Remedial Investigation and Risk Assessment Summary Report Addendum

Southern Wood Piedmont and North Carolina State Ports Authority Site
Wilmington, NC
NCD 058 517 467

Prepared for:

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Acronyms

µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ADAF	age-dependent adjustment factor
AOC	Administrative Order on Consent
ATSDR	Agency for Toxic Substances and Disease Registry
BAF	bioaccumulation factor
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BW	body weight
CCA	chromated copper arsenate
cm^2	square centimeters
COC	constituent of concern
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
DNAPL	dense non-aqueous phase liquid
ECAO	Environmental Criteria and Assessment Office
Eco-SSL	Ecological Soil Screening Level
EDD	estimated daily dose
EPC	exposure point concentration
EqP	equilibrium partitioning
ESB	EqP-based sediment benchmarks
ESBTU	equilibrium-partitioning sediment benchmark toxic units
ESL	ecological screening level
FCV	final chronic value
g	gram
GWSL	Groundwater Screening Level
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HMW	high molecular weight
HQ	hazard quotient
HxCDD	Hexachlorodibenzo-p-dioxin
IRIS	Integrated Risk Information System
IUR	inhalation unit risk factor
LANL	Los Alamos National Laboratory

LOAEC	lowest observed adverse effect concentrations
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
LMW	low molecular weight
MATC	maximum acceptable toxicant concentration
mg	milligrams
mg/day	milligrams per day
mg/kg	milligrams per kilogram
MRL	minimal risk level
NCBP	North Carolina Brownfields Program
NCDENR	North Carolina Department of Environment and Natural Resources
NCDEQ	North Carolina Department of Environmental Quality
NCSPA	North Carolina State Ports Authority
ng/kg	nanograms per kilogram
NOAEL	no observed adverse effects level
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD/F	polychlorinated dibenzo-p-dioxins and polychlorinated dibenzo-p-furans
PCP	pentachlorophenol
ppt	parts per thousand
PRG	preliminary remediation goal
PSRG	Preliminary Soil Remediation Goal
RA	Risk Assessment
RAGS	Risk Assessment Guidance for Superfunds
RAP	Remedial Action Plan
RBA	relative bioavailability
RBC	risk-based concentration
RfC	reference concentration
RfD	reference dose
RG	remedial goal
RGO	remedial goal objective
RI	Remedial Investigation
RPF	relative potency factor
RSL	Regional Screening Level
SF	slope factor
SVOC	semi-volatile organic compound
SWP	Southern Wood Piedmont Company
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin

TEF	toxicity equivalency factor
TEQ	toxicity equivalency quotient
TOC	total organic carbon
tPAH	total polycyclic aromatic hydrocarbons
TRV	toxicity reference value
UCL	upper confidence limit
UF	uncertainty factor
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WHO	World Health Organization

1 Introduction

On behalf of the Southern Wood Piedmont Company (SWP), EHS Support LLC ("EHS Support") has prepared this *Remedial Investigation and Risk Assessment Summary Report* ("RI/RA Summary Report") *Addendum* ("Addendum") to summarize the human health and ecological risk-based remedial goals developed for the SWP and North Carolina State Ports Authority (NCSPA) Site ("the Site") located at the West Foot of Greenfield Street in Wilmington, New Hanover County, North Carolina (**Figure 1-1**). The risk-based remedial goals were developed based on results of the remedial investigations and risk assessments completed pursuant to the requirements of the 1999 Administrative Order on Consent (AOC; Docket No. 97-SF-117) between SWP and the North Carolina Department of Environment and Natural Resources (NCDENR, now known as the North Carolina Department of Environmental Quality [NCDEQ]). This Addendum supplements the 2017 RI/RA Summary Report (Arcadis, 2017) prepared as a component of SWP's "Proposed Path to Complete AOC Requirements," which was documented in a letter to NCDEQ dated February 28, 2017 and approved by NCDEQ in a letter to SWP dated March 7, 2017.

Key components of the 2017 RI/RA Summary Report (Arcadis, 2017) are summarized within this Addendum where pertinent to the human health and/or ecological risk-based remedial goals for the Site. Investigation activities conducted by SWP (or NCSPA) since completion of the 2017 RI/RA Summary Report and an update on the anticipated future land use of the Site (i.e., the NCSPA conceptual development plan for a multi-purpose terminal on the northern parcel) are also summarized within this Addendum. Further details on the remedial investigations and risk assessments are provided in the 2017 RI/RA Summary Report (Arcadis, 2017) and other documents previously submitted to NCDENR/NCDEQ.

Consistent with federal and state guidance, the remedial goals summarized within this Addendum are clear and reasonable, protective of human health and the environment, and take into consideration Site-specific conditions and anticipated future land use. It is understood that the remedial goals will be used to support the development of a Remedial Action Plan (RAP) for the Site. To evaluate remedial alternatives and support remedial goal objectives (RGOs) outlined in the RAP, risk-based remedial goals were developed for soil (human health and ecological) and sediment (ecological).

1.1 Objectives

The primary objectives of this Addendum are to:

- Describe the approach and derivation of human health risk-based remedial goals for soil.
- Describe the approach and derivation of ecological risk-based remedial goals for sediment and soil.
- Discuss the remedial goals and any related uncertainties in the context of the NCSPA conceptual development plan.
- Outline the application of the remedial goals during remedial action.

1.2 Report Organization

This Addendum is organized into the following sections:

- **Section 2** – Site Background: includes an overview of the Site location and setting, and summaries of the historical wood treating operations, remedial investigations, additional sampling activities in 2018 and 2021, and human health and ecological risk assessments.
- **Section 3** – Human Health Risk-Based Remedial Goals: includes an overview of receptors, exposure pathways, media, and constituents of potential concern (COPCs); the development of human health risk-based remedial goals for soil; and the comparison of human health risk-based remedial goals to existing Site data.
- **Section 4** – Ecological Risk-Based Remedial Goals: includes a review of the ecological risked based remedial goals for sediment and the derivation of risk-based goals for soil, and comparison of the remedial goals to existing Site data.
- **Section 5** – Integrated Risk-Based Recommendations: integrates the human health and ecological risk-based remedial goals and provides recommendations for risk management.
- **Section 6** – References: lists all sources cited in this Addendum.

2 Site Background

This section provides an overview of the Site background, including a description of the Site location and setting (including current and anticipated future land use), and summaries of the historical wood treating operations, remedial investigations, additional sampling activities in 2018 and 2021, and human health and ecological risk assessments. Further details on these background elements are provided in the RI/RA Summary Report (Arcadis, 2017), except for the additional sampling activities conducted in 2018 and 2021, which are further detailed in **Appendix A**[1] and **Appendix B**.

2.1 Site Location and Setting

The Site is located at the West Foot of Greenfield Street within an industrial area of Wilmington, North Carolina (**Figure 1-1**). The Site is comprised of two parcels of land owned by NCSPA. The southern parcel (tax map no. 05320; parcel no. 002) totals 44.58 acres (7 acres were leased to SWP) and has been owned by NCSPA since 1968. The northern parcel (tax map no. 05320, parcel no. 001) totals 51.57 acres and was acquired by the City of Wilmington around 1920. NCSPA purchased the northern parcel from the City of Wilmington in 1998. The City of Wilmington leased the property over the years to Newport Shipbuilding Company, North State Creosoting Company, Taylor Colquitt Creosoting Company, Taylor Piedmont, and SWP. The Site, initially developed for World War I barge and ship construction, housed wood-treating operations from the 1930s until the early 1980s. Since that time, all equipment and buildings have been removed from the Site, and unpaved areas have become covered with grass and vegetation. Sections of unpaved and paved roads, concrete slabs, and partially buried railroad ties remain on the Site from previous operations. The Site is currently inactive, except for a wood-chip operation in the central portion of the Site (Arcadis, 2017).

The Site's current and future land use is restricted for industrial purposes and will not be used for residential or recreational purposes. NCSPA's 1998 purchase of the northern parcel from the City of Wilmington included a special warranty deed specifying that land use is restricted to "an industrial site devoted to port-related operations" and specifically excluding use for residential or recreational purposes. NCSPA's conceptual development plan for the Site includes constructing a multi-purpose terminal on the northern parcel, which is presented in the February 1, 2018 illustrative plan prepared by Bermello Ajamil and Partners (**Figure 2-1**). This parcel of land was granted eligibility for inclusion in the North Carolina Brownfields Program (NCBP) by NCDEQ on July 31, 2017. The adjoining southern parcel of land was not granted eligibility into the NCBP program and is not currently part of NCSPA's conceptual development plan (CATLIN, 2018).

Current and future land use surrounding the Site will likely remain industrial. The Site is located within an area of Wilmington that has historically (over 100 years) been developed with heavy industrial and manufacturing facilities. Historical operations on and around the Site have included lumber mills, ship building activities, general warehousing activities, wood preservation, turpentine production, paint formulation, bulk storage of petroleum and chemicals, coal gasification, and petroleum refining activities. The Cape Fear River waterfront upstream and downstream of the Site has historically been used for industrial purposes. Further details on the Site and surrounding land use are provided in the RI/RA Summary Report (Arcadis, 2017).

[1] Letter report, tables, and figures only. Attachments not included due to file size.

The Site includes both aquatic and terrestrial habitats (albeit of lesser quality due to the industrial setting of the Site and surrounding area). Aquatic habitats consist of the Drainage Ditch, Greenfield Creek, and margins of the Cape Fear River. The Drainage Ditch receives runoff from most of the Site and flows into Greenfield Creek, which in turn flows into the Cape Fear River via a tide gate. The Drainage Ditch and Greenfield Creek exhibit some tidal influence. The quality of habitat within Greenfield Creek has been degraded by the nature of the creek's industrialized setting and influence of Greenfield Lake,[2] located just upstream from the Site. The Cape Fear River near the Site is primarily estuarine and tidally influenced, with an oligohaline (0.5 to 5 parts per thousand [ppt]) salinity range (Arcadis, 2017).

Terrestrial habitats on-site include wooded areas, riparian and wetland vegetation, and grassy open fields. Terrestrial habitats may support mammalian food webs; though, the quality of the habitat provided has been degraded by the industrial nature of the Site and its surroundings and will be further degraded by the anticipated future land use as NCSPA's conceptual development plan includes expansive coverage by impervious surfaces and buildings. A more detailed habitat characterization of the Site and its surroundings is presented in Section 3.2 of the *Revised Baseline Ecological Risk Assessment* (2007 BERA; AMEC, 2007).

2.2 Summary of Historical Wood Treating Operations

Wood-preserving operations occurred at the Site from 1932 to May 1983 and included the use of coal tar creosote, chromated copper arsenate (CCA), and pentachlorophenol (PCP) in diesel fuel. North State Treating Company, Taylor-Colquitt, and Taylor Piedmont operated the Site from 1932 to 1969.[3] ITT Corporation (SWP) took over operations at the Site in 1969. Information regarding the storage and disposal of waste materials during the period prior to management by SWP is not available. Prior to 1972, creosote oil was the only wood preservative used at the Site. CCA was introduced as a wood preservative in 1972. SWP began using PCP in 1980. Further details on the wood preservatives/ processes, process wastewater management, hazardous materials storage, historical Site impacts, and historical Site remediation are provided in the 2017 RI/RA Summary Report (Arcadis, 2017).

2.3 Remedial Investigation Summary

The purpose of the remedial investigation was to evaluate the extent of potential impacts related to wood preserving operations conducted at the Site. To meet this purpose, remedial investigation activities were conducted in several phases between 1981 and 2012. Remedial investigation activities included surface and subsurface soil sampling, surface sediment sampling, groundwater and surface water sampling, and the collection of fish and emergent aquatic insect tissue samples. Sampling methodology and analytical schedules for historical sampling are provided in Section 3 of the 2017 RI/RA Summary Report (Arcadis, 2017). Additional studies to characterize the surrounding habitat and

[2] Greenfield Lake receives stormwater runoff from the City of Wilmington and is on the state's most impaired list. The lake is unsafe for swimming and has been reported to be one of the most polluted lakes in North Carolina. The lake is impacted by heavy metals, oils, fecal coliform, fertilizer, insecticides, pesticides, and other wastes. Greenfield Lake has been drawn down annually for over 30 years by opening valves at the Greenfield Lake spillway allowing impacted water and sediment to be transported downstream to Greenfield Creek. Due to the proximity of Greenfield Lake to the Site, non-Site related constituents that have been detected in Greenfield Creek likely migrated from Greenfield Lake (Arcadis, 2017).

[3] Taylor-Colquitt became part of Taylor Piedmont which became part of SWP.

hydrogeology and to delineate dense, non-aqueous phase liquid (DNAPL) and groundwater were also conducted to support the remedial investigation. A summary of the key findings from these efforts is provided in Section 3 of the 2017 RI/RA Summary Report (Arcadis, 2017). A brief sample summary and overview of the COPCs identified in soil and sediment are provided in **Sections 2.3.1** and **2.3.2**.

2.3.1 Soil

A total of 181 surface and 70 subsurface soil samples were collected as part of remedial investigation activities between 1982 and 2001 (Arcadis, 2017). The following COPCs have been identified in soils at concentrations greater than the North Carolina Industrial/Commercial Use Health-Based Preliminary Soil Remediation Goals (PSRGs; referred to in this Addendum as "Industrial/Commercial PSRGs"):

- Certain polycyclic aromatic hydrocarbons (PAHs)
- 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalency quotient (TEQ)
- Arsenic
- Chromium
- Lead

Soil samples with concentrations exceeding the Industrial/Commercial PSRGs for one or more of these COPCs were located in the treated wood storage areas, non-treated wood storage areas, landfarm area, production area, covered ditch, and the area adjacent to Greenfield Creek (see Figure 9 in Arcadis, 2017).

2.3.2 Sediment

A total of 119 surface sediment samples were collected as part of remedial investigation activities between 1985 and 2001. Because North Carolina does not have promulgated sediment guideline values, the Industrial/Commercial PSRGs were conservatively used to screen historical sediment concentrations at the Site (Arcadis, 2017). The following COPCs have been identified at concentrations greater than the Industrial/Commercial PSRGs:

- Certain PAHs
- TCDD-TEQ
- Polychlorinated biphenyls (PCBs) - Aroclor 1260
- Aluminum
- Arsenic
- Chromium
- Copper
- Iron
- Lead
- Vanadium

Sediment samples with concentrations exceeding the Industrial/Commercial PSRGs for one or more of these COPCs were identified in segments of the Drainage Ditch and Greenfield Creek (Arcadis, 2017).

2.4 Additional Sampling Activities

A summary of findings from more recent sampling at the Site, including the 2018 Brownfields Program soil sampling conducted by CATLIN Engineers and Scientists (Catlin, 2018) and the 2021 supplemental sediment and surface water sampling conducted by EHS Support, is provided below.

2.4.1 2018 Brownfields Soil Sampling

In 2018, a total of 14 surface soil samples (0.0 to 2.0 feet) were collected at the Site as part of the NCDEQ Brownfields Program (**Appendix A**). Eleven samples were collected from the northern parcel, two samples were collected from the southern parcel, and one sample was collected off-site along Greenfield Street, immediately east of the northern parcel. Soil samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), select metals, pesticides and herbicides, PCBs, and dioxins/furans. Analytical results were screened against the NCDEQ PSRGs for the Protection of Groundwater, Residential Health-Based, and Industrial/Commercial Health-Based beneficial uses. Multiple analytes were detected at concentrations greater than the Protection of Groundwater PSRGs and the Residential Health-Based PSRGs. Additionally, nine analytes were detected at concentrations greater than the Industrial/Commercial Health-Based PSRGs. These analytes included arsenic; benzo(a)pyrene; chromium; dibenzo(a,h)anthracene; pentachlorophenol; 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD); 1,2,3,6,7,8-HxCDD; 1,2,3,7,8,9-HxCDD; and 2,3,7,8-TCDD (CATLIN, 2018). Many of these analytes were previously identified as COPCs in prior remedial investigation activities (Arcadis, 2017).

2.4.2 2021 Supplemental Sediment and Surface Water Sampling

At the request of NCDEQ,[4] supplemental sediment and surface water sampling was conducted at the Site in March 2021 to verify current conditions and ensure that any ecological risk-based conclusions drawn from historical sediment data are representative of current conditions. To this end, surface sediment samples (0.00 to 0.25 feet) were collected at two locations in the Drainage Ditch, four locations in Greenfield Creek, and one background location in Greenfield Creek. Mid-column surface water samples were also collected at one location in the Drainage Ditch, two locations in Greenfield Creek, and one background location in Greenfield Creek (**Appendix B1**).

Analytical results for the March 2021 sediment and surface water samples are provided in **Appendix B2**. The analytical results for surface sediments were compared to historical results as well as the ecological risk-based remedial goals (RGs) proposed in the 2007 BERA (AMEC, 2007) for selected constituent groups (i.e., summed polychlorinated dibenzo-p-dioxins and polychlorinated dibenzo-p-furans [PCDD/Fs] and total polycyclic aromatic hydrocarbons [tPAHs]) (**Appendix B1**). The summed PCDD/F concentrations in surface sediment from the Drainage Ditch and Greenfield Creek were comparable to historical results and exceeded the proposed ecological risk-based RG of 59 micrograms per kilogram (µg/kg) summed PCDD/Fs at all March 2021 sampling stations except the most downstream station in Greenfield Creek (GC01) and the background station in Greenfield Creek (GC05). Surface sediment concentrations of tPAHs were comparable to historical results in the Drainage Ditch and Greenfield Creek except at station GC02, located immediately downstream from the confluence of the Drainage

[4] Virtual meeting between the SWP and NCDEQ technical teams on November 17, 2020.

Ditch. At station GC02, the concentration of tPAHs exceeded the historical maximum concentration reported for Greenfield Creek but was lower than the historical maximum concentration reported for the Drainage Ditch. Station GC02 was the only sampling location in March 2021 where the concentration of tPAHs exceeded the proposed ecological risk-based RG of 700 milligrams per kilogram (mg/kg) for tPAHs (**Appendix B1**).

2.5 Risk Assessment Summary

The following sections summarize findings of the *Revised Supplemental Human Health Risk Assessment* (2009 HHRA; AMEC, 2009) and 2007 BERA (AMEC, 2007).

2.5.1 Human Health Risk Assessment

The 2009 HHRA (AMEC, 2009) is a revision to the 2001 HHRA (AMEC, 2001b) and addresses NCDENR comments received following the submittal of the 2001 HHRA. The approach taken in the 2009 HHRA was the development of Site-specific risk-based concentrations (RBCs) based on potential human exposures to COPCs identified in soil, sediment, surface water, and fish, as well as a comparison of these RBCs to individual sample results. The 2009 HHRA developed Site-specific RBCs for the following receptors, media, and exposure pathways:

Table 1 Summary of 2009 HHRA Potential Receptors and Associated Exposure Pathways

Receptor	Media	Exposure Pathways
Adolescent Trespasser	Surface Soil	Ingestion, Dermal
	Sediment	Ingestion, Dermal
	Surface Water	Ingestion, Dermal
	Fish	Ingestion
Utility Repair Worker	Surface Soil	Ingestion, Dermal, Inhalation
Construction Worker	Surface Soil	Ingestion, Dermal, Inhalation
	Subsurface Soil	Ingestion, Dermal, Inhalation
Facility Worker	Surface Soil	Ingestion, Dermal

The 2009 HHRA (AMEC, 2009) concluded that individual sample results are lower than the Site-specific RBCs for most COPCs, except for arsenic, chromium, select PAHs, and TCDD-TEQ concentrations in some soil and sediment locations, and TCDD-TEQ concentrations in two fish samples (only one was a gamefish). The 2009 HHRA acknowledged that a point-specific exceedance of an RBC does not necessarily constitute a potential cause for concern given the likelihood that true human exposures would more realistically occur over an area and thus would be more indicative of average COPC concentrations (Arcadis, 2017).

2.5.2 Baseline Ecological Risk Assessment

The 2007 BERA (AMEC, 2007) was a revision to the 2001 BERA (AMEC, 2001a) and the *Revised Supplemental Risk Evaluation for Insectivorous Birds* (AMEC, 2006), and addressed comments received

from the United States Environmental Protection Agency (USEPA) and NCDENR on those documents. USEPA and NCDENR submitted comments on the 2007 BERA to SWP in February 2008, and a response to comment letter was subsequently submitted to NCDENR by AMEC (on behalf of SWP) in May 2008.

The 2007 BERA evaluated potential risk to aquatic receptors, including benthic invertebrates and fish, semi-aquatic piscivorous wildlife (American mink [*Neovison vison*]), piscivorous wading birds (great blue heron [*Ardea herodias*]), terrestrial carnivorous birds (red-tailed hawk [*Buteo jamaicensis*]), and insectivorous birds (Eastern kingbird [*Tyrannus tyrannus*]) in aquatic and wetland areas of the Site. The Drainage Ditch, Greenfield Creek, wetlands, and Cape Fear River waterfront were evaluated using average exposures for environmental media in those areas. Empirical data were available for sediment, wetland soil, surface water, fish tissue, and emergent aquatic insect tissue. Sediment toxicity testing data for two invertebrate species (amphipod [*Hyalella azteca*] and midge larvae [*Chironomus dilutes*; formerly named *C. tentans*]) were also available for the Drainage Ditch and Greenfield Creek.

Potential for excess risk, as defined by No Observed Adverse Effects Level Hazard Quotient (HQ_{NOAEL}) greater than 1 in the BERA, was identified for the great blue heron due to exposure to PAHs in sediment and for benthic invertebrates due to direct contact exposure to dioxins/furans in sediment. Additionally, sediment toxicity was observed at several Site locations in the Drainage Ditch and Greenfield Creek. Potential Site-related risk was identified in the Drainage Ditch and Greenfield Creek, but not in the Cape Fear River (AMEC, 2007).

The 2007 BERA (AMEC, 2007) included the development of RGs for aquatic receptors in the Drainage Ditch and Greenfield Creek, which were back-calculated from the great blue heron dietary dose model for PAHs and based on observed sediment toxicity to benthic invertebrates for dioxins/furans. Two additional terrestrial receptors (American robin [*Turdus migratorius*] and short-tailed shrew [*Blarina brevicauda*]) were also evaluated as part of the RG development assessment. However, these terrestrial receptors were not included in the risk characterization since the property was anticipated to be developed as an industrial ports facility in the future, which was expected to result in incomplete terrestrial exposure pathways (AMEC, 2007).

The NCSPA's conceptual development plan for the Site (**Figure 2-1**) indicates that some terrestrial habitats (albeit of lesser quantity and quality due to the anticipated industrial development and industrial setting of the Site and surrounding area) may remain intact post-development. Therefore, further consideration of the terrestrial exposure pathways is warranted (**Section 4.2**).

3 Human Health Risk-Based Remedial Goals

This section describes the development of human health risk-based RGs for soil. Human health risk-based RGs were originally developed for the Site in the *Revised Supplemental Human Health Risk Assessment* (2009 HHRA; AMEC, 2009). The levels presented herein have been updated from the 2009 levels to support NCSPA's February 2018 conceptual development plan for the Site (**Figure 2-1**) and to address changes in USEPA and NCDEQ risk assessment methodology (NCDEQ, 2020 and 2021).

3.1 Receptors, Exposure Pathways, Media, and Constituents of Potential Concern

Section 3.1.1 through Section 3.1.3 present the exposure setting, potential exposure pathways, and COPCs, respectively.

3.1.1 Exposure Setting

As described in **Section 2.1**, the Site is currently inactive, except for a wood-chip operation in the central portion of the Site. Current and future on-site land use is restricted for industrial purposes and will not be used for residential or recreational purposes. Current and future use surrounding the Site will also most likely remain industrial.

3.1.2 Potential Exposure Pathways

The results of the 2009 HHRA (AMEC, 2009) were used to identify potential receptors and exposure pathways for risk-based remedial goal development. Based on current and reasonably anticipated future land uses, the following potential on-site receptors were identified:

- Future Commercial/Industrial Worker: Commercial/industrial workers associated with NCSPA's conceptual development plan were considered potential receptors. Commercial/industrial workers are potentially exposed to COPCs in surface soil (0 to 1 foot below ground surface [bgs]). Exposure to subsurface soil is only achieved during intrusive activities (i.e., excavation and construction). However, an evaluation of COPCs in subsurface soil was also considered since hypothetical future excavation activities may bring deeper soil to the surface.
- Future Long-Term Utility/Excavation Worker: The long-term utility/excavation worker is potentially exposed to COPCs in surface soil (0 to 1 foot bgs) and COPCs in subsurface soil (1 to 12 feet bgs) while repairing or installing sanitary sewer, electrical, water, or other utility lines at the Site. For this receptor, it was conservatively assumed that exposure would occur each year during different repair or maintenance events.
- Future Short-Term Construction Worker: The short-term construction worker is potentially exposed to COPCs in surface soil (0 to 1 foot bgs) and COPCs in subsurface soil (1 to 12 feet bgs) while performing short-term construction related to future re-development of the Site.
- Current/Future Youth Trespasser: While locked and gated, the Site may be accessible by foot. Thus, it is possible, under current conditions, that adolescents could access the Site to gain access to the Greenfield Creek area or the Cape Fear River. Therefore, trespassers were considered potential receptors. The trespasser is assumed to be an adolescent (youth) aged 7 to 16 years that would be potentially exposed to COPCs in surface soil (0 to 1 foot bgs). It should be noted that trespassers have not been observed on the Site (AMEC, 2009). Similar to future commercial/industrial workers, exposure to COPCs in subsurface soil was also considered.

Potentially complete exposure pathways for these receptors may include the following:

- Future Commercial/Industrial Worker: incidental ingestion of, and dermal contact with, soil column (surface and subsurface soil); inhalation of soil-derived particulates and vapors.
- Future Short-Term Construction Worker: incidental ingestion of, and dermal contact with, soil column (surface and subsurface soil); inhalation of soil-derived particulates and vapors.
- Future Long-Term Utility/Excavation Worker: incidental ingestion of, and dermal contact with, soil column (surface and subsurface soil); inhalation of soil-derived particulates and vapors.
- Current Youth Trespasser: incidental ingestion of, and dermal contact with, surface soil; inhalation of surface soil-derived particulates and vapors.
- Future Youth Trespasser: incidental ingestion of, and dermal contact with, soil column (surface and subsurface soil); inhalation of soil-derived particulates and vapors.

Risks associated with the consumption of groundwater at the Site were not evaluated in the 2009 HHRA (AMEC, 2009). As detailed in the HHRA, groundwater is not used as a municipal water supply in Wilmington. There are no groundwater users within a two-mile radius of the Site. Most residents within four miles of the Site are supplied water by the City of Wilmington Water Department or the Leland Sanitary District. Other factors limit the viability of Site groundwater being used in the future for human consumption, including the following:

- Availability at the Site of potable water supplied by the City of Wilmington
- Salinity in the local aquifer due to brackish conditions in the Cape Fear River
- Existence of a city ordinance requiring a permit for the use of groundwater for human consumption within the Wilmington City limits

Collectively, these limitations are believed to effectively preclude the future use of Site groundwater for potable purposes, removing this potential pathway of exposure to Site-related constituents now and in the future (Arcadis, 2017).

Risks associated with vapor intrusion pathways at the Site were also not evaluated in the 2009 HHRA (Arcadis, 2017). At the request of NCDEQ during a meeting in November 2020,[5] an evaluation of this pathway was conducted. Groundwater data collected at the Site during the most recent monitoring event in 2012 was compared to NCDEQ Non-Residential Groundwater Screening Levels (GWSLs). One constituent, naphthalene, exceeded GWSLs in two shallow aquifer monitoring well locations (MW-13 and MW-24R). These exceedances were further evaluated using NCDEQ's Risk Calculator. Using the maximum detected concentration (66 micrograms per liter [µg/L]), no unacceptable risk was identified. The calculated cancer risk and non-cancer hazard was less than target risk levels (cumulative cancer risk of $1x10^{-4}$ and a hazard index less than 1). Groundwater data screening tables and the NCDEQ Risk Calculator output are provided in **Appendix C**.

3.1.3 Constituents of Concern

The soil data set used in the 2009 HHRA (AMEC, 2009) consisted of soil samples (surface and subsurface) collected at the Site between 1991 and 2001. To identify COPCs for this remedial goal evaluation, the 2009 HHRA data set was supplemented with surface soil data collected more recently during the 2018 Brownfields Program investigation (CATLIN, 2018). In addition, historical sediment samples collected

[5] Virtual meeting between the SWP and NCDEQ technical teams on November 17, 2020.

within wetland portions of the Site were also considered part of this remedial goal data set, as these locations may be dry for a portion of the year.

As previously discussed, institutional controls have been implemented at the Site to establish appropriate future non-residential land use; therefore, NCDEQ PSRGs for industrial soil (June 2021 edition) were used to identify COPCs for Site soils. The PSRGs were based on a cancer risk of 1 in 1 million (1×10^{-6}) and an HQ of 0.2 (for non-carcinogens). Dioxin and furan results in soil were converted to TEQs using the 2005 World Health Organization (WHO) toxicity equivalency factors (TEF). The total TEQs were compared to the PSRG for 2,3,7,8-TCDD. TEQ calculations are provided in **Appendix C**.

Table 3-1 and **Table 3-2** identify COPCs for surface soil (defined as depths less than 1 ft bgs) and subsurface soil (defined as depths greater than 1 ft bgs), respectively. As indicated in the tables, the following COPCs were identified for remedial goal derivation:

- PAHs
  - 2-Methylnaphthalene
  - Benzo(a)anthracene
  - Benzo(a)pyrene
  - Benzo(b)fluoranthene
  - Benzo(b,k)fluoranthene
  - Dibenz(a,h)anthracene
  - Fluoranthene
  - Fluorene
  - Indeno(1,2,3-cd)pyrene
  - Naphthalene
  - Phenanthrene
  - Pyrene
- Dioxin/Furans
  - 2,3,7,8-TCDD TEQ
  - Dibenzofuran
- Inorganics
  - Arsenic
  - Chromium

Of the COPCs identified above, the cancer potency of the following carcinogenic PAHs (cPAHs) are determined relative to benzo(a)pyrene:

- Benzo(a)anthracene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene

As a result, a remedial goal will be derived for benzo(a)pyrene but not for the other five cPAHs identified as COPCs. Similar to dioxin/furans, cPAH soil results will be converted to TEQs using USEPA recommended relative potency factors (RPFs) (USEPA, 1993). The total TEQs will be compared to the remedial goal derived for benzo(a)pyrene to assess areas for remedial action.

3.2 Remedial Goal Approach – On-Site Industrial/Commercial Workers

NCDEQ PSRGs for industrial soil or USEPA Regional Screening Levels (RSLs) for industrial soil were identified as the risk-based remedial goals for future on-site industrial/commercial workers. PSRGs or RSLs were adjusted using simple equations to account for a cumulative risk target goal of 1 in 10 thousand (1×10^{-4}) and a hazard index of 1 by target organ/critical effect group (**Table 3-3**). PSRGs or RSLs were adjusted using one of the three procedures detailed in **Section 3.2.1** through **Section 3.2.3**.

3.2.1 Soil Contaminants with Only Carcinogenic Effects

Default PSRGs for carcinogens are based on an excess lifetime cancer risk of 1 x 10^{-6}. Since the maximum cumulative excess cancer risk for all contaminants and all pathways is a cancer risk of 1 x 10^{-4}, the PSRG for carcinogens ("C") may be adjusted to a cumulative cancer risk goal of 1 x 10^{-4} using the following equation:

$$Adjusted\ PSRG = \frac{PSRG\ x\ 100}{No.of\ \text{"C" contaminants}}$$

3.2.2 Soil Contaminants with Only Non-Carcinogenic Effects

Default PSRGs for non-carcinogens are based on an HQ of 0.2. The hazard quotient of 0.2 is used to account for multiple (average of five) non-carcinogens in the same target organ or critical effect group. For Sites with five or less non-carcinogens ("N"), the remedial goals may be adjusted using the following calculation:

$$Adjusted\ PSRG = \frac{PSRG\ x\ 5}{No.of\ \text{"N" contaminants}}$$

Where the number of "N" contaminants is based on the number of non-carcinogens per target organ/critical effect group. Critical effects for oral and inhalation pathways are detailed in **Table 3-4.**

3.2.3 Soil Contaminants with Both Carcinogenic and Non-Carcinogenic Effects

If a contaminant has both carcinogenic and non-carcinogenic effects, then the default PSRG cannot be adjusted. As a result, the USEPA RSL (based on cancer risk of 1x10^{-6} and an HQ of 1) is used. The remedial goal is the lower (more health protective) of the following two concentrations:

$$Adjusted\ RSLc = \frac{EPA\ RSLc\ x\ 100}{No.of\ \text{"C" contaminants}}$$

$$Adjusted\ RSLn = \frac{EPA\ RSLn}{No.of\ \text{"N" contaminants}}$$

Where the number of "N" contaminants is based on the number of non-carcinogens per target organ/critical effect group. As previously noted, critical effects for oral and inhalation pathways are detailed in **Table 3-4**.

3.3 Remedial Goal Approach – Other Workers and Trespassers

Risk-based remedial goals protective of multiple-route exposure were calculated for the other potential receptors (utility/excavation workers, construction workers, and trespassers) using USEPA risk assessment methodology (USEPA, 1989 and 2009) and USEPA's RSL calculator. The USEPA risk assessment equations calculate risk levels based on the constituent concentration, magnitude of exposure, and the toxicity of the constituent. To calculate the remedial goals, the equations are

rearranged to solve for an allowable constituent concentration based on a target risk level, magnitude of exposure, and toxicity.

Appendix C provides the RSL calculator inputs and outputs. For each receptor, risk-based values were calculated to be protective of potential carcinogenic and non-carcinogenic (systemic) effects. Exposure assumptions presented in the RSL calculator input are detailed in **Table 3-5.** Toxicity values are presented in **Table 3-4** and **Table 3-6**.

Table 3-7 to **Table 3-9** provide a summary of the calculated values for each receptor. As detailed in the tables, similar to the future industrial/commercial worker risk-based remedial goals, risk-based remedial goals for the other receptors were also adjusted using simple equations detailed in the tables to account for a cumulative risk target goal of $1x10^{-4}$ and a hazard index of 1 by target organ/critical effect group.

The following sections describe the exposure assumptions and toxicity values used in the remedial goal derivation.

3.4 Exposure Assumptions

The risk-based values were calculated using the assumptions summarized in **Table 3-5**. The assumptions are conservative and likely overestimate actual exposure but can be used for developing remedial goals. As shown in the table, exposure assumptions were based on a combination of USEPA-recommended values, NCDEQ-recommended values, and professional judgment considering Site-specific information. Site-specific values were obtained from the 2009 HHRA (AMEC, 2009).

Rationale for selection of the exposure assumptions is provided below.

3.4.1 Soil Ingestion Rate

The soil ingestion rate refers to the amount of soil that is ingested daily due to incidental ingestion (e.g., hand-to-mouth contact). USEPA's recommended soil ingestion rate of 330 milligrams per day (mg/day) (USEPA, 2002) for construction workers was assumed for long-term utility/excavation workers and short-term construction workers. Similarly, USEPA's and NCDEQ's recommended soil ingestion rate for a child resident (200 mg/day) was assumed for a youth trespasser (age 7 to 16 years).

3.4.2 Exposed Skin Surface Area

Exposed skin surface area is relevant when evaluating uptake of chemicals that are absorbed dermally. USEPA default body surface areas (3,527 square centimeters [cm^2]) calculated for potential exposure to head, hands, and forearms were used for long-term utility/excavation workers and short-term construction workers (USEPA, 2014). The NCDEQ-recommended body surface area for an adult resident (6,032 cm^2) was used for a youth trespasser (NCDEQ, 2021).

3.4.3 Dermal Adherence Rate

Dermal soil adherence is used, in conjunction with exposed skin surface area, to define the total amount of soil adhering to exposed skin surfaces. A weighted soil adherence rate of 0.3 milligrams per square

centimeter (mg/cm^2) was used for short-term construction workers and long-term utility/excavation workers. Consistent with USEPA guidance (USEPA, 2014), this value was based on the arithmetic average of the weighted mean of body part specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities. USEPA-recommended soil adherence rate for a child resident (0.2 mg/cm^2) was used for youth trespasser exposure to soil or sediment (USEPA, 2014).

3.4.4 Dermal Absorption

Dermal absorption values are used to estimate chemical absorption from soil through the skin (**Table 3-4**). Available chemical-specific or recommended dermal absorption factors were used in the remedial goal derivation (USEPA, 2004).

3.4.5 Exposure Frequency, Duration, and Time

Exposure frequency refers to the number of days per year that an individual is exposed to Site COPCs. Exposure duration refers to the number of years in which exposure occurs.

3.4.5.1 Utility/Excavation Workers

The long-term utility/excavation worker is assumed to be involved in short duration projects that could occur each year. As defined in the 2009 HHRA (AMEC, 2009), for utility/excavation workers, it was assumed that a worker may come into contact with soil (surface and subsurface) during inspection and repair of utility lines or other intrusive and/or maintenance activity for 8 hours per day, 1 day per year for 25 years.

3.4.5.2 Construction Workers

For short-term construction workers, the NCDEQ and USEPA-recommended value of 8 hours per day, 250 days per year for 1 year was assumed for soil exposures. The exposure frequency assumes 5 days per week, 50 weeks per year (250 days/year).

3.4.5.3 Trespassers

Based on professional judgment, Site-specific estimates of exposure time, frequency, and duration were assumed for recreational trespassing activities. As outlined in the 2009 HHRA (AMEC, 2009), it was assumed that potential receptors would access the Site 1 day per month during warmer months (March to December) (or 10 days per year). NCDEQ and USEPA-recommended value of 10 years (for ages 7 to 16 years) was assumed for the exposure duration.

Each visit to the Site was assumed to last 2 hours, consistent with NCDEQ recommendations (NCDEQ, 2021). The exposure time variable is applicable to the soil inhalation pathway calculations only.

3.5 Toxicity Values

Toxicity values for use in the remedial goal calculations are presented in **Table 3-4**. The table contains slope factors (SFs) and inhalation unit risk factors (IURs) for carcinogenic effects, cancer weight of

evidence classification for chemicals with carcinogenic effects, and chronic reference doses (RfDs) and reference concentrations (RfCs) for chemicals with noncarcinogenic effects. In accordance with USEPA guidance (USEPA, 2003a), toxicity values specific to the oral and inhalation pathways were obtained from the following sources:

- Integrated Risk Information System (IRIS) online database (USEPA, 2021b)
- Provisional toxicity values obtained from the USEPA Environmental Criteria and Assessment Office (ECAO) as reported in the USEPA RSL Table (USEPA, 2021a)
- California USEPA toxicity values as cited in the USEPA RSL Table (USEPA, 2021a)
- Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs) (ATSDR, 2021)
- Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997)

3.5.1 Oral Toxicity Factors

SFs and RfDs may be available for the oral exposure route. SFs are upper 95 percent confidence limits of the probability of response per unit intake of chemical (by oral or inhalation routes) over a lifetime. SFs are based on mathematical extrapolation from experimental animal data and epidemiological studies, when available. SFs are expressed in units of risk per milligrams per kilogram body weight per day (mg/kg BW/day). Because SFs are upper-bound estimates, the actual cancer potency of chemicals may be lower than estimated and may even be zero.

The RfD is a pathway-specific (e.g., oral) estimate of a daily chemical intake per unit body weight that is likely to be without deleterious effects (chronic) for a lifetime of exposure, including sensitive subpopulations (USEPA, 1989). The RfDs are derived from experimental data and include safety factors to account for differences among species and within populations and other uncertainties in the experimental data. The USEPA has developed chronic RfDs to evaluate long-term exposures (7 years to a lifetime) and subchronic RfDs to evaluate exposures of shorter duration (2 weeks to 7 years). Consistent with USEPA (1989) guidance, subchronic RfDs were used, where available, in the remedial goal calculations to evaluate construction worker exposure scenarios (**Table 3-6**). In the absence of subchronic RfDs, the chronic value was used to evaluate construction worker exposure scenarios.

When assessing the health effects of chemicals in a risk assessment such as this, it is USEPA's practice to assume that carcinogenic effects are additive, regardless of the specific end organ that may be affected by a particular constituent. For noncancer effects however, it is appropriate to assume that additive effects apply only to constituents that affect the same target organ (USEPA, 1989). **Table 3-4** and **Table 3-6** identify the critical effect (target organ) for each COPC. As previously discussed, this information was used in adjusting the remedial goals in consideration of cumulative noncancer hazards.

As indicated in **Table 3-4** and **Table 3-6**, for chromium, it was assumed that chromium was present in the hexavalent form (Chromium VI). For phenanthrene, which lacks toxicity data, the oral toxicity value for pyrene was used. This is considered a more conservative surrogate than structurally similar anthracene.

3.5.2 Inhalation Toxicity Factors

IURs and RfCs may be available for the inhalation exposure routes. In accordance with the *Risk Assessment Guidance for Superfunds* (RAGS) Part F (USEPA, 2009), inhalation toxicity values (RfCs and IURs), expressed in terms of concentration in air rather than in terms of dose, were used in the remedial goal calculations. Subchronic RfCs were used, where available, in the calculations to evaluate construction worker exposure scenarios (**Table 3-6**).

For chromium, it was assumed that chromium was present in the hexavalent form (Chromium VI). Inhalation toxicity values for hexavalent chromium (as particulates) were used.

3.5.3 Dermal Toxicity Factors

Oral toxicity values used to evaluate dermal absorption were adjusted for use in the remedial goal calculations using the recommended criteria as found in the 2004 USEPA *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*. Following the guidance document, toxicity values were adjusted for gastrointestinal absorption only where chemical-specific gastrointestinal absorption values were less than 50 percent. One COPC met this criterion – chromium. **Table 3-4** includes the available gastrointestinal absorption rates.

3.5.4 Mutagens

Recommendations presented in the USEPA *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (USEPA, 2005a) were used in the remedial goal calculations. This guidance document recommends 10-fold and 3-fold adjustments in SFs to be combined with age-specific exposure estimates when estimating cancer risks from early life exposure (young children and adolescents) to carcinogens that act through a mutagenic mode of action (such as benzo[a]pyrene). For youth trespassers, as indicated in the remedial goal calculations, an age-dependent adjustment factor (ADAF) was combined with corresponding age-specific estimates of exposure to assess cancer risk.

3.5.5 Bioavailability

For arsenic, the toxicity values in IRIS are based upon exposure to arsenic in water (USEPA, 2021a). The default assumption for assessing risk from arsenic in soil is that the bioavailability of arsenic in soil is the same as the bioavailability of arsenic dissolved in water. In other words, the relative bioavailability (RBA) of arsenic (all forms) in soil compared to water-soluble arsenic is assumed to be 1. This assumption will result in an overestimate of the true risk if the bioavailability of arsenic in soil is less than that of arsenic in water (USEPA, 2012). Therefore, consistent with recommendations in USEPA's RSL Table and the USEPA document *Compilation and Review of Data on Relative Bioavailability of Arsenic in Soil* (USEPA, 2012), the oral toxicity value used to evaluate soil ingestion was adjusted for use in the remedial goal calculations using the recommended RBA value of 0.6.

3.6 Comparison of Human Health Risk-Based Remedial Goals to Site Data

Table 3-10 provides a summary of the soil risk-based remedial goals calculated for each potential receptor. The lower of the values for the carcinogenic and non-carcinogenic endpoints for each constituent are shown in the table. A comparison of these remedial goals to maximum Site soil concentrations identified the following exceedances (Table 2):

Table 2 Summary of Human Health Remedial Goal Exceedances

Future Industrial/Commercial Worker	Future Short-Term Construction Worker	Future Long-Term Utility/Excavation Worker	Current/Future Youth Trespasser
2-Methylnaphthalene Benzo(a)pyrene TEQ Dibenzofuran Naphthalene Phenanthrene 2,3,7,8-TCDD TEQ Arsenic Chromium	2-Methylnaphthalene Benzo(a)pyrene TEQ Dibenzofuran Naphthalene 2,3,7,8-TCDD TEQ Arsenic Chromium	Benzo(a)pyrene TEQ 2,3,7,8-TCDD TEQ Arsenic Chromium	Benzo(a)pyrene TEQ Dibenzofuran 2,3,7,8-TCDD TEQ Arsenic Chromium

TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalency quotient

Exceedance locations are depicted in **Figure 3-1**. These locations are based on a comparison to remedial goals derived for future industrial/commercial workers, which are also protective of both future utility/excavation workers and current/future youth trespassers. Any future re-development of the Site by the NCSPA, would likely involve the placement of fill and pavement across the majority of the northern parcel. As indicated in the figure, few exceedances are located outside the extent of the conceptual cover.

Exceedances of remedial goals derived for future construction workers are not depicted on **Figure 3-1**. Consistent with NCDEQ's Risk Calculator User's Guide, the risk to construction workers should not drive a cleanup level but be used to help guide safety concerns during re-development activities.

4 Ecological Risk-Based Remedial Goals

This section summarizes ecological risk-based RGs for sediment and soil presented in the 2007 BERA (AMEC, 2007). Consistent with USEPA Region IV guidance (USEPA, 2015), RGs were calculated for constituents of potential ecological concern (COPECs) and receptors with calculated HQ values greater than 1 based on comparisons to lowest observed adverse effect level (LOAEL) toxicity reference values (TRVs). The 2007 BERA identified the following COPECs and receptors for RG development:

- Summed PCDD/Fs: Benthic invertebrate exposure via direct contact to sediment.
- tPAHs: Wildlife ingestion exposure via direct ingestion of benthic invertebrates and incidental ingestion of sediment.

Details on the development of the ecological risk-based sediment RGs are provided in the 2007 BERA (AMEC, 2007). **Section 4.1** presents a review of the sediment RGs developed in the 2007 BERA and provides supplementary data analyses to evaluate the protectiveness of the sediment RGs for additional exposure pathways associated with Greenfield Creek and the Drainage Ditch.

In addition to the development of sediment RGs, the 2007 BERA (AMEC, 2007) included an uncertainty analysis to evaluate the suitability of calculated sediment RGs for summed PCDD/Fs and tPAHs to other exposure media, specifically soil and sediment in adjacent wetlands and upland habitats adjoining Greenfield Creek and the Drainage Ditch. Preliminary soil RGs were estimated in the 2007 BERA for small invertivorous mammals based on potential exposure to short-tailed shrew and small invertivorous birds based on potential exposure to American robin. The 2007 BERA concluded that sediment-based RG values would not be protective of potential invertivorous receptors inhabiting adjacent terrestrial habitats; however, the BERA concluded that development of the property as a ports industrial site would likely eliminate complete terrestrial exposure pathways. Further consideration of terrestrial exposure pathways as an integrated part of the industrial development of the property was recommended in the 2007 BERA (AMEC, 2007). **Section 4.2** provides further evaluation of potential terrestrial exposure in the context of the current NCSPA conceptual development plan. Soil RGs are presented for the protection of ecological receptors for application in areas of the Site that are outside of the current development footprint.

4.1 Sediment Remedial Goals

The proposed RGs for dioxins/furans and PAHs in sediment and key ecological receptors that drove development of these values are presented in **Table 4-1**. The 2007 BERA did not derive sediment RG values for dioxins/furans or Site-related metals (i.e., arsenic, chromium, and copper) for wildlife since the individual HQ_{LOAEL} values were less than one (AMEC, 2007). A supplemental assessment of the direct contact exposure pathway for benthic invertebrate receptors to PAHs is also included within this section. The proposed RGs and supplemental assessment are summarized below.

4.1.1 Summed PCDD/Fs

The 2007 BERA (AMEC, 2007) proposed an ecological risk-based sediment RG for dioxins/furans of 59 µg/kg summed PCDD/Fs for the protection of direct contact toxicity to benthic invertebrate receptors (**Table 4-1**; AMEC, 2007). This RG was estimated based on 10-day sediment toxicity testing results for *H. azteca* and *C. dilutus* (formerly named *C. tentans*), and corresponding bulk sediment chemistry data. The

RG was estimated as 59 µg/kg, which was the greatest summed PCDD/F concentration measured in *H. azteca* and *C. dilutus* toxicity tests that had approximately 80 percent or greater survival and did not result in reduced growth. Given the absence of adverse effects on benthic invertebrate test organisms in Site-specific toxicity tests, 59 µg/kg summed PCDD/Fs was established as a reasonable RG for the protection of direct contact exposure to benthic invertebrate receptors (AMEC, 2007).

Sediment RGs for PCDD/F TEQs were not established for wildlife ingestion exposure pathways because food chain modeling of representative semi-aquatic avian and mammalian receptors presented in the 2007 BERA did not indicate hazard quotients greater than 1 based on LOAEL TRVs (AMEC, 2007). Food chain models estimating ingestion exposure to piscivorous receptors (American mink and great blue heron) and an insectivorous bird (Eastern kingbird) were based on Site-specific measurements of PCDD/Fs in fish tissue and emergent insect tissue.

Remediation of sediments based on the 59 µg/kg summed PCDD/Fs RG for the protection of direct contact exposure to benthic invertebrates will further reduce exposure point concentrations (EPCs) to wildlife receptors potentially foraging within the limited habitat of Greenfield Creek and the Drainage Ditch. The reduction of PCDD/F EPCs will reduce uncertainties associated with the exposure parameters and area use factors incorporated into the food chain models to further support the BERA conclusions regarding the absence of unacceptable risk to wildlife receptors through ingestion pathways.

4.1.2 PAHs

The proposed sediment RG for PAHs based on the wildlife ingestion pathway proposed in the 2007 BERA (AMEC, 2007) is presented below. A supplemental assessment of the direct contact exposure pathway for benthic invertebrate receptors to PAHs is also presented.

4.1.2.1 Wildlife Ingestion Pathways

The 2007 BERA proposed an ecological risk-based sediment RG for PAHs of 70 mg/kg for any individual PAH but allowed for greater concentrations provided that the average tPAH concentration does not exceed 700 mg/kg (**Table 4-1**; AMEC, 2007). The proposed sediment RGs were based on back-calculations from the wildlife ingestion model for the great blue heron. Risk to the great blue heron was driven by exposure via direct ingestion of benthic invertebrates and incidental ingestion of sediment while foraging. PAHs were not detected in fish tissue which comprised 99 percent of the modeled great blue heron diet (AMEC, 2007). Further details on the development of the sediment RG for PAHs are provided in the 2007 BERA (AMEC, 2007).

4.1.2.2 Direct Contact Pathways

In response to previous USEPA/NCDEQ comments on the proposed sediment RG for PAHs (NCDEQ, 2008), a supplemental evaluation of the direct contact exposure pathway to benthic invertebrates was conducted. PAHs do not readily bioaccumulate within aquatic food webs. As stated above, PAHs were below laboratory analytical detection limits in fish tissue. PAH toxicity in sediments is primarily associated with direct contact toxicity to benthic invertebrates via narcosis (USEPA, 2003b).

The assessment of potential direct contact toxicity of sediment PAHs to benthic invertebrate receptors was conducted using summed equilibrium-partitioning sediment benchmark toxic units (ESBTU) for PAHs within a given sample (∑ESBTUs) based on the analysis of bulk sediment data collected during the remedial investigations and 2021 supplemental sediment sampling, consistent with USEPA *Procedures for the Derivation of Equilibrium Partitioning* (EqP) *Sediment Benchmarks for the Protection of Benthic Organisms: PAH Mixtures* (USEPA, 2003b). This approach accounts for the varying bioavailability of constituents in different sediments as a function of PAH partitioning to total organic carbon (TOC) and allows for the incorporation of the appropriate biological effects concentration.

EqP-based sediment benchmarks (ESBs) derived in USEPA (2003b) were used to estimate the potential additive narcotic effects of PAH mixtures in sediment based on theoretical partitioning of PAH compounds between organic carbon and pore water. Exposure to PAH mixtures was evaluated based on the sum of ESBTUs calculated from individual PAH compounds:

$$\sum ESBTU_{FCV,34} = \sum_{i=1}^{13} \frac{C_{oc,PAHi}}{C_{oc,PAHi,FCVi}} \times UF$$

where:

$\sum ESBTU_{FCV,34}$ = Sum of ESBTUs for the mixture of 34 PAH compounds (unitless)

C_{ocPAHi} = Organic carbon normalized concentration of PAH *i* (micrograms per gram organic carbon [µg/g_{oc}])

$C_{ocPAHi,FCVi}$ = Organic carbon normalized critical concentration of PAH *i* based on the final chronic value (FCV; µg/g_{oc})

UF = Uncertainty factor to estimate the toxicity of total PAHs (based on 34 PAHs – 18 parent and 16 alkylated compounds)

∑ESBTU values were calculated based on the analysis of PAH-34 compounds ($\sum ESBTU_{FCV,34}$) to represent the $\sum ESBTU_{FCV,Total}$ values that USEPA (2003b) used as the basis for predicting toxicity to benthic invertebrate receptors. However, bulk sediment samples collected during the remedial investigation and 2021 supplemental sediment sampling activities were analyzed for fewer than 34 PAH compounds. Therefore, $\sum ESBTU_{FCV,34}$ values were estimated using ∑ESBTU values calculated based on the analysis of 13 PAH compounds ($\sum ESBTU_{FCV,13}$) and a conservative uncertainty factor (UF) of 2.75 (USEPA, 2003b) to account for the potential additive toxicity of unmeasured PAHs.

The resultant $\sum ESBTU_{FCV,34}$ values are shown in **Figure 4-1** and summarized in **Table 4-2**. PAH mixtures resulting in $\sum ESBTU_{FCV,34}$ values less than or equal to 1.0 are considered acceptable for the protection of benthic invertebrate receptors (USEPA, 2003b). $\sum ESBTU_{FCV,34}$ values marginally exceeding a value of 1.0 represent an uncertainty in the assessment but are unlikely to pose unacceptable risk due to the conservative nature of the UF applied.

4.2 Soil Remedial Goals

The 2007 BERA (AMEC, 2007) included an uncertainty analysis to evaluate the suitability of calculated sediment RGs for summed PCDD/Fs and tPAHs for application in soil and sediment in adjacent wetlands and upland habitats adjoining Greenfield Creek and the Drainage Ditch. The 2007 BERA concluded that

sediment-based RG values would not be protective of representative invertivorous receptors (short-tailed shrew or American robin) potentially foraging in adjacent terrestrial habitats but concluded that the development of the property as a ports industrial site would likely eliminate complete terrestrial exposure pathways. Further consideration of terrestrial exposure pathways as an integrated part of the industrial development of the property was recommended in the 2007 BERA (AMEC, 2007). The sections below present a supplemental assessment of potential terrestrial exposure to Site-related metals (i.e., arsenic, chromium, copper), PAHs (low molecular weight [LMW], high molecular weight [HMW], and tPAHs), and PCDD/Fs in the context of the current NCSPA conceptual development plan. Soil RGs are presented for the protection of ecological receptors for application in areas of the Site that are outside of the current development footprint.

