Environmental Compliance and Cleanup Branch
Park Facility Management Division

National Park Service
U.S. Department of the Interior

Draft-Final Jaite Paper Mill Cuyahoga Valley National Park Engineering Evaluation/ Cost Analysis Report

Prepared by

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List of Abbreviations and Acronyms

ACM	Asbestos Containing Material
ADAF	Age-Dependent Adjustment Factors
ALM	Adult Lead Methodology
amsl	above mean sea level

AP	Aeration Pond Area
ARAR	Applicable or Relevant and Appropriate Requirements
AST	Aboveground Storage Tank
AVS	Acid Volatile Sulfide
BERA	Baseline Ecological Risk Assessment
BC	Brandywine Creek
bgs	below ground surface
BLD	Building Foundation Area
BMP	Best Management Practice
BTEX	benzene, toluene, ethylbenzene, and xylenes
BUSTR	Ohio Bureau of Underground Storage Tank Regulations
CDEP	Connecticut Department of Environmental Protection
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHF	Central Hazardous Materials Fund
cm/sec	centimeters per second
COC	Contaminants of Concern
COEC	Contaminants of Ecological Concern
COPC	Contaminants of Potential Concern
COPEC	Contaminants of Potential Ecological Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CST	Contaminant Site Team
CTE	Central Tendency Exposure
CUVA	Cuyahoga Valley National Park
CWA	Clean Water Act
CWP	Central Waste Pile Area
CWP1N	Northern portion of Central Waste Pile 1
CWP1S	Southern portion of Central Waste Pile 1
CWP2N	Northern portion of Central Waste Pile 2
CWP2S	Southern portion of Central Waste Pile 2
1,2-cDCE	1,2-cis-dichloroethene
1,2-tDCE	1,2-trans-dichloroethene
DCR	DCR Services & Construction, Inc.
4,4-DDD	dichlorodiphenyldichloroethane
4,4-DDE	dichlorodiphenyldichloroethylene
4,4-DDT	dichlorodiphenyltrichloroethane
DEHP	bis(2-ethylhexyl)phthalate
DSW	Division of Surface Water
DU	Decision Unit
EC	Engineering Controls
ECM	Environmental Compliance Memorandum
EE/CA	Engineering Evaluation/Cost Analysis

EMSL	EMSL Analytical, Inc.
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
ESL	Ecological Screening Level
ESV	Ecological Screening Value
EU	Exposure Unit
°F	Fahrenheit
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
foc	fraction of organic carbon
ft	foot or feet
ft^2	square feet
ft/day	feet per day
ft/ft	feet per foot
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
i	horizontal gradient of an area
IC	Institutional Controls
IEUBK	Integrated Exposure Uptake Biokinetic
IDW	Investigation Derived Waste
ISM	Incremental Sampling Methodology
ITRC	Interstate Technology Regulatory Council
IUR	Inhalation Unit Risk
J	estimated value
K	hydraulic conductivity
Koc	partitioning coefficient of organic carbon
LANL	Los Alamos National Laboratory
LCS	List of Classified Structures
LOAEL	Lowest Observed Adverse Effect Level
MCL	Maximum Contaminant Level
MDL	Method Detection limit
µg/dL	micrograms per deciliter
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µmol/goc	micromoles per gram of organic carbon
mg/l	milligrams per liter
mg/kg	milligrams per kilogram
MW	monitoring well
n	porosity
NCP	National Contingency Plan
NEOSD	Northeast Ohio Sewer District
NOAEL	No Observed Adverse Effect Level

NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NTR	North of the Railroad Tracks area
NTCRA	Non-Time Critical Removal Action
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OMZA	Outside the Mixing Zone Average
ORAM	Ohio Rapid Assessment Method
ORNL	Oak Ridge National Laboratory
PAHs	Polycyclic Aromatic Hydrocarbons
PALs	Project Action Levels
PbB	blood lead level
PCBs	Polychlorinated Biphenyls
PCE	tetrachloroethene (tetrachloroethylene)
PEC	Probable Effects Concentrations
PEF	Particulate Emission Factor
PPE	Personal Protection Equipment
PRGs	Preliminary Removal Goals
PRP	Potentially Responsible Party
PRSC	Post-Removal Site Controls
PWS	Professional Wetland Scientist
PZ	Piezometer
QA/QC	Quality assurance/quality control
QAPP	Quality Assurance Project Plan
RA	Risk Assessment
RAO	Removal Action Objectives
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
REF	reference or background location DU
RfC	Reference Concentration
RfD	Reference Dose
RGs	Removal Action Goals
RL	Reporting limit
RME	Reasonable Maximum Exposure
RR	Railroad Area
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SEM	Simultaneously Extracted Metals
SLERA	Screening-Level Ecological Risk Assessment
SQB	Sediment Quality Benchmark
SVOCs	Semi-Volatile Organic Compounds
SW	Surface Water

SWP	Southern Waste Pile
TA	TestAmerica
TBC	to be considered
2,3,7,8-TCDD	2,3,7,8 tetrachlorodibenzo-p-dioxin
TCE	trichloroethene (trichloroethylene)
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time Critical Removal Action
TEC	Threshold Effect Concentration
TEQ	TCDD-equivalent concentration or Toxicity Equivalent
TOC	Total Organic Carbon
TR	Former transformer pad
TRV	Toxicity Reference Value
TU	Toxic Unit
U	analyte was undetected at the reporting limit concentration shown
UCL	Upper Confidence Limit
USACE	US Army Corps of Engineers
USC	United States Code
USDOI	U.S. Department of Interior
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
v	average linear velocity of groundwater
VOCs	Volatile Organic Compounds
VF	Volatilization Factor
VDEQ	Virginia Department of Environmental Quality
VURAM	Virginia Unified Risk Assessment Model
WASO-ECCB	Washington Support Office-Environmental Compliance and Cleanup Branch
yd^3	cubic yards

Executive Summary

The purpose of the Engineering Evaluation/Cost Analysis (EE/CA) Executive Summary is to highlight the key information contained in the EE/CA Report. The Executive Summary contains a summary of the site description, including investigation results and an updated conceptual site model based on these results. A summary of the risk assessment and of Applicable or Relevant and Appropriate Requirements (ARARs) also is included along with the scope and objectives of the removal action. The final sections of the Executive Summary provide information on the removal action alternatives analyzed and the recommended removal action.

ES 1. Introduction and Purpose

The former Jaite Paper Mill site (the Site) is located within the Cuyahoga Valley National Park (CUVA), which is owned by the United States and managed by the National Park Service (NPS). The Site is being investigated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). NPS is the lead agency under CERCLA at the Site because the Site is under the jurisdiction, custody, or control of NPS. NPS retained DCR Services and Construction, Inc, (DCR) to fully characterize the Site and prepare this EE/CA Report.

This EE/CA has been prepared pursuant to the authorities of Section 104(b) of CERCLA and Section 300.415 (b)(4)(i) of the National Oil and Hazardous Substances Pollution Contingency Plan, commonly called the National Contingency Plan (NCP), which authorizes NPS to conduct investigations and studies to characterize the nature and extent of contamination at the Site and to evaluate the need for a response to such contamination to protect public health or welfare or the environment.

The purpose of the EE/CA is to document the release, nature, and extent of hazardous substances at the Site and provide a framework for evaluating removal action alternatives. The EE/CA identifies Removal Action Objectives (RAOs) and analyzes the effectiveness, implementability, and cost of removal action alternatives that may be used to satisfy the RAOs.

ES 2. Site Description, Investigation Results, and Conceptual Site Model

The Site is defined as the former Jaite Paper Mill facility comprised of approximately 30 acres of parkland. The Site is bounded to the north by Brandywine Creek and to the southwest by the Cuyahoga River, beyond which extend several acres of wooded parkland crossed by park roads and recreational paths (Figure 1-1). The Site is bounded on the east and southeast by the Brandywine Ski Resort, and on the south by wooded parkland. The Brandywine Ski Resort property line falls immediately east of the Towpath Trail and south of the Site boundary. Two small lakes southeast of the Site and across the Towpath Trail, Brandywine Lake and an unnamed lake, are associated with the ski area (Figure 2-1).

The Site (shown in Figure 2-1) includes the area of the former Jaite Paper Mill, of which only a concrete foundation remains, the Fourdrinier Machine (used to make paper), as well as former railroad spurs and surrounding waste disposal areas associated with mill activities. All above-ground structures were demolished in 2006. The former mill building area, located immediately west of the Towpath Trail, is closed to the public and secured by a perimeter fence with locked gates. A similar perimeter fence encloses Pond 1 of three ponds east of the Towpath Trail, and the Dump site west of the former mill building area and bordered by the Cuyahoga River. Access to other adjacent areas of the Park and the Towpath Trail is unrestricted. An abandoned railroad track extends from a bridge across the Cuyahoga River onto the Site where it divides into five spurs that terminate in operational areas along the southern, eastern, and northern sides of the former mill building.

The Cuyahoga River and Brandywine Creek abut the Site on the west/south and north sides of the Site, respectively. The flows in the Cuyahoga River and Brandywine Creek are dependent on precipitation and tributaries upstream of the Site. During heavy precipitation events, often in winter and spring, the flows in the River and Creek regularly flood portions of the Site. The areas that are most prone to flooding from high flows in the Cuyahoga River include the area southwest of the building foundation and the Dump site. Flooding along Brandywine Creek occurs in the aeration pond areas north of Pond P1, around Pond P3, and north of the railroad tracks north of the Dump site. When these areas are flooded, access is limited as water levels can exceed four feet of water and vehicular and foot traffic is not possible.

Numerous investigations and several cleanup actions have been performed at the Site since 1990. Some of these investigations and cleanup actions focused on the former mill building and its demolition in 2006, and include information related to releases and/or threatened releases of hazardous substances from structures inside or associated with the building. Other investigations focused on characterizing specific areas of potential environmental concern across the Site including: the Concrete Transformer Pad, Former Septic Tank and Leach Field, Aeration and Settling Ponds, the former mill building area, former Underground Storage Tanks (USTs), and waste disposal areas (Figure 2-1). The 2005 Site Characterization Report by Tetra Tech compared analytical results for pesticides, herbicides, metals, Semi-Volatile Organic Compounds (SVOCs), Volatile Organic Compounds (VOCs), and Polychlorinated Biphenyls (PCBs) in soil, sediment, groundwater, waste, and surface water samples to human and ecological screening levels. Cleanup actions have included removal of USTs, demolition of the former building, asbestos abatement of Asbestos-Containing Material (ACM) identified in the former building, removal of PCB impacted liquid in a trench beneath the Fourdrinier Machine, partial removal of lead-based paint from the Fourdrinier Machine and removal of containers used to store chemicals.

This EE/CA Site investigation included 300 sample locations from seven media: 1) three vertical zones of soils; 2) five different surface water bodies; 3) 35 groundwater locations; 4) 16 sediment locations; 5) seven waste piles, 6) concrete; and 7) one Fourdrinier Machine. From these samples, data were validated from 11 analytical groups including metals, SVOCs, VOCs, PCBs, pesticides, dioxins/furans, asbestos, hardness, pH, Acid Volatile Sulfide (AVS)/Simultaneously Extracted metals (SEM), and Total Organic Carbon (TOC). Most of these analytical groups were sampled from the seven media groups that were divided into sample location areas know as Decision Units (DUs). The DUs were carefully determined based on criteria such as Site use history, estimated contamination area variability, and contaminant transport patterns. The soil and sediment DU sample areas are shown on Figure 2-7. DUs were also established for the seven waste piles, the concrete foundation of the former paper mill operations, and surface water sample areas that matched sediment sampling DUs.

Sampling results show that the primary Contaminants of Concern (COC) are metals and SVOCs (primarily Polycyclic Aromatic Hydrocarbons [PAHs]). The highest concentrations of these COCs are located in surface and subsurface soils, and in waste piles including black slag waste (sand to cobble sized clasts of black and red granular waste product). As shown in Figure 2-10, nearly all black slag waste was discovered in DUs located west of the Towpath in and surrounding the former paper mill buildings and operations area, including under the building foundation concrete slab. The highest concentrations of PAHs are associated with black slag waste. Figure 2-9a shows the relatively high concentration areas of PAHs, which are nearly identical to areas where black slag waste is located with PAH concentrations generally highest where the thickest slag deposits are located. Elevated metals concentrations, shown in Figure 2-9, are distributed across the Site, including in all waste piles.

Typically, metals with the highest concentrations are antimony, arsenic, barium, chromium, copper, lead, and mercury, with lead as much as approximately 150 times the reference and background concentrations in the Dump site adjacent to the Cuyahoga River.

A Conceptual Site Model (CSM) generally is a representation of the environmental system and the physical, chemical, and biological processes that determine transport of contaminants from sources to receptors. The CSM is derived from existing site data, experience from other similar contaminant sites, and often provides a basic visualization of site-specific contaminant transport. Essential elements of a CSM typically include information about contaminant sources, transport pathways, exposure pathways, and receptors (USEPA, 2005).

Figure 2-18 provides a visualization of the CSM where Site geology and hydrogeology may be visualized as dictating more restrictions to contaminant transport than providing pathways. Ground surface fill and waste material, including waste piles and slag contamination, are uniformly underlain by 4 to 12 feet of low permeability silt and clay restricting vertical transport to the underlying sand and gravel aquifer. The relatively thin sand and gravel aquifer, 3 to 8 feet in thickness, provides a reliable transport pathway throughout the Site given its relatively high permeability for dissolved transport and uniform Site distribution. Further vertical transport is restricted by a thick and low permeability clay and silt underlying the sand and gravel aquifer that extends to at least 75 feet below the sand and gravel aquifer. Natural attenuation from dilution of dissolved contamination in the sand and gravel aquifer is expected to be a dominant process in this unit to reduce concentrations with time, evidenced by relatively low detections and limited compounds of readily dissolved contaminants such as VOCs. Counter to the sand and gravel aquifer attenuation mechanisms, the low permeability silts and clay units above and below this unit can provide long term mechanisms of contamination retention through sorption and low dissolved transport rates resulting in long-term sources of contamination strongly absorbed to organic matter and soil particles, such as PAHs and metals. Consequently, the highest levels of contamination at the Site are metals and PAHs detected at and near the ground surface where these types of contaminants typically tend to sorb to low permeability silts and clays.

As a result of these Site-specific physical conditions and the physical and chemical characteristics of Site contaminants, contamination appears to be almost entirely contained in the surface fill, waste material, and the shallow silts and clays above the sand and gravel aquifer. Consequently, the primary and most direct exposure pathway on the Site is human and ecological contact with surface soils and surface waste material. Also, ground surface, creek and river erosion of the Site's shallow contamination is currently the dominant contaminant transport process given this Site's location in an active erosional valley along the Cuyahoga River. Sediment concentrations and Cuyahoga River magnetometer detections of metal waste show Creek and River erosion is occurring at surface soils and Site waste piles with some of the highest concentrations of metals and SVOCs on the Site.

In summary regarding the CSM, as a result of time, Site hydrogeology, and an active dominant river valley system, the primary contamination remaining on the Site are SVOCs and metals sorbed into shallow surface soils and Site waste material. These Site conditions provide long-term sources of contamination to human and ecological receptors as surface soil and surface water erosion furnish the dominant mechanism for off-Site contaminant transport to the Cuyahoga River.

ES 3. Risk Assessment Summary

<u>Human Health Risk Assessment</u>

Health protective assumptions were used to estimate non-cancer hazards and cancer risks for a range of human receptor populations expected to be present at the Site. Risk estimates were determined based on both larger Exposure Units (EUs) and individual DUs. Given the small areal extent of the individual DUs, it is unlikely the entirety of the Site exposure time for most receptors would occur in only a single DU. Nevertheless, human health exposures and risks were quantified for each individual DU to provide information on the spatial variability in potential exposures across the Site and inform risk management decision-making.

Potentially unacceptable risks for human health are associated with the following chemicals and exposure media:

- Arsenic (soil; sediment; surface water)
- Chromium VI (soil; sediment)
- Lead (soil; sediment)
- Manganese (soil)
- Carcinogenic PAHs (soil)
- bis[2-ethylhexyl] phthalate (DEHP) (soil)
- Dioxins/furans (soil)
- PCBs (Toxicity Equivalent (TEQ) (dioxin-like PCB) (soil)

For arsenic and manganese, potentially unacceptable risks are also associated with soil and sediment in the reference/background areas, which suggests Site risks may not be entirely attributable to Site-related impacts. Therefore, naturally occurring concentrations and local reference conditions were considered when determining appropriate cleanup levels.

Ecological Risk Assessment

Compounds of Potential Environmental Concerns (COPECs) in each environmental medium were identified by comparing the maximum detected concentration for each chemical in each medium to its respective Ecological Screening Value (ESV). Chemicals with maximum detected concentrations above their respective ESV were selected as COPECs and retained for further evaluation in the initial Baseline Environmental Risk Assessment (BERA). For soil/waste piles, the list of COPECs includes most metals (including chromium and mercury), several pesticides, PCBs (as aroclors), a few VOCs, several PAHs and phthalates, and dioxin/furan and dioxin-like PCB congeners. For sediment, the types of COPECs are generally similar to COPECs in soil, including metals, pesticides, PCBs, VOCs, PAHs, phthalates, and dioxins/furans. For surface water, the list of COPECs includes most metals, but only two organic chemicals, including gamma-chlordane and pyrene.

Potential risk for ecological receptors from exposure to contaminants in soil, surface water, or sediment is based on many factors, including the type of receptor, location of contamination, accessibility of contamination, the availability of contaminants for uptake, the exposure route (e.g., direct contact or via ingestion of food items), the types of food consumed, and the receptor use of the area (as defined by a home range size). In the BERA, risks were evaluated separately for the following ecological receptor groups and exposure scenarios:

- Terrestrial plants and soil invertebrates from direct contact with COPECs in soil;
- Aquatic receptors (i.e., aquatic plants, fish, water column-dwelling aquatic invertebrates) from direct contact with COPECs in surface water;
- Amphibians from direct contact with COPECs in surface water;
- Sediment-dwelling aquatic invertebrates from direct contact with COPECs in sediment; and
- Wildlife from ingestion of COPECs in soil, sediment, surface water, and dietary items derived from the Site. This evaluation includes risk estimates for both terrestrial-feeding and aquatic-feeding wildlife.

Risks were further evaluated using a refined Hazard Quotient (HQ) approach. Based on the initial BERA HQ results, several chemicals in soil/waste piles, sediment, and surface water have the potential to be present within the Site at concentrations that result in unacceptable ecological exposures.

ES 4. Identification and Analysis of Applicable or Relevant and Appropriate Requirements

Applicable or Relevant and Appropriate Requirements (ARARs) include standards, requirements, criteria, or limitations under federal, or more stringent State, environmental law as set forth in CERCLA Section 121 (d)(2)(A), which states that a remedial action selected for a CERCLA site shall attain a degree of cleanup which assures protection of human health and the environment and attains "legally applicable or relevant and appropriate standard(s), requirement(s), criteria, or limitation(s)." The NCP also compels attainment of ARARs during removal actions to the extent practicable, considering the exigencies of the situation. See 40 Code of Federal Regulations (CFR) § 300.415(i) and § 300.435(b)(2). To be adopted as an ARAR at an NPS CERCLA site, NPS must determine that the requirement is either "applicable" to conditions at the Site or, if not applicable, that it is both "relevant" and "appropriate" based on Site conditions. ARARs fall into one of three categories: chemical-specific, location-specific, and action-specific.

Chemical-specific ARARs that apply to this Site include: federal and state of Ohio surface water criteria that affect the Cuyahoga River drainage basin; NPS and the US Environmental Protection Agency (EPA) guidance and screening levels for chemical contaminants in soil, sediment, groundwater, and surface water; and PCB cleanup and disposal levels and decontamination standards.

Location-specific ARARs apply to this Site because the Site is located within a national park and is in an area that is highly accessible and used by millions of CUVA visitors per year. Specifically, the NPS Organic Act, as amended, 54 United States Code (USC) § 10010(a), created the NPS and remains the fundamental legal authority guiding NPS land management decisions. The numerous piles of exposed waste material on the surface of the Site, and surface and subsurface soil concentrations exceeding human and ecological risk standards, do not comply with the Organic Act ARAR. Similar and additional examples of location-specific ARARs that apply include:

- CUVA legislation that preserves and protects the Cuyahoga River and adjacent lands for public use and enjoyment.
- Restrictions on solid waste disposal in National Parks.
- NPS Policies for Restoration of Natural Systems and for Managing Wildlife and Plant Resources requires the NPS to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated.
- Protection of Wetlands Executive Order "mandates that federal agencies and Potentially Responsible Parties (PRPs) avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands."
- NPS Policies Concerning Waste Management and Contaminant Issues states that NPS will "remove landfill operations and associated impacts from parks where feasible," and provides that NPS "will make every reasonable effort to prevent or minimize the release of contaminants on or that will affect NPS lands or resources, and ….. will take all necessary actions to control or minimize such releases when they occur."

Action-specific ARARs that apply include: NPS and other federal policies and regulations regarding management transport and disposal of hazardous waste that exist on this Site; regulations limiting discharge of pollutants into water of the United States; management of PCB and ACMs; and various hazardous waste handling requirements such as air and dust emissions, excavation and staging of wastes, tracking and record keeping.

ES 5. Removal Action Objectives and Preliminary Removal Goals

RAOs provide a general description of the cleanup goals. The RAOs for this Site have been developed based on analysis of the sources, nature and extent of contamination; the results of the risk assessments; and the identified ARARs. The RAOs for this EE/CA include:

- Eliminate, or reduce to the extent practicable, unacceptable cancer risks and non-cancer hazards for human receptor populations of interest at the Site from exposures to site-related non-lead COCs in soil, sediment, and surface water.
- Eliminate, or reduce to the extent practicable, unacceptable blood lead levels for human receptor populations of interest at the Site from exposures to lead in Site soil and sediment.
- Eliminate, or reduce to the extent practicable, unacceptable risks to terrestrial ecological receptors at the Site from exposures to Site-related contaminants in soil.
- Eliminate, or reduce to the extent practicable, unacceptable risks to aquatic ecological receptors from exposures to Site-related contaminants in sediment and surface water.
- Eliminate, or reduce to the extent practicable, levels of COCs and Contaminants of Ecological Concern (COEC) in aboveground or buried waste materials at the Site that present unacceptable risk to human receptor populations and animals.
- Eliminate the uncontrolled discharge of waste material into waters of the US from waste piles susceptible to active erosion.
- Eliminate contaminant-related constraints to the full enjoyment and utilization of park resources consistent with NPS mandates.
- Attain all other federal and state ARARs.

To achieve the RAOs, the scope of the removal action will focus on eliminating or reducing impacts to human health and ecological receptors from surface and subsurface soil, sediment, waste piles, and surface water. These areas contain COCs that exceed the Preliminary Removal Goals (PRGs) or do not comply with the location ARARs, resulting in an impairment of Site use. The Removal Action Goals (RGs) are selected by comparing all PRGs (human health, ecological, ARAR-based) and selecting the most stringent, unless the reference concentration of the contaminant in the medium is greater than the PRGs, in which case the reference concentration was selected as the RG. To ensure cleanup will be technically feasible and cost effective, the PRGs also are compared to background for naturally-occurring COCs and COECs, as well as reference locations for anthropogenic COCs and COECs in all media at the Site.

RGs were primarily exceeded for a number of metals across the Site, and were also sometimes exceeded for select SVOCs, PCBs, and VOCs. The majority of the Site DUs exceed RGs, which includes 26 soil DUs, 7 waste piles DUs, 8 sediment DUs, and 8 surface water DUs.

ES 6. Identification of Removal Action Alternatives

To begin development of removal action alternatives, multiple potential technologies and process options were identified and screened on the basis of effectiveness, implementability, and cost. Remaining and viable technologies and process options were then combined as components of various removal action alternatives. Each removal action alternative is comprehensive and designed to address the COCs and COECs in each media of concern (i.e., soil, surface water, waste material, and sediment). Media of concern also includes surface concrete foundation materials, the remaining Fourdrinier Machine, former railroad spurs, and other remnant Site features. Technologies and process options were identified based on currently available and tested technologies that can address, treat, remove, or contain, the COCs or COECs in the specific media of concern.

Potential technologies and process options were evaluated and screened to eliminate those that do not have the potential to be sufficiently effective or implementable, or that will be significantly more costly or difficult to implement without being more effective than at least one other option. When evaluating each technology, consideration was given to what media it addresses and how it could be combined with other components in a removal action alternative.

After evaluation, three removal action alternative were proposed:

- Alternative 1 - No action (as required by the NCP)
- Alternative 2 - Contaminated soil, pond sediment, and waste material excavation and off-site disposal with the concrete foundation repaired or replaced and retained as a cap over the contaminated soil and waste beneath the concrete foundation.
- Alternative 3 - Contaminated soil, pond sediment, and waste material excavation, removal of the concrete foundation and the underlying contaminated soil and waste, and off-site disposal.

Each removal action alternative includes components that will address the three media, either separately or collectively, and positively affect surface waters as a fourth media. Each of the removal action alternatives is designed to address contaminated soil, pond sediment, and waste material with COCs exceeding RGs, present in DUs covering an area of approximately 547,000 square feet (ft^2) (about 12.5 acres).

ES 7. Comparative Analysis of Removal Action Alternatives

Pursuant to the NCP, each alternative was analyzed using the following evaluation criteria: effectiveness, implementability, and cost. The effectiveness of each alternative was evaluated by each alternative's protectiveness of human health and the environment; compliance with ARARs; reduction of toxicity, mobility, or volume through treatment; long-term effectiveness and permanence; and short-term effectiveness. The implementability criterion addresses technical feasibility (including availability of services and materials), administrative feasibility, and regulatory and community acceptance. Projected costs were calculated using direct capital costs, indirect capital costs, and annual Post-Removal Site Control Costs (PRSC). Consistent with guidance, the costs presented are estimated using current costs of labor and materials, and actual costs are expected to range from 30 percent below to 50 percent above the costs presented. The projected costs presented for the EE/CA removal action alternatives are estimates only for the sole purpose of comparing alternatives and should not be considered design-level cost estimates.

Based on these evaluation criteria, Alternative 1 is not protective of human health or the environment, and is not effective at eliminating or alleviating an impaired condition to the CUVA or the public. While feasible to implement, acceptance by the State and community is unlikely. There are no costs associated with this alternative because no Institutional Controls/Engineering Controls (ICs/ECs) are assumed.

The partial removal and partial capping of Alternative 2 can be effective by: protecting human health and the environment; reducing contaminant mobility, toxicity, and volume; and it is effective short- and long-term. However, the effectiveness relies upon regular cap maintenance in perpetuity to protect against erosion from weathering including flooding. Specifically, ongoing Site flooding can expose contamination under the concrete cap, which is likely without vigilant cap maintenance. Consequently, this alternative is not in compliance with the ARARs associated with the NPS Organic Act regarding impairment of CUVA resources, and possible impairment to human health and the environment should cap failure occur from poor maintenance and/or flooding. This alternative will also not comply with many ARARs that do not allow waste storage in a Park, or contaminant exposure to the environment should cap failure occur. Alternative 2 is technically and administratively feasible, but this alternative has not been evaluated by the State or the public for acceptance. The alternative has an estimated net present value of approximately $47.2 million.

Alternative 3 provides full removal of all contamination posing risk to human health and the environment. This alternative complies with all aspects of effectiveness. Alternative 3 is technically and administratively feasible; however, like Alternative 2, this alternative has not been evaluated by the State or public. This alternative has an estimated net present value of approximately $45 million.

ES. 8 Recommended Removal Action Alternative

Taking into consideration each of the nine evaluation criteria, the recommended removal action alternative for the Site is Alternative 3. Alternative 3 consists of full removal of contaminated soil, sediment, and waste material, removal of the concrete building foundation and the underlying contaminated soil and waste, and off-site disposal (Figure 6-6). Alternative 3 also addresses contaminated remnant Site features including the Fourdrinier Machine, buried transite piping, railroad spurs; and data gaps including beater tank(s), basement backfill, concrete, and the Pond P1 concrete liner.

The type of contaminants that dominate the Site (metals and PAHs), the extensive variety and number of these contaminants, and their wide distribution and variability across the Site in relatively shallow soils and bounded by active surface water bodies to the north and west, combined with the predominantly fine grained, mostly clay geology at the Site make the Site ideally suited to a thorough and accessible Site-wide cleanup proposed by Alternative 3. Accordingly, Alternative 3 is the best viable alternative to remediate the Site quickly, effectively, permanently, in a way that is protective of human health and the environment, complies with ARARs, and is cost effective.

Once the EE/CA is finalized, it will be made available for public comment for 30 days to allow for public comment on the EE/CA and the Administrative Record supporting this EE/CA. Following receipt and evaluation of public comments, NPS will prepare an Action Memorandum. The Action Memorandum, as the decision document selecting a Non-Time Critical Removal Action (NTCRA), summarizes the need for the removal action, identifies the selected action, provides the rationale for the action, and addresses significant comments received from the public, including those received from other jurisdictions (e.g., states, tribes, United States Environmental Protection Agency [USEPA]).

1. Introduction

The purpose of Section 1 is to describe the National Park Service (NPS) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authority and the purpose of the Engineering Evaluation/Cost Analysis (EE/CA) Report.

This EE/CA Report has been prepared to evaluate the nature and extent of contamination for the Jaite Paper Mill (the Site) and document selection of a recommended removal action for the Site located at Cuyahoga Valley National Park (CUVA) in the state of Ohio. The Site is located on the eastern bank of the Cuyahoga River at its confluence with Brandywine Creek in Sagamore Hills, Ohio. The Site is approximately 30-acres and is situated in the central portion of CUVA west of and across the Towpath Trail from the Brandywine Ski Resort. The CUVA headquarters are located across the Cuyahoga River from the Site at the former mill town of Jaite. The 33,000-acre CUVA extends for 22 miles along the Cuyahoga River between the major metropolitan centers of Cleveland to the north and Akron to the south. The eastern and western CUVA boundaries lie slightly more than 1 mile east and west of the Site.

The Jaite area of CUVA is situated approximately 7 miles northeast of the intersection of Interstates 271 and 77, which afford access from the east or west. The Site is accessed via a dirt road that parallels the Towpath Trail for 0.25 mile south of Highland Road on the eastern side of the Cuyahoga River. The Site is bounded to the north by Brandywine Creek and to the southwest by the Cuyahoga River, beyond which extend several acres of wooded parkland crossed by park roads and recreational paths.

The Site lies at the bottom of the Cuyahoga River valley at an elevation of approximately 640 to 650 feet (ft) above mean sea level (amsl), Figure 1-1. Hills to the east and west of the Cuyahoga River valley rise to approximately 900 ft amsl. The topography of the Site generally slopes from the southeast towards the confluence of the Cuyahoga River and Brandywine Creek to the north and northwest. The Ohio & Erie Canal (now dry) is defined by levees rising above grade. A low-lying dry area between the former mill building and the Towpath Trail, called the "Prism" was formerly used as a 500,000 gallon fire protection reservoir filled by diverting canal water (EMG 1993a).

The Site (shown in Figure 2-1) includes the area of the former Jaite Paper Mill, of which only a concrete foundation remains, as well as former railroad spurs, a papermaking machine called a Fourdrinier Machine, three ponds, and surrounding waste disposal areas associated with mill activities. All above-ground structures were demolished in 2006. The former mill building area, located immediately west of the Towpath Trail, is closed to the public and secured by a perimeter fence with locked gates. A similar perimeter fence encloses Pond 1 of three ponds east of the Towpath Trail. Access to other adjacent areas of the Park and the Towpath Trail is unrestricted. An abandoned railroad track extends from a bridge across the Cuyahoga River onto the Site, where it divides into five spurs that terminate in operational areas along the southern, eastern, and northern sides of the former mill building.

A wedge-shaped spit of wooded floodplain formed by the confluence of the Cuyahoga River and Brandywine Creek extends beyond the abandoned railroad track immediately northwest of the Site. The Brandywine Ski Resort, which is not owned or operated by CUVA, abuts the Site to the east and southeast. The Brandywine Ski Resort property line falls immediately east of the Towpath Trail and south of the Site boundary. Two small lakes southeast of the Site and across the Towpath Trail, Brandywine Lake and an unnamed lake, are associated with the ski area and are not part of the Site.

The nearest occupied buildings to the Site are associated with the Brandywine Ski Resort, located approximately 200 ft east of the easternmost settling pond and approximately 1,000 ft east and upgradient of the former mill building. The adjacent Brandywine Ski Resort is only open during the winter for day-use skiing and does not include hotels or residences. In addition to recreational use associated with the ski resort and the trails within the Park, land use immediately beyond the Site boundaries is either agricultural or undeveloped. Residential neighborhoods are outside of the Park boundaries, approximately 0.8 mile to the east and approximately 1.2 miles to the west.

1.1. National Park Service CERCLA Authority

The NPS is authorized under CERCLA, 42 United States Code (USC) Section 9601 et seq., to respond as the lead agency to a release or threatened release of hazardous substances, and/or a release or threatened release of any pollutant or contaminant that may present an imminent and substantial danger to public health or the environment, on NPS-managed land. Section 104(b) of CERCLA, 42 USC Section 9604(b), authorizes NPS to conduct investigations and other studies to characterize the nature and extent of a release or threat of release, determine if response is necessary to protect public health or welfare or the environment, and evaluate response alternatives. Section 104(a) of CERCLA, 42 USC Section 9604(a), authorizes NPS to select and implement a response action when NPS determines a response is necessary.

CERCLA’s implementing regulations, codified in the National Oil and Hazardous Substances Pollution Contingency Plan, commonly called the National Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, establishes the framework for responding to such releases and threatened releases. The NCP authorizes and describes two processes for responding to releases: (1) a removal action process and (2) a remedial action process (see NCP Sections 300.400 through 300.440). Based on preliminary investigations at the Site, NPS determined that Site conditions warranted additional response to address the release or threatened release of hazardous substances and that a non-time-critical removal action is appropriate at the Site as specified in 40 CFR Section 300.415(b). This determination was formalized in an EE/CA Approval Memorandum, signed on April 8, 2008 by the Midwest Regional Director, and is included in the Administrative Record for the Site.

