Revised Draft Onsite Soils Corrective Measures Study

Pompton Lakes Works Site
Pompton Lakes, Passaic County, New Jersey

PI #007411

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The Chemours Company FC, LLC
2000 Cannonball Road
Pompton Lakes, NJ 07442

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Acronyms

ACO	Administrative Consent Order
ALM	Adult Lead Model
AOC	area of concern
ARS	Alternative Soil Remediation Standards
BEE	baseline ecological evaluation
bgs	below ground surface
BLL	blood lead level
BTV	background threshold value
Chemours	The Chemours Company FC, LLC
CGMP	*Comprehensive Groundwater Monitoring Program*
CMIWP	Corrective Measure Implementation Work Plan
CMS	Corrective Measures Study
CSM	conceptual Site model
COC	constituent of concern
COPEC	constituent of potential ecological concern
DuPont	E.I. du Pont de Nemours and Company
EMA	Former Eastern Manufacturing Area
EPC	exposure point concentration
ESNR	environmental sensitive natural resource
ERG	ecological risk-based remediation goal
GWIIA	Class IIA Ground Water Quality Standards
HMW	high molecular weight
HSWA	Hazardous and Solid Waste Amendments of 1984
I-287	New Jersey Interstate 287
IGW	impact to groundwater
IGW Approach	*Proposed Approach to Address Impact to Groundwater Comments*
IGWSSL	Impact to Groundwater Soil Screening Level
IGWSRS	Impact to Groundwater Soil Remediation Standards
IRM	interim remedial measure
KH	Henry's Law Constant value

K_{oc}	water/organic carbon partition coefficient
LANL	Los Alamos National Laboratory
LDR	land disposal restrictions
LMW	low molecular weight
mg/kg	milligrams per kilogram
ND	non-detect
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
N.J.S.A.	New Jersey Statutes Annotated
NMA	Former Northern Manufacturing Area
NRDCSRS	Non-Residential Direct Contact Soil Remediation Standards
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PLW	Pompton Lakes Works
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RDCSRS	Residential Direct Contact Soil Remediation Standards
RI	remedial investigation
RIR	Remedial Investigation Report
SOGWIR	*Supplemental Onsite Groundwater Investigation Report*
SPLP	synthetic precipitation leaching procedure
SRS	Soil Remediation Standards
Technical Memo	*Draft Technical Memorandum – Proposed Site Synthetic Precipitation Leaching Procedure Sampling Plan*
TRSR	*Technical Requirements for Site Remediation*
TRV	toxicity reference value
UCL95	95% upper confidence limit of the arithmetic mean concentration
µg/dL	micrograms per deciliter
UPL95	95% upper prediction limit
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WMA	Former Western Manufacturing Area

1 Introduction

The Pompton Lakes Works (PLW) Site is located at 2000 Cannonball Road in Pompton Lakes, Passaic County, New Jersey (see Figure 1). The Site is divided into the following three former manufacturing areas as shown on Figure 2:

- Eastern Manufacturing Area (EMA) located east of Wanaque River, south of New Jersey Interstate 287 (I-287), and west of Ringwood State Park.
- Northern Manufacturing Area (NMA) located north of I-287 along Wanaque River; and
- Western Manufacturing Area (WMA) located south of I-287 along Wanaque River.

The Site was historically owned and operated by E.I. du Pont de Nemours and Company (DuPont). On July 1, 2015, DuPont transitioned ownership of the PLW Site to The Chemours Company FC, LLC (Chemours).

1.1 Regulatory Background

In September 1988, DuPont entered into an Administrative Consent Order (ACO) with the New Jersey Department of Environmental Protection (NJDEP). In June 1992, the U.S. Environmental Protection Agency (USEPA) issued DuPont a Hazardous Waste Management Facility Permit under Section 9003 of the Hazardous and Solid Waste Amendments of 1984 (HSWA). The ACO and HSWA permit, which were revised in 1996, required DuPont to conduct a remedial investigation (RI) addressing contamination at, or emanating from, the Site. RI activities and remedial actions have been ongoing, both onsite and offsite, since 1988 to address media potentially impacted by former Site operations.

For onsite soils, the following Remedial Investigation Reports (RIRs) have been submitted to NJDEP and USEPA (hereinafter referred to as the Agencies when referenced together):

- The *South Plant Remedial Investigation Report* (encompassing activities in the southern portion of the EMA) was submitted on October 2, 2002. The Agencies approved the report on March 26, 2003.
- The *Remedial Investigation Report Western Manufacturing Area* was submitted on June 30, 2010. Responses to NJDEP comments on the RIR were submitted on October 7, 2010. The RIR and response to comments were approved by the Agencies on November 24, 2010.
- The *Remedial Investigation Report Northern Manufacturing Area* was submitted on June 30, 2010. Responses to NJDEP comments on the RIR were submitted on December 21, 2010. The RIR and response to comments

were verbally approved by the Agencies during meetings held on December 6 and 8, 2011.

- The *Remedial Investigation Report Eastern Manufacturing Area* (encompassing activities in the northern and middle portions of the EMA) was submitted on June 30, 2010. On September 12, 2011, NJDEP provided comments on the report and identified areas where additional soil sampling was required to address data gaps. Responses to NJDEP comments on the RIR were submitted on November 2, 2011 and a supplemental RI was conducted in 2012 to address data gaps. The *Former Eastern Manufacturing Area Supplemental Remedial Investigation Report* was submitted on October 15, 2012. The Agencies approved the report on February 20, 2013.

The February 20, 2013 correspondence from the Agencies approved the RIRs for the Site; thus, constituting completion of the RI phase for onsite soils. The correspondence requested the submittal of a Corrective Measures Study (CMS) as a next phase to evaluate remedial actions for impacted soils in the EMA, NMA, and WMA. The *Onsite Soils Corrective Measures Study* was submitted to the Agencies on June 28, 2013.

The Agencies provided comments on the CMS on November 26, 2013. In the second paragraph of this correspondence, it stated that there were still comments forthcoming on aspects of the CMS including Appendix A (Alternative Soil Remediation Standards Memorandum) and Appendix B (Impact to Groundwater Evaluation).

A project status conference call was held with the Agencies on December 18, 2013 during which time DuPont discussed the following concerns:

- As part of the Resource Conservation and Recovery Act (RCRA) HSWA Permit Modified Compliance Schedule issued on May 4, 2010, it was agreed by the Agencies that a "streamlined" CMS would be adequate for submittal. The comments provided in the November 2013 correspondence indicated that a more comprehensive document was required which was inconsistent with the previous agreement between the Agencies and DuPont. As such, the scope of the document needed to be clearly understood such that an adequate schedule for submission could be developed.
- In order to proceed with revisions to the document, agreement on two major elements of the CMS were needed: (1) future land use and (2) soil remediation standards (SRS). This agreement was needed to address comments pertaining to technology evaluation, limits of excavation, etc.
- Finally, it was unclear how a revised document could be prepared when all comments from the Agencies had not yet been received. DuPont's goal was to be able to submit a revised CMS which would addresses all comments from the Agencies on the original document.

On January 9, 2014, DuPont submitted correspondence to the Agencies requesting an extension for submittal of the revised CMS. In that correspondence, it was reiterated that resolution of the above-stated items from the December 2013 conference call would aide in evaluating the path forward and schedule for submitting a revised CMS.

Based on discussions during the December 2013 conference call, it was also agreed between the Agencies and DuPont that a meeting to discuss the CMS comments would be beneficial in order to proceed with revisions to the document. This meeting took place on January 29, 2014 and focused on the broader comments provided by the Agencies in their November 2013 correspondence. At that time, it was also agreed that separate meetings with the technical team would be held to specifically discuss the elements of both Appendix A and B. An additional meeting between the Agencies and DuPont was held on March 12, 2014 to again discuss higher-level comments on the CMS and potential path forward.

The timelines for Appendix A and B were as follows:

- Appendix A: A technical team conference call was held on February 12, 2014 to discuss comments on Appendix A of the CMS; specifically the development of SRS. Prior to the call, NJDEP provided comments to DuPont via email on February 7, 2014 (memorandum dated January 16, 2014) and February 10, 2014. A follow-up conference call was held on May 20, 2014. A revision to Appendix A (Alternative Soil Remediation Standards Memorandum) was submitted to the Agencies on June 20, 2014. Based on a subsequent conversation with the Agencies after their review of the June 2014 submittal, Appendix A was revised to incorporate requested changes to the calculations and modeling and was resubmitted to the Agencies on August 12, 2014.

- Appendix B: The technical team conference call held on February 12, 2014 also discussed comments on Appendix B of the CMS; specifically the process of evaluating impact to groundwater (IGW) at the Site. A follow-up meeting was held on May 8, 2014 to further discuss the path forward for IGW. Based on these meetings, the *Proposed Approach to Address Impact to Groundwater Comments* (IGW Approach) was submitted to the Agencies on June 6, 2014. NJDEP provided verbal confirmation to proceed with the IGW Approach in August 2014. The data evaluation activities presented in the IGW Approach were completed in the fall of 2014. The *Draft Technical Memorandum – Proposed Site Synthetic Precipitation Leaching Procedure Sampling Plan* (Technical Memo) was submitted to the Agencies on December 1, 2014. The Agencies provided comments on the Technical Memo on April 14, 2015. A response to comments was submitted to the Agencies on May 18, 2015. The sampling program was approved by the Agencies on July 21, 2015. The IGW investigation was conducted from September 2015 through November 2015. On January 20, 2016, Chemours met with NJDEP to review the results of the sampling program. NJDEP concurred with the approach that had been taken and it was agreed that revisions to Appendix B could be submitted as part of the overall revision to the CMS.

A meeting was held with the Agencies on December 16, 2015 to continue discussions regarding resolution on future land use and SRS so that revisions to the CMS could be started. On January 28, 2016, a meeting was held with the Agencies to specifically discuss the use of Alternative Soil Remediation Standards (ARS). During the meeting, the Agencies' risk assessors stated that they concurred with the approach and results outlined in the revised Appendix A submitted in August 2014.

Chemours received correspondence from NJDEP dated May 31, 2017 regarding additional comments on the CMS. NJDEP stated in this correspondence that they did not have any additional comments. However, USEPA provided comments on previously-submitted documents and responses to previous Agency comments. On August 18, 2017, Chemours submitted a response to USEPA comments presented in the May 2017 correspondence. Chemours reiterated in this correspondence that it remained unclear how a revised document could be prepared when an appropriate path forward on SRS had not been resolved.

Chemours submitted the *Draft Impact to Groundwater Standards Technical Report* to the Agencies on March 22, 2018. This report presented the data collected during the IGW investigation activities and the calculation of IGW Soil Remediation Standards (IGWSRS) for the Site.

On November 14, 2018, a meeting between the Agencies and Chemours was held to discuss the additional CMS comments. USEPA transmitted correspondence to Chemours dated January 2, 2019 providing comments on the August 2017 response to comments and the March 2018 *Draft Impact to Groundwater Standards Technical Report*. As stated in USEPA's correspondence, the documents constituting the totality of the Agencies' comments to date on the June 2013 CMS that needed to be addressed as part of the submittal of a revised CMS include:

- Correspondence from NJDEP dated November 26, 2013, and
- Correspondence from USEPA dated January 2, 2019.

With the transmittal of the January 2, 2019 correspondence from USEPA, it still remains unclear how a revised document can be prepared when the appropriate path forward in regards to comments from USEPA have not been resolved; most notably SRS which form the basis of the CMS. However, in an effort to move this project forward, Chemours is submitting a revised CMS that proposes a corrective measure for the remediation of onsite soils that will be protective of human health and the environment. This revised CMS addresses comments from the Agencies where a resolution had been previously agreed to and provides the appropriate level of justification for a proposed path forward for those comments where resolution has yet to be attained.

1.2 Purpose of Corrective Measure Study

NJDEP's *Technical Requirements for Site Remediation* (TRSR) no longer requires that a Remedial Action Selection Report be completed as part of a remedial action. Therefore, as directed by the Agencies, this revised CMS has been prepared for onsite soils in accordance with USEPA's *RCRA Corrective Action Plan*.

As stated in the first paragraph of the introduction to Chapter IV (Corrective Measures Study) of the *RCRA Corrective Action Plan*, "The purpose of the Corrective Measures Study (CMS) portion of the RCRA corrective action process is to identify and evaluate potential remedial alternatives for the releases that have been identified at a facility. The scope and requirements of the CMS, however, need to be balanced with the expeditious initiation of remedies and rapid restoration of contaminated media, both major goals of the RCRA corrective action program. In keeping with these goals, the implementing agency may allow a streamlined approach to remedy selection, enabling a facility to move from facility investigation to corrective measures implementation more rapidly."

To date, RIs for onsite soils have been completed for the three former manufacturing areas (EMA, WMA, and NMA) and interim remedial measures (IRMs) have been completed for select Areas of Concern (AOCs) (see Figure 3). The impacted media evaluated as part of this revised CMS is only onsite soils. Onsite groundwater is currently being addressed under the Agency-approved July 1993 *Groundwater Remedial Action Plan* (implemented in 1998) and the Agency-approved November 1995 *Comprehensive Groundwater Monitoring Program* (CGMP) which has been ongoing at the Site since 1996.

The objective of this CMS is to identify and propose a corrective measure alternative to address impacts to onsite soils from former manufacturing operations in a comprehensive, Site-wide manner; satisfying the requirements of the ACO and HSWA and being protective of human health and the environment. Beneficial reuse of the property is also considered in identifying and proposing the corrective measure alternative.

1.3 Report Organization

The overall organization of this report is consistent with USEPA's CMS process as outlined in Chapter IV of the *RCRA Corrective Action Plan*. Brief summaries of the remaining sections are presented below.

- Section 2: Site Background and Physical Setting – This section provides a description of the Site, operational history, land use, and summary of previous investigations and remedial activities. It also provides a detailed summary of the physical setting of the Site, including a description of the conceptual Site model (CSM).

- Section 3: Applicable Soil Remediation Standards – This section presents the applicable SRS for onsite soils. Based on the potential receptors identified for each area of potential land use, SRS are evaluated for human health and ecological receptors as well as IGW.
- Section 4: Remedial Action Objectives – This section presents the remedial action objectives (RAOs) for onsite soils. RAOs are developed to protect human health and the environment based on the end-use of the Site.
- Section 5: Identification and Screening of Technologies – This section presents the identification and screening of technologies for the Site. The universe of potentially applicable technologies is reduced by evaluating the options with respect to technical implementability and effectiveness.
- Section 6: Identification of Corrective Measure Alternatives – This section includes a description of each corrective measure alternative developed to address the remediation of onsite soils.
- Section 7: Evaluation of Corrective Measure Alternatives – This section presents an analysis of the corrective measure alternatives for the Site with respect to RCRA evaluation criteria.
- Section 8: Proposed Corrective Measure Alternative – This section presents the proposed corrective measure alternative for onsite soils and provides a brief description of other factors associated with its implementation such as pre-design activities and anticipated permitting requirements.
- Section 9: Path Forward – This section discusses the path forward for future work pertaining to the remediation of onsite soils at the Site.
- Section 10: References – This section lists the references cited in this document.

2 Site Background and Physical Setting

2.1 Site Description and Location

The approximate 580-acre Site consists of northeast/southwest trending ridges and valleys containing two major drainage areas: Wanaque River (former Lake Inez) on the west and Acid Brook on the east. I-287 crosses the northern and western portions of the Site isolating approximately 70 acres. The Site is bordered to the northeast and east by Ringwood State Park, to the south by the town of Pompton Lakes (industrial, commercial/services, and residential land use) and Pompton Lake, and to the west and northwest by Twin Lake Valley (commercial/services and residential land use) and the Borough of Wanaque.

2.2 Site Operational History

In the late 1800's, the H. Julius Smith Blasting Cap Plant and the American Smokeless Powder Plant operated in the western portion of the Site, and the Metallic Cap Company operated in the eastern portion. In 1902, DuPont purchased the Site and began operation of the DuPont Electric Exploder Company in the WMA. Structures within the WMA consisted of buildings for manufacturing, magazine storage for explosive products and materials, and an engineered tunnel for conducting cladding operations. These structures were primarily located along the banks and ridge slopes of Lake Inez (Wanaque River). In 1908, DuPont opened the DuPont Cap Works in the EMA. DuPont ceased production in the WMA in 1926 and consolidated operations in the EMA. Structures within the EMA consisted of buildings for manufacturing and offices, quality control laboratories, magazine storage for explosive products, and an engineered tunnel for conducting cladding operations. These structures were primarily located in the low-lying lands of the valley. From that time until April 1994 when operations permanently ceased, DuPont production activities manufactured a variety of explosive products. A majority of the structures across the Site have been removed (with the exception of four buildings in the southern portion of the EMA) and the two cladding tunnel entrances have been sealed.

2.3 Site Land Use

The Site totals approximately 580 acres within multiple tax lots. Six tax lots totaling approximately 299 acres are located in the Borough of Wanaque, and three tax lots totaling approximately 289 acres are located in the Borough of Pompton Lakes (see Figure 4).

The existing deed notice for the Site dated April 9, 2015 and filed with the Passaic County Clerk on April 20, 2015 indicates that "*in no event shall the property be used* *as a daycare or child care facility or for residential purposes"*. This deed restriction is consistent with the current and anticipated future land use for the Site as further discussed in the subsections below.

2.3.1 Current Land Use

Borough of Wanaque Parcels

The following six parcels are located within the Borough of Wanaque:

- Block 479, Lot 3 – located north of I-287 and encompassing the western portion of the NMA;
- Block 479, Lot 4 – located north of I-287 and encompassing the eastern portion of the NMA;
- Block 479, Lot 5 – located west of I-287;
- Block 479.01, Lot 1 – located south of I-287 and encompassing the northwestern portion of the WMA;
- Block 479.01, Lot 2 – located south of I-287 and Block 479.01, Lot 1 in the WMA; and
- Block 479.01, Lot 3 – located south of I-287 in the northern portion of EMA, spanning south along the northeastern portion of the WMA, and ending in the western portion of the WMA south of Block 479.01, Lot 2.

Although currently zoned for industrial use, the land located in Wanaque is generally undeveloped and features heavily wooded terrain of varying topography. With the exception of Lots 4 and 5, Wanaque River passes through these parcels.

Currently, adjacent and surrounding properties to the north of Block 479, Lots 3 and 4, and west of Block 479, Lot 3 and Block 479.01, Lot 3 are generally undeveloped. A small number of residential houses are located adjacent to the southwest corner of Block 479.01, Lot 3. Land to the east and south of the Wanaque parcels consists of the remainder of the Site located within the Borough of Pompton Lakes. A majority of the Site located in Wanaque has been designated as a Preservation Area under the New Jersey Highlands Water Protection and Planning Act.

Borough of Pompton Lakes Parcels

The following three parcels are located within the Borough of Pompton Lakes:

- Block 100, Lot 3 – encompasses the majority of the EMA and southeastern portion of the WMA;
- Block 100, Lot 6.01 – portion of Wanaque River; and
- Block 100, Lot 7 – southwestern portion of the WMA.

The two western tax parcels (Block 100, Lots 6.01 and 7) located in Pompton Lakes consist of undeveloped land and Wanaque River. This area of the property is currently undeveloped and features a heavily wooded landscape, waterway, and floodplain. The main parcel (Block 100, Lot 3) located in Pompton Lakes includes approximately 231 acres of land. Features in this main parcel include a mix of open areas and heavily wooded terrain of varying topography. A freight rail is located adjacent to the property along the southeastern border. Various surface water tributaries pass through the parcel. The entire Site located in Pompton Lakes has been designated as a Planning Area under the New Jersey Highlands Water Protection and Planning Act.

Ringwood State Park borders the property to the east. An active industrial facility and a residential area border the property to the south. The only vehicular access to the property is via Cannonball Road, a corridor primarily consisting of industrial, commercial, and multi-family land uses.

2.3.2 Anticipated Future Land Use

A majority of the property contains steep slopes, with intermittent areas of moderately level land, rendering many areas inaccessible. The Site contains intermittent wetlands and two watercourses. These ecological assets, combined with the Site's location within the boundaries of the New Jersey Highlands Act, limit the potential redevelopment of portions of the Site.

Within Wanaque Borough, approximately 70 acres of land north and west of I-287 has been designated for transfer to the State of New Jersey under the previously-negotiated *Natural Resource Damage Settlement for Ground Water Injuries in New Jersey* (between NJDEP and DuPont). Redevelopment of the remaining land within Wanaque Borough would be limited under the New Jersey Highlands Water Protection and Planning Act.

In accordance with the Borough of Pompton Lakes *2017 Master Plan Reexamination Report* and proposed Ordinance No. 19-13 – An Ordinance Amending, Deleting and Adding Certain Provisions of the Borough Land Use Code Dealing with Zoning Changes for the DuPont (Chemours) Tract (Block 100 Lots 3, 6.01 and 7), the portion of the Site located within Pompton Lakes is to be used for low impact, light industrial uses that are sensitive to environmental conditions, the natural landscape, and surrounding residential use and parkland. Ordinance No. 19-13 was approved for First Reading and Introduction at a regular meeting of the Pompton Lakes Mayor and Council held on March 27, 2019. The Ordinance is to be presented for Second Reading and Final Adoption after the Borough of Pompton Lakes Planning Board provides a recommendation to the Mayor and Council. The Planning Board approved Ordinance No. 19-13 on April 16, 2019.

Within the Pompton Lakes portion of the Site, approximately 69 acres in size has been identified for future redevelopment as shown in Figure 5. This Redevelopment

Area, located within the EMA, was identified based on the relatively flat land and its location along an industrial corridor.

2.4 Previous Investigations and Remedial Actions

2.4.1 Previous Remedial Investigations

As depicted on Figure 3, there are 202 AOCs identified at the Site. A total of 62 AOCs require no further action as approved by the Agencies in the five RIRs submitted for the Site (outlined in Section 1.1). Soils from the remaining 140 AOCs are being evaluated as part of this CMS.

Numerous investigations have been performed at the Site to facilitate the characterization of onsite soils. The five RIRs approved by the Agencies provide information related to the delineation and characterization of potential impacts associated with former operations at AOCs located within the EMA, NMA, and WMA.

2.4.2 Previous Remedial Actions

Soils impacted by Site-related constituents at 30 of the 202 AOCs have been addressed by remedial and/or stabilization measures while groundwater remedial activities include an ongoing groundwater extraction and treatment system.

The following IRMs have been conducted for impacted soils in the EMA:

- Acid Brook (AOC 118) was de-silted onsite and offsite and then restored with clean fill, geotextile, and riprap stone. Part of the restoration included installation of engineering controls to control storm water run-off.
- Soils in the northern portion of the EMA have been excavated from the Old Cap Destruction Facility (AOC 1), Shooting Pond (AOC 5), and Shooting Pond Sludge Pile (AOC 6). The Upper Burning Ground (AOC 2) and Old Lead Recycling Area (AOC 3) have had interim stabilization measures installed to help control erosion.
- Soils in the middle portion of the EMA have been excavated from the Black Powder Mill (AOC 47), Mercury Fulminate Storage Building (AOC 52), Sawdust Pile (AOC 56), Old Cap Test Area (AOC 57), Burned Wire Dump (AOC 58), Cap Test Well (AOC 59), Canister Disposal (AOC 104), and Scrap Metal Dump (AOC 105). Additionally, soils from the Mercury Fulminate Plant (AOC 74) have been excavated and the Mercury Fulminate Fume Lines (AOCs 75 and 76) were removed. The Lower Burning Ground (AOC 60) and Old Lead Recycling Area (AOC 61) have had interim stabilization measures installed to help control erosion.
- Soils in the southern portion of the EMA have been excavated from the Rivet Line Lagoon (AOC 102) and Sewage Treatment (AOC 106). Three gasoline underground storage tanks were also removed (AOCs 120, 121, and 122).

The following IRMs have been conducted for impacted soils in the WMA;

- Soils have been excavated from the Main Office Shooting Ground (AOC 107), Old Fuze Works Wire Dump (AOC 192), Old Fuze Works Dump (AOC 194), and Area of Tar Deposits (AOC 198).
- The Old Fuze Works Miscellaneous Waste Site (AOC 193) had interim stabilization measures installed to help control erosion.
- Offsite soils south of the property boundary associated with the eastern and western banks of Wanaque River (East Bank IRM and West Bank IRM) have been remediated through excavation.

2.5 Conceptual Site Model

A CSM is an essential tool that is used to clearly describe and explain site-specific information and conditions within an environmental system. Data collected as part of environmental investigations are used to understand the extent and source(s) of site-specific impacts along with the physical, chemical, and biological processes that determine the fate and transport of these constituents and to understand the potential receptors (human and ecological) that may be potentially exposed. CSMs are continually re-evaluated and refined, as necessary, when new data are collected. The CSM developed for onsite soils is presented in the following subsections based on the investigations completed across the Site.

2.5.1 Environmental Setting

Geology

The Site is situated within the Highlands Physiographic Province adjacent to the northwestern boundary of the Newark Basin. Bedrock beneath the Site consists of Precambrian gneiss and diabase. Previous studies show that two primary geologic units, crystalline bedrock and alluvial deposits consisting of colluviums and stratified glacial drift, underlie the Site. The crystalline bedrock is comprised of deformed and metamorphosed high-grade gneisses.

The topography of the bedrock surface varies from gently undulating to steeply sloping. A 45-foot thick diabase dike bisects the Site on the eastern ridge between the EMA and WMA. The bedrock contains joints that are observable in outcrops at the Site.

Former Eastern Manufacturing Area

The EMA is characterized by bedrock ridges with extensive to scattered outcrops in the northern and middle portions and along the western edge in the southern portion. The alluvial deposits in the EMA are up to 120 feet thick in the southern portion thinning up the valley to approximately 10 feet or less in the northern portion. The alluvial deposits are a fining downward stratified glacial sequence which can generally be divided into three depositional types. The shallow alluvial depositional type is comprised of fill, colluvium, and till deposits and ranges from approximately 5 to 20 feet thick. The intermediate alluvial deposits are generally comprised of very fine to medium-grained sand and range from 15 to 80 feet thick. The intermediate zone is not present in the northern portion of the EMA. The deep alluvial deposits are generally comprised of very fine-grained silty sand and very fine-grained sandy silt. The thickness of this zone is highly variable and can be up to 90 feet thick in bedrock surface structural lows. The deep zone pinches out in the middle portion of the EMA and is not present in the northern portion.

Former Northern and Western Manufacturing Areas

The NMA and WMA is characterized by bedrock ridges with extensive to scattered outcrops in the east and west. The topography of the bedrock surface is moderately steep to very steeply sloping. The alluvial deposits are roughly confined to the 100-year floodplain. The alluvium is composed of poorly sorted fine to coarse-grained sand and gravel, and may contain layers of very coarse gravel and traces of silt, clay, and cobbles. The deposits range in thickness from a thin soil cover where bedrock outcrops to approximately 60 feet. No weathered zone has been detected at the bedrock surface.

Hydrogeology

The ridge between the EMA and NMA/WMA creates a groundwater divide, as does the ridge between Wanaque River and Twin Lake to the west. Generally, groundwater flow occurs within the alluvial aquifer and becomes restricted to the surface of the overburden/bedrock interface at locations of limited overburden. Groundwater flow directly between the bedrock and the alluvial aquifers is considered to be limited because of the low permeability of the bedrock and the fact that there is a groundwater divide between the two watersheds. The limited groundwater observed in the bedrock ridges flows toward the valleys, generally following the topography, so that the groundwater surface mimics the topography. A component of groundwater recharge is comprised of run-off from the bedrock hills around the Site that infiltrates into the alluvial aquifer.

Former Eastern Manufacturing Area

Groundwater depths measured in existing monitoring wells in the EMA range from approximately 3 to 26 feet below ground surface (bgs). Water levels fluctuate up to 5 feet seasonally in response to precipitation. The saturated thickness of the alluvial aquifer ranges from several feet in the northern portion of the EMA to 125 feet near the southern Site boundary. Since the alluvium is a fining downward sequence, groundwater will flow faster in the shallower zones because it is more permeable (courser) than the deep zones. Groundwater within the EMA generally flows toward the south. However, where the alluvium is thin in the areas of bedrock outcrops, topography controls the groundwater flow direction and groundwater flows down slope towards Acid Brook or its tributaries until it flows into the main valley area.

Former Northern and Western Manufacturing Areas

Groundwater depths measured in existing monitoring wells in the WMA range from approximately 6 to 19 feet bgs. Water levels fluctuate from 7 to 11 feet seasonally in response to precipitation, run-off into Wanaque River, and water discharged from Wanaque Reservoir into the river. The saturated thickness of the alluvial aquifer ranges from approximately 32 feet mid-valley to 47 feet near the southern boundary of the WMA. The groundwater flow direction in the alluvium is generally toward the river and south. However, where the alluvium is thin in the areas of scattered to extensive bedrock outcrops, topography controls the groundwater flow direction and groundwater flows down slope.

Surface Water

There are two surface water bodies present on the former facility, Acid Brook and Wanaque River.

Acid Brook

Acid Brook generally flows from north to south. This intermittent stream originates in the Ringwood State Park land north/northeast of the Site where several springs combine with overland flow. Acid Brook enters the Site on the northeastern boundary just north of the shooting pond and flows westerly until it meets the main valley area (vicinity of monitoring well 20), where it flows to the south. Approximately one-half mile south of the Site, Acid Brook discharges into Pompton Lake.

Groundwater flow generally mimics surface topography, flowing down slope toward Acid Brook and its tributaries in the north and middle reaches. The interaction between groundwater and surface water changes seasonally and spatially. If the water table elevation is greater than the elevation of the bottom of the stream, groundwater is discharging to the stream, but if the water table is lower, then any water in the stream is discharging to groundwater. Seasonally, when the recharge and run-off rates are high, Acid Brook is a gaining stream. Spatially, the stream is usually a gaining stream in the north and middle reaches, and a losing stream in the southern reach.

Wanaque River

Wanaque River flows from north to south. The river originates at Wanaque Reservoir, where water flow is controlled approximately one mile upstream of the Site as water exits Wanaque Reservoir through Raymond Dam. Wanaque River eventually discharges into Pequannock River at the Riverdale-Pompton Lakes municipal boundary. The river was formerly dammed just downstream of the WMA to create Lake Inez; however, the dam was removed in 1984 and the river returned to its channel.

In the WMA, the width of Wanaque River is variable, ranging from approximately 40 feet wide in the northern portion to 100 feet wide in the section upstream of the former dam. The river is relatively shallow with depths generally less than 2 feet. Groundwater flows toward the river and south, eventually discharging to the river.

2.5.2 Summary of Soil Constituents of Concern

Extensive soil sampling programs have been completed as part of the RIs at the Site. Figure 6 shows the areal extent of previously-completed soil sampling at the Site. As documented in the Agency-approved RIRs, onsite soils have been delineated to the appropriate NJDEP SRS as follows:

- Soils within the NMA were delineated to the Residential Direct Contact Soil Remediation Standards (RDCSRS);
- Soils at the property boundary in the EMA and WMA, where historical manufacturing activities occurred in the area, were delineated to the RDCSRS; and
- Remaining soils within the EMA and WMA were delineated to the Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS).

Based on the comparison of these standards to the analytical results presented in the RIRs, the primary constituents of concern (COCs) in onsite soils for each manufacturing area are summarized on Table 2-1.

Table 2-1 Constituents of Concern for Onsite Soils

COC	EMA	WMA	NMA
Metals			
Antimony	X	X	
Arsenic	X	X	X
Cadmium	X		
Copper	X	X	
Lead	X	X	X
Mercury	X	X	
Selenium		X	
Vanadium	X		
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo(a)anthracene	X	X	
Benzo(b)fluoranthene	X	X	
Benzo(a)pyrene	X	X	X
Dibenz(a,h)anthracene	X	X	
Indeno(1,2,3-cd)pyrene	X	X	
Naphthalene	X		
Volatile Organic Compounds (VOCs)			
Carbon tetrachloride	X		
Chloroform	X		
Tetrachloroethene	X		
Trichloroethene	X		
Polychlorinated Biphenyls (PCBs)			
PCBs	X		

With the exception of arsenic, these COCs are consistent with the Site's operational history in the production of a variety of explosive products. Arsenic is further discussed in Section 3.1. Table 2-2 summarizes the onsite soils data for each former manufacturing area including the minimum, maximum, and mean detected concentrations. Data is separated by surface soil from 0 to 2 feet bgs and subsurface soil below 2 feet.