4.2.1 Supplemental Terrestrial Exposure Evaluation

The 2007 BERA focused on quantifying ecological risks to aquatic (benthic invertebrates and fish) and semi-aquatic wildlife with complete exposure pathways to sediments and surface water within Greenfield Creek and the Drainage Ditch (AMEC, 2007). Except for a Site-wide evaluation of exposure to red-tailed hawk and the uncertainty analysis of the suitability of sediment RGs for summed PCDD/Fs and tPAHs for application in soil and sediment in adjacent wetlands and upland habitats, risks to terrestrial receptors potentially exposed to Site-related constituents in adjacent wetland and upland soils were not evaluated in the 2007 BERA based on the assumption that the anticipated development of the property would eliminate potential terrestrial exposure pathways (AMEC, 2007).

Based on the current NCSPA conceptual development plan, potential terrestrial exposure pathways will be eliminated by the construction of a multi-purpose terminal on the northern parcel (**Figure 2-1**); however, the southern parcel of the property may remain undeveloped and potential exposure pathways to terrestrial receptors may remain complete. Given that terrestrial exposure pathways may remain complete following development, an evaluation of potential terrestrial exposure was conducted to supplement the risk evaluations presented in the 2007 BERA (AMEC, 2007). Additional soil data collected as part of the 2018 Brownfields Program sampling (**Section 2.4.1**) were also included in the supplemental terrestrial exposure evaluation.

Analytical results for Site-related metals and PAHs in wetland and upland soils were screened against the soil screening values for plants, soil invertebrates, mammals, and birds presented in the *Region 4 Ecological Risk Assessment Supplement Guidance Interim Draft* (USEPA, 2015). The minimum soil screening value for each receptor group was used to identify soil COPECs that may require further evaluation or the development of soil RGs.

The results of the screening evaluation are presented in **Table 4-3**. Based on the screening evaluation using conservative USEPA Region 4 screening criteria, PCDD/Fs, PAHs (LMW and HMW), arsenic, and copper were retained as COPECs for RG development.

4.2.2 Soil Remedial Goal Approach

Based on the finding of the supplemental terrestrial exposure evaluation presented in the preceding section, preliminary soil RGs for the protection of ecological receptors were developed for the following Site-related COPECs:

- PCDD/Fs: 2,3,7,8-TCDD (direct contact) and 2,3,7,8-TCDD TEQ (wildlife)
- LMW and HMW PAHs
- Arsenic
- Copper

Preliminary soil RGs were developed for the protection of wildlife ingestion pathways based on back-calculations of food chain models from LOAEL TRVs. Preliminary soil RGs for the protection of direct contact toxicity to soil invertebrate and terrestrial plant communities were developed based on lowest observed effect concentration (LOEC) benchmarks derived from literature sources. The minimum RG calculated for the protection of direct contact and wildlife ingestion pathways was selected as the preliminary soil RG protective of each terrestrial receptor group for the undeveloped upland and wetland habitats at the Site. A summary of preliminary soil RGs is presented in **Table 4-4**.

Preliminary soil RGs were based on low-effect (rather than no-effect) endpoints. This is consistent with the derivation of preliminary remediation goals (PRGs) at the Los Alamos National Laboratory (LANL) and other commonly cited guidance (LANL, 2017b; Efroymson et al., 1997). As stated in Efroymson et al. (1997), PRGs are thresholds for significant effects, and are anticipated to correspond to minimal and acceptable levels of effects.

Ecological risk assessment databases, such as the LANL EcoRisk Database (LANL, 2017a) also use low-effect endpoints in the development of their recommended PRGs. LANL (2017b) PRG guidance recommends using LOAELs and LOECs to develop PRGs that are protective of wildlife populations, which is the appropriate level of protection for the assessment endpoints identified in the 2007 BERA (AMEC, 2007). The following sections present the approach for developing soil RGs for wildlife ingestion and direct contact exposure pathways.

4.2.2.1 Wildlife Ingestion Pathways

The 2007 BERA calculated ecological risk-based RGs for PCDD/Fs (on a 2,3,7,8-TCDD TEQ basis) in soil for the protection of invertivorous mammals and birds, based on back-calculations of dietary exposure models from LOAEL TRVs for the short-tailed shrew and American robin, respectively (AMEC, 2007). The RG based on the short-tailed shrew model was calculated as 91 nanograms per kilogram (ng/kg) 2,3,7,8-TCDD TEQ_{mammal} and the RG based on the American robin model was calculated as 38 ng/kg 2,3,7,8-TCDD TEQ_{avian} (AMEC, 2007). These values were evaluated as part of the RG development assessment for the 2007 BERA but were not included in the risk characterization since the property was anticipated to be developed as an industrial ports facility in the future, which was expected to result in incomplete terrestrial exposure pathways (AMEC, 2007).

As part of the development of preliminary RGs for wildlife ingestion pathways, the risk-based 2,3,7,8-TCDD TEQ RGs for invertivorous receptors calculated in the 2007 BERA were re-evaluated. The re-evaluation identified multiple discrepancies in the RG calculations presented in the 2007 BERA including:

- American robin dietary model: An inconsistent moisture basis was used for modeling dietary ingestion to American robin. Food ingestion rates were based on ingestion rates for wet weight dietary items, while dietary concentrations in the model were based on dry weight concentrations.

- Short-tailed shrew dietary model: The LOAEL TRV was based on the TRVs presented in the 2007 BERA for American mink (*Mustela vison*). Mink TRVs were derived in the 2007 BERA by allometric scaling of the LOAEL endpoint for rat test organisms from Murray et al. (1979) for application to mink based on differences in body weight of the test organism and modeled receptor (AMEC, 2007). The allometrically scaled TRVs for mink are inappropriate for application in the short-tailed shrew exposure model based on the differences in body weight between the modeled receptors.
- Soil-to-invertebrate bioaccumulation factors (BAFs): Soil-to-earthworm BAFs were updated for 2,3,7,8-TCDD based on studies conducted since the submittal of the 2007 BERA.

Revised dietary models were developed to address the discrepancies in the risk-based 2,3,7,8-TCDD TEQ RGs for invertivorous receptors calculated in the 2007 BERA. Additional risk-based RGs were also calculated from the revised dietary models for the Site-related COPECs identified in the supplemental terrestrial exposure evaluation (**Section 4.2.1**).

Dietary Exposure Model Structure

Preliminary RGs for the protection of wildlife ingestion pathways were derived consistent with the approach presented in USEPA guidance for developing Ecological Soil Screening Levels (Eco-SSLs; USEPA 2005b). Preliminary RGs were established based on back-calculations of dietary exposure models from LOAEL TRVs; model calculations and supporting input parameters are provided in **Appendix D**. Preliminary RGs were established by calculating the estimated daily dose (EDD) to a receptor that is equivalent to an LOAEL dose using the following dietary exposure model:

$$EDD = FIR \times \left(C_s \times P_s + B_i\right) = LOAEL$$

where:

EDD = Estimated daily dose to the receptor (mg/kg BW wet weight/day)
FIR = Food ingestion rate (kg food dry weight/kg BW wet weight/day; **Table D-1**)
Ps = Soil ingestion as proportion of diet (**Table D-1**)
Cs = Soil concentration equivalent to the preliminary RG (mg/kg dry weight)
Bi = Estimated concentration in dietary item (mg/kg dry weight; **Table D-2**)
LOAEL = Lowest observable adverse effects level (mg/kg BW wet weight/day; **Table D-3**)

Based on the dietary exposure model above, preliminary soil RGs were solved iteratively[6] for each receptor by adjusting the soil concentration (C_s) until the EDD was equivalent to the LOAEL-based TRV. The soil concentration resulting in an EDD equivalent to the LOAEL was established as the preliminary RG for each receptor. Calculations of LOAEL-based preliminary RGs for each representative wildlife receptor are presented in **Table D-4**. The lowest (most sensitive) preliminary RG calculated for avian and mammalian receptors, shown in bold in **Table D-4**, was selected as the preliminary RG protective of wildlife exposure for each respective COPEC.

Consistent with the development of Eco-SSLs, preliminary soil RGs were calculated for wildlife receptors that are representative of the primary trophic groups that may be exposed to terrestrial soils at the Site.

[6] Preliminary RGs were solved iteratively using the Goal Seek function in Microsoft Excel. The C_s variable was modified iteratively using Goal Seek until the EDD was equal to the LOAEL. The C_s variable resulting in an EDD equal to the LOAEL was identified as the preliminary RG for each modeled receptor.

Except for one avian (American robin) and one mammalian (red fox) receptor, the receptors selected for the calculation of preliminary RGs were identical to the receptors used in the derivation of Eco-SSLs. American robin and red fox were identified as more appropriate receptors than American woodcock and long-tailed weasel, respectively, because they are more common and representative of the primary trophic groups at the Site. The use of American robin as a representative invertivorous receptor is also consistent with its use as a representative receptor in the 2007 BERA (AMEC, 2007). Preliminary RGs for 2,3,7,8-TCDD TEQ were calculated only for invertivorous receptors, due to their sensitivity to PCDD/F exposure via bioaccumulation into soil invertebrate dietary items and the limited information on the bioaccumulation of PCDD/F into terrestrial plants and small mammals that are the modeled dietary items for other receptor groups. The following sections describe the selection of exposure parameters, BAFs, and TRVs used in the preliminary soil RG calculations for wildlife.

Exposure Parameters

Exposure parameters, including BWs, food ingestion rates, soil ingestion rates, and assumed dietary composition for receptors included in the development of Eco-SSLs were identical to those presented in the Eco-SSLs guidance (USEPA, 2005b; **Table D-1**). Exposure parameters for American robin and red fox were derived from literature sources of wildlife exposure parameters as indicated in **Table D-1** (Sample et al., 1994; Nagy, 2001; Beyer et al., 1994).

Soil-to-Biota Bioaccumulation Factors

The bioaccumulation of COPECs from soil to wildlife dietary items was estimated using literature-derived BAFs and regression models. Estimates of soil-to-biota uptake of metal COPECs and PAHs were obtained primarily from literature sources used in the derivation of Eco-SSLs (Bechtel-Jacobs, 1998; Sample et al., 1999, 1998a, 1998b; Baes et al., 1984; USEPA, 2007).

The soil-to-earthworm BAF for PCDD/Fs used in the dietary exposure models for American robin and short-tailed shrew was based on BAFs derived from an earthworm bioaccumulation study conducted by Henriksson et al. (2017) at contaminated sawmill sites. BAFs calculated from the analysis of PCDD/Fs in paired earthworm tissue and soil samples (samples 057 and 058 in Henriksson et al. [2017]) were selected for BAF derivation based on similarity to Site soils. The 90th percentile BAF for 2,3,7,8-TCDD (0.975)[7] calculated from eight paired earthworm tissue and soil samples was selected as a conservative BAF for use in the dietary exposure models.

Toxicity Reference Values

TRVs used in the derivation of preliminary RGs for metals and PAHs (LMW and HMW) were calculated based on LOAELs obtained from toxicological data compiled for the derivation of Eco-SSLs and other literature sources (**Table D-3**). Growth and reproductive endpoints were selected as the basis for TRVs, consistent with the derivation of Eco-SSLs (USEPA, 2007). LOAEL endpoints were used as the basis for

[7] Earthworm tissues in Henriksson et al. (2017) were reported on a wet-weight basis. Therefore, wet-weight tissue concentrations reported in Henriksson et al. (2017) were converted to dry weight tissue concentrations based on an assumed moisture content of 30 percent, consistent with the assumed moisture content of earthworms in the 2007 BERA. BAF calculations were based on dry weight tissue and dry weight soil to ensure a consistent moisture basis in the dietary exposure models.

TRVs in the calculation of preliminary RGs to represent potential threshold concentrations above which adverse ecological effects may occur. As a result, preliminary RGs derived based on LOAEL endpoints represent concentrations that are more appropriate as the basis for remedial decision-making than conservative ecological screening criteria (e.g., Eco-SSLs) that are intended for initial phases of the ecological risk assessment process.

For COPECs with greater than four bounded LOAELs[8], the 20th percentile of bounded LOAELs for growth and reproduction endpoints from accepted Ecological Soil Screening Level (Eco-SSL) studies was selected as a representative LOAEL. If less than four bounded LOAELs were available for a COPEC, the 20th percentile of available LOAELs for growth and reproduction endpoints reported in accepted Eco-SSL studies was selected as a representative LOAEL.

Insufficient toxicological data were available from accepted Eco-SSL studies to derive LOAEL TRVs for avian exposure to PAHs (LMW and HMW PAHs) and 2,3,7,8-TCDD (avian and mammalian). LOAELs for avian exposure to LMW and HMW PAHs were derived from studies by Patton and Dieter (1980) and Trust et al. (1994), respectively. LOAELs for 2,3,7,8-TCDD were selected from an avian study (Nosek et al. 1992) and a mammalian study (Murray et al., 1979) selected in the Sample et al. (1996) compilation of toxicological benchmarks for wildlife. Consistent with the approach in the 2007 BERA, the LOAEL TRV for short-tailed shrew was allometrically scaled from the rat test organism body weight (0.35 kg) to the short-tailed shrew body weight (0.018 kg) based on the following relationship:

$$NOAEL_{Receptor} = NOAEL_{Test} \times \left(\frac{BW_{Test}}{BW_{Receptor}}\right)^{0.25}$$

where:

$NOAEL_{Receptor}$ = NOAEL for the modeled receptor (mg/kg BW wet weight/day)
$NOAEL_{Test}$ = NOAEL for the test organism (mg/kg BW wet weight/day)
$BW_{Receptor}$ = Body weight of modeled receptor (kg wet weight)
BW_{Test} = Body weight of test organism (kg wet weight)

4.2.2.2 Direct Contact Pathways

Direct contact preliminary soil RGs for the protection of terrestrial plants and soil invertebrates were based on LANL Ecological Screening Level LOEC (ESL_{LOEC}) values provided in the LANL EcoRisk Database (Version 4.1; LANL, 2017a) or lowest observed adverse effect concentrations (LOAECs) and maximum acceptable toxicant concentrations (MATCs) from studies accepted for use in the derivation of Eco-SSLs (**Table 4-4**). These low effect-based concentrations are considered protective of the maintenance and sustainability of terrestrial plant and soil invertebrate communities.

4.3 Comparison of Ecological Risk-Based Remedial Goals to Site Data

Preliminary RGs are intended to serve as delineation criteria to identify the potential extent of remedial action; however, wildlife RGs represent concentrations that may potentially result in adverse effects to

[8] Bounded refers to LOAELs derived from studies that report NOAEL and LOAEL endpoints to bound the threshold of observed adverse effects.

wildlife through integrated exposure over the entire foraging range of each representative receptor. As a result, preliminary wildlife RGs do not represent a not-to-exceed concentration at any single sampling location, but rather an average concentration that is not to be exceeded over the entire foraging range of the most sensitive receptor. A risk assessor should be consulted regarding additional details and appropriate applications of preliminary RGs during remedial decision-making to ensure that the assumptions and conditions that are inherent in the preliminary RG calculations are considered at an early stage of the remedial decision-making process.

It is also important to emphasize that preliminary RGs should be applied as one line of evidence in a weight-of-evidence approach to risk management decision-making for sediment and soils at the Site. Potential remedial actions to mitigate exposure to EPCs exceeding preliminary RGs should consider the extent of remediation to ensure a net environmental benefit in balancing ecological risk reduction with habitat loss due to the remedial action. Further, the application of preliminary RGs should also consider potential receptor exposure based on the availability of ecological habitats and complete exposure pathways under current and planned future land use for the Site.

Section 4.3.1 and Section 4.3.2 present results of the comparison of ecological risk-based RGs to sediment and soil data collected from the Site.

4.3.1 Sediment Remedial Goals

Exceedances of the proposed sediment RG for dioxins/furans (59 µg/kg summed PCDD/Fs) are shown in **Figure 4-2**. Exceedances of this RG were primarily identified in the Covered Ditch Area, the majority of the Drainage Ditch, in segments of Greenfield Creek (near the confluence of the Drainage Ditch and elbow area), and at one station within the slip along the Cape Fear River margin. Sediments from several wetland stations, primarily associated with the Drainage Ditch, also exceeded the proposed sediment RG for dioxins/furans (**Figure 4-2**).

The $\sum ESBTU_{FCV,34}$ assessment of PAHs in sediment supplements the direct contact exposure assessment for benthic invertebrates (**Figure 4-1**). Sediment sampling stations with $\sum ESBTU_{FCV,34}$ values greater than 1.0 largely correspond to stations exceeding the proposed sediment RG for dioxins/furans. Several exceptions were noted at stations associated with the Covered Ditch Area and Drainage Ditch, within Greenfield Creek and the Cape Fear River margin. $\sum ESBTU_{FCV,34}$ values marginally greater than 1 represent an uncertainty but are unlikely to pose unacceptable risk to benthic invertebrate due to the conservative nature of the UF.

Exceedances of the proposed sediment RG for tPAHs based on the great blue heron dietary model were identified at three stations in the Drainage Ditch (SD-07, SD-26, and SD-28) and one station in Greenfield Creek (GC02). These four stations correspond with stations also exceeding an $\sum ESBTU_{FCV,34}$ value of 1.0 for PAHs and the proposed sediment RG for dioxins/furans.

4.3.2 Soil Remedial Goals

Exceedances of the proposed soil RG for dioxins/furans for the protection of small invertivorous mammals (105 ng/kg 2,3,7,8-TCDD TEQ on mammalian basis) are shown in **Figure 4-3**. Exceedances of this RG were identified in wetland soils near the Covered Ditch Area and Drainage Ditch, one wetland

station in the central portion of the southern land parcel (SD-15), and at several upland stations in the northern parcel, primarily within the former land farm area. The upland stations exceeding the proposed soil RG for dioxins/furans within the northern parcel are located within the footprint of the NCSPA conceptual development plan, except for station SS-06, which is located immediately outside of the proposed footprint (**Figure 4-3**).

Exceedances of the soil RG for dioxins/furans for the protection of invertivorous birds (878 ng/kg 2,3,7,8-TCDD TEQ on avian basis) are shown in **Figure 4-4**. Exceedances of this RG were identified at one wetland soil station near the Drainage Ditch (SD-28) and several upland stations within the northern parcel, primarily within the former land farm area. The upland stations exceeding the proposed soil RG for dioxins/furans within the northern parcel are located within the footprint of the NCSPA conceptual development plan, except for station SS-06 (**Figure 4-4**).

The integrated exceedances of the proposed soil RGs for direct contact and wildlife ingestion exposure pathways to terrestrial receptors are summarized in **Table 4-5** and depicted in **Figure 4-5**. Exceedances of the proposed soil RGs, based on the most sensitive terrestrial receptor, were identified in wetland soils near the Covered Ditch Area and Drainage Ditch, several wetland stations in the southern land parcel, and multiple upland stations in the northern parcel. The upland stations exceeding the proposed soil RGs within the northern parcel are primarily located within the footprint of the NCSPA conceptual development plan (**Figure 4-5**).

5 Integrated Risk-Based Recommendations

Exceedances of the human health and/or ecological risk-based RGs for soil are integrated in **Figure 5-1.** Exceedances of the proposed risk-based RGs for soils were identified in wetland and/or upland soils associated with the Covered Ditch Area and Drainage Ditch, the central portion of the southern parcel, and multiple locations within the northern parcel (**Figure 5-1**). For sediment, exceedances of the ecological risk-based RGs were identified in the Covered Ditch Area and Drainage Ditch (and associated wetlands), in segments of Greenfield Creek, and at one station within the slip along the Cape Fear River margin in an area likely to be modified by NCSPA development activities (**Figure 4-2**).

If the NCSPA conceptual development plan for a multi-purpose terminal on the northern parcel of the Site or other plans for development move forward, remedial goals for soil within the development footprint should be based on the protection of human health.

It is anticipated that the risk-based remedial goals presented within this Addendum will be used to define the extent of remedial action undertaken at the Site and verify that conditions remaining following completion of the remedial action are protective to potential receptors under current and future land uses. The risk-based remedial goals should not be construed as not-to-exceed values. It is recommended that during remedial alternative evaluations, the risk-based remedial goals be compared to exposure point concentrations estimated to represent the reasonable maximum exposure (95 percent upper confidence limit [UCL] on the arithmetic mean) that is expected to occur at the Site.

6 References

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Tables

Table 3-1
Selection of Constituents of Potential Concern for Surface Soil
SWP and NCSPA Site
Wilmington, NC

Analyte[1]	CAS No.	Units	Number of Samples	Number of Detects	Detection Frequency (%)	Minimum Detect	Maximum Detect	NCDEQ Ind/Com Health-Based PSRG[2]	Exceed PSRG?	COPC Y/N?	Rationale[3]
Volatile Organic Compounds											
1,2,4-Trimethylbenzene	95-63-6	MG/KG	16	1	6%	6.77E-02	6.77E-02	3.7E+02	No	No	BSL
Acetone	67-64-1	MG/KG	44	7	16%	6.40E-02	1.44E+00	1.4E+05	No	No	BSL
Chloroform	67-66-3	MG/KG	44	5	11%	5.55E-02	9.74E-02	1.5E+00	No	No	BSL
Methyl Ethyl Ketone	78-93-3	MG/KG	44	2	5%	2.10E-02	2.90E-02	4.0E+04	No	No	BSL
Methylene Chloride	75-09-2	MG/KG	72	2	3%	9.40E-03	1.10E-02	6.5E+02	No	No	BSL
m,p-Xylene	108-38-3/106-42-3	MG/KG	44	3	7%	6.50E-03	1.10E-02	5.0E+02	No	No	BSL
Semi-volatile Organic Compounds											
2,4-Dimethylphenol	105-67-9	MG/KG	114	2	2%	6.05E-02	7.00E-02	3.3E+03	No	No	BSL
3&4-Methylphenol	108-39-4/106-44-5	MG/KG	41	1	2%	7.58E-02	7.58E-02	8.2E+03	No	No	BSL
2-Chlorophenol	95-57-8	MG/KG	114	1	1%	3.90E-02	3.90E-02	1.2E+03	No	No	BSL
1-Methylnaphthalene	90-12-0	MG/KG	16	3	19%	9.00E-02	1.08E+00	7.3E+01	No	No	BSL
2-Methylnaphthalene	91-57-6	MG/KG	42	10	24%	4.70E-02	9.72E-01	6.0E+02	No	No	BSL
Acenaphthene	83-32-9	MG/KG	114	15	13%	2.30E-02	6.00E+01	9.0E+03	No	No	BSL
Acenaphthylene	208-96-8	MG/KG	113	27	24%	3.17E-02	1.10E+01	4.5E+03	No	No	BSL
Anthracene	120-12-7	MG/KG	114	50	44%	3.40E-02	2.00E+02	4.5E+04	No	No	BSL
Benzo(a)anthracene	56-55-3	MG/KG	114	78	68%	3.70E-02	6.40E+01	2.1E+01	**Yes**	**Yes**	**ASL**
Benzo(a)pyrene	50-32-8	MG/KG	114	77	68%	3.57E-02	2.90E+01	2.1E+00	**Yes**	**Yes**	**ASL**
Benzo(b)fluoranthene	205-99-2	MG/KG	49	43	88%	3.43E-02	6.00E+01	2.1E+01	**Yes**	**Yes**	**ASL**
Benzo(b,k)fluoranthene	See note	MG/KG	65	49	75%	1.50E-01	6.00E+01	2.1E+01	**Yes**	**Yes**	**ASL**
Benzo(g,h,i)perylene	191-24-2	MG/KG	42	32	76%	2.41E-02	1.70E+01	4.5E+03	No	No	BSL
Benzo(k)fluoranthene	207-08-9	MG/KG	49	38	78%	4.00E-01	3.00E+01	2.1E+02	No	No	BSL
Bis(2-Ethylhexyl)phthalate	117-81-7	MG/KG	42	5	12%	7.46E-02	8.00E-01	1.6E+02	No	No	BSL
Carbazole	86-74-8	MG/KG	114	33	29%	4.60E-02	1.10E+01	No Value	No	No	NTX
Chrysene	218-01-9	MG/KG	114	91	80%	4.20E-02	7.80E+01	2.1E+03	No	No	BSL
Dibenz(a,h)anthracene	53-70-3	MG/KG	114	11	10%	2.52E-02	2.61E+00	2.1E+00	**Yes**	**Yes**	**ASL**
Dibenzofuran	132-64-9	MG/KG	42	16	38%	2.80E-02	4.60E+00	2.3E+02	No	No	BSL
Di-n-butyl phthalate	84-74-2	MG/KG	36	2	6%	5.80E-02	1.00E-01	1.6E+04	No	No	BSL
Fluoranthene	206-44-0	MG/KG	114	92	81%	4.80E-02	3.90E+02	6.0E+03	No	No	BSL
Fluorene	86-73-7	MG/KG	42	12	29%	2.81E-02	9.60E+01	6.0E+03	No	No	BSL
Hexachlorobenzene	118-74-1	MG/KG	37	1	3%	4.00E-02	4.00E-02	9.9E-01	No	No	BSL
Indeno(1,2,3-cd)pyrene	193-39-5	MG/KG	114	61	54%	3.36E-02	1.70E+01	2.1E+01	No	No	BSL
Naphthalene	91-20-3	MG/KG	114	19	17%	4.20E-02	9.90E-01	8.8E+00	No	No	BSL
p-Chloroaniline	106-47-8	MG/KG	21	1	5%	6.20E-01	6.20E-01	1.1E+01	No	No	BSL
Pentachlorophenol	87-86-5	MG/KG	114	9	8%	1.60E-01	5.30E+00	4.0E+00	Yes	No	IFD
Phenanthrene	85-01-8	MG/KG	114	56	49%	3.04E-02	2.30E+02	4.5E+03	No	No	BSL
Pyrene	129-00-0	MG/KG	42	33	79%	5.21E-02	2.30E+02	4.5E+03	No	No	BSL
Herbicides/Pesticides/PCBs											
2,4-DB	94-82-6	MG/KG	14	3	21%	3.75E-02	7.72E-02	4.9E+03	No	No	BSL
4,4-DDD	72-54-8	MG/KG	35	2	6%	1.12E-02	2.14E-02	4.9E+00	No	No	BSL
4,4-DDE	72-55-9	MG/KG	35	2	6%	1.50E-02	1.15E-01	9.3E+00	No	No	BSL
4,4-DDT	50-29-3	MG/KG	35	5	14%	8.70E-04	2.18E-02	8.5E+00	No	No	BSL
Dichloroprop	120-36-5	MG/KG	14	1	7%	1.38E-02	1.38E-02	No Value	No	No	NTX
Endosulfan I	959-98-8	MG/KG	35	6	17%	5.20E-03	1.30E-01	1.4E+03	No	No	BSL
Endosulfan Sulfate	1031-07-8	MG/KG	35	1	3%	1.15E-01	1.15E-01	9.8E+02	No	No	BSL
Endrin	72-20-8	MG/KG	35	1	3%	1.50E-01	1.50E-01	4.9E+01	No	No	BSL
Endrin Aldehyde	7421-93-4	MG/KG	35	1	3%	1.29E-02	1.29E-02	4.9E+01	No	No	BSL
Endrin Ketone	53494-70-5	MG/KG	35	2	6%	6.60E-04	1.95E-02	4.9E+01	No	No	BSL
Dioxin/Furans											
TCDD-TEQ	1746-01-6	MG/KG	44	44	100%	1.03E-06	1.30E-02	2.2E-05	**Yes**	**Yes**	**ASL**
Inorganics											
Aluminum	7429-90-5	MG/KG	35	35	100%	3.10E+02	6.86E+03	2.3E+05	No	No	BSL
Arsenic	7440-38-2	MG/KG	114	94	82%	4.10E-01	1.30E+03	3.0E+00	**Yes**	**Yes**	**ASL**
Barium	7440-39-3	MG/KG	21	21	100%	2.00E+00	4.30E+01	4.7E+04	No	No	BSL
Cadmium	7440-43-9	MG/KG	21	1	5%	1.00E+00	1.00E+00	2.0E+02	No	No	BSL
Chromium	18540-29-9	MG/KG	114	114	100%	1.40E+00	1.20E+03	6.5E+00	**Yes**	**Yes**	**ASL**
Cobalt	7440-48-4	MG/KG	21	5	24%	8.00E-01	2.80E+00	7.0E+01	No	No	BSL
Copper	7440-50-8	MG/KG	114	92	81%	5.40E-01	1.60E+03	9.3E+03	No	No	BSL
Cyanide	57-12-5	MG/KG	35	14	40%	6.20E-02	1.10E-01	3.1E+01	No	No	BSL
Lead	7439-92-1	MG/KG	35	35	100%	1.60E+00	1.00E+02	8.0E+02	No	No	BSL
Manganese	7439-96-5	MG/KG	21	21	100%	3.80E+00	2.30E+02	5.6E+03	No	No	BSL
Mercury	7487-94-7	MG/KG	21	5	24%	1.20E-01	7.70E-01	7.0E+01	No	No	BSL
Nickel	7440-02-0	MG/KG	21	3	14%	1.30E+00	6.00E+00	4.7E+03	No	No	BSL
Vanadium	7440-62-2	MG/KG	21	20	95%	2.40E+00	1.90E+01	1.2E+03	No	No	BSL
Zinc	7440-66-6	MG/KG	21	21	100%	1.80E+00	1.00E+02	7.0E+04	No	No	BSL

Notes:

1 - Constituents detected in soil samples (surface, 0-1') collected at the Site since between 1991 and 2018. Data as presented in February 12, 2009 Revised Supplemental Human Health Risk Evaluation and April 27, 2018 Draft Brownfields Update Report. Tentatively identified compounds (TICs) and essential nutrients (calcium, iron, magnesium, potassium and sodium) were excluded from the evaluation.

TEQ - Toxicity Equivalence. TEQ for each analyte is determined by multiplying the toxicity equivalency factor (TEF) by the laboratory concentration.
TEF values based on the 2005 WHO update of TEF values as recommended in USEPA's December 2010 guidance.

2 - North Carolina Department of Environmental Quality (NCDEQ) Preliminary Soil Remediation Goals (PSRGs) based on cancer risk of $1x10^{-6}$ and a hazard quotient (HQ) of 0.2 (June 2021 version)
Value for chromium is PSRG for hexavalent chromium
Value for cyanide is lowest PSRG listed for cyanide species
Value for mercury is PSRG for mercuric chloride
Value for TCDD-TEQ is PSRG for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)

The following surrogates were used for constituents without a PSRG value:

Analyte	Surrogate
Acenaphthylene	Pyrene
Benzo(b,k)fluoranthene	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	Pyrene
Phenanthrene	Pyrene
Endosulfan I	Endosulfan
Endrin Aldehyde	Endrin
Endrin Ketone	Endrin

3 - Rationale codes:
ASL - Above Screening Level
BSL - Below Screening Level
IFD - Infrequently detected (less than 5% detection or exceedance frequency)
NTX - No toxicity information

Bold text and yellow shading indicates COPC selection

CAS - Chemical Abstracts Service
COPC - constituent of potential concern
MG/KG - milligrams per kilogram
PCB - polychlorinated biphenyls
TCDD-TEQ - 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalence
WHO - World Health Organization
2,4-DB - 2,4-dichlorophenoxybutyric acid
4,4-DDD - 4,4-Dichlorodiphenyldichloroethane
4,4-DDE - 4,4-dichlorodiphenyldichloroethylene
4,4-DDT - 4,4-dichlorodiphenyltrichloroethane

NCDEQ, 2021. Preliminary Soil Remediation Goals Table. June 2021
USEPA, 2010. Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8- Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, DC. EPA/100/R10/005. December 2010. Available online at: http://www.epa.gov/osa/raf/hhtefguidance/

Table 3-2
Selection of Constituents of Potential Concern for Subsurface Soil
SWP and NCSPA Site
Wilmington, NC

Analyte[1]	CAS No.	Units	Number of Samples	Number of Detects	Detection Frequency (%)	Minimum Detect	Maximum Detect	NCDEQ Ind/Com Health-Based PSRG[2]	Exceed PSRG?	COPC Y/N?	Rationale[3]
Volatile Organic Compounds											
Benzene	71-43-2	MG/KG	47	1	2%	7.80E-02	7.80E-02	5.4E+00	No	No	BSL
Ethylbenzene	100-41-4	MG/KG	47	4	9%	2.10E-02	5.30E-01	2.7E+01	No	No	BSL
Methyl Ethyl Ketone	78-93-3	MG/KG	21	4	19%	1.90E-02	7.10E-02	4.0E+04	No	No	BSL
Toluene	108-88-3	MG/KG	47	1	2%	5.50E-01	5.50E-01	9.7E+03	No	No	BSL
m,p-Xylene	108-38-3/106-42-3	MG/KG	26	6	23%	6.40E-03	4.40E-01	5.0E+02	No	No	BSL
o-Xylene	95-47-6	MG/KG	26	1	4%	2.00E-01	2.00E-01	5.9E+02	No	No	BSL
Xylenes (total)	1330-20-7	MG/KG	21	3	14%	4.70E-02	2.30E+00	5.3E+02	No	No	BSL
Semivolatile Organic Compounds											
2-Methylnaphthalene	91-57-6	MG/KG	21	8	38%	4.20E-02	2.40E+03	6.0E+02	**Yes**	**Yes**	**ASL**
Acenaphthene	83-32-9	MG/KG	68	16	24%	5.30E-02	4.90E+03	9.0E+03	No	No	BSL
Acenaphthylene	208-96-8	MG/KG	68	7	10%	4.20E-02	2.30E+00	4.5E+03	No	No	BSL
Anthracene	120-12-7	MG/KG	68	23	34%	3.70E-02	4.60E+03	4.5E+04	No	No	BSL
Benzo(a)anthracene	56-55-3	MG/KG	68	32	47%	3.70E-02	1.40E+03	2.1E+01	**Yes**	**Yes**	**ASL**
Benzo(a)pyrene	50-32-8	MG/KG	68	29	43%	4.10E-02	3.70E+02	2.1E+00	**Yes**	**Yes**	**ASL**
Benzo(b)fluoranthene	205-99-2	MG/KG	26	14	54%	1.30E+00	9.90E+01	2.1E+01	**Yes**	**Yes**	**ASL**
Benzo(b,k)fluoranthene	See note	MG/KG	42	22	52%	4.40E-02	1.00E+03	2.1E+01	**Yes**	**Yes**	**ASL**
Benzo(g,h,i)perylene	191-24-2	MG/KG	21	11	52%	4.20E-02	1.60E+01	4.5E+03	No	No	BSL
Benzo(k)fluoranthene	207-08-9	MG/KG	26	13	50%	4.40E-01	3.60E+01	2.1E+02	No	No	BSL
Carbazole	86-74-8	MG/KG	68	9	13%	3.90E-02	1.20E+03	No Value	No	No	NTX
Chrysene	218-01-9	MG/KG	68	36	53%	4.10E-02	1.40E+03	2.1E+03	No	No	BSL
Dibenz(a,h)anthracene	53-70-3	MG/KG	68	1	1%	6.00E-01	6.00E-01	2.1E+00	No	No	BSL
Dibenzofuran	132-64-9	MG/KG	21	8	38%	7.90E-02	4.00E+03	2.3E+02	**Yes**	**Yes**	**ASL**
Fluoranthene	206-44-0	MG/KG	68	43	63%	7.70E-02	7.30E+03	6.0E+03	**Yes**	**Yes**	**ASL**
Fluorene	86-73-7	MG/KG	21	9	43%	6.90E-02	7.00E+03	6.0E+03	**Yes**	**Yes**	**ASL**
Indeno(1,2,3-cd)pyrene	193-39-5	MG/KG	68	20	29%	5.70E-02	8.80E+01	2.1E+01	**Yes**	**Yes**	**ASL**
Naphthalene	91-20-3	MG/KG	68	10	15%	5.40E-02	2.90E+03	8.8E+00	**Yes**	**Yes**	**ASL**
Phenanthrene	85-01-8	MG/KG	68	26	38%	6.00E-02	1.50E+04	4.5E+03	**Yes**	**Yes**	**ASL**
Pyrene	129-00-0	MG/KG	21	17	81%	4.90E-02	4.60E+03	4.5E+03	**Yes**	**Yes**	**ASL**
Pesticides/PCBs											
4,4-DDD	72-54-8	MG/KG	21	3	14%	2.00E-02	6.40E-02	4.9E+00	No	No	BSL
4,4-DDE	72-55-9	MG/KG	21	2	10%	6.30E-03	3.50E-02	9.3E+00	No	No	BSL
4,4-DDT	50-29-3	MG/KG	21	1	5%	7.50E-03	7.50E-03	8.5E+00	No	No	BSL
Alpha-chlordane	5103-71-9	MG/KG	21	1	5%	1.50E-01	1.50E-01	1.0E+02	No	No	BSL
Dieldrin	60-57-1	MG/KG	21	1	5%	1.40E-02	1.40E-02	1.4E-01	No	No	BSL
Endosulfan I	959-98-8	MG/KG	21	7	33%	2.40E-03	8.90E-02	1.4E+03	No	No	BSL
Heptachlor epoxide	1024-57-3	MG/KG	21	1	5%	6.30E-03	6.30E-03	3.3E-01	No	No	BSL
Dioxin/Furans											
TCDD-TEQ	1746-01-6	MG/KG	6	6	100%	3.54E-07	4.04E-04	2.2E-05	**Yes**	**Yes**	**ASL**
Inorganics											
Aluminum	7429-90-5	MG/KG	21	21	100%	3.40E+02	1.30E+04	2.3E+05	No	No	BSL
Arsenic	7440-38-2	MG/KG	68	40	59%	1.20E+00	1.10E+02	3.0E+00	**Yes**	**Yes**	**ASL**
Barium	7440-39-3	MG/KG	21	21	100%	7.40E-01	4.70E+01	4.7E+04	No	No	BSL
Cadmium	7440-43-9	MG/KG	21	1	5%	9.60E-01	9.60E-01	2.0E+02	No	No	BSL
Chromium	18540-29-9	MG/KG	68	66	97%	1.10E+00	3.80E+02	6.5E+00	**Yes**	**Yes**	**ASL**
Cobalt	7440-48-4	MG/KG	21	6	29%	7.50E-01	6.20E+00	7.0E+01	No	No	BSL
Copper	7440-50-8	MG/KG	68	38	56%	3.10E+00	1.20E+02	9.3E+03	No	No	BSL
Cyanide	57-12-5	MG/KG	21	1	5%	1.20E+01	1.20E+01	3.1E+01	No	No	IFD
Lead	7439-92-1	MG/KG	21	21	100%	9.30E-01	1.80E+02	8.0E+02	No	No	BSL
Manganese	7439-96-5	MG/KG	21	19	90%	2.20E+00	1.30E+02	5.6E+03	No	No	BSL
Mercury	7487-94-7	MG/KG	21	2	10%	4.80E-01	1.00E+00	7.0E+01	No	No	BSL
Nickel	7440-02-0	MG/KG	21	1	5%	1.10E+01	1.10E+01	4.7E+03	No	No	BSL
Vanadium	7440-62-2	MG/KG	21	20	95%	1.40E+00	3.40E+01	1.2E+03	No	No	BSL
Zinc	7440-66-6	MG/KG	21	20	95%	2.20E+00	1.20E+02	7.0E+04	No	No	BSL

Notes:

1 - Constituents detected in soil samples (subsurface, >1') collected at the site since between 1991 and 2018. Data as presented in February 12, 2009 Revised Supplemental Human Health Risk Evaluation and April 27, 2018 Draft Brownfield Update Report. Tentatively identified compounds (TICs) and essential nutrients (calcium, iron, magnesium, potassium and sodium) were excluded from the evaluation.

TEQ - Toxicity Equivalence. TEQ for each analyte is determined by multiplying the toxicity equivalency factor (TEF) by the laboratory concentration.

TEF values based on the 2005 WHO update of TEF values as recommended in USEPA's December 2010 guidance.

2 - North Carolina Department of Environmental Quality (NCDEQ) Preliminary Soil Remediation Goals (PSRGs) based on cancer risk of $1x10^{-6}$ and a hazard quotient (HQ) of 0.2 (June 2021 version)

Value for chromium is PSRG for hexavalent chromium

Value for cyanide is lowest PSRG listed for cyanide species

Value for mercury is PSRG for mercuric chloride

Value for TCDD-TEQ is PSRG for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)

The following surrogates were used for constituents without a PSRG value:

Analyte	Surrogate
Acenaphthylene	Pyrene
Benzo(b,k)fluoranthene	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	Pyrene
Phenanthrene	Pyrene
Endosulfan I	Endosulfan

3 - Rationale codes:

ASL – Above Screening Level

BSL - Below Screening Level

IFD - Infrequently detected (less than 5% detection or exceedance frequency)

NTX - No toxicity information

Bold text and yellow shading indicates COPC selection

CAS - Chemical Abstracts Service
COPC - constituent of potential concern
MG/KG - milligrams per kilogram
PCB - polychlorinated biphenyls
TCDD-TEQ - 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalence
WHO - World Health Organization
4,4-DDD - 4,4-Dichlorodiphenyldichloroethane
4,4-DDE - 4,4-dichlorodiphenyldichloroethylene
4,4-DDT - 4,4-dichlorodiphenyltrichloroethane

NCDEQ, 2021. Preliminary Soil Remediation Goals Table. June 2021

USEPA, 2010. Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8- Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, DC. EPA/100/R10/005. December 2010. Available online at: http://www.epa.gov/osa/raf/hhtefguidance/

Table 3-3
Risk-Based Remedial Goals - Future Industrial Worker
SWP and NCSPA Site
Wilmington, NC

Analyte[1]	CAS No.	Units	NCDEQ Ind/Com Health-Based PSRG[2]		USEPA Regional Screening Level[3]		Critical Effect - Oral[4]	Critical Effect - Inhalation[4]	Adjusted PSRG[5]	Adjusted RSLc[5]	Adjusted RSLn[5]	Industrial Worker Risk-Based Remedial Goal[6]
					Cancer Endpoint	Non-Cancer Endpoint						
2-Methylnaphthalene	91-57-6	MG/KG	6.0E+02	N		3.00E+03	Respiratory	-	1.00E+03	-	-	1.00E+03
Benzo(a)pyrene	50-32-8	MG/KG	2.1E+00	C/N	2.10E+00	2.20E+02	Developmental	Developmental	-	4.20E+01	5.50E+01	4.20E+01
Dibenzofuran	132-64-9	MG/KG	2.3E+02	N		1.20E+03	Developmental	-	2.92E+02	-	-	2.92E+02
Fluoranthene	206-44-0	MG/KG	6.0E+03	N		3.00E+04	Systemic (Liver, Kidney)	-	1.51E+04	-	-	1.51E+04
Fluorene	86-73-7	MG/KG	6.0E+03	N		3.00E+04	Circulatory	-	1.51E+04	-	-	1.51E+04
Naphthalene	91-20-3	MG/KG	8.8E+00	C/N	8.60E+00	5.90E+02	Developmental	Neurological, Respiratory	-	1.72E+02	1.48E+02	1.48E+02
Phenanthrene	85-01-8	MG/KG	4.5E+03	N		2.30E+04	NOEL	-	1.13E+04	-	-	1.13E+04
Pyrene	129-00-0	MG/KG	4.5E+03	N		2.30E+04	Sytemic (Kidney)	-	1.13E+04	-	-	1.13E+04
2,3,7,8-TCDD	1746-01-6	MG/KG	2.2E-05	C/N	2.20E-05	7.20E-04	Reproductive/Endocrine	-	-	4.40E-04	7.20E-04	4.40E-04
Arsenic	7440-38-2	MG/KG	3.0E+00	C/N	3.00E+00	4.80E+02	Dermal (Skin), Circulatory	Developmental	-	6.00E+01	1.20E+02	6.00E+01
Chromium	18540-29-9	MG/KG	6.5E+00	C/N	6.30E+00	3.50E+03	NOAEL	Respiratory	-	1.26E+02	1.17E+03	1.26E+02

Notes:

MG/KG - milligram per kilogram N - Noncarcinogen C - Carcinogen

1 - COPCs identified in Table 3-1 and 3-2.

2 - North Carolina Department of Environmental Quality (NCDEQ) Preliminary Soil Remediation Goals (PSRGs) based on cancer risk of $1x10^{-6}$ and a hazard quotient (HQ) of 0.2. June 2021 version

Value for chromium is PSRG for hexavalent chromium

Value for TCDD-TEQ is PSRG for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)

The following surrogates were used for constituents without a PSRG value:

Analyte	Surrogate
Phenanthrene	Pyrene

3 - USEPA Regional Screening Levels (RSL) for industrial soil. RSLs based on a cancer risk of 1 x 10-6 and a hazard quotient (HQ) of 1. May 2021 version.

4 - Critical effect/target organ for non-carcinogenic effects as reported in USEPA's Integrated Risk Information System (IRIS) or the Risk Assessment Information System (RAIS) (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chemmeta)

5 - PSRGs and RSLs were adjusted as follows:

Soil Contaminant with Only Carcinogenic Effects

$$\text{Adjusted PSRG} = \frac{\text{PSRG x 100}}{\text{No. of "C" Contaminants}}$$

Soil Contaminant with Only Non-Carcinogenic Effects

$$\text{Adjusted PSRG} = \frac{\text{PSRG x 5}}{\text{No. of "N" Contaminants}}$$

Number of non-carcinogens per target organ/critical effect group

Soil Contaminants with Both Carcinogenic and Non-Carcinogenic Effects

$$\text{Adjusted RSLc} = \frac{\text{USEPA RSLc x 100}}{\text{No. of "C" Contaminants}}$$

$$\text{Adjusted RSLn} = \frac{\text{USEPA RSLn}}{\text{No. of "N" Contaminants}}$$

Number of non-carcinogens per target organ/critical effect group

6 - Risk-based remedial goal is the adjusted PSRG or lower of the adjusted RSL values.

2,3,7,8-TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
CAS - Chemical Abstracts Service
COPC - constituent of potential concern
NOAEL - no-observed-adverse-effect level
NOEL - no-observed-effect level

NCDEQ, 2021. Preliminary Soil Remediation Goals Table. June 2021
USEPA. 2021. USEPA Regional Screening Level Table. (On-Line). Available: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. May.

Table 3-4
Toxicity Factors and Dermal Constants
SWP and NCSPA Site
Wilmington, NC

Constituent	RfDo (mg/kg-day)		RfC (mg/m^3)		SFo $(mg/kg\text{-}day)^{-1}$		IUR $(\mu g/m^3)^{-1}$		GI ABS	Adjustment Required	RfD (mg/kg-day)	SfD $(mg/kg\text{-}day)^{-1}$	ABSd	VF soil	Critical Effect - Oral	Critical Effect - Inhalation	Carcinogen Class	Mutagen?
2-Methylnaphthalene	4.00E-03	I	-	-	-	-	-	-	1.0	No	4.00E-03	-	0.13	5.80E+04	Respiratory	-	-	
Benzo(a)pyrene	3.00E-04	I	2.00E-06	I	1.00E+00	I	6.00E-04	I	1.0	No	3.00E-04	1.00E+00	0.13	NA	Developmental	Developmental	B2	Yes
Dibenzofuran	1.00E-03	X	-	-	-	-	-	-	1.0	No	1.00E-03	-	0.03	1.56E+05	Developmental	-	-	
Fluoranthene	4.00E-02	I	-	-	-	-	-	-	1.0	No	4.00E-02	-	0.13	NA	Systemic (Liver, Kidney)	-	-	
Fluorene	4.00E-02	I	-	-	-	-	-	-	1.0	No	4.00E-02	-	0.13	2.81E+05	Circulatory	-	-	
Naphthalene	2.00E-02	I	3.00E-03	I	1.20E-01	C	3.40E-05	C	1.0	No	2.00E-02	1.20E-01	0.13	4.63E+04	Developmental	Neurological, Respiratory	C	
Phenanthrene	3.00E-02	I	-	-	-	-	-	-	1.0	No	3.00E-02	-	0.13	6.43E+05	NOEL	-	-	
Pyrene	3.00E-02	I	-	-	-	-	-	-	1.0	No	3.00E-02	-	0.13	2.38E+05	Sytemic (Kidney)	-	-	
2,3,7,8-TCDD	7.00E-10	I	4.00E-08	C	1.30E+05	C	3.80E+01	C	1.0	No	7.00E-10	1.30E+05	0.03	1.96E+06	Reproductive/Endocrine	N/A	N/A	
Arsenic	3.00E-04	I	1.50E-05	C	1.50E+00	I	4.30E-03	I	1.0	No	3.00E-04	1.50E+00	0.03	NA	Dermal (Skin), Circulatory	Developmental	A	
Chromium	3.00E-03	I	1.00E-04	I	5.00E-01	C	8.40E-02	S	0.025	Yes	7.50E-05	2.00E+01	NV	NA	NOAEL	Respiratory	CA	Yes

Notes:

µg = microgram
IUR = inhalation unit risk factor
kg = kilogram
m = meter
mg = milligrams
N/A - Not available
NA - Not applicable
NOAEL = no observed adverse effect level
NOEL = no observed effect level
NV - No chemical-specific value
RfC = inhalation reference concentration
RfD = dermal reference dose = RfDo (or RfDo x GI ABS)
RfDo = oral reference dose
SFd = dermal slope factor = SFo (or SFo / GI ABS)
SFo = oral slope factor
TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin

Dashed cells indicate no value or critical effect is available

Toxicity factors were obtained from USEPA's Integrated Risk Information System (IRIS) (http://www.epa.gov/ngispgm3/iris/irisdat/) (i) (searched December 2020) and USEPA's Regional Screening Level Table dated May 2021.
For chromium, the toxicity value is for hexavalent chromium
For phenanthrene, the toxicity value is for pyrene

Source codes:
I - IRIS
P - PPRTV
C - CalEPA
E - ECAO
X - PPRTV Appendix
H - HEAST
S - IRIS toxicity value divided by 7, as recommended by USEPA in the RSL table
Critical effects and carcinogenic class listed were obtained from IRIS and Risk Assessment Information System (RAIS) searched December 2020

Carcinogenic class -
A - known carcinogen
B1 - probable human carcinogen
B2 - probable human carcinogen
C - possible human carcinogen
D - not classifiable
LC - Likely to be carcinogenic to humans (post-2005 cancer classification guideline)
CA - Carcinogenic to humans (post-2005 cancer classification guideline)

Critical Effects Categories and Target Organs:
Systemic - Liver, kidney, urinary tract
Circulatory - Arteries, veins, heart and blood
GI - Buccal cavity, esophagus, stomach, intestines, gall bladder
Dermal-Ocular - Skin and eyes
Respiratory - Lungs, trachea, and nasal passageway
Neurological - Brain, spinal cord, neurons and neuroglia
Reproductive/Endocrine - Testes, ovaries, thyroid, adrenal, pituitary, pancreas, and parathyroid
Developmental - Tetratology, growth retardation, structural malformations, abnormal development

ABSd = Dermal absorbed fraction (EPA, 2004). There are no default dermal absorption values for volatile organic compounds nor inorganic classes of compounds.
GI ABS = Gastrointestinal absorbed fraction (EPA, 2004). GI absorption efficiencies may be used to adjust oral toxicity factors for use in evaluating dermally absorbed doses.
Following recommendations by USEPA, the oral toxicity factors were adjusted if the GI absorption fraction was significantly less than 1 (i.e., less than 50%).
Only values reported for non-aqueous media were used.
VFsoil = Chemical-specific volatilization factors for soil obtained from EPA SL Table (dated May 2021).

References:

USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment).Final. EPA/540/R/99/005. July 2004 (updated November 2007)

USEPA. 2021. USEPA Regional Screening Level Table. (On-Line). Available: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. May.

Table 3-5
Soil Exposure Assumptions - Human Health Remedial Goals
SWP and NCSPA Site
Wilmington, NC

	Exposure Assumption	Future Construction Worker	Future Utility/Excavation Worker	Current/Future Trespasser
IR	Ingestion Rate, soil (mg/day) (1)	330	330	200
AF	Dermal Adherence Factor, soil (mg/cm^2) (2)	0.3	0.3	0.2
AB	Dermal Absorption Fraction (unitless) (3)	Chemical-specific	Chemical-specific	Chemical-specific
PEF	Particulate Emission Factor (m^3/kg) (4)	1.06E+06	1.06E+06	5.93E+10
VF	Soil to Air Volatilization Factor, m^3/kg (5)	Chemical-specific	Chemical-specific	Chemical-specific
SA	Skin Surface Area, (cm^2) (6)	3527	3527	6032
ET	Exposure Time (hours/day) (7)	8	8	2
EF	Exposure Frequency (days/year) (7)	250	5	10
ED	Exposure Duration - (years) , (7)	1	25	10
FC	Fraction contacted (unitless) (8)	1	1	1
CFs	Conversion Factor, soil (kg/mg)	1.E-06	1.E-06	1.E-06
CFa	Conversion Factor, air (mg/µg)	1.E-03	1.E-03	1.E-03
BW	Body Weight - (kg) (9)	80	80	45
AT	Averaging Time (days) (10)			
	Noncarcinogenic, ED x 365 d/yr	350	9,125	3,650
	Carcinogenic,70 yr x 365d/yr	25,550	25,550	25,550

Notes:

(1) Soil ingestion rate: USEPA recommended value for construction worker (USEPA, 2002).
USEPA recommended value for a construction worker noted above was assumed for an on-site utility/excavation worker.
NCDEQ recommended value for a youth trespasser (NCDEQ, 2021).

(2) Adherence Factor: USEPA recommended value for construction workers (Exhibit 3-3 [construction workers], USEPA 2004), construction worker value represents 95th percentile for high-end soil activity, used for construction and utility workers. USEPA recommended value for child resident (USEPA, 2014) assumed for the youth trespasser.

(3) Chemical-specific values obtained from Exhibit 3-4 in USEPA (2004). Default values are not available for VOC and inorganic compound classes.

(4) Particulate Emission Factor: NCDEQ default PEF used for workers and trespassers (NCDEQ, 2021).

(5) Volatilization Factor: USEPA chemical-specific value for volatile constituents (USEPA, 2021). For short-term construction workers, USEPA chemical-specific subchronic VF values were generated as using USEPA's on-line RSL calculator.

(6) Skin Surface Area: USEPA recommended values for workers (USEPA, 2014). NCDEQ recommended value for youth trespasser (NCDEQ, 2021).

(7) Exposure Frequency: USEPA and NCDEQ recommended values for construction worker (USEPA, 2002 and NCDEQ, 2021).
Site-specific value for a utility/excavation worker assumes that the inspection and repair of utility lines occurs five days per year for 25 years.
Site-specific value for a trespasser (age 7-16 years) assumes 1 visit per month (March to December).
Exposure Time and Duration: NCDEQ and USEPA recommended value (USEPA, 2002 and USEPA, 2014) for workers and trespassers (NCDEQ, 2021).

(8) Fraction contacted: Represents the proportion of soil that is contaminated by the chemical(s) of concern at the property. A value of 1 was assumed for each receptor.

(9) Body weight: USEPA recommended values for workers and youth trespassers (USEPA, 2014 and USEPA Region 4, 2018).

