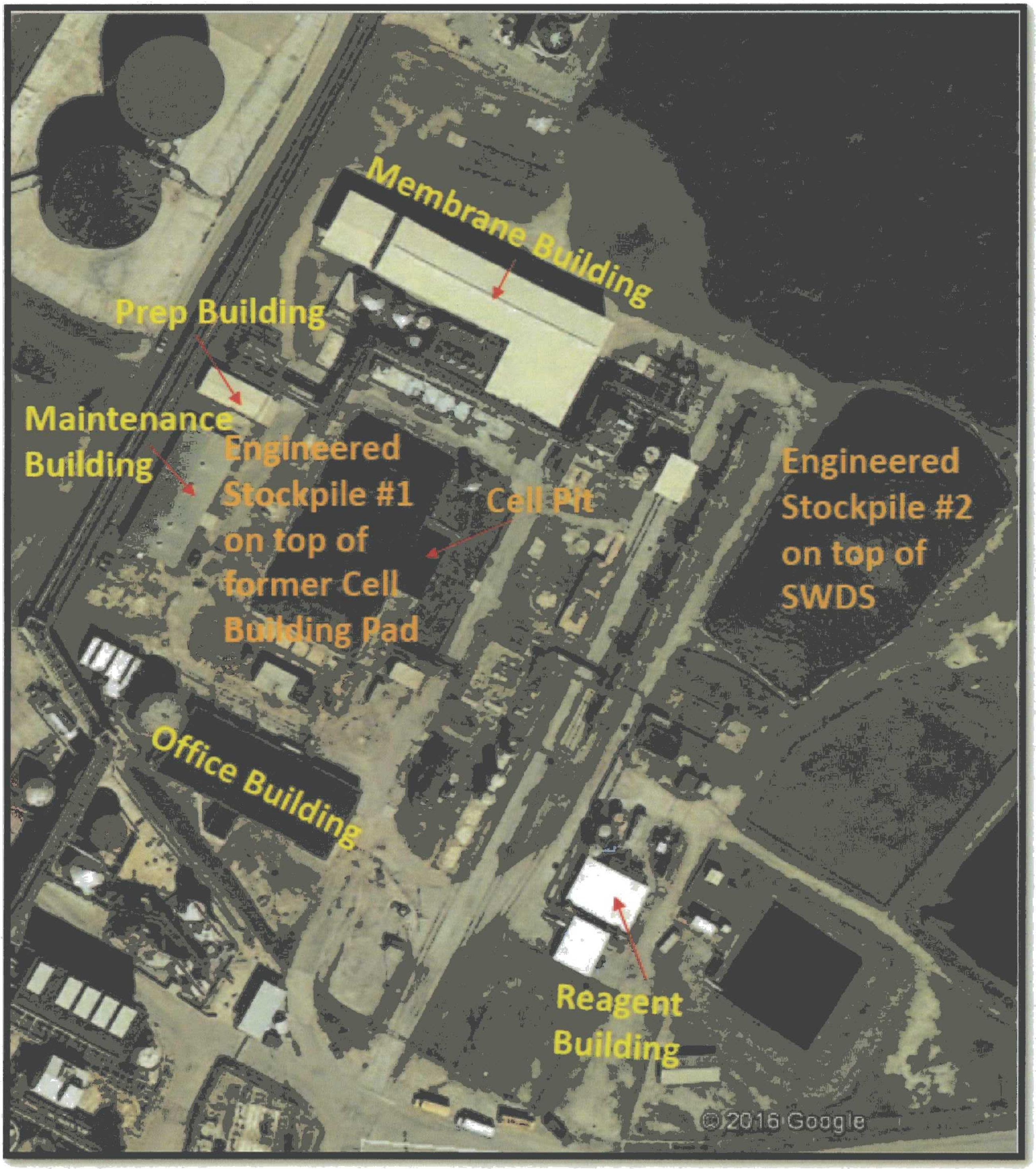
- Fencing – An eight-foot high chain link fence that runs from the northwest property boundary to the southeastern portion of the property controls access. Three access gates are part of the fencing. No fencing is present along the site and Cape Fear River boundary or the eastern wooded boundary between the site and IP.
- Railroad Spur – A railroad spur on-site is the terminus of an active railroad track that leaves the site in a southwestern direction.

Buildings

Five buildings remain at the site as described below and shown in **Figure 13**.

- Office Building – The office building is currently used for administration, laboratory and worker support activities. It is a single story, approximately 9,600 square foot brick and cinder block structure.
- Prep Building – The Prep Building is currently used for general material storage. It is a single story, approximately 2,100 square foot metal structure.
- Membrane Building – The Membrane Building is currently used for material storage (e.g. drums, sandbags, various equipment). It is a single story, approximately 15,300 square foot metal structure with a corrugated exterior.
- Reagent Building – The Reagent Building is currently used to store chemicals, drums from former assessment activities, and site equipment. It is a single story, approximately 2,400 square foot metal structure.
- Maintenance Building – The Maintenance Building is not in use. It is a single story, approximately 6,000 square foot brick and metal structure.

Figure 13: Buildings Remaining On-site



Partially Dismantled UPA Components

Six process components were partially dismantled. Partially dismantled remaining structures are shown in **Figure 14** and include:

- Cell Building Pad – The Cell Building Pad is an approximately 20,000 square foot (ft^2) concrete floor of the former Mercury Cell Building. Contractors dismantled and removed the mercury cell building during the 2002-2004 Removal Action. Engineered Stockpile #1, which contains approximately 6,700 yd^3 of WWTS, is currently on top of the pad.
- Cell Pit – The Cell Pit is immediately adjacent to the Cell Building Pad. It has an approximate capacity of 60,000 gallons.
- Retort Pad – The Retort Pad is an approximately 4,000 ft^2 concrete structure of the former mercury retort operation. A liner and clean backfill material currently cover it.
- Former Bleach area – The former bleach area consists of remnant concrete structures of that operation.
- Former Brine Tank area – The former brine tank area (also referred to as the Brine Saturators in the Old Salt Dock area) consists of remnant concrete pads.

UPA RCRA Units

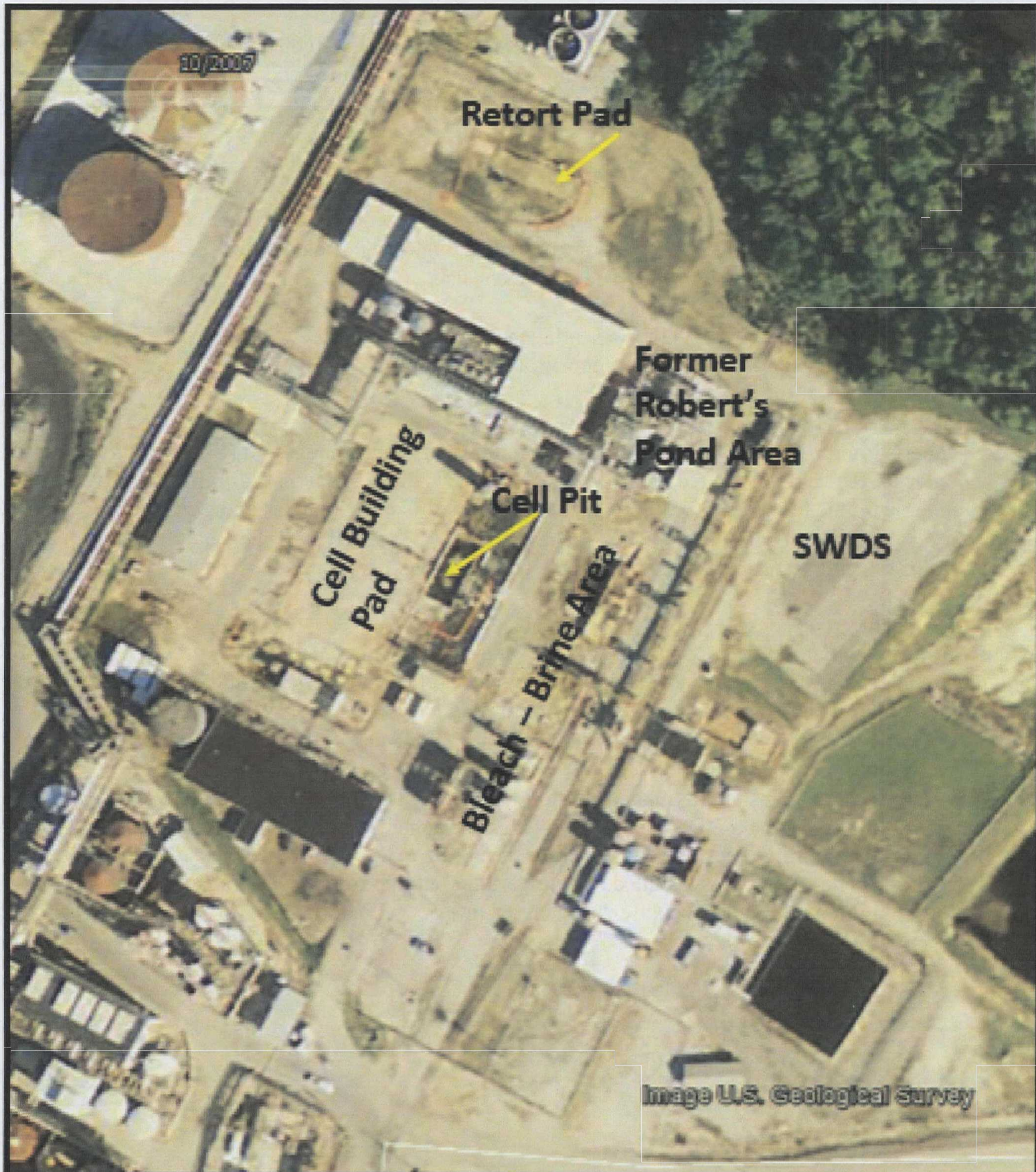
- Roberts Pond – Roberts Pond was a former solid waste management unit (SWMU). It was closed under RCRA, but did not receive clean closure certification. About half of it is currently underneath the Membrane Building, and the other half is beneath a dirt and gravel drive.
- Solid Waste Disposal Site (SWDS) — The SWDS, also referred to as the Vault, has an asphalt cover. It is a RCRA unit that is currently beneath Engineered Stockpile #2.

Temporary Engineered Stockpiles (ESP)

WWTS from IP containing PCB-contaminated soils and sludge with concentrations greater than 50 mg/kg are enclosed in two engineered stockpiles. Both stockpiles consist of top and bottom high density polyethylene (HDPE) liners that are sealed together to fully encapsulate the WWTS.

- Stockpile #1 contains approximately 6,700 yd^3 of WWTS and covers the entire footprint of the Cell Building Pad.
- Stockpile #2 contains approximately 15,800 yd^3 of WWTS, concrete, and piping, and covers the entire footprint of the SWDS. This stockpile has a leachate extraction system consisting of three vertical de-watering pipes placed on the north end, the east side and the west side of the stockpile. The system was installed to remove fluid buildup from water drainage of the WWTS. Fluid buildup within this stockpile was pumped into 55-gallon drums.

Figure 14: Partially Dismantled Process Area



Stormwater/Wastewater Treatment Components

- Stormwater Collection System – The storm water collection system consists of a series of catch basins and concrete underground piping that directs surface water run-off within the UPA to the retention basins in the UNPA. The underground piping has deteriorated in many sections.
- MESS Head Area – The MESS Head area consists of a sub-grade sump, a 20,000-gallon tank and a filter press. Pre-treatment of mercury-contaminated wastewater, prior to discharge to final treatment, occurred in the MESS Head Area.
- Wastewater Treatment Plant – The wastewater treatment plant consists of a borohydride treatment system, ASTs and a treatment pool (referred to as the Econo Pool). Wastewater is treated and pumped to IP, where the treated effluent mixes with IP's wastewater for further treatment and discharge.
- IP Mill and Fire Protection Water – IP provides water to the site through underground piping. A transite pipe runs underground from the southwest corner of the site towards the east to the wastewater treatment plant. The underground piping for fire protection water is an 8-inch ductile iron pipe that generally loops the central portion of the UPA. Several fire hydrants associated with this system are present on site.
- ASTs are used for wastewater processing and storage. The AST identifier, their capacities and location are included in **Table 3.**

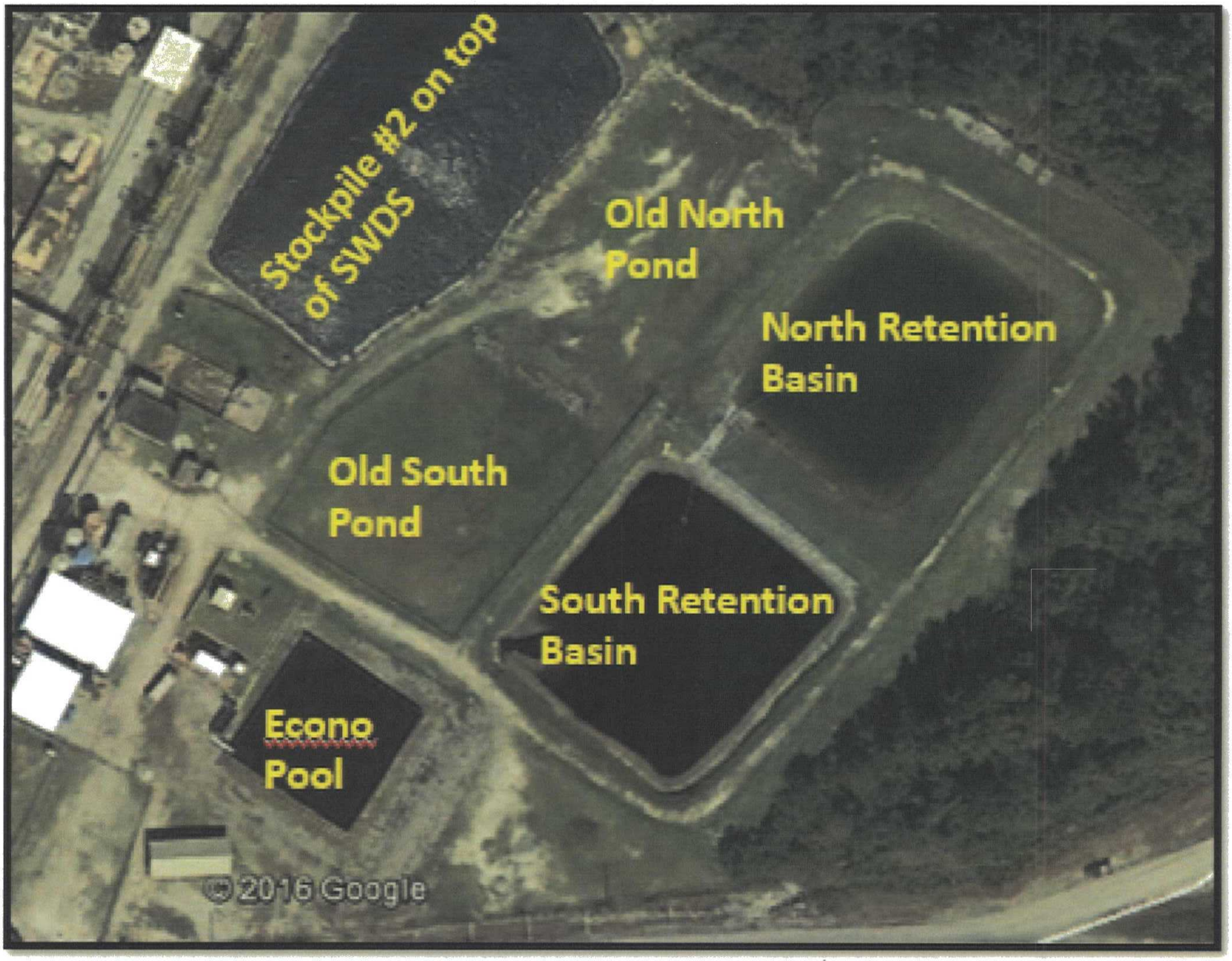
Table 3: Above Ground Storage Tanks

Identifier	Volume in gallons	Location
Collection Tank #1	9,000	Wastewater Treatment Area
Collection Tank #2	18,000	Wastewater Treatment Area
Collection Tank #3	20,000	Wastewater Treatment Area
Mess Head Tank	20,000	MESS Area
North Storm water	22,000	Bleach Plant Area
South Storm water	22,000	Bleach Plant Area
North Raven	20,000	Wastewater Treatment Area
South Raven	20,000	Wastewater Treatment Area
Econo Pool	250,000	Wastewater Treatment Area

5.3.2 Upland Non-Process Area

The UNPA contains two surface impoundments and two retention basins surrounded by grassed areas. The two surface impoundments, referred to as the Old North Pond and Old South Pond, are covered with soil/gravel and low-lying grass, respectively. The retention basins capture storm water in addition to wastewater. The south retention basin contains the initial effluent from the collection systems. Water from this basin is transferred to the Econo Pool for treatment. The north retention basin collects rainwater that falls into it, as well as serving as an overflow measure for the south retention basin.

Figure 15: Upland Non-Process Areas (with some UPA features also shown)



5.3.3 Wooded Bottomland Area

The WBA does not contain any man-made surface or subsurface features.

Figure 16: Wooded Bottomland Area

5.4 Sampling Strategy

RCRA referred the site to Superfund in 2002. Since that time, several different entities have conducted numerous sampling events. The sections below provide a summary of the field activities conducted since 2002, and incorporation of historical RCRA data where appropriate.

5.4.1 Surveys

Surface features of the site were documented through historical engineering drawings, aerial and field surveys by registered land surveyors (RLS), field measurements and observations. The information below provides a general description of these surveys:

- 1978: Simons - Eastern Company, Inc. prepared a survey plat of the process area and related topographic conditions, operational areas, and drainage features. Historical surface features were also evaluated through vintage engineering drawings.
- 1999: American Geographic. Inc. RLS conducted a topographic aerial survey of the site and portions of the surrounding IP property using the National Geodetic Vertical Datum of 1929 (NGVD 29). This survey was conducted as part of a RCRA Hazardous Waste Permit application renewal. The geospatial data from this survey was later used in the initial portions of the EE/CA Phase I investigation.
- 2005: W. K. Dickson RLS completed a survey of the former and newly installed groundwater monitoring wells within the UNPA using the NGVD 29.

- 2006: Taylor Wiseman & Taylor RLS conducted a survey of the site's topography, drainage features and horizontal control for the site structures, the EE/CA Phase II soil, sediment, surface water, and air sampling locations, and groundwater monitoring wells using the NAVD 88. Sampling locations from previous assessment work including the iESI/RA and EE/CA Phase I investigations were incorporated into the 2006 survey. This survey has been used as a base map for subsequent sampling efforts.
- 2007: CH2M Hill conducted a survey of the drainage channels in the WBA using a Global Positioning System (GPS) unit.
- 2009: Cape Fear Design Services prepared an as-built survey of the two engineered stockpiles.

5.4.2 Air

The following historical information was reviewed to evaluate meteorological data and characterize the atmospheric transport of contaminants:

- air quality records and related air permits for the discharge of chlorine, hydrochloric acid, and mercury during facility operations;
- past operational processes including the impregnation of Aroclor 1268 into graphite anodes and mercury emissions from the cell building ventilation fans;
- the *Waccamaw Atmospheric Mercury Study* published by the North Carolina Division of Air Quality in March 2002, which examined air quality in the Riegelwood area from 1998 to 2000.

<u>Monitoring</u>
From 2002 to the present, air monitoring for mercury occurs daily when staff are present on-site. In September 2005, a radiation survey was conducted.

<u>Sampling</u>
Between December 2004 and May 2007, seven Time Integrated Air Sampling (TIAS) events were conducted. These events took place quarterly and consisted of six days of sample collection performed within a three-week period. Air samples were collected using air sample pumps over a six to seven-hour period each day from six locations surrounding the former Cell Building's concrete pad.

In 2005, air samples were collected to evaluate indoor air. The buildings sampled included the Office Building, Membrane Building, Prep Building, and Air Compressor Building. Samples were collected from both inside the buildings and just outside exits to the buildings.

5.4.3 Surface Water and Sediment

5.4.3.1 Surface Water Sampling

During 2002, 2004, 2005, 2006 and 2009, a total of 40 surface water samples were collected at the site and surrounding waterways. The sampling conducted in 2002 was part of the iESI/RA. The sampling conducted in 2004 and 2005 was part of the EE/CA. The sampling in 2006 was immediately following a storm event to evaluate potential surface water transport of contamination. The sampling conducted in 2009 was to fill in data gaps in order to complete the Baseline Ecological Risk Assessment (BERA). The focus of each sampling event varied in purpose, location and analysis and is summarized in **Table 4.**

Table 4: Surface Water Sampling Strategy Summary 2002-2009

Area	# of samples	Parameters	Sample Year	Sample ID
Cape Fear River	3	Full Scan	2002	LCP-001, -006, -007
Cape Fear River	1	TAL Metals, TCL VOCs and SVOCs	2002	LCP-005
	4	**Number of Surface Water Samples Collected In 2002**		
Cape Fear River	6	Full Scan; Aroclor 1268; pH; Dioxins for IP-2	2004	IP-2; River Ref-1; River Up-1, -2; River Down-1, -2
Livingston Creek	1	Full Scan; Aroclor 1268	2004	Wright-2
	7	**Number of Surface Water Samples Collected In 2004**		
Cape Fear River	3	Mercury	2005	SW-1, -2, -3
Western Drainage Ditch	3	Full Scan; Aroclor 1268; TOC; Hardness; TSS; Dioxins for SW-11, -12	2005	SW-11, -12, -28
Eastern Drainage Ditch	7	Full Scan; Aroclor 1268; TOC; Hardness; TSS; Dioxins for SW-22	2005	SW-17, -18, -20, -22, -24, -29, -30
Central Drainage Ditch	5	Full Scan; Aroclor 1268; TOC; Hardness; TSS; Dioxins for SW-7, -13, -15	2005	SW-7, -9, -10, -13, -15
	18	**Number of Surface Water Samples Collected In 2005**		
Stormwater Event Western Drainage Ditch	2	Full Scan; Aroclor 1268; TOC; Hardness; TSS; Dioxins	2006	SW-4, -14
Stormwater Event Central Drainage Ditch	2	Full Scan; Aroclor 1268; TOC; Hardness; TSS; Dioxins; (SW-5 no TOC analysis)	2006	SW-5, -16
Stormwater Event Eastern Drainage Ditch	3	Full Scan; Aroclor 1268; TOC; Hardness; TSS; Dioxins	2006	SW-6, -8, -19
	7	**Number of Surface Water Samples Collected In 2006**		
Eastern Drainage Ditch	3	Full scan (no VOCs); Aroclor 1268; pH; Hardness; methyl mercury; amphibian toxicity	2009	SW-40, -41, -42
Background Off-site	1	Full scan; Aroclor 1268; methyl mercury	2009	SWREF-1
	4	**Number of Surface Water Samples Collected In 2009**		
	40	**TOTAL NUMBER OF SURFACE WATER SAMPLES 2002-2009**		

Notes:

Full Scan = Target Analyte List Metals (TAL metals); Target Compound List Volatile Organic Compounds (TCL VOCs), Semi-Volatile Organic Compounds (SVOCs), Polychlorinated Biphenyls (PCBs) + Aroclor 1268, pesticides (Aroclor 1268 is noted when added to the PCB analysis).

TOC = Total Organic Carbon

TSS = Total Suspended Solids

5.4.3.2 Sediment Sampling

Over 130 sediment samples were collected in the combined years of 2002, 2004, 2005, 2007 and 2009.[3] The sampling conducted in 2002 was part of the iESI/RA. The sampling conducted in 2004 and 2005 was part of the EE/CA. The sampling conducted in 2007 was to address data gaps identified at the conclusion of the EE/CA Phase 2 sampling. The sampling conducted in 2009 was to fill in data gaps in order to complete the BERA. The focus of each sampling event varied in purpose, location and analysis and is summarized in **Table 5.**

Table 5: Sediment Sampling Strategy Summary 2002-2009

Area	# of samples	Parameters	Year	Sample ID
Central Drainage Ditch	2	Full Scan; Total Cyanide	2002	HC-15, -16
Eastern Drainage Ditch	7	Full Scan; Total Cyanide	2002	HC-17 through HC-22
Cape Fear River	4	Full Scan; Dioxins	2002	LCP-001, -002, -005 and -007
	13	**Number of Sediment Samples Collected in 2002**		
Cape Fear River	9	Full Scan; Aroclor 1268; TOC; pH; Dioxins for IP-1, -3	2004	IP-1, -3; Site-1, -2; River Up-1, -2; River Down-1, -2; and Creek Discharge
Sewer System (SS)	5	Full Scan; Aroclor 1268	2004	SED-1 through -4, -6
Cape Fear River Background	5	Full Scan; Aroclor 1268; TOC	2004	River Ref-1 through Ref-5
North Retention Basin	3	Full Scan; Aroclor 1268; TCLP	2004	SED-7, -8
South Retention Basin	4	Full Scan; Aroclor 1268; TCLP	2004	SED-9, -10
Livingston Creek	3	Full Scan; Aroclor 1268; TOC	2004	Wright-1 through -3
Central Drainage Ditch	5	Full Scan; Aroclor 1268	2004	WSED-1 and -2
Eastern Drainage Ditch	6	Full Scan; Aroclor 1268	2004	WSED-3 through -5
	40	**Number of Sediment Samples Collected in 2004**		
Eastern Drainage Ditch	8	Mercury, PCB; Aroclor 1268; TOC; pH for WSED-19	2005	WSED-16, -19, -21, -25
Eastern Drainage Ditch	16	Full Scan; Aroclor 1268; TOC; pH; Dioxins for WSED-17, -18, -20	2005	WSED-17, -18, -20, -22 to -24, -29, -30
Western Drainage Ditch	6	Full Scan; Aroclor 1268; TOC; Dioxins for WSED-28	2005	WSED-26 to -28
Central Drainage Ditch	10	mercury; PCB; Aroclor 1268; TOC	2005	WSED-6, -8, -11, -12, -14
Central Drainage Ditch	10	Full Scan; Aroclor 1268; TOC; pH; Dioxins for WSED-9	2005	WSED-7, -9, -10, -13, -15
	50	**Number of Surface Water Samples Collected in 2005**		
Western Drainage Ditch	3	Aroclor 1268	2007	WSED-39
Eastern Drainage Ditch	4	Mercury	2007	WSED-31, -32
Central Drainage Ditch	9	Aroclor 1268	2007	WSED-33, -35, -37
Central Drainage Ditch	4	Mercury	2007	WSED-34, -38

[3] Note: This does not include the sampling conducted by IP's contractors in their former wastewater treatment lagoon. Information about sampling of that area is included in section 5.4.4.3.

Area	# of samples	Parameters	Year	Sample ID
Central Drainage Ditch	3	mercury and Aroclor 1268	2007	WSED-36
	23	**Number of Sediment Samples Collected in 2007**		
Eastern Drainage Ditch	4	Full scan (no VOCs); Aroclor 1268; methyl mercury	2009	WSED-40, -41, -42, SEDREF-1
Background Off-site	1	Full scan; Aroclor 1268; methyl mercury	2009	SEDREF-1
	5	**Number of Sediment Samples Collected in 2009**		
	131	**TOTAL NUMBER OF SEDIMENT SAMPLES 2002-2009**		

Notes:
Full Scan = Target Analyte List Metals (TAL metals); Target Compound List Volatile Organic Compounds (TCL VOCs), Semi-Volatile Organic Compounds (SVOCs), Polychlorinated Biphenyls (PCBs) + Aroclor 1268, pesticides (Aroclor 1268 is noted when added to the PCB analysis).
TCLP = Toxicity characteristic leaching procedure
TOC = Total Organic Carbon

5.4.3.3 WWTS

During June through October 2008, 19 samples were collected of the WWTS transported to the ESPs. Samples were collected at a rate of one sample per approximately 1,000 yd^3. The purpose was to assist in evaluating treatment options for this material relative to constituents other than PCBs.

5.4.4 Geology

Geological investigations for the site and surrounding area included research of published literature of the regional and local geologic conditions, and the evaluation of subsurface information obtained during geological and environmental investigations.

Over 50 soil borings were advanced at the site primarily for purposes of geologic evaluation and well installation. The majority of the borings were drilled in the mid-1980s through the late 1990s. This work focused primarily on the surficial portion (upper 30 to 40 feet) of the underlying materials within the UNPA near the two closed surface impounds (Old North and South Ponds), the retention basins, and the WBA. Deeper subsurface conditions were also investigated while the site was regulated under RCRA by drilling and sampling three soil borings to depths of approximately 140 ft bgs and one boring to approximately 200 ft bgs. Down-hole geophysical logging, including electrical (apparent resistivity, spontaneous potential) and gamma logging, was performed on each of the four deep borings. Grain size distribution analyses was also conducted. In 2004, seven additional groundwater monitoring wells were installed in the UPA, with depth ranges of 12 to 20 ft bgs.

5.4.5 Soil

Over 660 soil samples were collected in the years 2002 – 2005, 2007 and 2009. In 2002, soil samples were collected during the iESI/RA. In 2003, high-density soil sampling was performed around the Retort Pad perimeter; surface and subsurface soil samples were collected from 46 locations. In 2004, two soil sampling events occurred. The first one was part of legal discovery in which surface and subsurface soil samples were split from the plaintiffs' consultant. The second soil sampling event in 2004 was conducted as part of the EE/CA Phase 1 activities. In 2005, soil samples were collected as part of EE/CA Phase 2 activities. At the completion of the Phase 1 work, mercury and Aroclor 1268 were identified as the primary contaminants the site. Vertical and horizontal delineation sampling was performed in areas identified in Phase 1 with high concentrations of mercury and/or Aroclor 1268. In 2007, surface and subsurface soil samples were collected from 21 locations in the WBA to address data gaps identified after the EE/CA Phase 2 sampling was completed. In 2009, CH2M Hill collected 16 additional soil samples from the WBA to fill in data gaps in order to complete the BERA. The focus of each sampling event varied in purpose, location and analysis and is summarized in **Table 6**.

Table 6: Soil Sampling Strategy Summary 2002-2009

Area	# of samples	Parameters	Sample Year	Sample ID
Background Off-site	3	Full Scan	2002	HC-23
Fill Area	7	Full Scan; Total Cyanide	2002	HC-06, -07, -12
Old Parking Area	2	Full Scan; Total Cyanide	2002	HC-24
Retort Area	15	Full Scan; Total Cyanide	2002	HC-01 to -05
Roberts Pond	6	Full Scan; Total Cyanide	2002	HC-08 and -09
WBA	2	Full Scan; Total Cyanide	2002	HC-13 and -14
	35	**Soil Samples Collected in 2002**		
Retort Area	118	mercury	2003	LC Samples
	118	**Soil Samples Collected in 2003**		
Litigation Samples	22	mercury, PCB; Aroclor 1268	2004	Site #1 B1, #1 B2, #1 B3, #1 B4, #1 Surface, #2 B1, #2 B2, #2 Debris, #2 Surface
Background	6	Full Scan; Aroclor 1268	2004	SB-26 to -28
Bleach Plant	1	Full Scan; Aroclor 1268	2004	SB-15
North Cell Building Pad Area	5	Full Scan; Aroclor 1268	2004	SB-4, -11, -12
Old Parking Area	6	Full Scan; Aroclor 1268; pH	2004	SB-21 to -23
Old Salt Dock	2	Full Scan; Aroclor 1268	2004	SB-13
Products Area	2	Full Scan; Aroclor 1268	2004	SB-14
Rail Yard Area	5	Full Scan; Aroclor 1268	2004	SB-5, -16, -17
Rail Yard Area	7	mercury and Aroclor 1268	2004	Site #3 B1, Site #3 Surface
Retort Area	4	Full Scan; Aroclor 1268	2004	SB-1, -2
SWDS	6	Full Scan; Aroclor 1268; SPLP	2004	W-1, W-2 and W-3
South Cell Building Pad Area	2	Full Scan; Aroclor 1268; pH	2004	SB-9
Wastewater Treatment Area	3	Full Scan; Aroclor 1268; pH	2004	SB-19 and -20
West Cell Building Pad Area	10	Full Scan; Aroclor 1268	2004	SB-3, -6, -7, -8, -10
	81	**Soil Samples Collected in 2004**		
Background	6	Full scan; Aroclor 1268; Dioxins; TOC	2005	SB-104 to -106

Area	# of samples	Parameters	Sample Year	Sample ID
East Cell Building Pad Area	2	Full scan; Aroclor 1268; Dioxins	2005	SB-73
East Cell Building Pad Area	18	mercury	2005	SB-118 to -121, -134, -135
Fill Area	69	Aroclor 1268	2005	SB-47 to -56, -58, -59, -301, -302
North Cell Building Pad Area	16	Aroclor 1268	2005	SB-30, -31, -33 to -38
North Cell Building Pad Area	15	mercury	2005	SB-122 to -126
Old North Pond	3	Full scan; Aroclor 1268; Dioxins for SB-77	2005	SB-76 to -78
Old North Pond	1	Full scan (no VOCs); Aroclor 1268	2005	UNP-5
Old Parking Area	6	Aroclor 1268	2005	SB-65 to -67
Rail Yard Area	22	Aroclor 1268	2005	SB-39 to -42, -57, -64
Rail Yard Area	4	Full scan; Aroclor 1268; Dioxins	2005	SB-71, -74
Retort Area	25	Aroclor 1268	2005	SB-43 to -46, -60
Retort Area	8	Full scan; Aroclor 1268; Dioxins	2005	SB-68 to -70
Retort Area	65	mercury	2005	SB-108 to -117, -136 to -150, -152 to -154
Roberts Pond	15	Aroclor 1268	2005	SB-61 to -63
SWDS	6	Total metals	2005	W-4 to -6
South Cell Building Pad Area	2	Full scan; Aroclor 1268; Dioxins	2005	SB-72
South Cell Building Pad Area	6	mercury	2005	SB-132, -133
Wastewater Treatment Area	2	Full scan; Aroclor 1268; Dioxins	2005	SB-75
West Cell Building Pad Area	2	Aroclor 1268	2005	SB-29, -32
West Cell Building Pad Area	21	mercury	2005	SB-127 to -131, -155 to -157
North Retention Basin	5	Full scan; Aroclor 1268; Dioxins for SB-102, -103, 310	2005	SB-81, -82, -102, -103, -310
South Retention Basin	2	Full Scan; Aroclor 1268	2005	SB-83, -84
WBA	2	Full Scan; Aroclor 1268	2005	SB-79 and -80
WBA	22	Full scan; Aroclor 1268; Dioxins; TOC for SB-98; VOCs and SVOCs for SB-89	2005	SB-85 to -101
	345	**Soil Samples Collected in 2005**		
WBA	59	Aroclor 1268	2007	SB-158 to -178

Area	# of samples	Parameters	Sample Year	Sample ID
	59	**Soil Samples Collected in 2007**		
WBA	17	Full scan; Aroclor 1268	2009	TERA-1 to -5, WB-1 to -5
UNPA	5	Full scan; Aroclor 1268	2009	UNP-1 to -5
Background Off-site	1	Full scan; Aroclor 1268; methyl mercury	2009	SEDREF-1
	23	**Soil Samples Collected in 2009**		
TOTAL OF	**661**	**SOIL SAMPLES 2002-2009**		

Notes:

Full Scan = Target Analyte List Metals (TAL metals); Target Compound List Volatile Organic Compounds (TCL VOCs), Semi-Volatile Organic Compounds (SVOCs), Polychlorinated Biphenyls (PCBs) + Aroclor 1268, pesticides (Aroclor 1268 is noted when added to the PCB analysis).

SPLP = synthetic precipitation leaching procedure

TOC = Total Organic Carbon

5.4.6 Groundwater

Prior to the year 2000, over 50 groundwater monitoring wells were installed at the site. In 2004, seven groundwater monitoring wells were installed in the UPA as part of the EE/CA. In 2012, one additional groundwater monitoring well was installed in the WBA near the head of the central drainage ditch. Some of the wells have been abandoned or destroyed. Currently there are 45 groundwater monitoring wells on-site. All of the wells consist of PVC pipes with diameters ranging from one to four inches. A summary of the construction data for the wells currently on-site is in **Table 7**.

Table 7: Groundwater Monitoring Well Construction Information

Well ID	Date Installed	Screen Interval (ft bgs)	Well Diameter/ Type	Current Status
BG	4/20/1992	18-28	2"/PVC	Background Monitoring Well
NUS-4R	4/20/1992	12.5-17.5	4"/PVC	Monitoring Well
4A	11/24/1986	10-15	2"/PVC	Monitoring Well
4B	11/24/1986	25-30	2"/PVC	Monitoring Well/Piezometer
5A	11/24/1986	15-20	2"/PVC	Monitoring Well
5B	11/24/1986	30-35	2"/PVC	Monitoring Well/Piezometer
6A	11/24/1986	15-20	2"/PVC	Monitoring Well/Piezometer
6B	11/24/1986	30-35	2"/PVC	Monitoring Well/Piezometer
B8	10/20/1986	13-23	2"/PVC	Monitoring Well/Piezometer
9A	Jun-1989	~1-6	2"/PVC	Monitoring Well
9B	Jun-1989	~5-10	2"/PVC	Monitoring Well/Piezometer
9C	Jun-1989	~8.5-13.5	2"/PVC	Monitoring Well/Piezometer
10AR	1/13/2000	10-20	2"/PVC	Monitoring Well
10BR	6/23/1999	34.5-39.5	2"/PVC	Monitoring Well
11A	1/19/1987	14-19	2"/PVC	Monitoring Well
11B	1/19/1987	29-34	2"/PVC	Monitoring Well
11C	2/16/1990	14-23.5	2"/PVC	Monitoring Well/Piezometer
12A	1/19/1987	10-15	2"/PVC	Monitoring Well/Piezometer
12B	1/20/1987	29.5-34.5	2"/PVC	Monitoring Well/Piezometer
13A	1/20/1987	10-15	2"/PVC	Monitoring Well
13B	1/20/1987	29.5-34.5	2"/PVC	Monitoring Well/Piezometer
14A	1/20/1987	10-15	2"/PVC	Monitoring Well
14B	1/20/1987	24.5-29.5	2"/PVC	Monitoring Well/Piezometer
POC-1R	Dec-1999	14-19	4"/PVC	Monitoring Well
POC-2R	1/12/2000	10-20	4"/PVC	Monitoring Well
POC-3	4/20/1992	13.5-18.5	4"/PVC	Monitoring Well
PZ-1	11/20/2001	2-12	2"/PVC	Monitoring Well/Piezometer
PZ-2	11/20/2001	1.5-11.5	2"/PVC	Monitoring Well/Piezometer
PZ-3	11/20/2001	1.5-11.5	2"/PVC	Monitoring Well/Piezometer

Well ID	Date Installed	Screen Interval (ft bgs)	Well Diameter/ Type	Current Status
PZ-4	11/20/2001	2-12	2"/PVC	Monitoring Well/Piezometer
PZ-5	11/20/2001	2-12	2"/PVC	Monitoring Well/Piezometer
PZ-6	11/20/2001	2-12	2"/PVC	Monitoring Well/Piezometer
P5	8/11/1999	10-20	1"/PVC	Monitoring Well/Piezometer
P6	8/11/1999	10-20	1"/PVC	Monitoring Well/Piezometer
P8	8/11/1999	10-20	1"/PVC	Monitoring Well/Piezometer
P9	8/2/2012	2-7	2"/PVC	Monitoring Well/Piezometer
RW-1	2/14/1990	14.2-23.7	4"/PVC	Recovery well/Inactive
RW-2	2/15/1990	17.4-26.9	4"/PVC	Recovery well/Inactive
MW-15	11/4/2004	2-12	4"/PVC	Monitoring Well
MW-16	11/10/2004	4.2-14.2	4"/PVC	Monitoring Well
MW-17	11/11/2004	3.4-13.4	4"/PVC	Monitoring Well
MW-18	11/9/2004	4.8-14.8	4"/PVC	Monitoring Well
MW-19	11/9/2004	7.7-17.7	4"/PVC	Monitoring Well
MW-20	11/9/2004	8.7-18.7	4"/PVC	Monitoring Well
MW-21	11/11/2004	9.3-19.3	4"/PVC	Monitoring Well
Notes:				
ft bgs = feet below ground surface				
PVC = polyvinyl chloride				

5.4.6.1 Groundwater Level Measurements

Groundwater levels have been measured for differing purposes over time. In the mid-1980s water levels were measured to evaluate the vertical and horizontal gradients of the underlying aquifers. Since 2004, three groundwater gauging events (2004, 2007 and 2009) were conducted to evaluate groundwater flow conditions as part of the EE/CA and RI work.

5.4.6.2 Aquifer Testing

Slug testing was performed on over 20 wells to assess subsurface hydraulic conductivity. In addition to the slug testing, long term groundwater extraction rates from recovery wells RW-1 and RW-2 were evaluated for purposes of RCRA corrective action. The hydraulic conductivity values and flow rates from the recovery wells were used in developing the hydrogeologic characteristics at the site.

5.4.6.3 Groundwater Sampling and Analysis

Historical RCRA compliance monitoring activities included: quarterly monitoring for mercury and indicator parameters for 12 compliance monitoring wells and one background monitoring well (1992 through 2003); and annual monitoring for RCRA Appendix 9 constituents from the point of compliance (POC) monitoring wells during January 1993 through December 2003.

Under CERCLA, groundwater samples were collected and analyzed in 2002, 2004, 2008, 2009, and 2012. The sampling conducted in 2002 was performed during the iESI/RA. The sampling conducted in 2004 and 2009 were part of the EE/CA and RI. The single sample collected in 2008 was during the IP Removal Action. The single sample collected in 2012 was to fill in a data gap for completion of the RI. The focus of each sampling event varied in purpose, location and analysis and is summarized in **Table 8**.

Table 8: Groundwater Sampling Strategy Summary

Area	# of samples	Parameters	Sample Year	Sample ID
UPA	1	Hg, inorganics	1992-2003 (Q)	BG
UNPA	7	Hg, inorganics	1992-2003 (Q)	POC-2R, 10AR, 10 BR, 11A, 11B, 13A, 14A
WBA	5	Hg, inorganics	1992-2003 (Q)	POC-3, NUS-4R, 4A, 5A, 9A
	13	**Groundwater Samples Collected Each Quarter during 1992-2003**		
UNPA	2	Appendix 9	1993-2003 (A)	POC-1R*, POC-2R
WBA	1	Appendix 9	1993-2003 (A)	POC-3
	3	**Groundwater Samples Collected Annually during 1993-2003**		
Old Parking Area	1	Full scan	2002	HC-24
Roberts Pond	1	Full scan	2002	HC-09
Fill Area	1	Full scan	2002	HC-07
Retort Area	5	Full scan	2002	HC-01 to -05
	8	**Groundwater Samples Collected in 2002**		
UPA	8	Full scan; Aroclor 1268; cations & anions	2004	BG; MW-15, -16, -17, -18, -19, -20, -21
UNPA	2	Full scan; Aroclor 1268; cations & anions	2004	POC-2R, 14A
WBA	4	Full scan; Aroclor 1268; cations & anions	2004	POC-3R, NUS-4R, 6A, 6B
	14	**Groundwater Samples Collected in 2004**		
SWDS	1	Hg; Aroclor 1268	2008	AV-1
	1	**Groundwater Samples Collected in 2008**		
UPA	8	Full scan; Aroclor 1268; cations & anions	2009	BG; MW-15, -16, -17, -18, -19, -20, -21
UNPA	3	Full scan; Aroclor 1268; cations & anions	2009	POC-2R, 11A, 14A
WBA	3	Full scan; Aroclor 1268; cations & anions	2009	POC-3R, NUS-4R, B8
	14	**Groundwater Samples Collected in 2009**		
WBA	1	Hg; Aroclor 1268	2012	P9
	1	**Groundwater Sample Collected in 2012**		

Notes:

Full Scan = Target Analyte List Metals (TAL metals); Target Compound List Volatile Organic Compounds (TCL VOCs), Semi-Volatile Organic Compounds (SVOCs), Polychlorinated Biphenyls (PCBs) + Aroclor 1268, pesticides (Aroclor 1268 is noted when added to the PCB analysis).

A = annually

Hg = mercury

Q = quarterly

5.5 Sources of Contamination

5.5.1 On-site

Based on the site use and operational history, the manufacturing process areas represent the bulk of the potential source areas. Mercury and Aroclor 1268 are the contaminants that pose the greatest risks to human health and the environment (see **Section 7.0, Summary of Site Risks**). The facility operated a mercury cell electrolytic process. The facility treated the graphite anodes of the mercury cell with chlorinated hydrocarbons, including Aroclor 1268, to remove impurities from the anodes. Mercury and Aroclor 1268 are concentrated in operational areas and in the drainage pathways across the site. Other contaminants posing risks were commonly located with these main contaminants.

Historical photographs and engineering drawings indicate that early plant operations may not have adequately contained runoff from process areas. Storm water runoff from the chemical storage and process operations was likely a primary source of contamination for the soils and sediment in the WBA.

Above ground sources of contamination was removed from the site as part of the 2002-2004 Removal Action. These areas included the former Mercury Cell Building, the Retort equipment, the MESS equipment, equipment and tanks within the Products Area, the salt brine saturator tanks and associated equipment within Salt Dock Area, and equipment and tanks within the Bleach Plant area.

A summary of the remaining source areas:

- The Cell Building Pad Area: This area is suspected to contain PTW. Elemental mercury was observed in cracks and fissures in the concrete pad, prior to and following the removal of the building. Mercury is likely present within the concrete pad and beneath the pad within the underlying soils. However, the PRP's contractor did not conduct sampling to define the depth of this contamination.
- The Retort Pad Area: This area is suspected to contain PTW. Elemental mercury was observed in cracks and fissures in the concrete pad, prior to and following the removal of the retort equipment. Mercury is likely present within the concrete pad and immediately beneath the pad within the underlying soils. Densely gridded soil sampling and analysis in this area indicated the presence of mercury within the soils immediately adjacent to the concrete pad.
- The Fill Area: The facility created the Fill Area in the late 1990s during the construction of the Membrane Building. This area contains process chemicals and waste materials from past operations.
- PCB Impregnation and Use of Graphite Anodes: There is no available documentation regarding using PCBs at the site. However, Aroclor 1268 was detected in site samples and in IP's waste water treatment lagoon at concentrations that pose risks to human health and the environment. Information regarding other chlor-alkali facilities suggest that Aroclor 1268 was likely used to remove impurities from the graphite anodes.
- The Solid Waste Disposal Site Area: This RCRA unit reportedly contains encapsulated process sludge materials. Records indicate that the SWDS had a PVC liner and an asphalt cap. The waste material was stabilized and the unit was closed in place.
- The Old South Pond: This RCRA unit reportedly contains encapsulated process sludge materials along with materials excavated from the Old North Pond. The Old South Pond has a synthetic liner and cap

- The Old North Pond: This RCRA unit formerly contained wastes which were excavated, stabilized, and placed into the Old South Pond. Afterwards it was backfilled with clean soil. However, it did not receive RCRA clean closure status.
- Robert's Pond Area: This RCRA unit operated for nearly a decade and was unlined. It was used to dispose of brine wastes containing mercury impurities. Roberts Pond was excavated and backfilled in 1987. The closure activities conducted at Robert's Pond did not satisfy requirements for clean closure under RCRA authority. Historical soil sample analytical results from this area suggest mercury is present in low concentrations within the soil.
- The North and South Retention Basins: The North and South Retention Basins were constructed sometime between the late 1970's to earlier 1980's. The basins receive surface water runoff, which the facility pumps to the wastewater treatment area and processes it prior to discharge. The retention basins are unlined but reportedly have a clay base or rest directly on top of the Peedee Formation.
- Sewer System: The sewer system winds through the UPA to carry process wastewater and storm water to the Wastewater Treatment Area. The sewer system was evaluated via visual assessment and video survey in 2002. The video survey was limited in some portions due to pipe blockages. The video documented cracks near several of the joints and completely corroded piping in some areas. It also documented multiple impacted areas north of the Cell Building Pad and in the piping leading to and from the diversion chamber in the wastewater treatment area.
- Historical Process Area Drainage Pathways: Historically, two other drainage pathways existed at the site that no longer exist. One includes a former drain from IP through the northern portion of the Manufacturing Process Area to the WBA. The second includes a former drainage ditch from the Wastewater Treatment Area to IP's wastewater lagoon.
- Wastewater Area: The sewer lines congregate in the Wastewater Area for processing. Processing includes a settling tank, stabilization, flocculation, and filtration. Prior to development of the Wastewater Area in 1987, the facility diverted process water and storm water through a drainage ditch extending to the east from the wastewater treatment area to the adjacent IP facility for off-site treatment and disposal. Herman's Hollow is a sump area that historically received pretreated water from the Mercury Cell Building and associated process areas as well. The base of the sump has eroded away and filled with sediment.
- Wooded Bottomland Area: The WBA has been undeveloped throughout the site operational history. The drainage areas in the WBA received unprocessed water prior to implementation of environmental regulations.
- Engineered Stockpiles: Although currently completely contained, PCB-contaminated material in the engineered stockpiles described in **Section 2.4.2**, could become a source of contamination if a remedial action does not occur.

5.5.2 Off-site

Potential off-site sources of contamination to the site may include current and former operations from the adjacent IP facility. Historical information indicates two former sources of potential contamination to the site.

Historical photographs and drawings indicate IP maintained an open ditch that discharged effluent directly into the WBA. The source of this effluent was reportedly seepage from the black liquor pond located to the west and adjacent to the site. This ditch was later covered and piped. IP closed the black liquor pond in the mid-2000s. Black liquor is the spent cooking liquor from the kraft process when digesting pulpwood into paper pulp removing lignin, hemicelluloses and other extractives from the wood to free the cellulose fibers. Spent pulping liquor is a corrosive complex mixture with a pH ranging from approximately 11.5 to 13.5. The inorganic constituents in black liquor come from the cooking liquor used to pulp the wood chips and comprised of sodium hydroxide, sodium sulfide, sodium carbonate, sodium sulfate, sodium thiosulfate and sodium chloride. Collectively, inorganic salts constitute 18% to 25% of the solids in black liquor.

The process of bleaching pulp at paper mills using cellulose fibers produces dioxins and furans. Currently, bleaching pulp and paper mills are the only significant known source of dioxins released into surface waters. Since the IP mill used the chlorine gas produced from the site in their pulp bleaching process, this facility may have contributed to the detectable concentrations of dioxins furans at the site through air emissions and effluent discharges. IP reportedly began production of their own chlorine dioxide in the 1990s. Published literature suggests that the use of chlorine dioxide in the bleaching process at pulp and paper mills greatly reduces the production of dioxins and furans.

5.6 Types of Contamination and Affected Media

This section is organized by media. Contamination was found in all media (air, surface water, sediment, WWTS, soil and groundwater) at varying concentrations. However, only soil, sediment and surface water have concentrations detected of contaminants that pose risks to human health and the environment. See **Section 7.0** for information regarding risk assessments. Summaries of the sampling results for each media are discussed in the following subsections.

5.6.1 Air

Air monitoring using a handheld mercury vapor analyzer began during the first removal action and continues to occur daily when staff are present on-site. Documentation of air monitoring data is extensive and is available in the site file.

Air samples were collected inside and outside of buildings on several occasions. The first event occurred as part of the Post-Removal Site Control Plan (PRSCP) to evaluate whether mercury contributed to air contamination from the former Mercury Cell Building pad after the first removal action was completed (discussed further in **Section 5.6.1.1**). The second event occurred during the EE/CA-RI for the purposes of determining if a risk was posed to human health via vapor intrusion (discussed further in **Section 5.6.1.2**).

5.6.1.1 Time Integrated Air Sampling

After the first removal action concluded at the site, (summarized in **Section 2.4.2**), seven Time Integrated Air Sampling (TIAS) events occurred between December 2004 and May 2007. During each sampling event, air samples were collected from six locations on six days during an approximate three-week period. This resulted in the collection of over 250 air samples between 2004 and 2007.

The daily sampling period was approximately 6-7 hours. Sample locations included upgradient, center of the mercury cell building pad, downgradient edge of the mercury cell building pad, and three other downgradient locations. The locations for all but the center sample varied daily depending on the wind direction.

On most dates, the laboratory detected mercury in the "blank" sample. The sample location with the highest average mercury concentration overall was TI-D1. **Table 9** includes sample results for that location, minus the concentration found in the blank sample(s) of that batch.

Each sample location, except for the upgradient locations, had a mercury concentration that exceeded the residential Removal Action Level (RAL) of 0.9 micrograms per cubic meter ($\mu g/m^3$) for mercury on at least one day. Mercury concentrations ranged from not detected to 17 $\mu g/m^3$. All results were below the commercial/industrial RAL of 25 $\mu g/m^3$. The laboratory did not detect mercury in any of the samples on two dates: May 12, 2006 and May 15, 2007. The highest concentration detected was on May 16, 2006. Location D3 concentration was 17 $\mu g/m^3$ with location D1 a close second at 16 $\mu g/m^3$. The temperature that day was 64-75°F and wind was coming from the west at 3 mph. The sample locations for the May 16, 2006 sampling event are included in **Figure 17**. A summary of the results from 2004-2007 are included in **Table 9.**

Figure 17: TIAS sample locations on date of highest concentrations

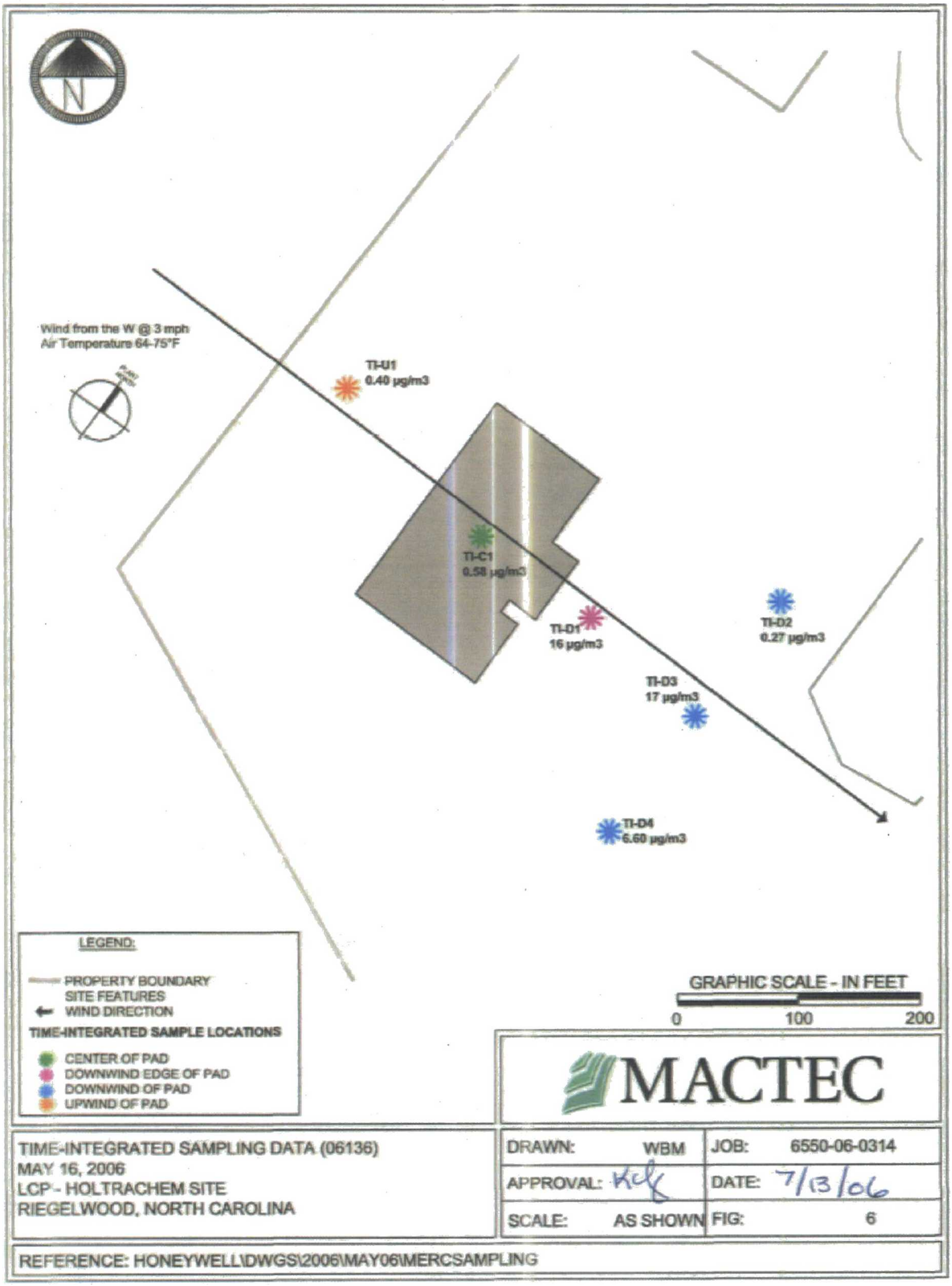


Table 9: TIAS Data Summary for the Location with the Highest Average Concentration

Location: Downgradient Edge of Pad (TI-D1)

Sampling Event	Date	Average Ambient Temperature (°F)	Wind	Blank Corrected Concentration	Average Concentration for Sampling Event
December 2004	11/29/2004	57	from NE @ 7 mph	0.61	0.47
	12/2/2004	55	from NE @ 4 mph	0.36	
	12/3/2004	55	from N/NW @ 6 mph	0.33	
	12/8/2004	67	from SW @ 4 mph	0.68	
	12/13/2004	49	from SW @ 7 mph	0.39	
	12/16/2004	37	from N @ 1 mph	<0.2	
March 2005	3/30/2005	74-80	from ENE @ 2-8 mph	0.5	0.70
	4/4/2005	69-78	from W @ 2-12 mph	**1.36**	
	4/5/2005	76-83	from NE @ 2-4 mph	0.53	
	4/6/2005	75-84	from SE @ 3-6 mph	**0.96**	
	4/11/2005	70-77	from SE @ 2-4 mph	0.45	
	4/12/2005	66-69	from ESE @ 1-4 mph	0.37	
June 2005	6/21/2005	85		**2.66**	**1.09**
	6/22/2005	77		0.38	
	6/24/2005	84		0.24	
	6/28/2005	87		0.66	
	7/1/2005	87		0.65	
	7/6/2005	88		**1.96**	
November 2005	11/16/2005	72-76	from SE/S @ 5-11 mph	0.24	0.22
	11/17/2005	52-56	from NW @ 8 mph	0.29	
	11/18/2005	38-50	from NW/N @ 8 mph	0.13	
	11/22/2005	52-56	from NW/W shifting	0.23	
	11/23/2016	38-48	from W @ 1-6 mph	0.28	
	11/30/2016	60-78	from NW @ 5-8 mph	0.16	
May 2006	5/1/2006	60-72	from N/NW @ 3-8 mph	0.68	**4.11**
	5/3/2016	75-84	from W/NW @ 9-11 mph	0.85	
	5/5/2006	68-80	from S/SE @ 2-7 mph	**1.4**	
	5/10/2006	64-80	from SW @ 0-6 mph	**1.6**	
	5/12/2006	70-82	from S @ 6-16 mph	<0.26	
	5/16/2006	64-75	from W @ 3 mph	**16**	
August 2006	8/1/2006	88-100	from W/SW @ 3 mph	0.38	**2.92**
	8/2/2006	80-100	from S @ 4-7 mph	**4.8**	
	8/3/2006	82-102	from S @ 2-4 mph	**9.4**	
	8/7/2006	78-98	rom SW-NW/N @ 0-7 mph	**0.92**	
	8/9/2006	84-92	from N/NE @ 0-4 mph	**0.94**	
	8/15/2006	84-90	from S/SW/SE @ 2-4 mph	**1.1**	
May 2007	5/14/2007	74-82	rom N/NW-NE @ 2-4 mph	<0.3	0.63
	5/15/2007	84-86	from SE/E-S @ 3-7 mph	<0.3	
	5/21/2007	82-86	from SW @ 0-2 mph	0.7	
	5/23/2007	84-86	from SW @ 0-2 mph	<0.3	
	5/25/2007	84-86	from N-NE @ calm	0.7	
	5/30/2007	89-90	from W-NE @ 5-6 mph	0.5	
			Average:	**1.47**	**1.45**

Notes:

Samples were collected over a 6-7 hour period each day

All concentration results are in micrograms per cubic meter (µg/m³)

-- means that information was not included in the report's summary table

Blank Corrected means that the concentration of mercury detected in the blank sample for that day was subtracted from the concentration detected in the sample.

Removal Action Levels (RALs) for mercury are 0.9 µg/m³ for residential and 25 µg/m³ for

Yellow highlight indicates concentration detected exceeds the residential RAL of 0.9 µg/m³

5.6.1.2 Vapor Intrusion Assessment Sampling

In 2004, air samples were collected from nine locations within primary buildings and immediately adjacent to those buildings as part of a vapor intrusion (VI) evaluation. **Table 10** summarizes the analytical results.

Table 10: Vapor Intrusion Air Sample Results Summary

Analyte	Units	FOD%	Minimum Conc.	Maximum Conc.
mercury	mg/m^3	33	0.0006	0.00078
Volatile Organic Compounds detected in at least one sample:				
1,1,2-trichlorotrifluoroethane	PPBV	22	0.1 J	0.1 J
1,2,4-trimethylbenzene	PPBV	44	0.13 J	0.85
1,3,5-trimethylbenzene	PPBV	11	0.23 J	0.23 J
benzene	PPBV	89	0.22 J	1.3
bromomethane	PPBV	11	0.27 J	0.27 J
chlorobenzene	PPBV	11	0.13 J	0.13 J
chloroform	PPBV	89	0.22 J	0.96
chloromethane	PPBV	100	0.93	1.5
cis-1,2-dichloroethene	PPBV	11	1.1	1.1
dichlorodifluoromethane	PPBV	100	0.5	0.64
ethylbenzene	PPBV	44	0.27	0.5
methylene chloride	PPBV	11	0.39 J	0.39 J
m&p-xylene	PPBV	67	0.13 J	1.4
o-xylene	PPBV	33	0.44	0.52
styrene	PPBV	44	0.13 J	0.66
tetrachloroethene	PPBV	11	1.2	1.2
toluene	PPBV	89	0.23 J	2.9
trichloroethene	PPBV	11	0.31	0.31
trichlorofluoromethane	PPBV	100	0.23 J	1.2
vinyl chloride	PPBV	11	0.27	0.27

Notes:

Conc. = concentration

FOD% = percentage frequency of detection. 9 samples were analyzed for each analyte. Therefore, FOD% of 33 means that 3 of the 9 samples analyzed had detections of the analyte.

J = estimated value

mg/m^3 = milligrams per cubic meter

PPBV = parts per billion volume

5.6.2 Surface Water

Surface water samples were collected from multiple locations in the on-site WBA drainage pathways, the Cape Fear River and Livingston Creek. During 2004 through 2009, surface water samples were collected in the WBA during five separate sampling events. The 2006 sampling events were to evaluate conditions in the WBA drainage pathways when a storm event occurred. All three drainage paths (eastern, central and western) flow to the Cape Fear River. Flow through the western drainage ditch is ephemeral and dependent on rainfall, while flow through the central and east drainage ditches is perennial.

This section is divided into three subsections: on-site surface water, on-site storm water and off-site surface water. The laboratory reported multiple constituents detected. The following discussion provides a summary of the surface water and storm water analytical results for each of these areas. The notes below are applicable to each subsection table.

Notes:
$CaCO_3$ = calcium carbonate
Conc. = concentration
FOD% = percentage frequency of detection. For example, if 20 samples were analyzed for the analyte and only one had a detection FOD would be 1/20 = 5%.
ng/L = nanogram per liter
µg/L = micrograms per liter

5.6.2.1 WBA Surface Water

Water Quality Parameters

Seventeen surface water samples were collected from the WBA drainage ditches and analyzed for hardness, Total Suspended Solids (TSS) and Total Organic Carbon (TOC). **Table 11** summarizes the frequency of detection, range of concentrations, and location of the maximum detected concentration.

Table 11: Bottomland Drainage Ditch Surface Water Data Summary – Water Quality Parameters

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Method E130.2. Concentration units are in µg/L				
hardness, Total as $CaCO_3$	100%	254,000	512,000	SW-9
Method E160.2. Concentration units are in µg/L				
Total Suspended Solids	100%	6,800	1,010,000	SW-24
Method SW9060. Concentration units are in µg/L				
total organic carbon (TOC)	100%	9,700	43,000	SW-10

VOCs

Seventeen surface water samples were collected from the WBA drainage ditches and analyzed for VOCs. Collectively, the samples contained nine detected VOCs. **Table 12** summarizes detected VOCs, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 12: Bottomland Drainage Ditch Surface Water Data Summary – VOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
VOCs via method SW8260. Concentration units are in µg/L				
1,2,4-Trichlorobenzene	6%	0.79	0.79	SW-24
1,3-Dichlorobenzene	18%	0.69	3.3	SW-29
1,4-Dichlorobenzene	12%	1.3	2.6	SW-29
acetone	6%	2	2	SW-28
carbon disulfide	6%	0.57	0.57	SW-2
chlorobenzene	12%	0.77	1.6	SW-29
chloromethane	6%	0.24	0.24	SW-28
tetrachloroethene (PCE)	6%	0.14	0.14	SW-28
trichloroethene (TCE)	6%	0.51	0.51	SW-29

SVOCs

Twenty surface water samples were collected from the WBA drainage ditches and analyzed for SVOCs. Collectively, the samples contained seven detected SVOCs. **Table 13** summarizes detected SVOCs, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 13: Bottomland Drainage Ditch Surface Water Data Summary – SVOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
SVOCs via method SW8270. Concentration units are in µg/L				
1,1-biphenyl	33%	0.023	0.023	SW-41
acenaphthene	10%	0.054	0.059	SW-40
anthracene	15%	0.023	0.048	SW-42
bis(2-Ethylhexyl)phthalate	20%	1.4	2.7	SW-11
carbazole	10%	0.031	0.031	SW-40, SW-41
fluoranthene	10%	0.074	0.13	SW-40
pyrene	15%	0.022	0.073	SW-40

Inorganics

Twenty surface water samples were collected from the WBA drainage ditches and analyzed for inorganics. Many inorganics are naturally occurring. **Table 14** summarizes detected inorganics, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 14: Bottomland Drainage Ditch Surface Water Data Summary – Inorganics

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Inorganics via method SW6010. Concentration units are in µg/L				
aluminum	90%	119	8990	SW-2
arsenic	10%	5.8	6.8	SW-2
barium	100%	40.6	227	SW-2
cadmium	10%	5.8	6.8	SW-2
calcium	100%	54,200	172,000	SW-28
chromium	40%	0.82	20	SW-18
cobalt	10%	0.5	2.8	SW-2
copper	15%	3.2	8.4	SW-2
iron	95%	639	24,900	SW-2
lead	5%	11.3	11.3	SW-2
magnesium	100%	5,650	21,700	SW-42
manganese	100%	37.3	802	SW-30
nickel	70%	2	16.6	SW-2
potassium	100%	5,580	44,400	SW-9
selenium	20%	4.8	7.4	SW-7
sodium	100%	243,000	6,150,000	SW-9
vanadium	70%	3.2	41	SW-2
zinc	75%	6.9	181	SW-2
Mercury via methods SW7470 and SW7473. Concentration units are in µg/L				
mercury	78%	0.07	22.9	SW-28

Pesticides

Twenty surface water samples were collected from the WBA drainage ditches and analyzed for pesticides. Collectively, the analysis detected eight pesticides. **Table 15** summarizes detected pesticides, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 15: Bottomland Drainage Ditch Surface Water Data Summary – Pesticides

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Pesticides via method SW8081. Concentration units are in µg/L				
4,4'-DDD	10%	0.023	0.024	SW-2
4,4'-DDT	10%	0.034	0.084	SW-7
delta-BHC	5%	0.045	0.045	SW-24
endosulfan II	5%	0.017	0.017	SW-7
endosulfan sulfate	5%	0.026	0.026	SW-28
endrin	5%	0.049	0.049	SW-24
endrin aldehyde	40%	0.022	0.26	SW-2
endrin ketone	33%	0.049	0.049	SW-40

PCBs

Twenty surface water samples from the WBA drainage ditches and were analyzed for Aroclors and four samples were analyzed for PCB congeners. Collectively, the analysis detected two Aroclors and 12 PCB congeners. **Table 16** summarizes detected PCBs, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 16: Bottomland Drainage Ditch Surface Water Data Summary – PCBs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Aroclors via method SW8082. Concentration units are in µg/L				
Aroclor 1254	5%	0.15	0.15	SW-7
Aroclor 1268	85%	0.062	17	SW-7
PCB Congeners via method E1668. Concentration units are in ng/L				
PCB-105	100%	0.0365	31.6	SW-7
PCB-106/118	100%	0.129	99.4	SW-7
PCB-114	50%	0.105	1.74	SW-7
PCB-123	50%	0.102	1.38	SW-7
PCB-126	50%	0.0867	0.873	SW-7
PCB-156	75%	0.131	11.7	SW-7
PCB-157	75%	0.0284	2.94	SW-7
PCB-167	75%	0.128	7.42	SW-7
PCB-169	75%	0.0299	0.86	SW-7
PCB-189	100%	0.0459	11.6	SW-7
PCB-77	75%	0.0592	5.47	SW-7
PCB-81	50%	0.0663	1.34	SW-7

Dioxins/Furans

Six surface water samples were analyzed for dioxin/furan congers, and four surface water samples for dioxin-like PCB congeners. A representative 2,3,7,8-TCDD toxicity equivalency quantity (TEQ) was calculated for each sample. Using the TEQ system, each of the dioxin/furan congeners and dioxin-like PCB congeners are assigned a Toxic Equivalency Factor (TEF) based on the congener's toxicity relative to 2,3,7,8-TCDD, with the toxicity of TCDD being equal to 1.0. The concentration of each dioxin/furan or dioxin-like PCB congener is multiplied by its respective TEF and the results are summed. The sum of the products of the concentrations multiplied by the appropriate TEF is known as the TEQ of the sample.

Table 17 summarizes detected dioxins and furans, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 17: Bottomland Drainage Ditch Surface Water Data Summary – Dioxins/Furans

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Dioxins/Furans via method E1613. Concentration units are in ng/L				
1,2,3,4,6,7,8-HpCDD	83%	0.0156	0.493	SW-7
1,2,3,4,6,7,8-HpCDF	100%	0.0134	5.17	SW-7
1,2,3,4,7,8,9-HpCDF	83%	0.00681	0.181	SW-7
1,2,3,4,7,8-HxCDD	17%	0.00604	0.00604	SW-7
1,2,3,4,7,8-HxCDF	100%	0.00394	1.36	SW-7
1,2,3,6,7,8-HxCDD	17%	0.00726	0.00726	SW-7
1,2,3,6,7,8-HxCDF	83%	0.00773	0.279	SW-7
1,2,3,7,8,9-HxCDD	17%	0.00449	0.00449	SW-7
1,2,3,7,8,9-HxCDF	83%	0.0016	0.0492	SW-7
1,2,3,7,8-PeCDD	17%	0.00181	0.00181	SW-7
1,2,3,7,8-PeCDF	83%	0.00286	0.152	SW-7
2,3,4,6,7,8-HxCDF	83%	0.0136	0.391	SW-7
2,3,4,7,8-PeCDF	83%	0.00482	0.17	SW-7
2,3,7,8-TCDF	67%	0.013	0.0694	SW-7
HpCDD	83%	0.0377	1.1	SW-7
HpCDF	100%	0.0259	7.25	SW-7
HxCDD	83%	0.012	0.116	SW-7
HxCDF	100%	0.0205	4.93	SW-7
OCDD	100%	0.0574	8.86	SW-7
OCDF	100%	0.00997	4.33	SW-7
PeCDD	50%	0.00549	0.0281	SW-7
PeCDF	100%	0.0254	1.5	SW-7
TCDD	17%	0.00749	0.00749	SW-7
TCDF	100%	0.0113	0.532	SW-7
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Bird	100%	0.0107	1.02	SW-7
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Fish	100%	0.00404	0.372	SW-7
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Mammal	100%	0.00662	0.457	SW-7
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Bird	100%	0.00451	0.522	SW-7
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Fish	100%	0.0039	0.366	SW-7
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Mammal	100%	0.00338	0.338	SW-7
Total 2,3,7,8-TCDD TEQ (PCB) - Bird	100%	0.000142	0.00646	SW-7
Total 2,3,7,8-TCDD TEQ (PCB) - Fish	100%	0.00624	0.502	SW-7
Total 2,3,7,8-TCDD TEQ (PCB) - Mammal	100%	0.00324	0.119	SW-7

Surface Water Summary

Preliminary Remediation Goals (PRGs) were developed during the human health and ecological risk assessments, and were updated in the Feasibility Study.[4] **Table 18** lists sample locations that had at least one contaminant that exceeded a PRG concentration in WBA drainage ditch surface water. **Figure 18** highlights the sampling locations which had Aroclor 1268 and/or dioxin/furan concentrations that exceeded PRGs.

Table 18: Bottomland Drainage Ditch Surface Water Data – Sample Results that Exceeded a PRG

Site Area	Location ID	Aroclor 1268		Total 2,3,7,8-TCDD TEQ (dioxin/furan) Mammals	Total 2,3,7,8-TCDD TEQ (PCB) Mammals
Preliminary Remediation Goal (PRGs):		**0.44**		**0.0000087**	**0.0000095**
Central Drainage Ditch	SW-07	**17**	**B**	**0.000338**	**0.000119**
Central Drainage Ditch	SW-09	**2.4**	**B**	NA	NA
Central Drainage Ditch	SW-10	**3**	**B**	NA	NA
Central Drainage Ditch	SW-10	**7.6**	**B**	NA	NA
Central Drainage Ditch	SW-13	ND		**0.0000737**	NA
Central Drainage Ditch	SW-15	ND		**0.000012**	NA
Eastern Drainage Ditch	SW-17	**1.7**		NA	NA
Eastern Drainage Ditch	SW-24	**0.86**	**J**	NA	NA
Eastern Drainage Ditch	SW-40	**2.3**		NA	NA
Western Drainage Ditch	SW-11	**1.6**		**0.0000603**	5.61E-07
Western Drainage Ditch	SW-12	0.21	J	**0.0000524**	0.00000016
Western Drainage Ditch	SW-28	**3.7**		NA	NA

Notes:

Results are expressed in the concentration of micrograms per liter (µg/L)

Only samples that had a concentration that exceeded at least one PRG are included in this table.