This EE/CA Report was generated in accordance with CERCLA Section 104(b) and the NCP, 40 CFR Section 300.415(b)(4)(i), the U.S. Environmental Protection Agency (USEPA) *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA 1993a), and the U.S. Department of the Interior (USDOI) Environmental Compliance Memorandum (ECM) 16-3 (USDOI 2016).

1.2. EE/CA Purpose and Organizational Structure

This EE/CA Report is organized by the following topical headings, which also represent the overall objectives of the EE/CA:

- Characterize the nature and extent of contamination at the Site and conduct risk assessments (Sections 2 and 3).
- Identify Applicable or Relevant and Appropriate Requirements (ARARs) (Section 4).
- Develop Removal Action Objectives (RAOs) and Preliminary Removal Goals (PRGs) (Section 5).
- Identify and analyze potential removal action alternatives (Section 6).
- Conduct a comparative evaluation of the removal action alternatives (Section 7).
- Recommend a removal action alternative (Section 8).

1.2.1. *Impact of NPS-Specific Requirements and Policies on EE/CA Development*

The NPS has several requirements and policies that must be satisfied when undertaking a response to the release of hazardous substances, or pollutants or contaminants on NPS-managed land (see NPS 2015), including the NPS Organic Act of 1916 (Organic Act) (54 USC § 100101 *et seq*.; 36 CFR Chapter 1, Part 1), which requires that the NPS manages parks to conserve the scenery, natural and historic objects, and wildlife and provide for their enjoyment by such means as will leave them unimpaired for the enjoyment of future generations. In accordance with this mandate, NPS strives to clean up contaminated sites with long-term, comprehensive solutions that do not rely on Post-Removal Site Controls (PRSCs) to the maximum extent practicable.

This EE/CA Report will be the basis for selecting what is intended to be a final, permanent response action to address human health risk, ecological risk, and ARARs at the Site. Consequently, in accordance with NPS policy, this EE/CA Report includes a baseline Human Health Risk Assessment (HHRA), a Screening-Level Ecological Risk Assessment (SLERA), and an initial Baseline Ecological Risk Assessment (BERA).

1.2.2. *Park-Specific Considerations during EE/CA Development*

The purpose of the Park is to preserve and protect for public use and enjoyment the historic, scenic, natural, and recreational values of the Cuyahoga River and its valley; to maintain the necessary recreational open space in connection with the urban environment; and to provide for the recreational and educational needs of the visiting public (NPS 2006).

The Cuyahoga River connects the Park with the Great Lakes, the largest system of fresh water in the world. This “river that burned” in 1969 gave international attention to water quality issues and encouraged action through the passage of environmental legislation, especially the United States Clean Water Act. Understanding the watershed connections demonstrates the potentially far-reaching impacts of land preservation, community engagement, and individual daily decisions on environmental health.

The Park also provides refuge for a surprisingly rich natural diversity of plants and animals, including rare, threatened, and endangered species whose survival depends on Park protection. This unique species composition is a result of the Park's location in a transition zone between major regions of the country, combined with its glacial history and varied topography.

2. Site Description, Investigation Results, and Conceptual Site Model

The purpose of Section 2 is to provide information on the extent of contamination and the physical characteristics of the Site and to present the Conceptual Site Model (CSM) so that the location and fate and transport of contamination is understood.

This section includes a summary of Site features, operational history, historical sources and releases of contaminants, the specific hazardous substances released at the Site, and other factors that influence contaminant migration such as hydrogeology, hydrology, climate, the extent of contaminants in Site media, and contaminant transport pathways and behavior. All these elements contribute to the development of the CSM, which is presented in Section 2.12 and shown in Figure 2-18.

2.1. Site Description

This section describes Site features such as the physical and natural characteristics, previous and current use, geology, and hydrogeology. The Site is defined as the former Jaite Paper Mill facility and is comprised of approximately 30 acres of parkland. The Site is bounded to the north by Brandywine Creek and to the southwest by the Cuyahoga River, beyond which extend several acres of wooded parkland crossed by park roads and recreational paths. The Site is bounded on the east and southeast by the Brandywine Ski Resort, and on the south by wooded parkland. The Brandywine Ski Resort property line falls immediately east of the Towpath Trail and south of the Site boundary. Two small lakes southeast of the Site and across the Towpath Trail, Brandywine Lake and an unnamed lake, are associated with the ski area and are not part of the Site.

The Site (shown in Figure 2-1) includes the area of the former Jaite Paper Mill, of which only a concrete foundation remains, the Fourdrinier Machine (used to make paper), as well as former railroad spurs and surrounding waste disposal areas associated with mill activities. All above ground structures were demolished in 2006. The former mill building area, located immediately west of the Towpath Trail, is closed to the public and secured by a perimeter fence with locked gates. A similar perimeter fence encloses Pond 1 of three ponds east of the Towpath Trail, and another perimeter fence encloses the Dump site west of the former mill building area and bordered by the Cuyahoga River. Access to other adjacent areas of the Park and the Towpath Trail is unrestricted. An abandoned railroad track extends from a bridge across the Cuyahoga River onto the Site where it divides into five spurs that terminate in operational areas along the southern, eastern, and northern sides of the former mill building.

2.2. Operational History

Jaite Paper Mill was constructed at the Site in 1905 and was in use, although not continuously, until 1984 (NPS 1979). The mill originally produced paper bags for flour and cement with pulp produced in-house from rags and wood (NPS 1979). Pulp was later imported from outside sources (NPS 1979). Other products produced through the years of mill operations included fertilizer bags, bread sacks, rope, high quality kraft paper, and corrugated boxes (NPS 1979; EMG 1993b). The original mill building was ultimately expanded to 180,000 square feet (ft^2) and included above and below grade areas for boilers, chemical storage tanks, maintenance shops, paper storage, and production machinery. Owners and operators of the mill before its incorporation into the CUVA included Jaite Paper Company, National Container Corporation, Owens Illinois, Inc., Tecumseh Corrugated Box Company, TCBC II, and JMJ Development. The building was listed in the National Register of Historic Places (NRHP) in 1979 (NPS 1979). The United States acquired the closed mill and grounds on January 16, 1985, to make it part of CUVA (EMG 1993b). A fire in October 1992 severely damaged much of the southern portion of the mill building, which was thereafter deemed ineligible for the NRHP (Foster Wheeler 2003).

After several structural and safety assessments throughout the 1990s and early 2000s, above-grade structures were demolished between January and July 2006 (TetraTech 2006). Current information on buried or overhead utilities at the Site has not been obtained. However, it is known that a utility company removed power lines from the Site before building demolition (TetraTech 2006). Previous studies noted that gas meters were once located adjacent to the former #6 fuel oil ASTs, which were east of the southern end of the building, as shown on Figure 2-1 (URSG 1997).

Based on previous investigations, waste and production wastewater were disposed on-site along with slag material and numerous Underground Storage Tank (UST) fuel and cleaning solvent releases during the years of mill operations. Lands south and west of the former mill building have been identified as waste disposal areas (EMG 1993b; TetraTech 2005). Production wastewater from papermaking are believed to have been discharged to the Cuyahoga River before 1967 (NPS 1979) and to Brandywine Creek (EMG 1993b), both abutting approximately two-thirds of the Site property boundary. A series of ponds was constructed east of the former mill building across the Ohio & Erie Canal and Towpath Trail in the 1960s and 1970s to treat production wastewater (EMG 1993b). Wastes associated with individual physical units of the Site are described in the following section.

2.3. Historically and Culturally Significant Features

The mill building was listed in the NRHP in 1979 (NPS 1979). However, a fire in October 1992 severely damaged much of the southern portion of the mill building, which was thereafter deemed ineligible for the NRHP (Foster Wheeler 2003). The building was demolished in 2006 and only the concrete building foundation and one Fourdrinier Machine remain on the Site.

The floodplain to the west of the building has been tentatively identified as an area of archeological interest, particularly with respect to Native American historical use.

The Towpath Trail, which crosses through the Site, sees more than 2 million visitors a year on foot or bicycle, and is a popular route for birders. The Towpath Trail follows the historic route of the Ohio & Erie Canal. To the east of the Towpath Trail are the aeration ponds and to the west is the mill building foundation. A canoe launch area was installed at the Park’s Boston Store Visitor Center approximately 0.25 miles upstream of the Site as part of a pilot study to look at recreational use and educational programming on this stretch of the Cuyahoga River. Therefore, the reach of the Cuyahoga River adjacent to the Site may be subject to increased public interest and accessibility.

The Site is accessed by a gravel road that parallels the towpath from Highland Road a quarter mile to the Site. Near the northern edge of the Site the access road crosses Brandywine Creek on a historic stone culvert. The Brandywine Creek Culvert was recorded for the Ohio Historic Inventory (SUM-3262-1), but is not located within the designated area of the Ohio and Erie Canal NRHP Historic District due to a loss of integrity of the surrounding area. However, the NPS considers the culvert to be eligible for the NRHP, and it is included in the CUVA Park List of Classified Structures (LCS). The NPS also considers the culvert to be a contributing element to broader Ohio and Erie Canal cultural landscape in the park, an office NPS designation.

2.4. Waste Characteristics

Based on historical investigations and recent Site visits, the Site has been divided into the following 15 distinct physical units based on previous use, which are described below and shown on Figure 2-1 (features generally outside of the former mill building) and Figure 2-2 (features inside the former mill building).

Physical unit 1, the former mill building (approximately 4 acres) – All above-grade structures at the former 180,000 square ft, roughly U-shaped, plant were demolished in 2006 (TetraTech 2006). The concrete and rebar building slab and outer foundation wall, which is approximately 4 ft high in some areas, remain largely in place, outlining the footprint of the former building and loading docks.

The following areas no longer have an exposed concrete slab as a result of the 2006 demolition work (Figure 2-2):

- Building 19 (“Beaters”): the floor was demolished and removed;
- Buildings 11 (“Pump Expansion Room”), 17 (“Rotary Mixers”), and 21 (“Boilers”): basements were filled with non-asbestos brick, concrete, and/or masonry debris from the building after the concrete floor of the basements were broken to allow drainage; and
- Buildings 8 (Mill Supplies Storage), 9 (Autos) and 10 (Vacuum Pumps).

The following area had portions of the concrete removed leaving disconnected slabs of concrete.

- Buildings 25 (Former Power House), 26 (Truck & Repair Shop on) and 27 (Former Pulp Mill).

The remaining slab is generally fairly to poorly competent, with vegetation becoming established in cracks. An approximately 210-ft long metal Fourdrinier Machine (a large paper press and dryer) is currently located in the central portion of the building slab, which is the same location it has occupied since its installation around 1926 (NPS 1979). Historically there were two Fourdrinier Machines at the Site. Only one remained at the time of demolition, and it was "decontaminated of asbestos-containing material and… pressure washed to remove loose layers of lead-based paint", and preserved in place; waste water from pressure washing was captured and disposed of properly (TetraTech 2006). Basement foundations, slabs, underground pipes, and other sub-slab infrastructure were left in place (TetraTech 2006). Contents of trenches, the septic tank, and the basement were pumped out or removed; the structures were cleaned and filled with concrete or punctured and filled with limestone or broken concrete, brick, concrete blocks, and masonry from demolition (TetraTech 2006). Among the other recognized conditions relevant to future subgrade demolition and remediation of the Site was the discovery of subgrade transite (Asbestos Containing Material [ACM]) pipe near the former power house.

The sub-slab investigation performed as part of the EE/CA investigation encountered concrete thicknesses ranging from 0.5 feet to more than 2 feet. The concrete slab is underlain by an approximately 3 to 8 inch thick layer of gravel which overlies fill material consisting of silt and clay soils with interlayered black slag material. The fill material ranges from 2 to over 6 feet in thickness. Additional details on findings are presented in the EE/CA Site Investigation Report in Appendix B.

Two above ground storage tanks (ASTs) used for gasoline and kerosene were formerly located outside the southeast wall of the former mill building (URSG 1997). Two additional #6 fuel oil ASTs were located east of the gasoline and kerosene ASTs (URSG 1997). The ASTs were not observed during Site visits conducted in 2011 or part of the 2005/2006 demolition activities. The ASTs were likely removed sometime prior to 2005. Former USTs are discussed as physical unit 6 below.

Physical unit 2, the concrete transformer pad – A concrete pad is located outside the former building immediately west of the "Storage" and "Welding" areas on the northern side of the former building area adjacent to the former railroad spur (Figure 2-1). The concrete pad remains in-place, but the transformers it supported have been removed.

Physical unit 3, the septic system leach field and forest north of the railroad tracks – Sanitary waste water from the former mill building was discharged for an unknown period of time to a system consisting of a septic tank and sand filter/leach field (EMG 1993b). The septic tank was located in the Dump site (described below as physical unit 7) outside the former building perimeter fence until it was pumped dry, demolished, and filled during demolition in 2006 (TetraTech 2006). A concrete block structure located on the north side of the main railroad spur is believed to be the former Leach Field. The walls of the structure have partially or completely fallen down and the area enclosed by the walls was empty except for grass and trees. The term Leach Field refers to the area previously labeled as such (EMG 1993a) and as the Sand Filter (EMG 1993b) in previous reports. This area also includes the forest north of the railroad tracks, which may be affected by the former leach field or previously uncharacterized releases.

Physical unit 4, the aeration and settling ponds – A series of three aeration and settling ponds was used to dispose of production wastewater from mill operations for an unknown period of time (EMG 1993a; EMG 1993b). The ponds are located east of the Towpath Trail, immediately north of Brandywine Lake. The westernmost pond (the P1 pond in Figure 2-1) is concrete lined including sides and bottom, within a rectangular soil berm extending approximately 5 ft above the top of the concrete pond edge. Two circular aerators, one at either end, are present in this pond. The pond is approximately 4 to 5 feet deep when full. A concrete overflow outfall leading down the berm and north towards a marshy area to the north was identified at the northeast corner of P1 during the May 2008 Site visit.

A second, smaller, square-shaped former pond adjacent and east of the P1 pond has been reported in multiple investigations to contain a floating mat of vegetation above surface water (EMG 1993a; TetraTech 2005). This area was previously called Pond 2 but was referred to in this investigation as P2 because it is no longer an open-water pond. The P2 area is covered by a partially floating vegetation mat that covers the center of the P2 footprint while vegetation at the edges is not floating. The P2 area is considered a wetland (Wetland report, 2016). The depth of water beneath the center of P2 varies with seasonal precipitation, but was approximately 1 to 2 ft below the base of vegetation during the EE/CA investigation in 2016 and 2017. At the edge of P2, the water depth was observed to be approximately 0 to 4 inches when the field crew stepped on the vegetation during the 2016 Site visit.

The third, easternmost former pond, previously called Pond 3, referred to as P3 because it now includes an area of wet soil in addition to a pond within the U-shaped footprint. During the May 2008 Site visit, P3 was overgrown with marshy vegetation and contained shallow surface water; a clay drainpipe was observed at the northwest corner. The drainpipe appeared to be installed beneath a berm and discharge northwards into the floodplain of Brandywine Creek. However, during the November 2011 Site visit, a pond was present in the northwestern section of the U-shape and water in the remaining marshy area in P3 was too deep to cross by field staff wearing rubber boots. During the summer and fall 2016 EE/CA investigation, P3 was wet but with no standing water. The P3 area was submerged under approximately 1 to 3 feet of water during the spring and fall 2017 field activities. In 1993, EMG identified a fourth pond east of P3 for sediment sampling, but subsequent investigations did not distinguish or address a fourth pond. During the 2008 and 2011 Site visits and during the 2016 and 2017 field activities, this area east of P3 was observed to be low-lying and marshy, with muddy soil but no standing water. This area may have received discharge from P3 and, based on its outline in the 2010 aerial photograph, appears to be a constructed feature.

Physical unit 5, the building pond – During the November 2011 Site visit, game trails were followed to a pond enclosed by the concrete slab of the former pulp storage and baled paper storage rooms in the northern portion of the former building. This area also appeared to be a pond in the 2010 aerial photograph. Presumably, the depression filled with water following the Site demolition work because it was not previously identified as a pond, nor is it visible in the 2006 aerial photograph. During the 2016 and 2017 field investigation no standing water was observed in this area.

Physical unit 6, the former UST areas – Three UST graves are located just outside the footprint of the former building. USTs in Areas 1, 2, and 3 (Figure 2-1) were reportedly used for storage of gasoline, fuel oil, and diesel, respectively. The USTs were removed in 1994 (SunPro 1994). The Ohio Bureau of Underground Storage Tank Regulations (BUSTR) granted No Further Action status for all UST areas in 2004 (ODC 2004), indicating that the State did not require further investigation of these areas; this designation does not preclude additional investigation under CERCLA.

Physical unit 7, the Dump site (approximately 2 acres) – A waste disposal area has been identified northwest of the former mill building, bounded to the north by the main railroad spur and the southwest by the Cuyahoga River. The Dump site has been found to contain twisted wire, cellophane, rubber tires, several partial drums, numerous intact drums, glass, plastic, reddish granular material resembling crushed brick, large household appliances, car engine parts, metal cabinets, and slag fill (TetraTech 2005). Waste wire is twisted around plastic sheeting and strapping because entire bundles of scrap paper and cardboard were placed into the pulper, and the wire and plastic did not dissolve in the pulper (EMG 1993b). The slag encountered is comprised of sand to cobble sized clasts of black and red waste product. Waste was encountered from ground surface to between approximately 2 and 5 ft below ground surface (bgs). The Dump site is vegetated with grasses and several stands of mature trees. Access for drill rigs to the western end of the Dump site has been limited in the past by difficult conditions (TetraTech 2005). More recent 2016 and 2017 investigations continued to encounter drill rig access difficulty throughout the Dump site, as well as difficult vertical access. Exposed waste material was observed in a steep, eroded bank of the Cuyahoga River at the southern border of the Dump site where the river makes a sharp turn to the west.

Physical unit 8, Central Waste Pile (CWP) 1 – This area consists of three waste piles: 1) one waste pile located immediately adjacent to and northwest of the former mill building (CWP1N); 2) a buried waste pile (CWP1S-A) southwest of CWP1N; and 3) a separate mound (CWP1S-B) above CWP1S-A. Excavations and borings in and around the CWP1N indicate the pile is composed predominantly of black slag to approximately 15 ft bgs (TetraTech 2005 and DCR, 2017a). Direct push borings from the buried waste pile CWP1S-A indicate that the waste pile is composed predominately of black slag to approximately 12 ft bgs. The upper two to three feet of CWP1S-A is comprised of the slag material mixed with wire bundles and cellophane, wood, and metal waste (DCR, 2017a). The mound at CWP1S-B was found to contain generally well-graded sand and underlain by a plastic liner (DCR, 2017a). The central waste pile area was covered by thick vegetation during the fall 2016 field investigation, requiring extensive brush clearing and tree removal to allow access for drill rigs and excavators.

Physical unit 9, Central Waste Pile 2 – This area consists of two waste piles: 1) one above ground waste pile (CWP2N) is located south of the former rail spur that runs along the northern side of the courtyard area (Figure 2-1); and 2) a buried waste pile (CWP2S) in the remaining portions of the courtyard area south, east and west of CWP2N. Field observations and excavations in and around CWP2N indicate the waste pile is predominately comprised of rusted and twisted wire and cellophane bundles, with minor amounts of slag, glass, metal, plastic, and wood waste approximately 4 to 6 feet high (TetraTech 2005 and DCR, 2017a). Waste pile CWP2N overlies the north central portion of CWP2S. Soil borings in CWP2S indicate that this waste pile is composed predominately of slag to approximately 6 to 10 ft bgs (DCR, 2017a). Currently, the CWP2S surface is depressed several feet below the grade of the building foundation and is sparsely vegetated. Trees and brush were removed from CWP2N and CWP2S during 2016 Phase I & II field activities.

Physical unit 10 and 11, the Southern Waste Pile (SWP) and Southeastern Waste Pile (SEWP) – Initial Site observations during a 2008 Site visit by Johnson Company identified two separate waste piles located southwest of the former mill building outside the perimeter fence and east of the Cuyahoga River. Based on field observation during the 2016 Phase I & II field activities, the two waste piles were determined to be one continuous waste pile; therefore, the SEWP was included in the SWP (DCR, 2017a). The surface is approximately 6 ft below the elevation of the former building foundation and is within the floodplain of the Cuyahoga River. Waste material consisting of twisted wire and cellophane, metal (drums, and unidentified large pieces), concrete, brick, and slag was recorded from approximately 3 ft above ground to 5 ft bgs (DCR, 2017a). In addition to concentrated waste known to exist in the SWP, sparsely scattered rubble and rusty metal was observed on the ground surface outside the southern edge of the former mill building perimeter fence.

Physical unit 12, Brandywine Creek and the Cuyahoga River – Brandywine Creek flows generally east to west along the northern boundary of the Site before converging with the Cuyahoga River. The Brandywine Creek watershed is located east of the Site and includes areas inside CUVA and beyond the eastern boundary of the Park. The Cuyahoga River flows generally north to south then east to west along the western and southern boundary of the Site. The building slab is constructed slightly above Brandywine Creek and the Cuyahoga River, which are flooded after heavy rain or during high volume flows.

Prior to the 2018 construction of the engineered bank stabilization on the southern edge of the Dump site, discussed in Section 2.9.1, the Cuyahoga River was actively eroding the northern bank of the river adjacent to the Dump site. Based on analysis of current and historical aerial imagery, the US Army Corps of Engineers (USACE) found that the Cuyahoga River adjacent to the Jaite Dump site eroded approximately 26 feet of streambank at the Dump site from 2012 to 2018 (USACE, 2019). A 2018 Basis of Design Report, prepared as part of the engineered bank stabilization design, estimated that 75,400 cubic yards (yd^3) or 3,400 tons of material was eroded from the southern edge of the Dump site along the Cuyahoga River from 2007 to 2018 (DCR 2018b). The USACE report also noted that "the impacts of the stabilization work at the Jaite Site is also evident and the project is successfully preventing further downstream contamination along the Cuyahoga River." Prior to the 2018 Time Critical Removal Action (TCRA), waste material was being deposited adjacent to the Dump site and was visible in the river bed. A geophysical survey using a magnetometer was conducted during 2017 Phase III field activities along the riverbed to delineate the areal extent of the waste from upstream to downstream of the Site. The findings of the survey are discussed in Section 2.9.5.

Physical unit 13, the former oil and gas well - There are historical reports that oil and gas wells were drilled in the vicinity to provide fuel for the original mill (EMG 1993a; NPS 1979), though previous investigations did not report any evidence of those installations. During the May 2008 Site visit, however, an abandoned well, derrick, piping, and two approximately 5,000 to 10,000 gallon ASTs were observed on a knoll east of the Towpath on land owned by Brandywine Ski Resort, Inc. (Figure 2-1). The installation was enclosed by a fence, smelled of petroleum, and appeared abandoned. Subsequent research showed that the well, derrick, and associated structures are in fact an oil and gas well identified by American Petroleum Institute #34153202530000 (ODNR 2008a). A well completion report shows that the well was drilled between September and November 1954 to a depth of 1,708 ft bgs. The landowner from the time of drilling is listed as "Hunt, F.F." The original Geological Survey of Ohio oil and gas well log from 1954 lists the well owner as "S.C. Kramer – Allied." The current electronic well completion report lists the owner only as "Historic Owner" and the well status as "producing" (ODNR 2008b). Because this well is listed as producing and is not owned by the Park, it was not included in the investigation; however, it is identified as a separate physical unit for completeness as a potential source of contamination.

Physical unit 14, rail spurs – A main railroad line was built in 1906 to connect the mill to the former company town via a bridge across the Cuyahoga River (NPS 1979). Based on field observations and sampling results, the railroad base consisted of sand to cobble sized material comprised predominately of slag. The railroad is elevated approximately 5 to 7 feet above the surrounding surface as it enters the Site at the bridge and becomes slightly elevated above the surrounding ground surface as it approaches the building foundation and former loading dock areas. At the Dump site, the main railroad line splits into two main spurs. One transects the Dump site and continues along the southwestern side of the building. The other main spur splits just past the eastern portion of the Dump site into two secondary spurs (Figure 2-1). One secondary spur continues east along the northern side of the building where it splits just east of the transformer pad and continues along the northeastern and southwestern sides of the former Bailer Storage area. The other secondary spur continues southeast to the central portion of the building where is splits into two additional spurs. One spur continues along the northeastern side of the Central Waste Piles (CWP) 2S and 2N and the second continues along the southwestern side of CWP2S, as shown on Figure 2-1. The bridge has deteriorated and is no longer functional. Although the Park operates a scenic railway, the Site is not accessible by rail, and the spurs are not used. A barrier was constructed across the eastern end of the bridge as part of the perimeter fence. Although it is likely that the majority of materials transported by rail to and from the Site were dry goods (e.g., wood pulp, paper, and cardboard), it is possible that petroleum, coal, or chemicals were loaded and unloaded at the rail spurs.

Physical unit 15, Fourdrinier Machine – The Fourdrinier Machine is comprised of a metal framework with numerous rollers, gears, and other metallic and plastic attachments. A 2017 field inspection identified suspect ACM Gaskets attached to former pipe flanges, lubricant reservoirs some partially filled with lubricant, apparent residual lubricant on the metal framework, and residual lead-based paint on the metal framework.

2.5. Geology and Hydrogeology

2.5.1. *Regional and Local Geology*

The Site is located within the glaciated Allegheny Plateau and is dominated by Wisconsin-aged lacustrine valley-fill deposits primarily composed of laminated to interbedded silt and clay with thin fine sand or gravel layers (Pavey *et al* 2000). Underlying bedrock in the vicinity consists of the Devonian Ohio Shale (Larsen and Slucher 1996).

According to the *Soil Survey of Summit County*, soil in the portion of the Site west of the Towpath Trail is classified as Chagrin silt loam, alkaline (USDA 1974). The Chagrin series consists of nearly level, deep, well-drained, loamy soils on flood plains throughout the country. These soils formed in recent alluvium. The Chagrin soils have a moderate permeability and high available moisture capacity, and occasionally flood in spring. The Chagrin silt loam specific to the Site is found on the wide flood plains of the Cuyahoga River and is mildly alkaline and has higher silt content than typical Chagrin soils. Soils in the Aeration and Settling Ponds area of the Site, east of the Towpath trail, are classified as Orville Silt Loam, Frequently Flooded or Chili Loam, 0 to 2% slopes (USDA 2016).

The native geology of the Site can be generally characterized by an upper low permeability 3 to 10 foot-thick silt and clay layer uniformly overlying a 3 to 8 foot-thick sand and gravel layer. These are uniformly underlain by a stiff moderately to highly plastic clay. Deep borings showed this stiff clay extended to more than 75 feet below the sand and gravel layer including minor layers of silt and silty sands less than 2 feet in thickness. This sequence is approximately the same throughout the Site and explained in greater detail in Figure 2-3. The Site geology was developed from 22 monitoring well borings, 15 piezometer borings, 90 test borings, and 41 test pits investigated during the fall 2016 fieldwork. Three additional deep borings were drilled in June 2017 as deep as 90 ft bgs from east to west across the Site.

Waste material, including black slag, covers more than 60% of the Site including the waste piles and surrounding areas, and the areas around the building foundation, but not including the building foundation concrete. The waste material ranges in thickness from 1 to 12 feet. The slag encountered is comprised of sand to cobble size clasts of black and red waste product. Waste material was not encountered in most of the aeration and settling pond areas, north of railroad tracks, and southwest of the building foundation in the Cuyahoga River floodplain area. The waste pile test pits and test borings did not encounter the sand and gravel because they were not advanced into the upper silt and clay zone beyond the contact between the waste and the native soil. The native soils encountered beneath the waste material fill or topsoil consist of a brown to gray silt and clay ranging in thickness from 3 to 10 feet at depths of 1 to 15 ft bgs. Discontinuous fine-grained sand lenses ranging in thickness from 0.5 to 1.5 feet were encountered in this upper silt and clay zone, which is dry to moist but not saturated. Twenty-one of the 22 monitoring wells and all 15 of the piezometers encountered a sand and gravel zone underlying the silt and clay that ranged in thickness from 3 to 8 feet at depths of 7 to 20 ft bgs. The sand and gravel zone was discovered throughout the Site area as shown by the blue squares and green circles in Figure 2-4, and is assumed to be uniformly distributed. The sand and gravel zone is typically fully saturated where monitoring well and piezometer screens were installed. The EE/CA Work Plan reported the sand and gravel as lenses, suggesting and illustrating the sand and gravels as discontinuous beneath the Site. However, this investigation discovered a more continuous sand and gravel zone beneath the Site of relatively uniform thickness. Fourteen of the 22 well borings and 2 of the 15 piezometer borings exhibited stiff gray clay beneath the sand and gravel that was dry to moist and was encountered in all areas with blue squares in Figure 2-4. The clay zone was not encountered in the majority of the shallow piezometers because the hand drilling technique could not fully penetrate the upper sand and gravel zone.

In summary, the Site geology encountered in this investigation is represented by a 3 to 8 foot-thick sand and gravel zone uniformly distributed throughout the Site, and sandwiched between relatively lower permeability silts and clays, also uniformly distributed and extending well below the sand and gravel zone. While the total depth and thickness of the lower stiff clay is unknown, deep borings show it extends to at least 75 feet below the sand and gravel unit and 90 feet bgs apparently increasing in thickness toward the west and the Cuyahoga River, as previously suspected. However, no bedrock was encountered in any of the deep borings, which was also suspected previously and shown in a regional Ohio surface geologic map (Pavey, et, al, 2002).

2.5.2. *Hydrogeology*

The horizontal groundwater flow or gradient directions interpreted for the Site based on the October 2016, May, June, and September 2017 water-level data are approximately the same as the anticipated flow directions reported in the EE/CA Work Plan and shown in Figure 15 in the EE/CA Work Plan. In the eastern portion of the Site and east of the towpath, the gradient direction to the northwest is influenced by Brandywine Lake to the southeast, the former aeration and settling ponds, particularly Pond 1, and the local topography resulting in the majority of that area's gradient to be toward Brandywine Creek. West of the towpath, equipotential lines turn to a more north to south orientation resulting in more of an east to west groundwater gradient direction toward the Cuyahoga River. Brandywine Creek appears to influence the gradient direction east of the towpath as a possible local groundwater discharge area. The vertical gradients measured between Brandywine Creek piezometers and staff gauges shown in Table 2-1 continue to be primarily downward representing a losing Brandywine Creek or surface water migration downward to the groundwater table. One notable exception is the area of Monitoring Well (MW) MW-BC-03, where there is an apparent gradient change and possible reversal of flow from the groundwater to Brandywine Creek, i.e., Brandywine Creek is gaining water from groundwater. However, the geologic and sample log for this five-foot well screen noted that the screen is located in less permeable material relative to Brandywine Creek piezometers, and consequently is not likely representing the actual vertical gradient direction from the sand and gravel unit under Brandywine Creek. While a 7.7 x 10^{-3} upward gradient was measured at the western end of the Site at Piezometer (PZ) PZ-BC-05 in 2016, a relatively stronger downward gradient of 2.4 and 4.3 x 10^{-2} was measured in 2017.

Areas of losing and gaining portions of Brandywine Creek can vary seasonally and following relatively large precipitation events, but during spring conditions and high Brandywine Creek flow events, the downward gradients from Brandywine Creek to groundwater are expected to increase. Therefore, the apparent hydrogeologic influence from Brandywine Creek as a groundwater discharge zone east of the towpath shown by the northeast to southwest orientation of the equipotential lines appears to actually be a result of the high groundwater levels caused by local topography, Brandywine Lake to the southeast, and Pond 1. Brandywine Creek appears to dominantly discharge surface water to the groundwater table for the entire length of the Site.

Another relevant impact on the Site groundwater gradient direction is the area of the Dump site at the western end of the Site where the Dump site is possibly causing a groundwater mound, similar to Pond 1 east of the Site, but significantly larger in area. While the Dump site may be located in an area where a natural local groundwater divide is created by the Cuyahoga River erosional path and floodplain to the north, higher infiltration rates at the Dump site may be possible through more permeable disturbed soil and waste. These higher infiltration rates result in groundwater mounding that is typical of landfills and relatively significant dump sites. In addition, the combination of these two factors may have resulted in emphasizing the magnitude and diversity of the gradient at the Dump site where gradient direction can vary by approximately 90 degrees from north/northwest to west to south/southwest. These relatively higher water levels at the Dump site may also be causing the upward gradient measured at PZ-BC-05 in October 2016 to Brandywine Creek in this area.

Regarding Figures 2-5a to 2-5d Water Table Potentiometric Maps, estimated equipotential lines confirm the gradient directions anticipated prior to the investigation. However, more accurate data emphasizes the impact of Brandywine Lake and Pond 1 east of the towpath likely responsible for the appearance of, but not actual, groundwater discharge to Brandywine Creek. Horizontal gradients vary from approximately 0.02 feet per foot (ft/ft) toward the northwest from Pond 1 north toward Brandywine Creek, to 0.004 ft/ft toward the west from the Site building foundation west to the Cuyahoga River. The horizontal gradient reduces from east to west with a change in the topographic relief and as groundwater flow discharges to the Cuyahoga River, shown by the change in equipotential lines separation distance in all Figures 2-5a to 2-5d. Brandywine Creek apparently loses surface water to groundwater throughout the reach along the Site with downward vertical gradients from approximately 0.006 to 0.07, except intermittently near the western end where the Dump site area may produce a groundwater mound and discharge from groundwater to Brandywine Creek. In addition, Figures 2-5a to 2-5d show that the monitoring system installed at the Site is well positioned to intercept dissolved contaminant transport from all potential contaminant source areas, as designed.

Dissolved contaminant transport at the Site is limited by the physical transport constraint of the relatively thin 3 to 8 foot thick sand and gravel zone uniformly isolated between lower permeability silt and clay surface soils and mostly clay subsurface soils. The hydraulic conductivity (K) of the sand and gravel zone, based on slug tests from all 22 monitoring well locations ranges from approximately 224 to 0.04 feet per day (ft/day), as shown in Table 2-2. The mean hydraulic conductivity across the Site is approximately 20 ft/day or 7 x 10^{-3} centimeters/second (cm/sec). The K range of approximately four orders of magnitude, or 10,000, includes location MW-BC-03 at 0.04 feet per day, which resembles this location's geologic log of a silty clay material rather than the sand and gravel zone. As discussed above, water level elevations measured at MW-BC-03 were consistently above Brandywine Creek surface water levels at this location indicating a groundwater discharge zone unlike all other locations measured along Brandywine Creek. However, as the observed geology and permeability measurements indicate for this location, it does not accurately represent the sand and gravel zone typically observed throughout the Site; therefore, groundwater is not anticipated to be discharging in this area (i.e., the higher water levels in MW-BC-03 relative to Brandywine Creek are a result of low permeability geology and not because the area is a discharge zone).