(10) Averaging time: Noncarcinogens = ED expressed in days. Carcinogens = 70-year lifetime expressed in days. For construction workers, AT = EW (50 weeks/year) x 7 days/week x ED

µg = microgram
cm^2 = square centimeters
d/yr = days per year
kg = kilogram
m^3 = cubic meter
mg = milligrams
NCDEQ = North Carolina Department of Environmental Quality
RSL = regional screening level
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

References:

USEPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Emergency and Remedial Response. OSWER 9355.4-24. December.
USEPA. 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment).Final. EPA/540/R/99/005. July 2004 (updated November 2007).
USEPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Exposure Factors. OSWER Directive 9200.1-120.
USEPA. 2021. Regional Screening Level Table User's Guide. May 2021 edition.
USEPA Region 4. 2018. Region 4 Human Health Risk Assessment Supplemental Guidance. Scientific Support Section, Superfund Division. March 2018 Update.
NCDEQ. 2021. Risk Evaluation Equations and Calculations. June 2021.

Table 3-6
Subchronic Toxicity Factors
SWP and NCSPA Site
Wilmington, NC

Constituent	Subchronic RfDo		Subchronic RfC		GI ABS	Adjust Req.?	Subchronic RfD	Subchronic Critical Effect Category - Oral	Subchronic Critical Effect Category - Inhalation	Subchronic VFsoil
2-Methylnaphthalene	NA		-		1.0	No	NA	Respiratory	-	1.26E+04
Benzo(a)pyrene	NA		NA		1.0	No	NA	Developmental	Developmental	N/A
Dibenzofuran	4.00E-03	p	-		1.0	No	4.00E-03	Developmental	-	3.38E+04
Fluoranthene	1.00E-01	p	-		1.0	No	1.00E-01	Systemic (Kidney)	-	N/A
Fluorene	4.00E-01	a	-		1.0	No	4.00E-01	Systemic (Liver)	-	6.10E+04
Naphthalene	6.00E-01	a	NA		1.0	No	6.00E-01	Neurological	Neurological, Respiratory	1.01E+04
Phenanthrene	3.00E-01	p	-		1.0	No	3.00E-01	NOEL	-	1.40E+05
Pyrene	3.00E-01	p	-		1.0	No	3.00E-01	Systemic (Kidney)	-	5.16E+05
2,3,7,8-TCDD	2.00E-08	a	NA		1.0	No	2.00E-08	Reproductive/Endocrine	Not Available	4.26E+05
Arsenic	NA		NA		1.0	No	NA	Dermal (Skin), Circulatory	Developmental	N/A
Chromium	5.00E-03	a	3.00E-04	a	0.025	Yes	1.25E-04	Circulatory	Respiratory	N/A

Notes:

NOEL = no observed effect level
RfC = inhalation reference concentration
RfD = reference dose
Dashed cells indicate no value or critical effect is available

RfDd = dermal reference dose = RfDo x GI ABS
RfDo = oral reference dose
TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin

RSL = regional screening level
USEPA = United States Environmental Protection Agency

Toxicity Factor Sources:

Where available, subchronic reference doses were obtained from the sources as listed in USEPA's on-line Regional Screening Level calculator (searched May 2021).
p - PPRTV a - ATSDR
NA - Subchronic value not available, chronic value (see Table 3-4) used in the derivation.
N/A - Not applicable
For chromium, the toxicity value is for hexavalent chromium
For phenanthrene, the toxicity value is for pyrene

Critical effects listed were obtained from Risk Assessment Information System (RAIS) searched December 2020.
Critical Effects Categories and Target Organs:

Systemic - Liver, kidney, urinary tract
Circulatory - Arteries, veins, heart and blood
GI - Buccal cavity, esophagus, stomach, intestines, gall bladder
Dermal-Ocular - Skin and eyes
Respiratory - Lungs, trachea, and nasal passageway
Neurological - Brain, spinal cord, neurons and neuroglia
Reproductive/Endocrine - Testes, ovaries, thyroid, adrenal, pituitary, pancreas, and parathyroid
Developmental - Tetratology, growth retardation, structural malformations, abnormal development

GI ABS = Gastrointestinal absorbed fraction (USEPA, 2004). GI absorption efficiencies may be used to adjust oral toxicity factors for use in evaluating dermally absorbed doses.
Following recommendations by USEPA, the oral toxicity factors were adjusted if the GI absorption fraction was significantly less than 1 (I.e., less than 50%).
Only values reported for non-aqueous media were used.
Subchronic VFsoil = Chemical-specific volatilization factors for soil obtained from USEPA RSL calculator.

References:

USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment).Final. EPA/540/R/99/005. July 2004 (updated November 2007)

USEPA. 2021. USEPA Regional Screening Level Table. (On-Line). Available: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. May.

Table 3-7
Risk-Based Remedial Goals - Future Long-Term Utility/Excavation Worker
SWP and NCSPA Site
Wilmington, NC

Analyte[1]	CAS No.	Units		Utility Worker Remedial Goal[2]		Critical Effect - Oral[3]	Critical Effect - Inhalation[3]	Adjusted RGc[4]	Adjusted RGn[4]	Utility Worker Risk-Based Remedial Goal[5]
				Noncancer Effects	Cancer Effects					
2-Methylnaphthalene	91-57-6	MG/KG	N	5.00E+04	-	Respiratory	-	-	1.67E+04	1.67E+04
Benzo(a)pyrene	50-32-8	MG/KG	C/N	4.13E+02	3.39E+01	Developmental	Developmental	6.78E+02	1.03E+02	1.03E+02
Dibenzofuran	132-64-9	MG/KG	N	1.77E+04	-	Developmental	-	-	4.43E+03	4.43E+03
Fluoranthene	206-44-0	MG/KG	N	5.00E+05	-	Systemic (Liver, Kidney)	-	-	2.50E+05	2.50E+05
Fluorene	86-73-7	MG/KG	N	5.00E+05	-	Circulatory	-	-	2.50E+05	2.50E+05
Naphthalene	91-20-3	MG/KG	C/N	2.61E+04	2.14E+02	Developmental	Neurological, Respiratory	4.28E+03	6.53E+03	4.28E+03
Phenanthrene	85-01-8	MG/KG	N	3.75E+05	-	NOEL	-	-	1.88E+05	1.88E+05
Pyrene	129-00-0	MG/KG	N	3.75E+05	-	Sytemic (Kidney)	-	-	1.88E+05	1.88E+05
2,3,7,8-TCDD	1746-01-6	MG/KG	C/N	1.13E-02	3.37E-04	Reproductive/Endocrine	N/A	6.74E-03	1.13E-02	6.74E-03
Arsenic	7440-38-2	MG/KG	C/N	2.39E+03	3.61E+01	Dermal (Skin), Circulatory	Developmental	7.22E+02	5.98E+02	5.98E+02
Chromium	18540-29-9	MG/KG	C/N	1.62E+04	7.18E+00	NOAEL	Respiratory	1.44E+02	5.40E+03	1.44E+02

Notes:

MG/KG - milligram per kilogram N - Noncarcinogen C - Carcinogen

1 - COPCs identified in Table 3-1 and Table 3-2.

2 - Risk-based remedial goal for a utility worker based on cancer risk of $1x10^{-6}$ and a hazard quotient (HQ) of 1. Calculations provided in Appendix C.

3 - Critical effect/target organ for non-carcinogenic effects as reported in USEPA's Integrated Risk Information System (IRIS) or the Risk Assessment Information System (RAIS) (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chemmeta)

4 - Remedial goals (RGs) were adjusted as follows:

$$\text{Adjusted RGc} = \frac{\text{RGc x 100}}{\text{No. of "C" Contaminants}}$$

$$\text{Adjusted RGn} = \frac{\text{RGn}}{\text{No. of "N" Contaminants}}$$

Number of non-carcinogens per target organ/critical effect group

5 - Risk-based remedial goal is the lower of the adjusted RG values.

2,3,7,8-TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
CAS - Chemical Abstracts Service
COPC - constituent of potential concern
N/A - Not available
NOAEL - no-observed-adverse-effect level
NOEL - no-observed-effect level
RGc = remedial goal carcinogens
RGn = remedial goal non-carcinogens
TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin
USEPA = United States Environmental Protection Agency

Dashed cells indicate calculation is not applicable

Table 3-8
Risk-Based Remedial Goals - Short-Term Future Construction/Excavation Worker
SWP and NCSPA Site
Wilmington, NC

Analyte[1]	CAS No.	Units		Construction Worker Remedial Goal[2]		Critical Effect - Oral[3]	Critical Effect - Inhalation[3]	Adjusted RGc[4]	Adjusted RGn[4]	Construction Worker Risk-Based Remedial Goal[5]
				Noncancer Effects	Cancer Effects					
2-Methylnaphthalene	91-57-6	MG/KG	N	9.58E+02	-	Respiratory	-	-	3.19E+02	3.19E+02
Benzo(a)pyrene	50-32-8	MG/KG	C/N	7.92E+00	1.69E+01	Developmental	Developmental	3.38E+02	1.98E+00	1.98E+00
Dibenzofuran	132-64-9	MG/KG	N	1.36E+03	-	Developmental	-	-	3.40E+02	3.40E+02
Fluoranthene	206-44-0	MG/KG	N	2.40E+04	-	Systemic (Kidney)	-	-	1.20E+04	1.20E+04
Fluorene	86-73-7	MG/KG	N	9.58E+04	-	Systemic (Liver)	-	-	9.58E+04	9.58E+04
Naphthalene	91-20-3	MG/KG	C/N	1.25E+02	5.56E+01	Neurological	Neurological, Respiratory	1.11E+03	4.17E+01	4.17E+01
Phenanthrene	85-01-8	MG/KG	N	7.19E+04	-	NOEL	-	-	3.60E+04	3.60E+04
Pyrene	129-00-0	MG/KG	N	7.19E+04	-	Systemic (Kidney)	-	-	3.60E+04	3.60E+04
2,3,7,8-TCDD	1746-01-6	MG/KG	C/N	5.52E-03	1.62E-04	Reproductive/Endocrine	N/A	3.24E-03	5.52E-03	3.24E-03
Arsenic	7440-38-2	MG/KG	C/N	4.58E+01	1.81E+01	Dermal (Skin), Circulatory	Developmental	3.62E+02	1.15E+01	1.15E+01
Chromium	18540-29-9	MG/KG	C/N	7.47E+02	3.59E+00	Circulatory	Respiratory	7.18E+01	2.49E+02	7.18E+01

Notes:

MG/KG - milligram per kilogram N - Noncarcinogen C - Carcinogen

1 - COPCs identified in Table 3-1 and Table 3-2.

2 - Risk-based remedial goal for a construction worker based on cancer risk of $1x10^{-6}$ and a hazard quotient (HQ) of 1. Calculations provided in Appendix C.

3 - Critical effect/target organ for non-carcinogenic effects as reported in USEPA's Integrated Risk Information System (IRIS) or the Risk Assessment Information System (RAIS) (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chemmeta)

4 - Remedial goals (RGs) were adjusted as follows:

$$\text{Adjusted RGc} = \frac{\text{RGc x 100}}{\text{No. of "C" Contaminants}}$$

$$\text{Adjusted RGn} = \frac{\text{RGn}}{\text{No. of "N" Contaminants}}$$

Number of non-carcinogens per target organ/critical effect group

5 - Risk-based remedial goal is the lower of the adjusted RG values.

2,3,7,8-TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
CAS - Chemical Abstracts Service
COPC - constituent of potential concern
N/A - Not available
NOEL - no-observed-effect level
RGc = remedial goal carcinogens
RGn = remedial goal non-carcinogens
USEPA = United States Environmental Protection Agency

Dashed cells indicate calculation is not applicable

Table 3-9
Risk-Based Remedial Goals - Current/Future Youth Trespasser
SWP and NCSPA Site
Wilmington, NC

Analyte[1]	CAS No.	Units		Trespasser Remedial Goal[2]		Critical Effect - Oral[3]	Critical Effect - Inhalation[3]	Adjusted RGc[4]	Adjusted RGn[4]	Trespasser Risk-Based Remedial Goal[5]
				Noncancer Effects	Cancer Effects					
2-Methylnaphthalene	91-57-6	MG/KG	N	1.84E+04	-	Respiratory	-	-	6.13E+03	6.13E+03
Benzo(a)pyrene	50-32-8	MG/KG	C/N	1.38E+03	1.07E+01	Developmental	Developmental	2.14E+02	3.45E+02	2.14E+02
Dibenzofuran	132-64-9	MG/KG	N	8.21E+03	-	Developmental	-	-	2.05E+03	2.05E+03
Fluoranthene	206-44-0	MG/KG	N	1.84E+05	-	Systemic (Liver, Kidney)	-	-	9.20E+04	9.20E+04
Fluorene	86-73-7	MG/KG	N	1.84E+05	-	Circulatory	-	-	9.20E+04	9.20E+04
Naphthalene	91-20-3	MG/KG	C/N	3.66E+04	2.52E+02	Developmental	Neurological, Respiratory	5.04E+03	9.15E+03	5.04E+03
Phenanthrene	85-01-8	MG/KG	N	1.38E+05	-	NOEL	-	-	6.90E+04	6.90E+04
Pyrene	129-00-0	MG/KG	N	1.38E+05	-	Sytemic (Kidney)	-	-	6.90E+04	6.90E+04
2,3,7,8-TCDD	1746-01-6	MG/KG	C/N	4.87E-03	3.74E-04	Reproductive/Endocrine	N/A	7.48E-03	4.87E-03	4.87E-03
Arsenic	7440-38-2	MG/KG	C/N	3.15E+03	4.91E+01	Dermal (Skin), Circulatory	Developmental	9.82E+02	7.88E+02	7.88E+02
Chromium	18540-29-9	MG/KG	C/N	2.46E+04	3.83E+01	NOAEL	Respiratory	7.66E+02	8.20E+03	7.66E+02

Notes:

MG/KG - milligram per kilogram N - Noncarcinogen C - Carcinogen

1 - COPCs identified in Table 3-1 and Table 3-2.

2 - Risk-based remedial goal for a trespasser based on cancer risk of $1x10^{-6}$ and a hazard quotient (HQ) of 1. Calculations provided in Appendix C.

3 - Critical effect/target organ for non-carcinogenic effects as reported in USEPA's Integrated Risk Information System (IRIS) or the Risk Assessment Information System (RAIS) (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chemmeta)

4 - Remedial goals (RGs) were adjusted as follows:

$$\text{Adjusted RGc} = \frac{\text{RGc x 100}}{\text{No. of "C" Contaminants}}$$

$$\text{Adjusted RGn} = \frac{\text{RGn}}{\text{No. of "N" Contaminants}}$$

Number of non-carcinogens per target organ/critical effect group

5 - Risk-based remedial goal is the lower of the adjusted RG values.

2,3,7,8-TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
CAS - Chemical Abstracts Service
COPC - constituent of potential concern
N/A - Not available
NOAEL - no-observed-adverse-effect level
NOEL - no-observed-effect level
RGc = remedial goal carcinogens
RGn = remedial goal non-carcinogens
USEPA = United States Environmental Protection Agency

Dashed cells indicate calculation is not applicable

Table 3-10
Comparison of Risk-Based Remedial Goals to Site Soil Concentrations
SWP and NCSPA Site
Wilmington, NC

Analyte[1]	CAS No.	Units	Surface Soil Max Detect[2]	Risk-Based Remedial Goal[3]				Subsurface Soil Max Detect[2]	Risk-Based Remedial Goal[3]			
				Industrial Worker	Short-Term Construction Worker	Long-Term Utility Worker	Youth Trespasser		Industrial Worker	Short-Term Construction Worker	Long-Term Utility Worker	Youth Trespasser
2-Methylnaphthalene	91-57-6	MG/KG	9.72E-01	1.00E+03	3.19E+02	1.67E+04	6.13E+03	2.40E+03	1.00E+03	3.19E+02	1.67E+04	6.13E+03
Benzo(a)pyrene TEQ	50-32-8	MG/KG	8.73E+01	4.20E+01	1.98E+00	1.03E+02	2.14E+02	6.20E+02	4.20E+01	1.98E+00	1.03E+02	2.14E+02
Dibenzofuran	132-64-9	MG/KG	4.60E+00	2.92E+02	3.40E+02	4.43E+03	2.05E+03	4.00E+03	2.92E+02	3.40E+02	4.43E+03	2.05E+03
Fluoranthene	206-44-0	MG/KG	3.90E+02	1.51E+04	1.20E+04	2.50E+05	9.20E+04	7.30E+03	1.51E+04	1.20E+04	2.50E+05	9.20E+04
Fluorene	86-73-7	MG/KG	9.60E+01	1.51E+04	9.58E+04	2.50E+05	9.20E+04	7.00E+03	1.51E+04	9.58E+04	2.50E+05	9.20E+04
Naphthalene	91-20-3	MG/KG	9.90E-01	1.48E+02	4.17E+01	4.28E+03	5.04E+03	2.90E+03	1.48E+02	4.17E+01	4.28E+03	5.04E+03
Phenanthrene	85-01-8	MG/KG	2.30E+02	1.13E+04	3.60E+04	1.88E+05	6.90E+04	1.50E+04	1.13E+04	3.60E+04	1.88E+05	6.90E+04
Pyrene	129-00-0	MG/KG	2.30E+02	1.13E+04	3.60E+04	1.88E+05	6.90E+04	4.60E+03	1.13E+04	3.60E+04	1.88E+05	6.90E+04
TCDD-TEQ	1746-01-6	MG/KG	1.30E-02	4.40E-04	3.24E-03	6.74E-03	4.87E-03	4.04E-04	4.40E-04	3.24E-03	6.74E-03	4.87E-03
Arsenic	7440-38-2	MG/KG	1.30E+03	6.00E+01	1.15E+01	5.98E+02	7.88E+02	1.10E+02	6.00E+01	1.15E+01	5.98E+02	7.88E+02
Chromium	18540-29-9	MG/KG	1.20E+03	1.26E+02	7.18E+01	1.44E+02	7.66E+02	3.80E+02	1.26E+02	7.18E+01	1.44E+02	7.66E+02

Notes:

1 - COPCs identified in Table 3-1 and Table 3-2.

2 - Maximum detected concentrations presented in Table 3-1 (surface soil) and Table 3-2 (subsurface soil).

3 - Risk-based remedial goals derived in Appendix C and summarized in Tables 3-3, 3-7, 3-8, and 3-9.

Green shading indicates maximum detect greater than cleanup level

CAS - Chemical Abstracts Service
COPC - constituent of potential concern
MG/KG - milligrams per kilogram
TCDD-TEQ - 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalency quotient
TEQ - Toxicity equivalency quotient

Table 4-1
Summary of Proposed Ecological Risk-Based Remedial Goals (RGs) for Sediment
RI/RA Summary Report Addendum
SWP and NCSPA Site
Wilmington, NC

COPC	Media	Proposed RG Value	Key Receptor and Area	Comment
Total PAHs	Sediment	700 mg/kg	Great blue heron; Greenfield Creek	Ceiling value. Also target 70 mg/kg for individual PAHs, where possible.
Sum PCDD/Fs	Sediment	59 µg/kg	Benthic invertebrates; Drainage Ditch and Greenfield Creek	

Notes:
The proposed remediation goals (RGs) and other information provided within this table are presented as provided in the *Revised Baseline Ecological Risk Assessment* (AMEC, 2007).
µg/kg - micrograms per kilogram
COPC - constituent of potential concern
mg/kg - milligrams per kilogram dry weight
NA - not applicable
PAHs - polycyclic aromatic hydrocarbons
PCDD/Fs - polychlorinated dibenzodioxins / polychlorinated dibenzofurans
RG - remediation goal

Table 4-2
Equilibrium Partitioning Sediment Benchmark Units (ESBTUs) for PAHs
RI/RA Summary Report Addendum
SWP and NCSPA Site
Wilmington, NC

Sample Code (sys_sample_code)	Location Code (sys_loc_code)	% TOC	n PAHs	n Non-Detects	n Detects	ESBTU13	ESBTU34	tPAH (mg/kg)
SD-01_11/10/1996	SD-01	--	15	5	10	--	--	9.75
SD-03_11/10/1996	SD-03	0.25	15	6	9	2.34	6.43	4.38
SD-05_11/08/1996	SD-05	4.5	15	7	8	0.08	0.23	2.79
SD-06_11/09/1996	SD-06	1.1	15	4	11	65.27	179.48	563.2
SD-07_11/09/1996	SD-07	10	15	4	11	14.69	40.39	934
SD-08_11/09/1996	SD-08	5	15	7	8	0.87	2.39	28.12
SD-09_11/09/1996	SD-09	1	15	5	10	13.68	37.62	102.05
SD-10_11/10/1996	SD-10	5.5	15	9	6	0.02	0.06	1
SD-11_11/10/1996	SD-11	5.7	15	8	7	0.10	0.28	4.31
SD-12_11/10/1996	SD-12	--	15	15	0	--	--	ND
SD-13_11/08/1996	SD-13	12	15	9	6	0.02	0.05	1.78
SD-14_11/08/1996	SD-14	6.9	15	5	10	0.20	0.56	11.459
SD-15_11/08/1996	SD-15	26	15	15	0	0.00	0.00	ND
SD-16_11/08/1996	SD-16	0.43	15	15	0	0.00	0.00	ND
SD-17_11/08/1996	SD-17	0.93	15	14	1	0.01	0.02	0.051
SD-18_11/08/1996	SD-18	0.92	15	10	5	0.11	0.31	0.86
SD-19_11/08/1996	SD-19	2.1	15	6	9	0.53	1.45	9.41
SD-20_11/08/1996	SD-20	11	15	10	5	0.00	0.01	0.441
SD-21_01/24/2001	SD-21	0.24	16	11	5	0.15	0.40	0.298
SD-22_01/24/2001	SD-22	0.25	16	1	15	37.22	102.37	80.64
SD-23_01/25/2001	SD-23	4.3	16	9	7	0.31	0.86	11.05
SD-24_01/25/2001	SD-24	18	16	12	4	0.03	0.08	4.2
SD-25_01/24/2001	SD-25	1.6	16	3	13	10.62	29.19	116.7
SD-26_01/23/2001	SD-26	15	16	8	8	32.36	89.00	3240
SD-27_01/23/2001	SD-27	4.8	16	4	12	5.26	14.46	172.1
SD-28_01/23/2001	SD-28	8.7	16	7	9	22.41	61.62	1377
SD-29_01/23/2001	SD-29	0.48	16	6	10	5.12	14.09	19.88
SD-30_01/10/2001	SD-30	2.1	16	13	3	0.23	0.64	3.27
SD-30_01/23/2001_DUP1	SD-30	3.6	16	1	15	1.68	4.62	49.5
SD-31_01/10/2001	SD-31	0.27	16	16	0	0.00	0.00	ND
SD-32_01/10/2001	SD-32	1.1	16	12	4	0.48	1.33	3.99
SD-33_01/10/2001	SD-33	0.1	16	16	0	0.00	0.00	ND
SD-34_01/10/2001	SD-34	9	16	8	8	0.47	1.30	32.6
SD-35_01/10/2001	SD-35	1.6	16	9	7	0.41	1.12	6.11
SD-36_01/25/2001	SD-36	15	16	16	0	0.00	0.00	ND
SD-37_01/25/2001	SD-37	5.8	16	16	0	0.00	0.00	ND
SD-38_01/25/2001	SD-38	6.1	16	10	6	0.19	0.51	9.8
SD-39_02/19/2001	SD-39	39	16	16	0	0.00	0.00	ND
SD-40_03/22/2001	SD-40	0.33	16	10	6	0.13	0.36	0.399
SD-40_03/22/2001_DUP1	SD-40	0.24	16	11	5	0.10	0.26	0.211
SD-41_01/25/2001	SD-41	7.3	16	16	0	0.00	0.00	ND
SD-48_01/25/2001	SD-48	--	16	16	0	--	--	ND
SS-01_10/04/1996	SS-01	8.15	15	8	7	0.02	0.05	1.28
SS-03_11/13/1996	SS-03	1.5	15	5	10	0.12	0.33	1.454
SS-04_10/04/1996	SS-04	6.9	15	6	9	0.04	0.10	1.92
SS-05_11/13/1996	SS-05	0.6	15	4	11	1.70	4.68	8.078
SS-07_11/14/1996	SS-07	2.23	15	3	12	3.07	8.44	57.54
SS-08_11/14/1996	SS-08	4.1	15	1	14	0.91	2.50	28.88
SS-09_11/14/1996	SS-09	0.41	15	5	10	0.94	2.58	3.161
SS-10_11/14/1996	SS-10	--	15	3	12	--	--	25.51
SS-11_11/13/1996	SS-11	0.345	15	15	0	0.00	0.00	ND
SS-12_02/15/1996	SS-12	5.1	13	6	7	0.46	1.26	16.99
SS-12_11/13/1996	SS-12	5.1	15	3	12	0.07	0.20	2.813
SS-12DUP_02/15/1996	SS-12	5.1	13	7	6	0.36	0.98	13.13
SS-16_02/15/1996	SS-16	1.8	13	10	3	0.41	1.11	5.8
SS-16_02/15/1996_DUP1	SS-16	1.8	13	10	3	0.41	1.13	5.8
SS-16_11/13/1996	SS-16	1.8	15	15	0	0.00	0.00	ND
SS-18_02/15/1996	SS-18	4.9	13	8	5	0.42	1.15	14.1
SS-18_10/05/1996	SS-18	2.665	15	6	9	0.14	0.39	3.11
SS-20_02/15/1996	SS-20	7.3	13	12	1	0.05	0.14	2.6
SS-20_11/13/1996	SS-20	5.7	15	5	10	0.04	0.11	1.942
SS-21_02/15/1996	SS-21	0.19	13	6	7	83.25	228.94	178
SS-21_11/14/1996	SS-21	0.19	15	3	12	2.90	7.96	4.479
SS-22_02/15/1996	SS-22	0.42	13	11	2	1.70	4.67	4.7
SS-23_02/15/1996	SS-23	2.7	13	11	2	3.94	10.84	72
SS-24_02/15/1996	SS-24	0.12	13	13	0	0.00	0.00	ND

Notes:
ESBTU - equilibrium partitioning sediment benchmark toxic units
ESBTU13 - equilibrium partitioning sediment benchmark toxic units based on 13 PAHs (unitless)
ESBTU34 - equilibrium partitioning sediment benchmark toxic units based on 34 PAHs (using conservative uncertainty factor of 2.75; unitless)
mg/kg - milligrams per kilogram dry weight
n - sample size
ND - nondetect
PAHs - polycyclic aromatic hydrocarbons
TOC - total organic carbon
tPAH - total polycyclic aromatic hydrocarbons

Table 4-3
Ecological Soil Screening Summary
RI/RA Summary Report Addendum
SWP and NCSPA Site

Constituent	Units	Number of Samples	Number of Detections	Detection Frequency	Minimum Detected Result	Maximum Detected Result	Mean Detected Result	SD Detected Result	Minimum Region IV Soil Screening Level	Number of SL Exceedances
Metals										
Aluminum	mg/kg	65	65	100.0%	310	28000	2378	3839	No SSV	--
Arsenic	mg/kg	198	148	74.7%	0.15	1300	21.7	108.4	18	24
Barium	mg/kg	51	50	98.0%	0.74	110	13.8	17.7	330	0
Cadmium	mg/kg	59	8	13.6%	0.18	1	0.651	0.358	0.36	5
Chromium	mg/kg	198	195	98.5%	0.78	1200	18.9	86.7	28	27
Cobalt	mg/kg	51	19	37.3%	0.37	15	2.43	3.33	13	1
Copper	mg/kg	203	159	78.3%	0.54	1600	37.5	131.3	28	43
Iron	mg/kg	65	65	100.0%	570	59000	4146	7841	No SSV	--
Lead	mg/kg	93	93	100.0%	0.93	290	28.8	51.2	11	40
Manganese	mg/kg	51	49	96.1%	2.2	230	34.3	49	220	1
Mercury	mg/kg	51	7	13.7%	0.12	1	0.416	0.348	0.1	7
Nickel	mg/kg	59	12	20.3%	1.3	52	11.8	16	38	1
Selenium	mg/kg	51	2	3.9%	1.2	1.6	1.4	0.283	0.52	2
Vanadium	mg/kg	51	49	96.1%	1.4	85	8.02	12.7	7.8	12
Zinc	mg/kg	59	58	98.3%	1.8	640	51.7	114.3	46	15
PAHs										
HMW PAHs	mg/kg	198	160	80.8%	0.051	16154	178.5	1372	1.1	137
LMW PAHs	mg/kg	198	102	51.5%	0.0439	34400	469.8	3509	29	21
PCDD/F										
2378-TCDD TEQ	mg/kg	64	64	100.0%	0.00000035	0.013	0.00056	0.00183	0.00000315	1
SVOCs										
1,1-Biphenyl	mg/kg	3	3	100.0%	0.2	500	168.4	287.2	0.2	2
2-Chlorophenol	mg/kg	184	1	0.5%	0.039	0.039	0.039	--	0.06	0
2,4-Dimethylphenol	mg/kg	184	1	0.5%	0.07	0.07	0.07	--	0.04	1
Benzoic Acid	mg/kg	1	1	100.0%	0.08	0.08	0.08	--	0.01	1
bis(2-Ethylhexyl)phthalate	mg/kg	58	1	1.7%	0.8	0.8	0.8	--	0.02	1
Carbazole	mg/kg	184	50	27.2%	0.039	1200	34.8	176.9	0.16	41
Di-n-butyl phthalate	mg/kg	58	2	3.4%	0.058	0.1	0.079	0.0297	0.011	2
Dibenzofuran	mg/kg	58	21	36.2%	0.042	4000	202.5	870.5	0.15	12
Hexachlorobenzene	mg/kg	58	1	1.7%	0.04	0.04	0.04	--	0.079	0
p-Chloroaniline	mg/kg	51	1	2.0%	0.62	0.62	0.62	--	1	0
Pentachlorophenol	mg/kg	184	6	3.3%	0.16	4.8	1.41	1.81	2.1	1
VOCs										
1,1,1-Trichloroethane	mg/kg	121	1	0.8%	0.32	0.32	0.32	--	0.04	1
1,2-Dichloropropane	mg/kg	128	1	0.8%	0.065	0.065	0.065	--	0.28	0
2-Butanone (MEK)	mg/kg	58	7	12.1%	0.019	0.32	0.0763	0.109	1	0
Acetone	mg/kg	58	3	5.2%	0.019	0.064	0.0347	0.0254	1.2	0
Benzene	mg/kg	128	2	1.6%	0.002	0.078	0.04	0.0537	0.12	0
Dichloromethane	mg/kg	128	32	25.0%	0.006	0.059	0.0156	0.01	0.21	0
Ethylbenzene	mg/kg	128	15	11.7%	0.001	0.54	0.121	0.213	0.27	3
m,p-Xylene	mg/kg	70	20	28.6%	0.001	0.3	0.0277	0.0668	No SSV	--
o-Xylene	mg/kg	70	12	17.1%	0.001	0.22	0.0298	0.063	No SSV	--
Toluene	mg/kg	128	15	11.7%	0.001	0.55	0.0407	0.141	0.15	1
Total Xylenes	mg/kg	58	4	6.9%	0.037	2.3	0.824	1.07	0.1	2

Table 4-3
Ecological Soil Screening Summary
RI/RA Summary Report Addendum
SWP and NCSPA Site

Constituent	Units	Number of Samples	Number of Detections	Detection Frequency	Minimum Detected Result	Maximum Detected Result	Mean Detected Result	SD Detected Result	Minimum Region IV Soil Screening Level	Number of SL Exceedances
Pesticides										
4,4-DDD	mg/kg	51	4	7.8%	0.0078	0.064	0.034	0.025	0.044	1
4,4-DDE	mg/kg	51	3	5.9%	0.0063	0.035	0.0188	0.0147	0.11	0
4,4-DDT	mg/kg	51	2	3.9%	0.0075	0.01	0.00875	0.00177	0.0063	2
Alpha-chlordane	mg/kg	51	1	2.0%	0.15	0.15	0.15	--	0.27	0
Chlordane (Technical)	mg/kg	51	1	2.0%	0.00043	0.00043	0.00043	--	2.2	0
Dieldrin	mg/kg	51	2	3.9%	0.0014	0.014	0.0077	0.00891	0.0049	1
Endosulfan I	mg/kg	51	13	25.5%	0.0024	0.13	0.0352	0.0425	0.64	0
Endosulfan sulfate	mg/kg	51	2	3.9%	0.0026	0.016	0.0093	0.00948	0.0065	1
Endrin	mg/kg	51	1	2.0%	0.15	0.15	0.15	--	0.0014	1
Heptachlor epoxide	mg/kg	51	1	2.0%	0.0063	0.0063	0.0063	--	0.0004	1
Methoxychlor	mg/kg	51	1	2.0%	0.049	0.049	0.049	--	5	0
Other Inorganics										
Ammonia Nitrogen	mg/kg	39	33	84.6%	0.55	110	18	28	No SSV	--
Cyanide	mg/kg	65	15	23.1%	0.062	12	0.871	3.08	0.1	2
Sulfide (acid soluble)	mg/kg	8	2	25.0%	53	370	211.5	224.2	No SSV	--
Other Organics										
3-Methylphenol, 4-Methylphenol	mg/kg	57	1	1.8%	0.26	0.26	0.26	--	No SSV	--
Carboxylic Acids	mg/kg	5	5	100.0%	0.5	3	1.42	1.06	No SSV	--
Dimethyl naphthalene	mg/kg	8	8	100.0%	0.09	20	3.81	6.94	No SSV	--
Endrin aldehyde	mg/kg	51	1	2.0%	0.00078	0.00078	0.00078	--	No SSV	--
Tetrachlorophenols, Total	mg/kg	133	1	0.8%	2.8	2.8	2.8	--	No SSV	--

Notes:
COPEC - Constituent of potential ecological concern
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
HMW - high molecular weight
HQ - hazard quotient
LMW - low molecular weight
MEK - methyl ethyl ketone
mg/kg - milligrams per kilogram dry weight
PAH - polycyclic aromatic hydrocarbons
PCDD/F - polychlorinated dibenzodioxins / polychlorinated dibenzofurans
RG - remediation goal
SD - standard deviation
SSV - soil screening value
SVOC - semivolatile organic compounds
TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ - toxicity equivalency quotient
VOC - volatile organic compound
Dashed cells indicate no value.

Table 4-3
Ecological Soil Screening Summary
RI/RA Summary Report Addendum
SWP and NCSPA Site

Constituent	Region IV Soil Screening Values (SSVs)				Hazard Quotient		Rationale
	Plant SSV	Soil Invertebrates SSV	Mammalian SSV	Avian SSV	HQ_{Max}	HQ_{Mean}	
Metals							
Aluminum	--	--	--	--	--	--	Not identified as a soil COPEC in soils with pH > 5.5 (USEPA, 2005)
Arsenic	18	60	46	43	72.2	1.2	**COPEC Retained for Soil RG Development**
Barium	110	330	2000	1000	<1	<1	HQ_{Max} < 1
Cadmium	32	140	0.36	0.77	2.8	1.8	Low HQ_{mean} based on conservative screening value.
Chromium	--	--	45	28	42.9	<1	HQ_{mean} < 1
Cobalt	13	--	230	120	1.2	<1	HQ_{mean} < 1
Copper	70	80	49	28	57.1	1.3	**COPEC Retained for Soil RG Development**
Iron	--	--	--	--	--	--	Not identified as a soil COPEC in soils with pH 5 to 8 (USEPA, 2005)
Lead	120	1700	56	11	26.4	2.6	Low HQ_{mean} based on conservative screening value.
Manganese	220	450	4000	4300	1.0	<1	HQ_{mean} < 1
Mercury	0.3	0.1	1.7	0.013	10.0	4.2	Low HQ_{mean} based on conservative screening value.
Nickel	38	280	130	210	1.4	<1	HQ_{mean} < 1
Selenium	0.52	4.1	0.63	1.2	3.1	2.7	Detection Frequency < 5%
Vanadium	60	--	280	7.8	10.9	1.0	Low HQ_{mean} based on conservative screening value.
Zinc	160	--	79	46	13.9	1.1	Low HQ_{mean} based on conservative screening value.
PAHs							
HMW PAHs	--	18	1.1	--	14685.5	162.3	**COPEC Retained for Soil RG Development**
LMW PAHs	--	29	100	--	1186.2	16.2	**COPEC Retained for Soil RG Development**
PCDD/F							
2378-TCDD TEQ	--	0.0088	0.00000315	0.000016	4127	177.8	**COPEC Retained for Soil RG Development**
SVOCs							
1,1-Biphenyl	60	0.2	--	--	2500.0	842.0	Potential COPEC associated with creosote
2-Chlorophenol	--	0.06	0.54	0.69	<1	<1	HQ_{Max} < 1; Detection Frequency < 5%
2,4-Dimethylphenol	--	0.04	--	--	1.8	1.8	Detection Frequency < 5%
Benzoic Acid	--	0.01	1	--	8.0	8.0	Uncertainty: Single sample
bis(2-Ethylhexyl)phthalate	--	0.23	0.59	0.02	40.0	40.0	Detection Frequency < 5%
Carbazole	--	0.16	80	--	7500.0	217.5	Potential COPEC associated with creosote
Di-n-butyl phthalate	160	0.22	180	0.011	9.1	7.2	Detection Frequency < 5%
Dibenzofuran	6.1	0.15	--	--	26666.7	1350.0	Potential COPEC associated with creosote
Hexachlorobenzene	10	10	0.2	0.079	<1	<1	HQ_{Max} < 1; Detection Frequency < 5%
p-Chloroaniline	1	1.8	--	--	<1	<1	HQ_{Max} < 1; Detection Frequency < 5%
Pentachlorophenol	5	31	2.8	2.1	2.3	<1	Detection Frequency < 5%; HQ_{mean} < 1
VOCs							
1,1,1-Trichloroethane	--	0.04	260	--	8.0	8.0	Detection Frequency < 5%
1,2-Dichloropropane	--	0.28	--	--	<1	<1	HQ_{Max} < 1; Detection Frequency < 5%
2-Butanone (MEK)	--	1	360	--	<1	<1	HQ_{Max} < 1
Acetone	--	0.04	1.2	14	<1	<1	HQ_{Max} < 1
Benzene	--	0.12	24	--	<1	<1	HQ_{Max} < 1; Detection Frequency < 5%
Dichloromethane	1600	0.21	2.6	--	<1	<1	HQ_{Max} < 1
Ethylbenzene	--	0.27	--	--	2.0	<1	HQ_{mean} < 1
m,p-Xylene	--	--	--	--	--	--	Uncertainty: No SSV
o-Xylene	--	--	--	--	--	--	Uncertainty: No SSV
Toluene	200	0.15	23	--	3.7	<1	HQ_{mean} < 1
Total Xylenes	100	0.1	1.4	41	23.0	8.2	Low HQ_{mean} based on conservative screening value; low detection frequency.

Table 4-3
Ecological Soil Screening Summary
RI/RA Summary Report Addendum
SWP and NCSPA Site

Constituent	Region IV Soil Screening Values (SSVs)				Hazard Quotient		Rationale
	Plant SSV	Soil Invertebrates SSV	Mammalian SSV	Avian SSV	HQ_{Max}	HQ_{Mean}	
Pesticides							
4,4-DDD	4.1	3.37	0.044	0.36	1.5	<1	HQ_{mean} < 1
4,4-DDE	--	0.0038	3.7	0.11	<1	<1	HQ_{Max} < 1
4,4-DDT	--	0.0001	4.1	0.0063	1.6	1.4	Detection Frequency < 5%
Alpha-chlordane	2.2	0.17	0.27	0.28	<1	<1	HQ_{Max} < 1; Detection Frequency < 5%
Chlordane (Technical)	2.2	0.17	2.2	2.3	<1	<1	HQ_{Max} < 1; Detection Frequency < 5%
Dieldrin	10	0.1	0.0049	0.021	2.9	1.6	Detection Frequency < 5%
Endosulfan I	--	0.0009	0.64	22	<1	<1	HQ_{Max} < 1
Endosulfan sulfate	--	0.0065	--	--	2.5	1.4	Detection Frequency < 5%
Endrin	0.0034	0.025	0.023	0.0014	107.1	107.1	Detection Frequency < 5%
Heptachlor epoxide	--	0.0004	--	--	15.8	15.8	Detection Frequency < 5%
Methoxychlor	--	0.0025	5	18	<1	<1	HQ_{Max} < 1; Detection Frequency < 5%
Other Inorganics							
Ammonia Nitrogen	--	--	--	--	--	--	Uncertainty: No SSV
Cyanide	--	0.9	--	0.1	120.0	8.7	Uncertainty: Low confidence SSV
Sulfide (acid soluble)	--	--	--	--	--	--	Uncertainty: No SSV
Other Organics							
3-Methylphenol, 4-Methylphenol	--	--	--	--	--	--	Detection Frequency < 5%
Carboxylic Acids	--	--	--	--	--	--	Uncertainty: No SSV
Dimethyl naphthalene	--	--	--	--	--	--	Uncertainty: No SSV
Endrin aldehyde	--	--	--	--	--	--	Detection Frequency < 5%
Tetrachlorophenols, Total	--	--	--	--	--	--	Detection Frequency < 5%

Notes:
COPEC - Constituent of potential ecological concern
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
HMW - high molecular weight
HQ - hazard quotient
LMW - low molecular weight
MEK - methyl ethyl ketone
mg/kg - milligrams per kilogram dry weight
PAH - polycyclic aromatic hydrocarbons
PCDD/F - polychlorinated dibenzodioxins / polychlor
RG - remediation goal
SD - standard deviation
SSV - soil screening value
SVOC - semivolatile organic compounds
TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ - toxicity equivalency quotient
VOC - volatile organic compound
Dashed cells indicate no value.

Table 4-4
Summary of Ecological Risk-Based Remedial Goals (RGs) for Soil
RI/RA Summary Report Addendum
SWP and NCSPA Site
Wilmington, NC

Constituent	Terrestrial Plant LOEC-Based Soil RGs (mg/kg)	Terrestrial Plant LOEC-Based Soil RGs Source	Soil Invertebrate LOEC-Based Soil RGs (mg/kg)	Soil Invertebrate LOEC-Based Soil RGs Source	Wildlife LOAEL-Based RGs (mg/kg)	Most Sensitive Wildlife Receptor	Ecological Remediation Goal (mg/kg)	Most Sensitive Ecological Receptor
Arsenic	91	LANL GMM LOEC	68	LANL GMM LOEC	76.2	Mourning dove	68	Soil Invertebrates
Copper	497	LANL GMM LOEC	530	LANL GMM LOEC	859	Mourning dove	497	Terrestrial Plants
Total LMW PAHs	100	Eco-SSL LOAEC	175	Eco-SSL MATC	343	Short-tailed shrew	100	Terrestrial Plants
Total HMW PAHs	--	--	80	Eco-SSL MATC	46.2	Short-tailed shrew	46.2	Short-tailed shrew
2,3,7,8-TCDD TEQ	--	--	--	--	0.000105	Short-tailed shrew	0.000105	Short-tailed shrew
2,3,7,8-TCDD	--	--	10	LANL LOEC	--	--	10	Soil Invertebrates

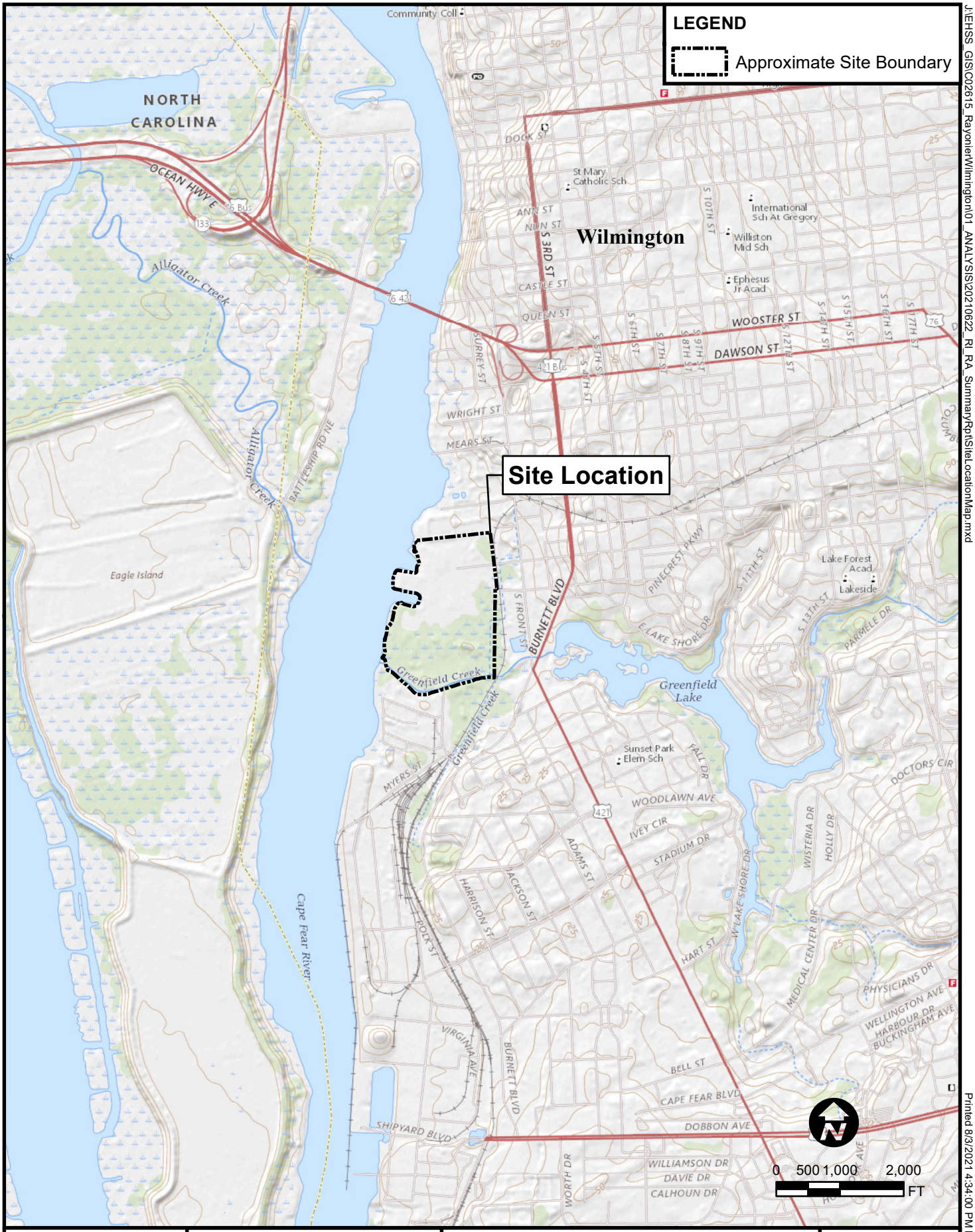
Notes:
LOAEL, Toxicity reference value (TRV) based on lowest observable effects level (LOAEL) endpoints for growth and reproduction.
Eco-SSL - ecological soil screening level
HMW - high molecular weight
LANL - Los Alamos National Laboratory
LMW - low molecular weight
LOAEC - lowest observed adverse effect concentrations
MATC - maximum acceptable toxicant concentration
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbons
RG - remediation goal
TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ - toxicity equivalency quotient

Table 4-5
Summary of Historical Soil Results for Site COCs
RI/RA Summary Report Addendum
SWP and NCSPA Site
Wilmington, NC

Analyte	Units	Number of Samples	Number of Detections	Minimum Detected Result	Maximum Detected Result	Mean Detected Result	SD Detected Result	Preliminary Remediation Goal (RG)	Number of RG Exceedances
2,3,7,8-Tetrachlorodibenzo-p-dioxin	mg/kg	50	27	0.00000014	0.000023	0.00000259	0.00000456	10	0
2378-TCDD TEQ	mg/kg	64	64	0.00000035	0.013035	0.0005565	0.00182694	0.000105	26
Arsenic	mg/kg	198	148	0.15	1300	21.65	108.41	68	5
Copper	mg/kg	203	159	0.54	1600	37.47	131.32	497	1
HMW PAHs	mg/kg	198	160	0.05	16154	178.54	1371.76	46.2	30
LMW PAHs	mg/kg	198	102	0.04	34400	469.75	3508.85	100	11

Notes:
Landfarm locations LF1 and LF2 were routinely sampled at two month intervals from the mid-1980s through the early 1990s, over which time 96 composite soil samples, composed of hundreds of sub-samples were collected. These samples were excluded from this summary to avoid skewing the results.
COC - constituent of concern
HMW - high molecular weight
LMW - low molecular weight
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbons
RG - remediation goal
SD - standard deviation
TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ - toxicity equivalency quotient

Figures



Reviewed By: G. Murphy

EHS Support	**Site Location Map**	**Southern Wood Piedmont and North Carolina State Ports Authority Site Wilmington, NC**	**FIGURE 1-1**

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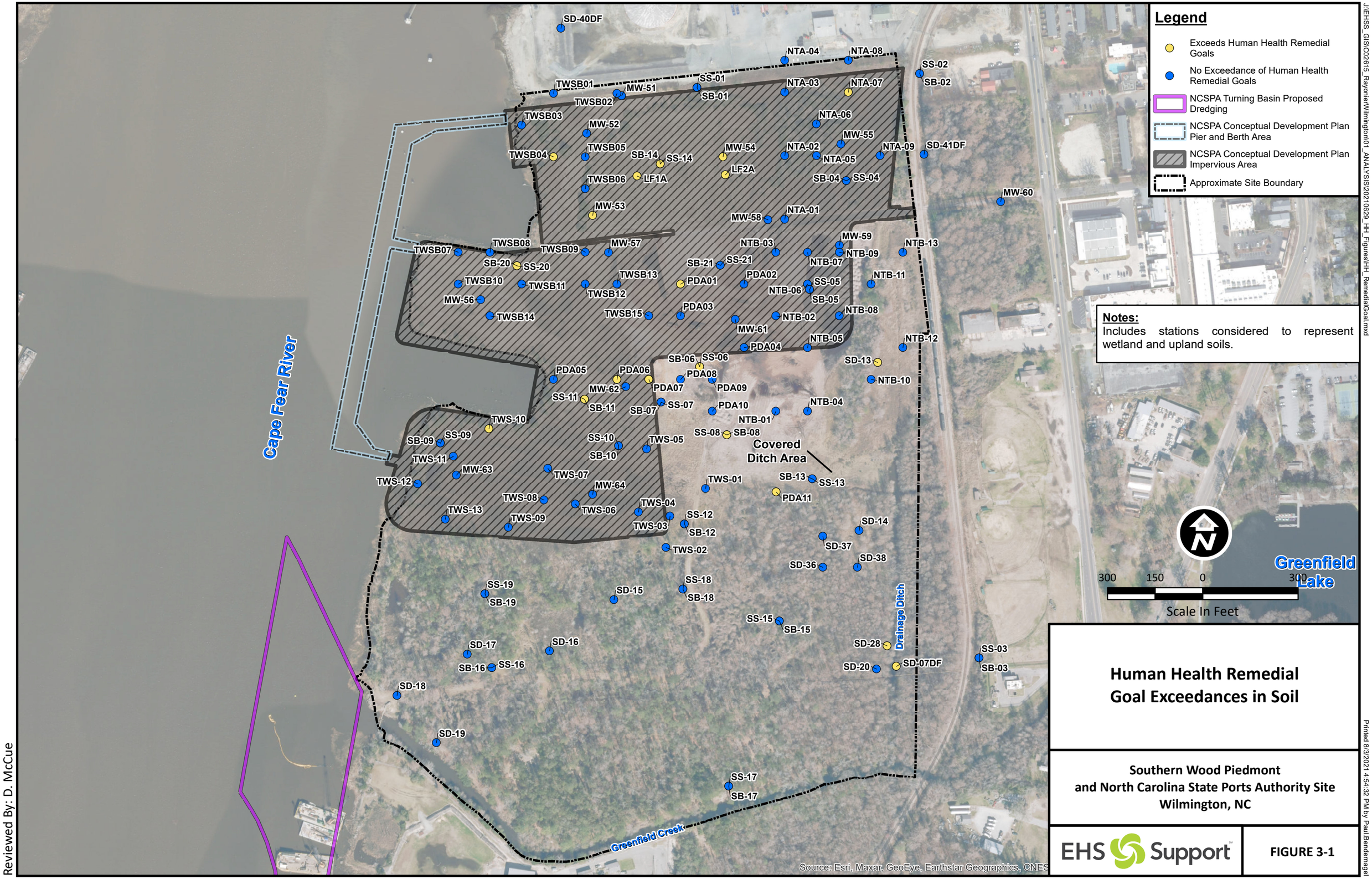
EHS Support	**North Carolina State Ports Authority Conceptual Development Plan**	**SWP and NCSPA Site Wilmington, NC**	**Figure 2-1**



Human Health Remedial Goal Exceedances in Soil

Southern Wood Piedmont
and North Carolina State Ports Authority Site
Wilmington, NC

EHS Support™

FIGURE 3-1

Reviewed By: D. McCue

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Legend

Sediment ESBTU34 values

- ESBTU34 > 1
- ESBTU34 < 1
- NCSPA Turning Basin Proposed Dredging
- NCSPA Conceptual Development Plan Pier and Berth Area
- NCSPA Conceptual Development Plan Impervious Area
- Approximate Site Boundary

Notes:

-A value of zero was substituted for all non-detects.
-ESBTU34 = ESBTU13 * 2.75 UF
-ESBTU34 values less than or equal to 1.0 are considered acceptable for the protection of benthic invertebrate receptors. ESBTU34 values exceeding a value of 1.0 are considered potentially

Cape Fear River

Covered Ditch Area

Greenfield Creek

Drainage Ditch

Greenfield Lake

SS-18 1.15
SS-18 0.39
SS-16 ND
SS-16 1.11
SS-16 1.13
SS-20 0.14
SS-20 0.11
SD-11 0.28
SS-21 7.96
SS-21 228.94
SS-22 4.67
SS-23 10.84
SS-24 ND
SD-10 0.06
SD-18 0.31
SS-09 2.58
GC05-SE 0.11
SD-19 1.45
SD-35 1.12
SD-34 1.3
SS-10
GC04-SE 0.53
GC03-SE 0.53
SD-09 37.62
SD-15 ND
SD-17 0.02
SD-16 ND
SS-05 4.68
SD-05 0.23
SD-41 ND
SS-03 0.33
SD-23 0.86
SD-03 6.43
SD-24 0.08
SD-13 0.05
SD-21 0.4
SD-22 102.37
SD-25 29.19
SD-06 179.48
SS-04 0.1
SS-07 8.44
SD-37 ND
SD-14 0.56
SD-26 89
DD01-SE 0.63
SD-36 ND
SD-38 0.51
SD-27 14.46
SD-28 61.62
SD-20 0.01
SD-07 40.39
SS-08 2.5
SD-29 14.09
DD02-SE 4.81
GC02-SE 104
SD-30 4.62
SD-08 2.39
SD-30 0.64
SD-31 ND
SS-11 ND
SD-32 1.33
SD-33 ND
SS-01 0.05
SS-12 1.26
SS-12 0.98
SS-12 0.2
GC01-SE 0.26

300 150 0 300
Scale In Feet

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES

Equilibrium Partitioning Sediment Benchmark Units (ESBTUs) for PAHs

Southern Wood Piedmont and North Carolina State Ports Authority Site Wilmington, NC