B = blank contamination. The analyte was found in an associated blank as well as in the sample

J = estimated concentration

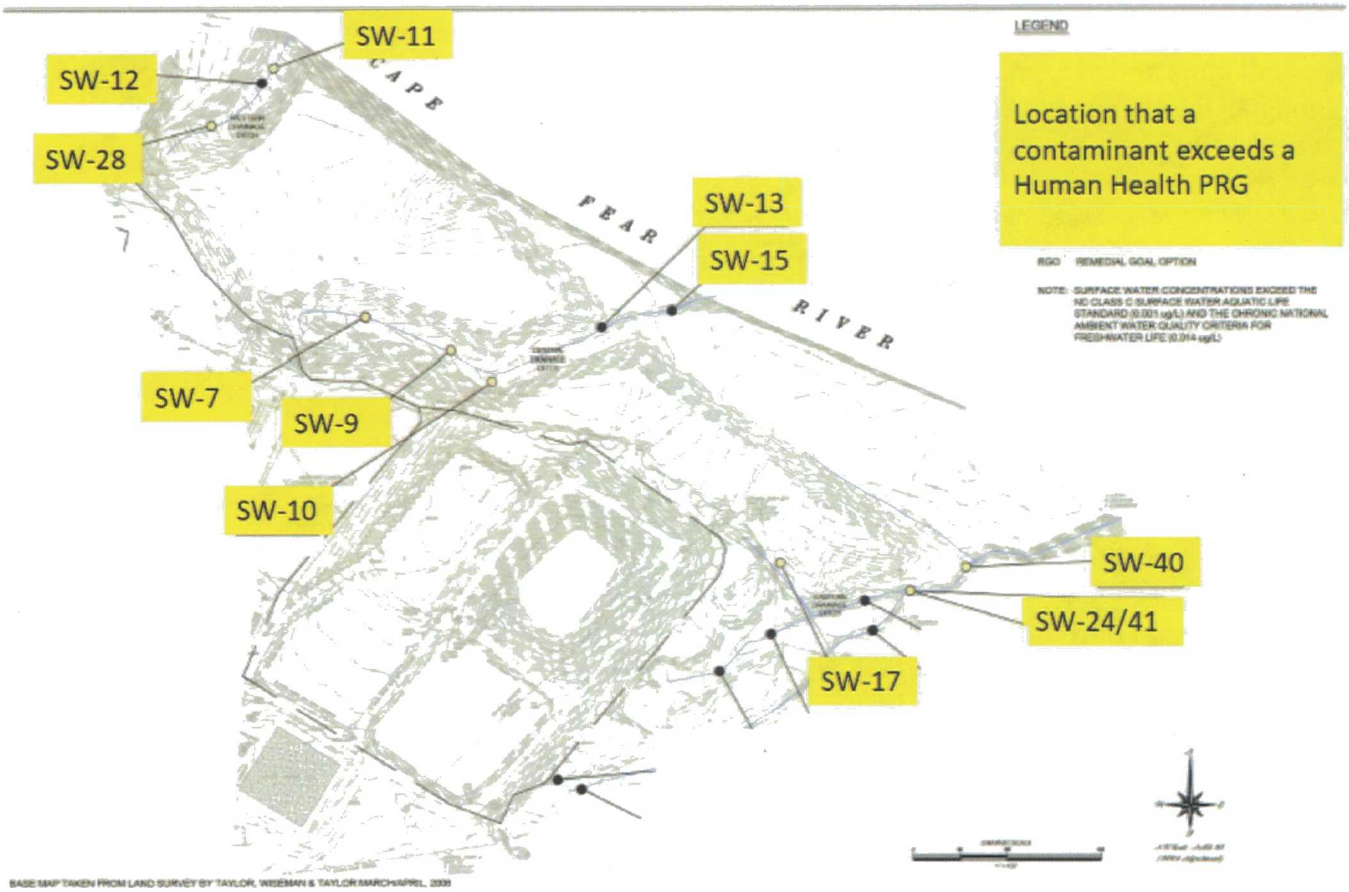
NA = not analyzed

ND = was not detected above the laboratory reporting limit of 1

Bold value exceeds PRG

[4]More information about PRGs can be found in **Section 7.0**, Summary of Site Risks.

Figure 18: Locations where constituents in Wooded Bottomland Drainage ditch surface water exceed a Human Health PRG



5.6.2.2 Storm Water

Storm water samples were collected from seven locations in the WBA drainage ditches during extreme rain events in 2006. As shown in **Figure 19**, the sample locations were in the western, central and eastern ditches. All three ditches flow to the Cape Fear River. An off-site laboratory analyzed the samples for VOCs, SVOCs, inorganics, pesticides, dioxins and water quality criteria.

Table 19 through **Table 24** summarize storm water results. With the exception of VOCs, a broad range of constituents was present in storm water in the WBA drainage ditches.

Water Quality Parameters

Seven storm water samples were collected from the WBA drainage ditches and analyzed for hardness, TSS and pH; and four storm water samples were analyzed for TOC. **Table 19** summarizes detected water quality parameters, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 19: Bottomland Drainage Ditch Storm Water Data Summary - Water Quality Criteria

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Water Quality Parameters				
Method E130.2. Concentration units are in µg/L				
Hardness, Total as $CaCO_3$	100%	20,200	316,000	SW-19
Method E160.2. Concentration units are in µg/L				
Total Suspended Solids	100%	3,200	452,000	SW-8
Method SW9040B. No units.				
pH	100%	7	8	SW-8
Method SW9060. Concentration units are in µg/L				
Total Organic Carbon	100%	1,900	7,600	SW-4

VOCs and SVOCs

Eight storm water samples were collected from the WBA drainage ditches and analyzed for VOCs and SVOCs. VOCs were not detected. Collectively, the samples contained four detected SVOCs. The four SVOCs were present at concentrations greater than during normal flow conditions. For example, the maximum concentration of bis(2-ethylhexyl)phthalate during a non-storm event was 2.7 μg/L compared to 9.4 μg/L during the storm event. **Table 20** includes a summary of detected SVOCs in storm water, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 20: Bottomland Drainage Ditch Storm Water Data Summary - SVOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
SVOCs via method SW8270. Concentration units are in μg/L				
bis(2-ethylhexyl)phthalate	25%	1.7	9.4	SW-5
Fluoranthene	13%	2.1	2.1	SW-8
Phenanthrene	13%	1.3	1.3	SW-8
Pyrene	13%	1.5	1.5	SW-8

Inorganics

Sixteen storm water samples were collected from the WBA drainage ditches and analyzed for inorganics. Some inorganics had lower concentrations than during normal flow events, while others had higher concentrations. The maximum concentration of mercury detected in the storm event was 3.5 times higher than during normal flow conditions. **Table 21** includes a summary of detected inorganics in storm water, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 21: Bottomland Drainage Ditch Storm Water Data Summary - Inorganics

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Inorganics via method SW6010. Concentration units are in µg/L				
aluminum	69%	202	8,010	SW-16
barium	100%	29.3	111	SW-5
calcium	100%	17,300	101,000	SW-19
chromium	63%	8	13	SW-4
cobalt	6%	2.3	2.3	SW-5
copper	50%	7.6	13.5	SW-4
iron	100%	237	7,540	SW-16
lead	50%	4.7	9.2	SW-4
magnesium	100%	1,180	14,600	SW-19
manganese	100%	27.4	234	SW-4
nickel	63%	5	11	SW-4
potassium	100%	1,870	21,100	SW-5
sodium	100%	9,190	3,040,000	SW-5
vanadium	75%	11.1	24.3	SW-16
zinc	100%	6	218	SW-4
Mercury via method SW7470. Concentration units are in µg/L				
mercury	88%	0.43	81.8	SW-4

Pesticides

Eight storm water samples were collected from the WBA drainage ditches and analyzed for pesticides. Collectively, the samples contained three detected pesticides. The concentrations of the pesticides were slightly less than the concentrations of the same pesticides detected during non-storm events. **Table 22** summarizes detected pesticides in storm water, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 22: Bottomland Drainage Ditch Storm Water Data Summary - Pesticides

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Pesticides via method SW8081. Concentration units are in µg/L				
4,4'-DDD	13%	0.02	0.02	SW-5
4,4'-DDT	13%	0.03	0.03	SW-5
endrin aldehyde	25%	0.023	0.03	SW-5

PCBs

Eight storm water samples were collected from the WBA drainage ditches for Aroclor 1268 and PCB congeners. **Table 23** summarizes detected PCBs in storm water, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 23: Bottomland Drainage Ditch Storm Water Data Summary - PCBs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Aroclors via method SW8082. Concentration units are in µg/L				
Aroclor 1268	88%	0.1	6.3	SW-4
PCB Congeners via method E1668. Concentration units are in ng/L				
PCB-105	100%	0.104	13.7	SW-14
PCB-106/118	100%	0.0545	33.6	SW-14
PCB-114	63%	0.109	0.876	SW-14
PCB-123	63%	0.0785	0.461	SW-4
PCB-126	63%	0.0889	0.352	SW-14
PCB-156	75%	0.0499	5.12	SW-14
PCB-157	63%	0.121	1.08	SW-14
PCB-167	63%	0.676	2.96	SW-14
PCB-169	63%	0.111	0.552	SW-4
PCB-189	88%	0.0721	5.12	SW-4
PCB-77	63%	0.26	1.26	SW-4
PCB-81	63%	0.0553	0.368	SW-14

Dioxins/Furans

Eight storm water samples were collected from the WBA drainage ditches and analyzed for dioxin/furan congers and dioxin-like PCB congeners. A representative 2,3,7,8-TCDD toxicity equivalency quantity (TEQ) was calculated for each sample. Using the TEQ system, each of the dioxin/furan congeners and dioxin-like PCB congeners are assigned a Toxic Equivalency Factor (TEF) based on the congener's toxicity relative to 2,3,7,8-TCDD, with the toxicity of TCDD being equal to 1.0. The concentration of each dioxin/furan or dioxin-like PCB congener is multiplied by its respective TEF and the results are summed. The sum of the products of the concentrations multiplied by the appropriate TEF is known as the TEQ of the sample.

The results for 2,3,7,8-TCDD TEQs were similar to the concentrations detected in non-storm event surface water. **Table 24** summarizes detected dioxins/furans in storm water, frequency of detection, range of concentrations, and the location of the maximum concentration.

Table 24: Bottomland Drainage Ditch Storm Water Data Summary - Dioxins/Furans

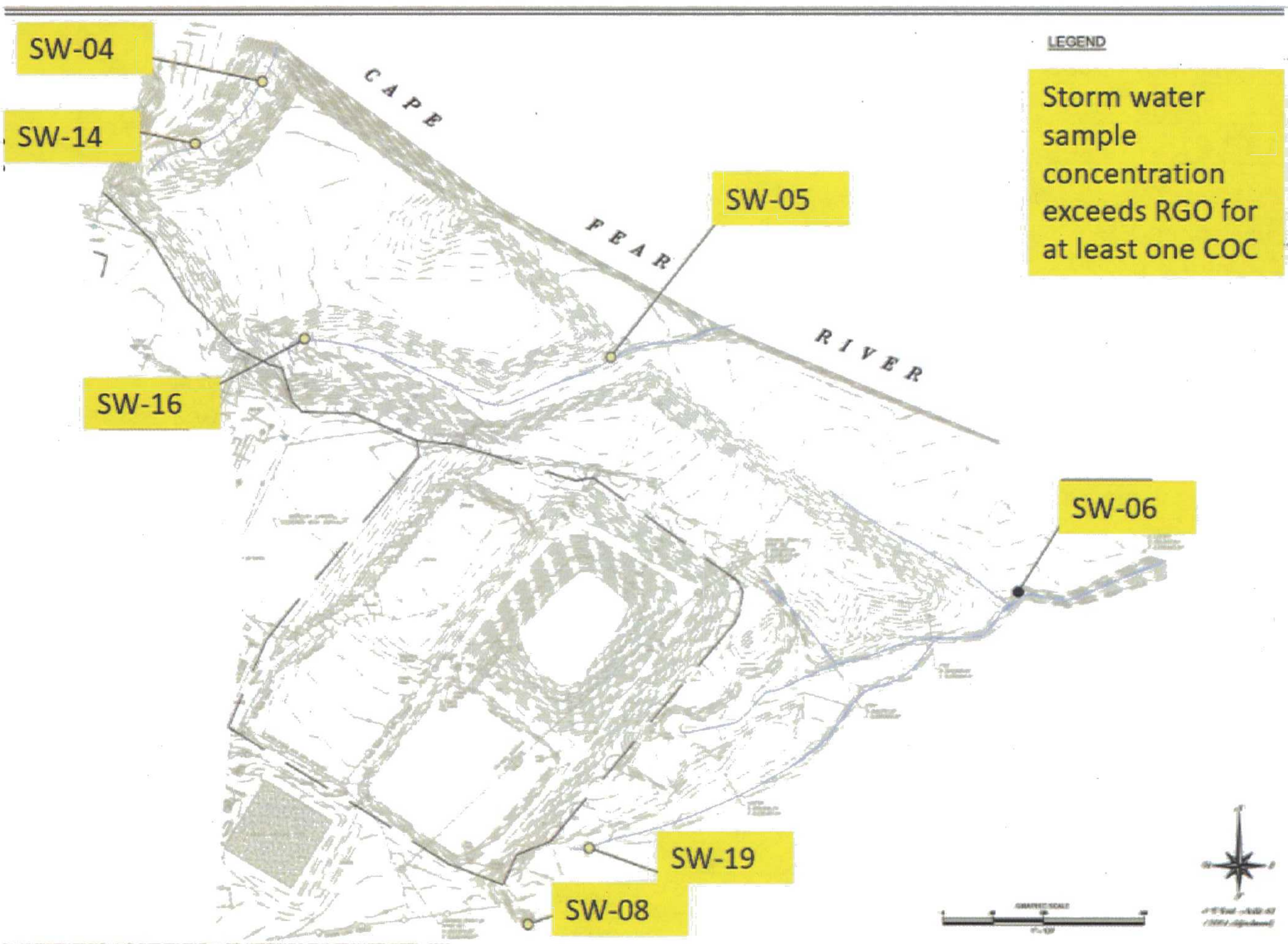
Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Dioxins/Furans via method E1613. Concentration units are in ng/L.				
1,2,3,4,6,7,8-HpCDD	75%	0.0148	0.611	SW-8
1,2,3,4,6,7,8-HpCDF	88%	0.0182	5.83	SW-4
1,2,3,4,7,8,9-HpCDF	63%	0.0299	0.253	SW-4
1,2,3,4,7,8-HxCDD	25%	0.0102	0.0159	SW-4
1,2,3,4,7,8-HxCDF	88%	0.00787	1.74	SW-4
1,2,3,6,7,8-HxCDD	25%	0.0145	0.0155	SW-8
1,2,3,6,7,8-HxCDF	63%	0.0289	0.37	SW-4
1,2,3,7,8,9-HxCDD	25%	0.0121	0.015	SW-8
1,2,3,7,8,9-HxCDF	75%	0.00256	0.0741	SW-4
1,2,3,7,8-PeCDF	75%	0.00516	0.268	SW-4
2,3,4,6,7,8-HxCDF	88%	0.00375	0.422	SW-4
2,3,4,7,8-PeCDF	75%	0.00569	0.247	SW-4
2,3,7,8-TCDF	63%	0.0177	0.149	SW-4
HpCDD	75%	0.0363	3.05	SW-8
HpCDF	88%	0.0354	8.27	SW-4
HxCDD	75%	0.00373	0.316	SW-8
HxCDF	100%	0.0119	5.5	SW-4
OCDD	100%	0.045	9.07	SW-8
OCDF	88%	0.0184	4.69	SW-4
PeCDD	38%	0.00625	0.0255	SW-4
PeCDF	88%	0.045	1.57	SW-4
TCDF	88%	0.0355	0.735	SW-4
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Bird	100%	0.0279	0.884	SW-4
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Fish	100%	0.0117	0.488	SW-4

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Mammal	100%	0.0163	0.491	SW-4
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Bird	100%	0.0154	0.759	SW-4
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Fish	100%	0.0114	0.486	SW-4
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Mammal	100%	0.00975	0.44	SW-4
Total 2,3,7,8-TCDD TEQ (PCB) - Bird	100%	0.0000277	0.00239	SW-14
Total 2,3,7,8-TCDD TEQ (PCB) - Fish	100%	0.0122	0.131	SW-14
Total 2,3,7,8-TCDD TEQ (PCB) - Mammal	100%	0.00633	0.00505	SW-4

Summary

Figure 19 illustrates sampling locations that had concentrations of contaminants in storm water that exceeded PRGs.

Figure 19: Location of storm water samples that had a concentration that exceeds a surface water PRG for at least one COC



5.6.2.3 Cape Fear River and Livingston Creek

Surface water samples were collected from multiple locations in the Cape Fear River and Livingston Creek during 2002 through 2005. **Table 25** through **Table 29** include summary statistics for detected constituents in these off-site surface waters, frequency of detection, range of concentrations, and the location of the maximum concentration. **Figure 20** illustrates the sampling locations.

Table 25: Cape Fear River and Livingston Creek Surface Water Data Summary – Water Quality Parameters

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Water Quality Parameters				
Method E130.2. Concentration units are in µg/L				
Hardness, Total as $CaCO_3$	100%	20,200	316,000	SW-19
Method E160.2. Concentration units are in µg/L				
Total Suspended Solids	100%	3,200	452,000	SW-8
Method SW9040B. No units.				
pH	100%	7	7.4	IP-SW

Table 26: Cape Fear River and Livingston Creek Surface Water Data Summary - VOCs and SVOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
VOCs via method SW8260. Concentration units are in µg/L				
acetone	9%	2.5	2.5	WRIGHT-SW
methylene chloride	27%	10	10	LCP001, 5 & 6
toluene	9%	0.26	0.26	WRIGHT-SW
SVOCs via method SW8270. Concentration units are in µg/L				
bis(2-ethylhexyl)phthalate	36%	3.1	3.4	RIVER-UP-2

Table 27: Cape Fear River and Livingston Creek Surface Water Data Summary - Inorganics

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Inorganics via method SW6010. Concentration units are in µg/L				
aluminum	82%	123	1,320	RIVER-DN-1
antimony	45%	0.74	6.1	RIVER-REF
barium	100%	25.7	40	LCP007
calcium	100%	6,200	11,800	WRIGHT-SW
cobalt	9%	2	2	RIVER-REF
iron	100%	538	1,520	RIVER-DN-1
lead	45%	0.78	2	RIVER-REF
magnesium	100%	2,190	2,940	RIVER-REF
manganese	100%	21.7	110	LCP007
potassium	100%	2,450	4,500	LCP007
selenium	9%	3.7	3.7	RIVER-REF
sodium	100%	7,590	31,000	LCP007
strontium	100%	44	54	LCP007
thallium	55%	2.8	4.7	RIVER-DN-2
titanium	100%	6.9	11	LCP006 & LCP007
vanadium	64%	2.6	11	LCP007
zinc	100%	5.8	12	LCP007
Mercury via method E1631. Concentration units are in µg/L				
mercury	100%	0.0022	0.00634	SW-3

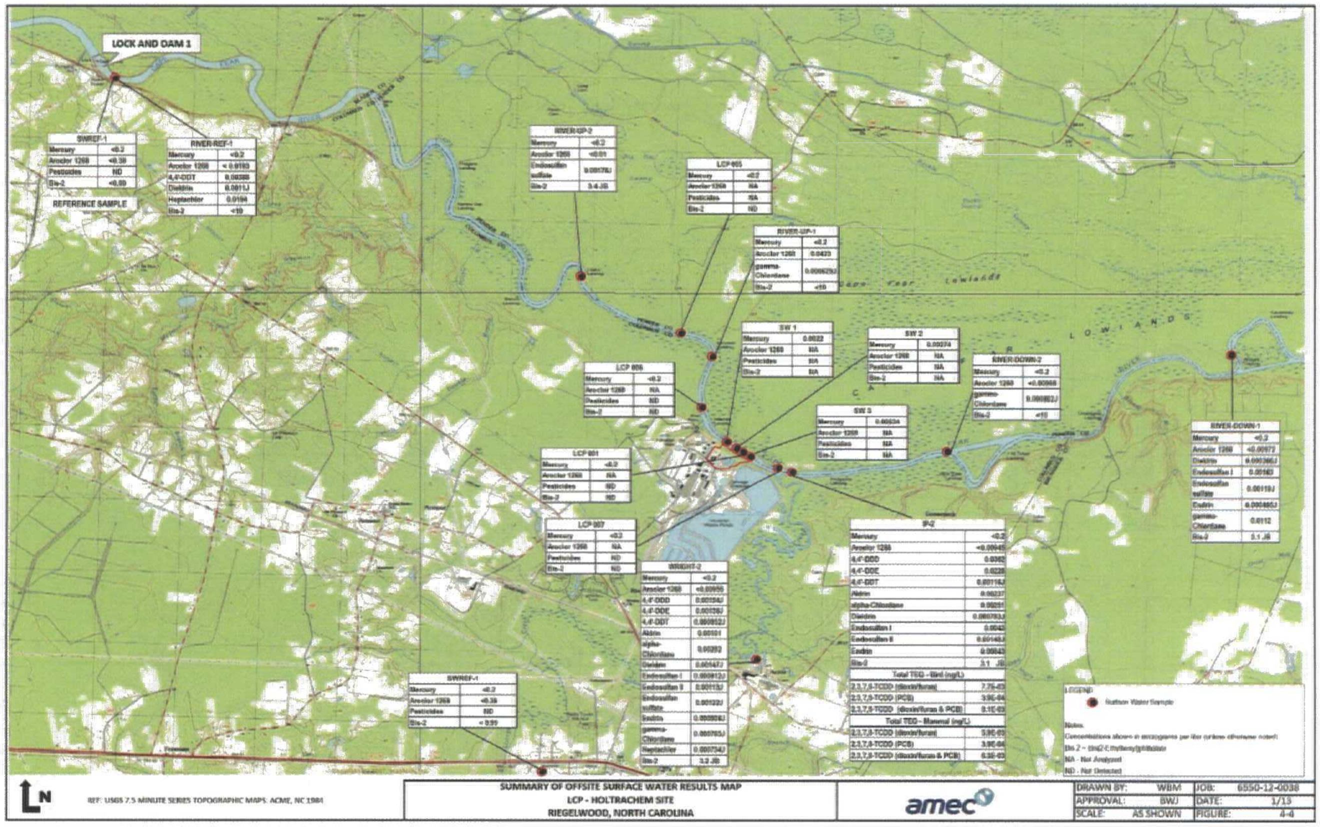
Table 28: Cape Fear River and Livingston Creek Surface Water Data Summary - Pesticides

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Pesticides via method SW8081. Concentration units are in µg/L				
4,4'-DDD	20%	0.00154	0.0362	IP-SW
4,4'-DDE	20%	0.00136	0.0228	IP-SW
4,4'-DDT	30%	0.000952	0.00388	RIVER-REF
acetone	9%	2.5	2.5	WRIGHT-SW
Aldrin	20%	0.00101	0.00237	IP-SW
alpha-chlordane	20%	0.00251	0.00282	WRIGHT-SW
dieldrin	40%	0.000366	0.00147	WRIGHT-SW
Endosulfan I	30%	0.000812	0.0043	IP-SW
Endosulfan II	20%	0.00113	0.00148	IP-SW
Endosulfan sulfate	30%	0.0019	0.00176	RIVER-UP-2
endrin	30%	0.000495	0.00843	IP-SW
gamma-chlordane	40%	0.000629	0.0112	RIVER-DN-1
heptachlor	20%	0.000754	0.0194	RIVER-REF

Table 29: Cape Fear River and Livingston Creek Surface Water Data Summary - Aroclors and Dioxins/Furans

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Aroclors via method SW8082. Concentration units are in µg/L				
Aroclor 1268	14%	0.0423	0.0423	RIVER-UP-1
Dioxins/Furans via method E1613. Concentration units are in pg/L.				
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Bird	100%	8.05	8.05	IP-SW
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Fish	100%	6.89	6.89	IP-SW
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Mammal	100%	6.27	6.27	IP-SW
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Bird	100%	7.66	7.66	IP-SW
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Fish	100%	6.87	6.87	IP-SW
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Mammal	100%	5.88	5.88	IP-SW
Total 2,3,7,8-TCDD TEQ (PCB) - Bird	100%	0.0196	0.0196	IP-SW
Total 2,3,7,8-TCDD TEQ (PCB) - Fish	100%	0.391	0.391	IP-SW
Total 2,3,7,8-TCDD TEQ (PCB) - Mammal	100%	0.391	0.391	IP-SW

Figure 20: Surface water result for COCs in Cape Fear River and Livingston Creek



5.6.3 Sediment

During 2002 through 2009, 130 sediment samples were collected from multiple locations in the WBA drainage pathways, the storm sewers, the Cape Fear River and Livingston Creek. The following subsections discuss the data for each of the three areas.

5.6.3.1 WBA Drainage Pathways Sediment

The WBA drainage pathways are comprised of eastern, central and western channels. Sediment samples were collected and analyzed for VOCs, SVOCs, inorganics, pesticides, PCBs and dioxins/furans. Chemicals from each category were detected.

Table 30 summarizes solids, moisture, TOC and pH, including value ranges and location of the maximum value.

Table 30: Wooded Bottomland Drainage Pathway Sediment Data Summary - Characterization

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Sediment Characterization				
Method E160.3				
Total Solids	100%	74.66%	78.79%	WSED-41
Method SM2540G				
Percent Solids	100%	73.90%	78.20%	WSED-41
Method E160.3M				
Percent Moisture	100%	14.50%	54.00%	WSED-20-D0.5-1
Method 9045				
pH	100%	6.8	9.1	WSED-17-D0.5-1
Method 9060. Concentration units are in mg/kg.				
Total Organic Carbon	89%	1,400	43,000	WSED-25-D0-0.5

VOCs

Fifty-four sediment samples were collected from the WBA drainage ditches and analyzed for VOCs. Collectively, the samples contained 12 detected VOCs. **Table 31** summarizes detected VOCs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 31: Wooded Bottomland Drainage Pathway Sediment Data Summary - VOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
VOCs via method SW8260. Concentration units are in µg/kg.				
1,3-Dichlorobenzene	9%	3.4	47	WSED-4-D1-2
1,4-Dichlorobenzene	7%	3.2	76	WSED-29-D0.5-1
2-butanone	13%	6.2	18	WSED-20-D0.5-1
acetone	17%	7.8	200	WSED-9-D0-0.5
bromomethane	2%	6.1	6.1	WSED-20-D0.5-1
carbon disulfide	6%	1.3	8.4	WSED-20-D0.5-1
chlorobenzene	7%	0.87	7.3	WSED-29-D0.5-1
chloroform	4%	2.1	4.6	WSED-1-D1-2
cis-1,2-dichloroethene	2%	2.3	2.3	WSED-7-D0.5-1
toluene	13%	0.89	2.7	WSED-20-D0.5-1
trichloroethene (TCE)	4%	0.88	1.6	WSED-7-D0.5-1
trichlorofluoromethane	21%	1.8	5.5	WSED-20-D0.5-1

SVOCs

Fifty-seven sediment samples were collected from the WBA drainage ditches and analyzed for SVOCs. Collectively, the samples contained 30 detected SVOCs. **Table 32** summarizes detected SVOCs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 32: Wooded Bottomland Drainage Pathway Sediment Data Summary - SVOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
SVOCs via method SW8270. Concentration units are in mg/kg.				
2-methylnaphthalene	2%	0.085	0.085	HC-16-SS
3,3'-dichlorobenzidine	4%	0.1	1.3	WSED-9-D0.5-1
3+4-methylphenol	5%	0.15	0.15	HC-16-SS
3-nitroaniline	2%	0.031	0.031	WSED-5-D1-2
4-methylphenol	3%	0.024	0.024	WSED-40-SED
acenaphthene	9%	0.0026	0.1	WSED-30-D0.5-1
acenaphthylene	2%	0.028	0.028	WSED-5-D0-0.5
anthracene	7%	0.036	0.76	WSED-5-D0-0.5
benzo(a)anthracene	33%	0.065	2.1	WSED-5-D0-0.5 & WSED-09-D0.5-1
benzo(a)pyrene	19%	0.0087	1.5	WSED-9-D0.5-1
benzo(b)fluoranthene	19%	0.022	1.7	WSED-5-D0-0.5 & WSED-09-D0.5-1
benzo(g,h,i)perylene	19%	0.0094	0.75	WSED-9-D0.5-1
benzo(k)fluoranthene	18%	0.042	1.3	WSED-9-D0.5-1
bis(2-ethylhexyl)phthalate	32%	0.056	0.63	WSED-9-D0.5-1
butyl benzyl phthalate	7%	0.045	0.36	WSED-24-D0.5-1
caprolactam	8%	0.02	0.02	WSED-40-SED
carbazole	4%	0.047	0.075	WSED-30-D0.5-1
chrysene	35%	0.013	2.7	WSED-5-D0-0.5
dibenzo(a,h)anthracene	7%	0.12	0.28	WSED-15-D0-0.5
dibenzofuran	4%	0.08	0.097	WSED-5-D0-0.5
diethyl phthalate	25%	0.032	0.3	WSED-9-D0.5-1
dimethyl phthalate	2%	0.096	0.096	WSED-10-D0-0.5
fluoranthene	37%	0.0083	6.7	WSED-5-D0-0.5
fluorene	7%	0.0043	0.24	WSED-5-D0-0.5
hexachlorobenzene	44%	0.027	1.3	WSED-9-D0.5-1
hexachloroethane	4%	0.036	0.18	WSED-2-D0-0.5
ideno(1,2,3-cd)pyrene	21%	0.0078	0.72	WSED-9-D0.5-1
naphthalene	4%	0.029	0.14	HC-16-SS
phenanthrene	30%	0.014	3.5	WSED-2-D0-0.5
pyrene	37%	0.005	6	WSED-5-D0-0.5

Inorganics

Fifty-seven sediment samples were collected from the WBA drainage ditches and analyzed for inorganics. Thirty more samples were collected and analyzed for only mercury. Collectively, the samples contained 25 detected inorganics and mercuric compounds. Many inorganics are naturally occurring. **Table 33** summarizes detected inorganics and mercuric compounds, frequency of detection, concentration ranges and location of the maximum concentration.

Table 33: Wooded Bottomland Drainage Pathway Sediment Data Summary - Inorganics

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Inorganics via method SW6010. Concentration units are in mg/kg.				
aluminum	95%	355	30,000	HC-16-SS
antimony	5%	0.3	0.47	WSED-4-D1-2
arsenic	64%	0.52	6.8	WSED-20-D0.5-1
barium	95%	1.4	76	HC-16-SS
beryllium	42%	0.069	0.93	WSED-20-D0.5-1
cadmium	49%	0.12	2	WSED-20-D0.5-1
calcium	95%	353	42,500	WSED-42
chromium	93%	1.2	55.4	WSED-20-D0.5-1
cobalt	74%	0.28	5.4	WSED-15-D0.5-1
copper	81%	0.26	13	HC-16-SS
iron	95%	403	32,100	WSED-20-D0.5-1
lead	93%	0.67	64.3	WSED-9-D0.5-1
magnesium	95%	48.8	3,070	WSED-20-D0.5-1
manganese	95%	4	208	WSED-30-D0-0.5
nickel	88%	0.56	23.9	WSED-10-D0-0.5
potassium	93%	58	2,890	WSED-20-D0.5-1
silver	2%	1.8	1.8	WSED-9-D0.5-1
sodium	82%	91.4	16,000	HC-16-SS
thallium	11%	0.35	0.8	WSED-4-D1-2
vanadium	95%	1.2	66	HC-16-SS
zinc	95%	3.1	262	WSED-9-D0.5-1
Mercury via method SW7471. Concentration units are in mg/kg.				
mercury	94%	0.038	126	WSED-16-D0.5-1
Mercury via method SW1630. Concentration units are in mg/kg.				
methylmercury	100%	0.00058	0.00164	WSED-40
Mercury via method SW1631. Concentration units are in mg/kg.				
mercury	100%	0.471	0.635	WSED-42
mercury fraction 1 bloom ES&T	100%	0.0095	0.015	WSED-41 & 42
mercury fraction 5 bloom ES&T	100%	0.0315	0.144	WSED-42

Pesticides

Fifty-seven sediment samples were collected from the WBA drainage ditches and analyzed for pesticides. Collectively, the samples contained 19 detected pesticides. **Table 34** summarizes detected pesticides, frequency of detection, concentration ranges and location of the maximum concentration.

Table 34: Wooded Bottomland Drainage Pathway Sediment Data Summary - Pesticides

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Pesticides via method SW8081. Concentration units are in mg/kg.				
4,4'-DDD	46%	0.00023	1.1	WSED-9-D0.5-1
4,4'-DDE	32%	0.00038	0.052	WSED-13-D0-0.5
4,4'-DDT	49%	0.0019	7.9	WSED-9-D0.5-1
aldrin	44%	0.000514	0.17	WSED-9-D0.5-1
alpha-BHC	20%	0.00034	0.064	WSED-41
alpha-chlorodane	4%	0.00153	0.00153	WSED-4-D0-0.5
beta-BHC	49%	0.011	0.88	WSED-9-D0.5-1
delta-BHC	26%	0.00023	0.14	WSED-9-D0.5-1
dieldrin	26%	0.00038	0.28	WSED-9-D0.5-1
endosulfan I	28%	0.00032	0.01	WSED-13-D0-0.5
endosulfan II	46%	0.00016	0.024	WSED-20-D0-0.5
endosulfan sulfate	28%	0.00033	0.042	WSED-13-D0-0.5
endrin	42%	0.00045	0.54	WSED-9-D0.5-1
endrin aldehyde	57%	0.0011	2.6	WSED-9-D0.5-1
gamma-BHC	35%	0.0009	0.19	WSED-9-D0.5-1
gamma-chlordane	11%	0.000944	0.00218	WSED-4-D0-0.5
heptachlor	12%	0.000677	0.012	WSED-10-D0-0.5
heptachlor epoxide	35%	0.00073	0.014	WSED-27-D0.5-1
methoxychlor	17%	0.00055	0.019	WSED-27-D0.5-1

PCBs

Seventy-seven sediment samples were collected from the WBA drainage ditches and analyzed for PCBs. Collectively, the samples contained four detected Aroclors and 13 PCB congeners. **Table 35** summarizes detected PCBs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 35: Wooded Bottomland Drainage Pathway Sediment Data Summary - PCBs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Aroclors via method SW8082. Concentration units are in mg/kg.				
Aroclor 1016	1%	1.9	1.9	WSED-13-D0-0.5
Aroclor 1248	3%	0.051	1.6	WSED-11-D0.5-1
Aroclor 1254	42%	0.0084	14	WSED-102705-001
Aroclor 1268	98%	0.042	1,500	WSED-9-D0.5-1
PCBs via method E1668. Concentration units are in ng/kg.				
PCB-105	8%	7.14	88,700	WSED-9-D0.5-1
PCB-106/118	100%	18.6	247,000	WSED-9-D0.5-1
PCB-114	67%	7.01	4,830	WSED-9-D0.5-1
PCB-118	90%	1.25	137	WSED-2-D1-2
PCB-123	67%	8.36	2,610	WSED-9-D0.5-1
PCB-126	67%	5.84	1,990	WSED-9-D0.5-1
PCB-156	83%	31.3	28,300	WSED-9-D0.5-1
PCB-157	83%	5.49	5,810	WSED-9-D0.5-1
PCB-167	83%	23.1	15,200	WSED-9-D0.5-1
PCB-169	75%	6.47	1,510	WSED-9-D0.5-1
PCB-189	83%	38.1	24,700	WSED-9-D0.5-1
PCB-77	83%	15.9	21,900	WSED-9-D0.5-1
PCB-81	67%	5.49	3,860	WSED-9-D0.5-1

Dioxins/Furans

Twenty-two sediment samples were collected from the WBA drainage ditches and analyzed for dioxins/furans.

Table 36 summarizes detected dioxins/furans, frequency of detection, concentration ranges and location of the maximum concentration.

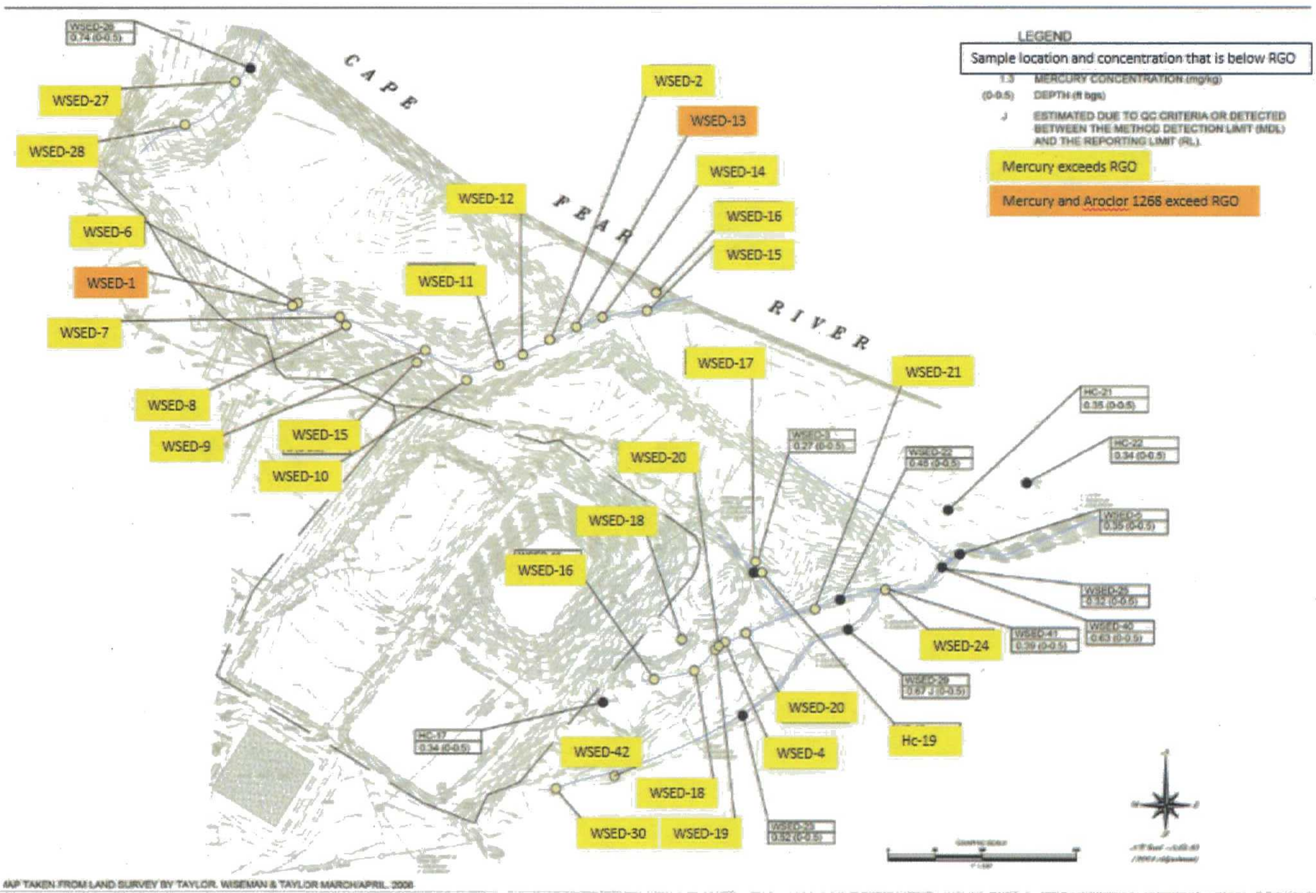
Table 36: Wooded Bottomland Drainage Pathway Sediment Data Summary - Dioxins/Furans

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Dioxins/Furans via methods E1613 and SW8290. Concentration units are in ng/kg.				
1,2,3,4,6,7,8-HpCDD	100%	0.705	852	WSED-9D0.5-1
1,2,3,4,6,7,8-HpCDF	95%	1.41	34,300	WSED-2-D1-2
1,2,3,4,7,8,9-HpCDF	86%	0.736	1,720	WSED-9D0.5-1
1,2,3,4,7,8-HxCDD	59%	0.298	42	WSED-9D0.5-1
1,2,3,4,7,8-HxCDF	91%	0.552	9,950	WSED-9D0.5-1
1,2,3,6,7,8-HxCDD	68%	0.31	31.5	WSED-9D0.5-1
1,2,3,6,7,8-HxCDF	86%	0.737	2,170	WSED-9D0.5-1
1,2,3,7,8,9-HxCDD	68%	0.289	20.9	WSED-9D0.5-1
1,2,3,7,8,9-HxCDF	75%	2.29	360	WSED-9D0.5-1
1,2,3,7,8-PECDD	32%	0.243	11.1	WSED-9D0.5-1
1,2,3,7,8-PeCDF	86%	0.405	747	WSED-9D0.5-1
2,3,4,6,7,8-HxCDF	86%	0.815	3,140	WSED-9D0.5-1
2,3,4,7,8-PeCDF	86%	0.606	1,120	WSED-9D0.5-1
2,3,7,8-TCDD	32%	0.14	3.78	WSED-9D0.5-1
2,3,7,8-TCDF	86%	0.341	265	WSED-9D0.5-1
HpCDD	100%	1.87	2,460	WSED-9D0.5-1
HpCDF	100%	0.983	50,200	WSED-2-D1-2
HxCDD	100%	1.02	781	WSED-9D0.5-1
HxCDF	100%	0.906	37,000	WSED-9D0.5-1
OCDD	100%	37.7	10,500	WSED-26D0.5-1
OCDF	84%	1.4	34,500	WSED-9D0.5-1
PeCDD	27%	0.415	59.3	WSED-2-D1-2
PeCDF	91%	0.388	12,000	WSED-9D0.5-1
TCDD	68%	0.102	38.6	WSED-9D0.5-1
TCDF	91%	0.539	3,510	WSED-9D0.5-1
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Bird	100%	0.428	1,650	WSED-2-D1-2
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Fish	100%	0.384	1,480	WSED-2-D1-2
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Mammal	100%	0.38	1,450	WSED-2-D1-2
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Bird	100%	0.397	1,640	WSED-2-D1-2
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Fish	100%	0.382	1,480	WSED-2-D1-2
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Mammal	100%	0.349	1,430	WSED-2-D1-2
Total 2,3,7,8-TCDD TEQ (PCB) - bird	100%	0.00152	0.82	WSED-28-D0-0.5
Total 2,3,7,8-TCDD TEQ (PCB) - fish	100%	0.0303	56.5	WSED-27-D0.5-1
Total 2,3,7,8-TCDD TEQ (PCB) - Mammal	100%	0.0303	20.9	WSED-28-D0-0.5

Summary

Mercury and Aroclor 1268 are the contaminant that pose the greatest risks in the WBA sediments.[5] **Figure 21** illustrates the extent of mercury and Aroclor 1268 in W sediment. Mercury concentrations ranged from non-detect to 126 mg/kg. Aroclor 1268 concentrations in the wooded bottomland sediments ranged from non-detect to 1,500 mg/kg.

Figure 21: Wooded Bottomland Drainage Pathways Sediment Sample Locations



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[5] See **Section 7.0** for risk assessment information.

5.6.3.2 Storm Water Sewer System Sediment

The storm water sewer system currently drains the UPA rainfall and storm water to the UNPA retention basins. Historically it may have collected spilled chemicals. The water flows through the sewer system and is treated prior to discharge to IP for further treatment. After treatment, it is discharged to the Cape Fear River. The sediment remaining in the sewer system was sampled during the EE/CA-RI.

VOCs

Twelve sediment samples were collected from the storm water sewer system and analyzed for VOCs. Collectively, the samples contained 10 detected VOCs. **Table 37** summarizes detected VOCs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 37: Storm Sewer Sediment Data Summary - VOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
VOCs via method SW8260. Concentration units are in µg/kg.				
1,2-dichloroethene (total)	25%	2.2	27	SED-9-D1-3
acetone	67%	12	200	SED-8-D0-1
carbon disulfide	75%	0.74	1.8	SED-1-1204
carbon tetrachloride	17%	2.9	3.3	SED-9-D1-3
chloroform	17%	0.99	3.5	SED-6-1204
methyl isobutyl ketone	58%	5.2	11	SED-8-D0-1
tetrachloroethene (PCE)	17%	7.6	150	SED-6-1204
trichloroethene (TCE)	25%	1.2	32	SED-9-D1-3
vinyl chloride	17%	1.8	4.5	SED-9-D1-3
xylenes, total	8%	4.2	4.2	SED-6-1204

SVOCs

Twelve storm water sewer system sediment samples were collected and analyzed for SVOCs. Collectively, the samples contained 26 detected SVOCs. **Table 38** summarizes detected SVOCs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 38: Storm Sewer Sediment Data Summary - SVOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
SVOCs via method SW8270. Concentration units are in mg/kg.				
1,2,4-trichlorobenzene	8%	0.14	0.14	SED-6-1204
1,4-Dichlorobenzene	8%	0.069	0.069	SED-6-1204
3+4-methylphenol	8%	0.063	0.063	SED-1-1204
acenaphthene	25%	0.027	0.063	SED-6-1204
anthracene	33%	0.023	0.35	SED-1-1204
benzo(a)anthracene	58%	0.04	0.29	SED-1-1204
benzo(a)pyrene	42%	0.04	0.17	SED-1-1204
benzo(b)fluoranthene	42%	0.056	0.26	SED-1-1204
benzo(g,h,i)perylene	58%	0.025	0.094	SED-1-1204
benzo(k)fluoranthene	67%	0.035	0.22	SED-1-1204
bis(2-ethylhexyl)phthalate	58%	0.093	1.9	SED-1-1204
butyl benzyl phthalate	42%	0.021	0.11	SED-1-1204
carbazole	17%	0.046	0.1	SED-1-1204
chrysene	67%	0.036	0.41	SED-1-1204
dibenzo(a,h)anthracene	17%	0.022	0.031	SED-9-D0-1
dimethyl phthalate	33%	0.066	0.34	SED-6-1204
di-n-butyl phthalate	17%	0.14	0.74	SED-2-1204
di-n-octyl phthalate	8%	0.066	0.066	SED-1-1204
fluoranthene	67%	0.061	0.62	SED-1-1204
fluorene	25%	0.035	0.056	SED-1&6-1204
hexachlorobenzene	58%	0.027	1.1	SED-6-1204
hexachlorobutadiene	17%	0.053	0.37	SED-6-1204
hexachloroethane	17%	0.066	1.2	SED-6-1204
ideno(1,2,3-cd)pyrene	50%	0.026	0.097	SED-1-1204
phenanthrene	58%	0.044	0.39	SED-1&6-1204
pyrene	67%	0.058	0.59	SED-1-1204

Inorganics

Twelve storm water sewer system sediment samples were collected and analyzed for inorganics and mercury. Collectively, the samples contained 22 detected inorganics and mercuric compounds. Many inorganics are naturally occurring. **Table 39** summarizes detected inorganics and mercuric compounds, frequency of detection, concentration ranges and location of the maximum concentration.

Table 39: Storm Sewer Sediment Data Summary - Inorganics

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Inorganics via method SW6010. Concentration units are in mg/kg.				
aluminum	100%	1,850	7,630	SED-10-D3-4
antimony	42%	0.33	6.4	SED-2-1204
arsenic	92%	0.61	27.6	SED-2-1204
barium	100%	6.2	85.4	SED-1-1204
beryllium	100%	0.082	0.57	SED-7-D1-2
cadmium	42%	0.11	1.2	SED-1-1204
calcium	100%	1,230	53,100	SED-1-1204
chromium	100%	4.1	94.6	SED-2-1204
cobalt	100%	0.57	14.8	SED-2-1204
copper	100%	0.9	564	SED-2-1204
iron	100%	4,420	155,000	SED-2-1204
lead	100%	2.5	27.3	SED-2-1204
magnesium	100%	441	2,860	SED-7-D1-2
manganese	100%	18.7	597	SED-2-1204
nickel	100%	1.6	112	SED-2-1204
potassium	100%	100	2,410	SED-7-D1-2
silver	25%	0.45	5.4	SED-1-1204
sodium	83%	261	4,000	SED-6-1204
thallium	42%	0.34	0.56	SED-7-D0-1
vanadium	100%	4	42.2	SED-2-1204
zinc	100%	10	499	SED-2-1204
Mercury via method SW7471. Concentration units are in mg/kg.				
mercury	100%	1.4	570	SED-6-1204

Pesticides

Twelve storm water sewer system sediment samples were collected and analyzed for pesticides. Collectively, the samples contained 12 detected pesticides. **Table 40** summarizes detected pesticides, frequency of detection, concentration ranges and location of the maximum concentration.

Table 40: Storm Sewer Sediment Data Summary - Pesticides

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Pesticides via method SW8081. Concentration units are in mg/kg.				
4,4'-DDD	17%	0.000508	0.0315	SED-6-1204
4,4'-DDE	25%	0.000615	0.0195	SED-6-1204
4,4'-DDT	42%	0.0158	0.0787	SED-6-1204
aldrin	58%	0.000407	0.0551	SED-6-1204
alpha-chlorodane	50%	0.000487	0.0139	SED-9-D0-1
dieldrin	50%	0.00224	0.0198	SED-9-D1-3
endosulfan I	25%	0.000681	0.0156	SED-9-D1-3
endosulfan II	50%	0.00133	0.0199	SED-9-D1-3
endosulfan sulfate	8%	0.0379	0.0379	SED-6-1204
endrin	25%	0.00136	0.0323	SED-9-D1-3
gamma-chlordane	58%	0.000553	0.2	SED-6-1204
heptachlor	58%	0.00056	0.235	SED-1-1204

PCBs

Twelve storm water sewer system sediment samples were collected and analyzed for Aroclor 1268. **Table 41** summarizes detected PCBs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 41: Storm Sewer Sediment Data Summary - Aroclor 1268

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Aroclor 1268 via method SW8082. Concentration units are in mg/kg.				
Aroclor 1268	100%	0.172	21.9	SED-2-1204

5.6.3.3 Off-site Sediment in the Cape Fear River and Livingston Creek

Twenty-one sediment samples were collected from the Cape Fear River and Livingston Creek. **Table 42** summarizes detected moisture content, pH and TOC, frequency of detection, concentration/percentage ranges and location of the maximum concentration/percentage.

Table 42: Cape Fear River and Livingston Creek Sediment Data Summary - Characterization

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Sediment Characterization				
Method E160.3M				
Percent Moisture	100%	30%	51.1%	IP-SED3
Method 9045				
pH	100%	6.7	6.7	IP-SED1&3
Method 9060. Concentration units are in mg/kg.				
Total Organic Carbon	100%	21	109	IP-SED3

VOCs

Twenty-one sediment samples were collected from the Cape Fear River and Livingston Creek and analyzed for VOCs. Collectively, the samples contained five detected VOCs. **Table 43** summarizes detected VOCs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 43: Cape Fear River and Livingston Creek Sediment Data Summary - VOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
VOCs via method SW8260. Concentration units are in µg/kg.				
acetone	71%	32	4,500	RIVER-REF-4-SED
carbon disulfide	86%	1.3	12	LCP005SD
methyl isobutyl ketone	29%	7.9	41	RIVER-REF-1-SED
styrene	76%	2.1	7.5	RIVER-UP-1-SED
o-xylene	100%	130	130	LCP007SD

SVOCs

Twenty-one sediment samples were collected from the Cape Fear River and Livingston Creek and were analyzed for SVOCs. Collectively, the samples contained 14 detected SVOCs. **Table 44** includes a summary of detected SVOCs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 44: Cape Fear River and Livingston Creek Sediment Data Summary - SVOCs

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
SVOCs via method SW8270. Concentration units are in mg/kg.				
benzo(a)anthracene	24%	0.043	0.067	WRIGHT-SED3
benzo(a)pyrene	10%	0.036	0.078	WRIGHT-SED3
benzo(b)fluoranthene	10%	0.05	0.098	WRIGHT-SED3
benzo(g,h,i)perylene	14%	0.027	0.048	WRIGHT-SED3
benzo(k)fluoranthene	19%	0.042	0.094	WRIGHT-SED3
bis(2-ethylhexyl)phthalate	33%	0.05	0.36	RIVER-UP-1&2-SED
butyl benzyl phthalate	19%	0.042	0.17	WRIGHT-SED3
chrysene	57%	0.041	0.17	WRIGHT-SED3
dibenzo(a,h)anthracene	5%	0.04	0.04	WRIGHT-SED3
fluoranthene	67%	0.038	0.13	RIVER-UP-1-SED; RIVER-REF-1-SED
hexachlorobenzene	10%	0.12	0.37	SITE-2-SED
ideno(1,2,3-cd)pyrene	19%	0.024	0.063	RIVER-UP-1-SED
phenanthrene	14%	0.026	0.065	WRIGHT-SED3
pyrene	76%	0.041	0.13	RIVER-UP-1-SED

Inorganics

Twenty-one sediment samples were collected from the Cape Fear River and Livingston Creek and were analyzed for for inorganics and mercury. Collectively, the samples contained 27 detected inorganics and mercuric compounds. Many inorganics are naturally occurring. **Table 45** summarizes detected inorganics and mercuric compounds, frequency of detection, concentration ranges and location of the maximum concentration.

Table 45: Cape Fear River and Livingston Creek Sediment Data Summary - Inorganics

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Inorganics via method SW6010. Concentration units are in mg/kg.				
aluminum	100%	2,920	26,800	RIVER-UP-1-SED
antimony	67%	0.36	4.2	WRIGHT-SED2
arsenic	100%	0.76	64.5	wRIGHT-SED3
barium	100%	16	399	WRIGHT-SED2
beryllium	100%	0.1	1.4	RIVER-UP-1-SED
cadmium	43%	0.14	7.2	wRIGHT-SED3
calcium	100%	676	41,000	LCP007SD
chromium	100%	6.5	34.1	RIVER-UP-1-SED
cobalt	100%	2.1	19.6	RIVER-UP-1-SED
copper	100%	3.4	456	
iron	100%	6,740	31,300	RIVER-UP-1-SED
lead	100%	4.3	272	WRIGHT-SED3
magnesium	100%	108	4,100	LCP007SD
manganese	100%	28.1	1,560	RIVER-UP-2-SED
molybdenum	25%	0.8	0.8	LCP007SD
nickel	100%	1.4	14.8	RIVER-UP-1-SED
potassium	100%	94.9	2,400	LCP007SD
selenium	24%	0.57	1.7	RIVER-REF-4-SED
silver	10%	0.059	0.065	WRIGHT-SED3
sodium	14%	170	1,100	LCP002SD
strontium	100%	8.8	140	LCP007SD
thallium	71%	0.47	1.9	RIVER-UP-2-SED
titanium	100%	40	49	LCP001SD
vanadium	100%	6	60.5	RIVER-UP-1-SED
yttrium	100%	6.1	11	LCP001SD
zinc	100%	20	637	WRIGHT-SED2
Mercury via method SW7471. Concentration units are in mg/kg.				
mercury	90%	0.024	1.3	LCP001SD

Pesticides

Twenty-one sediment samples were collected from the Cape Fear River and Livingston Creek and were analyzed for pesticides. Collectively, the samples contained 11 detected pesticides. **Table 46** summarizes detected pesticides, frequency of detection, concentration ranges and location of the maximum concentration.

Table 46: Cape Fear River and Livingston Creek Sediment Data Summary - Pesticides

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Pesticides via method SW8081. Concentration units are in mg/kg.				
4,4'-DDD	43%	0.00122	0.148	WRIGHT-SED3
4,4'-DDE	67%	0.00171	0.0425	WRIGHT-SED3
4,4'-DDT	62%	0.00126	0.0794	WRIGHT-SED2
aldrin	38%	0.000484	0.00786	WRIGHT-SED3
alpha-chlorodane	52%	0.000568	0.0147	WRIGHT-SED3
beta-BHC	25%	0.0027	0.0027	LCP002SD
dieldrin	29%	0.0018	0.0405	WRIGHT-SED3
endosulfan II	10%	0.000649	0.00105	WRIGHT-SED1
endrin	10%	0.0014	0.0073	LCP002SD
gamma-chlordane	38%	0.000855	0.0301	WRIGHT-SED3
heptachlor	10%	0.000918	0.00168	WRIGHT-SED3

PCBs

Seventeen sediment samples were collected from the Cape Fear River and Livingston Creek and were analyzed for Aroclor 1268. **Table 47** summarizes detected PCBs, frequency of detection, concentration ranges and location of the maximum concentration.

Table 47: Cape Fear River and Livingston Creek Sediment Data Summary – Aroclor 1268

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Aroclor 1268 via method SW8082. Concentration units are in mg/kg.				
Aroclor 1268	65%	0.0043	0.434	SITE-1-SED

Dioxins/Furans

Six sediment samples were collected from the Cape Fear River and Livingston Creek and were analyzed for dioxins/furans. **Table 48** summarizes detected dioxins/furans, frequency of detection, concentration ranges and location of the maximum concentration.

Table 48: Cape Fear River and Livingston Creek Sediment Data Summary – Dioxins/Furans

Analyte	FOD%	Minimum Conc.	Maximum Conc.	Max location
Dioxins/Furans via methods E1613 and SW8290. Concentration units are in ng/kg.				
1,2,3,4,6,7,8-HpCDD	100%	0.84	179	IP-SED3
1,2,3,4,6,7,8-HpCDF	83%	0.38	170	LCP002SD
1,2,3,4,7,8,9-HpCDF	50%	0.405	5	LCP001SD
1,2,3,4,7,8-HxCDD	50%	0.565	1.38	IP-SED3
1,2,3,4,7,8-HxCDF	83%	0.38	31	LCP002SD
1,2,3,6,7,8-HxCDD	50%	1.6	4.26	IP-SED3
1,2,3,6,7,8-HxCDF	67%	0.28	5.4	LCP002SD
1,2,3,7,8,9-HxCDD	67%	2.02	6.8	LCP001SD
1,2,3,7,8-PECDD	33%	0.28	0.47	LCP005SD
1,2,3,7,8-PeCDF	20%	0.31	0.31	LCP007SD
2,3,4,6,7,8-HxCDF	67%	0.563	11	LCP002SD
2,3,4,7,8-PeCDF	50%	0.389	2.3	LCP001SD
2,3,7,8-TCDD	33%	0.171	0.255	IP-SED3
2,3,7,8-TCDF	50%	0.328	1.4	LCP001SD
HpCDD	100%	219	411	IP-SED3
HpCDF	100%	16.2	37	IP-SED3
HxCDD	100%	31	62.9	IP-SED3
HxCDF	100%	6.55	12.5	IP-SED3
OCDD	83%	2,700	7,600	LCP002SD
OCDF	83%	0.78	110	LCP002SD
PeCDD	100%	4.64	5.86	IP-SED3
PeCDF	100%	1.41	2.06	IP-SED3
TCDD	100%	5.78	8.27	IP-SED3
TCDF	100%	2.83	3.49	IP-SED3
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Bird	100%	2.23	4.74	IP-SED3
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Fish	100%	1.58	4.16	IP-SED3
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Mammal	100%	3.03	7.49	IP-SED3
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Bird	100%	2.18	4.67	IP-SED3
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Fish	100%	1.58	4.15	IP-SED3
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Mammal	100%	2.99	7.41	IP-SED3
Total 2,3,7,8-TCDD TEQ (PCB) - bird	100%	0.00241	0.00393	IP-SED3
Total 2,3,7,8-TCDD TEQ (PCB) - fish	100%	0.0482	0.0786	IP-SED3

Total 2,3,7,8-TCDD TEQ (PCB) - Mammal	100%	0.0482	0.0786	IP-SED3

5.6.4 Wastewater Treatment Solids

During the removal action at IP in 2008-2009, sediments with concentrations of PCBs greater than 50 mg/kg were transported to the site for temporary storage in engineered stockpiles. Samples were collected of the WWTS at an interval of about one per 1,000 yd^3. An off-site laboratory analyzed the samples for VOCs, SVOCs, metals, pesticides and dioxins. **Table 49** through **Table 53** summarize the analytical results of the 21 samples collected (which includes two duplicate samples). The maximum location indicates the sample ID that had the highest concentration of the analyte. Sample ID description: for example, ESP-7-071008 means that this was the seventh sample collected of WWTS entering the engineered stockpile, collected on July 10, 2008.

Notes for Tables in section 5.6.4:
21 samples were analyzed for each analyte. Only analytes detected in at least one sample are included in these tables. Complete analytical data reports are included in the IP Removal Action Report.
Sample ID: Example ESP-6-070808. The 6th sample collected from WWTS placed in the engineered stockpile (ESP); the sample was collected on July 8, 2008.
ESP = Engineered Stockpile
FOD = frequency of detection = number of samples with a detected concentration of the analyte divided by the total number of samples analyzed for the analyte.
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
TCDD = tetrachlorodibenzodioxin
TCDF = tetrachlorodibenzofuran
µg/kg = micrograms per kilogram

VOCs

Sixteen VOCs were detected in WWTS placed in the engineered stockpiles (ESP). **Table 49** summarizes VOC sample results, frequency of detection, concentration ranges and location of the maximum concentration.

Table 49: WWTS Data Summary – VOCs

Analyte	FOD%	minimum conc. (µg/kg)	maximum conc. (µg/kg)	Sample ID of highest concentration
1,1-dichloroethene	5%	37	37	ESP-7-071008
1,2,4-trichlorobenzene	57%	1	350	ESP-5-070108
1,3-dichlorobenzene	67%	1.5	480	ESP-8-071608
1,4-dichlorobenzene	62%	0.99	940	ESP-7-071008
2-butanone	19%	9.6	30	ESP-1-061408
acetone	52%	21	370	ESP-1-061408
benzene	10%	1.3	2.6	ESP-6-070808
carbon disulfide	33%	2.4	29	ESP-1-061408
chlorobenzene	43%	0.65	1,100	ESP-7-071008
chloroform	48%	1.1	1,000	ESP-7-071008
cis-1,2-dichloroethene	5%	83	83	ESP-5-070108
dichlorodifluoromethane	5%	3.2	3.2	ESP-10-073108
methyl acetate	19%	3,900	26,000	ESP-5-070108
tetrachloroethene	14%	2.1	130	ESP-5-070108
toluene	14%	1.6	180	ESP-8-071608
trichloroethene	24%	1.1	130	ESP-7-071008

SVOCs

Five VOCs were detected in WWTS placed in the ESPs. **Table 50** summarizes SVOC frequency of detection, concentration ranges and location of the maximum concentration.

Table 50: WWTS Data Summary - SVOCs

Analyte	FOD%	minimum conc. (µg/kg)	maximum conc. (µg/kg)	Sample ID of highest concentration
benzaldehyde	29%	28	98	ESP-16-092408
bis(2-ethylhexyl)phthalate	19%	120	240	ESP-18-100108
hexachlorobenzene	62%	83	18,000	ESP-17-092908
hexachloroethane	33%	130	960	ESP-6-070808
pyrene	5%	94	94	ESP-19-100208

Inorganics

Eight inorganics were detected in WWTS placed in the ESPs. **Table 51** summarizes inorganics detected, frequency of detection, concentration ranges and location of the maximum concentration.

Table 51: WWTS Data Summary - Inorganics

Analyte	FOD%	minimum conc. (mg/kg)	maximum conc. (mg/kg)	Sample ID of highest concentration
arsenic	95%	0.4	19.2	ESP-7-071008
barium	100%	10.3	146	ESP-18-100108-DUP
cadmium	57%	0.17	0.42	ESP-18-100108-DUP
chromium	100%	3.9	61	ESP-16-092408
lead	100%	3.3	56.7	ESP-6-070808
mercury	100%	0.56	185	ESP-6-070808
selenium	38%	0.87	2.2	ESP-18-100108
silver	67%	0.07	0.39	ESP-6-070808

Pesticides

Twenty pesticides were detected in WWTS placed in the ESPs. **Table 52** summarizes pesticides detected, frequency of detection, concentration ranges and location of the maximum concentration.

Table 52: WWTS Data Summary – Pesticides

Analyte	FOD%	minimum conc. (µg/kg)	maximum conc. (µg/kg)	Sample ID of highest concentration
4,4'-DDD	38%	77	3,700	ESP-6-070808
4,4'-DDE	67%	0.88	330	ESP-7-071008
4,4'-DDT	100%	5.2	3,800	ESP-6-070808
aldrin	38%	1	120	ESP-7-071008
alpha-BHC	33%	0.38	43	ESP-6-070808
alpha-chlordane	33%	2.4	130	ESP-7-071008
beta-BHC	100%	1.7	1,900	ESP-6-070808
beta-chlordane	38%	6.3	250	ESP-7-071008
delta-BHC	33%	0.46	81	ESP-15-081908
dieldrin	76%	1.2	810	ESP-6-070808
endosulfan I	38%	0.32	64	ESP-15-081908
endosulfan II	38%	5.1	230	ESP-6-070808
endosulfan sulfate	14%	76	2,600	ESP-3-061908
endrin	67%	1.1	880	ESP-6-070808
endrin aldehyde	29%	91	19,000	ESP-5-070108
endrin ketone	19%	4	4,500	ESP-3-061908
gamma-BHC (lindane)	5%	63	63	ESP-15-081908
heptachlor	38%	1	740	ESP-15-081908
heptachlor epoxide	52%	4.3	260	ESP-7-071008
methoxychlor	10%	4	1,600	ESP-15-081908

Dioxins and Furans

Dioxins and furans were detected in all of the samples collected from WWTS placed in the ESPs. **Table 53** summarizes dioxin and furans detected, frequency of detection, concentration ranges and location of the maximum concentration.

Table 53: WWTS Data Summary – Dioxins and Furans

Analyte	FOD%	minimum conc. (ng/kg)	maximum conc. (ng/kg)	Sample ID of highest concentration
1,2,3,4,6,7,8-HpCDD	100%	13.3	1,070	ESP-7-071008
1,2,3,4,6,7,8-HpCDF	100%	31.5	56,700	ESP-6-070808
1,2,3,4,7,8,9-HpCDF	100%	2.58	2,420	ESP-6-070808
1,2,3,4,7,8-HxCDD	95%	0.522	24.2	ESP-6-070808
1,2,3,4,7,8-HxCDF	100%	9.84	15,500	ESP-7-071008
1,2,3,6,7,8-HxCDD	100%	0.885	41.3	ESP-7-071008
1,2,3,6,7,8-HxCDF	100%	2.29	2,950	ESP-6-070808
1,2,3,7,8,9-HxCDD	95%	0.558	17.7	ESP-7-071008
1,2,3,7,8,9-HxCDF	76%	0.813	102	ESP-7-071008
1,2,3,7,8-PeCDD	62%	0.439	3.16	ESP-7-071008
1,2,3,7,8-PeCDF	100%	2.66	3,210	ESP-7-071008
2,3,4,6,7,8-HxCDF	100%	3.62	3,350	ESP-6-070808
2,3,4,7,8-PeCDF	100%	1.89	1,580	ESP-6-070808
2,3,7,8-TCDD	100%	0.463	16.7	ESP-2-061708
2,3,7,8-TCDF	100%	18.7	1,670	ESP-7-071008
OCDD	100%	456	8,030	ESP-7-071008
OCDF	100%	53.3	55,400	ESP-6-070808
Total HpCDD	100%	34.8	2,240	ESP-7-071008
Total HpCDF	100%	69.6	67,500	ESP-6-070808
Total HxCDD	100%	6.29	8,635	ESP-18-100108
Total HxCDF	100%	39.3	43,400	ESP-6-070808
Total PeCDD	52%	0.857	33.9	ESP-6-070808
Total PeCDF	100%	31.3	24,900	ESP-18-100108
Total TCDD	95%	1.1	28.3	ESP-7-071008
Total TCDF	100%	68.1	7,690	ESP-7-071008
Toxic Equivalents	100%	17	3,900	ESP-6-070808

5.6.5 Soil

Over 650 soil samples were collected from different areas at the site and background locations. The results discussion is broken down into the following three sub sections: UPA/UNPA, WBA, and off-site.

5.6.5.1 Upland Area Soil

Over 100 soil samples were collected from the UPA and UNPA. There were analyzed for a variety of contaminants and summarized below.

VOCs

Ninety-eight soil samples were collected from the UPA and 10 soil samples from the UNPA. Sample depths ranged from the surface soil to ten ft bgs. Twenty-four VOCs were detected in the UPA, while only three VOCs were detected in the UNPA. **Table 54** summarizes VOCs detected, frequency of detection, concentration ranges and location of the maximum concentration.

Table 54: Upland Area Soil Data Summary - VOCs

Analyte	FOD%	minimum conc.	maximum conc.	maximum location	maximum location depth (feet)
VOCs via method SW8260. Concentration units are in µg/kg.					
1,1-dichloroethane	2%	0.95	2.4	SB-68V	5-10
1,2-dibromo-3-chloropropane	1%	0.89	0.89	SB-77	0-0.5
1,2-dichloroethene (total)	3%	52	52	SB-10	2-2.5
2-butanone	4%	5	600	SB-13	0-0.5
acetone	31%	4.9	28,000	SB-7	1-2
acetophenone	7%	120	220	HC-02	SS
benzene	2%	0.7	3.3	SB-1	2-3.5
bromodichloromethane	2%	6.5	360	SB-13	0-0.5
bromoform	2%	4.5	140	SB-13	0-0.5
bromomethane	1%	3.9	3.9	SB-8	0-0.5
carbon disulfide	27%	0.66	4,800	SB-7	1-2
carbon tetrachloride	3%	3.3	2,400	SB-13	0-0.5
chlorodibromomethane	1%	1.2	1.2	SB-13	2-4
chloroform	8%	1.4	20,000	SB-13	0-0.5
cis-1,2-dichloroethene	3%	0.82	1	SB-70V	1-5
ethylbenzene	3%	1.5	180	SB-13	0-0.5
isopropylbenzene (cumene)	1%	1.9	1.9	SB-310V	0-0.5
methyl isobutyl ketone	23%	4.7	48	SB-13	2-4
methylene chloride	1%	230	230	SB-13	0-0.5
styrene	1%	900	900	SB-13	0-0.5
tetrachloroethene (PCE)	7%	1.1	870	SB-13	0-0.5

Analyte	FOD%	minimum conc.	maximum conc.	maximum location	maximum location depth (feet)
toluene	10%	0.81	5	HC-03	SBA
trans-1,2-dichloroethene	2%	2.1	2.1	SB-68V	5-10
trichloroethene (TCE)	6%	0.72	84	SB-13	0-0.5
vinyl chloride	2%	3.4	8.1	SB-10	2-2.5
xylenes (total)	2%	3.3	300	SB-13	0-0.5

SVOCs

One hundred and two soil samples were collected from the UPA and 14 soil samples were collected from the UNPA and analyzed for SVOCs. Sample depths ranged from the surface soil to ten ft bgs. Forty-seven SVOCs were detected in the UPA, while only 21 SVOCs were detected in the UNPA. **Table 55** summarizes SVOCs detected, frequency of detection, concentration ranges and location of the maximum concentration.

Table 55: Upland Area Soil Data Summary - SVOCs

Analyte	FOD%	minimum conc.	maximum conc.	maximum location	maximum location depth (feet)
SVOCs via method SW8270. Concentration units are in mg/kg.					
1,1-biphenyl	2%	0.35	0.35	HC-05	SBB
1,2,4-trichlorobenzene	4%	0.03	0.11	SB-1	2-3.5
1,3-dichlorobenzene	3%	0.033	0.039	SB-3	2-5
1,4-dichlorobenzene	1%	0.039	0.039	SB-13	0-0.5
2,4,6-trichlorophenol	1%	2.6	2.6	SB-13	0-0.5
2,4-dichlorophenol	1%	0.12	0.12	SB-13	0-0.5
2,4-dimethylphenol	2%	0.11	0.12	SB-9	0-0.5
2,6-dinitrotoluene	2%	0.14	0.16	SB-8	0-0.5
2-methylnaphthalene	9%	0.021	2.3	SB-14	0-0.5
2-methylphenol	1%	0.075	0.075	SB-14	0-0.5
3,3-dichlorobenzidine	1%	0.18	0.18	SB-70	1-5
3+4-methylphenol	5%	0.062	0.3	HC-06	SBB
4-methylphenol	2%	0.066	0.066	SB-68	5-10
acenaphthene	10%	0.0027	9.3	SB-14	0-0.5
acenaphthylene	3%	0.0025	0.15	SB-14	0-0.5
anthracene	15%	0.0023	16	SB-14	0-0.5
benzaldehyde	4%	0.11	0.28	HB-05	SBB
benzo(a)anthracene	47%	0.0047	37	SB-14	0-0.5

Analyte	FOD%	minimum conc.	maximum conc.	maximum location	maximum location depth (feet)
benzo(a)pyrene	28%	0.0045	26	SB-14	0-0.5
benzo(b)fluoranthene	34%	0.02	30	SB-14	0-0.5
benzo(g,h,i)perylene	32%	0.0057	13	SB-14	0-0.5
benzo(k)fluoranthene	36%	0.014	24	SB-14	0-0.5
bis(2-ethylhexyl)phthalate	28%	0.039	15	SB-68	1-5
butyl benzyl phthalate	13%	0.019	2.4	SB-7	0-0.5
caprolactam	6%	0.043	0.064	HC-04	SBA
carbazole	10%	0.0023	7.1	SB-14	0-0.5
chrysene	53%	0.0065	38	SB-14	0-0.5
dibenzo(a,h)anthracene	14%	0.0033	7.8	SB-14	0-0.5
dibenzofuran	7%	0.025	3.7	SB-14	0-0.5
diethyl phthalate	2%	0.023	0.03	SB-4	0-0.5
dimethyl phthlate	19%	0.0035	7.4	SB-13	0-0.5
di-n-butyl phthalate	4%	0.025	1.4	SB-13	0-0.5
di-n-otyl phthalate	4%	0.058	0.27	SB-9	0-0.5
fluoranthene	56%	0.0034	67	SB-14	0-0.5
fluorene	11%	0.0016	7.4	SB-14	0-0.5
hexachlorobenzene	54%	0.006	39	SB-14	0-0.5
hexachlorobutadiene	4%	0.043	0	SB-1	2-3.5
hexachlorocyclopentadiene	1%	0.54	1	SB-13	0-0.5
hexachloroethane	29%	0.011	3.8	SB-1	2-3.5
ideno(1,2,3-cd)pyrene	33%	0.0033	13	SB-14	0-0.5
naphthalene	10%	0.02	2	SB-14	0-0.5
nitrobenzene	1%	0.12	0.12	HC-02	SS
n-nitrosodiphenylamine	1%	0.28	0.28	SB-9	0-0.5
pentachlorophenol	2%	0.67	7.1	SB-13	0-0.5
phenanthrene	46%	0.022	61	SB-14	0-0.5
phenol	2%	0.07	0.11	SB-14	0-0.5
pyrene	57%	0.0028	65	SB-14	0-0.5

Inorganics

One hundred and ten soil samples from the UPA and 16 soil samples from the UNPA were collected and analyzed for inorganics. Mercury was analyzed in 353 soil samples. Sample depths ranged from the surface soil to ten ft bgs. Twenty-three inorganics were detected in the UPA, while only 21 inorganicss were detected in the UNPA. **Table 56** summarizes inorganics detected, frequency of detection, concentration ranges and location of the maximum concentration

Table 56: Upland Area Soil Data Summary - Inorganics

Analyte	minimum conc.	maximum conc.	maximum location	maximum location depth (feet)
Inorganics via method SW6010/7471. Concentration units are in mg/kg.				
aluminum	280	25,200	SB-2	0-0.5
antimony	0.27	40	SB-9	0-0.5
arsenic	0.27	17.1	SB-14	0-0.5
barium	1.6	241	SB-12	0-0.5
beryllium	0.029	1	SB-68	0-0.5
cadmium	0.087	8.3	SB-9	0-0.5
calcium	180	306,000	W-5	0-0.5
chromium	0.99	120	HC-02	SS
cobalt	0.29	22.2	SB-13	0-0.5
copper	0.37	570	HC-01	SS
iron	220	197,000	SB-13	0-0.5
lead	0.79	222	SB-14	0-0.5
magnesium	28	8,140	SB-68	0-0.5
manganese	2	894	SB-13	0-0.5
mercury	0.00822	11,000	HC-05	SBB
nickel	0.52	870	HC-05	SBB
potassium	22	7,260	SB-74	0-0.5
selenium	0.27	1.5	HC-02	SS
silver	0.082	24.4	SB-9	0-0.5
sodium	52.2	5,200	HC-06	SBB
thallium	0.36	4.3	HC-02	SS
vanadium	0.7	93.1	SB-2	0-0.5
zinc	1.9	4,430	SB-14	0-0.5

Pesticides

Ninety-four soil samples from the UPA and 14 soil samples from the UNPA were collected and analyzed for pesticides. Sample depths ranged from the surface soil to ten feet bgs. Nineteen pesticides were detected in both the UPA and UNPA. **Table 57** summarizes pesticides detected, frequency of detection, concentration ranges and location of the maximum concentration

Table 57: Upland Area Soil Data Summary - Pesticides

Analyte	minimum conc.	maximum conc.	maximum location	maximum location depth (feet)
Pesticides via method SW8081. Concentration units are in mg/kg.				
4,4'-DDD	0.0002	0.243	SB-1	0-0.5
4,4'-DDE	0.000264	0.154	SB-1	0-0.5
4,4'-DDT	0.00077	1.31	SB-14	0-0.5
aldrin	0.00053	0.525	SB-1	2-3.5
alpha-BHC	0.00019	0.12	UNP-1-SO-1-050609	
alpha-chlordane	0.000368	0.286	SB-1	0-0.5
beta-BHC	0.00027	0.092	SB-70	0-0.5
delta-BHC	0.00022	0.014	SB-70	0-0.5
dieldrin	0.00031	0.865	SB-14	0-0.5
endosulfan I	0.00015	0.0729	SB-14	2-2.5
endosulfan II	0.00014	0.6	SB-4	0-0.5
endosulfan sulfate	0.00021	0.162	SB-14	0-0.5
endrin	0.00024	0.264	SB-4	0-0.5
endrin aldehyde	0.001	0.6	SB-70	1-5
endrin ketone	0.53	0.53	HC-02	SBA
gamma-BHC (lindane)	0.00016	0.15	SB-70	0-0.5
gamma-chlordane	0.00267	0.286	SB-13	0-0.5
heptachlor	0.000448	0.721	SB-1	2-3.5
heptachlor epoxide	0.0002	0.049	SB-9	1-5
methoxychlor	0.00026	0.48	HC-06	SBB

PCBs

Two hundred and thirty soil samples from the UPA and 14 soil samples from the UNPA were collected and analyzed. Sample depths ranged from the surface soil to 10 ft bgs. **Table 58** summarizes PCBs detected, frequency of detection, concentration ranges and location of the maximum concentration

Table 58: Upland Area Soil Data Summary - PCBs

Analyte	minimum conc.	maximum conc.	maximum location	maximum location depth (feet)
Aroclors via method SW8082. Concentration units are in mg/kg.				
Aroclor 1254	0.0074	5.1	SB-69	1-5
Aroclor 1268	0.0036	2,500	SB-63	1-3
PCB Congeners via method E1668. Concentration units are in ng/kg.				
PCB-77	3.6	2,970	SB-70	1-5
PCB-81	4.93	810	SB-70	1-5
PCB-105	10.9	23,100	SB-69	0.5-1
PCB-106/118	27.9	129,000	SB-69	0.5-1
PCB-114	3.2	1,030	SB-69	0.5-1
PCB-123	6.75	632	SB-70	1-5
PCB-126	7.18	697	SB-70	1-5
PCB-156	5.56	16,200	SB-69	0.5-1
PCB-157	4.56	2,750	SB-69	0.5-1
PCB-167	4.18	7,310	SB-69	0.5-1
PCB-169	3.48	991	SB-70	1-5
PCB-189	8.29	8,800	SB-70	1-5

Dioxins and Furans

Twenty-five soil samples from the UPA and five soil samples from the UNPA were collected and analyzed for dioxins and furans. Sample depths ranged from the surface soil to ten feet bgs.