Relative to the permeability measurements from all Site wells, the silt and clay units above and below the sand and gravel zone are presumably three to six orders of magnitude less permeable (i.e.,1000 to 100,000 times less permeable) based on geologic logs, experience, and literature references (Freeze and Cherry, 1979). These silts and clays not only inhibit downward migration from the surface as a result of relatively low permeability, but also limit transport of dissolved contaminants by providing adsorption sites for less soluble contaminants such as metals, Semi-Volatile Compounds (SVOCs), and Polychlorinated Biphenyls (PCBs). Consequently, the primary transport path for groundwater through the Site must be through the sand and gravel unit. The average linear velocity of groundwater (v) through that unit, known as the Darcy velocity, may be calculated by multiplying K of the sand and gravel unit by the horizontal gradient of an area (i), and dividing by the porosity (n) (Freeze and Cherry, 1979).

$$v = Ki/n$$

Assuming the mean K of 20 ft/day (shown on Table 2-2), the highest horizontal gradient of 0.02 in the "AP" area, and an assumed porosity of 35% for sands and gravels (Freeze and Cherry, 1979), the average linear velocity is a maximum of approximately 1.0 ft/day. Assuming the same mean hydraulic conductivity of 20 ft/day, the lower horizontal gradient of 0.004 in the western area of the Site, and the same porosity of 35%, the minimum average linear velocity is approximately 0.2 feet/day. Therefore, travel time from the "AP " area near the eastern edge of the Towpath heading west through the Site to the Cuyahoga River, approximately 1,000 feet west, is between approximately 1,000 and 5,000 days, or 2.7 and 13.7 years, respectively. However, travel times from paper mill operations areas and waste piles are approximately one half to two-thirds that time given their closer proximity to the Cuyahoga River, or 1.5 to 9 years.

In summary, based on the current Site physical hydrogeology, dissolved contaminant migration appears to be significantly confined to relatively shallow depths of the 3 to 8 feet thick sand and gravel zone, and rapid throughout the Site. The lower stiff clay unit, greater than 90 feet in thickness below the sand and gravel zone, offers an apparent low permeability barrier to downward migration where upward hydraulic gradients should persist at depth given the Site location in a regional groundwater discharge zone to the Cuyahoga River. While the regional Ohio surface geology map (Pavey et al, 2002) estimate of an alluvium thickness is 20 feet in this area, the 2017 Site investigation showed a minimum thickness of greater than 90 feet at this Site. Given a groundwater travel time of 1.5 to 9 years across the Site, all possible areas of Site contaminated groundwater have migrated to discharge to the River since the paper mill ceased operations in 1984. In addition, the shallow sand and gravel zone has been flushed with multiple aquifer volumes, approximately 3 to 22 times. In other words, groundwater in the sand and gravel zone has passed from the eastern side of the plant operations area to the Cuyahoga River approximately 3 to 22 times providing numerous removals or flushing of all the groundwater underlying the Site.

Groundwater Use

No residential or municipal wells have been documented at the Site. The mill was served by two flowing artesian wells, identified approximately 100 ft south of the former mill building, which supplied approximately 500,000 gallons per day (EMG 1993b). Documentation for one water well at the former mill from the Ohio Department of Natural Resources (ODNR) shows that it was drilled to 314 ft bgs in 1951 and yielded approximately 6 gallons per minute from 165 ft bgs (MVTI 2002). The 1979 National Register of Historic Places nomination form states that an artesian well with a total depth of 390 ft served the mill (NPS 1979). It is presumed that one or both of these entries refer to the flowing artesian wells. One of these wells is currently capped above ground surface while the other is open. A buried drainpipe allows them to discharge onto the ground surface near the wells toward the Southern Waste Pile. The open artesian well was sampled for water quality in the summer of 2016 and has been approved by NPS for use as make up water and decontamination water for the Site. The groundwater chemistry data for this well is included in this report and discussed in Section 2.10.

2.6. Site Surface Water

2.6.1. *Regional Surface Water*

The nearest major surface water features to the Site are the Cuyahoga River and its tributary, Brandywine Creek, which abut the Site to the west/south and north, respectively, surrounding approximately three-quarters of the Site's boundary. Segments of Brandywine Creek including Brandywine Tributaries are considered by the State of Ohio as warm water habitat for aquatic species. Additional use designations for Brandywine Creek are Agricultural Water Supply, Industrial Water Supply and Primary Contract Recreation. After its confluence with Brandywine Creek from the east, the Cuyahoga River flows north approximately 20 miles before discharging into Lake Erie at downtown Cleveland. The Site is located adjacent to the Cuyahoga River downstream of the urban areas of Akron and Canton. Although much progress has been made since the early 1970s to improve water quality in the Cuyahoga River, sections of the river remain on the list of impaired waters as established under Section 303(d) of the Clean Water Act. The Site is located in the Cuyahoga River drainage basin, or watershed. Portions of the Cuyahoga River Watershed, including the section of river that travels through CUVA, have been classified as one of the 43 Great Lakes Areas of Concern.

The United States Geological Survey (USGS) has a gauging station near the Site (Number 04206425), located downstream on the Cuyahoga River at the Vaughn Road bridge in Jaite (USGS 2018). According to information from this station, the Cuyahoga drainage area at the USGS station is 555 square miles. The 2012-2017 annual average discharge has ranged between 826.5 and 1,070 cubic feet per second (cfs) with the minimum and maximum daily flows for the same period reported at 139 cfs (June and July) and 6,350 cfs (May). The highest mean daily flows for the same number of years is reported at 2,150 cfs and 2,190 cfs in April and May, respectively. At the gauging station, the wetted channel is between 77 and 107 ft wide, an average of 2.4 to 6.6 ft deep, and has a sand, gravel, and/or boulder bed.

There are two small lakes located southeast and east of the Site, as shown on Figure 2-1. Both lakes are associated with the Brandywine Ski Resort, and topographically higher than, therefore, upstream of the Site.

Based on an analysis of historical topographic maps from 1903 to 1994 and aerial photographs from 1952 to 2010 shown on Figures 6 and 7 in the EE/CA Work Plan, two significant changes in the orientation of the Cuyahoga River channel and Brandywine Creek occurred during the years of mill operation:

North of the Site - Between 1963 and 1967, the Cuyahoga River and Brandywine Creek shifted course on the north side of the former mill building. Figures 6 and 7 from the EE/CA Work Plan (a topographic map from 1963 and an aerial photo from 1952, respectively) show the river flowing around a meander immediately north of the former mill building. The open end of the "U" shape of the meander is oriented northwards. Brandywine Creek flows into the river just east of the southern, closed end of the "U." The Cuyahoga River cut off the open, north end of the "U" sometime between 1963 and 1967. The flow path of Brandywine Creek also changed significantly during the same time period. The aerial photo from 1952 and topographic map from 1963 depict the Creek flowing into the river just east of the southern end of the "U." Aerial photos and topographic maps from 1967 and later show the Creek flowing past the former mill building and then through the western side of the meander previously occupied by the Cuyahoga River. The end result of these changes is that Brandywine Creek currently flows west past the former mill building and then north through the western side of the meander in the same incision through which the Cuyahoga River flowed southwards before 1967. Neither Brandywine Creek nor the Cuyahoga River currently flows through the eastern side of the river's former meander.

West of the Site - An aerial photo from 1982 (EE/CA Work Plan Figure 7, copied and included within this EE/CA) shows that the main river channel, which was previously adjacent to the southwestern edge of the former mill building, moved westward, creating a new floodplain. Aerial photos from 2006, 2010 and 2017 show the river in its current orientation separated from the former mill building by a 150 to 300-ft floodplain.

These shifts in fluvial patterns evident from historical topographic maps and aerial photos are significant features to consider in the Site evaluation. The river deposits associated with these previous river channels may have influenced historical groundwater and subsurface contaminant migration patterns. Knowledge of these historical channels assist with interpretations of possible preferential pathways formed by historical surface water flow paths. The aerial photos and topographic maps may also explain the absence of waste between the Dump site and the Southern Waste Pile southwest of the former mill building: the main channel of the Cuyahoga River occupied the area during the years of mill operations, precluding land disposal of waste.

The Cuyahoga River currently flows north and makes a right angle turn west at the southeastern corner of the Dump site and flows west past the Dump site. The River turns north again at the railroad bridge. The east to west flowing portion of the Cuyahoga River actively eroded the northern bank of the River adjacent to the Dump site and waste from the Dump site was visible in the River bed, at the time NPS completed a TCRA in December 2018 (DCR, 2017a and 2019).

Brandywine Creek currently flows generally east to west along the northern edge of the Site to north of the central waste pile CWP1N then turns north to its confluence with the Cuyahoga River approximately 0.25 mile north of the Site.

The adjacent Brandywine Ski Resort has two ponds located south and southeast of the Site. Brandywine Lake is located south of the aeration pond area with an outlet on the north side as an unnamed stream that flows west and enters the Site south of P1, then crosses the Towpath Trail then turns north to its confluence with Brandywine Creek (Figure 2-1). The second lake is an unnamed lake located southwest of Brandywine Lake and east and southeast of the Site.

2.6.2. *On-site Surface Water*

As described in the Operational History subsection, surface water on the Site includes a series of three ponds/wetlands that formerly received mill production wastewater. The pond at P1 is concrete lined and permanently retains water, evidenced by surface water sampling events documented in prior investigations. The middle former pond, P2, is classified as a wetland. The third is P3, a U-shaped former pond that retains surface water only during the wet season winter and spring; in 2004, TetraTech stated that the water in the pond at P3 was too shallow to sample, but in 2011 the pond was too deep to walk across. Similar conditions were observed in the summer and fall of 2016 when P3 had no standing water, but in the spring 2017, there was up to 3 feet of standing water in the pond and surrounding area. Based on historical aerial photos and topographic maps, all three ponds associated with the former mill building and the two lakes to the south on the adjacent property are constructed, and not considered natural features (EMG, 1993). The pond at P1 was constructed between 1963 and 1967, and the pond at P3 and Brandywine Lake were constructed sometime between 1967 and 1979. A pond at P2 is absent from all topographic maps and no open water is present in any of the reviewed aerial photographs. The unnamed lake south of the Site appears for the first time in an aerial photograph from 1982.

A small unnamed on-Site stream is located immediately east of the canal levee and Towpath Trail. This stream receives water from Brandywine Lake and flows west approximately 100 feet south of P1. This stream then crosses under the Towpath Trail, turns north along the western side of the Towpath Trail for approximately 150 to 200 feet, and finally crosses back under the Towpath Trail to the east where it flows north along the eastern base of the canal levee and Towpath Trail. Well-defined reaches of this stream are shown on Site figures. The stream discharges into Brandywine Creek approximately 50 to 100 feet east of a stone culvert that conveys Brandywine Creek surface water under the Towpath Trail.

Former surface water features on the Site include the Ohio & Erie Canal, which flowed north-south between the former mill building and pond area, and the 500,000 gallon "Prism" fire protection reservoir located between the former mill building and former canal (EMG 1993b).

Two catch basins were identified near the former mill building in previous Site investigations (TetraTech 2005; TetraTech 2006). One was located immediately north of the Concrete Transformer Pad approximately 70 ft south of the southern bank of Brandywine Creek. The other was located immediately west of the northwestern end of the former mill building north of UST Area 2. The catch basins were excavated and pipes leading into them were plugged with concrete during demolition (TetraTech 2006).

2.7. Local Climate

The following climatological data is summarized from National Oceanic and Atmospheric Administration (NOAA) daily totals for 1971-2000 for the Cleveland, Ohio area (NOAA 2008). The mean annual precipitation for Cleveland is approximately 39 inches. In general, less precipitation falls in the winter months, with the highest amounts falling between June and September. Lake effect snow arising from Lake Erie contributes significantly to the winter climate and precipitation.

The mean maximum temperature ranges from 33 degrees Fahrenheit (°F) in January to 82°F in July. Mean minimum temperatures range from 19°F in January to 62°F in July. The mean annual temperature is 50°F.

2.8. Sensitive Environments

Based on the comprehensive list in the Interim Hazard Ranking System Guidance Manual's Section A2 (EPA, 1992a) the following specific sensitive environments have been identified on the Site. "Sensitive environments" which is defined as "A terrestrial or aquatic resource, fragile natural setting, or other area with unique or highly-valued environmental or cultural features" (USEPA 1992a). CUVA has the following sensitive environments.

Habitat known to be used by Federal Designated or Proposed Endangered or Threatened Species:

The Site is located in the Cuyahoga River floodplain, which is characterized by floodplain forests where cottonwood (*Populus deltoids*), American sycamore (*Platanus occidentalis*), black willow (*Salix nigra*), and silver maple (*Acer saccharinum*) dominate. Palustrine and riverine wetland habitats also exist on and near the Site. Characteristic herbaceous species for the Cuyahoga River floodplain are grasses (*Poa* spp.), sedges (*Carex* spp.), enchanter's nightshade (*Circaea lutetiana*), and violets (*Viola* spp.). Shrub cover, where present, is typically viburnums (*Viburnum* spp.), honeysuckles (*Lonicera* spp.), privit (*Ligustrum* vulgare), and Japanese multiflora rose (*Rosa multiflora*) (NPS 2008).

Faunal species associated with the Cuyahoga River floodplain area include various species of birds, aquatic macroinvertebrates, fish, mammals, amphibians, and reptiles characteristic of palustrine and riverine wetland habitats. Nesting bald eagles, which are federally protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, have successfully fledged young since 2007 from a nest in Cuyahoga County along the Cuyahoga River approximately 3 miles north of the Site, and a bald eagle (*Haliaeetus leucocephalus*) nest has been reported more recently within approximately 0.5 mile of the Site. A peregrine falcon (*Falco peregrinus*) nest is approximately 0.75 miles from the Site. Bat species in the Park include little browns (*Myotis lucifugus*), big browns (*Eptesicus fuscus*), red (*Lasiurus borealis*), as well as the Indiana bat (*Myotis sodalis*), which is endangered in all counties in Ohio (USFWS 2015). Other large species known to reside within the Park that may be present on or near the Site are coyotes (*Canis latran*), beaver (*Castor canadensis*), great blue herons (*Ardea herodias*), raccoons (*Procyon lotor*), woodchucks/groundhogs (*Marmota monax*), Canada geese (*Branta canadensis*), and large populations of whitetail deer (*Odocoileus virginianus*) (NPS 2008), as well as skunks (*Mephitis mephitis*), and river otters (*Lontra canadensis*). Small mammals at the Site include moles and voles.

The Johnson Company performed a Site visit at the beginning of November 2011 and observed whitetail deer, a rabbit (unknown genus), a frog (near the natural pond at P3; unknown genus), and various birds, including mallard ducks (*Anas platyrhynchos)*, chickadees (*Poecile atricapillus*), and crows (*Corvus brachyrhynchos*). Vegetation in and around the ponds and on the Dump site was identified as reed canary grass. Silver maples were identified in the forest areas on the west, north, and east parts of the Site, indicating forested floodplain wetland. In areas that have been disturbed and revegetated, a combination of tall grasses, reeds, and brush was observed.

Wetlands: The National Wetlands Inventory does not have any parts of the Site mapped as wetland (USFWS 2016).

A wetland delineation survey was conducted by a Certified Professional Wetland Scientist (PWS) in accordance with the specification listed in the EE/CA Work Plan and Sampling and Analysis

Plan (SAP) on the Site. It consisted of two phases. The wetlands were classified using the Ohio Rapid Assessment Method (ORAM) Classifications. Text Table 2.1 lists the identified wetlands and Figure 2-6 depicts the locations of the wetlands. Appendix B-7 presents the delineation survey report depicting the results of the desktop review and the on-Site assessment.

Text Table 2.1. Wetlands Inventory Table

Wetland Designation	ORAM[1] Score	ORAM Classification	Vegetation Type	On-Site Acreage
Wetland A	34	1 or 2 Gray Zone	Emergent	0.031
Wetland B	34	1 or 2 Gray Zone	Emergent	0.043
Wetland C	41	Modified 2	Emergent	0.107
			Forested	0.072
Wetland D	19	1	Emergent	0.041
Wetland E	55	2	Emergent	0.007
Wetland F	48	2	Emergent	0.081
			Forested	0.844
Wetland G	35	Modified 2	Forested	0.008
Wetland H	50	2	Emergent	0.015
Wetland I	57	2	Emergent	2.857
			Forested	0.790
				Total: 4.896 acres

Notes
[1]*ORAM: Ohio Rapid Assessment Method for Wetlands*

Towpath Trail: The Towpath Trail, which crosses through the Site, sees more than 2 million visitors a year on foot or bicycle, and is a popular route for birders.

A canoe launch area was installed at the Park's Boston Store Visitor Center approximately 0.25 miles upstream of the Site as part of a pilot study to look at recreational use and educational programming on this stretch of the Cuyahoga River. Therefore, the reach of the Cuyahoga River adjacent to the Site may be subject to increased public interest and accessibility.

The floodplain to the west of the building has been tentatively identified as an area of archeological interest, particularly with respect to Native American historical use.

2.9. Previous Investigations and Response Actions

Numerous investigations and several cleanup actions have been performed at the Site since 1990. Some of these investigations and cleanup actions focused on the former mill building and its demolition in 2006, and include information related to releases and/or threatened releases of hazardous substances from structures inside or associated with the building. Other investigations focused on characterizing specific areas of potential environmental concern across the Site including: the Concrete Transformer Pad, Former Septic Tank, Leach Field, Aeration and Settling Ponds, the former mill building area, former USTs, and waste disposal areas (Figure 2-1). The 2005 Site Characterization Report by Tetra Tech compared analytical results for pesticides, herbicides, metals, SVOCs, Volatile Organic Compounds (VOCs), and PCBs in soil, sediment, groundwater, waste, and surface water samples to human and ecological screening levels. The report also included a waste delineation effort, as detailed in Section 2.2 of the EE/CA Work Plan. A complete list of previous building and environmental investigations is provided as follows.

- Jaite Paper Mill: Asbestos Hazard Assessment, Wadsworth/Alert Laboratories, Inc., 1990
- Soil Gas Survey Report, Environmental Design Group, Inc., 1991
- Asbestos Assessment Report, Environmental Mitigation Group, Inc. (EMG), 1992
- Screening Investigation, EMG, 1993
- Phase I Environmental Site Assessment, EMG, 1993
- Project Report: Underground Storage Tank Removal Project Former Jaite Paper Mill Property, SunPro, Inc., 1994
- Former Jaite Paper Mill BUSTR Site Assessment Report, URS Greiner, 1997
- Phase II Environmental Site Assessment, MVTechnologies, Inc., 2002
- Jaite Paper Mill Site Inventory Report, Foster Wheeler Environmental Corporation, 2003
- Risk Assessment for the Former Jaite Paper Mill, MVTechnologies, Inc., 2003
- Final Jaite Paper Mill Project Management Plan, TetraTech FW, Inc., 2004
- Final Jaite Paper Mill Site Characterization Report, TetraTech FW, Inc., 2005
- Final Jaite Paper Mill Demolition Plan, TetraTech EC, Inc., 2006
- Final Jaite Paper Mill Project Completion Report, TetraTech EC, Inc., 2006
- Final EE/CA Phase I-II Technical Memorandum, Cuyahoga Valley National Park, DCR 2017
- Final EE/CA Phase III Technical Memorandum, Cuyahoga Valley National Park, DCR 2018
- Final Time Critical Removal Action Completion Report, DCR, 2019

2.9.1. *Nature and Extent of Contaminants Controlled or Treated through Previous Cleanup Actions*

While the majority of the previous work on Site has been focused on investigation activities, some cleanup action has occurred to assist in the performance of these investigations. Cleanup actions have included removal of USTs, demolition of the former building, asbestos abatement of ACM identified in the former building, removal of PCB impacted liquid in a trench beneath the Fourdrinier Machine, removal of lead-based paint from the Fourdrinier Machine and removal of containers used to store chemicals. The following is a summary of the cleanup actions and provides brief narratives on the nature and extent of contaminants that were controlled or treated during the investigations. Additional details and discussion of the previous investigations is presented in Section 2.2 of the EE/CA Work Plan.

UST Removals

Three former UST areas exist at the Site (Figure 2-1). UST Area 1, located adjacent to the southeast wall of the former mill building north of the former Aboveground Storage Tank (AST) area, previously contained two 550-gallon gasoline tanks. UST Area 2, located adjacent to the northwest side of the former mill building, previously contained one 10,000-gallon fuel oil tank. UST Area 3, located in the northern portion of the central courtyard area of the former mill building, previously contained one 550-gallon gasoline tank. In 1994, all USTs were removed from the Site and excavations were backfilled (SunPro 1994). Including the UST removal report, the UST areas have been the subject of four investigations between 1994 and 2003.

UST Area 1 (Gasoline):

Soil sampling at the time of excavation in 1994 detected benzene, toluene, ethylbenzene, and xylenes (BTEX) above the action level in UST Area 1 (SunPro 1994), and subsequent sampling in 1997 reported BTEX above action levels in one soil boring (URSG, 1997). URSG developed a remedial action plan in 1997. A Phase II investigation was conducted by MVTechnologies (MVTI) in 2002 to address the remedial action plan. The 2002 investigation indicated the presence of benzene in groundwater (MVTI, 2002). An Ohio BUSTR investigation and risk assessment for UST Area 1 was completed in 2003 by MVTI. Based on the risk assessment results, MVTI recommended no additional corrective action be taken and requested a no further action status from the Ohio BUSTR, which is not a CERCLA program. UST Area 1 received no further action status from the Ohio BUSTR in 2004 (ODC 2004), fulfilling the state regulatory requirements for remedial action first identified by URSG in 1997.

UST Area 2 (Fuel Oil):

During the removal of the 10,000 gallon tank from UST Area 2 in 1994, tetrachloroethene (PCE) and trichloroethene (TCE) were detected in sludge (SunPro, 1994). However, the soil samples collected in UST Area 2 were not analyzed for chlorinated VOCs, only for BTEX compounds. No BTEX compounds were detected in the soil samples collected. One Polycyclic Aromatic Hydrocarbon (PAH) was detected above the action level. The presence of chlorinated VOCs in the UST 2 sludge sampling results indicates that this UST may have been a waste oil tank rather than a fuel oil UST as previously identified. The results were submitted to the Ohio BUSTR, and no additional action was required by the State (SunPro, 1994).

UST Area 3 (Gasoline):

No petroleum-related contamination was detected at UST Area 3 (SunPro, 1994). The results were submitted to the Ohio BUSTR, and no additional action was required by the State.

Building Demolition

In 2006 the former mill building was demolished and all building materials were removed and disposed of properly (TetraTech, 2006). Investigations conducted prior to the demolition had identified contamination inside the building including ACM and lead-based paint on building materials, metals, petroleum and chlorinated VOCs and PCBs contamination in liquids and solids in tanks, trenches, unlabeled containers and from spills on the concrete floors (TetraTech, 2005).

Chemical and Waste Removal

Investigations from 1993 to 2006 collected samples from tanks, drums, unlabeled containers, trenches, and spills located inside the former building. These samples were collected in machine shops, power house, beaters room and boiler room, and storage areas within the former building. The sampled containers and tanks within the former mill building typically held petroleum products, although three located in the northern end of the building also contained chlorinated VOCs (TetraTech, 2005, 2006, and EMG, 1993). The tanks, drums and containers were removed from the building prior to beginning the building demolition (TetraTech, 2006). PCB was detected above action levels in liquid in a trench beneath the Fourdrinier Machine (EMG, 1993). During the building demolition the liquid was removed and disposed of properly and the trench backfilled with concrete to the surface (TetraTech, 2006).

Additional cleanup actions included removal and proper disposal of wastes encountered in the basement during building demolition in 2006. None of the removed waste materials were characterized as hazardous waste or had contaminants above the action levels used in the TetraTech 2005 or 2006 reports (TetraTech, 2006). The basement was cleaned, inspected for floor drains, photographed, and backfilled with clean hard fill (TetraTech 2006). Demolished building material was removed from the Site except for what was used for clean hard fill for basements (TetraTech 2006). No basement drains were found, and holes were punctured in concrete basement floors for drainage (TetraTech 2006). The basement was completely filled and is no longer accessible.

Lead-based Paint Removal

According to the demolition report, the Fourdrinier Machine was pressure-washed to remove the loose layers of lead-based paint (TetraTech, 2006). The wash water was "captured and disposed of properly" (TetraTech, 2006). The pressure washing only removed the loose paint present in 2006. Significant areas of the Fourdrinier Machine framework are still painted, with some areas currently exhibiting peeling and sloughing. The existing paint was tested as part of the EE/CA investigation and classified as lead-based paint (See Section 2.10).

Asbestos Abatement

Three asbestos assessment investigations were conducted on the Site buildings from 1992 to 2006. ACM was detected in 79 of 144 samples. Because the buildings were unsafe to work in, asbestos abatement occurred after demolition; building materials were wetted to eliminate visible dust emissions during demolition, and ACM was removed and disposed of according to regulations (TetraTech 2006). ACM was also reportedly removed from the Fourdrinier Machine during the building demolition (TetraTech, 2006). Additional ACM is still present on the Fourdrinier Machine as identified during the EE/CA investigations in 2017 (See Section 2.10) (DCR, 2018).

Catch Basin and Septic Tank Removal

A former catch basin was located at the western edge of the bailed storage area and north of the former transformer pad. TetraTech collected water samples from the catch basin in 2004. Based on the analytical results, the liquid in the catch basin was not classified as hazardous. The liquid was removed prior demolition of the catch basin in 2006 by TetraTech.

TetraTech collected two unfiltered liquid samples in 2004 from the former septic tank. The septic tank was located in the Dump site prior to demolition. The two samples were analyzed for metals, VOCs, PCBs, SVOCs, and herbicides and pesticides. Multiple metals as well as low detections of chlorinated VOCs (TCE at 3.4 micrograms per liter [µg/L]), two SVOCs, one herbicide, and three pesticides were detected in water contained in the Former Septic Tank. TetraTech collected one unfiltered liquid sample from the septic tank in March 2006 which was analyzed only for a shorter list of metals and not VOCs. Concentrations of the shorter list of metals were significantly lower in the 2006 Septic Tank sample than in samples collected in 2004. Because the water was not used as habitat or for drinking, action levels were not applied; additionally, the Former Septic Tank was demolished and filled in 2006.

Time Critical Removal Action

In November and December 2018, NPS conducted a TCRA consisting of an engineered bank stabilization project on the southern edge of the Dump site. The engineered bank stabilization structure was built to reduce or eliminate the migration of hazardous substances from the Site into the Cuyahoga River. NPS observed that approximately 15 feet of the River bank along the Dump site had eroded between 2017 and 2018, due to increased extreme weather conditions, such as precipitation and flooding, which caused the migration of hazardous substances into the Cuyahoga River. As stated previously in Section 2.4, based on analysis of current and historical aerial imagery, USACE found that approximately 26 feet of River bank along the Dump site eroded into the River from 2012 to 2018 (USACE, 2019). Further, the Basis of Design Report estimated 3,400 tons of material had been eroded from the Dump site between 2007 and 2018 (DCR 2018b).

During November and December 2018, an approximately 510 foot long engineered bank stabilization structure was successfully constructed along the southern edge of the Dump site. The engineered bank stabilization structure consists of an eight-foot deep by three-foot wide key way, excavated into the River bed. The key way is designed to support a 3:1 slope of a three-foot thick Type B sandstone wall front, and protect the toe of the wall from River scouring during high flow or flood events. Approximately 2,640 yd^3 of Type B sandstone were used to install the key way and front wall covering approximately 2,550 yd^3 of #2 crushed river gravels, used as granular fill behind the Type B sandstone front wall.

The River bank stabilization structure, or wall, now reduces and possibly eliminates human and ecological exposure to the release of hazardous substances eroding from the Dump site into the Cuyahoga River. A discrete sample of red material excavated and analyzed as part of the wall construction investigation derived waste (IDW) from the eroding River bank revealed the highest concentrations of lead, chromium VI, cobalt, chromium III, barium, and thallium ever detected on the Site at 210,000 mg/kg, 4,000, 360, 2,400, 5,600, and 9.6 mg/kg, respectively (TCRA 2019).

The completed bank stabilization structure now completely covers the entire River bank where Dump site wastes previously eroded into the Cuyahoga River, including the red waste material.

Excavated materials from the key way and River bank excavations were stockpiled, sampled, and analyzed to determine disposal options. The excavated material was disposed of properly at a licensed non-hazardous disposal facility.

2.9.2. *Equipment/Utilities/Installations at the Site*

No permanent equipment or utilities were installed during the previous investigations or cleanup actions. The former mill operations utilized natural gas from a gas well located east of the Towpath. Natural gas was piped from the gas well to the facility using underground piping. No utilities are currently associated with the Site.

2.9.3. *Site-Specific Conditions*

The Site description in Section 2.1 provides an overall description of the Site and surrounding area. However, there are several Site-specific conditions that will need to be addressed during remedial actions. The following is a list of Site-specific conditions that will need to be addressed during development and implementation of future remedial actions.

<u>Towpath Trail:</u>
The Towpath Trail is a hiking and biking trail that follows the former Ohio & Erie Canal and has more than 2 million users each year. The Towpath Trail passes through the Site with the aeration pond area on the east side and the remaining portions of the Site on the western side. The Site access road utilizes the Towpath Trail from the historic culvert associated with Brandywine Creek to the former parking area of the mill. There are vehicular traffic restrictions along the Towpath Trail. Any removal action for the Site is likely to result in an increase in vehicular traffic including project vehicles, haul trucks, and heavy equipment along the access road and the Towpath Trail. Any prolonged use during the removal action would likely affect or require modifications to increase the efficiency, structural integrity of the historic culvert, and increase overall safety of workers and visitors. Therefore, any removal action will need to address construction vehicle traffic along this section and develop plans to minimize impacts to the trail integrity, the historic culvert and to Park visitors.

<u>Site Access Road/Historic Stone Culvert-Vehicular Traffic</u>
The Site is currently accessed by a one-quarter mile long one lane gravel access road from Highland Road to the Site. At Brandywine Creek, the access road joins the Towpath Trail for approximately 500 feet then separates from the trail when it enters the Site at the former mill parking area. In addition to the portion along the Towpath Trail, the access road crosses over a historic stone culvert approximately 150 feet north of where the access road and the trail join. Brandywine Creek currently flows through the culvert beneath the Towpath Trail and the access road on its path to the Cuyahoga River approximately ½ mile northwest of the culvert. Depending on the removal action chosen, it is likely that large numbers of heavy trucks and

construction vehicles will need to traverse the stone culvert on a regular basis (daily) for several months. Currently the culvert is used by small NPS vehicles such as pickup trucks or SUVs, mowers and occasional larger truck for short term park projects. The impact on the culvert to withstand vehicular traffic anticipated during remedial action including large volumes of heavy trucks and equipment will need to be addressed. In addition, a Site access gate at the northeast corner of the Site near Brandywine Creek had previously provided Site access, but is no longer a viable option without an improved engineered solution as a result of recent flooding that has compromised the area.

<u>Seasonal Flooding from the Cuyahoga River and Brandywine Creek</u>
The flows in the Cuyahoga River and Brandywine Creek are dependent on precipitation and tributaries upstream of the Site. During heavy precipitation events, often in winter and spring, the flows in the River and Creek have been known to flood portions of the Site. The areas that are most prone to flooding from high flows in the Cuyahoga River include the area southwest of the building foundation and the Dump site. Flooding along Brandywine Creek occurs in the aeration pond areas north of Pond P1 and around Pond P2 and P3. When these areas are flooded, access is limited as water levels can exceed 4 feet of water and vehicular and foot traffic is not possible. The work conducted along the Cuyahoga River bank during the 2018 TCRA has prevented additional flooding and erosion of the Dump site.

<u>Vegetation/Wetlands</u>
The Site is covered by moderate to heavy vegetation consisting of grasses, brush and trees which can impact access to portions of the Site. The vegetation impacts access to areas of the Site for vehicles, equipment and personnel. In particular, several areas of the Site, including the Dump site, the southern and central waste piles, have numerous moderate to large trees that block access for vehicles and equipment. The trees also may be roosting places for endangered Indiana bats that are found in CUVA between May and October. Any remedial action that includes the need to remove any trees will require a bat survey and potential restrictions on tree removal. The grasses and brush on non-wetland areas can be cleared with heavy mowers or brush clearing equipment.

The 2016 wetland delineation survey identified eight emergent and four forested wetlands on the Site (DCR, 2017a). Figure 2-6 depicts the locations of the eight emergent and four forested wetlands. Additional discussion of the results of this wetland delineation is provided in Section 2.10.1.1.

2.10. Site Contaminants

The analytical data discussed in this EE/CA Report are validated data from analytical reports produced by TestAmerica Laboratories, Inc. (TA) and EMSL Analytical, Inc. (EMSL), analyzed as required by the project Quality Assessment Project Plan (QAPP). The analytical results were validated prior to developing the referenced data summary tables.

Color coded summary tables for metals and SVOCs concentrations for comparison with maximum reference/background concentrations are presented in Tables 2-3 to 2-10 attached to this report. Analytical data summary tables including all analytes are provided in Appendix A, Tables A-1 through A-18. These summary tables have bolded blue concentration values exceeding the Project Action Levels (PALs). These PALs are provided in the project QAPP, HHRA, and SLERA. Where provided, all data qualifiers used in these tables are explained at the bottom of each table. Analytical data discussion summaries in this section are provided relative to the PALs and shaded ranges of concentrations above the background and reference locations' highest concentrations. Background samples represent the naturally occurring concentrations of contaminants on a site. Reference samples determine the anthropogenic, or human influenced, contaminants that are not deposited by Site historical operations. Text tables within these discussions provide additional summaries of Tables 2-3 through 2-10. Laboratory analytical reports, validated data reports, and data summary tables including quality assurance/quality control data and validation qualifying information are provided in the EE/CA Investigation Report in Appendix B-4.