EHS Support

FIGURE 4-1

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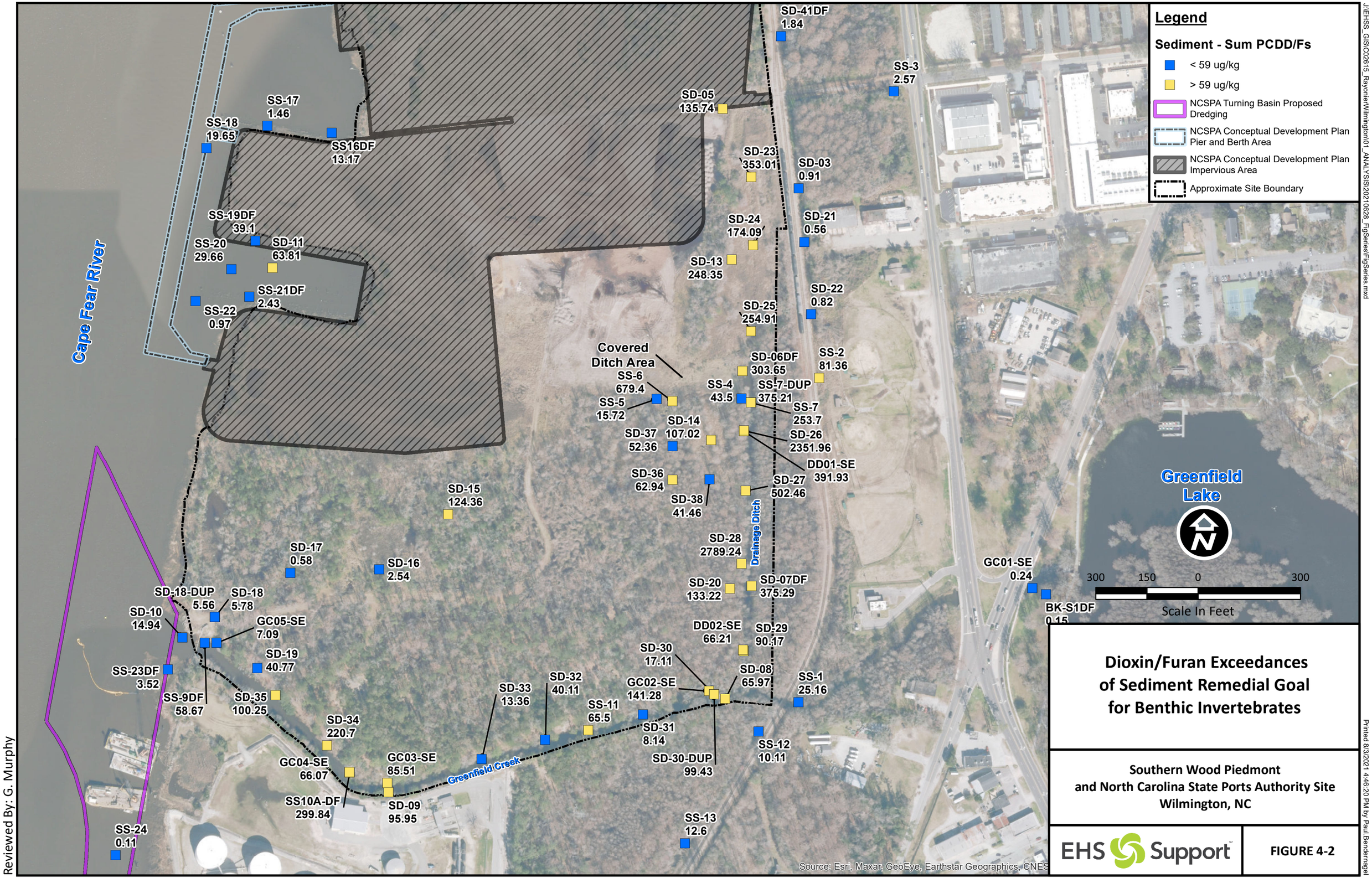

Dioxin/Furan Exceedances of Sediment Remedial Goal for Benthic Invertebrates

Southern Wood Piedmont
and North Carolina State Ports Authority Site
Wilmington, NC

EHS Support

FIGURE 4-2

Reviewed By: G. Murphy

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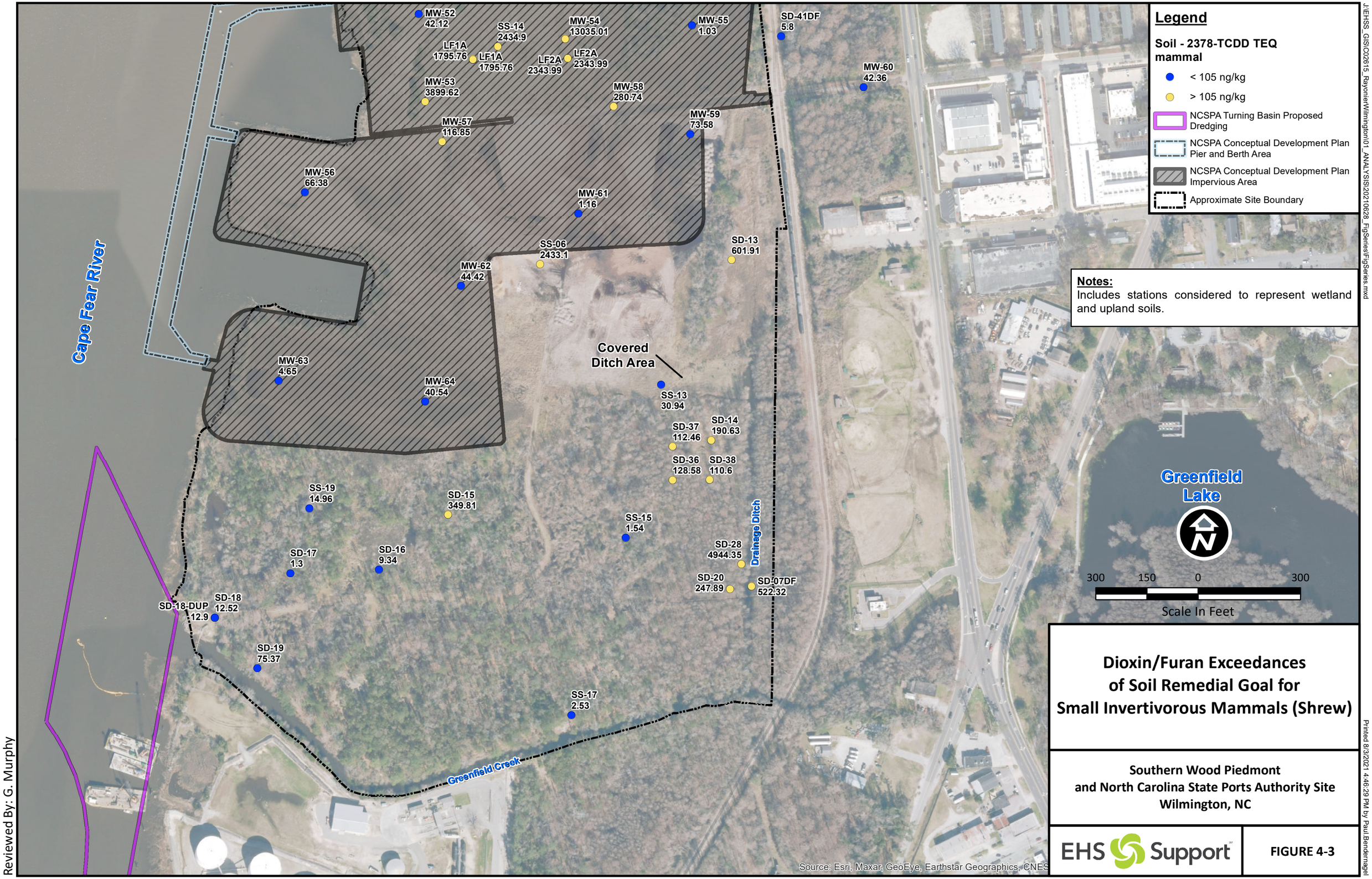

Reviewed By: G. Murphy

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Dioxin/Furan Exceedances of Soil Remedial Goal for Small Invertivorous Mammals (Shrew)

Southern Wood Piedmont and North Carolina State Ports Authority Site
Wilmington, NC

EHS Support℠

FIGURE 4-3

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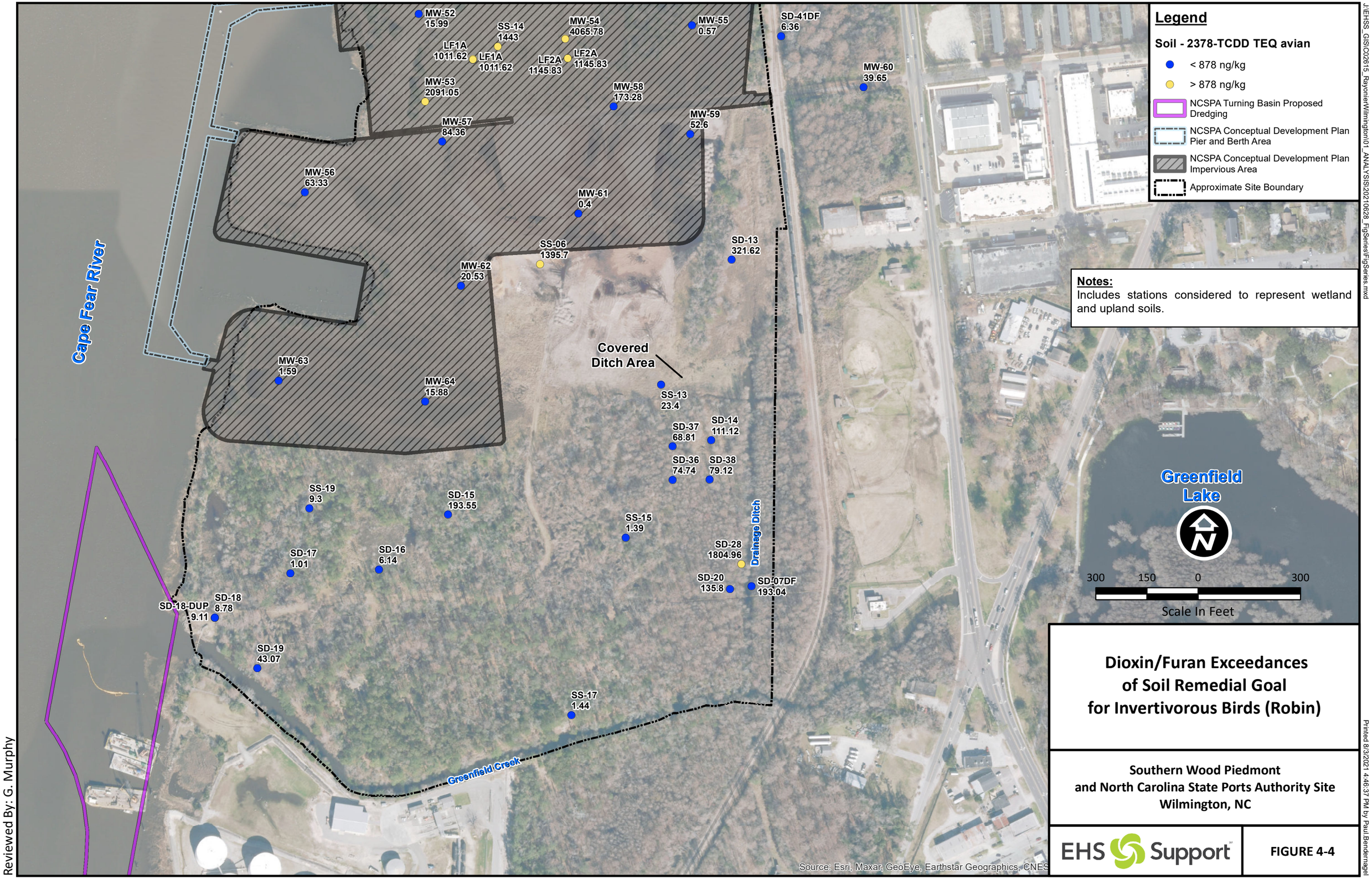

Dioxin/Furan Exceedances of Soil Remedial Goal for Invertivorous Birds (Robin)

Southern Wood Piedmont and North Carolina State Ports Authority Site
Wilmington, NC

EHS Support

FIGURE 4-4

Reviewed By: G. Murphy

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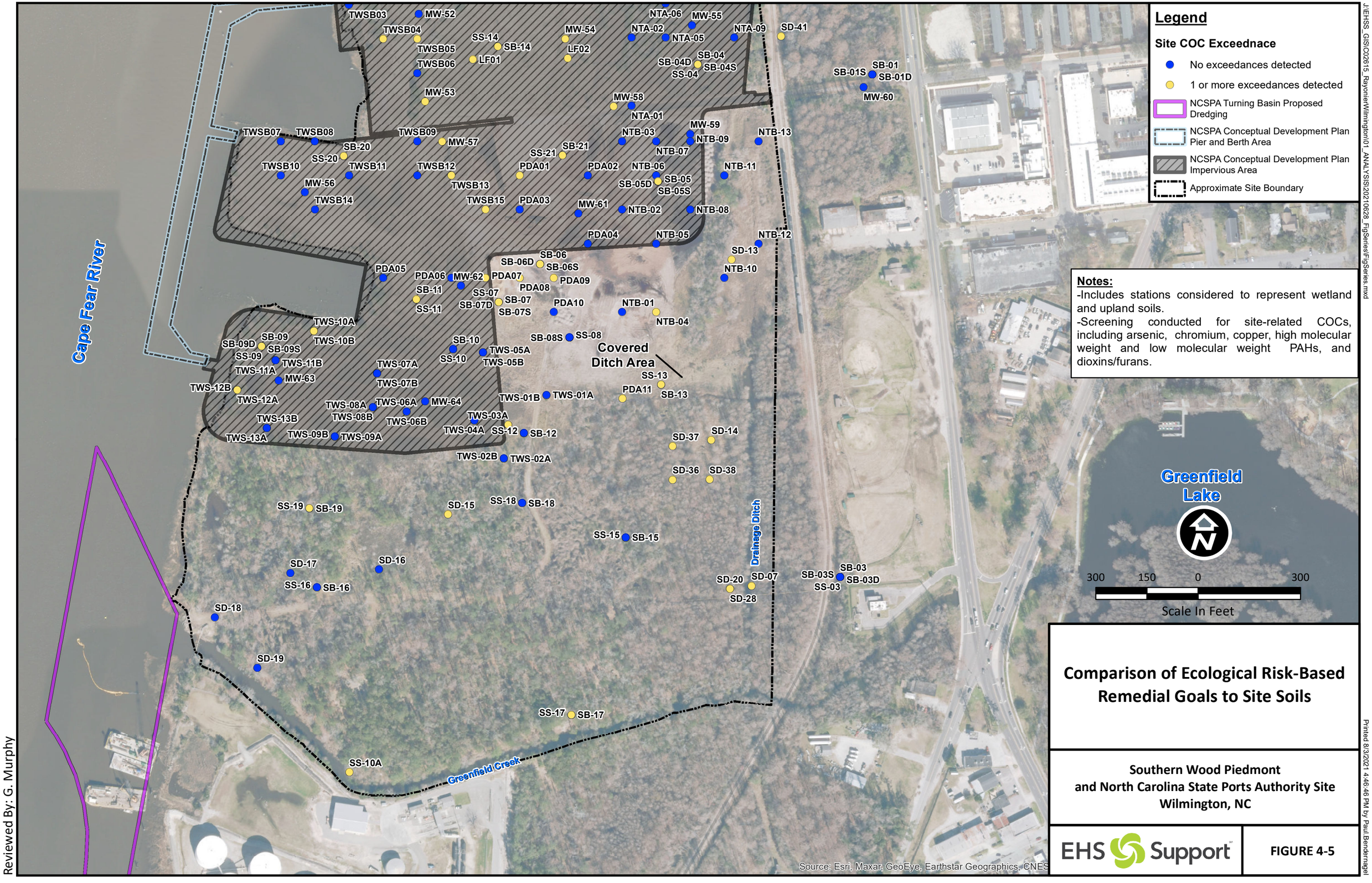
Legend
Site COC Exceednace
No exceedances detected
1 or more exceedances detected
NCSPA Turning Basin Proposed Dredging
NCSPA Conceptual Development Plan Pier and Berth Area
NCSPA Conceptual Development Plan Impervious Area
Approximate Site Boundary
Notes:
-Includes stations considered to represent wetland and upland soils.
-Screening conducted for site-related COCs, including arsenic, chromium, copper, high molecular weight and low molecular weight PAHs, and dioxins/furans.
Cape Fear River
Covered Ditch Area
Greenfield Lake
Greenfield Creek
Drainage Ditch
TWSB03
MW-52
TWSB04
SS-14
SB-14
MW-54
LF02
NTA-06
MW-55
NTA-02
NTA-05
NTA-09
SD-41
TWSB05
TWSB06
LF01
SB-04D
SB-04
SB-04S
SS-04
SB-01S
SB-01
SB-01D
MW-60
MW-53
MW-58
NTA-01
TWSB07
TWSB08
TWSB09
MW-57
SB-20
SS-20
NTB-03
MW-59
NTB-09
NTB-13
SS-21
SB-21
NTB-07
TWSB10
TWSB11
TWSB12
PDA01
PDA02
NTB-06
NTB-11
MW-56
TWSB13
SB-05D
SB-05
SB-05S
TWSB14
TWSB15
PDA03
MW-61
NTB-02
NTB-08
PDA04
NTB-05
NTB-12
SD-13
SB-06
SB-06D
SB-06S
NTB-10
PDA05
PDA06
MW-62
PDA07
PDA09
PDA08
SB-11
SS-07
SB-07
SB-07D
SB-07S
PDA10
NTB-01
NTB-04
SS-11
TWS-10A
SB-09
SB-09D
TWS-10B
SB-08S
SS-08
SB-10
TWS-05A
SB-09S
SS-09
SS-10
TWS-05B
TWS-11B
TWS-07A
TWS-11A
MW-63
SS-13
TWS-12B
TWS-07B
PDA11
SB-13
TWS-12A
TWS-01B
TWS-01A
TWS-08A
TWS-06A
MW-64
TWS-03A
TWS-13B
TWS-08B
TWS-06B
TWS-04A
SS-12
SB-12
TWS-13A
TWS-09B
TWS-09A
SD-37
SD-14
TWS-02B
TWS-02A
SD-36
SD-38
SS-19
SB-19
SD-15
SS-18
SB-18
SS-15
SB-15
SD-17
SD-16
SS-16
SB-16
SD-18
SD-19
SS-17
SB-17
SS-10A
SB-03S
SB-03
SB-03D
SS-03
SD-20
SD-07
SD-28
300
150
0
300
Scale In Feet
Comparison of Ecological Risk-Based Remedial Goals to Site Soils
Southern Wood Piedmont
and North Carolina State Ports Authority Site
Wilmington, NC
EHS Support
FIGURE 4-5
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES
Reviewed By: G. Murphy
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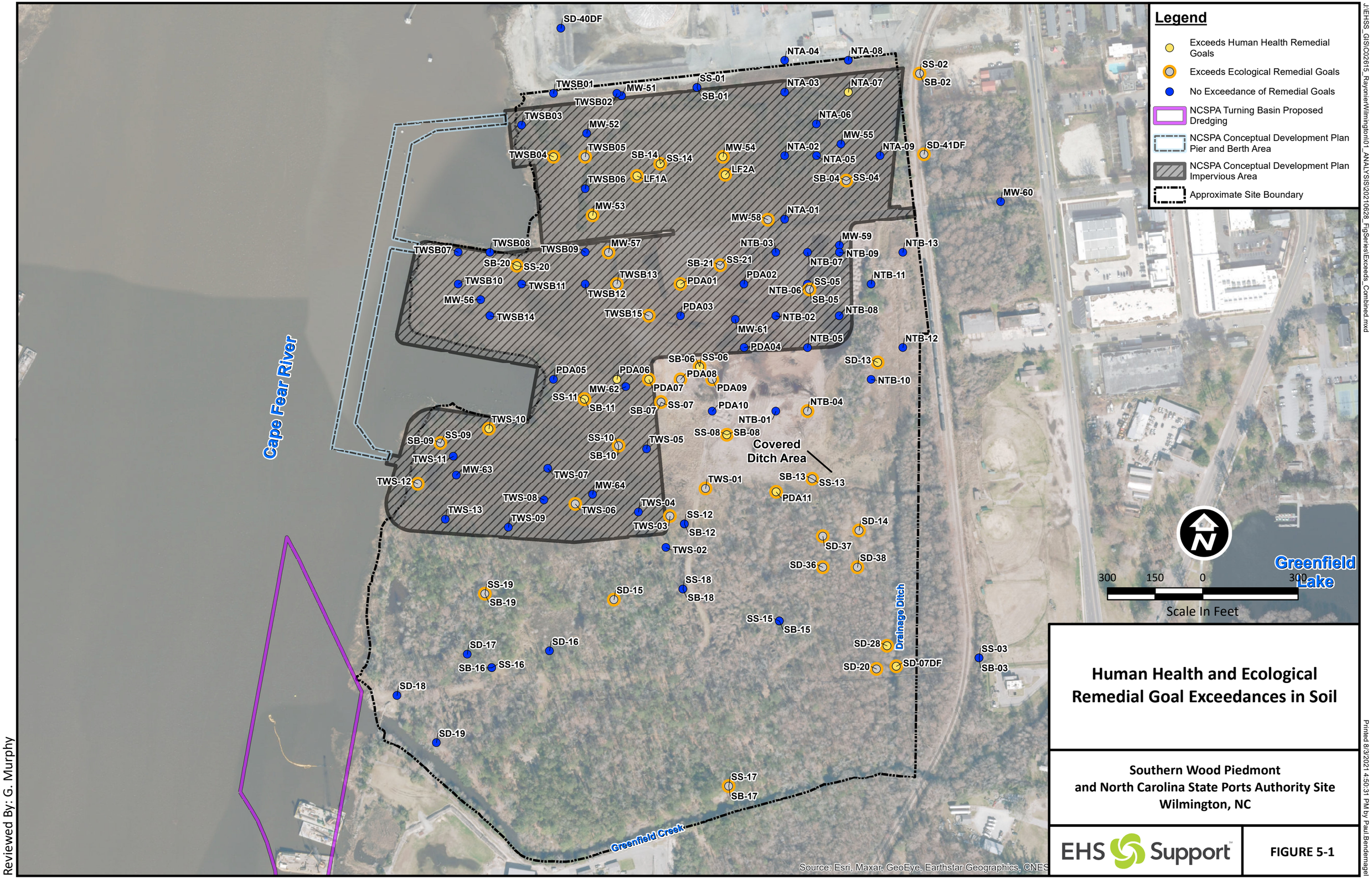

Human Health and Ecological Remedial Goal Exceedances in Soil

Southern Wood Piedmont and North Carolina State Ports Authority Site
Wilmington, NC

EHS Support™

FIGURE 5-1

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Appendix A 2018 Brownfields Update Report

CATLIN
Engineers and Scientists

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April 27, 2018

North Carolina State Ports Authority
Attn: Mark Blake, P.E.
2202 Burnett Blvd.
Wilmington, NC 28401

Re: **DRAFT** Brownfields Update Report
NCSPA Multi-Use Terminal at Former Southern Wood Piedmont Site
Greenfield Street, Wilmington, NC
Brownfields Project No. 21025-17-065
CATLIN Project No. 216100.02
NCSPA Contract No. IH-852(A)

Dear Mr. Blake:

Catlin Engineers and Scientists (CATLIN) is pleased to present you with the following update report to document the recent field activities associated with soil sampling under the North Carolina Department of Environmental Quality (NCDEQ) Brownfields Program at the Former Southern Wood Piedmont (SWP) Site in Wilmington, North Carolina (NC). CATLIN was tasked with collecting 14 soil samples for laboratory analyses at locations across the subject site. This report documents the site background and current soil sampling activities/results and recommendations moving forward.

Site History and Background Information

The North Carolina State Ports Authority (NCSPA) owns a parcel of land (R05320-001-001-000) which is referred to as the Former SWP Northern Parcel Site in Wilmington, NC (See Figure 1). The site has been approved for inclusion in the North Carolina Brownfields Program (NCBP) by the NCDEQ per a letter dated July 31, 2017.

The SWP Site was located on two parcels of land along the Cape Fear River in Wilmington, North Carolina. The site operated as a wood treatment facility from the early 1930s until June 1983 at which time site operations ceased. The SWP operations were on approximately 52 acres that were leased to SWP by owners of the two parcels over the years of operation. The northern parcel is approximately 45 acres and is where the majority of site operations and production occurred. The northern parcel was owned by the City of Wilmington from the early 1900s until 1998 at which time it was acquired by the NCSPA. The southern parcel of land is also approximately 45 acres; however, only a small portion of the southern parcel was leased and used by SWP (conflicting reports of the exact area but somewhere between six and 16 acres of the southern parcel was leased/used by SWP). The southern parcel was owned by Atlantic Coast Terminals in 1960 and a signed lease existed for the portion of the parcel being leased by SWP (then called Taylor-Colquitt Company). In 1962 Tenneco Oil Company

acquired the southern parcel from Atlantic Coast Terminals and the lease with SWP continued. In 1968 the NCSPA acquired the southern parcel from Tenneco Oil Company and the lease with SWP continued. The lease of the portion of the southern parcel between SWP and the NCSPA continued until 1983 at which time SWP ceased operations.

The first environmental investigation conducted at the SWP site was in 1981 and samples were only collected on the northern parcel. Results from this investigation revealed soil and groundwater contamination and that groundwater flow generally paralleled the Cape Fear River and flowed north to south. From 1984 to 1991 "land farming" of the most contaminated soils on the northern parcel was conducted in three areas. In 1985 an environmental investigation conducted by the Environmental Protection Agency (EPA) identified areas of soil contamination, with the highest concentrations of contaminants at areas in the southern portion of the northern parcel. From the early 1990s through the early 2000s numerous environmental investigations were conducted at the subject site. These investigations revealed several areas of free-phase product (mainly creosote, Dense Non-Aqueous Phase Liquid [DNAPL] and some diesel fuel), soil contamination and dissolved-phase groundwater contamination. Based on historical information, the source areas for the above-stated contamination were located on the northern parcel. The area of the southern parcel leased to SWP was used as a storage area for treated wood poles. The most recent groundwater sampling results for the subject site are from 2012 and indicate that DNAPL and dissolved-phase contamination still exist at the subject site. Data from the investigations conducted in the 1990s, 2000s and 2012 indicate that groundwater flow in the shallow and intermediate aquifers is generally west, southwest or south.

In May 2017, CATLIN in coordination with the NCSPA submitted a Brownfields Property Eligibility Application for the subject site. In the application, it was requested that both the northern and southern parcels of the property be eligible for inclusion in the Brownfields Program. However, in the July 31, 2017 letter from the NCBP only the northern parcel of the Former SWP Site was granted eligibility into the program.

January/February 2018 Soil Sampling – Field Activities

As previously stated, CATLIN was tasked with collecting 14 soil samples for laboratory analyses at locations across the subject site to assess the current surficial soil contamination concentrations. CATLIN personnel mobilized to the site and conducted drilling/sampling activities between January 24, 2018 and February 8, 2018. Please note, the 14 soil borings were also being installed at the subject site as part of the geotechnical project associated with this site. In an effort to assess current conditions with respect to soil contamination at the subject site, soil samples were collected continuously during the advancement of these borings from the surface to approximately 10 feet Below Land Surface (BLS) and then at five-foot intervals until boring termination. Soils samples were described in the field utilizing visual/manual techniques as described in the ASTM International (ASTM) D-2488. The soils were classified in accordance with the Unified Soils Classification System (USCS) and a log

of each boring was produced. Boring logs can be found in Attachment A. Also, soil samples were visually examined for evidence of contamination and screened using a Photo Ionization Detector (PID). At each of the 14 boring locations (MW-51 through MW-64), a soil sample from the 0-2 foot interval was collected for laboratory analysis. All soil samples were packed in laboratory supplied glassware, labeled and placed on ice and transported under proper Chain-of-Custody (CoC) to SGS North America, Inc. (SGS) in Wilmington, North Carolina. Soil samples were analyzed for the following:

1. Volatile Organic Compounds (VOCs),
2. Semi-Volatile Organic Compounds (SVOCs),
3. Select Metals,
4. Pesticides and Herbicides
5. Polychlorinated Biphenyls (PCBs)
6. Dioxins & Furans.

Also, at each of the 14 boring locations a permanent, two-inch diameter, shallow monitoring well was installed, developed and the newly installed wells were gauged for depth to water. For each of the 14 wells a North Carolina Non-Residential Well Construction Record was produced and these are included in Attachment A. All monitoring well installation activities were conducted under the direct supervision of a North Carolina Licensed Well Contractor. Please note, groundwater samples were not collected at this time from these wells; however, groundwater sampling will likely occur at a future date. Soil cuttings from boring installation and groundwater from well development were containerized in 55-gallon drums and will be disposed off site in a State-approved disposal facility.

January/February 2018 Soil Sampling – Results

As previously stated, 14 soil samples for laboratory analysis were collected in late January/early February 2018 at the subject site. Laboratory reports and CoC documentation for the soil samples analyzed as part of this investigation are included in Attachment B and are summarized below.

<u>EPA Method 8260B – VOCs</u>

As indicated in Table 1 and depicted on Figure 2, two EPA Method 8260B compounds were detected at concentrations above the established NCDEQ Preliminary Soil Remediation Goals (PSRGs). Naphthalene was detected in sample MW-54 (0-2') at a concentration of 1.21 mg/kg which was above the Protection of Groundwater PSRG but below the Residential Health-Based PSRG and the Industrial/Commercial Health-Based PSRG. Additionally, 11 soil samples contained concentrations of Methylene Chloride above the Protection of Groundwater PSRG but below the Residential Health-Based PSRG and the Industrial/Commercial Health-Based PSRG. However; please note, all the samples containing Methylene Chloride had to be processed with Methanol by the laboratory and therefore the low concentrations of Methylene Chloride detected in these samples are likely from laboratory contamination. All other EPA Method 8260B

compounds were either below the established PSRGs or below the laboratory method detection limit (BMDL). See Figure 2 for a site map with a summary of the soil sample laboratory results in excess of PSRGs and the associated Table 1.

EPA Method 8270D – SVOCs

As indicated in Table 2 and depicted on Figure 3, the following 10 EPA Method 8270D compounds were detected at concentrations above the established NCDEQ PSRGs: Pentachlorophenol, Acenaphthene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, 1-Methylnaphthalene and Naphthalene. One or more of these compounds were detected above at least the lowest PSRGs in the following samples: MW-52 (0-2'), MW-53 (0-2'), MW-54 (0-2'), MW-56 (0-2'), MW-58 (0-2'), MW-60 (0-2'), MW-61 (0-2'), MW-62 (0-2') and MW-63 (0-2'). Four of the above stated compounds were found at concentrations above the Residential Health-Based PSRG but below the Industrial/Commercial Health-Based PSRG.

Additionally, three compounds were detected at concentrations above the Industrial/Commercial Health-Based PSRGs. These compounds were Pentachlorophenol in sample MW-54 (0-2'), Benzo(a)pyrene in samples MW-53 (0-2') and MW-54 (0-2') and Dibenzo(a,h)anthracene in samples MW-53 (0-2') and MW-54 (0-2'). All other EPA Method 8270D compounds were either below the established PSRGs or BMDL. See Figure 3 for a site map with a summary of the soil sample laboratory results in excess of PSRGs and the associated Table 2.

EPA Method 8081B/8151A/8082A – Pesticides/Herbicides/PCBs

As indicated in Table 3 and depicted on Figure 4, no PCBs (EPA Method 8082A) were detected above the laboratory method detection limits in any of the samples. Also, no Pesticides (EPA Method 8081B) were detected at concentrations above any of the established PSRGs. Only one Herbicide (EPA Method 8151A), Pentachlorophenol was detected at concentrations above the established PSRGs. Soil samples MW-52 (0-2'), MW-56 (0-2'), MW-57 (0-2') and MW-63 (0-2') contained concentrations of Pentachlorophenol which were above the Protection of Groundwater PSRG but below the Residential Health-Based PSRG and the Industrial/Commercial Health-Based PSRG. Soil samples MW-53 (0-2') and MW-54 (0-2') contained concentrations of Pentachlorophenol which were above the Protection of Groundwater PSRG and above the Residential Health-Based PSRG but below the Industrial/Commercial Health-Based PSRG. All other EPA Method 8081B/8151A/8082A compounds were either below the established PSRGs or BMDL. See Figure 4 for a site map with a summary of the soil sample laboratory results in excess of PSRGs and the associated Table 3.

EPA Method 6010D/9012B – Metals

As indicated in Table 4 and depicted on Figure 5, three metals (Arsenic, Chromium and Iron) were detected at concentrations above the established NCDEQ PSRGs. One or

more of these metals were detected above at least the lowest PSRGs in all the samples, MW-51 (0-2') through MW-64 (0-2'). Arsenic was detected at concentrations above the Residential Health-Based PSRG in all soil samples except, MW-56 (0-2') and MW-61 (0-2'). Arsenic was detected at concentrations above the Industrial/Commercial Health-Based PSRG in the following samples: MW-52 (0-2'), MW-53 (0-2'), MW-54 (0-2'), MW-57 (0-2'), MW-58 (0-2'), MW-59 (0-2'), MW-62 (0-2') and MW-64 (0-2'). Arsenic was detected at concentrations above the Protection of Groundwater PSRG in the following samples: MW-53 (0-2'), MW-54 (0-2'), MW-58 (0-2'), MW-59 (0-2'), MW-62 (0-2') and MW-64 (0-2').

Chromium was detected at concentrations above the Residential Health-Based PSRG in all soil samples. Chromium was detected at concentrations above the Protection of Groundwater PSRG in the following samples: MW-53 (0-2'), MW-54 (0-2'), MW-57 (0-2'), MW-58 (0-2'), MW-60 (0-2'), MW-62 (0-2') and MW-64 (0-2'). Chromium was detected at concentrations above the Industrial/Commercial Health-Based PSRG in the following samples: MW-53 (0-2'), MW-54 (0-2'), MW-58 (0-2'), MW-62 (0-2') and MW-64 (0-2'). Iron was detected in all samples (MW-51 (0-2') through MW-64 (0-2')) at concentrations which were above the Protection of Groundwater PSRG. However, all detected concentrations of Iron were below the Residential Health-Based PSRG and the Industrial/Commercial Health-Based PSRG. It should be noted that generally the levels of Iron detected in the soil at the subject site appear to be consistent with naturally occurring levels for the Eastern North Carolina region.

All other EPA Method 6010D/9012B compounds were either below the established PSRGs or BMDL. See Figure 5 for a site map with a summary of the soil sample laboratory results in excess of PSRGs and the associated Table 4.

<u>EPA Method 8290A – Dioxins/Furans</u>

As indicated in Table 5 and depicted on Figure 6, the following four EPA Method 8290A compounds were detected at concentrations above the established NCDEQ PSRGs: 2,3,7,8-TCDD; 1,2,3,4,7,8-HxCDD; 1,2,3,6,7,8-HxCDD; 1,2,3,7,8,9-HxCDD. One or more of these compounds were detected above at least the lowest established PSRGs in the following samples: MW-53 (0-2'), MW-54 (0-2') and MW-58 (0-2'). Soil sample MW-53 (0-2') contained two of these compounds (1,2,3,6,7,8-HxCDD and 1,2,3,7,8,9-HxCDD) at concentrations above the Residential and Industrial/Commercial Health-Based PSRG. Soil sample MW-54 (0-2') contained all four of the above-stated compounds at concentrations above the Residential and Industrial/Commercial Health-Based PSRG. Soil sample MW-58 (0-2') contained two of these compounds (1,2,3,6,7,8-HxCDD and 1,2,3,,7,8,9-HxCDD) at concentrations above the Residential Health-Based PSRGs but below the Industrial/Commercial Health-Based PSRGs.

Please note, the majority of the Dioxins/Furans do not have established PSRGs. Therefore, Table 5 should be considered preliminary as additional Toxicity Equivalence (TEQ) action levels will need to be added to this table after they are calculated. CATLIN will work and coordinate with the NCBP to determine the appropriate TEQ action levels,

Table 5 will then be finalized and any other revisions needed will be made to this report. Also, to facilitate review of the Dioxin/Furan results by the NCBP Excel versions of the laboratory reports will be provided to the NCBP. See Figure 6 for a site map with a summary of the soil sample laboratory results in excess of PSRGs and the associated Table 5.

Conclusions and Recommendations

CATLIN collected 14 surface soil samples between January 25, 2018 and February 7, 2018 at the subject site under the NCBP. The soil samples were analyzed for VOCs, SVOCs, Pesticides, Herbicides, PCBs, Metals and Dioxins/Furans. The analytical results revealed numerous compounds were detected at concentrations above the Protection of Groundwater PSRG and the Residential Health-Based PSRG. Also, nine compounds were detected at concentrations above the established Industrial/Commercial Health-Based PSRGs. These nine compounds were: Pentachlorophenol; Benzo(a)pyrene; Dibenzo(a,h)anthracene; Arsenic; Chromium; 2,3,7,8-TCDD; 1,2,3,4,7,8-HxCDD; 1,2,3,6,7,8-HxCDD and 1,2,3,7,8,9-HxCDD. Three of the above-stated compounds are SVOCs (Pentachlorophenol; Benzo(a)pyrene and Dibenzo(a,h)anthracene) and were detected at concentrations above the established Industrial/Commercial Health-Based PSRGs in soil samples MW-53 (0-2') and MW-54 (0-2'). Two of the above-stated compounds are Metals (Arsenic and Chromium) and were detected at concentrations above the established Industrial/Commercial Health-Based PSRGs in soil samples MW-52 (0-2'), MW-53 (0-2'), MW-54 (0-2'), MW-57 (0-2'), MW-58 (0-2'), MW-59 (0-2'), MW-62 (0-2') and MW-64 (0-2'). Four of the above-stated compounds are Dioxins/Furans (2,3,7,8-TCDD; 1,2,3,4,7,8-HxCDD; 1,2,3,6,7,8-HxCDD and 1,2,3,7,8,9-HxCDD) and were detected at concentrations above the established Industrial/Commercial Health-Based PSRGs in soil samples MW-53 (0-2') and MW-54 (0-2'). Therefore, it appears that with respect to surficial soil contamination soil samples MW-53 and MW-54 are the most impacted locations.

CATLIN recommends that this DRAFT Brownfields Update Report be submitted to the NCBP Project Manager for his review. Also, to facilitate review of the Dioxin/Furan results by the NCDEQ Excel versions of the laboratory reports should be provided to the NCBP.

Sincerely,

Shane Chasteen

Shane Chasteen, P.G.
Project Manager

Attachments

TABLES

TABLE 1
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: SW846 8260B

Incident Name and No.: NCSPA SWP Brownfields

Sample ID	Contaminant of Concern → Date Collected	Sample depth (ft.BLS)	Acetone	Chloroform	Methylene Chloride	Naphthalene	1,2,4-Trimethylbenzene	All Other Analytes/Compounds
Residential Health-Based PSRG (mg/kg)			12,000	0.34	58	4.1	63	Varies
Industrial/Commercial Health-Based PSRG (mg/kg)			140,000	1.5	650	18	370	Varies
Protection of Groundwater PSRG (mg/kg)			25	0.39	0.025	0.39	12	Varies
MW-51 (0-2')	1/25/2018	0-2	0.419 JB	<0.046	**0.226 JB**	<0.069	<0.034	BMDL
MW-52 (0-2')	1/26/2018	0-2	<0.37	<0.049	**0.269 BJ**	<0.073	<0.037	BMDL
MW-53 (0-2')	1/25/2018	0-2	1.08 JB	<0.049	**0.469B**	0.204	<0.037	BMDL
MW-54 (0-2')	1/26/2018	0-2	1.29 JB	<0.077	**0.931 JB**	**1.21**	0.0677 J	BMDL
MW-55 (0-2')	2/7/2018	0-2	<0.46	<0.062	**0.272 JB**	<0.093	<0.046	BMDL
MW-56 (0-2')	1/29/2018	0-2	0.742 J	0.0555 J	<0.15	<0.074	<0.037	BMDL
MW-57 (0-2')	1/29/2018	0-2	0.949 J	0.0671 J	<0.16	<0.078	<0.039	BMDL
MW-58 (0-2')	1/29/2018	0-2	1.44 J	0.0974 J	<0.25	<0.12	<0.062	BMDL
MW-59 (0-2')	2/5/2018	0-2	<0.44	<0.059	**0.266 JB**	<0.088	<0.044	BMDL
MW-60 (0-2')	1/29/2018	0-2	<0.37	0.0677 J	<0.15	<0.075	<0.037	BMDL
MW-61 (0-2')	2/2/2018	0-2	<0.42	<0.055	**0.330 JB**	0.122 J	<0.042	BMDL
MW-62 (0-2')	1/29/2018	0-2	0.715 J	0.0642 J	<0.18	<0.088	<0.044	BMDL
MW-63 (0-2')	2/7/2018	0-2	<0.41	<0.055	**0.224 JB**	<0.082	<0.041	BMDL
MW-64 (0-2')	2/6/2018	0-2	<0.58	<0.077	**0.442 JB**	<0.12	<0.058	BMDL
MW-60 (0-2') DUPLICATE	2/8/2018	0-2	<0.26	<0.035	**0.142 JB**	<0.052	<0.026	BMDL
MW-62 (0-2') DUPLICATE	2/8/2018	0-2	<0.28	<0.038	**0.146 JB**	0.112 J	<0.028	BMDL

All results in milligrams per kilogram (mg/kg)

BMDL = Below Method Detection Limit

ft. BLS = Feet Below Land Surface.

< = Less than method detection limit

PSRG = Preliminary Soil Remediation Goals

J = indicates an estimated value

B = indicates an analyte found in associated method blank

Bold results indicate concentration above at least the lowest of the PSRGs

TABLE 2
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: SW846 8270D

Incident Name and No.: NCSPA SWP Brownfields

Sample ID	Contaminant of Concern →		2,4-Dimethylphenol	3&4-Methylphenol	Pentachlorophenol	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Dibenzofuran	bis(2-Ethylhexyl)phthalate	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene	Phenanthrene	Pyrene	All Other Analytes/Compounds
	Date Collected	Sample depth (ft.BLS)																								
Residential Health-Based PSRG (mg/kg)			250	NE	1.0	720	NE	3,600	1.1	0.11	1.1	NE	11	110	0.11	15	390	480	480	1.1	18	48	4.1	NE	360	Varies
Industrial/Commercial Health-Based PSRG (mg/kg)			3,300	NE	4.0	9,000	NE	45,000	21	2.1	210	NE	210	2,100	2.1	210	160	6,000	6,000	21	73	600	18	NE	4,500	Varies
Protection of Groundwater PSRG (mg/kg)			2.4	NE	0.0083	16	41	1,300	0.35	0.12	1.2	15,600	12	36	0.38	10	14	670	110	3.9	0.11	3.1	0.39	134	440	Varies
MW-51 (0-2')	1/25/2018	0-2	<0.049	<0.030	<0.18	<0.019	<0.018	<0.020	0.0594 J	0.0923 J	0.0971 J	0.0687 J	0.0635 J	0.0782 J	<0.023	<0.018	<0.037	0.0480 J	<0.020	0.0872 J	<0.018	<0.018	<0.018	<0.018	0.0546 J	BMDL
MW-52 (0-2')	1/26/2018	0-2	0.0605 J	0.0758 J	**0.915**	0.0434 J	1.09	2.01	**2.18**	**1.58**	**4.54**	1.20	2.45	4.68	**0.390**	<0.018	<0.035	11.6	0.110 J	**1.45**	<0.018	<0.018	<0.018	1.63	8.66	BMDL
MW-53 (0-2')	1/25/2018	0-2	<0.49	<0.30	**2.70 J**	0.526 J	3.46	7.93	**11.1**	**11.8**	**22.1**	7.54	**12.4**	14.0	**2.25**	0.311 J	<0.37	21.8	0.702 J	**9.77**	<0.18	<0.18	0.360 J	5.72	21.0	BMDL
MW-54 (0-2')	1/26/2018	0-2	<0.56	<0.35	**5.30 J**	**20.5**	5.12	NM	**17.1**	**17.8**	**35.6**	9.52	**13.6**	25.7	**2.61**	4.60	<0.42	NM	10.4	**13.2**	**1.08 J**	0.972 J	**0.905 J**	12.7	NM	BMDL
MW-55 (0-2')	2/7/2018	0-2	<0.055	<0.034	<0.21	<0.022	<0.021	<0.023	0.0397 J	0.0370 J	0.0652 J	0.0256 J	0.0602 J	0.0668 J	<0.026	<0.021	0.0968 J	0.0908 J	<0.022	0.0336 J	<0.021	<0.021	<0.021	<0.021	0.0775 J	BMDL
MW-56 (0-2')	1/29/2018	0-2	<0.049	<0.030	<0.18	<0.019	0.0749 J	0.138 J	0.182	**0.157 J**	0.218	0.105 J	0.176 J	0.257	<0.023	<0.018	<0.037	0.435	<0.020	0.131 J	<0.018	<0.018	<0.018	0.0712 J	0.408	BMDL
MW-57 (0-2')	1/29/2018	0-2	<0.051	<0.032	<0.19	<0.020	0.0727 J	0.105 J	0.0776 J	0.0709 J	0.150 J	0.0598 J	0.0855 J	0.111 J	<0.024	<0.019	<0.038	0.117 J	0.0281 J	0.0715 J	<0.019	<0.019	<0.019	0.0418 J	0.121 J	BMDL
MW-58 (0-2')	1/29/2018	0-2	<0.61	<0.38	<2.3	0.382 J	0.646 J	1.48 J	**1.71 J**	**1.57 J**	**2.57**	1.05 J	1.55 J	1.98 J	<0.29	<0.23	<0.46	4.09	0.372 J	**1.41 J**	<0.23	<0.23	<0.23	1.05 J	3.65	BMDL
MW-59 (0-2')	2/5/2018	0-2	<0.056	<0.035	<0.21	<0.022	<0.021	<0.024	0.0370 J	0.0368 J	0.0694 J	0.0241 J	0.0486 J	0.0586 J	<0.026	<0.021	<0.042	0.0589 J	<0.023	0.0338 J	<0.021	<0.021	<0.021	<0.021	0.0521 J	BMDL
MW-60 (0-2')	1/29/2018	0-2	<0.21	<0.13	<0.77	<0.082	<0.077	<0.087	0.171 J	**0.168 J**	0.207 J	0.130 J	0.170 J	0.184 J	<0.097	<0.077	<0.15	0.250 J	<0.083	0.133 J	<0.077	<0.077	<0.077	0.130 J	0.247 J	BMDL
MW-61 (0-2')	2/2/2018	0-2	<0.053	<0.033	<0.20	1.03	0.0317 J	9.36	**0.697**	**0.288**	0.295	0.0986 J	0.227	0.738	0.0252 J	1.52	0.284 J	4.37	5.47	0.133 J	<0.020	0.178 J	<0.020	19.9	2.72	BMDL
MW-62 (0-2')	1/29/2018	0-2	<0.056	<0.035	**0.283 J**	0.0230 J	0.304	0.918	**0.758**	**0.670**	**2.03**	0.530	0.942	1.55	**0.162 J**	0.0280 J	<0.042	1.63	0.0656 J	0.728	<0.021	<0.021	0.0474 J	0.187 J	1.91	BMDL
MW-63 (0-2')	2/7/2018	0-2	<0.053	<0.033	<0.20	<0.021	0.0431 J	0.0821 J	0.308	**0.261**	0.356	0.140 J	0.319	0.379	0.0465 J	<0.020	0.139 J	0.431	<0.021	0.174 J	<0.020	<0.020	<0.020	0.0304 J	0.464	BMDL
MW-64 (0-2')	2/6/2018	0-2	<0.062	<0.039	<0.23	<0.025	<0.023	<0.026	0.0400 J	0.0357 J	0.0343 J	<0.024	<0.031	0.0420 J	<0.029	<0.023	0.0746 J	0.0638 J	<0.025	<0.029	<0.023	<0.023	<0.023	0.0439 J	0.0587 J	BMDL

All results in milligrams per Kilogram (mg/kg)
BMDL = Below Method Detection Limit
NM = Not Measured
NE = None Established
ft. BLS = Feet Below Land Surface
< = Less than method detection limit
PSRG = Preliminary Soil Remediation Goals
J = indicates an estimated value
Bold results indicate concentration above at least the lowest of the PSRGs

TABLE 3
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: SW846 8081B/8151A/8082A

Incident Name and No.: NCSPA SWP Brownfields

Sample ID	Method →		8081B							8151A				8082A
	Date Collected	Sample depth (ft.BLS)	4,4'-DDD	4,4'-DDE	4,4'-DDT	Endosulfan sulfate	Endrin aldehyde	Endrin ketone	All Other 8081A Analytes/Compounds	Dichloroprop	2,4-DB	Pentachlorophenol	All Other 8151A Analytes/Compounds	All 8082A Analytes/Compounds
Residential Health-Based PSRG (mg/kg)			0.38	2.0	1.9	NE	NE	NE	Varies	NE	NE	1.0	Varies	Varies
Industrial/Commercial Health-Based PSRG (mg/kg)			4.9	9.3	8.5	NE	NE	NE	Varies	NE	NE	4.0	Varies	Varies
Protection of Groundwater PSRG (mg/kg)			0.47	0.47	0.67	16	NE	NE	Varies	NE	NE	0.0083	Varies	Varies
MW-51 (0-2')	1/25/2018	0-2	<0.00050	<0.00067	0.00087 J	<0.00048	<0.00042	<0.00057	BMDL	<0.0090	<0.0094	<0.00076	BMDL	BMDL
MW-52 (0-2')	1/26/2018	0-2	<0.0098	<0.013	0.0176 J	<0.0093	<0.0082	<0.011	BMDL	0.0138 J	0.0375	**0.223**	BMDL	BMDL
MW-53 (0-2')	1/25/2018	0-2	<0.010	<0.013	0.0218 J	<0.0097	0.0129 J	0.0195 J	BMDL	<0.0089	0.0772	**1.12**	BMDL	BMDL
MW-54 (0-2')	1/26/2018	0-2	<0.11	<0.15	<0.12	0.115 J	<0.094	<0.13	BMDL	<0.010	0.0520	**1.80**	BMDL	BMDL
MW-55 (0-2')	2/7/2018	0-2	<0.00058	<0.00076	<0.00064	<0.00055	<0.00048	<0.00066	BMDL	<0.010	<0.011	<0.00088	BMDL	BMDL
MW-56 (0-2')	1/29/2018	0-2	<0.0049	<0.0065	<0.0055	<0.0047	<0.0042	<0.0056	BMDL	<0.0090	<0.0094	**0.0167**	BMDL	BMDL
MW-57 (0-2')	1/29/2018	0-2	<0.011	<0.014	<0.012	<0.010	<0.0089	<0.012	BMDL	<0.0093	<0.0098	**0.0542**	BMDL	BMDL
MW-58 (0-2')	1/29/2018	0-2	0.0112 J	<0.0083	<0.0070	<0.0060	<0.0053	<0.0072	BMDL	<0.011	<0.012	0.0072	BMDL	BMDL
MW-59 (0-2')	2/5/2018	0-2	<0.00057	<0.00075	<0.00063	<0.00055	<0.00048	0.00066 J	BMDL	<0.010	<0.011	0.0078	BMDL	BMDL
MW-60 (0-2')	1/29/2018	0-2	0.0214 J	0.115	0.0163 J	<0.0051	<0.0045	<0.0061	BMDL	<0.0095	<0.0099	0.0016 J	BMDL	BMDL
MW-61 (0-2')	2/2/2018	0-2	<0.00054	<0.00071	<0.00060	<0.00051	<0.00045	<0.00061	BMDL	<0.0098	<0.010	<0.00083	BMDL	BMDL
MW-62 (0-2')	1/29/2018	0-2	<0.0057	<0.0075	<0.0063	<0.0055	<0.0048	<0.0065	BMDL	<0.010	<0.011	0.0077	BMDL	BMDL
MW-63 (0-2')	2/7/2018	0-2	<0.0027	<0.0036	<0.0030	<0.0026	<0.0023	<0.0031	BMDL	<0.0099	<0.010	**0.0102**	BMDL	BMDL
MW-64 (0-2')	2/6/2018	0-2	<0.00066	<0.00087	<0.00073	<0.00063	<0.00055	<0.00075	BMDL	<0.012	<0.012	<0.0010	BMDL	BMDL

All results in milligrams per Kilogram (mg/kg)

BMDL = Below Method Detection Limit

NE = None Established

ft. BLS = Feet Below Land Surface

< = Less than method detection limit

PSRG = Preliminary Soil Remediation Goals

J = indicates an estimated value

Bold results indicate concentration above at least the lowest of the PSRGs

TABLE 4
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: SW846 6010D, 9012B

Incident Name and No.: NCSPA SWP Brownfields

Sample ID	Contaminant of Concern → Date Collected	Sample depth (ft.BLS)	Aluminum	Arsenic	Chromium	Copper	Iron	Lead	Cyanide, Total
Residential Health Based PSRG (mg/kg)			16,000	0.68	0.31	630	11,000	400	3.1
Industrial/Commercial Health Based PSRG (mg/kg)			230,000	3.0	6.5	9300	160,000	800	31
Protection of Groundwater PSRG (mg/kg)			110,000	5.80	3.8	700	150	270	0.42
MW-51 (0-2')	1/25/2018	0-2	1030	**1.5**	**3.3**	10.2	**2,150**	17.8	0.065
MW-52 (0-2')	1/26/2018	0-2	1170	**4.5**	**3.4**	9.6	**2,050**	68.5	0.063
MW-53 (0-2')	1/25/2018	0-2	2020	**13.6**	**10**	29.5	**3,560**	21.2	0.10 J
MW-54 (0-2')	1/26/2018	0-2	6860	**16.8**	**13.3**	54.0	**10,000**	29.7	0.11 J
MW-55 (0-2')	2/7/2018	0-2	654	**0.72**	**2.2**	2.1	**1,060**	2.1	0.076
MW-56 (0-2')	1/29/2018	0-2	561	0.60	**1.8**	0.54 J	**1,230**	1.6	0.062
MW-57 (0-2')	1/29/2018	0-2	833	**7.0**	**5.5**	9.0	**1,980**	13.8	0.071 J
MW-58 (0-2')	1/29/2018	0-2	1700	**25.4**	**30.0**	64.8	**4,630**	39.7	0.079
MW-59 (0-2')	2/5/2018	0-2	1420	**7.8**	**3.6**	34.7	**3,630**	47.3	0.075
MW-60 (0-2')	1/29/2018	0-2	2600	**2.4**	**4.8**	22.3	**4,080**	99.0	0.068
MW-61 (0-2')	2/2/2018	0-2	681	0.41 J	**2.1**	0.61 J	**1,070**	2.1	0.065
MW-62 (0-2')	1/29/2018	0-2	1310	**13.3**	**16.9**	15.7	**1,640**	7.8	0.073
MW-63 (0-2')	2/7/2018	0-2	714	**2.9**	**3.2**	2.6	**1,110**	2.4	0.072
MW-64 (0-2')	2/6/2018	0-2	4990	**10**	**8.9**	6.1	**5,940**	7.6	0.086

All results in milligrams per Kilogram (mg/kg)

BMDL = Below Method Detection Limit

ft. BLS = Feet Below Land Surface

< = Less than method detection limit

PSRG = Preliminary Soil Remediation Goals

J = indicates an estimated value

Bold results indicate concentration above at least the lowest of the PSRGs

TABLE 5
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: 8290A

Incident Name and No. NCSPA SWP Brownfields

Sample ID	Contaminant of Concern → Date Collected	Sample Depth (ft. BLS)	2,3,7,8-TCDD	1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD	1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	OCDD	2,3,7,8-TCDF	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF	2,3,4,6,7,8-HxCDF	1,2,3,7,8,9-HxCDF	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	OCDF	Total Tetra-Dioxins	Total Penta-Dioxins	Total Hexa-Dioxins	Total Hepta-Dioxins	Total Tetra-Furans	Total Penta-Furans	Total Hexa-Furans	Total Hepta-Furans
Residential Health Based PSRG (pg/g)			4.8	NE	100	100	100	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Industrial/Commercial Health Based PSRG (pg/g)			22	NE	470	470	470	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Protection of Groundwater PSRG (pg/g)			2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
MW-51 (0-2')	1/25/2018	0-2	0.0745	2.78	15.7	37.7	21.4	1,910	20,200	< 0.348	0.611	4.96	6.77	5.82	12.1	< 1.74	306	26.8	975	5.72	16.3	366	5,760	6.34	49.5	225	983
MW-52 (0-2')	1/26/2018	0-2	< 0.365	2.44	15.9	44.6	18.4	1,980	20,300	< 0.365	0.373	1.03	6.71	6.37	6.91	< 1.83	307	22.3	960	0.902	13.5	398	6,610	< 0.365	18.3	215	934
MW-53 (0-2')	1/25/2018	0-2	**2.3**	109	**391**	**4,860**	**987**	153,000	1,180,000	20.5	139	362	1,240	527	997	< 1.99	84,200	1,700	101,000	66.3	855	30,200	508,000	176	2,490	45,800	191,000
MW-54 (0-2')	1/26/2018	0-2	**27**	197	**1,020**	**11,200**	**1,720**	705,000	7,930,000	21	83.8	194	1,880	585	1,400	< 2.25	125,000	7,900	699,000	336	4,830	117,000	2,060,000	337	2,640	81,700	555,000
MW-55 (0-2')	2/7/2018	0-2	< 1.34	< 6.72	< 6.72	1.45	< 6.72	29.8	299	< 1.34	< 6.72	< 6.72	1.18	< 6.72	1.24	< 6.72	25.3	< 6.72	20.6	< 1.34	1.09	14.9	103	< 1.34	< 6.72	16.7	43.8
MW-56 (0-2')	1/29/2018	0-2	< 0.478	3.25	16.8	36.2	21.6	1,170	12,900	< 0.478	2.11	20.5	51	20.7	117	< 2.39	1,390	60.1	1,720	24.5	79.7	437	3,390	14	161	900	2,830
MW-57 (0-2')	1/29/2018	0-2	0.881	2.32	12	62.8	20.4	3,130	33,700	< 0.445	1.58	13.7	37.2	16.8	39.5	< 2.22	4,700	66	5,180	1.75	27.2	899	16,400	5.3	107	1,760	9,350
MW-58 (0-2')	1/29/2018	0-2	< 0.431	29.1	47.5	**215**	**110**	8,920	89,500	< 0.431	< 2.15	20	90.7	73.4	80.1	< 2.15	6,390	168	7,810	< 0.431	272	2,800	34,900	< 0.431	345	3,530	13,700
MW-59 (0-2')	2/5/2018	0-2	< 1.37	4.09	17	52.4	27.7	1,940	20,600	< 1.37	5.11	8.77	32.2	25.4	34.2	<6.85	2,140	33.5	1,660	16.4	55.7	635	7,520	14.7	179	1,230	4,030
MW-60 (0-2')	1/29/2018	0-2	< 0.446	3.87	8.43	29.6	13.2	1,160	13,700	< 0.446	< 2.23	19.6	11.5	9.3	20.3	< 2.23	727	14.4	848	18.5	61.2	469	5,650	52.8	263	504	1,540
MW-61 (0-2')	2/2/2018	0-2	< 1.44	< 7.21	< 7.21	1.34	1.52	46.7	1,080	< 1.44	< 7.21	< 7.21	< 7.21	< 7.21	< 7.21	< 7.21	7.92	< 7.21	5.29	10.1	8.16	39.6	130	< 1.44	2.3	5.56	13.7
MW-62 (0-2')	1/29/2018	0-2	< 0.433	2.69	7.72	41	18	1,850	25,400	< 0.433	1.11	3.01	7.97	3.83	7.49	< 2.16	553	14.8	1,300	13.5	37.3	509	8,440	<0.433	27.8	321	1,560
MW-63 (0-2')	2/7/2018	0-2	< 1.21	< 6.05	1.47	3.89	2.32	233	2,660	< 1.21	< 6.05	< 6.05	2.53	0.66	1.56	< 6.05	26	< 6.05	71.2	< 1.21	7.04	83.6	1,230	< 1.21	5.45	34.7	79.7
MW-64 (0-2')	2/6/2018	0-2	< 1.63	2.92	11.8	29.5	22	1,860	22,400	< 1.63	< 8.17	< 8.17	7.6	4.13	6.6	< 8.17	367	17.8	952	23	42.1	722	11,400	< 1.63	20.6	230	1,030

All results in picograms per gram (pg/g) parts per trillion (ppt)
NE = None Established
ft. BLS = Feet Below Land Surface.
< = Less than method detection limit
PSRG = Preliminary Soil Remediation Goals
Bold results indicate concentration above at least the lowest of the PSRGs

FIGURES

Data Source: Adapted from ARCGIS Online Topographic Maps.