Table 2-2 Summary of Onsite Soils Data

COC	Surface (0 to 2 feet bgs)				Subsurface (below 2 feet bgs)			
	# of detections	Min (mg/kg)	Max (mg/kg)	Median (mg/kg)	# of detections	Min (mg/kg)	Max (mg/kg)	Median (mg/kg)
NMA								
Arsenic	313	1.39	270	17.5	84	1.14	356	6.205
Lead	655	5.37	94,701.75	296	93	0.955	25,600	13.9
Benzo(a)pyrene	27	0.01	0.38	0.061	0	NA	NA	NA
WMA								
Antimony	51	0.884	2950	2.3	38	0.184	16.4	1.53
Arsenic	538	0.908	86.4	5.895	342	0.615	323	2.765
Copper	675	5.89	85,853.77	76.933	444	3.65	53,200	24.5
Lead	785	2.525	173,000	143	431	0.101	96,000	9.299
Mercury	879	0.0101	22,100	6.48	327	0.0072	1,090	0.335
Selenium	71	0.549	18,600	1.67	45	0.51	59.9	1.03
Benzo(a)anthracene	213	0.015	38	0.24	9	0.047	1	0.08
Benzo(b)fluoranthene	251	0.026	40	0.32	14	0.039	1.6	0.0895
Benzo(a)pyrene	278	0.015	130	0.265	15	0.057	1.1	0.14
Dibenz(a,h)anthracene	124	0.009	11	0.172	4	0.051	0.25	0.057
Indeno(1,2,3-cd)pyrene	179	0.01	15	0.24	6	0.063	0.77	0.129
EMA – Redevelopment Area								
Antimony	18	0.75	43.8	5.75	7	0.92	33.8	4.3
Arsenic	277	0.54	65.4	2.83	291	0.48	81.5	1.4
Cadmium	139	0.069	47.7	0.54	101	0.06	452	0.24
Copper	983	0.704	73,809.401	55.6	907	2.3	3,210.953	17.6
Lead	1,074	0.679	50,606.84	71.55	760	0.151	18,500	10.95
Mercury	1,112	0.008	11,100	5.1305	762	0.0025	14,700	3.016
Vanadium	129	8.9	2,110	32.6	112	6.2	480	29.15
Benzo(a)anthracene	148	0.006	46	0.375	25	0.005	21	0.13
Benzo(b)fluoranthene	213	0.006	39	0.51	34	0.006	22	0.17
Benzo(a)pyrene	234	0.006	51	0.33	30	0.026	20	0.125
Dibenz(a,h)anthracene	55	0.019	3.8	0.12	7	0.045	0.71	0.084
Indeno(1,2,3-cd)pyrene	107	0.039	14	0.25	21	0.041	11	0.099
Naphthalene	13	0.041	19	0.13	3	0.042	0.75	0.14
Carbon tetrachloride	4	0.006	1.6	0.22	3	0.002	3.2	0.083
Chloroform	8	0.002	47	0.019	21	0.002	140	0.005
Tetrachloroethene	86	0.001	3,900	0.0495	63	0.001	84	0.01
Trichloroethene	49	0.0009	100	0.015	25	0.001	5.1	0.045
PCBs	154	0.0072	240	0.905	32	0.0052	2.6	0.12
EMA – Outside Redevelopment Area								
Antimony	48	0.81	10,700	6.35	37	0.72	1,110	8.1
Arsenic	118	0.55	18.9	4.5	103	0.64	18.4	3.3

COC	Surface (0 to 2 feet bgs)				Subsurface (below 2 feet bgs)			
	# of detections	Min (mg/kg)	Max (mg/kg)	Median (mg/kg)	# of detections	Min (mg/kg)	Max (mg/kg)	Median (mg/kg)
Cadmium	67	0.11	172	0.89	70	0.084	1,180	0.81
Copper	1,192	0.126	384,000	65.996	608	0.494	334,000	23.8
Lead	1,717	0.153	236,000	164.8	763	0	95,700	42
Mercury	1,230	0.016	21,374.26	11.8145	595	0.0084	33,800	3.5
Vanadium	7	11.8	51	20.1	6	24.6	69.4	38.85
Benzo(a)anthracene	128	0.005	33	0.255	13	0.004	4.1	0.083
Benzo(b)fluoranthene	148	0.011	52	0.355	11	0.008	5	0.17
Benzo(a)pyrene	195	0.007	30	0.36	16	0.005	14	0.084
Dibenz(a,h)anthracene	79	0.008	2.5	0.13	6	0.067	0.76	0.24
Indeno(1,2,3-cd)pyrene	127	0.006	14	0.24	10	0.037	2.5	0.205
Naphthalene	11	0.046	2.6	0.14	2	0.08	0.53	0.305
Carbon tetrachloride	1	0.002	0.002	0.002	0	NA	NA	NA
Chloroform	0	NA	NA	NA	0	NA	NA	NA
Tetrachloroethene	11	0.002	0.054	0.012	2	0.001	0.007	0.004
Trichloroethene	6	0.002	0.074	0.005	3	0.002	0.005	0.004
PCBs	100	0.0082	100	0.52	5	0.0043	0.42	0.13

mg/kg = milligrams per kilogram
NA = not applicable; there were no detections for that COC within the identified former manufacturing area.

As part of the Agency-approved RIRs, the following baseline ecological evaluations (BEEs) were completed to evaluate constituents of potential ecological concern (COPECs) for the Site:

- EMA BEE (Appendix D of EMA RIR);
- NMA BEE (Appendix D of NMA RIR); and
- WMA BEE (Appendix F of WMA RIR).

Based on the results of these BEEs, Table 2-3 summarizes the COPECs identified for each former manufacturing area.

Table 2-3 Constituents of Potential Ecological Concern for Onsite Soils

COPEC	EMA	WMA	NMA
Metals			
Antimony	X	X	
Arsenic	X	X	X
Barium	X		
Cadmium	X	X	
Chromium	X	X	
Cobalt	X		
Copper	X	X	X
Lead	X	X	X
Manganese		X	
Mercury	X	X	X
Nickel	X	X	X
Selenium	X	X	X
Silver	X	X	

COPEC	EMA	WMA	NMA
Thallium	X	X	
Vanadium	X		
Zinc	X	X	X
Cyanide	X		
VOCs			
Tetrachloroethene	X		
PAHs			
Total Low Molecular Weight (LMW) PAHs	X		
Total High Molecular Weight (HMW) PAHs	X	X	X
Other Semivolatile Organic Compounds			
Bis(2-ethylhexyl)phthalate	X		

COPECs identified in the EMA only include data from the middle and northern portions. COPECs were not identified in the southern portion of the EMA due to the lack of environmental sensitive natural resources (ESNRs) in this area and the anticipated redevelopment of the area for commercial use.

2.5.3 Fate and Transport

The migration of chemical constituents through various media is governed by the physical and chemical properties of the detected chemicals and the surface and subsurface media through which the chemicals are present. The principal properties affecting environmental fate and transport of chemical constituents are solubility, chemical partitioning coefficients, degradation rates, and Henry's Law Constant. These properties provide information that can be used to evaluate constituent mobility in the environment.

Water solubility is a measure of the saturated concentration of a constituent in water at a given temperature and pressure. Generally, the tendency for a constituent to be transported by groundwater is directly related to its solubility and inversely related to both its tendencies to adsorb to soil and to volatilize from water. Constituents with high water solubilities tend to desorb from soils, are less likely to volatilize from water, and are susceptible to biodegradation. The water solubility of a constituent varies with temperature, pH, and the presence of other dissolved constituents (including organic carbon and humic acids).

Partitioning coefficients are used to assess the relative affinities of constituents for solution or solid phase adsorption. The tendency of organic chemicals to be sorbed is also dependent on the organic content of the soil and the degree of hydrophobicity (lack of affinity for water) of the solute (constituent). The octanol-water partition coefficient can be used to estimate the tendency for a chemical to partition between environmental phases of different polarity. The water/organic carbon partition coefficient (K_{oc}) is a measure of the tendency of a constituent to partition between soil and water. The K_{oc} is defined as the ratio of the absorbed constituent per unit weight of organic carbon to the aqueous solute concentration. This coefficient can be used to estimate the degree to which a compound will adsorb to soil and thus not migrate with groundwater.

The Henry's Law Constant value (KH) for a constituent is a measure of the ratio of the compound's vapor pressure to its aqueous solubility. The KH value can be used to make general predictions about the compound's tendency to volatilize from water.

As summarized on Table 2-1, metals, PAHs, PCBs, and limited VOCs are the COCs for the EMA while only metals and PAHs are COCs for the WMA and NMA. The fate and transport of these COCs provide the basis for characterizing potential exposure pathways and receptors, which in turn provide a framework for evaluating appropriate corrective measure alternatives for onsite soils.

Metals

The transport of metals in soil is generally governed by the ability to mobilize to groundwater and physical movement of the soil in which the constituent is present. In general, most metals in soil tend to adsorb onto the soil particles. Surface run-off or wind can potentially cause erosion resulting in the transport of soil particles containing these metals. Precipitation and surface run-off may also cause the dissolution of some metals into water, and transport these dissolved metals via surface run-off or cause downward migration through the soil column where it may potentially reach groundwater. However, there are numerous factors that can influence the transport of metals in soil including ground cover (i.e., vegetative, asphalt), topography, soil chemistry, and physical/chemical properties of the metals.

Metals adsorbed onto soil particles in surface and subsurface soils generally have limited ability to undergo dissolution and be transported vertically through the soil column. Therefore, migration to groundwater is expected to be minimal (McLean and Bledsoe, 1992). The dissolution of metals into groundwater and the fate of dissolved metals in groundwater are controlled by the soil and water chemistry. The metals of concern generally have limited solubility in groundwater with naturally occurring geochemistry, and consequently will remain in the soil and not dissolve into the groundwater. Should dissolved metals be introduced into the groundwater, the metals will tend to sorb to soil or combine with other constituents in groundwater and precipitate out of solution. These processes will tend to limit the magnitude and extent of dissolved metal transport in groundwater.

The metals identified as COCs on Table 2-1 can and do occur naturally in the environment. For areas of the Site where the concentrations of these metals in soil may have resulted from historical Site manufacturing operations, Site soil and groundwater data provide multiple lines of evidence that support the CSM in that metals of concern have limited ability to migrate to and/or be transported to groundwater.

As presented in the RIRs, impacts to soils due to metals are primarily found in surface soils (see Table 2-2). There are localized impacts to onsite soils at depth in the EMA and WMA due to historical manufacturing operations that would generate dissolved metals concentrations (i.e., lagoons, sumps, dry wells, disposal operations) as well as historical redevelopment and repurposing of operational areas.

As documented in the *Supplemental Onsite Groundwater Investigation Report* (SOGWIR) dated November 15, 2012, groundwater investigations were conducted in the NMA, WMA, and EMA to assess the potential for metals concentrations in soil to impact groundwater:

- NMA - The presence of overburden groundwater is limited within the NMA and groundwater metals concentrations are below NJDEP's Class IIA Ground Water Quality Standards (GWIIA). These findings support the fact that these metals are sorbed onto soil particles with minimal dissolution into and migration with groundwater.
- WMA - The groundwater data presented in the SOGWIR indicated that COC metal concentrations are below the GWIIA with the exception of localized detections of selenium, copper, and arsenic. The selenium and copper detections above the GWIIA were localized since downgradient concentrations of these metals were not above the GWIIA. These findings support the fact that metals are sorbed onto soil particles with minimal dissolution into and migration with groundwater. The occurrence of arsenic has been demonstrated to be naturally occurring (further discussed in Section 3.1).
- EMA - The groundwater data indicate that COC metal concentrations are below the GWIIA with the exception of localized detections of arsenic (3 out of 38 total samples collected), lead (2 out 38 samples), mercury (6 out of 38 samples), and selenium (1 out of 38 samples). The occurrence of arsenic has been demonstrated to be naturally occurring (see Section 3.1). Historical groundwater investigations indicate that onsite soil concentrations of metals (lead, mercury, and selenium) have only impacted groundwater at localized locations. Dissolved metals concentrations in groundwater were lower than total metals concentrations in most samples; indicating samples may have been affected by soil particles entrained in the samples. Metals concentrations above the GWIIA were not observed downgradient or side gradient of localized exceedances. These findings support the fact that metals are sorbed onto soil particles with minimal dissolution into and migration with groundwater.

A well-established vegetative cover exists throughout the Site. Its presence minimizes the potential erosional effects of both wind and surface run-off. Areas of the Site with impacted soils also have a generally flat topography which limits transport of metals via overland flow. However, there are areas of the Site where impacted soil may be transported to surface water (i.e., some areas along the Wanaque River banks). Potential impacts to surface water in Wanaque River have been evaluated as part of the August 2011 *Wanaque River Remedial Investigation Report* and are being addressed under a separate CMS.

PAHs and PCBs

Both PAHs and PCBs in onsite soils are strongly sorbed to soil particles. PCBs experience tight adsorption with adsorption generally increasing with the degree of chlorination of the PCB. They generally do not leach significantly in aqueous soil systems; the higher chlorinated congeners have a lower tendency to leach than the lower chlorinated congeners. Although the biodegradation of higher chlorinated congeners may occur very slowly on an environmental basis, no other degradation mechanisms have been shown to be important in natural water and soil systems.

Erosion of soil via surface run-off or wind can result in the transport of these constituents. Unlike metals, both of these constituent groups biodegrade and can volatilize in soil and water. Volatilization is generally not considered a significant transport or fate process for PAHs and PCBs because of their low KH (see Table 2-4 below). The dissolution of PAHs and PCBs into water and the fate of dissolved PAHs and PCBs in surface water and groundwater are typically limited as documented by their low solubility (see Table 2-4 below). Both PAHs and PCBs strongly sorb to soil, as documented by their high K_{oc} values (see Table 2-4 below) and sorption increases in the presence of naturally occurring organic carbon in the soil. If PAHs and PCBs are detected in groundwater, they are usually associated with dissolved solids within the water column; thereby limiting the extent of transport within groundwater.

As presented in the RIRs, impact to soils due to PAHs and PCBS are primarily found in surface soils. PCBs are localized to areas where former pole- or pad-mounted transformers were located. PAHs are localized to areas adjacent to locations where former operations were decommissioned. As documented in the SOGWIR, groundwater investigations were conducted in the EMA to assess the potential for PCB concentrations in soil to impact groundwater. PCBs were either not detected or were detected at concentrations below the GWIIA in groundwater, which is consistent with their low solubility and low mobility. Historical groundwater investigations did not identify PAHs in Site groundwater, which is consistent with the fate and transport mechanisms for PAHs.

A well-established vegetative cover exists throughout the Site. Its presence minimizes the potential erosional effects of both wind and surface run-off. Areas of the Site with impacted soils also have a generally flat topography which also limits transport of PAHs and PCBs via overland flow.

VOCs

VOCs move in soils by diffusion and advection. Some VOCs (e.g., non-polar, such as tetrachloroethene) are adsorbed predominantly by soil organic matter. VOC vapors are also absorbed by soil minerals. Physical transport of VOCs at the Site could occur by the erosion and transport of soil particles. VOCs will preferentially tend to volatilize directly to the atmosphere from surface soils. While surface water transport of dissolved VOCs can occur, the magnitude and extent of transport is typically limited because VOCs tend to volatilize into the atmosphere. The extent of transport can be controlled by subsurface soil permeability, sorption, dispersion, dilution, volatilization, and biodegradation. These processes will act to reduce the concentrations and extent of VOC transport. Some of the physical properties to be considered as it relates to potential transport of Site-related constituents are provided in Table 2-4 below.

As shown on Table 2-2, detections of VOCs in the EMA (outside Redevelopment Area) are below SRS. Detections of VOCs in the Redevelopment Area above SRS are located at two AOCs: AOC 79 (Machine Shop Solvent Sump 1) and AOC 72/143/144 (Powder Sump Areas). Due to the limited location of VOC soils above SRS, physical transport of soils are not considered a primary migration pathway for this COC group. Site-related VOCs observed to be present within low permeable subsurface soils can become stored as sorbed phase in or on soils and potentially migrate to groundwater where present. Over time, the VOCs can be released into the more transmissive zones beneath the low permeable soils by diffusion or slow advection due to degradation of the dissolved phase VOCs within the transmissive zone. Both adsorption and diffusion/advection are the main transport mechanisms occurring at the Site as seen at AOC 72/143/144 (Powder Sump Areas).

VOCs are also subject to biodegradation both when they are sorbed to soil and when they are dissolved in water. Biodegradation will act to reduce concentrations, degrade constituents into other VOCs, and eventually break down the VOCs. VOC degradation parameters are detected in Site groundwater, suggesting that biodegradation is occurring.

VOCs in Site soils are subject to the following fate and transport mechanisms: adsorption, diffusion/advection, and biodegradation. Limited low-level VOCs are present in limited surface soil locations at the Site; therefore physical transport of soils are not considered a primary migration pathway for this COC group.

Table 2-4 Physical Properties of Organic Constituents of Concern

Constituent	Molecular Weight (g/mol)	Density (g/cm^3)	Solubility (mg/l)	K_{oc} (ml/g)	Henry's Constant (atm-m^3/mol)
		PAHs			
Benzo(a)anthracene	*228.3*	*1.274*	0.0094	358,000	0.00000335
Benzo(a)fluoranthene	*252.3*	---	*0.0012*	---	*0.0000122*
Benzo(a)pyrene	*252.3*	*0.9*	0.00162	969,000	0.00000113
Dibenz(a,h)anthracene	*278.35*	*1.282*	0.00249	1,790,000	1.47E-08
Indeno(1,2,3-cd)pyrene	*276.3*	---	0.000022	3,470,000	0.0000016
Naphthalene	128.19	---	31	1,190	0.000483
		PCBs			
PCBs (1016 - 1268)	*258 - 453*	1.37 - 1.81	0.59 - 0.0027	>5,000	0.0046 - 0.00029
		VOCs			
Carbon tetrachloride	153.8	1.59	825	439	0.0298
Tetrachloroethene	165.8	1.63	200	155	0.0184
Trichloroethene	131.5	1.46	1,100	166	0.0103
Chloroform	*119.4*	1.49	8,000	44	0.00358

Source – Pankow and Cherry, 1996
Shaded – http://www.epa.gov/superfund/health/conmedia/soil/pdfs/part_5.pdf
Shaded – http://www.epa.gov/oswer/riskassessment/pdf/1340-erasc-003.pdf
Shaded – http://www.epa.gov/ogwdw/pdfs/factsheets/soc/tech/pcbs.pdf
Italic – http://www.toronto.ca/health/pdf/cr_appendix_b_pah.pdf
atm-m3/mol = atmosphere-meter per mold
g/mol = grams per mole
g/cm3 = grams per cubic centimeter
K_{oc} = Soil Organic Carbon-Water Partitioning Coefficient
mg/l = milligrams per liter
ml/g = milliliters per gram
--- = no value

Summary

The fate and transport of Site COCs in soils is influenced by numerous factors. Physical and chemical properties of the constituents themselves as well as that of the environmental media can limit the migration of COCs. As indicated by Site data, concentrations of metals, PAHs, and PCBs in onsite soils generally remain with the soil; concentrations are generally not detected above the GWIIA or GWIIA exceedances have been demonstrated to be localized or naturally occurring. Limited low-level VOCs are present in limited location of surface and subsurface soils at the Site. Sorption, dispersion, dilution, volatilization, and biodegradation are processes that are acting to reduce the concentrations and extent of VOC transport. Subsurface soils that could represent a potential source of VOCs to groundwater (e.g., monitoring well 13 area) are currently being evaluated under a separate program.

Migration of COCs at the Site due to erosion and transport of soil particles is not anticipated. The potential for erosional effects of metals, PAHs, and PCBs due to wind and surface run-off are minimized due to the well-established vegetative cover throughout the Site and the generally flat topography in areas of impacted soils.

Potential impacts to surface water in Wanaque River due to metals (mercury) in river bank soils have been evaluated and are being addressed under a separate CMS.

2.5.4 Potential Receptors and Exposure Pathways

As discussed above, migration of COCs due to physical and chemical properties of the constituents are limited. For the purpose of this revised CMS, the media of concern is onsite soils.

Potential Receptors

Direct contact with COCs present in soils may result in exposure to ecological and human receptors. Based on the anticipated beneficial reuse for the Site, the following potential receptors were identified for each potential land area:

- NMA – wildlife receptors and recreational users;
- WMA – wildlife receptors and recreational users;
- EMA (Redevelopment Area) – non-residential users which assumes potential exposure of adult workers during an 8-hour work day; and
- EMA (outside Redevelopment Area) – wildlife receptors and recreational trespassers.

Migration of constituents from the unsaturated soil zone to groundwater may result in exposure to human and ecological receptors. The IGW risk for VOCs is currently addressed with engineering and institutional controls (i.e., groundwater extraction and treatment system and Classification Exception Areas).

Exposure Pathways

Exposure to soil due to erosion and transport of soil particles is not anticipated. The well-established vegetative cover throughout the Site and the generally flat topography in areas of impacted soils minimizes the potential for erosional effects. Direct contact with onsite soils is the primary exposure to COCs. The methods by which receptors can come into direct contact with constituents include ingestion, inhalation, and dermal contact. The areas of potential direct contact is identified as the surface vertical zone of 0 to 2 feet bgs for human health and 0 to 1 feet bgs for ecological receptors.

3 Applicable Soil Remediation Standards

For the purpose of this revised CMS, the media of concern is onsite soils. Based on the potential receptors identified for each area of potential land use, applicable SRS were evaluated for human health, ecological receptors, and IGW as discussed below.

3.1 Arsenic

A Site-specific SRS was developed for arsenic based on an estimate of representative background concentrations. To estimate natural background concentrations of arsenic in soil at the Site, a background soil investigation was conducted in accordance with NJDEP's *Soil Investigation Technical Guidance* dated February 21, 2012 and with the concurrence of NJDEP. A summary of the findings were presented in the *Arsenic Natural Background Investigation for Soil Technical Memorandum* submitted to the Agencies on September 4, 2012. Soil samples collected from portions of the WMA and NMA during the RI indicated arsenic concentrations above the NJDEP RDCSRS of 19 milligrams per kilogram (mg/kg); however, historical operating records do not indicate the use, storage, or disposal of arsenic at the Site. To evaluate potential background and offsite sources of arsenic to soils in the WMA and NMA, background surface (0 to 0.5 feet bgs) and subsurface (1 to 1.5 feet bgs) soil samples were collected for arsenic analyses from 16 locations outside of the influence of Site activities (i.e., topographically upgradient and upwind) in the northernmost section of the Site within Wanaque River valley.

Analytical results for arsenic from background sample locations were used to estimate a representative background concentration consistent with NJDEP's 2012 guidance document. The background dataset was evaluated for outliers using statistical tests prescribed by NJDEP and statistical outlier tests (e.g., Dixon's test and Rosner's test) included in USEPA's ProUCL software program (Version 5.1). The results of NJDEP and ProUCL outlier tests did not identify statistical outliers within the background dataset. In accordance with NJDEP's 2012 guidance document, the highest arsenic concentration measured in surface and subsurface soil background samples (75 mg/kg) was recommended as the Site-specific background-based SRS (O'Brien & Gere, 2012). NJDEP approved the background-based SRS for arsenic on February 21, 2013.

Subsequent reviews of the Site-specific background-based SRS for arsenic conducted by USEPA recommended a revised calculation based on the identification of potential statistical outliers in the background dataset (USEPA, 2019; USEPA, 2017). More robust statistical outlier tests conducted by USEPA (e.g., PROP estimate, minimum covariance determinant) indicated that potential statistical outliers may have been masked in the statistical outlier tests prescribed by NJDEP guidance or included within USEPA ProUCL software. USEPA recommended revised estimates of the Site-specific background-based SRS for arsenic based on the removal of outliers identified by the more robust outlier tests.

As discussed during a meeting with the Agencies on November 14, 2018, decisions about the proper disposition of potential outlying soil data points for arsenic should consider the conceptual understanding of Site conditions as they relate to arsenic sources and fate/transport processes to the background sampling area in addition to statistical evaluations; statistical tests alone cannot determine whether a statistical outlier should be investigated further (USEPA, 2015).

The CSM for the WMA indicates that the source of arsenic to the background sampling area in the Wanaque River floodplain was not related to Site operations but originated offsite in upgradient source areas. As stated, historical operating records do not indicate the use, storage, or disposal of arsenic in the WMA. Consistent with the lack of documented onsite use, storage, or disposal, arsenic concentration gradients in soil that would be indicative of a historical release or discharge were not identified in the WMA as part of the RI. However, potential offsite arsenic sources were identified upgradient of the background sampling area. A natural gas line easement located adjacent to and upgradient of the Site and background sampling area is regularly treated with herbicides that may contain arsenic. In addition, historical farmland had the potential to use arsenical pesticides. Arsenic may have migrated from surface soil in offsite upgradient source areas through erosion and transport during high flow events in Wanaque River, resulting in downstream deposition within the Wanaque River floodplain. Floodplain deposition of arsenic transported via these fluvial transport processes is consistent with statistically greater concentrations observed in surface soil samples relative to subsurface soil samples in the background sampling area.

The use of arsenical pesticides or herbicides in upgradient areas and conceptual transport pathways downgradient may have contributed to background soil arsenic concentrations in the background sampling area and portions of the WMA within the Wanaque River floodplain. Because these offsite arsenic sources likely contributed to concentrations observed in the background sampling area and potential onsite areas within the WMA, the concentrations may be representative of true upper end values in the distribution. While some arsenic concentrations at the upper end of the distribution were identified as statistical outliers using the more robust methods presented by USEPA, it cannot be determined that the concentrations identified as outliers are not associated with conceptual pathways from potential upgradient offsite arsenic sources. Therefore, the removal of the data points identified as statistical outliers may distort the true estimates of the upper end of the distribution of the background population, which may underestimate the influence of potential upgradient offsite sources on arsenic concentrations in floodplain soils within the WMA.

Based on the conceptual understanding of potential offsite sources of arsenic and the absence of arsenic in the historical operating records for the former facility, the background datasets likely represent the range of arsenic concentrations (maximum

75 mg/kg) that may be found in soils within the NMA and WMA. However, given the uncertainty identified by USEPA regarding the influence of potential outliers on the estimation of a representative background threshold value (BTV), the 95% upper prediction limit (UPL95) arsenic concentration of 57.12 mg/kg calculated by USEPA will be used as the Site-specific background-based SRS (USEPA, 2019). USEPA calculated the UPL95 arsenic concentration of 57.12 mg/kg using the combined surface and subsurface soil datasets without four upper end outlying values identified using the more robust outlier tests recommended by USEPA. Given the potential for offsite arsenic sources to influence surficial soil concentrations within the Wanaque River floodplain, the removal of the four upper end outliers likely results in a conservative estimate of the Site-specific background-based arsenic SRS.

Detected arsenic concentrations above this standard within the NMA and WMA will be addressed as part of the corrective measure for onsite soils. Pursuant to New Jersey Statutes Annotated (N.J.S.A.) 58:10B-12g(4), remediation beyond natural background levels is not required. Therefore, no further action is proposed for arsenic soil concentrations detected below this Site-specific SRS of 57.12 mg/kg within the NMA and WMA.

3.2 Human Health Soil Remediation Standards

Based on the anticipated future use of the Site presented in Section 2.3.2, the applicable human health SRS for the NMA (State of New Jersey Land Transfer Area) will be the RDCSRS. The applicable remediation standards for the EMA (Redevelopment Area) will be the NRDCSRS. Direct contact SRS values for residential and non-residential scenarios are promulgated in New Jersey Administrative Code (N.J.A.C.) 7:26D.

Consistent with Section 7 and Appendix 4 of N.J.A.C. 7:26D, ARS can be developed and used for the protection of human health based on the future use of the Site. For the purpose of developing Site-specific ARS for human health, passive recreational land use (such as walking or hiking) was considered for both the WMA and the EMA (outside Redevelopment Area). NJDEP defines recreational purposes as site-specific uses that do not reflect either a residential or non-residential land use scenario. The development of ARS is documented in Appendix A (also see summary in Section 1.1 [Appendix A Timeline]).

For the lead ARS, the value proposed in the August 2014 prepared version of Appendix A (see summary in Section 1.1 [Appendix A Timeline]) was selected by the Agencies after running USEPA's Adult Lead Model (ALM) using various inputs, including a blood lead level (BLL) of 5 micrograms per deciliter (µg/dL) and a BLL of 10 µg/dL. USEPA Region 2 has recently implemented an updated regional risk reduction goal of no more than 5% of the target population exceeding a BLL of 5 µg/dL. As such, ARS for lead was revised using USEPA's ALM with USEPA Region 2's reduced risk reduction goal and currently recommended USEPA default input values, except for previously agreed Site-specific values for exposure, frequency, and averaging time. The application of this model in this manner is consistent with the Rolling Knolls Superfund Site, which the Agencies mentioned as an example during the November 2018 meeting.

A summary of the proposed human health SRS for COCs associated with each of the anticipated future land uses are presented on Table 3-1.

Table 3-1 Human Health Soil Remediation Standards

COC	ARS (mg/kg)		NRDCSRS (mg/kg)	RDCSRS (mg/kg)
	EMA (outside Redevelopment Area)	WMA	EMA (Redevelopment Area)	NMA (State of NJ Land Transfer Area)
Antimony	140	110	-	-
Arsenic	19	57.12[1]	19	57.12[1]
Cadmium	300	-	-	-
Copper	14,000	11,000	45,000	-
Lead	2,000	1,600	800	400
Mercury	110	82	65	-
Selenium	-	1,400	-	-
Vanadium	1,800	-	1,100	-
Benzo(a)anthracene	19	15	17	-
Benzo(b)fluoranthene	19	15	17	-
Benzo(a)pyrene	1.9	1.5	2	0.5
Dibenz(a,h)anthracene	1.9	1.5	2	-
Indeno(1,2,3-cd)pyrene	19	15	17	-
Naphthalene	140	-	17	-
Carbon tetrachloride	40	-	-	-
Chloroform	20	-	2	-
Tetrachloroethene	1,200	-	1,500	-
Trichloroethene	70	-	10	-
PCBs	2	-	1	-

- = Not a COC for human health as identified in the RIRs for the Site

[1]Arsenic background value

The NJDEP-required Alternative or New Remediation Standard and/or Screening Level Application Form for the above-listed ARS are included in Appendix B.

3.3 Ecological Soil Remediation Standards

Ecological risk-based remediation goals (ERGs) for onsite soils were developed for the protection of wildlife receptors that may be exposed to COPECs at the Site. Consistent with NJDEP's *Ecological Evaluation Technical Guidance (Version 2.0)*, these numeric goals are intended to serve as delineation criteria for onsite soils to evaluate the extent of potential corrective measures on the basis of ecological risk.

ERGs for the protection of ecological receptors were evaluated for COPECs identified in BEEs completed for the following areas of the Site:

- EMA (middle and northern portions),
- NMA, and
- WMA.

ERGs were not derived for the southern portion of the EMA due to the lack of ESNRs identified in this area during the BEE and the anticipated future redevelopment of this area for commercial use.

Documentation on how the ERGs were derived for the protection of wildlife is presented in Appendix A (also see summary in Section 1.1 [Appendix A Timeline]). A summary of the proposed ERGs for the COPECs associated with the Site are as follows:

Table 3-2 Ecological Soil Remediation Standards

COC	ERG (mg/kg)
Antimony	62
Arsenic	153.5
Barium	3,270
Cadmium	5.7
Chromium	455
Cobalt	521
Copper	1,100
Lead	892
Manganese	9,091
Mercury	20.4
Nickel	609
Selenium	5
Silver	181
Thallium	4.3
Vanadium	62
Zinc	1,507
LMW PAHs	382
HMW PAHs	47.5

The NJDEP-required Alternative or New Remediation Standard and/or Screening Level Application Form for the above-listed ERGs are included in Appendix B.