The sample locations described in Section 2.10.1 are presented in Figures 2-7, 2-7a through 2-16. These figures depict the locations for groundwater, soil, sediment, surface water, waste pile, concrete, and Fourdrinier Machine samples. Figures 2-7, 2-7a, and 2-8 depict the configuration of the Decision Units (DU) and their location on the Site. Details regarding locations, and analytical and sampling methods can be found in the EE/CA Work Plan, the September 2017 Work Plan Addendum, and in the EE/CA Investigation Report provided in Appendix B.

2.10.1. *Data Summary*

The following data summary discussion presents the analytical data according to the media sampled, which are then discussed relative to specific DU areas of the Site, where applicable. Surface and subsurface soil results are grouped together for discussion given their close proximity of being sampled within the same DU and similar analytical chemistry within the same DU. For each media, the highest concentration reference or background sample analytical results are presented prior to discussing the media results. Both reference and background samples were collected and analyzed at this Site. Some of the analytical results detected above PALs are representative of existing reference and/or background concentrations either from naturally occurring geology and/or existing upgradient contamination unrelated to Site contamination, respectively. Results are then discussed relative to their PALs and the highest concentration of reference or background sample results, whichever is the highest, and where notable trends are observed. When specific concentration detections are presented from locations where three replicate samples were collected resulting in three concentrations, the highest concentration is discussed. Details regarding analytical and sampling methods can be found in the EE/CA SAP and QAPP.

The number of samples and complexity is summarized as follows.

- 14 Physical Unit sample areas as described in Section 2.4 including 136 DUs consisting of 9,754 increments.
- 164 discrete sample locations.
- seven media sampled including: 1) three vertical zones of soils (surface and subsurface); 2) five different surface water bodies; 3) 35 groundwater locations; 4) 16 sediment locations; 5) seven waste piles, 6) concrete; and 7) one Fourdrinier Machine.
- eleven analytical groups including: 1) metals, 2) SVOCs, 3) VOCs, 4) PCBs (including aroclors and congeners), 5) pesticides, 6) dioxins/furans, 7) asbestos, 8) hardness, 9) pH, 10) Acid Volatile Sulfide (AVS)/Simultaneously Extracted metals (SEM), and 11) Total Organic Carbon (TOC).

These requirements from the EE/CA Work Plan generated 300 sample locations, and 517 samples sent to the laboratory for analysis of 2,371 analytical group samples. Total analytical data points include approximately 42,000 analytes and 20,000 Quality Assessment/Quality Control (QA/QC) analytes.

Summary of Media Group Results

a) Surface and Subsurface Soil Sample Investigation Results

The surface and subsurface soil investigation consisted of 144 samples collected from 33 DUs at zero to six inches for the surface soil samples and six inches to three feet for the subsurface samples. Samples were analyzed for metals, SVOCs/VOCs, PCBs/Pesticides, dioxins/furans, asbestos, and pH. Analytical results for all analytes for surface and subsurface soil samples are presented in Appendix A, Tables A-1 and A-2. Site analytical results for surface and subsurface soils were then compared with the analytical results from the two reference locations and one background location to identify trends, Site areas, or specific metals with relatively elevated concentrations. Tables 2-3 and 2-4 present all the metals and SVOC analytical results for surface and subsurface soils with Site concentrations color shaded for comparison to the maximum reference/background values. Site surface and subsurface soil sample locations are shown on Figures 2-7 and 2-7a as the surveyed DUs sampled by Incremental Sampling Methodology (ISM). The Interstate Technology Regulatory Council (ITRC) ISM guidance manual (ITRC, 2012) and the Hawai'i's Department of Health Technical Guidance Manual Decision Unit Characterization Section 4.0 (Hawai'i, 2016) were reviewed and consulted for the ISM sampling.

Reference/Background Surface & Subsurface Soil Results

The term "background" is typically used to describe naturally occurring chemicals, whereas the term "reference" is used to describe chemicals that are ubiquitous because of anthropogenic (but not site-related) impacts. Metals are naturally occurring in soil, while some metals (e.g., lead) and organic chemicals (e.g., PAHs, dioxins/furans) may be present in the environment due to anthropogenic, but non-site related, impacts (USEPA 2002a).

The three reference/background DUs are: reference location IS-REF-01 at the eastern end of the Site east of the former aeration pond area; reference location IS-REF-02 south of the Site along the Cuyahoga River; and background location IS-REF-03 approximately 1500 feet north of the Site on a west-facing hillside east of the Redlock Trailhead parking lot shown in Figure 2-7a. As described below, the majority of metals analyzed were detected above their PALs in these three areas.

Reference/Background Metals

The most notable characteristic regarding the surface soil reference/background sample results is the similarity in both concentrations and analytes detected in all three locations, as shown in Text Table 2.2. In the surface soils, reference area IS-REF-02 contains higher concentrations than the other two locations for most of the metals analyzed, and background area IS-REF-03 contains lower concentrations than the other two reference areas (IS-REF-02 and IS-REF-01) for most of the metals analyzed. This distinction is more pronounced for surface soils than subsurface soils, where metals concentrations are similar at all three locations for most metals analyzed. The distinctions between metals concentrations in the reference/background areas are also represented in Text Graphs 2.10.1 for surface soils and 2.10.2 for subsurface soils.

Metals detected at least an order of magnitude (i.e., 10 times higher) above their PAL at any of the surface soil reference areas are aluminum, arsenic, lead, chromium III, thallium, vanadium, and zinc. Metals detected at less than an order of magnitude, but above their respective PALs in any of the surface soil reference areas include antimony, barium, cadmium, cobalt, copper, iron, manganese, mercury, nickel, and selenium. Chromium VI was estimated at its PAL of 0.3 milligram per kilogram (mg/kg) in IS-REF-01. Three additional metals (antimony, cadmium, and selenium) were not detected above their PALs from surface soil background location IS-REF-03. Background area IS-REF-03 sample was not analyzed for chromium III or chromium VI.

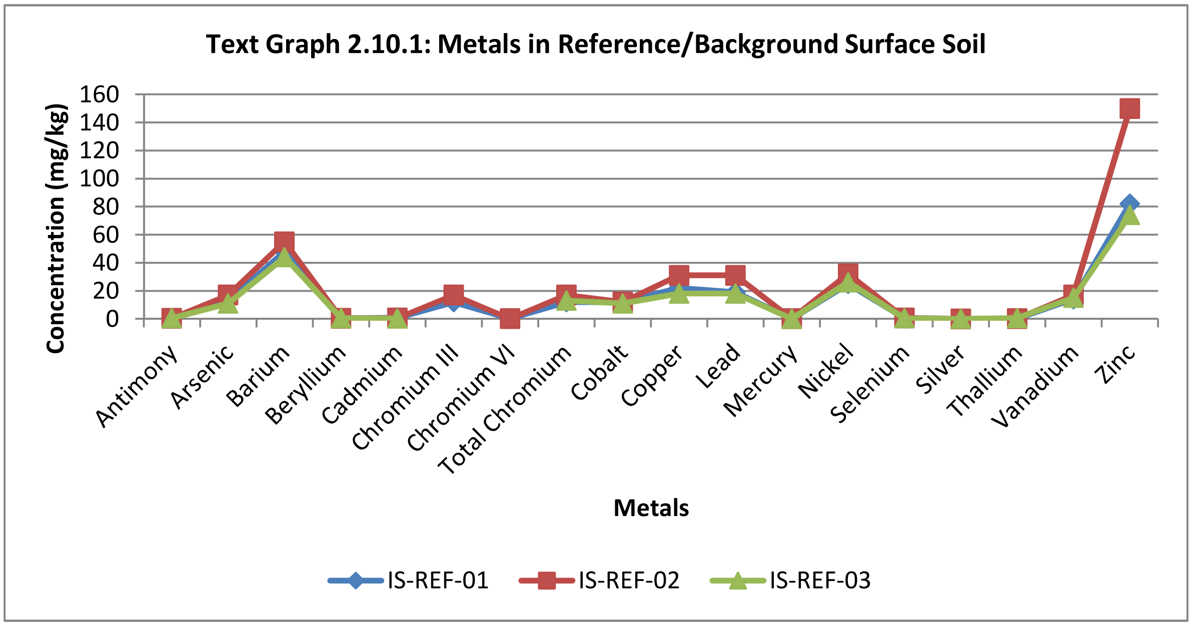
In summary, of the 21 metals analyzed in surface soil reference/background samples, all but four (beryllium; chromium VI; total chromium, which has no PAL; and silver) were detected in at least one of the three reference/background areas above their PALs.

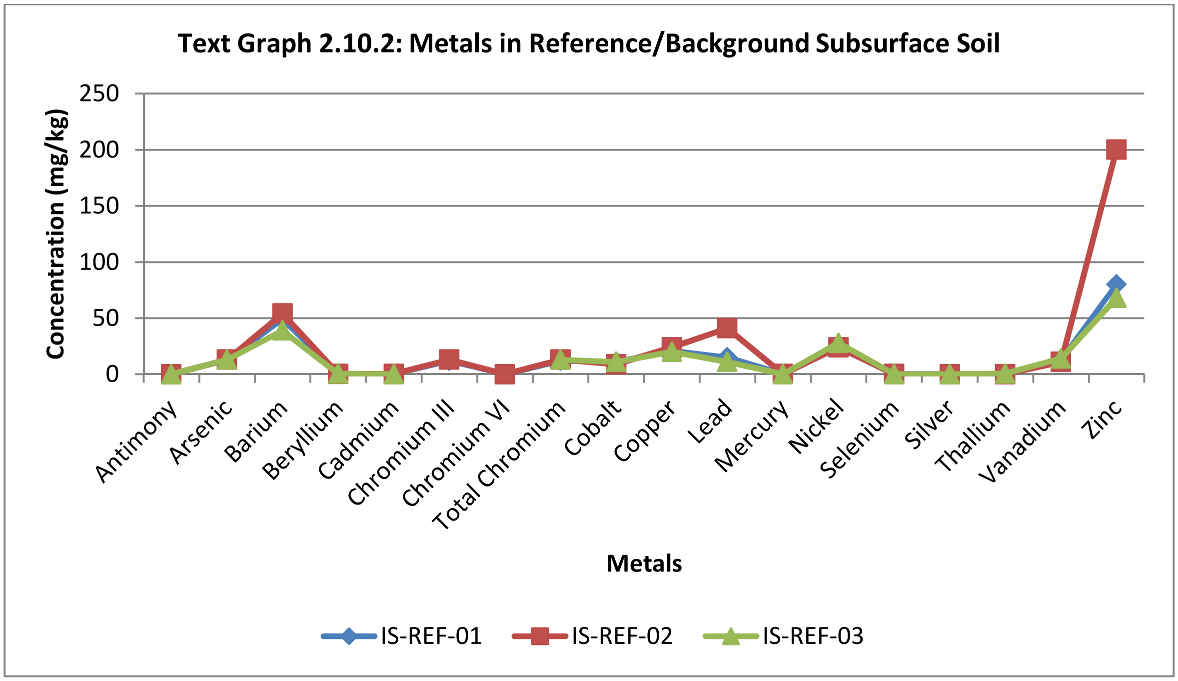
The subsurface soil reference/background area DUs show nearly identical results as the surface soil reference/background areas for metals. Fifteen of the 21 metals analyzed were detected in subsurface reference area IS-REF-01, IS-REF-02, and background area IS-REF-03 above their PALs, compared to 17 metals in surface soil. Metals in the subsurface were detected at similar concentrations as surface soil, with the same metals exceeding their PALs by at least an order of magnitude including aluminum, arsenic, chromium III, lead, thallium, vanadium, and zinc. The metals detected at less than an order of magnitude above their PALs, but still above their PALs were similar and include barium, cadmium, cobalt, copper, iron, manganese, and nickel. Mercury was detected at an order of magnitude higher than the PAL in subsurface reference area IS-REF-02. Antimony, beryllium chromium VI, selenium, and silver were not detected above their respective PALs in the subsurface soils of any of the reference or background areas. Cadmium

Text Table 2.2 Reference/Background Analytical Results for Surface and Subsurface Soil							
Sample Location[1] (DU)	**Project Action Level**	**IS-REF-01**	**IS-REF-02**	**IS-REF-03**	**IS-REF-01**	**IS-REF-02**	**IS-REF-03**
Depth[2]		0-0.5 ft bgs	0-0.5 ft bgs	0-0.5 ft bgs	0.5-3 ft bgs	0.5-3 ft bgs	0.5-3 ft bgs
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Metals							
Aluminum	**50**	**7100 J**	**9100 J**	**8400 J**	**6700 J**	**6000J**	**8600 J**
Antimony	**0.25**	**0.28 J**	2.1 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.1 UJ
Arsenic	**0.25**	**13 J**	**17 J**	**11 J**	**13 J**	**13**	**13 J**
Barium	**17.2**	**48 J**	**55 J**	**44 J**	**49 J**	**54 J**	**39 J**
Beryllium	**2.42**	0.44	0.51	0.48	0.42	0.36	0.45
Cadmium	**0.27**	**0.80 J**	**0.56 J**	0.26 J	**0.28**	**0.38 J**	0.28 U
Chromium III	**0.83**	**12 J**	**17 J**	--	**12**	**13**	--
Chromium VI	**0.3**	0.30 J	4.1 U	--	4.0 U	1.6 U	--
Total Chromium	**None**	12 J	17	13 J	12 J	13 J	13 J
Cobalt	**2.3**	**12**	**12**	**11**	**11**	**8.8**	**11**
Copper	**15**	**22 J**	**31 J**	**18 J**	**21 J**	**24**	**20 J**
Iron	**5500**	**22000 J**	**30000 J**	**19000 J**	**21000 J**	**20000**	**21000 J**
Lead	**0.94**	**19 J**	**31 J**	**18 J**	**15 J**	**41 J**	**11 J**
Manganese	**180**	**490 J**	**500 J**	**360 J**	**460 J**	**370 J**	**360 J**
Mercury	**0.013**	**0.033 J**	**0.1 J**	**0.075 J+**	**0.037 J**	**0.21 J**	**0.029 J**
Nickel	**9.7**	**25**	**32**	**26**	**24**	**24**	**28**
Selenium	**0.33**	**0.44 J**	**0.56 J**	0.20 J	0.18 J	0.21 J	1.1 UJ
Silver	**2**	0.54 U	0.54 U	0.55 U	0.063 U	0.53 U	0.55 UJ
Thallium	**0.027**	1.1 U	2.1 U	**0.47 J**	1.1 U	1.1 U	**0.55 J**
Vanadium	**0.714**	**14 J**	**17 J**	**15 J**	**13 J**	**11**	**14**
Zinc	**6.62**	**82**	**150**	**74 J+**	**80**	**200**	**68**
SVOCs							
2-Methylnaphthalene	16	0.052	0.044	0.012	0.039	0.052	0.0071 U
Acenaphthene	0.25	0.0087	0.011	0.0056 J	0.026 U	0.015 J	0.0071 U
Acenaphthylene	120	0.011	0.017	0.0041 J	0.026 U	0.018 J	0.0071 U
Anthracene	6.8	0.03	0.031	0.0099	0.031	0.065	0.0071 U
Benzo(a)anthracene	**0.16**	0.13	0.13	0.060	0.12	**0.25**	0.0056 J
Benzo(a)pyrene	**0.016**	**0.16**	**0.15**	**0.063**	**0.15**	**0.23**	0.0052 J
Benzo(b)fluoranthene	**0.16**	**0.28**	**0.23**	0.087	**0.21**	**0.31**	0.0087
Benzo(g,h,i)perylene	2	0.14	0.1	0.038 J	0.13	0.13	0.0061 J
Benzo(k)fluoranthene	1.6	0.084	0.1	0.041	0.11	0.087	0.0058 J
bis(2-ethylhexyl) phthalate	**0.02**	0.072 U	0.073 U	**0.037 J**	0.090 U	0.28 U	0.074 U
Butyl benzyl phthalate	90	0.072 U	0.073 U	0.074 U	0.27 U	0.28 U	0.074 U
Chrysene	2.4	0.16	0.17	0.080	0.18	0.23	0.0092

Text Table 2.2 Reference/Background Analytical Results for Surface and Subsurface Soil							
Sample Location[1] (DU)	**Project Action Level**	**IS-REF-01**	**IS-REF-02**	**IS-REF-03**	**IS-REF-01**	**IS-REF-02**	**IS-REF-03**
Depth[2]		0-0.5 ft bgs	0-0.5 ft bgs	0-0.5 ft bgs	0.5-3 ft bgs	0.5-3 ft bgs	0.5-3 ft bgs
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Dibenzo(a,h)anthracene	**0.016**	**0.038**	**0.025**	0.0098	**0.035**	**0.034**	0.0071 U
Diethyl phthalate	100	0.072 U	0.073 U	0.074 U	0.27 U	0.28 U	0.074 U
Dimethyl phthalate	10	0.072 U	0.073 U	0.074 U	0.27 U	0.28 U	0.074 U
Di-n-butyl phthalate	0.011	0.072 U	0.073 U	0.074 U	0.27 U	0.28 U	0.074 U
Di-n-octyl phthalate	0.91	0.072 U	0.073 U	0.074 U	0.27 U	0.28 U	0.074 U
Fluoranthene	10	0.31	0.31	0.14	0.26	0.48	0.013
Fluorene	3.7	0.013	0.011	0.0069 J	0.026 U	0.018 J	0.0071 U
Indeno(1,2,3-cd)pyrene	0.16	0.11	0.087	0.038 J	0.10	0.11	0.0071 U
Naphthalene	1	0.036	0.029	0.013	0.026 U	0.040	0.0071 U
Phenanthrene	5.5	0.14	0.14	0.070	0.13	0.25	0.0081
Pyrene	10	0.23	0.25	0.11	0.23	0.42	0.011

[1]Sample Location (DU) = Decision Unit Name- the highest reported value of the replicates used for table
[2]Depth 0-0.5 ft = surface soils; 0.5 to 3 feet= subsurface soil
DU: Decision Unit
mg/kg = milligram per kilogram
ft bgs = feet below ground surface
--: Not analyzed
U: The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit
UJ: The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
J: The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample
J+: The result is an estimated quantity, but the result may be biased high.
The Project Action Limit values are blue bold for any analyte that exceeds this value, and blue bold for any sample that exceeds this value.
Non highlighted cell numerical value less than 2 times Project Action Level
Green highlighted cell numerical value 2 to 4.9 times Project Action Level.
Yellow highlighted cell numerical value 5 to 9.9 times Project Action Level
Orange highlighted cell numerical value 10 to 99.9 times Project Action Level
Dark Orange highlighted cell numerical value more than 100 times Project Action Level
Complete summary table of analytical results are attached to the report in Appendix A





Note:
mg/kg; milligrams per kilogram

was not detected above its PALs from background location IS-REF-03. Background area IS-REF-03 subsurface soil was not analyzed for chromium III or chromium VI.

<u>*Reference/Background SVOCs/VOCs*</u>
Eighteen of the 23 SVOCs analyzed were detected in one or more of the two surface soil reference areas and one background area as shown in Text Table 2.2 and Appendix A, Table A-1.

In reference areas IS-REF-01 and IS-REF-02, three of the 23 SVOCs analyzed were detected above the PALs including, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene. In the surface soil background area IS-REF-03, two of the 23 SVOCs analyzed were detected above its PAL in surface soil, benzo(a)pyrene and bis[2-ethylhexyl] phthalate (DEHP), but these SVOCs were not detected above their PALs in subsurface soil at this location. Most of the same SVOCs were detected in background area IS-REF-03, but at concentrations as much as six times lower than reference areas IS-REF-01 and IS-REF-02.

In summary, the surface soil SVOCs detected and not detected at all reference locations are similar, but the concentrations of SVOCs detected at background location IS-REF-03 are generally lower than the other two reference areas.

The subsurface soil reference and background area DUs show nearly identical results as the surface soil reference/background areas for SVOCs, except background location IS-REF-03 where SVOC detections in subsurface soil are notably lower with fewer detections than the two reference areas (Text Table 2.2). Eighteen of the 23 SVOCs analyzed were detected in IS-REF-01 and IS-REF-02, but nine were detected in the IS-REF-03 sample. Four SVOCs were detected above their PALs at IS-REF-01 and IS-REF-02, and no SVOCs were detected above their PALs at IS-REF-03.

Reference/Background PCBs/Pesticides

Two of the seven PCB aroclors analyzed (aroclor 1016 and 1254) for surface soils were detected at IS-REF-02 near the Cuyahoga River (Appendix A, Table A-1). No PCBs were detected at IS-REF-01 or REF-03. These detections are estimated above the Method Detection Limit (MDL) and below the Reporting Limit (RL). No PCBs were detected above their PALs in the reference or background areas. Six of the 22 organochlorine pesticides analyzed were detected at IS-REF-02, of which three are above their PALs, 4,4- dichlorodiphenyldichloroethane (4,4’- DDD), 4,4’-Dichlorodiphenyldichloroethylene (4,4-DDE), and 4,4’- dichlorodiphenyltrichloroethane (4,4-DDT), and three are estimated above the MDL, delta-BHC, Endosulfan I, and endrin aldehyde. One organochlorine pesticide, delta-BHC estimated at 0.0012 mg/kg was detected at IS-REF-01. No organochlorine pesticides were detected at IS-REF-03.

There were no detections of PCBs in the subsurface soil reference areas or the background area. Two pesticides were detected at estimated concentrations below the RL for 4,4’-DDE and 4,4’-DDT at IS-REF-02, and one pesticide was detected, 4,4’-DDT at IS-REF-01. No pesticides were detected in IS-REF-03.

Reference/Background pH

Surface and subsurface soil pH was measured at the two reference areas and one background area between 7.1 and 7.7, for surface soil, and 7.5 and 8.0, for subsurface soil. The surface soil pH average was 7.4 and the subsurface average was 7.7.

Surface and subsurface soils in the reference/background area DUs were not analyzed for dioxins, hardness, TOC, or asbestos (refer to EE/CA Work Plan).

Site Surface & Subsurface Soil Investigation Results

Metals

As shown in Table 2-3 and Table 2-4, soils were analyzed for 21 metals throughout the Site. The color coded tables include the analytical results for metals for all surface and subsurface soils as compared to the maximum reference/background value and PALs. These data show DU areas where the metals results for soil samples are similar to and have notably higher concentrations than reference or background samples, which may represent Site contamination with metal concentration more than 10 times the highest reference/background concentrations.

Metals in Aeration Pond Area DUs

Seventeen of 21 metals were detected in surface soil samples from the Aeration Pond Area (AP) above their respective PALs. Surface soil metals concentrations in the AP DUs IS-AP-01, 02, 03, 05, 06, and 07, shown in Figure 2-7 east of the towpath, are similar to or approximately two to five times higher than reference or background concentrations for antimony, chromium III, total chromium, copper, and lead. Chromium VI was detected more than 10 times the maximum reference/background value in most of these DUs (Table 2-3). Seven metals in AP DU IS-AP-04 including antimony, chromium III and VI, total chromium, copper, lead, and mercury were detected from 2 to more than 10 times the highest reference/background concentrations (Table 2-3).

Sixteen of 21 metals sampled were detected in subsurface soil samples from the AP area above their respective PALs (Appendix A). Subsurface soils in the AP area DUs differ from the surface soils as follows: as much as 10 times lower lead, mercury, and chromium VI levels; lower copper concentrations by approximately a factor of two to ten; and lower chromium III, barium, and zinc as shown in Table 2-4.

Metals in Building Foundation Area DUs

Surface soil metals concentrations in the Building Foundation Area (BLD) DUs surrounding the building concrete foundation (Figure 2-7) are similar to the reference/background concentrations with the following notable differences: more than an order of magnitude higher chromium VI at IS-BLD-01 relative to the maximum reference/background value; two to four times higher arsenic, barium, beryllium, selenium, and manganese and more than an order of magnitude higher chromium VI at IS-BLD-03; and two to three times higher barium and copper at IS-BLD- 04 (Table 2-3).

Subsurface soil metals concentrations in BLD DUs are similar to the subsurface reference and background concentrations with the following notable differences: an order of magnitude higher barium, copper, lead, and mercury at IS-BLD-03; two to five times higher chromium III, total chromium, and copper at IS-BLD-01 adjacent to the foundation; and two to five times higher arsenic, chromium III, chromium VI, total chromium, and cadmium at IS-BLD-03 (Table 2-4). Antimony and chromium VI were detected above their PALs in IS-BLD-03. Subsurface soils in the BLD DUs differ from the surface soils as follows: lower chromium VI; higher barium, copper, lead, and mercury at IS- BLD-03; and higher total chromium and chromium III at IS-BLD-03. With the exception of IS-BLD-03, subsurface soil metals concentrations are similar to surface soils.

Metals in Central Waste Pile Area DUs

Surface soil metals concentrations in CWP areas IS-CWP-01 west of the building foundation (Figure 2-7), have more than two times higher beryllium, chromium III, total chromium, lead, and manganese than the highest reference/background areas. Detections at IS-CWP-02 north of the building foundation are also more than two times higher than reference/background concentrations for antimony, arsenic, beryllium, chromium III, total chromium, lead, and selenium (Table 2-3).

Subsurface soil metals concentrations in CWP areas appear to have approximately the same concentrations as surface soils. Subsurface soils metals in the CWP DUs differ from the surface soils as follows: lower lead, manganese, vanadium, and zinc levels.

Metals in North of the Railroad Tracks Area DUs

Surface soil metals concentrations North of the Railroad Tracks area (NTR) north of the Dump site appear to have the same concentrations as the reference and background areas, especially IS-REF-02 adjacent to the Cuyahoga River as shown in Table 2-3. One notable exception is chromium VI, which is 5 to 6 times the reference/background areas in NTR DUs IS-NTR-01 and 02.

Subsurface soil metals concentrations in the NTR area follow similar concentrations as surface soils.

Metals in Railroad Tracks Area DUs

Surface soil metals concentrations in the two Railroad Track (RR) DUs appear to contain approximately two to eight times higher levels of antimony, arsenic, chromium III, total chromium, copper, and selenium than the reference and background areas. Lead is approximately nine times higher in DU IS-RR-02 than the reference or background areas. In DU IS-RR-01, the arsenic concentrations are more than ten times higher than in the reference and background areas as shown in Table 2-3. Arsenic was once a common wood preservative used in railroad ties (USEPA 2008 and Rail to Trails 2004).

Subsurface soil metals concentrations in the RR DUs are similar to surface soils, but with notably lower antimony, arsenic, copper, and lead.

Metals in Southern Waste Pile Area DUs
Surface soil metals concentrations in the Southern Waste Pile area (SWP) of three DUs at the southern end of the Site mimic the reference area IS-REF-02 adjacent to the Cuyahoga River.

Likewise, subsurface soil metals concentrations in the SWP area are similar to reference area IS-REF-02, but higher than surface soils for cadmium, chromium III, and zinc.

Metals in Former Transformer Pad Area DU
Surface soil metals concentrations at the former Transformer Pad (TR) DU area are similar to most metals in reference area IS-REF-02, but include concentrations at least two times this reference area for antimony, cadmium, chromium VI, copper, lead, and mercury as shown in Table 2-3.

Subsurface soil metals concentrations in the TR DU are similar to the surface soil metals with the exception of copper, which is more than two times higher than surface soil metals as shown in Table 2-4.

Metals in Former Underground Storage Tank Areas DUs
Surface soil metals concentrations at the three UST DUs adjacent to the building foundation contained more than three times higher barium and eight times higher mercury at IS-UST1-01, more than two times higher beryllium and manganese at IS-UST2-01, and more than two times higher antimony, arsenic, copper, lead, and selenium at IS-UST3-01 than maximum reference/background values, as shown in Table 2-3. The metals above their PALs in UST DUs are similar to reference and background area metals above PALs, but the maximum concentration of these metals varies at each location, e.g., barium is highest at IS-UST1-01, manganese is highest at IS-UST2-01, and copper and lead are highest at IS-UST3-01.

Subsurface soil metals concentrations at the three UST DUs differ from the surface soils as follows: arsenic and chromium III at IS-UST3-01 is higher than surface soils.

SVOCs

SVOCs in Aeration Pond Area DUs
Surface soil SVOC detections in the AP area were similar to the reference and background areas, but with four compounds detected above their PALs compared to three compounds in reference DUs IS-REF-01 and IS-REF-02, and two compounds above their PALs in background DU IS-REF-03 (Appendix A, Table A-1). Benzo(a)pyrene and benzo(b)fluoranthene were detected above their PALs in six of the seven AP area DUs, but at lower concentrations than the highest reference or background area concentrations. Bis(2-ethylhexyl) phthalate was the only SVOC detected above the PAL in the IS-AP-04 sample at 100 times higher than the highest reference or background area (Table 2-3). Fewer SVOCs were detected in DU IS-AP-03 and IS-AP-04 because the RLs and MDLs were higher than other AP area samples. Bis(2-ethylhexyl) phthalate

was also detected in DUs IS-AP-01, IS-AP-02, IS-AP-03, and IS-AP-06 above their PALs. Di-n-butyl phthalate was only detected in IS-AP-01 above its PAL.

Subsurface soil SVOC detections in the AP area were similar to the reference areas with three notable differences including two to three times higher 2-methylnaphthalene, and naphthalene in IS-AP-01 (Table 2-4). Relative to surface soils, subsurface soil SVOCs in the AP area DUs have fewer detections at slightly lower concentrations and fewer PAL exceedances.

SVOCs in Building Foundation Area DUs

Five of 23 SVOCs analyzed were detected above their PALs in the BLD DUs. Seven of the nine BLD DUs detected similar compounds and concentrations as the maximum reference/background locations' concentrations including; IS-BLD-04, IS-BLD-05, IS-BLD-06, IS-BLD-07, IS-BLD-08, IS-BLD-09, and IS-BLD-10. Naphthalene and 2-methylnaphthalene were detected in IS-BLD-03, IS-BLD-05, IS-BLD-06, IS-BLD-07, and IS-BLD-08 below their PALs, but two to over ten times the highest concentration in the reference/background areas. Naphthalene was detected above its PAL, and 2-methynaphthalene was detected below its PAL in IS-BLD-01, but over 40 times the highest reference/background location concentrations. DUs IS-BLD-01 and IS-BLD-03 had two to three additional SVOCs detected above their PALs than the reference/background locations. SVOC concentrations in DUs IS-BLD-01 and IS-BLD-03 were approximately 2 to 40 times higher than the reference/background areas and other building foundation area DUs. Both of these DUs had slag material in surface and subsurface soils, unlike the other BLD DUs. IS-BLD-03 detections included eleven SVOCs with concentrations at least an order of magnitude higher than the highest reference/background areas (Table 2-3). DU IS-BLD-01 SVOC detections are typically lower than DU IS-BLD-03, but these two locations contained more SVOC detections and higher SVOC concentrations than the other seven BLD DUs.

Subsurface soil SVOCs in the BLD DUs show a similar number of SVOCs above PALs and higher than reference and background locations, but at lower concentrations compared to BLD surface soil.

SVOCs in Central Waste Pile Area DUs

Twelve of the 23 SVOCs analyzed in the CWP DUs were detected above their PALs and at approximately 3 times to more than 2 orders of magnitude higher concentration levels compared to the maximum reference areas, compared to four SVOCs detected above their PALs in reference areas (Table 2-3). Naphthalene and 2-methylnaphthalene concentrations were more than 2 orders of magnitude higher than the maximum reference/background area concentrations in DU IS-CWP-02 and more than 30 times higher in DU IS-CWP-01 than the reference and background areas. Both DUs have slag material in surface and subsurface soils.

Six of the 23 SVOCs analyzed for subsurface CWP soils were detected above their PALs and at approximately two to more than 45 times higher concentration levels compared to the reference and background areas (Table 2-4). Naphthalene and 2-methylnaphthalene concentrations, while below their respective PALs, were approximately 20 to 45 times higher than the maximum reference/background concentrations in DU IS-CWP-02 and DU IS-CWP-01. Subsurface soils SVOCs in the CWP DUs have fewer SVOCs above PALs than the surface soil SVOCs; six SVOCs above PALs in subsurface soils compared to 13 in surface soils. The concentrations are approximately 2 to 30 times lower in IS-CWP-01 and IS-CWP-02 than their respective surface soil samples.

SVOCs in North of the Railroad Tracks Area DUs
Similar to the reference and background areas, four of 23 SVOCs analyzed were detected in the NTR area surface soils above their PALs at similar concentrations and compounds as shown in attached Table 2-3.

Similar to surface soils, three of 23 SVOCs analyzed for subsurface soils were detected above their PALs at similar concentrations and compounds in the NTR area as reference and background areas. The SVOC concentrations are generally lower in the subsurface soils than surface soils with the exception of naphthalene and 2-methylnaphthalene concentrations in IS-NTR-01 which are approximately up to 13 times higher than maximum reference and background concentrations, showing an increase with depth (Table 2-4). Subsurface soil SVOCs in the NTR DUs IS-NTR-02 and IS-NTR-03 are similar to surface soil SVOCs.

SVOCs in Railroad Tracks Area DUs
Sixteen of the 23 SVOCs (15 of 17 PAHs) analyzed in surface soil were detected above their PALs and at approximately 1 to more than 2 orders of magnitude higher concentration levels in the Railroad Track (RR) DUs compared to the highest concentrations in the reference and background areas as shown in Table 2-3. The SVOCs above the PALs included 15 of 17 PAHs and one phthalate. These data represent a comparably notable increase in concentration and number of PAH SVOCs detected on the Site relative to reference and background areas, where 2 to 4 PAH SVOCs were detected above the PALs. In addition, the PAH detections in the RR DUs are approximately an order of magnitude higher than the CWP DUs; thereby, representing the highest SVOC concentrations in surface soil on the Site.

Six of the 23 SVOCs analyzed in subsurface soil RR DUs were detected above their PALs and at approximately 5 times to more than 2 order of magnitude higher concentration levels compared to the maximum concentrations in reference and background areas (Table 2-4). The SVOCs above the PALs included six of 17 PAHs. Subsurface soil SVOCs in RR DUs have fewer compounds above their PALs compared to surface soils, and concentrations were approximately 10 to 100 times lower.