CATLIN Engineers and Scientists 220 Old Dairy Road Wilmington, NC 28405 Corporate Licensure No. for Engineering Services C-0585	PROJECT NCSPA SWP SITE BROWNFIELDS #21025-17-065 WILMINGTON, NC		TITLE **SITE LOCATION MAP**			**FIGURE** **1**
	JOB NO. 216100.02	DATE APR 2018	SCALE AS SHOWN	DRAWN BY THW	CHECKED BY SAC	

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SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: SW846 8260B

Incident Name and No.: NCSPA SWP Brownfields

Sample ID	Contaminant of Concern → Date Collected	Sample depth (ft.BLS)	Acetone	Chloroform	Methylene Chloride	Naphthalene	1,2,4-Trimethylbenzene	All Other Analytes/Compounds
Residential Health-Based PSRG (mg/kg)			12,000	0.34	58	4.1	63	Varies
Industrial/Commercial Health-Based PSRG (mg/kg)			140,000	1.5	650	18	370	Varies
Protection of Groundwater PSRG (mg/kg)			25	0.39	0.025	0.39	12	Varies
MW-51 (0-2')	1/25/2018	0-2	0.419 JB	<0.046	**0.226 JB**	<0.069	<0.034	BMDL
MW-52 (0-2')	1/26/2018	0-2	<0.37	<0.049	**0.269 BJ**	<0.073	<0.037	BMDL
MW-53 (0-2')	1/25/2018	0-2	1.08 JB	<0.049	**0.469B**	0.204	<0.037	BMDL
MW-54 (0-2')	1/26/2018	0-2	1.29 JB	<0.077	**0.931 JB**	**1.21**	0.0677 J	BMDL
MW-55 (0-2')	2/7/2018	0-2	<0.46	<0.062	**0.272 JB**	<0.093	<0.046	BMDL
MW-56 (0-2')	1/29/2018	0-2	0.742 J	0.0555 J	<0.15	<0.074	<0.037	BMDL
MW-57 (0-2')	1/29/2018	0-2	0.949 J	0.0671 J	<0.16	<0.078	<0.039	BMDL
MW-58 (0-2')	1/29/2018	0-2	1.44 J	0.0974 J	<0.25	<0.12	<0.062	BMDL
MW-59 (0-2')	2/5/2018	0-2	<0.44	<0.059	**0.266 JB**	<0.088	<0.044	BMDL
MW-60 (0-2')	1/29/2018	0-2	<0.37	0.0677 J	<0.15	<0.075	<0.037	BMDL
MW-61 (0-2')	2/2/2018	0-2	<0.42	<0.055	**0.330 JB**	0.122 J	<0.042	BMDL
MW-62 (0-2')	1/29/2018	0-2	0.715 J	0.0642 J	<0.18	<0.088	<0.044	BMDL
MW-63 (0-2')	2/7/2018	0-2	<0.41	<0.055	**0.224 JB**	<0.082	<0.041	BMDL
MW-64 (0-2')	2/6/2018	0-2	<0.58	<0.077	**0.442 JB**	<0.12	<0.058	BMDL
MW-60 (0-2') DUPLICATE	2/8/2018	0-2	<0.26	<0.035	**0.142 JB**	<0.052	<0.026	BMDL
MW-62 (0-2') DUPLICATE	2/8/2018	0-2	<0.28	<0.038	**0.146 JB**	0.112 J	<0.028	BMDL

All results in milligrams per kilogram (mg/kg)

BMDL = Below Method Detection Limit

ft. BLS = Feet Below Land Surface.

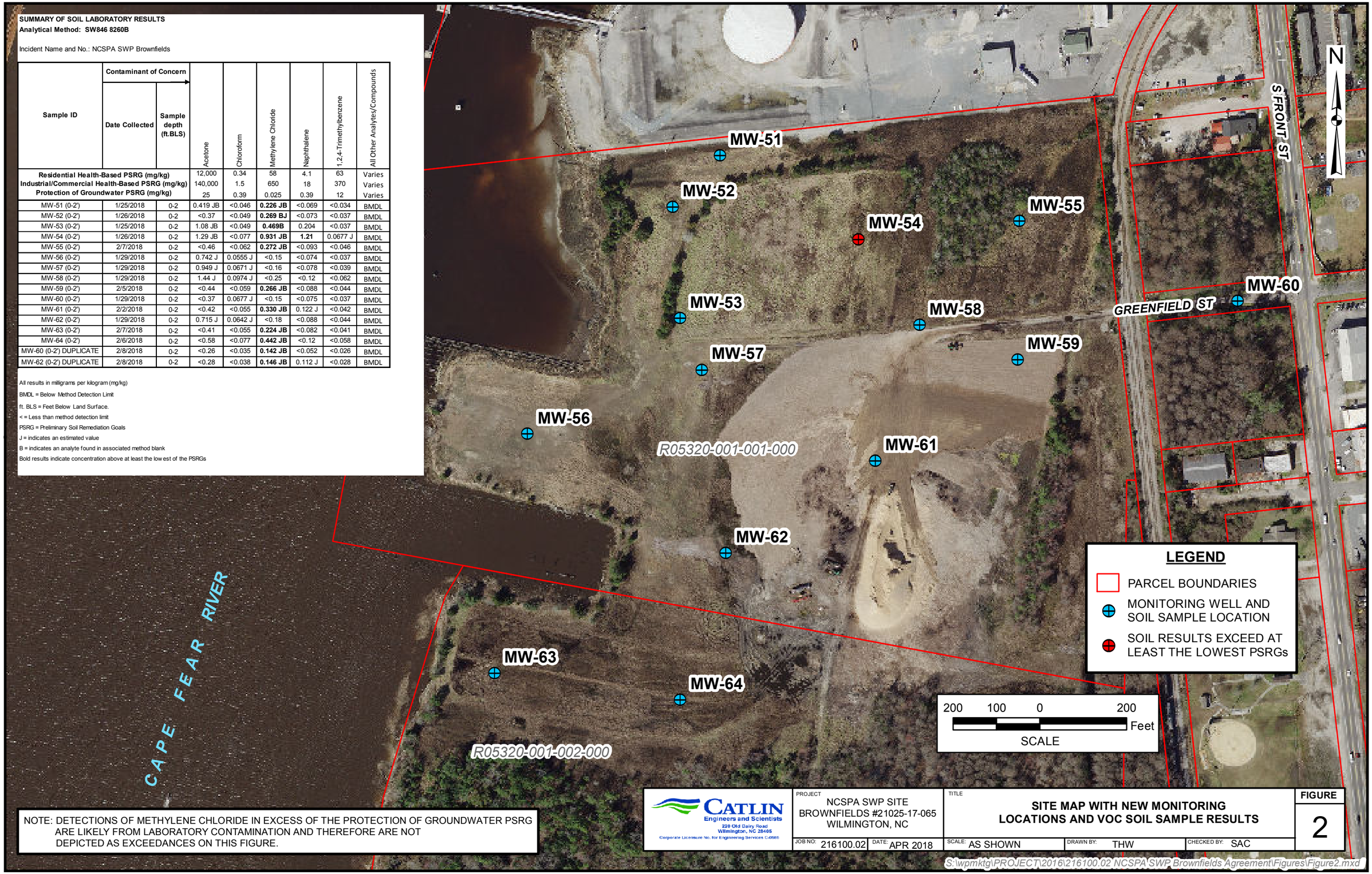
< = Less than method detection limit

PSRG = Preliminary Soil Remediation Goals

J = indicates an estimated value

B = indicates an analyte found in associated method blank

Bold results indicate concentration above at least the lowest of the PSRGs



NOTE: DETECTIONS OF METHYLENE CHLORIDE IN EXCESS OF THE PROTECTION OF GROUNDWATER PSRG ARE LIKELY FROM LABORATORY CONTAMINATION AND THEREFORE ARE NOT DEPICTED AS EXCEEDANCES ON THIS FIGURE.

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PROJECT: NCSPA SWP SITE BROWNFIELDS #21025-17-065 WILMINGTON, NC

TITLE: **SITE MAP WITH NEW MONITORING LOCATIONS AND VOC SOIL SAMPLE RESULTS**

FIGURE: 2

JOB NO: 216100.02 | DATE: APR 2018 | SCALE: AS SHOWN | DRAWN BY: THW | CHECKED BY: SAC

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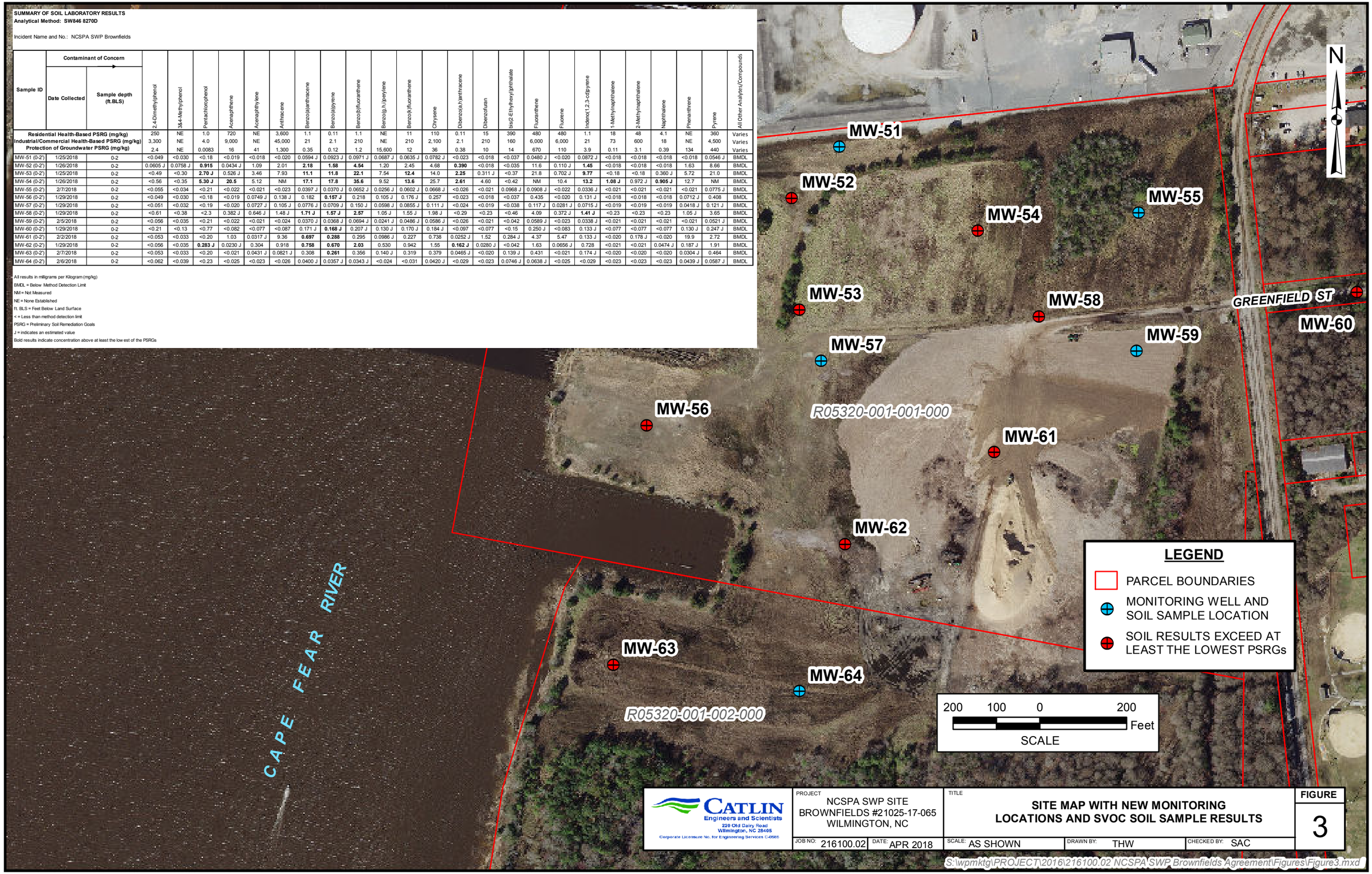
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: SW846 8270D

Incident Name and No.: NCSPA SWP Brownfields

Sample ID	Contaminant of Concern → Date Collected	Sample depth (ft.BLS)	2,4-Dimethylphenol	3&4-Methylphenol	Pentachlorophenol	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Dibenzofuran	bis(2-Ethylhexyl)phthalate	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene	Phenanthrene	Pyrene	All Other Analytes/Compounds
Residential Health-Based PSRG (mg/kg)			250	NE	1.0	720	NE	3,600	1.1	0.11	1.1	NE	11	110	0.11	15	390	480	480	1.1	18	48	4.1	NE	360	Varies
Industrial/Commercial Health-Based PSRG (mg/kg)			3,300	NE	4.0	9,000	NE	45,000	21	2.1	210	NE	210	2,100	2.1	210	160	6,000	6,000	21	73	600	18	NE	4,500	Varies
Protection of Groundwater PSRG (mg/kg)			2.4	NE	0.0083	16	41	1,300	0.35	0.12	1.2	15,600	12	36	0.38	10	14	670	110	3.9	0.11	3.1	0.39	134	440	Varies
MW-51 (0-2')	1/25/2018	0-2	<0.049	<0.030	<0.18	<0.019	<0.018	<0.020	0.0594 J	0.0923 J	0.0971 J	0.0687 J	0.0635 J	0.0782 J	<0.023	<0.018	<0.037	0.0480 J	<0.020	0.0872 J	<0.018	<0.018	<0.018	<0.018	0.0546 J	BMDL
MW-52 (0-2')	1/26/2018	0-2	0.0605 J	0.0758 J	**0.915**	0.0434 J	1.09	2.01	**2.18**	**1.58**	**4.54**	1.20	2.45	4.68	**0.390**	<0.018	<0.035	11.6	0.110 J	**1.45**	<0.018	<0.018	<0.018	1.63	8.66	BMDL
MW-53 (0-2')	1/25/2018	0-2	<0.49	<0.30	**2.70 J**	0.526 J	3.46	7.93	**11.1**	**11.8**	**22.1**	7.54	**12.4**	14.0	**2.25**	0.311 J	<0.37	21.8	0.702 J	**9.77**	<0.18	<0.18	0.360 J	5.72	21.0	BMDL
MW-54 (0-2')	1/26/2018	0-2	<0.56	<0.35	**5.30 J**	**20.5**	5.12	NM	**17.1**	**17.8**	**35.6**	9.52	**13.6**	25.7	**2.61**	4.60	<0.42	NM	10.4	**13.2**	**1.08 J**	0.972 J	**0.905 J**	12.7	NM	BMDL
MW-55 (0-2')	2/7/2018	0-2	<0.055	<0.034	<0.21	<0.022	<0.021	<0.023	0.0397 J	0.0370 J	0.0652 J	0.0256 J	0.0602 J	0.0668 J	<0.026	<0.021	0.0968 J	0.0908 J	<0.022	0.0336 J	<0.021	<0.021	<0.021	<0.021	0.0775 J	BMDL
MW-56 (0-2')	1/29/2018	0-2	<0.049	<0.030	<0.18	<0.019	0.0749 J	0.138 J	0.182	**0.157 J**	0.218	0.105 J	0.176 J	0.257	<0.023	<0.018	<0.037	0.435	<0.020	0.131 J	<0.018	<0.018	<0.018	0.0712 J	0.408	BMDL
MW-57 (0-2')	1/29/2018	0-2	<0.051	<0.032	<0.19	<0.020	0.0727 J	0.105 J	0.0776 J	0.0709 J	0.150 J	0.0598 J	0.0855 J	0.111 J	<0.024	<0.019	<0.038	0.117 J	0.0281 J	0.0715 J	<0.019	<0.019	<0.019	0.0418 J	0.121 J	BMDL
MW-58 (0-2')	1/29/2018	0-2	<0.61	<0.38	<2.3	0.382 J	0.646 J	1.48 J	**1.71 J**	**1.57 J**	**2.57**	1.05 J	1.55 J	1.98 J	<0.29	<0.23	<0.46	4.09	0.372 J	**1.41 J**	<0.23	<0.23	<0.23	1.05 J	3.65	BMDL
MW-59 (0-2')	2/5/2018	0-2	<0.056	<0.035	<0.21	<0.022	<0.021	<0.024	0.0370 J	0.0368 J	0.0694 J	0.0241 J	0.0486 J	0.0586 J	<0.026	<0.021	<0.042	0.0589 J	<0.023	0.0338 J	<0.021	<0.021	<0.021	<0.021	0.0521 J	BMDL
MW-60 (0-2')	1/29/2018	0-2	<0.21	<0.13	<0.77	<0.082	<0.077	<0.087	0.171 J	**0.168 J**	0.207 J	0.130 J	0.170 J	0.184 J	<0.097	<0.077	<0.15	0.250 J	<0.083	0.133 J	<0.077	<0.077	<0.077	0.130 J	0.247 J	BMDL
MW-61 (0-2')	2/2/2018	0-2	<0.053	<0.033	<0.20	1.03	0.0317 J	9.36	**0.697**	**0.288**	0.295	0.0986 J	0.227	0.738	0.0252 J	1.52	0.284 J	4.37	5.47	0.133 J	<0.020	0.178 J	<0.020	19.9	2.72	BMDL
MW-62 (0-2')	1/29/2018	0-2	<0.056	<0.035	**0.283 J**	0.0230 J	0.304	0.918	**0.758**	**0.670**	**2.03**	0.530	0.942	1.55	**0.162 J**	0.0280 J	<0.042	1.63	0.0656 J	0.728	<0.021	<0.021	0.0474 J	0.187 J	1.91	BMDL
MW-63 (0-2')	2/7/2018	0-2	<0.053	<0.033	<0.20	<0.021	0.0431 J	0.0821 J	0.308	**0.261**	0.356	0.140 J	0.319	0.379	0.0465 J	<0.020	0.139 J	0.431	<0.021	0.174 J	<0.020	<0.020	<0.020	0.0304 J	0.464	BMDL
MW-64 (0-2')	2/6/2018	0-2	<0.062	<0.039	<0.23	<0.025	<0.023	<0.026	0.0400 J	0.0357 J	0.0343 J	<0.024	<0.031	0.0420 J	<0.029	<0.023	0.0746 J	0.0638 J	<0.025	<0.029	<0.023	<0.023	<0.023	0.0439 J	0.0587 J	BMDL

All results in milligrams per Kilogram (mg/kg)
BMDL = Below Method Detection Limit
NM = Not Measured
NE = None Established
ft. BLS = Feet Below Land Surface
< = Less than method detection limit
PSRG = Preliminary Soil Remediation Goals
J = indicates an estimated value
Bold results indicate concentration above at least the low est of the PSRGs



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PROJECT: NCSPA SWP SITE BROWNFIELDS #21025-17-065 WILMINGTON, NC

TITLE: **SITE MAP WITH NEW MONITORING LOCATIONS AND SVOC SOIL SAMPLE RESULTS**

FIGURE: 3

JOB NO: 216100.02 | DATE: APR 2018 | SCALE: AS SHOWN | DRAWN BY: THW | CHECKED BY: SAC

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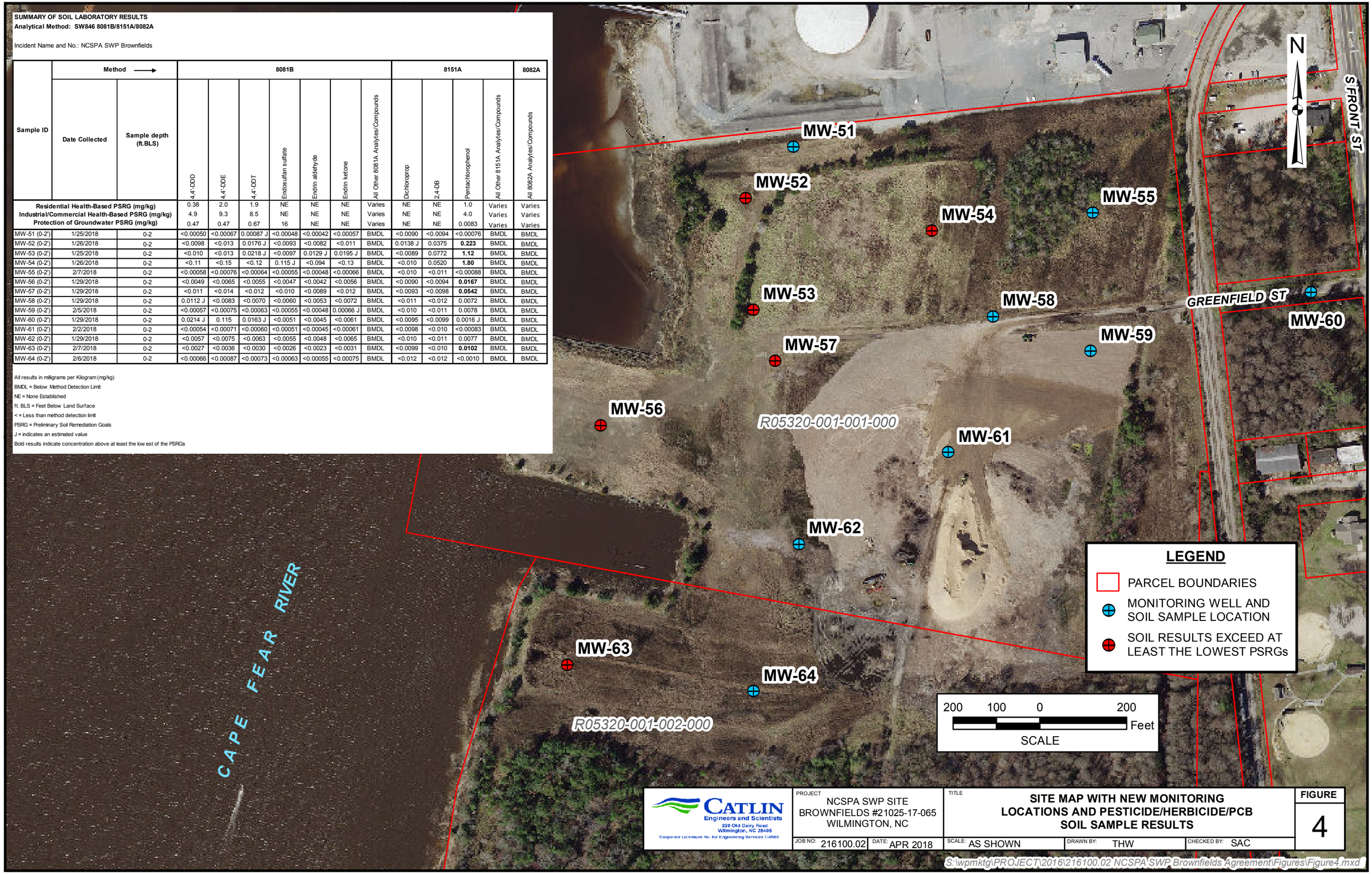
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: SW846 8081B/8151A/8082A

Incident Name and No.: NCSPA SWP Brownfields

Sample ID	Method →		8081B							8151A				8082A
	Date Collected	Sample depth (ft.BLS)	4,4'-DDD	4,4'-DDE	4,4'-DDT	Endosulfan sulfate	Endrin aldehyde	Endrin ketone	All Other 8081A Analytes/Compounds	Dichloroprop	2,4-DB	Pentachlorophenol	All Other 8151A Analytes/Compounds	All 8082A Analytes/Compounds
Residential Health-Based PSRG (mg/kg)			0.38	2.0	1.9	NE	NE	NE	Varies	NE	NE	1.0	Varies	Varies
Industrial/Commercial Health-Based PSRG (mg/kg)			4.9	9.3	8.5	NE	NE	NE	Varies	NE	NE	4.0	Varies	Varies
Protection of Groundwater PSRG (mg/kg)			0.47	0.47	0.67	16	NE	NE	Varies	NE	NE	0.0083	Varies	Varies
MW-51 (0-2')	1/25/2018	0-2	<0.00050	<0.00067	0.00087 J	<0.00048	<0.00042	<0.00057	BMDL	<0.0090	<0.0094	<0.00076	BMDL	BMDL
MW-52 (0-2')	1/26/2018	0-2	<0.0098	<0.013	0.0176 J	<0.0093	<0.0082	<0.011	BMDL	0.0138 J	0.0375	**0.223**	BMDL	BMDL
MW-53 (0-2')	1/25/2018	0-2	<0.010	<0.013	0.0218 J	<0.0097	0.0129 J	0.0195 J	BMDL	<0.0089	0.0772	**1.12**	BMDL	BMDL
MW-54 (0-2')	1/26/2018	0-2	<0.11	<0.15	<0.12	0.115 J	<0.094	<0.13	BMDL	<0.010	0.0520	**1.80**	BMDL	BMDL
MW-55 (0-2')	2/7/2018	0-2	<0.00058	<0.00076	<0.00064	<0.00055	<0.00048	<0.00066	BMDL	<0.010	<0.011	<0.00088	BMDL	BMDL
MW-56 (0-2')	1/29/2018	0-2	<0.0049	<0.0065	<0.0055	<0.0047	<0.0042	<0.0056	BMDL	<0.0090	<0.0094	**0.0167**	BMDL	BMDL
MW-57 (0-2')	1/29/2018	0-2	<0.011	<0.014	<0.012	<0.010	<0.0089	<0.012	BMDL	<0.0093	<0.0098	**0.0542**	BMDL	BMDL
MW-58 (0-2')	1/29/2018	0-2	0.0112 J	<0.0083	<0.0070	<0.0060	<0.0053	<0.0072	BMDL	<0.011	<0.012	0.0072	BMDL	BMDL
MW-59 (0-2')	2/5/2018	0-2	<0.00057	<0.00075	<0.00063	<0.00055	<0.00048	0.00066 J	BMDL	<0.010	<0.011	0.0078	BMDL	BMDL
MW-60 (0-2')	1/29/2018	0-2	0.0214 J	0.115	0.0163 J	<0.0051	<0.0045	<0.0061	BMDL	<0.0095	<0.0099	0.0016 J	BMDL	BMDL
MW-61 (0-2')	2/2/2018	0-2	<0.00054	<0.00071	<0.00060	<0.00051	<0.00045	<0.00061	BMDL	<0.0098	<0.010	<0.00083	BMDL	BMDL
MW-62 (0-2')	1/29/2018	0-2	<0.0057	<0.0075	<0.0063	<0.0055	<0.0048	<0.0065	BMDL	<0.010	<0.011	0.0077	BMDL	BMDL
MW-63 (0-2')	2/7/2018	0-2	<0.0027	<0.0036	<0.0030	<0.0026	<0.0023	<0.0031	BMDL	<0.0099	<0.010	**0.0102**	BMDL	BMDL
MW-64 (0-2')	2/6/2018	0-2	<0.00066	<0.00087	<0.00073	<0.00063	<0.00055	<0.00075	BMDL	<0.012	<0.012	<0.0010	BMDL	BMDL

All results in milligrams per Kilogram (mg/kg)
BMDL = Below Method Detection Limit
NE = None Established
ft. BLS = Feet Below Land Surface
< = Less than method detection limit
PSRG = Preliminary Soil Remediation Goals
J = indicates an estimated value
Bold results indicate concentration above at least the low est of the PSRGs



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PROJECT: NCSPA SWP SITE BROWNFIELDS #21025-17-065 WILMINGTON, NC

TITLE: **SITE MAP WITH NEW MONITORING LOCATIONS AND PESTICIDE/HERBICIDE/PCB SOIL SAMPLE RESULTS**

FIGURE: 4

JOB NO: 216100.02 | DATE: APR 2018 | SCALE: AS SHOWN | DRAWN BY: THW | CHECKED BY: SAC

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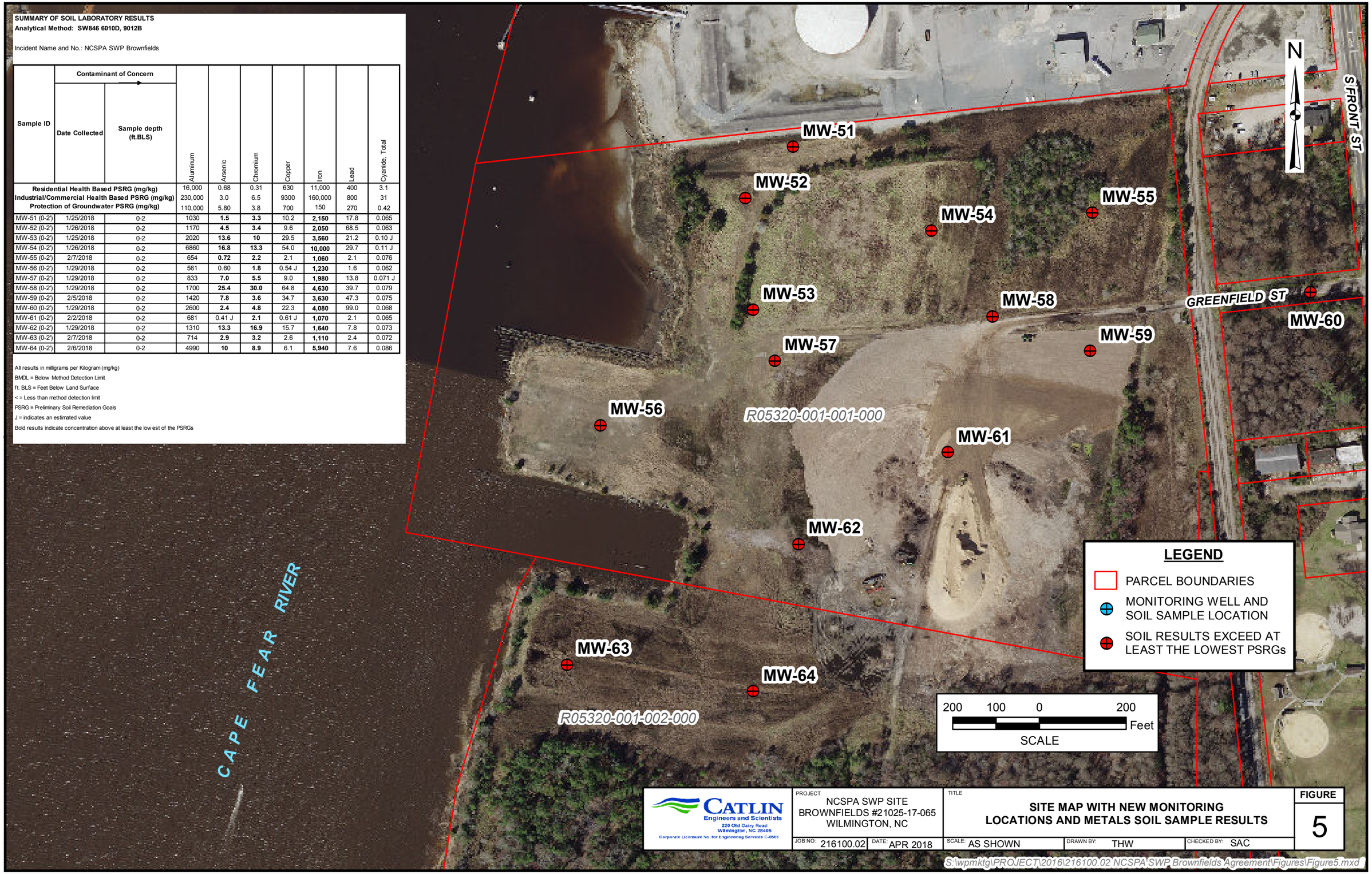
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: SW846 6010D, 9012B

Incident Name and No.: NCSPA SWP Brownfields

Sample ID	Date Collected	Sample depth (ft.BLS)	Aluminum	Arsenic	Chromium	Copper	Iron	Lead	Cyanide, Total
Residential Health Based PSRG (mg/kg)			16,000	0.68	0.31	630	11,000	400	3.1
Industrial/Commercial Health Based PSRG (mg/kg)			230,000	3.0	6.5	9300	160,000	800	31
Protection of Groundwater PSRG (mg/kg)			110,000	5.80	3.8	700	150	270	0.42
MW-51 (0-2')	1/25/2018	0-2	1030	**1.5**	**3.3**	10.2	**2,150**	17.8	0.065
MW-52 (0-2')	1/26/2018	0-2	1170	**4.5**	**3.4**	9.6	**2,050**	68.5	0.063
MW-53 (0-2')	1/25/2018	0-2	2020	**13.6**	**10**	29.5	**3,560**	21.2	0.10 J
MW-54 (0-2')	1/26/2018	0-2	6860	**16.8**	**13.3**	54.0	**10,000**	29.7	0.11 J
MW-55 (0-2')	2/7/2018	0-2	654	**0.72**	**2.2**	2.1	**1,060**	2.1	0.076
MW-56 (0-2')	1/29/2018	0-2	561	0.60	**1.8**	0.54 J	**1,230**	1.6	0.062
MW-57 (0-2')	1/29/2018	0-2	833	**7.0**	**5.5**	9.0	**1,980**	13.8	0.071 J
MW-58 (0-2')	1/29/2018	0-2	1700	**25.4**	**30.0**	64.8	**4,630**	39.7	0.079
MW-59 (0-2')	2/5/2018	0-2	1420	**7.8**	**3.6**	34.7	**3,630**	47.3	0.075
MW-60 (0-2')	1/29/2018	0-2	2600	**2.4**	**4.8**	22.3	**4,080**	99.0	0.068
MW-61 (0-2')	2/2/2018	0-2	681	0.41 J	**2.1**	0.61 J	**1,070**	2.1	0.065
MW-62 (0-2')	1/29/2018	0-2	1310	**13.3**	**16.9**	15.7	**1,640**	7.8	0.073
MW-63 (0-2')	2/7/2018	0-2	714	**2.9**	**3.2**	2.6	**1,110**	2.4	0.072
MW-64 (0-2')	2/6/2018	0-2	4990	**10**	**8.9**	6.1	**5,940**	7.6	0.086

All results in milligrams per Kilogram (mg/kg)
BMDL = Below Method Detection Limit
ft. BLS = Feet Below Land Surface
< = Less than method detection limit
PSRG = Preliminary Soil Remediation Goals
J = indicates an estimated value
Bold results indicate concentration above at least the lowest of the PSRGs



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Corporate Licensure No. for Engineering Services C-0585

PROJECT: NCSPA SWP SITE BROWNFIELDS #21025-17-065 WILMINGTON, NC

TITLE: **SITE MAP WITH NEW MONITORING LOCATIONS AND METALS SOIL SAMPLE RESULTS**

FIGURE: 5

JOB NO: 216100.02 | DATE: APR 2018 | SCALE: AS SHOWN | DRAWN BY: THW | CHECKED BY: SAC

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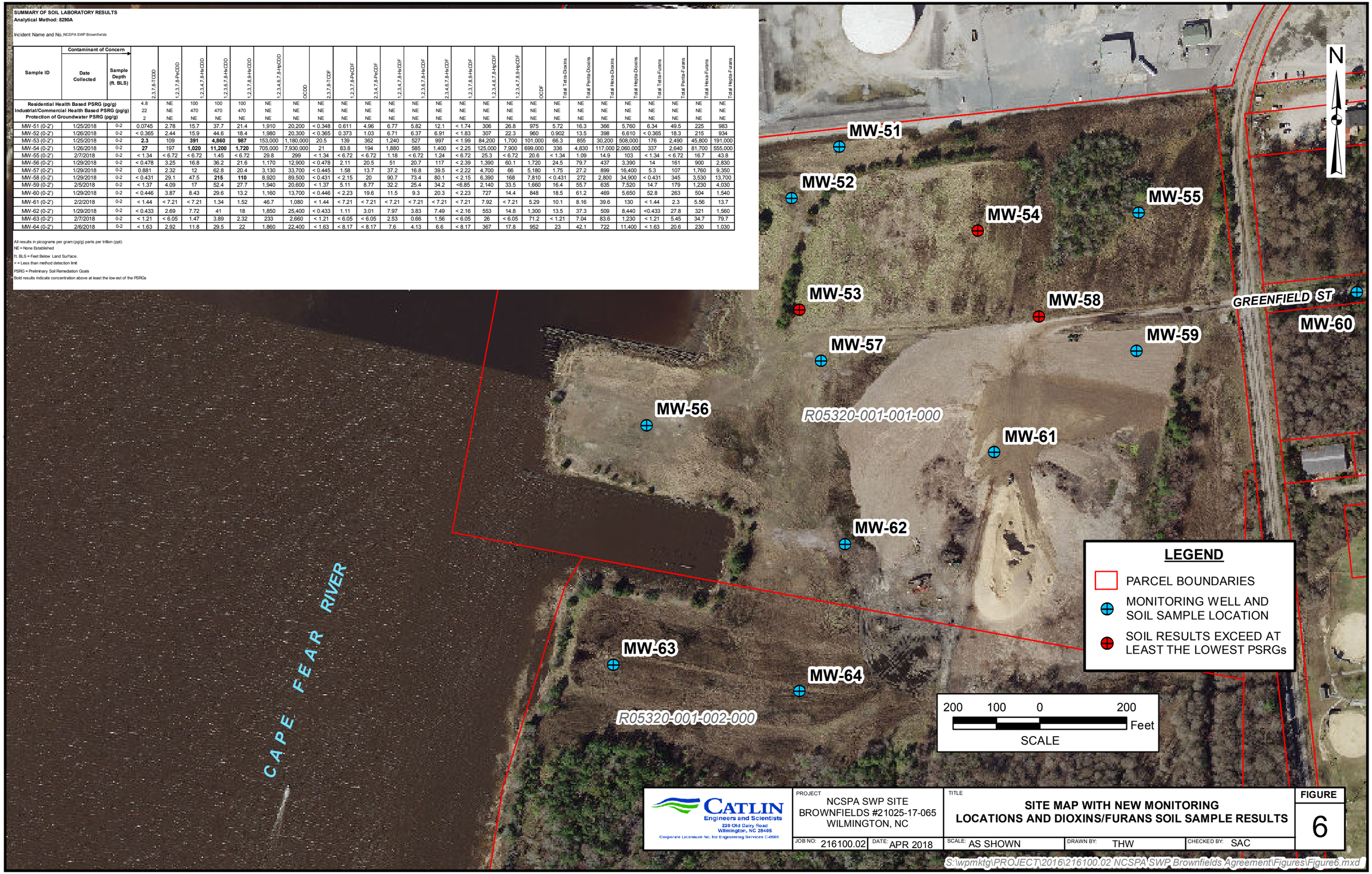
SUMMARY OF SOIL LABORATORY RESULTS
Analytical Method: 8290A

Incident Name and No. NCSPA SWP Brownfields

Sample ID	Date Collected	Sample Depth (ft. BLS)	2,3,7,8-TCDD	1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD	1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	OCDD	2,3,7,8-TCDF	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF	2,3,4,6,7,8-HxCDF	1,2,3,7,8,9-HxCDF	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	OCDF	Total Tetra-Dioxins	Total Penta-Dioxins	Total Hexa-Dioxins	Total Hepta-Dioxins	Total Tetra-Furans	Total Penta-Furans	Total Hexa-Furans	Total Hepta-Furans
Residential Health Based PSRG (pg/g)			4.8	NE	100	100	100	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Industrial/Commercial Health Based PSRG (pg/g)			22	NE	470	470	470	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Protection of Groundwater PSRG (pg/g)			2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
MW-51 (0-2')	1/25/2018	0-2	0.0745	2.78	15.7	37.7	21.4	1,910	20,200	< 0.348	0.611	4.96	6.77	5.82	12.1	< 1.74	306	26.8	975	5.72	16.3	366	5,760	6.34	49.5	225	983
MW-52 (0-2')	1/26/2018	0-2	< 0.365	2.44	15.9	44.6	18.4	1,980	20,300	< 0.365	0.373	1.03	6.71	6.37	6.91	< 1.83	307	22.3	960	0.902	13.5	398	6,610	< 0.365	18.3	215	934
MW-53 (0-2')	1/25/2018	0-2	**2.3**	109	**391**	**4,860**	**987**	153,000	1,180,000	20.5	139	362	1,240	527	997	< 1.99	84,200	1,700	101,000	66.3	855	30,200	508,000	176	2,490	45,800	191,000
MW-54 (0-2')	1/26/2018	0-2	**27**	197	**1,020**	**11,200**	**1,720**	705,000	7,930,000	21	83.8	194	1,880	585	1,400	< 2.25	125,000	7,900	699,000	336	4,830	117,000	2,060,000	337	2,640	81,700	555,000
MW-55 (0-2')	2/7/2018	0-2	< 1.34	< 6.72	< 6.72	1.45	< 6.72	29.8	299	< 1.34	< 6.72	< 6.72	1.18	< 6.72	1.24	< 6.72	25.3	< 6.72	20.6	< 1.34	1.09	14.9	103	< 1.34	< 6.72	16.7	43.8
MW-56 (0-2')	1/29/2018	0-2	< 0.478	3.25	16.8	36.2	21.6	1,170	12,900	< 0.478	2.11	20.5	51	20.7	117	< 2.39	1,390	60.1	1,720	24.5	79.7	437	3,390	14	161	900	2,830
MW-57 (0-2')	1/29/2018	0-2	0.881	2.32	12	62.8	20.4	3,130	33,700	< 0.445	1.58	13.7	37.2	16.8	39.5	< 2.22	4,700	66	5,180	1.75	27.2	899	16,400	5.3	107	1,760	9,350
MW-58 (0-2')	1/29/2018	0-2	< 0.431	29.1	47.5	**215**	**110**	8,920	89,500	< 0.431	< 2.15	20	90.7	73.4	80.1	< 2.15	6,390	168	7,810	< 0.431	272	2,800	34,900	< 0.431	345	3,530	13,700
MW-59 (0-2')	2/5/2018	0-2	< 1.37	4.09	17	52.4	27.7	1,940	20,600	< 1.37	5.11	8.77	32.2	25.4	34.2	<6.85	2,140	33.5	1,660	16.4	55.7	635	7,520	14.7	179	1,230	4,030
MW-60 (0-2')	1/29/2018	0-2	< 0.446	3.87	8.43	29.6	13.2	1,160	13,700	< 0.446	< 2.23	19.6	11.5	9.3	20.3	< 2.23	727	14.4	848	18.5	61.2	469	5,650	52.8	263	504	1,540
MW-61 (0-2')	2/2/2018	0-2	< 1.44	< 7.21	< 7.21	1.34	1.52	46.7	1,080	< 1.44	< 7.21	< 7.21	< 7.21	< 7.21	< 7.21	< 7.21	7.92	< 7.21	5.29	10.1	8.16	39.6	130	< 1.44	2.3	5.56	13.7
MW-62 (0-2')	1/29/2018	0-2	< 0.433	2.69	7.72	41	18	1,850	25,400	< 0.433	1.11	3.01	7.97	3.83	7.49	< 2.16	553	14.8	1,300	13.5	37.3	509	8,440	<0.433	27.8	321	1,560
MW-63 (0-2')	2/7/2018	0-2	< 1.21	< 6.05	1.47	3.89	2.32	233	2,660	< 1.21	< 6.05	< 6.05	2.53	0.66	1.56	< 6.05	26	< 6.05	71.2	< 1.21	7.04	83.6	1,230	< 1.21	5.45	34.7	79.7
MW-64 (0-2')	2/6/2018	0-2	< 1.63	2.92	11.8	29.5	22	1,860	22,400	< 1.63	< 8.17	< 8.17	7.6	4.13	6.6	< 8.17	367	17.8	952	23	42.1	722	11,400	< 1.63	20.6	230	1,030

All results in picograms per gram (pg/g) parts per trillion (ppt)
NE = None Established
ft. BLS = Feet Below Land Surface.
< = Less than method detection limit
PSRG = Preliminary Soil Remediation Goals
Bold results indicate concentration above at least the low est of the PSRGs



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PROJECT: NCSPA SWP SITE BROWNFIELDS #21025-17-065 WILMINGTON, NC

TITLE: **SITE MAP WITH NEW MONITORING LOCATIONS AND DIOXINS/FURANS SOIL SAMPLE RESULTS**

FIGURE: 6

JOB NO: 216100.02 | DATE: APR 2018 | SCALE: AS SHOWN | DRAWN BY: THW | CHECKED BY: SAC

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Appendix B 2021 Supplemental Sampling

Appendix B1 June 3, 2021 Monthly Status Report to NCDEQ

Greg Murphy

From: Greg Murphy
Sent: Thursday, June 3, 2021 3:34 PM
To: Dave Mattison
Cc: Richard Long
Subject: SWP Wilmington - Monthly Status Report
Attachments: Figures 1 to 3.pdf

Dave – The Southern Wood Piedmont (SWP) project team conducted the following activities related to the SWP Wilmington Site (Site) in May 2021:

- The SWP project team completed validation of analytical results from the March 2021 supplemental sediment and surface water sampling program. The supplemental sampling program was designed to verify current sediment and surface water quality conditions at the Site to ensure that any risk-based conclusions drawn from historical sediment and surface water data are representative of current Site conditions.
- The March 2021 analytical results for surface sediment from the Drainage Ditch and Greenfield Creek were compared to historical data for selected constituent groups (i.e., summed dioxin/furan congeners and total polycyclic aromatic hydrocarbons [tPAHs]) by graphical presentation of the statistical distributions (see attached **Figures 1 and 2**). The March 2021 results were also compared to the remediation goals proposed in the 2007 Revised Baseline Ecological Risk Assessment. Preliminary findings indicate:
    - The March 2021 summed dioxin/furan concentrations in surface sediment from the Drainage Ditch and Greenfield Creek were comparable to historical results (**Figure 1**).
        - The March 2021 summed dioxin/furan concentrations in surface sediment exceeded the proposed ecological risk-based remedial goal (RG) of 59,000 pg/g at all March 2021 sampling stations except GC01 and GC05. Station GC01 was the background station in Greenfield Creek, located just downstream from the spillway of Greenfield Lake. Station GC05 was the downstream-most station in Greenfield Creek, located just upstream from the tide gate and confluence with the Cape Fear River (see attached **Figure 3**).
    - The March 2021 tPAH concentrations in surface sediment from the Drainage Ditch and Greenfield Creek were comparable to historical results (**Figure 2**), except at station GC02 in Greenfield Creek. The March 2021 tPAH concentration at station GC02 in Greenfield Creek exceeded the historical maximum tPAH concentration reported for Greenfield Creek. However, it should be noted that station GC02 was located immediately downstream from the confluence of the Drainage Ditch (**Figure 3**) and the March 2021 tPAH concentration identified at station GC02 did not exceed the historical range of tPAH concentrations identified in sediment from the Drainage Ditch.
        - The March 2021 tPAH concentrations in surface sediment exceeded the proposed ecological risk-based RG of 700,000 ug/kg at one station (i.e., GC02) in Greenfield Creek.
    - There were consistent declining trends in the summed dioxin/furan concentrations and tPAH concentrations in surface sediment moving from upstream to downstream sampling stations in Greenfield Creek based on the March 2021 sampling results.
    - Sampling station GC05, located just upstream from the tide gate in Greenfield Creek and confluence with the Cape Fear River (**Figure 3**), did not exceed the proposed ecological risk-based remediation goals for summed dioxins/furans or tPAHs based on the March 2021 sampling results.
- The March 2021 data are being integrated within the pending Remedial Investigation / Risk Assessment (RIRA) Addendum.
- The anticipated schedule for the RIRA Addendum includes draft completion for client review in late June 2021 and submittal to NCDEQ in early to mid-July 2021.

Please let us know if you have any questions.