Table 59 summarizes dioxin and furans detected, frequency of detection, concentration ranges and location of the maximum concentration.

Table 59: Upland Area Soil Data Summary - Dioxins/Furans

Analyte	minimum conc.	maximum conc.	maximum location	maximum location depth (feet)
Dioxins/Furans via method E1613. Concentration units are in ng/kg.				
1,2,3,4,6,7,8-HpCDD	0.997	518	SB-75	1-5
1,2,3,4,6,7,8-HpCDF	0.328	5,200	SB-69	0-0.5
1,2,3,4,7,8,9-HpCDF	0.155	352	SB-70	0-0.5
1,2,3,4,7,8-HxCDD	0.257	11.3	SB-68	5-10
1,2,3,4,7,8-HxCDF	0.485	1,130	SB-70	0-0.5
1,2,3,6,7,8-HxCDD	0.283	8.32	SB-75	1-5
1,2,3,6,7,8-HxCDF	0.197	205	SB-69	0-0.5
1,2,3,7,8,9-HxCDD	0.303	7.92	SB-68	5-10
1,2,3,7,8,9-HxCDF	0.334	30.5	SB-69	0-0.5
1,2,3,7,8-PeCDD	0.252	2.23	SB-68	5-10
1,2,3,7,8-PeCDF	0.499	150	SB-70	0-0.5
2,3,4,6,7,8-HxCDF	0.171	301	SB-70	1-5
2,3,4,7,8-PeCDF	0.258	132	SB-70	1-5
2,3,7,8-TCDD	0.252	0.728	SB-69	0-0.5
2,3,7,8-TCDF	0.827	60	SB-70	0-0.5
OCDD	68	7,450	SB-75	1-5
OCDF	0.371	4,520	SB-69	0-0.5
HpCDD	4.49	2,000	SB-75	1-5
HpCDF	0.328	7,520	SB-69	0-0.5
HxCDD	1.07	260	SB-68	5-10
HxCDF	0.11	4,100	SB-70	1-5
PeCDD	0.181	25.7	SB-68	5-10
PeCDF	0.258	1,200	SB-70	1-5
TCDD	0.199	8.37	SB-70	1-5
TCDF	0.348	399	SB-70	1-5
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Bird	1.52	668	SB-70	1-5
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Fish	0.48	265	SB-69	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Mammal	0.92	334	SB-70	1-5
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Bird	0.53	366	SB-70	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Fish	0.46	264	SB-69	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Mammal	0.4	250	SB-69	0-0.5
Total 2,3,7,8-TCDD TEQ (PCB) - Bird	0.69	303	SB-70	1-5
Total 2,3,7,8-TCDD TEQ (PCB) - Fish	0.02	5	SB-70	1-5
Total 2,3,7,8-TCDD TEQ (PCB) - Mammal	0.36	102	SB-70	1-5

5.6.5.2 WBA Soil

The WBA consists of approximately nine acres of land with three drainage pathways that slope to the Cape Fear River. A broad range of constituents were detected in the WBA. Sample depths ranged from the surface soil to one foot bgs. **Table 60** lists the range for percent solids and total organic carbon for the WBA soils.

Table 60: Bottomland Area Soil Data Summary - Percent Solids and TOC

Analyte	minimum conc.	maximum conc.	maximum location	sample depth (feet)
E160.3				
Total Solids (%)	55.98%	93.97%	WB-2	
SM2540G				
Percent Solids	74.40%	91.80%	WB-2	
SW9060 mg/kg				
Total Organic Carbon	19,000	42,000	SB-98	0-0.5

<u>VOCs</u>

Thirty-one soil samples were collected from the WBA and were analyzed for VOCs. Six VOCs were detected. **Table 61** includes the concentration ranges for detected VOCs, the sample ID and depth for the maximum concentration.

Table 61: Bottomland Area Soil Data Summary - VOCs

Analyte	minimum conc.	maximum conc.	maximum location	sample depth (feet)
VOCs via method SW8260. Concentration units are in µg/kg.				
2-butanone	9.1	9.1	SB-79	0-0.5
carbon disulfide	1.1	1.1	SB-98	0-0.5
Chloroform	0.71	2	SB-95	0.5-1
isopropylbenzene (cumene)	1.5	24	SB-96	0-0.5
Toluene	1.1	2.3	SB-79	0-0.5
Trichlorofluoromethane	1.8	1.8	SB-96	0.5-1

SVOCs

Thirty-five soil samples were collected from the WBA and analyzed for SVOCs. Twenty-six SVOCs were detected. **Table 62** includes the concentration ranges for detected SVOCs, the sample ID and depth for the maximum concentration.

Table 62: Bottomland Area Soil Data Summary - SVOCs

Analyte	minimum conc.	maximum conc.	maximum location	sample depth (feet)
SVOCs via method SW8270. Concentration units are in mg/kg.				
3,3-dichlorobenzidine	0.12	0.27	SB-89	0.5-1
acenaphthene	0.0012	0.02	SB-99	0-0.5
acenaphthylene	0.0016	0.0016	TERA-3	0-1
anthracene	0.003	0.03	SB-89 & SB-99	0-1
benzo(a)anthracene	0.0068	0.46	SB-99	0-0.5
benzo(a)pyrene	0.0022	0.39	SB-99	0-0.5
benzo(b)fluoranthene	0.015	0.6	SB-99	0-0.5
benzo(g,h,i)perylene	0.0061	0.21	SB-99	0-0.5
benzo(k)fluoranthene	0.04	0.56	SB-99	0-0.5
bis(2-ethylhexyl)phthalate	0.11	0.24	SB-89	0.5-1
butyl benzyl phthalate	0.051	0.051	SB-90	0-0.5
caprolactam	0.0071	0.013	TERA-5	0-1
carbazole	0.0017	0.16	SB-99	0-0.5
chrysene	0.0096	0.91	SB-99	0-0.5
dibenzo(a,h)anthracene	0.11	0.11	SB-99	0-0.5
dibenzofuran	0.033	0.033	SB-99	0-0.5
dimethyl phthlate	0.038	0.042	TERA-5	0-1
di-n-butyl phthalate	0.054	0.054	SB-94	0-0.5
di-n-otyl phthalate	0.042	0.042	TERA-3	0-1
fluoranthene	0.0068	1.8	SB-99	0-0.5
fluorene	0.0018	0.025	SB-99	0-0.5
hexachlorobenzene	0.035	0.28	SB-91	0-0.5
hexachloroethane	0.026	0.12	SB-91	0-0.5
ideno(1,2,3-cd)pyrene	0.0016	0.21	SB-99	0-0.5
phenanthrene	0.16	1.2	SB-99	0-0.5
pyrene	0.0047	1.6	SB-99	0-0.5

Inorganics

Forty-two soil samples were collected from the WBA and analyzed for inorganics and 68 soil samples were collected and analyzed for mercury. Many inorganics naturally occur in soil. **Table 63** includes the concentration ranges for detected inorganics, the sample ID and depth for the maximum concentration.

Table 63: Bottomland Area Soil Data Summary - Inorganics

Analyte	minimum conc. (mg/kg)	maximum conc. (mg/kg)	maximum location	sample depth (feet)
Inorganics via method SW6010/7471.				
aluminum	1,200	25,900	SB-94	0.5-1
arsenic	0.3	6.7	SB-94	0-0.5
barium	7.9	166	SB-80 & SB-94	0-0.5
beryllium	0.17	1.3	SB-94 & SB-97	0-0.5
cadmium	0.06	2.7	SB-94	0-0.5
calcium	362	25,400	WB-3	0-1
chromium	2.2	52.1	SB-93	0-0.5
cobalt	0.38	18.5	SB-94	0.5-1
copper	1.1	65.8	SB-94	0-0.5
iron	1,590	30,600	SB-94	0.5-1
lead	2.1	122	SB-94	0-0.5
magnesium	148	2,690	SB-98	0-0.5
manganese	16.5	1,020	SB-93	0-0.5
nickel	1.5	59.6	SB-94	0-0.5
potassium	96.5	2,100	SB-91	0-0.5
selenium	0.65	1.7	SB-97	0-0.5
silver	0.21	3.9	SB-94	0-0.5
sodium	44.1	5,600	HC-14	SS
thallium	0.33	2	SB-97	0-0.5
vanadium	4.4	81.3	SB-93	0-0.5
zinc	3.7	781	SB-94	0-0.5
Methylmercury via method E1630.				
methylmercury	0.00064	0.0222	WB-5	0-1
Mercury fractions via method E1631.				
mercury	0.136	32.3	TERA-5	0-1
mercury fraction 1 Bloom ES&T	0.00768	1.6	TERA-5	0-1
mercury fraction 2 Bloom ES&T	0.00255	0.0239	TERA-5	0-1
mercury fraction 5 Bloom ES&T	0.00382	19.2	TERA-5	0-1
Mercury via method 7471.				
mercury	0.02	92	SB-94	0-0.5

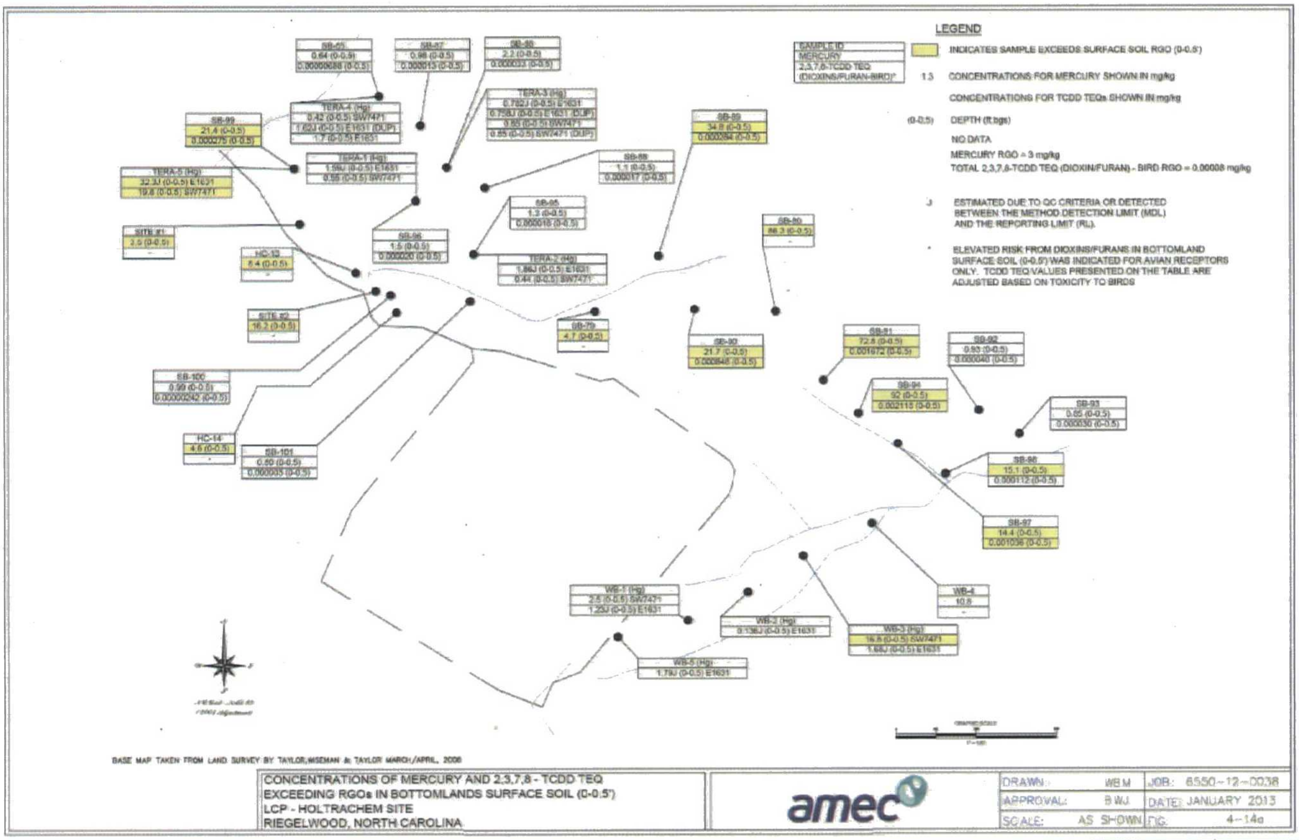
Table 64 lists the sample IDs and concentrations that exceeded the mercury PRG.

Table 64: Wooded Bottomland Surface Soil Sample Results that Exceed an Inorganic PRG

Location ID	Mercury (mg/kg)
Preliminary Remediation Goal (PRG):	**3**
HC-13	**8.4**
HC-14	**4.6**
SB-79	**4.7**
SB-80	**86.3**
SB-89	**34.8**
SB-90	**21.7**
SB-91	**72.8**
SB-94	**92**
SB-97	**14.4**
SB-98	**15.1**
SB-99	**21.4**
Site #1 Surface	**3.5**
Site #2 Surface	**16.2**
TERA-5 (E1631)	**32.3** J
TERA-5 (SW7471)	**19.8**
WB-3 (SW7471)	**16.8**
WB-4 (E1631)	**10.8**
Notes:	
Only samples that had a concentration that exceeded the PRG are included in this table.	
J = estimated concentration	

Figure 22 illustrates the distribution of the mercury in WBA soil. The northeastern portion of this area was designated as wetlands and is influenced primarily by the central drainage pathway. As evidenced by the pattern of occurrence, the mercury likely originated from the Fill and Retort Areas runoff and was transported in surface water and sediment from the central drainage pathway to the wetland areas.

Figure 22: Concentrations exceeding PRGs in Bottomlands



Pesticides

Thirty-five soil samples were collected from the WBA and analyzed for pesticides. Seventeen pesticides were detected. **Table 65** includes the concentration ranges for detected pesticides, the sample ID and depth for the maximum concentration.

Table 65: Wooded Bottomland Soil Data Summary - Pesticides

Analyte	minimum conc. (mg/kg)	maximum conc. (mg/kg)	maximum location	sample depth (feet)
Pesticides via method SW8081				
4,4'-DDD	0.00026	0.17	TERA-5	0-1
4,4'-DDE	0.00032	1.4	SB-89	0.5-1
4,4'-DDT	0.00075	2.3	SB-89	0.5-1
aldrin	0.00075	0.062	SB-89	0.5-1
alpha-BHC	0.00098	0.028	SB-89	0.5-1
beta-BHC	0.00041	0.16	SB-90	0.5-1
delta-BHC	0.00021	0.016	SB-79	0-0.5
dieldrin	0.00034	0.16	SB-89	0.5-1
endosulfan I	0.000098	0.19	SB-89	0.5-1
endosulfan II	0.00014	0.51	SB-89	0.5-1
endosulfan sulfate	0.00021	0.021	SB-79	0-0.5
endrin	0.00053	0.76	SB-89	0.5-1
endrin aldehyde	0.0033	1.4	SB-89	0.5-1
gamma-BHC (lindane)	0.00018	0.021	SB-79	0-0.5
heptachlor	0.0092	0.14	SB-89 & SB-94	0-1
heptachlor epoxide	0.00028	0.24	SB-89	0.5-1
methoxychlor	0.0021	0.082	SB-89	0.5-1

Aroclors

Ninety-seven soil samples were collected from the WBA and analyzed for Aroclor 1268. Sixty-four soil samples were collected from the WBA and analyzed for Aroclor 1254. **Table 66** includes the concentration ranges for detected Aroclors, the sample ID and depth for the maximum concentration.

Table 66: Wooded Bottomland Soil Data Summary - PCBs

Analyte	minimum conc. (mg/kg)	maximum conc. (mg/kg)	maximum location	sample depth (feet)
PCBs via method SW8082				
Aroclor 1254	0.0045	67	SB-89	0.5-1
Aroclor 1268	0.0071	1,200	SB-89	0.5-1
PCBs via method SW8280				
PCB 1268	0.027	3,800	SITE#1	0-0.5

Table 67 lists the samples and concentrations that exceeded the PRGs.

Table 67: Wooded Bottomland Surface Soil Sample Results that Exceed a PCB PRG

Sample ID	Sample Depth (feet)	Aroclor 1254 (mg/kg)	Aroclor 1268 (mg/kg)
Preliminary Remediation Goal (PRG):		**21**	**21**
SB-80	0-0.5	< 9.8	**190** B
SB-89	0-0.5	0.31 J	**38**
SB-89	0.5-1	**67**	**1200**
SB-90	0-0.5	1.5 J	**130**
SB-90	0.5-1	< 2.4	**130**
SB-91	0-0.5	2.2 J	**400**
SB-94	0-0.5	<2.7	**460**
SB-94	0.5-1	< 0.48	**24**
SB-97	0-0.5	1.1 J	**150**
SB-98	0-0.5	< 0.58	**23**
SB-99	0-0.5	0.25 J	**31**
SB-177	0-1	NA	**32.2**
Site #1 Surface	0-0.5	**< 36**	**3800**
Site #2 Surface	0-0.5	**< 37**	**1500**
Site #2 B2	0-0.8	< 1.7	**46**
TERA-5	0-0.5	< 0.091	**21**

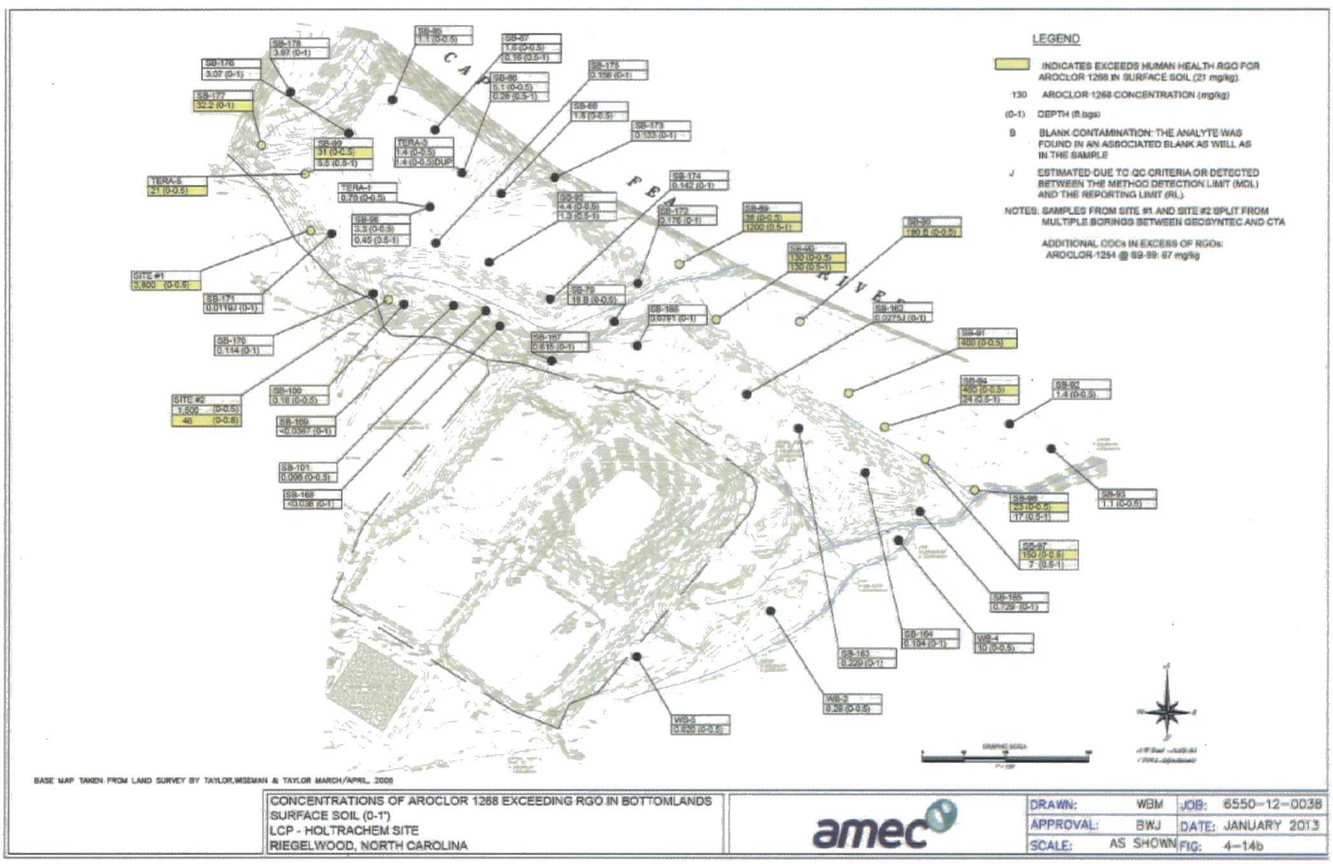
Notes:

Only samples that had a concentration that exceeded at least one PRG are included in this table.

Sample ID	Sample Depth (feet)	Aroclor 1254 (mg/kg)	Aroclor 1268 (mg/kg)
Preliminary Remediation Goal (PRG):		**21**	**21**
B = blank contamination. The analyte was found in an associated blank as well as in the sample			
J = estimated concentration			
NA = not analyzed			
< = less than the reporting limit. The reporting limit is included.			
< = less than the reporting limit. The reporting limit is included and exceeds the PRG.			
Bold value exceeds PRG			

Figure 23 illustrates the distribution of the PCBs in soil. The northeastern portion of this area was designated as wetlands and is influenced primarily by the central drainage pathway. Aroclor 1268 likely originated from historical Fill Area runoff and was transported in surface water and sediment from the central drainage pathway to the wetland areas.

Figure 23: Concentrations of Aroclor 1268 Exceeding PRG in Bottomlands



Dioxins/Furans and PCBs

Thirty-two soil samples were collected from the WBA and analyzed for dioxins/furans and dioxin/furan-like PCB congeners. **Table 68** and **Table 69** include the concentration ranges for detected PCB congeners and dioxins/furans respectively.

Table 68: Bottomland Area Soil Data Summary - PCB congeners

Analyte	minimum conc. (ng/kg)	maximum conc. (ng/kg)	maximum location	sample depth (feet)
PCB congeners via method E1668.				
PCB-77	2.51	11,700	SB-94	0-0.5
PCB-81	2.84	1,870	SB-91	0-0.5
PCB-105	21.8	50,000	SB-91	0-0.5
PCB-106/118	39.3	191,000	SB-91	0-0.5
PCB-114	2.04	2,490	SB-91	0-0.5
PCB-123	2.65	2,010	SB-91	0-0.5
PCB-126	1.66	1,870	SB-91	0-0.5
PCB-156	15.2	22,000	SB-91	0-0.5
PCB-157	3.13	5,760	SB-91	0-0.5
PCB-167	13.9	18,800	SB-91	0-0.5
PCB-169	2.24	3,260	SB-94	0-0.5
PCB-189	18.2	24,700	SB-91 & SB-94	0-0.5

Table 69: Bottomland Area Soil Data Summary - Dioxins/Furans

Analyte	minimum conc. (ng/kg)	maximum conc. (ng/kg)	maximum location	sample depth (feet)
Dioxins/furans via method E1613.				
1,2,3,4,6,7,8-HpCDD	2.44	2,990	SB-91	0-0.5
1,2,3,4,6,7,8-HpCDF	4.3	20,800	SB-94	0-0.5
1,2,3,4,7,8,9-HpCDF	0.84	988	SB-94	0-0.5
1,2,3,4,7,8-HxCDD	0.368	29.2	SB-90	0.5-1
1,2,3,4,7,8-HxCDF	2.08	5,550	SB-94	0-0.5
1,2,3,6,7,8-HxCDD	0.608	56.2	SB-97	0-0.5
1,2,3,6,7,8-HxCDF	0.499	1,090	SB-94	0-0.5
1,2,3,7,8,9-HxCDD	0.475	29.7	SB-94	0-0.5
1,2,3,7,8,9-HxCDF	0.412	217	SB-94	0-0.5
1,2,3,7,8-PeCDD	0.243	8.89	SB-94	0-0.5
1,2,3,7,8-PeCDF	0.311	531	SB-94	0-0.5
2,3,4,6,7,8-HxCDF	0.552	1,600	SB-94	0-0.5
2,3,4,7,8-PeCDF	0.396	679	SB-94	0-0.5
2,3,7,8-TCDD	0.163	7.14	SB-94	0-0.5
2,3,7,8-TCDF	0.514	293	SB-94	0-0.5
HpCDD	6.49	6,210	SB-91	0-0.5
HpCDF	6.15	31,600	SB-94	0-0.5
HxCDD	0.747	1,080	SB-97	0-0.5
HxCDF	6.33	22,400	SB-94	0-0.5
OCDD	53.1	40,700	SB-91	0-0.5
OCDF	1.53	21,700	SB-94	0-0.5
PeCDD	0.346	342	SB-97	0-0.5
PeCDF	1.77	9,390	SB-94	0-0.5
TCDD	0.274	77	SB-94	0-0.5
TCDF	0.846	4,630	SB-94	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Bird	2.3	3,041	SB-94	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Fish	1.3	1,495	SB-94	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan & PCB) - Mammal	1.48	1,660	SB-94	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Bird	1.52	2,118	SB-94	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Fish	1.27	1,484	SB-94	0-0.5
Total 2,3,7,8-TCDD TEQ (dioxin/furan) - Mammal	1.15	1,384	SB-94	0-0.5
Total 2,3,7,8-TCDD TEQ (PCB) - Bird	0.81	967	SB-91	0-0.5
Total 2,3,7,8-TCDD TEQ (PCB) - Fish	0.01	13	SB-91	0-0.5
Total 2,3,7,8-TCDD TEQ (PCB) - Mammal	0.32	282	SB-91	0-0.5

Table 70 lists sample locations with surface soil results that exceeded 2,3,7,8-TCDD TEQ PRGs.

Table 70: Wooded Bottomland Area Soil Sample locations that Exceed a Dioxin PRG

	Avian Ecological		Human Health
Location ID	**Total 2,3,7,8-TCDD TEQ (dioxin/furan) (mg/kg)**	**Total 2,3,7,8-TCDD TEQ (PCB) (mg/kg)**	**Total 2,3,7,8-TCDD TEQ (dioxin/furan + PCB) (mg/kg)**
Preliminary Remediation Goal (PRG):	**0.0000854**	**0.000196**	**0.000936**
SB-89	**0.000285**	0.000109	0.00024
SB-90	**0.000849**	**0.000262**	0.000651
SB-91	**0.00167**	**0.000967**	**0.00136**
SB-94	**0.00212**	**0.000923**	**0.00166**
SB-97	**0.00104**	**0.000264**	0.000743
SB-98	**0.000112**	0.0000321	0.0000613
SB-99	**0.000275**	0.000128	0.000189

Notes:

Only samples that had a concentration that exceeded the PRG are included in this table.

Bold value exceeds PRG

5.6.5.3 Off-site Soil

Eight soil samples were collected from background locations. The background soil data indicated that a broad range of constituents were present in surface and subsurface soils to a depth of 5 feet. **Table 71** through **Table 74** include summary statistics of the detected constituents in background soils. **Figure 24** illustrates the locations of the background samples.

Table 71: Background Soil Data Summary – Percent Solids, TOC, VOCs and SVOCs

Analyte	FOD%	minimum conc.	maximum conc.	maximum location	sample depth (feet)
E160.3					
Total Solids (%)	100%	91.46%	91.46%	SOREF-050709	
SM2540G					
Percent Solids	100%	92%	92%	SOREF-050709	
SW9060 mg/kg					
Total Organic Carbon	100%	1,700	15,000	SB-104	0-0.5
VOCs via method SW8260. Concentration units are in mg/kg.					
2-butanone	19%	0.0055	0.0066	SB-105	0-0.5
acetone	38%	0.013	0.14	SB-105	0-0.5
toluene	19%	0.00083	0.00094	SB-104	0-0.5
trichlorofluoromethane	60%	0.0016	0.0023	SB-104	0-0.5
SVOCs via method SW8270. Concentration units are in mg/kg.					
benzo(a)anthracene	7%	0.0029	0.0029	SOREF-050709	
benzo(a)pyrene	7%	0.0024	0.0024	SOREF-050709	
benzo(b)fluoranthene	7%	0.0066	0.0066	SOREF-050709	
benzo(g,h,i)perylene	7%	0.0061	0.0061	SOREF-050709	
bis(2-ethylhexyl)phthalate	7%	0.1	0.1	SB-28	2-5
chrysene	7%	0.0049	0.0049	SOREF-050709	
dibenzo(a,h)anthracene	7%	0.0053	0.0053	SOREF-050709	
fluoranthene	7%	0.0019	0.0019	SOREF-050709	
ideno(1,2,3-cd)pyrene	7%	0.0063	0.0063	SOREF-050709	

Table 72: Background Soil Data Summary – Inorganics

Analyte	FOD%	minimum conc.	maximum conc.	maximum location	sample depth (feet)
Inorganics via method SW6010/7471. Concentration units are in mg/kg.					
aluminum	100%	343	24,000	SB-28	2-5
antimony	6%	0.49	0.49	SB-28	2-5
arsenic	75%	0.26	3.5	SB-28	2-5
barium	100%	3.6	17.5	SB-28	2-5
beryllium	44%	0.041	0.25	SB-28	2-5
cadmium	19%	0.099	0.21	SB-105	1-5
calcium	100%	18.2	448	SB-26	0-0.5
chromium	94%	1.1	36	HC-23-SBB	
cobalt	31%	0.39	1.2	SB-28	2-5
copper	44%	0.54	3.2	SB-28	2-5
iron	100%	384	34,000	HC-23-SBB	
lead	100%	2.4	10	HC-23-SBB	
magnesium	100%	22.5	415	SB-28	2-5
manganese	100%	3.3	17.1	SB-26	0-0.5
mercury	56%	0.016	0.044	SB-104	0-0.5
nickel	94%	0.44	4.2	SB-28	2-5
potassium	50%	25.9	240	HC-23-SBB	
selenium	13%	0.35	1.8	HC-23-SBB	
sodium	19%	320	390	HC-23-SBB	
thallium	25%	0.33	2.8	HC-23-SBB	
vanadium	100%	3.7	49.1	SB-28	2-5
zinc	88%	1	8.8	HC-23-SBB	
E1630 (mg/kg)					
methylmercury	100%	0.00013	0.00013	SOREF-050709	
E1631 (mg/kg)					
mercury	100%	0.0268	0.0268	SOREF-050709	

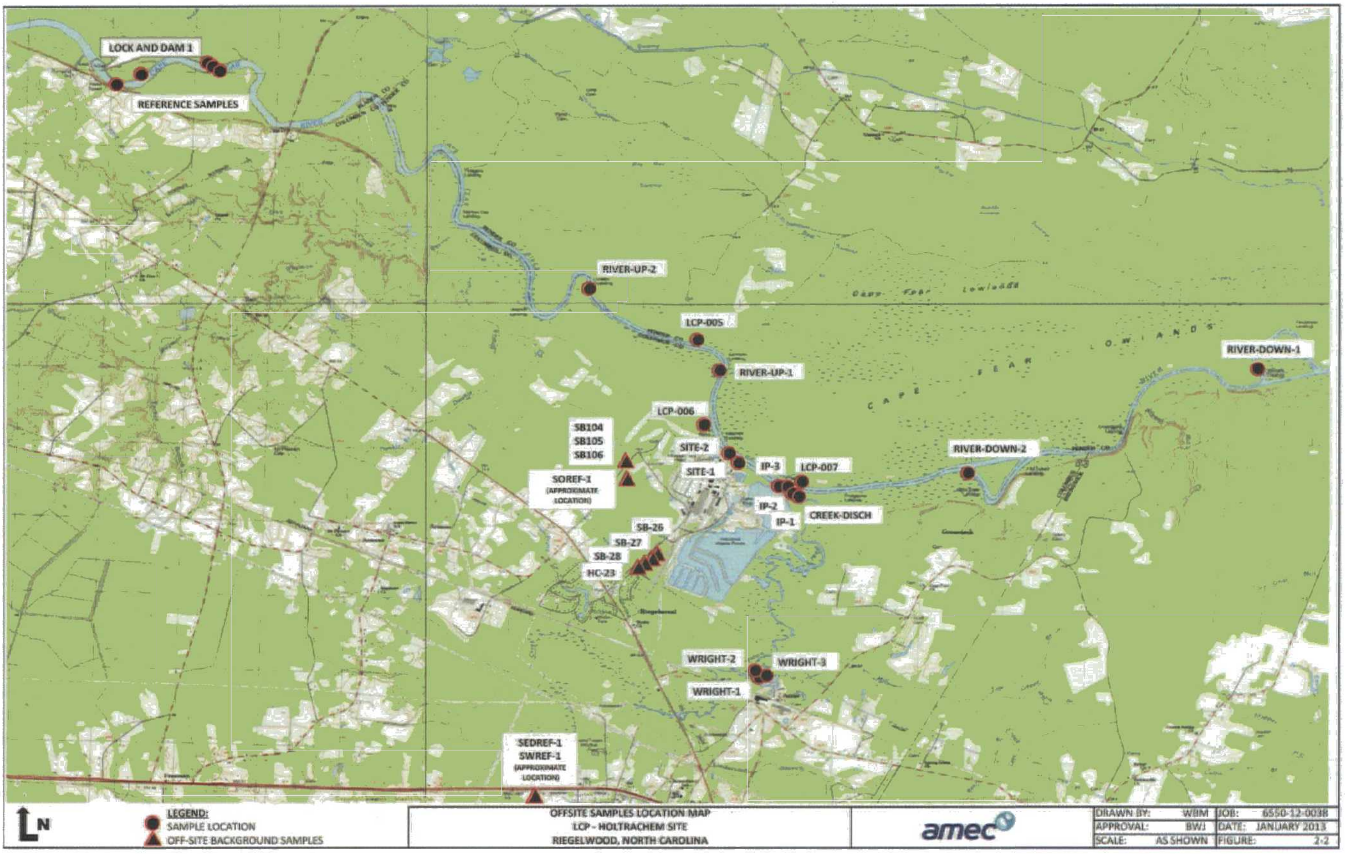
Table 73: Background Soil Data Summary – Pesticides and PCBs

Analyte	FOD%	minimum conc.	maximum conc.	maximum location	sample depth (feet)
Pesticides via method SW8081. Concentration units are in mg/kg.					
4,4'-DDD	19%	0.00027	0.00042	SB-104	0-0.5
4,4'-DDE	25%	0.00053	0.00137	SB-26	0-0.5
4,4'-DDT	13%	0.00069	0.00072	SB-104	0-0.5
alpha-chlordane	10%	0.000381	0.000381	SB-27	0-0.5
endosulfan I	19%	0.00021	0.000782	SB-27	0-0.5
endosulfan II	13%	0.00014	0.00015	SB-104	0-0.5
endosulfan sulfate	25%	0.00029	0.0014	SB-104	0-0.5
endrin	13%	0.00024	0.00071	SOREF-050709	
gamma-BHC (lindane)	10%	0.00028	0.00028	SB-104	0-0.5
gamma-chlordane	11%	0.000967	0.000967	SB-27	0-0.5
heptachlor epoxide	20%	0.00018	0.00033	SB-104	0-0.5
methoxychlor	30%	0.00042	0.00095	SB-104	0-0.5
PCBs via method SW8082. Concentration units are in mg/kg.					
Aroclor 1268	54%	0.0078	0.245	SB-26	0-0.5
PCB congeners via method E1668. Concentration units are in ng/kg.					
PCB-105	50%	8.79	45.2	SB-105	0-0.5
PCB-106/118	50%	22	117	SB-105	0-0.5
PCB-156	33%	15.5	19.2	SB-105	0-0.5
PCB-167	33%	9.79	9.8	SB-104	0-0.5
PCB-189	33%	5.35	7.67	SB-104	0-0.5

Table 74: Background Soil Data Summary – Dioxins/Furans

Analyte	FOD%	minimum conc.	maximum conc.	maximum location	sample depth (feet)
Dioxins/furans via method E1613. Concentration units are in ng/kg.					
1,2,3,4,6,7,8-HpCDD	100%	8.49	58.9	SB-104	1-5
1,2,3,4,6,7,8-HpCDF	67%	0.504	2.52	SB-104	0-0.5
1,2,3,4,7,8-HxCDF	67%	0.264	0.863	SB-104	0-0.5
1,2,3,6,7,8-HxCDD	17%	1.93	1.93	SB-105	0-0.5
1,2,3,6,7,8-HxCDF	33%	0.309	0.323	SB-105	0-0.5
1,2,3,7,8,9-HxCDD	17%	0.811	0.811	SB-104	0-0.5
1,2,3,7,8-PeCDD	50%	0.931	8.24	SB-105	0-0.5
2,3,4,6,7,8-HxCDF	50%	0.51	0.804	SB-105	0-0.5
2,3,7,8-TCDD	50%	3.12	5.38	SB-104	0-0.5
2,3,7,8-TCDF	33%	0.828	1.19	SB-105	0-0.5
HpCDD	100%	23.2	128	SB-104	1-5
HpCDF	67%	0.504	3.53	SB-104	0-0.5
HxCDD	100%	1.7	234	SB-105	0-0.5
HxCDF	80%	0.264	13.5	SB-105	0-0.5
OCDD	100%	288	8,890	SB-104	1-5
OCDF	33%	1.57	1.6	SB-104	0-0.5
PeCDD	67%	0.917	92	SB-105	0-0.5
PeCDF	50%	6.53	18.6	SB-105	0-0.5
TCDD	50%	4.69	6.6	SB-104	0-0.5
TCDF	50%	6.28	10.4	SB-105	0-0.5

Figure 24: Background Samples Location Map



5.6.6 Groundwater

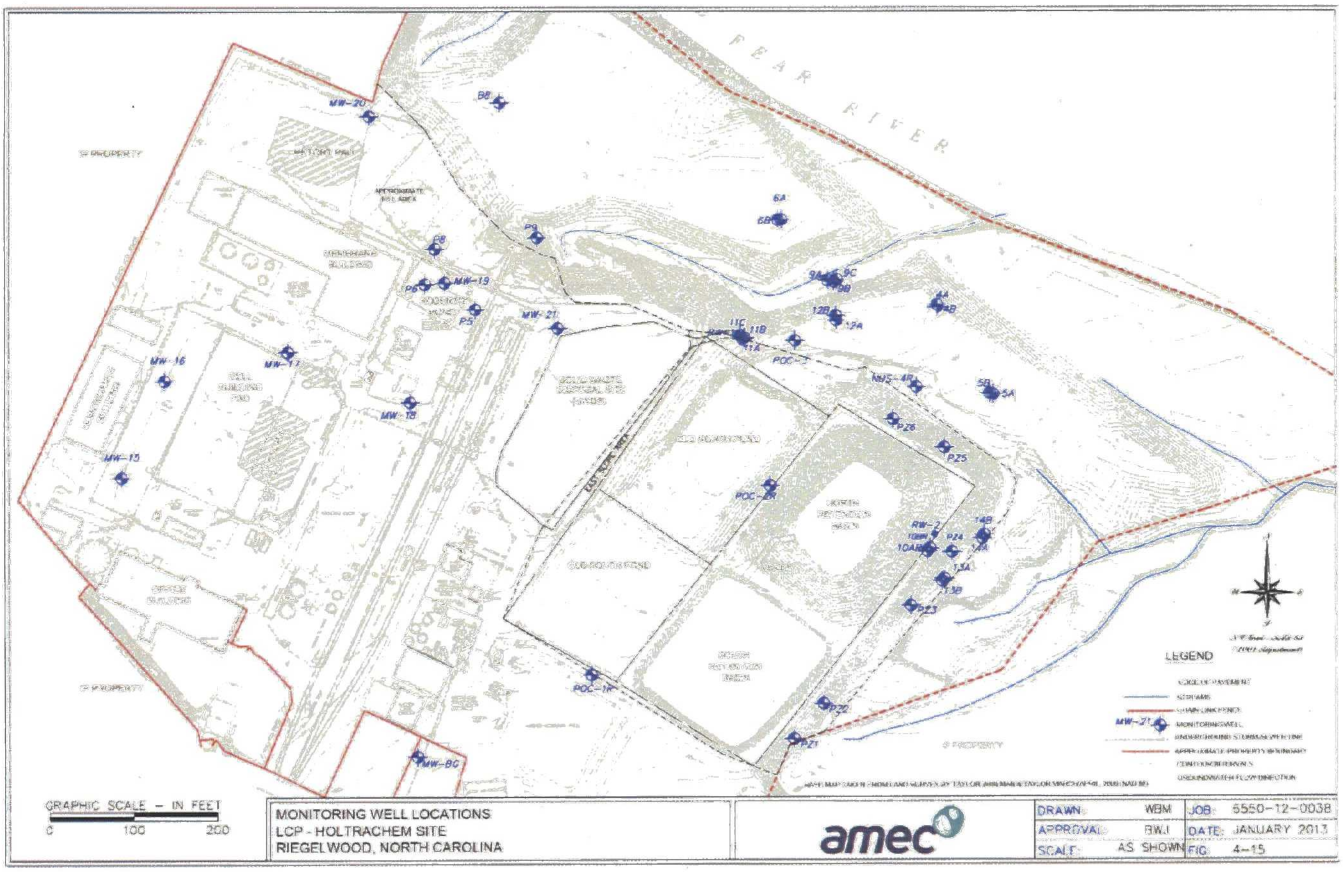
Groundwater monitoring at the site began in the early 1990s to comply with RCRA requirements. After RCRA transferred the site to the CERCLA program, contractors conducted additional groundwater monitoring to determine the nature and extent of groundwater contamination.

5.6.6.1 RCRA Groundwater Monitoring Data

Before 2000, RCRA regulated site activities. The RCRA groundwater monitoring included sampling 15 wells as part of post-closure monitoring in accordance with the hazardous waste permit. This included annual and quarterly groundwater sampling from about 1992 through 2003.

The monitoring wells were located in the upland non-process and bottomland areas. The wells included BG (background); POC-1, POC-1R, POC-2, POC-2R and POC-3; NUS-4R, 4A, 5A, 9A, 10A, 10AR, 10B, l0BR, 11A, 11B, 13A, and 14A. **Figure 25** shows well locations.

Figure 25: Monitoring Well Locations



<u>Annual Sampling</u>
Under RCRA, the facility performed annual monitoring for the three POC wells. **Table 75** through **Table 77** summarize the results of RCRA annual sampling events.

Table 75: Detected Analytes in POC-1/POC-1R during January 1993 - December 2000

Analyte	Standards		POC-1**						POC-1R	
	2L	MCL	Jan-93	Dec-93	Dec-94	Dec-95	Dec-96	Dec-98	Jan-00	Dec-00
VOCs (µg/L)										
1,1-dichloroethane	7	7	ND	ND	ND	ND	ND	ND	1	ND
trans-1,2-dichloroethene	100	100	ND	ND	ND	ND	ND	ND	1	ND
tetrachloroethene (PCE)	0.7	5	ND	ND	ND	ND	ND	ND	2	ND
trichloroethene (TCE)	2.8	5	ND	ND	ND	ND	ND	ND	19	5
vinyl chloride	0.015	2	ND	ND	ND	ND	ND	ND	1	ND
Inorganics (mg/L)										
arsenic	0.05	0.01	ND	0.014	ND	ND	ND	ND	ND	ND
barium	2	2	0.084	ND	0.056	0.035	0.059	ND	0.172	0.2
chromium	0.05	0.1	ND	0.052	ND	ND	0.005	ND	ND	ND
lead	0.015	0.015	ND	ND	0.011	ND	0.007	*	ND	ND
mercury	0.00105	0.002	0.0042	0.043	0.002	ND	0.0006	*	0.0019	ND
zinc	1.05	5	0.22	0.12	0.07	0.028	0.052	ND	ND	ND

Notes:
* no data readily available
**Well POC-1 was destroyed in September 1999 and replaced in December 1999. The new POC well was named POC-1R.
2L = Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (I5A NCAC 2L Standard)
MCL = Safe Drinking Water Act's Maximum Contaminant Level
ND = not detected
mg/L = milligrams per liter
µg/L = micrograms per liter
concentration exceeds 2L value but is less than the MCL
concentration exceeds MCL

Table 76: Detected Analytes in POC-2/POC-2R during January 1993 - December 2003

Analyte	Standards		POC-2**						POC-2R				
	2L	MCL	Jan-93	Dec-93	Dec-94	Dec-95	Dec-96	Dec-98	Jan-00	Dec-00	Dec-01	Dec-02	Dec-03
Inorganics (mg/L)													
arsenic	0.05	0.01	ND	ND	ND	ND	ND	ND	ND	ND	0.0114	ND	ND
barium	2	2	0.067	ND	0.041	0.03	0.022	ND	0.398	0.35	0.327	0.234	ND
mercury	0.00105	0.002	ND	ND	ND	ND	0.0002	*	0.0012	ND	ND	ND	ND
selenium	0.05	0.05	ND	ND	ND	ND	0.007	*	ND	ND	ND	ND	ND
vanadium	NS	NS	ND	0.063	ND	ND	ND	ND	ND	ND	ND	ND	ND
zinc	1.05	5	0.1	0.058	0.062	0.029	0.013	ND	ND	0.0224	ND	0.0306	ND

Notes:
Only analytes with at least one detection are included in this table. No VOCs, SVOCs, pesticides, herbicides or dioxins were detected.
* no data readily available
**Well POC-2 was destroyed in September 1999 and replaced in January 2000. The new well was named POC-2R.
2L = Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (I5A NCAC 2L Standard)
MCL = Safe Drinking Water Act's Maximum Contaminant Level
ND = not detected
NS = no standard has been established
mg/L = milligrams per liter
concentration exceeds 2L value but is less than the MCL
concentration exceeds MCL

Table 77: Detected Analytes in POC-3 during January 1993 - December 2003

Analyte	Standards		POC-3										
	2L	MCL	Jan-93	Dec-93	Dec-94	Dec-95	Dec-96	Dec-98	Jan-00	Dec-00	Dec-01	Dec-02	Dec-03
VOCs (µg/L)													
carbon disulfide	700	NS	ND	ND	ND	ND	ND	ND	1	1	17	ND	ND
Inorganics (mg/L)													
barium	2	2	0.17	ND	0.085	0.072	0.081	ND	ND	ND	ND	ND	ND
beryllium	NS	0.004	ND	ND	ND	ND	0.002	ND	ND	ND	ND	ND	ND
chromium	0.05	0.1	0.14	0.09	ND	ND	0.005	ND	ND	ND	ND	ND	ND
lead	0.015	0.015	ND	ND	0.01	ND	ND	*	ND	ND	ND	ND	ND
mercury	0.00105	0.002	ND	ND	ND	ND	ND	*	0.0026	ND	ND	ND	ND
zinc	1.05	5	0.24	0.13	0.061	0.041	0.055	ND	ND	ND	ND	0.0299	ND

Notes:
Only analytes with at least one detection are included in this table. No SVOCs, pesticides, herbicides or dioxins were detected.
* no data readily available
2L = Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (I5A NCAC 2L Standard)
MCL = Safe Drinking Water Act's Maximum Contaminant Level
ND = not detected
NS = no standard has been established
mg/L = milligrams per liter
µg/L = micrograms per liter
concentration exceeds MCL

Analytical results did not detect SVOCs, dioxins, pesticides, or herbicides in any of the well samples. PCBs were not required to be analyzed under RCRA. Analytical results did not detect VOCs at concentrations above drinking water standards in wells POC-1, POC-2, POC-2R and POC-3.

In 1999, the damaged POC-1 well was replaced with POC-1R. In January 2000, three VOCs were detected in well POC-1R above drinking water standards. These included PCE, TCE and vinyl chloride. In December 2000, the concentrations of these three VOCs decreased to non-detect for PCE and vinyl chloride, and from 19 to 5 µg/L for TCE.

Analytical results indicated concentrations of arsenic, chromium and mercury were in excess of drinking water standards sporadically in POC wells.

Quarterly sampling

Under RCRA, 15 wells were sampled quarterly from August 1992 through December 2003. Analysis was limited to mercury and select inorganic indicator parameters. **Table 78** summarizes the results of RCRA quarterly sampling events results for mercury.

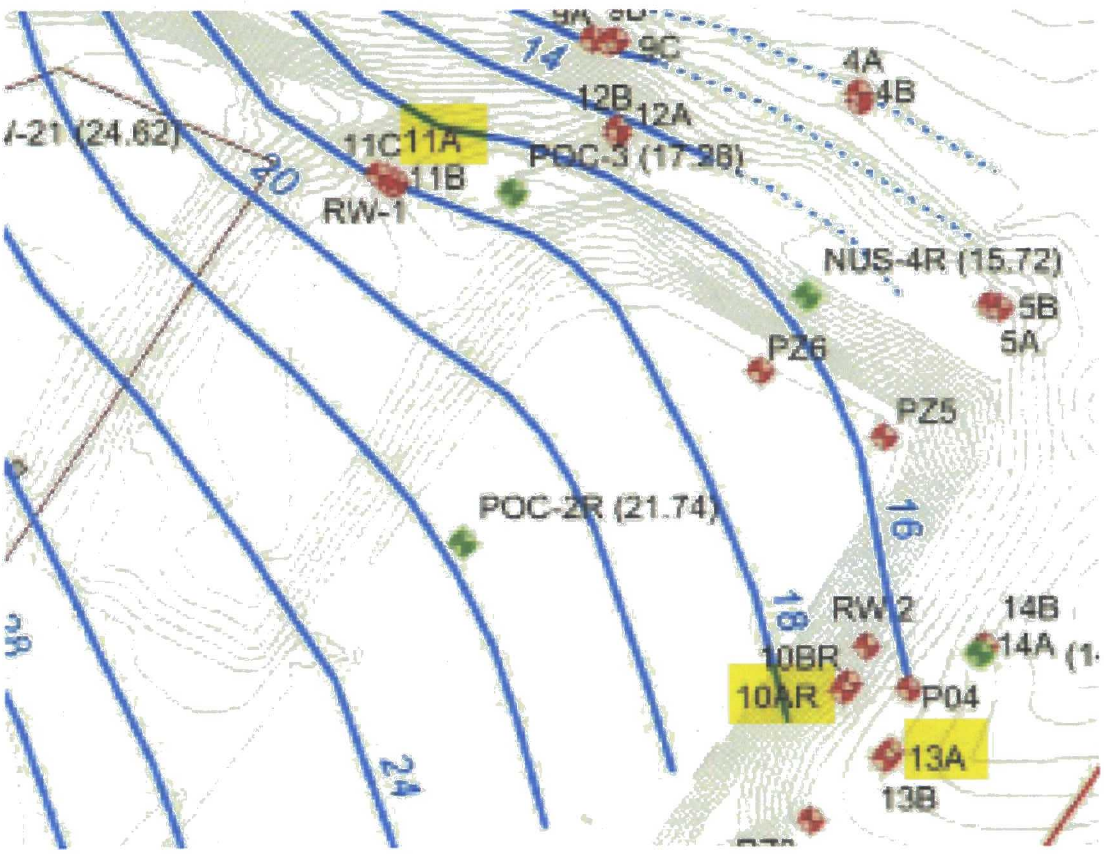
Table 78: Summary of mercury in groundwater during August 1992 – December 2003

Date	BG	POC-2R	POC-3	NUS-4R	4A	5A	9A	10AR	10BR	11A	11B	13A	14A
Aug-92	--	0.001	0.001	--	0.002	--	--	0.114	--	0.048	--	0.002	--
Dec-92	0.0002	0.0004	--	--	0.0008	--	0.0011	0.0152	--	0.0474	--	0.0022	--
Mar-93	--	0.0004	--	--	0.0003	--	0.0009	0.02	--	0.045	--	0.002	--
Jun-93	--	0.006	--	--	--	--	0.0003	0.003	--	0.044	--	0.0042	--
Sep-93	--	--	--	--	--	--	--	NS	--	0.1	--	--	--
Dec-93	--	--	--	--	NS	--	--	0.017	--	0.064	--	--	--
Mar-94	--	--	--	--	--	--	--	0.079	--	0.018	--	0.003	--
Jun-94	--	--	--	--	--	--	0.0045	NA	--	0.0508	--	0.0045	--
Sep-94	--	--	--	--	NA	--	--	0.06	--	0.048	--	0.004	--
Dec-94	--	--	--	--	--	--	--	0.041	--	0.045	--		--
Apr-95	--	--	--	--	--	--	--	0.076	--	0.033	--	0.002	--
Jun-95	--	--	--	--	--	--	--	0.1315	--	0.0369	--	0.0043	--
Sep-95	--	--	--	--	--	--	--	0.038	--	0.034	--	0.003	--
Dec-95	--	--	--	--	--	--	--	0.0108	--	0.0377	--	0.0039	--
Mar-96	--	--	--	--	--	--	--	0.0438	--	0.0342	--	0.0032	--
Jun-96	--	--	--	--	--	--	--	0.0093	--	0.036	--	--	--
Sep-96	--	--	--	--	--	--	0.0014	0.076	--	0.031	--	--	--
Dec-96	--	--	--	--	--	--	--	0.057	--	--	--	--	--
Mar-97	--	--	--	--	--	--	--	0.0164	--	0.0197	--	--	--
Jun-97	--	--	--	--	--	--	--	0.032	--	0.013	--	--	--
Sep-97	--	--	--	--	--	--	--	NS	--	0.0038	--	--	--
Dec-97	--	--	--	--	NS	--	--	NS	--	0.0036	--	0.0003	--
Mar-98	--	--	--	--	--	--	--	0.004	--	0.003	--	--	--
Jun-98	--	--	--	--	--	--	--	0.152	--	0.012	--	--	--
Sep-98	--	--	--	--	--	--	--	0.045	NS	0.005	--	--	--
Dec-98	--	0.0045	--	--	--	--	--	NS	NS	0.0087	--	0.0006	--
Mar-99	--	0.00054	--	--	--	--	--	0.00127	NS	0.00531	--	0.0006	--
Jun-99	--	0.00035	--	--	--	--	--	0.00525	--	0.00706	--	0.00185	--
Sep-99	--	NS	--	--	--	--	--	NS	NS	0.015	--	0.0019	--
Jan-00	0.0017	0.0012	0.0026	0.0007	0.0012	0.0012	0.0045	0.0011	0.0009	0.0011	0.0007	0.0031	0.0022
Mar-00	--	0.0008					0.0002			0.0107	--	0.0019	--
Jun-00	--	--	--	--	--	--	--	--	--	--	--	--	--
Sep-00	--	--	--	--	--	--	--	--	--	--	--	--	--
Dec-00	--	0.0007	--	--	NS	--	0.0006	0.0003	--	0.0137	--	0.0023	--
Mar-01	--	0.0002	--	--	NS	--	0.0003	0.0003	--	0.0113	--	0.0021	--
Jun-01	--	--	--	--	--	--	NS	0.0004	--	0.0149	--	0.0017	--
Sep-01	--	--	--	--	--	--	--	0.0004	--	0.0152	0.0004	0.0018	--
Dec-01	--	--	--	--	NS	--	--	--	--	0.0039	--	--	--
Mar-02	--	--	--	--	NS	--	--	--	--	0.0051	--	0.0006	--
Jun-02	--	--	--	--	NS	--	--	--	--	0.0071	--	--	--
Sep-02	--	--	--	--	NS	--	--	--	--	0.0079	--	0.0007	--
Dec-02	--	--	--	--	NS	--	--	--	--	--	--	--	--
Mar-03	--	--	--	--	NS	--	--	--	--	0.0023	--	0.0007	--
Jun-03	--	--	--	--	NS	--	--	--	--	0.0056	--	0.00071	--
Sep-03	--	--	--	--	NS	--	--	--	--	0.026	--	0.0005	--
Dec-03	--	--	--	--	NS	--	--	--	--	0.0044	--	0.0003	--
% Exceed 2L only	2.2%	2.2%	0.0%	0.0%	2.2%	2.2%	4.3%	4.3%	2.2%	2.2%	2.2%	8.7%	0.0%
% Exceed MCL	0.0%	2.2%	2.2%	0.0%	2.2%	0.0%	4.3%	47.8%	0.0%	89.1%	0.0%	32.6%	2.2%

Notes:
All concentrations are in milligrams per liter (mg/L)
Only wells with at least one detection of mercury are included in this table.
-- = not detected
NS = not sampled
2L = Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (15A NCAC 2L Standard)
MCL = Safe Drinking Water Act's Maximum Contaminant Level
concentration exceeds 2L value for mercury (0.0011 mg/L) but is less than the MCL (0.002 mg/L)
concentration exceeds MCL for mercury (0.002 mg/L)

The wells with frequent detections of mercury at concentrations above drinking water standards were UNPA wells 10AR, 11A and 13A. **Figure 26** illustrates the locations of these wells. Wells 10AR and 13A are on the east side of the North Retention Basin and well 11A is located north of the former North Pond.

Figure 26: Locations of wells 10AR, 11A and 13A



Detected mercury concentrations in wells 10AR and 13A dropped below drinking water standards in March of 2000 and December 2001, respectively. Detected mercury concentrations in well 11A dropped from 0.1 mg/L in 1993 to only slightly above the MCL in 2002 through 2003. **Figure 27** illustrates the trend of mercury concentrations in groundwater over time for well 11A. The mercury concentration in 11A has decreased significantly over time, trending to non-detect.

Figure 27: Graph of mercury concentrations over time from well 11A

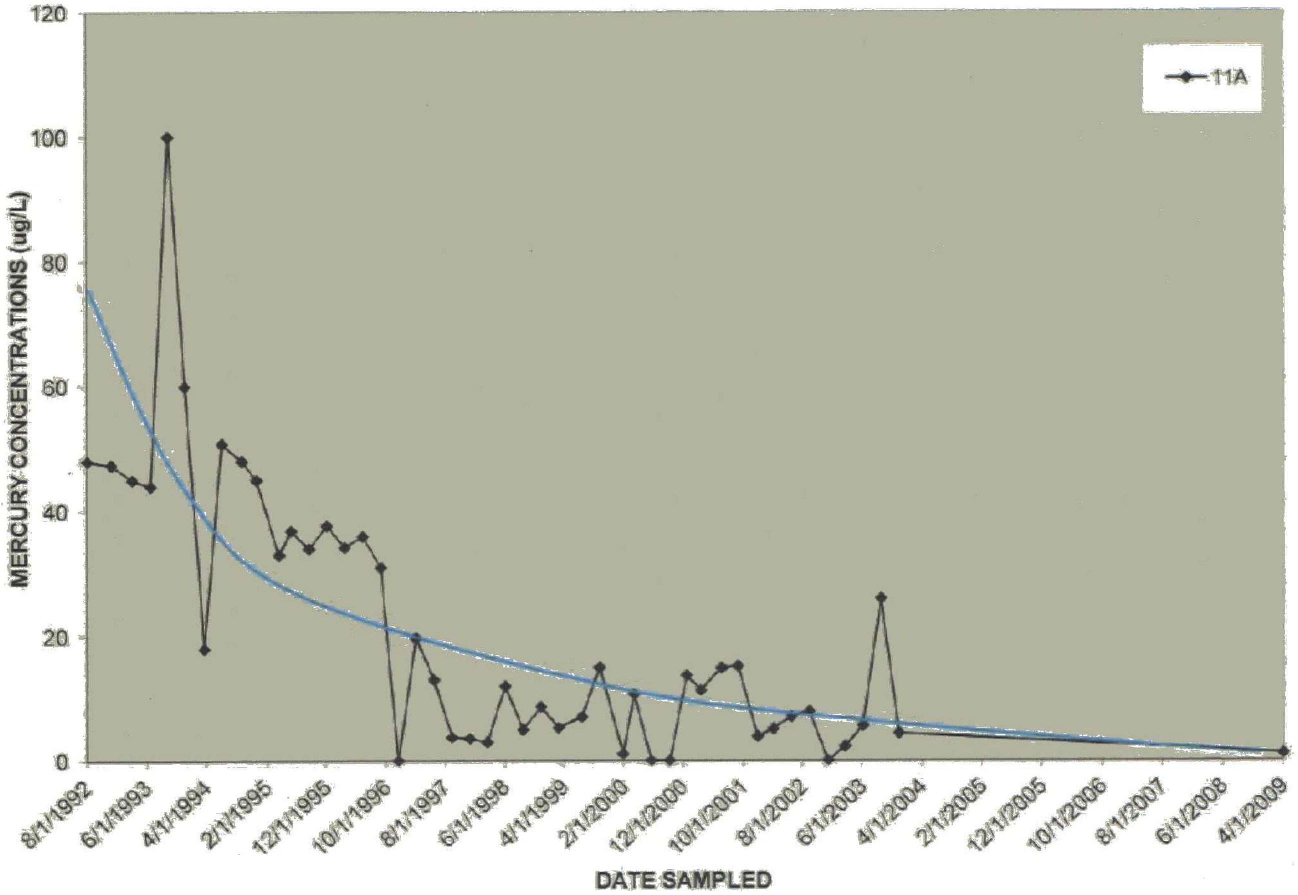


Illustration 4-2 – Graph of Hg concentrations in groundwater over time from well 11A

5.6.6.2 CERCLA Groundwater Monitoring Data

Under CERCLA authority, four groundwater sampling events have occurred and the results are discussed in the following three subsections.

5.6.6.2.1 April 2002 Sampling Event

Groundwater samples were collected during the iESI/RA from temporary wells in six locations in the UPA and two background locations. Unfiltered samples were analyzed for TAL metals; TCL VOCs; SVOCs, PCBs, pesticides, and inorganics.

Three VOCs and nine inorganics were detected at concentrations that exceeded drinking water standards. SVOCs were present at concentrations below drinking water standards. The laboratories did not detect PCBs or pesticides.[6] **Table 79** summarizes results that had a detectable concentration that exceeded a State or Federal drinking water standard. **Figure 28** illustrates the sample locations.

[6] Aroclor 1268 was not included in the list of PCBs analyzed.

Table 79: Constituents with Results Greater than Drinking Water Standards in April 2002 Sampling Event

	Standard		HC-01	HC-03	HC-04	HC-05	HC-07	HC-09	HC-23	HC-24
			On-Site						Background	
Analyte	2L	MCL	Retort Area				Fill Area	Robert's Pond	Off-site	Old Parking Area
VOCs (µg/L)										
1,1-dichloroethane	6	NE	25	13	18	5	--	NA	--	--
trichloroethene	3	5	3	1	2	--	--	NA	--	--
vinyl chloride	0.03	2	**8**	**9**	**13**	**4**	--	NA	--	--
INORGANICS (µg/L)										
aluminum	NE	50*	26,000	190	34,000	4,900	6,300	900	4,500	3,900
arsenic	10	10	**190**	**110**	**170**	**33**	--	**20**	--	**22**
beryllium	NE	4	--	--	--	--	--	**6.4**	--	--
cadmium	2	5	1.2	--	2.9	--	--	1.7	--	--
chromium	10	100	99	NA	78	9.6	16	8.6	3.6	11
iron	300	NE	3,000	410	3,200	3,100	6,400	4,400	5,700	31,000
mercury	1	2	**24**	0.67	**14**	0.96	**6.4**	**2.4**	--	--
manganese	50	NE	44	35	34	320	360	66	30	480
thallium	NE	2	--	NA	--	NA	NA	**6.4**	--	NA

Notes:

* Secondary MCL, not enforceable

2L = Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (I5A NCAC 2L Standard)

-- = not detected

MCL = Safe Drinking Water Act's Maximum Contaminant Level

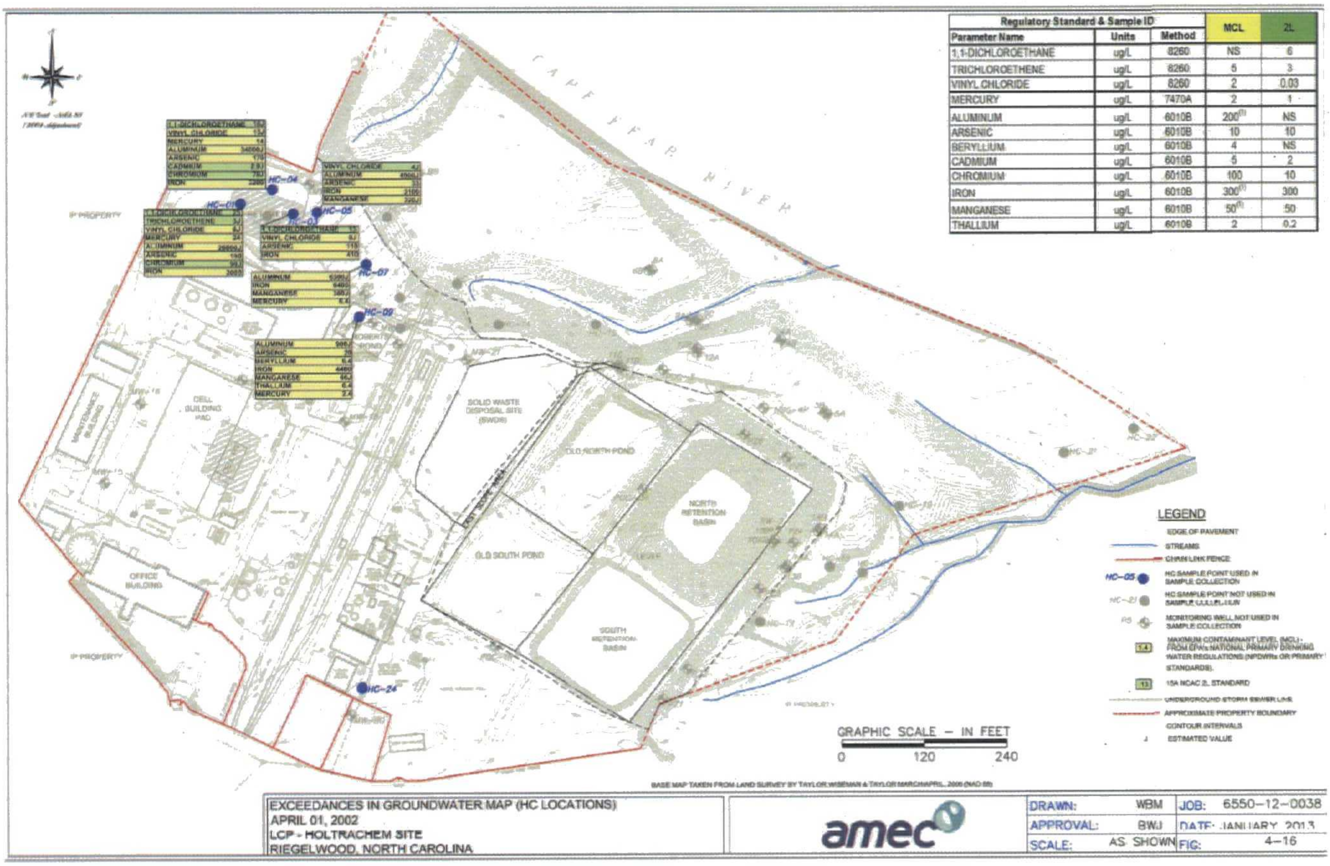
NA = not analyzed

NE = not established

concentration exceeds 2L value but is less than the MCL

concentration exceeds MCL value

Figure 28: Exceedances in groundwater from April 2002 sampling event



5.6.6.2.2 December 2004 and April 2009 Sampling Events

Site-wide groundwater sampling events occurred as part of the EE/CA-RI in 2004 and 2009. During each event, the groundwater samples were analyzed for TAL metals, TCL VOCs, SVOCs, PCBs + Aroclor 1268, pesticides, and inorganics.

A summary of the detected constituents and their 2L Standards, MCLs and SMCLs, where available, for the 2004 and 2009 sampling events are presented in **Table 80** and **Table 81** respectively.