The proposed remediation depth for ERGs is 0 to 1 feet bgs. USEPA's 2015 *Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic Ecological Risk Assessments* recommends sampling to a depth of 25 to 30 centimeters (approximately 1 foot) to characterize exposure in biologically relevant sampling depth intervals for the terrestrial biotic zone. This depth interval is recommended to capture exposure within the A-horizon of soil, which is associated with the biologically active zone of soils. The biologically active zone represents the soil interval where most ecological receptors live or forage. As a result, this zone is most relevant for the mitigation of risk associated with bioaccumulation exposure pathways from soil into dietary items (e.g., plants, soil invertebrates) that may be consumed by terrestrial receptors. Remediation of soils within the 0 to 1 foot bgs depth interval to exposure point concentrations that are less than or equal to the proposed ERGs is protective of terrestrial wildlife exposure pathways.

3.4 Impact to Groundwater Soil Remediation Standards

Reports previously submitted for the IGW pathway are outlined in Section 1.1 (Appendix B Timeline). The investigation collected a sufficient volume of data to calculate Site-specific IGWSRS for each geographic region shown on Figure 7. The Agencies' January 2, 2019 correspondence stated that the synthetic precipitation leaching procedure (SPLP) had been correctly executed and NJDEP's SPLP spreadsheets properly used to determine Site-specific IGWSRS which can be utilized as part of the CMS. Table 3-3 shows the geographic region-specific IGWSRS based on the NJDEP spreadsheet calculations.

Table 3-3 Impact to Groundwater Soil Remediation Standards

Geographic Region	Calculated IGW Standard[3] Lead (mg/kg)	Calculated IGW Standard[3] Mercury (mg/kg)	Calculated IGW Standard[3] PCBs (mg/kg)
NMA West	1,720	--[1]	--[2]
NMA Mid	170	--[1]	--[2]
NMA East	505	--[1]	--[2]
WMA Northwest/Southwest[4]	636	166	--[2]
WMA Mid	390	289	--[2]
WMA East	90 [5]	1,130	--[2]
EMA North of Well 20	350	101	--[2]
EMA North Central	90 [5]	34	0.2 [5]
EMA Northeast	90 [5]	18	--[2]
EMA Mid North	347	190	5
EMA Mid Central	269	84.4	--[2]
EMA Mid South	190	13	7.1
EMA Southwest	90 [5]	33.2	--[2]
EMA South Central	951	21.3	1.1
EMA Southeast	241	20	21

1. SPLP locations for mercury in the NMA were not selected due to low concentrations compared to the IGW soil screening level (IGWSSL) remaining in each region.
2. PCBs were only considered a COC in the EMA due to the presence of pole-mounted transformers. Operations ceased in the NMA and WMA in 1926; prior to the use of PCBs in transformers.
3. Geographic region-specific IGW standards were calculated using NJDEP's SPLP Spreadsheet, Version 3.1 dated November 2013 and NJDEP's SPLP Guidance, Version 3.0 dated November 2013.
4. Geographic regions WMA Northwest and WMA Southwest were merged into one geographic region. See *Draft Impact to Groundwater Standards Technical Report* dated March 22, 2018 for more information.
5. Based on NJDEP's spreadsheet calculations, the default NJDEP IGWSSL will be applied to this geographic region.

The NJDEP-required Alternative or New Remediation Standard and/or Screening Level Application Form for the above-listed IGWSRS are included in Appendix B.

3.4.1 Immobile Constituents

NJDEP's 2008 *Guidance for the Evaluation of Immobile Chemicals for the Impact to Ground Water Pathway* identifies procedures for evaluating potential IGW for immobile constituents. In this guidance, NJDEP identifies that certain constituents are likely to be strongly adsorbed to soil and are, under certain conditions, not likely to impact groundwater. Site-specific IGW COCs that are considered immobile constituents by NJDEP (as listed in their 2008 guidance) include lead and PCBs.

NJDEP does not require remediation of soil impacted by immobile constituents for IGW if the following criteria are met:

- There is a clean zone of at least 2 feet between impacted soil and groundwater; and
- There are no site conditions which would affect the ability of the immobile constituents to migrate to groundwater.

In the 2008 guidance, NJDEP identifies the following five conditions which could affect the ability of the immobile constituents to migrate.

1. The contaminant was discharged as part of a mixture that could affect the mobility of the contaminant;
2. A co-solvent is present that could affect the mobility of the contaminant;
3. Soil texture at the site is coarser than a sandy loam;
4. Soil pH has been altered by the discharge of acids or bases; or
5. The contaminant of concern is present at levels associated with free or residual product.

Since these five conditions do not exist at the PLW Site, remediation for lead and PCBs would not be required in areas where there is at least 2 feet of clean soil between impacted soil (above the IGWSRS) and groundwater.

3.5 Compliance Averaging

The SRS presented above do not represent a not-to-exceed concentration at any single sample location, but rather an average concentration that is not to be exceeded. Compliance averaging may be applied to selective remediation areas; to be developed and presented in the Corrective Measure Implementation Work Plan (CMIWP). Compliance averaging may be applied to small areas with limited exceedances, areas with limited access, areas with concentrations near SRS, and/or to constituents with limited exceedances.

The method and approach to compliance averaging would typically be included in the CMIWP. However, during a meeting with the Agencies on November 14, 2018 and in their letter dated January 2, 2019 USEPA requested that a description of compliance averaging procedures be included as part of the submittal of this CMS.

Several averaging methods may be used including, but not limited to, the arithmetic mean, the 95% upper confidence limit of the arithmetic mean concentration (UCL95), spatially-weighted averaging (e.g., Thiessen polygons), or 75%/10X rule. Compliance averaging will be applied in accordance with NJDEP's 2012 *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria*. Below is a summary of the compliance averaging options from Appendix A of NJDEP's 2012 compliance averaging guidance.

3.5.1 Functional Areas

The purpose of the functional area is to help select the samples to be included in the compliance averaging process.

Human Health Functional Areas

For attainment of applicable human health SRS, NJDEP's compliance averaging guidance indicates that the size of the functional area is dependent on the exposure pathway (inhalation or ingestion-dermal) and future land use (residential or non-residential). Based on the anticipated future land use described in Section 2.3.2, the functional areas will be applied as follows:

Table 3-4 Functional Area Sizing

	Inhalation Pathway	Ingestion-Dermal Pathway
NMA	0.5 Acres	0.25 acres
WMA and EMA	2.0 acres	2.0 acres

As outlined in NJDEP's compliance averaging guidance, the size of the final functional area to be evaluated may be increased by up to 50%. The preferred shape of the functional area is a square but can vary based on constituent distribution and site constraints. NJDEP prefers that the length of the functional area be kept to no more than four times the width.

Ecological Functional Areas

NJDEP's 2012 guidance does not specifically address compliance averaging based on ecological exposure. In general, guidance on the application of compliance averaging for the attainment of ERGs is limited. However the concept of attaining ERGs based on average exposure point concentrations (EPCs) is included in NJDEP's 2018 *Ecological Evaluation Technical Guidance, Version 2.0*. In the risk management discussion contained in Section 9.2 of that document, an example remedial scenario is presented where the ERG is to achieve an average of 300 mg/kg of lead in soil over a 90-acre wetland area for the protection of woodcock. This example supports the concept of averaging exposure point concentrations for the attainment of ERGs.

In addition to the example above, Los Alamos National Laboratory (LANL) recommends the application of various statistical methods to estimate areas greater than ERGs by interpolating between sample points for avian and mammalian receptors. The guidance also recommends that exposure point concentrations based on the UCL95 estimates be re-calculated based on proposed remedial alternatives to evaluate the effectiveness and extent of the action (e.g., iterative truncation; LANL, 2017). Similarly, USEPA's 2004 *Guidance on Surface Soil Cleanup at Hazardous Waste Sites: Implementing Cleanup Levels* describes statistical approaches for computing average exposure point concentrations over the exposure area of terrestrial receptors including iterative truncation, confidence response goal methods, and geostatistical methods. The examples of averaging exposure point concentrations over the receptor foraging range for the attainment of ERGs supports the application of compliance averaging to attain soil ERGs.

Human health exposure assumptions that are associated with compliance averaging to attain applicable human health SRS for ingestion-dermal pathways are consistent with the exposure assumptions associated with the attainment of ERGs. As discussed above, the attainment of applicable human health SRS for ingestion-dermal pathways assumes average exposure within the functional area defined based on land use (e.g., residential, non-residential). Consistent with the assumption of average exposure for human health, dietary intake models used to calculate ERGs assume that representative wildlife receptors integrate the estimated doses of COPECs while foraging randomly throughout the receptor foraging range (see Appendix A). Based on the assumption of random foraging, the integrated dose obtained from foraging within the foraging range will not exceed the chronic toxicity reference value (TRV) dose if average soil concentrations across the foraging range are equal to or less than the calculated ERGs.

The application of the compliance averaging approach for attaining ERGs requires specific consideration of ecological exposure for the following:

- Selection of ERGs protective of the most sensitive wildlife receptor evaluated (see Section 3.3).
- Definition of the horizontal and vertical extent of functional areas applicable to the attainment of ERGs for the most sensitive ecological receptor evaluated.

Below is a discussion of these specific considerations for applying compliance averaging for the attainment of soil ERGs at the Site.

Sensitive Receptor and Foraging Areas

Dietary intake models used to calculate ERGs assume that representative wildlife receptors integrate the estimated doses of COPECs while foraging randomly throughout the entire receptor foraging range within the Site. Based on the assumption of random foraging, the integrated dose obtained from foraging within the receptor foraging range will not exceed the TRV dose if average soil concentrations across the receptor foraging range are equal to or less than the calculated ERGs. Since the ERG selected as the ARS is protective of the most sensitive wildlife receptor, the remediation of soils to attain average concentrations within an exposure area that are equal to or less than the ERG will be protective of all wildlife receptors represented in the dietary intake models.

Table 3-5 Foraging Range of Most Sensitive Receptor

COC	Soil ERGs		
	LOAEL-Based Soil ERGs (mg/kg)	Most Sensitive Receptor(s)	Most Sensitive Receptor Foraging Range (acres)[1]
Antimony	6	Short-tailed shrew	0.96
Arsenic	153.5	Mourning dove	>1000
Barium	3,270	Short-tailed shrew	0.96
Cadmium	5	Short-tailed shrew	0.96
Chromium	455	Mourning dove	>1000
Cobalt	521	American robin	1.04
Copper	1,100	Mourning dove	>1000
Lead	892	American robin	1.04
Manganese	9,091	Mourning dove	>1000
Inorganic Mercury	20.4	Mourning dove	>1000
Nickel	609	Mourning dove	>1000
Selenium	5	Short-tailed shrew	0.96
Silver	181	American robin	1.04
Thallium	4	Short-tailed shrew	0.96
Vanadium	6	Mourning dove	>1000
Zinc	1,507	American robin	1.04
Total LMW PAHs	382	Short-tailed shrew	0.96
Total HMW PAHs	47.5	American robin	1.04

1. Foraging range for short-tailed shrew and American robin obtained from Sample and Suter (1994); foraging range for mourning dove obtained from Tomlinson et al. (1960) based on a foraging radius of 1.6 kilometers.
2. Lowest observable effects level (LOAEL) and TRV based on LOAEL endpoints for growth and reproduction.

The minimum size of the functional area for compliance averaging to attain the ERG-based ARS will be based on the minimum foraging range of the most sensitive wildlife receptors used in the calculations of ERGs. Based on the most sensitive wildlife receptors listed in Table 3-5, American robin (*Turdus migratorius*) and short-tailed shrew (*Blarina brevicauda*) have the smallest foraging range of approximately 1 acre (Sample and Suter, 1994). The maximum size of the functional area is based on the minimum foraging range of the most sensitive receptor (1 acre) plus a potential increase in the maximum size of the functional area of up to 50% (1.5 acres) per NJDEP’s compliance averaging guidance. An assumption of this approach is that habitat is relatively uniform across the functional area, whereas only portions of the functional area may be used by a specific receptor. Therefore, the availability of suitable habitat to support wildlife receptors may be a consideration in determining the size and shape of the functional area and the applicability of ERGs in the compliance averaging approach.

The shape of the functional area will vary based on the distribution of samples and dimensions of a given AOC. Per NJDEP’s guidance, functional area sizes will be designed so that the length of the functional area will not exceed approximately four times the width to the extent possible.

IGW Functional Area

The functional area will be based on the size of the geographic regions. The relevant dimension is the length of the geographic region in the direction parallel to groundwater flow and the delineated extent of impacts in all other directions.

There will be two vertical zones for the IGW pathway. The first zone will be from ground surface to 2 feet above the groundwater table. The second zone will be from 2 feet above the groundwater table to the water table itself.

3.5.2 Compliance Averaging Methods

Using the Arithmetic Mean

Compliance averaging using the arithmetic mean is only to be applied in situations where there are two or fewer distinct sample values or nine or fewer total sample points. To identify the arithmetic mean value of the data set, the sum of the sample values will be divided by the total number of samples. For non-detect (ND) values, zero will be used as the value.

95% Upper Confidence Limit of the Arithmetic Mean

To identify compliance with the applicable SRS, the average of the sample concentrations at the UCL95 will be estimated using USEPA's ProUCL software. A minimum of 10 samples are required for the use of the UCL95. To estimate a compliance average that is protective of human health and the environment, an appropriate functional area must first be defined using the procedures discussed above.

Once the functional area has been defined, the UCL95 for the area can be estimated. All data necessary for delineation within a given functional area and vertical zone will be utilized in the ProUCL evaluation. Data below applicable SRS that is not needed to delineate the area would not be included. If more than one potential UCL is identified by ProUCL, the lower value will be used as the UCL95. If the calculated UCL is greater than all values in the data set, the maximum sample value in the data set will be used for evaluation. The UCL95 for each COC within the functional area is then compared against the applicable SRS.

Spatially Weighted Average

To identify compliance with the applicable SRS, a spatially weighted average may be used. This approach is when the sample results are weighted according to the area they represent. The area would be defined using Thiessen polygons (also known as Voronoi or Dirichlet tessellations). Thiessen polygons are polygons whose boundaries define the area that is closest to each point relative to all other points.

The areas would be laid out using CAD or GIS software. To apply the spatially weighted average method, an iterative process is performed for each COC that exceeds the applicable SRS. The functional area will be evaluated in accordance with the procedures discussed above. For each functional area, the following steps may be followed:

1. Data points are plotted.
2. Polygon boundaries are identified and the initial spatially weighted average concentration is calculated. If this initial calculated concentration is below the applicable SRS, then no further action is required. For ND values, the reporting limit would be used.
3. If this initial concentration is above the applicable SRS, the most highly impacted polygon will be replaced with a fill or background concentration, and then the spatially weighted average will be recalculated.
4. This process continues progressively with the next most impacted polygon(s) until the spatially weighted average for the functional area is at or below the applicable SRS.
5. All polygons “removed” (replaced with actual analytical data for the fill or, if such data are not available, a background concentration) as part of this evaluation are required to be addressed as part of the remediation.

75%/10x Procedure

Compliance averaging using the 75%/10x procedure can only be applied to an area after a remedial action has been conducted.

The number of pre post-excavation samples required for this method is based on the volume of soil excavated. A minimum of eight pre post-excavation samples are required per area. The following table shows the minimum number of pre post-excavation samples required per cubic yards.

Table 3-6 75%/10x Procedure Minimum Number of Samples

Cubic yards of excavated soil	Minimum number of samples
Up to 125	8
Up to 3,000	12
For each additional 3,000	12

If 75% of all pre post-excavation samples are below the applicable SRS and none of the remaining samples exceed the applicable SRS by an order of magnitude (10x), the remedial action is considered to have met the remedial objective and no further action is necessary.

3.5.3 Compliance Averaging Approach

A compliance averaging approach may be used selectively at areas within the Site under specific remedial scenarios. If compliance averaging is applied at a select area, attainment of SRS will be based on compliance averaging procedures provided in NJDEP's 2012 guidance. Compliance averaging procedures will be integrated between ecological-, human health-, and IGW-based ARS to demonstrate protection of human health and the environment. Detailed scenarios for compliance averaging to attain applicable human health and ecological risk-based ARS will be presented in the CMIWP.

4 Remedial Action Objectives

RAOs are media-specific goals that are aimed at protecting human health and the environment. RAOs were developed based on the end-use of the Site. Given the above considerations, the RAOs developed for the Site are presented in Table 4-1.

Table 4-1 Remedial Action Objectives

	Human Health	Ecological Receptors	IGW
NMA	Reduce potential human exposure to lead and benzo(a)pyrene in soils with concentrations above RDCSRS and arsenic in soils above Site-specific background standard.	Reduce potential ecological exposure to COCs above ERGs.	Minimize potential migration of lead from unsaturated soil zone to groundwater.
WMA	Reduce potential human exposure to COCs in soils with concentrations above human health ARS and arsenic in soils above Site-specific background standard.	Reduce potential ecological exposure to COCs above ERGs.	Minimize potential migration of lead and mercury from unsaturated soil zone to groundwater.
EMA (Redevelopment Area)	Reduce potential human exposure to COCs in soils with concentrations above NRDCSRS.	Not applicable	Minimize potential migration of lead, mercury, and PCBs from unsaturated soil zone to groundwater.
EMA (outside Redevelopment Area)	Reduce potential human exposure to COCs in soils with concentrations above human health ARS.	Reduce potential ecological exposure to COCs above ERGs.	Minimize potential migration of lead, mercury, and PCBs from unsaturated soil zone to groundwater.

5 Identification and Screening of Technologies

As allowed under USEPA's *RCRA Corrective Action Plan* and as agreed to by the Agencies, the June 2013 CMS was a streamlined document prepared for the Site and presented a single proposed corrective measure alternative for onsite soils. As documented in USEPA's correspondence dated January 2, 2019, USEPA has re-assed its position on the use of a streamlined CMS approach to remedy evaluation for selecting a corrective measure for onsite soils at the Site. As such, USEPA has requested that the revised CMS evaluate a number of corrective measure alternatives in accordance with the *RCRA Corrective Action Plan* and USEPA's 1998 *Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA*; even though the PLW Site is not a Superfund Site.

General response actions/remedial technologies were identified and screened to develop a range of potential technically implementable corrective measures for the Site. The purpose of the technology screening process is to evaluate the suitability of the general response action/remedial technology to meet the RAOs, with effectiveness and implementability criteria being the main factors evaluated for each.

As identified in Section 2, metals are the primary COC in soil within the three former manufacturing areas at the Site. PAHs, PCBs, and VOCs may be co-located and/or adjacent to areas with metals. Therefore, the primary remedial technologies identified are established treatment technologies for metals in soil. Table 5-1 summarizes the general response actions/remedial technologies evaluated during this screening process.

Table 5-1 Screening of General Response Actions/Remedial Technologies

General Response Action/Remedial Technology	Description	Effectiveness and Implementability	Retained for Further Evaluation
No Action	No Action involves deferral of corrective measures of any kind.	Baseline evaluation alternative.	Yes
Institutional Controls	Deed notice for land use restrictions and monitoring of groundwater quality.	Land use restrictions, when enforced, are effective in controlling use and disturbance of Site soils. Monitoring is effective for evaluating concentrations and effects of COCs over the long term.	Yes
Containment	Cap/cover soil in place or consolidate and cap/cover soil material.	• Proven technology. • Readily available. • Reduces direct contact. • Can be used for material that contains variety of constituents and concentrations. • Does not reduce toxicity or volume. • Requires long-term maintenance and monitoring.	Yes

General Response Action/Remedial Technology	Description	Effectiveness and Implementability	Retained for Further Evaluation
Immobilization	Solidifies material by physically locking constituents within solidified matrix or stabilizing material by converting material to more immobile form. Usually involves mixing of reagent with soil.	• Proven technology. • Increases volume. • Difficult to identify reagent to treat multiple constituents effectively. • In-situ mixing may be difficult due to remote locations/topography of Site.	No
Soil Washing	Extraction of constituents from soil by physical separation or use of washing solution.	• Not extensively demonstrated. • Treatment fluids may be only effective on narrow range of constituents. • Extraction fluid may be toxic or develop toxic characteristics when mixed with constituents.	No
Removal	Impacted soil is excavated and transported to permitted offsite treatment and/or disposal facilities.	• Proven technology. • Readily implementable. • Some pretreatment of impacted soil usually required to meet land disposal restrictions (LDR). • Transfers impacted soil to different location for containment or treatment. • No operation and maintenance required.	Yes

6 Identification of Corrective Measure Alternatives

The primary objective of this CMS is to identify a corrective measure alternative for onsite soils in a comprehensive, Site-wide manner. In accordance with USEPA's *RCRA Corrective Action Plan*, a screening process was used to evaluate the effectiveness and implementability of the proposed corrective measure alternatives. Based on the screening conducted in Section 5, alternatives were developed to address the RAOs, and represent a range of containment and treatment combinations appropriate for the Site by addressing the impacted media and exposure routes.

6.1 Alternative 1 – No Action

Under this alternative, no action would be taken to remediate impacted soils at the Site. However, this alternative provides the baseline case for comparing corrective measure alternatives.

No implementation would be required under this alternative. Exposure to soil due to erosion and transport of soil particles is not anticipated. As described in Section 2.5.4, the well-established vegetative cover throughout the Site and the generally flat topography in areas of impacted soil minimizes the potential for erosional effects. Direct contact with onsite soils is the primary exposure to the COCs.

This alternative would not meet the RAOs established for the Site.

6.2 Alternative 2 – Limited Action

This alternative would include leaving impacted soils in place without conducting any further corrective measures. However, this alternative would consist of the implementation of institutional measures and maintaining existing fencing to control, limit, and monitor activities onsite. The objectives of the institutional measures would be to control the potential for exposure to impacted soils and limit future redevelopment or soil disturbance activities at the Site.

For this alternative, a deed notice would be implemented in accordance with N.J.A.C. 7:26C *Administrative Requirements for the Remediation of Contaminated Sites.* The deed notice will establish the restrictions for use (such as no residential use) of the property for current and subsequent owners, lessees, and operators; limits of soil impacts; procedures for change of ownership and rezoning; and requirements associated with alterations, improvements, and disturbances.

As part of this alternative, existing fencing would be maintained to minimize access to impacted soils. Additionally, an educational program could be set up to inform the public about the potential hazards of direct contact with impacted soils. The educational program would help guide the public away from areas with potential impacts.

This alternative would not meet the RAOs established for the Site.

6.3 Alternative 3 – Excavation, Onsite Consolidation/Capping in Redevelopment Area, and Monitoring for IGW

This alternative would involve excavating impacted soils within the NMA, WMA, and EMA (outside Redevelopment Area) that may present a potential direct contact risk to human and ecological receptors, and consolidation of these soils within the EMA (Redevelopment Area).

NMA

Impacted soils above the SRS identified in Section 3 would be excavated and transported to the EMA (Redevelopment Area) for consolidation. Remains of above-grade historical buildings would also be removed as part excavation activities. Figure 8 shows the approximate extent of impacted soils based on the SRS.

Clean backfill would be placed in excavated areas, as necessary.

WMA

To eliminate the potential for direct contact with soils above the human health ARS from 0 to 2 feet bgs and above the ERGs from 0 to 1 feet bgs, soils would be excavated and transported to the EMA (Redevelopment Area) for consolidation. Additionally, impacted soils above the water table that exceed the IGWSRS would be excavated and consolidated within the EMA (Redevelopment Area). Figure 8 shows the approximate extent of impacted soils based on these criteria.

Clean backfill would be placed in excavated areas, as necessary. A minimum of 2 feet of clean backfill would be required where subsurface soils remain in place above the human health ARS. These soil covers would be included in a deed notice (further discussed below).

EMA (outside Redevelopment Area)

To eliminate the potential for direct contact with soils above the human health ARS from 0 to 2 feet bgs and above the ERGs from 0 to 1 feet bgs, soils would be excavated and transported to the EMA (Redevelopment Area) for consolidation. Additionally, impacted soils above the water table that exceed the IGWSRS would be excavated and consolidated within the EMA (Redevelopment Area). Figure 8 shows the approximate extent of impacted soils based on these criteria.

Clean backfill would be placed in excavated areas, as necessary. A minimum of 2 feet of clean backfill would be required where subsurface soils remain in place above the human health ARS. These soil covers would be included in a deed notice (further discussed below).

EMA (Redevelopment Area)

Approximately 95,000 cubic yards of material would be consolidated within the EMA (Redevelopment Area). The excavated soil would be transported to this area and spread over the surface (see Figure 8). This material would be used to fill in existing depressions such as the historical lagoons. A low-permeability cap would then be installed over the area to prevent direct contact and minimize the transmission of water. No excavation of impacted soils would be conducted within the EMA (Redevelopment Area). The low-permeability cap would be included in a deed notice (further discussed below).

Institutional Controls and Monitoring

This alternative would include the implementation of institutional measures to control, limit, and monitor activities onsite. A deed notice would be implemented in accordance with N.J.A.C. 7:26C *Administrative Requirements for the Remediation of Contaminated Sites.* The deed notice will establish the restrictions for use of the property for current and subsequent owners, lessees, and operators; limits of soil impacts; engineering controls, procedures for change of ownership, and rezoning; and requirements associated with alterations, improvements, and disturbances. In accordance with N.J.A.C. 7:26-7.7, for remedial actions with engineering controls a biennial certification of the continued protectiveness of the remedial action is required.

Monitoring of groundwater in the capped areas would also be conducted to assess groundwater quality in the long term. The program would be developed as part of the CMIWP and incorporated into the existing CGMP at the Site.

6.4 Alternative 4 – Excavation, Offsite Disposal, Isolated Capping in EMA and Redevelopment Area, and Monitoring for IGW

This alternative would involve excavating impacted soils within the NMA, WMA, and targeted areas of the EMA to control the potential for direct contact with impacted soils and minimize the potential for migration of COCs within the vadose zone. The remaining areas of the EMA would have low-permeability caps installed to eliminate the potential for direct contact and minimize the migration of COCs within the IGW pathway.

NMA

Impacted soils above the SRS identified in Section 3 would be excavated and transported to an offsite treatment and/or disposal facility. Remains of above-grade historical buildings would also be removed as part excavation activities. Figure 9 shows the approximate extent of impacted soils based on the SRS.

Clean backfill would be placed in excavated areas, as necessary.

WMA

To eliminate the potential for direct contact with soils above the human health ARS from 0 to 2 feet bgs and above the ERGs from 0 to 1 feet bgs, soils would be excavated and transported to an offsite treatment and/or disposal facility. Additionally, impacted soils above the water table that exceed the IGWSRS would be excavated and transported to an offsite treatment and/or disposal facility. Figure 9 shows the approximate extent of impacted soils based on these criteria.

Clean backfill would be placed in excavated areas, as necessary. A minimum of 2 feet of clean backfill would be required where subsurface soils remain in place above the human health ARS. These soil covers would be included in a deed notice (further discussed below).

EMA (outside Redevelopment Area)

A cap would be constructed in isolated areas where COC concentrations are above the IGWSRS. The proposed cap locations are shown on Figure 9. Approximately 5.7 acres of impacted soils would be capped. A low-permeability cap would be installed over the impacted soil to prevent direct contact and minimize the transmission of water. The caps in these areas would extend beyond the boundaries of the impacted soils to prevent infiltrating water near the edges from reaching the impacted soils.

In the remaining areas where impacted soils are above the human health ARS from 0 to 2 feet bgs, above the ERGs from 0 to 1 feet bgs, and/or above the IGWSRS, soils would be excavated and transported to an offsite treatment and/or disposal facility.

Clean backfill would be placed in excavated areas, as necessary. A minimum of 2 feet of clean backfill would be required where subsurface soils remain in place above the human health ARS. These soil covers would be included in a deed notice (further discussed below).

EMA (Redevelopment Area)

A cap would be constructed in isolated areas where COC concentrations are above the IGWSRS. The proposed cap locations are shown on Figure 9. Approximately 4.1 acres of impacted soils would be capped. A low-permeability cap would be installed over the impacted soil to prevent direct contact and minimize the transmission of water. The caps in these areas would extend beyond the boundaries of the impacted soils to prevent infiltrating water near the edges from reaching the impacted soils.

In the remaining areas where impacted soils are above the NRDCSRS from 0 to 2 feet bgs and/or above the IGWSRS, soils would be excavated and transported to an offsite treatment and/or disposal facility.

Clean backfill would be placed in excavated areas, as necessary. A minimum of 2 feet of clean backfill would be required where subsurface soils remain in place above the NRDCSRS. These soil covers would be included in a deed notice (further discussed below).

Removal Volume Summary

Approximately 86,000 cubic yards of material would be excavated and disposed at an offsite disposal and/or treatment facility. Some pretreatment of impacted soils may be required in order to meet RCRA land disposal restrictions (LDRs). This would be further evaluated and presented in the CMIWP.

Institutional Controls and Monitoring

This alternative would include the implementation of institutional measures to control, limit, and monitor activities onsite. A deed notice would be implemented in accordance with N.J.A.C. 7:26C *Administrative Requirements for the Remediation of Contaminated Sites.* The deed notice will establish the restrictions for use of the property for current and subsequent owners, lessees, and operators; limits of soil impacts; engineering controls, procedures for change of ownership, and rezoning; and requirements associated with alterations, improvements, and disturbances. In accordance with N.J.A.C. 7:26-7.7, for remedial actions with engineering controls a biennial certification of the continued protectiveness of the remedial action is required.

Monitoring of groundwater in the capped areas would also be conducted to assess groundwater quality in the long term. The program would be developed as part of the CMIWP and incorporated into the existing CGMP at the Site.

6.5 Alternative 5 – Excavation, Offsite Disposal, Isolated Capping in Redevelopment Area, and Monitoring for IGW

This alternative would involve excavating impacted soils within the NMA, WMA, EMA (outside Redevelopment Area), and targeted areas of the EMA (Redevelopment Area) to control the potential for direct contact with impacted soils and minimize the potential for migration of COCs within the vadose zone. Within the EMA (Redevelopment Area), isolated areas would have low-permeability caps installed to eliminate the potential for direct contact and minimize the migration of COCs within the IGW pathway.

NMA

Impacted soils above the SRS identified in Section 3 would be excavated and transported to an offsite treatment and/or disposal facility. Remains of above-grade historical buildings would also be removed as part excavation activities. Figure 10 shows the approximate extent of impacted soils based on the SRS.

Clean backfill would be placed in excavated areas, as necessary.

WMA

To eliminate the potential for direct contact with soils above the human health ARS from 0 to 2 feet bgs and above the ERGs from 0 to 1 feet bgs, soils would be excavated and transported to an offsite treatment and/or disposal facility. Additionally, impacted soils above the water table that exceed the IGWSRS would be excavated and transported to an offsite treatment and/or disposal facility. Figure 10 shows the approximate extent of impacted soils based on these criteria.

Clean backfill would be placed in excavated areas, as necessary. A minimum of 2 feet of clean backfill would be required where subsurface soils remain in place above the human health ARS. These soil covers would be included in a deed notice (further discussed below).

EMA (outside Redevelopment Area)

To eliminate the potential for direct contact with soils above the human health ARS from 0 to 2 feet bgs, above the ERGs from 0 to 1 feet bgs, and/or above the IGWSRS, soils would be excavated and transported to an offsite treatment and/or disposal facility. Figure 10 shows the approximate extent of impacted soils based on these criteria.

Clean backfill would be placed in excavated areas, as necessary. A minimum of 2 feet of clean backfill would be required where subsurface soils remain in place above the human health ARS. These soil covers would be included in a deed notice (further discussed below).