SVOCs in Southern Waste Pile Area DUs
Surface soil SVOC detections in the Southern Waste Pile (SWP) area are nearly identical to the reference area IS-REF-02 adjacent to the Cuyahoga River with similar concentrations and compounds detected.

Subsurface soil SVOC detections in the SWP area are similar to the reference area IS-REF-02 adjacent to the Cuyahoga River with generally similar concentrations and compounds. Two notable differences are higher 2-methylnaphthalene and naphthalene concentrations in DUs IS-SWP-02 and IS-SWP-03. These concentrations do not exceed their respective PALs. Relative to surface soils, subsurface soil SVOCs at the SWP DUs have more compounds above their respective PALs, and concentrations are higher than the surface soil concentrations.

SVOCs in Former Transformer Pad Area DU
Nearly the same levels of SVOCs were detected in the Transformer Pad (TR) area DU as the CWP DUs. Thirteen of the 23 SVOCs analyzed were detected above their PALs and at approximately 1 to 2 orders of magnitude above the concentration levels compared 2 to 4 SVOCs at the reference areas (Table 2-3). The 13 SVOCs above the PALs included 13 of 17 PAHs and no phthalates.

Six of the 23 SVOCs analyzed in subsurface soils at the TR DU were detected above their PALs and at approximately two to 30 times higher than concentration levels compared to the maximum concentration in reference/background areas (Table 2-4). Relative to surface soils, subsurface soil SVOCs at the TR DU have fewer compounds above their respective PALs, and concentrations are approximately more than 10 times lower than the surface soil concentrations.

SVOCs in Former Underground Storage Tank Areas DUs
Ten of the 23 SVOCs analyzed in the UST area DUs were detected above their PALs up to 2 orders of magnitude higher than the highest concentration levels of the reference and background areas; similar to the RR, CWP and TR DU areas, in IS-UST2-01and IS-UST3-01, but at lower concentrations for IS-UST1-01 (Table 2-3).

Seven of the 23 SVOCs analyzed in subsurface UST DUs were detected above their PALs and at up to 75 times higher than the concentration levels of the reference areas and similar to the RR, CWP, and TR DU areas in DU IS-UST3-01, but at up to 2 orders of magnitude lower concentrations for IS-UST1-01 and IS-UST2-01. Subsurface soil SVOCs at the UST DUs had seven instead of ten SVOCs compared to surface soils above their PALs, and concentrations are up to 2 orders of magnitude lower.

PCBs/Pesticides

PCBs/Pesticides in Aeration Pond Area DUs
Aroclor 1254 was detected in surface soil in the AP area from 0.083 to 0.35 mg/kg in three of seven DUs above the PAL of 0.041 mg/kg; up to an order of magnitude above the reference area IS-REF-02 concentrations of 0.037 m/kg (Appendix A, Table A-1). Aroclor 1254 was detected in six of seven AP DUs. Aroclor 1260 was detected in IS-AP-01. Pesticides compound detections in the AP area of 4,4'-DDE, alpha-BHC, chlordane, cis-chlordane, delta-BHC, and endrin aldehyde are estimated below the RL with detections of one or more of these compounds in most of the AP DUs.

Aroclor 1254 and 1248 were detected in the AP area subsurface soils above their PALs (Appendix A, Table A-2). The concentration of aroclor 1254 was two to four times lower than PCB concentrations in surface soils from DUs IS-AP-02 and IS-AP-07. Aroclor 1254 was detected in IS-AP-01 and aroclor 1248 was detected in DU IS-AP-05 subsurface soils, but not in the surface soils. Similar pesticides were detected in the IS-AP-07 DU subsurface soils in the AP area also estimated below the RL.

PCBs/Pesticides in Building Foundation Area DUs

PCBs were generally undetected in surface soil BLD DUs with estimated detections below the RL of aroclor 1254 and 1260, and one detection above the RL at IS-BLD-03 of aroclor 1260 at a maximum of 0.16 mg/kg. Pesticides were primarily undetected and most detections above PALs were estimated. Three pesticides, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected above their PALs at IS-BLD-09, and IS-BLD-10, both similar to the IS-REF-02 area. IS-REF-02 is upgradient of both IS-BLD-09 and IS-BLD-10, and all three DU areas border the Cuyahoga River and are within its flood zone. Two pesticides, beta-BHC and Dieldrin, were also detected above their PALs at IS-BLD-01, and one pesticide, 4,4'-DDD, at IS-BLD-04, and Dieldrin at IS-BLD-05 and IS-BLD-07.

Subsurface soil PCBs in the BDL DUs are similar to surface soils at slightly less than twice the concentration of surface soil aroclor 1260. Pesticide detections were fewer compounds at lower concentrations in subsurface soils compared to surface soils, with no pesticides being detected above their PALs in subsurface soil BLD DUs.

PCBs/Pesticides in Central Waste Pile Area DUs

Aroclor 1248, was detected at 0.063 mg/kg above its PAL of 0.0072 mg/kg with a RL of 0.045 at DU IS-CWP-02. Aroclor 1260 was detected below the RL at 0.03 mg/kg and 0.24 mg/kg, but above the MDL in IS-CWP-01 and IS-CWP-02, respectively. One pesticide, 4,4'-DDE, was detected, but estimated below the RL in both samples. PCB and pesticide concentrations were similar to maximum reference area concentrations.

Subsurface soil PCBs in the CWP DUs are similar to surface soils, but no aroclor 1248 detection and lower aroclor 1260 detections. No pesticides were detected in the subsurface soils.

PCBs/Pesticides in North of the Railroad Tracks Area DUs

No PCBs were detected in the NTR area surface soils. Three of six pesticides detected, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, were above PALs, and three pesticides, Endosulfan I, endrin aldehyde, and delta-BHC, were detected below PALs. Four of these pesticides, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and Endosulfan I are the same pesticides detected at IS-REF-02 along the Cuyahoga River.

Aroclors 1254 and 1260 were detected below their PALs in subsurface soils in the NTR area. Pesticides in subsurface soils in the NTR DUs differ from the surface soils based on lower concentrations such that no PALs are exceeded.

PCBs/Pesticides in Railroad Tracks Area DUs
Estimated detections of aroclor 1260 below the RL are in the surface soil RR DUs, and one estimated detection of the pesticide methoxychlor at 0.11 mg/kg and 4,4'-DDE at 0.019 mg/kg at IS-RR-01.

No PCBs were detected in the subsurface soil in IS-RR-01. Aroclor 1260 was detected in IS-RR-02 at similar concentrations to surface soil concentrations. No pesticides were detected in the subsurface soil RR DUs.

PCBs/Pesticides in Southern Waste Pile Area DUs
PCB and pesticide detections at three SWP area DUs located immediately downgradient of reference area IS-REF-02, and adjacent to the Cuyahoga River, show similar results as IS-REF-02.

Subsurface and surface soil PCBs in the SWP area DUs have similar concentrations and compounds with estimated detections of aroclor 1254 below the RL and one detection of aroclor 1260 at similar concentrations in one subsurface SWP DU. Subsurface soil pesticide results are the same as surface soils, but concentrations are lower and fewer compounds detected above their respective PALs.

PCBs/Pesticides in Former Transformer Pad Area DU
Aroclor 1260 was detected below the RL and above the MDL at an estimated maximum concentration of 0.073 mg/kg at DU IS-TR-01. No pesticides were detected in the TR-DU.

Subsurface soil PCBs and pesticides at the TR-DU are similar to the reference areas and surface soils. No PCBs or pesticides were detected in the subsurface soils.

PCBs/Pesticides in Former Underground Storage Tank Areas DUs
Aroclor 1260 was detected at IS-UST2-01 and IS-UST3-01 below the RL and above the MDL as high as an estimate of 0.028 mg/kg. One pesticide, 4,4'-DDE was estimated below the RL at DUs IS-UST1-01 and IS-UST3-01 and methoxychlor was estimated below RL at DU IS-UST2-01.

Subsurface soil PCBs at the UST DUs are similar to the reference and background areas and surface soils. Aroclor 1260 was detected in the subsurface soil at IS-UST2-01 at a lower concentration than the surface soil. No PCBs were detected in IS-UST1-01 or IS-UST3-01. No pesticides were detected in the subsurface soils.

<u>Dioxins and Furans</u>
Dioxins and furans were sampled at one surface soil (as 3 replicates) and two subsurface soil locations. Eleven dioxins and furans were detected above the RL and six were estimated below their RLs, but above the MDL in the surface soil at DU IS-CWP-01. There were no dioxin or furan PALs established in the EE/CA Work Plan. The November 2017 the USEPA Regional

Screening Level (EPA RSL) (USEPA, 2017) documents lists screening levels for 2,3,7,8 tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) at 4.8E-6 mg/kg, which is above the concentrations of 2,3,7,8-TCDD reported in the surface or subsurface soil.

Dioxin and furan concentrations in subsurface soils are lower than surface soils.

Asbestos
The surface soil was analyzed for asbestos fibers in ISM soil samples immediately surrounding the former mill building foundation and in the areas adjacent to the towpath where the greatest soil exposures are likely to occur. These included all BLD DUs surrounding the building foundation and towpath (7 DU locations). In addition, the Dump site and all waste piles ISM samples (11 DU locations) were analyzed for asbestos. No asbestos was detected at any of these locations.

pH
Surface and subsurface soils pH were measured at all DUs. The pH values in surface soils range between 6.8 and 8.0, with an average of 7.5. The pH values in subsurface soils are similar to surface soils with values between 6.0 and 8.3, with an average of 7.3.

b) **Sub-slab Surface & Subsurface Soil Sample Investigation Results**

The sub-slab surface and subsurface soil investigation consisted of 26 ISM samples collected from 11 DUs at zero to six inches below the bottom of the concrete (bbc) for the surface soil samples and six inches to three feet bbc for the subsurface samples. Two discrete soil samples collected from DU IS-SS-13 at 4.5 to 5 ft bbc and DU IS-SS-07 at 3. To 3.5 ft bbc. ISM samples were evaluated for metals, SVOCs/VOCs, PCBs/Pesticides, and pH. Discrete soil samples were evaluated for SVOCs/VOCs, and PCBs. Analytical results for all analytes for surface and subsurface soil samples are presented in Appendix A, Table A-3, A-4, and A-5. Site analytical results for sub-slab surface and subsurface soils were then compared with the analytical results from the two reference locations and one background location to identify trends, Site areas, or specific metals with different concentrations. Table 2-5 and Table 2-6 present all the metals and SVOC analytical results for surface and subsurface soils with Site concentrations color shading for comparison to the maximum reference/background values.

Metals
Surface sub-slab soil metals concentrations in all sub-slab samples do not significantly differ from all reference and background area samples, including IS-REF-03, as shown on Table 2-5, with a few exceptions. Concentrations of lead in surface sub-slab soil sample locations IS-SS-04 and IS-SS-07 are two to four times higher than other sub-slab locations and the reference and background areas. Antimony is approximately four times higher than maximum reference concentrations at IS-SS-07 and mercury is five times higher at IS-SS-06.

Additionally, subsurface sub-slab soils metals concentrations are similar to all reference/background area samples, with a few exceptions. Lead and copper were two to three times higher in the subsurface sub-slab soil at IS-SS-06 than reference locations (Table 2-6). Lead was also two times higher than maximum reference concentrations at IS-SS-07. Beryllium and selenium were up to four times higher than the maximum reference concentrations at IS-SS-04. Barium was twice the maximum reference concentration at IS-SS-09.

SVOCs/VOCs
Nine of 11 sub-slab soil DUs contain SVOC detections in the surface sub-slab soils that are higher in concentration than maximum reference area concentrations, and up to an order of magnitude higher than reference areas in five of the 11 sub-slab DUs (Table 2-5). These five DUs had five to six SVOCs detected above their respective PALs. In five sub-slab DUs IS-SS-04, IS-SS-06, IS-SS-07, IS-SS-09, and IS-SS-13, the concentration of the SVOCs were 2 to 30 times higher than the reference areas as shown in Table 2-5.

SVOC detection in subsurface sub-slab soil DUs are similar compounds detected and similar number detected above their PALs as surface sub-slab soils (Table 2-6). SVOCs concentrations in seven of 11 subsurface sub-slab DUs are lower than the surface sub-slab soil. SVOC concentrations in four subsurface sub-slab DUs, IS-SS-04, IS-SS-10, IS-SS-11, and IS-SS-12 are higher than surface sub-slab soils.

Unlike Site ISM surface and subsurface soil sample DUs, the sub-slab ISM soil sample DUs were sampled and analyzed for VOCs as recommended in the 2017 Phase I-II Tech Memo, given the potential for VOC solvents to have been used to clean the Fourdrinier Machine and in machine shops. Appendix A Table A-3 shows maximum detections of VOCs in surface sub-slab soils such as 0.160 mg/kg of benzene, 0.89 mg/kg toluene, 1.8 mg/kg total xylenes, 0.670 mg/kg PCE, and approximately five other compounds at similar or lower concentrations. Subsurface sub-slab soils contained similar results but higher for most of these same compounds such as 0.260 mg/kg of benzene, 1.1 mg/kg toluene, 3.0 mg/kg total xylenes, and 1.1 mg/kg PCE (Appendix A, Table A-4). These higher concentrations in both surface and subsurface sub-slab soils occurred at location IS-SS-04 where there once existed a machine parts cleaning and chemical storage area. The PALs for PCE of 0.18 mg/kg and 1.4 mg/kg for total xylenes are exceeded for both surface and subsurface sub-slab soils at this location.

Black-stained soil samples with an odor were collected as discrete samples for VOC analysis at sub-slab locations IS-SS-07 and IS-SS-13 as DU-07-01 and DU-13-01, respectively. These samples were analyzed for SVOCs and VOCs (Appendix A, Table A-5). Location DU-13-01 SVOC detections are similar to the subsurface IS-REF-03 subsurface location with a similar number of relatively low detections of VOCs similar to the lowest VOC detections in sub-slab subsurface soils, and no PAL exceedances. However, location DU-07-01 SVOC detections are similar to surface and subsurface sub-slab soils with the highest SVOC concentrations including three compounds exceeding their PALs, one of which is highest concentration of naphthalene detected in sub-slab soils at 5.7 mg/kg relative to a 1.0 mg/kg PAL for naphthalene. Detections of VOCs at DU-07-01 are similar to the surface and subsurface sub-slab soils with the highest number of VOCs at similar concentrations including BTEX compounds and the highest concentration of total xylenes at 2.2 mg/kg compared to a PAL of 1.4 mg/kg.

PCBs/Pesticides

Aroclor 1260 was detected in the surface sub-slab soil below the RL and above the MDL as an estimate of 0.021 mg/kg at IS-SS-06 (Appendix A, Table A-3). Aroclor 1254 was detected in the subsurface sub-slab soil at an estimated concentration of 0.020 mg/kg in IS-SS-06. Three pesticides were detected in surface sub-slab soil. Methoxychlor was detected in IS-SS-03 at an estimated concentration of 0.003 mg/kg. Pesticides 4,4'-DDE and 4,4'-DDT were detected in IS-SS-13 and 4,4'-DDT was detected in IS-SS-10 at estimated concentrations of 0.0017 mg/kg, 0.0050 mg/kg, and 0.0015 mg/kg, respectively.

Aroclor 1260 was detected in the subsurface sub-slab soil as an estimate of 0.77 mg/kg at IS-SS-10 (Appendix A, Table A-4). No pesticides were detected in subsurface sub-slab soils.

pH

Surface sub-slab soil pH was measured at all 11 DUs (Appendix A, Table A-3). The pH values range between 9.1 and 10.8 for the surface sub-slab soil with an average of 10.3, which is higher than the reference areas and the Site surface soil averages of 7.5. The increase in the surface sub-slab soil pH may be caused by leaching of alkaline chemicals from the concrete into the upper soil raising the pH.

Subsurface sub-slab soil analytical results for pH were lower than the surface sub-slab soil ranging from 7.5 to 9.3 (Appendix A, Table A-4) with an average of 8.2, which is slightly higher than the reference area average of 7.3, again this may be caused by leaching from the concrete into the soil.

c) **Risk Assessment Sample Results**

The risk assessment soil investigation consisted of ten six-foot borings within ten existing soil DUs. Section 4.4.1 of the EE/CA Work Plan stated that with respect to spatial boundaries for NPS Park, construction, or utility workers, "deep subsurface samples will include soils between 0 and 6 ft bgs, samples of which may be collected in a later investigation phase using the most appropriate sampling techniques...to provide Park management with the data to make timely decisions if utility work is required." Samples were evaluated for metals, SVOCs/VOCs, PCBs/Pesticides, and pH. The locations of the ten six-foot deep risk assessment soil boring samples are shown in Figure 2-11, which include two reference borings and one background boring. Site analytical results soil samples collected from the borings were then compared with the analytical results from the two reference locations and one background location to identify trends, Site areas, or specific metals with different concentrations. Table 2-7 presents the metals and SVOC comparisons with maximum reference values and Appendix A, Table A-6 presents the summary table of analytical results for all analytes.

Background and Reference Risk Assessment Soil Boring Results

Metals

Eighteen of 21 metals were detected above their respective PALs and three metals were detected below their respective PAL in the two reference areas and one background area risk assessment borings, which is nearly identical to surface and subsurface soils reference and background analytical results located in DUs IS-REF-01, IS-REF-02, and IS-REF-03. The three risk assessment reference/background borings were located within these same surface and subsurface soil reference and background DUs.

SVOCs

SVOCs in the three risk assessment background and reference borings were similar to SVOCs in the surface and subsurface reference/background areas collected from the same DUs. Four SVOCs in the risk assessment reference and background borings were detected above their respective PALs compared to three to five in surface and subsurface soil reference and background areas.

PCBs and Pesticides

No PCBs were detected in the reference/background risk assessment borings. Three pesticides were detected at estimated values in reference boring IS-REF-02-RA. No pesticides were detected above their PALs. PCB and pesticide analytical results from the reference/background risk assessment borings are similar to analytical results from surface and subsurface reference samples collected in the same DUs.

pH

Risk assessment boring soil pH was measured at all three locations. The pH values range between 6.6 and 7.8 with an average of 7.3, which is similar to the subsurface reference pH average of 7.7.

Site Risk Assessment Soil Investigation Results

Metals

The majority of the risk assessment borings metal concentrations are similar to the background and reference soils, but detections at four locations show notably higher concentrations (Table 2-7). Risk assessment borings IS-BLD-03-RA, IS-CWP2S-RA, IS-SS-10-RA, and IS-TR-01-RA contained two to nearly thirty times higher concentrations than the highest concentrations in reference and other risk assessment borings for one or more of the following metals: antimony, arsenic, barium, cadmium, copper, iron, lead, mercury, thallium, and zinc. However, IS-BLD-03-RA concentrations of antimony, barium, copper, and lead are more than 10 times higher than other boring locations, but similar to the subsurface soil sample from DU IS-BLD-03. The metals with higher concentrations at IS-TR-01-RA were similar to the metals with higher concentrations in the subsurface soil sample from DU IS-TR-01.

SVOCs/VOCs

SVOC concentrations in the risk assessment borings are typically approximately 10 times higher than background area DU IS-REF-03 north of the Site, but similar to the two reference areas (and in some cases lower, e.g., IS-CWP2S-C-RA) except at borings IS-BLD-03-RA, IS-RR-01-RA, IS-TR-01-RA, and IS-SS-13-RA (attached Table 2-7). SVOC concentrations at these four boring locations can be up to 90 times higher than other risk assessment boring locations for many of the detected SVOCs. In risk assessment borings IS-CWP2S-C-RA, IS-UST2-01-RA and IS-SS-10-RA borings, two SVOCs, naphthalene and 2-methylnaphthalene, are two to seven times higher than the highest risk assessment reference boring location , IS-REF-02-RA, but the remaining SVOCs concentrations are similar to all of the reference borings. These three borings, along with IS-BLD-03-RA, IS-RR-01-RA, IS-TR-01-RA, and IS-SS-13-RA, contained varying amounts of slag material in the sample.

Two risk assessment boring samples collected under the concrete foundation were analyzed for VOCs: IS-SS-10-RA and IS-SS-13-RA. All VOC detections are estimated. At location IS-SS-10-RA, cyclohexane, methylcyclohexane, toluene, and total xylenes were detected at 0.088 mg/kg, 0.30 mg/kg, 0.11 mg/kg, and 0.25 mg/kg, respectively. At location IS-SS-13-RA, benzene, ethylbenzene, methylcyclohexane, styrene, toluene, and total xylenes were detected at similarly low estimated concentrations. Laboratory contaminants 2-butanone and methyl acetate were also detected in IS-SS-13-RA.

PCBs/Pesticides

PCBs and pesticide analytical results in the risk assessment soil borings were similar to the two reference risk assessment borings and to surface and subsurface reference analytical results. One PCB was detected in one risk assessment boring location IS-SS-10-RA at an estimated concentration of 0.043 mg/kg for aroclor 1260 (Appendix A, Table A-6). Three pesticides were detected at reference area IS-REF-02-RA as 4,4’-DDE, 4,4’-DDT, and heptachlor at estimated concentrations of 0.0044, 0.0045, and 0.0018 mg/kg, respectively. One pesticide, dieldrin at 0.0013 mg/kg, was detected at IS-REF-01-RA. One pesticide was detected in a Site non-reference sample at DU IS-SS-13-RA under the concrete slab as Endosulfan II at 0.0027 mg/kg.

d) Sediment Sample Results

The sediment investigation consisted of 20 samples collected from 16 DUs. The locations of the 16 sediment DUs are shown in Figure 2-7, The intended sediment DU area IP-BLD-01 did not contain ponded water at the time of this investigation, as anticipated, and consequently was sampled as a surface soil DU. Therefore, this DU IP-BLD-01 is not included in the total number of 20 sediment samples, or discussed as part of the sediment data. Samples were evaluated for metals, SVOCs/VOCs, PCBs, pesticides, dioxins/furans, pH, TOC, and AVS/SEM. Analytical results for all analytes for sediment samples are presented in Appendix A, Table A-7. Site analytical results for sediment were then compared with the analytical results from the reference locations to identify trends, Site areas, or specific contaminants with different concentrations.

Table 2-8 present all the analytical results for sediments with Site concentrations color shading for comparison to the maximum reference values.

Sediment Reference Areas Results

Four reference sediment samples were collected as far as 1,650 feet upstream of the Site to avoid Site impacts to these samples. The reference sediment sample data discussed below represent the anthropogenic impacts to upstream sediment samples.

Metals
Metal detections and concentrations are similar in all four reference sediment locations (Table 2-8). The most notable characteristic regarding the reference sample results for sediment is the similarity in both concentrations and analytes detected in all four reference locations. However, IL-AP-R typically contains higher concentrations and more metals above PALs than the other three reference locations, and the two Cuyahoga River reference locations, IL-CR-R and IL-CR-R2 typically contain lower concentrations than the other two locations. Of the 21 metals analyzed, seven were detected above their PALs in IL-AP-R, five in IL-BC-R, six in IL-CR-R, and four in IL-CR-R2. Arsenic, cobalt, iron and manganese were detected above PALs in all four reference sediment locations. Aluminum, nickel, and zinc were detected in IL-AP-R above their PALs, but below their PALs in the other three reference locations. Chromium VI was above its PAL in IL-CR-R. Thallium was detected in IL-BC-R and IL-CR-R above its PAL. Arsenic was detected at more than 20 times above its PAL at reference locations IL-AP-R at 16 mg/kg and IL-BC-R at 15 mg/kg above a PAL of 0.68 mg/kg, and more than ten times at IL-CR-R and IL-CR-R2. Metals detected at less than an order of magnitude above their respective PALs, include aluminum, chromium VI, cobalt, iron, manganese, nickel, and zinc.

SVOCs/VOCs
Eleven of 23 SVOCs were detected above their PALs at Brandywine Creek reference location IL-BC-R, thirteen SVOCs were detected above their PALs at the Cuyahoga River reference location IL-CR-R, and nine SVOCs were detected above their PALs at Cuyahoga River reference location IL-CR-R2 upstream of IL-CR-R (Table 2-8). The on-Site reference sediment sample IL-AP-R had three of 23 SVOCs detected above their PALs. SVOC concentrations were similar between the Cuyahoga River and Brandywine Creek reference locations, and were 2 to 15 times higher than the reference sediment location IL-AP-R.

No VOCs were detected in reference sediment samples with the exception of methyl acetate which is considered a laboratory contaminant (Appendix A, Table A-7).

PCBs/Pesticides
Aroclor 1260 was detected at Cuyahoga River sediment reference location IL-CR-R estimated at 0.021 mg/kg compared to an MDL of 0.018 mg/kg (Appendix A, Table A-7). Two organochlorine pesticides, 4,4’-DDE and 4,4’-DDT, were detected in both Cuyahoga River reference sample locations above their PALs. No pesticides were detected in Brandywine Creek

reference sediment samples. Methoxychlor was estimated in reference location IL-CR-R. Dieldrin was detected at an estimated concentration of 0.00021 mg/kg in IL-AP-R.

Total Organic Carbon
The TOC concentrations at the sediment reference sample locations ranged from 3,300 mg/kg at IL-CR-R to 20,000 mg/kg at IL-AP-R (Appendix A, Table A-7). TOC concentrations were similar between the Cuyahoga River and Brandywine Creek reference locations, which were up to 4 times lower than the sediment reference sample IL-AP-R.

pH
Sediment pH was measured at all four reference locations between 6.8 and 7.8 with an average of 7.4.

Site Sediment Investigation Results

Metals
Metals concentrations in all Cuyahoga River and Brandywine Creek sediment samples were nearly the same as the three reference areas from upgradient locations IL-BC-R, IL-CR-R, and IL-CR-R2 (Figure 2-7 and Table 2-8). Notable exceptions include copper detected in IL-BC-02 at 48 mg/kg more than three times the reference concentration of 14 mg/kg.

Metals concentrations in sediment sample IL-AP-01 (Figure 2-7) downgradient of the aeration pond area were nearly the same as the sample from reference area IL-AP-R, located upgradient. Surface water samples at the same locations exhibited similar metals.

Sediment samples were also collected from Ponds P1, P2, and, P3, shown in Figure 2-7. Metal detections and concentrations from these three sediment pond areas are notably higher and show more PAL exceedances than all other sediment sample DUs and reference areas. The highest metals detections in these three sediment samples is in IP-P2-01 where antimony, cadmium, chromium III, chromium VI, copper, lead, and mercury are up to 30 times higher than the sediment reference area IL-AP-R.

SVOCs/VOCs
The highest SVOC concentrations in sediment samples were detected in Brandywine Creek sediment sample IL-BC-02, which is immediately adjacent to some of the highest concentration DU areas of surface soil SVOCs on the Site, and topographically downgradient of the former operating paper mill and a large area of surface slag as shown in Figure 2-10. Thirteen SVOCs are above their PALs at IL-BC-02, which are five to ten times higher than SVOC concentrations detected at Brandywine Creek reference location, IL-BC-R, but decrease to less than two times the reference location further downgradient at the most downgradient Brandywine Creek location, IL-BC-03 (Table 2-8).

The next highest sediment SVOC concentrations were detected east of the Towpath in stream sediment sample location IL-AP-01 and Pond 3 sample, IP-P3-01, where a maximum of thirteen and eleven SVOCs are above there PALs, respectively, and at similar concentrations to each other. Similar SVOCs were detected in the Pond 1 sediment sample, IP-P1-0, but generally at lower concentrations and fewer SVOCs above PALs at seven. Concentration levels and the number of SVOCs detected above their PALs (usually 12 to 13) in Cuyahoga River sediment samples are nearly the same at all locations, which also match the reference location IL-CR-R. The highest SVOCs concentration in Cuyahoga River sediment samples are in sediment sample IL-CR-03 which is downgradient of the Dump site (Figure 2-7). Thirteen SVOCs are above their PALs at IL-CR-03. Five of these SVOCs concentrations are up to three times higher than SVOC concentrations detected at reference location IL-CR-R, but decrease to less than the reference location further downstream at IL-CR-04, the most downgradient Cuyahoga River location.

The only VOC detected in all sediment samples uniformly was an estimated concentration of methyl acetate near the MDL; presumably a laboratory contaminant.

PCBs/Pesticides
Aroclors 1242 and 1254 were detected in pond samples IP-P1-01 and IP-P2-01 above their PALs by a factor of approximately 3 to 15 times. Aroclor 1254 was detected below the PAL at an estimated concentration of 0.029 mg/kg in IP-P3-01. Two organochlorine pesticides, 4,4’-DDE and 4,4’-DDT, were detected in all four Cuyahoga River sediment sample locations and both reference locations, but were not detected in Brandywine Creek sediment samples. Methoxychlor was estimated in reference location IL-CR-R and sample location IL-CR-01 below their PALs. Chlordane was detected in IL-P2-01 and IL-P3-01 at estimated concentrations below their PALs. Two other pesticides, cis-chlordane and gamma chlordane, were also detected in IL-P2-01 at concentrations below the PAL for cis-chlordane and eight times higher than the PAL of 0.00324 mg/kg for gamma chlordane at 0.027 mg/kg.

Dioxins/Furans
Sixteen of sixteen dioxins were detected above the ML at IP-P1-01 (Appendix A, Table A-7). The dioxin 2,3,7,8-TCDD was detected above the ML at 1.30E-6 mg/kg, but below their EPA RSL at 4.8E-6 mg/kg. There are no PALs listed for dioxins in the EE/CA Work Plan, SAP or QAPP. Dioxins were not analyzed in the reference sediment samples.

pH
Sediment pH was measured at all sediment sample locations between 7.4 and 7.9 with an average of 7.7.

Total Organic Carbon
The TOC concentration along the Cuyahoga River and Brandywine Creek ranged from 2,200 mg/kg to 7,600 mg/kg, which is similar to the reference areas and with no discernable trend (Appendix A, Table A-7). The on-Site TOC concentrations ranged from 27,000 mg/kg in the unnamed stream downstream from Pond P1 to 150,000 mg/kg in Pond P2, which were higher

than the 20,000 mg/kg at the on-site upstream reference location IL-AP-R. These values are within the TOC concentrations reported by several studies conducted on sediment collected from the Cuyahoga River (near Lake Erie) and the Great Lakes area of 1,900 mg/kg to 280,000 mg/kg (0.19 % to 28 % or 0.0019 to 0.28 fraction of organic compound) (USACE, 2015, USACE, 2009, and Johnson, et. al., 1982).

AVS/SEM
Sediment samples were analyzed using the AVS and SEM method to obtain concentrations for use in the planned risk assessment. The concentrations of AVS/SEM components can be used to assess the potential for toxicity to sediment-dwelling organisms. More specifically, the concentrations of several heavy metals are measured, and at the same time, the amount of acid-volatile sulfide (which can be extracted from the sediment by treatment with hydrochloric acid) is determined. Based on the chemical interactions between heavy metals SEM and AVS, the concentrations of these two components can be used to assess the potential for toxicity to sediment-dwelling organisms. These data were evaluated and will be discussed in Section 3.0.

e) Waste Pile Sample Results

The waste pile investigation consisted of 13 ISM samples and 11 Toxicity Characteristic Leaching Procedure (TCLP) samples collected from 11 DUs. Samples were evaluated for metals, SVOCs/VOCs, PCBs/Pesticides, and hazardous waste (TCLP). Analytical results for all analytes for the waste piles are presented in Appendix A, Table A-8. Site analytical results for the waste piles were then compared with the analytical results from the two reference locations and one background location to identify trends, Site areas, or specific metals with different concentrations. Table 2-9 presents all the analytical results for waste piles with Site concentrations color shading for comparison to the maximum surface soil DUs reference/background values.

Site Waste Pile Investigation Results

Metals
The locations of the waste piles are depicted on Figure 2-12. Color coded comparison of waste pile analytical results discussed below are presented in Table 2-9 for metals and SVOCs using the surface soil maximum reference values for comparison. Other analytical results including PCB, pesticides, and dioxin/furans are presented in Appendix A, Table A-8. The metals concentrations from the waste piles exceeded their PALs for 19 of 21 metals analyzed except total chromium, which has no PAL and beryllium as shown in Table 2-9. Typically, the waste pile metals concentrations were from 5 to more than 100 times higher than all other areas sampled on the Site, and Dump site concentrations are the highest for all waste piles and some of the highest metals concentrations for all media on the Site. Notably, lead and copper were among the metals highest above reference and other areas. Lead was detected at IW-DS-01 at a maximum of 4,700 mg/kg relative to a PAL of 0.094 mg/kg, a maximum reference concentration of 31 mg/kg, and other typical waste pile lead concentrations, which are below 100 mg/kg except for the Southern Waste pile lead detection at 140 mg/kg. Copper detected at IW-DS-02 at a maximum of 2,400

mg/kg relative to a PAL of 15 mg/kg, and a maximum reference concentration of 31 mg/kg. Similarly high concentrations for antimony, barium, and manganese are reported for the Dump site (Table 2-9). While metals detections at other waste piles are significantly lower than the Dump site, all waste piles detected two to nine metals at least two times higher than the maximum reference sample concentrations.

SVOCs/VOCs
While 13 of the 23 SVOCs analyzed exceeded their PALs in waste pile samples, typical concentrations are the same or lower than the SVOC concentrations detected in the highest concentration DUs on the Site. Unlike the detection of metals, the highest concentrations of SVOCs were detected in the CWP 1S-A, CWP-2S-A, and SWP-01 (Table 2-9) where concentrations are 1 to 2 orders of magnitude higher than the reference areas, similar to relatively high SVOC concentrations detected in surface and subsurface soil DUs IS-BLD-03, IS-CWP-01, IS-TR-01, IS-UST1-01 and IS-UST2-01, but approximately 10 times lower than the highest SVOC surface soil detections on the Site from the RR DUs.

A “grab” sample of black stained soil with an odor was collected from the CWP2N waste pile and analyzed for VOCs. No VOCs were detected.

PCBs/Pesticides
At least one of seven aroclors 1248, 1254, or 1260 were detected in all the waste piles except IW-CWP2S-A, IW-CWP2S-B, IW-CWP2S-C, and IW-CWP1N (Appendix A, Table A-8). PALs were exceeded for aroclors 1248 and 1260 only in Dump site samples. One pesticide PAL was exceeded in a Dump site sample while other pesticide detections were few and estimated below their RLs.