Table 80: Summary of Detected Constituents - 2004 Groundwater

Table 4-17
Summary of Detected Constituents - 2004 Groundwater
RI Report
LCP-Holtrachem Site, Riegelwood, NC

			General Site Location		UPA								UNPA		Wooded Bottomland Area			
Regulatory Standard & Sample ID			2L	MCL	BG	MW-15	MW-16	MW-17	MW-18	MW-19	MW-20	MW-21	POC-2R	14A	POC-3	NUS-4R	6A	B8
Parameter Name	Units	Method			2004	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004
Field pH*	s.u.	150.1	6.5 - 8.5	6.5 - 8.5(1)	5.9	9.36	8.7	5.84	6.01	6.37	6.66	5.89	6.57	6.78	6.21	7.5	6.77	6.2
pH	s.u.	9040B	6.5 - 8.5	6.5 - 8.5(1)	7.5	10.2	9.2	6.5	7.2	7.5	6.9	6.3	6.9	7	6.7	7.3	7.4	6.5
CHLORIDE	mg/L	300.0A	250	250(1)	66.4	196	216	1060	7670	28600	3210	16000	2770	2520	2960	28.6	24.5	2470
NITROGEN, NITRATE (AS N)	mg/L	300.0A	10	10	0.5U	10U	5U	5U	5U	35.6	NA	3.8B	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
SULFATE	mg/L	300.0A	250	250(1)	26.9	953	282	3450	568	1280	48.2	376	169	129	755	240	592	166
ALPHA-CHLORDANE	ug/L	8081A	0.10	2	0.000335U	0.0064	0.393	0.00102U	0.00105U	0.192	0.00442	0.00232	0.000962U	0.00428	0.000962U	0.00111U	0.00115U	0.0154
BETA-CHLORDANE	ug/L	8081A	0.10	2	0.000456U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIELDRIN	ug/L	8081A	0.002	NE	0.000287U	0.00202U	0.04U	0.00203U	0.000953J	0.0583	0.000984J	0.00189U	0.00192U	0.00196U	0.00192U	0.00222U	0.0023U	0.00155J
HEPTACHLOR	ug/L	8081A	0.008	0.4	0.000718U	0.00101U	0.117	0.00102U	0.00105U	0.0841	0.0274	0.0215	0.0229	0.0226	0.000962U	0.00111U	0.00115U	0.021
AROCHLOR-1268	ug/L	8082	NE	0.5	0.0138J	0.0378	0.757E	0.00371J	0.191	0.0227	0.0243	0.00455J	0.00957J	0.0197U	0.0195U	0.0199U	0.0075J	0.0137J
BENZO(B)FLUORANTHENE	ug/L	8270C	0.05	NE	2U	1J	2U	2U	2U	2U	2U	2U	2U	2U	2U	2U	2U	2U
BIS(2-ETHYLHEXYL)PHTHALATE	ug/L	8270C	3	6	10U	3.7J	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
NAPHTHALENE	ug/L	8270C	6	NE	2U	27	2U	2U	2U	2U	2U	2U	2U	2U	2U	2U	2U	2U
ALUMINUM	ug/L	6010B	NE	50-200(1)	124B	4220	40700	280	9630	480B	527	612	154B	282	152B	200U	1120	152B
ANTIMONY	ug/L	6010B	NE	6	60U	17.9B	15.2B	60U	60U	600U	60U	60U	60U	60U	60U	60U	60U	60U
ARSENIC	ug/L	6010B	10	10	10U	288	280	10U	5.5B	100U	4B	10U	4B	10U	10U	10U	10U	10U
BARIUM	ug/L	6010B	700	2000	13.2B	27.3B	75	30B	109	323B	470	815	381	198	79.8	24.2B	74	156
CHROMIUM	ug/L	6010B	10	100	10U	253	352	10U	12.7	100U	4.8B	10U	10U	10U	10U	10U	3.1B	10U
IRON	ug/L	6010B	300	300(1)	77.3B	17700	11300	31500	5750	1000U	15500	13000	24100	280	107	162	1210	906
MANGANESE	ug/L	6010B	50	50(1)	3.3B	301	153	1700	347	125B	723	4460	1180	51.7	255	1.9B	145	578
MERCURY	ug/L	7470A	1	2	0.2U	0.43	0.64	0.16B	65.2	3.1	1.4	0.2U	0.2U	0.2U	0.2U	0.2U	0.2U	0.2U
NICKEL	ug/L	6010B	100	NE	40U	114	350	3.6B	12.3B	400U	9B	15B	40U	7.1B	6.4B	40U	2.9B	11.6B
SELENIUM	ug/L	6010B	20	50	5U	1.5B	6.2	5U	3.4B	23.9B	5U	2.2B	5U	5U	5U	5U	5U	5U
THALLIUM	ug/L	6010B	NE	2	3.3BJ	6.1BJ	7.3BJ	6.7BJ	4BJ	100U	3.9BJ	6.3BJ	4.3BJ	2.8BJ	3.9BJ	3.5BJ	10U	3.4BJ

Notes

ug/L = micrograms per liter / mg/L = milligrams per liter / s.u. = Standard Units / mS/cm = milli Siemens/centimeter
2L = Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (15A NCAC 2L Standard)
MCL = Maximum Contaminant Level - from EPA's National Primary Drinking Water Regulations (NPDWRs or primary standards).
(1) - National Secondary Drinking Water Standard was used where no National Primary Standard was established.
(2) Interim 2L Standard
Shaded & bold values indicate concentrations that exceed either a 2L or MCL regulatory standard
UPA - Upland Process Area
UNPA - Upland Non Process Area
NE = Not Established
NA = Not Analyzed

Qualifiers
B - When associated with metals, value is between the contract required detection limit (CRDL) and instrument detection limit (IDL)
B - When associated with organics, analyte was also detected in the blank
D - Compound quantitated on a diluted sample
E - Concentration exceeds the calibration range of the instrument
J - Estimated value, the result falls between the method detection limit and the limit of quantitation
JN - Estimated maximum possible concentration (EMPC)
U - Not detected, value shown is detection limit
UG - Elevated reporting limit due to matrix interference
N = estimated (for metals)

Table 81: Summary of Detected Constituents - 2009 Groundwater

Table 4-18
Summary of Detected Constituents - 2009 Groundwater
RI Report
LCP-Holtrachem Site, Riegelwood, NC

			General Site Location		UPA								UNPA			Wooded Bottomland Area		
Regulatory Standard & Sample ID			2L	MCL	BG	MW-15	MW-16	MW-17	MW-18	MW-19	MW-20	MW-21	POC-2R	11A	14A	POC-3	NUS-4R	B9
Parameter Name	Units	Method			2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Field pH*	s.u.	150.1	6.5 - 8.5	6.5 - 8.5[1]	6.72	**9.23**	**8.92**	6.72	7.42	7.84	6.93	**6.46**	7.14	**8.96**	6.73	**6.41**	7.01	6.52
pH	s.u.	9040B	6.5 - 8.5	6.5 - 8.5[1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLORIDE	mg/L	300.0A	250	250[1]	64	223	198	**866**	**1260**	**17800**	**1140**	**10100**	**1040**	**6610**	**2980**	**3720**	41.8	**1380**
NITROGEN, NITRATE (AS N)	mg/L	300.0A	10	10	0.078	0.05U	0.05U	0.05U	1.8	2.5UG	0.05U	0.24J	0.05U	1.2U	0.48J	0.5U	0.008J	0.15
SULFATE	mg/L	300.0A	250	250[1]	14.5	**1320**	**295**	**1900**	**63.7**	**734**	10.7	**165**	27.3	216	130	**960**	217	61.2
NAPHTHALENE	ug/L	8270C	6	NE	0.19U	4.4	0.97U	0.2U	0.19U	0.2U	0.2U	0.2U	0.19U	0.25	0.15J	0.19U	0.19U	0.19U
ALUMINUM	ug/L	6010B	NE	50-200[1]	30U	**2360**	**27300**	**255**	**46200**	**1140**	**319**	150U	**413**	150U	30U	30U	30U	30U
ANTIMONY	ug/L	6010B	NE	6	2U	5.5	**14.3**	2U	6	1.5J	2U	10U	2U	2.1J	2U	2U	2U	2U
ARSENIC	ug/L	6010B	10	10	1U	**78.4**	**133**	0.6J	**13.7**	1U	3.2	5U	3.8	5U	1U	1U	1U	1U
BARIUM	ug/L	6010B	700	2000	8J	13.2	68.6	26.7	33.4	23.4	56	520	105	9.4J	200	66.2	19.6	66.4
CHROMIUM	ug/L	6010B	10	100	2U	**121**	**228**	2U	**48.8**	2U	2U	10U	2U	10U	2U	2U	2U	2U
IRON	ug/L	6010B	300	300[1]	131	**3180**	**11700**	**2140**	**22800**	**900**	**1040**	114J	**4340**	250U	**476**	179	50U	**835**
MANGANESE	ug/L	6010B	50	50[1]	22.4	**86.8**	**69**	**360**	**138**	19.6	**158**	**353**	**210**	2.5U	**77.9**	**147**	4.1	**117**
MERCURY	ug/L	7470A	1	2	0.2U	0.19J	0.79	0.44	**87.8**	0.56	0.51	0.2U	0.2U	**1.2**	0.2U	0.2U	0.2U	0.2U
NICKEL	ug/L	6010B	100	NE	1.2	33.1	**211**	1.3	22.9	1.8	10.4	2.7J	2.6	6.5	3.4	3.9	1U	4.4
SELENIUM	ug/L	6010B	20	50	5U	1.9J	11.7	5U	1.2J	0.48J	2.6J	25U	0.96J	25U	5U	5U	5U	1.4J

Notes
ug/L = micrograms per liter / mg/L = milligrams per liter / s.u. = Standard Units / mS/cm = milli Siemens/centimeter
2L = Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (15A NCAC 2L Standard)
MCL = Maximum Contaminant Level - from EPA's National Primary Drinking Water Regulations (NPDWRs or primary standards).
(1) - National Secondary Drinking Water Standard was used where no National Primary Standard was established.
(2) Interim 2L Standard
Shaded & bold values indicate concentrations that exceed either a 2L or MCL regulatory standard
NE = Not Established
NA = Not Analyzed

Qualifiers
B - When associated with metals, value is between the contract required detection limit (CRDL) and instrument detection limit (IDL)
B - When associated with organics, analyte was also detected in the blank
D - Compound quantitated on a diluted sample
E - Concentration exceeds the calibration range of the instrument
J - Estimated value, the result falls between the method detection limit and the limit of quantitation
JN - Estimated maximum possible concentration (EMPC)
U - Not detected, value shown is detection limit
UG - Elevated reporting limit due to matrix interference
N = estimated (for metals)

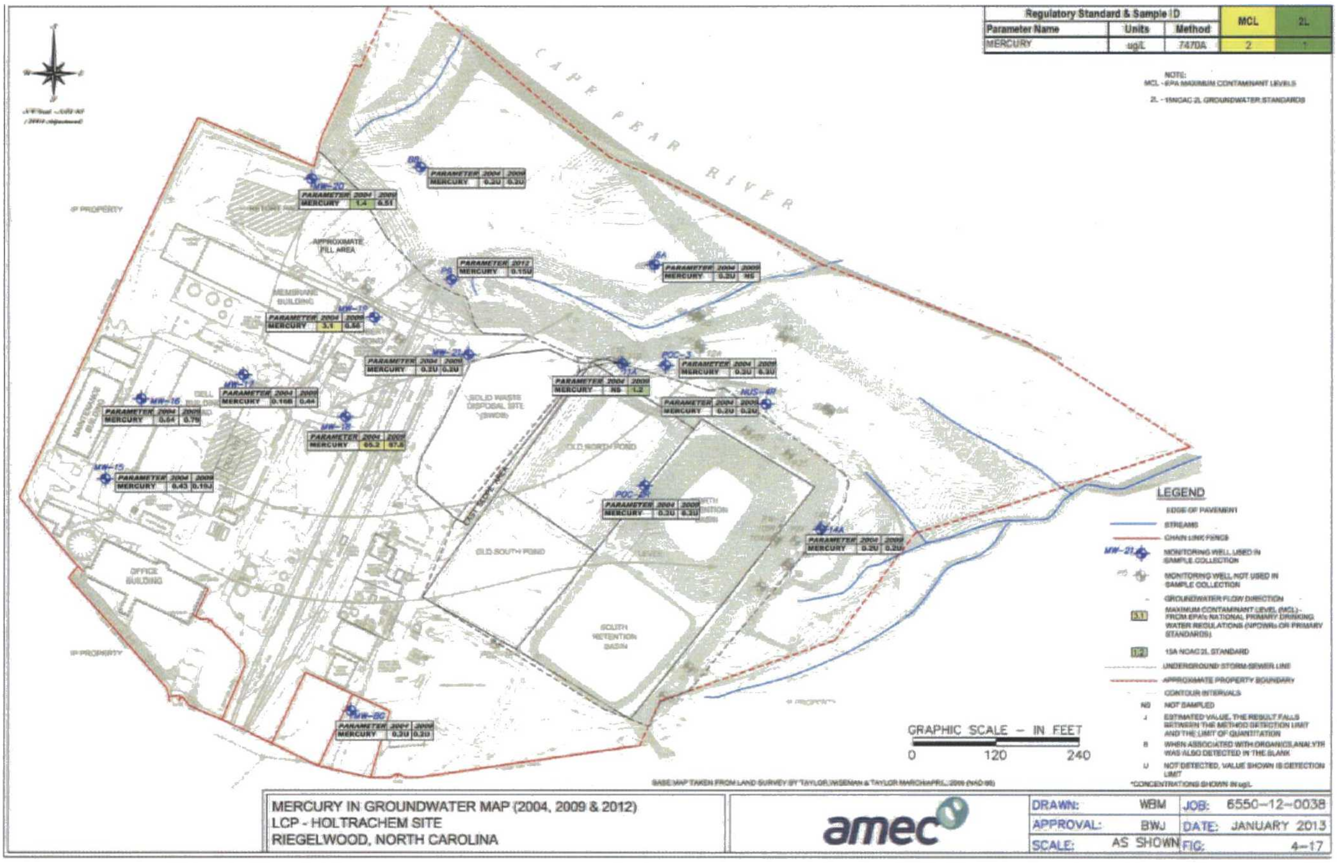
Several contaminants were present in groundwater at concentrations exceeding drinking water standards. The following paragraphs discuss these results.

Mercury

Figure 29 shows the distribution of mercury in groundwater for the 2004, 2009 and 2012 monitoring events. In 2004, mercury was present in the following three wells at concentrations exceeding drinking water standards: MW-18, MW-19, and MW-20. These wells are located in the UPA. No detectable concentrations of mercury were present in the UNPA or WBA during this event.

In 2009, mercury concentrations for MW-19 and MW-20 dropped to below the drinking water standards. Wells MW-11A and MW-18 were the only two wells with mercury concentrations in excess of a standard. The concentrations were 1.2 and 87.8 µg/L respectively. No detectable concentrations of mercury were present in the WBA during this event.

Figure 29: Mercury in Groundwater 2004, 2009 and 2012

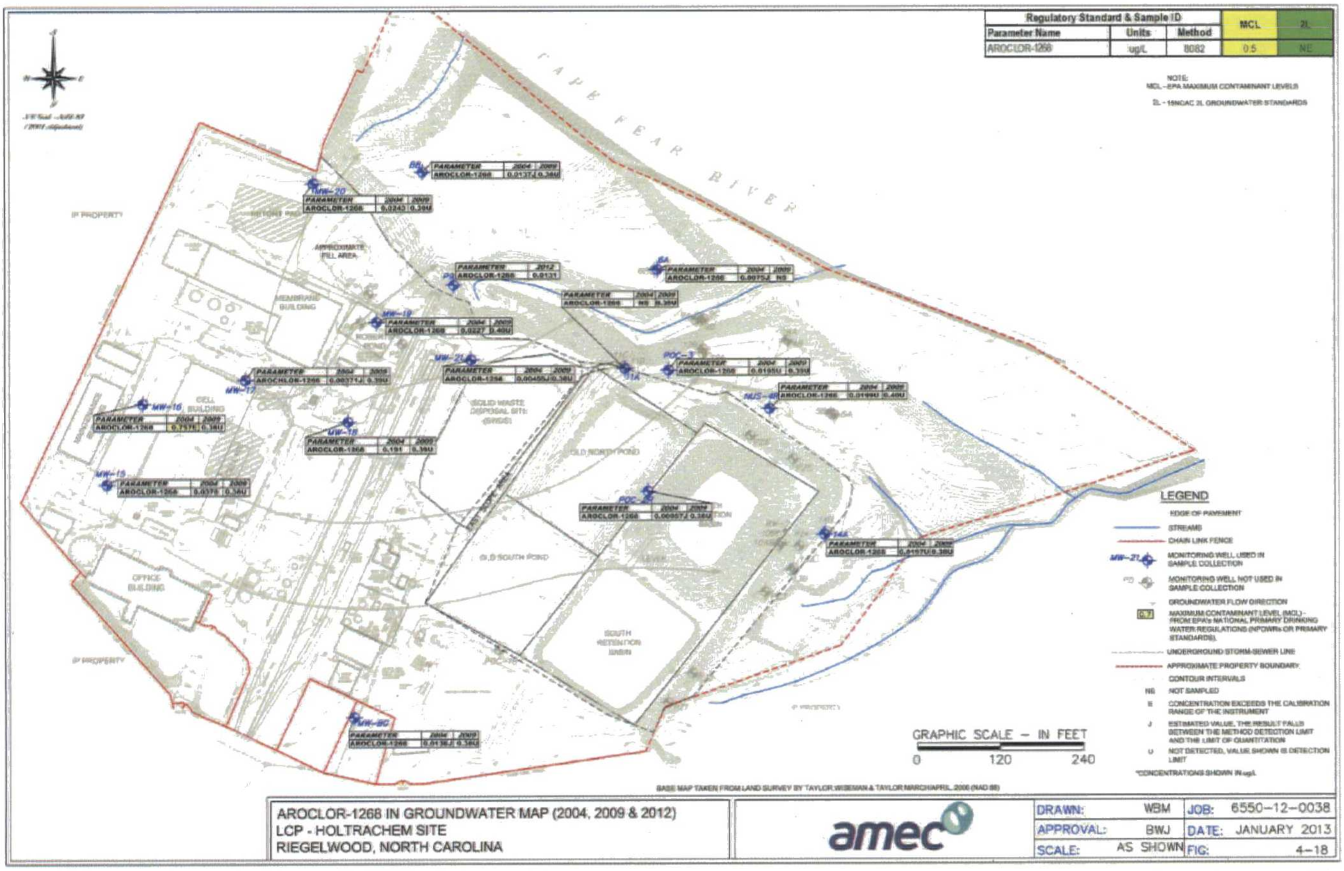


Aroclor 1268

Figure 30 shows the distribution of Aroclor 1268 in groundwater for the 2004, 2009 and 2012 monitoring events. In 2004, Aroclor 1268 was present in several wells, but only one well had a concentration above the MCL.[7] Well MW-16 had an estimated concentration of 0.757 µg/L. In 2009, no detectable concentrations of Aroclor 1268 were present in groundwater. The laboratory detection limit was below the MCL.

[7] The MCL value for Aroclor 1268 is 0.5 µg/L. There is no 2L standard for Aroclor 1268. https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants#Organic

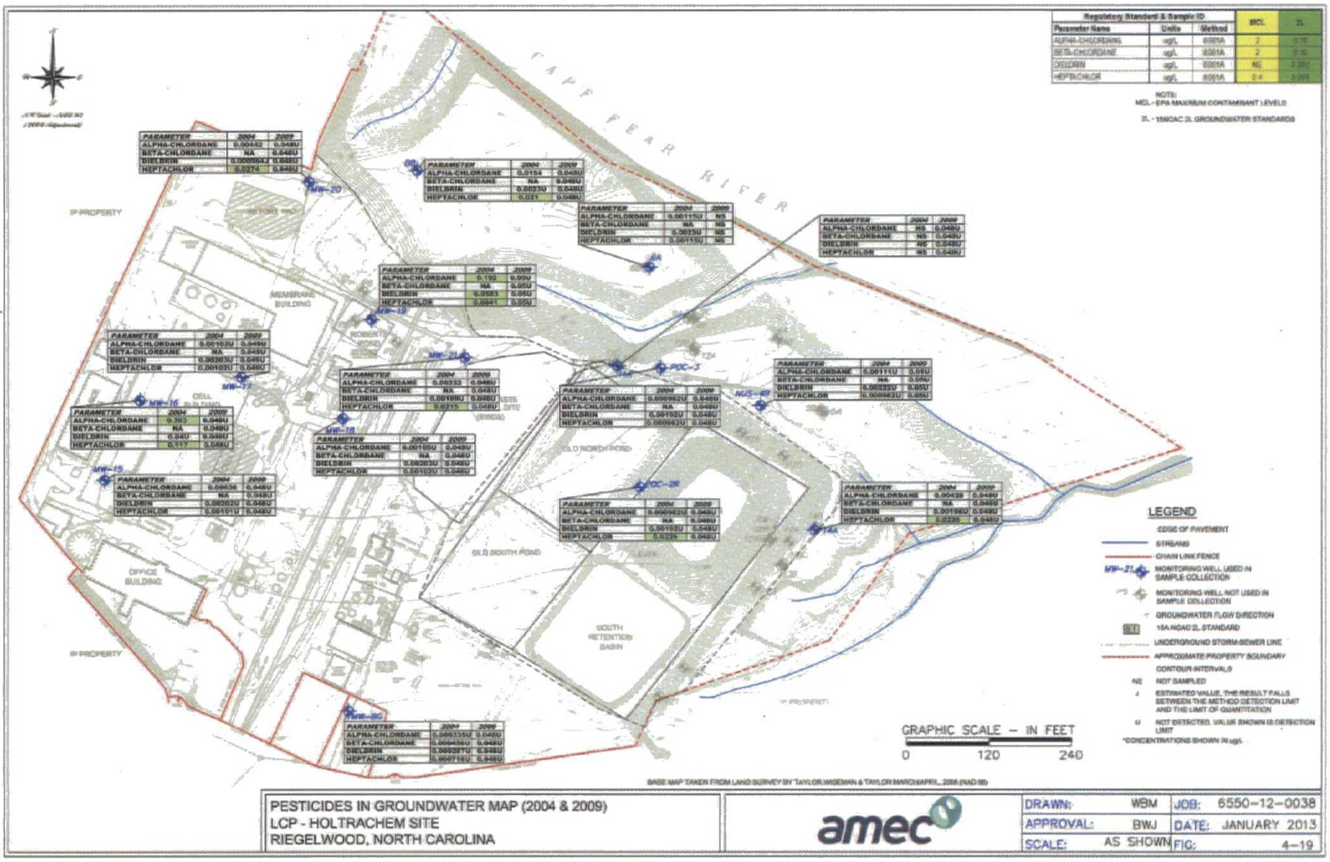
Figure 30: Aroclor 1268 in Groundwater 2004, 2009 and 2012



Pesticides

In 2004, pesticides were present at concentrations exceeding drinking water standards in wells in the UPA, UNPA and WBA. In 2009, there were no detectable concentrations of pesticides in any of the groundwater samples. As previously discussed, the annual RCRA sampling results from the three POC wells did not identify detectable concentrations of pesticides from 1992 to 2003. Previous investigations did not identify a source of pesticides at the site. **Figure 31** illustrates the concentrations of pesticides in groundwater in 2004 and 2009.

Figure 31: Pesticides in Groundwater 2004 & 2009



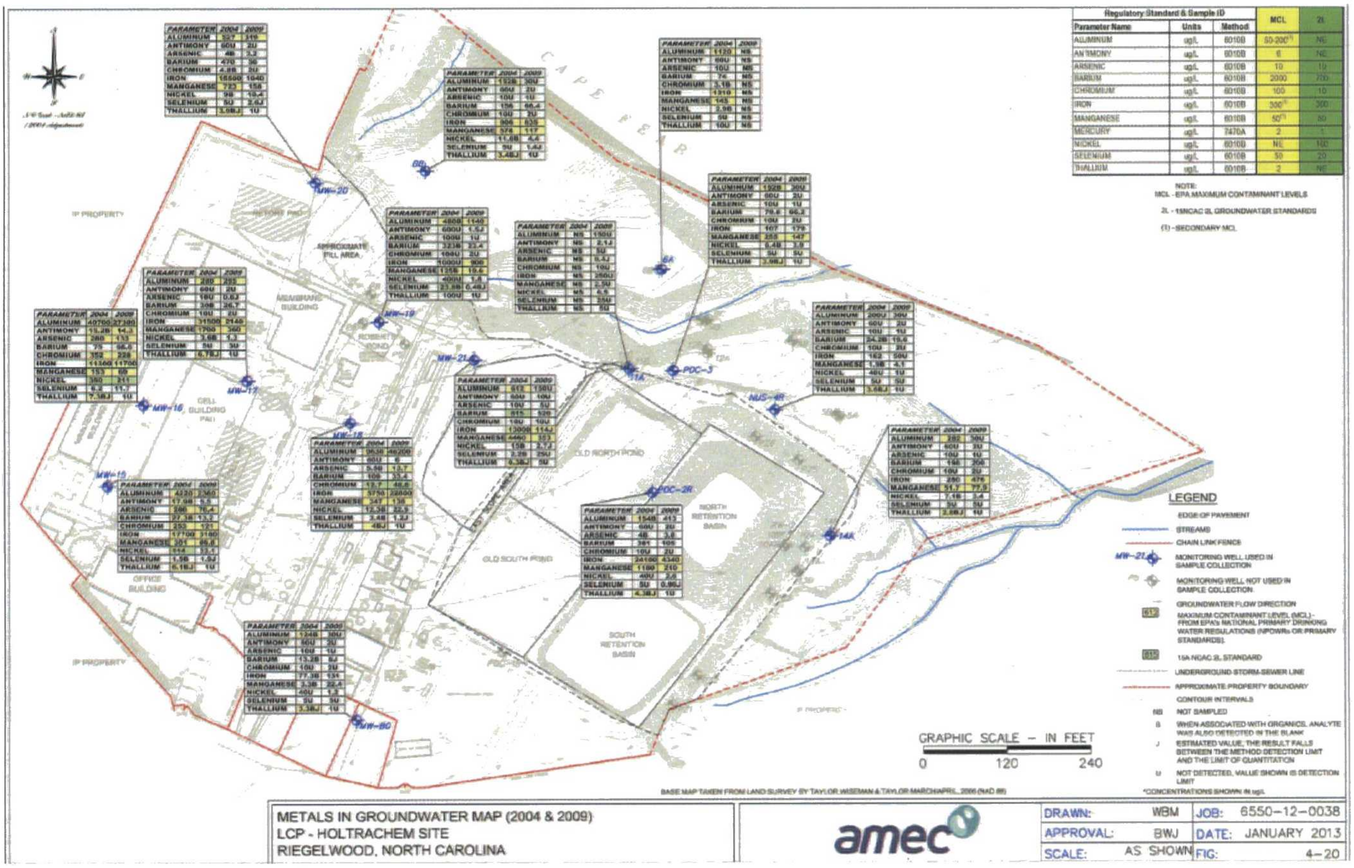
Metal Indicator Parameters

Figure 32 illustrates the concentrations of metals in groundwater in 2004 and 2009 that exceeded drinking water standards. The following inorganics were only present in the UPA groundwater at concentrations above a standard: antimony, arsenic, barium, chromium, nickel and selenium. Iron, manganese and thallium were present in groundwater above a standard across the site. The 2009 data indicated iron and manganese were the only metals detected in the WBA above a groundwater standard.

Antimony, arsenic, chromium and nickel were present in wells MW-15 and MW-16 in concentrations exceeding drinking water standards. These constituents do not appear to be migrating to down gradient wells as observed in the results from wells MW-17, MW-19 and MW-20.

Arsenic and chromium were present in well MW-18 in concentrations that exceeded drinking water standards. The 2009 data indicates these constituents are not migrating to the WBA as observed in the results from down gradient wells MW-19 and MW-21.

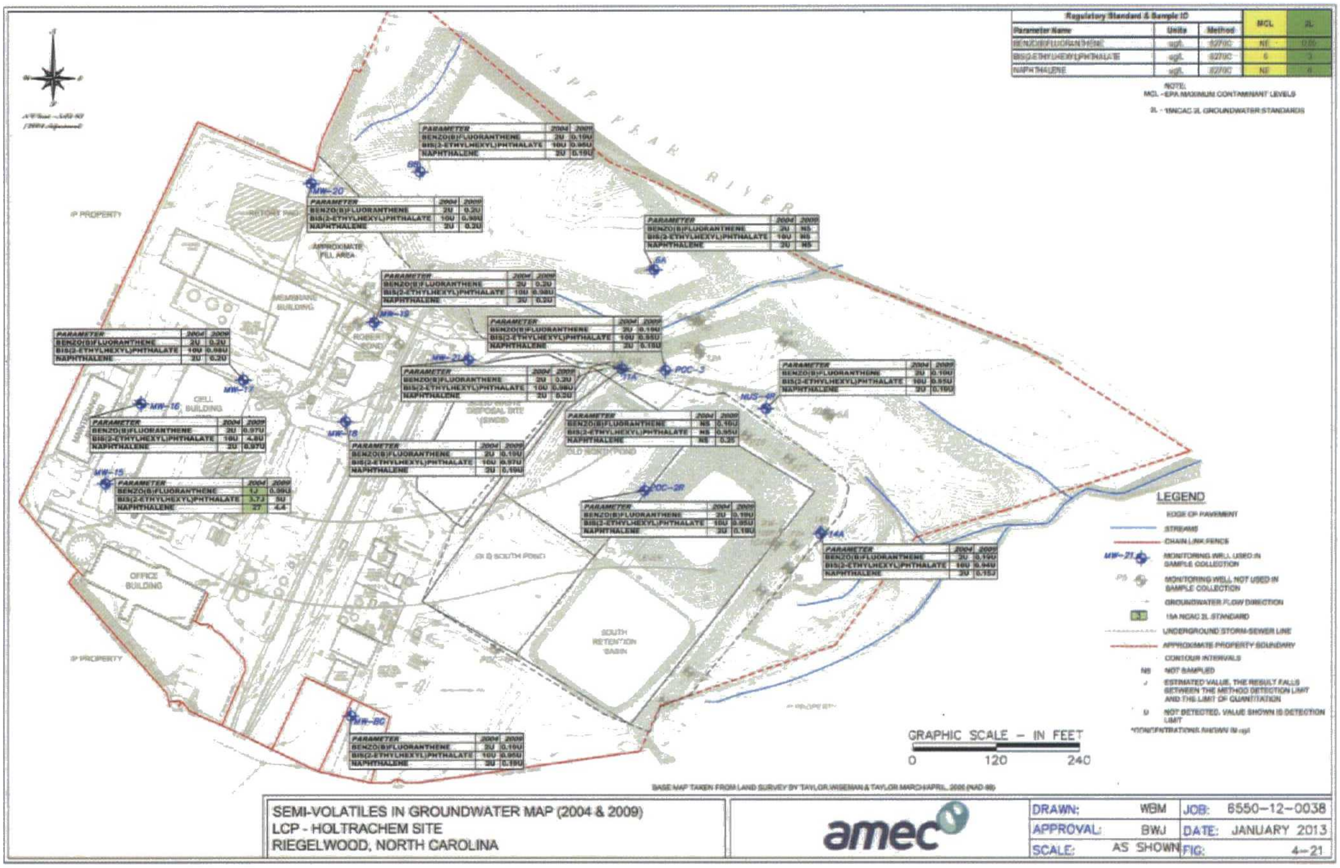
Figure 32: Metals in Groundwater 2004 & 2009



SVOCs

Figure 33 illustrates the concentrations of SVOCs in groundwater in 2004 and 2009 at concentrations that exceeded drinking water standards. In 2004, three SVOCs were present in well MW-15 at concentrations in excess of the 2L Standards. SVOCs were not detected in groundwater samples from the other wells. In 2009, the concentrations of SVOCs detected were less than 2L and MCL standards. The detected SVOCs do not appear to be migrating towards down gradient wells as observed from well MW-16. Previous investigations did not identify a source of SVOCs at the site.

Figure 33: SVOCs in Groundwater 2004 & 2009



5.6.6.2.3 September 2012 Sampling Event

The September 2012 sampling event included the collection of groundwater from well P9. Consultants installed well P9 at the toe of the UPA directly above the observed seep at the head of the central drainage pathway, as illustrated in **Figure 34**.

Figure 34: Location of P9 and Observed Intermittent Seep Area

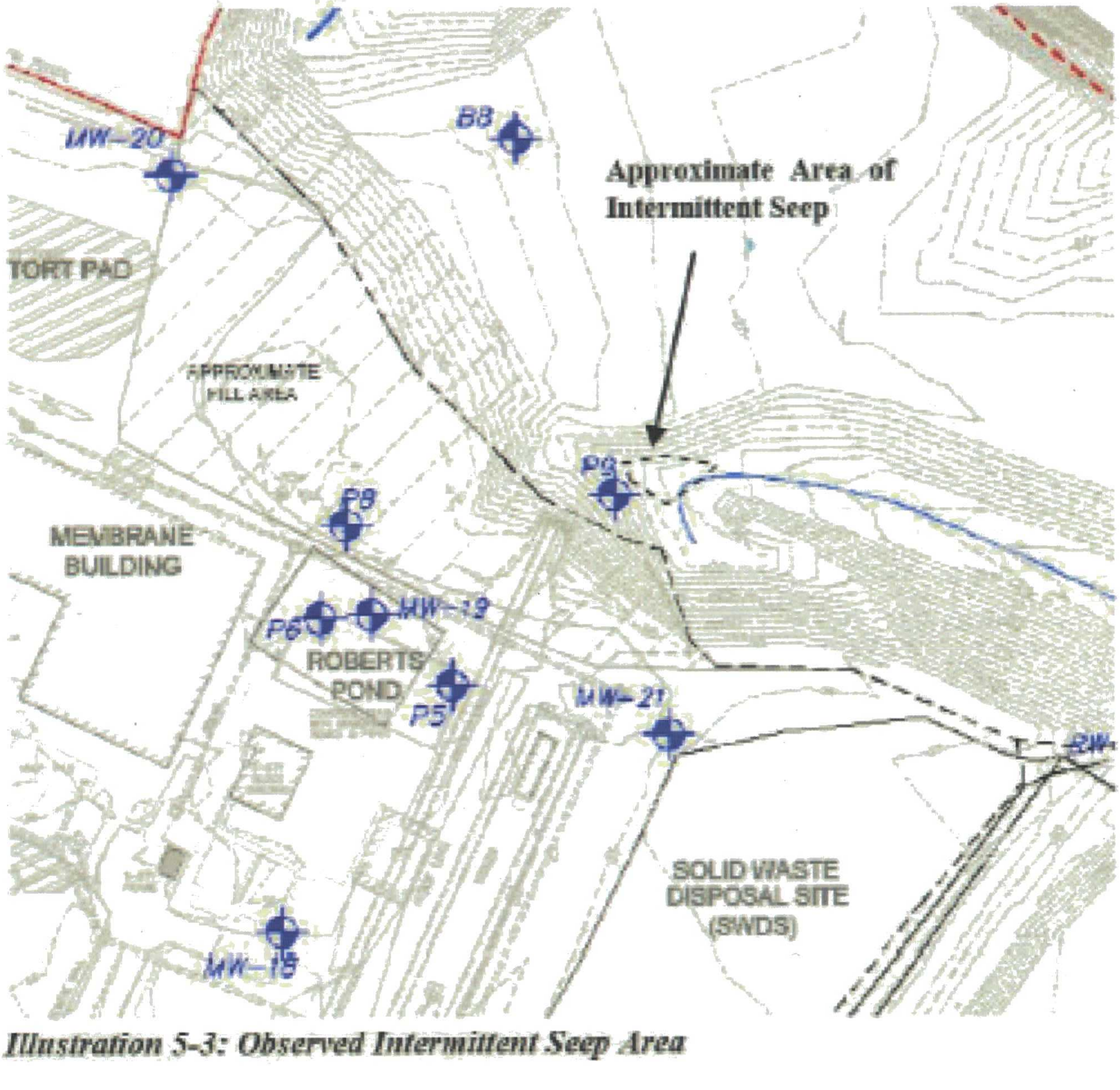


Illustration 5-3: Observed Intermittent Seep Area

Filtered and unfiltered groundwater samples were analyzed for mercury and Aroclor 1268. Mercury was not detected in either sample. Aroclor 1268 was detected at concentrations below the MCL in the unfiltered sample, but not detected in the filtered sample. The filtered results suggest particulates in the sample may have affected the detection of Aroclor 1268 in the unfiltered sample. **Table 82** summarizes the analytical results.

Table 82: Groundwater Data for Mercury and Aroclor 1268 in September 2012

	Standard		P-09 unfiltered	P-09 filtered
Analyte	2L	MCL	WBA	
mercury	1	2	< 0.15	< 0.15
Aroclor 1268	NE	0.5	0.131	< 0.0651

Notes:

Samples were only analyzed for mercury and Aroclor 1268

Concentrations units are milligrams per liter (mg/L)

2L = Title 15A North Carolina Administrative Code Subchapter 2L Groundwater Standards (I5A NCAC 2L Standard)

MCL = Safe Drinking Water Act's Maximum Contaminant Level

5.7 Location of Contamination and Routes of Migration

5.7.1 Location of Contamination

Figure 35: Remedial Footprint

Soil, Sediment and Surface Water

The pink shading in **Figure 35** illustrates areas that have contaminated soil, sediment and surface water at concentrations that may pose unacceptable risks to human health and/or the environment. Contamination depths vary across the site from only at the surface to ten feet or greater below land surface. It is estimated that there are approximately 75,000 yd^3 of contaminated soil, sediment and WWTS. The surface water becomes contaminated in the drainage pathways that are ephemeral and flow directly to the river. A calculation of volume of surface water was not estimated due to the variability.

Air

Currently, occasional concentrations of mercury are detected at the site during air monitoring events. The concentrations do not pose an unacceptable risk to human health or the environment.

Groundwater

Contamination was detected in groundwater in the surficial deposits. The contamination does not pose an unacceptable risk to human health or the environment. The water table ranges from less than one foot bgs to 13 feet bgs. No appreciable vertical flow is expected due to low formation permeability in the Peedee confining unit.

Groundwater in the surficial deposits at the site cannot be used for potable purposes according to 15A NCAC 2C.0107, because potable wells should be cased to a minimum depth of 35 feet bgs. Groundwater in the Peedee formation at the site cannot be a portable water supply due to its low permeability and low flow conditions estimated at about 20 gallons per day. Formations beneath the Peedee are reportedly naturally saline and would not be used for potable water purposes.

Based on multiple criteria, the aquifer does not meet the requirements specified in the EPA "Guidelines for Ground-Water Classification Under the EPA Groundwater Protection Strategy" to be considered a drinking water aquifer and is characterized as a EPA Class III, Subclass IIIA, not suitable as a potential source of drinking water and of limited beneficial use, and the human health and ecological pathways for groundwater are incomplete. This determination on groundwater is based on multiple lines of evidence that indicate detected constituents in groundwater are not migrating and that there is no current or future detriment to human health or the environment by this medium. The evidence supporting this determination is summarized below:

- Former production processes and equipment related to manufacturing that could produce additional sources of contamination were removed from the site.
- The time and direction of travel of the contaminants in groundwater have been projected with reasonable certainty.
- The only adjacent property onto which groundwater contaminants could migrate is the IP property.
- The groundwater data does not indicate site constituents will migrate onto the IP property.
- An existing public water supply system for the City of Wilmington, IP, the site, and surrounding community is dependent on surface water intakes from the Cape Fear River upstream of the site.
- The detected groundwater constituents are not expected to reach the Cape Fear River, which is the nearest downgradient surface water body.
- The thickness, hydraulic conductivity, and recharge rates observed for the shallow, perched aquifer fail to meet the minimum productivity requirements for it to be a drinking water aquifer.

5.7.2 Potential Routes of Current and Future Migration

Figure 9 on page 20 illustrates the Conceptual Site Model showing migration pathways. Potential current and future migration of contaminants could occur via

- overland flow of rain water that may transport contaminated soil and/or sediment to the WBA and Cape Fear River,
- permitted discharges of water to the Cape Fear River,
- potential damage to the Engineered Stockpiles, retention basins, etc. from a hurricane or tropical storm,
- atmospheric deposition, and
- leaching of contaminants into groundwater.

<u>Rainwater Migration Pathway</u>

Contaminated sediment within the drainage pathways is likely to be mostly immobile during low flow conditions and mobile during high flow conditions. Examples of high flow conditions include heavy precipitation or flooding events. The drainage pathways discharge uncontrolled storm water and possibly soil and sediment run-off into the Cape Fear River.

In June and August 2006, surface water samples were collected from drainage pathways during two extreme rain events. These two rainfall events had more rain than 91% and 99.95% of other rainfall events recorded at the U.S. Geological Survey's gauge for that year. The results for the eastern and central ditches indicate the storm water samples fall within the same range of the surface water concentrations for these two ditches. The western ditch results indicate the largest change in concentrations, where each of the compounds detected were higher for the storm water samples than the surface water samples. The Total Suspended Solids (TSS) concentration for the western ditch for the storm water results was also higher, suggesting a more turbid sample compared to the surface water samples. The data provides some indication that contaminated sediment in the drainage ditches may become mobile during storm events or flooding.

Permitted Discharges

The facility treats collected storm water and then sends it to IP. IP has an NPDES permit to discharge its treated water to the Cape Fear River. Contamination may migrate via this permitted discharge.

Hurricane and/or Tropical Storm Damage

The site has been affected by numerous hurricanes and tropical storms. A plan is currently in place to prepare for such events to minimize damage. However, there currently remains a potential that a major storm could cause damage to the Engineered Stockpiles, retention basins, stored chemicals used in the waste water treatment process, etc.

Atmospheric Deposition

Air monitoring is conducted at the facility frequently for mercury. Since the Engineered Stockpile #1 was placed on top of the former Mercury Cell Building, the concentrations of mercury detected in the air have reduced drastically. This migration pathway is minimal.

Leaching to groundwater

In general, the potential soil to groundwater transport mechanism is chemical leaching of constituents from soils or waste disposal areas, and transport through the shallow vadose zone to the water table. The two primary contaminants, mercury and Aroclor 1268, strongly sorb to soils at the site limiting their ability to leach. The groundwater data does not indicate site constituents will migrate onto the IP property or into the Cape Fear River. The transport of contaminants in groundwater is also restricted by the Peedee Formation confining unit.

Mercury is strongly sorbed to humic materials and sesquioxides in soils and sediments at a pH higher than four and to the surface layer of peat. Mercury is also sorbed to sediments and soils with high iron and aluminum content, which has been readily observed at the site. Once sorbed to soil and particulate material, inorganic mercury is often not readily desorbed.

The ability of PCBs to be degraded or transformed in the environment depends on the degree of chlorination of the biphenyl molecule as well as on the isomeric substitution pattern. Aroclors 1254 and 1268 are some of the more chlorinated compounds in the PCB family, they strongly sorb to soil as a result of their low water solubility and high K_{ow}.[8] Subsequently, this condition greatly limits these Aroclors ability to leach in soils. Higher clay and organic content, such as is the case with much of the site soil, also substantially reduces leaching of these Aroclors into groundwater.

[8] K_{ow} is the octanol: water distribution coefficient.

6.0 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

The facility ceased operations in 2000. Currently, the site use is limited to security, maintenance and storm water management. The majority of Columbus County, including the site property, is zoned "General Use".[9] The site and immediately surrounding property to the south, east and west include industrial facilities. The Cape Fear River borders the north side of the site. Property north of the Cape Fear River is undeveloped low-lying land. The closest residential property is located about 0.9 mile southwest, just outside the IP property boundary.

IP and the City of Wilmington use the Cape Fear River as a source for drinking water. IP maintains a surface water intake about ¼-mile west (upstream) of the site, where they draw river water into the Riegelwood Mills water treatment facility for local distribution. The City of Wilmington maintains a surface water intake 8.3 miles upstream of the site. People also use the Cape Fear River near the site recreationally.

Reasonably anticipated future land use of the site is industrial/vacant. Heavily industrialized IP is a thriving business that surrounds the site on three sides. EPA anticipates that the current land use will remain in place. Based on multiple criteria, the aquifer is characterized as an EPA Class III, Subclass IIIA, not suitable as a potential source of drinking water and of limited beneficial use per "Guidelines for Ground-Water Classification Under the EPA Groundwater Protection Strategy", and the human health and ecological pathways for exposure to contaminated groundwater are incomplete. Data indicates that detected constituents in groundwater are not migrating and are not causing detriment to human health or the environment.

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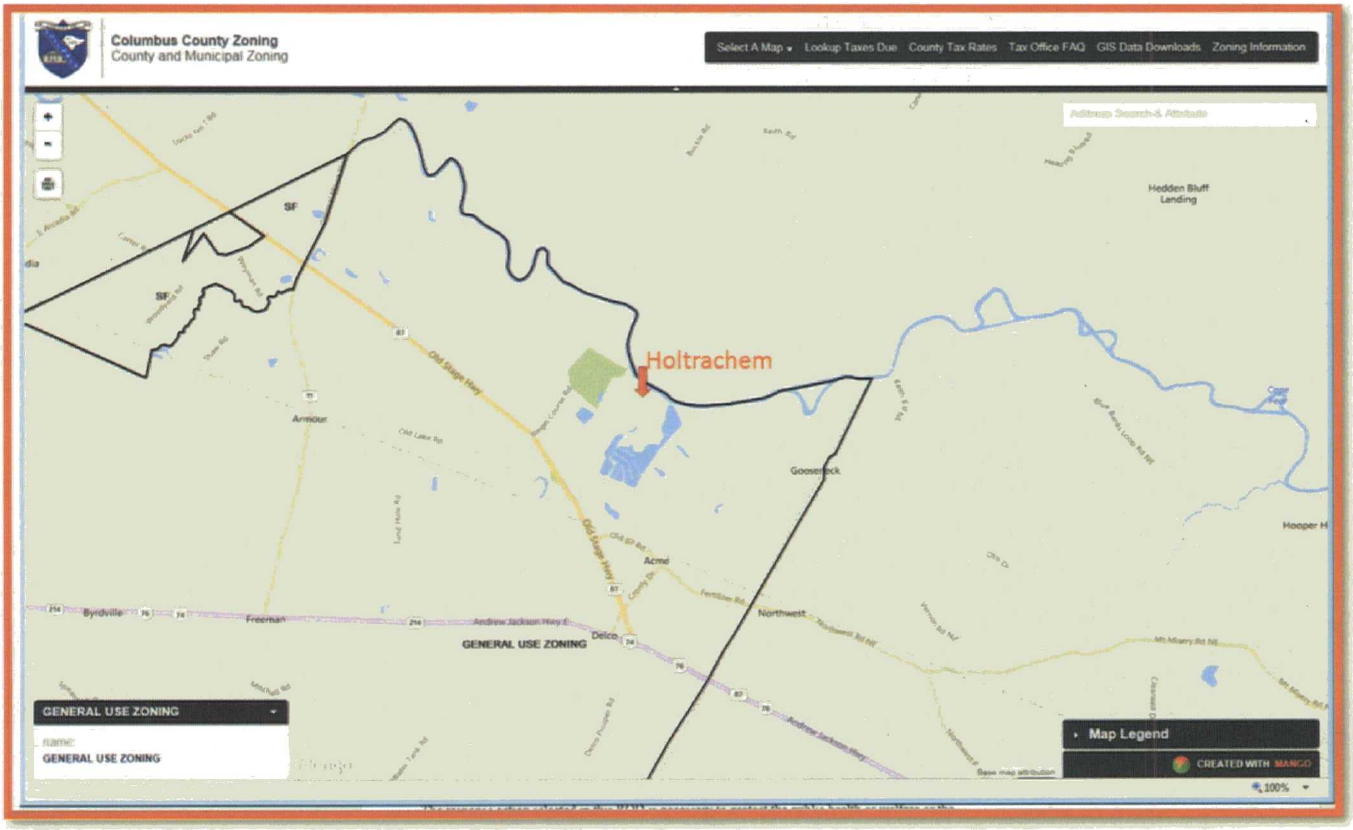
[9] http://mangomap.com/maps/20702/Columbus-County-Zoning#

Figure 36: Columbus County Zoning



7.0 SUMMARY OF SITE RISKS

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

7.1 Human Health Risk Assessment

The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that the remedial action needs to address. This section of the ROD summarizes the results of the baseline risk assessment.

7.1.1 Identification of Chemicals of Concern

The following three tables present the chemicals of concern (COCs) and exposure point concentration (EPC) for each of the COCs detected in surface soil, subsurface soil and surface water, respectively. They also include the range of concentrations detected for each COC, the frequency of detection (i.e., the number of times the chemical was detected in the samples collected at the site), and how the EPC was derived. EPC is the concentration that is used to estimate the exposure and risk from each COC. Sediment, groundwater and air data did not indicate risks to human health; therefore, only surface soil, subsurface soil and surface water are included in the tables.

The data indicates that Aroclor 1268, mercury, and 2,3,7,8-TCDD TEQ are the most frequently detected COCs in soils and surface water at the site. Aroclor 1254 and benzo(a)pyrene are less frequently detected, but contribute towards risks posed to human health.

Table 83: Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Surface Soil

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil (0-1 foot)

Exposure Point	Chemical of Concern	Concentration Detected		Frequency of Detection		Exposure Point Concentration *	Statistical Measure
		Minimum*	Maximum*	Percent	Number of Samples		
Upland Area Surface Soil	Aroclor-1268	0.016 J	2,700	99%	82/83	2,600	95% UCL-t
	benzo(a)pyrene	0.036 J	26 D	28%	17/61	3.5	97.5% Cheb-m
	mercury	0.0184 J	1,300	99%	196/197	2,800	99% Cheb-m
Wooded Bottomland Area Surface Soil	Aroclor-1254	0.0045 J	67	46%	19/41	20	99% Cheb-m
	Aroclor-1268	0.098	3,800	100%	39/39	1,300	97.5% Cheb
	2,3,7,8-TCDD TEQ (dioxins/furans)	0.00000115	0.001384	100%	29/29	0.0013	97.5% Cheb
	2,3,7,8-TCDD TEQ (PCBs)	0.00000032	0.000282	100%	29/29	0.00014	95% Cheb

Notes:
* = Concentrations are expressed in parts per million (ppm). In this table ppm = milligrams per kilogram (mg/kg)
Cheb = Chebyshev Minimum Variance Unbiased Estimate (MVUE) of Upper Confidence Limit (UCL)
Cheb-m = Chebyshev (mean,std) Upper Confidence Limit (UCL)
D = result reported from dilution
J = compound was detected below the reporting limit in the sample
PCBs = polychlorinated biphenyls
TCDD TEQ =tetrachlorodibenzo-p-dioxin toxicity equivalent quotient
UCL-t = Upper Confidence Limit of Log-transformed Data, H-Statistic

Table 84: Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Subsurface Soil

Scenario Timeframe: Future Medium: Soil Exposure Medium: Subsurface Soil (1-10 feet)							
Exposure Point	Chemical of Concern	Concentration Detected		Frequency of Detection		Exposure Point Concentration *	Statistical Measure
		Minimum*	Maximum*	Percent	# of Samples		
Upland Area Subsurface Soil	Aroclor-1254	0.0074 J	5.1	25%	25/101	3	97.5% Cheb-m
	Aroclor-1268	0.0036 J	2,700	96%	224/233	2,900	99% Cheb-m
	mercury	0.00822 J	11,000 X	99%	343/348	4,400	99% Cheb-m
Notes:							
* = Concentrations are expressed in parts per million (ppm). In this table ppm = milligrams per kilogram (mg/kg)							
Cheb-m = Chebyshev (mean,std) Upper Confidence Limit (UCL)							
J = compound was detected below the reporting limit in the sample							
X = sample contained beads of mercury							

Table 85: Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Surface Water

Scenario Timeframe: Current/Future Medium: Surface Water Exposure Medium: Wooded Bottomland Area Drainage Pathway Surface Water							
Exposure Point	Chemical of Concern	Concentration Detected		Frequency of Detection		Exposure Point Concentration *	Statistical Measure
		Minimum*	Maximum*	Percent	# of Samples		
Surface Water	Aroclor-1268	0.062	17	80%	12/15	4.4	App. Gamma
	Total 2,3,7,8-TCDD TEQ (dioxin/furan)	3.34E-06	3.38E-04	100%	6/6	3.40E-04	Max
	Total 2,3,7,8-TCDD TEQ (PCB)	3.20E-06	1.19E-04	100%	4/4	1.20E-04	Max
Notes:							
* = Concentrations are expressed in parts per billion (ppb). In this table ppb = micrograms per liter (µg/L)							
App. Gamma = Approximate Gamma							
J = compound was detected below the reporting limit in the sample							
Max = Maximum Detected Value							
TCDD TEQ =tetrachlorodibenzo-p-dioxin toxicity equivalent quotient							

7.1.2 Exposure Assessment

EPA risk assessment guidance documents and professional judgement were used to determine exposure intakes from soil, indoor air and surface water. These were based on the Conceptual Site Model (**Figure 9** on page 20). There is not an exposure pathway for groundwater. Potentially exposed populations include current and future trespassers, recreators, and anglers, as well as future industrial and construction workers.

The HHRA included both reasonable maximum exposure (RME) and central tendency exposure (CTE) intake calculations. RME intakes protect 95% or greater of the study population, while CTE intakes address moderate or median exposure scenarios. The HHRA discussed CTE intakes and related risk calculations in the Uncertainties section, used primarily as supplemental information and a risk management tool.

7.1.3 Toxicity Assessment

In the HHRA, the hierarchy of sources used for toxicity values was:

1) Integrated Risk Information System (IRIS),
2) Provisional Peer-Reviewed Threshold Values (PPRTVs) as presented in the Region 9 Preliminary Remediation Goal (PRG) Table, and
3) other sources such as the Human Effects Assessment Summary Tables (HEAST), National Center for Environmental Assessment (NCEA), and California EPA values as presented in the Region 9 PRG Table.

Oral reference doses (RfDs) and cancer slope factors (CSFs) were revised in accordance with Risk Assessment Guidance for Superfund (RAGS) Part E guidance. The HHRA provided a brief toxicity profile of mercury, PCBs, and dioxins furans.

7.1.4 Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

where: risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as $(mg/kg\text{-}day)^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in million chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally accepted risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). A HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. A HI less than 1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. A HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where: CDI = Chronic daily intake
RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

The HHRA identified cancer risks and non-cancer hazards. The following paragraphs summarize the estimates for each receptor:

Industrial Worker - Upland Surface Soil Exposures: Arsenic, six carcinogenic PAHs, dioxins, furans, and PCBs were associated with estimated carcinogenic risk greater than 10^{-6}. Mercury and Aroclor 1268 had hazard indices greater than 0.1. The primary exposure pathways were dermal absorption and ingestion of soil.

Industrial Worker - Indoor Air Exposures: VOCs in indoor air were associated with risks ranging from 1×10^{-5} in the Air Compressor Building to 8×10^{-5} in the New Cell Building. COCs per locations include

- **Air Compressor Building**: benzene, chloroform and trimethylbenzene;
- **New Cell Building**: benzene, chloroform, tetrachloroethene, trichloroethene, and vinyl chloride;
- **Office Building**: benzene and chloroform;
- **Prep Building**: benzene and chloroform

Trimethylbenzene and bromomethane were also estimated to have inhalation hazard indices greater than 0.1.

Hazards associated with mercury in ambient air (which were assumed to be mercury salts and not elemental mercury based on the sampling locations) were addressed by considering inhalation exposures to soil particulates and volatiles for industrial workers, construction workers, and trespassers. Calculated hazard indices for mercury by the inhalation pathways were well below one.

Detected concentrations of mercury and VOCs were either less than current industrial air Regional Screening Levels or are within the national background range for residential properties. Thus, these data do not indicate a risk from the vapor intrusion pathway.

Trespasser - Upland Surface Soil Exposures: Risk greater than 10^{-6} was associated with benzo(a)pvrene, dibenzo(a.h)anthracene, dioxins, furans, and PCBs in surface soils. Mercury and Aroclor 1268 were associated with hazard indices greater than 0.1. The primary pathways were dermal absorption and ingestion.

Construction Worker - Upland Surface and Subsurface Soil Exposures: Risk greater than 10^{-6} was associated with benzo(a)pvrene, iron, mercury. Aroclor 1254 and Aroclor 1268 were associated with hazard indices greater than 0.1. The primary pathways were dermal absorption and ingestion.

Trespasser Recreator - Bottomland Surface Soil Exposures: Dioxins furans and PCBs were associated with risk greater than 10^{-6}. Aroclor 1254 and Aroclor 1268 were associated with hazard indices greater than 0.1.

Surface Water Exposures: By the dermal pathway, dioxins furans and PCBs were associated with risk greater than 10^{-6}. Aroclor 1254 and Aroclor 1268 had hazard indices greater than 0.1.

Resident Angler - Fish ingestion from the Cape Fear River: DDD, DDE, DDT, Aldrin, dieldrin, alphachlordane, gamma-chlordane, and bis-2-ethvlhexylphtlialate were associated with risk greater than 10^{-6}. Dioxins, furans and PCBs were associated with risks greater than 10^{-6}. DDD and Aroclor 1268 were associated with hazard indices greater than 0.1.

7.1.5 Uncertainty Analysis

The HHRA includes a discussion of uncertainty associated with the data evaluation, exposure assessment, toxicity assessment, and risk characterization. Below are the primary uncertainty factors in this HHRA.

Limited data were available to model congener dioxins furans and PCB concentrations from surface water to fish tissue, resulting in a high degree of uncertainty. In particular, although only octachlorodibenzo-p-dioxin (OCDD) was detected in surface water, the HHRA assumed that the other congeners of dioxins, furans, and PCBs were present at the sample-specific detection limits. As a result, less than 1% of the estimated risk is associated with detected OCDD in surface water. If the other congeners were not included in the risk characterization, the estimated risk would not have exceeded 10^{-6}. In addition, the HHRA discounted mercury data prior to the risk characterization because of data quality issues. This approach for mercury may have resulted in an underestimation of hazards for fish ingestion.

There is uncertainty associated with mercury concentrations in Upland Area soils. The sampling team visually observed mercury beads at the Retort Pad area and former Cell Building area, but collected limited soil samples where they observed beaded mercury. Thus, the overall mercury concentrations in upland soils may be underestimated.

Risk characterization based on RME scenarios is conservative and may serve to overestimate risks associated with site media. However, use of the moderate CTE scenarios did not significantly reduce the hazards or risks noted with the RME scenarios.

7.2 Ecological Risk Assessment

The ecological risk assessment is a multi-step process. The assessment was completed in accordance with *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA 1997), NCDENR's *Guidelines for Performing Screening Level Ecological Risk Assessments within the North Carolina Division of Waste Management* (NCDENR 2003) and the *Baseline Ecological Risk Assessment Work Plan and Sampling and Analysis Plan* (CH2M HILL 2009).

The documents prepared that are part of the ecological risk assessment include:

- *Ecological Risk Assessment Step 1 through Step 3(a), LCP-Holtrachem Site, Riegelwood, NC* (March 2006),
- *Ecological Risk Assessment Revised Step 3a. LCP-Holtrachem Site, Riegelwood, NC* (January 2008),
- *Baseline Problem Formulation Step 3b. LCP-Holtrachem Site. Riegelwood, NC* (February 2009; revised September 2009), and
- *Baseline Ecological Risk Assessment for LCP-Holtrachem Site, Riegelwood, NC* (September 2010).

During the risk assessment process, constituents of potential concern, ecological habitats, and representative ecological receptors were identified. For each representative ecological receptor group, measurable assessment endpoints were formulated and potential risks were then estimated for each endpoint. EPA approved the Baseline Ecological Risk Assessment (BERA) in October 2010. A summary of the process results follows.

7.2.1 Assessment Endpoints

The following receptor groups were evaluated in the BERA:

- Soil invertebrates
- Insectivorous birds (terrestrial)
- Insectivorous mammals (terrestrial)
- Herbivorous birds (terrestrial)
- Herbivorous mammals (terrestrial)
- Amphibians and reptiles (aquatic terrestrial)
- Omnivorous birds (aquatic terrestrial)
- Omnivorous piscivorous birds (aquatic terrestrial)
- Insectivorous piscivorous mammals (aquatic and terrestrial)
- Benthic macroinvertebrates

7.2.2 Constituents of Potential Ecological Concern

During Step 3a, a refined screening for constituents of potential ecological concern (COPECs) was completed using supplemental toxicological benchmarks and a weight of evidence (WOE) approach. The WOE approach includes consideration of the magnitude of potential risk, background data, frequency of detection, frequency of exceedances over screening levels, and bioaccumulation potential. The list of COPECs identified in Step 3a is summarized in **Table 86.**

Table 86: Lower Trophic Level Final Direct Toxicity COPECs

Soil	Sediment		Surface water		Stormwater
Upland and Bottomland	Bottomland Drainage Ditches	Cape Fear River	Bottomland Drainage Ditches	Cape Fear River	Bottomland Drainage Ditches
Chromium	Mercury	Mercury	Aluminum	Aluminum	Aluminum
Manganese	Aroclor-1016*	Aroclor-1016*	Arsenic	Barium	Cadmium
Mercury	Aroclor-1221*	Aroclor-1221*	Barium	Iron	Copper
Vanadium	Aroclor-1232*	Aroclor-1232*	Cadmium	Lead	Iron
Aroclor-1016*	Aroclor-1242*	Aroclor-1242*	Chromium	Manganese	Manganese
Aroclor-1221*	Aroclor-1248*	Aroclor-1248*	Iron	Silver*	Mercury
Aroclor-1232*	Aroclor-1254	Aroclor-1254	Lead	Thallium	Silver
Aroclor-1242*	Aroclor-1260*	Aroclor-1260*	Manganese	Vanadium	Vanadium
Aroclor-1248*	Aroclor-1268	Aroclor-1268	Mercury	Zinc	Zinc
Aroclor 1254	4,4'-DDD	4,4'-DDD	Nickel	Aroclor 1268	Aroclor 1268
Aroclor 1260*	4,4'-DDE	4,4'-DDE	Selenium	4,4'-DDD	Methoxychlor*
Aroclor 1268	4,4'-DDT	4,4'-DDT	Silver*	4,4'-DDE	Toxaphene*
4,4'-DDD	Chlordane (technical)*	Dieldrin	Vanadium	4,4'-DDT	4-Chloro-3-methylphenol*
4,4'-DDE	Dieldrin	Endrin	Zinc	Aldrin	Anthracene*
4,4'-DDT	Endrin	gamma-BHC (Lindane)*	Dioxins/PCBs TEQs – mammals, birds, and fish	Dieldrin	Benzo(a)pyrene*
beta-BHC	gamma-BHC (Lindane)	Heptachlor epoxide*	Total Dioxin/ Furan/ PCB 2,3,7,8-TCDD TEQs – mammal, birds, and fish	Endosulfan I	Benzo(b) fluoranthene*
Dieldrin	Heptachlor epoxide	Toxaphene*	Aroclor-1016*	Endosulfan II	Benzo(ghi) perylene*
Endrin	Toxaphene*	Chlordane (technical)*	Aroclor-1221*	Endosulfan sulfate	Benzo(k) fluoranthene*
gamma-BHC (Lindane)	Acenaphthene	Dioxins TEQs - mammals	Aroclor-1232*	Endrin	Hexachloro-butadiene*

During Step 3b, the COPECs were refined for inclusion in the BERA. In the first step of the refinement, concentrations of soil COPECs were compared to background. Next, wildlife No Observed Adverse Effects Level (NOAEL) and Lowest Observed Adverse Effects Level (LOAEL) PRGs were calculated for the detected COPECs and concentrations of COPECs were compared to PRGs as a way of evaluating risk. Concentrations of total mercury exceeded PRGs for methylmercury and mercuric chloride at the majority of soil sampling locations. Zinc also exceeded PRGs in nearly every soil sample.

Only in isolated areas did other COPECs exceed PRGs. Other COPECs exceeding PRGs consistently coincided with locations where mercury and zinc exceed their PRGs. COPECs were also compared to soil and benthic benchmarks and sediment from the Cape Fear River were compared to both wildlife PRGs and invertebrate benchmarks.

After the results of this analysis in Step 3b, it was decided that the BERA would focus on mercury compounds with additional analysis of zinc. Although other COPECs did exceed wildlife PRGs across multiple stations, the focus of the BERA was on mercury and zinc. Most instances of elevated detections of mercury and zinc coincided with elevated levels of these additional COPECs. Future remediation of these areas for mercury and zinc would likely remove the majority of the elevated detections of other less frequently detected COPECs. The final list of COPECs carried into the BERA included methylmercury, mercuric chloride, mercuric sulfide, and zinc.

7.2.3 Site Investigations in Support of the BERA

7.2.3.1 Terrestrial

Site investigation activities were conducted in Bottomland Area soils within Terrace A, the Upland Non-Process Area, and Wetland B. Due to the drier characteristics of the majority of Wetland B, the substrate is considered soil from an ecological exposure perspective. Media collected included soil and invertebrate and plant tissue. Toxicity tests were conducted on site soils. Community surveys of invertebrates were also completed.

Five surface soil samples were collected from each study area (15 total samples). Samples were analyzed for metals, mercury analysis, TOC, and pH. Six of the 15 samples were also analyzed for grain size. Mercury analyses included total mercury, methyl mercury, and fractions 1, 2, and 5. In addition, inorganic divalent mercury (mercury 2+) was also analyzed since this oxidized form of elemental mercury is the dominant form in the environment.

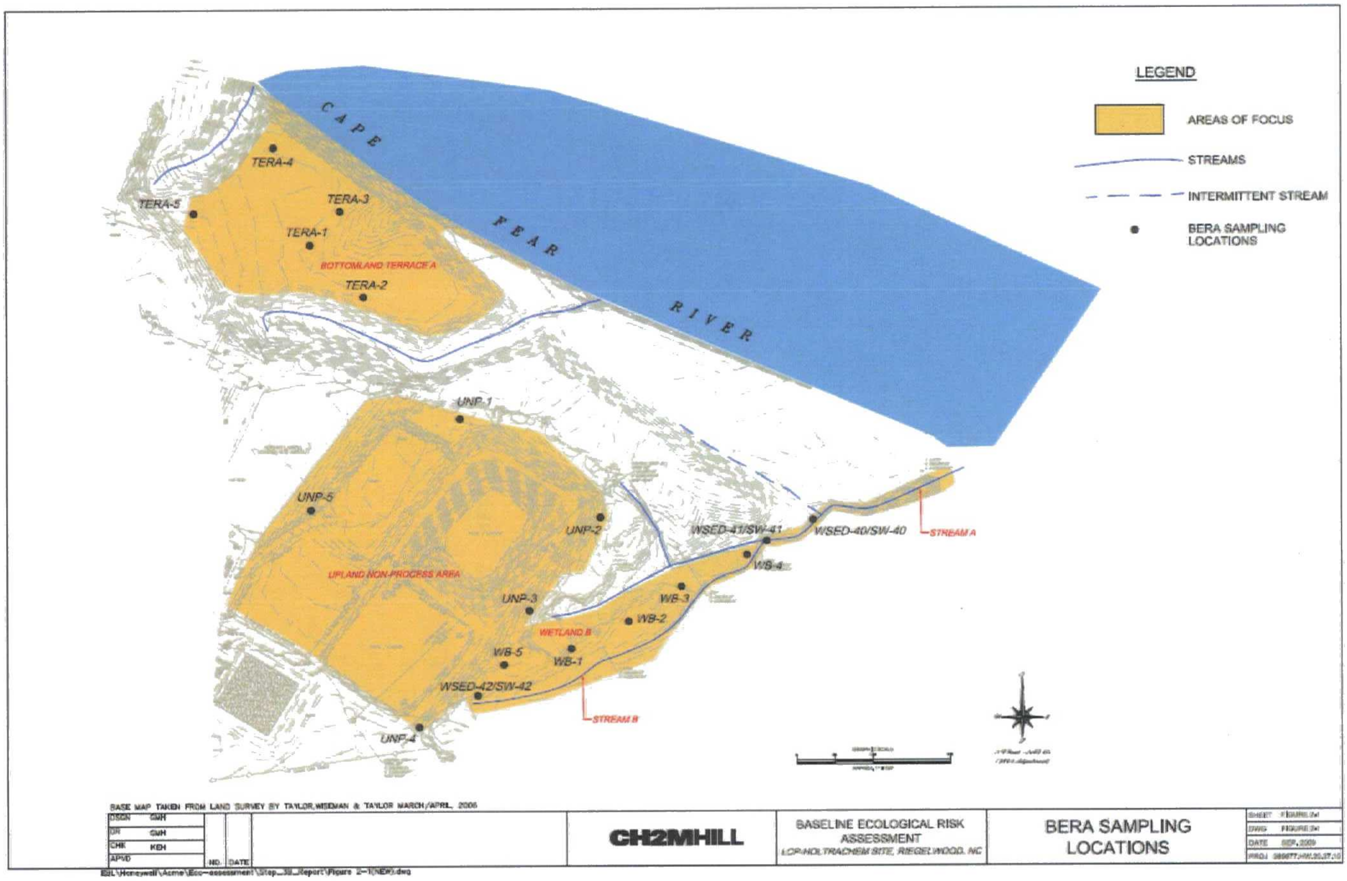
Plants and soil invertebrates were collected within 5 feet of the 15 soil samples, with the exception of UNP-5. Only plants could be collected at UNP-5. Plant and invertebrate species collected were those typically consumed by wildlife living at the site. Plant and invertebrate samples were analyzed for total mercury, methylmercury, mercury 2+, and zinc.

Laboratory toxicity testing (28-days) was completed for 9 soil samples (i.e. 3 from each study area). The test organism was the adult stage earthworm *Eisenia fetida*. Study endpoints were survival and growth. Similar toxicity testing was conducted in the reference area soil. At the conclusion of the toxicity tests, earthworms were depurated and the tissue was analyzed for total mercury, methylmercury, mercury 2+, and zinc.

A soil invertebrate survey was conducted at each soil sample location. An undisturbed area within 5 feet of the sample location was chosen for the survey. Invertebrates were first collected from leaf litter. Once leaf litter was cleared, a 1 square foot hole was dug six inches deep. Soil invertebrates in the hole were collected, counted, and identified.

A soil reference sample location SOREF-1 was collected in the same area as the Phase II sampling in November 2005. The reference sample was analyzed for metals, mercury fractions, VOCs, pesticides, PCBs, SVOCs, pH and TOC. Reference soil was used for toxicity testing of earthworms; however, earthworm tissue was not analyzed at the end of toxicity testing. A soil invertebrate survey was also conducted.

Figure 37: BERA Sampling Locations



7.2.3.2 Aquatic

Site investigation activities were conducted for Streams A and B[10] and the Cape Fear River. No fish or larval amphibians were observed within Streams A and B or the other streams on-site.[11] Media collected included surface water and sediment. Toxicity tests were conducted on collected sediments.

Three surface water samples were collected within Wetland B. An independent laboratory analyzed the samples for metals (filtered), total mercury, methylmercury, mercury 2+, pesticides, SVOCs, PCBs, pH, and hardness. Contractors collected temperature, pH, and dissolved oxygen data in the field. Three sediment samples (0-6 inches in depth) were collected within Wetland B. Samples were analyzed for metals, methylmercury, mercury fractions, pesticides, PCBs, and SVOCs.

[10] Streams A and B are also collectively referred to as the western drainage pathway in other portions of the ROD.

[11] "Streams on-Site" refer to the ephemeral drainage pathways in the wooded bottomland areas.

Two types of toxicity testing were conducted for site surface water and sediment. In the first toxicity test, the larval green frog (*Rana clamitans*) was exposed to bulk sediment and surface water for 30-days. The endpoints were mortality, percent malformation and growth. At the termination of the toxicity test, tadpole tissues were analyzed for total mercury, methylmercury, and mercury 2+ for bioaccumulation analysis. In the second test, neonate amphipods (*Hyalella azteca*) were exposed to bulk sediments for 28-days. Endpoints were mortality and growth.

A benthic invertebrate survey was conducted at each sediment sample location using the kick-net method. Invertebrates in the sediment were collected, counted, and identified.

An off-site upgradient stream was sampled to provide background information on aquatic media. Surface water from the reference stream was analyzed for metals (dissolved), total mercury, methylmercury, mercury 2+, VOCs, SVOCs, pesticides, PCBs, pH, and hardness. Reference sediment was analyzed for mercury, methylmercury, mercury fractions, VOCs, SVOCs, pesticides, and PCBs. Reference water and sediment samples were used for toxicity testing, and a benthic invertebrate survey was also completed as described above.

7.2.4 Exposure Analysis

The exposure analysis considered direct exposure by lower trophic-level organisms (e.g. benthic macroinvertebrates) to constituents in soil, surface water, and sediment. Likewise, the risk associated through the food web was considered for receptor of concern representing the assessment endpoints. Food web exposure includes the exposure of upper trophic-level receptors to COPECs in soil, surface water, and sediment through direct ingestion (intentional or inadvertent) and consumption of prey items with COPEC body burdens.

The following species were selected to represent receptors of concern in the food web modeling:

- Carolina wren - insectivorous bird (terrestrial)
- Short-tailed Shrew - insectivorous mammal (terrestrial)
- Purple Finch - herbivorous bird (terrestrial)
- Meadow Vole - herbivorous mammal (terrestrial)
- Bullfrog and Northern Water Snake - Amphibians and Reptiles (aquatic terrestrial)
- Wood Duck - omnivorous bird (aquatic)
- Green Heron - omnivorous piscivorous bird (aquatic)
- Mink - piscivorous mammal (aquatic)
- Little Brown Bat - insectivorous mammal (aquatic)

7.2.5 Exposure Point Concentrations

The upper confidence limit (UCL) on the mean (recommended 95 or 99 UCL) was used as an EPC where possible for each medium. Samples were pooled across the three areas. ProUCL 4 was used to calculate UCLs (if two recommended values were given, the higher value was used). If a UCL could not be calculated because of an insufficient sample size, as for sediment, surface water, and tadpole tissue, the maximum concentration was used. Sample concentrations from the reference location were not used to determine EPCs. For terrestrial invertebrates, only field collected invertebrates were used because these organisms are the most representative of site conditions.

To assess the potential for adverse effects from mercury exposure, toxicity values were available for three species of mercury (methyl mercury, mercuric chloride, mercuric sulfide). For the risk assessment, mercury 2+, Fraction 1, and Fraction 2 were treated as mercuric chloride. Fraction 5 was treated as mercuric sulfide. In most cases, the sum of the individual mercury species was less than the total mercury measured in the same sample. This mercury not accounted for (MNAF) was added to the mercuric chloride measurement when developing EPCs for food web modeling as a conservative measure. The MNAF was not treated as methylmercury since this constituent was measured directly in all media. The exception to the treatment of MNAF involved drinking water. For this media, total mercury detected was assumed to be mercuric sulfide for the purposes of modeling.

Mercury and zinc in aquatic plants, aquatic invertebrates, and small mammals were not measured directly and had to be estimated for food web exposure. For aquatic plants, sediment concentrations and the relationships among chemicals measured in soil and terrestrial plant tissue were used to develop site-specific bioaccumulation factors (BAFs), which were used to estimate aquatic plant EPCs. The BAF approach was also used for aquatic invertebrates. For small mammals, the BAF from Step 3b was applied to the total mercury concentration in soil. Methyl mercury and mercuric chloride were assumed to each represent 50% of the estimated total mercury tissue concentration.

7.2.6 Exposure Assumptions

Literature values for body weight and ingestion rates were available for most of the proposed receptors. Regression models were used to estimate receptor-specific ingestion rates and tissue concentrations. Parameters identified for each feeding guild included food and water ingestion rates, components of diet, incidental soil and sediment ingestion rates, and home ranges. Reference toxicity values were identified for both NOAELs and LOAELs. Assumptions and toxicity parameters have been reviewed and approved by FPA Region 4 risk assessors.

7.2.7 Risk Characterization – Direct Exposure

7.2.7.1 Soil Invertebrate Community

The potential for adverse effects to the soil invertebrate community was evaluated through a multi-parameter weight-of-evidence approach. The parameters considered using this approach were the result of a comparison of COPEC concentrations in soil to literature-based ecological screening values (ESVs), the 28-day bioassay results using *E. fetida* and the results of a qualitative survey of the soil invertebrate community at each sample location.

Only inorganic mercury exceeded the ESV with high exceedances (HQs greater than 10) in each of three areas. Methyl mercury did not exceed ESVs.

Toxicity tests using *E. fetida* were performed with nine soil samples from areas of elevated mercury concentrations in comparison to other areas of the site (TERA-1, TERA-3, TERA-5, UNP-1, LNP-3, UNP-5, WB-2, WB-4 and WB-5). A reference sample (SOREF-1) was also collected and a laboratory control also included in the toxicity testing. Although inorganic mercury concentrations in site toxicity test using *E. fetida* exceeded the ESV, negative effects were not observed in site samples when compared to the reference area. Since consistent performance was observed across site samples, the differences from the laboratory control were attributed to a less variable physical characteristic of the soils such as TOC.

The results of the community survey indicated that lower numbers of organisms or classes of organisms were not associated with high levels of mercury, except at UNP-3. Sample location UNP-3 had the highest concentration of inorganic mercury of the sites surveyed and one of the lowest number of total organisms compared to other survey locations. Sample location UNP-3 also tended to be drier and contained fill material, resulting in poor soil quality which may have contributed to the low number of organisms observed.

Risks to the survival, growth, and reproduction of soil invertebrate community were considered to be within protective levels because differences from the reference area were not observed and there was no trend in toxicity test response, survey results, or concentrations of constituents in soil.

7.2.7.2 Aquatic Community (Fish and Reptiles)

The potential for adverse effects to the fish and reptile community was evaluated using a similar weight-of-evidence approach with two parameters: a comparison of mercury concentrations in surface water to literature-based ESVs and 30-day bioassay results using *R. clamitans.*

Comparison of surface water data to mercury ESVs indicate mercury concentrations were above the Region 4 ESV but below the National Recommended Water Quality Criteria (NRWQC) and the total mercury criterion continuous concentration (CCC) of 0.77 µg/L for amphibians.

Toxicity tests using *R. clamitans* were performed with site surface water and sediment from three locations with sediment mercury concentrations that were elevated in comparison to other areas of the site (WSED-40, WSED-41, and WSED-42). A reference sample (SEDREF-1) was also collected and a laboratory control also included in the toxicity testing. Of the three site samples, only WSED-42 had significantly greater frequency of mortality compared to the laboratory control and reference. No significant differences were observed in the mean malformation and wet weight of site samples and the control and reference samples. However, the three site samples had significantly less mean length compared to the control, and WSED-40 and WSED-42 showed significantly lower mean length measurements than the reference.

The results of the toxicity testing indicated that WSED-42 had the highest mortality (51 percent) and lowest growth (1.6 cm organism and 47 mg organism) and was associated with the highest concentration of total mercury in sediment. Based on significant differences from the reference location, sediment mortality lowest observed effect concentration (LOEC) of 0.75 mg/kg and growth LOEC (based on length) of 0.63 mg kg were identified for mercury. Sediment mercury concentrations at WSED-41 were below the identified LOECs for mortality and growth. Mercury concentrations of 0.75 mg/kg (Method 7471) and 0.635 mg/kg (Method E1631) were observed at WSED-42 which meet the LOEC for mortality but are below the LOEC for growth. Surface water toxicity values could not be determined from results because total mercury was not detected in WSED-42.

To identify other potential causes of toxicity, a sample-by-sample comparison of concentrations in the toxicity test samples for constituents other than mercury was performed for surface water and sediment. Other possible surface water contributors to observed effects on tadpoles in the toxicity tests were identified as barium and Aroclor 1268 in surface water. However, further evaluation of these two compounds concluded that barium and Aroclor 1268 were unlikely contributors to observed effects in the bioassays. Barium compounds were considered to have a low toxicity to aquatic organisms because the form (barium sulfate) likely present is essentially non-toxic. In a literature review, ENSR (2004) reported 7- or 10-day lethal Aroclor concentrations with 50 percent mortality (LC50s) for amphibian early life stages ranging from 1,030 µg/L to 28,000 µg/L. Sample concentrations in the site toxicity tests were much lower, ranging from 0.14 to 2.3 µg/L. Considering that the highest concentrations of PCBs in surface water were also observed at SW-40, which had the lowest effects among the site samples, surface water toxicity was determined to be an unlikely contributor to observed effects in the bioassays.

In sediment, mercury concentrations from all three sample locations exceeded the lower effects level (LEL), but not the upper effects level (UEL). Other possible sediment contributors to observed effects in the amphibian toxicity tests were identified as manganese, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene in sediment. Further evaluation of these constituents showed that sediment concentrations of manganese, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene at WSED-40 and WSED-41 were either not detected or detected below ESVs, though significant negative effects were also observed at these locations. As a result, the contribution to toxicity by these constituents has been determined to be limited.

Amphibian growth was reduced compared to the reference, but the reduction was only approximately 15% of the reference condition. This difference is unlikely to have community-level effects, which is the endpoint being evaluated. Risks to the survival, growth, and reproduction of fish and reptile community are considered to be within protective levels because mortality differences from the reference area were observed at only one location, only marginal differences in growth were observed, the actual level of exposure is expected to be low because of the poor quality habitat for fish and reptiles in the drainage pathways, and attribution to total mercury is unclear.

7.2.7.3 Benthic Invertebrates

The potential for adverse effects to the benthic invertebrate community was evaluated using a multi-parameter weight-of-evidence approach. The parameters considered in this approach were the results of a comparison of COPEC concentrations in sediment to literature-based ESVs, 28-day bioassay results using *H. Azteca*, and the results of a qualitative survey of the aquatic invertebrate community. Mercury exceeded the LEL, but not the UEL, in all site samples when compared to literature-based ESVs.

The results of the *H. azteca* toxicity testing showed mortality and weight were not significantly different between site and control or reference samples. Other possible contributors to observed effects include manganese, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene in sediment. While these constituents may contribute to toxicity at WSED-42, where the highest effects were observed concentrations were either not detected or were detected below ESVs at the other two locations where significant negative effects were also observed. As a result, the contribution to toxicity was determined to be limited, abundance and diversity information gathered from the aquatic invertebrate community survey appeared to be unrelated to levels of mercury. There is some uncertainty that the survey size and area sampled at each location were limited.