EMA (Redevelopment Area)

A cap would be constructed in isolated areas where COC concentrations are above the IGWSRS. The proposed cap locations are shown on Figure 10. Approximately 4.1 acres of impacted soils would be capped. A low-permeability cap would be installed over the impacted soil to prevent direct contact and minimize the transmission of water. The caps in these areas would extend beyond the boundaries of the impacted soils to prevent infiltrating water near the edges from reaching the impacted soils.

In the remaining areas where impacted soils are above the NRDCSRS from 0 to 2 feet bgs and/or above the IGWSRS, soils would be excavated and transported to an offsite treatment and/or disposal facility.

Clean backfill would be placed in excavated areas, as necessary. A minimum of 2 feet of clean backfill would be required where subsurface soils remain in place above the human health ARS. These soil covers would be included in a deed notice (further discussed below).

Removal Volume Summary

Approximately 119,000 cubic yards of material would be excavated and disposed at an offsite disposal and/or treatment facility. Some pretreatment of impacted soils may be required in order to meet RCRA LDRs. This would be further evaluated and presented in the CMIWP.

Institutional Controls and Monitoring

This alternative would include the implementation of institutional measures to control, limit, and monitor activities onsite. A deed notice would be implemented in accordance with N.J.A.C. 7:26C *Administrative Requirements for the Remediation of Contaminated Sites.* The deed notice will establish the restrictions for use of the property for current and subsequent owners, lessees, and operators; limits of soil impacts; engineering controls, procedures for change of ownership, and rezoning; and requirements associated with alterations, improvements, and disturbances. In accordance with N.J.A.C. 7:26-7.7, for remedial actions with engineering controls a biennial certification of the continued protectiveness of the remedial action is required.

Monitoring of groundwater in the capped areas would also be conducted to assess groundwater quality in the long term. The program would be developed as part of the CMIWP and incorporated into the existing CGMP at the Site.

7 Evaluation of Corrective Measure Alternatives

An evaluation was conducted for each of the corrective measure alternatives presented in Section 6 to assess the general effectiveness of the alternative. The following criteria from Chapter IV of USEPA's *RCRA Corrective Action Plan* were used in this evaluation:

1. Protect human health and the environment.
2. Attain media cleanup standards (see Section 3).
3. Control source of releases to reduce or eliminate, to the extent practicable, further releases that may pose threat to human health and the environment.
4. Comply with applicable standards for management of wastes.
5. Other factors such as:
    a. Long-term reliability and effectiveness;
    b. Reduction in mobility, toxicity, and/or volume of wastes;
    c. Short-term effectiveness; and
    d. Implementability.

Implementability of the corrective measure alternative was evaluated against technical and administrative factors such as:

- Engineering and scientific feasibility of technology;
- Availability of services and resources required for implementation;
- Uncertainties associated with construction, operation, and performance; and
- Whether technology can be implemented within reasonable timeframe.

Table 7-1 summarizes the results of the alternatives evaluation.

Table 7-1 Evaluation of Corrective Measure Alternatives

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Comments
Protect Human Health and the Environment	○	◐	●	●	●	Soil removal and/or containment would reduce potential exposures. Containment would minimize potential for COCs to migrate from unsaturated soil zone to groundwater.
Attain Media Cleanup Standards	○	○	●	●	●	Capping and/or removal would meet applicable SRS.
Control Source of Releases	○	○	●	●	●	Capping and/or removal would minimize potential for further releases that may pose threat to human health and the environment.
Comply with Applicable Standards for Management of Wastes	○	○	◐	●	●	Corrective Action Management Units (CAMU) regulations may be applicable to Alternative 3.
Long-Term Reliability and Effectiveness	○	○	●	●	●	Long-term monitoring and maintenance of cap(s) and groundwater monitoring would be adequate and reliable for verifying that remedy is providing protection over time.
Reduction in Mobility, Toxicity, and/or Volume	○	○	◐	●	●	Soil removal and/or containment would reduce mobility of impacted soils. Removal with offsite disposal would reduce volume and toxicity of impacted soils at Site.
Short-Term Effectiveness	●	●	◐	◐	◐	No further action and limited action could be implemented with no short-term risks to onsite workers. Implementation of removal and containment would increase potential exposure risk to workers. Work would be performed under health and safety plan to limit worker exposure. Planned truck routes would aid in protection of community. Implementation of removal activities would result in temporary disruption of existing wetland and habitats. Excavation of material requires large-scale intrusion and material disturbance which could increase opportunity for emission and material release into environment. Best management practices would be employed to minimize impacts.
Engineering and Scientific Feasibility	●	●	●	●	●	These are proven technologies that could be readily implemented.
Availability of Services and Resources	●	●	●	●	●	Alternative could be implemented with existing contractors and equipment.
Implementation and Performance Uncertainties	●	●	◐	●	◐	CMIWP would be developed to confirm appropriate implementation methods are selected. Alternative 5 increase in volume for offsite disposal would require increased waste characterization than Alternative 4. Additional testing would be required to evaluate potential treatment needed to meet LDRs.
Implementation Timeframe	●	●	◐	◐	◐	No action does not require implementation. Limited action could be implemented in relatively short timeframe. Excavation and containment would be implemented following completion of design and permitting.

● Meets Evaluation Criteria
◐ Partially Meets Evaluation Criteria
○ Does Not Meet Evaluation Criteria

8 Proposed Corrective Measure Alternative

Based on the corrective measure alternatives evaluation, Alternative 4 – which includes excavation, offsite disposal, isolated capping, and IGW monitoring – is being proposed as the corrective measure for onsite soils. The proposed alternative will meet RAOs by reducing and controlling the potential for human and ecological exposure to impacted soils. Excavation, offsite disposal, and isolated capping of impacted soils will reduce the overall area of potential exposure to impacted material. The proposed alternative will eliminate the potential direct contact with impacted soils; thus eliminating the potential exposure pathway for soils as identified in Section 2.5.4. Additionally, offsite disposal of excavated material will reduce the overall volume of soils remaining onsite. Capping of remaining impacted soils would minimize potential for migration of constituents.

The proposed corrective measure alternative uses conventional technologies that have a demonstrated performance history at other sites. Excavation, offsite disposal, and capping are reliable controls that, with proper maintenance of the caps, constitute a permanent remedy. The long-term monitoring and maintenance of the caps will be adequate and reliable for verifying that the remedy is providing protection over time. Long-term monitoring of groundwater downgradient of the capped areas will aide in assessing groundwater quality over time and trigger any additional actions that may be required. The proposed alternative allows for beneficial reuse of the Site immediately after implementation (construction) of the remedy.

8.1 Pre-Design Activities

8.1.1 Supplemental Sampling

Existing soil data will be utilized to define the excavation limits as much as possible. However, additional samples may be needed to meet the proposed sample intervals for pre post-excavation samples. Pre post-excavation sampling would be conducted to establish final excavation limits based on the SRS identified in Section 3.

Consistent with the sampling approach previously discussion with NJDEP, pre post-excavation samples would be collected at a frequency of 1 sample for every 65 linear feet of each sidewall of the excavation, with a minimum of 1 sample from each sidewall of the excavation. One sample from the bottom of the excavation would be collected for every 1,500 square feet of bottom area with samples biased towards the highest historical concentration levels where possible.

Additional waste characterization sampling and potential stabilization testing would be required to evaluate potential pre-treatment necessary to meet LDRs.

8.1.2 Project Plan Development

A CMIWP would be developed to confirm appropriate implementation methods are selected. The CMIWP would include multiple project plans such as, but are not limited to:

- Health and Safety Plan,
- Contingency Plan,
- Spill Containment and Response Plan,
- Erosion and Sediment Control Plan, and
- Quality Assurance Project Plan.

All project plans would be completed during pre-design activities and submitted to the Agencies for approval prior to obtaining permits for corrective measure implementation.

8.2 Anticipated Permitting Requirements

Corrective measure implementation will require authorizations and approvals from state and local authorities for temporary disturbances within regulated areas. The following list of permits and approvals are anticipated based on a preliminary review of regulatory requirements for the conceptual corrective measure activities described in previous sections of this CMS.

State

- NJDEP Air Quality Permitting Program
- NJDEP Flood Hazard Individual Permit
- NJDEP Historic Preservation Office Phase 1A Cultural Resources Investigation
- NJDEP Highlands Applicability & Water Quality Management Plan Consistency Determination/Preservation Area Exemption
- NJDEP Stormwater Construction General Permit (RFA)
- New Jersey Pollutant Discharge Elimination System Storm Water Permits – quality of cap storm water runoff
- NJDEP Wetlands General Permit #4 – Hazardous Investigation and Clean-Up

Local

- Passaic County Soil Erosion and Sediment Control Approval
- Pompton Lakes and Wanaque Borough Soil Removal Permits/Minor Site Plan Approval

A more detailed description of anticipated permit requirements will be presented as part of the CMIWP and after a NJDEP pre-application meeting. These evaluations may result in a modification to this list of permitting requirements and approvals.

8.3 Draft Deed Notice

As discussed in Section 6, a deed notice would be required as part of implementation of the proposed corrective measure alternative. A deed notice would be implemented in accordance with N.J.A.C. 7:26C *Administrative Requirements for the Remediation of Contaminated Sites.* The deed notice would establish the restrictions for use of the property for current and subsequent owners, lessees, and operators; limits of soil impacts; engineering controls, procedures for change of ownership and rezoning; and requirements associated with alterations, improvements, and disturbances. In accordance with N.J.A.C. 7:26-7.7 for remedial actions with engineering controls, a biennial certification of the continued protectiveness of the corrective measure would also be required.

The deed notice is a NJDEP requirement to be included as part of the remedial action report upon completion of the remedial action. However, in their letter dated January 2, 2019 USEPA requested that a draft deed notice be included as part of the submittal of this CMS. As such, a draft deed notice is included in Appendix C for the selected corrective measure (Alternative 4). A majority of the supporting documents for the deed notice cannot be generated until completion of the design phase. The samples included in the draft deed notice are estimated locations based on the proposed caps. Final nature and extent of impacted soils would be identified after completion of the corrective measure. A detailed description of the engineering controls (caps) cannot be generated until design of the caps is completed as part of the CMIWP. As-built diagrams of engineering controls would be generated after completion of the remediation.

9 Path Forward

Preparation of a CMIWP for the proposed corrective measure alternative is contingent on Agency approval of this revised CMS. Prior to submittal of a CMIWP, pre-design activities will be completed to identify the limits of excavation areas; select an appropriate approach for excavation in each area; evaluate transportation methods; and design a cap. Upon approval of this report, the pre-design activities will be completed.

The CMIWP will be submitted to the Agencies for review within 365 days of approval of the RCRA Permit Modification for onsite soils.

10 References

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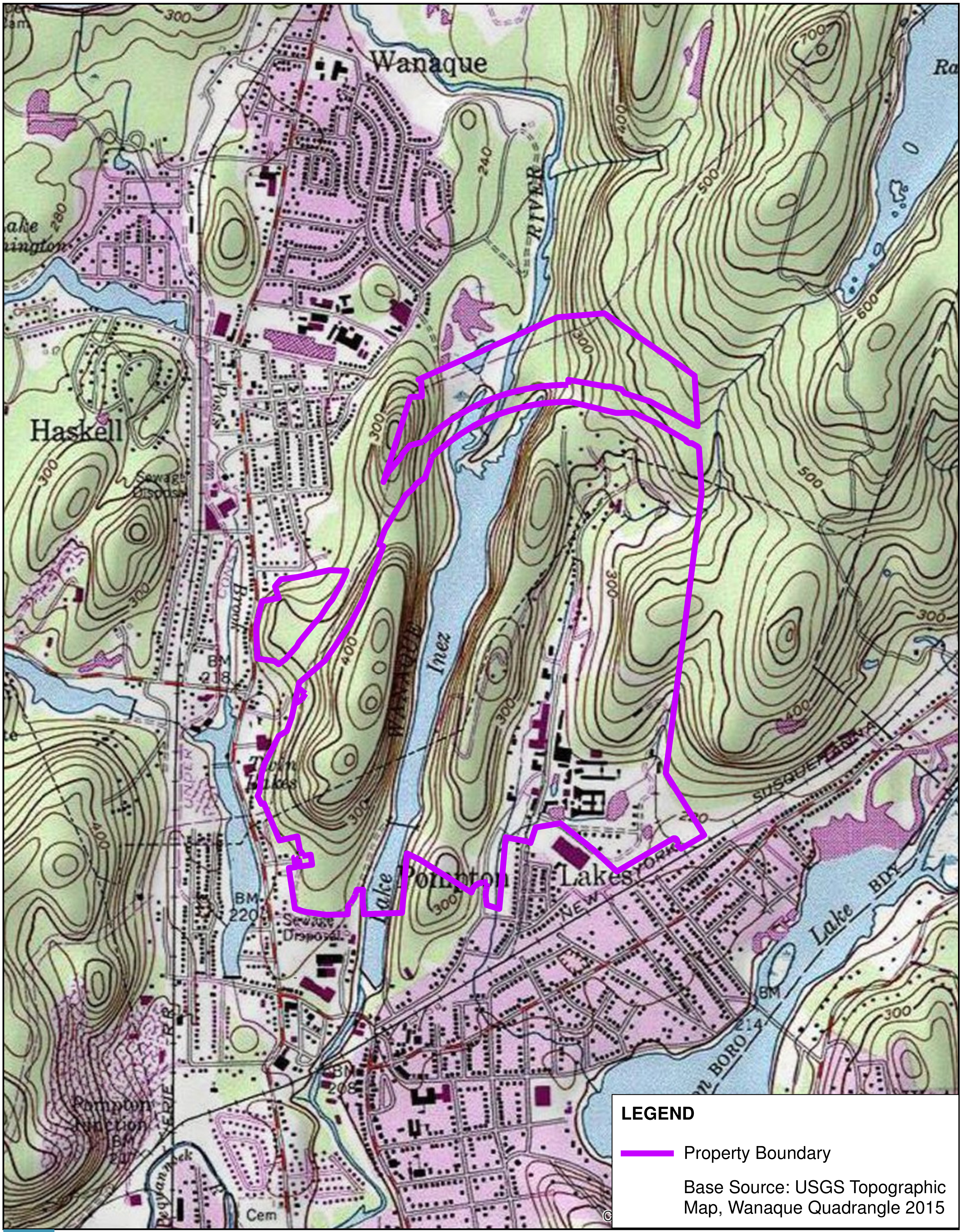
Figures

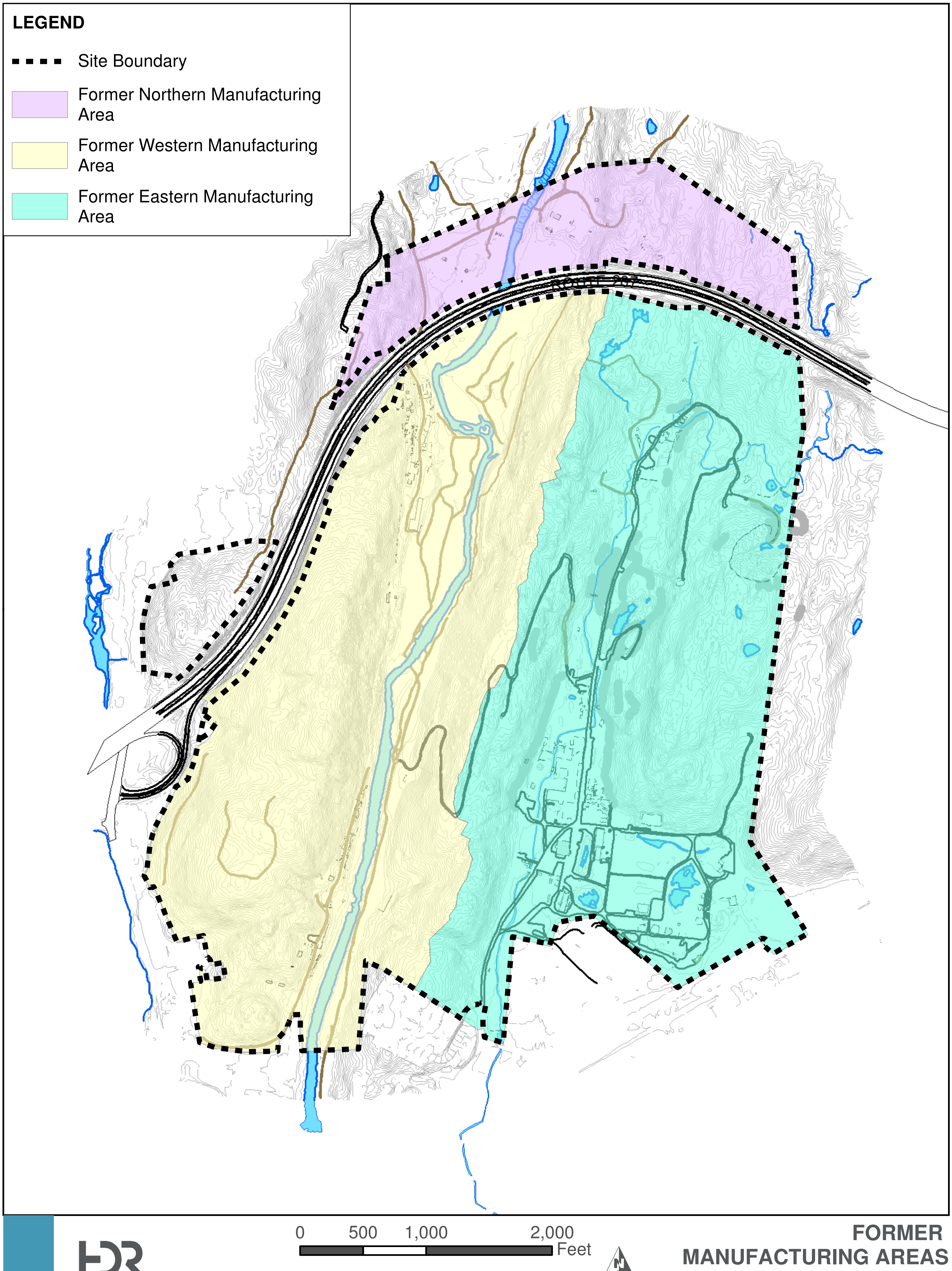


0 750 1,500 3,000 Feet

1 inch = 1,500 feet

SITE LOCATION MAP

FIGURE 1

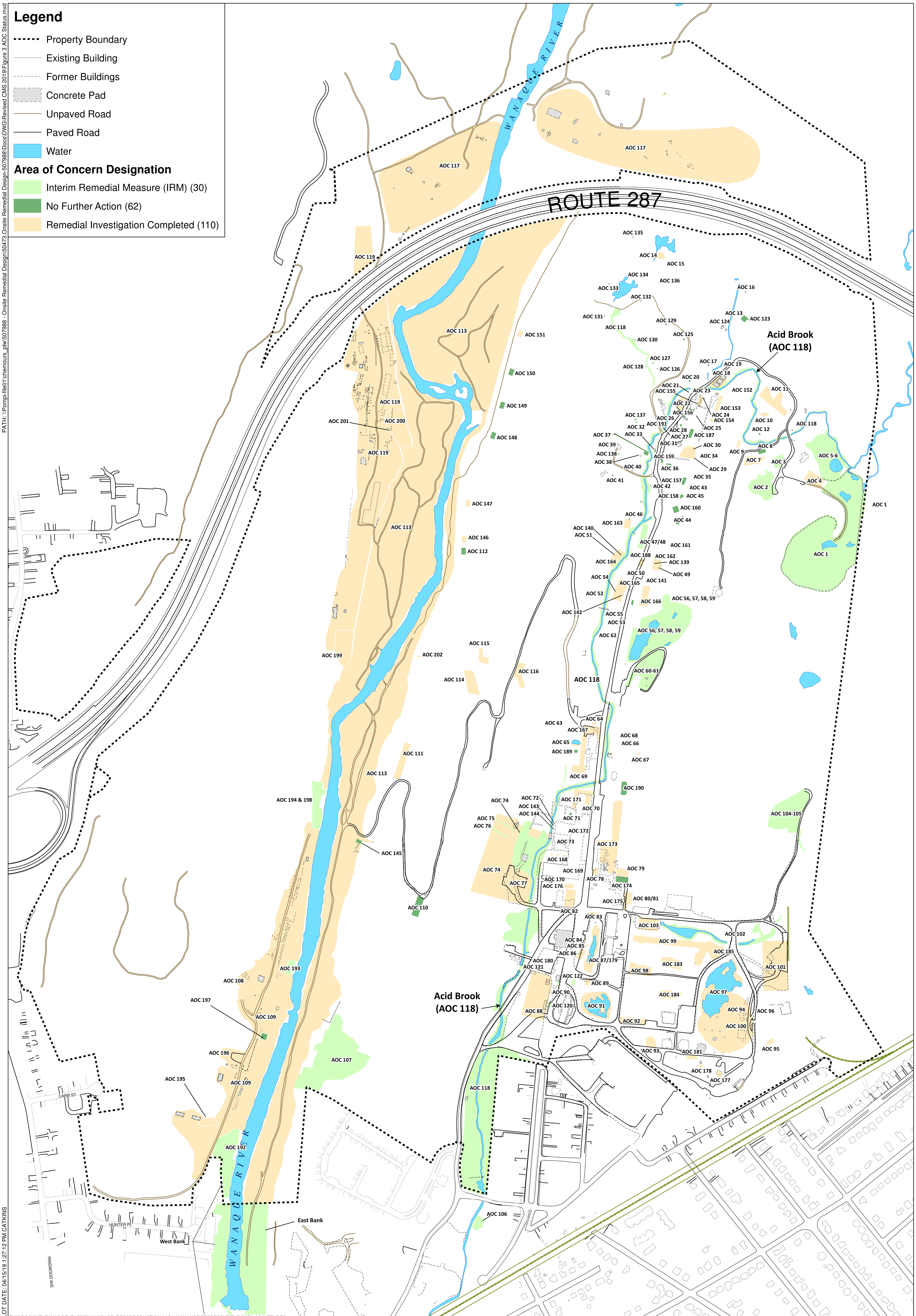


FDR

FORMER MANUFACTURING AREAS

FIGURE 2

PATH: \\POMPI-FILE01\CHEMOURS_PLW\507844 - WANAQUE RIVER VALLEY RD\48334.WANAQUE RIVER VALLEY RD - 507844\DOCS\DWG\WR CMS\FIGURE 2 BOUNDARIES OF FORMER MANUFACTURING AREAS.MXD - USER: CATKINS - DATE: 4/15/2019



PATH: \\Pompi-file01\chemours_plw\507988 - Onsite Remedial Design\50473.Onsite Remedial Design-507988\Docs\DWG\Revised CMS 2019\Figure 3 AOC Status.mxd

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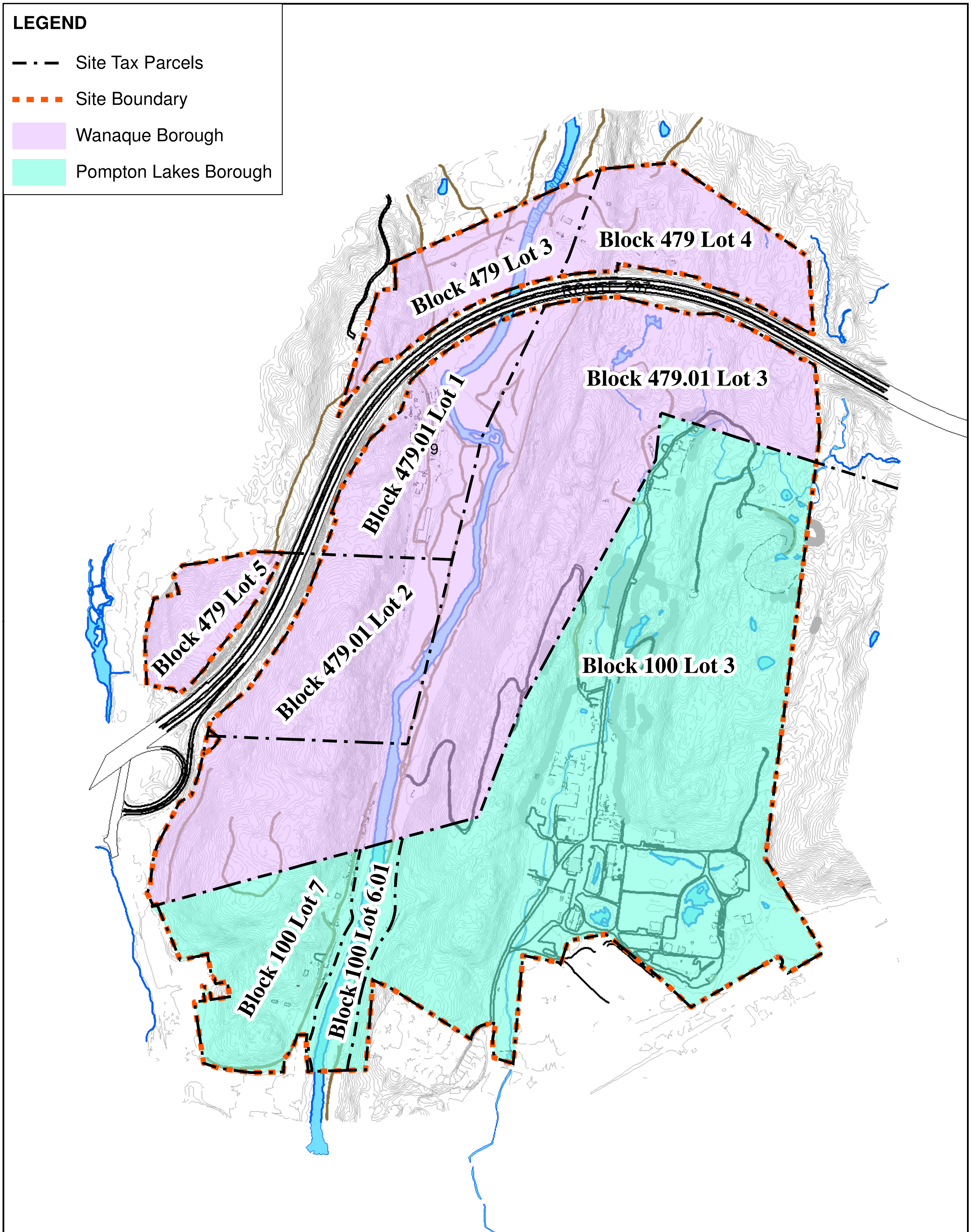
HDR

AREA OF CONCERN STATUS

FIGURE 3

POMPTON LAKES WORKS SITE
POMPTON LAKES, NEW JERSEY

0 100 200 400 600 800
Feet



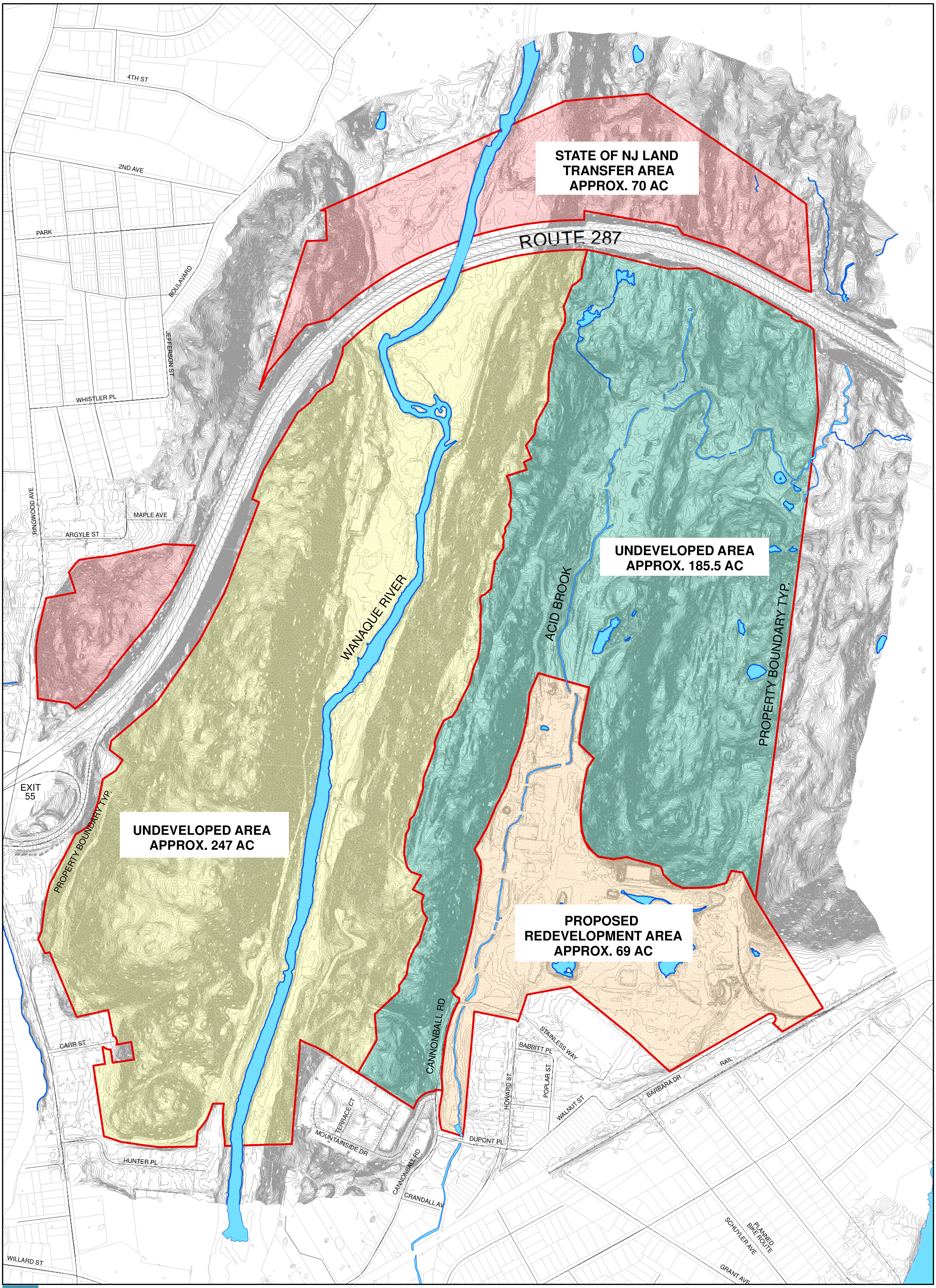
0 500 1,000 2,000 Feet

1 inch = 1,000 feet

TAX PARCELS

FIGURE 4

PATH: \\POMPI-FILE01\CHEMOURS_PLW\507988 - ONSITE REMEDIAL DESIGN\50473.ONSITE REMEDIAL DESIGN-507988\DOCS\DWG\REVISED CMS 2019\FIGURE 4 TAX PARCELS.MXD - USER: CATKINS - DATE: 4/15/2019