Dioxins/Furans
All sixteen dioxins/furans were detected in waste pile samples above their RLs or as estimated value between the RL and MDL. Waste pile samples from the Dump site samples were up to over an order of magnitude higher than the samples from waste piles IW-CWP2S-B and IW-CWP1N The USEPA RSL for 2,3,7,8-TCDD of 4.6E-6 mg/kg was exceeded in IW-DS-02 at 8.5E-6 mg/kg. The USEPA RSL for 2,3,7,8-TCDD was not exceeded in either of the other two waste pile samples.

Toxicity Characteristic Leaching Procedure Results

The EE/CA Work Plan proposed collecting waste pile soil samples to characterize the waste for potential future disposal as either solid waste or hazardous waste. Waste pile samples were collected at the same time as the ISM samples discussed above and were submitted as separate samples for TCLP analysis and not ISM protocols. A total of thirteen samples were submitted to the laboratory. Analytical results for TCLP are presented in Appendix A, Table A-9.

Metals
Three of the eight Resource Conservation and Recovery Act (RCRA) metals were detected in all eleven waste pile TCLP samples including arsenic, barium, and chromium as shown in Appendix A, Table A-9. Lead was detected in ten waste pile TCLP samples, cadmium was detected in nine, and selenium was detected in three. Mercury and silver were not detected in any of the waste pile samples. Lead TCLP concentrations in the Dump site waste sample IW-DS-02 exceeded the TCLP maximum concentration of 5.0 milligrams per liter (mg/L) at 19 mg/L, and is therefore considered hazardous waste based on toxicity characteristics. The TCLP metal concentrations from the other waste piles were below the regulatory limits for hazardous waste. The highest TCLP metal concentrations were detected in the Dump site samples for barium, cadmium, chromium, and lead, and in IW-CWP2N TCLP samples for arsenic and selenium.

SVOCs/VOCs
The SVOC hexachlorobutadiene was detected at an estimated concentration of 0.00099 mg/L below the regulatory limit of 0.5 mg/L. Two VOCs were detected at concentrations above the RL, and one was detected below the RL, but above the MDL. PCE was detected at 0.12 mg/L below the regulatory limit of 0.7 mg/L. Trichloroethene was detected at 0.24 mg/L below the regulatory limit of 0.5 mg/L. The third VOC, 2-butanone with an estimated concentration of 0.086 mg/L is considered a laboratory contaminant.

Pesticides
One pesticide, methoxychlor, was detected in waste pile CWP2N at an estimated concentration of 0.000021 mg/L, which is below the regulatory level of 10.0 mg/L.

f) Concrete Surface Sample Results

The concrete surface of the building foundation was sampled only for PCBs as ISM samples consisting of three replicates from each of 11 concrete DUs. Of the 11 concrete (CONC) DUs sampled and two discrete samples from the former transformer pad (total of 35 samples) (Figure 2-8), PCBs were detected at eight locations, as shown on Appendix A, Table A-10. Aroclor 1260 was detected at CONC-10 above the PAL for aroclor 1260 detected at 1.4 mg/kg with a PAL of 0.24 mg/kg. Five DUs had estimated detections of aroclor 1260 above the MDL but below the RL; CONC-06 at 0.047 mg/kg, CONC-07 at 0.090 mg/kg, CONC-08 at 0.088 mg/kg, CONC-09 at 0.051 mg/kg, and CONC-11 at 0.14 mg/kg. The two discrete samples from the former transformer pad TR-01 at 0.091 mg/kg, and TR-02 at 0.082 mg/kg had estimated concentrations of aroclor 1260. No PCBs were detected in CONC-01, CONC-03, CONC-04, CONC-12 and CONC-13.

g) Groundwater Sample Results

The groundwater investigation consisted of two sampling events. The first sampling event in 2016 consisted of 39 samples collected from 35 monitoring wells and piezometers and the second event in 2017 consisted of 37 samples collected from 33 samples monitoring wells and piezometers. Samples were analyzed for metals, SVOCs/VOCs, pesticides, and PCBs. Samples were also evaluated in the field for temperature, pH, conductivity, dissolved oxygen, oxygen reduction potential, and turbidity, Analytical results for all analytes for groundwater samples are presented in Appendix A, Table A-11. Site analytical results for groundwater were then compared with the analytical results from six upgradient reference locations to identify trends, Site areas, or specific contaminants with different concentrations.

Groundwater Reference Location Results

The reference locations were identified as upgradient wells or piezometers from the Site as estimated from equipotential lines depicted on Figure 2-5a. Based on Figure 2-5a, the following four wells and two piezometers are considered reference locations for the Site; monitoring wells AQ-01, MW-R-01, MW-AP-01, and MW-BLD-01; and piezometers PZ-BC-R and PZ-CR-R. Groundwater samples were collected in fall 2016 and in spring 2017.

Metals

PALs were exceeded for a total of nine metals in groundwater sampled from the four reference wells MW-R-01, MW-AP-01, MW-BLD-01, and the artesian well AQ-1, and two reference piezometers PZ-BC-R, and PZ-CR-R, as shown on Appendix A, Table A-11 in the fall sampling event. Barium exceeded PAL at all six reference locations. Arsenic and manganese exceeded PALs at five of the six reference locations. Iron exceeded PALs in all reference locations with the exception of MW-R-01. Cobalt exceeded PAL at four of the six reference locations. Copper and lead were detected above PALs at AQ-01, but were not detected in the other five reference locations. Aluminum was above PALs in three of the reference locations. Eight metals exceeded their PALs in spring sampling event and at similar concentrations to the fall sampling (Appendix A, Table A-12). Reference well AQ-1 was not sampled in spring. The metal concentrations are generally similar between the five reference locations that were sampled in both the fall and the spring sampling events.

SVOCs/VOCs

Naphthalene was detected above its PAL in PZ-BC-R during fall 2016 sampling but was not detected during spring 2017 sampling. Diethyl phthalate was detected below its PAL during the fall or spring sampling events in MW-AP-01, MW-R-01, MW-BLD-01, PZ-BC-R and PZ-CR-R. No SVOCs were detected in the artesian well. No SVOCs were detected in the reference wells and piezometers above their PALs during the spring sampling event.

No VOCs were detected in the reference wells in either the fall or spring sampling events with the exception of acetone and 2-hexanone, which are considered laboratory contaminants.

PCBs/Pesticides

Aroclor 1260 was detected above the PAL in MW-AP-01 in the spring sampling event. No other PCBs or pesticides were detected in the reference wells and piezometers, or the artesian well.

Site Groundwater Investigation Results

<u>Metals</u>

Metals in Aeration Pond Area

Aeration pond groundwater monitoring piezometers and wells detected metals at similar number as the reference wells MW-AP-01 and MW-R-01 and reference piezometer PZ-BC-R for the fall and spring sampling events. Similar to reference wells, arsenic, barium, cobalt, iron, and manganese were detected above their PALs in the aeration well MW-AP-02 and piezometers PZ-AP-04 and PZ-AP-05. Differences include detections of aluminum, copper, lead, and nickel above their PALs in PZ-AP-05 and aluminum in PZ-AP-04, but not in the reference wells and piezometers. Additional metals and higher concentrations were detected in spring 2017 than fall 2016 (Appendix A, Tables A-11 and A-12).

Metals in Brandywine Creek

Brandywine Creek groundwater monitoring piezometers, detected similar metals at similar concentrations as reference wells for the fall and spring sampling events (Appendix A, Tables A-11 and A-12). Higher iron and manganese concentrations were detected in spring 2017, and higher than fall 2016 in PZ-BC-02, and PZ-BC-05. Four to eight metals were detected in the BC wells and piezometers above their PALs, similar to the six metals above PALs in the reference piezometer PZ-BC-R. Lead and copper were detected in MW-BC-03 above their PALs in spring 2017. Lead was detected in PZ-BC-05 above its PAL in fall 2016.

Metals in the Cuyahoga River

Cuyahoga River piezometer groundwater chemistry is similar to the reference wells in number of metals detected and concentrations. Exceptions include higher iron concentrations than the reference piezometer PZ-CR-R for both fall and spring sampling events in all four Cuyahoga piezometers.

Metals in the Dump site

Eight metals were detected above their PALs in the three Dump site wells, MW-DS-01, MW-DS-02 and MW-CR-04 in fall and spring sampling events; similar to nine metals above their PALs in the reference wells. Mercury was not detected in any of the reference wells in either fall 2016 or spring 2017, however, it was detected in MW-DS-02 at an estimated value of 0.095 µg/L above the PAL of 0.026 µg/L in fall 2016 but not in spring 2017.

Metals in the Building Foundation Area

Building monitoring well MW-BLD-02 downgradient and west of the building foundation, detected the same or fewer metals and at similar concentrations as the reference wells and piezometers. Although, numerous monitoring wells are positioned downgradient of the building foundation including all the UST and CWP wells, in this report, MW-BLD-02 is considered as the only "building area" well.

Metals in Former Underground Storage and Transformer Pad Areas
The metals detected in groundwater samples from three of the four UST area monitoring wells and MW-TR-01 downgradient of the former transformer pad were similar to groundwater reference locations in number of metals detected and concentrations for the fall and spring sampling events (Appendix A, Tables A-11 and A-12). Concentrations of detected metals were similar between the fall and spring sampling events. However, 13 metals were detected above their PALs in MW-UST3-01 compared to 4 to 7 metals detected in the other three UST area monitoring wells, MW-TR-0,1 and the reference wells. Concentrations of detected metals in the fall sampling event were higher in MW-UST3-01 than the reference wells and piezometers. Metals concentrations in MW-UST3-01 were generally higher than the other area wells. Metals concentrations were lower in the spring than fall for all UST area wells.

Metals in Central and Southern Waste Pile Areas
Metals concentrations in the two central waste pile wells and the two southern waste pile wells are similar to reference well concentrations (Appendix A, Tables A-11 and A-12). However, barium and iron concentrations in MW-SWP-01 during the fall sampling event are higher than the reference concentrations. The metals concentrations are generally lower in the spring sampling event in the CWP and SWP wells.

Metals in North of the Railroad Tracks Area
Metals concentrations in the three groundwater wells north of the Dump site in the NTR area are similar to reference locations for metals (Appendix A, Tables A-11 and A-12). Manganese concentrations in monitoring well MW-NTR-02 are higher than the reference concentrations. The metal concentrations are similar between the fall and spring sampling events.

<u>SVOCs/VOCs</u>

SVOCs/VOCs in Aeration Pond Area
SVOC concentrations in groundwater in the AP area are similar to the reference samples with the exception of naphthalene detected above its PAL at locations PZ-AP-04 and at PZ-AP-05 downgradient from Pond 1 during the fall 2016 sampling event, as shown in Appendix A, Table A-11. Naphthalene was detected above its 0.17 µg/L PAL at 3.8 µg/L and 1.9 µg/L at PZ-AP-04 and PZ-AP-05, respectively. Two additional SVOCs, DEHP and diethyl phthalate, were detected in PZ-AP-04 and PZ-AP-05 below their PALs in the fall. Fewer SVOCs and at lower concentrations were detected in the spring sampling event (Appendix A, Table A-12). No VOCs were detected in the AP wells with the exception of the laboratory contaminant acetone in the spring results (Appendix A, Tables A-11 and A-12).

SVOCs/VOCs in Brandywine Creek Area
SVOC concentrations in Brandywine Creek groundwater wells and piezometers are similar to reference location concentrations and number of SVOCs detected. An exception included the detection of naphthalene above PALs at all locations on Brandywine Creek, except MW-BC-03, from 0.19 to 0.47 µg/L including the upgradient reference piezometer, PZ-BC-R, during the fall

sampling event (Appendix A, Table A-11). These detections exceed naphthalene's PAL of 0.17 µg/L. Naphthalene was not detected in the spring sampling event (Appendix A, Table A-12). Phenanthrene was detected at 0.19 µg/L in PZ-BC-02 in spring. Relative to the reference locations diethyl phthalate, was detected in one or more Brandywine Creek piezometers and wells at similar concentrations in both the fall and spring sampling events. The MW-BC-03 monitoring well is installed deeper than the piezometers and in lower permeability soils, which may explain the difference in the lack of naphthalene detection relative to other Brandywine Creek piezometers in the fall. The VOC cis-1,2-dichloroethene (1,2-cDCE) was detected at PZ-BC-05 below its PAL of 3.6 µg/L at 0.85 µg/L in fall and 0.69 µg/L in spring, as shown in Appendix A, Tables A-11 and A-12).

SVOCs/VOCs in Cuyahoga River Area
Cuyahoga River area SVOC chemistry in groundwater is similar to the reference wells' chemistry (Appendix A, Tables A-11 and A-12). However, naphthalene was detected at PZ-CR-03 and 05 above its PAL in the fall sampling event, but not in any other Cuyahoga River piezometers or in the spring sampling. SVOCs fluorene and phenanthrene were detected below their PALs in PZ-CR-03 in the fall 2016 sampling, but not in the spring 2017. Diethyl phthalate was detected in all four Cuyahoga River piezometers in spring sampling. Di-n-butyl phthalate was detected in four piezometers in fall sampling below their PALs. No VOCs were detected in the fall or spring with the exception of the laboratory contaminant acetone (Appendix A, Tables A-11 and A-12) in the spring.

SVOCs/VOCs in Dump Site
No SVOCs were detected in Dump site groundwater wells MW-DS-01 and 02 in fall 2016 or spring 2017 or in MW-CR-04 in fall 2016 (Appendix A, Table A-11). Three SVOCs were detected in the Dump site groundwater well MW-CR-04 in the spring. Fluoranthene and pyrene exceeded their PALs of 0.04 µg/L and 0.025 µg/L being detected at 0.27 µg/L and 0.20 µg/L, respectively. Phenanthrene was detected at 0.19 µg/L in MW-CR-04, which is below its PAL of 0.4 µg/L. Cis-1,2-dichlorethene was the only VOC detected at the Dump site, other than laboratory contamination, in the fall and spring sampling events at MW-DS-02 below its PAL of 3.6 µg/L at 0.77 µg/L in fall and 1.4 µg/L in spring (Appendix A, Table A-12). Cis-1,2-dichlorethene was detected in MW-DS-01 in the fall at 0.3 µg/L but not in the spring. No additional VOCs were detected in the fall or spring.

SVOCs/VOCs in the Building Foundation Area
No SVOCs, were detected in Building Foundation Area groundwater well MW-BLD-02 in the fall or spring sampling events. Chlorobenzene was detected in fall 2016 and spring 2017 at MW-BLD-02 at 1.1 µg/L and 0.56 µg/L, respectively, relative to a PAL of 1.3 µg/L. No additional VOCs were detected in the fall or spring.

SVOCs/VOCs in the Central and Southern Waste Pile Areas
SVOC concentrations in the two central waste pile wells, and the two southern waste pile wells, are also similar to reference wells and piezometers . One SVOC, diethyl phthalate, was detected

below its PAL in MW-CWP-02 in spring 2017 and MW-SWP-02 in fall 2016. No VOCs were detected in either the fall or spring sampling events except the laboratory contaminant acetone.

SVOCs/VOCs in North of the Railroad Tracks Area
The three groundwater wells north of the Dump site in the NTR area are similar to groundwater reference wells and piezometers with SVOC detections of diethyl phthalate and DEHP at estimated concentrations in MW-NTR-03 in fall 2016.

Two VOCs were detected above their PALs in the NTR wells as shown in Appendix A, Tables A-11 and A-12. TCE concentrations in MW-NTR-01, were at 2.4 µg/L, above its PAL of 0.28 µg/L in fall 2016, but lower in spring 2017 at 0.81 µg/L. Cis-1,2-dichlorethene concentrations in MW-NTR-02 were 10 µg/L in fall and 6.5 µg/L in spring, relative to a PAL of 3.6 µg/L. Cis-1,2-dichloroethene was also detected in MW-NTR-01 and MW-NTR-03, but at concentrations below the PAL. PCE was detected in MW-NTR-01 at 1.4 µg/L, below its PAL of 4.1 µg/L in fall 2016 and at 0.67 µg/L in spring 2017. PCE was also detected in MW-NTR-02 in spring 2017 below the PAL. In fall 2016, trans-1, 2-dichloroethene (1,2-tDCE) was detected at 1.3 µg/L in MW-NTR-02 relative to a PAL of 36 µg/L, and at 0.98 µg/L in spring 2017. Acetone was detected below its PAL in MW-NTR-01 in the spring, detected in laboratory blanks, and is considered a laboratory contaminant.

PCBs/Pesticides
No PCBs or pesticides were detected in groundwater during the fall or spring sampling events with the exception of aroclor 1260 in MW-AP-01 in the spring 2017 sampling event at an estimated concentration of 0.038 µg/L, which is above its PAL of 0.0078 µg/L.

h) Surface Water Sample Results

The surface water investigation consisted of two sampling events consisting of 8 samples collected from 6 locations in 2016 and 30 samples collected from 26 locations in 2017. Samples were analyzed for filtered and unfiltered metals, SVOCs/VOCs, PCBs, pesticides, and hardness. Samples were also evaluated in the field for temperature, pH, conductivity, dissolved oxygen, oxygen reduction potential, and turbidity. Analytical results for all analytes for surface water samples are presented in Appendix A, Table A-13 and Table A-14. Site analytical results for surface water were then compared with the analytical results from three upgradient reference locations to identify trends, Site areas, or specific contaminants with different concentrations. Table 2-10 present all the metals and SVOC analytical results for surface water with Site concentrations color shading for comparison to the maximum upgradient reference values.

Surface Water Reference Location Results

Metals
Three upstream surface water locations were sampled as reference locations for surface water: one to the east in Brandywine Creek, SW-BC-R; a second in the unnamed stream which drains

Brandywine Lake to the southeast and south of Pond 1, SW-AP-R, described as the aeration pond reference; and a third upstream and southwest of the Site in the Cuyahoga River, SW-CR-R. PALs were exceeded for six metals in unfiltered surface water sampled from the aeration pond reference location SW-AP-R in fall 2016 and spring 2017 sampling, including aluminum, arsenic, barium, copper, iron, and manganese. PALs were exceeded for five and eleven metals in unfiltered surface water from Brandywine Creek and Cuyahoga River reference locations SW-BC-R and SW-CR-R, respectively in spring 2017 (Appendix A, Tables A-13 and A-14). The five metals exceeding PALs common to both locations include aluminum, arsenic, barium, copper and iron. The additional six metals exceeding PALs in the Cuyahoga River reference location include cobalt, lead, manganese, nickel, selenium, and zinc. Metals detected above the PALs in filtered reference samples include four in the aeration pond, and three each for Brandywine Creek and the Cuyahoga River. These metals include arsenic, barium and copper at all three locations with manganese exceeding its PAL only at the aeration pond reference location. The metal concentrations from the aeration pond and Brandywine Creek reference locations were similar when comparing filtered and unfiltered at both locations. Metal concentrations from the unfiltered Cuyahoga River were generally higher than the unfiltered metals from the other two reference locations. The filtered sample from the Cuyahoga River reference location was similar to slightly lower than the other two locations. Analytical results from the reference locations are presented on Appendix A, Tables A-13 and A-14 and all surface water sample locations are depicted on Figure 2-13.

SVOCs/VOCs
No SVOCs or VOCs were detected in the reference samples locations in the fall or spring sampling events.

PCBs/Pesticides
No PCBs or pesticides were detected in surface water reference locations in the fall and spring sampling events.

Hardness
Hardness values for the three reference locations were as follows; 230 mg/L at Brandywine reference location SW-BC-R, 210 mg/L at the Cuyahoga River reference location SW-CR-R and 300 mg/L at the aeration pond reference location SW-AP-R in the spring. The hardness value was 240 mg/L at the aeration pond reference location SW-AP-R in the fall.

Site Surface Water Investigation Results

Metals
Metals in Brandywine Creek
Metals concentrations in the three Brandywine Creek the spring unfiltered samples, SW-BC-01, SW-BC-02, and SW-BC-03, are approximately the same as Brandywine reference sample SW-BC-R (Table 2-10). Exceptions are two to three times higher aluminum and iron in the unfiltered Brandywine Creek samples. The filtered Brandywine samples mimic the reference sample

location with one exception, iron at two to three times the reference sample concentration. Filtered samples metal concentrations are generally lower than the unfiltered samples.

Metals in Aeration Ponds and Unnamed Stream
Metal concentrations in the aeration ponds and the unnamed stream in unfiltered surface water are similar to the unfiltered reference samples for both the fall and spring sampling events. Differences include higher arsenic, iron, lead and manganese in the unfiltered samples than the reference location in the stream and the ponds. The Pond P3 sample, SW-P3-01, had higher metals concentrations for both filtered and unfiltered for arsenic, iron and manganese compared to the stream and Pond P1 metals concentrations. The Pond P1 sample, SW-P1-01, also contained similar metal detections as reference locations, but at lower concentrations for both filtered and unfiltered samples, presumably as a result of low turbidity in this immobile body of standing water. The Pond P3 unfiltered sample metals results were similar to all non-reference surface water samples, but with lower aluminum concentrations similar to reference locations.

Metals in the Cuyahoga River
Metals detections and concentrations in the Cuyahoga River filtered and unfiltered surface water samples are similar to the Cuyahoga River filtered and unfiltered reference samples. Metals concentrations generally decrease from upstream to downstream with the highest values at sample location SW-CR-01upstream of the Dump site.

<u>*SVOCs/VOCs*</u>
SVOCs/VOCs in Brandywine Creek
No SVOCs or VOCs were detected in Brandywine Creek surface water samples.

SVOCs/VOCs in Aeration Ponds and Unnamed Stream
No SVOCs were detected in aeration ponds and the unnamed stream surface water samples.

Toluene was detected in unfiltered sample SW-P3-01 at 1.9 µg/L in spring 2017. No additional VOCs were detected in the surface water samples with the exception of acetone, considered a laboratory contaminant.

SVOCs/VOCs in the Cuyahoga River
SVOCs detections and concentrations in the Cuyahoga River surface water are similar to reference detections and concentrations with no detections of SVOCs with the exception of pyrene. Pyrene was detected above its PAL of 0.025 µg/L in surface water at Cuyahoga River location SW-CR-03 in an unfiltered sample at 0.20 µg/L in spring 2017. Pyrene was not detected in the filtered sample. No VOCs were detected in the surface water samples with the exception of acetone and 2-butanone, both considered laboratory contaminants.

<u>*PCBs/Pesticides*</u>
No PCBs were detected in any surface water samples.

No pesticides were detected in fall 2016. During spring 2017 sampling, one organochlorine pesticide, gamma-chlordane, was detected above its PALs at Brandywine Creek location SW-BC-03 at 0.095 µg/L, and at two Cuyahoga River locations, SW-CR-02 at 0.018 µg/L and SW-CR-03 at 0.049 µg/L, all from filtered samples. In spring 2017 sampling, methoxychlor was detected in the unfiltered duplicate sample SW-P1-105-U-201705 below its PAL, but not in the filtered sample or in the primary unfiltered sample, SW-P1-01-201705. No other pesticides were detected.

Hardness
Aeration pond area hardness ranged from 16 mg/L at SW-P1-01 to 310 mg/L at SW-AP-01 compared to a reference concentration of 240 mg/L in the fall and from 36 mg/L to 310 mg/L compared to a reference concentration of 300 mg/L in the spring. In the spring sampling event Cuyahoga River hardness ranged from 150 mg/L to 210 mg/L which was similar to the reference location hardness of 210 mg/L and Brandywine Creek hardness ranged from 140 mg/L to 300 compared to a reference concentration of 230 mg/L.

i) Porewater Sample Results

Development and sampling of the porewater drive point samplers were unsuccessful because of fine sediment clogging the well screen and preventing adequate porewater sampler development and subsequent sample collection. Alternative locations for the samplers were attempted with the same result. Based on these results, this form of data collection is not possible at this Site without collecting sediment resulting in inadequate sample quality; therefore, the porewater sampling task was cancelled. To address this issue, other analytical data collected from the Site, including sediment, surface water, and groundwater samples, will be considered in this document and for the risk assessment in the EE/CA Report to determine the potential risk to porewater, i.e., the existing data is considered sufficient to evaluate aquatic ecological risks.

j) Fourdrinier Machine Sample Results

The Fourdrinier Machine investigation consisted of 21 samples collected from 7 locations for asbestos analyses; 11 samples collected from 10 locations for lead analyses; and 11 samples collected from 10 locations for lubricant analyses. Analytical results for all analytes for the Fourdrinier Machine samples are presented in Appendix A, Table A-15, A-16, and A-17.

Asbestos Sample Results
Of the 21 asbestos samples analyzed, nine contained between 40% and 80% chrysotile and above the PAL of 0.025%. Asbestos was identified in 6-inch diameter pink and white gaskets attached to exterior flanges on pre and post drying rollers on the west side of the Fourdrinier Machine and identified as Sections 3 and 4 in the Phase III Tech Memo (DCR, 2018), and brown irregular shaped gaskets associated with several of the lubrication reservoirs attached to the pre and post drying rollers in identified as Sections 3, 4, 8, and 9 in the Phase III Tech Memo (DCR, 2018). During the field inspection 27 pink and white round gaskets and 4 brown irregular gaskets were

observed. These gaskets were all damaged and friable. Asbestos was also identified on the two black and white brake belts associated with the paper reel brakes at the southern end of the Fourdrinier Machine identified as Section 10 in the Phase III Tech Memo (DCR, 2018). The brake belts are in fair condition and are not considered friable unless disturbed or damaged. The orange rubberized gaskets associated with piping around the head box and press sections at the north end of the Fourdrinier Machine did not have detectable asbestos. Sample locations are shown in Figures 2-14 to 2-16 and analytical results are presented in Appendix A, Table A-15.

Lead-Based Paint Sample Results
Lead-based paint results are summarized in Appendix A, Table A-16, and the 10 sample locations are shown on Figures 2-14 to 2-16. Concentrations from paint chips ranged from 520 mg/kg at LBP-02 to 250,000 mg/kg at LBP-04. Average lead concentration was approximately 41,000 mg/kg including the duplicate result. The USEPA considers paint with a concentration of 5,000 mg/kg to be lead-based paint and subject to federal lead regulations (40 CFR 745).

Lubricant Sample Results
The 10 lubricant samples collected from the Fourdrinier Machine locations shown on Figures 2-14 to 2-16 were analyzed for SVOCs, VOCs and PCB aroclors. Analytical results are presented in Appendix A, Table A-17. Nine of the 23 SVOCs analyzed were detected above their PALs estimated at concentrations ranging from 71 to 1.2 mg/kg. One of these SVOCs, DEHP, was also detected in blank samples. Most other SVOCs were not detected. The greatest number of detections occurred at location LUB-07. VOC detections appear to be a minimal number of compounds at relatively low detections, limited to being qualified as estimated, and in sample blanks. There is one VOC detection of methyl acetate at 8.6 mg/kg detected in sample LUB-09, but considered to be laboratory contaminant. Aroclor 1254 was detected at five locations, and all detections were estimated above the 0.041 mg/kg PAL ranging from 0.11 mg/kg to 0.23 mg/kg. The duplicate sample for LUB-07, LUB-101, did not detect aroclor 1254, but did detect aroclor 1248 at 0.35 mg/kg, and 1260 at 0.28 mg/kg above their PALs of 0.0072 mg/kg and 0.24 mg/kg, respectively.

k) Wetlands Delineation Results

A wetland delineation survey was conducted by a Certified Professional Wetland Scientist in accordance with the specification listed in the EE/CA Work Plan and SAP to identify and delineate wetlands, watercourses, and open water areas. The first phase was a desktop review of existing information and imagery including aerial imagery (NAIP, 2016), USGS topographic map (USGS, 1994), county soil survey maps (NRCS, 2011, National Wetland Inventory (NWI) maps (USFWS, 2016), National Hydrography Dataset (NHD) maps (USGS, 2014) and Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) (FEMA, 2014). The desktop review identified seven soil types that underlie the Site, one of which is considered a soil conductive to “growth and regeneration” of wetland vegetation. The desktop review also identified three wetlands that corresponded to floodways of the Cuyahoga River, a storm water pond (Pond 1), and two streams located along the western and northern boundary of the Site (the

Cuyahoga River and the Brandywine Creek). The entire Site reportedly lies within the 100 year floodplain. The second phase was an on-site field assessment to identify and delineate wetlands, watercourses, and open water areas. The on-site assessment was conducted over two days and identified nine wetlands, three streams and one storm water pond within the approximately 30-acre Site boundary. The wetlands were identified as either forested or emergent and totaled approximately 4.9 acres. Based on the ORAM Classifications the wetlands were classified as either Category 1, 2 or modified 2. Category 1 wetlands are defined as low quality, supporting minimal wildlife habitat and hydrological functions. Category 2 wetlands are defined as moderate quality, supporting moderate wildlife habitat and hydrological functions. Two of the wetlands were classified between Category 1 and 2. The three streams consisted of the Cuyahoga River with a linear footage of 1,381 feet, the Brandywine Creek with a linear footage of 1,761 linear feet and the unnamed stream at 421 linear feet. The Cuyahoga River and Brandywine Creek were listed as perennial streams and the unnamed stream as an intermittent stream. Pond 1 was listed as a storm water pond at approximately 0.29 acres. The full report and report figures and appendices are presented in Appendix B-7.

l) **Magnetic Intensity Survey Results**

The Cuyahoga River is eroding the bank adjacent to the Dump site. Field observations from the Dump site and a River reconnaissance during the Phase II investigations identified waste material in the river bed, and in and along the river bank. The river bank is considered the southern edge of the Dump site.

Because of these observations and the detection of high metals concentrations in Dump site waste materials, an investigation of the extent of metal Dump site waste in the Cuyahoga River was necessary. This included performing geophysical transects using magnetometry in the Cuyahoga River upgradient and downgradient from the Dump site area to determine the extent of physical Dump site waste in the River. The survey was conducted to delineate the extent of ferrous objects that are present in the Cuyahoga River channel in the vicinity of the Jaite Mill Site. The survey consisted of three segments: 1) a segment upstream and south of the Dump site; 2) a segment adjacent to the Dump site; and 3) a segment downstream and north of the Dump site. The surveying was performed along three linear profiles within each segment along the left bank, right bank and center line of the river as shown in Figure 2-17. In areas where numerous ferrous objects were identified, additional shorter linear profiles were surveyed adjacent to the main profile. In addition to the magnetic intensity survey, visual observations of the river channel and gravel bars were conducted to identify waste material and to correlate the intensity readings with types of ferrous waste material. Figure 2-17 depicts the location of the three segments and the location of the identified ferrous waste. Additional details and a discussion of survey methods can be found in the full magnetic intensity survey report presented in Appendix B-8.

Upstream Segment
The upstream magnetic intensity survey consisted of an approximately 750 foot long segment upstream of the Dump site with a gravel bar on river right (as viewed looking downstream) and a

cut bank on river left. The upstream survey included 245 stations. The upstream segment survey identified three metallic objects including a metal bar, a fence post (identified as a damaged stream gauge installed during Phase II and removed during Phase III), and a possible metal object in deep water. Visual observations from the survey identified minor quantities of plastic and broken glass liter in a gravel bar on river right upstream of the Dump site. The survey did not identify any ferrous objects similar to the waste materials associated with the Dump site within the upstream segment.

Adjacent to the Dump site Segment

The segment located adjacent to the Dump site consisted of an approximately 500 foot long section of the river flowing east to west with a sandy gravel bar on river left and a cut bank on river right along the Dump site. Within the Dump site segment of the survey, the river is actively eroding the Dump site side of the river. A total of 296 stations were surveyed of which 188 were identified as ferrous objects. The survey identified numerous ferrous objects including braided wire, matted metal material, metal objects, tanks, drums, concrete block and brick in the upper portion of the cut bank and along the shoreline adjacent to the Dump site. The survey also identified a mid-channel bar in the middle of the segment that was approximately 40 foot long, 7 foot wide and 20 inches thick comprised of matted metal waste and extended approximately 50 feet downstream “as a discontinuous linear feature” (Figure 2-17).

Downstream Segment

The downstream segment consisted of an approximately 950 foot long segment downstream of the Dump site starting at the downstream side of the railroad bridge. This segment consisted of a cut bank on river left and a gravel bar on river right. A total of 123 stations identified 48 ferrous objects within the river channel. This section of the river has a gravel floored channel with isolated ferrous objects that include unidentified “industrial metal objects,” tanks, and pieces of motor vehicles visible on the surface of the gravel floor. The gravel bar on river right is comprised of numerous small metal objects, slag, concrete blocks fragments, and brick. The report indicated that based on the findings within the downstream segment additional ferrous waste is likely “present downstream of the area surveyed.” The report further stated that no large buried ferrous objects were identified at any of the stations surveyed but buried ferrous waste could be present at locations not surveyed.

2.10.2. *Contaminant Fate and Transport*

Contaminant migration, or transport, and the ultimate fate, or location of contamination is influenced by many factors related to the type of contaminants present at a site and the site-specific conditions including: chemical, physical, and biological properties of a site’s contaminants; site-specific physical and naturally existing chemical characteristics, such as geology, aquifer permeability, groundwater flow directions, and naturally existing minerals and organic matter; and the site-specific nature of the source areas, such as volume of contamination and its location relative to site-specific transport mechanisms including surface erosion or impeding clay layers. Briefly, contaminant fate and transport refers to the processes that impact and alter contaminants as they migrate through a site. This section will discuss those processes that are most applicable to this Site. Section 2.10.3 provides chemical, physical, and biological processes that are typically associated with the detected Site contaminants, and considered typical fate and transport control mechanisms at many sites, but are likely the leading mechanisms at this particular Site. Section 2.10.5 describes the primary influencing physical characteristics measured and observed at the Site that promote or inhibit contaminant transport. Section 2.10.6 discusses the dominant Site-specific contaminant transport mechanism resulting from these many factors taking into account where contamination was detected and concentration levels as a result of Site investigations.

2.10.3. *Chemical and Physical Properties of Site Contaminants*

Migration of contaminants detected at any site is significantly influenced by the chemical, physical, and biological processes related to surrounding conditions and individual analytes or contaminants. Site-specific physical processes move mass across a site. Site-specific chemical and biological processes redistribute mass to different phases changing concentrations. This section focuses on chemical and physical properties of contaminants, and does not present an exhaustive list of all possible processes that could impact the contaminants' transport on this Site because that is not an objective of this investigation, nor is it necessary. However, the more pronounced processes impacting contaminants that impact this Site likely include sorption, chemical precipitation, solubility or dissolution, chemical and biological degradation, and volatilization. These processes are described followed by how they may have impacted the analytical groups of Site contaminants discussed in the previous section.