Since growth differences from the reference area were observed at only one location and the difference was marginal, risks to the survival, growth, and reproduction of the benthic invertebrates were considered to be within protective levels.

7.2.8 Food Web Exposure – Terrestrial

7.2.8.1 Insectivorous Terrestrial Birds – Carolina Wren

Potential risks to the survival, growth, and reproduction of insectivorous bird populations were evaluated with the Carolina wren as the representative receptor. Exposure doses exceeded Toxicity Reference Values (TRVs) for methyl mercury (NOAEL-based HQ of 1.6 and LOAEL-based HQ of 0.9), mercuric chloride (NOAEL-based HQ of 2.1 and LOAEL-based HQ of 1.0), mercuric sulfide (NOAEL-based HQ of 3.0 and LOAEL-based HQ of 1.5), and zinc (NOAEL-based HQ of 16 and LOAEL-based HQ of 1.8) because of concentrations in terrestrial invertebrates and incidental soil ingestion. NOAEL-based and LOAEL-based HQs for the wren were also greater than 1.0 indicating the potential for adverse effects to this receptor. Invertebrates comprised the majority of the exposure doses for methyl mercury, mercuric chloride, and zinc, and incidental soil ingestion comprised the majority of the exposure dose for mercuric sulfide.

7.2.8.2 Insectivorous Mammal – Short-tailed Shrew

Potential risks to the survival, growth, and reproduction of insectivorous mammal populations were evaluated with the short-tailed shrew as the representative receptor. Exposure doses exceeded TRVs for mercuric chloride (LOAEL-based HQ of 1.4) and zinc (NOAEL-based HQ of 3.7 and LOAEL-based HQ of 1.3). NOAEL-based and LOAEL-based HQs for the shrew were also greater than 1.0 indicating the potential for adverse effects for this receptor group. Terrestrial invertebrates comprised nearly 100% of the exposure doses for mercuric chloride and zinc. Incidental soil ingestion was included in the exposure calculation.

7.2.8.3 Herbivorous Birds – Purple Finch

Potential risks to the survival, growth, and reproduction of herbivorous bird populations were evaluated with the purple finch as the representative receptor. Exposure doses exceeded TRVs for mercuric chloride (NOAEL-based HQ of 1.7: the LOAEL was not exceeded) and zinc (NOAEL-based HQ of 31 and LOAEL-based HQ of 3.5). NOAEL-based and LOAEL-based HQs for the finch were also greater than 1.0. Terrestrial plants comprised nearly 100% of the exposure doses for mercuric chloride and zinc.

7.2.8.4 Herbivorous Mammals – Meadow Vole

Potential risks to the survival growth, and reproduction of herbivorous mammal populations were evaluated with the meadow vole as the representative receptor. Exposure doses exceeded TRVs for mercuric chloride (LOAEL-based HQ of 1.2) and zinc (NOAEL-based HQ of 6.8 and LOAEL-based HQ of 2.4. The LOAEL-based HI for mercury was also greater than 1.0. Terrestrial plants comprised nearly 100% of the exposure doses for mercuric chloride and zinc.

Even though HIs for terrestrial receptors were generally greater than 1, the identified risks to terrestrial receptors were concluded as being unlikely to have population level effects, the endpoint being evaluated. Factors for this conclusion were that the magnitudes of TRV exceedances are low, the sample locations with elevated concentrations are few and represent only a small percent of the total area, and the analysis included three conservative features: the inclusion of a full soil ingestion factor for species consuming soil invertebrates, the exclusion of Area Use Factor (AUFs), and the use of the UCL as an EPC. Furthermore, the elevated concentrations of zinc in plants were described as possibly due to a natural occurrence. Risks to the survival, growth, and reproduction of terrestrial avian and mammalian species populations were considered low.

7.2.9 Food Web Exposure – Aquatic

7.2.9.1 Amphibians and Reptiles – Bullfrog and Northern Water Snake

Potential risks to the survival, growth, and reproduction of amphibian and reptile populations were evaluated with the bullfrog and northern water snake as the representative receptors. Except for the exposure of northern water snake to methyl mercury, exposure doses did not exceed TRVs. However, methyl mercury was estimated as 50% of the total mercury concentration in vertebrate prey. In general, methyl mercury content varies greatly among vertebrate species and within specific tissues (hair and brain tissue typically have the highest content, while liver and kidney content are lower as a result of demethylation). Risks to the survival, growth, and reproduction of northern water snake populations were listed as low because the approach used to estimate 50% methyl mercury content was determined to likely overestimate the actual methyl mercury content, and. because the magnitude of the TRV exceedance is small.

Based on these results, risks to the survival, growth, and reproduction of amphibians and reptile populations was considered low.

7.2.9.2 Omnivorous Birds – Wood Duck

Potential risks to the survival, growth, and reproduction of omnivorous bird populations were evaluated with the wood duck as the representative receptor. Since mercury and zinc exposure doses did not exceed TRVs risks to the survival, growth, and reproduction of omnivorous bird populations were considered low.

7.2.9.3 Omnivorous/Piscivorous Birds – Green Heron

Potential risks to the survival, growth, and reproduction of omnivorous piscivorous bird populations were evaluated with the green heron as the representative receptor. Since mercury and zinc exposure doses did not exceed TRVs. and only the NOAEL-based HI was greater than 1.0, risks to the survival, growth, and reproduction of omnivorous piscivorous bird populations were considered low.

7.2.9.4 Insectivorous & Piscivorous Mammals – Little Brown Bat and Mink

Potential risks to the survival, growth, and reproduction of insectivorous piscivorous mammal populations were evaluated with the little brown bat and mink as the representative receptors. Since mercury and zinc exposure doses did not exceed TRVs, risks to the survival, growth, and reproduction of insectivorous piscivorous mammal populations were considered low.

Except for mercuric sulfide and the northern water snake, no risks were identified for the survival, growth, and reproduction of aquatic avian and mammalian species populations. For water snakes exposed to methyl mercury, the identified risks were described as unlikely to have population level effects (the endpoint being evaluated) since the magnitude of the TRV exceedance was low, the sample locations with elevated concentrations are few and represent only a small percent of the total area, and the analysis included conservative factors. Risks to the survival, growth, and reproduction of northern water snake populations were also low.

7.2.10 Other Food Web Exposure Constituents of Interest

Food web exposure COPECs identified in Step 3a were compared to PRGs developed using assumptions presented in the Step 3b problem formulation. These comparisons were made to identify: (1) whether other COPECs (e.g. non risk-drivers) exceed PRGs in areas where the risk drivers do not: and (2) data gaps warranting further investigation. A few of these constituents exceeded NOAEL-based PRGs in one or more locations but were below the LOAEL-based PRGs. These constituents were not addressed further. Constituents exceeding LOAEL-based PRGs included mercury, TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin) Toxicity Equivalents (TEQs), aldrin, hexachlorobenzene, and chromium. Step 3b led to the conclusion that collection of additional data for mercury was sufficient to complete the BERA.

7.2.10.1 Chromium, Aldrin, and Hexachlorobenzene

Risks to the survival, growth, and reproduction of terrestrial avian and mammalian species populations from chromium, aldrin, and hexachlorobenzene, were considered to be within protective levels due to the low frequency of exceedance (3%).

7.2.10.2 TCDD TEQs

Calculated NOAEL-based and LOAEL-based HQs did not exceed 1.0 for piscivorous or omnivorous avian and reptile wildlife represented by the wood duck, green heron, adult bullfrog, and northern water snake. Risks to the survival, growth, and reproduction of avian piscivorous or omnivorous species populations from TCDD TEQs were considered to be within protective levels.

For the Carolina wren, NOAEL-based and LOAEL-based HQs exceeded 1.0 when all data was used. When elevated data from either TERA-5 or both TERA-5 and UNP-1 data were excluded, NOAEL-based HQs were reduced by an order of magnitude to levels between 1 and 3. LOAEL-based HQs were below 1.0.

Since the magnitude of exceedances of TRVs was low and there are few sample locations with elevated concentrations, which represent only a small percentage of the total area, risks to the survival, growth, and reproduction of reptile species populations were considered to be within protective levels. Risks from TCDD TEQs could not be ruled out due to an elevated LOAEL -based HQ when all data were used. Therefore, a soil PRG based on TCDD TEQ risk to the Carolina wren was calculated as part of the RI. The soil PRG was determined by back calculating the risk equations to a TCDD TEQ concentration in surface soil (0 to 0.5 foot bgs) that corresponds to an HQ of 1. The NOAEL-based soil PRG for the Carolina wren is 0.008 μg/kg, and the LOAEL-based soil PRG is 0.08 μg/kg. It should also be noted that TERA-5 is also the area of highest total mercury concentrations in soil, and future remediation for total mercury will likely remove elevated levels of TCDD.

Risk estimates for mammalian wildlife were calculated for the entire data set and with elevated data from TERA-5 or both TERA-5 and UNP-1 excluded. Since NOAEL-based or LOAEL-based HQs did not exceed 1.0 for mammalian herbivorous or omnivorous wildlife represented by the meadow vole or mink, risks to the survival, growth, and reproduction of mammalian herbivorous or omnivorous species populations from TCDD TEQs were considered to be within protective levels.

For flying insectivorous mammalian wildlife represented by the little brown bat, risk estimates using all data resulted in a NOAEL-based HQ for total TEQs of 6.6 and a LOAEL-based HQ of 0.6. These HQs suggest that population level effects, the endpoint being evaluated, are unlikely. Risks to the survival, growth and reproduction of flying insectivorous mammalian wildlife species populations from TCDD TEQs were considered to be within protective levels.

For insectivorous mammalian wildlife represented by the shrew, risk estimates using all data resulted in a NOAEL-based HQ for total TEQs of 66 and a LOAEL-based HQ of 6. An additional TRV was then used based on a mink study; the original TRV study was conducted on a rat.

With this additional TRV a range of HQs was established for the shrew using all data and with elevated data from TERA-5 or both TERA-5 and UNP-1 excluded. Under these scenarios, HQs based on the rat study ranged from 63 to 14 based on the NOAEL and between 6.6 and 1.4 based on the LOAEL. Under the same scenarios using the mink TRV NOAEL-based HQs were all below 1.

The identified risks from TCDD TEQs to insectivorous mammalian wildlife represented by the shrew are unlikely to have population level effects, the endpoint being evaluated. Factors contributed to this conclusion include the magnitude of exceedances of TRVs was low. TRVs are not exceeded when additional TRVs are considered, the sample locations with elevated concentrations are few and represent only a small percent of the total area, and off-site sources of TEQs are present. TERA-5 is also the area of highest total mercury concentrations in soil and future remediation for total mercury will likely remove elevated levels of TCDD. Risks to the survival, growth, and reproduction of insectivorous mammalian wildlife populations were considered to be within protective levels.

7.2.11 Uncertainties

Uncertainties included in the BERA include:

- The use of the MNAF in developing EPCs and for assessing toxicity may overestimate or underestimate risk.
- Incidental soil ingestion was included in the total chemical exposure calculations for terrestrial wildlife that ingest invertebrates, even though invertebrates were not depurated prior to chemical analyses. Incidental soil ingestion was included in the total chemical exposure calculations as a conservative assumption, even though some of the soil ingestion would come from invertebrates collected in the field. As a result of this approach, risks to terrestrial wildlife may be overestimated.
- Tissue concentrations were measured in tadpoles exposed to site sediment and surface water because in situ organisms were not available. Tissue concentrations based on laboratory exposure of tadpoles to site sediment and surface water were then used as surrogates for fish tissue concentrations for piscivorous wildlife. Differences in fish and tadpole bioaccumulation are not well studied, but are assumed to be minor. Risks to piscivorous wildlife may be under- or overestimated.

- Mercury and zinc concentrations in aquatic plants, aquatic invertebrates, and small mammals were not measured directly and had to be estimated using BAFs. Although the strongest available relationships were used, the use of modeled tissue concentrations and literature-based BAFs may under- or overestimate risk.
- Except for vertebrate prey, the values used in the BERA were based on measured tissue values (measured directly or by relationships derived from the measured tissue levels) and are considered more applicable for determining risks in the BERA. In general, methyl mercury content varies greatly among vertebrate species and within specific tissues. For vertebrate prey, the BERA used the EPA requested value of 50% based on the total mercury soil UCL (16.7 mg/kg) multiplied by the BAF and 0.5. Therefore, risk from exposure to methyl mercury may be overestimated.
- The recommended UCL from ProUCL 4.0 was used as the EPC, or if a UCL could not be calculated, the maximum concentration was used as the EPC. For some constituents, the actual EPC may be closer to the arithmetic average than the UCL. Risks based on UCL and maximum EPCs may be overestimated if the actual EPC is closer to the arithmetic average.
- An adequate avian TRV for mercuric sulfide was not identified and the TRV for mercuric chloride was used as a surrogate instead. Since mercuric sulfide is considered to be less toxic than mercuric chloride, risk estimates for birds and mercuric sulfide may be overestimated.
- A soil reference sample, location SOREF-1 was collected in the same area that was previously identified as the reference location for the site during the Phase II sampling in November 2005. This area showed poor earthworm survival, poor soil quality, and limited numbers or classes of organisms during the soil community survey. If earthworm survival had been higher in the reference area, survival in site soils may have been statistically lower.

Uncertainties identified by an EPA ecological risk assessor in reviewing the draft ROD include:

1. Site-specific data was collected for bioaccumulation of mercury into terrestrial invertebrates. Site-specific data was unavailable for bioaccumulation of Aroclor 1268 into insects. There is some uncertainty in the cleanup levels in the draft ROD on account of having used literature assumptions for bioaccumulation in the food-chain models that were used to develop the cleanup levels for Aroclor 1268. The uncertainty does not affect the selected remedy for the Wooded Bottomland Area Drainage Pathways. Most of the concentrations of Aroclor 1268 above preliminary remedial goals (PRGs) derived from conservative assumptions are encompassed in the footprint selected for excavation.

2. The changes to the toxicity reference value (TRV) and the bioaccumulation factors (BAFs) since the point at which the risk assessment was prepared may indicate uncertainty in the cleanup goal for protection of ecological receptors from Aroclor 1268 in Wooded Bottomland Area soils. The concentrations of Aroclor 1268 in Wooded Bottomland Area soils outside of the remedial footprint are mostly below 3 mg/kg. Soils with concentrations of Aroclor 1268 substantially above 3 mg/kg are typically located adjacent to the areas that are planned to be excavated under the selected remedy. It is recommended that any adjustments to toxicity values or other assumptions in the risk assessments be evaluated during the remedial design phase. Slight adjustments might be possible to the remedial footprint, but the overall remedy will remain the same.

3. The food-chain models that were used to derive the CULs in the ROD were checked as part of this review. The life history parameters were found in Table 3-15 of the baseline

ecological risk assessment (BERA) CH2MHILL (2010). The TRVs were found in Table 4-13 of the BERA. The ecological CULs from the BERA food-chain models used in the ROD were:

- 3 mg/kg for total mercury in Wooded Bottomland Area Soils (HI = 1) for the short-tailed shrew.
- 0.0854 µg/kg for 2,3,7,8-TCDD toxicity equivalents in Wooded Bottomland Area Soils (HQ = 0.9) for the Carolina wren
- 47 mg/kg for Aroclor 1268 in Wooded Bottomland Area Drainage Pathway Sediments (HQ = 1) for the green heron.

The transfer factors between abiotic media and concentrations in tissues needed to derive the PRGs were uptake of mercury from soil into terrestrial invertebrates to support the diet of the short-tailed shrew. Overall, the CULs were okay. It was difficult to review them because the information was in the BERA but also in the Step 3b document (CH2MHILL 2009). It would be advantageous to have a summary of the derivation of CULs in an appendix to the ROD for ease of reference.

4. A site-specific uptake factor from measurements of mercury in terrestrial invertebrates was used in the BERA (Figure 1). The calculation of the PRG for mercury in soils for the short-tailed shrew is shown in Appendix B of the BERA.

5. The PRG for 2,3,7,8-TCDD Toxicity Equivalents for the Carolina wren required an uptake factor for 2,3,7,8-TCDD from soil to terrestrial plants and an uptake factor for 2,3,7,8-TCDD from soil to terrestrial invertebrates. The uptake factor for 2,3,7,8-TCDD for plants came from EPA (2007). The document presented a formula for estimating a BAF for uptake from soils to plants for organic compounds as a function of the octanol-water partition coefficient in Figure 5 of the guidance document.

Uptake of 2,3,7,8-TCDD toxicity equivalents in to terrestrial plants:
$\log BAF_{plant} = -0.229 \times \log K_{OW} + 1.0237$

BAF = Bioaccumulation Factor (concentration in plant in mg/kg dry weight to concentration in soil in mg/kg dry weight)

K_{OW} = Octanol-water partition coefficient, L/kg

Log K_{OW} (2,3,7,8-TCDD) = 6.8 L/kg.

BAF_{TCDD} = 0.29 in dry weight units.

Uptake of 2,3,7,8-TCDD into Terrestrial Invertebrates (Sample *et al.* 1998)

$\ln(earthworm) = B0 + B1(\ln[soil])$
earthworm = concentration in earthworm, mg/kg dry weight

soil = concentration in soil, mg/kg dry weight

B0 = 1.182
B1=3.533.

6. The uptake of 2,3,7,8-TCDD toxicity equivalents in to terrestrial invertebrates was an equation obtained from Sample *et al.* 1998. The equation is presented in Table 7-2 of CH2MHILL (2009).

7. The calculation of the PRG for 2,3,7,8-TCDD toxicity equivalents is shown in Appendix C-2 to CH2MHILL (2009). The contribution to exposure to the Carolina wren from ingestion of plants is the concentration of TCDD in plants (0.0854 µg/kg x 0.29) multiplied by the dietary fraction of plants (0.06). The outcome (0.0854 µg/kg x 0.29 x 0.06) will be summed with the calculated exposure through ingestion of terrestrial invertebrates and incidental ingestion of soil. The predicted concentration in terrestrial invertebrates for 8.54E-5 mg/kg in soil was 5.3E-04 mg/kg in terrestrial invertebrates. The predicted TCDD concentration in terrestrial invertebrates is multiplied by the dietary fraction (0.94). The outcome (5.3E-04 x 0.94) will be summed with the calculated exposure through incidental ingestion of soil. The fraction of the food ingestion rate that was assumed to be incidental ingestion of soil was 10%. The rate is multiplied by the concentration of TCDD in soil. Total intake is:

   (8.54E-5 mg/kg x 0.29 X 0.06 +
   5.3E-04 mg/kg x 0.94 +
   8.54E-05 mg/kg * 0.1) x 0.248 / 1.4E-04,

   Where 0.248 is the body-weight normalized food ingestion rate of the Carolina wren, and 1.4E-4 mg/kg-day is the Lowest Observable Adverse Effect Level (LOAEL) TRV for 2,3,7,8-TCDD toxicity equivalents. The hazard quotient should be 0.9, which it is.

The green heron (*Butorides virescens*) was considered to be the most sensitive ecological receptor for Aroclor 1268 in Wooded Bottomland Area sediments with a CUL of 47 mg/kg. The calculation of the PRG for Aroclor 1268 in sediments for the green heron was found in CH2MHILL (2009). The green heron's diet consisted of aquatic invertebrates and forage fish in proportion of 55% aquatic invertebrates and 45% forage fish. The PRG for Aroclor 1268 in sediments for the green heron required an uptake factor for uptake of Aroclor 1268 from sediments to aquatic invertebrates and an uptake factor for Aroclor 1268 from sediments into forage fish. The uptake factors used came from the EPA comment memo that was attached to CH2MHILL (2009). The uptake factor from sediments to aquatic invertebrates used in CH2MHILL (2009) was 0.95, which was an average biota-to-sediment transfer (BSAF) in units of concentration in tissue normalized to lipid concentration to concentration in sediment normalized to organic carbon concentration. The comment indicated that the lipid content in benthic invertebrate tissue can be assumed to be 5%. The organic carbon content in sediments was indicated to be assumed to be 1%. The BSAF would ideally have been adjusted by the lipid content in the organism before using it in the food-chain model to calculate the PRG for the green heron. Since this multiplication was not performed, the previous model in Table 7-2, which came from Bechtel-Jacobs, 1998, was used for checking.

> Uptake of Aroclor 1268 into Aquatic Invertebrates (Bechtel Jacobs, 1998)
>
> ln(aq. invertebrate)=B0+B1(ln[sediment])
>
> B0 = 1.6
> B1 = 0.939.

7.2.12 Conclusions

The BERA was finalized in 2010 and addressed Steps 1 through 3B of the ERA process. Ecological resources at the site were identified and evaluated for potential risk from site-related COPECs. Ecological risk calculations included in the BERA were developed for areas containing viable wildlife habitat and did not include areas that were intended to be removed as part of the site redesign or planned remedial activities. Areas with available habitats include the terrestrial areas of the Upland Non-Process and Wooded Bottomland Areas. Soil, sediment, and surface water samples collected throughout the Wooded Bottomland Area, Upland Non-Process Area, Streams A and B, and Wetland B were used to evaluate potential risk in the BERA.

The BERA identified wildlife hazards associated with exposure to mercury and PCBs for the Wooded Bottomland Area, the Upland Non-Process Area, and Wetland B. The BERA focused on indicator COCs rather than all detected constituents in site media.

Hazards from mercury in sediment and soil are considered low. The hazards were spatially isolated, inputs to the risk analysis were conservative, and field observations indicated significant wildlife use. A PRG of 3 mg/kg for mercury in Wooded Bottomland Area soil was calculated by EPA based on the data collected for the BERA, and 3 mg/kg was selected as the Wooded Bottomland Area soil PRG for mercury. Although the BERA did not define a PRG for mercury in sediments, potential sediment toxicity to amphibians and benthic macroinvertebrates was indicated at a concentration greater than 0.75 mg/kg mercury. The value of 0.75 mg/kg was selected as the PRG for on-site sediments based on the lowest observed effects concentration in *R. clamitans* and *H. azteca* toxicity tests in the BERA.

Sediment PRGs for the COPEC driving most of the unacceptable risk in Bottomland surface sediment (i.e., Aroclor 1268) was determined by reverse calculation of LOAEL-based ecological risk equations to an HI equal to 1.0 for each receptor and COPEC evaluated in Step 3B. For Aroclor 1268, the most sensitive aquatic receptor (i.e., the receptor corresponding to the calculated lowest PRG) was the green heron. The LOAEL-based sediment PRG for Aroclor 1268 is 47 mg/kg. Aroclor 1268 was not an ecological COC for surface soil.

Although 2,3,7,8-TCDD TEQ was not listed as a COC in the BERA, a PRG was calculated as part of the Final FS Report for 2,3,7,8-TCDD TEQ (dioxins/furans) and 2,3,7,8-TCDD (dioxin-like PCBs) in Wooded Bottomland Area surface soil based on risk to the Carolina wren. The 2,3,7,8-TCDD TEQ (dioxins/furans) PRG for Bottomland surface soils (0-0.5 feet) is 85.4 ng/kg. The 2,3,7,8-TCDD TEQ (dioxin-like PCBs) PRG for Bottomland surface soils (0-0.5 feet) is 196 ng/kg.

In the FS, Bottomland sediments were also evaluated in the calculation of potential PRGs protective of wildlife receptors exposed to 2,3,7,8-TCDD TEQ (dioxins/furans) and 2,3,7,8-TCDD TEQ (dioxin-like PCBs). Potential risk was identified to the green heron from exposure to Bottomland sediments. The 2,3,7,8-TCDD TEQ (dioxin-like PCBs) PRG for Bottomland Area surface sediment (0-0.5 feet) is 210 ng/kg. The 2,3,7,8-TCDD TEQ (dioxins/furans) PRG for Bottomland Area surface sediment (0-0.5 feet) is 280 ng/kg.

Overall, available information suggests that the upgradient portion of Stream B may be an isolated area of concern. Stream A, upgradient of its confluence with Stream B, was previously identified for remedial action. Constituent concentrations downgradient of these two areas are expected to decrease with remediation in either stream.

8.0 REMEDIAL ACTION OBJECTIVES

The Remedial Action Objectives (RAOs) for the site are:

Upland Process and Non-Process Areas

- Reduce risk to construction/industrial workers from exposure through dermal adsorption and incidental ingestion from surface and subsurface soils containing mercury and Aroclor 1268 by reducing concentrations to levels that are protective for commercial and industrial uses.
- Prevent migration of mercury and Aroclor 1268 from upland surface soils and the solids in the storm water conveyance system to the Wooded Bottomland Area by reducing concentrations to levels that are protective of human and ecological receptors.
- Reduce risks to construction/industrial workers from and prevent migration of principal threat wastes by treating/solidifying the mercury waste and contaminated soils beneath the former Mercury Cell Building and Retort pads.

Wooded Bottomland Areas

- Reduce risk to adolescent trespassers from exposure through dermal adsorption of surface water containing Aroclor 1268 by reducing concentrations to protective levels.
- Reduce risk to adolescent trespassers from exposure through dermal absorption and incidental ingestion of surface soil containing Aroclor 1268 by reducing concentrations to protective levels.
- Reduce risk to ecological receptors from sediment contaminated with mercury and Aroclor 1268 by reducing concentrations to protective levels.
- Reduce risk to ecological receptors from surface soil contaminated with mercury by reducing concentrations to protective levels.

The completed remedy will reduce risks to human and ecological receptors to levels provided for in the NCP (i.e. excess cancer risk equal to or less than 10^{-5}, and excess non-cancer risk equal to or less than HI of 1). The selected remedy will lower the risks by reducing the concentrations of the soil, sediment and surface water contaminants to the cleanup levels in **Section 12.4** (**Table 104** and **Table 105**).

9.0 DESCRIPTION OF ALTERNATIVES

The site remedial alternatives are grouped into two categories within the site, Overall Site (Alternatives A-1 through A-6) and mercury waste and soil contamination considered PTW which is located in the Retort Area and Mercury Cell Building Pads (Alternatives S-1 through S-4). This grouping simplified the alternative development and evaluation due to the different conditions within each category. The evaluation and selection of the remedial alternative for mercury waste and contaminated soils associated with the Retort Area and Cell Building pads (S-1 through S-4) is independent of the remedial alternative selection for the remainder of the site. Implementation of the remedies under each category may be conducted concurrently where this would result in potential cost savings and efficiencies through reuse of common remedial components such as labor, equipment, access roads, and staging areas. Sequencing of remedial alternatives will be considered during remedial design. The final remedy selected for the site will include one alternative from the A-group and one alternative from the S-group. **Table 87** lists the ten alternatives designation and title.

Table 87: List of Remedial Alternatives

Area	FS Designation	Title
Overall Site	A-1	No Action
	A-2	Capping with Limited Excavation, Off-site Disposal or On-site Treatment, and Institutional Controls (ICs)/Engineering Controls (ECs)
	A-3	Combination of Capping and Excavation, On-site Disposal, and ICs/ECs
	A-4	Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs
	A-5	Excavation, On-site Disposal, and ICs/ECs
	A-6	Excavation, Off-site Disposal, and ICs/ECs
Retort and Cell Building Pad Areas	S-1	No Action
	S-2	Capping with Vertical Impermeable Barrier Installation and ICs
	S-3	Treatment with In-Situ Stabilization/Solidification, Capping and ICs
	S-4	Excavation and Off-site Treatment and Disposal

9.1 Description of Remedy Components

Descriptions of each of the ten alternatives follow in Sections 9.1.1 through 9.1.10. **Table 88** lists each remedial area. The former RCRA surface impoundments that are closed are part of the site and will be included in the selected remedy although no separate remedial alternatives were developed and evaluated.

Table 88: Remedial Area Description

Remedial Area	Associated AOIs*	Area Description
A	WCBPA & NCBPA	Area West of CBP
B	WWTP	Soutwest Corner of WWTP
C	OSD, RYD & RP	Membrane Plant Ancilliary Areas
D	FIL	Fill Area
E	NCBPA, OPA & RYD	Areas Northeast of Cell Building Pad
F	RET	Retort Area
G	CBP	Cell Building Pad
H	WWTS	Wastewater Treatment Solids
I	SCS	Stormwater Conveyance System
J	Drainage Pathways	Wooded Bottomland Areas (Including Drainage Pathways)
K	WBA (North)	Wooded Bottomland Area (North of Fill Area)
L	ONP & NRB	Areas Northeast Corner of ONP and Southeast Corner of NRB
M	WBA (North)	Wooded Bottomland Area (North of Fill Area)

Notes:
AOIs* - The Areas of Interest noted are remedial areas that were selected for remedial action and subsequent technology screening. Some AOIs were excluded from remedial action as the RI results in these areas did not exceed PRGs. These remedial areas may only include a portion of the AOI or all of the AOI, which was dependent on the RI results, PRGs, regulatory requirements and alternative technologies selected. A complete list of all AOIs evaluated are discussed in Table 1-4 of the FS.

Acronyms:

CBP -	Cell Building Pad
FIL	Fill Area
NCBPA	North Cell Building Pad Area
WCBPA	West Cell Building Pad Area
NRB -	North Retention Basin
ONP -	Old North Pond
OPA	Old Parking Area
OSD	Old Salt Dock
RET	Retort Area
RP	Robert's Pond
RYD	Rail Yard
SCS	Stormwater Conveyance System
SWDS -	Solid Waste Disposal Site
WBA	Wooded Bottomland Area
WWTS -	Wastewater Treatment Solids
WWTP -	Wastewater Treatment Plant

9.1.1 Alternative A-1: No Action

Estimated Costs:	
Capital Cost	$0
Annual O&M Cost	$0
Total Cost	$0
Total Present Worth Cost	$0
Estimated Timeframes:	
Construction Timeframe	0 months
Time to Achieve RAOs	beyond our lifetime

No Action includes no new remedial measures or ICs. According to the NCP (40 CFR § 300.430(e)(6)), No Action is retained for detailed analysis and used as a baseline in comparing alternatives. The No Action alternative assumes that current security monitoring and restrictions on trespassing would not be enforced, no additional monitoring would be conducted, and operation of the existing stormwater treatment system would be discontinued.

9.1.2 Alternative A-2: Capping with Limited Excavation, Off-site Disposal, and ICs/ECs

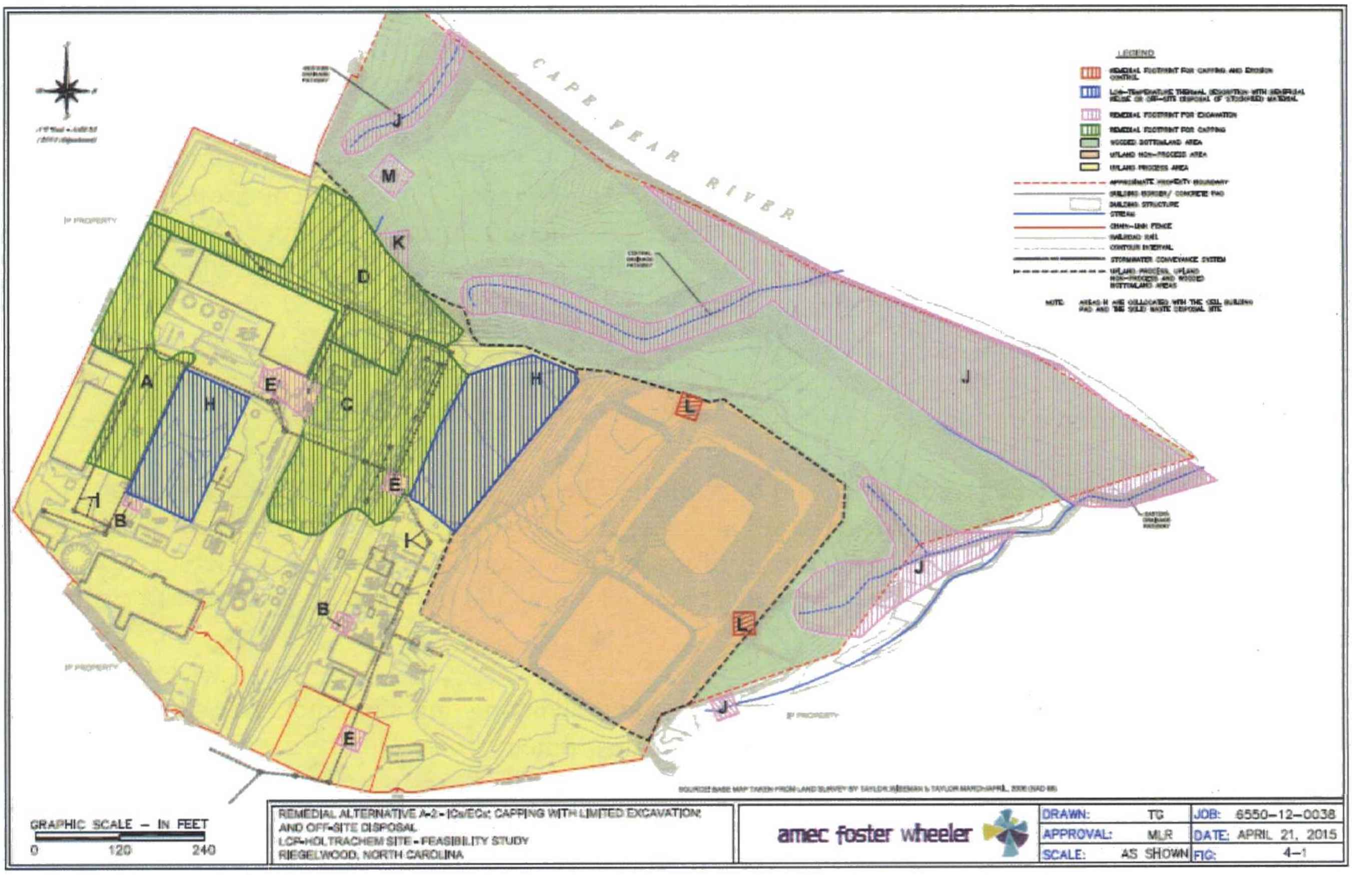
Estimated Costs	A-2a (off-site disposal of WWTS)	A-2b (on-site treatment of WWTS)
Capital Cost	$ 18,647,700	$ 20,180,300
Annual O&M Cost	$ 31,500	$ 31,500
Total Cost	$ 19,700,000	$ 21,300,000
Total Present Worth Cost	$ 19,000,000	$ 20,600,000
Estimated Timeframes		
Construction Timeframe	12 months	12 months
Time to Achieve RAOs	12 months	12 months

This alternative includes:

- Capping of most of the UPA
- Excavation of the Wooded Bottomland Area drainage ditches, low-lying portions of the Wooded Bottomland Area, and other isolated areas to approximately 2 feet with disposal of excavated material in an off-site EPA-approved TSCA chemical waste landfill
- Closure of the stormwater conveyance system
- Decommissioning of the stormwater treatment system and restoration of the site to natural drainage following completion of remedial action
- ICs/ECs
- Either transporting and disposing the WWTS off-site or treating the solids by low temperature thermal destruction (LTTD) so that the treated residuals can be beneficially reused as fill on the site
- Capping/erosion control would be implemented in the L Areas along the berm of the Upland Non-Process Area

Figure 38 illustrates remedial actions for Areas A through M (minus F and G).

Figure 38: Alternative A-2 Conceptual Remedial Plan



The rationale for selecting areas to be capped or removed is based on the size/local extent of detected contamination, the magnitude of PCB and mercury concentrations, and the location/exposure risk. Remedial activities in the UPA include mostly capping with excavation of isolated areas with mercury or PCB concentrations that exceed cleanup levels protective of the industrial or construction worker in accordance with the RAOs.

Capping and excavation in the UPA would also serve to protect the Wooded Bottomland Area by preventing contact of UPA soil with surface runoff and the potential migration of soil into the Wooded Bottomland Area. Areas in the UPA to be capped under Alternative A-2 include Areas A, C, and D. Several isolated areas (B, E, K, and M) with concentrations greater than the cleanup levels would be excavated because long-term maintenance of a small cap in each of these areas would not be practical. Similarly, the remedial areas in the Wooded Bottomlands Area (J Areas) would also be excavated to limit long-term maintenance. Excavated areas would be backfilled to approximately original grade and revegetated under this alternative. Capping and erosion control would occur in the L Areas, which are located along the steep portion of the Upland Non-Process Area berm. Removal of L Areas is not recommended due to the potential for destabilizing the berm during remedial action.

Capping

In Alternative A-2, a cap would be applied over the larger contiguous UPA that exceed the Aroclor 1254 and Aroclor 1268 surface and subsurface soil cleanup level of 11 mg/kg (Areas A, C, and D) and the L Areas along the berm of the Upland Non-Process Area impoundments. The anticipated extent of capping for this scenario is shown on **Figure 38**. The total cap area for this alternative is estimated to be approximately 2.4 acres. The final cap footprint would be confirmed during remedial design sampling.

Capping includes placing a membrane-soil cap system with a vegetated cover over the remediation area. The cap design must meet the North Carolina substantive requirements for a final cover on a RCRA Subtitle D solid waste landfill as well as post-closure requirements that are determined by EPA to be "relevant and appropriate" and identified as ARARs. Before cap placement, the area would be prepared by clearing vegetation and leveling in-ground structures. A protective soil layer and geotextile membrane would be placed over the area to isolate the PCB-containing soil. Another layer of protective soil would be placed on top of the membrane, plus a layer of topsoil that would be vegetated for final restoration and erosion control.

Material specifications would require fill soil to be clean. The cap composition assumed for costing is a protective underlayment of fill soil (compacted in place), a geosynthetic liner, a protective layer of fill soil on top of the liner soil, plus up to six inches of topsoil to support revegetation. The actual cap composition and soil layer thicknesses would be evaluated during the remedial design and will comply with capping ARARs.

Cap placement activities would be conducted using standard construction equipment (e.g., backhoes, bulldozers, graders, etc.). Topographic survey and GPS instrumentation would be used to confirm extents and final grades of cap emplacement.

Excavation

Alternative A-2 consists of excavating isolated Upland Process Areas B and E and Wooded Bottomland Areas J, K, and M. Areas B and E exceed the UPA Aroclor 1254+Aroclor 1268 surface and subsurface soil cleanup level (11 mg/kg). Areas J exceed the Wooded Bottomland Area Aroclor 1268 sediment cleanup level (47 mg/kg) and the mercury sediment cleanup level (0.75 mg/kg). Areas K and M exceed the Wooded Bottomland Area Aroclor 1254+Aroclor 1268 surface soil cleanup level (21 mg/kg). The anticipated extent of excavation for this scenario is shown on **Figure 38**. The total in-place excavation volume is estimated to be 10,900 yd^3. The actual excavation footprints of the isolated areas would be confirmed during remedial design sampling. Following excavation, clean backfill/topsoil would be placed in the areas to restore the ground surface to approximately pre-excavation grades and the areas seeded/revegetated to control erosion.

Removal activities would be conducted using standard construction equipment (e.g., backhoes, bulldozers) equipped with GPS instrumentation to monitor removal progress and confirm that excavations meet the established horizontal and vertical goals. Backfill would be placed to predetermined elevations using conventional earthmoving equipment. Seeding and erosion controls would be implemented upon verification that backfill design elevations have been met.

Where required, excavated soil would be stockpiled within a materials staging area for dewatering to meet appropriate disposal requirements before transportation. Drying would be accomplished through a combination of gravity dewatering and/or the addition of amendments (e.g., bed ash, fly ash, or portland cement). Drainage from dewatering operations and potentially impacted stormwater would be managed through the existing stormwater conveyance and treatment system. Excavated and dewatered materials would be transported for disposal to an appropriate EPA-approved off-site permitted RCRA solid waste or hazardous waste landfill or TSCA chemical waste landfill.

Stormwater Conveyance

The stormwater conveyance system (I Areas) would be closed by cleaning and/or sealing off and solidifying the pipes/inlets in place using flowable grout. Solids, if removed during closure of the system, would be dewatered and disposed in an appropriate off-site EPA-approved landfill.

Following completion of site-wide remedial activities active stormwater collection and management would no longer be necessary. Therefore, the existing stormwater treatment system would be decommissioned and the site returned to natural drainage. Long-term maintenance would include inspection and repair of erosion controls designed to mitigate sedimentation during stormwater flow events.

WWTS

WWTS (Areas H) containing PCB concentration greater than 50 mg/kg are temporarily stockpiled at the Mercury Cell Building pad and the SWDS. Alternative A-2 consists of either off-site disposal of the WWTS at an EPA-approved TSCA chemical waste landfill or treatment of PCBs through LTTD so that the residue can be beneficially reused as fill on-site where possible. The total volume of the stockpiled soil on both the Mercury Cell Building pad and the SWDS is approximately 23,700 yd^3.

LLTD ex-situ treatment would employ the application of heat and reduced pressure to volatilize and desorb PCBs from soil. The stockpiled soil would be dried, screened, and then placed in a thermal desorber, such as a rotary kiln or auger system, and heated to volatilize and transfer PCBs to a gas stream. The off-gas stream would be passed through wet scrubbers or fabric filters to remove particulate matter. PCBs would typically be removed through condensation followed by carbon adsorption, or destroyed in a secondary combustion chamber or a catalytic oxidizer.

Ancillary Activities

Site preparation would include the construction of access roads, support zones, and staging areas for personnel, equipment, and material. Clearing and installation of erosion controls would be required for support and staging areas.

Ancillary activities to support construction activities would include: cap/excavation area access and preparation, erosion control, backfill material delivery and staging, excavated material staging and handling, cover soil delivery and staging, construction waste disposal, cap placement verification, waste soil transport and disposal, stormwater management, dust monitoring/control, seeding/planting, and restoration, as needed.

Ambient air would be monitored for dust during construction. Dust control measures would be implemented, and would include wetting roads, stockpiles, and staging areas. Real-time air monitoring would be performed during construction activities to verify compliance with ARARs.[12]

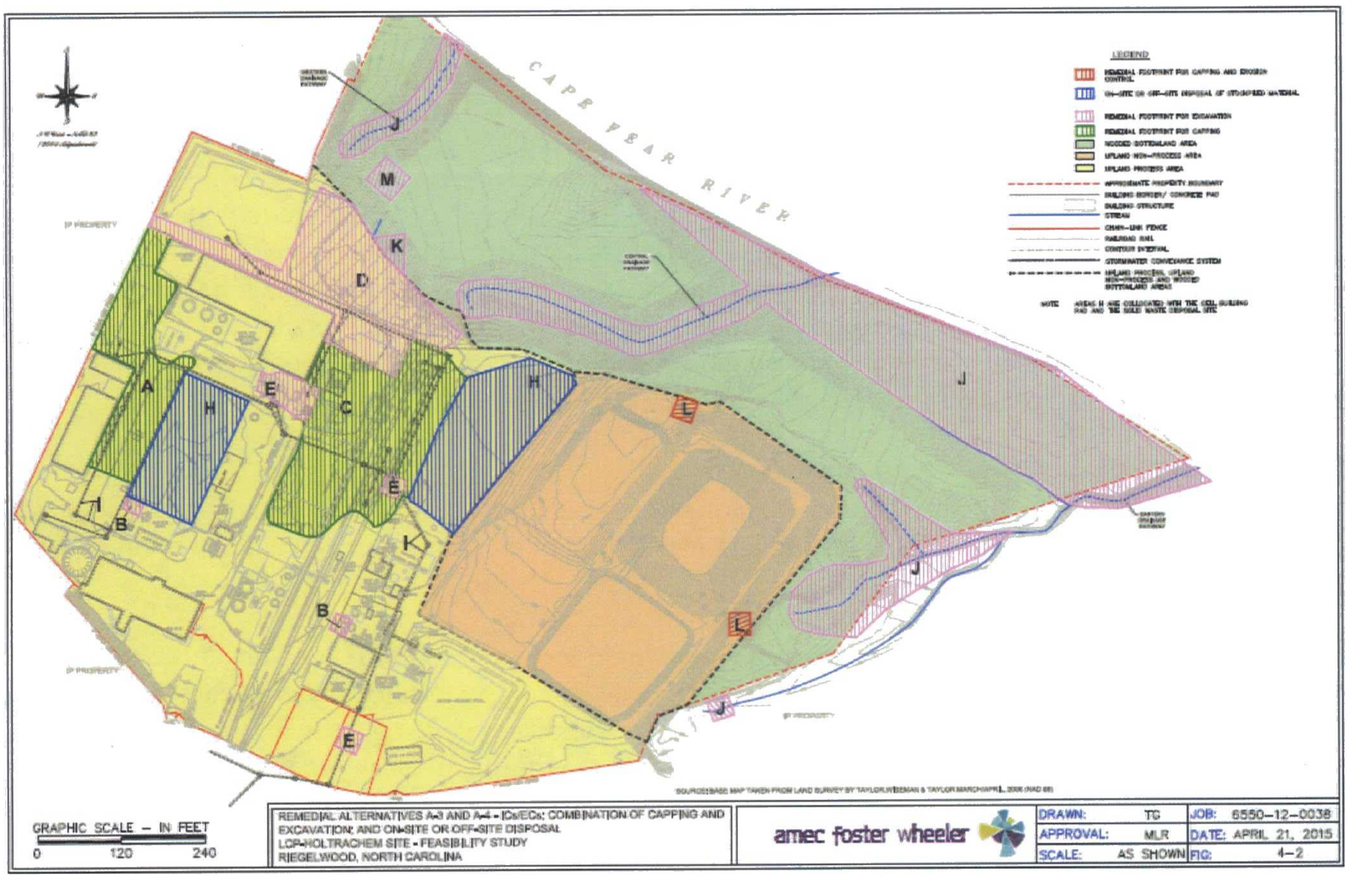
[12] The list of ARARs for the remedy alternatives is in Section 9.2, beginning on page 212.

Site-wide long-term maintenance and inspection would be required to evaluate backfill erosion and to verify cap and previously-closed RCRA unit performance over time. Long-term monitoring of groundwater would also be required to confirm closed unit integrity and compliance with ARARs. Periodic maintenance would be carried out as needed to preserve or restore the integrity of these systems. ICs and ECs would be employed to prevent unacceptable exposure to humans. ICs would consist of land use restrictions included in a deed notice and/or environmental restrictive covenant that is drafted in accordance with North Carolina statutory requirements and recorded in the County. ECs would consist of warning signs and fencing. The site is currently fenced along the west, south, and east property boundaries.

9.1.3 Alternative A-3: Combination of Capping and Excavation, On-site Disposal and ICs/ECs

Figure 39 illustrates remedial actions for areas A through M (minus F and G). The rationale for selecting areas to be capped or excavated is based on the size/local extent of detected contamination, the magnitude of PCB and mercury concentrations, and the location/exposure risk.

Figure 39: Alternatives A-3 and A-4 Conceptual Remedial Plan



Estimated Costs:	
Capital Cost	$12,122,700
Annual O&M Cost	$36,500
Total Cost	$13,300,000
Total Present Worth Cost	$12,600,000
Estimated Timeframes:	
Construction Timeframe	18-24 months
Time to Achieve RAOs	18-24 months

This alternative includes:

- Excavation of approximately 15,400 yd^3 of contaminated soil and sediment
- Capping approximately 1.7 acres of contaminated soil with a geosynthetic liner and vegetative cover
- Construction, operation, closure, maintenance and monitoring of an on-site disposal unit that meets TSCA chemical waste landfill ARARs in 40 CFR § 761.75
- Closure of the underground storm water conveyance system by cleaning and/or sealing off and solidifying the pipes/inlets in place using flowable grout
- Disposal of stockpiled WWTS, solids removed from the storm water conveyance system, and excavated contaminated soil and sediment that are not RCRA hazardous wastes in the constructed on-site TSCA disposal unit
- Treatment and/or disposal of RCRA hazardous wastes including soil that is considered RCRA characteristic waste or contains RCRA listed waste, if generated, at an off-site permitted RCRA treatment/disposal facility
- Decommissioning of the storm water treatment system and restoration of the site to natural drainage following completion of remedial action
- Disposal or recycling of demolition debris from the stormwater treatment system and other potentially dismantled structures. Disposition will be determined based on testing of the debris to determine if it is RCRA hazardous wastes.
- Monitoring and maintenance of the closed RCRA units (former surface impoundments) in accordance with RCRA ARARs for post-closure care of a hazardous waste surface impoundment
- Groundwater monitoring in accordance with ARARs to confirm TSCA disposal unit and closed RCRA units' integrity
- ECs in the form of fencing, warning signs and erosion control measures to control sedimentation from stormwater runoff
- ICs in the form of a restrictive covenant and/or Notice of Contaminated Site in accordance with North Carolina statute
- FYRs

Remedial activities in the UPA include capping and excavation of soil areas with mercury or PCB concentrations that exceed cleanup levels protective of the industrial or construction worker in accordance with the RAOs. Capping and excavation in the UPA would also serve to protect the Wooded Bottomland Area by preventing contact of UPA soil with surface runoff and the potential migration of soil into the Wooded Bottomland Area.

Table 88 on page 161 describes each remedial area. Areas in the UPA to be capped include Areas A and C. Areas A and C have detected concentrations of PCBs greater than 25 mg/kg but less than 50 mg/kg. Area D contains concentrations of PCBs greater than 50 mg/kg, and would be excavated under this alternative. Several isolated areas (B, E, K, and M) with concentrations greater than the cleanup levels would be excavated because long-term maintenance of a small cap in each of these areas would not be practical.

Similarly, the remedial areas in the Wooded Bottomlands Area (J Areas) would be excavated to limit long-term maintenance. Excavated areas would be backfilled to approximately original grade and revegetated under this alternative. Capping and erosion control would occur in the L Areas, which are located along the steep portion of the Upland Non-Process Area berm. Removal of L Areas is not recommended due to the potential for destabilizing the berm during remedial action.

Capping

In Alternative A-3, a cap would be applied over the larger contiguous Upland Process Areas that exceed the Aroclor 1254+Aroclor 1268 surface and subsurface soil cleanup level of 11 mg/kg in Areas A and C and the L Areas along the berm of the Upland Non-Process Area impoundments. The anticipated extent of capping for this scenario is shown on **Figure 39**. The total cap area for this alternative is estimated to be approximately 1.7 acres. The final cap area footprint in some areas would be confirmed during remedial design sampling.

Capping would be achieved by the same methods described for Alternative A-2. The cap composition assumed for costing is a protective underlayment of fill soil (compacted in place), a geosynthetic liner, a protective layer of fill soil on top of the liner soil, plus up to six inches of topsoil to support revegetation. The actual cap composition and soil layer thicknesses would be evaluated during the remedial design. Cap placement activities would be conducted using standard construction equipment (e.g., backhoes, bulldozers, graders, etc.). Topographic survey and GPS instrumentation would be used to confirm extents and final grades of cap emplacement.

The caps will be designed to meet site-specific ARARs which include the North Carolina RCRA Subtitle D landfill final cover as well as post-closure requirements that are relevant and appropriate.

Excavation

Alternative A-3 consists of excavating soil contamination in the Upland Process Areas B, D, and E and Wooded Bottomland Areas J, K, and M. Areas B, D, and E exceed the Upland Process Area Aroclor 1254+Aroclor 1268 surface and subsurface soil cleanup level (11 mg/kg) protective of human health. Areas J exceed the Wooded Bottomland Area Aroclor 1268 sediment cleanup level (47 mg/kg) and the mercury sediment cleanup level (0.75 mg/kg) protective of ecological receptors. Areas K and M exceed the Wooded Bottomland Area Aroclor 1254+Aroclor 1268 surface soil cleanup level (21 mg/kg) protective of an adolescent trespasser/recreators.

The anticipated extent of excavation for this scenario is shown on **Figure 39**. The total in-place excavation volume is estimated to be 15,400 yd^3. The actual excavation footprints of the isolated areas would be confirmed during remedial design sampling. Following excavation, clean backfill/topsoil would be placed in the areas to restore the ground surface to approximately pre-excavation grades and the areas would be seeded/re-vegetated to control erosion.

Removal activities would be conducted as described for Alternative A-2.

Stormwater Conveyance System

The stormwater conveyance system (I Areas) would be closed by cleaning and/or sealing off and solidifying the pipes/inlets in place using flowable grout. Solids, if removed during closure of the system, would be dewatered and disposed either (1) in the on-site TSCA disposal unit, or (2) at an EPA-approved off-site landfill if determined to be a RCRA hazardous waste.

Following completion of site-wide remedial activities active stormwater collection and management would no longer be necessary. Therefore, the existing stormwater treatment system would be decommissioned and the site returned to natural drainage. Long-term maintenance would include inspection and repair of erosion controls designed to mitigate sedimentation during stormwater flow events.

WWTS

WWTS (Areas H) containing PCB concentration greater than 50 mg/kg are temporarily stockpiled at the Mercury Cell Building pad and the SWDS. Alternative A-3 includes disposal of the WWTS in an on-site disposal unit that meets TSCA chemical waste landfill requirements which are identified as ARARs. The total volume of the stockpiled soil on both the Mercury Cell Building pad and the SWDS is approximately 23,700 yd^3.

On-site TSCA Disposal Unit

Approximately 39,100 yd^3 of contaminated soil, sediment, and solids would be disposed of in an on-site newly constructed TSCA disposal unit. Because some of the contaminated media include PCBs at concentrations greater than 50 mg/kg, the disposal unit will be designed and constructed to meet the requirements of a TSCA chemical waste landfill as listed in 40 CFR §761.75 that are identified as ARARs. RCRA hazardous wastes, if generated during the remedial action, will not be placed in the on-site TSCA disposal unit. They will be disposed of at an off-site EPA-approved RCRA Subtitle C landfill.

Waiver and Design

40 CFR § 761.75(b)(3) requires that the bottom of a chemical waste landfill be at least 50 feet above the historical high groundwater table. This distance is not naturally available at the site because there is shallow groundwater. The 50 feet depth requirement is the only item in paragraph (b) which cannot be met at the site. TSCA regulations at 40 CFR 761.75(c)(4) allows the Regional Administrator[13] to waive one or more of the requirements of paragraph (b) if evidence is submitted that indicates that operation of the landfill will not present an unreasonable risk of injury to health or the environment from PCBs when one or more of the requirements of paragraph (b) of this section are not met. This "no unreasonable risk of injury to health or environment" standard is less stringent than the CERCLA Section 121(b) threshold requirement that the selected remedy be protective of human health and the environment. The CERCLA protectiveness requirement is addressed as part of the Comparative Analysis of Alternatives in **Section 10.1**.

[13] Approval authority for CERCLA remedies selected in RODs (which includes ARAR determinations and use of a waiver where justified) has been delegated from the Regional Administrator to the Superfund Division Director.

To support the approval of a waiver under 40 CFR 761.75(c)(4) and meet the CERCLA threshold protectiveness requirement, the TSCA disposal unit will be constructed using a dual-liner system. A summary of the design specifications for a dual liner system includes the following:

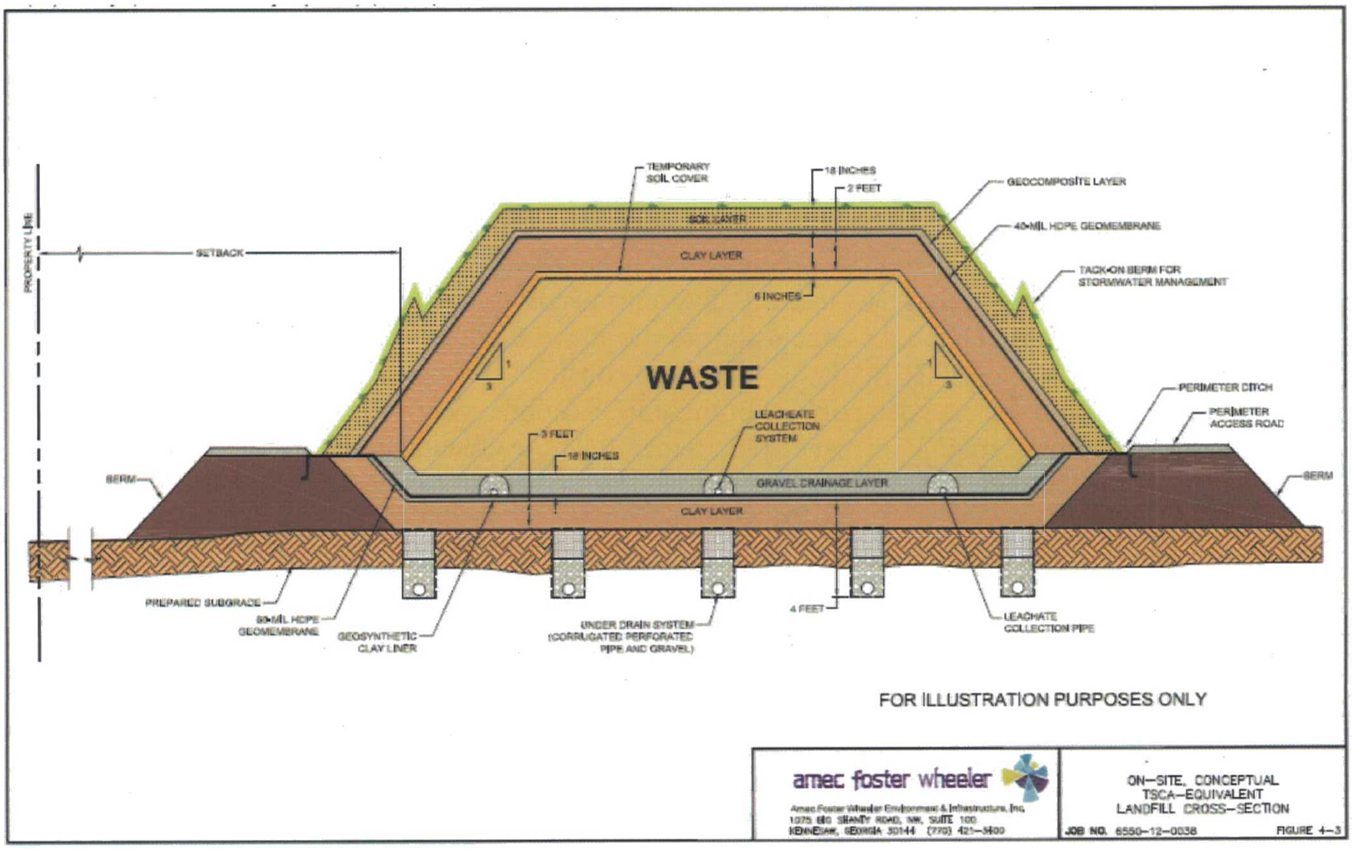
- The dual liner system would consist of a primary and secondary liners, each constructed with synthetic membranes embedded between protective soil layers
- Each membrane would have a permeability equal to or less than 1×10^{-7} cm/sec, be made of a material that is chemically compatible with PCBs, and be at least 30 mils thick
- Both membranes would be placed upon an adequate soil underlining and with a soil cover to prevent excessive stress or rupture
- Between the liner systems would be a porous leachate collection layer (e.g., coarse gravel) that can be monitored (i.e., interstitial monitoring) for leak detection from the upper liner.

Installation of a dual liner system meeting the specifications will contain and confine the TSCA disposal unit contents from direct contact with groundwater, equivalent to a 50-foot natural buffer. A 200-foot thick dense clay confining unit (the Peedee formation) lies beneath the planned TSCA disposal unit location and shallow surficial aquifer and further limits the potential for migration of PCBs. Implementation of a dual-liner design along with the presence of the natural clay formation would prevent releases of PCBs and thus the on-site TSCA disposal unit would not present an unreasonable risk of injury to health and the environment from PCBs under TSCA and also meet the CERCLA protectiveness requirement.

A conceptual cross-section for the TSCA disposal unit is shown on **Figure 40**. The primary components include the following:

- TSCA disposal unit subgrade preparation including grading, compaction, and protection against desiccation and cracking
- A clay or equivalent underlayer to serve as a base for the sealing layer
- A geosynthetic, clay, or equivalent sealing liner at the base of the TSCA disposal unit to provide additional containment of the material inside the unit
- A base geomembrane on top of the sealing liner to contain and prevent exfiltration of leachate from the TSCA disposal unit
- A second gravel drainage layer to collect leachate and to divert it to drains at the edge of the TSCA disposal unit for discharge to the surface
- An underdrain system between the bottom of the TSCA disposal unit liner system and groundwater
- Disposed waste surrounded by fill material (daily soil cover)
- A clay cap or equivalent layer to contain the disposed material
- A geomembrane sealing layer covering the TSCA disposal unit to stop infiltration of precipitation into the disposed material
- A permeable geocomposite drainage layer on top of the geomembrane to divert infiltration to drains at the sides of the TSCA disposal unit
- A drainage system at the edge of the cover to move stormwater runoff away from the TSCA disposal unit
- A layer of topsoil, seeded with vegetation for cover stabilization and to encourage evapotranspiration of moisture that infiltrates the topsoil cover

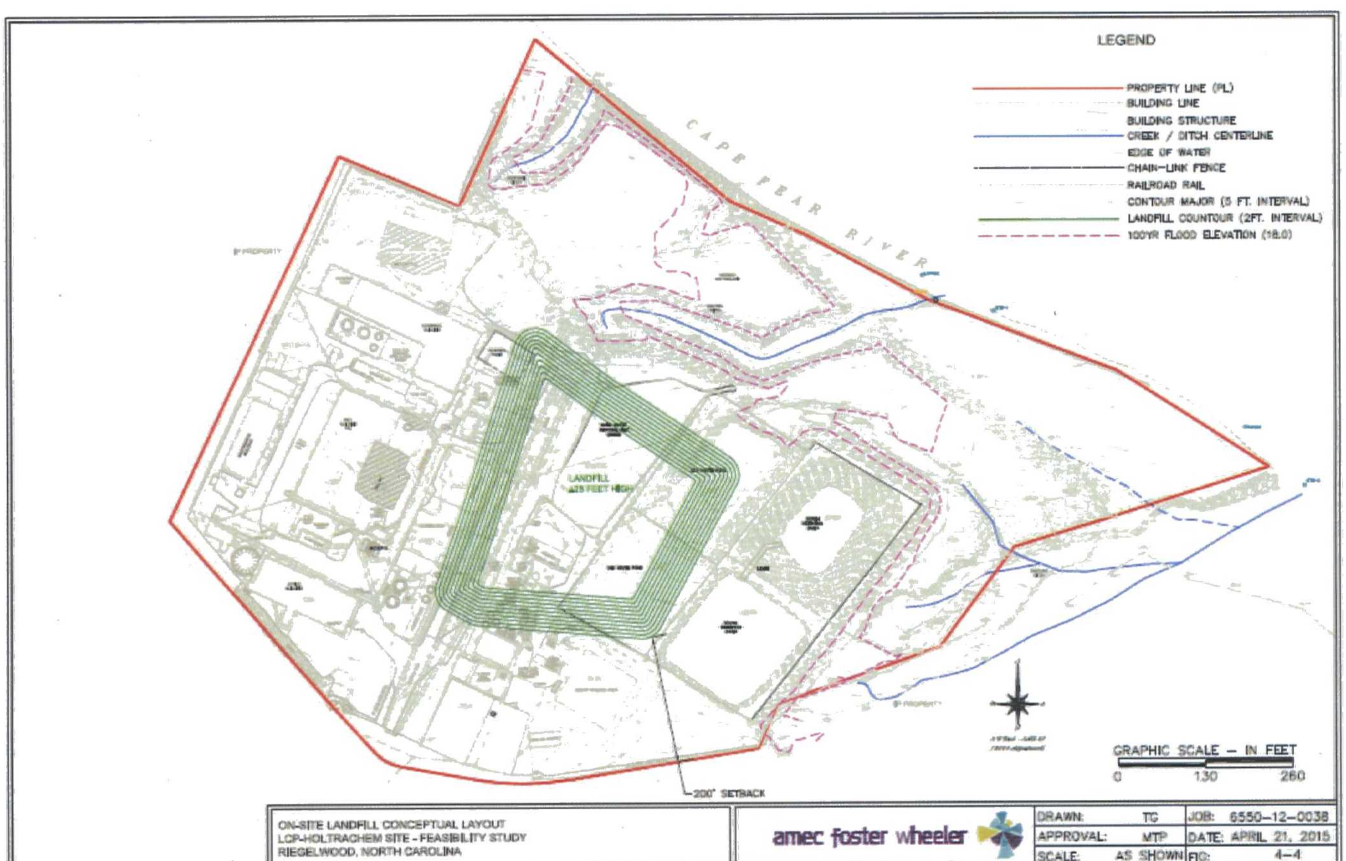
Figure 40: On-site Conceptual TSCA Disposal Unit Cross-Section



Location

The TSCA disposal unit must meet buffer requirements identified in 15A NCAC 13B.0503(2)(f), identified as ARARs. Because of the size of the property and a portion being within a 100-year flood zone there are limited locations on the property where the TSCA disposal unit can be constructed. An example conceptual TSCA disposal unit layout that would meet disposal volume requirements with a footprint allowing for up to a 200-foot setback is shown in **Figure 41**. The selection of the TSCA disposal unit location on the property will be based on the results of pre-design studies including but not limited to geotechnical testing and evaluation, structural evaluation, hydrogeological evaluations, surface hydraulics evaluation, material handling planning, and sequencing of remedial actions. The potential to place the cell on top of the closed RCRA units or to avoid them will be carefully considered in the remedial design, based upon the conclusions of the above evaluations. Should the TSCA disposal unit be placed over these closed RCRA units, its design, construction, monitoring, and maintenance must be compatible with the intended purpose of these RCRA units, their structural capacity/stability, and their associated monitoring/maintenance requirements. The evaluation could result in a determination that the on-site TSCA disposal unit cannot be located at the site due to concerns with structural integrity and prevention of releases, such that another remedial alternative would have to selected through a modification of the remedy.

Figure 41: On-site TSCA Disposal Unit Conceptual Layout



Monitoring and Maintenance
It is also possible that a TSCA disposal unit may extend over the retort and cell building pads where remedial technologies such as ISS or a vertical barrier followed by placement of a soil cap may be implemented. Should the TSCA disposal unit be placed over the retort and cell building pad areas, its design, construction, monitoring, and maintenance must be conducted in a manner that will preserve the protectiveness and effectiveness of selected alternative for the retort and cell building pads.

Long-term monitoring and maintenance for both the on-site TSCA disposal unit and closed-in-place RCRA units would be conducted in accordance with TSCA and RCRA ARARs.

<u>Ancillary Activities</u>
Site preparation activities would include the construction of access roads, support zones, and staging areas for personnel, equipment, and material. Clearing and installation of erosion controls would be required for support and staging areas.

Ancillary activities required to support construction activities include:

- cap/excavation area access and preparation,
- erosion control,
- backfill material delivery and staging,
- excavated material staging and handling,
- cover soil delivery and staging,
- construction waste disposal,
- cap placement verification,
- waste soil transport and disposal,
- stormwater management,
- dust monitoring/control,
- seeding/planting, and
- restoration, as necessary.

Ambient air would be monitored for dust during construction. Dust control measures would be implemented, and would include wetting roads, stockpiles, and staging areas. Real-time air monitoring would be performed during construction to verify compliance with ARARs.

Site-wide long-term maintenance and inspection would be required to evaluate backfill erosion and to verify cap, TSCA disposal unit, and previously closed RCRA unit performance over time. Long-term monitoring of groundwater would also be required to confirm TSCA disposal unit and closed RCRA unit integrity and compliance with ARARs. Periodic maintenance would be carried out as needed to preserve or restore the integrity of these systems. ICs and ECs would be employed to limit risks to human and ecological receptors. ICs would consist of deed and land use restrictions in a recorded a Notice and/or restrictive covenant. ECs would consist of warning signs and fencing. The site is currently fenced along the west, south, and east property boundaries.

9.1.4 Alternative A-4: Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs

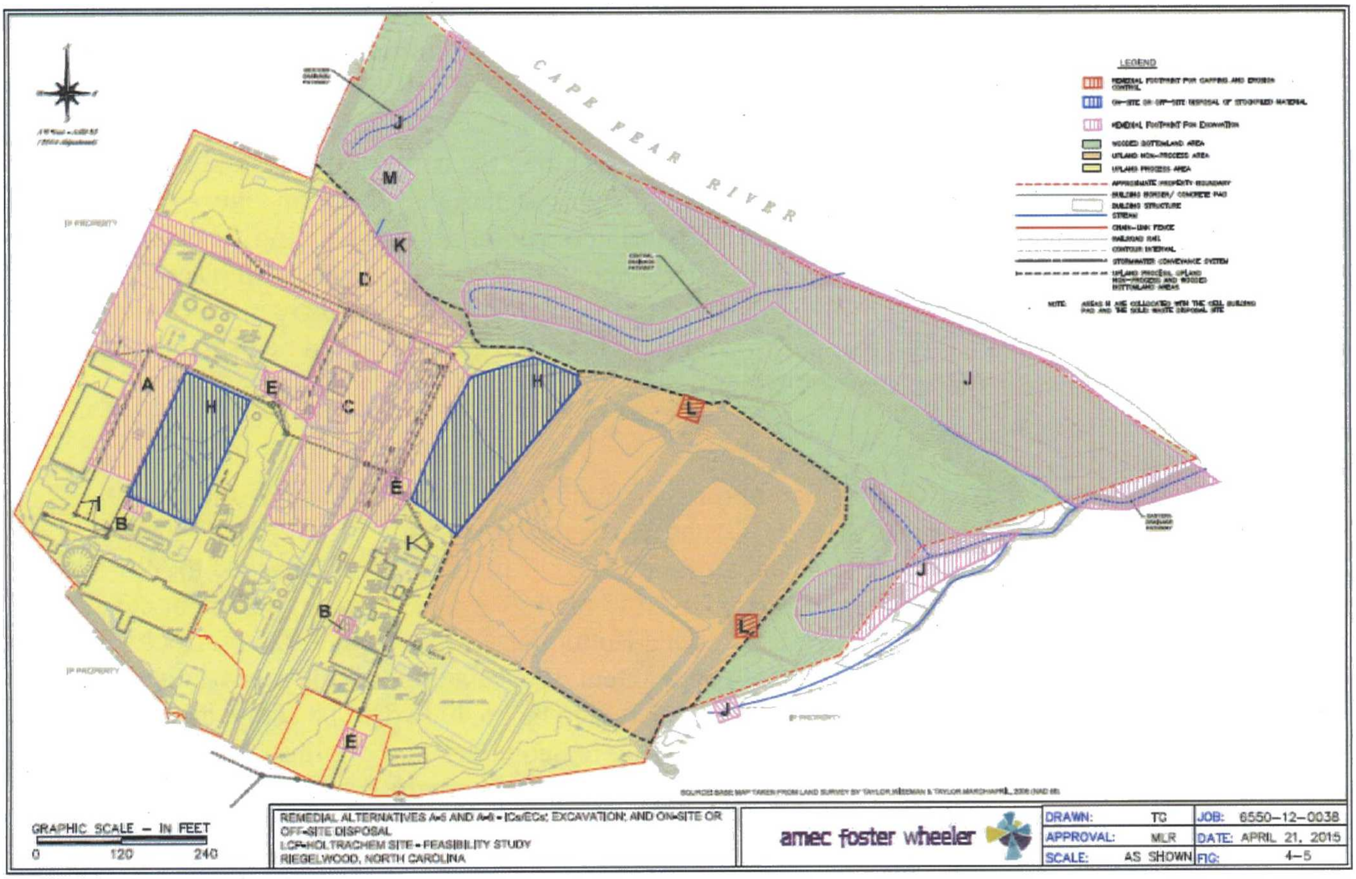
Estimated Costs:	
Capital Cost	$20,453,700
Annual O&M Cost	$31,500
Total Cost	$21,600,000
Total Present Worth Cost	$20,900,000
Estimated Timeframes:	
Construction Timeframe	12 months
Time to Achieve RAOs	12 months

This alternative is the same as Alternative A-3, but with off-site disposal of excavated material in an EPA-approved TSCA chemical waste landfill.

9.1.5 Alternative A-5: Excavation, On-site Disposal, and ICs/ECs

Estimated Costs:	
Capital Cost	$12,851,800
Annual O&M Cost	$31,500
Total Cost	$14,000,000
Total Present Worth Cost	$13,300,000
Estimated Timeframes:	
Construction Timeframe	18-24 months
Time to Achieve RAOs	18-24 months

Figure 42: Alternatives A-5 and A-6



This alternative includes:

- Excavation of contaminated soil in the Upland Process and Wooded Bottomland Areas
- Disposal of excavated material and WWTS in an on-site TSCA disposal unit
- Closure of the stormwater conveyance system
- Decommissioning of the stormwater treatment system and restoration of the site to natural drainage following completion of remedial action
- Implementation of ICs/ECs

This alternative, although titled as excavation, also includes a limited amount of capping in Area L. Capping/erosion control would be implemented in the L areas along the berm of the Upland Non-Process Area. The conceptual remedial plan shown on **Figure 42** identifies remedial areas A through M (minus F and G). **Table 88** on page 161 describes each remedial area. The rationale for selecting areas to be capped or excavated is based on the size/local extent of detected contamination, the magnitude of PCB and mercury concentrations, and the location/exposure risk.

Remedial activities in the Upland Process Area include excavation of soil areas with mercury or PCB concentrations that exceed cleanup levels protective of the industrial or construction worker in accordance with the RAOs. Excavation in the Upland Process Area would also serve to protect the Wooded Bottomland area by preventing contact of Upland Process Area soil with surface runoff and the potential migration of soil into the Wooded Bottomland Area. Areas to be excavated include Areas A, B, C, D, E, J, K, and M. Backfilling of excavated areas to approximately original grade and revegetation would also be included in this overall site remedial alternative. Capping and erosion control would occur in the L Areas, which is located along the steep portion of the Upland Non-Process Area berm. Removal of L Areas is not recommended due to potential instability of the slope during remedial action.

Capping

In Alternative A-5, a cap would be applied over the L Areas along the berm of the Upland Non-Process Area impoundments. The anticipated extent of capping for this scenario is shown on **Figure 42**. The final cap area footprint in some areas would be confirmed during remedial design sampling. The cap composition assumed for costing is a protective underlayment of fill soil (compacted in place), a geosynthetic liner, a protective layer of fill soil on top of the liner soil, plus up to six inches of topsoil to support revegetation. The actual cap composition and soil layer thicknesses would be evaluated during the remedial design to meet site-related ARARs.

Excavation

Alternative A-5 consists of excavating Upland Process Areas A, B, C, D, and E and Wooded Bottomland Areas J, K, and M. Areas A, B, C, D, and E exceed the Upland Process Area Aroclor 1254+Aroclor 1268 surface and subsurface soil cleanup level (11 mg/kg). Areas J exceed the Wooded Bottomland Area Aroclor 1268 sediment cleanup level (47 mg/kg) and the mercury sediment cleanup level (0.75 mg/kg). Areas K and M exceed the Wooded Bottomland Area Aroclor 1254+Aroclor 1268 surface soil cleanup level (21 mg/kg). The anticipated extent of excavation for this scenario is shown on **Figure 42**. The total in-place excavation volume is estimated to be 26,400 yd^3. The actual excavation footprints of the isolated areas would be confirmed during remedial design sampling. Following excavation, clean backfill/topsoil would be placed in the areas to restore the ground surface to approximately pre-excavation grades and the areas would be seeded/revegetated to control erosion.

Removal activities would be conducted as described under Alternative A-2. Excavated and dewatered materials would be disposed in an on-site TSCA disposal unit designed and constructed as described in Alternative A-3.

Stormwater Conveyance System

The stormwater conveyance system (I Areas) would be closed by cleaning and/or sealing off and solidifying the pipes/inlets in place using flowable grout. Solids, if removed during closure of the system, would be dewatered and disposed in an on-site TSCA disposal unit.

Following completion of site-wide remedial activities active stormwater collection and management would no longer be necessary. Therefore, the existing stormwater treatment system would be decommissioned and the site returned to natural drainage. Long-term maintenance would include inspection and repair of erosion controls.

WWTS

WWTS (Areas H) containing PCB concentrations greater than 50 mg/kg are temporarily stockpiled at the Mercury Cell Building pad and the SWDS. Alternative A-5 includes disposal of the WWTS in an on-site TSCA disposal unit. The total volume of the stockpiled soil on both the Mercury Cell Building pad and the SWDS is approximately 23,700 yd^3.