Regards,

Greg Murphy
Senior Scientist / Project Manager

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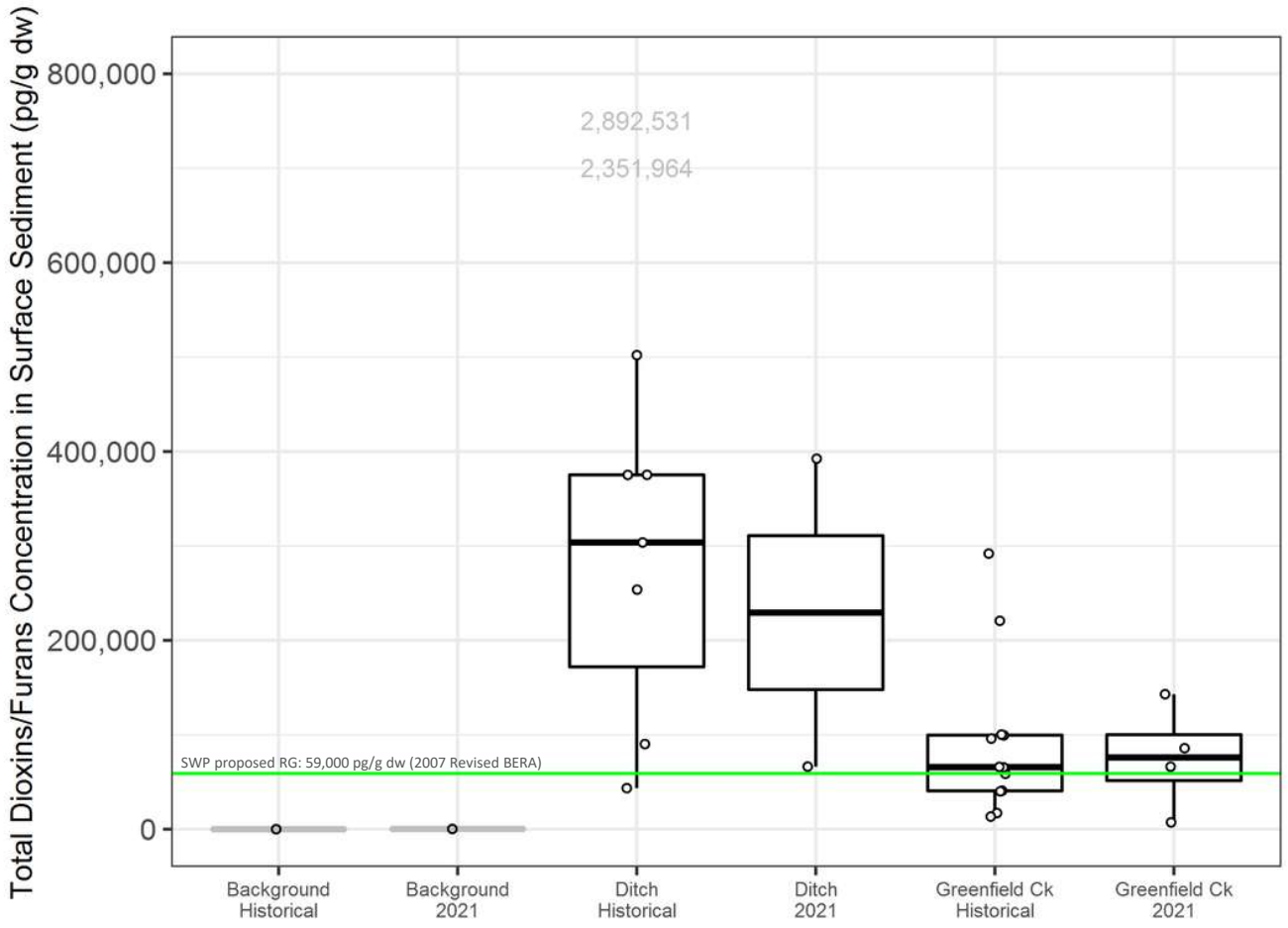
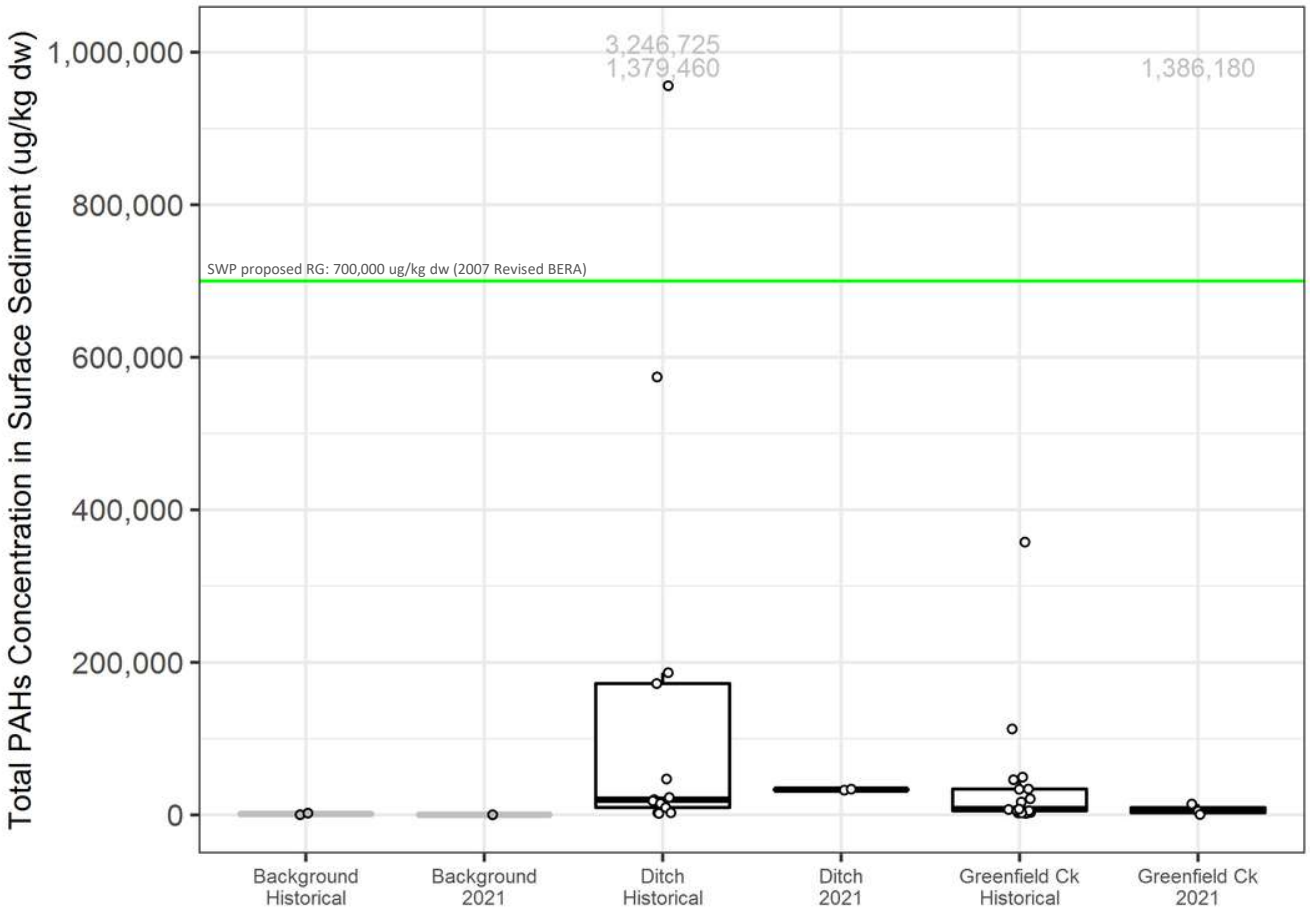


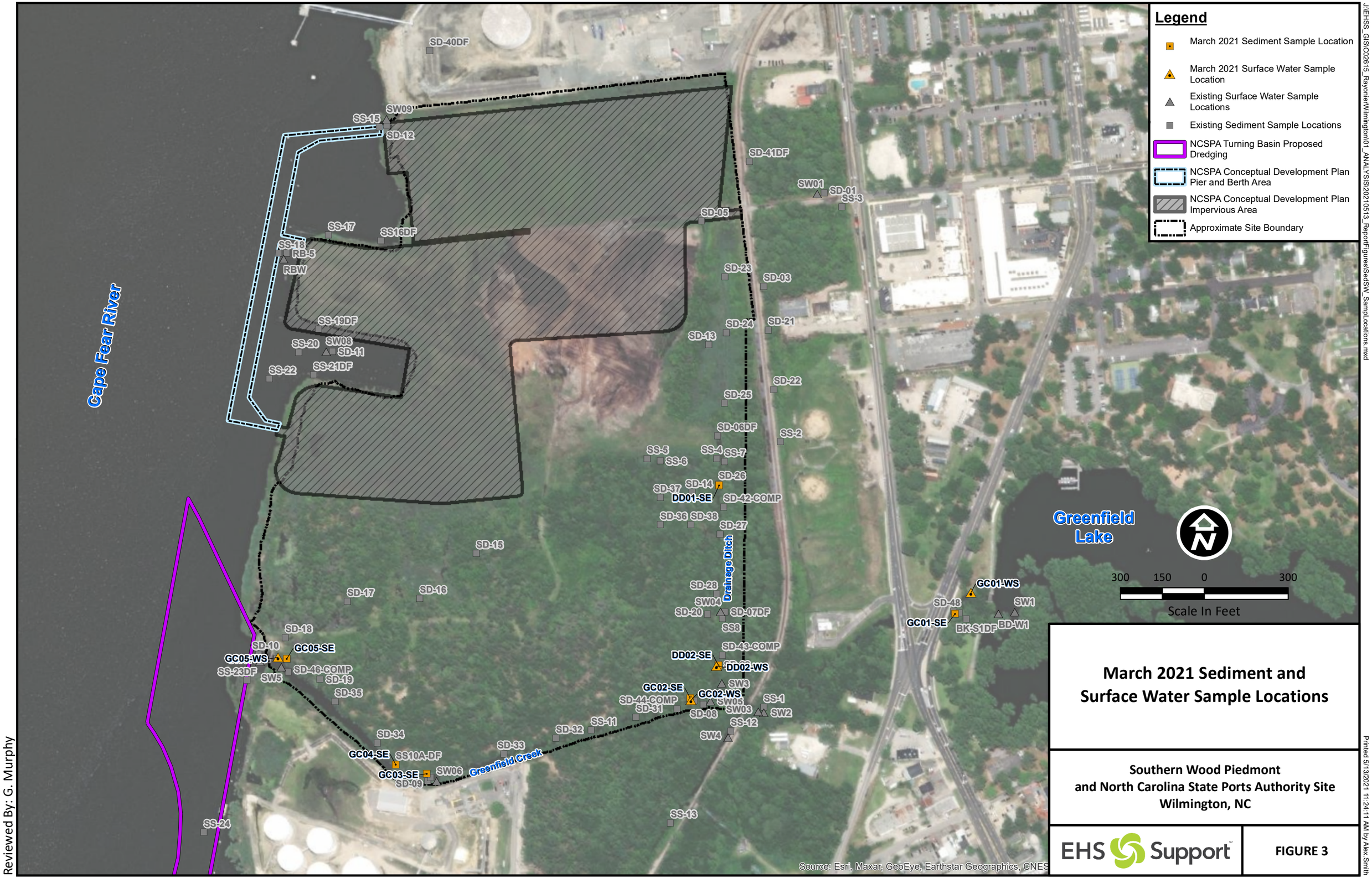
Notes:
Values outside of y-axis range are listed above each associated box and whisker plot.
Ck - creek
dw - dry weight
pg/g - picogram per gram
RG - remedial goal from 2007 Revised Baseline Ecological Risk Assessment
SWP - Southern Wood Piedmont

EHS Support	**Statistical Distributions of Historical and 2021 Total Dioxin/Furan Concentrations in Surface Sediment from the Drainage Ditch and Greenfield Creek**	**SWP Wilmington Site Wilmington, NC**	**Figure 1**



Notes:
Values outside of y-axis range are listed above each associated box and whisker plot.
Ck - creek
dw - dry weight
PAH - polycyclic aromatic hydrocarbon
RG - remedial goal from 2007 Revised Baseline Ecological Risk Assessment
SWP - Southern Wood Piedmont
ug/kg - microgram per kilogram

EHS Support	**Statistical Distributions of Historical and 2021 Total PAH Concentrations in Surface Sediment from the Drainage Ditch and Greenfield Creek**	**SWP Wilmington Site Wilmington, NC**	**Figure 2**



March 2021 Sediment and Surface Water Sample Locations

Southern Wood Piedmont and North Carolina State Ports Authority Site
Wilmington, NC

EHS Support

FIGURE 3

Reviewed By: G. Murphy

Printed 5/13/2021 11:24:11 AM by Alex.Smith

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Appendix B2 March 2021 Supplemental Sediment and Surface Water Sampling Analytical Results

Appendix B2 - Table 1
March 2021 Sediment Analytical Results
SWP and NCSPA Site
Wilmington, NC

		Location ID	DD01-SE		DD02-SE		GC01-SE		GC02-SE		GC03-SE		GC03-SE		GC04-SE		GC05-SE	
		Sample ID	DD01-SE(0.00-0.25)		DD02-SE(0.00-0.25)		GC01-SE(0.00-0.25)		GC02-SE(0.00-0.25)		FD01-SE		GC03-SE(0.00-0.25)		GC04-SE(0.00-0.25)		GC05-SE(0.00-0.167)	
		Depth	0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.167FT	
		Sample Date	3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/23/2021		3/23/2021	
		Sample Type (N: Normal, FD: Field Duplicate)	N		N		N		N		FD		N		N		N	
Chemical	CAS No.	Unit	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
DIOXIN/FURAN																		
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	mg/kg	0.036	J	0.0012		6.90E-06		0.08		0.0029		0.0022	J	0.0015		0.00031	
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	mg/kg	0.027	J	0.0057		1.10E-05		0.0029		0.0058		0.0068	J	0.0045		0.00026	
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	mg/kg	0.0005	J	4.10E-05	J	4.50E-07	J	< 0.00059	U	6.90E-05		6.10E-05	J	3.50E-05	J	4.30E-06	J
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	mg/kg	0.00037	J	1.90E-05	J	< 2.6e-007	U	0.00067		3.50E-05	J	3.40E-05	J	2.50E-05	J	< 3.4e-006	U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	mg/kg	< 8.4e-005	UJ	< 1.1e-005	U	4.10E-07	J	< 3.7e-006	U	1.90E-05	J	< 1.1e-005	UJ	1.20E-05	J	2.80E-06	J
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	mg/kg	< 0.00028	UJ	< 1.9e-005	U	3.30E-07	J	0.00022	J	< 3.5e-005	U	< 3.8e-005	UJ	< 2.6e-005	U	< 5.4e-006	U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	mg/kg	0.00064	J	8.80E-05		4.70E-07	J	0.00082		0.00011		0.00013	J	9.30E-05		< 8.7e-006	U
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	mg/kg	< 7.3e-005	UJ	< 3.2e-006	U	< 9.2e-008	U	< 0.00012	U	< 8.4e-006	U	< 1.3e-005	UJ	< 8.7e-006	U	< 5.3e-007	U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	mg/kg	0.00035	J	4.80E-05	J	6.70E-07	J	0.00033	J	7.10E-05		7.00E-05	J	< 3.7e-005	U	1.30E-05	
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	mg/kg	< 3.4e-005	UJ	4.20E-06	J	< 8.5e-008	U	< 4e-005	U	< 2.5e-006	U	< 2.4e-006	UJ	< 1.7e-006	U	< 6.8e-007	U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	mg/kg	3.30E-05	J	3.20E-06	J	9.70E-08	J	< 2.3e-005	U	< 3.9e-006	U	< 3.8e-006	UJ	< 2.9e-006	U	< 9.9e-007	U
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	mg/kg	< 9.6e-005	UJ	< 5.4e-006	U	< 2.7e-007	U	< 0.00011	U	< 8.5e-006	U	1.20E-05	J	8.60E-06	J	1.30E-06	J
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	mg/kg	2.70E-05	J	3.30E-06	J	1.70E-07	J	4.50E-05	J	< 4.9e-006	U	7.30E-06	J	< 1.7e-006	U	< 3.8e-007	U
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	mg/kg	5.40E-06	J	< 1.1e-006	U	1.30E-07	J	< 4.5e-006	U	< 1.3e-006	U	< 2.4e-006	UJ	< 1.1e-006	U	7.00E-07	J
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	mg/kg	< 3.4e-006	UJ	< 7.2e-007	U	< 6e-008	U	< 2.7e-006	U	< 7.9e-007	U	< 1.2e-006	UJ	< 7.3e-007	U	< 1.9e-007	U
Octachlorodibenzofuran	39001-02-0	mg/kg	0.037	J	0.0031		1.00E-05		0.051		0.0045		0.0042	J	0.0029		< 0.00024	U
Octachlorodibenzo-p-dioxin	3268-87-9	mg/kg	0.29	J	0.056	J	0.00021		0.0053		0.073	J	0.072	J	0.057	J	0.0065	J
GENERAL CHEMISTRY																		
Total Organic Carbon	TOC	mg/kg	200000		27000		2700		55000		75000		95000		34000		18000	
GENERAL CHEMISTRY - SEM																		
Acid Volatile Sulfides	18496-25-8-AVS	µmol/g	150		2.4		< 0.20	U	3.5		1.3	J	2.5		1.5	F1	1.5	
GEOPHYSICAL																		
Clay	CLAY	%	18		3.2		0.6		23.3				5.8		5.3		44.4	
Coarse Sand	COARSESAND	%	4		1.8		0.9		0.8				6.2		1.7		0.4	
Fine Sand	FINESAND	%	18.9		80.9		59.7		43.2				48.9		66.3		12.2	
Gravel	GRAVEL	%	4.3		1.8		5		1.6				7.7		1.4		0	
Hydrometer, Reading 1, Percent Passing	HYD01	% Passing	53		5.5		1.7		38.7				9.9		7.9		68.1	
Hydrometer, Reading 2, Percent Passing	HYD02	% Passing	32		4.8		1.7		34.1				8.6		7.2		63.8	
Hydrometer, Reading 3, Percent Passing	HYD03	% Passing	25		4		1.2		31				7.2		6.6		56.2	
Hydrometer, Reading 4, Percent Passing	HYD04	% Passing	21.5		3.2		1.2		27.9				5.8		5.9		49.8	
Hydrometer, Reading 5, Percent Passing	HYD05	% Passing	18		3.2		0.6		23.3				5.8		5.3		44.4	
Hydrometer, Reading 6, Percent Passing	HYD06	% Passing	14.5		2.5		0.6		18.7				4.4		4		33.6	
Hydrometer, Reading 7, Percent Passing	HYD07	% Passing	11.1		1.7		0.09		12.6				3		2.7		25	
Medium Sand	GSMSAND	%	12.3		11		30.2		10.1				9.9		6.1		7.9	
Percent Passing 0.375 Inch (3/8 Inch Sieve)	SIEVE0.375IN	% Passing	100		100		95.7		100				100		100		100	
Percent Passing 0.75 Inch (3/4 Inch Sieve)	SIEVE0.75IN	% Passing	100		100		100		100				100		100		100	
Percent Passing 1 Inch (1 Inch Sieve)	SIEVE1.0IN	% Passing	100		100		100		100				100		100		100	
Percent Passing 1.5 Inch (1.5 Inch Sieve)	SIEVE1.5IN	% Passing	100		100		100		100				100		100		100	
Percent Passing 2 Inch (2 Inch Sieve)	SIEVE2.0IN	% Passing	100		100		100		100				100		100		100	
Sand	308075-07-2	%	35.2		93.7		90.8		54.1				65		74.1		20.5	
Sieve No. 10, Percent Passing	SIEVE10	% Passing	91.7		96.4		94.1		97.6				86.1		96.9		99.6	
Sieve No. 200, Percent Passing	SIEVE200	% Passing	60.5		4.5		4.2		44.3				27.3		24.5		79.5	
Sieve No. 4, Percent Passing	SIEVE4	% Passing	95.7		98.2		95		98.4				92.3		98.6		100	
Sieve No. 40, Percent Passing	SIEVE40	% Passing	79.4		85.4		63.9		87.5				76.2		90.8		91.7	
Sieve No. 80, Percent Passing	SIEVE80	% Passing	70.4		52		9.8		63.3				57.8		44.3		81.9	
Sieve, No. 100, Percent Passing	SIEVE100	% Passing	65		32.3		5.9		54.1				46.7		33.6		80.9	
Sieve, No. 20, Percent Passing	SIEVE20	% Passing	84.1		93.6		90.3		93.9				82.5		95.5		97.7	
Sieve, No. 60, Percent Passing	SIEVE60	% Passing	73.7		68.9		23.7		74.6				67.5		67.6		83.8	
Sieve-US Std. 3-inch (75 mm)	SIEVE3INCH	% Passing	100		100		100		100				100		100		100	
Silt	E52456985	%	42.5		1.3		3.6		21				21.5		19.2		35.1	

Appendix B2 - Table 1
March 2021 Sediment Analytical Results
SWP and NCSPA Site
Wilmington, NC

		Location ID	DD01-SE		DD02-SE		GC01-SE		GC02-SE		GC03-SE		GC03-SE		GC04-SE		GC05-SE	
		Sample ID	DD01-SE(0.00-0.25)		DD02-SE(0.00-0.25)		GC01-SE(0.00-0.25)		GC02-SE(0.00-0.25)		FD01-SE		GC03-SE(0.00-0.25)		GC04-SE(0.00-0.25)		GC05-SE(0.00-0.167)	
		Depth	0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.167FT	
		Sample Date	3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/23/2021		3/23/2021	
		Sample Type (N: Normal, FD: Field Duplicate)	N		N		N		N		FD		N		N		N	
Chemical	**CAS No.**	**Unit**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**	**Result**	**Qual**
METALS																		
Aluminum	7429-90-5	mg/kg	11000	J	1500		420		13000	J	6200	J	5600	J	3300		18000	
Antimony	7440-36-0	mg/kg	1	J	0.12	J	< 0.028	UJ	0.21	J	0.57	J	0.46	J	0.21		0.22	
Arsenic	7440-38-2	mg/kg	13	J	1.8		0.2		5.8	J	4	J	3.7	J	2.8		4.7	
Barium	7440-39-3	mg/kg	69	J	9.1		2.2		52	J	23	J	25	J	15		48	
Beryllium	7440-41-7	mg/kg	0.56	J	0.13		< 0.046	U	0.64	J	0.37	J	0.35	J	0.2		0.66	
Cadmium	7440-43-9	mg/kg	0.44	J	0.21		< 0.011	U	0.22	J	0.33	J	0.25	J	0.12		0.019	J
Calcium	7440-70-2	mg/kg	5000	J	980		310		1800	J	2500	J	3000	J	1300		1600	
Chromium, total	7440-47-3	mg/kg	26	J	4.8		0.93		23	J	18	J	14	J	8.9		25	
Cobalt	7440-48-4	mg/kg	4.7	J	1.1		0.13		5.4	J	2.8	J	2.5	J	1.6		6.7	
Copper	7440-50-8	mg/kg	36	J	4.5		0.9		28	J	32	J	21	J	13		16	
Iron	7439-89-6	mg/kg	36000	J	4000		510		16000	J	5700	J	8200	J	5600		23000	
Lead	7439-92-1	mg/kg	57	J	8.4		2.9		25	J	53	J	34	J	20		23	
Magnesium	7439-95-4	mg/kg	2100	J	350		190		2100	J	1600	J	1600	J	670		2200	
Manganese	7439-96-5	mg/kg	160	J	29	J	11	J	180	J	37	J	73	J	46		160	
Nickel	7440-02-0	mg/kg	8.7	J	1.5		0.45		7.1	J	5.3	J	4.4	J	2.7		8.7	
Potassium	7440-09-7	mg/kg	830	J	250		38		1100	J	740	J	650	J	360		800	
Selenium	7782-49-2	mg/kg	0.8	J	0.13	J	< 0.078	U	0.42	J	0.47	J	0.4	J	0.22	J	0.34	J
Silver	7440-22-4	mg/kg	0.15	J	< 0.023	U	< 0.018	U	0.098	J	0.096	J	0.057	J	0.042	J	0.046	J
Sodium	7440-23-5	mg/kg	670	J	110		< 13	U	400	J	260	J	250	J	130		770	
Thallium	7440-28-0	mg/kg	< 0.25	UJ	< 0.058	U	< 0.045	U	0.28	J	< 0.096	UJ	< 0.14	UJ	< 0.069	U	0.16	
Vanadium	7440-62-2	mg/kg	46	J	7.2		0.87		32	J	26	J	25	J	13		54	
Zinc	7440-66-6	mg/kg	160	J	22	J	5.2	J	67	J	98	J	73	J	49		53	
METALS - SEM																		
Cadmium	7440-43-9	µmol/g	0.0057	J	0.00087	J	0.000093	J	0.0013	J	0.0027	J	0.0029	J	0.0012	J	0.0006	J
Copper	7440-50-8	µmol/g	0.53		0.041		0.017		0.03		0.31		0.32		0.13		0.11	
Lead	7439-92-1	µmol/g	0.36		0.041		0.013		0.067		0.24		0.25		0.1		0.13	
Nickel	7440-02-0	µmol/g	0.092	J	0.0091	J	0.0014	J	0.023	J	0.031	J	0.038	J	0.017	J	0.028	J
SEM/AVS Ratio	SEM/AVS	None	0.026		0.21		0		0.19		1.4		0.81		0.56		0.36	
Zinc	7440-66-6	µmol/g	3		0.39		0.066		0.55		1.2		1.4		0.59		0.28	
SVOCs																		
2,4,5-Trichlorophenol	95-95-4	mg/kg	< 0.042	UJ	< 0.008	U	< 0.0031	U	< 0.25	U	< 0.017	U	< 0.045	UJ	< 0.0095	U	< 0.0043	U
2,4,6-Trichlorophenol	88-06-2	mg/kg	< 0.032	UJ	< 0.0062	U	< 0.0024	U	< 0.2	U	< 0.013	U	< 0.035	UJ	< 0.0073	U	< 0.0033	U
2,4-Dichlorophenol	120-83-2	mg/kg	< 0.045	UJ	< 0.0087	U	< 0.0033	U	< 0.28	U	< 0.018	U	< 0.049	UJ	< 0.01	U	< 0.0046	U
2,4-Dimethylphenol	105-67-9	mg/kg	< 0.036	UJ	< 0.007	U	< 0.0027	U	< 0.22	U	< 0.014	U	< 0.04	UJ	< 0.0083	U	< 0.0037	U
2,4-Dinitrophenol	51-28-5	mg/kg	< 3.2	UJ	< 0.62	U	< 0.24	U	< 20	U	< 1.3	U	< 3.5	R	< 0.74	U	< 0.33	U
2,4-Dinitrotoluene	121-14-2	mg/kg	< 0.088	UJ	< 0.017	U	< 0.0065	U	< 0.54	U	< 0.035	U	< 0.096	UJ	< 0.02	U	< 0.0091	U
2,6-Dinitrotoluene	606-20-2	mg/kg	< 0.036	UJ	< 0.0069	U	< 0.0026	U	< 0.22	U	< 0.014	U	< 0.039	UJ	< 0.0082	U	< 0.0037	U
2-Chloronaphthalene	91-58-7	mg/kg	< 0.027	UJ	< 0.0051	U	< 0.002	U	< 0.16	U	< 0.011	U	< 0.029	UJ	< 0.0061	U	< 0.0028	U
2-Chlorophenol	95-57-8	mg/kg	< 0.027	UJ	< 0.0052	U	< 0.002	U	< 0.17	U	< 0.011	U	< 0.03	UJ	< 0.0062	U	< 0.0028	U
2-Methylnaphthalene	91-57-6	mg/kg	0.058	J	0.2		< 0.0021	U	0.24	J	0.013	J	< 0.031	UJ	0.02	J	< 0.0029	U
2-Methylphenol (O-Cresol)	95-48-7	mg/kg	< 0.17	UJ	< 0.032	U	< 0.012	U	< 1	U	< 0.067	U	< 0.18	UJ	< 0.038	U	< 0.017	U
2-Nitroaniline	88-74-4	mg/kg	< 0.27	UJ	< 0.051	U	< 0.02	U	< 1.6	U	< 0.11	U	< 0.29	UJ	< 0.061	U	< 0.027	U
2-Nitrophenol	88-75-5	mg/kg	< 0.093	UJ	< 0.018	U	< 0.0068	U	< 0.57	U	< 0.037	U	< 0.1	UJ	< 0.021	U	< 0.0096	U
3,3'-Dichlorobenzidine	91-94-1	mg/kg	< 0.54	UJ	< 0.1	U	< 0.04	U	< 3.3	U	< 0.22	U	< 0.59	R	< 0.12	U	< 0.056	U
3-Nitroaniline	99-09-2	mg/kg	< 0.15	UJ	< 0.029	U	< 0.011	U	< 0.91	U	< 0.059	U	< 0.16	UJ	< 0.034	U	< 0.015	U
4,6-Dinitro-2-Methylphenol	534-52-1	mg/kg	< 1	UJ	< 0.19	U	< 0.074	U	< 6.2	U	< 0.4	U	< 1.1	R	< 0.23	U	< 0.1	U
4-Bromophenyl Phenyl Ether	101-55-3	mg/kg	< 0.041	UJ	< 0.0079	U	< 0.003	U	< 0.25	U	< 0.016	U	< 0.045	UJ	< 0.0093	U	< 0.0042	U
4-Chloro-3-Methylphenol	59-50-7	mg/kg	< 0.027	UJ	< 0.0053	U	< 0.002	U	< 0.17	U	< 0.011	U	< 0.03	UJ	< 0.0063	U	< 0.0028	U
4-Chloroaniline	106-47-8	mg/kg	< 0.04	UJ	< 0.0076	U	< 0.0029	U	< 0.24	U	< 0.016	U	< 0.043	UJ	< 0.0091	U	< 0.0041	U
4-Chlorophenyl Phenyl Ether	7005-72-3	mg/kg	< 0.035	UJ	< 0.0068	U	< 0.0026	U	< 0.22	U	< 0.014	U	< 0.039	UJ	< 0.0081	U	< 0.0036	U
4-Methylphenol (P-Cresol)	106-44-5	mg/kg	< 0.17	UJ	< 0.033	U	< 0.013	U	< 1	U	< 0.068	U	< 0.19	UJ	< 0.039	U	< 0.018	U
4-Nitroaniline	100-01-6	mg/kg	< 0.028	UJ	< 0.0054	U	< 0.0021	U	< 0.17	U	< 0.011	U	< 0.031	UJ	< 0.0065	U	< 0.0029	U
4-Nitrophenol	100-02-7	mg/kg	< 0.41	UJ	< 0.079	U	< 0.03	U	< 2.5	U	< 0.16	U	< 0.45	UJ	< 0.093	U	< 0.042	U
Acenaphthene	83-32-9	mg/kg	3.3	J	0.76		0.0041	J	92		0.11		0.18	J	0.08		0.024	
Acenaphthylene	208-96-8	mg/kg	0.39	J	0.29		0.0031	J	1.6		0.17		0.27	J	0.11		0.0073	J
Acetophenone	98-86-2	mg/kg	< 0.032	UJ	< 0.0061	U	< 0.0023	U	< 0.19	U	< 0.013	U	< 0.035	UJ	< 0.0072	U	< 0.0033	U
Anthracene	120-12-7	mg/kg	1.6	J	6.1		0.012		120		0.54	J	1.7	J	0.74		0.014	
Atrazine	1912-24-9	mg/kg	< 0.25	UJ	< 0.049	U	< 0.019	U	< 1.6	U	< 0.1	U	< 0.28	UJ	< 0.058	U	< 0.026	U
Benzaldehyde	100-52-7	mg/kg	0.16	J	< 0.014	U	< 0.0053	U	< 0.44	U	< 0.029	U	< 0.079	UJ	0.036	J	0.014	J
Benzo[a]anthracene	56-55-3	mg/kg	2	J	2.9		0.015		53		0.45	J	1.2	J	0.34		0.042	

Appendix B2 - Table 1
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SWP and NCSPA Site
Wilmington, NC

		Location ID	DD01-SE		DD02-SE		GC01-SE		GC02-SE		GC03-SE		GC03-SE		GC04-SE		GC05-SE	
		Sample ID	DD01-SE(0.00-0.25)		DD02-SE(0.00-0.25)		GC01-SE(0.00-0.25)		GC02-SE(0.00-0.25)		FD01-SE		GC03-SE(0.00-0.25)		GC04-SE(0.00-0.25)		GC05-SE(0.00-0.167)	
		Depth	0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.25FT		0-0.167FT	
		Sample Date	3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/24/2021		3/23/2021		3/23/2021	
		Sample Type (N: Normal, FD: Field Duplicate)	N		N		N		N		FD		N		N		N	
Chemical	CAS No.	Unit	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Benzo[a]pyrene	50-32-8	mg/kg	1.5	J	1.6		0.016		18		0.45	J	0.94	J	0.34		0.043	
Benzo[b]fluoranthene	205-99-2	mg/kg	2.7	J	2.6		0.021		26		0.85	J	1.6	J	0.62		0.051	
Benzo[g,h,i]perylene	191-24-2	mg/kg	0.94	J	0.79		0.014		4.4		0.38	J	0.71	J	0.26		0.035	
Benzo[k]fluoranthene	207-08-9	mg/kg	0.9	J	0.83		0.0091		9.6		0.25	J	0.67	J	0.16		0.021	
Benzyl Butyl Phthalate	85-68-7	mg/kg	< 0.4	UJ	0.24		0.078		< 2.5	U	0.3		0.83	J	< 0.092	U	< 0.041	U
Biphenyl (Diphenyl)	92-52-4	mg/kg	< 0.024	UJ	0.049	J	< 0.0018	U	< 0.15	U	< 0.0097	U	< 0.027	UJ	< 0.0056	U	< 0.0025	U
Bis(2-Chloroethoxy) Methane	111-91-1	mg/kg	< 0.028	UJ	< 0.0053	U	< 0.002	U	< 0.17	U	< 0.011	U	< 0.03	UJ	< 0.0064	U	< 0.0029	U
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	111-44-4	mg/kg	< 0.021	UJ	< 0.0041	U	< 0.0016	U	< 0.13	U	4.6	J	< 0.023	UJ	< 0.0048	U	< 0.0022	U
Bis(2-Chloroisopropyl) Ether	108-60-1	mg/kg	< 0.043	UJ	< 0.0083	U	< 0.0032	U	< 0.26	U	< 0.017	U	< 0.047	UJ	< 0.0099	U	< 0.0045	U
Bis(2-Ethylhexyl) Phthalate	117-81-7	mg/kg	< 0.62	UJ	< 0.12	U	< 0.046	U	< 3.8	U	< 0.25	U	< 0.68	UJ	< 0.14	U	< 0.064	U
Caprolactam	105-60-2	mg/kg	< 0.38	UJ	< 0.073	U	< 0.028	U	< 2.3	U	< 0.15	U	< 0.42	UJ	< 0.087	U	0.075	J
Carbazole	86-74-8	mg/kg	0.21	J	1.4		< 0.002	U	0.86		0.058		0.12	J	0.11		< 0.0028	U
Chrysene	218-01-9	mg/kg	2.6	J	3.3		0.018		45		0.7	J	1.9	J	0.53		0.047	
Dibenz(A,H)Anthracene	53-70-3	mg/kg	0.33	J	0.25		< 0.0055	U	1.8		0.13		0.26	J	0.084		0.01	J
Dibenzofuran	132-64-9	mg/kg	0.29	J	0.54		0.003	J	71		0.041	J	0.071	J	0.06	J	0.007	J
Diethyl Phthalate	84-66-2	mg/kg	< 0.2	UJ	< 0.039	U	< 0.015	U	1.3	J	< 0.081	U	< 0.22	UJ	< 0.047	U	< 0.021	U
Dimethyl Phthalate	131-11-3	mg/kg	< 0.043	UJ	< 0.0083	U	< 0.0032	U	< 0.26	U	< 0.017	U	< 0.047	UJ	< 0.0099	U	< 0.0045	U
Di-N-Butyl Phthalate	84-74-2	mg/kg	< 0.25	UJ	< 0.049	U	< 0.019	U	< 1.6	U	< 0.1	U	< 0.28	UJ	< 0.058	U	< 0.026	U
Di-N-Octylphthalate	117-84-0	mg/kg	< 0.34	UJ	< 0.065	U	< 0.025	U	< 2.1	U	< 0.13	U	< 0.37	R	< 0.077	U	< 0.035	U
Fluoranthene	206-44-0	mg/kg	7.7	J	5.6		0.03		290		0.71	J	2	J	0.64		0.12	
Fluorene	86-73-7	mg/kg	1.7	J	1.4		0.0035	J	110		0.078		0.15	J	0.13		0.008	J
Hexachlorobenzene	118-74-1	mg/kg	< 0.042	UJ	< 0.0081	U	< 0.0031	U	< 0.26	U	< 0.017	U	< 0.046	UJ	< 0.0096	U	< 0.0043	U
Hexachlorobutadiene	87-68-3	mg/kg	< 0.034	UJ	< 0.0066	U	< 0.0025	U	< 0.21	U	< 0.014	U	< 0.037	UJ	< 0.0078	U	< 0.0035	U
Hexachlorocyclopentadiene	77-47-4	mg/kg	< 0.06	UJ	< 0.011	U	< 0.0044	U	< 0.36	U	< 0.024	U	< 0.065	R	< 0.014	U	< 0.0061	U
Hexachloroethane	67-72-1	mg/kg	< 0.03	UJ	< 0.0058	U	< 0.0022	U	< 0.18	U	< 0.012	U	< 0.033	UJ	< 0.0069	U	< 0.0031	U
Indeno(1,2,3-C,D)Pyrene	193-39-5	mg/kg	0.93	J	0.78		0.011		4.6		0.38	J	0.7	J	0.25		0.029	
Isophorone	78-59-1	mg/kg	< 0.03	UJ	< 0.0057	U	< 0.0022	U	< 0.18	U	< 0.012	U	< 0.032	UJ	< 0.0068	U	< 0.0031	U
Naphthalene	91-20-3	mg/kg	0.19	J	0.096		< 0.0017	U	0.18	J	0.018	J	0.025	J	0.016	J	0.0037	J
Nitrobenzene	98-95-3	mg/kg	< 0.21	UJ	< 0.041	U	< 0.016	U	< 1.3	U	< 0.085	U	< 0.23	UJ	< 0.049	U	< 0.022	U
N-Nitrosodi-N-Propylamine	621-64-7	mg/kg	< 0.039	UJ	< 0.0076	U	< 0.0029	U	< 0.24	U	< 0.016	U	< 0.043	UJ	< 0.009	U	< 0.0041	U
N-Nitrosodiphenylamine	86-30-6	mg/kg	< 0.19	UJ	< 0.037	U	< 0.014	U	< 1.2	U	< 0.077	U	< 0.21	UJ	< 0.044	U	< 0.02	U
Pentachlorophenol	87-86-5	mg/kg	< 0.94	UJ	< 0.18	U	< 0.069	U	< 5.7	U	< 0.37	U	< 1	R	< 0.21	U	< 0.097	UJ
Phenanthrene	85-01-8	mg/kg	0.52	J	2.2		0.016		400		0.19	J	0.36	J	0.17		0.015	
Phenol	108-95-2	mg/kg	< 0.18	UJ	< 0.034	U	< 0.013	U	< 1.1	U	< 0.07	U	< 0.19	UJ	< 0.04	U	< 0.018	U
Pyrene	129-00-0	mg/kg	5.2	J	4.3		0.025		210		0.56	J	1.6	J	0.47		0.089	

Notes:
Grey values denote non-detected results.
mg/kg - Milligrams per kilogram dry weight
µmol/g - Micromoles per gram
AVS - Acid volatilve sulfide
CAS - Chemical Abstracts Service
FT - feet
J - Concentration greater than method detection limit but less than reporting limit
SEM - Simultaneously extracted metals
SVOCs - Semivolatile organics compounds
U - Non-detected concentration

Appendix B2 - Table 2
March 2021 Surface Water Analytical Results
SWP and NCSPA Site
Wilmington, NC

Location ID				DD02-WS		GC01-WS		GC02-WS		GC05-WS		GC05-WS	
Sample Date				3/23/2021		3/23/2021		3/23/2021		3/23/2021		3/23/2021	
Sample Type (N: Normal, FD: Field Duplicate)				N		N		N		N		FD	
Chemical	CAS No.	Fraction	Unit	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
GENERAL CHEMISTRY													
Hardness (As CaCO3)	HARD	T	µg/L	88000		74000		80000		120000		120000	
METALS													
Aluminum	7429-90-5	D	µg/L	< 13	U	< 13	U	< 13	U	< 13	U	< 13	U
Aluminum	7429-90-5	T	µg/L	44		34		40		51		56	
Antimony	7440-36-0	D	µg/L	< 0.38	U	< 0.38	U	< 0.38	U	< 0.38	U	< 0.38	U
Antimony	7440-36-0	T	µg/L	< 0.38	U	< 0.38	U	< 0.38	U	< 0.38	U	< 0.38	U
Arsenic	7440-38-2	D	µg/L	0.42	J	0.44	J	< 0.31	U	0.79	J	0.38	J
Arsenic	7440-38-2	T	µg/L	1.4		0.65	J	0.54	J	0.56	J	0.48	J
Barium	7440-39-3	D	µg/L	27		23		27		23		24	
Barium	7440-39-3	T	µg/L	30		24		28		26		25	
Beryllium	7440-41-7	D	µg/L	< 0.18	U	< 0.18	U	< 0.18	U	< 0.18	U	< 0.18	U
Beryllium	7440-41-7	T	µg/L	0.35	J	< 0.18	U	< 0.18	U	< 0.18	U	< 0.18	U
Cadmium	7440-43-9	D	µg/L	< 0.22	U	< 0.22	U	< 0.22	U	< 0.22	U	< 0.22	U
Cadmium	7440-43-9	T	µg/L	0.46	J	< 0.22	U	< 0.22	U	< 0.22	U	< 0.22	U
Calcium	7440-70-2	D	µg/L	32000		30000		32000		30000		31000	
Calcium	7440-70-2	T	µg/L	33000		31000		32000		34000		33000	
Chromium, total	7440-47-3	D	µg/L	< 1.5	U	< 1.5	U	< 1.5	U	< 1.5	U	< 1.5	U
Chromium, total	7440-47-3	T	µg/L	< 1.5	U	< 1.5	U	< 1.5	U	< 1.5	U	< 1.5	U
Cobalt	7440-48-4	D	µg/L	< 0.13	U	< 0.13	U	< 0.13	U	< 0.13	U	< 0.13	U
Cobalt	7440-48-4	T	µg/L	0.59		< 0.13	U	< 0.13	U	< 0.13	U	< 0.13	U
Copper	7440-50-8	D	µg/L	0.85	J	1.1	J	0.93	J	1	J	1.1	J
Copper	7440-50-8	T	µg/L	1.9	J	1.7	J	1.3	J	1.6	J	1.6	J
Iron	7439-89-6	D	µg/L	130	J	57	J	130	J	230	J	110	J
Iron	7439-89-6	T	µg/L	800		140		610		310		300	
Lead	7439-92-1	D	µg/L	< 0.13	U	0.22	J	< 0.13	U	0.14	J	< 0.13	U
Lead	7439-92-1	T	µg/L	0.89	J	0.44	J	0.39	J	0.42	J	0.43	J
Magnesium	7439-95-4	D	µg/L	3200		1800		3200		6600		6300	
Magnesium	7439-95-4	T	µg/L	3600		1900		3100		12000		11000	
Manganese	7439-96-5	D	µg/L	33		7.3		32		16		15	
Manganese	7439-96-5	T	µg/L	41		10		32		18		17	
Nickel	7440-02-0	D	µg/L	< 0.34	U	< 0.34	U	< 0.34	U	< 0.34	U	< 0.34	U
Nickel	7440-02-0	T	µg/L	0.8	J	< 0.34	U	0.35	J	0.34	J	< 0.34	U
Potassium	7440-09-7	D	µg/L	2300		1900		2300		3300		3400	
Potassium	7440-09-7	T	µg/L	2400		2000		2300		5100		4900	
Selenium	7782-49-2	D	µg/L	< 1.5	U	< 1.5	U	< 1.5	U	< 1.5	U	< 1.5	U
Selenium	7782-49-2	T	µg/L	< 1.5	U	< 1.5	U	< 1.5	U	< 1.5	U	< 1.5	U
Silver	7440-22-4	D	µg/L	< 0.18	U	< 0.18	U	< 0.18	U	< 0.18	U	< 0.18	U
Silver	7440-22-4	T	µg/L	< 0.18	U	< 0.18	U	< 0.18	U	< 0.18	U	< 0.18	U
Sodium	7440-23-5	D	µg/L	18000		7300		18000		48000		47000	
Sodium	7440-23-5	T	µg/L	21000	J	7600	J	16000	J	93000	J	85000	J
Thallium	7440-28-0	D	µg/L	< 0.15	U	< 0.15	U	< 0.15	U	0.22	J	< 0.15	U
Thallium	7440-28-0	T	µg/L	0.99	J	< 0.15	U	< 0.15	U	< 0.15	U	< 0.15	U
Vanadium	7440-62-2	D	µg/L	< 0.99	U	1		< 0.99	U	1.7		< 0.99	U
Vanadium	7440-62-2	T	µg/L	1.5		1.1		1		1.1		1.1	
Zinc	7440-66-6	D	µg/L	< 3.2	U	< 3.2	U	< 3.2	U	3.4	J	< 3.2	U
Zinc	7440-66-6	T	µg/L	3.8	J	3.7	J	3.2	J	< 3.2	U	3.5	J

Appendix B2 - Table 2
March 2021 Surface Water Analytical Results
SWP and NCSPA Site
Wilmington, NC

Location ID				DD02-WS		GC01-WS		GC02-WS		GC05-WS		GC05-WS	
Sample Date				3/23/2021		3/23/2021		3/23/2021		3/23/2021		3/23/2021	
Sample Type (N: Normal, FD: Field Duplicate)				N		N		N		N		FD	
Chemical	CAS No.	Fraction	Unit	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
SVOCs													
2,4,5-Trichlorophenol	95-95-4	T	µg/L	< 0.059	U	< 0.061	U	< 0.061	U	< 0.066	UJ	< 0.064	U
2,4,6-Trichlorophenol	88-06-2	T	µg/L	< 0.065	U	< 0.068	U	< 0.068	U	< 0.074	UJ	< 0.071	U
2,4-Dichlorophenol	120-83-2	T	µg/L	< 0.049	U	< 0.051	U	< 0.051	U	< 0.055	UJ	< 0.053	U
2,4-Dimethylphenol	105-67-9	T	µg/L	0.33	J	< 0.041	U	0.41	J	< 0.045	UJ	< 0.043	U
2,4-Dinitrophenol	51-28-5	T	µg/L	< 1.5	U	< 1.5	U	< 1.5	U	< 1.7	U	< 1.6	U
2,4-Dinitrotoluene	121-14-2	T	µg/L	< 0.049	U	< 0.051	U	< 0.051	U	< 0.055	UJ	< 0.053	U
2,6-Dinitrotoluene	606-20-2	T	µg/L	< 0.058	U	< 0.06	U	< 0.06	U	< 0.065	UJ	< 0.063	U
2-Chloronaphthalene	91-58-7	T	µg/L	< 0.057	U	< 0.059	U	< 0.059	U	< 0.064	UJ	< 0.061	U
2-Chlorophenol	95-57-8	T	µg/L	< 0.062	U	< 0.064	U	< 0.064	U	< 0.07	UJ	< 0.067	U
2-Methylnaphthalene	91-57-6	T	µg/L	< 0.06	U	< 0.062	U	< 0.062	U	< 0.067	UJ	< 0.065	U
2-Methylphenol (O-Cresol)	95-48-7	T	µg/L	< 0.29	U	< 0.3	U	< 0.3	U	< 0.33	UJ	< 0.31	U
2-Nitroaniline	88-74-4	T	µg/L	< 0.53	U	< 0.55	U	< 0.55	U	< 0.6	U	< 0.57	U
2-Nitrophenol	88-75-5	T	µg/L	< 0.059	U	< 0.061	U	< 0.061	U	< 0.066	UJ	< 0.064	U
3,3'-Dichlorobenzidine	91-94-1	T	µg/L	< 0.56	U	< 0.58	U	< 0.58	U	< 0.63	R	< 0.61	U
3-Nitroaniline	99-09-2	T	µg/L	< 0.064	U	< 0.067	U	< 0.067	U	< 0.073	UJ	< 0.07	U
4,6-Dinitro-2-Methylphenol	534-52-1	T	µg/L	< 1.4	U	< 1.5	U	< 1.5	U	< 1.6	U	< 1.5	U
4-Bromophenyl Phenyl Ether	101-55-3	T	µg/L	< 0.061	U	< 0.063	U	< 0.063	U	< 0.068	UJ	< 0.066	U
4-Chloro-3-Methylphenol	59-50-7	T	µg/L	< 0.059	U	< 0.061	U	< 0.061	U	< 0.066	UJ	< 0.064	U
4-Chloroaniline	106-47-8	T	µg/L	< 0.042	U	< 0.044	U	< 0.044	U	< 0.048	UJ	< 0.046	U
4-Chlorophenyl Phenyl Ether	7005-72-3	T	µg/L	< 0.059	U	< 0.061	U	< 0.061	U	< 0.066	UJ	< 0.064	U
4-Methylphenol (P-Cresol)	106-44-5	T	µg/L	< 0.36	U	< 0.37	U	< 0.37	U	< 0.4	UJ	< 0.39	U
4-Nitroaniline	100-01-6	T	µg/L	< 0.056	U	< 0.058	U	< 0.058	U	< 0.063	UJ	< 0.06	U
4-Nitrophenol	100-02-7	T	µg/L	< 0.14	U	< 0.14	U	< 0.14	U	< 0.15	U	< 0.15	U
Acenaphthene	83-32-9	T	µg/L	0.76		< 0.065	U	0.88		0.12	J	0.12	J
Acenaphthylene	208-96-8	T	µg/L	< 0.063	U	< 0.065	U	0.34		< 0.071	UJ	< 0.068	U
Acetophenone	98-86-2	T	µg/L	< 0.06	U	< 0.062	U	< 1	U	< 0.067	UJ	< 0.065	U
Anthracene	120-12-7	T	µg/L	< 0.047	U	< 0.049	U	< 0.049	U	< 0.053	UJ	< 0.051	U
Atrazine	1912-24-9	T	µg/L	< 0.61	U	< 0.63	U	< 0.63	U	< 0.69	U	< 0.66	U
Benzaldehyde	100-52-7	T	µg/L	< 0.11	U	< 0.11	U	< 0.11	U	< 0.12	U	< 0.12	U
Benzo[a]anthracene	56-55-3	T	µg/L	< 0.072	U	< 0.075	U	< 0.075	U	< 0.082	UJ	< 0.078	U
Benzo[a]pyrene	50-32-8	T	µg/L	< 0.051	U	< 0.053	U	< 0.053	U	< 0.058	UJ	< 0.055	U
Benzo[b]fluoranthene	205-99-2	T	µg/L	< 0.093	U	< 0.097	U	< 0.097	U	< 0.11	UJ	< 0.1	U
Benzo[g,h,i]perylene	191-24-2	T	µg/L	< 0.066	U	< 0.069	U	< 0.069	U	< 0.075	UJ	< 0.072	U
Benzo[k]fluoranthene	207-08-9	T	µg/L	< 0.085	U	< 0.088	U	< 0.088	U	< 0.096	UJ	< 0.092	U
Benzyl Butyl Phthalate	85-68-7	T	µg/L	0.58	J	< 0.46	U	0.53	J	0.8	J	1.6	
Biphenyl (Diphenyl)	92-52-4	T	µg/L	< 0.057	U	< 0.059	U	< 0.059	U	< 0.064	UJ	< 0.061	U
Bis(2-Chloroethoxy) Methane	111-91-1	T	µg/L	< 0.064	U	< 0.067	U	< 0.067	U	< 0.073	UJ	< 0.07	U
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	111-44-4	T	µg/L	< 0.038	U	< 0.04	U	< 0.04	U	< 0.043	UJ	< 0.042	U
Bis(2-Chloroisopropyl) Ether	108-60-1	T	µg/L	< 0.056	U	< 0.058	U	< 0.058	U	< 0.063	UJ	< 0.06	U
Bis(2-Ethylhexyl) Phthalate	117-81-7	T	µg/L	< 6	U	< 6.2	U	< 6.2	U	< 6.8	U	< 6.5	U
Caprolactam	105-60-2	T	µg/L	< 0.45	U	< 0.47	U	< 0.47	U	< 0.51	UJ	< 0.49	U
Carbazole	86-74-8	T	µg/L	0.5		< 0.051	U	0.54		< 0.055	UJ	< 0.053	U
Chrysene	218-01-9	T	µg/L	< 0.078	U	< 0.081	U	< 0.081	U	< 0.088	UJ	< 0.084	U
Dibenz(A,H)Anthracene	53-70-3	T	µg/L	< 0.069	U	< 0.072	U	< 0.072	U	< 0.078	UJ	< 0.075	U
Dibenzofuran	132-64-9	T	µg/L	0.33	J	< 0.073	U	0.4	J	< 0.079	UJ	< 0.076	U
Diethyl Phthalate	84-66-2	T	µg/L	< 0.55	U	< 0.57	U	< 0.57	U	< 0.62	U	< 0.59	U
Dimethyl Phthalate	131-11-3	T	µg/L	< 0.054	U	< 0.056	U	< 0.056	U	< 0.061	UJ	< 0.058	U
Di-N-Butyl Phthalate	84-74-2	T	µg/L	< 1.1	U	< 1	U	< 1.3	U	< 1.4	UJ	< 1.3	U
Di-N-Octylphthalate	117-84-0	T	µg/L	< 0.66	U	< 0.69	U	< 0.69	U	< 0.74	U	< 0.71	U
Fluoranthene	206-44-0	T	µg/L	0.12	J	< 0.06	U	0.12	J	< 0.065	UJ	< 0.063	U

Appendix B2 - Table 2
March 2021 Surface Water Analytical Results
SWP and NCSPA Site
Wilmington, NC

Location ID				DD02-WS		GC01-WS		GC02-WS		GC05-WS		GC05-WS	
Sample Date				3/23/2021		3/23/2021		3/23/2021		3/23/2021		3/23/2021	
Sample Type (N: Normal, FD: Field Duplicate)				N		N		N		N		FD	
Chemical	CAS No.	Fraction	Unit	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Fluorene	86-73-7	T	µg/L	0.47		< 0.069	U	0.54		< 0.075	UJ	< 0.072	U
Hexachlorobenzene	118-74-1	T	µg/L	< 0.054	U	< 0.056	U	< 0.056	U	< 0.061	UJ	< 0.058	U
Hexachlorobutadiene	87-68-3	T	µg/L	< 0.066	U	< 0.069	U	< 0.069	U	< 0.075	UJ	< 0.072	U
Hexachlorocyclopentadiene	77-47-4	T	µg/L	< 0.48	U	< 0.5	U	< 0.5	U	< 0.54	R	< 0.52	U
Hexachloroethane	67-72-1	T	µg/L	< 0.06	U	< 0.062	U	< 0.062	U	< 0.067	UJ	< 0.065	U
Indeno(1,2,3-C,D)Pyrene	193-39-5	T	µg/L	< 0.082	U	< 0.085	U	< 0.085	U	< 0.092	UJ	< 0.089	U
Isophorone	78-59-1	T	µg/L	< 0.052	U	< 0.054	U	< 0.054	U	< 0.059	UJ	< 0.056	U
Naphthalene	91-20-3	T	µg/L	< 0.057	U	< 0.059	U	< 0.059	U	< 0.064	UJ	< 0.061	U
Nitrobenzene	98-95-3	T	µg/L	< 0.48	U	< 0.5	U	< 0.5	U	< 0.54	U	< 0.52	U
N-Nitrosodi-N-Propylamine	621-64-7	T	µg/L	< 0.068	U	< 0.071	U	< 0.071	U	< 0.077	UJ	< 0.074	U
N-Nitrosodiphenylamine	86-30-6	T	µg/L	< 0.11	U	< 0.12	U	< 0.12	U	< 0.13	UJ	< 0.12	U
Pentachlorophenol	87-86-5	T	µg/L	< 0.81	UJ	< 0.85	U	< 0.85	U	< 0.92	U	< 0.88	U
Phenanthrene	85-01-8	T	µg/L	0.12	J	< 0.055	U	0.19		< 0.06	UJ	0.091	J
Phenol	108-95-2	T	µg/L	< 0.47	U	< 0.49	U	< 0.49	U	< 0.53	UJ	< 0.51	U
Pyrene	129-00-0	T	µg/L	0.058	J	< 0.054	U	0.061	J	< 0.059	UJ	< 0.056	U

Notes:
Grey values denote non-detected results.
µg/L - Micrograms per liter
CaCO3 - calcium carbonate
CAS - Chemical Abstracts Service
D - Dissolved fraction
J - Concentration greater than method detection limit but less than reporting limit
R - Rejected
SVOCs - Semivolatile organics compounds
T - Total fraction
U - Non-detected concentration

Appendix C Human Health Assessment

Appendix C1 Vapor Intrusion Screening

Appendix C1
Summary of Shallow Aquifer Groundwater Monitoring Result Comparison to NCDEQ GWSLs
Southern Wood Piedmont
Wilmington, NC

Analyte	Method	Units	NCDEQ GWSL	Sample	MW-07(01-17-2012)			MW-08(01-17-2012)			MW-09(01-19-2012)			MW-10(01-19-2012)		
					Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ
Acetone	SW-846 8260B	µg/L	1.9E+07		ND	3.0	5.0	ND	3.0	5.0	81	3.0	5.0	ND	3.0	5.0
Benzene	SW-846 8260B	µg/L	6.9E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Bromodichloromethane	SW-846 8260B	µg/L	3.8E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
2-Butanone	SW-846 8260B	µg/L	1.9E+06		ND	1.0	5.0	ND	1.0	5.0	ND	1.0	5.0	ND	1.0	5.0
Chloroform	SW-846 8260B	µg/L	3.6E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
1,2-Dichloropropane	SW-8468260B	µg/L	2.9E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Ethylbenzene	SW-846 8260B	µg/L	1.5E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Methylene Chloride	SW-846 8260B	µg/L	4.0E+03		ND	0.2	0.5	ND	0.2	0.5	ND	0.2	0.5	ND	0.2	0.5
1,1,2,2-Tetrachloroethane	SW-846 8260B	µg/L	1.4E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Toluene	SW-846 8260B	µg/L	1.6E+04		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
1,1,2-Trichloroethane	SW-846 8260B	µg/L	5.2E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Xylene (Total)	SW-846 8260B	µg/L	3.2E+02		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Benzo(a)anthracene	SW-846 8270D SIM	mg/L	4.2E-01		0.000017 J	0.000010	0.000052	ND	0.000010	0.000052	ND	0.000010	0.000052	0.000012 J	0.000010	0.000052
Naphthalene	SW-846 8270D SIM	mg/L	2.0E-02		ND	0.000031	0.000052	ND	0.000031	0.000052	ND	0.000031	0.000052	0.000043 J	0.000031	0.000052

Notes:
µg/L - micrograms per liter
DUP - Duplicate Sample
J - estimated value
LOQ - Limit of Quantitation
MDL - Method Detection Limit
mg/L - milligrams per liter
NCDEQ GWSL - North Carolina Department of Environmental Quality Non-Residential Groundwater Screening Level (June 2021)
ND - not detected
Yellow shading indicates exceedance of GWSL.