Sorption: When contaminants adsorb or absorb to materials or a solid matrix in the environment, it is referred to as sorption. Both soluble and insoluble contaminants may sorb to sediments, soils, or suspended soils limiting the availability for a portion of the contaminants to transport or be available for other processes. In other words, solids permanently or temporarily hold or retard the contaminant as groundwater continues to migrate. The properties of the contaminant that affect sorption or retardation can be measured, such as bulk density and partition coefficients. Partition coefficients for organic compounds, measures of sorption characteristics, are widely available and useful in describing the environmental behavior of contaminants and their potential to transfer from an aqueous solution to a solid such as organic carbon or soil.

The sorption capacity of contaminants in soil or sediment is significantly influenced by the TOC content and the ion exchange capacity of solids, which affects contaminants that exist as ionic species, such as heavy metals (Nyer et al., 1996). Depending on the pH of the solution, or groundwater, sorption of positively or negatively charged metals species can be appreciable, especially where colloidal-sized particles are common such as clays (Freeze & Cherry, 1979).

Many contaminants tend to sorb to organic carbon depending on the log of the organic carbon partition coefficient, (K_{oc}), of that contaminant, which is the ratio of the adsorbed chemical per unit weight of organic carbon to the aqueous solute concentration. A low log K_{oc} (e.g., <1 or 2) suggests that the contaminant tends to dissolve into groundwater or surface water, while a high log K_{oc} (e.g., >4) the contaminant may sorb to available organic carbon. Sorption is typically greater for contaminants with lower water solubility such as most PCBs and many SVOCs. The degree of decreased migration by sorption is expressed as a retardation factor, which can be calculated if the K_{oc} and organic carbon content in the aquifer are known.

Sorption of metals by ion exchange with clays and high organic matter can decrease their mobility and transport, particularly in near neutral pH media. For SVOCs, higher molecular weight PAHs, such as benzo(a)pyrene, are strongly adsorbed to organic matter and soil particles, whereas lighter molecular weight PAHs, such as naphthalene, are less strongly absorbed. PAH sorption is an important process regarding their fate and transport. Likewise, sorption by organic matter of PCBs, and pesticides is a dominant process affecting these compounds. Compared to PAHs, halogenated and non-halogenated VOCs, such as benzene, are not as affected by organic compound sorption as a result of their relatively lower K_{oc} values coupled with higher water solubility and volatility. Because of their high volatility, moderate to high solubility, low sorption to soils, most chlorinated and other VOCs are relatively mobile and not persistent in soils (USEPA, 1989a).

Chemical Precipitation: Chemical precipitation and biotransformation (or biodegradation discussed more below under "Degradation") can chemically or biochemically cause contaminants to change their form, or precipitate becoming a solid and no longer transporting in the groundwater or detectable in monitoring wells. Precipitation is a well-known chemical reaction for the reduction of heavy metals such as lead, arsenic, copper, cadmium, and zinc (Nyer et al., 1996). The solubility of a metal or compound or its tendency to precipitate is regulated by the surrounding conditions, especially pH and oxidation/reduction potential. This process is not generally relevant for SVOCs, VOCs, PCBs, or pesticides.

Solubility: Solubility is the measure of a contaminant's ability to dissolve in water expressed in units of mass/unit volume of water. The solubility of individual compounds is the maximum concentration of that compound in water at a given temperature and pressure. Aqueous solubility is an important determinant of concentration. Highly soluble compounds dissolve readily in water, remain in solution, and tend not to volatilize. Low solubility compounds tend not to remain in solution, and sorb and/or precipitate (USEPA 1989a). Typically when industrial processes use heavy metals, the solutions are acidic and the metals would be relatively soluble and transport in groundwater. As groundwater migrates from the use or release area, aquifer solids can neutralize the groundwater pH and cause metals to precipitate (Nyer et al., 1996).

Sites where soil and water pH is near neutral and sorption capacity is high, metals and heavy molecular weight SVOCs, solubility is not an important transport process. However, chemical reactions which affect environmental conditions such as oxidation and reduction, pH, and chemical precipitation can enhance metals solubility and migration. As many metals reactions are reversible along a transport path, distributions of metals concentrations can be variable. For PAHs with relatively higher solubilities than most PAHs, such as naphthalene, dissolved transport in groundwater and surface water can be an important transport mechanism. Given their relatively high solubilities, most VOCs are readily transported as dissolved compounds. PCBs and dioxins are not typically expected to migrate in the dissolved phase, and solubility of pesticides is low for most compounds.

Degradation: Reactions involving degradation of organic compounds can be controlled by geochemical conditions favorable to microorganisms that can biodegrade many organic compounds. Several factors affect biodegradation rates or whether or not it occurs at all, including number of microorganisms, contaminant properties and concentrations, pH, presence of nutrients, and oxygen content (USEPA 1989a). Aerobic biodegradation is considered successful at degrading aromatic VOCs, such as BTEX, if sufficient dissolved oxygen is present. While anaerobic biodegradation can successfully degrade chlorinated VOCs, such as PCE, but may generate more toxic end products.

Biological transformation includes a variety of reactions such as oxidation and reduction that involve removal or addition of electrons from or to a target compound. Usually influenced by microorganisms, oxidation and reduction reactions can significantly impact the fate of contaminants altering chemical and toxicological properties of contaminants. Degradation of metals by removal mechanisms such as cationic exchange and precipitation can decrease transport, but varies according to many factors including pH and oxidation and reduction potential. SVOCs are generally low in solubility with an affinity for organic matter and soil particles making them persistent and resistant to most forms of degradation. Biodegradation of PCBs is dependent upon the degree of chlorination as more chlorinated aroclors (e.g., 1248, 1254, and 1260) can be more resistant to biodegradation, which is similar for chlorinated pesticides.

Volatilization: Volatilization describes the movement of a contaminant from the surface of a liquid or solid matrix to a gas or vapor phase resulting in a loss of mass from liquids and solids, i.e., reduced concentrations. This process will occur most readily for compounds with high vapor pressure and a high Henry's Law Constant Value, a measure of the ratio of a compound's vapor pressure to its aqueous solubility. VOCs with low solubility will partition to the gaseous phase (e.g., xylenes) while VOCs with greater aqueous solubility (e.g., benzene) tend to remain in solution. The effectiveness of volatilization tends to decrease with depth in the soil column (USEPA, 1989a). Volatilization can be an effective mass reduction mechanism for many VOCs, but not as effective for most SVOCs, or metals and PCBs.

2.10.4. *Reference and Background Concentrations*

As stated in Section 2.10.1, three surface and subsurface soil DUs were sampled as reference/background locations: 1) IS-REF-01 is a reference location at the eastern end of the Site east of the former aeration pond area and adjacent to Brandywine Creek; 2) reference location IS-REF-02 is south and upstream of the Site along the Cuyahoga River and within its floodplain; and 3) background location IS-REF-03 approximately 1500 feet north of the Site on a west-facing hillside east of the Redlock Trailhead parking lot. However, because of the flooding impacts to the low lying areas surrounding the Site from the Cuyahoga River and Brandywine Creek, only soil sample DU IS-REF-03 may be considered a background location. Location IS-REF-03 is approximately 27 and 29 feet higher topographic elevation than locations IS-REF-02 and IS-REF-01, respectively. Relatively lower detections of some metals and PAHs in soils were analyzed from IS-REF-03 samples (Text Table 2.2), and no organochlorine pesticides were detected. Also, as described in Section 2.10.1, other additional reference locations were sampled for groundwater, and sediment and surface water in the Cuyahoga River and Brandywine Creek.

In addition to reference areas IS-REF-02 and IS-REF-01 impacted by River and Creek flooding, three other soil sample areas are influenced by the regular flooding of the Cuyahoga River and Brandywine Creek, including the NTR and SWP DU areas, and BLD DUs BLD-09 and BLD-10 (locations shown in Figure 2.7). Sections of the Cuyahoga River remain on the list of impaired waters under the Clean Water Act and the Site is in an urban environment; thus, establishing reference conditions is important for determining Site-related contamination. This anthropogenic impact from Cuyahoga River and Brandywine Creek flooding in an urban environment should be taken into account when distinguishing Site contamination from those areas impacted by flooding. The similar soil chemistry of the DUs located within the flood plain relative to the chemistry of the two reference areas shown in Text Table 2.3 warrant the consideration of these DUs as additional reference areas.

Text Table 2.3 shows the similar contaminant chemistry as Exposure Point Concentrations ([EPCs] defined in notes at the end of Text Table 2.3) of potential compounds of concern in surface soil concentrations from the DUs sampled in these areas impacted by flooding relative to the two reference areas also impacted by flooding. Text Table 2.3 also compares flooding impacted reference areas IS-REF-01, IS-REF-02 and DUs impacted by flooding to background area IS-REF-03. As shown in Text Table 2.3, the majority of PAHs and metals are lower in background area IS-REF-03 than in the other reference areas and floodplain areas. These data also show the similarity in EPC results of flood plain DU areas relative to the two reference areas also impacted by flooding, and that remediation/cleanup of the floodplain DUs is not reasonable.

Text Table 2.3 Soil Exposure Point Concentrations for COPCs and COPECs for the Reference and Flood Plain DUs											
Analyte	Reference DUs			Flood Plain DUs							
	IS-REF-01	IS-REF-02	IS-REF-03	IS-BLD-09	IS-BLD-10	IS-NTR-01	IS-NTR-02	IS-NTR-03	IS-SWP-01	IS-SWP-02	IS-SWP-03
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Metals											
Aluminum	7,257	9,351	8,624	10,112	9,252	9,503	9,307	6,655	10,036	9,703	9,779
Antimony	0.28	0.24U	0.24U	0.24U	0.24U	0.24U	0.24U	0.24U	0.24U	0.24U	R
Arsenic	22	17	11	16	16	16	16	14	16	15	15
Barium	49	55	45	58	55	55	54	46	65	55	67
Beryllium	0.46	0.52	0.50	0.56	0.51	0.57	0.51	0.4	0.55	0.53	0.52
Cadmium	1.2	0.59	0.27	0.011U	0.44	0.48	0.53	0.38	0.57	0.90	0.37
Chromium III	12	18	NA	16	15	18	15	12	19	18	16
Chromium VI	0.30	0.075U	NA	0.075U	0.075U	1.5	1.8	0.075U	0.075U	0.075U	0.075U
Total Chromium	12	18	13	16	15	17	16	12	19	18	16
Cobalt	14	12	11	13	12	11	11	9.1	14	12	12
Copper	22	33	18	29	27	30	28	25	31	32	31
Iron	22,786	33,359	19,000	31,120	27,786	23,786	24,120	21,517	31,359	30,517	31,905
Lead	22	33	19	24	22	28	26	26	29	33	25
Manganese	510	510	380	480	520	430	450	380	470	470	400
Mercury	0.042	0.12	0.091	0.069	0.057	0.080	0.084	0.12	0.0070U	0.0070U	0.062
Nickel	26	33	26	33	32	32	31	24	36	32	33
Selenium	0.59	0.56	0.20	0.61	0.47	0.4	0.44	0.51	0.62	0.80	0.62
Silver	0.032U	0.032U	0.032U	0.032U	0.032U	0.032U	0.032U	0.032U	0.032U	0.032U	0.032U

Text Table 2.3 Soil Exposure Point Concentrations for COPCs and COPECs for the Reference and Flood Plain DUs											
Analyte	Reference DUs			Flood Plain DUs							
	IS-REF-01	IS-REF-02	IS-REF-03	IS-BLD-09	IS-BLD-10	IS-NTR-01	IS-NTR-02	IS-NTR-03	IS-SWP-01	IS-SWP-02	IS-SWP-03
Units	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Thallium	0.065U	0.065U	0.49	0.065U	0.065U	0.065U	0.065U	0.065U	0.065U	0.065U	0.065U
Vanadium	14	18	16	19	17	16	18	13	21	19	18
Zinc	80	150	80	120	120	150	140	140	170	190	120
SVOCs											
2-Methylnaphthalene	0.058	0.055	0.015	0.039	0.041	0.11	0.046	0.072	0.044	0.043	0.038
Acenaphthene	0.010	0.013	0.0059	0.0069	0.009	0.012	0.011	0.021	0.011	0.012	0.008
Acenaphthylene	0.013	0.021	0.0048	0.01	0.015	0.039	0.018	0.026	0.0087	0.013	0.0095
Anthracene	0.035	0.034	0.011	0.031	0.028	0.041	0.049	0.066	0.021	0.033	0.033
Benzo(a)anthracene	0.15	0.14	0.072	0.14	0.14	0.14	0.19	0.23	0.084	0.12	0.13
Benzo(a)pyrene	0.18	0.16	0.074	0.17	0.18	0.18	0.23	0.25	0.10	0.013	0.16
Benzo(b)fluoranthene	0.30	0.25	0.093	0.27	0.32	0.30	0.36	0.38	0.15	0.27	0.21
Benzo(g,h,i)perylene	0.16	0.11	0.053	0.21	0.20	0.15	0.20	0.19	0.085	0.073	0.17
Benzo(k)fluoranthene	0.087	0.12	0.046	0.13	0.17	0.11	0.13	0.15	0.053	0.11	0.089
bis(2-ethylhexyl) phthalate	0.0095U	0.0095U	0.037	0.0095U	0.0095U	0.0095U	0.0095U	0.0095U	0.0095U	0.0095U	0.0095U
Chrysene	0.17	0.18	0.095	0.21	0.20	0.18	0.26	0.26	0.12	0.16	0.17
Dibenzo(a,h)anthracene	0.044	0.029	0.0098	0.038	0.026	0.052	0.042	0.057	0.00033U	0.00033U	0.028
Di-n-butyl phthalate	0.0075U	0.0075U	0.0075U	0.0075U	0.0075U	0.0075U	0.0075U	0.0075U	0.0075U	0.0075U	0.0075U
Di-n-octyl phthalate	0.00395U	0.00395U	0.00395U	0.00395U	0.00395U	0.00395U	0.00395U	0.00395U	0.00395U	0.00395U	0.00395U
Fluoranthene	0.34	0.33	0.16	0.29	0.30	0.31	0.44	0.54	0.18	0.26	0.26

Text Table 2.3 Soil Exposure Point Concentrations for COPCs and COPECs for the Reference and Flood Plain DUs											
Analyte	Reference DUs			Flood Plain DUs							
	IS-REF-01	IS-REF-02	IS-REF-03	IS-BLD-09	IS-BLD-10	IS-NTR-01	IS-NTR-02	IS-NTR-03	IS-SWP-01	IS-SWP-02	IS-SWP-03
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Fluorene	0.015	0.012	0.0085	0.015	0.24	0.013	0.019	0.028	0.011	0.018	0.014
Indeno(1,2,3-cd)pyrene	0.12	0.092	0.055	0.15	0.13	0.14	0.18	0.18	0.065	0.064	0.11
Naphthalene	0.040	0.038	0.016	0.029	0.027	0.082	0.032	0.049	0.039	0.038	0.035
Phenanthrene	0.16	0.14	0.008	0.15	0.15	0.16	0.22	0.29	0.098	0.16	0.16
Pyrene	0.25	0.27	0.13	0.27	0.28	0.24	0.36	0.40	0.15	0.26	0.25
Total HMW PAHs	1.9	1.8	0.94	1.8	1.7	1.7	2.4	2.6	0.94	1.3	1.5
Total LMW PAHs	0.38	0.31	0.17	0.22	0.27	0.38	0.39	0.54	0.23	0.32	0.23
VOCs											
Tetrachloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (total)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs											
Aroclor 1242	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Aroclor 1248	0.0085U	0.0085U	0.0085U	0.0085U	0.0085U	0.0085U	0.0085U	0.0085U	0.0085U	0.0085U	0.0085U
Aroclor1254	0.007U	0.050	0.007U	0.019	0.018	0.007U	0.007U	0.007U	0.021	0.036	0.016
Aroclor 1260	0.009U	0.009U	0.009U	0.009U	0.009U	0.009U	0.009U	0.009U	0.009U	0.009U	0.009U
Pesticides											
4,4-DDD	0.0001U	0.041	0.00165U	0.012	0.0098	0.0030	0.0040	0.0080	0.0042	0.0093	0.0046
4,4-DDE	0.00014U	0.094	0.0006U	0.085	0.033	0.048	0.056	0.04	0.048	0.044	0.057
4,4-DDT	0.00016U	0.028	0.00070U	0.071	0.032	0.052	0.053	0.035	0.044	0.031	0.047

Text Table 2.3 Soil Exposure Point Concentrations for COPCs and COPECs for the Reference and Flood Plain DUs											
Analyte	Reference DUs			Flood Plain DUs							
	IS-REF-01	IS-REF-02	IS-REF-03	IS-BLD-09	IS-BLD-10	IS-NTR-01	IS-NTR-02	IS-NTR-03	IS-SWP-01	IS-SWP-02	IS-SWP-03
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Beta-BHC	0.00018U	0.00018U	0.0020	0.00018U	0.00018U	0.00018U	0.00018U	0.00018U	0.00018U	0.00018U	0.00018U
Dieldrin	0.00008U	0.00008U	0.000045U	0.0014	0.00008U	0.00008U	0.00008U	0.00008U	0.00008U	0.00008U	0.00008U
Dioxin/Furan TCDD-TEQ and PCB TCDD-TEQ											
Dioxin/Furan TCDD-TEQ	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
PCB TCDD-TEQ	no data	no data	no data	no data	no data	no data	no data	no data	no data	1.8E-06	no data

Notes:

The listed concentration is the Exposure Point Concentration (EPC) used in the risk assessment and is one of the following: 1) the maximum 95Upper Confidence Limit (UCL) values obtained from the three replicates from each of the DUs; 2) the maximum detected value for DUs with less than three replicates of less than three detections; 3) ½ MDL if all three replicates were non-detect.
mg/kg = milligram per kilogram
U: The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit (QL). The listed value is ½ MDL.
NA: not analyzed. Chromium VI was not analyzed for in IS-REF-03 and VOCs were not analyzed in soils with the exception of the sub-slab soils.
R: The analytical result was rejected during the data validation process and is not listed in the table. See data validation report for the reasons for rejection of the analytical result.
COPC: Chemicals of Potential Concern
COPEC: Chemicals of Potential Ecological Concern
DU: Decision Unit
Orange shaded cells are the maximum EPC value for that analyte in the 11 DUs. Non-detect analytes are listed with a U at the end of the value and are not shaded unless they are the maximum value for that analyte. The shaded cell value is carried forward as the reference value in Text Table 2.4 and Section 5 Text Table5.1.
All value with the exception of aluminum and iron are listed with two significant figures.

Text Table 2.4 lists the reference/flood plain maximum concentrations for the Contaminants of Concern (COC) and Contaminants of Ecological Concern (COEC) for each medium sampled at the Site. These COCs and COECs were determined by the risk assessment and discussed in the next section.

Text Table 2.4 Summary of Relevant Reference Values for COCs and COECs in Site Media				
Analyte	Soil[1] mg/kg	Sediment[2] mg/kg	Surface Water[3] µg/L	Groundwater[4] µg/L
Metals				
Aluminum	NA	NA	2,900 (unfiltered)	NA
Antimony	0.28	NA	NA	NA
Arsenic	22	16	4.5 (unfiltered)	NA
Barium	67	NA	43 (filtered)	NA
Beryllium	NA	NA	0.20 (filtered)	NA
Cadmium	1.2	0.37	NA	NA
Chromium (total)	19	13	NA	NA
Chromium VI	1.8	0.44	NA	NA
Copper	33	24	NA	NA
Iron	NA	NA	140 (filtered)	NA
Lead	33	20	0.23 (filtered)	NA
Manganese	520	NA	55 (filtered)	NA
Mercury	0.12	0.059	NA	NA
Nickel	36	25	NA	NA
Selenium	0.80	NA	0.45 (filtered)	NA
Vanadium	21	NA	NA	NA
Zinc	190	NA	NA	NA
SVOCs				
Acenaphthene	0.021	NA	NA	NA
Anthracene	0.066	NA	NA	NA
Benzo(a)anthracene	0.23	NA	NA	NA
Benzo(a)pyrene	0.25	NA	NA	NA
Benzo(b)fluoranthene	0.38	NA	NA	NA
Benzo(g,h,i)perylene	NA	0.19	NA	NA
Bis(2-ethylhexyl) phthalate	0.037	0.056	NA	NA
Butyl benzyl phthalate	NA	0.0050	NA	NA
Chrysene	0.26	NA	NA	NA
Dibenzo(a,h)anthracene	0.057	NA	NA	NA
Di-n-butyl phthalate	0.0075	0.021	NA	NA
Fluoranthene	0.54	NA	NA	NA
Indeno(1,2,3, cd)pyrene	0.18	NA	NA	NA
Naphthalene	0.082	NA	NA	NA
Phenanthrene	0.29	NA	NA	NA
Pyrene	0.40	NA	NA	NA

Text Table 2.4 Summary of Relevant Reference Values for COCs and COECs in Site Media				
Analyte	Soil[1]	Sediment[2]	Surface Water[3]	Groundwater[4]
	mg/kg	mg/kg	µg/L	µg/L
Total HMW PAHs	NA	2.0	NA	NA
Total LMW PAHs	NA	0.37	NA	NA
PCBs				
Aroclor 1248	0.0085	NA	NA	NA
Aroclor-1254	0.050	0.0070	NA	NA
Pesticides				
Alpha Chlordane	NA	0.0019	NA	NA
Chlordane	NA	0.0060	NA	NA
Dieldrin	8.0E-05	NA	NA	NA
Gamma Chlordane	NA	0.00075	0.0065 (filtered)	NA
VOCs				
Tetrachloroethene	No data	NA	NA	NA
Xylenes (total)	No data	NA	NA	NA
Dioxin TEQ				
Dioxin/Furan TEQ	No data	NA	No data	No data
PCB-TEQ	1.8E-06	NA	No data	No data

Notes:
[1]Listed Soil concentrations are the maximum EPC of the three reference DUs and the eight flood plain DUs. The EPCs are equal to the 95UCL or maximum detect.
[2]Listed sediment concentrations are the maximum of the reference values.
[3]Listed surface water concentrations are the maximum of the reference values.
[4]No groundwater analyte was considered a COC or COEC.
mg/kg : milligrams per kilogram
µg/L: micrograms per liter
NA: analyte not identified as a COC or COEC (See Section 3 below)
TEQ: toxicity equivalent

2.10.5. *Physical Site Characteristics Affecting Contaminant Migration*

Contaminant migration, persistence, and absence at the Jaite Site are substantially affected by specific dominant physical Site characteristics of which many relate to the local geology, the Site's location relative to the regional groundwater and surface water flow systems, and various transport and attenuation processes.

Site Geology: As described in Section 2.5, the active groundwater transport zone consist of a 3 to 8 foot-thick sand and gravel zone uniformly distributed throughout the Site, and sandwiched between relatively lower permeability silts and clays, also uniformly distributed and extending well below the sand and gravel zone. The effects of this geologic sequence on contaminant migration include the following.

- Metals, PCBs, pesticides, SVOCs, and VOCs can sorbed, precipitate, volatilize, and generally be restricted and retarded from migrating through the upper surface organic material and silts and clays in the upper unit above the sand and gravel zone. This 4 to as much as 12 foot-thick low permeability surficial unit can significantly restrict contaminant migration of low solubility contaminants with its high sorption capacity.

- If contaminants can vertically penetrate the upper low permeability silt and clay layer, dissolved contaminants such as VOCs migrating in the 3- to 8-feet thick relatively high permeability sand and gravel layer can readily migrate through the entire Site in as little as 1.5 years. This relatively rapid migration rate provides a mechanism for dissolved mass dilution as the entire Site aquifer volume can be flushed by groundwater potentially as much as approximately 22 times since the paper mill ceased operation.
- Below the sand and gravel unit, a stiff low permeability clay unit appears to underlie the entire Site, which can provide a complete barrier to vertical contaminant migration to any depth below the shallow sand and gravel layer.

Surface Water Erosion: This physical contaminant transport process is not typically discussed or realized as a dominant process for sites, because subsurface contamination is usually considered to migrate in groundwater by means of hydraulic properties; such as advection as a function of groundwater velocity through soil pores and fractures. However, at sites where the majority of contamination is sorbed onto near surface solid media (soils, sediment, and organics), the site is located within or adjacent to a dynamic river and stream environment, and other migration pathways are limited (e.g., a dominantly clay stratigraphy with limited aquifer thickness like this Site), then seasonal flooding and scouring of surficial site soils become the dominant contaminant transport mechanism.

Recent observations of Site flooding during the past three to five years by NPS shows that many areas of the Site can be under water a number of times per year. The Cuyahoga River flow volume can increase from daily mean minimums of approximately 140 cfs to daily mean maximums of 6,350 cfs with a peak flow of 8,390 cfs during high flood events resulting in a maximum rise of approximately 14 feet above average river levels (2012 -2018 data from the Jaite, OH gauging station located at the Highland Road bridge near the Site).

Groundwater Discharge Zone Location: The Site's location bordering the Cuyahoga River in a pronounced river valley for the region places it in a dominating groundwater discharge zone, where all groundwater flow must eventually flow upward to discharge into the Cuyahoga River. Water-level measurements from Site monitoring wells show shallow horizontal groundwater gradient directions toward the Site surface water bodies and show upward vertical gradients, which confirm the Site's groundwater flow system is restricted to the Site area until groundwater must discharge to the Cuyahoga River and Brandywine Creek. In addition, these water bodies serve as barriers to Site groundwater flow, which cannot migrate beyond these surface water bodies. The combined impact of the Site's location in a significant groundwater discharge zone along with the barrier to deep groundwater flow by the underlying low permeability clay create a restrictive area for contaminant transport and enhances aquifer volume flushing.

Advection, Dispersion, Diffusion: Dissolved phase contaminant migration can occur by two physical processes of advection and dispersion. Advection involves migration at the mean velocity of groundwater flow in the direction of the hydraulic gradient, ignoring attenuation mechanisms. As contaminants migrate by advection, they are subject to spreading in aquifer pore spaces, and this spreading is known as dispersion. Hydrodynamic dispersion has two components: molecular diffusion and mechanical dispersion. Diffusion is the process by which molecular constituents migrate under the influence of a chemical gradient. Mechanical dispersion occurs as groundwater flows through media and compounds spread out through the tortuous pathways of the soil matrix and mix with clean water. The result is a dilution of the contaminant or compound by dispersion (USEPA, 1989a). At low groundwater velocities, diffusion is the dominant process, and at higher velocities, mechanical dispersion is the dominant process. At this Site where a high permeability sand and gravel aquifer is sandwiched between two low permeability clay and silt units, both processes are relevant. While dispersive processes are typically dominated by advection, contaminant diffusion into clay units during long time periods can leave behind a long-term source of contamination in the clay; however, diffusion can also reverse out of clay units when aquifer contaminant concentrations reduce.

Site Sorption Capacity: The rate of migration of contaminants primarily depends upon the groundwater velocity and the degree of sorption. Rates of other processes such as volatilization and biodegradation are directly dependent on the extent of adsorption (Montgomery, 1991). The shallow unsaturated zone typically contains a greater amount of organic material and metal oxides (which may also act as sorbents) than the saturated zone, which can result in a lower rate of migration than the saturated zone (USEPA. 1989a). If a contaminant, organic or inorganic, is extensively adsorbed by soil particles or organic matter, the contaminant can be relatively immobile. In general, the relative amount of sorption by soil or sediment that does not contain organic matter is as follows: clay > silt > sand > gravel (Walton, 1988). Clay is one of the predominant soil types at this Site. As noted previously, this Site has extensive clay and silt deposits on the surface, and nearly all clay measured as deep as 90 ft bgs underlying the sand and gravel unit, as well as organics in Aeration Pond area, ponds, and surface water body sediments. Typically, the higher the TOC content of soil, the greater it's potential to sorb contamination. TOC from the Cuyahoga River and Brandywine Creek samples range from 2,200 mg/kg to 7,600 mg/kg. The on Site TOC concentration range from 27,000 mg/kg in the unnamed stream downstream from Pond 1 to 150,000 mg/kg in Pond 2, which is a maximum of 15% TOC.

As a result of the extensive amount of clay and silt at this Site, particularly at and near the surface, in addition to appreciable organic material measured in many areas at the surface, sorption is expected to strongly retard contaminant migration at this Site and even binding contaminants making them immobile near the ground surface to some extent. With the exception of underground storage tank releases, Site contamination was placed in waste piles on the surface or presumably spilled at the surface. Absent erosional processes, Site contaminant migration must begin at the ground surface and moved vertically through surficial organic material and clays and silts before transporting in the sand and gravel aquifer. This initial migration pathway subjects contaminants to high sorption capacity soils in the unsaturated zone. As dissolved contaminants are forced to migrate horizontally following the Site gradient direction, additional sorption to clays and silts above and below the sand and gravel aquifer is likely.

As noted in Section 2.10.3, sorption of metals by ion exchange with clays and high organic matter can decrease their mobility and transport, particularly in near neutral pH media as measured at the Site. The surface and subsurface soil pH values average 6.5 to 7.7 across the Site with no observable trends between reference and other areas. Groundwater pH values averaged between 6.5 and 6.9 and surface water pH values averaged around 6.7 to 7.0.

2.10.6. *Site-Specific Contaminant Transport*

This section describes the dominant form of Site-specific contaminant transport. Additional discussion of site-specific transport pathways and why concentrations may be distributed in the patterns detected during these recent investigations are provided in Section 2.12 regarding the CSM.

Based on Site measurements, observations, recent analytical results of current conditions across the Site, and the known and presumed primary chemical and physical migration processes, erosion appears to be the dominant contaminant transport process at this time. The fact that Site conditions and dominant contaminants present are favorable to sorption, and that Site physical characteristics act to contain contamination to shallow depths translates to erosional processes likely transporting greater volumes of contaminant mass off Site than all other processes. Dissolved transport in the shallow aquifer may have historically transported higher concentrations than measured during recent investigations, but dissolved contaminants have been flushed through the Site and possibly biodegraded, sources available for dissolved contaminant transport such as USTs have been removed, and/or dissolved sources were never a significant part of the total mass transport migration off Site.

This gradual erosion led NPS to include additional investigation of River sediments adjacent to the Dump site in Phase III of its EE/CA in 2017. The geophysical survey discussed previously using a magnetometer along the River bed delineated the areal extent of waste from upstream to downstream of the Site. Based on the findings of the magnetic intensity survey, waste material consisting of matted metal bundles, drums, tanks, and other metal pieces are being eroded from the Dump site by the Cuyahoga River. The greatest portion of metal waste material was deposited adjacent to the Dump site in the form of individual pieces or as part of a mid-channel bar. A portion of the eroded (mobilized) metal waste material has been transported downstream at least 950 feet, the greatest extent of the magnetometer survey.

As discussed in Section 2.10.1, the highest metals concentrations detected on Site are in the Dump site waste material and soil located adjacent to the Cuyahoga River where the greatest erosion was taking place prior to the 2018 TCRA. Similarly, erosion at and near the northern boundary of the Site along Brandywine Creek is occurring as a result of Brandywine Creek flooding where some of the highest metals concentrations were detected in shallow surface soils along with the highest SVOC concentrations (e.g., DUs IS-BLD-01, IS-TR-01, IS-UST3-1, and IS-RR-01 shown in Figures 2-9 and 2-9a). The evidence of this erosion can be seen in Brandywine Creek sediment SVOC concentrations where an increase in concentrations by a factor of 5 to 10 times higher was detected at location IL-BC-02 immediately downgradient from the Site paper mill facility compared to upstream sediment samples and then a decrease downgradient at location IL-BC-03 (Table 2-8). Presumably, greater impacts from erosional deposition of surface soil contamination can be detected if sediment and surface water samples are collected during and immediately after flooding events. Cuyahoga River periodic increases to maximum flow volumes presented previously provide additional evidence of the River's erosion potential.

Sorption capacity of this Site's shallow soils, and the dominant Site contaminants' sorption properties create a stable shallow source of contamination that can be subjected to erosion. Typically, the combination of these types of contaminants with high sorption capacity (metals, SVOCs, PCBs, and pesticides) along with the transport limiting physical factors of the Site would severely limit contaminant transport, but the unique erosional capacity of the area's surface water system dominates all other factors, effectively minimizing their contribution to contaminant attenuation.

Groundwater contaminant transport may have at one time been a more pronounced transport mechanism when more significant dissolved mass may have been present on the Site, but time, aquifer flushing, and possibly biodegradation have reduced this mechanism to be inconsequential relative to erosional transport. Evidence of anaerobic biodegradation is present in the northwestern NTR area of the Site where parent and biodegradation daughter products of chlorinated VOCs were detected.

In summary, these Site-specific physical characteristics can contain contaminant transport to the shallow ground surface where a relatively high permeability but thin groundwater transport zone flushes soluble dissolved contaminants such as VOCs, and surface erosion gradually strips away surface and near surface contaminants bound by sorption.

2.11. Current/Future Land Uses

The former mill building area, located west of the Towpath Trail, is closed to the public and secured by a perimeter fence with locked gates; however, holes cut in the fence by trespassers enable unauthorized access. A similar perimeter fence encloses Pond 1 in the Aeration and Settling Ponds area east of the Towpath Trail and the Dump site west of the former mill building area and bordered by the Cuyahoga River and northern abandoned railroad track. Access to other adjacent areas of the Site and the Towpath Trail is unrestricted. There is no direct road access to or parking available at the Site. Current and future use is expected to be recreational accessed by the adjacent Towpath Trail. NPS employees and construction or utility workers may also work at the Site for short periods.

NPS is considering future recreational options for the Site after completion of any removal action. These potential options may include an access area for Cuyahoga River users, and reconnecting the Jaite Loop Trail to the Towpath with an associated parking lot to the west of the Towpath. There are Site development options being considered to the east of the Towpath in the aeration pond area that may be implemented in cooperation with the Brandywine Ski area and the

Northeast Ohio Sewer District (NEOSD). There are no plans for permanent buildings or dwellings on the Site in the future.