Legend: Land Use Areas

- PROPOSED REDEVELOPMENT AREA
- STATE OF NJ LAND TRANSFER AREA
- UNDEVELOPED AREA
- UNDEVELOPED AREA

POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

SITE REUSE CONCEPTUAL MODEL

0 300 600 1,200 Feet

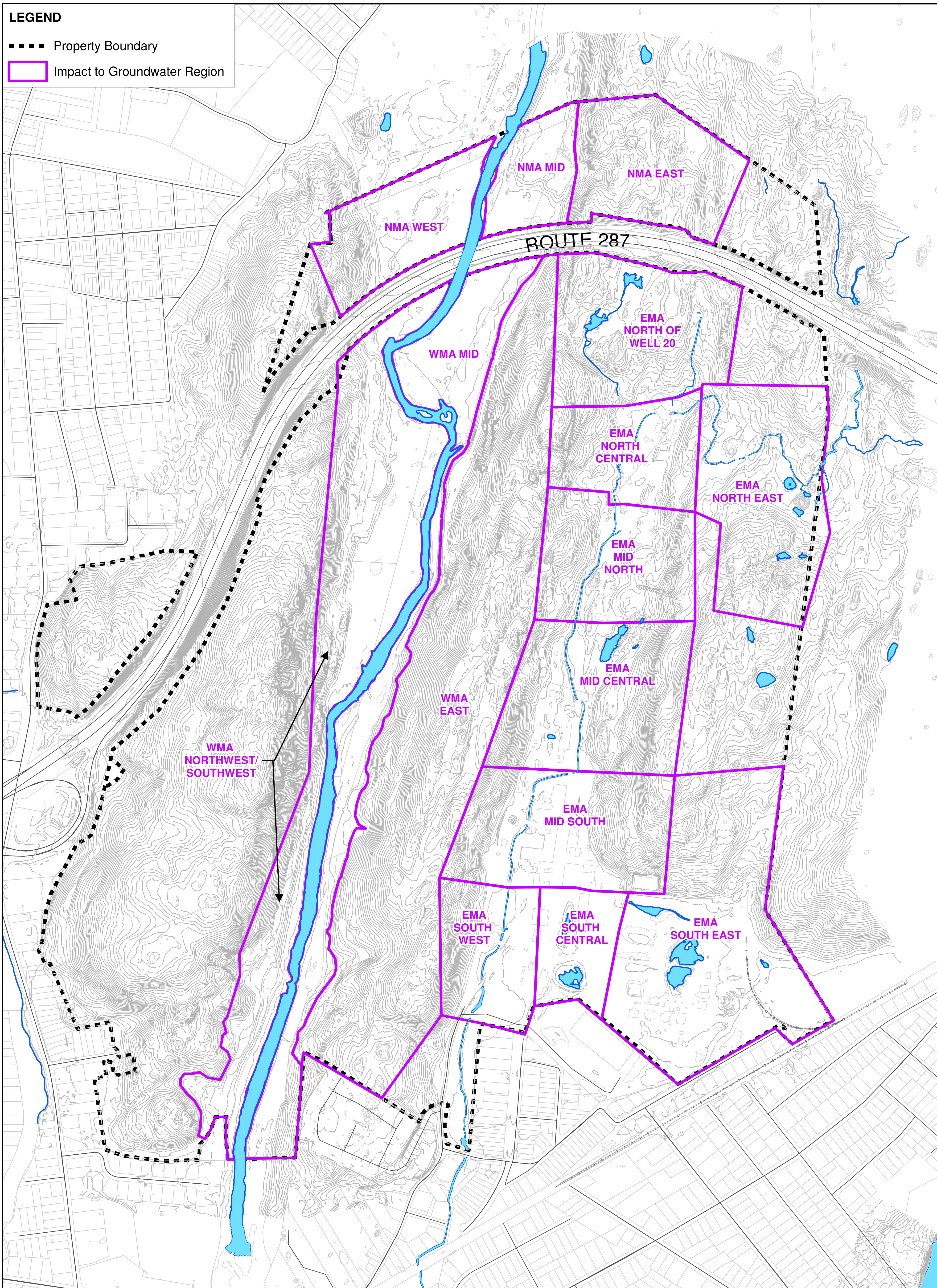
1 inch = 600 feet

FIGURE 5

HDR

PATH: \\POMPI-FILE01\CHEMOURS_PLW\507988 - ONSITE REMEDIAL DESIGN\50473.ONSITE REMEDIAL DESIGN-507988\DOCS\DWG\REVISED CMS 2019\FIGURE 5 SITE REUSE CONCEPTUAL MODEL.MXD - USER: CATKINS - DATE: 4/18/2019

FIGURE 6
AREAL EXTENT OF SAMPLE LOCATIONS
POMPTON LAKES WORKS



POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

FIGURE 7

IMPACT TO GROUNDWATER REGIONS

0 300 600 1,200 Feet
1 inch = 600 feet

HDR

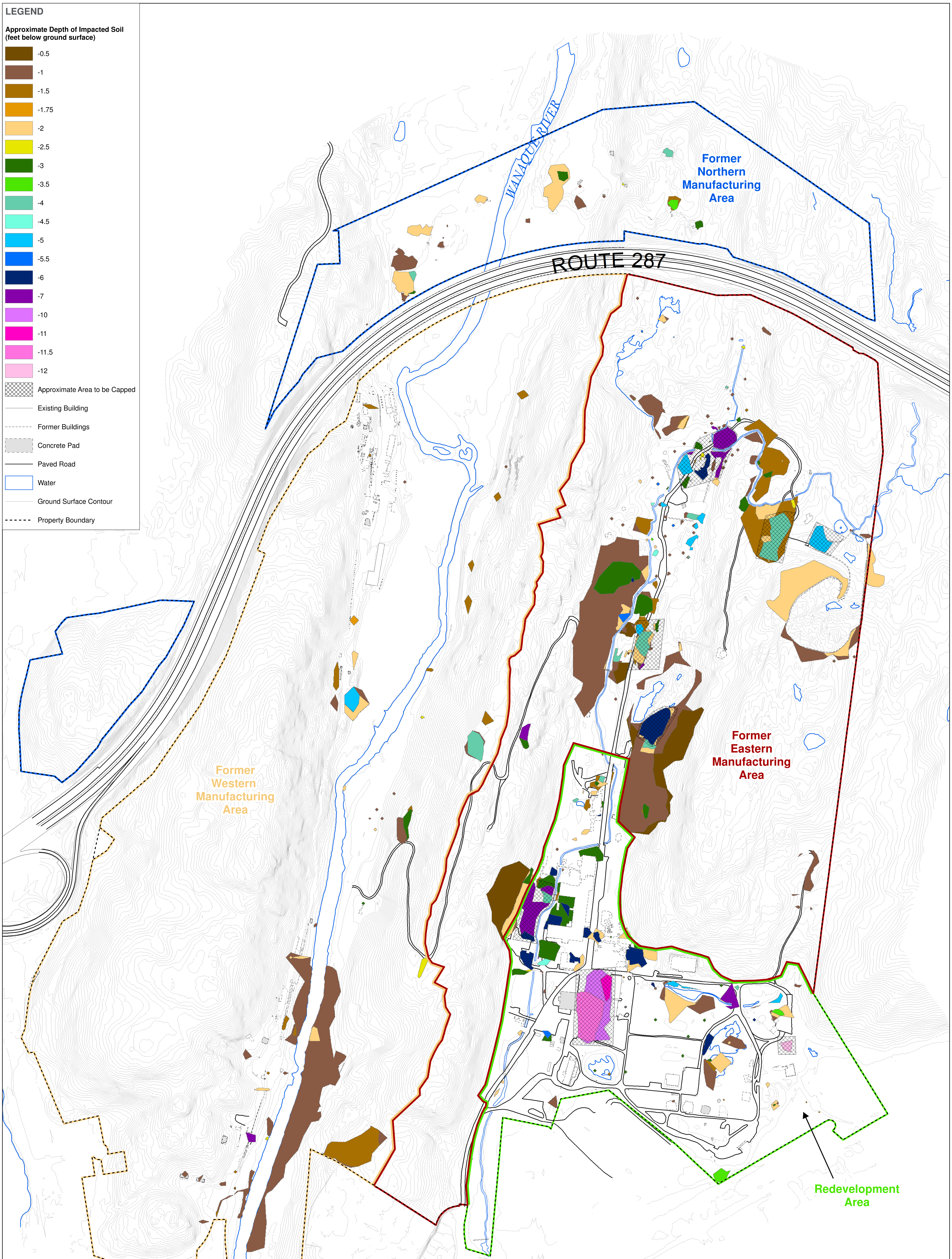
PATH: \\POMPI-FILE01\CHEMOURS_PLW\507988 - ONSITE REMEDIAL DESIGN\50473.ONSITE REMEDIAL DESIGN-507988\DOCS\DWG\REVISED CMS 2019\FIGURE 7 IGW REGIONS.MXD - USER: CATKINS - DATE: 4/15/2019

Notes:
1. Lowest of the Ecological Risk-Based Remediation Goals (ERGs), Human Health Soil Remediation Standards (HHSRS), or Impact to Groundwater Soil Remediation Standards (IGWSRS) were applied from 0 to 1 foot below grade.
2. HHSRS were applied from 1 to 2 feet below grade, except in the NMA where it was used to evaluate full depth.
3. Impact to Groundwater was evaluated per geographic region to a maximum depth of the localized water table.
4. Excavations are not anticipated within the identified capped areas.

This document was developed in color. Reproduction in black and white may not represent data as intended.

FIGURE 8
ALTERNATIVE 3
EXCAVATION, ONSITE CONSOLIDATION/CAPPING IN REDEVELOPMENT AREA, AND MONITORING FOR IGW
POMPTON LAKES WORKS

PATH: \\POMPI-FILE01\CHEMOURS_PLW\507988 - ONSITE REMEDIAL DESIGN\50473.ONSITE REMEDIAL DESIGN-507988\DOCS\DWG\REVISED CMS 2019\FIGURE 8 ALTERNATIVE 3.MXD - USER: CATKINS - DATE: 4/29/2019



Notes:
1. Lowest of the Ecological Risk-Based Remediation Goals (ERGs), Human Health Soil Remediation Standards (HHSRS), or Impact to Groundwater Soil Remediation Standards (IGWSRS) were applied from 0 to 1 foot below grade.
2. HHSRS were applied from 1 to 2 feet below grade, except in the NMA where it was used to evaluate full depth.
3. Impact to Groundwater was evaluated per geographic region to a maximum depth of the localized water table.
4. Excavations are not anticipated within the identified capped areas.

This document was developed in color. Reproduction in black and white may not represent data as intended.

HDR

FIGURE 9
ALTERNATIVE 4
EXCAVATION, OFFSITE DISPOSAL, ISOLATED CAPPING IN EMA AND REDEVELOPMENT AREA, AND MONITORING FOR IGW
POMPTON LAKES WORKS

PATH: \\POMPI-FILE01\CHEMOURS_PLW\507988 - ONSITE REMEDIAL DESIGN\50473.ONSITE REMEDIAL DESIGN-507988\DOCS\DWG\REVISED CMS 2019\FIGURE 9 ALTERNATIVE 4.MXD - USER: CATKINS - DATE: 4/29/2019

Notes:
1. Lowest of the Ecological Risk-Based Remediation Goals (ERGs), Human Health Soil Remediation Standards (HHSRS), or Impact to Groundwater Soil Remediation Standards (IGWSRS) were applied from 0 to 1 foot below grade.
2. HHSRS were applied from 1 to 2 feet below grade, except in the NMA where it was used to evaluate full depth.
3. Impact to Groundwater was evaluated per geographic region to a maximum depth of the localized water table.
4. Excavations are not anticipated within the identified capped areas.

FIGURE 10
ALTERNATIVE 5
EXCAVATION, OFFSITE DISPOSAL, ISOLATED CAPPING IN REDEVELOPMENT AREA, AND MONITORING FOR IGW
POMPTON LAKES WORKS

Appendices

Appendix A

Alternative Soil Remediation Standards

MEMO

To: David Epps – Chemours Project Director

From: Dana McCue – Senior Risk Assessor,
Gary Long – Sediment Assessment & Remediation Service Line Leader

CC: Alicia Lyding - HDR

Date: April 26, 2019

Re: Alternative Soil Remediation Standards, Pompton Lakes Works Site, Pompton, New Jersey

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This memorandum describes the development of alternative soil remediation standards (SRS) for the Pompton Lakes Works (PLW) site located in Pompton Lakes, New Jersey (the site). The alternative SRS values will be used to support the Corrective Measures Study (CMS) for the former manufacturing areas. In particular, the alternative SRS values will form the basis to determine the extent (i.e., define the horizontal and vertical limits) of remedial action. The Site is divided into the following three former manufacturing areas:

- Eastern Manufacturing Area (EMA) located east of the Wanaque River, south of New Jersey Interstate 287 (I-287), and west of Ringwoood State Park.
- Northern Manufacturing Area (NMA) located north of I-287 along the Wanaque River; and,
- Western Manufacturing Area (WMA) located south of I-287 along the Wanaque River.

The proposed future land used is discussed in more detail in the CMS Section 2.3. Based on that land use description, the applicable remediation standards for the NMA (State of New Jersey Land Transfer Area) will be the Residential Direct Contact Soil Remediation Standards (RDCSRS). The applicable remediation standards for the Redevelopment Area of the EMA identified for industrial/commercial reuse will be the Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS). Direct contact SRS values for protection of residential and non-residential receptors are promulgated in the New Jersey Administrative Code (NJAC) 7:26D – Remediation Standards (date last amended September 18, 2017).

Consistent with Section 7 and Appendix 4 of NJAC 7:26D, alternative remediation standards can be developed for the protection of human health based on future use of the Site. For the purpose of developing a remedial standard, passive recreational land use (such as walking or hiking) was considered for both the WMA and EMA (outside Redevelopment Area). NJDEP defines recreational purposes as site-specific uses that do not reflect either a residential or nonresidential land use scenario. There was the assumption that no public access to the EMA (outside Redevelopment Area) will be allowed. Alternative SRS values were, therefore, developed in this memorandum.

Alternative SRS values for the protection of human health direct contact exposure pathways were calculated consistent with procedures found in NJAC 7:26D, and the New Jersey Department of Environmental Protection (NJDEP) guidance documents *Development of Alternative Remediation*

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Standards for the Ingestion-Dermal Pathways (NJDEP, 2008a) and *Development of Alternative Remediation Standards for the Inhalation Pathway* (NJDEP, 2008b). Alternative SRS values protective of multiple-route exposure were calculated using USEPA risk assessment methodology (USEPA, 1989). 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 alternative SRS values, the equations are rearranged to solve for an allowable constituent concentration based on a target risk level (hazard quotient of 1 or cancer risk of 10^{-6}), magnitude of exposure, and toxicity.

Ecological risk-based remediation goals (ERGs) were developed for soil for the protection of wildlife receptors consistent with NJDEP's *Ecological Evaluation Technical Guidance* (NJDEP, 2012). ERGs were estimated as the concentration in soil equivalent to a lowest observable adverse effects level (LOAEL) dose to wildlife receptors.

This memorandum has been revised from the URS August 2014 version to address United States Environmental Protection Agency (USEPA) Region 2 and NJDEP comments received by Chemours in a letter dated May 31, 2017; responses from Chemours in a letter to USEPA and NJDEP dated August 18, 2017; discussions with USEPA, NJDEP, Chemours, AECOM[1] and EHS Support during a meeting on November 14, 2018; and, USEPA Region 2 and NJDEP comments received by Chemours in a letter dated January 2, 2019. Specifically, the Adult Lead Model was revised and alternative SRS values were updated for the following constituents to address changes in toxicity values: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a, h)anthracene, and indeno(1,2,3-cd)pyrene.

Regarding the alternative SRS values for lead, the values proposed in the August 2014 memorandum were selected by USEPA Region 2 and NJDEP after running USEPA's Adult Lead Model (ALM) using various inputs, including a blood lead level (BLL) of 5 micrograms per deciliter (µg/dL) and a BLL of 10 µg/dL. USEPA Region 2 has recently implemented an updated regional risk reduction goal of no more than 5% of the target population exceeding a BLL of 5 µg/dL. As such, the alternative SRS value for lead was revised using USEPA's ALM with USEPA Region 2's reduced risk reduction goal and currently recommended USEPA default input values, except for previously agreed site-specific values for exposure frequency and averaging time. The application of this model in this manner is consistent with the Rolling Knolls Superfund Site, which USEPA and NJDEP mentioned as an example during the November 2018 meeting.

Alternative SRS Values for Protection of Human Health

Alternative SRS values are intended to serve as delineation criteria for shallow soil to evaluate the extent of potential remedial action on the basis of human health exposure.

The following sections describe the toxicity values and exposure assumptions used in the alternative SRS derivation for each of the constituents listed in the table below and on the following page. These constituents of potential concern (COPCs) for human health direct contact exposure pathways were identified during Remedial Investigations (RI) conducted for each area (Parsons, 2010a; Parsons, 2010b; Parsons, 2010c). A summary of the alternative SRS values calculated for the EMA (outside Redevelopment Area) and WMA are provided in Tables A-1 and B-1, respectively.

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[1] URS and AECOM merged to form one company in October 2014

COPCs for Human Health	EMA (outside Redevelopment Area)	WMA
Metals		
Antimony	●	●
Cadmium	●	
Copper	●	●
Lead	●	●
Mercury	●	●
Selenium		●
Vanadium	●	
Polycyclic Aromatic Hydrocarbons (PAHs)		
Benzo(a)anthracene	●	●
Benzo(b)fluoranthene	●	●
Benzo(a)pyrene	●	●
Dibenz(a,h)anthracene	●	●
Indeno(1,2,3-cd)pyrene	●	●
Naphthalene	●	
Volatile Organic Compounds (VOCs)		
Carbon tetrachloride	●	
Chloroform	●	
Tetrachloroethylene	●	
Trichloroethene	●	
Polychlorinated Biphenyls (PCBs)		
PCBs	●	

Toxicity Values

Tables provided in Appendix A (for the EMA) and Appendix B (for the WMA) lists the numerical toxicity values that were used in the alternative SRS derivation. The values are reference doses (RfDs) or reference concentrations (RfCs) for systemic (noncancer) effects and slope factors (SFs) or unit risk factors (URFs) for cancer effects. Consistent with NJDEP alternative SRS guidance (NJDEP, 2008a and 2008b), toxicity values specific to the oral and inhalation pathways were obtained from USEPA's Integrated Risk Information System (IRIS) online database (USEPA, 2018a). Where a toxicity value was not available in IRIS the following hierarchy of sources was reviewed to identify the most up-to-date toxicity information:

- Provisional toxicity values obtained from the USEPA Environmental Criteria and Assessment Office (ECAO) as reported in the USEPA's Regional Screening Level Table (USEPA, 2018b).
- Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs) (ATSDR, 2018).

- California EPA toxicity values as cited in the USEPA's Regional Screening Level Table (USEPA, 2018b).
- Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a)

Oral toxicity values used to evaluate dermal absorption were considered for adjustment in the alternative SRS derivation 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 are adjusted for gastrointestinal absorption only where chemical-specific gastrointestinal absorption values were less than 50%. The following site-specific constituents met this criterion: antimony, cadmium, and mercury.

Recommendations presented in the USEPA *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (USEPA, 2005a) were utilized in the alternative SRS derivation. 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). Age-dependent adjustment factors (ADAFs) for young child (age 2 to 6 years of age) and youth (age 7 to 16 years of age) recreational users are detailed in the appendix tables.

Consistent with recommendations in USEPA's IRIS toxicity assessment for trichloroethene (TCE), the kidney risk for TCE was assessed using the mutagenic equations and the liver and non-Hodgkin lymphoma (NHL) risk was addressed using the standard cancer equations. Toxicity factors appropriate for the aforementioned target organ are detailed in Appendix A (for the East WMA). TCE is not a site-specific constituent for the WMA.

Exposure Assumptions

Tables A2 – A6 and Tables B2 - B6 detail the calculation of the alternative SRS values for the direct contact and inhalation pathways estimated for young child, youth and adult receptors using the EMA (outside Redevelopment Area) or WMA for recreational uses. A young child was assumed to be age 2 to 6 years, since walking and hiking activities for a child younger than 2 years of age would be unlikely due to the uneven and rugged terrain. In addition, a child younger than 2 years of age would likely spend most of their time carried by an adult or in a stroller (where usable).

The alternative SRS values were calculated using the assumptions listed in the tables. The assumptions are conservative (likely to overestimate actual exposure) but can be used for developing remediation standards. As shown in the tables, exposure assumptions were based on a combination of NJDEP recommended values, USEPA recommended values and professional judgment considering site-specific information. Rationale for selection of these exposure assumptions are detailed below.

- **Exposure Time, Frequency and Duration** - Based on professional judgment, conservative estimates of exposure time, frequency and duration were assumed for recreational users of the WMA, where passive recreational use such as walking or hiking will be allowed. It was assumed that potential receptors would visit the WMA more frequently in the summer months (5 days per week) and less frequently in the spring and fall months (2 days per week). It was assumed that the ground is frozen or covered three months out of the year with snow. This value (108 days per year) is considered consistent with activity patterns discussed in the USEPA's *Exposure Factors Handbook* (USEPA, 2011) and the range of values recommended by other states and regions for recreational land use (such as Maine – 90 days per year and Virginia – 195 days per year).

For the EMA (outside Redevelopment Area) it was assumed that no public access will be allowed. However, recreational trespassing activities were considered. As a result, it was assumed potential receptors would visit the area 3 days per week in the summer months and 2 days per week in the spring and fall months (or 84 days per year).

For both areas, as recommended by NJDEP, each visit was assumed to last four hours. This value exceeds USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011). The exposure time variable is applicable to the inhalation pathway calculations only.

- **Body Surface Area** - Using age-specific body part surface area measurements, a value of 4,500 cm^2 was calculated for adolescents (age 7 to 16 years) (USEPA, 2008). USEPA recommended values (2,690 cm^2 and 6,032 cm^2) were used for young child and adult receptors, respectively (USEPA, 2014). Receptors were assumed to wear short-sleeved shirts and shorts with shoes; therefore, the exposed skin surface is limited to head, hands, forearms, and lower legs. These assumptions are considered reasonably conservative since exposure is assumed to also occur in cooler weather months when additional clothing (and less exposed surface area) is more likely.
- **Adherence Factors** – Recommended soil adherence factors for youth soccer players (0.04 mg/cm^2 – event) was used for child and youth recreational users and is considered representative of sitting, walking or other low to medium intensity activities expected to occur in the EMA (outside Redevelopment Area) or WMA. Recommended soil adherence factors for adult residents (0.07 mg/cm^2-event) were used for adult recreational users (USEPA, 2004a).

Lead Evaluation

Lead does not have USEPA-established toxicity values (such as an RfD); and, therefore development of alternative SRS values cannot be performed in the same manner as for other constituents. As a result, USEPA's *Adult Lead Model* (ALM) (USEPA, 2009) and USEPA updates to the ALM (USEPA, 2017) were used to calculate the alternative SRS values.

The ALM was used to estimate an average (arithmetic mean) soil lead concentration that is not expected to result in a greater than 5% probability that the fetus of an adult woman of child-bearing age has a blood lead level exceeding the level of concern of 5 micrograms per deciliter (µg/dL) of blood. Therefore, soil lead concentrations that are protective of fetuses and children are also considered protective for teenagers and adults (USEPA, 2016).

ALM guidance states that the exposure duration (ED) should be sufficiently long to allow blood lead concentrations to approach quasi-steady state (USEPA, 2016). Based on estimates of the first order elimination half-life for lead in blood of approximately 30 days for adults (Rabinowitz, et al., 1976; Chamberlain et al., 1978), a constant lead intake rate over a duration of 90 days would be expected to achieve a blood lead concentration that is sufficiently close to a quasi-steady state (USEPA, 2003). This is the minimum exposure duration (exposure duration is also used as the averaging time in the ALM) to which this methodology should be applied. A minimum frequency of exposure of 1 day per week is also recommended (USEPA, 2003). Therefore, the minimum amount of exposure necessary for the ALM to be used to predict PbB levels in fetuses of adult recreational users at the site is at least once per week for at least 13 consecutive weeks. The exposure factors for the recreational user will meet the minimum requirements of the ALM.

Tables A-7 and B-7 details the ALM equations, model input parameters, and results of the ALM. Default USEPA recommended input parameter values were used in the ALM with the exception of values for exposure frequency (EF) and averaging time (AT). Site-specific EF and AT values were consistent with those discussed in the prior section. In general, USEPA recommends the use of central tendency exposure factors for input in the ALM since the model output is an estimate of the 95th percentile (i.e., an RME) of blood lead levels. The ALM generated a preliminary remediation goal (PRG) based on baseline (PbBo) and geometric standard deviations (GSDi) for blood lead levels recommended by USEPA in the most recent iteration of the model. PRGs calculated using the ALM represent the average concentration (such as an arithmetic mean) in soil (USEPA, 2009).

Application of Alternative SRS Values for Protection of Human Health

In determining compliance with remediation standards during remedial action, SRS values for protection of human health are based on the lower of the direct contact SRS values and impact to groundwater (IGW) SRS values. This memorandum has developed alternative SRS values protective of direct contact pathways. The applicability of SRS values protective of the IGW pathway are discussed in the CMS.

Tables A-1 and B-1 provide a summary of the alternative SRS values calculated for the EMA (outside Redevelopment Area) and WMA, respectively. The lower of the young child, youth and adult values for the carcinogenic and non-carcinogenic endpoints for each pathway are shown in the tables. For lead, in agreement with NJDEP, the value derived using the Adult Lead Model is shown in the tables. The alternative SRS values presented in Tables A-1 and B-1 should not be considered a "not-to-exceed" concentration during remedial action. Consistent with NJDEP's *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (dated September 2012), compliance with the SRS values can be achieved using either single-point compliance or compliance averaging. Several averaging methods can be used including, but not limited to, the arithmetic mean, the 95 percent upper confidence limit of the mean (UCL_{95}), spatially-weighted averaging (e.g., Thiessen polygons) or 75%/10X rule. The alternative SRS values are considered applicable to the surface vertical zone (0 to 2 feet bgs).

Development of Ecological Risk-Based Remediation Goals

Ecological risk-based remediation goals (ERGs) for soil were developed for the protection of wildlife receptors that may be exposed to constituents of potential ecological concern (COPECs) in soil at the site. Consistent with NJDEP's *Ecological Evaluation Technical Guidance*, these numeric goals are intended to serve as delineation criteria for soils to evaluate the extent of potential remedial action on the basis of ecological risk (NJDEP, 2012).

ERGs for the protection of ecological receptors were evaluated for COPECs identified in Baseline Ecological Evaluations (BEEs) completed for the following areas of the site:

- EMA – Mid and North Plant areas (URS, 2010a presented as Appendix D in Parsons, 2010a)
- NMA (URS, 2010b presented as Appendix D in Parsons, 2010b)
- WMA (URS, 2010c presented as Appendix F in Parsons, 2010c)

ERGs were not derived for the South Plant area of the EMA due to the lack of environmental sensitive natural resources (ESNRs) identified in this plant region in the BEE and the anticipated redevelopment of this area for commercial use (URS, 2010a).

COPECs identified in site areas containing habitat and potentially complete ecological exposure pathways, as identified in the BEEs include:

Constituent of Potential Ecological Concern (COPEC)	EMA[1]	WMA	NMA
Metals			
Antimony	●	●	
Arsenic	●	●	●
Barium	●		
Cadmium	●	●	
Chromium	●	●	
Cobalt	●		
Copper	●	●	●
Lead	●	●	●
Manganese	●		
Mercury	●	●	●
Nickel	●	●	
Selenium	●	●	●
Silver	●	●	
Thallium	●	●	
Vanadium	●		
Zinc	●	●	●
Cyanide	❍		
Volatile Organic Compounds (VOCs)			
Tetrachloroethylene	❍		
Polycyclic Aromatic Hydrocarbons (PAHs)			
Total Low Molecular Weight (LMW) PAHs	●		
Total High Molecular Weight (HMW) PAHs	●	●	●
Other Semi-volatile Organic Compounds (SVOCs)			
Bis(2-ethylhexyl)phthalate	❍		

Notes:

●, ERGs derived for identified COPEC

❍, ERGs not derived for identified COPEC

1, COPECs identified in the EMA include only data from the Mid and North Plant areas as defined in the BEEs

ERGs were derived for 16 metals, low molecular weight polycyclic aromatic hydrocarbons (LMW PAHs), and high molecular weight PAHs (HMW PAHs) identified as COPECs in the BEEs. ERGs were not derived for cyanide, tetrachloroethylene (PCE), and bis(2-ethylhexyl)phthalate (BEHP) due to low frequency of exceedance of screening criteria and limited exceedances of screening criteria in samples collected from forested and wetland habitats identified in the EMA (URS, 2010a). Forested and wetland areas in the

EMA provide greater habitat to support ecological receptors relative to the developed portions of the former manufacturing area (URS, 2010a). As reported in the BEE conducted for the EMA, cyanide concentrations in surface soils exceeded ecological screening criteria in only two of 18 samples evaluated in the Mid and North Plants; the two soil samples containing cyanide concentrations exceeding ecological screening criteria were collected within the former manufacturing area of the Mid Plant region and not in forest and wetland habitats identified in the BEE (URS, 2010a). PCE concentrations exceeded soil screening criteria in only two of 15 samples collected within the Mid and North Plant areas of the EMA. Only one exceedance of PCE was located in areas identified as ecological habitat in the BEE (URS, 2010a). BEHP concentrations exceeded ecological screening criteria in only one of 71 samples in the EMA; the sample with the BEHP concentration exceeding the soil screening criterion was located within the former manufacturing area where ecological habitat is limited. Based on the limited frequency of exceedances of the conservative ecological soil screening criteria presented in the BEE, the derivation of ERGs was not warranted for these constituents.

As summarized in Table C-1, ERGs were derived based on dietary intake models developed for the protection of wildlife species representative of the primary trophic groups that may be exposed to soils in the EMA (Mid and North Plants), WMA, and NMA (NJDEP, 2012; USEPA, 1997b). Information supporting the calculations of ERGs is presented in Tables C-2 through C-5. The following sections present the methods used to derive ERGs based on wildlife exposure.

Derivation of ERGs for the Protection of Wildlife

ERGs for the protection of wildlife were derived consistent with the approach presented in USEPA guidance for developing Ecological Soil Screening Levels (Eco-SSLs; USEPA 2005b) and NJDEP's *Ecological Evaluation Technical Guidance* (NJDEP, 2012). ERGs were established by calculating the estimated daily dose to a receptor that is equivalent to a LOAEL using the exposure model represented in the equation presented in Table C-5.

Consistent with the development of Eco-SSLs, ERGs for the site were calculated for wildlife receptors that are representative of the primary trophic groups that may be exposed to terrestrial soils at the site. With the exception of one avian and one mammalian receptor, the receptors selected for the calculation of ERGs were identical to the receptors used in the derivation of Eco-SSLs. American robin was selected as a more appropriate receptor to represent avian invertivore exposure than American woodcock used in Eco-SSL development; red fox was selected as a more appropriate mammalian carnivore for the site than long-tailed weasel used in the derivation of Eco-SSLs. American robin and red fox were considered to be more appropriate receptors because they are more common and representative of the primary trophic groups at the site.

Receptor Exposure Parameters

Exposure parameters, including body weights, 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 C-1). Exposure parameters for American robin and red fox were derived from literature sources of wildlife exposure parameters as indicated in Table C-1 (Sample et al., 1994; Nagy, 2001; Beyer et al., 1994).

Estimation of Bioaccumulation

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

Bioaccumulation estimates for mercury and thallium, constituents not included in the development of Eco-SSLs, were obtained from literature-based bioaccumulation studies. Total mercury bioaccumulation from soil to biota was estimated based on the recommended single variable regression models developed in terrestrial bioaccumulation studies (Bechtel-Jacobs 1998; Sample et al. 1999; Sample et al. 1998b). Thallium uptake into terrestrial biota was estimated based on the bioaccumulation factor presented in Baes et al. (1984) for plant uptake, USCHPPM (2004) for soil invertebrate uptake, and Sample et al. (1998b) for small mammal uptake. BAFs and regression model equations and input variables use to estimate uptake for each COPEC are presented in Table C-3.

Toxicity Reference Values (TRVs)

Toxicity reference values (TRVs) used in the derivation of ERGs were calculated based on LOAELs obtained from toxicological data compiled for the derivation of Eco-SSLs and other literature sources. 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 TRVs in the calculation of ERGs to represent potential threshold concentrations above which adverse ecological effects may occur. As a result, ERGs 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.

With the exception of the TRVs selected for mercury, thallium, and avian exposure to PAHs, LOAELs used in the calculation of ERGs were obtained from toxicological data compiled for the derivation of Eco-SSLs (Table C-4). Studies included in the derivation of Eco-SSLs were compiled from comprehensive literature searches and screened by a rigorous data evaluation process to identify publications meeting minimum acceptance criteria (USEPA 2005b). The geometric mean of LOAELs for growth and reproduction endpoints reported from the studies meeting Eco-SSL acceptance criteria were used as TRVs for the calculation of ERGs for the site (Table C-4).