Source: Schnabel Engineering. 2012. DNAPL and Groundwater Monitoring Report. (Table 5)

Appendix C1
Summary of Shallow Aquifer Groundwater Monitoring Result Comparison to NCDEQ GWSLs
Southern Wood Piedmont
Wilmington, NC

Analyte	Method	Units	NCDEQ GWSL	Sample	MW-12(01-20-2012)			MW-13(01-20-2012)			MW-15(01-20-2012)			MW-16(01-17-2012)		
					Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ
Acetone	SW-846 8260B	µg/L	1.9E+07		ND	3.0	5.0	ND	3.0	5.0	11	3.0	5.0	13	3.0	5.0
Benzene	SW-846 8260B	µg/L	6.9E+00		0.1 J	0.1	0.5	2.3	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Bromodichloromethane	SW-846 8260B	µg/L	3.8E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
2-Butanone	SW-846 8260B	µg/L	1.9E+06		ND	1.0	5.0	ND	1.0	5.0	ND	1.0	5.0	ND	1.0	5.0
Chloroform	SW-846 8260B	µg/L	3.6E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
1,2-Dichloropropane	SW-8468260B	µg/L	2.9E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Ethylbenzene	SW-846 8260B	µg/L	1.5E+01		ND	0.1	0.5	11	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Methylene Chloride	SW-846 8260B	µg/L	4.0E+03		ND	0.2	0.5	ND	0.2	0.5	ND	0.2	0.5	ND	0.2	0.5
1,1,2,2-Tetrachloroethane	SW-846 8260B	µg/L	1.4E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Toluene	SW-846 8260B	µg/L	1.6E+04		ND	0.1	0.5	0.6	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
1,1,2-Trichloroethane	SW-846 8260B	µg/L	5.2E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Xylene (Total)	SW-846 8260B	µg/L	3.2E+02		ND	0.1	0.5	8.0	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Benzo(a)anthracene	SW-846 8270D SIM	mg/L	4.2E-01		0.00010	0.000010	0.000052	0.00013	0.000010	0.000052	ND	0.000010	0.000051	0.000022 J	0.000010	0.000051
Naphthalene	SW-846 8270D SIM	mg/L	2.0E-02		0.0012	0.000031	0.000052	0.066	0.00031	0.00052	0.000033 J	0.000031	0.000051	ND	0.000031	0.000051

Notes:

µg/L - micrograms per liter

DUP - Duplicate Sample

J - estimated value

LOQ - Limit of Quantitation

MDL - Method Detection Limit

mg/L - milligrams per liter

NCDEQ GWSL - North Carolina Department of Environmental Quality Non-Residential Groundwater Screening Level (June 2021)

ND - not detected

Yellow shading indicates exceedance of GWSL.

Source: Schnabel Engineering. 2012. DNAPL and Groundwater Monitoring Report. (Table 5)

Appendix C1
Summary of Shallow Aquifer Groundwater Monitoring Result Comparison to NCDEQ GWSLs
Southern Wood Piedmont
Wilmington, NC

Analyte	Method	Units	NCDEQ GWSL	Sample	DUP-01(01-17-2012); MW-16			MW-17(01-18-2012)			DUP-02(01-18-2012); MW-17			MW-18(01-20-2012)		
					Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ
Acetone	SW-846 8260B	µg/L	1.9E+07		13	3.0	5.0	50	3.0	5.0	50	3.0	5.0	270	30	50
Benzene	SW-846 8260B	µg/L	6.9E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Bromodichloromethane	SW-846 8260B	µg/L	3.8E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
2-Butanone	SW-846 8260B	µg/L	1.9E+06		ND	1.0	5.0	ND	1.0	5.0	ND	1.0	5.0	ND	1.0	5.0
Chloroform	SW-846 8260B	µg/L	3.6E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
1,2-Dichloropropane	SW-8468260B	µg/L	2.9E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Ethylbenzene	SW-846 8260B	µg/L	1.5E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Methylene Chloride	SW-846 8260B	µg/L	4.0E+03		ND	0.2	0.5	ND	0.2	0.5	ND	0.2	0.5	ND	0.2	0.5
1,1,2,2-Tetrachloroethane	SW-846 8260B	µg/L	1.4E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Toluene	SW-846 8260B	µg/L	1.6E+04		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
1,1,2-Trichloroethane	SW-846 8260B	µg/L	5.2E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Xylene (Total)	SW-846 8260B	µg/L	3.2E+02		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5
Benzo(a)anthracene	SW-846 8270D SIM	mg/L	4.2E-01		0.000013 J	0.000010	0.000051	0.000022 J	0.000010	0.000051	0.000018 J	0.000010	0.000051	ND	0.000010	0.000051
Naphthalene	SW-846 8270D SIM	mg/L	2.0E-02		ND	0.000031	0.000051	0.000036 J	0.000030	0.000051	0.000038 J	0.000030	0.000051	ND	0.000030	0.000051

Notes:

µg/L - micrograms per liter

DUP - Duplicate Sample

J - estimated value

LOQ - Limit of Quantitation

MDL - Method Detection Limit

mg/L - milligrams per liter

NCDEQ GWSL - North Carolina Department of Environmental Quality Non-Residential Groundwater Screening Level (June 2021)

ND - not detected

Yellow shading indicates exceedance of GWSL.

Source: Schnabel Engineering. 2012. DNAPL and Groundwater Monitoring Report. (Table 5)

Appendix C1
Summary of Shallow Aquifer Groundwater Monitoring Result Comparison to NCDEQ GWSLs
Southern Wood Piedmont
Wilmington, NC

Analyte	Method	Units	NCDEQ GWSL	Sample	MW-19(01-19-2012)			MW-20(01-19-2012)			MW-21(01-17-2012)			MW-23(01-18-2012)		
					Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ
Acetone	SW-846 8260B	µg/L	1.9E+07		4.1 J	3.0	5.0	ND	3.0	5.0	ND	3.0	5.0	ND	15	25
Benzene	SW-846 8260B	µg/L	6.9E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Bromodichloromethane	SW-846 8260B	µg/L	3.8E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
2-Butanone	SW-846 8260B	µg/L	1.9E+06		ND	1.0	5.0	ND	1.0	5.0	ND	1.0	5.0	ND	5.0	25
Chloroform	SW-846 8260B	µg/L	3.6E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
1,2-Dichloropropane	SW-8468260B	µg/L	2.9E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Ethylbenzene	SW-846 8260B	µg/L	1.5E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Methylene Chloride	SW-846 8260B	µg/L	4.0E+03		ND	0.2	0.5	ND	0.2	0.5	ND	0.2	0.5	ND	1.0	2.5
1,1,2,2-Tetrachloroethane	SW-846 8260B	µg/L	1.4E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Toluene	SW-846 8260B	µg/L	1.6E+04		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
1,1,2-Trichloroethane	SW-846 8260B	µg/L	5.2E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Xylene (Total)	SW-846 8260B	µg/L	3.2E+02		0.4 J	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Benzo(a)anthracene	SW-846 8270D SIM	mg/L	4.2E-01		0.00013	0.000010	0.000052	0.000017 J	0.000010	0.000052	ND	0.000010	0.000051	0.000019 J	0.000010	0.000051
Naphthalene	SW-846 8270D SIM	mg/L	2.0E-02		0.00058	0.000031	0.000052	0.000037 J	0.000031	0.000052	ND	0.000031	0.000051	ND	0.000030	0.000051

Notes:
µg/L - micrograms per liter
DUP - Duplicate Sample
J - estimated value
LOQ - Limit of Quantitation
MDL - Method Detection Limit
mg/L - milligrams per liter
NCDEQ GWSL - North Carolina Department of Environmental Quality Non-Residential Groundwater Screening Level (June 2021)
ND - not detected
Yellow shading indicates exceedance of GWSL.

Source: Schnabel Engineering. 2012. DNAPL and Groundwater Monitoring Report. (Table 5)

Appendix C1
Summary of Shallow Aquifer Groundwater Monitoring Result Comparison to NCDEQ GWSLs
Southern Wood Piedmont
Wilmington, NC

Analyte	Method	Units	NCDEQ GWSL	Sample	MW-24R(01-19-2012)			MW-25(01-20-2012)			MW-28(01-18-2012)			MW-29(01-19-2012)		
					Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ
Acetone	SW-846 8260B	µg/L	1.9E+07		ND	3.0	5.0	5.6	3.0	5.0	ND	3.0	5.0	ND	15	25
Benzene	SW-846 8260B	µg/L	6.9E+00		0.5 J	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Bromodichloromethane	SW-846 8260B	µg/L	3.8E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
2-Butanone	SW-846 8260B	µg/L	1.9E+06		ND	1.0	5.0	ND	1.0	5.0	ND	1.0	5.0	ND	5.0	25
Chloroform	SW-846 8260B	µg/L	3.6E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
1,2-Dichloropropane	SW-8468260B	µg/L	2.9E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Ethylbenzene	SW-846 8260B	µg/L	1.5E+01		11	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Methylene Chloride	SW-846 8260B	µg/L	4.0E+03		ND	0.2	0.5	ND	0.2	0.5	ND	0.2	0.5	ND	1.0	2.5
1,1,2,2-Tetrachloroethane	SW-846 8260B	µg/L	1.4E+01		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Toluene	SW-846 8260B	µg/L	1.6E+04		0.3 J	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
1,1,2-Trichloroethane	SW-846 8260B	µg/L	5.2E+00		ND	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Xylene (Total)	SW-846 8260B	µg/L	3.2E+02		4.6	0.1	0.5	ND	0.1	0.5	ND	0.1	0.5	ND	0.5	2.5
Benzo(a)anthracene	SW-846 8270D SIM	mg/L	4.2E-01		0.000059 J	0.000051	0.00025	ND	0.002	0.006	0.000032 J	0.000010	0.000051	ND	0.000010	0.000052
Naphthalene	SW-846 8270D SIM	mg/L	2.0E-02		0.061	0.0015	0.0025	ND	0.0006	0.001	ND	0.000030	0.000051	ND	0.000031	0.000052

Notes:
µg/L - micrograms per liter
DUP - Duplicate Sample
J - estimated value
LOQ - Limit of Quantitation
MDL - Method Detection Limit
mg/L - milligrams per liter
NCDEQ GWSL - North Carolina Department of Environmental Quality Non-Residential Groundwater Screening Level (June 2021)
ND - not detected
Yellow shading indicates exceedance of GWSL.

Source: Schnabel Engineering. 2012. DNAPL and Groundwater Monitoring Report. (Table 5)

Appendix C1
Summary of Shallow Aquifer Groundwater Monitoring Result Comparison to NCDEQ GWSLs
Southern Wood Piedmont
Wilmington, NC

Analyte	Method	Units	NCDEQ GWSL	Sample	MW-30(01-18-2012)			MW-31(01-17-2012)			MW-34(01-19-2012)			MW-37(01-20-2012)		
					Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ
Acetone	SW-846 8260B	µg/L	1.9E+07		39	3.0	5.0	ND	30	50	7.0	3.0	5.0	ND	3.0	5.0
Benzene	SW-846 8260B	µg/L	6.9E+00		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
Bromodichloromethane	SW-846 8260B	µg/L	3.8E+00		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
2-Butanone	SW-846 8260B	µg/L	1.9E+06		ND	1.0	5.0	ND	10	50	ND	1.0	5.0	ND	1.0	5.0
Chloroform	SW-846 8260B	µg/L	3.6E+00		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
1,2-Dichloropropane	SW-8468260B	µg/L	2.9E+01		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
Ethylbenzene	SW-846 8260B	µg/L	1.5E+01		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
Methylene Chloride	SW-846 8260B	µg/L	4.0E+03		ND	0.2	0.5	ND	2.0	5.0	ND	0.2	0.5	ND	0.2	0.5
1,1,2,2-Tetrachloroethane	SW-846 8260B	µg/L	1.4E+01		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
Toluene	SW-846 8260B	µg/L	1.6E+04		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
1,1,2-Trichloroethane	SW-846 8260B	µg/L	5.2E+00		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
Xylene (Total)	SW-846 8260B	µg/L	3.2E+02		ND	0.1	0.5	ND	1.0	5.0	ND	0.1	0.5	ND	0.1	0.5
Benzo(a)anthracene	SW-846 8270D SIM	mg/L	4.2E-01		0.000033 J	0.000010	0.000051	0.000016 J	0.000010	0.000051	0.00049	0.000010	0.000051	ND	0.000010	0.000052
Naphthalene	SW-846 8270D SIM	mg/L	2.0E-02		ND	0.000030	0.000051	0.000033 J	0.000031	0.000051	0.00020	0.000030	0.000051	ND	0.000031	0.000052

Notes:
µg/L - micrograms per liter
DUP - Duplicate Sample
J - estimated value
LOQ - Limit of Quantitation
MDL - Method Detection Limit
mg/L - milligrams per liter
NCDEQ GWSL - North Carolina Department of Environmental Quality Non-Residential Groundwater Screening Level (June 2021)
ND - not detected
Yellow shading indicates exceedance of GWSL.

Source: Schnabel Engineering. 2012. DNAPL and Groundwater Monitoring Report. (Table 5)

Appendix C1
Summary of Shallow Aquifer Groundwater Monitoring Result Comparison to NCDEQ GWSLs
Southern Wood Piedmont
Wilmington, NC

Analyte	Method	Units	NCDEQ GWSL	Sample	MW-40(01-19-2012)			MW-48(01-19-2012)			MW-49(01-17-2012)			MW-50(01-18-2012)		
					Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ	Result	MDL	LOQ
Acetone	SW-846 8260B	µg/L	1.9E+07		7.9	3.0	5.0	ND	15	25	ND	3.0	5.0	ND	15	25
Benzene	SW-846 8260B	µg/L	6.9E+00		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
Bromodichloromethane	SW-846 8260B	µg/L	3.8E+00		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
2-Butanone	SW-846 8260B	µg/L	1.9E+06		ND	1.0	5.0	ND	5.0	25	ND	1.0	5.0	ND	5.0	25
Chloroform	SW-846 8260B	µg/L	3.6E+00		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
1,2-Dichloropropane	SW-8468260B	µg/L	2.9E+01		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
Ethylbenzene	SW-846 8260B	µg/L	1.5E+01		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
Methylene Chloride	SW-846 8260B	µg/L	4.0E+03		ND	0.2	0.5	ND	1.0	2.5	ND	0.2	0.5	ND	1.0	2.5
1,1,2,2-Tetrachloroethane	SW-846 8260B	µg/L	1.4E+01		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
Toluene	SW-846 8260B	µg/L	1.6E+04		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
1,1,2-Trichloroethane	SW-846 8260B	µg/L	5.2E+00		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
Xylene (Total)	SW-846 8260B	µg/L	3.2E+02		ND	0.1	0.5	ND	0.5	2.5	ND	0.1	0.5	ND	0.5	2.5
Benzo(a)anthracene	SW-846 8270D SIM	mg/L	4.2E-01		0.000023 J	0.000010	0.000052	0.000011 J	0.000010	0.000052	ND	0.000010	0.000051	ND	0.000010	0.000051
Naphthalene	SW-846 8270D SIM	mg/L	2.0E-02		ND	0.000031	0.000052	ND	0.000031	0.000052	ND	0.000031	0.000051	ND	0.000030	0.000051

Notes:
µg/L - micrograms per liter
DUP - Duplicate Sample
J - estimated value
LOQ - Limit of Quantitation
MDL - Method Detection Limit
mg/L - milligrams per liter
NCDEQ GWSL - North Carolina Department of Environmental Quality Non-Residential Groundwater Screening Level (June 2021)
ND - not detected
Yellow shading indicates exceedance of GWSL.

Source: Schnabel Engineering. 2012. DNAPL and Groundwater Monitoring Report. (Table 5)

Appendix C2 Dioxin/Furan and PAH TEQ Calculations

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical Dioxin/Furan Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	TEF	Units	Sample ID_Date	SD-13_01/25/2001		SD-14_01/25/2001		SD-15_01/25/2001		SD-16_01/25/2001		SD-17_01/25/2001		SS-02_10/05/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	NG/KG		6500	65	4240	42.4	2650	26.5	52.9	0.529	17.4	0.174	42	0.42
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	NG/KG		22800	228	6970	69.7	12200	122	264	2.64	43	0.43		0
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	NG/KG		178	1.78	56.9	0.569	99.4	0.994	2.03	0.0203		0	1	0.01
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	NG/KG		139	13.9	60.3	6.03	50.4	5.04	1.44	0.144	0.631	0.0631		0
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		240	24	19.2	1.92	150	15	3.88	0.388		0		0
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		107	10.7	23.7	2.37	40.7	4.07	1.53	0.153	0.631	0.0631	4	0.4
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		562	56.2	148	14.8	331	33.1	8.5	0.85	1.42	0.142		0
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	NG/KG		37.3	3.73	21.1	2.11	13.3	1.33		0		0		0
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		270	27	47.6	4.76	323	32.3	8.21	0.821	0.726	0.0726	1.3	0.13
1,2,3,7,8-Pentachlorodibenzofuran	0.03	NG/KG		21.8	0.654	6.06	0.1818	6.84	0.2052	0.464	0.01392	0.286	0.00858		0
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1	NG/KG		70.3	70.3	7.12	7.12	58.5	58.5	1.93	1.93		0	0.076	0.076
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		165	16.5	38.5	3.85	89.8	8.98	2.41	0.241	0.666	0.0666	17	1.7
2,3,4,7,8-Pentachlorodibenzofuran	0.3	NG/KG		33.8	10.14	19.9	5.97	14.2	4.26	0.77	0.231	0.428	0.1284	3.2	0.96
2,3,7,8-Tetrachlorodibenzofuran	0.1	NG/KG		6.39	0.639	2.46	0.246	2.31	0.231		0		0		0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	NG/KG		8.24	8.24		0	4.79	4.79	0.721	0.721		0		0
Octachlorodibenzofuran	0.0003	NG/KG		7210	2.163	4360	1.308	5330	1.599	112	0.0336	26.7	0.00801	28	0.0084
Octachlorodibenzo-p-dioxin	0.0003	NG/KG		210000	63	91000	27.3	103000	30.9	2080	0.624	493	0.1479		0
			Total TEQ		**6.02E+02**		**1.91E+02**		**3.50E+02**		**9.34E+00**		**1.30E+00**		**3.70E+00**

Notes:
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WHO - World Health Organization

USEPA. 2010.Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. EPA/100/R-10/005. December 2010.

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical Dioxin/Furan Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	TEF	Units	Sample ID_Date	SS-06_11/16/1996		SS-13_11/14/1996		SS-14_11/16/1996		SS-15_10/05/1996		SS-17_11/14/1996		SS-17_11/14/1996_DUP4	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	NG/KG		12000	120	2500	25	94000	940	410	4.1	3100	31		0
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	NG/KG		84000	840	7900	79	76000	760		0	24000	240		0
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	NG/KG		850	8.5	68	0.68	1100	11	4.6	0.046	99	0.99		0
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	NG/KG			0		0		0		0		0		0
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		1100	110	44	4.4	250	25		0	46	4.6		0
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		550	55		0	390	39	2	0.2		0		0
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		2500	250	130	13	1700	170		0	350	35		0
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	NG/KG			0		0		0		0		0		0
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		1800	180	130	13	660	66		0	120	12		0
1,2,3,7,8-Pentachlorodibenzofuran	0.03	NG/KG			0		0		0		0		0		0
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1	NG/KG		360	360	12	12	40	40		0		0		0
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		1100	110		0	580	58	2.6	0.26		0		0
2,3,4,7,8-Pentachlorodibenzofuran	0.3	NG/KG		170	51		0	66	19.8		0		0		0
2,3,7,8-Tetrachlorodibenzofuran	0.1	NG/KG		100	10		0	16	1.6		0		0		0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	NG/KG		23	23		0		0		0		0		0
Octachlorodibenzofuran	0.0003	NG/KG		52000	15.6	5000	1.5	75000	22.5	210	0.063		0	11000	3.3
Octachlorodibenzo-p-dioxin	0.0003	NG/KG		1000000	300	100000	30	940000	282		0	300000	90		0
			Total TEQ		**2.43E+03**		**1.79E+02**		**2.43E+03**		**4.67E+00**		**4.14E+02**		**3.30E+00**

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USEPA. 2010.Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Asses

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical Dioxin/Furan Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	TEF	Units	Sample ID_Date	SS-19_10/05/1996		LF1_02/15/1996		LF2_02/15/1996		SD-36_01/25/2001		SD-37_01/25/2001		SD-38_01/25/2001	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	NG/KG		160	1.6	56260	562.6	51580	515.8	2100	21	2430	24.3	3640	36.4
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	NG/KG		460	4.6	55750	557.5	90080	900.8	4850	48.5	3770	37.7	2870	28.7
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	NG/KG			0	1100	11	1080	10.8	40.6	0.406	39.4	0.394	42.4	0.424
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	NG/KG			0	956	95.6	1160	116	35.8	3.58	35	3.5	43.6	4.36
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		7	0.7	191	19.1	263	26.3	25.4	2.54	18.9	1.89	12.6	1.26
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		2.1	0.21	206	20.6	217	21.7	20.3	2.03	20.3	2.03	20.4	2.04
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		12	1.2	1600	160	1910	191	108	10.8	94	9.4	83.2	8.32
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	NG/KG			0		0	62.5	6.25	11.2	1.12	11.3	1.13	15.7	1.57
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		14	1.4	526	52.6	789	78.9	48.2	4.82	39.5	3.95	32.9	3.29
1,2,3,7,8-Pentachlorodibenzofuran	0.03	NG/KG			0	55.2	1.656	63.3	1.899	3.75	0.1125	3.85	0.1155	4.28	0.1284
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1	NG/KG		2.6	2.6	42.2	42.2	55.2	55.2	9.35	9.35	8.01	8.01	5.28	5.28
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG			0	469	46.9	171	17.1	37.1	3.71	31.1	3.11	34.7	3.47
2,3,4,7,8-Pentachlorodibenzofuran	0.3	NG/KG		1.2	0.36	51.1	15.33	53.1	15.93	11.8	3.54	10	3	10.7	3.21
2,3,7,8-Tetrachlorodibenzofuran	0.1	NG/KG			0	11.3	1.13	14.5	1.45	3.79	0.379	1.76	0.176	1.78	0.178
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	NG/KG		0.9	0.9	2.4	2.4	4.2	4.2		0		0	1.58	1.58
Octachlorodibenzofuran	0.0003	NG/KG		250	0.075	154750	46.425	155250	46.575	2830	0.849	2650	0.795	3040	0.912
Octachlorodibenzo-p-dioxin	0.0003	NG/KG		4400	1.32	583460	175.038	496210	148.863	52800	15.84	43200	12.96	31600	9.48
			Total TEQ		**1.50E+01**		**1.81E+03**		**2.16E+03**		**1.29E+02**		**1.12E+02**		**1.11E+02**

Notes:
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USEPA. 2010.Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Asses

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical Dioxin/Furan Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	TEF	Units	Sample ID_Date	SD-41DF_10/24/2000		SD-18_01/25/2001		SD-19_01/25/2001		SD-20_01/23/2001		SD-07DF_10/24/2000		SD-28_01/23/2001	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	NG/KG		55.3	0.553	171	1.71	1300	13	4900	49	5860	58.6	66560	665.6
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	NG/KG		148	1.48	429	4.29	2950	29.5	9920	99.2	26100	261	268000	2680
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	NG/KG		1.35	0.0135	3.66	0.0366	25.6	0.256	81.4	0.814	172	1.72	1870	18.7
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	NG/KG		1.32	0.132	3.41	0.341	21.8	2.18	69.7	6.97	103	10.3	943	94.3
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		1.14	0.114	3.08	0.308	9.19	0.919	24.3	2.43	42.5	4.25	406	40.6
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		1.53	0.153	2.03	0.203	9.25	0.925	39.8	3.98	34.2	3.42	267	26.7
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		4.52	0.452	10.2	1.02	60.2	6.02	197	19.7	459	45.9	5610	561
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	NG/KG			0		0	6.06	0.606	20.6	2.06	32.6	3.26	257	25.7
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		2.72	0.272	5.18	0.518	18.8	1.88	53.2	5.32	74.7	7.47	1440	144
1,2,3,7,8-Pentachlorodibenzofuran	0.03	NG/KG		0.442	0.01326	0.711	0.02133	1.96	0.0588	6.69	0.2007	9.23	0.2769	95.6	2.868
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1	NG/KG		0.782	0.782	1.41	1.41	3.63	3.63	8.71	8.71	9.6	9.6	36.6	36.6
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		3.28	0.328	3.76	0.376	17.5	1.75	54	5.4	66	6.6	487	48.7
2,3,4,7,8-Pentachlorodibenzofuran	0.3	NG/KG		3.29	0.987	2.26	0.678	8.34	2.502	20.4	6.12	24.1	7.23	244	73.2
2,3,7,8-Tetrachlorodibenzofuran	0.1	NG/KG		0.381	0.0381	0.658	0.0658	1.58	0.158	5.5	0.55		0	50.9	5.09
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	NG/KG			0		0	1.08	1.08	2.09	2.09		0	3.66	3.66
Octachlorodibenzofuran	0.0003	NG/KG		76.4	0.02292	284	0.0852	2340	0.702	6820	2.046	12300	3.69	186260	55.878
Octachlorodibenzo-p-dioxin	0.0003	NG/KG		1540	0.462	4860	1.458	34000	10.2	111000	33.3	330000	99	2360000	708
			Total TEQ		**5.80E+00**		**1.25E+01**		**7.54E+01**		**2.48E+02**		**5.22E+02**		**5.19E+03**

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USEPA. 2010.Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Asses

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical Dioxin/Furan Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	TEF	Units	Sample ID_Date	SD-40DF_10/24/2000		SD-40DF_10/24/2000_DUP1		SS-02DF_02/19/2001		SS-17DF_01/25/2001		SS-14DF_01/25/2001		SS-13DF_01/25/2001	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	NG/KG		2.74	0.0274	2.88	0.0288	58.2	0.582	2.7	0.027	44.2	0.442	7.63	0.0763
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	NG/KG		12.4	0.124	14.2	0.142	244	2.44	4.02	0.0402	53.8	0.538	61.5	0.615
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	NG/KG			0		0	2.88	0.0288		0		0		0
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	NG/KG		0.185	0.0185	0.203	0.0203	4.94	0.494	0.402	0.0402	0.992	0.0992	0.448	0.0448
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG			0	0.16	0.016	3.33	0.333		0		0	0.908	0.0908
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		0.179	0.0179	0.189	0.0189	8.06	0.806	0.373	0.0373	0.649	0.0649	0.481	0.0481
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		0.353	0.0353	0.419	0.0419	7.63	0.763		0	1.76	0.176	1.77	0.177
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	NG/KG			0		0		0		0	0.544	0.0544		0
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG			0	0.36	0.036	6.48	0.648		0	0.72	0.072	1.09	0.109
1,2,3,7,8-Pentachlorodibenzofuran	0.03	NG/KG			0		0	3.54	0.1062	0.363	0.01089	0.456	0.01368		0
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1	NG/KG			0		0	2.14	2.14		0	0.491	0.491	0.558	0.558
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		0.323	0.0323	0.354	0.0354	15.6	1.56	0.432	0.0432	0.834	0.0834	0.612	0.0612
2,3,4,7,8-Pentachlorodibenzofuran	0.3	NG/KG		0.459	0.1377	0.492	0.1476	23.7	7.11	0.461	0.1383	0.764	0.2292	0.372	0.1116
2,3,7,8-Tetrachlorodibenzofuran	0.1	NG/KG			0		0	6.09	0.609		0		0		0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	NG/KG			0		0	1.91	1.91		0		0		0
Octachlorodibenzofuran	0.0003	NG/KG		6.85	0.002055	7.96	0.002388	81.9	0.02457	2.39	0.000717	50.2	0.01506	20.6	0.00618
Octachlorodibenzo-p-dioxin	0.0003	NG/KG		181	0.0543	209	0.0627	8840	2.652	54.1	0.01623	693	0.2079	5120	1.536
			Total TEQ		**4.49E-01**		**5.52E-01**		**2.22E+01**		**3.54E-01**		**2.49E+00**		**3.43E+00**

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SWP and NCSPA Site
Wilmington, NC

Analyte	TEF	Units	Sample ID_Date	SS-13DF_01/25/2001_DUP1		SS-06DF_01/25/2001	
				Result	TEQ	Result	TEQ
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	NG/KG		9.18	0.0918	16700	167
1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	0.01	NG/KG		65.7	0.657	8440	84.4
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	NG/KG			0	161	1.61
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	NG/KG		0.442	0.0442	159	15.9
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		0.651	0.0651	47	4.7
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		0.465	0.0465	40.6	4.06
1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG		1.42	0.142	463	46.3
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	NG/KG			0	67	6.7
1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	0.1	NG/KG			0	154	15.4
1,2,3,7,8-Pentachlorodibenzofuran	0.03	NG/KG			0	13.2	0.396
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	1	NG/KG			0	9.42	9.42
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	NG/KG		0.721	0.0721	81.6	8.16
2,3,4,7,8-Pentachlorodibenzofuran	0.3	NG/KG		0.384	0.1152	24	7.2
2,3,7,8-Tetrachlorodibenzofuran	0.1	NG/KG			0		0
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	NG/KG			0		0
Octachlorodibenzofuran	0.0003	NG/KG		25.4	0.00762	15000	4.5
Octachlorodibenzo-p-dioxin	0.0003	NG/KG		3730	1.119	92900	27.87
			Total TEQ		**2.36E+00**		**4.04E+02**

Notes:
TEF - Toxicity Equivalency Factor. TEF values are based on the
2005 WHO update of TEF values as recommended in USEPA's December 2010 guidance
TEQ - Toxicity Equivalency. TEQ for each analyte is determined
by multiplying the TEF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

NCSPA - North Carolina State Ports Authority
NG/KG - nanograms per kilogram
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company
USEPA - United States Environmental Protection Agency
WHO - World Health Organization

USEPA. 2010.Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Asses

Appendix C2
Dixon/Furan and PAH TEQ Calculations - 2018 Dioxin/Furan Soil Data
SWP and NCSPA Site
Wilmington, NC

Sample ID	Contaminant of Concern → Date Collected	Sample Depth (ft. BLS)	2,3,7,8-TCDD	1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD	1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	OCDD	2,3,7,8-TCDF	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF	2,3,4,6,7,8-HxCDF	1,2,3,7,8,9-HxCDF	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	OCDF	**2378-TCDD TEQ (HH)**
MW-51 (0-2')	1/25/2018	0-2	0.07	2.78	1.57	3.77	2.14	19.10	6.06	0.00	0.02	1.49	0.68	0.58	1.21	0.00	3.06	0.27	0.29	**4.31E+01**
MW-52 (0-2')	1/26/2018	0-2	0.00	2.44	1.59	4.46	1.84	19.80	6.09	0.00	0.01	0.31	0.67	0.64	0.69	0.00	3.07	0.22	0.29	**4.21E+01**
MW-53 (0-2')	1/25/2018	0-2	2.30	109.00	39.10	486.00	98.70	1530.00	354.00	2.05	4.17	108.60	124.00	52.70	99.70	0.00	842.00	17.00	30.30	**3.90E+03**
MW-54 (0-2')	1/26/2018	0-2	27.00	197.00	102.00	1120.00	172.00	7050.00	2379.00	2.10	2.51	58.20	188.00	58.50	140.00	0.00	1250.00	79.00	209.70	**1.30E+04**
MW-55 (0-2')	2/7/2018	0-2	0.00	0.00	0.00	0.15	0.00	0.30	0.09	0.00	0.00	0.00	0.12	0.00	0.12	0.00	0.25	0.00	0.01	**1.03E+00**
MW-56 (0-2')	1/29/2018	0-2	0.00	3.25	1.68	3.62	2.16	11.70	3.87	0.00	0.06	6.15	5.10	2.07	11.70	0.00	13.90	0.60	0.52	**6.64E+01**
MW-57 (0-2')	1/29/2018	0-2	0.88	2.32	1.20	6.28	2.04	31.30	10.11	0.00	0.05	4.11	3.72	1.68	3.95	0.00	47.00	0.66	1.55	**1.17E+02**
MW-58 (0-2')	1/29/2018	0-2	0.00	29.10	4.75	21.50	11.00	89.20	26.85	0.00	0.00	6.00	9.07	7.34	8.01	0.00	63.90	1.68	2.34	**2.81E+02**
MW-59 (0-2')	2/5/2018	0-2	0.00	4.09	1.70	5.24	2.77	19.40	6.18	0.00	0.15	2.63	3.22	2.54	3.42	0.00	21.40	0.34	0.50	**7.36E+01**
MW-60 (0-2')	1/29/2018	0-2	0.00	3.87	0.84	2.96	1.32	11.60	4.11	0.00	0.00	5.88	1.15	0.93	2.03	0.00	7.27	0.14	0.25	**4.24E+01**
MW-61 (0-2')	2/2/2018	0-2	0.00	0.00	0.00	0.13	0.15	0.47	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	**1.16E+00**
MW-62 (0-2')	1/29/2018	0-2	0.00	2.69	0.77	4.10	1.80	18.50	7.62	0.00	0.03	0.90	0.80	0.38	0.75	0.00	5.53	0.15	0.39	**4.44E+01**
MW-63 (0-2')	2/7/2018	0-2	0.00	0.00	0.15	0.39	0.23	2.33	0.80	0.00	0.00	0.00	0.25	0.07	0.16	0.00	0.26	0.00	0.02	**4.65E+00**
MW-64 (0-2')	2/6/2018	0-2	0.00	2.92	1.18	2.95	2.20	18.60	6.72	0.00	0.00	0.00	0.76	0.41	0.66	0.00	3.67	0.18	0.29	**4.05E+01**
		TEF	1	1	0.1	0.1	0.1	0.01	0.0003	0.1	0.03	0.3	0.1	0.1	0.1	0.1	0.01	0.01	0.0003	

Source:
CATLIN. 2018. Brownfields Update Report. April 27.
Notes:
TEF - Toxicity Equivalency Factor. TEF values are based on the 2005 WHO update of TEF values as recommended in USEPA's December 2010 guidance
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the TEF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

All results in NG/KG - nanograms per kilogram

ft BLS - feet below land surface
HH - human health
HpCDD - heptachlorodibenzo-p-Dioxin
HpCDF - heptachlorodibenzofuran
HxCDD - hexachlorodibenzo-p-Dioxin
HxCDF - hexachlorodibenzofuran
NCSPA - North Carolina State Ports Authority
OCDD - octachlorodibenzo-p-dioxin
OCDF - octachlorodibenzofuran
PAH - polycyclic aromatic hydrocarbons
PeCDD - pentachlorodibenzo-p-Dioxin
PeCDF - pentachlorodibenzofuran
SWP - Southern Wood Piedmont Company
TCDD - tetrachlorodibenzo-p-dioxin
TCDF - tetrachlorodibenzofuran
USEPA - United States Environmental Protection Agency
WHO - World Health Organization

USEPA. 2010.Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. EPA/100/R-10/005. December 2010.

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	NTA-01_02/26/1991		NTA-02_02/26/1991		NTA-03_02/26/1991		NTA-04_02/26/1991		NTA-05_02/26/1991		NTA-06_02/26/1991		NTA-07_02/26/1991	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		1.2	0.12	1.6	0.16	1.1	0.11		0	0.57	0.057	0.47	0.047	0.97	0.097
Benzo(a)pyrene	1	MG/KG		1	1	1.1	1.1	1	1		0	0.41	0.41		0	0.77	0.77
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG		4.1	0.41	5.9	0.59	4.1	0.41	0.8	0.08	2.2	0.22		0	1.7	0.17
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0		0		0
Chrysene	0.001	MG/KG		1.7	0.0017	2.7	0.0027	1.7	0.0017		0	0.93	0.00093	0.93	0.00093	1.5	0.0015
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.68	0.068	0.66	0.066	0.85	0.085		0		0		0		0
			Total TEQ		**1.60E+00**		**1.92E+00**		**1.61E+00**		**8.00E-02**		**6.88E-01**		**4.79E-02**		**1.04E+00**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	NTA-08_02/26/1991		NTB-01_03/01/1991		NTB-02_03/01/1991		NTB-03_02/28/1991		NTB-04_03/01/1991		NTB-05_03/01/1991		NTB-06_02/28/1991	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		1.5	0.15	3.1	0.31	0.56	0.056		0	25	2.5		0	0.38	0.038
Benzo(a)pyrene	1	MG/KG		1.3	1.3	4.3	4.3		0		0	17	17		0	0.39	0.39
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG		2.9	0.29	11	1.1	1	0.1	0.45	0.045	50	5		0	1.7	0.17
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0		0		0
Chrysene	0.001	MG/KG		1.7	0.0017	4.6	0.0046	0.74	0.00074	0.4	0.0004	52	0.052	0.49	0.00049	0.82	0.00082
Dibenzo(a,h)anthracene	1	MG/KG			0	1.3	1.3		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.58	0.058	3.8	0.38		0		0		0		0		0
			Total TEQ		**1.80E+00**		**7.39E+00**		**1.57E-01**		**4.54E-02**		**2.46E+01**		**4.90E-04**		**5.99E-01**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	NTB-07_02/28/1991		NTB-08_03/01/1991		NTB-09_03/01/1991		NTB-10_03/01/1991		NTB-11_03/01/1991		NTB-12_03/01/1991		NTB-13_03/01/1991	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG			0		0		0	3.1	0.31	0.5	0.05		0	0.69	0.069
Benzo(a)pyrene	1	MG/KG			0		0		0	1.2	1.2		0		0		0
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG		1.5	0.15	1.2	0.12	2	0.2	5.5	0.55	1.7	0.17	1.2	0.12	1.3	0.13
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0		0		0
Chrysene	0.001	MG/KG		0.75	0.00075	0.79	0.00079	1.2	0.0012	4.5	0.0045	0.76	0.00076	0.59	0.00059	0.93	0.00093
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG			0		0		0	0.57	0.057		0		0		0
			Total TEQ		**1.51E-01**		**1.21E-01**		**2.01E-01**		**2.12E+00**		**2.21E-01**		**1.21E-01**		**2.00E-01**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	PDA1A-06_02/14/1996		PDA2A-06_02/14/1996		PDA3A-06_02/14/1996		PDA4A-06_02/14/1996		PDA5A-06_02/14/1996		PDA6A-06_02/14/1996		PDA7A-06_02/14/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		6.6	0.66	0.53	0.053	0.71	0.071		0	1.6	0.16	3.7	0.37	1.1	0.11
Benzo(a)pyrene	1	MG/KG		5.3	5.3	0.68	0.68	0.9	0.9		0	1.5	1.5	3.1	3.1	0.67	0.67
Benzo(b)fluoranthene	0.1	MG/KG		15	1.5	1.7	0.17	2.4	0.24	1.1	0.11	6.2	0.62	10	1	1.7	0.17
Benzo(b+k)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(k)fluoranthene	0.01	MG/KG		6	0.06	0.49	0.0049	0.86	0.0086		0	2	0.02	3.9	0.039	0.67	0.0067
Chrysene	0.001	MG/KG		11	0.011	0.91	0.00091	1.4	0.0014		0	3	0.003	7.2	0.0072	1.3	0.0013
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0	0.51	0.51		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG			0	0.63	0.063	0.57	0.057		0	1.7	0.17	2.9	0.29	0.46	0.046
			Total TEQ		**7.53E+00**		**9.72E-01**		**1.28E+00**		**1.10E-01**		**2.98E+00**		**4.81E+00**		**1.00E+00**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	PDA8A-06_02/14/1996		PDA9A-06_02/14/1996		SS-01_10/04/1996		SS-02_10/05/1996		SS-03_11/13/1996		SS-04_10/04/1996		SS-05_11/13/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		8.1	0.81	1.4	0.14		0		0	0.11	0.011		0	0.74	0.074
Benzo(a)pyrene	1	MG/KG		7.3	7.3	1.9	1.9	0.15	0.15	0.087	0.087	0.14	0.14	0.11	0.11	0.14	0.14
Benzo(b)fluoranthene	0.1	MG/KG		17	1.7	3.7	0.37		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG			0		0	0.22	0.022	0.15	0.015	0.26	0.026	0.3	0.03	1.6	0.16
Benzo(k)fluoranthene	0.01	MG/KG		6.3	0.063	1.5	0.015		0		0		0		0		0
Chrysene	0.001	MG/KG		12	0.012	2	0.002	0.22	0.00022	0.1	0.0001	0.15	0.00015	0.31	0.00031	1.3	0.0013
Dibenzo(a,h)anthracene	1	MG/KG			0	0.39	0.39		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		5	0.5	2	0.2	0.11	0.011	0.063	0.0063	0.14	0.014	0.092	0.0092	0.29	0.029
			Total TEQ		**1.04E+01**		**3.02E+00**		**1.83E-01**		**1.08E-01**		**1.91E-01**		**1.50E-01**		**4.04E-01**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	SS-06_11/16/1996		SS-07_11/14/1996		SS-08_11/14/1996		SS-09_11/14/1996		SS-10_11/14/1996		SS-10A_11/19/1993		SS-12_11/13/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		2.7	0.27	4.2	0.42	1.5	0.15	0.17	0.017	1.8	0.18	7.3	0.73	0.2	0.02
Benzo(a)pyrene	1	MG/KG		1.4	1.4	5.3	5.3	1	1	0.18	0.18	1.3	1.3	2.6	2.6	0.13	0.13
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0	6	0.6		0
Benzo(b+k)fluoranthene	0.1	MG/KG		2.8	0.28	13	1.3	6.2	0.62	0.83	0.083	5.5	0.55		0	0.46	0.046
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0	2.1	0.021		0
Chrysene	0.001	MG/KG		3.9	0.0039	6.6	0.0066	2.7	0.0027	0.34	0.00034	3.6	0.0036	9	0.009	0.27	0.00027
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.91	0.091	5	0.5	1.6	0.16	0.19	0.019	0.24	0.024		0	0.17	0.017
			Total TEQ		**2.04E+00**		**7.53E+00**		**1.93E+00**		**2.99E-01**		**2.06E+00**		**3.96E+00**		**2.13E-01**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	SS-13_11/14/1996		SS-14_11/16/1996		SS-17_11/14/1996		SS-18_10/05/1996		SS-19_10/05/1996		SS-20_11/13/1996		SS-21_11/14/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		0.19	0.019	21	2.1	3.7	0.37	0.35	0.035	0.2	0.02	0.14	0.014	0.27	0.027
Benzo(a)pyrene	1	MG/KG		0.31	0.31	29	29	4.7	4.7	0.34	0.34	0.25	0.25	0.095	0.095	0.26	0.26
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG		0.78	0.078	34	3.4	12	1.2	0.33	0.033	0.28	0.028	0.45	0.045	1.1	0.11
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0		0		0
Chrysene	0.001	MG/KG		0.28	0.00028	28	0.028	5.7	0.0057	0.3	0.0003	0.22	0.00022	0.29	0.00029	0.48	0.00048
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.55	0.055	17	1.7	4.5	0.45	0.21	0.021	0.13	0.013	0.097	0.0097	0.34	0.034
			Total TEQ		**4.62E-01**		**3.62E+01**		**6.73E+00**		**4.29E-01**		**3.11E-01**		**1.64E-01**		**4.31E-01**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	TWS-01A_02/28/1991		TWS-02A_02/28/1991		TWS-03A_02/28/1991		TWS-04A_02/28/1991		TWS-05A_02/28/1991		TWS-06A_02/28/1991		TWS-07A_02/27/1991	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		6.2	0.62	2.2	0.22	1.7	0.17	2.6	0.26	0.88	0.088	5	0.5	2.4	0.24
Benzo(a)pyrene	1	MG/KG		5.1	5.1	1.3	1.3	1.4	1.4	1.4	1.4	0.58	0.58	3.5	3.5	1.6	1.6
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG		12	1.2	6.7	0.67	7	0.7	8.2	0.82	0.73	0.073	13	1.3	7.4	0.74
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0		0		0
Chrysene	0.001	MG/KG		8	0.008	3.5	0.0035	3.2	0.0032	4.8	0.0048	0.95	0.00095	8.1	0.0081	3.6	0.0036
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0	0.49	0.49		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG			0	0.53	0.053	0.84	0.084	0.63	0.063		0	1.9	0.19	1	0.1
			Total TEQ		**6.93E+00**		**2.25E+00**		**2.36E+00**		**2.55E+00**		**7.42E-01**		**5.99E+00**		**2.68E+00**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	TWS-08A_02/27/1991		TWS-09A_02/27/1991		TWS-10A_02/27/1991		TWS-11A_02/27/1991		TWSB10A-06_02/14/1996		TWSB12A-06_02/14/1996		TWSB13A-06_02/14/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		1.2	0.12		0	23	2.3	2.9	0.29	0.9	0.09		0	10	1
Benzo(a)pyrene	1	MG/KG		0.89	0.89		0	17	17	1.6	1.6	0.54	0.54		0	8.8	8.8
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0	2.3	0.23	0.66	0.066	20	2
Benzo(b+k)fluoranthene	0.1	MG/KG		4.9	0.49	2	0.2	60	6	2.7	0.27		0		0		0
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0	1	0.01		0	10	0.1
Chrysene	0.001	MG/KG		2.5	0.0025	0.89	0.00089	27	0.027	4	0.004	2	0.002	0.54	0.00054	17	0.017
Dibenzo(a,h)anthracene	1	MG/KG			0		0	2.4	2.4		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.64	0.064		0	7.2	0.72	0.68	0.068	0.4	0.04		0	6.2	0.62
			Total TEQ		**1.57E+00**		**2.01E-01**		**2.84E+01**		**2.23E+00**		**9.12E-01**		**6.65E-02**		**1.25E+01**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	TWSB14A-06_02/14/1996		TWSB15A-06_02/14/1996		TWSB15ADUP_02/14/1996		TWSB1A-06_02/14/1996		TWSB2A-06_02/14/1996		TWSB4A-06_02/14/1996		TWSB5A-06_02/14/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		2.4	0.24	7.7	0.77	4.2	0.42	2.1	0.21	0.5	0.05	4.8	0.48	59	5.9
Benzo(a)pyrene	1	MG/KG		1.8	1.8	5.5	5.5	3.6	3.6	2.6	2.6	0.45	0.45	11	11	28	28
Benzo(b)fluoranthene	0.1	MG/KG		7	0.7	13	1.3	8.4	0.84	2.8	0.28	1.1	0.11	22	2.2	60	6
Benzo(b+k)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(k)fluoranthene	0.01	MG/KG		2.5	0.025	5.9	0.059	3.4	0.034	0.99	0.0099	0.4	0.004	7.1	0.071	30	0.3
Chrysene	0.001	MG/KG		5.2	0.0052	9.8	0.0098	6.4	0.0064	2.5	0.0025	0.88	0.00088	6.3	0.0063	68	0.068
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG			0	3.1	0.31	2	0.2	0.97	0.097		0	6.4	0.64	10	1
			Total TEQ		**2.77E+00**		**7.95E+00**		**5.10E+00**		**3.20E+00**		**6.15E-01**		**1.44E+01**		**4.13E+01**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	TWSB6A-06_02/14/1996		TWSB7A-06_02/14/1996		TWSB8A-06_02/14/1996		TWSB9A-06_02/14/1996		SD-28_01/23/2001		SD-38_01/25/2001		SD-40_03/22/2001_DUP1		SD-40_03/22/2001	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		2.7	0.27	0.64	0.064	0.85	0.085		0	64	6.4		0	0.048	0.0048	0.088	0.0088
Benzo(a)pyrene	1	MG/KG		2	2	0.36	0.36	0.52	0.52		0		0	1.5	1.5	0.038	0.038	0.052	0.052
Benzo(b)fluoranthene	0.1	MG/KG		5.6	0.56	1.4	0.14	1.5	0.15	0.58	0.058	29	2.9	2	0.2	0.031	0.0031	0.053	0.0053
Benzo(b+k)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0		0
Benzo(k)fluoranthene	0.01	MG/KG		1.9	0.019	0.55	0.0055	0.61	0.0061		0		0		0	0.052	0.00052	0.064	0.00064
Chrysene	0.001	MG/KG		4.7	0.0047	1.5	0.0015	1.4	0.0014	0.43	0.00043		0	1.9	0.0019	0.042	0.000042	0.096	0.000096
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0	78	78	1.6	1.6		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		1.5	0.15		0		0		0		0		0		0		0
			Total TEQ		**3.00E+00**		**5.71E-01**		**7.63E-01**		**5.84E-02**		**8.73E+01**		**3.30E+00**		**4.65E-02**		**6.68E-02**

Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH)* .
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	PDA1B-1218_02/14/1996		PDA2B-1218_02/14/1996		PDA3B-1218_02/14/1996		PDA4B-1218_02/14/1996		PDA5B-1218_02/14/1996		PDA7B-1218_02/14/1996		PDA8B-1218_02/14/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		0.71	0.071	0.51	0.051	1.3	0.13	0.64	0.064	4.2	0.42	2.8	0.28	4.9	0.49
Benzo(a)pyrene	1	MG/KG		0.78	0.78	0.47	0.47	1.1	1.1	0.53	0.53	2.9	2.9	1.2	1.2	4.2	4.2
Benzo(b)fluoranthene	0.1	MG/KG		2.2	0.22	1.3	0.13	2.5	0.25	1.7	0.17	12	1.2	3.2	0.32	6.2	0.62
Benzo(b+k)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(k)fluoranthene	0.01	MG/KG		0.74	0.0074	0.44	0.0044	1	0.01		0	7.1	0.071	1.2	0.012	2.8	0.028
Chrysene	0.001	MG/KG		1.3	0.0013	0.93	0.00093	2.4	0.0024	1	0.001	7.9	0.0079	2.9	0.0029	4.3	0.0043
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0	0.6	0.6
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.61	0.061		0		0		0	5.5	0.55	0.77	0.077	2.4	0.24
			Total TEQ		**1.14E+00**		**6.56E-01**		**1.49E+00**		**7.65E-01**		**5.15E+00**		**1.89E+00**		**6.18E+00**

Notes:

RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic*

TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	PDA9B-1218_02/14/1996		SB-01_10/04/1996		SB-03_11/13/1996		SB-03D_10/01/1997_DUP1		SB-04_10/04/1996		SB-05_11/13/1996		SB-06_11/16/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		2.8	0.28		0	0.057	0.0057	0.85	0.085		0	29	2.9	0.042	0.0042
Benzo(a)pyrene	1	MG/KG		6.9	6.9		0		0		0	0.1	0.1		0	0.051	0.051
Benzo(b)fluoranthene	0.1	MG/KG		12	1.2		0		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG			0	0.044	0.0044	0.11	0.011		0	0.16	0.016	24	2.4	0.077	0.0077
Benzo(k)fluoranthene	0.01	MG/KG		3.3	0.033		0		0		0		0		0		0
Chrysene	0.001	MG/KG		6.2	0.0062		0	0.081	0.000081	0.78	0.00078	0.16	0.00016	35	0.035	0.078	0.000078
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		3.9	0.39		0		0		0	0.086	0.0086		0		0
			Total TEQ		**8.81E+00**		**4.40E-03**		**1.68E-02**		**8.58E-02**		**1.25E-01**		**5.34E+00**		**6.30E-02**

Notes:

RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic*
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

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MG/KG - milligrams per kilogram
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PAH - polycyclic aromatic hydrocarbons
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Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	SB-06D_10/01/1997_DUP1		SB-06S_10/01/1997_DUP1		SB-07_11/14/1996		SB-08_11/14/1996		SB-09_11/14/1996		SB-10_11/14/1996		SB-11_11/13/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG			0		0	6.7	0.67	1400	140	0.53	0.053	0.12	0.012	26	2.6
Benzo(a)pyrene	1	MG/KG			0		0	26	26	370	370	0.58	0.58	0.12	0.12	9.3	9.3
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG		1.1	0.11	0.62	0.062	55	5.5	1000	100	0.96	0.096	0.22	0.022	21	2.1
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0		0		0
Chrysene	0.001	MG/KG		0.9	0.0009		0	19	0.019	1400	1.4	0.74	0.00074	0.15	0.00015	25	0.025
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG			0		0	16	1.6	84	8.4	0.35	0.035	0.057	0.0057	3.3	0.33
			Total TEQ		**1.11E-01**		**6.20E-02**		**3.38E+01**		**6.20E+02**		**7.65E-01**		**1.60E-01**		**1.44E+01**

Notes:

RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic*
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

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Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	SB-12_11/13/1996		SB-13_11/14/1996		SB-14_11/16/1996		SB-15_10/05/1996		SB-17_11/14/1996		SB-19_10/05/1996		SB-20_11/13/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		1.9	0.19	0.037	0.0037	0.2	0.02		0	0.19	0.019		0	0.51	0.051
Benzo(a)pyrene	1	MG/KG		1.5	1.5	0.31	0.31	0.15	0.15		0	0.14	0.14	0.041	0.041	0.48	0.48
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0		0		0
Benzo(b+k)fluoranthene	0.1	MG/KG		3.3	0.33	0.12	0.012	0.23	0.023	0.052	0.0052	0.42	0.042	0.052	0.0052	0.79	0.079
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0		0		0
Chrysene	0.001	MG/KG		2.7	0.0027	0.12	0.00012	0.27	0.00027		0	0.26	0.00026	0.041	0.000041	0.68	0.00068
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.83	0.083		0	0.094	0.0094		0	0.099	0.0099		0	0.42	0.042
			Total TEQ		**2.11E+00**		**3.26E-01**		**2.03E-01**		**5.20E-03**		**2.11E-01**		**4.62E-02**		**6.53E-01**

Notes:

RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic*
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

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MG/KG - milligrams per kilogram
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PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	SB-21_11/13/1996		TWS-02B_02/28/1991		TWS-03B_02/28/1991		TWS-10B_02/27/1991		TWS-11B_02/27/1991		TWS-12B_02/27/1991		TWSB13B128_02/14/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		0.41	0.041	0.66	0.066	17	1.7	800	80		0	12	1.2	0.57	0.057
Benzo(a)pyrene	1	MG/KG		0.54	0.54		0		0	290	290		0		0	0.6	0.6
Benzo(b)fluoranthene	0.1	MG/KG			0		0		0		0		0		0	1.4	0.14
Benzo(b+k)fluoranthene	0.1	MG/KG		1.6	0.16		0	20	2	690	69	1	0.1	30	3		0
Benzo(k)fluoranthene	0.01	MG/KG			0		0		0		0		0		0	0.78	0.0078
Chrysene	0.001	MG/KG		0.85	0.00085	0.73	0.00073	13	0.013	740	0.74	0.49	0.00049	19	0.019	1.1	0.0011
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.44	0.044		0		0	88	8.8		0		0		0
			Total TEQ		**7.86E-01**		**6.67E-02**		**3.71E+00**		**4.49E+02**		**1.00E-01**		**4.22E+00**		**8.06E-01**

Notes:

RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic*
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - Historical PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Analyte	RPF	Units	Sample ID_Date	TWSB14B128_02/14/1996		TWSB15B128_02/14/1996		TWSB4B1218_02/14/1996		TWSB5B1218_02/14/1996		TWSB6B1218_02/14/1996	
				Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ	Result	TEQ
Benzo(a)anthracene	0.1	MG/KG		1.6	0.16	4.7	0.47	73	7.3	15	1.5	5.5	0.55
Benzo(a)pyrene	1	MG/KG		1.7	1.7	4.6	4.6	57	57	10	10	6	6
Benzo(b)fluoranthene	0.1	MG/KG		2.2	0.22	7.9	0.79	99	9.9	21	2.1	8.7	0.87
Benzo(b+k)fluoranthene	0.1	MG/KG			0		0		0		0		0
Benzo(k)fluoranthene	0.01	MG/KG		0.69	0.0069	3.1	0.031	36	0.36	7.3	0.073	3.2	0.032
Chrysene	0.001	MG/KG		2.3	0.0023	5.7	0.0057	92	0.092	16	0.016	5.2	0.0052
Dibenzo(a,h)anthracene	1	MG/KG			0		0		0		0		0
Indeno(1,2,3-cd)pyrene	0.1	MG/KG		0.74	0.074	2.6	0.26		0		0	3.3	0.33
			Total TEQ		**2.16E+00**		**6.16E+00**		**7.47E+01**		**1.37E+01**		**7.79E+00**

Notes:

RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic*
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

MG/KG - milligrams per kilogram
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C2
Dixon/Furan and PAH TEQ Calculations - 2018 PAH Soil Data
SWP and NCSPA Site
Wilmington, NC

Sample ID	Contaminant of Concern		Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Indeno(1,2,3-cd)pyrene	Total TEQ
	Date Collected	Sample depth (ft BLS)								
MW-51 (0-2')	1/25/2018	0-2	0.0594	0.0923	0.0971	0.0635	0.0782		0.0872	**1.17E-01**
MW-52 (0-2')	1/26/2018	0-2	2.18	1.58	4.54	2.45	4.68	0.390	1.45	**2.82E+00**
MW-53 (0-2')	1/25/2018	0-2	11.1	11.8	22.1	12.4	14.0	2.25	9.77	**1.85E+01**
MW-54 (0-2')	1/26/2018	0-2	17.1	17.8	35.6	13.6	25.7	2.61	13.2	**2.72E+01**
MW-55 (0-2')	2/7/2018	0-2	0.0397	0.037	0.0652	0.0602	0.0668		0.0336	**5.15E-02**
MW-56 (0-2')	1/29/2018	0-2	0.182	0.157	0.218	0.176	0.257		0.131	**2.12E-01**
MW-57 (0-2')	1/29/2018	0-2	0.0776	0.0709	0.15	0.0855	0.111		0.0715	**1.02E-01**
MW-58 (0-2')	1/29/2018	0-2	1.71	1.57	2.57	1.55	1.98		1.41	**2.16E+00**
MW-59 (0-2')	2/5/2018	0-2	0.037	0.0368	0.0694	0.0486	0.0586		0.0338	**5.14E-02**
MW-60 (0-2')	1/29/2018	0-2	0.171	0.168	0.207	0.17	0.184		0.133	**2.21E-01**
MW-61 (0-2')	2/2/2018	0-2	0.697	0.288	0.295	0.227	0.738	0.0252	0.133	**4.29E-01**
MW-62 (0-2')	1/29/2018	0-2	0.758	0.670	2.03	0.942	1.55	0.162	0.728	**1.19E+00**
MW-63 (0-2')	2/7/2018	0-2	0.308	0.261	0.356	0.319	0.379	0.0465	0.174	**3.95E-01**
MW-64 (0-2')	2/6/2018	0-2	0.04	0.0357	0.0343		0.042			**4.32E-02**
		RPF	0.1	1.000	0.1	0.010	0.001	1	0.1	

All results in milligrams per kilogram (mg/kg)

Source:
CATLIN. 2018. Brownfields Update Report. April 27.
Notes:
RPF - Relative Potency Factor. RPF values are based on the USEPA's 1993 guidance titled *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH).*
TEQ - Toxicity Equivalency. TEQ for each analyte is determined by multiplying the RPF by the laboratory concentration.