On-site TSCA Disposal Unit and Ancillary Activities

Construction of the on-site TSCA disposal unit and ancillary activities would be performed as described in Alternative A-3.

9.1.6 Alternative A-6: Excavation, Off-site Disposal, and ICs/ECs

Estimated Costs:	
Capital Cost	$25,000,000
Annual O&M Cost	$29,000
Total Cost	$25,900,000
Total Present Worth Cost	$25,400,000
Estimated Timeframes:	
Construction Timeframe	12 months
Time to Achieve RAOs	12 months

This alternative is the same as that for Alternative A-5, but with off-site disposal of excavated material in a EPA-approved TSCA chemical waste landfill. The methods used for capping, excavation, closure of stormwater conveyance system, and ancillary activities are the same as those for Alternative A-5.

Alternatives for soil in Retort Area and Cell Building Pad Area

The following remedial alternatives were developed for soil associated with the Upland Process Area Retort Area and Cell Building pads.

9.1.7 Alternative S-1: No Action

Estimated Costs:	
Capital Cost	$0
Annual O&M Cost	$0
Total Cost	$0
Total Present Worth Cost	$0
Estimated Timeframes:	
Construction Timeframe	0 months
Time to Achieve RAOs	beyond our lifetime

No Action includes no remedial measures or ICs. According to NCP 40 CFR §300.430(e)(6), No Action is retained for detailed analysis and used as a baseline in comparing alternatives.

9.1.8 Alternative S-2: Capping with Vertical Impermeable Barrier Installation and ICs

Estimated Costs:	
Capital Cost	$1,300,000
Annual O&M Cost	see A alternatives
Total Cost	$1,300,000
Total Present Worth Cost	n/a
Estimated Timeframes:	
Construction Timeframe	6-12 months
Time to Achieve RAOs	6-12 months

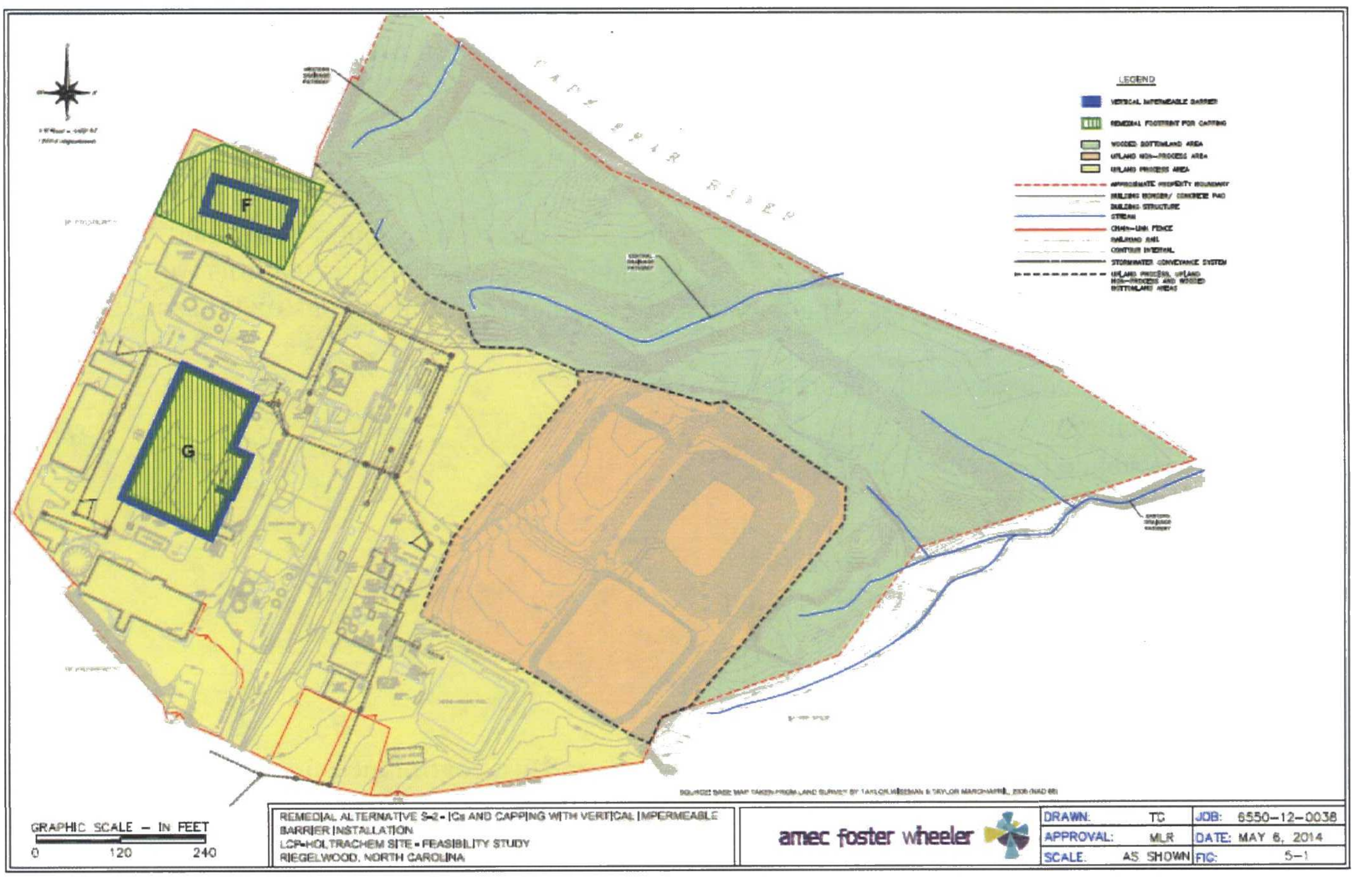
This alternative consists of construction of a vertical barrier, capping of mercury waste and contaminated soils associated with the Retort and Cell Building pads in Areas F and G, and ICs. **Table 88** on **page 161** describes these remedial areas. The remedial footprint for these areas is shown on **Figure 43**. The remedial footprint shown in this figure may be expanded during remedial design to include adjacent areas, such as the MESS.

This alternative provides containment of soils with mercury or PCB concentrations that exceed cleanup levels protective of the industrial or construction worker in accordance with the RAOs in these areas. It also protects the Wooded Bottomland Area by preventing contact of Upland Process Area soil with surface runoff and the potential migration of soil into the Wooded Bottomland Area. The purpose of the cap and vertical barrier is to isolate the soils associated with the Retort and Cell Building pads both horizontally and vertically. Historically, these soils have not served as a source of mercury or PCBs to groundwater. This alternative serves as an added measure so that they do not become a source in the future.

Vertical Impermeable Barrier Installation

Alternative S-2 consists of the installation of a vertical impermeable barrier around the outside of the pads. A vertical barrier would span a combined linear distance of approximately 1,100 feet around the areas of the pads. The barriers would be constructed using augers or other soil mixing equipment to inject and mix low permeability slurry (e.g., bentonite-cement) into the soil in sequential, overlapping vertical sections. The barriers would be keyed into the underlying Peedee Formation. Depths to the Peedee Formation are approximately 15 and 10 feet in Areas F and G, respectively.

Figure 43: Alternative S-2



Capping

In Alternative S-2, a cap would be installed following vertical perimeter barrier installation. The total cap area for this alternative is estimated to be about 1.3 acres. The final cap area footprint would be confirmed during remedial design sampling and may be expanded from that shown in **Figure 43**.

Capping would be achieved by placing a clay/geomembrane or equivalent RCRA cap system with a vegetated cover over Areas F and G. Before cap placement, the area would be prepared by leveling in-ground structures. The cap composition assumed for costing is a protective underlayment of fill soil (compacted in place), a geosynthetic liner, a protective layer of fill soil on top of the liner soil, plus up to six inches of topsoil to support revegetation. The actual cap composition and soil layer thicknesses would be evaluated during the remedial design and will comply with RCRA ARARs for a hazardous waste landfill final cover as well post-closure care requirements.

The cell pit area is east of the Cell Building pad as shown on **Figure 43**. It could potentially contain mercury residuals; however, no specific data are available to confirm the presence of mercury above cleanup levels. The cell pit would be drained, the stormwater would be managed through the existing stormwater collection and treatment system, the pit concrete surfaces would be sealed, and the pit would be backfilled with structural fill to prevent water accumulation following completion of remedial activities. A clay/geomembrane or equivalent cap would be placed over the area to isolate the contaminated soil and will comply with RCRA ARARs for a hazardous waste landfill final cover as well post-closure care requirements. The actual cap composition and soil layer thicknesses would be evaluated during the remedial design.

Cap placement activities would be conducted using standard construction equipment (e.g., backhoes, bulldozers, graders, drill augers, etc.). Topographic survey and GPS instrumentation would be used to confirm extents and final grades of cap emplacement.

Ancillary Activities

Site preparation activities would include the construction of access roads, support zones, and staging areas for personnel, equipment, and material. Clearing and installation of erosion controls would be required for support and staging areas. Ancillary activities required to support construction activities would include:

- remediation area access and preparation,
- erosion control,
- cap material delivery and staging,
- construction waste disposal,
- cap placement verification,
- storm water management,
- dust monitoring/control,
- seeding/planting, and
- restoration, as necessary.

Ambient air would be monitored for dust during construction. Dust control measures would be implemented, and would include wetting roads, stockpiles, and staging areas. Real-time air monitoring would be performed during construction activities to verify compliance with ARARs.

Long-term inspections would be required to verify cap and barrier performance over time. Periodic maintenance would be carried out as necessary to preserve or restore the integrity of these systems. ICs would be employed to limit risks to human and ecological receptors. ICs would consist of deed and land use restrictions in a recorded a Notice and/or restrictive covenant. Monitoring wells/piezometers within and outside the vertical barrier would be monitored for hydraulic pressure differences.

9.1.9 Alternative S-3: In-Situ Stabilization, Capping and ICs

Estimated Costs:	
Capital Cost	$2,900,000
Annual O&M Cost	see A alternatives
Total Cost	$2,900,000
Total Present Worth Cost	n/a
Estimated Timeframes:	
Construction Timeframe	6-12 months
Time to Achieve RAOs	6-12 months

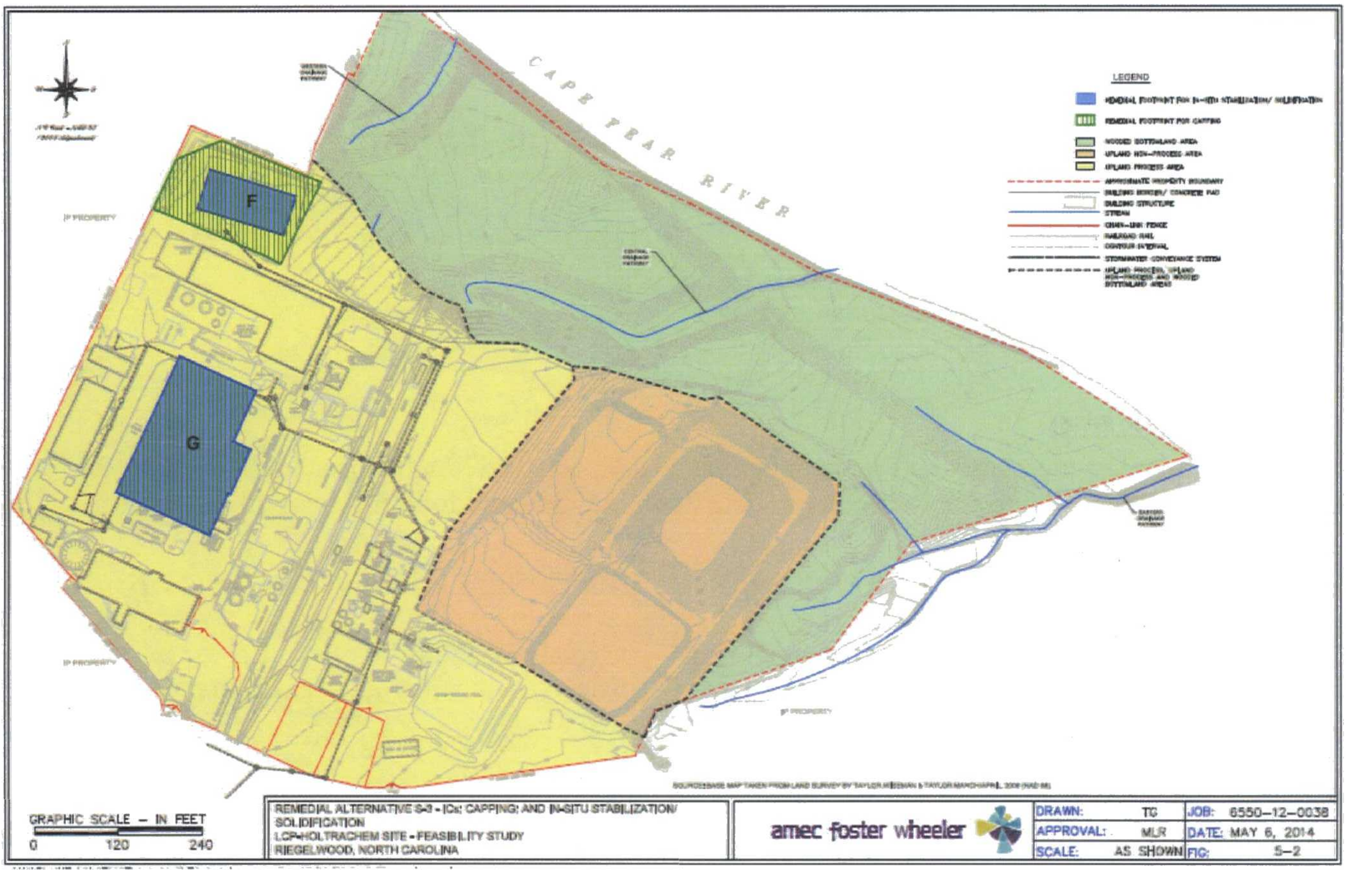
This alternative consists

- Treatment of mercury waste and contaminated soil, considered to be principal threat waste (PTW), located beneath the former mercury cell building and former retort pad via In-Situ Stabilization (ISS)
- Capping of the areas treated by ISS that meets RCRA Subtitle C landfill final cover ARARs

Table 88 on **page 161** describes these remedial areas. The remedial footprint of these areas is shown on **Figure 44**. The remedial footprint shown in this figure may be expanded during remedial design to include adjacent areas, such as the MESS.

This alternative treats soils under and around the pads (10-foot buffer beyond the pad edge). Soil outside this buffer zone in Area F would be capped. Together, ISS and capping protects industrial/construction workers through solidification/stabilization of soil with mercury or PCB concentrations that exceed cleanup levels protective of the industrial or construction worker in accordance with the RAOs in these areas. It also protects the Wooded Bottomland Area by preventing contact of Upland Process Area soil with surface runoff and the potential migration of soil into the Wooded Bottomland Area. The purpose of the ISS is to treat and isolate the mercury waste and contaminated soils through encapsulation. Historically, these soils have not served as a source of mercury or PCBs to groundwater. This alternative would serve as an added measure so that they do not become a source in the future.

Figure 44: Alternative S-3



ISS

Alternative S-3 consists of ISS of the mercury waste and contaminated soil under and around the Retort Area and Cell Building pads in Areas F and G. The footprint of the both ISS areas would be capped to minimize infiltration and potential for leaching of contaminants. ISS reagents such as portland cement or lime/pozzolans (e.g., fly ash and cement kiln dust) or other agents would be selected to reduce the leachability of COCs through encapsulation, binding, and/or limiting the hydraulic conductivity of the final solidified matrix. A treatability study would be performed during remedial design to develop a suitable mix design to achieve post-solidification leachability goals and establish parameters for field performance testing (e.g., compressive strength, hydraulic conductivity, and /or wet/dry cycle durability). Various mix agents, such as sulfides and activated carbon, will be evaluated during the treatability study to select the optimum mixing agent.

During field implementation, the ISS agents are injected into the subsurface environment and mixed with the soil using augers or other soil mixing equipment. The outside clean perimeter of the ISS area may be augured first to act as a vertical barrier and avoid migration of COCs during implementation. Performance sampling is conducted at a pre-specified frequency, with samples collected from various depth intervals during mixing. The individual samples are visually examined to confirm mix homogeneity and then composited into cylinders representing the depth range of the aliquots. The cylinders are cured and analyzed per the performance testing plan.

The cell pit in Area G would be drained and the collected stormwater would be managed through the existing stormwater collection and treatment system. The pit concrete would be pulverized and solidified as part of the ISS area. The addition of solidification agents and physical mixing may increase the volume of the treated soils, and this volume would be solidified and remain within the treated area footprint. The potential increase in volume will be considered during the design phase. The total treated in-situ volume is estimated to be 15,500 yd^3.

Capping

In Alternative S-3, a cap would be installed over Areas F and G following ISS implementation. The total cap area for this alternative is estimated to be about 1.3 acres. The final cap area footprint would be confirmed during remedial design sampling and may be expanded from that shown in **Figure 44**, as appropriate.

Capping would be achieved by placing a clay/geomembrane or equivalent cap system with a vegetated cover over Areas F and G. Before cap placement, the area would be prepared by leveling in-ground structures. A composite clay/geomembrane/cover soil or equivalent cap would be placed over the area to isolate the waste and contaminated soil and will comply with RCRA ARARs for a hazardous waste landfill final cover as well post-closure care requirements. The cap composition assumed for costing is a protective underlayment of fill soil (compacted in place), a geosynthetic liner, a protective layer of fill soil on top of the liner soil, plus up to six inches of topsoil to support revegetation. The actual cap composition and soil layer thicknesses would be evaluated during the remedial design.

Cap placement activities would be conducted using standard construction equipment (e.g., backhoes, bulldozers, graders, drill augers, etc.). Topographic survey and GPS instrumentation would be used to confirm extents and final grades of cap emplacement.

Ancillary Activities

Site preparation activities would include the construction of:

- access roads,
- support zones, and
- staging areas for personnel, equipment, and material.

Clearing and installation of erosion controls would be required for support and staging areas.

Ancillary activities required to support construction activities include:

- area access and preparation,
- erosion control,
- reagent material delivery and staging,
- construction waste disposal,
- stormwater management,
- dust monitoring/control,
- seeding/planting, and
- restoration, as necessary.

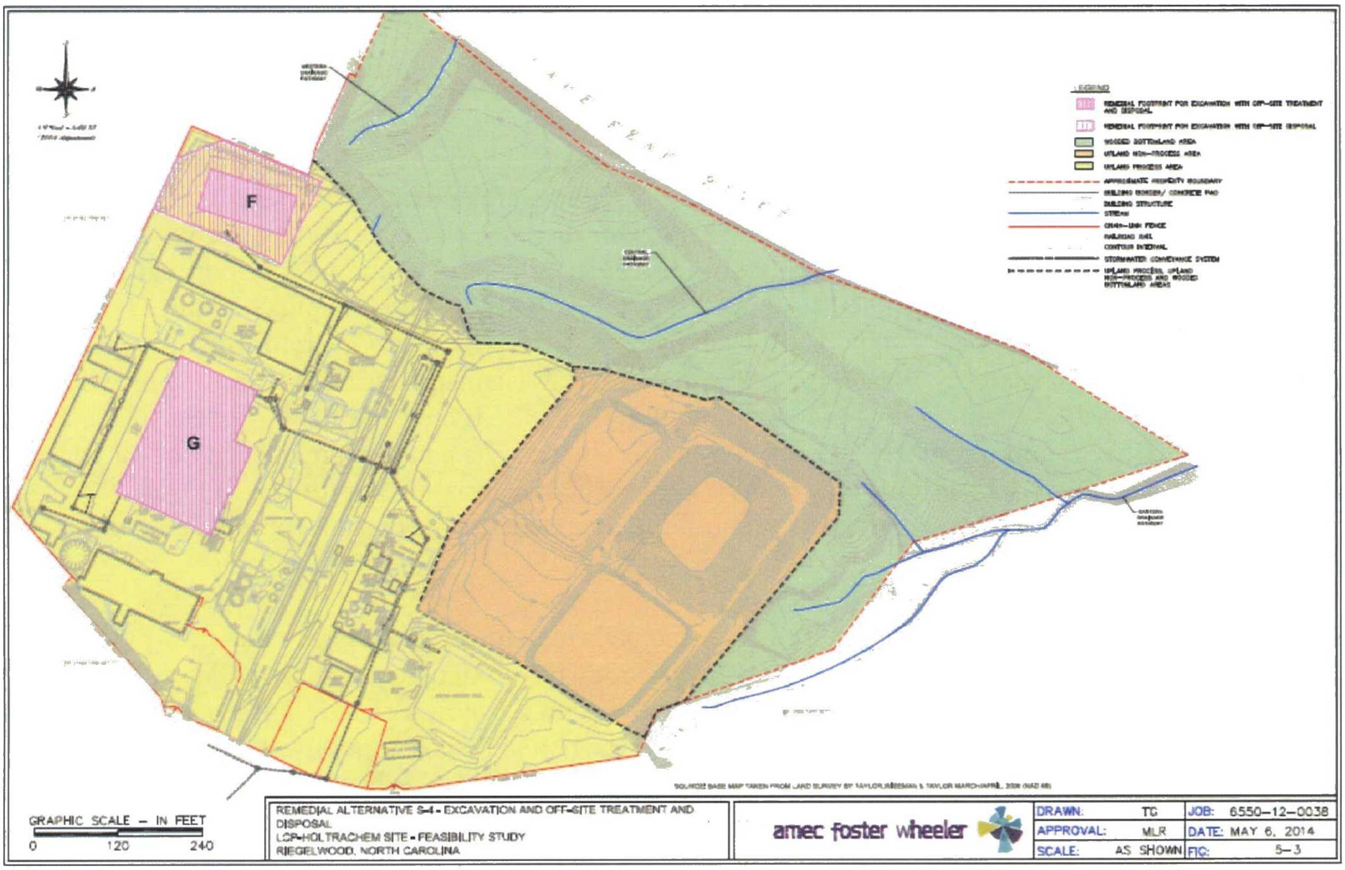
Ambient air would be monitored for dust during construction. Dust control measures would be implemented, and would include wetting roads, stockpiles, and staging areas. Real-time air monitoring would be performed during construction activities to verify compliance with ARARs. Inspections would be required to verify system performance over time. ICs would be employed to limit risks to human and ecological receptors. ICs would consist of deed and land use restrictions.

9.1.10 Alternative S-4: Excavation and Off-site Treatment and Disposal

Estimated Costs:	
Capital Cost	$56,000,000
Annual O&M Cost	see A alternatives
Total Cost	$56,000,000
Total Present Worth Cost	n/a
Estimated Timeframes:	
Construction Timeframe	7-8 years
Time to Achieve RAOs	7-8 years

This alternative includes ICs, excavation of the soils associated with the Retort Area and Cell Building pads in Areas F and G, and off-site treatment and disposal of excavated material. **Table 88** on page 161 describes these remedial areas. The remedial footprint of these areas is shown on **Figure 45**. This alternative involves removal, treatment, and disposal of soils with mercury or PCB concentrations that exceed cleanup levels protective of the industrial or construction worker in accordance with the RAOs in these areas. It also protects the Wooded Bottomland Area by preventing contact of Upland Process Area soil with surface runoff and the potential migration of soil into the Wooded Bottomland Area.

Figure 45: Alternative S-4



Excavation

Alternative S-4 consists of excavating the soils that exceed the cleanup levels for the UPA. Excavation depths are 15 and 10 feet near the Retort and Cell Building pads, respectively. The total in-place excavation volume is estimated to be 25,000 yd^3. Approximately 15,500 yd^3 of the mercury wastes and contaminated soil beneath the Retort Area and Cell Building pads would go to an off-site approved RCRA treatment and disposal facility; 9,500 yd^3 of the excavated volume from around the Area F Retort pad would go to an off-site, EPA-approved landfill for TSCA and/or RCRA waste. As part of remediation in the former Cell Building area, the cell pit would be drained and the collected stormwater would be managed through the existing stormwater collection and treatment system. The pit concrete would be demolished and managed as part of the excavated waste material. Following excavation, clean backfill/topsoil would be placed in the areas to restore the ground surface to approximately pre-excavation grades, and the areas would be seeded/revegetated.

Removal activities would be conducted using standard construction equipment (e.g., backhoes, bulldozers) equipped with GPS instrumentation to monitor the removal progress and confirm that excavations meet the established horizontal and vertical goals. Shoring of the excavated area would be required until the area is backfilled. Backfill would be placed to predetermined elevations using conventional earthmoving equipment. Seeding and erosion controls would be implemented upon verification that backfill design elevations have been met.

Where required, excavated soil would be stockpiled within a materials staging area prior to transportation. Potentially impacted stormwater would be managed through the existing stormwater conveyance and treatment system.

Off-site Treatment and Disposal

If excavated waste and soils are hazardous due to characteristic toxicity and mercury is present at concentrations greater than or equal to 260 mg/kg, EPA requires treatment by retorting/incineration before disposal in accordance with land ban restrictions for mercury characteristic hazardous waste as defined in 40 CFR §268.40 and §268.48. Therefore, excavated material would be transported to an off-site retort/incineration and disposal facility approved by EPA to accept both mercury- and PCB-containing wastes. The number of such facilities in the U.S. is very limited. One retort facility operated by Waste Management Mercury Waste, Inc. in Union Grove, Wisconsin, has been identified as willing to accept mixed waste containing both mercury and PCBs if the PCB concentrations are less than 50 mg/kg. This facility is approximately 985 miles from the site and has a maximum capacity of 40 yd^3 of material per week. Disposal facilities may reject the excavated material upon profiling if PCB concentrations are greater than 50 mg/kg so that off-site treatment and/or disposal options are not available.

Soil associated with the Retort Area and Cell Building pads may differ in quality in that they potentially contain higher mercury concentrations that may be hazardous by toxicity characteristic. Therefore, this soil would be handled differently than the soil outside the Area F Retort pad. The soil beneath the Retort Area and Cell Building pads would go to an off-site treatment and disposal facility; and the soil outside of the Area F Retort pad would go to an off-site EPA-approved TSCA and/or RCRA landfill.

Ancillary Activities

Site preparation activities would include construction of
- access roads,
- support zones, and
- staging areas for personnel, equipment, and material.

Clearing and installation of erosion controls would be required for support and staging areas.

Ancillary activities required to support construction activities include:
- excavation area access and preparation,
- erosion control,
- backfill material delivery and staging,
- long-term excavated material staging and handling while awaiting transport (see Implementability discussion below),
- construction waste disposal,
- waste soil transport and disposal,
- stormwater management,
- dust monitoring/control,
- seeding/planting, and
- restoration, as necessary.

Ambient air would be monitored for dust during construction. Dust control measures would be implemented, and would include wetting roads, stockpiles, and staging areas. Real-time air monitoring would be performed during construction activities to verify compliance with ARARs.

9.2 Applicable or Relevant and Appropriate Requirements (ARARs)

NCP §300.430(e)(9)(iii)(B) states: "*Compliance with ARARs.* The alternatives shall be assessed to determine whether they attain applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility siting laws or provide grounds for invoking one of the waivers under paragraph (f)(1)(ii)(C) of this section."

There are three broad categories of ARARs: chemical-specific, location-specific, and action-specific. Lead and support regulatory agencies may, as appropriate, identify additional advisories, criteria, or To-Be-Considered (TBC) guidance for a particular site. TBCs are not legally binding and lack the status of ARARs. The remedial alternatives are screened against their ability to meet ARARs and TBCs.

Under CERCLA Section 121(e)(1), federal, state, or local permits are not required for the portion of any removal or remedial action conducted entirely on-site as defined in 40 CFR § 300.5. See also 40 CFR §§ 300.400(e)(1) & (2). In addition, CERCLA actions must only comply with the "substantive requirements," not the administrative requirements of regulations. Administrative requirements include permit applications, reporting, record keeping, and consultation with administrative bodies. Although consultation with state and federal agencies responsible for issuing permits is not required, it is recommended to consult with the agencies for determining compliance with certain requirements, such as those typically identified as Location-Specific ARARs.

Applicable requirements, as defined in 40 CFR § 300.5, means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or state facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site. Only those state standards that are identified by the state in a timely manner and that are more stringent than federal requirements may be applicable. *Relevant and appropriate requirements*, as defined in 40 CFR § 300.5, means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or state facility siting laws that, while not "applicable" to a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well-suited to the particular site. Only those state standards that are identified by the state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate.

Per 40 CFR § 300.400(g)(5), only those state standards which are promulgated, are identified in a timely manner, and are more stringent than federal requirements may be applicable or relevant and appropriate. For the purposes of identification and notification of promulgated state standards, the term "promulgated" means that the standards are of general applicability and are legally enforceable. State ARARs are considered more stringent where there is no corresponding federal ARAR, where the state ARAR provides a more stringent concentration of a contaminant, or the where a state ARAR is broader in scope than a federal requirement.

In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular release. The To-Be-Considered (TBC) category consists of advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. See 40 CFR § 300.400(g)(3). TBCs can be used in the absence of ARARs, when ARARs are insufficient to develop cleanup goals, or when multiple contaminants may be posing a cumulative risk.

In accordance with 40 CFR § 300.400(g), EPA and NCDEQ have identified the potential ARARs and TBCs for the evaluated alternatives. The majority were included in the FS. The final ARARs for the selected remedy are included in **Appendix A – ARARs.**

9.3 Common Elements and Distinguishing Features of Each Alternative

9.3.1 Components

Components common to all active remedial alternatives include ICs such as deed restrictions and ECs such as erosion control and fencing. Each remedial alternative also includes long-term monitoring for site media including groundwater and surface water. In addition, the former RCRA units that were closed will be monitored and maintained in accordance with RCRA ARARs for post-closure care of a hazardous waste surface impoundment. The components and distinguishing features for the A-alternatives and S- alternatives are summarized in **Table 89** and **Table 90** respectively.

Table 89: Alternatives A1-A6 Common Elements and Distinguishing Features

Remedial Area	Area Description	A-1	A-2a	A-2b	A-3	A-4	A-5	A-6
		NO ACTION	CAPPING WITH LIMITED EXCAVATION, OFF-SITE DISPOSAL, AND ICs/ECs	same as 2a except for H area	COMBINATION OF CAPPING AND EXCAVATION, ON-SITE DISPOSAL, AND ICs/ECs	COMBINATION OF CAPPING AND EXCAVATION, ON-SITE DISPOSAL, AND ICs/ECs	EXCAVATION, ON-SITE DISPOSAL, AND ICs/ECs	EXCAVATION, OFF-SITE DISPOSAL, AND ICs/ECs
A	Area west of CBP (PCB 25-49 mg/kg)	nothing	cap				excavate, on-site landfill	excavate, off-site disposal
B	Southwest corner of WWTP	nothing	excavate, off-site disposal		excavate, on-site landfill	excavate, off-site disposal	excavate, on-site landfill	excavate, off-site disposal
C	Membrane Plant Ancilliary Areas (PCB 25-49 mg/kg)	nothing	cap				excavate, on-site landfill	excavate, off-site disposal
D	Fill Area (PCB >50 mg/kg)	nothing	cap		excavate, on-site landfill	excavate, off-site disposal	excavate, on-site landfill	excavate, off-site disposal
E	Areas Northeast of Cell Building Pad	nothing	excavate, off-site disposal		excavate, on-site landfill	excavate, off-site disposal	excavate, on-site landfill	excavate, off-site disposal
H	Waste Water Treatment Solids	nothing	off-site disposal	LTTD treatment	on-site landfill	off-site disposal	on-site landfill	off-site disposal
I	Stormwater Conveyance System	nothing	cleaned and sealed					
J	Wooded Bottomland Areas (Including Drainage Pathways)	nothing	excavate, off-site disposal		excavate, on-site landfill	excavate, off-site disposal	excavate, on-site landfill	excavate, off-site disposal
K	Wooded Bottomland Area (North of Fill Area)	nothing	excavate, off-site disposal		excavate, on-site landfill	excavate, off-site disposal	excavate, on-site landfill	excavate, off-site disposal
L	Areas Northeast Corner of ONP and Southeast Corner of NRB	nothing	cap/erosion control					
M	Wooded Bottomland Area (North of Fill Area)	nothing	excavate, off-site disposal		excavate, on-site landfill	excavate, off-site disposal	excavate, on-site landfill	excavate, off-site disposal
Threshold criteria	1. Protectiveness	No	Yes	Yes	Yes	Yes	Yes	Yes
	2. ARAR compliance	No	Yes	Yes	Yes	Yes	Yes	Yes
Balancing criteria	3. Long-term	No	Yes	Yes	Yes	Yes	Yes	Yes
	4. TMV	No	TMV	TMV	TM	TMV	TM	TMV
	5. Short-term	No	Yes	Yes	Yes	Yes	Yes	Yes
	6. Implementability	0 months	12 months	12 months	18-24 months	12 months	18-24 months	12 months
	7. Cost	$ -	$ 19,700,000	$ 21,300,000	$ 13,300,000	$ 21,600,000	$ 14,000,000	$ 25,900,000
Modifying Criteria	8. State Acceptance	No	Yes	Yes	Yes	Yes	Yes	Yes
	9. Community Acceptance	No Comments received from community members.						

Notes:

ECs = Engineering Controls

ICs = Institutional Controls

LTTD = low temperature thermal desporption

mg/kg = milligrams per kilogram

TMV = toxicity, mobility, volume

Table 90: Alternatives S1-S4 Common Elements and Distinguishing Features

Remedial Area	Area Description	S-1	S-2	S-3	S-4
		NO ACTION	CAPPING WITH VERTICAL IMPERMEABLE BARRIER INSTALLATION AND ICs	**ISS, CAPPING, AND ICs**	EXCAVATION AND OFF-SITE TREATMENT AND DISPOSAL
F	Retort Area	nothing	capping, vertical barrier	capping, ISS	excavate, off-site Treatment and disposal
G	Cell Building Pad				
Threshold criteria	1. Protectiveness	No	Yes	Yes	Yes
	2. ARAR compliance	No	Yes	Yes	Uncertain
Balancing criteria	3. Long-term	No	Yes	Yes	Yes
	4. TMV	No	TM	TM	TMV
	5. Short-term	No	Yes	Yes	Yes
	6. Implementability	0 months	6-12 months	6-12 months	7-8 years
	7. Cost	$ -	$ 1,300,000	$ 2,900,000	$ 56,000,000
Modifying Criteria	8. State Acceptance	No	Yes	Yes	Yes
	9. Community Acceptance	No comments received from community members.			

Notes:

ICs = Institutional Controls

ISS = In-Situ Stabilization

TMV = Toxicity, Mobility, Volume

9.3.2 Volumes

Table 91 illustrates the distinguishing differences regarding volumes to be capped, excavated, off-site treatment or disposal, and on-site TSCA disposal unit.

Table 91: Volume Comparisons by Remedy Mode

Alternative	Acres Capped	Excavated Volume (yd^3)	WWTS Volume (yd^3)	Off-site Disposal or Treatment (yd^3)	On-site TSCA Disposal Unit (yd^3)
A-1	0	0	23,700	0	0
A-2	2.4	10,900	23,700	34,600	0
A-3	1.7	15,400	23,700	0	39,100
A-4	1.7	15,400	23,700	39,100	0
A-5	0.02	26,400	23,700	0	50,100
A-6	0.02	26,400	23,700	50,100	0
S-1	0	0	N/A	0	0
S-2	1.3	0	N/A	0	0
S-3	1.3	0	N/A	0	0
S-4	0	25,000	N/A	25,000	0

Notes:
N/A not applicable (addressed in A- alternatives)
WWTS Wastewater Treatment Solids
yd^3 cubic yards

9.3.3 Costs and Timeframes

Table 92 illustrates the similarities and differences in timeframes and estimated costs.

Table 92: Estimated Cost and Timeframes

	Estimated Costs				Timeframes (years)	
	Capital	**Annual O&M**	**Total**	**Total Present Worth**	**Construction**	**To Achieve RAOs**
A-1	$0	$0	$0	$0	0	beyond our lifetime
A-2a	$18,647,700	$31,500	$19,700,000	$19,000,000	1	1
A-2b	$20,180,300	$31,500	$21,300,000	$20,600,000	1	1
A-3	$12,122,700	$36,500	$13,300,000	$12,600,000	1.5-2	1.5-2
A-4	$20,453,700	$31,500	$21,600,000	$20,900,000	1	1
A-5	$12,851,800	$31,500	$14,000,000	$13,300,000	1.5-2	1.5-2
A-6	$25,000,000	$29,000	$25,900,000	$25,400,000	1	1
S-1	$0	*	$0	$0	0	beyond our lifetime
S-2	$1,300,000	*	$1,300,000	N/A	0.5-1	0.5-1
S-3	$2,900,000	*	$2,900,000	N/A	0.5-1	0.5-1
S-4	$56,000,000	*	$56,000,000	N/A	7-8	7-8

Notes:

*	Annual O&M costs are included in the A- alternatives
N/A	Not Applicable
RAOs	Remedial Action Objectives

9.3.4 NCP Criteria

All of the alternatives except for the No Action alternatives are protective of human health and the environment.

All alternatives comply with ARARs, with the waiver invoked in this ROD for Alternatives A-3 and A-5. The waiver used is TSCA regulation 40 CFR §761.75(c)(4) for construction of a chemical waste landfill. The necessity for this waiver is due to not meeting the 50-foot depth requirement from the TSCA disposal unit bottom liner to groundwater. Due to the engineered design of the TSCA disposal unit and natural clay formation present at the site, potential releases of PCBs will be addressed in a manner that does not present an unreasonable risk of injury to human health and the environment under TSCA and will be protective of human health and the environment under CERCLA.

All of the alternatives reduce mobility to some extent. S-3 which includes ISS as on-site treatment, will reduce toxicity and mobility of PTW in areas F and G. In addition, alternatives A-2, A-4, A-6 and S-4 also reduce volume due to off-site transportation, treatment and disposal.

All of the alternatives include minimal to moderate short-term risks. These risks are primarily to impacts to ecological receptors, risks to the public during transportation of wastes to disposal facilities.

All of the alternatives are implementable, however implementation of alternative S-4 will be difficult due to the treatment facility's limitations on how much waste they can accept/treat per day and the large volume estimated under this alternative.

Alternative costs range from $0 to $25.9 million for the overall site alternatives and $0 to $56 million for the S- alternatives.

Remedial Action timeframes range from 12 to 24 months of the overall site alternatives and 6 months to 8 years (S-4) for the S- alternatives.

NCDEQ supports EPA's selected remedy. EPA did not receive any comments from community members regarding the proposed remedy.

9.4 Expected Outcomes of Each Alternative

After completion of the remedial action, the land use will be limited to industrial use or ecological habitat for each alternative. This is primarily due to being surrounded on three sides by IP and the fourth side bordering the Cape Fear River. As discussed in **Section 6.0,** groundwater at the site cannot be used for potable purposes. This will remain the same after completion of the remedial action, regardless of which alternative is selected.

10.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 400.430(f)(5)(i) of the NCP requires that the ROD explain how the nine evaluation criteria in NCP §300.430(e)(9)(iii) were used to select the remedy. The nine criteria are divided into three categories: threshold criteria (must be met), balancing criteria (basis for alternative selection), and modifying criteria (applied after the public comment period ends for the Proposed Plan). The specific evaluation criteria that fall under each of these categories are listed below:

Threshold Criteria
- Overall protection of human health and the environment
- Compliance with ARARs

Balancing Criteria
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria
- State Acceptance
- Community Acceptance

The remedial alternatives were evaluated for the criteria and then compared with one another to identify their respective strengths and weaknesses. Reduction of toxicity, mobility and volume has been evaluated with and without treatment in the FS, with the understanding that EPA has a preference for treatment, when applicable. **Table 93** and **Table 94** summarize the comparative analysis for the A-alternatives and the S-alternatives, respectively.

Sections 10.1 through **10.9** discuss each criterion in detail. As recommended in Highlight 6-23 in *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, the discussion of each criterion presents each alternative in decreasing order from the most to least advantageous. Where alternatives have equal advantages, they are listed in numerical name order.

Table 93: Comparative Analysis Summary for A-1 through A-6

Remedial Area	Area Description	A-1	A-2a	A-2b	A-3	A-4	A-5	A-6
		NO ACTION	CAPPING WITH LIMITED EXCAVATION, OFF-SITE DISPOSAL, AND ICs/ECs	same as 2a except for H area	**COMBINATION OF CAPPING AND EXCAVATION, ON-SITE DISPOSAL, AND ICs/ECs**	COMBINATION OF CAPPING AND EXCAVATION, ON-SITE DISPOSAL, AND ICs/ECs	EXCAVATION, ON-SITE DISPOSAL, AND ICs/ECs	EXCAVATION, OFF-SITE DISPOSAL, AND ICs/ECs
Threshold criteria	1. Protectiveness	No	Yes	Yes	Yes	Yes	Yes	Yes
	2. ARAR compliance	No	Yes	Yes	Yes	Yes	Yes	Yes
Balancing criteria	3. Long-term	No	Yes	Yes	Yes	Yes	Yes	Yes
	4. TMV	No	TMV	TMV	TM	TMV	TM	TMV
	5. Short-term	No	Yes	Yes	Yes	Yes	Yes	Yes
	6. Implementability	0 months	12 months	12 months	18-24 months	12 months	18-24 months	12 months
	7. Cost	$ -	$ 19,700,000	$ 21,300,000	$ 13,300,000	$ 21,600,000	$ 14,000,000	$ 25,900,000
Modifying Criteria	8. State Acceptance	No	Yes	Yes	Yes	Yes	Yes	Yes
	9. Community Acceptance	No Comments received from community members.						

Notes:

ECs = Engineering Controls

ICs = Institutional Controls

LTTD = low temperature thermal desporption

mg/kg = milligrams per kilogram

TMV = toxicity, mobility, volume

Table 94: Comparative Analysis Summary for S-1 through S-4

Remedial Area	Area Description	S-1	S-2	S-3	S-4
		NO ACTION	CAPPING WITH VERTICAL IMPERMEABLE BARRIER INSTALLATION AND ICs	**ISS, CAPPING, AND ICs**	EXCAVATION AND OFF-SITE TREATMENT AND DISPOSAL
Threshold criteria	1. Protectiveness	No	Yes	Yes	Yes
	2. ARAR compliance	No	Yes	Yes	Uncertain
Balancing criteria	3. Long-term	No	Yes	Yes	Yes
	4. TMV	No	TM	TM	TMV
	5. Short-term	No	Yes	Yes	Yes
	6. Implementability	0 months	6-12 months	6-12 months	7-8 years
	7. Cost	$ -	$ 1,300,000	$ 2,900,000	$ 56,000,000
Modifying Criteria	8. State Acceptance	No	Yes	Yes	Yes
	9. Community Acceptance	No comments received from community members.			

Notes:

ICs = Institutional Controls

ISS = In-Situ Stabilization

TMV = Toxicity, Mobility, Volume

10.1 Overall Protection of Human Health and the Environment

NCP §300.430(e)(9)(iii)(A) states: "*Overall protection of human health and the environment.* Alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals consistent with §300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs."

Table 95 provides a summary comparison of each alternative regarding the criteria of overall protection.

Table 95: Criteria 1 – Overall Protection Summary

Alternative		Overall Protection?
Overall Site Alternatives		
A-1	No Action	No
A-2a	Capping with Limited Excavation, Off-site Disposal, and ICs/ECs	Yes
A-2b	same as A-2a except for WWTS treated with LTTD	Yes
A-3	Combination of Capping and Excavation, On-site Disposal and ICs/ECs	Yes
A-4	Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs	Yes
A-5	Excavation, On-site Disposal, and ICs/ECs	Yes
A-6	Excavation, Off-site Disposal, and ICs/ECs	Yes
Soil Beneath Retort Pad and Mercury Cell Building Pad Alternatives		
S-1	No Action	No
S-2	Capping with Vertical Impermeable Barrier Installation and ICs	Yes
S-3	In-Situ Stabilization, Capping and ICs	Yes
S-4	Excavation, Off-site Treatment and Disposal	Yes

Notes:
Green background indicates that the alternative meets the criteria of that column
Red background indicates that the alternative does not meet the criteria.
ECs = Engineering Controls
ICs = Institutional Controls
LTTD = low temperature thermal desorption
WWTS = Waste Water Treatment Solids

10.1.1 A- Alternatives

All of the A- alternatives, except A-1, provide overall protection. Further discussion on each alternative follows.

Alternative A-2 provides overall protectiveness. Capping isolates and prevents erosion and direct exposure of human and ecological receptors to COCs in soil. Excavation and backfilling remove COC-impacted material and protect human and ecological receptors from potential exposure to residual COCs in soil and sediment. Alternative-2b includes a smaller volume of contaminated material that would be transported through communities to an off-site landfill. Therefore, it presents less of a short-term risk to community members than Alternative-2a. ICs control access and further limit exposure to human receptors.

Alternative A-3 provides overall protectiveness. Capping isolates and prevents erosion and direct exposure of human and ecological receptors to COCs in soil. Excavation and backfilling remove COC-impacted material and protect human and ecological receptors from potential exposure to residual COCs in soil and sediment. Containment of excavated material in an on-site TSCA disposal unit prevents its erosion and migration, and precludes further exposure to human and ecological receptors. On-site disposal limits the short-term impacts to community members. ICs control access and further limit exposure to human receptors.

Alternative A-4 provides overall protectiveness. Capping isolates and prevents erosion and direct exposure of human and ecological receptors to COCs in soil. Excavation and backfilling remove COC-impacted material and protect human and ecological receptors from potential exposure to residual COCs in soil and sediment. Contaminated material would be transported through communities to an off-site landfill; therefore, it presents short-term risks to community members. ICs control access and further limit exposure to human receptors.

Alternative A-5 provides overall protectiveness. It includes the largest volume excavated to remove COC-impacted material. Excavation and backfill protect on-site human and ecological receptors from potential exposure to residual COCs in soil and sediment. Containment of excavated material in an on-site TSCA disposal unit prevents erosion and migration, and precludes further exposure to human and ecological receptors. On-site disposal limits the short-term impacts to community members. ICs control access and further limit exposure to human receptors.

Alternative A-6 provides overall protectiveness. Excavation and backfilling remove COC-impacted material and protect human and ecological receptors from potential exposure to residual COCs in soil and sediment. This alternative includes the largest volume of contaminated material that would be transported through communities to an off-site landfill; therefore, it presents short-term risks to community members. ICs control access and further limit exposure to human receptors.

10.1.2 S- Alternatives

All of the S- alternatives, except S-1, provide overall protectiveness. Further discussion on each alternative follows.

Alternative S-2 provides overall protectiveness. Containment by a vertical barrier/cap system isolates and prevents erosion and direct exposure of human and ecological receptors to mercury and PCBs in soil. It would also control migration of mercury and PCBs in groundwater. ICs control access and further limit exposure to human receptors.

Alternative S-3 provides overall protectiveness. ISS treats the soil to eliminate potential future mobility and prevent erosion and potential exposure to COCs in soil to human receptors. ICs control access and further limit exposure to human receptors.

Alternative S-4 provides overall protectiveness. Excavation, treatment, disposal, and backfilling remove COC-impacted material and protect human and ecological receptors from potential exposure to residual COCs in soil. The long duration to implement the remedy and the volume of contaminated material that would be transported off-site makes this alternative have the highest level of short-term risk to workers and community members. ICs control access and further limit exposure to human receptors.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements

NCP §300.430(e)(9)(iii)(B) states: "*Compliance with ARARs.* The alternatives shall be assessed to determine whether they attain applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility siting laws or provide grounds for invoking one of the waivers under paragraph (f)(1)(ii)(C) of this section."

Section 9.2 explains the different types of ARARs. The majority of ARARs developed for all of the alternatives evaluated are included in the FS. Those were refined further for the selected remedy and are included in **APPENDIX A – ARARs.**

Table 96 summarizes whether or not each alternative complies with ARARs. The evaluation is described further in **Sections 10.2.1** and **10.2.2**.

Table 96: Criteria 2 – Compliance with ARARs Summary

Alternative		Compliance with ARARs?
Overall Site Alternatives		
A-1	No Action	No
A-2a	Capping with Limited Excavation, Off-site Disposal, and ICs/ECs	Yes
A-2b	same as A-2a except for WWTS treated with LTTD	Yes
A-3	Combination of Capping and Excavation, On-site Disposal and ICs/ECs	Yes
A-4	Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs	Yes
A-5	Excavation, On-site Disposal, and ICs/ECs	Yes
A-6	Excavation, Off-site Disposal, and ICs/ECs	Yes
Soil Beneath Retort Pad and Mercury Cell Building Pad Alternatives		
S-1	No Action	No
S-2	Capping with Vertical Impermeable Barrier Installation and ICs	Yes
S-3	In-Situ Stabilization, Capping and ICs	Yes
S-4	Excavation, Off-site Treatment and Disposal	TBD - dependent on waste profiling data

Notes:
Green background indicates that the alternative meets the criteria of that column
Yellow background indicates that additional information is needed to ensure the alternative complies with ARARs.
Red background indicates that the alternative does not meet the criteria.
ARARs = Applicable or Relevant and Appropriate Requirements
ECs = Engineering Controls
ICs = Institutional Controls
TBD = to be determined
TSCA = Toxic Substances Control Act

10.2.1 A- alternatives

All alternatives except for A-1 comply with ARARs. For alternatives A-3 and A-5, a waiver under TSCA regulation 40 CFR §761.75(c)(4) is being applied at this site for the TSCA chemical waste landfill requirement of a depth of 50 feet between the TSCA disposal unit bottom liner and groundwater.

10.2.2 S- alternatives

Alternatives S-2 and S-3 comply with ARARs. Alternative S-4 complies with ARARs with uncertainty. If PCB concentrations in excavated material exceed 50 mg/kg, compliance by treatment and disposal facilities may not allow off-site retort/incineration. The concentrations of PCBs in these soils are not fully known because no samples beneath the pads are available. Therefore, compliance with ARARs is not certain. Alternative S-1 does not comply with ARARs.

10.3 Long-Term Effectiveness and Permanence

NCP §300.430(e)(9)(iii)(C) states: "*Long-term effectiveness and permanence.* Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following:

(*1*) Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

(*2*) Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement."

Table 97 summarizes whether or not each alternative provides long-term effectiveness and permanence and includes the volume of contaminated material that will be treated or disposed. The evaluation is described further in **Sections 10.3.1** and **10.3.2**.

Table 97: Criteria 3 – Long-Term Effectiveness and Permanence Summary

Alternative		Volume Treated or Disposed*	Long-Term Effectiveness
Overall Site Alternatives			
A-1	No Action	-	No
A-2a	Capping with Limited Excavation, Off-site Disposal, and ICs/ECs	34,600	Yes
A-2b	same as A-2a except for WWTS treated with LTTD	34,600	Yes
A-3	Combination of Capping and Excavation, On-site Disposal and ICs/ECs	39,100	Yes
A-4	Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs	39,100	Yes
A-5	Excavation, On-site Disposal, and ICs/ECs	50,100	Yes
A-6	Excavation, Off-site Disposal, and ICs/ECs	50,100	Yes
Soil Beneath Retort Pad and Mercury Cell Building Pad Alternatives			
S-1	No Action	-	No
S-2	Capping with Vertical Impermeable Barrier Installation and ICs	-	Yes
S-3	In-Situ Stabilization, Capping and ICs	25,000	Yes
S-4	Excavation, Off-site Treatment and Disposal	25,000	Yes

Notes:

* volume units are cubic yards

Green background indicates that the alternative meets the criteria of that column

Red background indicates that the alternative does not meet the criteria.

ECs = Engineering Controls

ICs = Institutional Controls

10.3.1 A- alternatives

Alternatives A-2 through A-6 are effective and permanent long-term remedial solutions. They all reduce risks at the site to varying degrees. The controls needed are adequate and reliable.

Alternative A-2 will treat or dispose of approximately 34,600 yd^3 of waste and will cap 2.4 acres. It will require the following controls:

- ICs to limit disturbance of the backfill/cover soil in excavated areas;
- ICs to limit disturbance of the caps
- inspections/maintenance of erosion controls and revegetated areas; and
- groundwater monitoring to confirm remedy protectiveness.

Alternative A-3 will treat or dispose of approximately 39,100 yd^3 of waste and will cap 1.7 acres. It will require the following controls:

- ICs to limit disturbance of the backfill/cover soil in excavated areas;
- ICs to limit disturbance of the caps
- ICs to limit disturbance of the TSCA disposal unit cap and cover soil
- inspections/maintenance of erosion controls and revegetated areas; and
- groundwater monitoring to confirm remedy protectiveness.

Alternative A-4 will treat or dispose of approximately 39,100 yd^3 of waste and will cap 1.7 acres. This alternative will require the same controls as Alternative A-2.

Alternative A-5 will excavate and place into an on-site TSCA disposal unit approximately 50,100 yd^3 of waste. This alternative will require the same controls as Alternative A-3.

Alternative A-6 will treat or dispose of the highest volume of waste (approximately 50,100 yd^3) at an off-site treatment/disposal facility. The only controls needed will be ICs to limit disturbance of the backfill/cover soil and groundwater monitoring to confirm remedy protectiveness for the closed RCRA units.

10.3.2 S- alternatives

Alternatives S-2 through S-4 are effective and permanent long-term remedial solutions. They all reduce risks at the site to varying degrees. The controls needed are adequate and reliable.

Alternative S-2 is a containment remedy. The contaminated areas would be contained, not treated. The controls needed include:

- long-term maintenance,
- ICs to limit disturbance of the cap,
- inspections/maintenance of erosion controls, and
- groundwater monitoring to confirm remedy protectiveness

Alternative S-3 will utilize a proven treatment technology to treat approximately 25,000 yd^3 of mercury waste and contaminated soil. In-situ solidification/stabilization is a permanent solution and reduces mobility of contaminants. This technology has been used effectively on wastes at the site when the facility was regulated under RCRA. The controls needed include:

- ICs to limit disturbance of the stabilized areas; and
- groundwater monitoring to confirm remedy protectiveness.

Alternative S-4 involves excavation and off-site treatment/disposal of approximately 25,000 yd^3 of contaminated material.

10.4 Reduction of toxicity, mobility, or volume through treatment

NCP §300.430(e)(9)(iii)(D) states: "*Reduction of toxicity, mobility, or volume through treatment.* The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume of hazardous substances shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:

(*1*) The treatment or recycling processes the alternatives employ and materials they will treat;
(*2*) The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled;
(*3*) The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specification of which reduction(s) are occurring;
(*4*) The degree to which the treatment is irreversible;
(*5*) The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents; and
(*6*) The degree to which treatment reduces the inherent hazards posed by principal threats at the site."

Table 98: Criteria 4 - Reduction of Toxicity, Mobility or Volume via Treatment Summary

	Alternative	Treatment?	Volume Treated*	Volume Disposed*	Reduction of TMV?
Overall Site Alternatives					
A-1	No Action	No	-	-	No
A-2a	Capping with Limited Excavation, Off-site Disposal, and ICs/ECs	No	-	34,600	TMV
A-2b	same as A-2a except for WWTS treated with LTTD	Yes	23,700	10,900	TMV
A-3	Combination of Capping and Excavation, On-site Disposal and ICs/ECs	No	-	39,100	TM
A-4	Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs	No	-	39,100	TMV
A-5	Excavation, On-site Disposal, and ICs/ECs	No	-	50,100	TM
A-6	Excavation, Off-site Disposal, and ICs/ECs	No	-	50,100	TMV
Soil Beneath Retort Pad and Mercury Cell Building Pad Alternatives					
S-1	No Action	No	-	-	No
S-2	Capping with Vertical Impermeable Barrier Installation and ICs	No	-	-	TM
S-3	In-Situ Stabilization, Capping and ICs	Yes	25,000	25,000	TM
S-4	Excavation, Off-site Treatment and Disposal	Yes	25,000	25,000	TMV

Notes:
* volume units are cubic yards
Green background indicates that the alternative meets the criteria of that column
Red background indicates that the alternative does not meet the criteria or has the highest costs.
ECs = Engineering Controls
ICs = Institutional Controls
LTTD = low temperature thermal desorption
TMV = toxicity, mobility, volume
WWTS = Waste Water Treatment Solids

10.4.1 A- alternatives

The only A- alternative that includes treatment is alternative A-2b. The remainder of the A- alternatives, except for A-1, reduce toxicity, mobility and/or volume through capping and/or on-site containment in a TSCA disposal unit or off-site containment in an EPA-approved landfill.

Aternative A-2a does not include treatment but would reduce toxicity, mobility and volume at the site. Off-site disposal would reduce the volume of contaminated material at the site by approximately 34,600 yd^3. Capping would reduce mobility of COCs in soil by creating a barrier and preventing contact with surface water and receptors.

Alternative A-2b would reduce toxicity and mobility through treatment. Approximately 23,700 yd^3 of WWTS would be treated via LTTD. Capping of approximately 2.4 acres would reduce mobility of COCs in soil by creating a barrier and preventing contact with surface water and receptors.

Alternative A-3 does not involve treatment but would move the second highest volume of contaminated material into an on-site disposal unit that complies with TSCA ARARs. Approximately 39,100 yd^3 of contaminated soil and sediment would be placed in a constructed TSCA disposal unit. This alternative would reduce mobility of and exposure to the toxicity of COCs in soil by creating a barrier or isolating material in an on-site TSCA disposal unit. These actions, once completed, would prevent contaminant contact with surface water and receptors.

Alternative A-4 does not involve treatment but would reduce toxicity, mobility and volume at the site. Off-site disposal of approximately 39,100 yd^3 of contaminated soil and sediment would reduce the volume of contaminated material on-site. Capping would reduce mobility of and exposure to COCs in soil by creating a barrier and preventing contact with surface water and receptors.

Alternative A-5 does not involve treatment but would move the highest volume of contaminated material into an on-site TSCA disposal unit. Approximately 50,100 yd^3 of contaminated soil and sediment would be placed in an on-site TSCA disposal unit. The disposal unit would reduce mobility of and exposure to the toxicity of COCs in soil by creating a barrier or isolating material in an on-site TSCA disposal unit. These actions, once completed, would prevent contaminant contact with surface water and receptors.

Alternative A-6 does not involve treatment but would remove the highest volume of contaminated material from the site. Approximately 50,100 yd^3 of contaminated soils and sediments would be removed from the site and disposed of in an EPA-approved off-site landfill. Capping in the L Areas would reduce mobility of and exposure to COCs in soil by creating a barrier and preventing contact with surface water and receptors.

10.4.2 S- alternatives

Alternatives S-3 and S-4 are the only S- alternatives that include treatment. Alternative S-2 would reduce mobility via containment. Alternative S-3 would reduce toxicity and mobility via treatment using ISS. Alternative S-4 would reduce toxicity, mobility and volume through excavation and off-site treatment. However, treatment may not be possible if the waste includes concentrations of both mercury and PCBs at levels that require treatment. Facilities currently cannot treat RCRA hazardous waste that also has TSCA PCB waste at concentrations greater than 50 mg/kg.

10.5 Short-Term Effectiveness

NCP §300.430(e)(9)(iii)(E) states: "*Short-term effectiveness.* The short-term impacts of alternatives shall be assessed considering the following:

(*1*) Short-term risks that might be posed to the community during implementation of an alternative;
(*2*) Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures;
(*3*) Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and
(*4*) Time until protection is achieved."

Table 99: Criteria 5 – Short-term Effectiveness Summary

Alternative		Short-Term Effectiveness
Overall Site Alternatives		
A-1	No Action	not effective; no negative short-term effects
A-2a	Capping with Limited Excavation, Off-site Disposal, and ICs/ECs	short-term impacts to ecological receptors. Short-term risk to public during transportation to disposal facilities
A-2b	same as A-2a except for WWTS treated with LTTD	short-term impacts to ecological receptors. Short-term risk to public during transportation to disposal facilities
A-3	Combination of Capping and Excavation, On-site Disposal and ICs/ECs	minimal risk to worker; short-term impacts to ecological receptors.
A-4	Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs	short-term impacts to ecological receptors. Short-term risk to public during transportation to disposal facilities
A-5	Excavation, On-site Disposal, and ICs/ECs	minimal risk to worker; short-term impacts to ecological receptors.
A-6	Excavation, Off-site Disposal, and ICs/ECs	short-term impacts to ecological receptors. Short-term risk to public during transportation to disposal facilities
Soil Beneath Retort Pad and Mercury Cell Building Pad Alternatives		
S-1	No Action	not effective; no negative short-term effects
S-2	Capping with Vertical Impermeable Barrier Installation and ICs	minimal risk to worker; short-term impacts to ecological receptors.
S-3	In-Situ Stabilization, Capping and ICs	minimal risk to worker; short-term impacts to ecological receptors.
S-4	Excavation, Off-site Treatment and Disposal	short-term impacts to ecological receptors. Short-term risk to public during transportation to disposal facilities
Notes:		
Green background indicates that the alternative meets the criteria of that column		
Yellow background indicates that the alternative meets the criteria of that column, but not as well as alternatives with green background		
Red background indicates that the alternative does not meet the criteria.		
ECs = Engineering Controls		
ICs = Institutional Controls		

10.5.1 A- alternatives

Alternative A-1 does not provide short-term protectiveness. The other A- alternatives provide short-term effectiveness as discussed below.

Alternative A-2 is an effective short–term remedial solution. Capping and excavation provide immediate risk reduction. Minimal risk to workers would be expected during construction activities. Localized, short-term impacts on the ecological community would be limited to the Wooded Bottomland Area and would be mitigated through restoring and revegetating to initiate habitat recovery. Risk to workers would be managed through safe work practices and appropriate personal protective equipment (PPE). Air monitoring would be required during earthmoving activities, and dust would be controlled through dust suppression practices. Short-term risk of releases and public exposure during transportation of contaminated material over long distances to disposal sites is limited to the relatively small volume of material excavated.

Alternative A-3 is an effective short-term remedial solution. Capping and excavation provide immediate risk reduction. Minimal risk to workers would be expected during construction activities. Localized, short-term impacts on the ecological community would be limited to the Wooded Bottomland Area and would be mitigated through restoring and revegetating to initiate habitat recovery. Risk to workers would be managed through safe work practices and appropriate PPE. Air monitoring would be required during earthmoving activities, and dust would be controlled through dust suppression practices.

Alternative A-4 is an effective short–term remedial solution. Capping and excavation provide immediate risk reduction. Minimal risk to workers would be expected during construction activities. Localized, short-term impacts on the ecological community would be limited to the Wooded Bottomland Area and would be mitigated through restoring and revegetating to initiate habitat recovery. Risk to workers would be managed through safe work practices and appropriate PPE. Air monitoring would be required during earthmoving activities, and dust would be controlled through dust suppression practices. Transportation of contaminated material over long distances to disposal sites increases short-term risk of releases and public exposure.

Alternative A-5 is an effective short-term remedial solution. Excavation provides immediate risk reduction. Minimal risk to workers would be expected during construction activities. Localized, short-term impacts on the ecological community would be limited to the Wooded Bottomland Area and would be mitigated through restoring and revegetating to initiate habitat recovery. Risk to workers would be managed through safe work practices and appropriate PPE. Air monitoring would be required during earthmoving activities, and dust would be controlled through dust suppression practices.

Alternative A-6 is an effective short–term remedial solution. Excavation provides immediate risk reduction. Minimal risk to workers would be expected during construction activities. Localized, short-term impacts on the ecological community would be limited to the Wooded Bottomland Area and would be mitigated through restoring and revegetating to initiate habitat recovery. Risk to workers would be managed through safe work practices and appropriate PPE. Air monitoring would be required during earthmoving activities, and dust would be controlled through dust suppression practices. Transportation of contaminated material over long distances to disposal sites increases short-term risk of releases and public exposure.

10.5.2 S- alternatives

Alternative S-1 does not provide short-term protectiveness. The other S- alternatives provide short-term effectiveness and risks as explained below.

Alternative S-2 is an effective short term remedial solution. Capping provides immediate risk reduction. Minimal risk to workers would be expected during construction activities. Risk to workers would be managed through safe work practices and appropriate PPE. Air monitoring would be required during earthmoving activities, and dust would be controlled through dust suppression practices.

Alternative S-3 is an effective short term remedial solution. ISS provides immediate risk reduction. Minimal risk to workers would be expected during construction activities. Risk to workers would be managed through safe work practices and appropriate PPE. Air monitoring would be required during implementation activities, and dust would be controlled through dust suppression practices.

Alternative S-4 is an effective short–term remedial solution; however, potential for exposure to waste material and physical hazards are acknowledged. Potential risk to workers would be expected during construction activities due to the potential for direct contact and inhalation of air borne particles. This risk would be managed through safe work practices and appropriate PPE. Air monitoring would be required during earthmoving activities, and dust would be controlled through dust suppression practices. Transportation of contaminated soils over long distances to disposal sites increases short-term risk of releases and public exposure.

10.6 Implementability

NCP §300.430(e)(9)(iii)(F) states: "*Implementability.* The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate:

(*1*) Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.

(*2*) Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions);

(*3*) Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies.

Table 100: Criteria 6 - Implementability Summary

Alternative		Implementability
Overall Site Alternatives		
A-1	No Action	Yes
A-2a	Capping with Limited Excavation, Off-site Disposal, and ICs/ECs	Yes
A-2b	same as A-2a except for WWTS treated with LTTD	Yes
A-3	Combination of Capping and Excavation, On-site Disposal and ICs/ECs	Yes
A-4	Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs	Yes
A-5	Excavation, On-site Disposal, and ICs/ECs	Yes
A-6	Excavation, Off-site Disposal, and ICs/ECs	Yes
Soil Beneath Retort Pad and Mercury Cell Building Pad Alternatives		
S-1	No Action	Yes
S-2	Capping with Vertical Impermeable Barrier Installation and ICs	Yes
S-3	In-Situ Stabilization, Capping and ICs	Yes
S-4	Excavation, Off-site Treatment and Disposal	Difficult
Notes:		
Green background indicates that the alternative meets the criteria of that column		
Red background indicates that the alternative does not meet the criteria.		
ECs = Engineering Controls		
ICs = Institutional Controls		

10.6.1 A- alternatives

Alternative A-1 is "No Action". Therefore, it is the easiest to implement.

Alternative A-2a is the 2nd easiest to implement. This alternative includes excavation and off-site disposal of the lowest volume of wastes compared to the other alternatives. It includes long-term monitoring plus inspections and maintenance of ECs. Access roads and staging areas would need to be constructed to implement work. Implementation materials and equipment are readily available and techniques are commonly applied. Long-haul distances to an off-site EPA-approved landfill would be anticipated. Time to complete implementation is estimated at approximately 12 months, assuming continuous 24-hour/7 days per week operation and limited downtime.

Alternative A-2b is the most difficult to implement. WWTS will be treated by LTTD so that the treated residual can be beneficially reused on-site. This alternative includes long-term monitoring plus inspections and maintenance of ECs. Access roads and staging areas would need to be constructed to implement work. Implementation materials and equipment are readily available and techniques are commonly applied. Long-haul distances to an off-site EPA-approved landfill would be anticipated. Time to complete implementation is estimated at approximately 12 months, assuming continuous 24-hour/7 days per week operation and limited downtime.

Alternative A-3 implementation is straightforward and includes long-term monitoring plus inspections and maintenance of on-site TSCA disposal unit and RCRA units, in addition to and ECs. Access roads and staging areas would need to be constructed to implement work. Implementation materials and equipment are readily available and techniques are commonly applied. Time to complete implementation is estimated at approximately 18 to 24 months.

Alternative A-4 implementation is straightforward and includes long-term monitoring plus inspections and maintenance of ECs. Access roads and staging areas would need to be constructed to implement work. Implementation materials and equipment are readily available and techniques are commonly applied. Long-haul distances to an off-site EPA-approved landfill would be anticipated. Time to complete implementation is estimated at approximately 12 months.

Alternative A-5 implementation is straightforward and includes long-term monitoring plus inspections and maintenance of the on-site TSCA disposal unit and RCRA units, in addition to ECs. Access roads and staging areas would need to be constructed to implement work. Implementation materials and equipment are readily available and techniques are commonly applied. Time to complete implementation is estimated at approximately 18 to 24 months.

Alternative A-6 implementation is straightforward and includes long-term monitoring plus inspections and maintenance of ECs. Access roads and staging areas would need to be constructed to implement work. Implementation materials and equipment are readily available and techniques are commonly applied. Long-haul distances to an off-site EPA-approved treatment/disposal facility would be anticipated. Time to complete implementation is estimated at approximately 12 months.

10.6.2 S- alternatives

Alternative S-1 is "No Action". Therefore, it is the easiest to implement.

Alternative S-2 implementation is straightforward and includes long-term monitoring plus inspections and maintenance. Access roads and staging areas would need to be constructed to implement work. Implementation materials and equipment are readily available and techniques are commonly applied. Time to complete implementation is estimated at approximately 6 to 12 months.

Alternative S-3 implementation is straightforward using conventional equipment and stabilization agents. Access roads and staging areas would need to be constructed to implement work. Implementation materials and equipment are readily available and techniques are commonly applied. Time to complete implementation is estimated at approximately 6 to 12 months.

Alternative S-4 is the most difficult to implement. Implementation is difficult because of extensive excavation/shoring required to excavate down to the Peedee Formation (10 to 15 feet), extremely long-haul distances, and the limited availability of treatment facilities that will incinerate/retort soils that contain both PCBs and mercury. Waste treatment and disposal facilities may reject the excavated material if PCB concentrations are greater than 50 mg/kg, so that off-site treatment and disposal is not available. Time to complete implementation may require up to 7 to 8 years due to the limited throughput capacity of the identified retort facility.

10.7 Costs

NCP §300.430(e)(9)(iii)(G) states: "*Cost.* The types of costs that shall be assessed include the following:
(*1*) Capital costs, including both direct and indirect costs;
(*2*) Annual operation and maintenance costs; and
(*3*) Net present value of capital and O&M costs."

Table 101: Criteria 7 – Cost Summary

		Estimated Costs			
Alternative		Capital	Annual O&M	Total	Net Present Worth*
Overall Site Alternatives					
A-1	No Action	$0	$0	$0	$0
A-3	Combination of Capping and Excavation, On-site Disposal and ICs/ECs	$12,122,700	$36,500	$13,300,000	$12,600,000
A-5	Excavation, On-site Disposal, and ICs/ECs	$12,851,800	$31,500	$14,000,000	$13,300,000
A-2a	Capping with Limited Excavation, Off-site Disposal, and ICs/ECs	$18,647,700	$31,500	$19,700,000	$19,000,000
A-2b	same as A-2a except for WWTS treated with LTTD	$20,180,300	$31,500	$21,300,000	$20,600,000
A-4	Combination of Capping and Excavation, Off-site Disposal, and ICs/ECs	$20,453,700	$31,500	$21,600,000	$20,900,000
A-6	Excavation, Off-site Disposal, and ICs/ECs	$25,000,000	$29,000	$25,900,000	$25,400,000
Soil Beneath Retort Pad and Mercury Cell Building Pad Alternatives					
S-1	No Action	$0	*	$0	$0
S-2	Capping with Vertical Impermeable Barrier Installation and ICs	$1,300,000	*	$1,300,000	N/A
S-3	In-Situ Stabilization, Capping and ICs	$2,900,000	*	$2,900,000	N/A
S-4	Excavation, Off-site Treatment and Disposal	$56,000,000	*	$56,000,000	N/A

Notes:

*	A discount rate of 7.0% was used in calculating Net Present Worth
**	Annual O&M costs are included in the A- alternatives

Estimated costs are considered to be -30% to +50% in accuracy
ECs = Engineering Controls
ICs = Institutional Controls
LTTD = low temperature thermal destruction
O&M = operation and maintenance

Alternatives A-1 and S-1, No Action, are the least expensive alternatives. As shown in **Table 101,** the Total Present worth costs range from $0 to $25.4 million for the A- alternatives and $0 to $56 million for the S- alternatives. In order of least expensive to most expensive the A- alternatives are: A-1, A-3, A-5, A-2a, A-2b, A-4 and A-6. Similarly, the order for the S- alternatives are S-1, S-2, S-3 and S-4.

10.8 State Acceptance

NCP §300.430(e)(9)(iii)(H) states: "*State acceptance.* Assessment of state concerns may not be completed until comments on the RI/FS are received but may be discussed, to the extent possible, in the proposed plan issued for public comment. The state concerns that shall be assessed include the following:

(*1*) The state's position and key concerns related to the preferred alternative and other alternatives; and
(*2*) State comments on ARARs or the proposed use of waivers."

NCDEQ has been actively involved with the site and has reviewed and provided comments on draft documents throughout removal and remedial processes. Their comments resulted in a revision of the FS during the public comment period of the Proposed Plan. NCDEQ submitted ARARs which are included in this ROD. Their comments on the draft ROD have been incorporated into this revised version.

NCDEQ concurs with all alternatives except for A-1 and S-1 (no action).

10.9 Community Acceptance

NCP §300.430(e)(9)(iii)(I) states: "*Community acceptance.* This assessment includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. This assessment may not be completed until comments on the proposed plan are received."

Community members did not submit or voice comments on the Proposed Plan. A transcript of the Proposed Plan public meeting is included in **APPENDIX B.**

10.10 Comparative Analysis Summary

10.10.1 A- alternatives

The seven remedial overall site alternatives were compared relative to the CERCLA criteria. All alternatives except Alternative A-1 meet the threshold criteria of protecting human health and environment and compliance with ARARs. Therefore, the No Action alternative is rejected. The remaining alternatives are effective in the short and long term and are implementable using standard construction equipment.

Total costs range from approximately $13,300,000 for Alternative A-3 with a combination of capping and excavation with on-site disposal, to $25,900,000 for Alternative A-6 with the largest excavation remedial footprint and off-site disposal. Both alternatives A-3 and A-5 include long-term maintenance for the on-site TSCA disposal unit, previously-closed RCRA units, and installed caps; ICs; site security; and long-term monitoring. The difference between these alternatives is that A-3 includes capping in some additional upland process with discrete PCB samples above the site industrial worker exposure goals of 11 mg/kg for total PCBs and within the TSCA level (below 50 mg/kg) for capping. Capping is suitable for these areas, provides equivalent protectiveness, meets threshold criteria, is cost effective, and does not impose a burden of additional monitoring because long-term monitoring is included in both A-3 and A-5 for the on-site TSCA disposal unit.

EPA's preferred overall site remedial alternative is Alternative A-3. This alternative is protective of human health and the environment, is implementable using standard equipment, reduces mobility and exposure to the toxicity of the COCs, and is effective both in the short and long term. The on-site TSCA disposal unit also avoids drawbacks associated with some of the other alternatives, particularly those resulting from hauling excavated materials over long distances. Transportation of contaminated soils long distances to disposal sites increases risk of releases and public exposure. Truck traffic hauling contaminated materials would be significantly increased in the local community. Therefore, on-site disposal is also a more sustainable approach to the remedial issues represented by this site.

10.10.2 S- alternatives

The four alternatives for the soil associated with the former Cell Building and Retort pads were compared relative to the CERCLA criteria. The No Action alternative (S-1) is rejected because it does not meet the threshold criteria of protecting human health and environment and compliance with ARARs.

Both Alternatives S-2 (Capping with Vertical Impermeable Barrier Installation and ICs) and S-3 (ISS, Capping, and ICs) meet the threshold criteria. Both are effective in the short and long term, minimize risk to workers during construction, and are implementable using standard equipment. Alternative S-3 offers the advantage of treatment and reduces mobility, with a slight increase in volume to accommodate the solidification/stabilization agents, plus the thickness of the cap over the ISS areas. Alternative S-2 has the disadvantage of long-term monitoring of water levels inside the vertical barrier so that water does not infiltrate the cap and accumulate such that hydraulic pressure increases.

Alternative S-4 (Excavation and Off-site Treatment and Disposal) may or may not comply with ARARs, depending on the concentrations of PCBs in the excavated material and the ability of a treatment facility to accept waste with PCB concentrations above TSCA regulated concentrations of 50 mg/kg if encountered.