Literature studies and toxicological reviews were used to derive TRVs for mercury, thallium, and avian exposure to PAHs (Table C-4). For avian exposure to mercury, the LOAEL for inorganic mercury reported by Sample et al. (1996) was used in the calculation. No LOAEL was reported by Sample et al. (1996) for mammals exposed to inorganic mercury; therefore, the ERG for mammals exposed to inorganic mercury was conservatively based on the no observable adverse effects level (NOAEL) reported by Sample et al. (1996). A mammalian TRV for exposure to thallium was obtained from a review of toxicological studies presented in USCHPPM (2007). TRVs for avian exposure to LMW and HMW PAHs were derived from studies by Patton and Dieter (1980) and Trust et al. (1994), respectively. Insufficient data were available in the literature to support the development of avian TRVs for antimony, barium, and thallium.

Calculation of Soil ERGs for the Protection of Wildlife

Using Equation 1 and the input variables described in the preceding sections, the ERGs were solved iteratively for each receptor by adjusting the soil concentration (C_s) until the EDD was equivalent to the

LOAEL-based TRV. The soil concentration that resulted in an EDD equivalent to the LOAEL was established as the ERG for that receptor. Calculations of ERGs for each representative receptor are presented in Table C-5. The lowest ERG calculated for avian and mammalian receptors, as shown in bold type in Table C-5, was selected as the ERG protective of wildlife exposure for each respective COPEC.

Application of Soil ERGs for Protection of Wildlife Receptors

In determining compliance and protectiveness of wildlife receptors, the type of soil (hydric vs non-hydric) needs to be considered. The soil ERG derived for mercury, which was based on uptake and exposure to inorganic forms of mercury, may not be applicable in hydric soils where the production of methylmercury, a more toxic and bioaccumulative form, is likely greater relative to upland soils (Selvendiran et al., 2008; Skyllberg et al., 2003; St. Louis et al., 1996; Rudd, 1995). Soil ERGs derived using the approach described in the preceding sections are intended for application to upland (i.e., non-hydric) soils within the EMA, NMA, WMA where habitat exists and ecological pathways are complete. The soil ERG derived for mercury, which was based on uptake and exposure to inorganic forms of mercury, may not be applicable in hydric soils where the production of methylmercury, a more toxic and bioaccumulative form, is likely greater relative to upland soils (Selvendiran et al., 2008; Skyllberg et al., 2003; St. Louis et al., 1996; Rudd, 1995).

As specified in NJDEP's *Ecological Evaluation Technical Guidance*, ERGs are intended to serve as delineation criteria for soils in determining the potential extent of remedial action (NJDEP, 2012). However, the calculated ERG value, as described in the preceding sections, represents the concentration that may potentially result in adverse effects to wildlife through integrated exposure over the entire foraging range of each representative receptor. As a result, the ERG does 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.

To evaluate the need for remedial action based on wildlife exposure, soil ERGs summarized in Table C-1 will be compared to the 95 percent upper confidence limit of the arithmetic mean concentration (UCL_{95}) calculated for each COPEC for the exposure areas within the site. If the UCL_{95} exceeds the ERG for a given COPEC, the iterative truncation method will be used to identify the maximum soil concentration to be addressed through remedial action to reduce the overall exposure point concentration below the ERG. As described in USEPA (2004b), iterative truncation involves removing (truncating) maximum values, replacing the next highest value with the concentration in clean fill, and calculating the hypothetical post-remediation concentration. In accordance with USEPA guidance (2004b), the UCL_{95} will be calculated for the data set following each iteration with the USEPA software program ProUCL Ver. 4.1 until the UCL_{95} exposure point concentration is at or below the ERG.

Alternative SRS Summary

A summary table of the alternative SRS values for protection of human health and ERGs for protection of wildlife receptors is provided on the following page for site-specific constituents identified for each area. The most conservative (or lowest) of the alternative SRS values and ERGs should be used to evaluate compliance during remedial action. For completeness, the table also includes generic RDCSRS and NRDCSRS values.

Analyte	Human Health Soil Remediation Standards (mg/kg)				Ecological Risk-Based Remediation Standards (mg/kg)
	Alternative SRS		NRDCSRS	RDCSRS	
	EMA (outside Redevelopment Area)	WMA	EMA (Redevelopment Area)	NMA (State of NJ Land Transfer Area)	
Antimony	140	110	-	-	62
Arsenic	19	57.12[1]	19	57.12[1]	153.5
Barium	-	-	-	-	3,270
Cadmium	300	-	-	-	5.7
Chromium	-	-	-	-	455
Cobalt	-	-	-	-	521
Copper	14000	11000	45000	-	1,100
Lead	2000	1600	800	400	892
Manganese	-	-	-	-	9,091
Mercury	110	82	65	-	20.4
Nickel	-	-	-	-	609
Selenium	-	1400	-	-	5
Silver	-	-	-	-	181
Thallium	-	-	-	-	4.3
Vanadium	1800	-	1100	-	62
Zinc	-	-	-	-	1,507
LMW PAHs					382
HMW PAHs					47.5
Benzo(a)anthracene	19	15	17	-	
Benzo(b)fluoranthene	19	15	17	-	
Benzo(a)pyrene	1.9	1.5	2	0.5	
Dibenz(a,h)anthracene	1.9	1.5	2	-	
Indeno(1,2,3-cd)pyrene	19	15	17	-	
Naphthalene	140	-	17	-	
Carbon tetrachloride	40	-	-	-	**
Chloroform	20	-	2	-	**
Tetrachloroethylene	1200	-	1500	-	**
Trichloroethene	70	-	10	-	**
PCBs	2	-	1	-	**

LMW PAHs, low molecular weight polycyclic aromatic hydrocarbons
HMW PAHs, high molecular weight polycyclic aromatic hydrocarbons
'- Not a constituent of concern for human health identified in the RIs (see earlier discussion)
** Not a COPEC identified in the BEEs or an ERG not derived (see earlier discussion)
[1] Arsenic background value further discussed in *Revised Draft Onsite Soils Corrective Measures Study.*

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URS. 2010c. Western Manufacturing Area Baseline Ecological Evaluation. DuPont Pompton Lakes Works. June 2010.

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USEPA. 2017. Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters and the Integrated Exposure Uptake Biokinetic Model's Default Maternal Blood Lead Concentration at Birth Variable. OSWER 9285.6-56. May.

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Tables

Table A-1

Summary of Alternative Soil Remediation Standard (SRS) - EMA (Outside Redevelopment Area)

Pompton Lakes Works

Pompton Lakes, New Jersey

Analyte	CAS No.	Site-Specific Recreational Ingestion-Dermal Health Based Criterion (mg/kg)	Site-Specific Recreational Inhalation Health Based Criterion (mg/kg)	Site-Specific Recreational Direct Contact Soil Remediation Standards (mg/kg)
Antimony	7440-36-0	140	1000000	140
Cadmium	7440-43-9	300	60000	300
Copper	7440-50-8	14100	1000000	14000
Lead	7439-92-1	See Note	See Note	2000
Mercury	7439-97-6	110	700	110
Vanadium	NA	1760	1000000	1800
Benzo(a)anthracene	56-55-3	19	1000000	19
Benzo(b)fluoranthene	205-99-2	19	1000000	19
Benzo(a)pyrene	50-32-8	1.9	165000	1.9
Dibenz(a,h)anthracene	53-70-3	1.9	165000	1.9
Indeno(1,2,3-cd)pyrene	193-39-5	19	1000000	19
Naphthalene	91-20-3	6600	140	140
Carbon tetrachloride	56-23-5	90	40	40
Chloroform	67-66-3	200	20	20
Tetrachloroethylene	127-18-4	2110	1150	1200
Trichloroethene	79-01-6	100	70	70
PCBs	1336-36-3	2	1000000	2

Notes:

Calculated values greater than 1,000,000 were replaced with 1,000,000

Lower of values calculated for child, youth and adult receptors shown for each pathway (ingestion-dermal and inhalation)

- Toxicity data is unavailable to calculate a value for the pathway

The overall direct contact SRS in the shaded column is the lower of the inhalation and ingestion-dermal values

If value was lower than the PQL, then the PQL is listed

The value for lead is based on the Adult Lead Model

Table A-2
Combined Ingestion and Dermal Absorption Exposure to
Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - EMA (Outside Redevelopment Area)
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times BW \times AT \times 365\ d/yr}{(EF \times ED \times CF \times ADAF) \times ((IR \times SFo) + (SA \times EV \times AF \times ABSd \times SF_{ABS}))}$$

Parameter	Definition	Young Child	Older Child/Youth	Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	Calculated	
TR	Target risk (unitless)	1.00E-06	1.00E-06	1.00E-06	Default
AT	Averaging time (yr)	70	70	70	Default
BW	Body weight, kg	16.2	44	70	USEPA, 2008 (Youth is average of age-specific body weight for ages 6-11 years and 11-16 years in Table 8-1). Default value for adult.
SFo	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Chemical-Specific	Chemical-Specific	Chemical-Specific	
SF_{ABS}	Dermally adjusted cancer slope factor $(mg/kg\text{-}day)^{-1}$	SFo/ABS_{GI}	SFo/ABS_{GI}	SFo/ABS_{GI}	
ADAF	Age-dependent Adjustment Factor for mutagens	3	3	1	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
SA	Skin Surface Area, cm^2	2690	4500	6032	USEPA, 2014 and USEPA, 2008 (Average of age-specific body parts for ages 6-11 years and 11-16 years in Table 7-2 (mean))
AF	Skin-soil adherence factor $(mg/cm^2\text{-event})$	0.04	0.04	0.07	Child/Youth AF value: Recommended AF for youth soccer players, considered representative of sitting, walking or other low to medium intensity activities
ED	Exposure duration, years	4	10	30	Young Child age 2-6 years, Older Child/Youth age 7-16 years
EF	Exposure frequency (days/yr)	84	84	84	3 days/week in summer; 2 days/week in spring and fall
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	Chemical-Specific	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	1	1	Default
CF	Conversion factor, kg/mg	1.00E-06	1.00E-06	1.00E-06	Default
IR	Soil ingestion rate, mg/day	200	100	100	USEPA, 2008. Youth value is recommended value for age 6-11 years.

Analyte	SFo	Source	SF_{ABS}	ABSd	RS-Child	RS - Youth	RS - Adult	
Antimony	-	-	-	-	-	-	-	
Cadmium	-	-	-	1.00E-03	-	-	-	
Copper	-	-	-	-	-	-	-	
Mercury	-	-	-	-	-	-	-	
Vanadium	-	-	-	-	-	-	-	
Benzo(a)anthracene	1.00E-01	ECAO	1.00E-01	1.30E-01		36	46	m
Benzo(b)fluoranthene	1.00E-01	ECAO	1.00E-01	1.30E-01		36	46	m
Benzo(a)pyrene	1.00E+00	IRIS	1.00E+00	1.30E-01		3.6	4.6	m
Dibenz(a,h)anthracene	1.00E+00	ECAO	1.00E+00	1.30E-01		3.6	4.6	m
Indeno(1,2,3-cd)pyrene	1.00E-01	ECAO	1.00E-01	1.30E-01		36	46	m
Naphthalene	-	-	-	1.30E-01	-	-	-	
Carbon tetrachloride	7.00E-02	IRIS	7.00E-02	-	90	190	100	
Chloroform	3.10E-02	Cal EPA	3.10E-02	-	200	430	230	
Tetrachloroethylene	2.10E-03	IRIS	2.10E-03	-	2930	6400	3400	
Trichloroethene	4.60E-02	IRIS	4.60E-02	-	100	210	150	
Trichloroethene (NHL+Liver)	3.70E-02	IRIS	3.70E-02	-	170	360	-	
Trichloroethene (ADAF)	9.30E-03	IRIS	9.30E-03	-		480	-	m
PCBs	2.00E+00	IRIS	2.00E+00	1.40E-01	3	5	2	

$TCE = 1/((1/TCE_{NHL+Liver}) + (1/TCE_{ADAF}))$

Table A-2
Combined Ingestion and Dermal Absorption Exposure to
Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - EMA (Outside Redevelopment Area)
Pompton Lakes Works
Pompton Lakes, New Jersey

Notes:
IRIS - USEPA's Integrated Risk Information System
ECAO - Environmental Criteria and Assessment Office as cited in EPA's Regional Screening Level Table (November 2018 edition)
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2018 edition)
m-mutagen calculations detailed in Table A-2A for the child receptor

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 (with 2007 errata).

USEPA, 2008. Child-Specific Exposure Factors Handbook. EPA/600/R-06/096F. September 2008

USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

USEPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120 dated February 6, 2014.

Table A-2A
Combined Ingestion and Dermal Absorption Exposure to
Mutagenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - EMA (Outside Redevelopment Area)
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times AT \times 365\ d/yr}{(EF \times CF) \times ((IRadj\text{-}m \times SFo) + (EV \times SFS\text{-}m \times ABSd \times SF_{ABS}))}$$

mutagen

Parameter	Definition	Value	Source
RS	Remediation Standard (mg/kg)	Calculated	
TR	Target risk (unitless)	1.00E-06	Default
AT	Averaging time (yr)	70	Default
SFo	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Chemical-Specific	
SF_{ABS}	Dermally adjusted cancer slope factor $(mg/kg\text{-}day)^{-1}$	SFo/ABS_{GI}	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	
SFS-m	Age-adjusted dermal factor (mg-year/kg-day), mutagen	80	See Below
EF	Exposure frequency (days/yr)	84	3 days/week in summer; 2 days/week in spring and fall
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	Default
CF	Conversion factor, kg/mg	1.00E-06	Default
IRadj-m	Age-adjusted soil ingestion rate, mutagen (mg-yr/kg-day)	148	See Below

Analyte	SFo	Source	SF_{ABS}	ABSd	RS
Benzo(a)anthracene	1.00E-01	ECAO	1.00E-01	1.30E-01	19.2
Benzo(b)fluoranthene	1.00E-01	ECAO	1.00E-01	1.30E-01	19.2
Benzo(a)pyrene	1.00E+00	IRIS	1.00E+00	1.30E-01	1.92
Dibenz(a,h)anthracene	1.00E+00	ECAO	1.00E+00	1.30E-01	1.92
Indeno(1,2,3-cd)pyrene	1.00E-01	ECAO	1.00E-01	1.30E-01	19.2
Trichloroethene (ADAF)	9.30E-03	IRIS	9.30E-03	-	221

Notes:
IRIS - USEPA's Integrated Risk Information System
ECAO - Environmental Criteria and Assessment Office as cited in EPA's Regional Screening Level Table (November 2018 edition)
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2018 edition)

Table A-2A
Combined Ingestion and Dermal Absorption Exposure to
Mutagenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - EMA (Outside Redevelopment Area)
Pompton Lakes Works
Pompton Lakes, New Jersey

$$INGam = \frac{INGchild \times EDchild_{2\text{-}6} \times ADAF}{BWchild}$$

$$SAam = \frac{SAchild \times AFchild \times EDchild_{2\text{-}6} \times ADAF}{BWchild}$$

where:

	Parameter	Value	Reference
INGama =	Age-adjusted soil ingestion factor for mutagens, mg-yr/kg	148.15	Calculated
SAama =	Age-adjusted dermal area/adherence factor for mutagens, mg-yr/kg-day	79.70	Calculated
INGchild =	soil ingestion rate, child, mg/day	200	USEPA, 2014
SAchild =	skin surface area, child (outdoor), cm2/day	2690	USEPA, 2014
AFchild =	soil adherence factor, child, mg/cm2	0.04	NJ Default
$EDchild_{2\text{-}6}$ =	exposure duration, child age 2-6, yr	4	USEPA, 2005
ADAF =	Age-dependent adjustment factor, 0-2 (10), 2-6 (3)	3	USEPA, 2005
BWchild =	body weight, child, kg	16.2	USEPA, 2008

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 (with 2007 errata).

USEPA. 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. United States Environmental Protection Agency, EPA/630/R-03/003F, March 2005.

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USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table A-3

Combined Ingestion and Dermal Absorption Exposure to

Non-Carcinogenic Contaminants in Soil

Site-Specific Recreational Land Use Scenario - EMA (Outside Redevelopment Area)

Pompton Lakes Works

Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{THQ \times BW \times AT \times 365\ d/yr}{(EF \times ED \times 10^{-6}\ kg/mg) \times [(1/RfDo \times IR) + (1/RfD_{ABS} \times AF \times ABS_d \times EV \times SA)]}$$

Parameter	Definition	Young Child Value	Older Child/Youth Value	Adult Value	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	Calculated	
THQ	Target hazard quotient unitless	1	1	1	Default
BW	Body weight (kg)	16.2	44	70	USEPA, 2008 (Youth is average of age-specific body weight for ages 6-11 years and 11-16 years in Table 8-1). Default value for adult
AT	Averaging time (yr)	4	10	30	Default
RfDo	Oral reference dose (mg/kg-day)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
IR	Soil ingestion rate (mg/day)	200	100	100	USEPA, 2008. Youth value is recommended value for age 6-11 years.
RfD_{ABS}	Dermally adjusted reference dose (mg/kg-day)	RfDo x ABS_{GI}	RfDo x ABS_{GI}	RfDo x ABS_{GI}	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	Chemical-Specific	Chemical-Specific	Consistent with RAGs Part E, used 100% absorption (no adjustment)
AF	Skin-soil adherence factor (mg/cm^2-event)	0.04	0.04	0.07	Older Child/Youth AF value: Recommended AF for youth soccer players, considered representative of sitting, walking or other low to medium intensity activities
EF	Exposure frequency (days/yr)	84	84	84	3 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (years)	4	10	30	Young Child age 2-6 years, Older Child/Youth age 7-16 years
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	Chemical-Specific	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	1	1	Default
SA	Skin Surface Area, cm^2	2690	4500	6032	USEPA, 2008 (Youth is average of age-specific body parts for ages 6-11 years and 11-16 years in Table 7-2 (mean))

Analyte	RfDo	Source	RfD_{ABS}	ABSd	RS - Child	RS - Youth	RS - Adult	
Antimony	4.00E-04	IRIS	6.00E-05	-	140	760	1200	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Cadmium	1.00E-03	IRIS	2.50E-05	1.00E-03	300	1800	2600	
Copper	4.00E-02	Heast	4.00E-02	-	14100	76000	120000	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Mercury	3.00E-04	IRIS	2.10E-05	-	110	570	910	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Vanadium	5.00E-03	RSL	5.00E-03	-	1760	9600	15200	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Benzo(a)anthracene	-	-	-	1.30E-01	-	-	-	
Benzo(b)fluoranthene	-	-	-	1.30E-01	-	-	-	
Benzo(a)pyrene	3.00E-04	IRIS	3.00E-04	1.30E-01	-	-	-	
Dibenz(a,h)anthracene	-	-	-	1.30E-01	-	-	-	
Indeno(1,2,3-cd)pyrene	-	-	-	1.30E-01	-	-	-	
Naphthalene	2.00E-02	IRIS	2.00E-02	1.30E-01	6600	31000	39000	
Carbon tetrachloride	4.00E-03	IRIS	4.00E-03	-	1410	7600	12000	
Chloroform	1.00E-02	IRIS	1.00E-02	-	3520	19000	30000	
Tetrachloroethylene	6.00E-03	IRIS	6.00E-03	-	2110	11000	18000	
Trichloroethene	5.00E-04	IRIS	5.00E-04	-	180	960	1500	
PCBs	-	-	-	1.40E-01	-	-	-	

Table A-3

Combined Ingestion and Dermal Absorption Exposure to

Non-Carcinogenic Contaminants in Soil

Site-Specific Recreational Land Use Scenario - EMA (Outside Redevelopment Area)

Pompton Lakes Works

Pompton Lakes, New Jersey

Notes:

IRIS - USEPA's Integrated Risk Information System

Heast -HEAST values as cited in EPA's Regional Screening Level Table (November 2018 edition)

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 (with 2007 errata)

USEPA, 2008. Child-Specific Exposure Factors Handbook. EPA/600/R-06/096F. September 2008

USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table A-4
Inhalation Soil Remediation Standards for Carcinogenic Particulate
Contamination for Site-Specific Recreational Land Use - EMA (Outside Redevelopment Area)
Pompton Lakes Works

Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times AT \times 365\ d/yr}{URF \times ADAF \times 1{,}000\ ug/mg \times EF \times ED \times ET \times (1\ day/24\ hour) \times (1/PEF + 1/VF)}$$

Parameter	Definition	Young Child	Older Child/Youth	Adult	Source
		Value			
RS	Remediation Standard (mg/kg)	Calculated	Calculated	Calculated	
TR	Target risk (unitless)	1.0E-06	1.0E-06	1.0E-06	
AT	Averaging time (yr)	70	70	70	
URF	Unit Risk Factor $(ug/m^3)^{-1}$	Chemical-Specific	Chemical-Specific	Chemical-Specific	
ADAF	Age-dependent Adjustment Factor for mutagens	3	3	1	
ET	Exposure time (hours/day)	4	4	4	Each visit was assumed to last four hours. This value exceeds USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).
EF	Exposure frequency (days/yr)	84	84	84	3 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (yr)	4	10	30	
VF	Volatilization Factor (m^3/kg)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
PEF	Particulate Emission Factor (m^3/kg)	1.7E+09	1.7E+09	1.7E+09	NJ default

Analyte	URF	Source	VF	Inh_pSRS Child	Inh_pSRS Youth	Inh_pSRS Adult	
Antimony	-	-	-	-	-	-	
Cadmium	1.80E-03	IRIS	-	440000	180000	60000	
Copper	-	-	-	-	-	-	
Mercury	-	-	87388	-	-	-	
Vanadium	-	-	-	-	-	-	
Benzo(a)anthracene	6.00E-05	ECAO	-	**4410000**	**1760000**	**1760000**	m
Benzo(b)fluoranthene	6.00E-05	ECAO	-	**4410000**	**1760000**	**1760000**	m
Benzo(a)pyrene	6.00E-04	IRIS	-	440000	180000	180000	m
Dibenz(a,h)anthracene	6.00E-04	ECAO	-	440000	180000	180000	m
Indeno(1,2,3-cd)pyrene	6.00E-05	ECAO	-	**4410000**	**1760000**	**1760000**	m
Naphthalene	3.40E-05	Cal EPA	77580	1040	420	140	
Carbon tetrachloride	6.00E-06	IRIS	3469	260	110	40	
Chloroform	2.30E-05	IRIS	6470	130	50	20	
Tetrachloroethylene	2.60E-07	IRIS	4925	8640	3460	1150	
Trichloroethene	4.10E-06	IRIS	4905	367	147	70	
Trichloroethene (NHL+Liver)	3.10E-06	IRIS	4905	720	290	-	
Trichloroethene (ADAF)	1.00E-06	IRIS	4905	750	300	-	m
PCBs	1.00E-04	IRIS	-	**7940000**	**3174750**	**1058250**	

$TCE = 1/((1/TCE_{NHL+Liver}) + (1/TCE_{ADAF}))$

Table A-4

Inhalation Soil Remediation Standards for Carcinogenic Particulate

Contamination for Site-Specific Recreational Land Use - EMA (Outside Redevelopment Area)

Pompton Lakes Works

Pompton Lakes, New Jersey

Notes:

Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2018 edition)

IRIS - USEPA's Integrated Risk Information System

Cells highlighted have values greater than 1,000,000

m - mutagen

References:

USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table A-5
Inhalation Soil Remediation Standards for Non-Carcinogenic Particulate Contamination for Site-Specific Recreational Land Use - EMA (Outside Redevelopment Area)
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{THQ \times AT \times 365\ d/yr}{EF \times ED \times ET \times (1\ day/24\ hours) \times (1/RfC) \times (1/PEF + 1/VF)}$$

Parameter	Definition	Value: Young Child	Value: Older Child/Youth	Value: Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	Calculated	
THQ	Target hazard quotient (unitless)	1	1	1	
AT	Averaging time (yr)	4	10	30	
RfC	Inhalation reference concentration (mg/m^3)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
ET	Exposure time (hours/day)	4	4	4	Each visit was assumed to last four hours. This value exceeds USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).
EF	Exposure frequency (days/yr)	84	84	84	3 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (yr)	4	10	30	
VF	Volatilization Factor (m^3/kg)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
PEF	Particulate Emission Factor (m^3/kg)	1.7E+09	1.7E+09	1.7E+09	NJ default

Analyte	RfC	Source	VF	Inh_pSRS Child	Inh_pSRS Youth	Inh_pSRS Adult
Antimony	2.00E-04	IRIS	-	**9070700**	**9070700**	**9070700**
Cadmium	2.00E-05	Cal EPA	-	907100	907100	907100
Copper	2.40E-03	NJDEP	-	**108848400**	**108848400**	**108848400**
Mercury	3.00E-04	IRIS	87388	700	700	700
Vanadium	1.00E-04	ATSDR	-	**4535400**	**4535400**	**4535400**
Benzo(a)anthracene	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-
Benzo(a)pyrene	2.00E-06	IRIS	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-
Naphthalene	3.00E-03	IRIS	77580	6100	6100	6100
Carbon tetrachloride	1.00E-01	IRIS	3469	9000	9000	9000
Chloroform	9.80E-02	ATSDR	6470	16500	16500	16500
Tetrachloroethylene	4.00E-02	IRIS	4925	5100	5100	5100
Trichloroethene	2.00E-03	IRIS	4905	300	260	260
PCBs	-	-	-	-	-	-

Notes:
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (May 2014 edition)
IRIS - USEPA's Integrated Risk Information System
ATSDR - ATSDR values as cited in EPA's Regional Screening Level Table (November 2018edition)
NJDEP - California EPA value as cited in NJDEP's Toxicity Factors for Copper
Cells highlighted have values greater than 1,000,000

References:
USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table A-6
Soil-to-Air Volatilization Factor Calculation - EMA (Outside Redevelopment Area)
Pompton Lakes Works
Pompton Lakes, New Jersey

$$VF\ (m^3/kg) = \frac{Q/C \times (3.14 \times Da \times T)^{1/2} \times 10^{-4}\ (m^2/cm^2)}{(2 \times rb \times Da)}$$ EPA 1996, eqn. 8

where:

$$Da = \frac{(qa^{10/3} \times Di \times H' + qw^{10/3} \times Dw)/n^2}{rb \times Kd + qw + qa \times H'}$$

Parameter			Value	Reference
VF	=	volatilization factor (m^3/kg)	Calculated	
Da	=	apparent diffusity (cm^2/sec)	Calculated	
Q/C	=	inverse of mean concentration at the center of a source (g/m^2-sec per kg/m^3)	90.4	NJ default for 0.5-acre site
T	=	release interval (seconds)	9.5E+08	NJ default
rb	=	dry soil bulk density (g/cm^3)	1.5	NJ default
qa	=	air-filled soil porosity (Lair/Lsoil) where qa = n - qw	0.180	NJ default
n	=	total soil porosity (Lpore/Lsoil) where n = 1-(rb/rs)	0.410	NJ default
qw	=	water-filled soil porosity (Lwater/Lsoil)	0.23	NJ default
rs	=	soil particle density (g/cm^3)	2.65	NJ default
Di	=	diffusivity in air (cm^2/sec)	chem-spec	EPA Regional Screening Level Table, November 2018
H	=	Henry's law constant (atm-m3/mol)	chem-spec	EPA Regional Screening Level Table, November 2018
H'	=	dimensionless Henry's law constant where H' = H x 41	chem-spec	
Dw	=	diffusivity in water (cm^2/sec)	chem-spec	EPA Regional Screening Level Table, November 2018
Kd	=	soil-water partition coefficient (cm^3/g)	chem-spec	NJ background and basis document
Koc	=	soil organic carbon/water partition coefficient (cm^3/g)	chem-spec	EPA Regional Screening Level Table, November 2018
foc	=	fraction organic carbon in soil (g/g)	0.002	NJ default

Table A-6
Soil-to-Air Volatilization Factor Calculation - EMA (Outside Redevelopment Area)
Pompton Lakes Works
Pompton Lakes, New Jersey

Constituent	Di	H	H'	Dw	Kd	Koc	Da	VF
Mercury	3.1E-02	1.1E-02	4.7E-01	6.3E-06	5.3E+01	-	3.5E-06	87388
Naphthalene	6.1E-02	4.4E-04	1.8E-02	8.4E-06	3.1E+00	1.5E+03	4.5E-06	77580
Carbon tetrachloride	5.7E-02	2.8E-02	1.1E+00	9.8E-06	8.8E-02	4.4E+01	2.2E-03	3469
Chloroform	7.7E-02	3.7E-03	1.5E-01	1.1E-05	6.4E-02	3.2E+01	6.4E-04	6470
Tetrachloroethylene	5.0E-02	1.8E-02	7.3E-01	9.5E-06	1.9E-01	9.5E+01	1.1E-03	4925
Trichloroethene	6.9E-02	9.9E-03	4.0E-01	1.0E-05	1.2E-01	6.1E+01	1.1E-03	4905

Chemical-specific values obtained from chemical parameters table in EPA's Regional Screening Level Table (November 2018 edition)
Naphthalene values from EPA's Vapor Intrusion Screening Level (VISL) table (available on-line)
Mercury Kd value obtained from NJDEP Background and Basis Document (June 2008)

References:

EPA 1996, Soil Screening Guidance: User's Guide. EPA/540/R-96/018.

EPA 2018a. Regional Screening Level Table. November 2018 edition.

EPA, 2018b. Vapor Intrusion Screening Level Calculator. Available on-line: https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

NJDEP 2008 . Inhalation Exposure Pathway Soil Remediation Standards, Background and Basis Document. June.

Table A-7
Soil Remediation Standard Calculation for Lead in Soil
Site-Specific Recreational Land Use Scenario (Adult Receptor) - EMA (Outside Redevelopment Area)
Pompton Lakes Works
Pompton Lakes, New Jersey

Calculations of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential Areas

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 06/14/2017

EDIT RED CELLS

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014	Reference
$PbB_{fetal, 0.95}$	Target PbB in fetus (e.g., 2-8 µg/dL)	µg/dL	5	Default
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	Default
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	Default
GSD_i	Geometric standard deviation PbB	--	1.8	Default
PbB_0	Baseline PbB	µg/dL	0.6	Default
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	Default
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	Default
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	84	3 days/week in summer; 2 days/week in spring and fall
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	270	9 month exposure duration
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**ppm**	**2,026**	

Where:

$$PRG = \frac{(PbB_{adult,central,goal} - PbB_0) \times AT_{S,D}}{(BKSF \times IR_s \times AF_{S,D} \times EF_{S,D})}$$ (Equation 4 - EPA, 2003)

$$PbB_{adult,central,goal} = \frac{PbB_{fetal,0.95}}{GSD_i^{1.645} \times R_{fetal/maternal}}$$ (Equation 2 - EPA, 2003)

USEPA, 2003. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*
EPA-540-R-03-001, OSWER Dir #9285.7-54. January (with 2009 update).