Empty cells indicate a non-detect value, non-detects (ND) set at 0.

ft BLS - feet below land surface
NCSPA - North Carolina State Ports Authority
PAH - polycyclic aromatic hydrocarbons
SWP - Southern Wood Piedmont Company

Appendix C3 Human Health Remedial Goal Calculations

Appendix C3
Human Health Remedial Goal Calculations - Construction Worker
SWP and NCSPA Site
Wilmington, NC

Variable	Construction Worker Soil - Other Default Value	Form-input Value
A (PEF Dispersion Constant)	2.4538	2.4538
A_{surf} (areal extent of site) m^2	2023.43	2023.43
B (PEF Dispersion Constant)	17.566	17.566
C (PEF Dispersion Constant)	189.0426	189.0426
F_D Unitless Dispersion Correction Factor	0.185837208	0.185837208
F(x) (function dependent on U_m/U_t derived using Cowherd et al. (1985))	0.194	0.194
$M_{m\text{-}doz}$ (Gravimetric soil moisture content) %	7.9	7.9
$M_{m\text{-}excav}$ (Gravimetric soil moisture content) %	12	12
M_{wind} (dust emitted by wind erosion) g	51288.84717	51288.84717
$N_{A\text{-}dump}$ (number of times soil is dumped)	2	2
$N_{A\text{-}till}$ (number of times soil is tilled)	2	2
Q/C_{sa} (inverse of the ratio of the geometric mean air concentration to the emission flux at the center of a square source) g/m^2-s per kg/m^3	14.31407	14.31407
p_{soil} (density) g/cm^3 - chemical-specific	1.68	1.68
s_{doz} (soil silt content) %	6.9	6.9
AF_{cw} (skin adherence factor - construction worker) mg/cm^2	0.3	0.3
AT_{cw} (averaging time - construction worker) days	365	365
BW_{cw} (body weight - construction worker) kg	80	80
ED_{cw} (exposure duration - construction worker) yr	1	1
EF_{cw} (exposure frequency - construction worker) day/yr	250	250
ET_{cw} (exposure time - construction worker) hr/day	8	8
THQ (target hazard quotient) unitless	0.1	1
IRS_{cw} (soil ingestion rate - construction worker) mg/day	330	330
LT (lifetime) yr	70	70
SA_{cw} (surface area - construction worker) cm^2/day	3527	3527
TR (target cancer risk) unitless	0.000001	0.000001
S_{doz} (dozing speed) kph	11.4	11.4
S_{grade} (grading speed) kph	11.4	11.4
s_{till} (soil silt content) %	18	18
t_c (overall duration of construction) hours	8400	8400
T_c (overall duration of construction) s	30240000	30240000
T (time over which traffic occurs) s	7200000	7200000
T_t (overall duration of traffic) s	7200000	7200000
U_m (mean annual wind speed) m/s	4.69	4.69
U_t (equivalent threshold value) m/s	11.32	11.32
V (fraction of vegetative cover)	0	0

Appendix C3
Human Health Remedial Goal Calculations - Construction Worker
SWP and NCSPA Site
Wilmington, NC

Site-specific

Construction Worker Regional Screening Levels (RSL) for Soil - Other

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o(mg/kg-day)$^{-1}$	SF_oRef	IUR (ug/m^3)$^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	GIABS	ABS	RBA	Soil Saturation Concentration (mg/kg)	S (mg/L)	K_{oc} (cm^3/g)	K_d (cm^3/g)	HLC (atm-m^3/mole)
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	1.50E+00	I	4.30E-03	I	3.00E-04	I /Chronic	1.50E-05	C /Chronic	1.00E+00	3.00E-02	6.00E-01	-	-	-	2.90E+01	-
Benzo[a]pyrene	50-32-8	Yes	No	Organics	1.00E+00	I	6.00E-04	I	3.00E-04	I /Chronic	2.00E-06	I /Chronic	1.00E+00	1.30E-01	1.00E+00	-	1.62E-03	5.87E+05	-	4.57E-07
Chromium(VI)	18540-29-9	Yes	No	Inorganics	5.00E-01	C	8.40E-02	G	5.00E-03	A /Subchronic	3.00E-04	A /Subchronic	2.50E-02	-	1.00E+00	-	1.69E+06	-	1.90E+01	-
Dibenzofuran	132-64-9	No	Yes	Organics	-		-		4.00E-03	P /Subchronic	-		1.00E+00	-	1.00E+00	-	3.10E+00	9.16E+03	5.50E+01	2.13E-04
Fluoranthene	206-44-0	No	No	Organics	-		-		1.00E-01	P /Subchronic	-		1.00E+00	1.30E-01	1.00E+00	-	2.60E-01	5.55E+04	-	8.86E-06
Fluorene	86-73-7	No	Yes	Organics	-		-		4.00E-01	A /Subchronic	-		1.00E+00	1.30E-01	1.00E+00	-	1.69E+00	9.16E+03	5.50E+01	9.62E-05
Methylnaphthalene, 2-	91-57-6	No	Yes	Organics	-		-		4.00E-03	P /Subchronic	-		1.00E+00	1.30E-01	1.00E+00	-	2.46E+01	2.48E+03	1.49E+01	5.18E-04
Naphthalene	91-20-3	No	Yes	Organics	1.20E-01	C	3.40E-05	C	6.00E-01	A /Subchronic	3.00E-03	I /Chronic	1.00E+00	1.30E-01	1.00E+00	-	3.10E+01	1.54E+03	9.26E+00	4.40E-04
Phenanthrene	85-01-8	No	Yes	Organics	-		-		-		-		1.00E+00	1.30E-01	1.00E+00	-	1.15E+00	1.67E+04	1.00E+02	4.23E-05
Pyrene	129-00-0	No	Yes	Organics	-		-		3.00E-01	P /Subchronic	-		1.00E+00	1.30E-01	1.00E+00	-	1.35E-01	5.43E+04	3.26E+02	1.19E-05
TCDD, 2,3,7,8-	1746-01-6	No	Yes	Organics	1.30E+05	C	3.80E+01	C	2.00E-08	A /Subchronic	4.00E-08	C /Chronic	1.00E+00	3.00E-02	1.00E+00	-	2.00E-04	2.49E+05	1.49E+03	5.00E-05

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Site-specific

Construction Worker Regional Screening Levels (RSL) for Soil - Other

Chemical	CAS Number	Henry's Law Constant Used in Calcs (unitless)	H` and HLC Ref	Normal Boiling Point BP (K)	BP Ref	Critical Temperature T_C (K)	T_C Ref	Chemical Type	D_{ia} (cm^2/s)	D_{iw} (cm^2/s)	D_A (cm^2/s)	Particulate Emission Factor (m^3/kg)	Volatilization Factor (m^3/kg)	Ingestion SL TR=1E-06 (mg/kg)	Dermal SL TR=1E-06 (mg/kg)	Inhalation SL TR=1E-06 (mg/kg)	Carcinogenic SL TR=1E-06 (mg/kg)
Arsenic, Inorganic	7440-38-2	-		8.88E+02	PHYSPROP	1.67E+03	CRC	INORGANIC	-	-	-	1.06E+06	-	2.75E+01	1.72E+02	7.56E+01	1.81E+01
Benzo[a]pyrene	50-32-8	1.87E-05	PHYSPROP	7.68E+02	PHYSPROP	9.69E+02	EPA 2001 Fact Sheet	PAH	2.55E-02	6.58E-06	-	1.06E+06	-	2.48E+01	5.94E+01	5.42E+02	1.69E+01
Chromium(VI)	18540-29-9	-		-		-		INORGANIC	-	-	-	1.06E+06	-	4.96E+01	-	3.87E+00	3.59E+00
Dibenzofuran	132-64-9	8.71E-03	EPI	5.60E+02	PHYSPROP	8.24E+02	CRC	FURAN	6.51E-02	7.38E-06	5.49E-07	1.06E+06	3.38E+04	-	-	-	-
Fluoranthene	206-44-0	3.62E-04	PHYSPROP	6.57E+02	PHYSPROP	9.05E+02	YAWS	PAH	2.76E-02	7.18E-06	-	1.06E+06	-	-	-	-	-
Fluorene	86-73-7	3.93E-03	PHYSPROP	5.68E+02	PHYSPROP	8.26E+02	YAWS	PAH	4.40E-02	7.89E-06	1.68E-07	1.06E+06	6.10E+04	-	-	-	-
Methylnaphthalene, 2-	91-57-6	2.12E-02	PHYSPROP	5.14E+02	PHYSPROP	7.61E+02	CRC	PAH	5.24E-02	7.78E-06	3.95E-06	1.06E+06	1.26E+04	-	-	-	-
Naphthalene	91-20-3	1.80E-02	PHYSPROP	4.91E+02	PHYSPROP	7.48E+02	CRC	PAH	6.05E-02	8.38E-06	6.20E-06	1.06E+06	1.01E+04	2.06E+02	4.95E+02	8.98E+01	5.56E+01
Phenanthrene	85-01-8	1.73E-03	PHYSPROP	6.13E+02	PHYSPROP	8.69E+02	YAWS	PAH	3.45E-02	6.69E-06	3.21E-08	1.06E+06	1.40E+05	-	-	-	-
Pyrene	129-00-0	4.87E-04	PHYSPROP	6.77E+02	PHYSPROP	9.36E+02	YAWS	PAH	2.78E-02	7.25E-06	2.35E-09	1.06E+06	5.16E+05	-	-	-	-
TCDD, 2,3,7,8-	1746-01-6	2.04E-03	EPI	6.52E+02	EPI	9.78E+02	Approx. from Tcrit=1.5xTBoil	DIOXIN	4.70E-02	6.76E-06	3.46E-09	1.06E+06	4.26E+05	1.91E-04	1.98E-03	2.45E-03	1.62E-04

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Appendix C3
Human Health Remedial Goal Calculations - Construction Worker
SWP and NCSPA Site
Wilmington, NC

Site-specific

Construction Worker Regional Screening Levels (RSL) for Soil - Other

Chemical	CAS Number	Ingestion SL THQ=1 (mg/kg)	Dermal SL THQ=1 (mg/kg)	Inhalation SL THQ=1 (mg/kg)	Noncarcinogenic SL THI=1 (mg/kg)	Screening Level (mg/kg)
Arsenic, Inorganic	7440-38-2	1.70E+02	1.06E+03	6.68E+01	4.58E+01	1.81E+01 ca**
Benzo[a]pyrene	50-32-8	1.02E+02	2.44E+02	8.90E+00	7.92E+00	7.92E+00 nc
Chromium(VI)	18540-29-9	1.70E+03	-	1.34E+03	7.47E+02	3.59E+00 ca
Dibenzofuran	132-64-9	1.36E+03	-	-	1.36E+03	1.36E+03 nc
Fluoranthene	206-44-0	3.39E+04	8.14E+04	-	2.40E+04	2.40E+04 nc
Fluorene	86-73-7	1.36E+05	3.26E+05	-	9.58E+04	9.58E+04 nc
Methylnaphthalene, 2-	91-57-6	1.36E+03	3.26E+03	-	9.58E+02	9.58E+02 nc
Naphthalene	91-20-3	2.04E+05	4.89E+05	1.25E+02	1.25E+02	5.56E+01 ca**
Phenanthrene	85-01-8	-	-	-	-	
Pyrene	129-00-0	1.02E+05	2.44E+05	-	7.19E+04	7.19E+04 nc
TCDD, 2,3,7,8-	1746-01-6	6.79E-03	7.06E-02	5.10E-02	5.52E-03	1.62E-04 ca*

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Appendix C3
Human Health Remedial Goal Calculations - Utility/Excavation Worker
SWP and NCSPA Site
Wilmington, NC

Variable	Outdoor Worker Soil Default Value	Form-input Value
A (PEF Dispersion Constant)	16.2302	16.2302
A (VF Dispersion Constant)	11.911	11.911
A (VF Dispersion Constant - mass limit)	11.911	11.911
B (PEF Dispersion Constant)	18.7762	18.7762
B (VF Dispersion Constant)	18.4385	18.4385
B (VF Dispersion Constant - mass limit)	18.4385	18.4385
City (PEF Climate Zone) Selection	Default	Default
City (VF Climate Zone) Selection	Default	Default
C (PEF Dispersion Constant)	216.108	216.108
C (VF Dispersion Constant)	209.7845	209.7845
C (VF Dispersion Constant - mass limit)	209.7845	209.7845
foc (fraction organic carbon in soil) g/g	0.006	0.006
F(x) (function dependent on U_m/U_t) unitless	0.194	0.194
n (total soil porosity) L_{pore}/L_{soil}	0.43396	0.43396
p_b (dry soil bulk density) g/cm^3	1.5	1.5
p_b (dry soil bulk density - mass limit) g/cm^3	1.5	1.5
PEF (particulate emission factor) m^3/kg	1359344438	1060000
p_s (soil particle density) g/cm^3	2.65	2.65
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	93.77
Q/C_{vol} (g/m^2-s per kg/m^3)	68.18	68.18
Q/C_{vol} (g/m^2-s per kg/m^3 - mass limit)	68.18	68.18
A_s (PEF acres)	0.5	0.5
A_s (VF acres)	0.5	0.5
A_s (VF mass-limit acres)	0.5	0.5
AF_{ow} (skin adherence factor - outdoor worker) mg/cm^2	0.12	0.3
AT_{ow} (averaging time - outdoor worker)	365	365
BW_{ow} (body weight - outdoor worker)	80	80
ED_{ow} (exposure duration - outdoor worker) yr	25	25
EF_{ow} (exposure frequency - outdoor worker) day/yr	225	5
ET_{ow} (exposure time - outdoor worker) hr	8	8
THQ (target hazard quotient) unitless	0.1	1
IRS_{ow} (soil ingestion rate - outdoor worker) mg/day	100	330
LT (lifetime) yr	70	70
SA_{ow} (surface area - outdoor worker) cm^2/day	3527	3527
TR (target cancer risk) unitless	0.000001	0.000001
T_w (groundwater temperature) Celsius	25	25
$Theta_a$ (air-filled soil porosity) L_{air}/L_{soil}	0.28396	0.28396
$Theta_w$ (water-filled soil porosity) L_{water}/L_{soil}	0.15	0.15
T (exposure interval) s	819936000	819936000
T (exposure interval) yr	26	26
U_m (mean annual wind speed) m/s	4.69	4.69
U_t (equivalent threshold value)	11.32	11.32
V (fraction of vegetative cover) unitless	0.5	0.5

Appendix C3
Human Health Remedial Goal Calculations - Utility/Excavation Worker
SWP and NCSPA Site
Wilmington, NC

Site-specific

Outdoor Worker Regional Screening Levels (RSL) for Soil

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o(mg/kg-day)$^{-1}$	SF_oRef	IUR (ug/m^3)$^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	GIABS	ABS	RBA	Soil Saturation Concentration (mg/kg)	S (mg/L)	K_{oc} (cm^3/g)	K_d (cm^3/g)	HLC (atm-m^3/mole)	Henry's Law Constant Used in Calcs (unitless)
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	1.50E+00	I	4.30E-03	I	3.00E-04	I	1.50E-05	C	1.00E+00	3.00E-02	6.00E-01	-	-	-	2.90E+01	-	-
Benzo[a]pyrene	50-32-8	Yes	No	Organics	1.00E+00	I	6.00E-04	I	3.00E-04	I	2.00E-06	I	1.00E+00	1.30E-01	1.00E+00	-	1.62E-03	5.87E+05	-	4.57E-07	1.87E-05
Chromium(VI)	18540-29-9	Yes	No	Inorganics	5.00E-01	C	8.40E-02	G	3.00E-03	I	1.00E-04	I	2.50E-02	-	1.00E+00	-	1.69E+06	-	1.90E+01	-	-
Dibenzofuran	132-64-9	No	Yes	Organics	-		-		1.00E-03	X	-		1.00E+00	-	1.00E+00	-	3.10E+00	9.16E+03	5.50E+01	2.13E-04	8.71E-03
Fluoranthene	206-44-0	No	No	Organics	-		-		4.00E-02	I	-		1.00E+00	1.30E-01	1.00E+00	-	2.60E-01	5.55E+04	-	8.86E-06	3.62E-04
Fluorene	86-73-7	No	Yes	Organics	-		-		4.00E-02	I	-		1.00E+00	1.30E-01	1.00E+00	-	1.69E+00	9.16E+03	5.50E+01	9.62E-05	3.93E-03
Methylnaphthalene, 2-	91-57-6	No	Yes	Organics	-		-		4.00E-03	I	-		1.00E+00	1.30E-01	1.00E+00	-	2.46E+01	2.48E+03	1.49E+01	5.18E-04	2.12E-02
Naphthalene	91-20-3	No	Yes	Organics	1.20E-01	C	3.40E-05	C	2.00E-02	I	3.00E-03	I	1.00E+00	1.30E-01	1.00E+00	-	3.10E+01	1.54E+03	9.26E+00	4.40E-04	1.80E-02
Phenanthrene	85-01-8	No	Yes	Organics	-		-		-		-		1.00E+00	1.30E-01	1.00E+00	-	1.15E+00	1.67E+04	1.00E+02	4.23E-05	1.73E-03
Pyrene	129-00-0	No	Yes	Organics	-		-		3.00E-02	I	-		1.00E+00	1.30E-01	1.00E+00	-	1.35E-01	5.43E+04	3.26E+02	1.19E-05	4.87E-04
TCDD, 2,3,7,8-	1746-01-6	No	Yes	Organics	1.30E+05	C	3.80E+01	C	7.00E-10	I	4.00E-08	C	1.00E+00	3.00E-02	1.00E+00	-	2.00E-04	2.49E+05	1.49E+03	5.00E-05	2.04E-03

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Appendix C3
Human Health Remedial Goal Calculations - Utility/Excavation Worker
SWP and NCSPA Site
Wilmington, NC

Site-specific

Outdoor Worker Regional Screening Levels (RSL) for Soil

Chemical	CAS Number	H` and HLC Ref	Normal Boiling Point BP (K)	BP Ref	Critical Temperature T_C (K)	T_C Ref	Chemical Type	D_{ia} (cm^2/s)	D_{iw} (cm^2/s)	D_A (cm^2/s)	Particulate Emission Factor (m^3/kg)	Volatilization Factor (m^3/kg)	Ingestion SL TR=1E-06 (mg/kg)	Dermal SL TR=1E-06 (mg/kg)	Inhalation SL TR=1E-06 (mg/kg)	Carcinogenic SL TR=1E-06 (mg/kg)	Ingestion SL THQ=1 (mg/kg)
Arsenic, Inorganic	7440-38-2		8.88E+02	PHYSPROP	1.67E+03	CRC	INORGANIC	-	-	-	1.06E+06	-	5.51E+01	3.43E+02	1.51E+02	3.61E+01	8.85E+03
Benzo[a]pyrene	50-32-8	PHYSPROP	7.68E+02	PHYSPROP	9.69E+02	EPA 2001 Fact Sheet	PAH	2.55E-02	6.58E-06	-	1.06E+06	-	4.96E+01	1.19E+02	1.08E+03	3.39E+01	5.31E+03
Chromium(VI)	18540-29-9		-		-		INORGANIC	-	-	-	1.06E+06	-	9.91E+01	-	7.74E+00	7.18E+00	5.31E+04
Dibenzofuran	132-64-9	EPI	5.60E+02	PHYSPROP	8.24E+02	CRC	FURAN	6.51E-02	7.38E-06	5.49E-07	1.06E+06	1.56E+05	-	-	-	-	1.77E+04
Fluoranthene	206-44-0	PHYSPROP	6.57E+02	PHYSPROP	9.05E+02	YAWS	PAH	2.76E-02	7.18E-06	-	1.06E+06	-	-	-	-	-	7.08E+05
Fluorene	86-73-7	PHYSPROP	5.68E+02	PHYSPROP	8.26E+02	YAWS	PAH	4.40E-02	7.89E-06	1.68E-07	1.06E+06	2.81E+05	-	-	-	-	7.08E+05
Methylnaphthalene, 2-	91-57-6	PHYSPROP	5.14E+02	PHYSPROP	7.61E+02	CRC	PAH	5.24E-02	7.78E-06	3.95E-06	1.06E+06	5.80E+04	-	-	-	-	7.08E+04
Naphthalene	91-20-3	PHYSPROP	4.91E+02	PHYSPROP	7.48E+02	CRC	PAH	6.05E-02	8.38E-06	6.20E-06	1.06E+06	4.63E+04	4.13E+02	9.91E+02	8.01E+02	2.14E+02	3.54E+05
Phenanthrene	85-01-8	PHYSPROP	6.13E+02	PHYSPROP	8.69E+02	YAWS	PAH	3.45E-02	6.69E-06	3.21E-08	1.06E+06	6.43E+05	-	-	-	-	-
Pyrene	129-00-0	PHYSPROP	6.77E+02	PHYSPROP	9.36E+02	YAWS	PAH	2.78E-02	7.25E-06	2.35E-09	1.06E+06	2.38E+06	-	-	-	-	5.31E+05
TCDD, 2,3,7,8-	1746-01-6	EPI	6.52E+02	EPI	9.78E+02	Approx. from Tcrit=1.5xTBoil	DIOXIN	4.70E-02	6.76E-06	3.46E-09	1.06E+06	1.96E+06	3.81E-04	3.96E-03	1.11E-02	3.37E-04	1.24E-02

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Appendix C3
Human Health Remedial Goal Calculations - Utility/Excavation Worker
SWP and NCSPA Site
Wilmington, NC

Site-specific

Outdoor Worker Regional Screening Levels (RSL) for Soil

Chemical	CAS Number	Dermal SL THQ=1 (mg/kg)	Inhalation SL THQ=1 (mg/kg)	Noncarcinogenic SL THI=1 (mg/kg)	Screening Level (mg/kg)
Arsenic, Inorganic	7440-38-2	5.52E+04	3.48E+03	2.39E+03	3.61E+01 ca*
Benzo[a]pyrene	50-32-8	1.27E+04	4.64E+02	4.13E+02	3.39E+01 ca*
Chromium(VI)	18540-29-9	-	2.32E+04	1.62E+04	7.18E+00 ca
Dibenzofuran	132-64-9	-	-	1.77E+04	1.77E+04 nc
Fluoranthene	206-44-0	1.70E+06	-	5.00E+05	5.00E+05 nc max
Fluorene	86-73-7	1.70E+06	-	5.00E+05	5.00E+05 nc max
Methylnaphthalene, 2-	91-57-6	1.70E+05	-	5.00E+04	5.00E+04 nc
Naphthalene	91-20-3	8.49E+05	2.92E+04	2.61E+04	2.14E+02 ca
Phenanthrene	85-01-8	-	-	-	
Pyrene	129-00-0	1.27E+06	-	3.75E+05	3.75E+05 nc max
TCDD, 2,3,7,8-	1746-01-6	1.29E-01	6.03E+00	1.13E-02	3.37E-04 ca*

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Appendix C3
Human Health Remedial Goal Calculations - Youth Trespasser
SWP and NCSPA Site
Wilmington, NC

Variable	Recreator Soil Default Value	Form-input Value
A (PEF Dispersion Constant)	16.2302	16.2302
A (VF Dispersion Constant)	11.911	11.911
A (VF Dispersion Constant - mass limit)	11.911	11.911
B (PEF Dispersion Constant)	18.7762	18.7762
B (VF Dispersion Constant)	18.4385	18.4385
B (VF Dispersion Constant - mass limit)	18.4385	18.4385
City (PEF Climate Zone) Selection	Default	Default
City (VF Climate Zone) Selection	Default	Default
C (PEF Dispersion Constant)	216.108	216.108
C (VF Dispersion Constant)	209.7845	209.7845
C (VF Dispersion Constant - mass limit)	209.7845	209.7845
foc (fraction organic carbon in soil) g/g	0.006	0.006
F(x) (function dependent on U_m/U_t) unitless	0.194	0.194
n (total soil porosity) L_{pore}/L_{soil}	0.43396	0.43396
p_b (dry soil bulk density) g/cm^3	1.5	1.5
p_b (dry soil bulk density - mass limit) g/cm^3	1.5	1.5
PEF (particulate emission factor) m^3/kg	1359344438	59300000000
p_s (soil particle density) g/cm^3	2.65	2.65
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	93.77
Q/C_{vol} (g/m^2-s per kg/m^3)	68.18	68.18
Q/C_{vol} (g/m^2-s per kg/m^3 - mass limit)	68.18	68.18
A_s (PEF acres)	0.5	0.5
A_s (VF acres)	0.5	0.5
A_s (VF mass-limit acres)	0.5	0.5
AF_{0-2} (skin adherence factor) mg/cm^2	0.2	0.2
AF_{2-6} (skin adherence factor) mg/cm^2	0.2	0.2
AF_{6-16} (skin adherence factor) mg/cm^2	0.07	0.2
AF_{16-30} (skin adherence factor) mg/cm^2	0.07	0.07
AF_{rec-a} (skin adherence factor - adult) mg/cm^2	0.07	0.2
AF_{rec-c} (skin adherence factor - child) mg/cm^2	0.2	0
AT_{rec} (averaging time)	365	365
BW_{0-2} (body weight) kg	15	15
BW_{2-6} (body weight) kg	15	15
BW_{6-16} (body weight) kg	80	45
BW_{16-30} (body weight) kg	80	80
BW_{rec-a} (body weight - adult) kg	80	45
BW_{rec-c} (body weight - child) kg	15	0
$DFS_{rec-adj}$ (age-adjusted soil dermal factor) mg/kg	0	2680.889
$DFSM_{rec-adj}$ (mutagenic age-adjusted soil dermal factor) mg/kg	0	8042.667
ED_{rec} (exposure duration - recreator) years	26	10

Appendix C3
Human Health Remedial Goal Calculations - Youth Trespasser
SWP and NCSPA Site
Wilmington, NC

Variable	Recreator Soil Default Value	Form-input Value
$ED_{0\text{-}2}$ (exposure duration) year	2	0
$ED_{2\text{-}6}$ (exposure duration) year	4	0
$ED_{6\text{-}16}$ (exposure duration) year	10	10
$ED_{16\text{-}30}$ (exposure duration) year	10	0
$ED_{rec\text{-}c}$ (exposure duration - child) years	6	0
EF_{rec} (exposure frequency) days/year	0	10
$EF_{0\text{-}2}$ (exposure frequency) days/year	0	0
$EF_{2\text{-}6}$ (exposure frequency) days/year	0	0
$EF_{6\text{-}16}$ (exposure frequency) days/year	0	10
$EF_{16\text{-}30}$ (exposure frequency) days/year	0	0
$EF_{rec\text{-}a}$ (exposure frequency - adult) days/year	0	10
$EF_{rec\text{-}c}$ (exposure frequency - child) days/year	0	0
ET_{rec} (exposure time - recreator) hours/day	0	2
$ET_{2\text{-}6}$ (exposure time) hours/day	0	0
$ET_{6\text{-}16}$ (exposure time) hours/day	0	2
$ET_{16\text{-}30}$ (exposure time) hours/day	0	0
$ET_{rec\text{-}a}$ (adult exposure time) hours/day	0	2
$ET_{rec\text{-}c}$ (child exposure time) hours/day	0	0
THQ (target hazard quotient) unitless	0.1	1
$IFS_{rec\text{-}adj}$ (age-adjusted soil ingestion factor) mg/kg	0	444.444
$IFSM_{rec\text{-}adj}$ (mutagenic age-adjusted soil ingestion factor) mg/kg	0	1333.333
$IRS_{0\text{-}2}$ (soil intake rate) mg/day	200	200
$IRS_{2\text{-}6}$ (soil intake rate) mg/day	200	200
$IRS_{6\text{-}16}$ (soil intake rate) mg/day	100	200
$IRS_{16\text{-}30}$ (soil intake rate) mg/day	100	100
$IRS_{rec\text{-}a}$ (soil intake rate - adult) mg/day	100	200
$IRS_{rec\text{-}c}$ (soil intake rate - child) mg/day	200	0
LT (lifetime - recreator) years	70	70
$SA_{0\text{-}2}$ (skin surface area) cm^2/day	2373	2373
$SA_{2\text{-}6}$ (skin surface area) cm^2/day	2373	2373
$SA_{6\text{-}16}$ (skin surface area) cm^2/day	6032	6032
$SA_{16\text{-}30}$ (skin surface area) cm^2/day	6032	6032
$SA_{rec\text{-}a}$ (skin surface area - adult) cm^2/day	6032	6032
$SA_{rec\text{-}c}$ (skin surface area - child) cm^2/day	2373	0
TR (target risk) unitless	0.000001	0.000001
T_w (groundwater temperature) Celsius	25	25
$Theta_a$ (air-filled soil porosity) L_{air}/L_{soil}	0.28396	0.28396
$Theta_w$ (water-filled soil porosity) L_{water}/L_{soil}	0.15	0.15
T (exposure interval) s	819936000	819936000

Appendix C3
Human Health Remedial Goal Calculations - Youth Trespasser
SWP and NCSPA Site
Wilmington, NC

Variable	Recreator Soil Default Value	Form-input Value
T (exposure interval) yr	26	26
U_m (mean annual wind speed) m/s	4.69	4.69
U_t (equivalent threshold value)	11.32	11.32
V (fraction of vegetative cover) unitless	0.5	0.5

Appendix C3
Human Health Remedial Goal Calculations - Youth Trespasser
SWP and NCSPA Site
Wilmington, NC

Site-specific

Recreator Regional Screening Levels (RSL) for Soil

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o(mg/kg-day)$^{-1}$	SF_oRef	IUR (ug/m^3)$^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	GIABS	ABS	RBA	Soil Saturation Concentration (mg/kg)	S (mg/L)	K_{oc} (cm^3/g)
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	1.50E+00	I	4.30E-03	I	3.00E-04	I	1.50E-05	C	1.00E+00	3.00E-02	6.00E-01	-	-	-
Benzo[a]pyrene	50-32-8	Yes	No	Organics	1.00E+00	I	6.00E-04	I	3.00E-04	I	2.00E-06	I	1.00E+00	1.30E-01	1.00E+00	-	1.62E-03	5.87E+05
Chromium(VI)	18540-29-9	Yes	No	Inorganics	5.00E-01	C	8.40E-02	G	3.00E-03	I	1.00E-04	I	2.50E-02	-	1.00E+00	-	1.69E+06	-
Dibenzofuran	132-64-9	No	Yes	Organics	-		-		1.00E-03	X	-		1.00E+00	-	1.00E+00	-	3.10E+00	9.16E+03
Fluoranthene	206-44-0	No	No	Organics	-		-		4.00E-02	I	-		1.00E+00	1.30E-01	1.00E+00	-	2.60E-01	5.55E+04
Fluorene	86-73-7	No	Yes	Organics	-		-		4.00E-02	I	-		1.00E+00	1.30E-01	1.00E+00	-	1.69E+00	9.16E+03
Methylnaphthalene, 2-	91-57-6	No	Yes	Organics	-		-		4.00E-03	I	-		1.00E+00	1.30E-01	1.00E+00	-	2.46E+01	2.48E+03
Naphthalene	91-20-3	No	Yes	Organics	1.20E-01	C	3.40E-05	C	2.00E-02	I	3.00E-03	I	1.00E+00	1.30E-01	1.00E+00	-	3.10E+01	1.54E+03
Phenanthrene	85-01-8	No	Yes	Organics	-		-		-		-		1.00E+00	1.30E-01	1.00E+00	-	1.15E+00	1.67E+04
Pyrene	129-00-0	No	Yes	Organics	-		-		3.00E-02	I	-		1.00E+00	1.30E-01	1.00E+00	-	1.35E-01	5.43E+04
TCDD, 2,3,7,8-	1746-01-6	No	Yes	Organics	1.30E+05	C	3.80E+01	C	7.00E-10	I	4.00E-08	C	1.00E+00	3.00E-02	1.00E+00	-	2.00E-04	2.49E+05

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Appendix C3
Human Health Remedial Goal Calculations - Youth Trespasser
SWP and NCSPA Site
Wilmington, NC

Site-specific

Recreator Regional Screening Levels (RSL) for Soil

Chemical	CAS Number	K_d (cm^3/g)	HLC (atm-m^3/mole)	Henry's Law Constant Used in Calcs (unitless)	H` and HLC Ref	Normal Boiling Point BP (K)	BP Ref	Critical Temperature T_C (K)	T_C Ref	Chemical Type	D_{ia} (cm^2/s)	D_{iw} (cm^2/s)	D_A (cm^2/s)	Particulate Emission Factor (m^3/kg)
Arsenic, Inorganic	7440-38-2	2.90E+01	-	-		8.88E+02	PHYSPROP	1.67E+03	CRC	INORGANIC	-	-	-	5.93E+10
Benzo[a]pyrene	50-32-8	-	4.57E-07	1.87E-05	PHYSPROP	7.68E+02	PHYSPROP	9.69E+02	EPA 2001 Fact Sheet	PAH	2.55E-02	6.58E-06	-	5.93E+10
Chromium(VI)	18540-29-9	1.90E+01	-	-		-		-		INORGANIC	-	-	-	5.93E+10
Dibenzofuran	132-64-9	5.50E+01	2.13E-04	8.71E-03	EPI	5.60E+02	PHYSPROP	8.24E+02	CRC	FURAN	6.51E-02	7.38E-06	5.49E-07	5.93E+10
Fluoranthene	206-44-0	-	8.86E-06	3.62E-04	PHYSPROP	6.57E+02	PHYSPROP	9.05E+02	YAWS	PAH	2.76E-02	7.18E-06	-	5.93E+10
Fluorene	86-73-7	5.50E+01	9.62E-05	3.93E-03	PHYSPROP	5.68E+02	PHYSPROP	8.26E+02	YAWS	PAH	4.40E-02	7.89E-06	1.68E-07	5.93E+10
Methylnaphthalene, 2-	91-57-6	1.49E+01	5.18E-04	2.12E-02	PHYSPROP	5.14E+02	PHYSPROP	7.61E+02	CRC	PAH	5.24E-02	7.78E-06	3.95E-06	5.93E+10
Naphthalene	91-20-3	9.26E+00	4.40E-04	1.80E-02	PHYSPROP	4.91E+02	PHYSPROP	7.48E+02	CRC	PAH	6.05E-02	8.38E-06	6.20E-06	5.93E+10
Phenanthrene	85-01-8	1.00E+02	4.23E-05	1.73E-03	PHYSPROP	6.13E+02	PHYSPROP	8.69E+02	YAWS	PAH	3.45E-02	6.69E-06	3.21E-08	5.93E+10
Pyrene	129-00-0	3.26E+02	1.19E-05	4.87E-04	PHYSPROP	6.77E+02	PHYSPROP	9.36E+02	YAWS	PAH	2.78E-02	7.25E-06	2.35E-09	5.93E+10
TCDD, 2,3,7,8-	1746-01-6	1.49E+03	5.00E-05	2.04E-03	EPI	6.52E+02	EPI	9.78E+02	prox. from Tcrit=1.5xTl	DIOXIN	4.70E-02	6.76E-06	3.46E-09	5.93E+10

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

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Site-specific

Recreator Regional Screening Levels (RSL) for Soil

Chemical	CAS Number	Volatilization Factor (m^3/kg)	Ingestion SL TR=1E-06 (mg/kg)	Dermal SL TR=1E-06 (mg/kg)	Inhalation SL TR=1E-06 (mg/kg)	Carcinogenic SL TR=1E-06 (mg/kg)	Ingestion SL Child THQ=1 (mg/kg)	Dermal SL Child THQ=1 (mg/kg)	Inhalation SL Child THQ=1 (mg/kg)	Noncarcinogenic SL Child THI=1 (mg/kg)	Ingestion SL Adult THQ=1 (mg/kg)	Dermal SL Adult THQ=1 (mg/kg)	Inhalation SL Adult THQ=1 (mg/kg)
Arsenic, Inorganic	7440-38-2	-	6.39E+01	2.12E+02	4.23E+07	4.91E+01	-	-	-	-	4.11E+03	1.36E+04	3.90E+08
Benzo[a]pyrene	50-32-8	-	1.92E+01	2.44E+01	1.01E+08	1.07E+01	-	-	-	-	2.46E+03	3.14E+03	5.19E+07
Chromium(VI)	18540-29-9	-	3.83E+01	-	7.21E+05	3.83E+01	-	-	-	-	2.46E+04	-	2.60E+09
Dibenzofuran	132-64-9	1.56E+05	-	-	-	-	-	-	-	-	8.21E+03	-	-
Fluoranthene	206-44-0	-	-	-	-	-	-	-	-	-	3.29E+05	4.19E+05	-
Fluorene	86-73-7	2.81E+05	-	-	-	-	-	-	-	-	3.29E+05	4.19E+05	-
Methylnaphthalene, 2-	91-57-6	5.80E+04	-	-	-	-	-	-	-	-	3.29E+04	4.19E+04	-
Naphthalene	91-20-3	4.63E+04	4.79E+02	6.11E+02	4.18E+03	2.52E+02	-	-	-	-	1.64E+05	2.09E+05	6.09E+04
Phenanthrene	85-01-8	6.43E+05	-	-	-	-	-	-	-	-	-	-	-
Pyrene	129-00-0	2.38E+06	-	-	-	-	-	-	-	-	2.46E+05	3.14E+05	-
TCDD, 2,3,7,8-	1746-01-6	1.96E+06	4.42E-04	2.44E-03	1.58E-01	3.74E-04	-	-	-	-	5.75E-03	3.18E-02	3.44E+01

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Appendix C3
Human Health Remedial Goal Calculations - Youth Trespasser
SWP and NCSPA Site
Wilmington, NC

Site-specific

Recreator Regional Screening Levels (RSL) for Soil

Chemical	CAS Number	Noncarcinogenic SL Adult THI=1 (mg/kg)	Screening Level (mg/kg)
Arsenic, Inorganic	7440-38-2	3.15E+03	4.91E+01 ca
Benzo[a]pyrene	50-32-8	1.38E+03	1.07E+01 ca
Chromium(VI)	18540-29-9	2.46E+04	3.83E+01 ca
Dibenzofuran	132-64-9	8.21E+03	8.21E+03 nc
Fluoranthene	206-44-0	1.84E+05	1.84E+05 nc max
Fluorene	86-73-7	1.84E+05	1.84E+05 nc max
Methylnaphthalene, 2-	91-57-6	1.84E+04	1.84E+04 nc
Naphthalene	91-20-3	3.66E+04	2.52E+02 ca
Phenanthrene	85-01-8	-	
Pyrene	129-00-0	1.38E+05	1.38E+05 nc max
TCDD, 2,3,7,8-	1746-01-6	4.87E-03	3.74E-04 ca

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Appendix D Ecological Remedial Goal Calculations

Table D-1
Wildlife Receptor Exposure Parameters
RI/RA Summary Report Addendum
SWP and NCSPA Site
Wilmington, NC

Receptor Group (Surrogate Species)	Body Weight[1] (kg)	Food Ingestion Rate (FIR)[2] (kg dw/kg bw day)	Soil Ingestion (P_s)[3,4]	Assumed Diet
Mammalian Herbivore (Meadow vole)	0.039	0.0875	0.032	100% foliage
Mammalian Ground Invertivore (Short-tailed shrew)	0.018	0.209	0.03	100% earthworms
Mammalian Carnivore (Red fox)	4.5	0.032	0.028	100% small mammals
Avian Granivore (Mourning dove)	0.115	0.19	0.139	100% seeds
Avian Ground Invertivore (American robin)	0.081	0.1477	0.104	100% earthworms
Avian Carnivore (Red-tailed hawk)	1.076	0.0353	0.057	100% small mammals

Notes:

1. Body weight for American robin and red fox were obtained from Sample et al. (1994); Body weight for all other receptors based on USEPA (2003).
2. FIR for American robin and red fox calculated based on allometric equations provided by Nagy (2001); FIR for other receptors based on USEPA (2005).
3. P_s, soil ingestion as proportion of diet
4. Soil ingestion rate for American robin and red fox calculated based on Beyer et al. (1994); Soil ingestion rate for other receptors based on USEPA (2005).

Table D-2
Terrestrial Soil-to-Biota Uptake Equations
RI/RA Summary Report Addendum
SWP and NCSPA Site
Wilmington, NC

Constituent	Soil-to-Plants		Soil-to-Earthworms		Soil-to-Small Mammals	
	Model	Source	Model	Source	Model	Source
Arsenic	$\ln(C_p) = -1.992 + 0.564 * \ln(C_s)$	1	$\ln(C_e) = -1.421 + 0.706 * \ln(C_s)$	2	$\ln(C_m) = 0.8188 * \ln(C_s) - 4.8471$	3
Copper	$\ln(C_p) = 0.669 + 0.394 * \ln(C_s)$	1	$\ln(C_e) = 1.67 + 0.26 * \ln(C_s)$	2	$\ln(C_m) = 2.042 + 0.1444 * \ln(C_s)$	3
Total LMW PAHs	$\ln(C_p) = 0.4544 * \ln(C_s) - 1.3205$	4	$C_e = 3.04 * C_s$	4	$C_m = 0$	4
Total HMW PAHs	$\ln(C_p) = 0.9469 * \ln(C_s) - 1.7026$	4	$C_e = 2.6 * C_s$	4	$C_m = 0$	4
2,3,7,8-TCDD	NA	---	$C_e = 5.3 * C_s$	5	NA	---

Notes:
Abbreviations:

C_s, Concentration in soil (mg/kg dw)
C_p, Concentration in plant tissue (mg/kg dw)
C_e, Concentration in earthworms (mg/kg dw)
C_m, Concentration in small mammals (mg/kg dw)
dw = dry weight
HMW = high molecular weight
kg = kilogram
LMW = low molecular weight
mg = milligram
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
2,3,7,8-TCDD = 2,3,7,8-2,3,7,8-Tetrachlorodibenzo-p-dioxin

Sources

1. Bechtel-Jacobs (1998)
2. Sample et al. (1999)
3. Sample et al. (1998a) (mammals)
4. USEPA (2007)
5. USEPA (1999)

Bechtel-Jacobs Company LLC. 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. BJC/OR-112
Sample, B.E., Beauchamp, J.J., Efroymson, R.A. and Suter, G.W. 1998a. Development and validation of bioaccumulation models for small mammals. Oak Ridge National Laboratory, Oak Ridge, Tennessee.
Sample, B.E., Suter, G.W., Beauchamp, J.J. and Efroymson, R.A. 1999. Literature-derived bioaccumulation models for earthworms: Development and validation. Environmental Toxicology and Chemistry: An International Journal, 18(9), pp.2110-2120.
USEPA. 2007. Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs).

Table D-3
Summary of Toxicity Reference Values (TRVs)
RI/RA Summary Report Addendum
SWP and NCSPA Site
Wilmington, NC

Constituent	Avian Receptors				Mammalian Receptors			
	Chronic NOAEL (mg/kg BW d^{-1})	Source	Chronic LOAEL (mg/kg BW d^{-1})	Source	Chronic NOAEL (mg/kg BW d^{-1})	Source	Chronic LOAEL (mg/kg BW d^{-1})	Source
Arsenic	2.24	Eco-SSL Lowest NOAEL	2.31	Eco-SSL 20th Percentile	2.47	Eco-SSL Geometric Mean	5.06	Eco-SSL Bounded 20th Percentile
Copper	18.5	Eco-SSL Geometric Mean	28	Eco-SSL Bounded 20th Percentile	25	Eco-SSL Geometric Mean	27.5	Eco-SSL Bounded 20th Percentile
Total LMW PAHs	16.1	Patton & Dieter (1980)	161.0	Patton & Dieter (1980)	169.8	Eco-SSL Geometric Mean	220.0	Eco-SSL Bounded 20th Percentile
Total HMW PAHs	2	Trust et al. (1994)	20	Trust et al. (1994)	18	Eco-SSL Geometric Mean	25.4	Eco-SSL Bounded 20th Percentile
2,3,7,8-TCDD TEQ	0.000014	Nosek et al. (1992) as cited in Sample et al. (1996) and AMEC (2008)	0.00014	Nosek et al. (1992) as cited in Sample et al. (1996) and AMEC (2008)	0.0000022	Murray et al. (1979) as cited in Sample et al. (1996)[1]	0.000022	Murray et al. (1979) as cited in Sample et al. (1996)[1]

Notes:
1, Scaled from test organism (see RI/RA Summary Report Addendum text).

2,3,7,8-TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin
BW = body weight
d = day
Eco-SSL = Ecological Soil Screening Level
HMW = high molecular weight
kg = kilogram
LMW = low molecular weight
LOAEL = lowest observed adverse effect level
mg = milligram
NOAEL = no observed adverse effect level
PAH = polycyclic aromatic hydrocarbons
TEQ = toxicity equivalency quotient

Patton, J.F. and Dieter, M.P. 1980. Effects of petroleum hydrocarbons on hepatic function in the duck. Comparative Biochemistry and Physiology Part C: Comparative Pharmacology, 65(1), pp.33-36.
Sample, B.E., Opresko, D.M. and Suter, G.W. 1996. Toxicological benchmarks for wildlife: 1996 revision (No. ES/ER/TM--86/R3). Lockheed Martin Energy Systems.
Trust, K.A., Hooper, M.J. and Fairbrother, A. 1994. Effects of 7, 12-dimethylbenz [A] anthracene on immune function and mixed-function oxygenase activity in the European starling. Environmental Toxicology and Chemistry: An International Journal, 13(5), pp.821-830.

Table D-4
Calculation of LOAEL-Based Soil Remediation Goals (RGs) for the Protection of Wildlife
RI/RA Summary Report Addendum
SWP and NCSPA Site
Wilmington, NC

Arsenic				
Receptor	**Soil Remediation Goal (Cs) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	1540	8.6	5.06	5.06
Mammalian Ground Invertivore (Short-tailed shrew)	327	14.4	5.06	5.06
Mammalian Carnivore (Red fox)	5332	8.8	5.06	5.06
Avian Granivore (Mourning dove)	**76**	1.6	2.31	2.31
Avian Ground Invertivore (American robin)	93	5.9	2.31	2.31
Avian Carnivore (Red-tailed hawk)	1105	2.4	2.31	2.31

Copper				
Receptor	**Soil Remediation Goal (Cs) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	7743	66.5	27.5	27.5
Mammalian Ground Invertivore (Short-tailed shrew)	2970	42.5	27.5	27.5
Mammalian Carnivore (Red fox)	29476	34.1	27.5	27.5
Avian Granivore (Mourning dove)	**859**	28.0	28.0	28.0
Avian Ground Invertivore (American robin)	1482	35.5	28.0	28.0
Avian Carnivore (Red-tailed hawk)	13383	30.4	28.0	28.0

Total LMW PAHs				
Receptor	**Soil Remediation Goal (Cs) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	77184	44.4	220	220
Mammalian Ground Invertivore (Short-tailed shrew)	**343**	1042.3	220	220
Mammalian Carnivore (Red fox)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	220
Avian Granivore (Mourning dove)	2370	518.0	161	161
Avian Ground Invertivore (American robin)	403	1048.1	161	161
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	161

Total HMW PAHs				
Receptor	**Soil Remediation Goal (Cs) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	1119	254.5	25.4	25.4
Mammalian Ground Invertivore (Short-tailed shrew)	**46.2**	120.1	25.4	25.4
Mammalian Carnivore (Red fox)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	25.4
Avian Granivore (Mourning dove)	274	67.2	20.0	20.0
Avian Ground Invertivore (American robin)	50.1	130.2	20.0	20.0
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	20.0

2,3,7,8-TCDD TEQ				
Receptor	**Soil Remediation Goal (Cs) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Ground Invertivore (Short-tailed shrew)	**0.000105**	0.00010	0.000022	0.000022
Avian Ground Invertivore (American robin)	0.000878	0.00086	0.000140	0.000140

Notes:

1, Soil remediation goal (RG) is solved iteratively by adjusting Cs until EDD = LOAEL:

$$EDD = FIR \times \left(C_s \times P_s + B_i\right) = LOAEL$$

where:

EDD = Estimated daily dose to the receptor (mg/kg BW d-1)
FIR = Food ingestion rate (kg food [dry weight]/kg bw [wet weight]/d)
P_s = Soil ingestion as proportion of diet
C_s= Soil concentration (mg/kg)
B_i= Estimated concentration in dietary item (mg/kg bw/d)
LOAEL= Lowest observable adverse effects level (mg/kg BW d-1)

2, Receptor parameters provided in Table D-1; Soil-to-biota accumulation models used to estimate prey concentrations provided in Table D-2
3, Doses are calculated on a dry weight basis
4, Bold values indicate ecological soil delineation criterion based on most sensitive wildlife receptor.
NA, Not applicable

2,3,7,8-TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin
BW = body weight
bw/d = body weight per day
HMW = high molecular weight
LMW = low molecular weight
mg/kg = milligrams per kilogram
PAH = polycyclic aromatic hydrocarbons
TEQ = toxicity equivalency quotient