Alternative S-4 would be effective in the long term, but there is a higher potential for risk to workers through dermal contact and inhalation. Toxicity and mobility would be reduced through treatment in this alternative. Transportation of contaminated soils over long distances to disposal sites increases the potential for short-term risk of releases and public exposure. Implementation is more difficult with Alternative S-4 compared to Alternatives S-2 and S-3 due to the extensive shoring of the excavation area, long haul distances, limited availability of approved and capable treatment and disposal facilities, potential for rejection of excavated material for treatment if PCB concentration are greater than 50 mg/kg, the need to contain the material for extensive periods in a staging area, and long treatment times (7 to 8 years). Cost is approximately 50 and 25 times more than Alternatives S-2 and S-3, respectively, with no substantial increase in protection or reduction in risk.

Therefore, the recommended alternative for the soils associated with the Retort and Cell Building pads is Alternative S-3 (ISS, Capping, and ICs). This alternative is protective of human health and the environment, is effective both in the short and long term with no short-term exposure resulting from hauling excavated materials over long distances and exposure to workers, is implementable using standard equipment, and reduces mobility of constituents through treatment. It also meets EPA's preference for treatment. In addition, Alternative S-3 lacks the many disadvantages associated with

Alternative S-4. Although it is slightly higher in cost compared to Alternative S-2, it does offer the advantage of treatment of the soils within the remedial footprint.

11.0 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure. In general, the priority for treatment for PTW is placed on source materials considered to be liquid, highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. There may be situations where the same treatment remedy will be selected for both PTWs and low level threat wastes.

Despite limited sampling, available information indicates that significant volumes of elemental mercury, a highly toxic material is present under the former Mercury Cell Building and Retort pads. Soil samples, observations on site, and operational history indicate the presence of soil that is heavily contaminated with elemental mercury. Puddles of elemental mercury on the floor in the former Mercury Cell Building triggered the first removal action. Elemental mercury has been observed in cracks and fissures in the concrete pad, prior to and following the removal of the building. The general understanding at this time is that elemental mercury and sorbed mercury is likely present within the concrete pad and beneath the pad within the underlying soils.

For these reasons, these areas are considered a source of contamination and as principal threat wastes. These areas were carved out into the S- alternatives. The S-alternatives included options for no action, containment, treatment, and off-site disposal/treatment. The selected alternative, ISS, is a treatment technology that will solidify the mercury in place to prevent direct exposure and migration, thus satisfying the statutory preference for treatment.

12.0 SELECTED REMEDY

12.1 Summary of the Rationale for the Selected Remedy

Based on the information available at this time, EPA and NCDEQ believe that the Selected Remedy combination satisfies the following statutory requirements of CERCLA Section 121(b) and Section 121(d): 1) protects human health and the environment; 2) complies with ARARs; 3) is cost effective; 4) utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfies the preference for treatment as a principal element. The selected remedy is the combination of remedial alternatives A-3 and S-3. The selected remedy meets the Threshold CERCLA evaluation criteria; it is protective of human health and the environment and complies with identified ARARs, although a waiver under TSCA at 40 CFR 761.75(c)(4) is necessary. The remedy reduces mobility of and exposure to COCs and the ISS in Alternative S-3 meets EPA's preference for treatment which reduces the toxicity and mobility of mercury waste and contaminated soil that are considered PTW. Both A-3 and S-3 are effective in the short and long term and are cost effective. There is no short-term exposure resulting from hauling excavated materials over long distances or worker exposure.

12.2 Description of the Selected Remedy

The remedial action selected in this ROD addresses contamination that poses unacceptable risks to human health and ecological receptors at the site. The contaminated media that poses unacceptable risks include soil, sediment, surface water, as well as mercury waste and Wastewater Treatment Solids (WWTS).

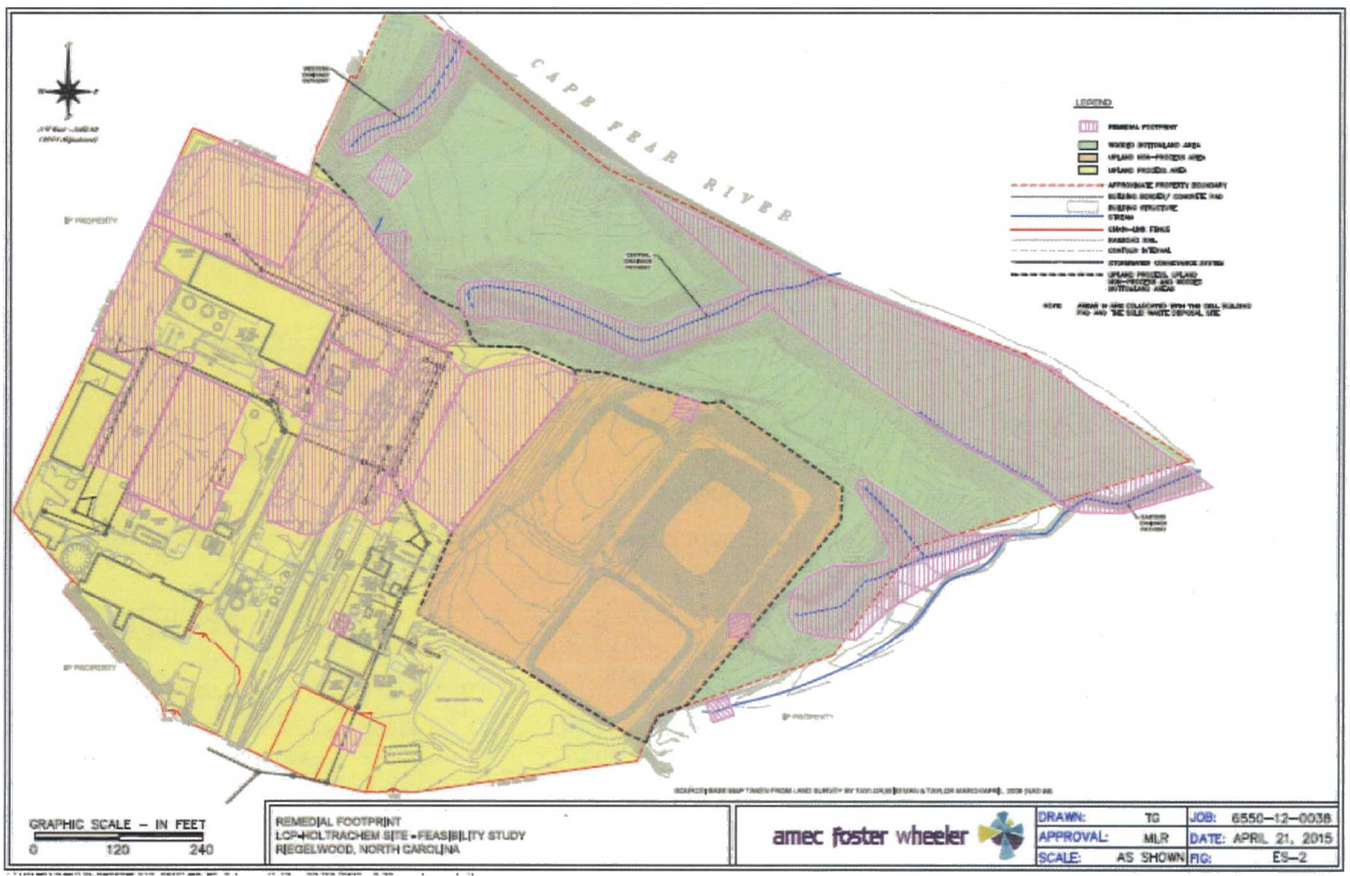
The selected remedy includes the following primary components:

- Treatment of mercury waste and contaminated soil, considered to be principal threat waste (PTW), located beneath the former mercury cell building and former retort pad via In-Situ Stabilization (ISS)
- Capping of the areas treated by ISS with a cover that meets RCRA Subtitle C landfill final cover ARARs
- Excavation of approximately 15,400 yd^3 of contaminated soil and sediment
- Capping approximately 1.7 acres of contaminated soil with a geosynthetic liner and vegetative cover
- Construction, operation, closure, maintenance and monitoring of an on-site disposal unit that meets TSCA chemical waste landfill ARARs in 40 CFR § 761.75
- Closure of the underground storm water conveyance system by cleaning and/or sealing off and solidifying the pipes/inlets in place using flowable grout
- Disposal of stockpiled WWTS, solids removed from the storm water conveyance system, and excavated contaminated soil and sediment that are not RCRA hazardous wastes in the constructed on-site TSCA disposal unit
- Treatment and/or disposal of RCRA hazardous wastes including soil that is considered RCRA characteristic waste or contains RCRA listed waste, if generated, at an off-site permitted RCRA treatment/disposal facility
- Decommissioning of the storm water treatment system and restoration of the site to natural drainage following completion of remedial action

- Disposal or recycling of demolition debris from the stormwater treatment system and other potentially dismantled structures. Disposition will be determined based on testing of the debris to determine if it is RCRA hazardous wastes.
- Monitoring and maintenance of the closed RCRA units (former surface impoundments) in accordance with RCRA ARARs for post-closure care of a hazardous waste surface impoundment
- Groundwater monitoring in accordance with ARARs to confirm TSCA disposal unit and closed RCRA units' integrity
- ECs in the form of fencing, warning signs and erosion control measures to control sedimentation from stormwater runoff
- ICs in the form of a restrictive covenant and/or Notice of Contaminated Site in accordance with North Carolina statute
- FYRs

The areas at the site that will be excavated, treated or capped are shaded in pink on **Figure 46.** The remedial footprint shown in this figure may be expanded during remedial design and/or remedial action to include adjacent areas. The remediation footprint consists of 13 areas which are described in **Table 88** on **page 161**.

Figure 46: Remedial Footprint



12.2.1 Wastes/Soils Beneath the Former Mercury Cell Building and Retort Pads

Areas F and G, described in **Table 88** and illustrated on **Figure 44**, are areas considered to contain mercury wastes. These areas correspond to the former retort and mercury cell building areas, respectively. The selected remedy for these areas is alternative S-3.

This alternative treats wastes and soils under and around the concrete pads plus an approximate 10-foot buffer beyond the pad edge with ISS. Soil outside the buffer zone in Area F will be capped. Together, ISS and capping protects industrial/construction workers through solidification/stabilization of soil with mercury and/or PCB concentrations that exceed cleanup levels protective of the industrial or construction worker in accordance with the RAOs in these areas. It also protects the Wooded Bottomland Area by preventing contact of Upland Process Area soil with surface runoff and the potential migration of soil into the Wooded Bottomland Area. The purpose of the ISS is to treat and isolate the mercury waste and contaminated soils through encapsulation. Historically, these soils have not served as a source of mercury or PCBs to groundwater. This alternative would serve as an added measure so that they do not become a source in the future.

ISS

The selected remedy consists of ISS of the mercury waste and contaminated soil under and around the former Retort Area and Mercury Cell Building pads in Areas F and G, respectively. The footprint of the both ISS areas will be capped to minimize infiltration and potential for leaching of contaminants. ISS reagents such as portland cement or lime/pozzolans (e.g., fly ash and cement kiln dust) or other agents will be selected to reduce the leachability of COCs through encapsulation, binding, and/or limiting the hydraulic conductivity of the final solidified matrix. A treatability study will be performed during the Remedial Design (RD) to develop a suitable mix design to achieve post-solidification leachability goals and establish parameters for field performance testing (e.g., compressive strength, hydraulic conductivity, and /or wet/dry cycle durability). Various mix agents, such as sulfides and activated carbon, will be evaluated during the treatability study to select the optimum mixing agent.

During field implementation, the ISS agents will be injected into the subsurface environment and mixed with the soil using augers or other soil mixing equipment. The outside clean perimeter of the ISS area may be augured first to act as a vertical barrier and avoid migration of COCs during implementation. Performance sampling will be conducted at a pre-specified frequency, determined during the RD, with samples collected from various depth intervals during mixing. The individual samples will be visually examined to confirm mix homogeneity and then composited into cylinders representing the depth range of the aliquots. The cylinders will be cured and analyzed per the performance testing plan.

The cell pit in Area G will be drained and the collected stormwater will be managed through the existing stormwater collection and treatment system. The cell pit concrete will be pulverized and solidified as part of the ISS area. The addition of solidification agents and physical mixing may increase the volume of the treated soils, and this volume will be solidified and remain within the treated area footprint. The potential increase in volume will be considered during the design phase. The total treated in-situ volume is estimated to be 15,500 yd^3.

Capping

The selected remedy includes installing a cap over Areas F and G following ISS implementation. The total cap area is estimated to be about 1.3 acres. The final cap area footprint will be confirmed during the RD sampling and may be expanded from what is shown in **Figure 44**, as appropriate.

Capping will include placing a clay/geomembrane or equivalent cap system with a vegetated cover over Areas F and G. Before cap placement, the area will be prepared by leveling in-ground structures. A composite clay/geomembrane/cover soil or equivalent cap will be placed over the area to isolate the waste and contaminated soil and will comply with RCRA ARARs for a hazardous waste landfill final cover as well post-closure care requirements. The cap composition assumed for costing is a protective underlayment of fill soil (compacted in place), a geosynthetic liner, a protective layer of fill soil on top of the liner soil, plus up to six inches of topsoil to support revegetation. The actual cap composition and soil layer thicknesses will be evaluated during the RD.

Cap placement activities will be conducted using standard construction equipment (e.g., backhoes, bulldozers, graders, drill augers, etc.). Topographic survey and GPS instrumentation will be used to confirm extents and final grades of cap emplacement.

Ancillary Activities

Site preparation activities will include the construction of:

- access roads,
- support zones, and
- staging areas for personnel, equipment, and material.

Ancillary activities required to support construction activities include:

- area access and preparation,
- erosion control,
- reagent material delivery and staging,
- construction waste disposal,
- stormwater management,
- dust monitoring/control,
- seeding/planting, and
- restoration, as necessary.

Ambient air will be monitored for dust during construction. Dust control measures will be implemented, and include wetting roads, stockpiles, and staging areas. Real-time air monitoring will be performed during construction activities to verify compliance with ARARs. Inspections and groundwater monitoring will be required to verify system performance over time. ICs will be employed to prevent risks to humans and damage to the selected remedy. ICs will consist of deed and land use restrictions.

12.2.2 Overall Site Remedy

Figure 39 on page 166 illustrates remedial actions for areas A through M (minus F and G, which were discussed in **Section 12.2.1**). The rationale for selecting areas to be capped or excavated is based on the size/local extent of detected contamination, the magnitude of PCB and mercury concentrations, and the location/exposure risk.

Remedial activities in the UPA include capping and excavation of soil areas with mercury and/or PCB concentrations that exceed cleanup levels protective of the industrial or construction worker in accordance with the RAOs. Capping and excavation in the UPA will also serve to protect the Wooded Bottomland Area by preventing contact of UPA soil with surface runoff and the potential migration of soil into the Wooded Bottomland Area.

Table 88 on page 161 describes each remedial area. Areas in the UPA to be capped include Areas A and C. Areas A and C have detected concentrations of PCBs greater than 25 mg/kg but less than 50 mg/kg. Area D contains concentrations of PCBs greater than 50 mg/kg, and will be excavated. Several isolated areas (B, E, K, and M) with concentrations greater than the cleanup levels will be excavated because long-term maintenance of a small cap in each of these areas would not be practical.

Similarly, the remedial areas in the Wooded Bottomlands Area (J Areas) will be excavated to limit long-term maintenance. Excavated areas will be backfilled to approximately original grade and either revegetated with native species or covered with an erosion control matting material and left for natural revegetation by the WBA canopy. Capping and erosion control will occur in the L Areas, which are located along the steep portion of the UNPA berm.

Capping

A cap will be applied over the larger contiguous Upland Process Areas that exceed the Aroclor 1254+Aroclor 1268 surface and subsurface soil cleanup level of 11 mg/kg in Areas A and C and the L Areas along the berm of the Upland Non-Process Area impoundments. The anticipated extent of capping is shown on **Figure 39**. The total cap area is estimated to be approximately 1.7 acres. The final cap area footprint in some areas will be confirmed during the RD.

Capping includes placing a membrane-soil cap system with a vegetated cover over the remediation area. The cap design will meet the North Carolina substantive requirements for a final cover on a RCRA Subtitle D solid waste landfill as well as post-closure requirements that are determined by EPA to be "relevant and appropriate" and identified as ARARs. Before cap placement, the area will be prepared by clearing vegetation and leveling in-ground structures. A protective soil layer and geotextile membrane will be placed over the area to isolate the PCB-containing soil. Another layer of protective soil will be placed on top of the membrane, plus a layer of topsoil that will be vegetated for final restoration and erosion control.

Material specifications will require fill soil to be clean. The cap composition assumed for costing is a protective underlayment of fill soil (compacted in place), a geosynthetic liner, a protective layer of fill soil on top of the liner soil, plus up to six inches of topsoil to support revegetation. The actual cap composition and soil layer thicknesses will be evaluated during the RD and will comply with capping ARARs.

Cap placement activities will be conducted using standard construction equipment (e.g., backhoes, bulldozers, graders, etc.). Topographic survey and GPS instrumentation will be used to confirm extents and final grades of cap emplacement.

Excavation

Contaminated soil above cleanup levels will be excavated in the Upland Process Areas B, D, and E and Wooded Bottomland Areas J, K, and M. Areas B, D, and E exceed the Upland Process Area Aroclor 1254+Aroclor 1268 surface and subsurface soil cleanup level (11 mg/kg) protective of human health. Areas J exceed the Wooded Bottomland Area Aroclor 1268 sediment cleanup level (47 mg/kg) and the mercury sediment cleanup level (0.75 mg/kg) protective of ecological receptors. Areas K and M exceed the Wooded Bottomland Area Aroclor 1254+Aroclor 1268 surface soil cleanup level (21 mg/kg) protective of an adolescent trespasser/recreators.

The anticipated extent of excavation for this scenario is shown on **Figure 39.** The total in-place excavation volume is estimated to be 15,400 yd^3. The actual excavation footprints of the isolated areas will be confirmed during the RD and further refined during the remedial action confirmation sampling. Following excavation, clean backfill/topsoil will be placed in the areas to restore the ground surface to approximately pre-excavation grades. The areas will be seeded/re-vegetated with a native species to control erosion. Alternatively, the WBA areas may be covered with an erosion control matting material and left for natural revegetation by the WBA canopy.

Removal activities will be conducted using standard construction equipment (e.g., backhoes, bulldozers) equipped with GPS instrumentation to monitor removal progress and confirm that excavations meet the established horizontal and vertical goals. Backfill will be placed to predetermined elevations using conventional earthmoving equipment. Seeding and erosion controls will be implemented upon verification that backfill design elevations have been met.

Where required, excavated soil will be stockpiled within a materials staging area for dewatering to meet appropriate disposal requirements. Drying will be accomplished through a combination of gravity dewatering and/or the addition of amendments (e.g., bed ash, fly ash, or portland cement). Drainage from dewatering operations and potentially impacted stormwater will be managed through the existing stormwater conveyance and treatment system. Excavated and dewatered materials will be transported for disposal to an appropriate EPA-approved off-site permitted RCRA hazardous waste treatment/disposal facility or placed in the on-site TSCA disposal unit.

Stormwater Conveyance System

The stormwater conveyance system (I Areas) will be closed by cleaning and/or sealing off and solidifying the pipes/inlets in place using flowable grout. Solids, if removed during closure of the system, will be dewatered and disposed either (1) in the on-site TSCA disposal unit, or (2) at an EPA-approved off-site RCRA hazardous waste treatment/disposal facility.

Following completion of site-wide remedial activities active stormwater collection and management will no longer be necessary. Therefore, the existing stormwater treatment system will be decommissioned and the site returned to natural drainage. Long-term maintenance will include inspection and repair of erosion controls designed to mitigate sedimentation during stormwater flow events.

WWTS

WWTS (Areas H) containing PCB concentration greater than 50 mg/kg are temporarily stockpiled at the Mercury Cell Building pad and the SWDS. The selected remedy includes disposal of the WWTS in an on-site disposal unit that meets TSCA chemical waste landfill requirements which are identified as

ARARs. The total volume of the stockpiled soil on both the Mercury Cell Building pad and the SWDS is approximately 23,700 yd^3.

On-site TSCA Disposal Unit

Approximately 39,100 yd^3 of contaminated soil, sediment, and solids will be disposed of in an on-site newly constructed TSCA disposal unit. This unit will only contain site-related wastes. Because some of the contaminated media include PCBs at concentrations greater than 50 mg/kg, the disposal unit will be designed and constructed to meet the requirements of a TSCA chemical waste landfill as listed in 40 CFR §761.75 that are identified as ARARs. RCRA hazardous wastes, if generated during the remedial action, will not be placed in the on-site TSCA disposal unit. They will be disposed of at an off-site EPA-approved RCRA Subtitle C landfill.

Waiver and Design

40 CFR § 761.75(b)(3) requires that the bottom of a chemical waste landfill be at least 50 feet above the historical high groundwater table. This distance is not naturally available at the site because there is shallow groundwater. The 50 feet depth requirement is the only item in paragraph (b) which cannot be met at the site. TSCA regulations at 40 CFR 761.75(c)(4) allows the Regional Administrator[14] to waive one or more of the requirements of paragraph (b) if evidence is submitted that indicates that operation of the landfill will not present an unreasonable risk of injury to health or the environment from PCBs when one or more of the requirements of paragraph (b) of this section are not met. This "no unreasonable risk of injury to health or environment" standard is less stringent than the CERCLA Section 121(b) threshold requirement that the selected remedy be protective of human health and the environment. The CERCLA protectiveness requirement is addressed as part of the Comparative Analysis of Alternatives in **Section 10.1**.

To support the approval of a waiver under 40 CFR 761.75(c)(4) and meet the CERCLA threshold protectiveness requirement, the TSCA disposal unit will be constructed using a dual-liner system. A summary of the design specifications for a dual liner system includes the following:

- The dual liner system would consist of a primary and secondary liners, each constructed with synthetic membranes embedded between protective soil layers
- Each membrane would have a permeability equal to or less than 1×10^{-7} cm/sec, be made of a material that is chemically compatible with PCBs, and be at least 30 mils thick
- Both membranes would be placed upon an adequate soil underlining and with a soil cover to prevent excessive stress or rupture
- Between the liner systems would be a porous leachate collection layer (e.g., coarse gravel) that can be monitored (i.e., interstitial monitoring) for leak detection from the upper liner.

Installation of a dual liner system meeting the specifications will contain and confine the TSCA disposal unit contents from direct contact with groundwater, equivalent to a 50-foot natural buffer. A 200-foot thick dense clay confining unit (the Peedee formation) lies beneath the planned TSCA disposal unit location and shallow surficial aquifer and further limits the potential for migration of PCBs. Implementation of a dual-liner design along with the presence of the natural clay formation would prevent releases of PCBs and thus the on-site TSCA disposal unit would not present an unreasonable

[14] Approval authority for CERCLA remedies selected in RODs (which includes ARAR determinations and use of a waiver where justified) has been delegated from the Regional Administrator to the Superfund Division Director.

risk of injury to health and the environment from PCBs under TSCA and also meet the CERCLA protectiveness requirement.

A conceptual cross-section for the TSCA disposal unit is shown on **Figure 40**. The primary components include the following:

- TSCA disposal unit subgrade preparation including grading, compaction, and protection against desiccation and cracking
- A clay or equivalent underlayer to serve as a base for the sealing layer
- A geosynthetic, clay, or equivalent sealing liner at the base of the TSCA disposal unit to provide additional containment of the material inside the unit
- A base geomembrane on top of the sealing liner to contain and prevent exfiltration of leachate from the TSCA disposal unit
- A second gravel drainage layer to collect leachate and to divert it to drains at the edge of the TSCA disposal unit for discharge to the surface
- An underdrain system between the bottom of the TSCA disposal unit liner system and groundwater
- Disposed waste surrounded by fill material (daily soil cover)
- A clay cap or equivalent layer to contain the disposed material
- A geomembrane sealing layer covering the TSCA disposal unit to stop infiltration of precipitation into the disposed material
- A permeable geocomposite drainage layer on top of the geomembrane to divert infiltration to drains at the sides of the TSCA disposal unit
- A drainage system at the edge of the cover to move stormwater runoff away from the TSCA disposal unit
- A layer of topsoil, seeded with vegetation for cover stabilization and to encourage evapotranspiration of moisture that infiltrates the topsoil cover

Location

The TSCA disposal unit must meet buffer requirements identified in 15A NCAC 13B.0503(2)(f), identified as ARARs. Because of the size of the property and a portion being within a 100-year flood zone there are limited locations on the property where the TSCA disposal unit can be constructed. An example conceptual TSCA disposal unit layout that would meet disposal volume requirements with a footprint allowing for up to a 200-foot setback is shown in **Figure 41**. The selection of the TSCA disposal unit location on the property will be based on the results of pre-design studies including but not limited to geotechnical testing and evaluation, structural evaluation, hydrogeological evaluations, surface hydraulics evaluation, material handling planning, and sequencing of remedial actions. The potential to place the cell on top of the closed RCRA units or to avoid them will be carefully considered in the RD, based upon the conclusions of the above evaluations. Should the TSCA disposal unit be placed over these closed RCRA units, its design, construction, monitoring, and maintenance must be compatible with the intended purpose of these RCRA units, their structural capacity/stability, and their associated monitoring/maintenance requirements. The evaluation could result in a determination that the on-site TSCA disposal unit cannot be located at the site due to concerns with structural integrity and prevention of releases, such that another remedial alternative would have to selected through a modification of the remedy.

Monitoring and Maintenance
It is possible that the TSCA disposal unit may extend over the retort and cell building pads where ISS followed by placement of a soil cap has been implemented. Should the TSCA disposal unit be placed over these areas, its design, construction, monitoring, and maintenance must be conducted in a manner that will preserve the protectiveness and effectiveness of selected remedy for the retort and cell building pads.

Long-term monitoring and maintenance for both the on-site TSCA disposal unit and closed-in-place RCRA units will be conducted in accordance with TSCA and RCRA ARARs.

<u>Ancillary Activities</u>
Site preparation activities will include the construction of access roads, support zones, and staging areas for personnel, equipment, and material. Clearing and installation of erosion controls would be required for support and staging areas.

Ancillary activities required to support construction activities include:

- cap/excavation area access and preparation,
- erosion control,
- backfill material delivery and staging,
- excavated material staging and handling,
- cover soil delivery and staging,
- construction waste disposal,
- cap placement verification,
- waste soil transport and disposal,
- stormwater management,
- dust monitoring/control,
- seeding/planting, and
- restoration, as necessary.

Ambient air will be monitored for dust during construction. Dust control measures will be implemented, and include wetting roads, stockpiles, and staging areas. Real-time air monitoring will be performed during construction to verify compliance with ARARs.

Site-wide long-term maintenance and inspection will be required to evaluate backfill erosion and to verify cap, TSCA disposal unit, and previously closed RCRA unit performance over time. Long-term monitoring of groundwater will also be required to confirm TSCA disposal unit and closed RCRA unit integrity and compliance with ARARs. Periodic maintenance will be carried out as needed to preserve or restore the integrity of these systems. ICs and ECs will be employed to limit risks to human and ecological receptors and protect the integrity of the remedy. ICs will consist of deed and land use restrictions in a recorded a Notice and/or restrictive covenant. ECs will consist of warning signs and fencing. The site is currently fenced along the west, south, and east property boundaries.

12.3 Summary of the Estimated Remedy Costs

The total estimated cost for the selected remedy is $13,300,000 for Alternative A-3 and $2,900,000 for Alternative S-3. The combined total is $16,200,000. The estimate is based on the current available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.3.1 Selected Remedy Alternative A-3

Costs for Alternative A-3 include the following:

- Preparation of work plans and remedial design including remedial design sampling
- Mobilization of equipment
- Site preparation including access roads, clearing and grubbing, temporary offices, decontamination pads, demarcation of remedial work zones, dust control, and turbidity curtain along the Cape Fear River
- Contractor site operations including utilities, dust control, storm water management, compaction testing, and land surveying
- Excavation of Areas B, D, E, J, K, and M; excavated material and stockpiled soil (H Areas) to be direct-loaded into trucks for disposal in an on-site landfill
- Construction of an on-site chemical waste landfill, consisting of the following:
    - Landfill design and construction plan
    - Mobilization of construction equipment
    - Demolition of existing structures and footings within landfill footprint
    - Grading and compacting landfill subgrade
    - Access road construction
    - Construction of landfill liner/bottom (groundwater underdrain, landfill liner, and leachate collection system)
    - Transfer of stockpiled soil (H Areas) and excavated material to the landfill
    - Spreading of compact material inside landfill and daily cover
    - Construction of landfill cap (install clay/membrane cap, geotextile drainage layer, topsoil, and seed/mulch)
    - Installation of a leachate/groundwater storage tank
- Capping of Areas A and C with geomembrane/soil cap (a protective underlayment of fill soil (compacted in place), a geosynthetic liner, a protective layer of fill soil on top of the liner soil, plus up to six inches of topsoil to support revegetation).
- Site restoration re-grading and seeding disturbed areas including:
    - Upland Areas with topsoil, seed, and mulch
    - Wooded Bottomland Areas with plantings
    - Stream areas with geotextile riprap/gabion mattresses
- Demobilization
- Post-construction confirmation sampling
- Labor, equipment, and materials for approximately 18 to 24 months of operations
- A 30-year, long-term operations, maintenance, monitoring, and reporting program including:
    - Annual inspections and maintenance

- Annual groundwater and surface water monitoring for mercury and PCBs
- Annual reports and five-year ROD review support

The total estimated cost for Alternative A-3 is approximately $13,300,000. The estimated costs are presented in **Table 102**.

Table 102: Alternative A-3 Cost Estimate Summary

Site: Holtrachem Site
Base Year: 2014
Description: This alternative consists of a combination of capping and excavation of the Upland Process area, excavation of Wooded Bottomland Areas and isolated areas, disposal of excavated material, stormwater conveyance system solids, and WWTS to an on-Site landfill, and ICs/ECs. Capping/erosion control would be implemented in Area L along the base of the Upland Non-Process Area

Description	Quantity	Unit	Unit Cost	Total Item Cost[1]	Comments/Notes
CAPITAL COSTS					
Work Plans, Schedules and Permits					
Work Plan	1	LS	$42,706	$42,700	Construction plan which includes HASP, QA/QC, site controls, etc.
Mobilization and Contractor Site Operations					
Mob for Excavation/Capping	1	LS	$14,047	$14,000	Mobilization of equipment, personnel, temp office, decon pad, etc
Temporary Offices, Storage, Trailers	1	LS	$98,586	$98,600	
Temporary Utilities	12	EA	$5,131	$61,600	
Decontamination Pads and Facilities	6	MTH	$4,782	$28,700	Continued decon over 6 month working (See note 3)
Temporary roads + barriers, etc	1	LS	$17,077	$17,100	Access roads, delineate work areas with barriers
Remedial Work Zone	1	LS	$204,107	$204,100	Establish restricted areas (exclusion, decontamination, etc. zones)
Dust Control	6	MTH	$15,023	$90,100	Water truck
Turbidity Curtain at River Edge	1,030	LF	$170	$175,200	Floating curtain with anchors, warning lights for nighttime traffic
Compaction Testing	1	LS	$41,551	$41,600	Proctor tests for backfilled areas
Survey	1	LS	$100,000	$100,000	Assumed a lump sum flat rate fee (see note 4)
PPE D & C	5,000	HR	$6	$30,000	Hazwoper training, medical surveillance, PPE as required (See note 5)
	Total Mob and Site Operations		$861,000		
Stormwater Management	1	LS	$256,700	$256,700	Stormwater management during construction
Clearing/Grubbing Area J	1.830	AC	$170,012	$311,100	Clearing of trees, grind stumps/brush, stockpile to landfill as waste
Close pipes & manholes, fill concrete	1	LS	$307,418	$307,400	In-place pipes, manholes, and fill concrete (See note 6)
Capping Areas A, C					Capping of isolated L area assumed to be covered by erosion
Capping Area A	0.574	AC	$225,600	$129,500	Assumed membrane/soil cap
Capping Area C	1.148	AC	$225,600	$259,000	
	Total Capping A & C		$388,500		
Excavation/Disposal to On-Site Landfill					
Excavate J Area parallel to river	6,000	CY	$18	$108,000	Clear and excavate to direct load into trucks (See note 7)
Excavate J Area Swales	4,100	CY	$18	$73,800	Clear and excavate to direct load into trucks (See note 7)
Excavate Area D	4,487	CY	$18	$80,800	Clear and large scale excavation, work from top of bluff down
Excavate Isolated Areas: E,I,K,M,B	765	CY	$18	$13,800	Clear and excavate to direct load into truck
Remove Area H	23,700	CY	$14	$331,800	Excavate to direct load into trucks
Stormwater Piping Residue	48,297	Pounds	$0.25	$12,100	Dewater and transfer to on-site landfill
	Total Excavation		$620,300		
Backfill					
Import Backfill to River Area	7,520	CY	$24	$180,500	Import clean soil to backfill excavated areas (See note 8)
Import Backfill to Swales	5,144	CY	$24	$123,500	Import clean soil to backfill excavated areas (See note 8)
Import Backfill to Area D	5,026	CY	$24	$120,600	Import clean soil to backfill excavated areas (See note 8)
Import Backfill to Isolated Areas	791	CY	$24	$19,000	Import clean soil to backfill excavated areas (See note 8)
	Total Backfill		$443,600		
Site Restoration					
Upland Restoration	1	LS	$65,400	$65,400	Placement of topsoil, seed, and mulch in upland areas
Wetland Restoration	1	LS	$523,450	$523,500	Wetland plantings (grass/shrub type) in areas next to the river
Stream Restoration	1	LS	$489,229	$489,200	Geotextile, rail/road type with riprap/gabion materials (See note 9)
	Total Site Restoration		$1,078,100		
Landfill Construction					
Work Plan	1	LS	$17,780	$17,800	Construction plan which includes HASP, QA/QC, site controls, etc.
Mobilization	1	LS	$15,768	$15,800	Mobilization of equipment, personnel, temp office, decon pad, etc
Demolition of Structures	3.949	AC	$272,255	$1,075,000	Demolition of structures in footprint of on-site landfill
Earthwork - Grading Landfill area	1	LS	$13,270	$13,300	Grading and compaction for landfill and road
Access Roads	1,764	LF	$218	$385,200	Grade, fill, and compact roadway, lay geofabric and 8" gravel
Landfill Cap	3.334	AC	$463,053	$1,543,800	Lay cap material, drainage layer, topsoil, and seed
Landfill Liner/Bottom	4.325	AC	$370,637	$1,603,000	Lay liner material, leachate drain, and under drain
Material Spread/Compact	100	DY	$3,605	$360,500	Spreading disposed material within landfill, daily cover, assume 100 days
Leachate/Groundwater Stg Tank	1	LS	$40,000	$40,000	Fiberglass Tank cost - $30,000, Installation - $10,000
	Total Landfill Construction		$5,054,400		
Demobilization					
Demobilization - Landfill Constr	1	LS	$34,685	$34,700	Breakdown of equipment, site cleanup, etc
Demobilization Excavation/Capping	1	LS	$32,188	$32,200	Breakdown of equipment, site cleanup, etc
	Total Demobilization		$66,900		
SUBTOTAL				$9,491,700	
Performance Bond	3%			$284,800	3% of $9491700
SUBTOTAL CONSTRUCTION				$9,776,500	
Contingency	10%			$977,700	
TOTAL CONSTRUCTION				$10,754,200	
PROFESSIONAL SERVICES					
Project Management	2%			$215,100	
Remedial Design	2%			$215,100	Remedial Design, 30%, 90%, and final, - landfill construction
Procurement & Permits	0.5%			$53,800	Procurement, Permitting/Agency fees
Construction Oversight	2%			$215,100	Field Oversight
Health & Safety/Legal	1%			$107,500	Safety Implementation
SUBTOTAL				$806,600	
Commissioning Fee	3%			$24,198	
Construction Management Fees	5%			$537,710	
SUBTOTAL				$1,368,500	
TOTAL CAPITAL COSTS				$12,122,700	- Total construction plus professional fees - Total Capital Costs

PERIODIC COSTS/ O&M COSTS						
Five Year Review Report		1	LS	$10,000	$10,000	Assume data evaluation and reporting
Non-Routine Maintenance		1	LS	$15,000	$15,000	Assumed every 10 years
ANNUAL COSTS						
Project Management		1	LS	$4,000	$4,000	Assume 2 hours per month of Project Management
Groundwater Monitoring		1	LS	$10,000	$10,000	Assume 15 wells and 5 SW locations, 2 people, 4 days, truck rental
Laboratory Analytical Cost		1	LS	$10,000	$10,000	Assume 30 samples including QA/QC samples
Routine Annual Maintenance		1	LS	$5,000	$5,000	
Visual Inspections		1	LS	$2,500	$2,500	Assume 2 people for 1 day
Reporting		1	LS	$5,000	$5,000	Assume [illegible] with no data evaluation/validation
SUBTOTAL					$36,500	
PERIODIC COSTS						
Description	Year					
Capital Costs	0	1	LS	$12,122,700	$12,122,700	
5-Year Review	5	1	LS	$10,000	$10,000	
Cover Maintenance	10	1	LS	$15,000	$15,000	
5-Year Review	10	1	LS	$10,000	$10,000	
5-Year Review	15	1	LS	$10,000	$10,000	
Cover Maintenance	20	1	LS	$15,000	$15,000	
5-Year Review	20	1	LS	$10,000	$10,000	
5-Year Review	25	1	LS	$10,000	$10,000	
Cover Maintenance	30	1	LS	$15,000	$15,000	
5-Year Review	30	1	LS	$10,000	$10,000	

PRESENT WORTH ANALYSIS

Cost Type	Year		Total Cost	Discount Factor[2]	Present Value
Capital Cost	0		$12,100,000	1.000	$12,100,000
Annual Cost	1 - 30	$36,500	$1,095,000	12.409	$452,900
5 Year Review Report	5		$10,000	0.713	$7,100
Cover Maintenance	10		$15,000	0.508	$7,620
5-Year Review	10		$10,000	0.508	$5,080
5-Year Review	15		$10,000	0.362	$3,620
Cover Maintenance	20		$15,000	0.258	$3,870
5-Year Review	20		$10,000	0.258	$2,580
5-Year Review	25		$10,000	0.184	$1,840
Cover Maintenance	30		$15,000	0.131	$1,965
5-Year Review	30		$10,000	0.131	$1,310
			$13,300,000		$12,600,000
TOTAL PRESENT WORTH[1]					$12,600,000
TOTAL COST[1]					$13,300,000

LS - Lump Sum
AC - Acres
CY - Cubic Yards
DY - Days
LF - Linear Feet
EA - Each

Prepared by: FRM 5/6/2014
Checked by: ADB 9/24/2014

Assumptions:

1. Estimated costs are considered to be -30% to +50% in accuracy and [illegible] between remedial alternatives (USEPA, 1988). Costs are rounded to three significant figures
2. A discount rate of 7.0% annually was applied to calculate present worth
3. [illegible] up to 150 trucks/day
4. Assumed a lump sum of $30,000 for alternatives 2, 4, and 6. Alternatives 3 and 5 have higher survey costs, [illegible] GPS [illegible]
   [illegible]
   Costs based on days on site
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible] GPS [illegible]
9. [illegible]
10. [illegible]

12.3.2 Selected Remedy Alternative S-3

Costs for Alternative S-3 include the following:

- Preparation of remedial design including remedial design sampling
- Mobilization/demobilization of equipment
- Areas F and G surface preparation
- Cleaning and backfilling of cell pit (next to Area G)
- In situ treatment of soil below the former pads at Areas F and G through ISS
- Capping of the F and G areas (including the ISS footprints and the area surrounding the former Retort Pad in Area F)
- Restoration of disturbed areas

Site preparation, contractor operations, and long-term operations/maintenance are included in Alternatives A-2 through A-6 and are not repeated for the S alternatives. The total estimated cost for Alternative S-3 is approximately $2,900,000. The estimated costs are presented in **Table 103**.

Table 103: Alternative S-3 Cost Estimate Summary

Site: Holtrachem Site

Base Year: 2014

Description: This option involves In-situ solidification of Area G (plus 10' buffer zone) and former Retort Area Pad inside Area F. Assume in-place vertical mixing of bentonite/cement slurry. Cap remainder of Area F.

Description	Quantity	Units	Unit Cost	Total Item Cost[1]	Comments/Notes
CAPITAL COSTS					
In-Situ Stabilization/Solidification					Additional cost for F & G areas planning and mobilization
Work Plan	1	LS	$10,172	$10,200	
Mob & Demob	1	LS	$55,680	$55,700	
Demolition of Structures					
Area G Demolish floor slab	30,060	SF	$3.91	$117,500	
Area G Load & Transport Concrete	1,060	CY	$3.49	$3,700	
Cellpit Base	60	CY	$130.14	$7,800	
Area G subsurface demolition	850	CY	$48.67	$41,400	
Area G Load & Transport Concrete	850	CY	$3.49	$3,000	
		Total Demolition	**$173,400**		
In-Situ Solidification/Stabilization					
Soil Area G	11,133	CY	$104.22	$1,160,300	In-situ soil mixing of portland/bentonite slurry, approx. 10 ft deep
Soil Area F (pad area only)	4,400	CY	$104.22	$458,600	In-situ soil mixing of portland/bentonite slurry, approx. 15 ft deep
		Total In-Situ Treatment	**$1,618,900**		
Capping					
Cap Area F	25,024	SF	$5.18	$129,600	Cap F and G areas (includes ISS areas plus F area soil around retort pad)
Cap Area G	30,060	SF	$5.18	$155,700	Assumes soil/membrane composite cap system.
		Total Capping	**$285,300**		
Site Restoration					
Site Restoration Area F	25030	SF	$0.94	$23,500	
Site Restoration Area G	30060	SF	$0.94	$28,200	
		Total Site Restoration	**$51,700**		
SUBTOTAL				$2,195,200	
Construction Bond	3%			$65,900	
SUBTOTAL				$2,261,100	
Contingency	10%			$226,100	
TOTAL CONSTRUCTION				$2,487,200	
Treatability Study					
Work Plan, Bench Study, and Reporting	1	LS	$45,000	$45,000	
PROFESSIONAL SERVICES					
Project Management	2%			$49,700	
ISS Treatability Study	3%			$74,600	
Remedial Design	2%			$49,700	
Procurement & Permits	0.5%			$12,400	
Construction Oversight	2%			$49,700	
Health & Safety/Legal	1%			$24,900	
SUBTOTAL				$261,000	
Communication Fee	3%			$7,830	
Construction Management Fees	5%			$124,360	
SUBTOTAL				$393,200	
TOTAL CAPITAL COSTS				**$2,900,000**	

LS - Lump Sum
CY - Cubic Yards
SF - Square Feet

Prepared by: FKM 5/6/2014
Checked by: ADB 9/24/2014
Revised: FKM 3/18/2015

Assumptions:
1. Estimated costs are considered to be -30% to +50% in accuracy and are meant to be comparative between
2. O&M is implemented under sitewide alternatives

12.4 Expected Outcome of the Selected Remedy

The expected outcome of the selected remedy is achievement of the RAOs described in **Section 8.0**. Expected land use would be ecological habitat, with the option of industrial use in the Upland Areas. The use will be limited by institutional controls that will prevent unacceptable land uses and protect the integrity of the remedy which includes caps, maintenance of former RCRA units, and an on-site TSCA disposal unit. Construction time frame is estimated at approximately 2 years. The completed remedy will reduce risks to human and ecological receptors to levels provided for in the NCP (i.e. cancer risk of 10^{-5}, and non-cancer equal to or less than HQ of 1). The selected remedy will lower the risks by reducing the concentrations of the soil, sediment and surface water contaminants to the cleanup levels in **Table 104** and **Table 105**. Cleanup levels are based on ARARs, which provide minimum legal standards, and in the absence of ARARs, risk-based concentrations.

Table 104: Upland Area Cleanup Levels

Site Area:	Upland Areas			
Available Use:	Industrial			
Controls to Ensure Restricted Use:	Deed Notice and/or Restrictive Covenant			
Chemical of Concern	**Cleanup Level**	**Basis for Cleanup Level**		**Risk at Cleanup Level**
Surface Soil (0-1 foot)				
Aroclor 1268	11 mg/kg	Risk Assessment	Construction Worker	HI = 1
benzo(a)pyrene	3.1 mg/kg	Risk Assessment	Industrial Worker	cancer risk = $1x10^{-5}$
mercury	516 mg/kg	Risk Assessment	Industrial Worker	HI = 1
Subsurface Soil (1-10 feet)				
Aroclor 1254 + Aroclor 1268	11 mg/kg	Risk Assessment	Construction Worker	HI = 1
mercury	926 mg/kg	Risk Assessment	Construction Worker	HI = 1
Notes:				
These values are for both the Upland Process Area and Upland Non-Process Area.				
HI = hazard index				
mg/kg = miligram per kilogram (or parts per million)				

Table 105: Wooded Bottomland Area Cleanup Levels

Site Area:	Wooded Bottomland Area			
Available Use:	Ecological Habitat			
Controls to Ensure Restricted Use:	Deed Notice and/or Restrictive Covenant			
Chemical of Concern	**Cleanup Level**	**Basis for Cleanup Level**		**Risk at Cleanup Level**
Surface Soil (0-0.5 foot) - Ecological				
2,3,7,8-TCDD TEQs (dioxins/furans)	8.54E-05 mg/kg	Risk Assessment	LOAEL risk to Carolina wren	HQ = 0.90
2,3,7,8-TCDD TEQs (PCBs)	1.96E-04 mg/kg	Risk Assessment	LOAEL risk to Carolina wren	HQ = 0.10
mercury compounds	3 mg/kg	Risk Assessment	Ecological Receptor	HI = 1
Surface Soil (0-1 foot) - Human Health				
2,3,7,8-TCDD TEQs (dioxins/furans + PCBs)	9.36E-04 mg/kg	Risk Assessment	Adolescent Trespasser/Recreator	cancer risk = $1x10^{-5}$
Aroclor 1254 + Aroclor 1268	21 mg/kg	Risk Assessment	Adolescent Trespasser/Recreator	HI = 1
Sediment (0-0.5 foot) - Ecological				
Aroclor 1268	47 mg/kg	Risk Assessment	LOAEL risk to green blue heron	HI = 1
mercury	0.75 mg/kg	Risk Assessment	LOEC in amphibian and macroinvertebrate toxicity testing	
Surface Water - Human Health				
2,3,7,8-TCDD TEQs (dioxins/furans)	8.70E-06 µg/L	Risk Assessment	Adolescent Trespasser/Recreator	cancer risk = $1x10^{-5}$
2,3,7,8-TCDD TEQs (PCBs)	9.50E-06 µg/L	Risk Assessment	Adolescent Trespasser/Recreator	cancer risk = $1x10^{-5}$
Aroclor 1268	0.44 µg/L	Risk Assessment	Adolescent Trespasser/Recreator	HI = 1

Notes:
HI = hazard index
HQ = hazard quotient
LOAEL = lowest observed adverse effects level
LOEC = lowest observed effects concentration
mg/kg = miligram per kilogram (or parts per million)
PCB = polychlorinated biphenyl
TCDD = total chlorinated dibenzo-p-dioxins
TEQ = Toxic Equivalent Quotient
µg/L = microgram per liter (or parts per billion)

13.0 STATUTORY DETERMINATIONS

Under CERCLA §121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

13.1 Protection of Human Health and the Environment

Selected remedy Alternative A-3 is protective of human health and the environment. Capping isolates and prevents erosion and direct exposure of human and ecological receptors to COCs in soil. Excavation and backfilling remove COC-impacted media and protect human and ecological receptors from potential exposure to residual COCs in soil and sediment. Containment of excavated material in an on-site TSCA disposal unit prevents its erosion and migration, and precludes further exposure to human and ecological receptors. ICs control access and further limit exposure to humans.

Selected remedy Alternative S-3 is protective of human health and the environment. ISS treats the mercury wastes and contaminated soil followed by installation of a RCRA cap to eliminate potential future mobility and prevent erosion and potential exposure to COCs in soil to human and ecological receptors. ICs control access and further limit exposure to humans.

ICs will be required as part of the selected remedy because contaminants will remain at levels above that suited for unlimited use and unrestricted exposure in the capped areas as well as within the on-site TSCA chemical waste landfill.

The following generally describes those ICs to be considered for implementation at the site to achieve the bulleted performance objectives:

- Prohibit residential or recreational land use at the site.
- Prohibit any consumptive use of groundwater including but not limited to drinking water, irrigation or industrial use.
- Prohibit intrusive activities such as excavation in the contaminated media areas that remain.
- Prevent interference with the integrity of any existing or future monitoring or remediation system including capped areas and groundwater monitoring wells.

ICs placed on the property will include recording and environmental restrictive covenant (following the State of North Carolina Declaration of Perpetual Land Use Restrictions process), which requires the recordation of a survey plat map defining the boundaries of the site and/or a Notice of Contaminated Site filed in Columbus County real property records in accordance with North Carolina General Statutes (NCGSs) 143B-279.9 and 143B-279.10. A restrictive covenant may be executed by the property owner and recorded that outline land and groundwater use restrictions including the prohibition of any residential or recreational reuse of the property. The covenant would also prohibit interference with the integrity of any existing or future monitoring or remediation system without prior EPA and NCDEQ approval. Notice of the application of land and groundwater use restrictions to the site via the restrictive covenant would be provided to the local regulatory agencies. The details for implementation of these ICs will be provided in the Remedial Action Work Plan, which will be reviewed and approved by EPA and NCDEQ.

Should any IC fail, EPA and NCDEQ will ensure that appropriate actions are taken to reestablish the remedy's protectiveness and may initiate legal action to either compel action by the PRP or a third party and/or to recover costs for remedying any discovered IC violations.

13.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions (RA) at CERCLA sites attain legally applicable or relevant and appropriate federal and more stringent state environmental requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless an ARAR waiver under CERCLA section 121(d)(4) is justified. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements, are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, RA, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site.

Under CERCLA Section 121(e)(1), federal, state, or local permits are not required for the portion of any removal or remedial action conducted entirely 'on-site' as defined in 40 CFR §300.5. See also 40 CFR §300.400(e)(1) & (2). Also, CERCLA response actions must only comply with the "substantive requirements," not the administrative requirements of a regulation or law. Administrative requirements include permit applications, reporting, record keeping, inspections, and consultation with administrative bodies. Although consultation with state and federal agencies responsible for issuing permits is not required, it is often recommended for determining compliance with certain requirements such as those typically identified as location-specific ARARs. See EPA, OSWER Directives No. 9234.1-01 and 9234.1-02, *CERCLA Compliance with Other Laws Manual: Parts 1 and Part II* (August 1988 and 1989).

In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular release that may be useful in developing Superfund remedies. See 40 CFR §300.400(g)(3). The "to-be-considered" (TBC) category consists of advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may assist in determining, for example health-based levels for a particular contaminant for which there are no ARARs or the appropriate method for conducting an action. TBCs are not considered legally enforceable and, therefore, are not considered to be applicable for a site but typically are evaluated along with Chemical-specific ARARs as part of the risk assessment to determine protective cleanup levels. See EPA, OSWER Directives No. 9234.1-01 and 9234.1-02, *CERCLA Compliance with Other Laws Manual: Parts 1 and Part II* (August 1988 and 1989), Section 1.4.

For purposes of ease of identification, the EPA has created three categories of ARARs: Chemical-, Location- and Action-Specific. Under 40 CFR §300.400(g)(5), the lead and support agencies shall identify their specific ARARs for a particular site and notify each other in a timely manner as described in 40 CFR §300.515(d).

Chemical-Specific ARARs/TBC Guidance

Chemical-specific ARARs are usually health or risk-based numerical values limiting the amount or concentration of a chemical that may be found in, or discharged to, the environment such as groundwater and surface water. The chemical-specific ARARs/TBC for the selected remedy to protect surface water and groundwater are identified in **Appendix A – ARARs.**

Location-Specific ARARs/TBC Guidance

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., wetlands, floodplains, critical habitats, streams). The location-specific ARARs/TBC for the selected remedy which includes requirements for actions in wetlands, floodplains and near aquatic resources are identified in **Appendix A – ARARs**.

Action-Specific ARARs/TBC Guidance

Action-specific ARARs are usually technology-based or activity-based requirements or limitations that control actions taken at hazardous waste sites. Action-specific requirements often include performance, design and controls, or restrictions on particular kinds of activities related to management of hazardous substances. Action-specific ARARs are triggered by the types of remedial activities and types of wastes that are generated, stored, treated, disposed, emitted, discharged, or otherwise managed. Action-specific ARARs for this site include TSCA requirements for construction, operation and closure/post-closure (including monitoring) of a chemical waste landfill, TSCA requirements for management and cleanup of PCB remediation wastes, general construction management requirements to control fugitive dust and stormwater during land disturbing activities, and RCRA waste characterization, treatment, storage and disposal requirements as well as RCRA landfill final cover requirements for capping contaminated areas at the site and post-closure care requirements for the RCRA surface impoundments that have been referred to the Superfund Program by NCDEQ. The action-specific ARARs for the selected remedy are identified in **Appendix A – ARARs.**

Due to the site conditions with respect to depth to groundwater, a waiver of one of the TSCA chemical waste landfill technical requirements at 40 CFR §761.75(b)(3) related to hydrologic conditions (so-called 50ft. buffer between bottom of the landfill liner and historically high water table) identified as an ARAR is required for the on-site TSCA disposal unit since groundwater is present at depths less than 50 ft. The waiver under the TSCA regulation 40 CFR §761.75(c)(4) requires that information has been provided to EPA that demonstrates the placement and operation of the on-site TSCA disposal unit will not present unreasonable risk of injury to health and the environmental from PCBs when one or more technical requirements are not met. Based upon the use of a dual liner with a leachate collection layer, the type and permeability of the liner materials, leak detection monitoring, as well as the clay formation underlying much of the Uplands areas of the site, the EPA believes the waiver is appropriate and the on-site TSCA disposal unit (as constructed with these additional specifications) will prevent groundwater intrusion into the bottom of the landfill and potential releases of PCBs and therefore is protective of human health and the environment under CERCLA.

13.3 Cost Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (NCP §300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent.

The estimated present worth cost of the selected remedy is $16.2 million. Alternative A-3 is the least expensive of the A- alternatives. Although Alternative S-3 is $1.6 million more expensive than S-2, the selected remedy provides for treatment whereas S-2 provides for containment. EPA believes that the selected remedy's additional cost for stabilization provides a significant increase in protection of human health and the environment and is cost-effective.

13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering State and community acceptance. The on-site TSCA disposal unit that will contain PCB waste and PCB contaminated soils is a permanent solution that is long-term effective and protective of human health and the environment despite that there is no treatment or resource recovery for that waste and soil.

13.5 Preference for Treatment as a Principal Element

CERCLA Section 121(b) establishes a preference for treatment as a principal element of a selected remedy. The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure. In general, the priority for treatment for PTW is placed on source materials considered to be liquid, highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. As stated in the preamble to the NCP (55 FR at 8703, March 8, 1990 and in Superfund Publication 9380.3-06FS, *"A Guide to Principal Threat and Low Level Threat Wastes"*), there may be situations where wastes identified as constituting a PTW may be contained (e.g. isolated) rather than treated due to inherent difficulties in treating the wastes. There may be situations where the same treatment remedy will be selected for both PTWs and low level threat wastes.

Despite limited sampling, available information indicates that significant volumes of elemental mercury, a highly toxic material is present under the former Mercury Cell Building and Retort pads. Soil samples, observations on site, and operational history indicate the presence of soil that is heavily contaminated with elemental mercury. Puddles of elemental mercury on the floor in the former Mercury Cell Building triggered the first removal action. Elemental mercury has been observed in cracks and fissures in the concrete pad, prior to and following the removal of the building. The general understanding at this time is that elemental mercury and sorbed mercury is likely present within the concrete pad and beneath the pad within the underlying soils. For these reasons, these areas are considered a source of contamination and as PTW.

The selected remedy treats the PTW beneath the former cell building and retort pad via stabilization to prevent direct exposure and migration of contaminants. By utilizing treatment as a significant portion of the remedy that reduces toxicity and mobility of hazardous substances, the statutory preference for remedies that employ treatment as a principal element is satisfied.

13.6 Five-Year Review Requirements

Section 121(c) of CERCLA and NCP §300.430(f)(5)(iii)(C) provide the statutory and legal bases for conducting five-year reviews. Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

After the Proposed Plan was published, AMECFW revised the FS during the public comment period based on comments from NCDEQ. The modifications did not significantly change the alternatives but included provided corrections/clarification of language in the FS. NCDEQ and EPA approved the revised FS.

PART 3: RESPONSIVENESS SUMMARY

EPA did not receive any comments from the public regarding the Proposed Plan. **Appendix B** includes the public meeting transcript.

APPENDIX A
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS TABLES

Table A-1. Chemical-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Chemical-Specific ARARs			
Action/Media	**Requirements**	**Prerequisite**	**Citation(s)**
Protection of surface water	The concentration of toxic substances, either alone or in combination with other wastes, in surface waters shall not render waters injurious to aquatic life or wildlife, recreational activities, public health, or impair waters for any designated uses.	Fresh surface waters classified as Class C waters which are protected for secondary recreation, fishing, aquatic life including propagation and survival, and wildlife – **relevant and appropriate**	15A NCAC 02B.0208(a) Standards for Toxic substances
Protection of surface water	The concentration of toxic substances shall not result in chronic toxicity. Any levels in excess of the chronic value shall be considered to result in chronic toxicity. In the absence of direct measurements of chronic toxicity, the concentration of toxic substances shall not exceed the concentration specified by the fraction of the lowest LC50 value that predicts a no effect chronic level (as determined by the use of acceptable acute/chronic ratios). If an acceptable acute/chronic ratio is not available, then that toxic substance shall not exceed one-one hundredth (0.01) of the lowest LC50 or if it is affirmatively demonstrated that a toxic substance has a half-life of less than 96 hours the maximum concentration shall not exceed one-twentieth (0.05) of the lowest LC50.		15A NCAC 02B.0208(a)(1) Aquatic Life Standards
Protection of surface water	The concentration of toxic substances shall not exceed the level necessary to protect human health through exposure routes of fish (shellfish) tissue consumption, water consumption, or other route identified as appropriate for the water body. • Polychlorinated biphenyls (PCBs) : 0.064 ng/l	Fresh surface waters classified as Class C waters which are protected for secondary recreation and fishing – **relevant and appropriate**	15A NCAC 02B.0208(a)(2),(B)(xii) Human Health Standards
Protection of surface water	The waters shall be suitable for aquatic life propagation and maintenance of biological integrity, wildlife, secondary recreation, and agriculture. Sources of water pollution that preclude any of these uses on either a short-term or long-term basis shall be considered to be violating a water quality standard.	Fresh surface waters classified as Class C waters which are protected for aquatic life including propagation and survival, and wildlife – **relevant and appropriate**	15A NCAC 02B.0211(2) Fresh surface standards for Class C

Chemical-Specific ARARs			
Action/Media	**Requirements**	**Prerequisite**	**Citation(s)**
Protection of surface water	Numerical water quality standards (maximum permissible levels) for the protection of aquatic life: • Mercury: 0.012 ug/l • Polychlorinated biphenyls (total of all PCBs and congeners identified): 0.001 ug/l Mercury and selenium water quality standards shall be based upon measurement of the total recoverable metal.	Fresh surface waters classified as Class C waters which are protected for aquatic life including propagation and survival, and wildlife – **relevant and appropriate**	15A NCAC 02B.0211(11)(b)(vii) and 15A NCAC 02B.0211(16) Aquatic Life Water Quality Criteria

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulation*

EPA = U.S. Environmental Protection Agency
NCAC = *North Carolina Administrative Code*

Table A-2. Location-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Aquatic Resources and Wetlands			
Presence of Wetlands	Shall take action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance beneficial values of wetlands.	Federal actions that involve potential impacts to, or take place within, wetlands – **TBC**	Executive Order 11990 Section 1(a) *Protection of Wetlands*
	Shall avoid undertaking construction located in wetlands unless: (1) there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use.		Executive Order 11990, Section 2(a) *Protection of Wetlands*
Location encompassing aquatic ecosystem as defined in 40 CFR 230.3(c)	No discharge of dredged or fill material into an aquatic ecosystem is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if will cause or contribute significant degradation of the waters of the US.	Action that involves the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands – **applicable**	40 CFR § 230.10(a) and (c) Clean Water Act Regulations – Section 404(b) Guidelines
	Except as provided in § 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps in accordance with Subpart H at 40 CFR 230.70 *et seq*. have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem		40 CFR § 230.10(d) Clean Water Act Regulations – Section 404(b) Guidelines
	Must comply with the substantive requirements of the NWP 38 General Conditions, as appropriate, any regional or case-specific conditions recommended by the Corps District Engineer, after consultation.	On-site CERCLA action conducted by Federal agency that involves the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands – **TBC**	Nation Wide Permit (38) Cleanup of Hazardous and Toxic Waste 33 CFR § 323.3(b)

Table A-2. Location-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Presence of wetlands or other waters influenced by wetlands	The following activities for which Section 404 permits are not required pursuant to Section 404(f)(1) of the Clean Water Act and which are not recaptured into the permitting process pursuant to Section 404(f)(2) are deemed to be in compliance with wetland standards in 15A NCAC 2B .0231: • construction of temporary sediment control measures or best management practices as required by the NC Sediment and Erosion Control Program on a construction site, provided that the temporary sediment control measures or best management practices are restored to natural grade and stabilized within two months of completion of the project and native woody vegetation is reestablished during the next appropriate planting season and maintained;	Activities within wetlands, as defined by G.S. 143-212(6), that comply with the most current versions of the federal regulations to implement Section 404 (f) (US Environmental Protection Agency and US Army Corps of Engineers including 40 CFR 232.3) and the Sedimentation Pollution Control Act, G.S. 113A, Article 4 – **applicable**	15A NCAC 02B.0230(a)(5)
Presence of wetlands or other waters influenced by wetlands	The following standards shall be used to assure the maintenance or enhancement of the existing uses of wetlands identified in Paragraph (a) of this Rule: • Liquids, fill or other solids or dissolved gases may not be present in amounts which may cause adverse impacts on existing wetland uses; • Floating or submerged debris, oil, deleterious substances, or other material may not be present in amounts which may cause adverse impacts on existing wetland uses; • Materials producing color, odor, taste or unsightliness may not be present in amounts which may cause adverse impacts on existing wetland uses;	Activities within, wetlands as defined by G.S. 143-212(6) – **applicable**	15A NCAC 02B.0231(b)(1)-(3)

Table A-2. Location-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Presence of wetlands or other waters influenced by wetlands *con't*	The following standards shall be used to assure the maintenance or enhancement of the existing uses of wetlands identified in Paragraph (a) of this Rule: • Concentrations or combinations of substances which are toxic or harmful to human, animal or plant life may not be present in amounts which individually or cumulatively may cause adverse impacts on existing wetland uses; • Hydrological conditions necessary to support the biological and physical characteristics naturally present in wetlands shall be protected to prevent adverse impacts on: (A) Water currents, erosion or sedimentation patterns; (B) Natural water temperature variations; (C) The chemical, nutrient and dissolved oxygen regime of the wetland; (D) The movement of aquatic fauna; (E) The pH of the wetland; and (F) Water levels or elevations. • The populations of wetland flora and fauna shall be maintained to protect biological integrity as defined at 15A NCAC 2B .0202.	Activities within, wetlands as defined by G.S. 143-212(6) – **applicable**	15A NCAC 02B.0231(b)(4)-(6)

Table A-2. Location-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Determination that surface water uses are not removed or degraded	Determining that existing uses are not removed or degraded by a discharge to classified surface waters for an activity which: (1) has no practical alternative under the criteria outlined in Paragraph (f) of this Rule; (2) will minimize adverse impacts to the surface waters based on consideration of existing topography, vegetation, fish and wildlife resources, and hydrological conditions under the criteria outlined in Paragraph (g) of this Rule; (3) does not result in the degradation of groundwaters or surface waters; (4) does not result in cumulative impacts, based upon past or reasonably anticipated future impacts, that cause or will cause a violation of downstream water quality standards; (5) provides for protection of downstream water quality standards through the use of on-site stormwater control measures; and (6) provides for replacement of existing uses through mitigation as described at Subparagraphs (h)(1) of this Rule. *NOTE:* Determination will be made by EPA in consultation with NCDEQ and the USACE, as appropriate and documented in CERCLA Remedial Design or Remedial Action Work Plan.	Discharge to classified surface waters – **applicable**	15A NCAC 02H .0506(b)

Table A-2. Location-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Determination that wetlands uses are not removed or degraded	The Director shall issue a certification upon determining that sufficient existing uses are not removed or degraded by a discharge to Class WL wetlands as defined at 15A NCAC 2B .0101(c)(8), for an activity which: (1) has no practical alternative as described in Paragraph (f) of this Rule[1], or impacts less than three acres of Class WL wetlands; (2) will minimize adverse impacts to the wetland based on consideration of existing topography, vegetation, fish and wildlife resources, and hydrological conditions under the criteria outlined in Paragraph (g) of this Rule; or impacts less than one acre of wetland within 150 feet (including less than 1/3 acre of wetland within 50 feet), of the mean high water line or normal water level of any perennial or intermittent water body as shown by the most recently published version of the United State Geological Survey 1:24,000 (7.5 minute) scale topographical map or other site specific data; (3) does not result in the degradation of groundwaters or surface waters; (4) does not result in cumulative impacts, based upon past or reasonably anticipated future impacts, that cause or will cause a violation of downstream water quality standards; (5) provides protection for downstream water quality standards through the use of on-site stormwater control measures; and (6) provides for replacement of existing uses through wetland mitigation under U.S. Army Corps of Engineers requirements or as described in Subparagraph (h)(1)-(8) of this Rule. *NOTE:* Certification is an administrative requirement. Determination will be made by EPA in consultation with NCDEQ and the USACE, as appropriate and documented in CERCLA Remedial Design or Remedial Action Work Plan to the extent that the wetlands on the site or portions of the wetlands on the site are Class WL.	Discharge to Class WL wetlands, as defined at 15A NCAC 2B .0101(c)(8) – **applicable**	15A NCAC 02H .0506(c)

Table A-2. Location-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Wetlands Mitigation	Replacement or mitigation of unavoidable losses of existing uses shall be reviewed in accordance with the guidelines provided in paragraphs (1) through (10) of this rule. *NOTE:* Permits are not required per CERCLA Section 121(e)(1); however consultation with other permitting agencies (such as the USACE) is necessary in order to demonstrate compliance with mitigation requirements.	Discharge to Class WL wetlands as defined at 15A NCAC 2B .0101(c)(8) – **applicable**	15A NCAC 02H .0506(h)
Discharges to Isolated Wetlands and Isolated Waters	The following are exempt from this Section and shall not be considered to remove existing uses of the isolated wetland or isolated surface waters: (1) Activities that are described in 15A NCAC 02B .0230 *ACTIVITIES DEEMED TO COMPLY WITH WETLANDS STANDARDS;* (2) Discharges to isolated, man-made ponds or isolated ditches except for those wetlands or waters constructed for compensatory mitigation or for on-site stormwater management; (3) Discharges of treated effluent into isolated wetlands and isolated classified surface waters resulting from activities which receive NPDES Permits or State Non-Discharge Permits; (4) Discharges for water dependent structures as defined in 15A NCAC 02B .0202(67); *NOTE:* Permits are not required per CERCLA Section 121(e)(1); however compliance with the substantive NPDES requirements for discharge is required by CERCLA Section 121(d).	Discharges[2] resulting from activities on isolated wetlands and isolated classified surface waters which require a determination by NCDEQ and the USACE – **applicable**	15A NCAC 02H .1300(d)

1 *Ref.* 15A NCAC 02H .0506(f) - A lack of practical alternatives may be shown by demonstrating that, considering the potential for a reduction in size, configuration or density of the proposed activity and all alternative designs the basic project purpose cannot be practically accomplished in a manner which would avoid or result in less adverse impact to surface waters or wetlands.

2 For the purpose of this Section, discharge shall be the deposition of dredged or fill material including but not limited to fill, earth, construction debris and soil.

Table A-2. Location-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Mitigation on ephemeral channels	Mitigation provider shall provide a delineation of the watershed draining to the ephemeral channel. The entire area proposed for mitigation shall be within the contributing drainage area to the ephemeral channel. The ephemeral channel shall be directly connected to an intermittent or perennial stream and contiguous with the rest of the mitigation site protected under a perpetual conservation easement. The area of the mitigation site on ephemeral channels shall comprise no more than 25 percent of the total area of buffer mitigation. The proposal shall meet all applicable requirements of Paragraph (n) of this Rule for restoration or enhancement. The proposal shall meet all applicable requirements of Subparagraph (o)(4) or (o)(5) of this Rule for preservation.	Activities affecting riparian buffers for ephemeral channels[3] – **relevant and appropriate**	15A NCAC 02B .0295(o)(7) MITIGATION PROGRAM REQUIREMENTS FOR PROTECTION AND MAINTENANCE OF RIPARIAN BUFFERS
Restoration and enhancement on ditches	The width of the restored or enhanced area shall not be less than 30 feet and shall not exceed 50 feet for crediting purposes. The applicant or mitigation provider shall provide a delineation of the watershed draining to the ditch. The watershed draining to the ditch shall be at least four times larger than the restored or enhanced area along the ditch. The perpetual conservation easement shall include the ditch and the confluence of the ditch with the intermittent or perennial stream, and provide language that prohibits future maintenance of the ditch. The proposal shall meet all applicable requirements of Paragraph (n) of this Rule for restoration or enhancement.	Activities affecting riparian buffers for ditches[4] – **relevant and appropriate**	15A NCAC 02B .0295(o)(8)

3 An "ephemeral channel" is defined as a natural channel exhibiting discernible banks within a topographic crenulation (V-shaped contour lines) indicative of natural drainage on the 1:24,000 scale (7.5 minute) quadrangle topographic map prepared by the U.S. Geologic Survey
4 A "ditch" is defined as a man-made channel other than a modified natural stream that was constructed for drainage purposes.

Table A-2. Location-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Restoration and enhancement on ditches	To be used for mitigation, a ditch shall meet all of the following criteria: (A) be directly connected with and draining towards an intermittent or perennial stream; (B) be contiguous with the rest of the mitigation site protected under a perpetual conservation easement; (C) stormwater runoff from overland flow shall drain towards the ditch; (D) be between one and three feet in depth; and (E) the entire length of the ditch shall have been in place prior to the effective date of the applicable buffer rule.	Activities affecting riparian buffers for ditches – **relevant and appropriate**	15A NCAC 02B .0295(o)(8)
Floodplains			
Presence of Floodplains designated as such on a map[5]	Shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains.	Federal actions that involve potential impacts to, or take place within, floodplains – **TBC**	Executive Order 11988 Section 1. *Floodplain Management*
	Shall consider alternatives to avoid, to the extent possible, adverse effects and incompatible development in the floodplain. Design or modify its action in order to minimize potential harm to or within the floodplain		Executive Order 11988 Section 2(a)(2) *Floodplain Management*
	Where possible, an agency shall use natural systems, ecosystem processes, and nature-based approaches when developing alternatives for consideration.		Executive Order 13690 Section 2(c)
Presence of floodplain designated as such on a map	The Agency shall design or modify its actions so as to minimize[6] harm to or within the floodplain.	Federal actions affecting or affected by Floodplain as defined in 44 CFR § 9.4 – **relevant and appropriate**	44 CFR § 9.11(b)(1) *Mitigation*

5 Under 44 CFR § 9.7 *Determination of proposed action's location*, Paragraph (c) Floodplain determination. One should consult the FEMA Flood Insurance Rate Map (FIRM), the Flood Boundary Floodway Map (FBFM) and the Flood Insurance Study (FIS) to determine if the Agency proposed action is within the base floodplain.
6 Minimize means to reduce to smallest amount or degree possible. See 44 CFR § 9.4 *Definitions*.

Table A-2. Location-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
	The Agency shall restore and preserve natural and beneficial floodplain values.		44 CFR § 9.11(b)(3) *Mitigation*
	The Agency shall minimize: • Potential harm to lives and the investment at risk from base flood, or in the case of critical actions[7] from the 500-year flood; • Potential adverse impacts that action may have on floodplain values.		44 CFR § 9.11(c)(1) and (3) *Minimization provisions*
Wildlife, Threatened or Endangered Species			
Presence of Migratory birds listed in 50 CFR § 10.13	No person may take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such bird except as may be permitted under the terms of a valid permit issued pursuant to the provisions of this part and part 13 of this chapter, or as permitted by regulations in this part, or part 20 of this subchapter (the hunting regulations).	Action that have potential impacts on, or is likely to result in a 'take' (as defined in 50 CFR § 10.12) of migratory birds – **applicable**	*Migratory Bird Treaty Act*, 16 U.S.C. §703(a) 50 CFR § 21.11

7 See 44 CFR § 9.4 *Definitions, Critical action*. Critical actions include, but are not limited to, those which create or extend the useful life of structures or facilities such as those that produce, use or store highly volatile, flammable, explosive, toxic or water-reactive materials.