Table B-1
Summary of Alternative Soil Remediation Standard (SRS) - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

Analyte	CAS No.	Site-Specific Recreational Ingestion-Dermal Health Based Criterion (mg/kg)	Site-Specific Recreational Inhalation Health Based Criterion (mg/kg)	Site-Specific Recreational Direct Contact Soil Remediation Standards (mg/kg)
Antimony	7440-36-0	110	1000000	110
Copper	7440-50-8	11000	1000000	11000
Lead	7439-92-1	See Note	See Note	1600
Mercury	7439-97-6	82	500	82
Selenium	7782-49-2	1400	1000000	1400
Benzo(a)anthracene	56-55-3	15	1000000	15
Benzo(b)fluoranthene	205-99-2	15	1000000	15
Benzo(a)pyrene	50-32-8	1.5	129000	1.5
Dibenz(a,h)anthracene	53-70-3	1.5	129000	1.5
Indeno(1,2,3-cd)pyrene	193-39-5	15	1000000	15

Notes:
Calculated values greater than 1,000,000 were replaced with 1,000,000
Lower of values calculated for child, youth and adult receptors shown for each pathway (ingestion-dermal and inhalation)
- Toxicity data is unavailable to calculate a value for the pathway
The overall direct contact SRS in the shaded column is the lower of the inhalation and ingestion-dermal values
If value was lower than the PQL, then the PQL is listed
The value for lead is based on the Adult Lead Model

Table B-2
Combined Ingestion and Dermal Absorption Exposure to
Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times BW \times AT \times 365\ d/yr}{(EF \times ED \times CF \times ADAF) \times ((IR \times SFo) + (SA \times EV \times AF \times ABSd \times SF_{ABS}))}$$

Parameter	Definition	Young Child	Older Child/Youth	Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	Calculated	
TR	Target risk (unitless)	1.00E-06	1.00E-06	1.00E-06	Default
AT	Averaging time (yr)	70	70	70	Default
BW	Body weight, kg	16.2	44	70	USEPA, 2008 (Youth is average of age-specific body weight for ages 6-11 years and 11-16 years in Table 8-1). Default value for adult.
SFo	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Chemical-Specific	Chemical-Specific	Chemical-Specific	
SF_{ABS}	Dermally adjusted cancer slope factor $(mg/kg\text{-}day)^{-1}$	SFo/ABS_{GI}	SFo/ABS_{GI}	SFo/ABS_{GI}	
ADAF	Age-dependent Adjustment Factor for mutagens	3	3	1	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
SA	Skin Surface Area, cm^2	2690	4500	6032	USEPA, 2014 and USEPA, 2008 (Average of age-specific body parts for ages 6-11 years and 11-16 years in Table 7-2 (mean))
AF	Skin-soil adherence factor $(mg/cm^2\text{-event})$	0.04	0.04	0.07	Child/Youth AF value: Recommended AF for youth soccer players, considered representative of sitting, walking or other low to medium intensity activities
ED	Exposure duration, years	4	10	30	Older Child/Youth age 7-16 years
EF	Exposure frequency (days/yr)	108	108	108	5 days/week in summer; 2 days/week in spring and fall
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	Chemical-Specific	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	1	1	Default
CF	Conversion factor, kg/mg	1.00E-06	1.00E-06	1.00E-06	Default
IR	Soil ingestion rate, mg/day	200	100	100	USEPA, 2008. Youth value is recommended value for age 6-11 years.

Analyte	SFo	Source	SF_{ABS}	ABSd	RS-Child	RS - Youth	RS - Adult	
Antimony	-	-	-	-	-	-	-	
Copper	-	-	-	-	-	-	-	
Mercury	-	-	-	-	-	-	-	
Selenium	-	-	-	-	-	-	-	
Benzo(a)anthracene	1.00E-01	ECAO	1.00E-01	1.30E-01		28	36	m
Benzo(b)fluoranthene	1.00E-01	ECAO	1.00E-01	1.30E-01		28	36	m
Benzo(a)pyrene	1.00E+00	IRIS	1.00E+00	1.30E-01		2.8	3.6	m
Dibenz(a,h)anthracene	1.00E+00	ECAO	1.00E+00	1.30E-01		2.8	3.6	m
Indeno(1,2,3-cd)pyrene	1.00E-01	ECAO	1.00E-01	1.30E-01		28	36	m

Notes:
IRIS - USEPA's Integrated Risk Information System
ECAO - Environmental Criteria and Assessment Office as cited in EPA's Regional Screening Level Table (November 2018 edition)

m-mutagen, calculations for a child receptor detailed in Table B-2A

Table B-2
Combined Ingestion and Dermal Absorption Exposure to
Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

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 (with 2007 errata).

USEPA, 2008. Child-Specific Exposure Factors Handbook. EPA/600/R-06/096F. September 2008

USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

USEPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120 dated February 6, 2014.

Table B-2A
Combined Ingestion and Dermal Absorption Exposure to Mutagenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times AT \times 365\ d/yr}{(EF \times CF) \times ((IRadj\text{-}m \times SFo) + (EV \times SFS\text{-}m \times ABSd \times SF_{ABS}))}$$ mutagen

Parameter	Definition	Value	Source
RS	Remediation Standard (mg/kg)	Calculated	
TR	Target risk (unitless)	1.00E-06	Default
AT	Averaging time (yr)	70	Default
SFo	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Chemical-Specific	
SF_{ABS}	Dermally adjusted cancer slope factor $(mg/kg\text{-}day)^{-1}$	SFo/ABS_{GI}	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	
SFS-m	Age-adjusted dermal factor (mg-year/kg-day), mutagen	80	See Below
EF	Exposure frequency (days/yr)	108	5 days/week in summer; 2 days/week in spring and fall
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	Default
CF	Conversion factor, kg/mg	1.00E-06	Default
IRadj-m	Age-adjusted soil ingestion rate, mutagen (mg-yr/kg-day)	148	See Below

Analyte	SFo	Source	SF_{ABS}	ABSd	RS
Benzo(a)anthracene	1.00E-01	ECAO	1.00E-01	1.30E-01	15
Benzo(b)fluoranthene	1.00E-01	ECAO	1.00E-01	1.30E-01	15
Benzo(a)pyrene	1.00E+00	IRIS	1.00E+00	1.30E-01	1.5
Dibenz(a,h)anthracene	1.00E+00	ECAO	1.00E+00	1.30E-01	1.5
Indeno(1,2,3-cd)pyrene	1.00E-01	ECAO	1.00E-01	1.30E-01	15

Notes:
IRIS - USEPA's Integrated Risk Information System
ECAO - Environmental Criteria and Assessment Office as cited in EPA's Regional Screening Level Table (November 2018 edition)

Table B-2A
Combined Ingestion and Dermal Absorption Exposure to Mutagenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

$$INGam = \frac{INGchild \times EDchild_{2\text{-}6} \times ADAF}{BWchild}$$

$$SAam = \frac{SAchild \times AFchild \times EDchild_{2\text{-}6} \times ADAF}{BWchild}$$

where:

	Parameter	Value	Reference
INGama =	Age-adjusted soil ingestion factor for mutagens, mg-yr/kg	148.15	Calculated
SAama =	Age-adjusted dermal area/adherence factor for mutagens, mg-yr/kg-day	79.70	Calculated
INGchild =	soil ingestion rate, child, mg/day	200	USEPA, 2014
SAchild =	skin surface area, child (outdoor), cm2/day	2690	USEPA, 2014
AFchild =	soil adherence factor, child, mg/cm2	0.04	See Table B-2
$EDchild_{2\text{-}6}$ =	exposure duration, child age 2-6, yr	4	USEPA, 2005
ADAF =	Age-dependent adjustment factor, 0-2 (10), 2-6 (3)	3	USEPA, 2005
BWchild =	body weight, child, kg	16.2	USEPA, 2011

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 (with 2007 errata).

USEPA. 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. United States Environmental Protection Agency, EPA/630/R-03/003F, March 2005.

USEPA, 2008. Child-Specific Exposure Factors Handbook. EPA/600/R-06/096F. September 2008

USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

USEPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120 dated February 6, 2014.

Table B-3
Combined Ingestion and Dermal Absorption Exposure to Non-Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{THQ \times BW \times AT \times 365\ d/yr}{(EF \times ED \times 10^{-6}\ kg/mg) \times [(1/RfDo \times IR) + (1/RfD_{ABS} \times AF \times ABS_d \times EV \times SA)]}$$

Parameter	Definition	Young Child Value	Older Child/Youth Value	Adult Value	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	Calculated	
THQ	Target hazard quotient unitless	1	1	1	Default
BW	Body weight (kg)	16.2	44	70	USEPA, 2008 (Youth is average of age-specific body weight for ages 6-11 years and 11-16 years in Table 8-1). Default value for adult.
AT	Averaging time (yr)	4	10	30	Default
RfDo	Oral reference dose (mg/kg-day)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
IR	Soil ingestion rate (mg/day)	200	100	100	USEPA, 2008. Youth value is recommended value for age 6-11 years.
RfD_{ABS}	Dermally adjusted reference dose (mg/kg-day)	RfDo x ABS_{GI}	RfDo x ABS_{GI}	RfDo x ABS_{GI}	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	Chemical-Specific	Chemical-Specific	Consistent with RAGs Part E, used 100% absorption (no adjustment)
AF	Skin-soil adherence factor (mg/cm^2-event)	0.04	0.04	0.07	Older Child/Youth AF value: Recommended AF for youth soccer players, considered representative of sitting, walking or other low to medium intensity activities
EF	Exposure frequency (days/yr)	108	108	108	5 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (years)	4	10	30	Young Child age 2-6 years, Older Child/Youth age 7-16 years
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	Chemical-Specific	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	1	1	Default
SA	Skin Surface Area, cm^2	2690	4500	6032	USEPA, 2014 and USEPA, 2008 (Youth is average of age-specific body parts for ages 6-11 years and 11-16 years in Table 7-2 (mean))

Analyte	RfDo	Source	RfD_{ABS}	ABSd	RS - Child	RS - Youth	RS - Adult	
Antimony	4.00E-04	IRIS	6.00E-05	-	110	590	900	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Copper	4.00E-02	Heast	4.00E-02	-	11000	59000	90000	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Mercury	3.00E-04	IRIS	2.10E-05	-	82	450	710	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Selenium	5.00E-03	IRIS	5.00E-03	-	1370	7440	11800	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Benzo(a)anthracene	-	-	-	1.30E-01	-	-	-	
Benzo(b)fluoranthene	-	-	-	1.30E-01	-	-	-	
Benzo(a)pyrene	3.00E-04	IRIS	3.00E-04	1.30E-01	-	-	-	
Dibenz(a,h)anthracene	-	-	-	1.30E-01	-	-	-	
Indeno(1,2,3-cd)pyrene	-	-	-	1.30E-01	-	-	-	

Notes:
IRIS - USEPA's Integrated Risk Information System
Heast -HEAST values as cited in EPA's Regional Screening Level Table (November 2018 edition)

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 (with 2007 errata).

USEPA, 2008. Child-Specific Exposure Factors Handbook. EPA/600/R-06/096F. September 2008

USEPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120 dated February 6, 2014.

Table B-4
Inhalation Soil Remediation Standards for Carcinogenic Particulate Contamination for Site-Specific Recreational Land Use - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times AT \times 365\ d/yr}{URF \times ADAF \times 1{,}000\ ug/mg \times EF \times ED \times ET \times (1\ day/24\ hour) \times (1/PEF + 1/VF)}$$

Parameter	Definition	Young Child	Older Child/Youth	Adult	Source
		Value			
RS	Remediation Standard (mg/kg)	Calculated	Calculated	Calculated	
TR	Target risk (unitless)	1.0E-06	1.0E-06	1.0E-06	
AT	Averaging time (yr)	70	70	70	
URF	Unit Risk Factor $(ug/m^3)^{-1}$	Chemical-Specific	Chemical-Specific	Chemical-Specific	
ADAF	Age-dependent Adjustment Factor for mutagens	3	3	1	
ET	Exposure time (hours/day)	4	4	4	Each visit was assumed to last four hours. This value exceeds USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).
EF	Exposure frequency (days/yr)	108	108	108	5 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (yr)	4	10	30	
VF	Volatilization Factor (m^3/kg)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
PEF	Particulate Emission Factor (m^3/kg)	1.7E+09	1.7E+09	1.7E+09	NJ default

Analyte	URF	Source	VF	Inh_pSRS Child	Inh_pSRS Youth	Inh_pSRS Adult	
Antimony	-	-	-	-	-	-	
Copper	-	-	-	-	-	-	
Mercury	-	-	87388	-	-	-	
Selenium	-	-	-	-	-	-	
Benzo(a)anthracene	6.00E-05	ECAO	-	**3430000**	**1370000**	**1370000**	m
Benzo(b)fluoranthene	6.00E-05	ECAO	-	**3430000**	**1370000**	**1370000**	m
Benzo(a)pyrene	6.00E-04	IRIS	-	340000	140000	140000	m
Dibenz(a,h)anthracene	6.00E-04	ECAO	-	340000	140000	140000	m
Indeno(1,2,3-cd)pyrene	6.00E-05	ECAO	-	**3430000**	**1370000**	**1370000**	m

Notes:
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2018 edition)

Cells highlighted have values greater than 1,000,000
m - mutagen

References:
USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table B-5
Inhalation Soil Remediation Standards for Non-Carcinogenic Particulate Contamination for Site-Specific Recreational Land Use - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{THQ \times AT \times 365\ d/yr}{EF \times ED \times ET \times (1\ day/24\ hours) \times (1/RfC) \times (1/PEF + 1/VF)}$$

Parameter	Definition	Child	Older Child/Youth	Adult	Source
		Value			
RS	Remediation Standard (mg/kg)	Calculated	Calculated	Calculated	
THQ	Target hazard quotient (unitless)	1	1	1	
AT	Averaging time (yr)	4	10	30	
RfC	Inhalation reference concentration (mg/m^3)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
ET	Exposure time (hours/day)	4	4	4	Each visit was assumed to last four hours. This value exceeds USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).
EF	Exposure frequency (days/yr)	108	108	108	5 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (yr)	4	10	30	
VF	Volatilization Factor (m^3/kg)	Chemical-Specific	Chemical-Specific	Chemical-Specific	
PEF	Particulate Emission Factor (m^3/kg)	1.7E+09	1.7E+09	1.7E+09	NJ default

Analyte	RfC	Source	VF	Inh_pSRS Child	Inh_pSRS Youth	Inh_pSRS Adult
Antimony	2.00E-04	IRIS	-	**7055000**	**7055000**	**7055000**
Copper	2.40E-03	NJDEP	-	**84659900**	**84659900**	**84659900**
Mercury	3.00E-04	IRIS	87388	500	500	500
Selenium	2.00E-02	Cal EPA	-	**705499000**	**705499000**	**705499000**
Benzo(a)anthracene	-	-	-		-	-
Benzo(b)fluoranthene	-	-	-		-	-
Benzo(a)pyrene	2.00E-06	IRIS	-		-	-
Dibenz(a,h)anthracene	-	-	-		-	-
Indeno(1,2,3-cd)pyrene	-	-	-		-	-

Notes:
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2018 edition)
IRIS - USEPA's Integrated Risk Information System
NJDEP - California EPA value as cited in NJDEP's Toxicity Factors for Copper
Cells highlighted have values greater than 1,000,000

References:
USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table B-6
Soil-to-Air Volatilization Factor Calculation - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

$$VF\ (m^3/kg) = \frac{Q/C \times (3.14 \times Da \times T)^{1/2} \times 10^{-4}\ (m^2/cm^2)}{(2 \times rb \times Da)}$$ EPA 1996, eqn. 8

where:

$$Da = \frac{(qa^{10/3} \times Di \times H' + qw^{10/3} \times Dw)/n^2}{rb \times Kd + qw + qa \times H'}$$

Parameter			Value	Reference
VF	=	volatilization factor (m^3/kg)	Calculated	
Da	=	apparent diffusity (cm^2/sec)	Calculated	
Q/C	=	inverse of mean concentration at the center of a source (g/m^2-sec per kg/m^3)	90.4	NJ default for 0.5-acre site
T	=	release interval (seconds)	9.5E+08	NJ default
rb	=	dry soil bulk density (g/cm^3)	1.5	NJ default
qa	=	air-filled soil porosity (Lair/Lsoil) where qa = n - qw	0.180	NJ default
n	=	total soil porosity (Lpore/Lsoil) where n = 1-(rb/rs)	0.410	NJ default
qw	=	water-filled soil porosity (Lwater/Lsoil)	0.23	NJ default
rs	=	soil particle density (g/cm^3)	2.65	NJ default
Di	=	diffusivity in air (cm^2/sec)	chem-spec	EPA Regional Screening Level Table, November 2018
H	=	Henry's law constant (atm-m3/mol)	chem-spec	EPA Regional Screening Level Table, November 2018
H'	=	dimensionless Henry's law constant where H' = H x 41	chem-spec	
Dw	=	diffusivity in water (cm^2/sec)	chem-spec	EPA Regional Screening Level Table, November 2018
Kd	=	soil-water partition coefficient (cm^3/g)	chem-spec	NJ background and basis document
Koc	=	soil organic carbon/water partition coefficient (cm^3/g)	chem-spec	EPA Regional Screening Level Table, November 2018
foc	=	fraction organic carbon in soil (g/g)	0.002	NJ default

Table B-6
Soil-to-Air Volatilization Factor Calculation - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

Constituent	Di	H	H'	Dw	Kd	Koc	Da	VF
Mercury	3.1E-02	1.1E-02	4.7E-01	6.3E-06	5.3E+01	-	3.5E-06	87388

Chemical-specific values obtained from chemical parameters table in EPA's Regional Screening Level Table (November 2018 edition)
Mercury Kd value obtained from NJDEP Background and Basis Document (June 2008)

References:
EPA 1996, Soil Screening Guidance: User's Guide. EPA/540/R-96/018.

EPA 2018. Regional Screening Level Table. November 2018 edition.

NJDEP 2008 . Inhalation Exposure Pathway Soil Remediation Standards, Background and Basis Document. June.

Table B-7
Soil Remediation Standard Calculation for Lead in Soil
Site-Specific Recreational Land Use Scenario (Adult Receptor) - WMA
Pompton Lakes Works
Pompton Lakes, New Jersey

Calculations of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 06/14/2017

EDIT RED CELLS

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014	Reference
$PbB_{fetal, 0.95}$	Target PbB in fetus (e.g., 2-8 µg/dL)	µg/dL	5	Default
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	Default
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	Default
GSD_i	Geometric standard deviation PbB	--	1.8	Default
PbB_0	Baseline PbB	µg/dL	0.6	Default
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	Default
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	Default
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	108	5 days/week in summer; 2 days/week in spring and fall
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	270	9 month exposure duration
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**ppm**	**1,576**	

Where:

$$PRG = \frac{(PbB_{adult,central,goal} - PbB_0) \times AT_{S,D}}{(BKSF \times IR_s \times AF_{S,D} \times EF_{S,D})}$$ (Equation 4 - EPA, 2003)

$$_{,central,goal} = \frac{PbB_{fetal,0.95}}{GSD_i^{1.645} \times R_{fetal/maternal}}$$ (Equation 2 - EPA, 2003)

USEPA, 2003. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*
EPA-540-R-03-001, OSWER Dir #9285.7-54. January (with 2009 update).

Table C-1
Summary of Ecological Risk-Based Remediation Goals (ERGs) for Soil
Pompton Lakes Works
Pompton Lakes, New Jersey

Constituent	Ecological Risk-Based Remediation Goals (ERGs) for Soil	
	LOAEL-Based Soil ERGs (mg/kg)	Most Sensitive Receptor(s)
Antimony	62	Short-tailed shrew
Arsenic	153.5	Mourning dove
Barium	3,270	Short-tailed shrew
Cadmium	5.7	Short-tailed shrew
Chromium	455	Mourning dove
Cobalt	521	American robin
Copper	1,100	Mourning dove
Lead	892	American robin
Manganese	9,091	Mourning dove
Inorganic Mercury	20.4	Mourning dove
Nickel	609	Mourning dove
Selenium	5	Short-tailed shrew
Silver	181	American robin
Thallium	4.3	Short-tailed shrew
Vanadium	62	Mourning dove
Zinc	1,507	American robin
Total LMW PAHs	382	Short-tailed shrew
Total HMW PAHs	47.5	American robin

Notes:
LOAEL, Toxicity reference value (TRV) based on lowest observable effects level (LOAEL) endpoints for growth and reproduction

Table C-2
Wildlife Receptor Exposure Parameters
Pompton Lakes Works
Pompton Lakes, New Jersey

Receptor Group	Body Weight[1]	Food Ingestion Rate (FIR)[2]	Soil Ingestion	Assumed Diet
(Surrogate Species)	(kg)	(kg dw/kg bw day)	(P_s)[3,4]	
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)	0.077	0.156	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 C-3
Terrestrial Soil-to-Biota Uptake Equations
Pompton Lakes Works
Pompton Lakes, New Jersey

Constituent	Soil-to-Plants		Soil-to-Earthworms		Soil-to-Small Mammals	
	Model	Source	Model	Source	Model	Source
Antimony	$\ln(C_p) = 0.938 * \ln(C_s) - 3.233$	6	$C_e = C_s$	6	$C_m = 0.001 * 50 * C_d$	6
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
Barium	$C_p = 0.156 * C_s$	1	$C_e = 0.091 * C_s$	4	$\ln(C_m) = -1.4120 + 0.700 * \ln(C_s)$	3
Cadmium	$\ln(C_p) = -0.476 + 0.546 * \ln(C_s)$	1	$\ln(C_e) = 2.114 + 0.795 * \ln(C_s)$	2	$\ln(C_m) = -1.2571 + 0.4723 * \ln(C_s)$	3
Chromium	$C_p = 0.041 * C_s$	1	$\ln(C_e) = 2.481 + (-0.067 * \ln(C_s))$	2	$\ln(C_m) = -1.4599 + 0.7338 * \ln(C_s)$	3
Cobalt	$C_p = 0.0075 * C_s$	1	$C_e = 0.122 * C_s$	4	$\ln(C_m) = 1.307 * \ln(C_s) - 4.4669$	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
Lead	$\ln(C_p) = -1.328 + 0.561 * \ln(C_s)$	1	$\ln(C_e) = -0.218 + 0.807 * \ln(C_s)$	2	$\ln(C_m) = 0.0761 + 0.4422 * \ln(C_s)$	3
Manganese	$C_p = 0.079 * C_s$	1	$\ln(C_e) = 0.682 * \ln(C_s) - 0.809$	2	$C_m = 0.0205 * C_s$	3
Total Mercury	$\ln(C_p) = -0.996 + 0.544 * \ln(C_s)$	1	$C_e = C_s * 0.0543$	4	$\ln(C_m) = -4.867 + (-2.276 * \ln(C_s))$	3
Nickel	$\ln(C_p) = 0.748 * \ln(C_s) - 2.223$	1	NA	--	$\ln(C_m) = 0.4658 * \ln(C_s) - 0.2462$	3
Selenium	$\ln(C_p)= -0.678 + 1.104 * \ln(C_s)$	1	$\ln(C_e) = -0.075 + 0.733 * \ln(C_s)$	2	$\ln(C_m) = -0.4158 + 0.3764 * \ln(C_s)$	3
Silver	$C_p = 0.014 * C_s$	1	$C_e = 2.045 * C_s$	2	$C_m = 0.004 * C_s$	3
Thallium	$C_p = C_s * 0.004$	5	$C_e = C_s * 0.054$	7	$C_m = 0.1124 * C_s$	3
Vanadium	$C_p = 0.00485 * C_s$	1	$C_e = 0.042 * C_s$	4	$C_m = 0.0123 * C_s$	3
Zinc	$\ln(C_p) = 1.575 + 0.555 * \ln(C_s)$	1	$\ln(C_e) = 4.449 + 0.328 * \ln(C_s)$	2	$\ln(C_m) = 4.4713 + 0.0738 * \ln(C_s)$	3
Total LMW PAHs	$\ln(C_p) = 0.4544 * \ln(C_s) - 1.3205$	6	$C_e = 3.04 * C_s$	6	$C_m = 0$	6
Total HMW PAHs	$\ln(C_p) = 0.9469 * \ln(C_s) - 1.7026$	6	$C_e = 2.6 * C_s$	6	$C_m = 0$	6

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)

Sources

1, Bechtel-Jacobs (1998)
2, Sample et al. (1999)
3, Sample et al. (1998a) (mammals)
4, Sample et al. (1998b) (earthworms)
5. Baes et al. (1984)
6. USEPA. 2007.
7. USCHPPM, 2004

Table C-4
Summary of Toxicity Reference Values (TRVs)
Pompton Lakes Works
Pompton Lakes, New Jersey

Constituent	Avian Receptors		Mammalian Receptors	
	Chronic LOAEL (mg/kg BW d^{-1})	Source	Chronic LOAEL (mg/kg BW d^{-1})	Source
Antimony	-	No TRV	13.3	Eco-SSL Geometric Mean[1]
Arsenic	4.5	Eco-SSL Geometric Mean	4.55	Eco-SSL Geometric Mean
Barium	-	No TRV	82.7	Eco-SSL Geometric Mean
Cadmium	6.35	Eco-SSL Geometric Mean	6.9	Eco-SSL Geometric Mean
Chromium	15.6	Eco-SSL Geometric Mean	58.2	Eco-SSL Geometric Mean
Cobalt	18.3	Eco-SSL Geometric Mean	18.9	Eco-SSL Geometric Mean
Copper	34.9	Eco-SSL Geometric Mean	69.0	Eco-SSL Geometric Mean
Lead	44.6	Eco-SSL Geometric Mean	187.6	Eco-SSL Geometric Mean
Manganese	376.6	Eco-SSL Geometric Mean	145.7	Eco-SSL Geometric Mean
Inorganic Mercury	0.9	Sample et al. (1996)	1.0	Sample et al. (1996)[2]
Nickel	18.6	Eco-SSL Geometric Mean	14.8	Eco-SSL Geometric Mean
Selenium	0.82	Eco-SSL Geometric Mean	0.66	Eco-SSL Geometric Mean
Silver	60.47	Eco-SSL Geometric Mean	118.62	Eco-SSL Geometric Mean
Thallium	-	No TRV	0.075	USCHPPM (2007)
Vanadium	1.7	Eco-SSL Geometric Mean	9.44	Eco-SSL Geometric Mean
Zinc	171.4	Eco-SSL Geometric Mean	297.6	Eco-SSL Geometric Mean
Total LMW PAHs	161.0	Patton & Dieter (1980)	355.9	Eco-SSL Geometric Mean
Total HMW PAHs	20	Trust et al. (1994)	38.4	Eco-SSL Geometric Mean

Notes:
1, Dose represents the geometric mean of no observable adverse effect level (NOAEL) endpoints from the Eco-SSL studies with growth and reproduction endpoints
2, Dose represents a no observable adverse effect level (NOAEL) endpoint; No LOAEL was reported for mammals by Sample et al. (1996)

Table C-5
Calculation of Soil ERGs for the Protection of Wildlife
Pompton Lakes Works
Pompton Lakes, New Jersey

Antimony				
Receptor	Soil Benchmark Concentration (C_s) (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)	2706	65.4	13.3	13.3
Mammalian Ground Invertivore (Short-tailed shrew)	**61.8**	61.8	13.3	13.3
Mammalian Carnivore (Red fox)	5327	266.4	13.3	13.3
Avian Granivore (Mourning dove)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Ground Invertivore (American robin)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV

Arsenic				
Receptor	Soil Benchmark Concentration (C_s) (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)	1375	8.0	4.55	4.55
Mammalian Ground Invertivore (Short-tailed shrew)	287.5	13.1	4.55	4.55
Mammalian Carnivore (Red fox)	4785	8.1	4.55	4.55
Avian Granivore (Mourning dove)	**154**	2.3	4.50	4.50
Avian Ground Invertivore (American robin)	185	9.6	4.50	4.50
Avian Carnivore (Red-tailed hawk)	2160	4.2	4.50	4.50

Barium				
Receptor	Soil Benchmark Concentration (C_s) (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)	5027	784.2	82.7	82.7
Mammalian Ground Invertivore (Short-tailed shrew)	**3270**	297.6	82.7	82.7
Mammalian Carnivore (Red fox)	70705	604.5	82.7	82.7
Avian Granivore (Mourning dove)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Ground Invertivore (American robin)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV

Cadmium				
Receptor	Soil Benchmark Concentration (C_s) (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)	1435	32.9	6.9	6.9
Mammalian Ground Invertivore (Short-tailed shrew)	**5.7**	32.9	6.9	6.9
Mammalian Carnivore (Red fox)	7029	18.7	6.9	6.9
Avian Granivore (Mourning dove)	167	10.2	6.35	6.35
Avian Ground Invertivore (American robin)	7.3	40.0	6.35	6.35
Avian Carnivore (Red-tailed hawk)	2937	12.4	6.35	6.35

Chromium				
Receptor	Soil Benchmark Concentration (C_s) (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)	9104	373	58.2	58.2
Mammalian Ground Invertivore (Short-tailed shrew)	9058	6.5	58.2	58.2
Mammalian Carnivore (Red fox)	43784	591.2	58.2	58.2
Avian Granivore (Mourning dove)	**455**	18.7	15.6	15.6
Avian Ground Invertivore (American robin)	887	7.6	15.6	15.6
Avian Carnivore (Red-tailed hawk)	5473	128.6	15.6	15.6

Cobalt				
Receptor	Soil Benchmark Concentration (C_s) (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)	5469	41.0	18.9	18.9
Mammalian Ground Invertivore (Short-tailed shrew)	595	72.6	18.9	18.9
Mammalian Carnivore (Red fox)	3502	492.6	18.9	18.9
Avian Granivore (Mourning dove)	659	4.9	18.3	18.3
Avian Ground Invertivore (American robin)	**521**	63.5	18.3	18.3
Avian Carnivore (Red-tailed hawk)	2766	361.9	18.3	18.3

Copper				
Receptor	Soil Benchmark Concentration (C_s) (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)	21535	99.5	69	69
Mammalian Ground Invertivore (Short-tailed shrew)	9110	56.9	69	69
Mammalian Carnivore (Red fox)	75650	39.0	69	69
Avian Granivore (Mourning dove)	**1100**	30.8	34.9	34.9
Avian Ground Invertivore (American robin)	1795	37.3	34.9	34.9
Avian Carnivore (Red-tailed hawk)	16795	31.4	34.9	34.9

Lead				
Receptor	Soil Benchmark Concentration (C_s) (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)	62925	130.4	187.6	187.6
Mammalian Ground Invertivore (Short-tailed shrew)	4812	753.3	187.6	187.6
Mammalian Carnivore (Red fox)	200800	238.7	187.6	187.6
Avian Granivore (Mourning dove)	1570.5	16.5	44.6	44.6
Avian Ground Invertivore (American robin)	**892**	193.3	44.6	44.6
Avian Carnivore (Red-tailed hawk)	20635	87.3	44.6	44.6

Manganese				
Receptor	Soil Benchmark Concentration (C_s) (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)	15001	1185.1	145.7	145.7
Mammalian Ground Invertivore (Short-tailed shrew)	13498	292.1	145.7	145.7
Mammalian Carnivore (Red fox)	93863	1924.2	145.7	145.7
Avian Granivore (Mourning dove)	**9091**	718.2	376.6	376.6
Avian Ground Invertivore (American robin)	19610	376.8	376.6	376.6
Avian Carnivore (Red-tailed hawk)	137645	2821.7	376.6	376.6

Inorganic Mercury				
Receptor	Soil Benchmark Concentration (C_s) (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)	170	6.0	1.0	1.0
Mammalian Ground Invertivore (Short-tailed shrew)	129	0.9	1.0	1.0
Mammalian Carnivore (Red fox)	375	20.4	1.0	1.0
Avian Granivore (Mourning dove)	**20.4**	1.9	0.9	0.9
Avian Ground Invertivore (American robin)	45	0.8	0.9	0.9
Avian Carnivore (Red-tailed hawk)	217	11.8	0.9	0.9

Table C-5
Calculation of Soil ERGs for the Protection of Wildlife
Pompton Lakes Works
Pompton Lakes, New Jersey

Nickel

Receptor	Soil Benchmark Concentration (C_s) (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)	3698	50.5	14.8	14.8
Mammalian Ground Invertivore (Short-tailed shrew)	NA	Not modeled - no uptake factor	Not modeled - no uptake factor	14.8
Mammalian Carnivore (Red fox)	14097	66.9	14.8	14.8
Avian Granivore (Mourning dove)	**609**	13.1	18.6	18.6
Avian Ground Invertivore (American robin)	NA	Not modeled - no uptake factor	Not modeled - no uptake factor	18.6
Avian Carnivore (Red-tailed hawk)	8311	52.3	18.6	18.6

Selenium

Receptor	Soil Benchmark Concentration (C_s) (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)	11.0	7.2	0.66	0.66
Mammalian Ground Invertivore (Short-tailed shrew)	**5.0**	3.0	0.66	0.66
Mammalian Carnivore (Red fox)	493	6.8	0.66	0.66
Avian Granivore (Mourning dove)	5.8	3.5	0.82	0.82
Avian Ground Invertivore (American robin)	8.3	4.4	0.82	0.82
Avian Carnivore (Red-tailed hawk)	307.0	5.7	0.82	0.82

Silver

Receptor	Soil Benchmark Concentration (C_s) (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)	29471	412.6	118.6	118.6
Mammalian Ground Invertivore (Short-tailed shrew)	274	559.3	118.6	118.6
Mammalian Carnivore (Red fox)	115841	463.4	118.6	118.6
Avian Granivore (Mourning dove)	2080	29.1	60.5	60.5
Avian Ground Invertivore (American robin)	**181**	369.3	60.5	60.5
Avian Carnivore (Red-tailed hawk)	28082	112.3	60.5	60.5

Thallium

Receptor	Soil Benchmark Concentration (C_s) (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)	23.7	0.1	0.075	0.075
Mammalian Ground Invertivore (Short-tailed shrew)	**4.3**	0.2	0.075	0.075
Mammalian Carnivore (Red fox)	16.7	1.9	0.075	0.075
Avian Granivore (Mourning dove)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Ground Invertivore (American robin)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV

Vanadium

Receptor	Soil Benchmark Concentration (C_s) (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)	2927	14.2	9.4	9.4
Mammalian Ground Invertivore (Short-tailed shrew)	627	26.3	9.4	9.4
Mammalian Carnivore (Red fox)	7317	90.0	9.4	9.4
Avian Granivore (Mourning dove)	**62**	0.3	1.7	1.7
Avian Ground Invertivore (American robin)	74.7	3.1	1.7	1.7
Avian Carnivore (Red-tailed hawk)	694.9	8.5	1.7	1.7

Zinc

Receptor	Soil Benchmark Concentration (C_s) (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)	47086	1894	297.6	297.6
Mammalian Ground Invertivore (Short-tailed shrew)	4035	1303	297.6	297.6
Mammalian Carnivore (Red fox)	324174	223	297.6	297.6
Avian Granivore (Mourning dove)	3347	436.7	171.4	171.4
Avian Ground Invertivore (American robin)	**1507**	943.2	171.4	171.4
Avian Carnivore (Red-tailed hawk)	81650	201.5	171.4	171.4

Total LMW PAHs

Receptor	Soil Benchmark Concentration (C_s) (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)	125383	55.4	355.9	355.9
Mammalian Ground Invertivore (Short-tailed shrew)	**555**	1686	355.9	355.9
Mammalian Carnivore (Red fox)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	355.9
Avian Granivore (Mourning dove)	2370	518.0	161.0	161.0
Avian Ground Invertivore (American robin)	**382**	993.2	161.0	161.0
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	161.0

Total HMW PAHs

Receptor	Soil Benchmark Concentration (C_s) (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)	1728	384.0	38.4	38.4
Mammalian Ground Invertivore (Short-tailed shrew)	69.8	181.5	38.4	38.4
Mammalian Carnivore (Red fox)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	38.4
Avian Granivore (Mourning dove)	274	67.2	20.0	20
Avian Ground Invertivore (American robin)	**47.5**	123.5	20.0	20
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	20

Notes:

1, Soil benchmark concentration solved iteratively by adjusting Cs until EDD = LOAEL:

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

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 C-2; Soil-to-biota accumulation models used to estimate prey concentrations provided in Table C-3
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

Appendix B

NJDEP Alternative or New Remediation Standard and/or Screening Level Application Form

New Jersey Department of Environmental Protection
Site Remediation and Waste Management Program

ALTERNATIVE OR NEW REMEDIATION STANDARD AND/OR SCREENING LEVEL APPLICATION FORM

Date Stamp
(For Department use only)

NOTE: This form shall be completed for all contaminants for which a direct contact exposure pathway alternative or new remediation standard, alternative impact to ground water soil remediation standard, alternative vapor intrusion screening level, ecological risk-based remediation goal, and/or ecological risk management decision goal is being implemented and/or requested for a site or area of concern. The form shall be used regardless of whether Department pre-approval is required.