Table A-2. Location-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Presence of federally Endangered and Threatened species listed in 50 CFR 17.11(h) – or critical habitat of such species listed in 50 CFR § 17.95	Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary of Interior, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section. *NOTE:* Despite that consultation may be considered an administrative requirement, it should be performed to ensure activities are in compliance with substantive provisions of the Endangered Species Act and regulations.	Agency action that may jeopardize listed wildlife species, or destroy or adversely modify critical habitat – **applicable**	16 U.S.C. §1536 (a)(2) –or Section 7(a)(2) of *the Endangered Species Act of 1973*
Presence of Threatened and Endangered Wildlife listed in 50 CFR § 17.11(h)	Except as provided in the rule, it is unlawful to take threatened or endangered wildlife in the United States. *NOTE:* Under 50 CFR § 10.12 *Definitions* the term *Take* means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect.	Action that may jeopardize American alligator, green turtle, and/or loggerhead turtle – **applicable**	50 CFR § 17.21(c) 50 CFR § 17.31(a) 50 CFR § 17.42(a)and (b)
Siting of TSCA Landfill			
Siting of a TSCA chemical waste landfill	The landfill shall be located in thick, relatively impermeable formations such as large area clay pans. Where this is not possible, the soil shall have a high clay and silt content with the following parameters: • In place soil thickness, 4-ft or compacted soil liner thickness, 3-ft; • Permeability (cm sec), equal to or less than 1 × 10-7; • Percent soil passing No. 200 sieve > 30; • Liquid limit, > 30; and • Plasticity index > 15.	Construction of a TSCA chemical waste landfill – **applicable**	40 CFR § 761.75(b)(1)

Table A-2. Location-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
Hydrologic conditions	The bottom of the landfill shall be above the historical high groundwater table as provided below. Floodplains, shorelands, and groundwater recharge areas shall be avoided. There shall be no hydraulic connection between the site and standing or flowing surface water. The site shall have monitoring wells and leachate collection. The bottom of the landfill liner system or natural in-place soil barrier shall be at least 50 ft. from the historical high water table. *NOTE*: The 50ft. depth from the bottom liner to groundwater requirement is being waived under 40 CFR §761.75(c)(4) and the justification is provided in the ROD.	Construction of a TSCA chemical waste landfill – **applicable**	40 CFR § 761.75(b)(3)
Waiver of a TSCA chemical waste landfill technical requirement	An owner or operator of a chemical waste landfill may submit evidence to the Regional Administrator that operation of the landfill will not present an unreasonable risk of injury to health or the environment from PCBs when one or more of the requirements of paragraph (b) of this section are not met. On the basis of such evidence and any other available information, the Regional Administrator may in his discretion find that one or more of the requirements of paragraph (b) of this section is not necessary to protect against such a risk and may waive the requirements in any approval for that landfill. Any finding and waiver under this paragraph will be stated in writing and included as part of the approval. *NOTE:* Waiver of any technical requirement shall be made as part of the CERCLA ROD process. The CERCLA remedy protectiveness standard applies in addition to the TSCA standard.	Construction of a TSCA chemical waste landfill – **applicable**	40 CFR § 761.75(c)(4)
Floodplain	Shall provide surface water diversion dikes around the perimeter of the landfill site with a minimum height equal to two feet above the 100-year floodwater elevation.	Construction of a TSCA chemical waste landfill (below the 100-year floodwater elevation) – **applicable**	40 CFR § 761.75(b)(4)(i)

Table A-2. Location-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Location-Specific ARARs and TBCs			
Location	**Requirements**	**Prerequisite**	**Citation(s)**
	Shall provide diversion structures capable of diverting all surface water runoff from a 24-hour, 25-year storm.	Construction of a TSCA chemical waste landfill (above the 100-year floodwater elevation) – **applicable**	40 CFR § 761.75(b)(4)(ii)
Topography	The landfill site shall be located in an area of low to moderate relief to minimize erosion and to help prevent landslides or slumping.		40 CFR § 761.75(b)(5)
Siting of a Disposal Site (i.e., solid waste landfill)	A site located in a floodplain shall not restrict the flow of the 100 -year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid wastes so as to pose a hazard to human life, wildlife, or land or water resources.	Construction of a disposal site (except a land clearing and debris landfill) located in North Carolina – **relevant and appropriate**	15A NCAC 13B .0503(1)(a)
	A disposal site shall meet the following buffer requirements: (i) A 50-foot minimum buffer between all property lines and disposal areas; (ii) A 500-foot minimum buffer between private dwellings and wells and disposal areas; and (iii) A 50-foot minimum buffer between streams and rivers and disposal areas.	Construction of a disposal site (except a land clearing and debris landfill) located in North Carolina – **relevant and appropriate**	15A NCAC 13B .0503(2)(f) *Buffer Requirements*

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
CWA = Clean Water Act of 1972
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
NCAC = *North Carolina Administrative Code*
NCDEQ = North Carolina Department of Environmental Quality
N.C.G.S. = North Carolina General Statutes
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl
POTW = Publicly Owned treatment Works
TBC = to be considered
TSCA = Toxic Substances Control Act of 1976
USACE = U.S. Army Corps of Engineers
U.S.C. = *United States Code*

Table A-2. *Location-Specific* ARARs *and* TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
General Construction Standards – All land–disturbing activities (i.e., excavation, trenching, grading etc.)			
Managing storm water runoff from land-disturbing activities	Shall install erosion and sedimentation control devices and practices sufficient to retain the sediment generated by the land-disturbing activity within the boundaries of the tract during construction.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-53) of more than 1 acre of land – **applicable**	N.C.G.S. Ch.113A-157(3) *Mandatory standards for land-disturbing activity*
	Shall plant or otherwise provide permanent ground cover sufficient to restrain erosion after completion of construction.		N.C.G.S. Ch.113A-157(3)
	The land-disturbing activity shall be conducted in accordance with the approved erosion and sedimentation control plan. *NOTE:* Plan which meets the objectives of 15A NCAC 4B.0106 would be included in the CERCLA Remedial Design or Remedial Action Work Plan		N.C.G.S. Ch.113A-157(5)
	Shall take all reasonable measures to protect all public and private property from damage caused by such activities.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land – **applicable**	15A NCAC 4B.0105
Managing storm water runoff from land-disturbing activities	Erosion and sedimentation control plan must address the following basic control objectives: (1) Identify areas subject to severe erosion, and off-site areas especially vulnerable to damage from erosion and sedimentation. (2) Limit the size of the area exposed at any one time. (3) Limit exposure to the shortest feasible time. (4) Control surface water run-off originating upgrade of exposed areas (5) Plan and conduct land-disturbing activity so as to prevent off-site sedimentation damage. (6) Include measures to control velocity of storm water runoff to the point of discharge.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land – **applicable**	15A NCAC 4B.0106

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Managing storm water runoff from land-disturbing activities con't	Erosion and sedimentation control measures, structures, and devices shall be planned, designed, and constructed to provide protection from the run-off of 10 year storm.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land – **applicable**	15A NCAC 4B.0108
	Shall conduct activity so that the post-construction velocity of the 10 year storm run-off in the receiving watercourse to the discharge point does not exceed the parameters provided in this Rule.		15A NCAC 4B.0109
	Shall install and maintain all temporary and permanent erosion and sedimentation control measures.		15A NCAC 4B.0113
Erosion control near High Quality Water zones	Erosion and sedimentation control measures, structures, and devices within High Quality Water (HQW) zones shall be planned, designed and constructed to provide protection from the runoff of the 25 year storm.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land in High Quality Water (HQW) zones – **applicable**	15A NCAC 4B.0124(b)
	Provisions for ground cover sufficient to restrain erosion must be provided for any portion of the land-disturbing activity with 15 working days or 60 calendar days following completion of the construction or development, which period is shorter.		15A NCAC 4B.0124(e)
	Implement good construction management techniques, best management practices for sediment and erosion controls, and storm water management measures in accordance with 15A NCAC 02H .1008 to ensure storm water discharges are in compliance.	Development activity (otherwise requiring a stormwater permit) within one mile of and draining to waters classified as High Quality Waters (HQW) – **relevant and appropriate**	15A NCAC 02H .1006, NC General Permit CNCG 0100000
Control of fugitive dust emissions	The owner/operator of a facility shall not cause fugitive dust emissions to cause or contribute to the substantive complaints or visible emissions.	Activities potentially generating fugitive dust as defined in 15A NCAC 02D .0540 (a)(2) – **relevant and appropriate**	15A NCAC 02D .0540
Discharge of Wastewater from De-watering of stockpiled soil and sediments			
General duty to mitigate for discharge	Take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of effluent standards which has a reasonable likelihood of adversely affecting human health or the environment.	Discharge of pollutants to surface waters of the State – **applicable**	40 CFR § 122.41(d)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Operation and maintenance of treatment system	Properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the effluent standards. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures.	Discharge of pollutants to surface waters of the State – **applicable**	40 CFR § 122.41(e)
Technology-based treatment requirements for wastewater discharge	To the extent that EPA promulgated effluent limitations are inapplicable, develop on a case-by-case Best Professional Judgment (BPJ) basis under Section 402(a)(1)(B) of the CWA, technology based effluent limitations by applying the factors listed in section 125.3(d) and shall consider: • The appropriate technology for this category or class of point sources, based upon all available information; and • Any unique factors relating to the discharger.	Discharge of pollutants to surface waters from other than a POTW – **applicable**	40 CFR § 125.3(c)(2) 15A NCAC 02B. 0406(e) *Effluent Limitations*
Water quality-based effluent limits for wastewater discharge	Must develop water quality based effluent limits that ensure that: • The level of water quality to be achieved by limits on point source(s) established under 40 CFR § 122.44(d)(1)(vii) is derived from, and complies with all applicable water quality standards; and • Effluent limits developed to protect narrative or numeric water quality criteria are consistent with the assumptions and any available waste load allocation for the discharge prepared by the State and approved by EPA pursuant to 40 *CFR* § 130.7.	Discharge of pollutants to surface waters that causes, or has reasonable potential to cause, or contributes to an instream excursion above a narrative or numeric criteria within a State water quality standard – **applicable**	40 CFR § 122.44(d)(1)(vii)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Monitoring requirements for discharges	In addition to 40 CFR § 122.48 (a) and (b) and to assure compliance with effluent limitations requirements to monitor, one must monitor, as appropriate, according to the substantive requirements provided in 40 CFR § 122.44(i)(1)(i) through (iv). *NOTE:* Monitoring location and frequency will be conducted in accordance with CERCLA Remedial Action Work Plan.	Discharge of pollutants to surface waters – **applicable**	40 CFR § 122.44(i)(1) 15A NCAC 02B.0505 *Monitoring Requirements* 40 CFR § 122.44(i)(2)
	All effluent limitations, standards and prohibitions shall be established for each outfall or discharge point, except as provided under 40 CFR § 122.44(k).		
	All effluent limitations, standards and prohibitions, including those necessary to achieve water quality standards, shall unless impracticable be stated as: Maximum daily and average monthly discharge limitations for all discharges	Continuous discharge of pollutants to surface waters – **applicable**	
Disposal of PCB contaminated precipitation, condensation, and leachate	May be disposed in a chemical waste landfill which complies with 40 CFR § 761.75 if: • disposal does not violate 40 CFR § 268.32(a) or § 268.42(a)(1); • liquids do not exceed 500 ppm PCB and are not an ignitable waste as described in 40 CFR § 761.75(b)(8)(iii).	PCB liquids at concentrations ≥ 50 ppm and ≤ 500 ppm from incidental sources such as precipitation, condensation, leachate or load separation and associated with PCB Articles or non-liquid PCB wastes – **applicable**	40 CFR § 761.60(a)(3) 40 CFR § 761.60(a)(3)(i) and (ii)
Discharge of PCB contaminated water	For water discharged to a treatment works (as defined in 40 CFR § 503.9 (aa), or to navigable waters, meet standard of < 3 ppb PCBs; Or a PCB discharge limit included in a permit issued under section 307(b) or 402 of the Clean Water Act.	Water containing PCBs regulated for disposal – **applicable**	40 CFR § 761.79(b)(1)(ii) 40 CFR § 761.450(a)(3)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Decontamination standard for water containing PCBs	For unrestricted use, meet standard of less than or equal to 0.5 ug/L (ie. Approximately ≤ 0.5 ppb PCBs).	Water containing PCBs regulated for disposal – **applicable**	40 CFR § 761.79(b)(1)(iii)
Waste Characterization – Primary Wastes (contaminated media and debris) and Secondary Wastes (wastewaters, spent treatment media, etc.)			
Characterization of *solid waste* (all primary and secondary wastes) [e.g., excavated sediments and soil]	Must determine if solid waste is a hazardous waste using the following method: • Should first determine if waste is excluded from regulation under 40 CFR261.4; and • Must then determine if waste is listed as a hazardous waste under subpart D 40 CFR part 261.	Generation of solid waste as defined in 40 CFR261.2 – **applicable**	40 CFR § 262.11(a) and (b) 15A NCAC 13A .0106, .107
Characterization of *solid waste* (all primary and secondary wastes) [e.g., excavated sediments and soil]	Must determine whether the waste is (characteristic waste) identified in subpart C of 40 CFR part 261 by either: (1) Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR §260.21; or (2) Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used.		40 CFR § 262.11(c) 15A NCAC 13A .0106
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste	Generation of solid waste which is determined to be hazardous – **applicable**	40 CFR § 262.11(d); 15A NCAC 13A .0106
Characterization of *hazardous waste* (all primary and secondary wastes) [e.g., excavated sediments and soil]	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	Generation of RCRA-hazardous waste for storage, treatment or disposal – **applicable**	40 CFR § 264.13(a)(1) 15A NCAC 13A .0109

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Determinations for management of hazardous waste [e.g., excavated sediments and soil]	Must determine if the hazardous waste has to be treated before land disposed. This is done by determining if the waste meets the treatment standards in 40 CFR 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods or use of generator knowledge of waste. This determination can be made concurrently with the hazardous waste determination required in 40 CFR § 262.11.	Generation of RCRA hazardous waste for storage, treatment or disposal – **applicable**	40 CFR § 268.7(a)(1) 15A NCAC 13A .0106
	Must comply with the special requirements of 40 CFR § 268.9 in addition to any applicable requirements in 40 CFR § 268.7.	Generation of waste or soil that displays a hazardous characteristic of ignitability, corrosivity, reactivity, or toxicity for storage, treatment or disposal – **applicable**	40 CFR § 268.7(a)(1) 15A NCAC 13A .0112
	Must determine each EPA Hazardous Waste Number (waste code) applicable to the waste in order to determine the applicable treatment standards under 40 CFR 268 *et seq.*. This determination may be made concurrently with the hazardous waste determination required in Sec. 262.11 of this chapter.	Generation of RCRA characteristic hazardous waste for storage, treatment or disposal – **applicable**	40 CFR § 268.9(a) 15A NCAC 13A .0112
	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the characteristic waste.	Generation of RCRA characteristic hazardous waste (and is not D001 non–wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal – **applicable**	40 CFR § 268.9(a) 15A NCAC 13A .0112
Management of PCB waste (e.g., contaminated PPE, equipment, wastewater)	Any person storing or disposing of PCB waste must do so in accordance with 40 CFR 761, Subpart D.	Generation of waste containing PCBs at concentrations ≥ 50 ppm – **applicable**	40 CFR § 761.50(a)
Characterization of PCB remediation waste	Any person cleaning up and disposing of PCBs shall do so based on the concentration at which the PCBs are found.	Generation of PCB remediation waste as defined in 40 CFR 761.3 – **applicable**	40 CFR § 761.61

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Waste Storage – Primary Wastes (contaminated media and debris) and Secondary Wastes (wastewaters, spent treatment media, etc.)			
Storage of solid waste	All solid waste shall be stored in such a manner as to prevent the creation of a nuisance, insanitary conditions, or a potential public health hazard.	Generation of solid waste which is determined *not* to be hazardous – **relevant and appropriate**	15A NCAC 13B .0104(f)
	Containers for the storage of solid waste shall be maintained in such a manner as to prevent the creation of a nuisance or insanitary conditions. Containers that are broken or that otherwise fail to meet this Rule shall be replaced with acceptable containers.		15A NCAC 13B .0104(e)
Temporary Storage of hazardous waste in containers [e.g., excavated sediments and soil]	A generator may accumulate hazardous waste at the facility provided that: • waste is placed in containers that comply with 40 CFR 265.171–173; and	Accumulation of RCRA hazardous waste on site as defined in 40 CFR §260.10 – **applicable**	40 CFR § 262.34(a); 15A NCAC 13A .0107 40 CFR §262.34(a)(1)(i);
	• the date upon which accumulation begins is clearly marked and visible for inspection on each container; • container is marked with the words "hazardous waste"; *or*		40 CFR § 262.34(a)(2) and (3) 15A NCAC 13A .0107
	• container may be marked with other words that identify the contents.	Accumulation of 55 gal. or less of RCRA hazardous waste <u>or</u> one quart of acutely hazardous waste listed in §261.33(e) at or near any point of generation – **applicable**	40 CFR § 262.34(c)(1) 15A NCAC 13A .0107
Use and management of hazardous waste in containers [e.g., excavated sediments and soil]	If container is not in good condition (e.g. severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition.	Storage of RCRA hazardous waste in containers – **applicable**	40 CFR § 265.171 15A NCAC 13A .0109
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired.		40 CFR § 265.172 15A NCAC 13A .0109

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
	Containers must be closed during storage, except when necessary to add/remove waste. Container must not opened, handled and stored in a manner that may rupture the container or cause it to leak.	Storage of RCRA hazardous waste in containers – **applicable**	40 CFR § 265.173(a) and (b) 15A NCAC 13A .0109
Storage of hazardous waste in container area [e.g., excavate sediments and soil]	Area must have a containment system designed and operated in accordance with 40 CFR §264.175(b).	Storage of RCRA–hazardous waste in containers with *free liquids* – **applicable**	40 CFR §264.175(a) 15A NCAC 13A .0109
	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or Containers must be elevated or otherwise protected from contact with accumulated liquid.	Storage of RCRA–hazardous waste in containers that *do not contain free liquids* (other than F020, F021, F022, F023, F026 and F027) – **applicable**	40 CFR § 264.175(c)(1) and (2) 15A NCAC 13A .0109
Closure performance standard for RCRA container storage unit	Must close the facility (e.g., container storage unit) in a manner that: • Minimizes the need for further maintenance; • Controls minimizes or eliminates to the extent necessary to protect human health and the environment, post–closure escape of hazardous waste, hazardous constituents, leachate, contaminated run –off, or hazardous waste decomposition products to the ground or surface waters or the atmosphere; and • Complies with the closure requirements of subpart, but not limited to, the requirements of 40 CFR 264.178 for containers.	Storage of RCRA hazardous waste in containers – **applicable**	40 CFR § 264.111 15A NCAC 13A .0109

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Closure of RCRA container storage unit	At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soils containing or contaminated with hazardous waste and hazardous waste residues must be decontaminated or removed. [Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate in accordance with40 CFR 261.3(d) of this chapter that the solid waste removed from the containment system is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of parts 262 through 266 of this chapter].	Storage of RCRA hazardous waste in containers in a unit with a containment system – **applicable**	40 CFR § 264.178 15A NCAC 13A .0109
Temporary storage of PCB waste in a container(s)	Container(s) shall be marked as illustrated in 40 CFR 761.45(a).	Storage of PCBs and PCB items at concentrations ≥ 50 ppm for disposal – **applicable**	40 CFR § 761.40(a)(1)
	Storage area must be properly marked as required by 40 CFR 761.40(a)(10).		40 CFR § 761.65(c)(3)
	Any leaking PCB Items and their contents shall be transferred immediately to a properly marked non-leaking container(s).		40 CFR § 761.65(c)(5)
	Container(s) shall be in accordance with requirements set forth in DOT HMR at 49 CFR 171-180.		40 CFR § 761.65(c)(6)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Storage of liquid PCBs in stationary containers (e.g., leachate in storage tank)	Storage containers can be larger than the containers specified in paragraph (c)(6) of 40 CFR § 761.65 provided that: • The containers are designed, constructed, and operated in compliance OSHA standards, 29 CFR 1910.106 *Flammable and combustible liquids*. Before using these containers for storing PCBs, the design of the containers must be reviewed to determine the effect on the structural safety of the containers that will result from placing liquids with the specific gravity of PCBs into the containers. • Owner/operator shall prepare and implement a Spill Prevention Control and Countermeasure (SPCC) Plan as described in part 112 of this title. *NOTE*: Substantive requirements of an SPCC Plan will be contained in the CERCLA Remedial Action Work Plan.	Storage of liquid PCB in *stationary containers* other than those meeting DOT HMR performance standards at 49 CFR parts 171 through 180 – **applicable**	40 CFR § 761.65(c)(7)(i) and (ii)
Storage of PCB waste in a RCRA-regulated container storage area	Does not have to meet storage unit requirements in 40 CFR § 761.65(b)(1) provided unit: • is permitted by EPA under RCRA §3004, or • qualifies for interim status under RCRA §3005; or • is permitted by an authorized state under RCRA §3006 and, • PCB spills cleaned up in accordance with Subpart G of 40 CFR 761. *NOTE*: Storage unit meeting the requirements of the RCRA ARARs for container storage unit identified above would qualify as "interim status.	Storage of PCBs and PCB Items designated for disposal – **applicable**	40 CFR § 761.65(b)(2)(i)-(iv)
Clean closure of TSCA storage facility	A TSCA/RCRA storage facility closed under RCRA is exempt from the TSCA closure requirements of 40 CFR 761.65(e). *NOTE*: This exemption would apply to storage of PCB waste in a RCRA container storage unit that meets the RCRA container unit requirements identified as ARARs.	Closure of TSCA/RCRA storage facility – **applicable**	40 CFR § 761.65(e)(3)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Temporary storage of bulk PCB remediation waste (e.g., excavated soils) in a TSCA waste pile	Waste must be placed in a pile that: • is designed and operated to control dispersal by wind, where necessary, by means other than wetting; • does not generate leachate through decomposition or other reactions;	Storage of PCB remediation waste or PCB bulk product waste at cleanup site or site of generation for up to 180 days – **applicable**	40 CFR § 761.65(c)(9)(i) and (ii)
	The storage site must have a liner designed, constructed, and installed to prevent any migration of wastes off or through liner into adjacent subsurface soil, groundwater or surface water at any time during active life (including closure period) of the storage site.		40 CFR § 761.65(c)(9)(iii)(A)
Construction of TSCA storage pile liner	Liner must be: • constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure because of pressure gradients, physical contact with waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation; • placed on foundation or base capable of providing support to liner and resistance to pressure gradients above and below the liner to present failure because of settlement compression or uplift; • installed to cover all surrounding earth likely to be in contact with waste.	Storage of PCB remediation waste or PCB bulk product waste at cleanup site or site of generation for up to 180 days – **applicable**	40 CFR § 761.65(c)(9)(iii)(A)(*1*)-(3)
Construction of TSCA storage pile cover	The storage site must have a cover that: • meets the requirements of 40 CFR § 761.65(c)(9)(iii)(A); • is installed to cover all of the stored waste likely to be contacted by precipitation; and • is secured so as not to be functionally disabled by winds expected under normal seasonal meteorological conditions; and	Storage of PCB remediation waste or PCB bulk product waste at cleanup site or site of generation for up to 180 days – **applicable**	40 CFR § 761.65(c)(9)(iii)(B)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Construction of TSCA storage pile run-on control system	The storage site must have a run-on control system designed, constructed, operated and maintained such that it: • prevents flow on the stored waste during peak discharge from at least a 25-year storm; • collects and controls at least the water volume resulting from a 24-hour, 25-year storm. Collection and holding facilities (e.g., tanks or basins) must be emptied or otherwise managed expeditiously after storms to maintain design capacity of the system.	Storage of PCB remediation waste or PCB bulk product waste at cleanup site or site of generation for up to 180 days – **applicable**	40 CFR § 761.65(c)(9)(iii)(C)(*1*) and (*2*)
Modification of TSCA waste pile requirements	Requirements of 40 CFR § 761.65(c)(9) may be modified under the risk-based disposal option of 40 CFR 761.61(c). *NOTE*: See ARAR entry below for requirements associated with use of 40 CFR § 761.61(c).		40 CFR § 761.65(c)(9)(iv)
Temporary on–site storage of remediation waste in RCRA staging pile (e.g., excavated soils)	Must be located within the contiguous property under the control of the owner/operator where the wastes are to be managed in the staging pile originated. For purposes of this section, storage includes mixing, sizing, blending or other similar physical operations so long as intended to prepare the wastes for subsequent management or treatment.	Accumulation of ***solid non–flowing hazardous remediation waste*** (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 CFR 260.10 – **applicable**	40 CFR § 264.554(a)(1)
	Staging piles may be used to store hazardous remediation waste (or remediation waste otherwise subject to land disposal restrictions) based on approved standards and design criteria designated for that staging pile. *NOTE*: Design and standards of the staging pile should be included in CERCLA Remedial Design document approved or issued by EPA.		40 CFR § 264.554(b)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Performance criteria for RCRA staging pile	Staging pile must be designed to: • facilitate a reliable, effective and protective remedy; • must be designed to prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross–media transfer *as necessary to protect human health and the environment* (e.g. use of liners, covers, run–off/run–on controls).	Storage of remediation waste in a staging pile **–applicable**	40 CFR § 264.554(d)(1)(i) and (ii)
Design criteria for RCRA staging pile	In setting standards and design criteria must consider the following factors: • Length of time pile will be in operation; • Volumes of waste you intend to store in the pile; • Physical and chemical characteristics of the wastes to be stored in the unit; • Potential for releases from the unit; • Hydrogeological and other relevant environmental conditions at the facility that may influence the migration of any potential releases; and • Potential for human and environmental exposure to potential releases from the unit.	Storage of remediation waste in a staging pile **– applicable**	40 CFR § 264.554(d)(2)(i) –(vi)
Operation of a RCRA staging pile	Must not place in the same staging pile unless you have complied with 40 CFR § 264.17(b).	Storage of "incompatible" remediation waste (as defined in 40 CFR 260.10) in staging pile – **applicable**	40 CFR § 264.554(f)(1)
	Must separate the incompatible waste or materials, or protect them from one another by using a dike, berm, wall or other device.	Staging pile of remediation waste stored nearby to incompatible wastes or materials in containers, other piles, open tanks or land disposal units – **applicable**.	40 CFR § 264.554(f)(2)
	Must not pile remediation waste on same base where incompatible wastes or materials were previously piled unless you have sufficiently decontaminated the base to comply with 40 CFR § 264.17(b).		40 CFR § 264.554(f)(3)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Closure of RCRA staging pile of remediation waste	Must be closed within 180 days after the operating term by removing or decontaminating all remediation waste, contaminated containment system components, and structures and equipment contaminated with waste and leachate. Must decontaminate contaminated sub-soils in a manner that EPA determines will protect human and the environment.	Storage of remediation waste in staging pile in ***previously contaminated area*** – **applicable**	40 CFR § 264.554(j)(1) and (2)
	Must be closed within 180 days after the operating term according to 40 CFR § 264.258(a) and § 264.111 or §265.258(a) and § 265.111.	Storage of remediation waste in staging pile ***in uncontaminated area*** – **applicable**	40 CFR § 264.554(k)
Operational limits of a RCRA staging pile	Must not operate for more than 2 years, except when an operating term extension under 40 CFR § 264.554(i) is granted. *NOTE:* Must measure the 2-year limit (or other operating term specified) from first time remediation waste placed in staging pile	Storage of remediation waste in a staging pile – **applicable**	40 CFR §264.554(d)(1)(iii)
	Must not use staging pile longer than the length of time designated by EPA in appropriate decision document.		40 CFR §264.554(h)
Treatment/Disposal of Wastes – Primary (contaminated media and debris) and Secondary Wastes (wastewaters, spent treatment media, etc.)			
Disposal of solid waste [e.g., off-site permitted landfill]	Shall ensure that waste is disposed of at a site or facility which is permitted to receive the waste.	Generation of solid waste intended for off-site disposal – **relevant and appropriate**	15A NCAC 13B .0106(b)
Disposal of RCRA–hazardous waste in a land–based unit [e.g., off-site permitted landfill]	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR § 268.40 before land disposal.	Land disposal, as defined in 40 CFR268.2, of restricted RCRA waste – **applicable**	40 CFR § 268.40(a) 15A NCAC 13A .0112
	All underlying hazardous constituents [as defined in 40 CFR § 268.2(i)] must meet the Universal Treatment Standards, found in 40 CFR § 268.48 Table UTS prior to land disposal.	Land disposal of restricted RCRA characteristic wastes (D001 –D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well – **applicable**	40 CFR §268.40(e) 15A NCAC 13A .0112

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Disposal of RCRA–hazardous waste in a land–based unit [e.g., off-site permitted landfill]	To determine whether a hazardous waste identified in this section exceeds the applicable treatment standards of 40 CFR § 268.40, the initial generator must test a sample of the waste extract or the entire waste, depending on whether the treatment standards are expressed as concentration in the waste extract or waste, or the generator may use knowledge of the waste. If the waste contains constituents (including UHCs in the characteristic wastes) in excess of the applicable UTS levels in 40 CFR § 268.48, the waste is prohibited from land disposal, and all requirements of part 268 are applicable, except as otherwise specified.	Land disposal of RCRA toxicity characteristic wastes (D004 –D011) that are newly identified (i.e., wastes, soil, or debris identified by the TCLP but not the Extraction Procedure) – **applicable**	40 CFR § 268.34(f) 15A NCAC 13A .0112
Disposal of RCRA–*hazardous waste soil* in a land–based unit [e.g., off-site permitted landfill]	Must be treated according to the alternative treatment standards of 40 CFR § 268.49(c) or according to the UTSs [specified in 40 CFR § 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 CFR § 268.2, of restricted hazardous *soils* – **applicable**	40 CFR § 268.49(b) 15A NCAC 13A .0112
Treatment of RCRA *hazardous waste soil*	Prior to land disposal, all "constituents subject to treatment" as defined in 40 CFR § 268.49(d) must be treated as follows:	Treatment of restricted hazardous waste soils – **applicable**	40 CFR § 268.49(c)(1)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Treatment of RCRA *hazardous waste soil*	• **For non –metals** (except carbon disulfide, cyclohexanone, and methanol), treatment must achieve a 90 percent reduction in total constituent concentrations, except as provided in 40 CFR § 268.49(c)(1)(C) • **For metals** and carbon disulfide, cyclohexanone, and methanol), treatment must achieve a 90 percent reduction in total constituent concentrations as measured in leachate from the treated media (tested according to TCLP) or 90 percent reduction in total constituent concentrations (when a metal removal technology is used), except as provided in 40 CFR § 268.49(c)(1)(C) • When treatment of any constituent subject to treatment to a 90 percent reduction standard would result in a concentration less than 10 times the Universal Treatment Standard for that constituent, treatment to achieve constituent concentrations less than 10 times the universal treatment standard is not required. [Universal Treatment Standards are identified in 40 CFR § 268.48 Table UTS] *NOTE*: Treatment required for soils considered hazardous waste is expected to be performed at an off-site RCRA permitted facility prior to disposal,	Treatment of restricted hazardous waste soils – **applicable**	40 CFR § 268.49(c)(1)(A)-(C)
Treatment of RCRA *hazardous waste soil*	In addition to the treatment requirement required by paragraph (c)(1) of this section, soils must be treated to eliminate these characteristics.	Soils that exhibit the characteristic of ignitability, corrosivity or reactivity intended for land disposal – **applicable**	40 CFR § 268.49(c)(2)
	Provides methods on how to demonstrate compliance with the alternative treatment standards for contaminated soils that will be land disposed.	On-site treatment of restricted hazardous waste soils following alternative soil treatment of 40 CFR § 268.49(c) – **To Be Considered**	*Guidance on Demonstrating Compliance with the LDR Alternative Soil Treatment Standards* [EPA 530 –R –02 –003, July 2002]

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Disposal of RCRA *hazardous waste debris* in a land–based unit [e.g., off-site permitted landfill]	Must be treated prior to land disposal as provided in 40 CFR § 268.45(a)(1)–(5) unless EPA determines under 40 CFR § 261.3(f)(2) that the debris no longer contaminated with hazardous waste or the debris is treated to the waste –specific treatment standard provided in 40 CFR 268.40 for the waste contaminating the debris. *NOTE*: Treatment required for hazardous waste debris is expected to be performed at an off-site RCRA permitted facility prior to disposal,	Land disposal, as defined in 40 CFR §268.2, of restricted RCRA–hazardous debris – **applicable**	40 CFR § 268.45(a)
Disposal of *treated hazardous debris* in a land–based unit [e.g., off-site permitted landfill]	Debris treated by one of the specified extraction or destruction technologies on Table 1 of 40 CFR § 268.45 and which no longer exhibits a characteristic is not a hazardous waste and need not be managed in RCRA Subtitle C facility Hazardous debris contaminated with listed waste that is treated by immobilization technology must be managed in a RCRA Subtitle C facility. *NOTE*: Treatment required for hazardous waste debris is expected to be performed at an off-site RCRA permitted facility prior to disposal,	Treated debris contaminated with RCRA listed or characteristic waste – **applicable**	40 CFR § 268.45(c)
Disposal of *hazardous debris treatment residues*	Except as provided in 40 CFR § 268.45(d)(2) and (d)(4), must be separated from debris by simple physical or mechanical means, and such residues are subject to the waste –specific treatment standards for the waste contaminating the debris	Residue from treatment of hazardous debris – **applicable**	40 CFR § 268.45(d)(1)
Disposal of RCRA characteristic wastewaters in an NPDES permitted WWTU	Are not prohibited, if the wastes are managed in a treatment system which subsequently discharges to waters of the U.S. pursuant to a permit issued under § 402 the CWA (i.e., NPDES permitted) unless the wastes are subject to a specified method of treatment other than DEACT in 40 *CFR* § 268.40, or are D003 reactive cyanide. *NOTE:* For purposes of this exclusion, a CERCLA on-site wastewater treatment unit that meets all of the identified CWA ARARs for point source discharges from such a system, is considered a wastewater treatment system that is NPDES permitted.	Land disposal of hazardous wastewaters that are hazardous only because they exhibit a hazardous characteristic and are not otherwise prohibited under 40 CFR Part 268 – **applicable**	40 CFR § 268.1(c)(4)(i)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Groundwater Monitoring Well Installation, Operation, and Abandonment			
Groundwater monitoring well(s) Groundwater Protection	No well shall be located, constructed, operated, or repaired in any manner that may adversely impact the quality of groundwater.	Installation of wells (including temporary wells, monitoring wells) other than for water supply – **applicable**	15A NCAC 02C .0108(a)
	Shall be located, designed, constructed, operated and abandoned with materials and by methods which are compatible with the chemical and physical properties of the contaminants involved, specific site conditions, and specific subsurface conditions.		15A NCAC 02C .0108(c)
Construction of groundwater monitoring well(s)	Monitoring well and recovery well boreholes shall meet the construction requirements set forth in the cited regulations related to: • Borehole depth and connectivity • Packing material, well screen and seals • Grout placement and contents • Well casing and covers • Wellhead protection	Installation of wells (including temporary wells, monitoring wells) and boreholes *other than for water supply* – **applicable**	15A NCAC 02C .0108(d) thru 15A NCAC 02C .0108(p) *Standards of Construction*
	Shall be constructed in such a manner as to preclude the vertical migration of contaminants within and along the borehole channel.	Installation of temporary wells and all other non-water supply wells – **applicable**	15A NCAC 02C .0108(s)
Monitoring well development	Shall be developed such that the level of turbidity or settleable *solids does not preclude accurate chemical analyses of any fluid* samples collected or adversely affect the operation of any pumps or pumping equipment.	Installation of wells (including temporary wells, monitoring wells) other than for water supply – **applicable**	15A NCAC 02C .0108(p)
Maintenance of groundwater monitoring well(s)	Every well shall be maintained by the owner in a condition whereby it will conserve and protect groundwater resources, and whereby it will not be a source or channel of contamination or pollution to the water supply or any aquifer.	Installation of wells (including temporary wells and monitoring wells) other than for water supply – **applicable**	15A NCAC 02C .0112(a)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Abandonment of groundwater monitoring well(s)	Shall be abandoned by filling the entire well up to land surface with grout, dry clay, or material excavated during drilling of the well and then compacted in place; and	Permanent abandonment of wells (including temporary wells, monitoring wells, and test borings) other than for water supply *less than 20 feet in depth* and which do not penetrate the water table – **applicable**	15A NCAC 02C .0113(d)(1)
	Shall be abandoned by completely filling with a bentonite or cement - type grout.	Permanent abandonment of wells (including temporary wells, monitoring wells, and test borings) other than for water supply *greater than 20 feet in depth* and which do not penetrate the water table – **applicable**	15A NCAC 02C .0113(d)(2)
	All wells shall be permanently abandoned in which the casing has not been installed or from which the casing has been removed, prior to removing drilling equipment from the site.	Permanent abandonment of wells (including temporary wells) other than for water supply – **applicable**	15A NCAC 02C .0113(f)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Capping Waste in Place – (Landfill Final Closure and Post-closure Care)			
Landfill closure performance standard (Areas F and G as well as the former RCRA surface impoundments closed as landfills)	Must close the unit in a manner that: • minimizes the need for further maintenance; and • controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post –closure escape of hazardous waste, hazardous constituents, leachate, contaminated run –off, or hazardous waste decomposition products to ground or surface waters or to the atmosphere; and • complies with the relevant closure and post –closure requirements of 40 CFR §264.310.	Closure of a RCRA hazardous waste management unit – **relevant and appropriate**	40 CFR § 264.111(a) – (c) 15A NCAC 13A .0109
Landfill cover design and construction (Areas F and G)	Must cover the landfill or cell with a final cover designed and constructed to: • provide long –term minimization of migration of liquids through the closed landfill; • function with minimum maintenance; • promote drainage and minimize erosion or abrasion of the cover; • accommodate settling and subsidence so that the cover's integrity is maintained; and • have a permeability less than or equal to the permeability of any bottom liner system or natural sub-soils present.	Closure of a RCRA hazardous waste management unit – **relevant and appropriate**	40 CFR § 264.310(a)(1)–(5) 15A NCAC 13A .0109

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Landfill cover design and construction (Areas F and G)	Describes a design for landfill covers that will meet the requirements of RCRA regulations. Multilayered system consisting, from the top down, of: • a top layer of at least 60 cm of soil, either vegetated or armored at the surface; • a granular or geo-synthetic drainage layer with a hydraulic transmissivity no less than 3 x 10"5 cm /sec; and • a two-component low permeability layer comprised of (1) a flexible membrane liner installed directly on (2) a compacted soil component with an hydraulic conductivity no greater than 1 x 10~7 cm/sec. Optional layers may be added, e.g., a biotic barrier layer or a gas vent layer, depending on the nature of the wastes being covered.	Construction of a RCRA hazardous waste landfill final cover – **TBC**	*EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments,* EPA OSWER 530–SW–89–047, (July 1989)
Run–on/run–off control systems for landfill cover (Areas F and G)	Run–on control system must be capable of preventing flow onto the active portion of the landfill during peak discharge from a 25–year storm event.	Construction of a RCRA hazardous waste landfill cover – **relevant and appropriate**	40 CFR § 264.301(g) 15A NCAC 13A .0109
	Run–off management system must be able to collect and control the water volume from a runoff resulting from a 24–hour, 25–year storm event.		40 CFR § 264.301(h) 15A NCAC 13A .0109
Protection of closed RCRA hazardous waste landfill (Areas F and G as well as the former RCRA surface impoundments closed as landfills)	Post–closure use of property must never be allowed to disturb the integrity of the final cover, liners, or any other components of the containment system or the facility's monitoring system unless necessary to reduce a threat to human health or the environment.	Closure of a RCRA hazardous waste landfill – **relevant and appropriate**	40 CFR § 264.117(c) 15A NCAC 13A .0109

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
General post–closure care for closed RCRA hazardous waste landfill (Areas F and G as well as the former RCRA surface impoundments closed as landfills)	Owner or operator must: • maintain the effectiveness and integrity of the final cover including making repairs to the cap as necessary to correct effects of settling, erosion, etc.; • maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of RCRA Subpart F of this part; • prevent run–on and run–off from eroding or otherwise damaging final cover; and • protect and maintain surveyed benchmarks used to locate waste cells. *NOTE:* Groundwater detection monitoring in accordance with 40 CFR 264.98 will be continued for the SWDS only. Monitoring requirements will be specified in a CERCLA Remedial Design or Remedial Action Work Plan.	Closure of a RCRA hazardous waste landfill – **relevant and appropriate**	40 CFR § 264.310(b)(1), (4), (5) and (6) 15A NCAC 13A .0109
Solid Waste Landfill cover design and construction (capping upland soil contamination)	Shall install a cap system that is designed to minimize infiltration and erosion. The cap system shall be designed and constructed to: (A) Have a permeability less than or equal to the permeability of any base liner system or the in-situ subsoils underlaying the landfill, or the permeability specified for the final cover in the *effective permit, or a permeability no greater than* 1 x 10-5 cm/sec, whichever is less; (B) Minimize infiltration through the closed MSWLF by the use of a low-permeability barrier that contains a minimum 18 inches of earthen material; and (C) Minimize erosion of the cap system and protect the low-permeability barrier from root penetration by use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.	Closure of a solid waste landfill (MSWLF) – **relevant and appropriate**	15A NCAC 13B .1627(c)(1)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Solid Waste Landfill cover design and construction (capping upland soil contamination)	The Division may approve an alternative cap system if the owner or operator can adequately demonstrate the following: (A) The alternative cap system will achieve an equivalent or greater reduction in infiltration as the low-permeability barrier specified in Subparagraph (1) of this Paragraph; and (B) The erosion layer will provide equivalent or improved protection as the erosion layer specified in Subparagraph (3) of this Paragraph. *NOTE:* In the event an alternative cover is sought, approval will be documented in a CERCLA decision document and NCDEQ concurrence obtained.	Closure of a solid waste landfill (MSWLF) – **relevant and appropriate**	15A NCAC 13B .1627(c)(2)
General post–closure care for closed Solid Waste Landfill	Maintaining the integrity and effectiveness of any cap system, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cap system.	Closure of a solid waste landfill (MSWLF) – **relevant and appropriate**	15A NCAC 13B .1627(d)(1)(A)
Treatment/Disposal of PCB waste (including PCB remediation waste and leachate)			
Disposal of decontamination waste and residues	Such waste shall be disposed of at their existing PCB concentration unless otherwise specified in 40 CFR § 761.79(g)(1) – (6).	Decontamination waste and residues – **applicable**	40 CFR § 761.79(g)
	Are regulated for disposal as PCB remediation waste.	Distillation bottoms or residues and filter media – **applicable**	40 CFR § 761.79(g)(1)
	Are regulated for disposal at their original concentration.	PCBs physically separated from regulated waste during decontamination, other than distillation bottoms and filter media – **applicable**	40 CFR § 761.79(g)(2)
	Shall be disposed of in accordance with provisions for wastes from cleanup of PCB remediation waste at 40 CFR § 761.61(a)(5)(v).	Non-liquid cleaning materials and PPE at any concentration PCBs, including non-porous surfaces and other non-liquid materials (e.g., rags, gloves, booties) resulting from decontamination – **applicable**	40 CFR § 761.79(g)(6)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Disposal of PCB contaminated precipitation, condensation, and leachate	May be disposed in a chemical waste landfill which complies with 40 CFR § 761.75 if: • disposal does not violate 40 CFR § 268.32(a) or § 268.42(a)(1); • liquids do not exceed 500 ppm PCB and are not an ignitable waste as described in 40 CFR § 761.75(b)(8)(iii).	PCB liquids at concentrations ≥ 50 ppm and ≤ 500 ppm from incidental sources such as precipitation, condensation, leachate or load separation and associated with PCB Articles or non-liquid PCB wastes – **applicable**	40 CFR § 761.60(a)(3) 40 CFR § 761.60(a)(3)(i) and (ii)
Disposal of PCB contaminated porous surfaces (self-implementing option)	Shall be disposed on-site or off-site as bulk PCB remediation waste according to 40 CFR 761.61(a)(5)(i) or decontaminated for use according to 40 CFR 761.79(b)(4).	PCB remediation waste *porous surfaces* (as defined in 40 CFR 761.3) – **relevant and appropriate**	40 CFR § 761.61(a)(5)(iii)
Disposal liquid PCB remediation waste (self-implementing option)	Shall either: • decontaminate the waste to the levels specified in 40 CFR 761.79(b)(1) or (2); or • dispose of the waste in accordance with 40 CFR 761.61(b) or a risk-based approval under 40 CFR 761.61(c).	Liquid PCB remediation waste (as defined in 40 CFR 761.3) – **relevant and appropriate**	40 CFR § 761.61(a)(5)(iv) 40 CFR § 761.61(a)(5)(iv)(A) and (B)
Disposal of PCB contaminated non-porous surfaces on-site (self- implementing option)	Shall be cleaned on-site or off-site to levels in 40 CFR 761.61(a)(4)(ii) using: • decontamination procedures under 40 CFR 761.79; • technologies approved under 40 CFR 761.60(e); or • risk-based procedures/technologies under 40 CFR 761.61(c).	PCB remediation waste *non-porous surfaces* (as defined in 40 CFR 761.3) – **relevant and appropriate**	40 CFR § 761.61(a)(5)(ii)(A)(*1*)-(*3*)
Disposal of bulk PCB remediation waste off-site (self-implementing option)	May be sent off-site for decontamination or disposal provided the waste is either dewatered on-site or transported off-site in containers meeting the requirements of DOT HMR at 49 CFR parts 171-180.	Generation of bulk PCB remediation waste (as defined in 40 CFR 761.3) for disposal – **relevant and appropriate**	40 CFR § 761.61(a)(5)(i)(B)
	Shall be disposed of in accordance with the provisions for Cleanup wastes at 40 CFR 761.61(a)(5)(v)(A).	Bulk PCB remediation waste which has been de-watered and with a PCB concentration < 50 ppm – **relevant and appropriate**	40 CFR § 761.61(a)(5)(i)(B)(2)*(ii)*

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Disposal of bulk PCB remediation waste off-site (self-implementing option)	Shall be disposed of: • in a hazardous waste landfill permitted by EPA under §3004 of RCRA; • in a hazardous waste landfill permitted by a State authorized under §3006 of RCRA; or • in a PCB disposal facility approved under 40 CFR 761.60.	Bulk PCB remediation waste which has been de-watered and with a PCB concentration ≥ 50 ppm – **relevant and appropriate**	40 CFR § 761.61(a)(5)(i)(B)(2)*(iii)*
Performance-based disposal of PCB remediation waste	Shall dispose by one of the following methods: • in a high-temperature incinerator approved under 40 CFR 761.70(b); • by an alternate disposal method approved under 40 CFR 761.60(e); • in a chemical waste landfill approved under 40 CFR 761.75; • in a facility with a coordinated approval issued under 40 CFR 761.77; or • through decontamination in accordance with 40 CFR 761.79. *NOTE*: On-site TSCA chemical waste landfill that complies with the ARARs identified in this table in the signed ROD would be considered an approved landfill.	Disposal of non-liquid PCB remediation waste (as defined in 40 CFR 761.3) – **relevant and appropriate**	40 CFR § 761.61(b)(2) 40 CFR § 761.61(b)(2)(i) 40 CFR § 761.61(b)(2)(ii)
	Shall be disposed according to 40 CFR 761.60(a) or (e), or decontaminate in accordance with 40 CFR 761.79.	Disposal of liquid PCB remediation waste – **relevant and appropriate**	40 CFR § 761.61(b)(1)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Risk-based disposal of PCB remediation waste	May sample, cleanup or dispose of PCB remediation waste in a manner other than prescribed in 40 CFR 761.61(a) or (b) or store remediation waste in a manner other than prescribed in 40 CFR § 761.65 if application approved in writing by EPA Regional Administrator and EPA finds that the method will not pose an unreasonable risk of injury to [sic] human health or the environment. Each application must include information described in 40 CFR § 761.61(a)(3). *NOTE*: Appropriate information required in an application can be provided in a CERCLA document (e.g. FS, PP, or ROD) that is approved or issued by EPA.	Disposal of PCB remediation waste – **relevant and appropriate**	40 CFR § 761.61(c)
Disposal of PCB cleanup wastes (e.g., PPE, rags, non-liquid cleaning materials) (self-implementing option)	Shall be disposed of either: • in a facility permitted, licensed or registered by a State to manage municipal solid waste under 40 CFR 258 or non-municipal, non-hazardous waste subject to 40 CFR 257.5 thru 257.30; or • in a RCRA Subtitle C landfill permitted by a State to accept PCB waste; or • in an approved PCB disposal facility; or • through decontamination under 40 CFR 761.79(b) or (c). *NOTE*: On-site TSCA chemical waste landfill that complies with the ARARs identified in this table in the signed ROD would be considered an approved PCB disposal facility.	Generation of non-liquid PCBs at any concentration during and from the cleanup of PCB remediation waste – **relevant and appropriate**	40 CFR § 761.61(a)(5)(v)(A)(*1*)-(*4*)
Disposal of PCB cleaning solvents, abrasives, and equipment (self-implementing option)	May be reused after decontamination in accordance with 40 CFR § 761.79; or For liquids, disposed in accordance with 40 CFR 761.60(a).	Generation of PCB wastes from the cleanup of PCB remediation waste – **relevant and appropriate**	40 CFR § 761.61(a)(5)(v)(B) 40 CFR § 761.60(b)(1)(i)(B)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
TSCA Chemical Waste Landfill Design and Operation			
Synthetic liner for a TSCA chemical waste landfill	Synthetic membrane liners shall be used when, in the judgment of the Regional Administrator, the hydrologic or geologic conditions at the landfill require such a liner in order to provide at least a permeability equivalent to the soils in paragraph (b)(1) of this section. Whenever a synthetic liner is used at a landfill site, special precautions shall be taken to insure that its integrity is maintained and that it is chemically compatible with PCBs. Adequate soil underlining and cover shall be provided to prevent excessive stress on the liner and to prevent rupture of the liner. The liner must have a minimum thickness of 30 mils.	Construction of a TSCA chemical waste landfill – **applicable**	40 CFR § 761.75(b)(2)
Surface water and Groundwater monitoring for TSCA chemical landfill	For all sites receiving PCBs, the ground and surface water from the disposal site area shall be sampled prior to commencing operations under an approval provided in paragraph (c) of this section for use as baseline data.	Construction of a TSCA chemical waste landfill – **applicable**	40 CFR § 761.75 (b)(6)(i)(A)
Surface water	Any surface watercourse designated by the Regional Administrator using the authority provided in paragraph(c)(3)(ii) of this section shall be sampled at least monthly when the landfill is being used for disposal operations.	Operation of TSCA chemical waste landfill monitoring program – **applicable**	40 CFR § 761.75(b)(6)(i)(B)
	Any surface watercourse designated by the Regional Administrator using the authority provided in paragraph (c)(3)(ii) of this section shall be sampled for a time period specified by the Regional Administrator on a frequency of no less than once every six months after final closure of the disposal area.		40 CFR § 761.75(b)(6)(i)(C)
Groundwater monitoring for TSCA chemical landfill	If underlying earth materials are homogenous, impermeable, and uniformly sloping in one direction, only three sampling points shall be necessary. These three points shall be equally spaced on a line through the center of the disposal area and extending from the area of highest water table elevation to the area of the lowest water table elevation.	Operation of TSCA chemical waste landfill groundwater monitoring program – **applicable**	40 CFR § 761.75(b)(6)(ii)(A)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Groundwater monitoring wells	All monitor wells shall be cased and the annular space between the monitor zone (zone of saturation) and the surface shall be completely backfilled with Portland cement or an equivalent material and plugged with Portland cement to effectively prevent percolation of surface water into the well bore. The well opening at the surface shall have a removable cap to provide access and to prevent entrance of rainfall or storm water runoff. The groundwater monitoring well shall be pumped before obtaining a sample for analysis to remove the volume of liquid initially contained in the well. The discharge shall be treated to meet applicable state or federal standards or recycled to the chemical waste landfill.		40 CFR § 761.75(b)(6)(ii)(B)
Water analysis requirements	As a minimum, all samples [groundwater and surface water] shall be analyzed for the following parameters: PCBs, pH, specific conductance, chlorinated organics and all data and records of the sampling and analysis shall be maintained as required in § 761.180(d)(1). Sampling methods and analytical procedures for these parameters shall comply with those specified in 40 *CFR* Part 136, as amended in 41 *Federal Register* 52779 on December 1, 1976.	Operation of TSCA chemical waste landfill groundwater monitoring program – **applicable**	40 CFR § 761.75 (b)(6)(iii)
Leachate collection system for TSCA landfill	A leachate collection monitoring system shall be installed above the chemical waste landfill. Leachate collection systems shall be monitored monthly for quantity and physicochemical characteristics of leachate produced. The leachate should be either treated to acceptable limits for discharge in accordance with a State or Federal permit or disposed of by another State or Federally approved method. Water analysis shall be conducted as provided in 40 *CFR* § 761.75(b)(6)(iii). Acceptable leachate monitoring/collection systems shall be any of the following designs, unless a waiver is obtained pursuant to paragraph (c)(4) of this section. *NOTE*: Leachate monitoring, including sampling and analysis will be conducted in accordance with parameters established in an EPA approved Long-term Monitoring Program document that incorporates the ARARs listed in this table.	Construction of a TSCA chemical waste landfill – **applicable**	40 CFR § 761.75(b)(7)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Simple leachate collection	This system consists of a gravity flow drainfield installed above the waste disposal unit liner. This design is recommended for use when semi-solid or leachable solid wastes are placed in a lined pit excavated into a relatively thick, unsaturated, homogenous layer of low permeability soil.	Construction of a TSCA chemical waste landfill – **applicable**	40 CFR § 761.75(b)(7)(i)
Compound leachate collection	A compound leachate collection system consists of a gravity flow drainfield installed above the waste disposal unit liner and above a secondary installed liner.		40 CFR § 761.75(b)(7)(ii)
TSCA chemical waste landfill operations	*Shall be placed in manner that will prevent damage to* containers or articles. Other wastes that are not chemically compatible with PCBs shall be segregated from the PCBs throughout the handling and disposal process.	*Disposal of PCBs or PCB Items in chemical* waste landfill – **applicable**	40 CFR § 761.75(b)(8)(i)
	An operation plan shall be developed and submitted to the Regional Administrator for approval as required in paragraph (c) of this section. This plan shall include detailed explanations of the procedures to be used for recordkeeping, surface water handling procedures, excavation and backfilling, waste segregation burial coordinates, vehicle and equipment movement, use of roadways, leachate collection systems, sampling and monitoring procedures, monitoring wells, environmental emergency contingency plans, and security measures to protect against vandalism and unauthorized waste placements. *NOTE*: Contents of the operation plan will be provided in a CERCLA Remedial Design and/or Remedial Action Work Plan.	Disposal of PCBs or PCB Items in chemical waste landfill – **applicable**	40 CFR § 761.75(b)(8)(ii)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
TSCA chemical waste landfill operations con't	Bulk liquids not exceeding 500ppm PCBs may be disposed of provided such waste is pretreated and/or stabilized (e.g., chemically fixed, evaporated, mixed with dry inert absorbent) to reduce its liquid content or increase its solid content so that a non-flowing consistency is achieved to eliminate the presence of free liquids prior to final disposal. Container of liquid PCBs with a concentration between 50 and 500 ppm PCB may be disposed of if each container is surrounded by an amount of inert sorbent material capable of absorbing all of the liquid contents of the container.	Disposal of dispose of liquid wastes containing between 50 ppm and 500 ppm PCB in chemical waste landfill – **applicable**	40 CFR § 761.75(b)(8)(ii)
Support facilities	A 6 ft. woven mesh fence, wall, or similar device shall be placed around the site to prevent unauthorized persons and animals from entering.	Construction of a TSCA chemical waste landfill – **applicable**	40 CFR § 761.75(b)(9)(i)
	Roads shall be maintained to and within the site that are adequate to support the operation and maintenance of the site without causing safety or nuisance problems or hazardous conditions.		40 CFR § 761.75(b)(9)(ii)
Wind dispersal control system	The site shall be operated and maintained in a manner to prevent safety problems or hazardous conditions resulting from spilled liquids and windblown materials.		40 CFR § 761.75(b)(9)(iii)

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Decontamination/Cleanup of PCB Waste			
Decontamination of PCB contaminated water	For discharge to a treatment works as defined in 40 CFR § 503.9 (aa), or discharge to navigable waters, meet standard of < 3 ppb PCBs; or For unrestricted use, meet standard of ≤ 0.5 ppb PCBs.	Water containing PCBs regulated for disposal – **applicable**	40 CFR § 761.79(b)(1)(ii) 40 CFR § 761.79(b)(1)(iii)
Decontamination of movable equipment contaminated by PCBs (self-implementing option)	May decontaminate by: • swabbing surfaces that have contacted PCBs with a solvent; • a *double wash/rinse* as defined in 40 CFR 761.360-378; or • another applicable decontamination procedure under 40 CFR § 761.79.	Movable equipment contaminated by PCBs and used in storage areas, tools and sampling equipment – **relevant and appropriate**	40 CFR § 761.79(c)(2)
Transportation of Wastes – Primary and Secondary			
Transportation of PCB wastes off-site	Must comply with the manifesting provisions at 40 CFR § 761.207 through § 761.218.	Relinquishment of control over PCB wastes by transporting, or offering for transport – **applicable**	40 CFR § 761.207(a)
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMTA and DOT HMR at 49 CFR §§ 171-180.	Any person who, , transports "in commerce," or causes to be transported or shipped, a hazardous material, including each person performing pre-transportation functions under contract with any department, agency, or instrumentality of the executive, legislative, or judicial branch of the Federal government – **applicable**	49 CFR § 171.1(b) and (c)
Transportation of hazardous waste *off site*	Must comply with the generator requirements of 40 CFR Sect. 262.20–23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding and Sect. 262.40, 262.41(a) for record keeping requirements and Sect. 262.12 to obtain EPA ID number.	Preparation and initiation of shipment of RCRA hazardous waste off-site – **applicable**	40 CFR § 262.10(h) 15A NCAC 13A .0108

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Transportation of hazardous waste *on–site*	The generator manifesting requirements of 40 CFR Sections 262.20–262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR § 263.30 and § 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right–of–way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way – **applicable**	40 CFR § 262.20(f) 15A NCAC 13A .0108
Management of samples (i.e., contaminated soils and wastewaters)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: • The sample is being transported to a laboratory for the purpose of testing; • The sample is being transported back to the sample collector after testing; and • The sample collector ships samples to a laboratory in compliance with U.S.DOT, U.S. Postal Service, or any other applicable shipping requirements, including packing the sample so that it does not leak, spill or vaporize from its packaging.	Generation of samples of hazardous waste for purpose of conducting testing to determine its characteristics or composition – **applicable**	40 CFR § 261.4(d)(1)(i) and (ii) 15A NCAC 13A .0108 40 CFR § 261.4(d)(2) 15A NCAC 13A .0108

Table A-3. Action-Specific ARARs and TBCs
for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
Institutional Controls			
Post-closure notices (former RCRA surface impoundments closed as landfill)	Must record, in accordance with State law, a notation on the deed to the facility property, or on some other instrument which is normally examined during a title search, that will in perpetuity notify any potential purchaser of the property that: • Land has been used to manage hazardous wastes; • Its use is restricted under 40 *CFR* Part 264 Subpart G regulations; and The survey plat and record of the type, location, and quantity of hazardous wastes disposed within each cell or other hazardous waste disposal unit of the facility required by Sections 264.116 and 264.119(a) have been filed with the local zoning authority and with the EPA Regional Administrator.	Closure of a RCRA hazardous waste landfill – **applicable**	40 CFR § 264.119(b)(1)(i)-(iii) 15A NCAC 13A .0109
Notice of Contaminated Site	Prepare and certify by professional land surveyor a survey plat which identifies contaminated areas which shall be entitled "NOTICE OF CONTAMINATED SITE". Notice shall include a legal description of the site that would be sufficient as a description in an instrument of conveyance and meet the requirements of N.C.G.S. 47-30 for maps and plans.	Contaminated site subject to current or future use restrictions included in a remedial action plan as provided in N.C.G.S. 143B-279.9(a) – **TBC**	N.C.G.S. 143B-279.10(a)
	The Survey plat shall identify: • the location and dimensions of any disposal areas and areas of potential environmental concern with respect to permanently surveyed benchmarks; • the type location, and quantity of contamination known to exist on the site; and • any use restriction on the current or future use of the site.		N.C.G.S. 143B-279.10(a)(1)-(3)
Notice of Contaminated Site con't	Notice (survey plat) shall be filed in the register of deeds office in the county which the site is located in the grantor index under the name of the owner.		N.C.G.S. 143B-279.10(b) and (c)

Table A-3. Action-Specific ARARs and TBCs for LCP Holtrachem Superfund Site Riegelwood, North Carolina

Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation(s)**
	The deed or other instrument of transfer shall contain in the description section, in no smaller type than used in the body of the deed or instrument, a statement that the property is a contaminated site and reference by book and page to the recordation of the Notice.	Contaminated site subject to current or future use restrictions as provided in N.C.G.S. 143B-279.9(a) that is to sold, leased, conveyed or transferred — **TBC**	N.C.G.S. 143B-279.10(e)

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
CWA = Clean Water Act of 1972
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
HMR = Hazardous Materials Regulations
HMTA = Hazardous Materials Transportation Act
MSWF = Municipal solid waste landfill
NCAC = *North Carolina Administrative Code*
N.C.G.S. = North Carolina General Statutes
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl
POTW = Publicly Owned treatment Works
PPE = personal protective equipment
RCRA = Resource Conservation and Recovery Act of 1976
SWDS = Solid waste Disposal Site
TBC = to be considered
TSCA = Toxic Substances Control Act of 1976
U.S. = United States
UTS = Universal Treatment Standard
WWTU = waste water treatment unit
> = greater than
< = less than
≥ = greater than or equal to
≤ = less than or equal to

APPENDIX B
TRANSCRIPT FROM PROPOSED PLAN PUBLIC MEETING

Deposition of

Date: August 23, 2016
Volume: I

Case: IMO: Holtrachem Site, Riegelwood, NC

Aurelia Ruffin _ Associates, Inc.
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U.S. ENVIRONMENTAL PROTECTION AGENCY

HOLTRACHEM SITE

RIEGELWOOD, NORTH CAROLINA

PUBLIC MEETING TO DISCUSS THE PROPOSED)
HOLTRACHEM SITE CLEANUP PLAN)
RIEGELWOOD, NC)

REPORTED BY:

TAMARA A. VIOLETTE, Notary Public and Court Reporter

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DATE REPORTED: August 23, 2016

LOCATION: Riegelwood, N.C.

APPEARANCES

For the EPA: SAMANTHA URQUHART-FOSTER
RONALD TOLLIVER
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61 Forsyth Street, SW
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(The Hearing commenced at 7:15 p.m.)

MR. TOLLIVER: Good evening, everyone. Welcome to our proposed plan meeting, and I do want to thank you all for coming out, and I do want to say I really, really enjoy being here in Wilmington. Very nice, very pleasant place. But we're going to get ready to get started with a proposed plan presentation with our project manager here, Samantha Foster. So with our -- the purpose of this meeting is to really highlight our plan for clean up in the Holtrachem site.

So we want to make sure you guys understand where we're coming from so we can get some input also from community members as well. This is really an important time, kind of get the ball rolling and get things started with the clean up and also reuse of the site.

Samantha, the first slide here is from The Superfund Process, and I'm sure most of you are familiar with it, but we start out with kind of like the site investigation phase is in the beginning, down there at the bottom; and then we move on -- once you investigate a site you move on to listing it on the National Priorities List. That way it can get funded.

Then from there we move onto our remedial investigation. So we investigate the feasibility study, seeing what all the resources that it's going to take to actually clean it up to come up with the best plan to -- plan of action, basically. That's where we're at now, we're at a plan of action, or proposed plan. We want to propose it to the community, and get some input and see how it will impact the community and get some input or comments so that we can take into consideration before we move onto our record of decision; kind of like a finalizing document that says, okay, this is what EPA is going to be responsible in doing to clean up this site here, Holtrachem.

So the rest of it will go into -- and Samantha is going to really describe this, the options that she went through, and also the one that we're going to recommend for this site. So Samantha, do you want to just kind of explain it?

MS. URQUHART-FOSTER: Hi, I'm Samantha Urquhart-Foster for those of you that I haven't met yet. I'm a remedial project manager for the EPA, particularly for this site. We have got a huge team of people that are working with us on this project, but the people that we have here tonight are myself; Ron Tolliver, Community

Involvement Coordinator; I have Dave Mattison with North Carolina; Prashant Gupta with Honeywell; Cynthia Draper and Walker Jones with Amec; and we have got a whole team of people back in the office that weren't able to come here tonite.

The site itself is located in Riegelwood. From where we are now it's -- you shoot down through IP. You have to drive through IP to get there. It's surrounded by International Paper with the Cape Fear River on the other border. The facility was developed in 1963, I believe, and was constructed; they prepared -- manufactured, it was chlor-alkali facility. They manufactured hydrochloric acid, chlorine dioxide and other chemicals to give to IP as well as just to sell to other facilities. It operated until 2000.

EPA has been involved with the site since 1999. Before that, North Carolina RCRO was involved with the project. In 1999 Hurricane Floyd came through and the EPA provided emergency response activities and then the facility stopped operation in 2000. EPA came in and oversaw the removal action that Honeywell's conducting in 2003 and 2004 then, again, in 2008 there was another removal that was done.

Hurricane Floyd came in and there were about 24 inches of rain that fell in that process and it caused the -- a breach of the stormwater retention basin. So the water that was contained on-site breached out of the basin and spilled into the Cape Fear River. It was about 2.2 million gallons of water that was released and a had a small amount of mercury in it.

Then in 2003 and 2004 EPA oversaw the removal action that Honeywell and their contractors did. They tore down the former mercury cell building, they containerized all the waste that was on-site and transported it off-site. There was, we were told, about 4 million pounds of waste that was removed from the site. There was about 34,000 pounds of mercury, a lot of scrap metal; brass, mercury, copper, titanium, as well as other hazardous materials that were transported off-site. So the majority of waste that was at the site has already been removed. What we're dealing with now is residual.

In 2008 we learned that back historically the waste water that was at Holtrachem was transferred to International Paper for treatment before it was disposed or released. International Paper did some sampling in the lagoon where they wanted to build another landfill cell in and it was found it was contaminated with PCBs. So after they discovered that and let us know, there was a removal action that was done and about 24,000 cubic yards of mercury -- I'm sorry, PCB contaminated soil, sludge was transferred over to the Holtrachem site for storage until we could get to their clean up plan.

The site has been divided in, like, three areas. There's an upland process area, upland nonprocess area and wooded bottomland area. The green is the bottomland area which borders the Cape Fear River. Yellow is a processing area and orange is the nonprocessing area.

So the scope and role to the remedial action is going to address any remaining contamination at the site. Groundwater is contaminated but it's not of usable -- it's not usable. So, I mean, our primarily -- our primary concern is to address the contaminated soil, sediment, surface water and we're going to do groundwater monitoring.

The main risk at the site; land use is currently industrial. We see it being industrial in the future. To get there you have to drive through International Paper. So we don't see any residential use in the future. It will either be industrial or wildlife habitat. Groundwater use hadn't -- I mean, groundwater hasn't been used at the site ever. Groundwater has been -- drinking water's been provided by International Paper in the past and we see that proceeding into the future.

The exposed populations are industrial workers, trespassers and wildlife. The human health risk associated with the site include industrial work, construction workers or trespassers onto the project. The site is fenced on three sides. You can only get there is to drive through International Paper and then the site's fenced. It's got people on-site managing the property. The only nonfenced side is on the Cape Fear River and there's a huge drop off between the site and the river. So it's like somebody decided to drive their boat up and come up is really the only way they could get access to it.

For the ecological risks, we did an ecological risk assessment. We found the primary receptors that were at harm were the green, Blue Heron, the Carolina Red and amphibian and micro invertebrates, based on toxicity testing.

This is the conceptual site model. The areas in purple are the areas that are primarily contaminated with mercury and PCBs. And as you can see, some of the buildings that are shown in purple. So this building here by the arrow in purple no longer exists. It was the former mercury cell building. That's been dismantled. The rest of the contamination are the areas in purple.

So our remedial action objectives are primarily cleaning up the site so it's safe for human -- human use and wildlife. The main contaminants are mercury and Araclor 1268 which is a PCB.

We developed remediation goals based on human health and ecological risk assessments. So we came out with these clean up levels. We had concentrations of PCBs or Araclor 1268, for example, in the upland area up to 2700 micrograms per kilogram. We're proposing 11 milligrams per kilogram, so clean up level. We have other mercury clean up level we're proposing is 536 and that's all based on risk assessments, assuming that it's going to be industrial use at the site.

The wooded bottomland area is slightly different. That area there's a lot of wildlife down there; and our goal is to protect the wildlife in that area. So we have lower clean up goals for that. In the wooded bottomland area, for example, we have 3 milligrams per kilogram to clean up for mercury versus 500 something in the upland area.

During the feasibility study of this process the contractors consulted and they looked at different areas and different alternatives and came up with 6 different alternatives for the majority of the site, and I'm just going to hit on the key ones. Our preferred remedy is Alternative 3 and the rest of the alternatives are included in the proposed plan. I don't know if you have a copy of that. If you don't we can give one to you.

So the 6 alternatives for the soil and sediment for the majority of the site include no action, which we have to do as a matter of the National Contingency Plan requires us to look at no action. That's obviously not going to be for this site because of the contamination of the site and that we're not comfortable with.

Alternative 2 is capping with limited excavation with off-site disposal or on-site treatment. Institutional controls and engineering controls.

Alternative 3, which is our preferred remedy, is a combination of capping, excavation, on-site disposal and institutional controls; and A4 is similar but it's, you know, different areas of capping.

A5, excavation and on-site disposal. A6 is excavation with off-site disposal. I'll go into a little more detail in each of these.

There are two areas at the site which are different than everyone else, F and G; and those have separate alternatives. There's no action for A1 or S1, which we don't agree with. Our preferred alternative is S3, which is capping within in-situ stabilization, solidification and capping and ICs, Institution Controls.

So the common elements, all 6 of the alternatives include capping and erosion control along the berm in the upland nonprocess area. There's one area that needs to be capped. They all include clean out and closing stormwater conveyance system, dewatering and off-site disposal of the materials from the stormwater system; decommissioning the stormwater treatment system; operation and maintenance is substantially controls, engineering controls and five year reviews.

Again, we looked at 6 alternatives. I'm just going to list or show us the one for what we propose. You can -- but I have got other slides if you want to see what the other alternatives are. What we're proposing doing is Alternative A3 and that includes excavation and capping as well as containing the waste, any excavated waste on-site into a landfill. The plan is to create a chemical waste landfill on-site that's going to be equivalent with the commercial chemical waste landfill. It includes excavating about 15,000 cubic yards of contaminated soil, as well as disposing of 39,000 cubic yards of contaminated soil, sludges into the landfill. It will take about ten -- two years to complete and about 13.3 million dollars.

For the more contaminated areas where the former mercury cell building was here at area G, we don't have a lot of data for that cell. Right now there is a top material on top of it and we're planning on capping it and solidifying the waste in place. As well, in area F where it was the former mercury cell building.

I might have that backwards. I'm sorry, F is where the retort pad area was and G is the former mercury cell building.

So to solidify that waste in place and cap it is gonna be about 2.9 million dollars and take about a year or two. Again, we looked at 6 different alternatives for the upland area and four different areas for F and G and we -- in the National Contingency Plan we're supposed to look at 9 different criteria; and there's a trade off of which alternatives are better than others. And so Alternative 1 is no action. That's not good for any of us.

So, again, our preferred alternative is to excavate the contaminated area, the wooded bottomland areas; bring it up; construct an on-site chemical waste landfill; put the contamination from the wooded bottomland areas, as well as the soil that was excavated from International Paper, and put it into their chemical waste landfill on-site.

This is kind of a conceptual drawing of the actual location, and the area may change during the remedial design; but this is kind of a conceptual idea of what we are planning on doing.

Community participation; we have established an information repository at the public library just across the street, and we're accepting public comments on this until September 14th. So you probably just got a flyer in the mail, which is like a two page summary. If you want to see much more about the project, what's involved as far as the feasibility study and the full proposed plan, it's available in the library if you want to look at it. We're accepting comments here tonite or you can Email them to me or send them through regular mail.

David Mattison is here with North Carolina and part of the nine criteria in the National Contingency Plan is State acceptance.

MR. MATTISON: The State has concurred with the proposed clean up plan.

MS. URQUHART-FOSTER: There are other community involvement activities that we have in the Superfund process. I'll let Ron speak to the groups, they can form and request a technical assistance grant to hire technical consultants to explain things better to the community if community members have difficulty understanding the technical content. Again, we have got the public record or the majority of the documents that are gonna be supporting this decision are in the library.

MR. TOLLIVER: Any questions? Y'all have any questions, would you please say the question and just state your name for the reporter and if you represent an organization just let us know.

MS. SORG: I'm Lisa Sorg, S-o-r-g. I'm from NC Policy Watch in Raleigh. I'm a reporter, and I had a question about surface water in the Cape Fear and fish. You know, is there a fish advisory? I'm wondering if there's sediment issues in the Cape Fear outside the scope of this, or how would that be addressed, if at all?

MS. URQUHART-FOSTER: Yeah, there are fish advisories from the Cape Fear and we did collect sediment and surface water sampling, but we found that the contamination that's in the river isn't coming from the site. There is existing fish advisories, though.

MR. MATTISON: I believe the fish advisory is for essentially everything east of 95. But that's not site related.

MS. SORG: Okay, got you.

MR. TOLLIVER: Anyone else?

MS. SORG: I think in the documents, maybe it was in one of the documents I read, there was a pipeline. Where is that pipeline located? Is it still in existence? Does it go, like, under --

MS. URQUHART-FOSTER: Are you talking about the pipe that went from Holtrachem to IP?

MS. SORG: I think that's it. It did some kind of discharge.

MS. URQUHART-FOSTER: That was excavated in 2008 when we did the clean up at International Paper. I don't know if we actually found the pipe. I know --

MR. GUPTA: Remnants of it.

MS. SORG: Were there any problems when the tornado hit? Of course, you guys remember Hurricane Floyd did a lot of damage, but the tornado, it wasn't that far from here. That didn't have any effect at all?

MS. URQUHART-FOSTER: Well, the facility has an ongoing Emergency Response Plan in place. So anytime they know there's going to be a hurricane coming or tornado we gear into action to prepare for that. There's been minor damage throughout the years, but it's all been proactively contained.

MS. SORG: I just have a couple more questions and that was, how close on the landfill, since it's going to be getting -- well possible waiver, how close to the groundwater is that landfill? Can you tell me, like, from the bottom of the landfill to kind of the water table, how far that is?

MS. URQUHART-FOSTER: The water table at the site is about ten feet deep, but that water at that level is not usable. It's not usable for drinking purposes. So they're going to put in a bottom drainage system and liner to get to meet the equivalent for the TSCO Waiver.

MS. SORG: And the only thing -- maybe this is -- did anyone ever follow the workers? When I was looking at the library today there were, I know, some workers back in the late 90s had high levels or abnormal levels of mercury in their urine. Was there any kind of study of -- health study for anybody?

MS. URQUHART-FOSTER: I know there was a lawsuit. I don't know beyond that. I could ask our ATSDR, Agency for Toxic Substances and Disease to follow-up on that.

MS. SORG: Okay, great. Thank you.

MR. TOLLIVER: That the last question?

MS. FAIL: My name is Kim Fail. I'm with International Paper. I had two questions. One of which I have already asked of Walker, but we'd like to understand the amount of leachate that's going to be generated from the site and how it will be disposed of. So that's one question that we had and I think he answered it for me.

MS. URQUHART-FOSTER: Good, because I can't answer that. He may know.

MR. JONES: My name is Walker Jones. We don't anticipate a significant amount of leachate from the landfill. The bulk of it's going to be sort of -- should be some saturation of soils, but we think we can manage that without waste water treatment. So it will be more of a collection than haul it off-site for disposal.

MS. FAIL: And my second question was about the -- I know there was an underground drainage system proposed as well, potentially proposed for this as well.

So what are your thoughts on -- with, you know, the ground water that pumps down? Where will that go?

MS. DRAPER: Cynthia Draper with Amec Foster Wheeler. I want to make sure I understand. The underground system that you're talking about, it goes -- it's a -- it goes underneath the landfill and it's either a dual liner system or a leachate collection system. It's an extra safety feature should the groundwater, for any reason, come up higher, you get higher than five feet, so that it could come in contact with the landfill. We want to avoid that. So this will not be something that would be generated on a regular basis. And I'm sorry, tell me again the question specifically?

MS. FAIL: Well, I mean, you're obviously going to have to draw down the groundwater, right? To keep -- you're saying no?

MS. DRAPER: No, we do not plan to continually depress that groundwater. For one thing, once you get past that top ten feet you're about 200 feet of very dense clay. It's very permeating from your site. You probably know all about that as well. So we do not plan to draw down the groundwater any further and put an under drain system just in the unlikely event it should rise up to the surface.

MS. FAIL: Thank you.

MR. TOLLIVER: Any other questions?

MS. URQUHART-FOSTER: We appreciate you coming out. Feel free to let your neighbors know about the information. We encourage anyone to comment and provide us feedback on the proposed clean up plan.

MR. TOLLIVER: September 14th, that's the end of the comment period. So we move forward after that. If you have any concerns please let one of us know and we'll answer. That concludes our meeting. Thank you all for coming and we look forward to hearing from you.

(The Hearing concluded at 7:45 p.m.)

STATE OF NORTH CAROLINA)
COUNTY OF PENDER)

CERTIFICATION OF REPORTER

I, TAMARA A. VIOLETTE, Notary Public and Court Reporter, have read the foregoing transcript, which was taken down and transcribed by me for AURELIA RUFFIN & ASSOCIATES, INC., and I find the contents of same to be true and correct to the best of my knowledge and belief.

This the 2nd day of September, 2016.

__________/S/__________

Notary Public, 20031180184

STATE OF NORTH CAROLINA)
COUNTY OF NEW HANOVER)

CERTIFICATION

I, PETER BROWNE RUFFIN, III Notary Public, Court Reporter and President of AURELIA RUFFIN & ASSOCIATES, INC., do hereby certify that the foregoing transcript constitutes a true and correct record of the testimony given, the same having been taken down and transcribed by TAMARA VIOLETTE, Notary Public and Court Reporter on the date and at the place set forth in the record and before those persons named therein;

FURTHER, that we are not related to and are not employed by any of the parties to this action, save and except for the explicit purpose of taking down the testimony herein and transcribing same; and that we, in no way, are interested in the outcome of said litigation;

FURTHER, that the original of this transcript will be bound for filing with the Environmental Protection Agency and will be forwarded to ANGELA R. MILLER, Environmental Protection Agency, Region 4, 61 Forsyth Street, S.W., 11th Floor, Atlanta, Georgia 30303.

WITNESS my hand and notarial seal this the 7th day of September, 2016.

Notary Public, #19971470080