SECTION A. SITE NAME AND LOCATION

Site Name: Pompton Lakes Works

List all AKAs:

Street Address: 2000 Cannonball Rd

Municipality: Pompton Lakes (Township, Borough or City)

County: Passaic Zip Code: 07442

Program Interest (PI) Number(s): 007411

Case Tracking Number(s):

SECTION B. REMEDIATION STANDARD NOTIFICATION SPREADSHEET

Complete and attach the Remediation Standard Notification Spreadsheet which can be found at: http://www.nj.gov/dep/srp/srra/forms/. This form will not be processed by the NJDEP if the spreadsheet is not attached.

SECTION C. PURPOSE FOR SUBMISSION

Pre-Approval Required:

- ☒ Ingestion/Dermal Alternative Soil Remediation Standard
- ☒ Inhalation Alternative Soil Remediation Standard (New Toxicity Data, New Modeling, etc.)
- ☐ Development of New Remediation Standard
- ☒ Ecological Risk Based Remediation Goal
- ☐ Ecological Risk Management Decision Goal

No Pre-Approval Required:

- ☐ Inhalation Alternative Soil Remediation Standard (Calculation Spreadsheet)
- ☒ Impact to Groundwater Alternative Soil Remediation Standard
- ☐ Vapor Intrusion Alternative Screening Level
- ☐ Development of New Vapor Intrusion Screening Level

SECTION D. PERSON RESPONSIBLE FOR CONDUCTING THE REMEDIATION INFORMATION AND CERTIFICATION

Full Legal Name of the Person Responsible for Conducting the Remediation: The Chemours Company FC, LLC

Representative First Name: Sheryl Representative Last Name: Telford

Title: Vice President EHS &CR

Phone Number: (302) 773-2597 Ext: Fax:

Mailing Address: 1007 N. Market Street

City/Town: Wilmington State: DE Zip Code: 19899

Email Address: SHERYL.A.TELFORD@chemours.com

This certification shall be signed by the person responsible for conducting the remediation who is submitting this notification in accordance with Administrative Requirements for the Remediation of Contaminated Sites rule at N.J.A.C. 7:26C-1.5(a).

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, including all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, to the best of my knowledge, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties.

Signature: [signature] Date: 4/26/19

Name/Title: Sheryl Telford, VP EHS&CR

New Jersey Department of Environmental Protection
Site Remediation Program

REMEDIATION STANDARD NOTIFICATION SPREADSHEET

Instructions | Clear Form

Site Name: Pompton Lakes Works-EMA

Program Interest Number: 7411

ALTERNATIVE STANDARDS OR SCREENING LEVELS REQUESTED/IMPLEMENTED

Chemical Name	CAS	Concentration Range on Site (include units)	ARS / Screening Level	Scenario	Type of Standard	Default Remediation Standard / Screening level (include units)	Proposed Remediation Standard / Screening level (include units)
Antimony	7440-36-0	ND to 10,700 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		140 mg/kg
Cadmium	7440-43-9	ND to 1,180 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		300 mg/kg
Copper	7440-50-8	ND to 384,000 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		14,000 mg/kg
Lead	7439-92-1	ND to 236,000 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		2000 mg/kg
Mercury	7439-97-6	ND to 33,800 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		110 mg/kg
Vanadium	7440-62-2	ND to 69.4 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		1,800 mg/kg
Benzo(a)anthracene	56-55-3	ND to 33 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		19 mg/kg
Benzo(b)fluoranthene	205-99-2	ND to 52 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		19 mg/kg
Benzo(a)pyrene	50-32-8	ND to 30 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		1.9 mg/kg
Dibenz(a,h)anthracene	53-70-3	ND to 2.5 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		1.9 mg/kg
Indeno(1,2,3-cd)pyrene	193-39-5	ND to 14 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		19 mg/kg
Naphthalene	91-20-3	ND to 2.6 mg/kg	Inhalation Exposure Pathway	Other	Alternative		140 mg/kg
Carbon tetrachloride	56-23-5	ND to 0.002 mg/kg	Inhalation Exposure Pathway	Other	Alternative		40 mg/kg
Chloroform	67-66-3	ND	Inhalation Exposure Pathway	Other	Alternative		20 mg/kg
Tetrachloroethylene	127-18-4	ND to 0.054 mg/kg	Inhalation Exposure Pathway	Other	Alternative		1,200 mg/kg
Trichloroethene	79-01-6	ND to 0.074 mg/kg	Inhalation Exposure Pathway	Other	Alternative		70 mg/kg
PCBs	1336-36-3	ND to 100 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		2 mg/kg

New Jersey Department of Environmental Protection
Site Remediation Program

Instructions | Clear Form

REMEDIATION STANDARD NOTIFICATION SPREADSHEET

Site Name: Pompton Lakes Works - WMA

Program Interest Number: 7411

ALTERNATIVE STANDARDS OR SCREENING LEVELS REQUESTED/IMPLEMENTED

Chemical Name	**CAS**	**Concentration Range on Site** (include units)	**ARS / Screening Level**	**Scenario**	**Type of Standard**	**Default Remediation Standard / Screening level** (include units)	**Proposed Remediation Standard / Screening level** (include units)
Antimony	7440-36-0	ND to 2,950 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		110 mg/kg
Copper	7440-50-8	ND to 85,853.77 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		11000 mg/kg
Lead	7439-92-1	ND to 173,000 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		1600 mg/kg
Mercury	7439-97-6	ND to 22,100 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		82 mg/kg
Selenium	7782-49-2	ND to 18,600 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		1400 mg/kg
Benzo(a)anthracene	56-55-3	ND to 38 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		15 mg/kg
Benzo(b)fluoranthene	205-99-2	ND to 40 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		15 mg/kg
Benzo(a)pyrene	50-32-8	ND to 130 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		1.5 mg/kg
Dibenz(a,h)anthracene	53-70-3	ND to 11 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		1.5 mg/kg
Indeno(1,2,3-cd)pyrene	193-39-5	ND to 15 mg/kg	Ingestion-Dermal Exposure Pathway	Other	Alternative		15 mg/kg

New Jersey Department of Environmental Protection
Site Remediation Program

REMEDIATION STANDARD NOTIFICATION SPREADSHEET

Instructions | Clear Form

Site Name: Pompton Lakes Works

Program Interest Number: 7411

ALTERNATIVE STANDARDS OR SCREENING LEVELS REQUESTED/IMPLEMENTED

Chemical Name	CAS	Concentration Range on Site (include units)	ARS / Screening Level	Scenario	Type of Standard	Default Remediation Standard / Screening level (include units)	Proposed Remediation Standard / Screening level (include units)
Antimony	7440-36-0	ND to 10,700 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		62 mg/kg
Arsenic	7440-38-2	ND to 356 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		153.5 mg/kg
Barium	7440-39-3	ND to 22,600 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		3,270 mg/kg
Cadmium	7440-43-9	ND to 1,180 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		5.7 mg/kg
Chromium	7440-47-3	ND to 251 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		455 mg/kg
Cobalt	7440-48-4	ND to 60.7 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		521 mg/kg
Copper	7440-50-8	ND to 384,000 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		1,100 mg/kg
Lead	7439-92-1	ND to 236,000 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		892 mg/kg
Manganese	7439-96-5	ND to 1,950 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		9,091 mg/kg
Mercury	7439-97-6	ND to 33,800 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		20.4 mg/kg
Nickel	7440-02-0	ND to 2,150 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		609 mg/kg
Selenium	7782-49-2	ND to 18,600 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		5 mg/kg
Silver	7440-22-4	ND to 79 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		181 mg/kg
Thallium	7440-28-0	ND to 20 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		4.3 mg/kg
Vanadium	7440-62-2	ND to 2,110 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		62 mg/kg
Zinc	7440-66-6	ND to 68,800 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		1,507 mg/kg
LMW PAHs		0.119 to 251.1 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		382 mg/kg
HMW PAHs		0.153 to 275.2 mg/kg	Ecological Risk Based Remediation Goal	Ecological	New		47.5 mg/kg

New Jersey Department of Environmental Protection
Site Remediation Program

Instructions | Clear Form

REMEDIATION STANDARD NOTIFICATION SPREADSHEET

Site Name: Pompton Lakes Works
Program Interest Number: 007411

ALTERNATIVE STANDARDS OR SCREENING LEVELS REQUESTED/IMPLEMENTED

Chemical Name	CAS	Geographic Region	Concentration Range on Site (include units)	ARS / Screening Level	Scenario	Type of Standard	Default Remediation Standard / Screening level (include units)	Proposed Remediation Standard / Screening level (include units)
Lead	7439-92-1	NMA West	ND to 8,747.648 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	1,720 mg/kg
Lead	7439-92-1	NMA Mid	ND to 35,300 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	170 mg/kg
Lead	7439-92-1	NMA East	ND to 94,701.75 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	505 mg/kg
Lead	7439-92-1	WMA Northwest	ND to 173,000 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	636 mg/kg
Mercury	7439-97-6	WMA Northwest	ND to 19.7 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	166 mg/kg
Lead	7439-92-1	WMA Southwest	ND to 8,006.727 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	363 mg/kg
Mercury	7439-97-6	WMA Southwest	ND to 2,210 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	166 mg/kg
Lead	7439-92-1	WMA Mid	ND to 3,195.998 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	390 mg/kg
Mercury	7439-97-6	WMA Mid	ND to 22,100 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	289 mg/kg
Mercury	7439-97-6	WMA East	ND to 1,130mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	1,130 mg/kg
Lead	7439-92-1	North of Well 20	ND to 137,000 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	350 mg/kg
Mercury	7439-97-6	North of Well 20	ND to 256.392 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	101 mg/kg
Mercury	7439-97-6	North-Central	ND to 4,986.446 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	34 mg/kg
Mercury	7439-97-6	Northeast	ND to 1,899.114 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	18 mg/kg
Lead	7439-92-1	Mid North	ND to 4,236.68 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	347 mg/kg
Mercury	7439-97-6	Mid North	ND to 33,800 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	190 mg/kg
Total PCBs	1336-36-3	Mid North	ND to 100 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.2 mg/kg	5 mg/kg
Lead	7439-92-1	Mid Central	ND to 236,000 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	269 mg/kg
Mercury	7439-97-6	Mid Central	ND to 4,160.57 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	84.4 mg/kg
Lead	7439-92-1	Mid South	ND to 50,606.84 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	190 mg/kg
Mercury	7439-97-6	Mid South	ND to 7,844.232 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	13 mg/kg
Total PCBs	1336-36-3	Mid South	ND to 56 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.2 mg/kg	7.1 mg/kg
Mercury	7439-97-6	Southwest	ND to 3,176.342 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	33.2 mg/kg
Lead	7439-92-1	South-Central	ND to 6,890 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	951 mg/kg
Mercury	7439-97-6	South-Central	ND to 14,700 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	21.3 mg/kg
Total PCBs	1336-36-3	South-Central	ND to 11 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.2 mg/kg	1.1 mg/kg
Lead	7439-92-1	Southeast	ND to 6,970 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	90 mg/kg	241 mg/kg
Mercury	7439-97-6	Southeast	ND to 11,100 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.1 mg/kg	20 mg/kg
Total PCBs	1336-36-3	Southeast	ND to 240 mg/kg	Impact to Ground Water – SPLP	NA	Alternative	0.2 mg/kg	21 mg/kg

Appendix C

Draft Deed Notice

Return Address:
The Chemours Company FC, LLC
1007 Market Street
Wilmington, Delaware 19899

APPENDIX B - MODEL DEED NOTICE

____
Instrument Number

DEED NOTICE

This shell document contains blanks and matter in brackets [ ]. These blanks shall be replaced with the required site information prior to recording.

Matter bracketed [ ] is not intended for deletion, but rather is intended to be descriptive of the variable information that may be contained in the final document.

IN ACCORDANCE WITH N.J.S.A. 58:10B-13, THIS DOCUMENT IS TO BE RECORDED IN THE SAME MANNER AS ARE DEEDS AND OTHER INTERESTS IN REAL PROPERTY.

Prepared by: _______________________________________
[Signature]

____
[Print name below signature]

Recorded by: _______________________________________
[Signature, Officer of County Recording Office]

____
[Print name below signature]

DEED NOTICE

This Deed Notice is made as of the _____ day of _____, ____, by [*Insert the full legal name and address of each current property owner*] (together with his/her/its/their successors and assigns, collectively "Owner").

1. THE PROPERTY. The Chemours Company FC, LLC is the owner in fee simple of certain real property designated as Block(s) 100 Lot(s) 3, 6.01 and 7, on the tax map of the Borough of Pompton Lakes and Block(s) 479, 479.01 Lot(s) 3,4,5, 1,2,3 on the tax map of the Borough of Wanaque, Passaic County; the New Jersey Department of Environmental Protection Program Interest Number (Preferred ID) for the contaminated site which includes this property is 007411;

and the property is more particularly described in Exhibit A, which is attached hereto and made a part hereof (the “Property”).

2. REMEDIATION.

i. [*Insert name of the Licensed Site Remediation Professional and LSRP License No. of the LSRP that approved this Deed Notice*] has approved this Deed Notice as an institutional control for the Property, which is part of the remediation of the Property.

ii. N.J.A.C. 7:26C-7 requires the Owner, among other persons, to obtain a soil remedial action permit for the soil remedial action at the Property. That permit will contain the monitoring, maintenance and biennial certification requirements that apply to the Property.

3. SOIL CONTAMINATION. [*Insert the full legal name of the person that was responsible for conducting the remediation*] has remediated contaminated soil at the Property, such that soil contamination remains at certain areas of the Property that contains contaminants in concentrations that do not allow for the unrestricted use of the Property. Such soil contamination is described, including the type, concentration and specific location of such contamination, and the existing engineering controls on the site are described, in Exhibit B, which is attached hereto and made a part hereof. As a result, there is a statutory requirement for this Deed Notice [*include if appropriate:* and engineering controls] in accordance with N.J.S.A. 58:10B-13.

4. CONSIDERATION. In accordance with the remedial action for the site which included the Property, and in consideration of the terms and conditions of that remedial action, and other good and valuable consideration, Owner has agreed to subject the Property to certain statutory and regulatory requirements that impose restrictions upon the use of the Property, to restrict certain uses of the Property, and to provide notice to subsequent owners, lessors, lessees and operators of the Property of the restrictions and the monitoring, maintenance, and biennial certification requirements outlined in this Deed Notice and required by law, as set forth herein.

5A. RESTRICTED AREAS. Due to the presence of contamination remaining at concentrations that do not allow for unrestricted use, the Owner has agreed, as part of the remedial action for the Property, to restrict the use of certain parts of the Property (the “Restricted Areas”); a narrative description of these restrictions is provided in Exhibit C, which is attached hereto and made a part hereof. The Owner has also agreed to maintain a list of these restrictions on site for inspection by governmental officials.

5B. RESTRICTED LAND USES. The following statutory land use restrictions apply to the Restricted Areas:

i. The Brownfield and Contaminated Site Remediation Act, N.J.S.A. 58:10B-12.g(10), prohibits the conversion of a contaminated site, remediated to non-residential soil remediation standards that require the maintenance of engineering or institutional controls, to a child care facility, or public, private, or charter school without the Department’s prior written approval, unless a presumptive remedy is implemented; and

ii. The Brownfield and Contaminated Site Remediation Act, N.J.S.A. 58:10B-12.g(12), prohibits the conversion of a landfill, with gas venting systems and or leachate collection systems, to a single family residence or a child care facility.

5C. ENGINEERING CONTROLS. Due to the presence and concentration of these contaminants, the Owner has also agreed, as part of the remedial action for the Property, to the placement of certain engineering controls on the Property; a narrative description of these engineering controls is provided in Exhibit C.]

6A. CHANGE IN OWNERSHIP AND REZONING.

i. The Owner and the subsequent owners, lessors, and lessees, shall cause all leases, grants, and other written transfers of an interest in the Restricted Areas to contain a provision expressly requiring all holders thereof to take the Property subject to the restrictions contained herein and to comply with all, and not to violate any of the conditions of this Deed Notice. Nothing contained in this Paragraph shall be construed as limiting any obligation of any person to provide any notice required by any law, regulation, or order of any governmental authority.

ii. The Owner and the subsequent owners shall provide written notice to the Department of Environmental Protection on a form provided by the Department and available at www.nj.gov/srp/forms within 30 calendar days after the effective date of any conveyance, grant, gift, or other transfer, in whole or in part, of the Owner's or subsequent owner's interest in the Restricted Area.

iii. The Owner and the subsequent owners shall provide written notice to the Department, on a form available from the Department at www.nj.gov/srp/forms, within thirty (30) calendar days after the owner's petition for or filing of any document initiating a rezoning of the Property to residential.

6B. SUCCESSORS AND ASSIGNS. This Deed Notice shall be binding upon Owner and upon Owner's successors and assigns, and subsequent owners, lessors, lessees and operators while each is an owner, lessor, lessee, or operator of the Property.

7A. ALTERATIONS, IMPROVEMENTS, AND DISTURBANCES.

i. The Owner and all subsequent owners, lessors, and lessees shall notify any person, including, without limitation, tenants, employees of tenants, and contractors, intending to conduct invasive work or excavate within the Restricted Areas, of the nature and location of contamination in the Restricted Areas, and, of the precautions necessary to minimize potential human exposure to contaminants.

ii. Except as provided in Paragraph 7B, below, no person shall make, or allow to be made, any alteration, improvement, or disturbance in, to, or about the Property which disturbs any engineering control at the Property without first retaining a licensed site remediation professional. Nothing herein shall constitute a waiver of the obligation of any person to comply with all applicable laws and regulations including, without limitation, the applicable rules of the Occupational Safety and Health Administration.

iii. A soil remedial action permit modification is required for any permanent alteration, improvement, or disturbance and the owner, lessor, lessee or operator shall submit the following within 30 days after the occurrence of the permanent alteration, improvement, or disturbance:

(A) A Remedial Action Workplan or Linear Construction Project notification and Final Report Form, whichever is applicable;

(B) A Remedial Action Report and Termination of Deed Notice Form; and

(C) A revised recorded Deed Notice with revised Exhibits, and Remedial Action Permit Modification or Remedial Action Permit Termination form and Remedial Action Report.

iv. No owner, lessor, lessee or operator shall be required to obtain a Remedial Action Permit Modification for any temporary alteration, improvement, or disturbance, provided that the site is restored to the condition described in the Exhibits to this Deed Notice, and the owner, lessee, or operator complies with the following:

(A) Restores any disturbance of an engineering control to pre-disturbance conditions within 60 calendar days after the initiation of the alteration, improvement or disturbance;

(B) Ensures that all applicable worker health and safety laws and regulations are followed during the alteration, improvement, or disturbance, and during the restoration;

(C) Ensures that human exposure to contamination in excess of the remediation standards does not occur; and

(D) Describes, in the next biennial certification the nature of the temporary alteration, improvement, or disturbance, the dates and duration of the temporary alteration, improvement, or disturbance, the name of key individuals and their affiliations conducting the temporary alteration, improvement, or disturbance, the notice the Owner gave to those persons prior to the disturbance.

7B. EMERGENCIES. In the event of an emergency which presents, or may present, an unacceptable risk to the public health and safety, or to the environment, or an immediate environmental concern, see N.J.S.A. 58:10C-2, any person may temporarily breach an engineering control provided that that person complies with each of the following:

i. Immediately notifies the Department of Environmental Protection of the emergency, by calling the DEP Hotline at 1-877-WARNDEP or 1-877-927-6337;

ii. Hires a Licensed Site Remediation Professional (unless the Restricted Areas includes an unregulated heating oil tank) to respond to the emergency;

iii. Limits both the actual disturbance and the time needed for the disturbance to the minimum reasonably necessary to adequately respond to the emergency;

iv. Implements all measures necessary to limit actual or potential, present or future risk of exposure to humans or the environment to the contamination;

v. Notifies the Department of Environmental Protection when the emergency or immediate environmental concern has ended by calling the DEP Hotline at 1-877-WARNDEP or 1-877-927-6337; and

vi. Restores the engineering control to the pre-emergency conditions as soon as possible; and

vii. Submits to the Department of Environmental Protection within 60 calendar days after completion of the restoration of the engineering control, a report including: (a) the nature and likely cause of the emergency; (b) the measures that have been taken to mitigate the effects of the emergency on human health and the environment; (c) the measures completed or implemented to restore the engineering control; and (d) any changes to the engineering control or site operation and maintenance plan to prevent reoccurrence of such conditions in the future.

8. TERMINATION OF DEED NOTICE.

i. This Deed Notice may be terminated only upon recording a Department-approved Termination of Deed Notice, available at N.J.A.C. 7:26C Appendix C, with the office of the [*Insert as appropriate the County Clerk/Register of Deeds and Mortgages*] of [*Insert the name of the County*] County, New Jersey, expressly terminating this Deed Notice.

ii. Within 30 calendar days after recording a Department-approved Termination of Deed Notice, the owner of the property should apply to the Department for termination of the soil remedial action permit pursuant to N.J.A.C. 7:26C-7.

9. ACCESS. The Owner, and the subsequent owners, lessors, lessees, and operators agree to allow the Department, its agents and representatives access to the Property to inspect and evaluate the continued protectiveness of the remedial action that includes this Deed Notice and to conduct additional remediation to ensure the protection of the public health and safety and of the environment if the subsequent owners, lessors, lessees, and operators, during their ownership, tenancy, or operation, and the Owner fail to conduct such remediation pursuant to this Deed Notice as required by law. The Owner, and the subsequent owners, lessors, and lessees, shall also cause all leases, subleases, grants, and other written transfers of an interest in the Restricted Areas to contain a provision expressly requiring that all holders thereof provide such access to the Department.

10. ENFORCEMENT OF VIOLATIONS.

i. This Deed Notice itself is not intended to create any interest in real estate in favor of the Department of Environmental Protection, nor to create a lien against the Property, but merely is intended to provide notice of certain conditions and restrictions on the Property and to reflect the regulatory and statutory obligations imposed as a conditional remedial action for this site.

ii. The restrictions provided herein may be enforceable solely by the Department against any person who violates this Deed Notice. To enforce violations of this Deed Notice, the Department may initiate one or more enforcement actions pursuant to N.J.S.A. 58:10-23.11, and N.J.S.A. 58:10C, and require additional remediation and assess damages pursuant to N.J.S.A. 58:10-23.11, and N.J.S.A. 58:10C.

11. SEVERABILITY. If any court of competent jurisdiction determines that any provision of this Deed Notice requires modification, such provision shall be deemed to have been modified automatically to conform to such requirements. If a court of competent jurisdiction determines that any provision of this Deed Notice is invalid or unenforceable and the provision is of such a nature that it cannot be modified, the provision shall be deemed deleted from this instrument as though the provision had never been included herein. In either case, the remaining provisions of this Deed Notice shall remain in full force and effect.

12A. EXHIBIT A. Exhibit A includes the following maps of the Property and the vicinity:

i. Exhibit A-1: Vicinity Map - A map that identifies by name the roads, and other important geographical features in the vicinity of the Property (for example, USGS Quad map, Hagstrom County Maps);

ii. Exhibit A-2: Metes and Bounds Description - A tax map of lots and blocks as wells as metes and bounds description of the Property, including reference to tax lot and block numbers for the Property;

iii. Exhibit A-3: Property Map - A scaled map of the Property, scaled at one inch to 200 feet or less, and if more than one map is submitted, the maps shall be presented as overlays, keyed to a base map; and the Property Map shall include diagrams of major surface topographical features such as buildings, roads, and parking lots.

12B. EXHIBIT B. Exhibit B includes the following descriptions of the Restricted Areas:

i. Exhibit B-1: Restricted Area Map -- A separate map for each restricted area that includes:

(A) As-built diagrams of each engineering control, including caps, fences, slurry walls, (and, if any) ground water monitoring wells, extent of the ground water classification exception area, pumping and treatment systems that may be required as part of a ground water engineering control in addition to the deed notice;

(B) As-built diagrams of any buildings, roads, parking lots and other structures that function as engineering controls; and

(C) Designation of all soil and all upland sediment sample locations within the restricted areas that exceed any soil standard that are keyed into one of the tables described in the following paragraph.

ii. Exhibit B-2: Restricted Area Data Table - A separate table for each restricted area that includes either (A) or (B) through (F):

(A) Only for historic fill extending over the entire site or a portion of the site and for which analytical data are limited or do not exist, a narrative that states that historic fill is present at the site, a description of the fill material (e.g., ash, cinders, brick, dredge material), and a statement that such material may include, but is not limited to, contaminants such as PAHs and metals;

(B) Sample location designation from Restricted Area map (Exhibit B-1);

(C) Sample elevation based upon mean sea level;

(D) Name and chemical abstract service registry number of each contaminant with a concentration that exceeds the unrestricted use standard;

(E) The restricted and unrestricted use standards for each contaminant in the table; and

(F) The remaining concentration of each contaminant at each sample location at each elevation.

12C. EXHIBIT C. Exhibit C includes narrative descriptions of the institutional controls and engineering controls as follows:

i. Exhibit C-1: Deed Notice as Institutional Control: Exhibit C-1 includes a narrative description of the restriction and obligations of this Deed Notice that are in addition to those described above, as follows:

(A) Description and estimated size [*Identify units of measure*] of the Restricted Areas as described above;

(B) Description of the restrictions on the Property by operation of this Deed Notice; and

(C) The objective of the restrictions.

ii. Exhibit C-2: [*Insert the name of the first engineering control*]: Exhibit C-2 includes a narrative description of [*Insert the name of the first engineering control*] as follows:

(A) Description of the engineering control;

(B) The objective of the engineering control; and

(C) How the engineering control is intended to function.

[*Repeat the contents of Exhibit C-2, renumbering accordingly, for each separate engineering control that is part of the remedial action for the site.*]

13. SIGNATURES. IN WITNESS WHEREOF, Owner has executed this Deed Notice as of the date first written above.

[If Owner is an individual]

WITNESS: ____________________________
[Signature]

____
[Print name below signature]

STATE OF [State where document is executed] SS.:
COUNTY OF [County where document is executed]

I certify that on ________, 20__, [Name of Owner] personally came before me, and this person acknowledged under oath, to my satisfaction, that this person [or if more than one person, each person]

(a) is named in and personally signed this document; and

(b) signed, sealed and delivered this document as his or her act and deed.

____

______________________________, Notary Public
[Print Name and Title]

14. SIGNATURES. IN WITNESS WHEREOF, Owner has executed this Deed Notice as of the date first written above.

[*If Owner is a general or limited partnership*]

WITNESS: [*Name of partnership*]

____________________ By:__________________________, General Partner
[*Signature*] [*Signature*]

________________________ ______________________________
[*Print name and title*] [*Print name*]

STATE OF [*State where document is executed*] SS.:
COUNTY OF [*County where document is executed*]

I certify that on _______________, 20___, [*Name of person executing document on behalf of owner partnership*] personally came before me, and this person acknowledged under oath, to my satisfaction, that this person:

(a) Is a general partner of [*Owner*], the partnership named in this document;

(b) Signed, sealed and delivered this document as his or her act and deed in his capacity as a general partner of [*Owner*]; and

(c) This document was signed and delivered by such partnership as its voluntary act, duly authorized.

____________________________________, Notary Public
[*Signature*]

____
[*Print name*]

15. SIGNATURES. IN WITNESS WHEREOF, Owner has executed this Deed Notice as of the date first written above.

[If Owner is a corporation]

ATTEST: [Name of corporation]

__________________________ By________________________

__________________________ __________________________
[Print name and title] [Signature]

STATE OF [State where document is executed] SS.:
COUNTY OF [County where document is executed]

I certify that on ________, 20__, [Name of person executing document on behalf of Owner] personally came before me, and this person acknowledged under oath, to my satisfaction, that:

(a) this person is the [secretary/assistant secretary] of [Owner], the corporation named in this document;

(b) this person is the attesting witness to the signing of this document by the proper corporate officer who is the [president/vice president] of the corporation;

(c) this document was signed and delivered by the corporation as its voluntary act and was duly authorized;

(d) this person knows the proper seal of the corporation which was affixed to this document; and

(e) this person signed this proof to attest to the truth of these facts.

____
[Signature]

____
[Print name and title of attesting witness]

Signed and sworn before me on ________, 20__

__________________________________, Notary Public

____
[Print name and title]