2.12. Conceptual Site Model

A CSM generally is a representation of the environmental system and the physical, chemical, and biological processes that determine transport of contaminants from sources to receptors. The CSM is derived from existing site data, experience from other similar contaminant sites, and often provides a basic visualization of site-specific contaminant transport. Essential elements of a CSM typically include information about contaminant sources, transport pathways, exposure pathways, and receptors (USEPA, 2005). An effective CSM can be a valuable tool to evaluate remedial alternatives by visually capturing contaminant transport pathways, which remedial actions are designed to exclude to reduce or eliminate exposure to human and ecological receptors to contaminants. An effective CSM can also explain a site's contaminant transport mechanisms and conditions in a simplified visualization and text explanation that is more accessible to a wider interested audience.

This section provides simplified explanations of previous discussions along with a visualization of Site subsurface conditions that have the most significant influence on contaminant transport. Historical and current contaminant sources are discussed as some are visualized to show their transport to potential receptors as transport processes impact contaminants. These representations of Site data relative to Site-specific transport processes provide insight to possible remediation alternatives as the most feasible solutions to elimination of receptor exposure to Site contamination.

Site-Specific Conditions Influencing Contaminant Transport

Figure 2-18 provides a visualization of the CSM revised since presented in the EE/CA Work Plan. This revision takes into consideration all Site data collected and discussed in this EE/CA Report. While not all aspects of the Site's subsurface and contaminant conditions can be presented at an accurate scale in one figure, this simplified visualization along with the overview of Site contaminant transport presented below is intended to allow wider access of understanding to Site-specific contaminant conditions.

Site geology and hydrogeology may be visualized as dictating more restrictions to contaminant transport than providing pathways. Ground surface fill and waste material, including waste piles and slag contamination, are uniformly underlain by 4 to 12 feet of low permeability silt and clay restricting vertical transport to the underlying sand and gravel aquifer. The relatively thin sand and gravel aquifer, 3 to 8 feet in thickness, provides a reliable transport pathway throughout the Site given its relatively high permeability for dissolved transport and uniform Site distribution. Further vertical transport is restricted by a thick and low permeability clay and silt underlying the sand and gravel aquifer that extends to at least 75 feet below the sand and gravel aquifer.

Natural attenuation from dilution of dissolved contamination in the sand and gravel aquifer is expected to be a dominant process in this unit to reduce concentrations with time, evidenced by relatively low detections and limited compounds of readily dissolved contaminants such as VOCs. Dissolved transport is primarily contained in the sand and gravel given the relatively low permeability of silts and clays above and below this unit, and given prevailing upward hydraulic gradients containing Site groundwater flow to discharge to surface water. As stated previously in this report, groundwater contaminant transport may have at one time been a more pronounced transport mechanism when more dissolved mass may have been present on the Site, but time, aquifer flushing, and possibly biodegradation have reduced this mechanism to be inconsequential. Counter to the sand and gravel aquifer attenuation mechanisms, the low permeability silts and clay units above and below this unit can provide long term mechanisms of contamination retention through sorption and low dissolved transport rates resulting in long-term sources of contamination strongly absorbed to organic matter and soil particles, such as PAHs and metals. Consequently, the highest levels of contamination at the Site are metals and PAHs detected at and near the ground surface where these types of contaminants typically tend to sorb to low permeability silts and clays.

As a result of these Site-specific physical conditions and the physical and chemical characteristics of Site contaminants, contamination appears to be almost entirely contained in the surface fill, waste material, and the shallow silts and clays above the sand and gravel aquifer. Ground surface, creek and river erosion of Site shallow contamination is currently the dominant contaminant transport process given this Site's location in an active erosional valley along the Cuyahoga River. Erosional impacts include Brandywine Creek bordering approximately three-quarters of the northern boundary of the Site, on-Site streams and ponds, and an upgradient lake. Sediment concentrations and Cuyahoga River magnetometer detections of metal waste show Creek and River erosion is occurring at some of the highest surface soils and Site waste piles concentrations of metals and SVOCs on the Site.

Contaminant Sources

Waste material covers more than sixty percent of the Site surface and near surface soils. This includes waste piles and their surrounding areas, and the areas around the building foundation with black slag material containing some of the highest concentrations of metals and SVOCs. Other minor sources of contamination include asbestos and lead paint associated with the Fourdrinier Machine, and VOC and SVOC sources and metals in soils under the concrete foundation slab that include black oil-stained soils and slag.

Based on data collected from historical cleanups of Site USTs, and relatively low concentrations of chlorinated VOCs in the NTR leach field area and under the concrete foundation, VOC contamination may have been a more prominent source of contamination than currently detected. However, dissolved contaminants have been flushed through the Site and possibly biodegraded, sources available for dissolved contaminant transport such as USTs have been removed, and/or dissolved sources were never a significant part of the total mass transport migration off Site.

Exposure Pathways

The primary and most direct exposure pathway on the Site is human and ecological contact with surface soils and surface waste material. The highest Site concentrations of metals and SVOCs detected likely extend as deep as 15 feet bgs, the maximum vertical extent slag and waste material were discovered.

Contaminated surface soils and Site waste piles are currently being eroded by flood waters and river/creek bank erosion resulting in contaminated soil deposition as sediment. Brandywine Creek sediment SVOC concentrations increase by a factor of 5 to 10 times higher than upstream sediment samples at location IL-BC-02, immediately downgradient from the Site where some of the highest SVOC concentrations were detected in surface soils. SVOCs detected in on-Site ponds and unnamed stream sediments increased in concentrations relative to the upgradient reference location. While SVOCs and metals concentrations detected in Cuyahoga River sediments are similar to upgradient reference samples, it has been well established that the Cuyahoga River is eroding substantial portions of the Dump site soils and metal waste into the River. The highest lead concentrations on the Site were detected in the Dump site soil. Consequently, it must be assumed that prior to the TCRA engineered bank stabilization wall construction in 2018, Dump site high concentration metals in soils were being eroded into the Cuyahoga River along with obvious metal waste detected in the magnetometer survey. Detection of high Site metal concentrations in sediment was not possible at the time of sediment sampling possibly as a result of dilution or more likely replacement from upgradient sediments during flood events.

Elimination of Exposure Pathways

Because elimination of natural flooding in this significant river valley system along with river and creek bank erosion is unlikely, elimination of the surface soil and waste source material is the most effective method of elimination of exposure pathways.

In summary, as a result of time, Site hydrogeology, and an active dominant river valley system, the primary contamination remaining on the Site are SVOCs and metals sorbed into shallow surface soils and Site waste material. These Site conditions provide long-term sources of contamination to human and ecological receptors as surface soil and surface water erosion furnish the dominant mechanism for off-Site contaminant transport to the Cuyahoga River. As a result of these many Site mechanisms related to existing natural conditions and types of Site waste releases, a significant majority of Site contamination is predominantly confined to near surface soils and waste material that can be readily removed.

3. Risk Assessment Summary

The purpose of Section 3 is to describe the risks to human health and ecological receptors posed by contamination at the Site i.e., the basis for needing to implement a removal action.

Risk assessments provide an estimation of the potential threat to human health and the environment posed by Site contaminants. The results of the risk assessment are used to determine if potential risks are unacceptable and, if so, to establish risk-based Removal Action Goals (RGs) that must be satisfied by the recommended removal action. EE/CA guidance (USEPA 1993a) discusses the use of streamlined risk evaluations for an EE/CA when used for interim response actions. However, when the EE/CA is the basis for selecting a final response action, streamlined risk evaluations are not sufficient. Instead, an HHRA and a SLERA are developed for the Site (USDOI 2016). A BERA may be required if the SLERA identifies the need to refine the Ecological Risk Assessment (ERA) with Site-specific or receptor-specific information. In accordance with risk assessment guidance, a baseline risk assessment is to evaluate potential adverse effects caused by hazardous releases from a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action).

A baseline HHRA and ERA were completed for this Site. The detailed risk assessment reports are provided as Appendix D and Appendix E, respectively. An overview of risk assessment approach and risk characterization conclusions are presented in Section 3.1 (HHRA) and Section 3.2 (ERA) below.

3.1. Baseline Human Health Risk Assessment

The HHRA was prepared according to USEPA guidance on conducting HHRAs at CERCLA sites (USEPA 1989b). The Site investigation data used for the HHRA was collected during the 2016-2017 EE/CA investigations and included soil, waste pile, sediment, surface water, and groundwater data. The results of the EE/CA investigation are discussed in Section 2.10.1, Risk Assessment Sample Results.

The HHRA includes the following components (described in detail in the HHRA report; Appendix D):

- Hazard identification
- Exposure assessment
- Toxicity assessment
- Risk characterization (including an uncertainty analysis)

3.1.1. *Hazard Identification*

Contaminants of potential concern (COPCs) were identified by comparing maximum detected concentrations in each media to the lowest appropriate risk-based screening levels, which were identified in the SAP. These screening levels are based on a target excess lifetime cancer risk of 1 in 1 million (1E-06) and a target non-cancer hazard quotient (HQ) of 0.1 based on exposure assumptions derived from a residential exposure scenario. These conservative screening levels ensure that potential contaminants are not prematurely rejected and are carried through the risk assessment and ARARs analysis specific to the Site.

Contaminants detected above these screening levels were identified as COPCs and carried forward in the risk assessment. Consistent with guidance, consideration of background concentrations for naturally occurring analytes (i.e., inorganics) will be factored into the final selection of COCs in the risk management section.

Table 3-1 presents a list of human health COPCs identified for soil/waste piles, sediment, surface water, and groundwater. As shown, for the solid media (soil, waste piles, and sediment), the list of COPCs includes several metals (including lead), PCBs (as aroclors), several PAHs, dioxin/furan and dioxin-like PCB congeners, and DEHP. For surface water, the list of COPCs includes several metals, but no organic chemicals. For groundwater, the list of COPCs includes several metals, as well as PCBs (as aroclors), naphthalene, 1,2-cDCE, and TCE.

3.1.2. *Exposure Assessment*

The risk assessment estimates current and future potential risk to different receptor populations. Human receptor populations are outlined in the human health pathway-receptor diagram**,** Figure 3-1, and complete, incomplete, or not applicable pathways are identified. Several receptors are anticipated to be present at the Site, including:

- A day-use recreational visitor (adult and child);
- A trespasser (adult and child), with the same exposure areas as the day-use visitor plus the former mill building and other fenced areas;
- An NPS worker performing maintenance, surveillance, and cleanup (adult); and
- A construction/utility worker/landscaper performing excavation activities (adult).

There are multiple media types and exposure pathways by which human receptors may be exposed to contaminants at the Site, as presented in Figure 3-1. For recreational visitors/trespassers, exposures were quantitatively evaluated for: incidental ingestion of and dermal contact with surface soil, inhalation of airborne particulates (derived from surface soil), incidental ingestion of sediment and surface water, and dermal contact with surface water while wading/swimming. For NPS workers, exposures were quantitatively evaluated for: incidental ingestion of and dermal contact with surface soil and inhalation of airborne particulates (derived from surface soil). For construction workers, exposures were quantitatively evaluated for: incidental ingestion of and dermal contact with surface soil, inhalation of airborne particulates (derived from surface soil), incidental ingestion of and dermal contact with subsurface soil, and inhalation of volatiles derived from contaminated groundwater while digging.

Under current conditions, with the exception of construction workers, exposures to subsurface soils are likely incomplete for the majority of receptor populations that would be present at the Site. However, it is possible future activities at the Site (e.g., excavation, removals) could unearth subsurface soils and humans could be exposed to these materials under future Site conditions. Therefore, subsurface soils are evaluated as potential future surface soil for all receptor populations.

Exposure parameters are related to human behaviors that define the rates, time, frequency, and duration of exposure. It is expected there will be differences in the exposure between different individuals within a given receptor population due to differences in the exposure parameters. There may be a wide range of average daily exposures between different individuals of an exposed population. In risk assessment, attention is focused on exposures near the central portion of the range (e.g., mean, median) and on exposures near the upper-end of the range (e.g., the 95th percentile). These two exposure estimates are referred to as central tendency exposure (CTE) and reasonable maximum exposure (RME), respectively.

The NCP indicates that Site decisions should be based on the RME estimates of exposure and risk. When possible, standard default values for RME exposure parameters (USEPA 1993b; 2014) were used in the HHRA. When standard default values were not available, RME exposure parameters were determined based on other sources (e.g., USEPA 2008; 2011) and best professional judgment. The exposure parameters used in the HHRA are provided in Appendix D.

Exposure areas are defined based on the receptor, exposure medium and the type and frequency of activities (USEPA 1989b). The exposure area is the geographical area in which a receptor is randomly exposed to the contaminated medium for the assumed exposure duration, which is based on the frequency of visits to the Site by each type of receptor.

Because risk assessments are based on chronic health effects, the most appropriate expression for the EPC is the long-term average concentration within the exposure area. The USEPA guidance states that, "because of the uncertainty associated with estimating the true average concentration [of a contaminant] at a site, the 95 percent Upper Confidence Limit (95UCL) of the arithmetic mean should be used" as the EPC (USEPA 1992a). The EPCs for each medium and each exposure area evaluated in the HHRA are presented in Appendix D.

NPS has determined that exposures for all Site receptors will be evaluated on a DU-by-DU basis to provide information on spatial variability in exposures and inform risk management decision-making. Figure 2-7 illustrates the soil/sediment DUs, Figure 2-12 illustrates the waste pile DUs, and Figure 2-8 illustrates the sub-slab soil DUs. Surface water DUs were set equal to the sediment DUs, as shown in Figure 2-7, and surface water sample locations are also shown in Figure 2-13. Groundwater DUs were set equal to the soil/waste pile DUs (as shown in Figures 2-7 and 2-12).

Because the DUs are generally small, it is highly unlikely the entirety of the Site exposure time for a given receptor would occur in only a single DU. Thus, in evaluating each DU as an exposure area, resulting exposure and risk estimates are likely to be overestimated for most receptors. Therefore, the HHRA also evaluated risks for several larger Exposure Units (EUs), which encompassed multiple DUs, for recreational visitors/trespassers and NPS workers as follows:

- Surface soil – One EU encompassing the area east of the Towpath Trail, which includes the Aeration Pond area (referred to as the "Eastern Sitewide Soil EU"). One EU encompassing the area west of the Towpath Trail, which includes the former mill building areas, waste piles, Dump site, and Railroad Tracks (referred to as "Western Sitewide Soil EU").
- Sediment and surface water – One EU encompassing all the Site streams, creeks, and ponds (referred to as "Sitewide Sediment/Surface Water EU"). One EU encompassing all downstream locations in the Cuyahoga River (referred to as "Cuyahoga Sediment/Surface Water EU").

The EU EPCs were calculated as the spatially-weighted average, weighting each DU-specific 95UCL by its areal coverage as follows:

$$\text{EU EPC} = \sum 95UCL_{DUi} * A_{DUi} / \sum A_{DUi}$$

where:

$95UCL_{DUi}$ = 95% upper confidence limit on the mean for DU 'i'
A_{DUi} = Area (square feet) of DU 'i'

For construction workers, it is reasonable to assume digging and excavation activities could be limited to smaller areas within the two-year exposure timeframe; therefore, exposures to subsurface soils and groundwater were evaluated on a DU-specific basis only. The Virginia Department of Environmental Quality (VDEQ) Virginia Unified Risk Assessment Model (VURAM) trench model was used to estimate exposures and risks to construction workers from inhalation of volatiles in groundwater.

The amount of a chemical ingested, inhaled, or absorbed through the skin is referred to as "intake" or "dose." The average daily intake is the dose rate averaged over a pathway-specific period of exposure expressed as a daily dose on a per-unit-body-weight basis. The detailed dose calculations for each receptor and each exposure pathway are provided in Appendix D.

Lead-specific Assessment

Exposure to lead is evaluated using a different approach than for most other chemicals. First, because lead is widespread in the environment, exposure can occur from many different sources. Thus, lead risks are usually based on consideration of total exposure (all sources) rather than just site-related sources. Second, because studies of lead exposures and resultant health effects in humans have traditionally been described in terms of blood lead level, lead exposures and risks are typically assessed by describing the levels of lead that may occur in the blood of exposed populations and comparing these to blood lead levels of potential health concern. For convenience, the concentration of lead in blood is usually abbreviated "blood lead level (PbB)", and is expressed in units of micrograms per deciliter (µg/dL).

Concern over health effects from elevated blood lead levels is greatest for young children or the fetus of pregnant women. When adults are exposed, the sub-population of chief concern is pregnant women and women of child-bearing age, since the blood lead level of a fetus is nearly equal to the blood lead level of the mother (Goyer 1990). USEPA recommends the use of toxicokinetic models to correlate blood lead concentrations with exposure and adverse health effects. USEPA recommends the use of the Integrated Exposure Uptake Biokinetic (IEUBK) model to evaluate exposures from lead-contaminated media in children in a residential setting (USEPA 1994), and Adult Lead Methodology (ALM) to evaluate potential risks from lead exposure in adults (females of child-bearing age) (USEPA 2003a). Both the IEUBK model and the ALM can be used to predict PbB concentrations in exposed individuals and estimate the probability of a PbB concentration exceeding a level of concern. The Centers for Disease Control[1] has identified a reference level of 5 µg/dL to identify children with elevated blood lead levels. When quantifying lead exposures in risk assessment, there should be no more than a 5% chance that a child or developing fetus will have a PbB concentration above 5 µg/dL (this probability is referred to as P5).

Exposure parameter inputs to the IEUBK model and ALM are CTE (not RME) estimates. In addition, the EPC for lead in a medium at an exposure area is equal to the arithmetic mean of the measured values for that medium (USEPA 1994; 2003a). Both the IEUBK model and the ALM are designed to evaluate approximately continuous exposures. When exposures are intermittent, use of these models becomes more difficult. For each receptor, continuous exposures were determined such that they accounted for contributions from both impacted media while onsite and unimpacted (background) media while offsite by computing a time-weighted average EPC. The detailed lead model inputs, including the lead-specific exposure parameters and EPCs, for each receptor are provided in Appendix D.

3.1.3. *Toxicity Assessment*

The objective of a toxicity assessment is to describe the adverse health effects caused by a chemical and identify how these adverse effects relate to exposure concentration. In addition, the toxic effects of a chemical frequently depend on the route of exposure (oral, inhalation) and the duration of exposure (subchronic, chronic, or lifetime).

There are typically major differences in the time course of action and the shape of the dose-response curve for cancer and non-cancer effects. Therefore, the toxicity assessment separates the non-cancer effects of chemicals from the cancer effects.

The threshold dose is typically estimated from toxicological data (derived from studies of humans and/or animals) by finding the highest dose that does not produce an observable adverse effect,

[1] https://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm

and the lowest dose which does produce an effect. These are referred to as the "No-observed-adverse-effect-level" (NOAEL) and the "Lowest-observed-adverse-effect-level" (LOAEL), respectively. The threshold is presumed to lie in the interval between the NOAEL and the LOAEL. However, in order to be conservative (protective), non-cancer risk evaluations are not based directly on the threshold exposure level, but on a value referred to as the Reference Dose (RfD) for oral exposures or the reference concentration (RfC) for inhalation exposures. The RfD and RfC are estimates (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Cancer effects were evaluated based on the assumption that any level of exposure to a carcinogenic compound can cause an effect. The USEPA extrapolated from observed laboratory animal data using a mathematical model known as the linear multi-stage model. This model plots a line back toward the origin, adjusting the background cancer rate in the control (unexposed) animal populations. For oral exposures, the Cancer Slope Factor (CSF) is the 95 percent upper bound on the slope of the dose-response curve in the low dose region and has dimensions of risk of cancer per unit dose. For inhalation exposures, cancer risk is characterized by an Inhalation Unit Risk (IUR) value, which represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 micrograms per cubic meter ($\mu g/m^{3)}$ in air.

Chemicals are classified as known, probable, or possible human carcinogens based on a USEPA weight-of-evidence scheme in which chemicals are systematically evaluated for their ability to cause cancer in humans or laboratory animals with the following descriptors: (1) carcinogenic to humans, (2) likely to be carcinogenic to humans, (3) suggestive evidence of carcinogenic potential, (4) inadequate information to assess carcinogenic potential, and (5) not likely to be carcinogenic to humans.

The USEPA RSLs tables[2] (November 2018 version) provide the toxicity values and physical and chemical properties for individual chemicals. The RfDs, RfCs, CSFs, and IURs identified for each COPC are provided in Appendix D.

PAH Toxicity

For COPCs identified as having a mutagenic mode of action for carcinogenesis (i.e., hexavalent chromium, PAHs), cancer risks were estimated in accordance with the *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (USEPA 2005a). In brief,

[2] https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

because chemical-specific data are not available for these chemicals, the default Age-Dependent Adjustment Factors (ADAFs) were applied to the CSF to account for differences in potency that may occur from exposure during early life (up to age 16). Thus, recreational visitor risks (which include exposures as a child and adult) were assessed by incorporating ADAFs to account for early life susceptibility.

Dioxin and Dioxin-like Congener Toxicity
In the case of dioxins/furans and PCBs with dioxin-like toxicity, concentration values for a subset of soil and sediment samples were measured and expressed as concentrations of individual congeners. The congener data were consolidated into a single toxicity-weighted concentration value using TCDD relative potency factors. This TCDD-equivalent concentration is referred to as TEQ and equal to the concentration of TCDD that would be of equivalent toxicity to humans.

3.1.4. *Risk Characterization*

Non Lead COPCs
Risk characterization is the process of quantifying the significance of residual chemicals in the environment in terms of their potential to cause adverse health effects. The quantitative estimates are expressed in terms of a probability statement for the potential excess lifetime cancer risk and an HQ for the likelihood of adverse non-cancer health effects. When there are multiple COPCs that cause non-cancer effects, the cumulative hazard index (HI) is calculated as the sum of HQs.

The NCP describes a potentially acceptable range of lifetime excess cancer risk between 1E-04 and 1E-06, and expresses a preference for establishing the acceptable target cancer risk at or near the more protective end of this range. Similarly, non-cancer health effects generally should not exceed an HI of 1. NPS generally considers cancer risks exceeding 1E-06 or non-cancer risks exceeding an HI of 1 to be unacceptable, absent compelling site-specific factors that preclude achieving these levels of protection. Selection of a target risk level of 1E-05 may be justified based on considerations of background concentrations for naturally occurring COCs, i.e., the calculated 1E-05 concentration of a COC is circum-background). However, 1E-04[4] is considered a threshold for emergency response and not adequately protective as a target risk level for final response actions within units of the National Park System.

The general methodologies used for estimating cancer risks and non-cancer hazards are described in Appendix D.

Estimated risks for exposures to non-lead COPCs for each receptor are summarized in Table 3-2 respectively, and are discussed below. Detailed risk estimates for all individual DUs are presented in Attachment D of Appendix D. These tables identify which exposure scenarios have potential excess cancer risks greater than 1E-06 or non-cancer HIs greater than 1. Risk estimates for the Site-specific reference areas are also presented in these tables to provide a frame of reference for interpreting the Site risk estimates.

Recreational Visitors/Trespassers

Estimated RME cancer risks and non-cancer hazards for recreational visitors/trespassers are summarized in Table 3-2 (Panel A). With the exception of 3 DUs, non-cancer HIs are less than 1 for all on-site soil/waste pile DUs and all sediment/surface water DUs. RME non-cancer HIs are greater than 1 for two of the Dump site DUs (IW-DS-01 and IW-DS-02) and one of the Railroad DUs (IS-RR-01). Although incidental soil ingestion exposures contribute most the total HI in these three DUs, there are no individual chemicals with HQs greater than 1.

For surface soil/waste pile exposures, estimated RME cancer risks are greater than 1E-06 for both Site-wide Soil EUs (East and West), as well as all individual soil DUs, due primarily to incidental ingestion of arsenic, chromium VI, benzo(a)pyrene, and dioxin/furans and dermal contact with arsenic and benzo(a)pyrene. With the exception of the two Railroad DUs and the former transformer pad (IS-TR-01), no individual soil DUs have lifetime cancer risk estimates greater than 6E-05. The Railroad DUs (IS-RR-01 and IS-RR-02) have the highest cancer risks (equal to 2E-04), attributable primarily to arsenic and several carcinogenic PAHs.

For exposures to subsurface soil (that are present on the surface in the future and become surface soil), estimated RME cancer risks are greater than 1E-06 for nearly all individual soil DUs and boring locations due primarily to incidental ingestion of arsenic and dermal contact with arsenic and benzo(a)pyrene in subsurface soil. Chromium VI, dioxins/furans, and dioxin-like PCBs were also identified as risk drivers for a few DUs (i.e., IW-DS-01, IW-DS-02, and IS-RR-02).

For sediment exposures, estimated RME cancer risks are also greater than 1E-06 for both the on-site Ponds-Creeks EU and Cuyahoga River EU, as well as all individual sediment DUs, due primarily to incidental ingestion of arsenic. Chromium VI is also identified as a risk driver in Pond 2 (DU IP-P2-01) and Pond 3 (DU IP-P3-01). There are no individual sediment DUs with cancer risks greater than 1E-05.

The surface water exposure scenario is often identified as a risk driver in the Cuyahoga River (including the reference DU SW-CR-R) and the onsite ponds. for any EU or individual DU (i.e., cancer risks are less than 1E-06). For the Site ponds, cancer risks are above 1E-06 due to incidental ingestion of arsenic and/or chromium VI in surface water and sediment while wading/swimming.

The RME cancer risk for the Reference EU is also greater than 1E-06 for sediment (6E-06) due to incidental ingestion of arsenic, which suggests a portion of the total arsenic exposure is not necessarily due to Site-related impacts.

NPS Workers

Estimated RME cancer risks and non-cancer hazards for NPS workers are summarized in Table 3-2 (Panel B). As shown, non-cancer HIs are less than or equal to 1 for all on-site soil/waste pile DUs. Estimated RME cancer risks are greater than 1E-06 for both Site-wide Soil EUs (East and West) and all individual DUs due primarily to incidental ingestion of and dermal contact with arsenic and incidental ingestion of dioxins/furans in surface soil.

With the exception of Railroad DU IS-RR-01, no individual soil DUs have estimated lifetime cancer risks greater than 4E-05. Railroad DU IS-RR-01 has the highest cancer risk (equal to 8E-05), attributable primarily to arsenic and carcinogenic PAHs (namely benzo(a)pyrene and dibenzo(a,h)anthracene). For the Dump site DU IW-DS-01, in addition to arsenic, dioxin-like PCBs, chromium VI, and DEHP are also risk drivers for the ingestion exposure pathway. For Dump site DU IW-DS-02, in addition to arsenic, dioxins/furans are a risk driver for the ingestion exposure pathway.

For exposures to subsurface soil (that are present on the surface in the future and become surface soil), cancer risk estimates are generally similar to those based on surface soil, with nearly all individual DUs having cancer risks greater than 1E-06 and the primary risk driver being incidental ingestion of arsenic.

The estimated RME cancer risk for the Reference EU is also greater than 1E-06, due to incidental ingestion of arsenic, which suggests a portion of the total arsenic exposure is not necessarily due to Site-related impacts.

Construction Workers

Estimated RME cancer risks and non-cancer hazards for construction workers are summarized in Table 3-2 (Panel C). For surface soil/waste pile exposures, estimated RME non-cancer HIs are greater than 1 for both Site-wide Soil EUs (East and West) and all individual DUs due primarily to the inhalation of manganese in air (i.e., airborne dust derived from surface soil). Although inhalation of arsenic and/or benzo(a)pyrene are also identified as HI drivers for some DUs. The individual DUs with the highest HIs include the Dump site DUs (IW-DS-01, IW-DS-02, IW-DS-04), Building Foundation DU IS-BLD-03, Central Waste Pile DU IS-CWP-01, and Railroad DU IS-RR-01. However, the non-cancer HI for the Reference EU is also greater than 1 due to inhalation of manganese in air, which suggests a portion of the total manganese exposure is not necessarily due to Site-related impacts.

For surface soil/waste pile exposures, estimated RME cancer risks are greater than 1E-06 for both Site-wide Soil EUs (East and West) and several individual DUs due almost entirely to the inhalation of chromium VI in air (i.e., airborne dust derived from surface soil). While there are numerous DUs with estimated RME cancer risks greater than 1E-06, there are no individual soil DUs with cancer risks greater than 1E-05. Cancer risks from surface soil exposures are highest for the Dump site DU IW-DS-01 and Railroad DU IS-RR-01.

For exposures to subsurface soil, most DUs have estimated non-cancer RME HIs greater than 1, and the primary risk driver is the inhalation of manganese in airborne particulates derived from subsurface soil, which has been exposed at the surface under a future exposure scenario. Although some individual DUs had total cancer risks slightly above 1E-06, risks are less than or equal to 1E-06 for all individual DUs based on both the ISM samples (0.5 to 3 feet in depth) and the boring locations (0 to 6 feet in depth).

The VURAM trench model was used to estimate exposures and risks to construction workers from inhalation of volatiles in groundwater. As discussed in Appendix D, estimated non-cancer HQs are less than 1 and cancer risks are less than 1E-06 for all volatile COPCs.

Chemicals of Concern
Based on these risk estimates, the following are identified as COCs for the Site:

- Arsenic (soil; sediment; surface water)
- Manganese (soil)
- Chromium VI (soil; sediment)
- Carcinogenic PAHs (soil)
- DEHP (soil)
- Dioxins/furans (soil)
- Dioxin-like PCBs (soil)

As noted above, for arsenic and manganese, potentially unacceptable risks are also associated with soil and sediment in the reference areas, which suggests Site risks may not be entirely attributable to Site-related impacts and risk managers will need to consider naturally occurring concentrations and local reference levels when determining cleanup levels.

Lead
Risks from lead exposures were evaluated using PbB models, which predict PbB concentrations in exposed individuals and estimate the probability of a PbB concentration exceeding a level of concern. For children (less than 6 years), lead risks are evaluated using the IEUBK model. For adults, lead risks are evaluated using the ALM model. When quantifying lead exposures in risk assessment, there should be no more than a 5% chance that a child or developing fetus will have a PbB concentration above 5 µg/dL (this probability is referred to as P5).

The P5 values for the recreational visitor/trespasser child, as estimated using IEUBK, are presented in Table 3-3 . The P5 values for adults for each receptor type, as estimated using ALM, are presented in Table 3-4. As shown, when evaluated on a larger exposure area basis (e.g., for the Site-wide EUs), P5 values are less than 5% for all receptor populations (children and adults).

However, if a receptor were to focus their exposure time in only a single DU, there are several DUs where exposures to lead have the potential to be unacceptable (as indicated by P5 values greater than 5% in Tables 3-3 and 3-4). For recreational visitor/trespasser child exposures to surface soil and sediment (Table 3-3), individual DUs with P5 values greater than 5% include two Dump site DUs (IW-DS-01, IW-DS-02) and Pond 2. For recreational visitor/trespasser adult exposures to surface soil and sediment (Table 3-4; Panel A), only Dump site DU IW-DS-01 has P5 values greater than 5%. For NPS worker exposures to surface soil (Table 3-4; Panel B), P5 values are greater than 5% for Dump site DUs (IW-DS-01, IW-DS-02). For construction workers (Table 3-4; Panel C), individual DUs with P5 values greater than 5% include two of the Dump site DUs (IW-DS-01 and IW-DS-02).

For recreational visitors/trespassers and NPS workers, because the DUs are generally small, it is highly unlikely the entirety of the Site exposure time for a given receptor would occur in only a single DU; however, it is possible construction worker exposures could be focused in a single, smaller area. Therefore, lead is identified as a COC for soil and sediment.

Short-term Exposures

Although the focus of the HHRA is on evaluating potential risks from chronic long-term exposures, in locations where chemical concentrations are significantly elevated (such as in the waste piles or Dump site where slag materials have been noted), it is possible even shorter-term exposures could result in adverse effects. For example, chromium VI surface soil concentrations in DUs IS-AP-03, IS-BLD-01, and IS-DS-01 are well above measured concentrations in other DUs. Chromium VI is a known skin irritant and can cause allergic contact dermatitis in sensitive individuals. There are no established medium-specific thresholds to evaluate the potential for adverse effects from short-term exposures (i.e., there are no acute-specific USEPA soil RSLs). However, for those individual DUs where COC concentrations yielded the highest HIs and cancer risks, risk managers may also need to consider the potential for short-term transient effects.

3.1.5. *Uncertainty Assessment*

A summary of the uncertainties inherent to each component of the HHRA process and how they may affect the quantitative risk estimates and conclusions of the risk analysis is provided here. Two types of uncertainty are addressed: (1) measurement uncertainty and (2) informational uncertainty.

Measurement uncertainty refers to the usual variance that accompanies scientific measurements such as the uncertainties associated with sampling and measurement variability. Informational uncertainties are those that stem from assumptions related to estimates of exposure and chemical toxicity. For example, in the HHRA, to account for uncertainties in the development of exposure assumptions, conservative assumptions are made to ensure estimated risks are protective of sensitive subpopulations or the maximum-exposed individuals, resulting in a bias toward over-predicting both cancer risks and non-cancer hazards.

Details of the specific uncertainties and assumptions made in estimating exposures relevant to the HHRA for this Site are described in Appendix D. The list below briefly summarizes some of the important uncertainties in the HHRA:

- *Pathways not evaluated.* Not all complete pathways were evaluated quantitatively in the HHRA. In most instances, the contribution from unevaluated pathways are believed to be minor. However, one exposure pathway that was not evaluated quantitatively could be a potential data gap – ingestion of fish in the Cuyahoga River downstream of the Site.
- *Detection limit adequacy.* The analytical methods employed in the investigation provide the best available detection limits using conventional analytical instruments. However, the achieved MDLs for several chemicals in water were inadequate relative to human health

screening levels. Exclusion of these chemicals from quantitative risk estimates could result in an underestimation of exposure and risk.

- *Lack of exposure data.* There are no measured data on air concentrations at the Site; estimates of airborne dust derived from soil and volatiles derived from groundwater were estimated using default Particulate Emission factor (PEF) and Volatilization Factor (VF) values, respectively.
- *Exposure point concentrations.* The true mean for an exposure area cannot be calculated based on a limited set of measurements. For soil and sediment, most samples were collected using ISM, which is the preferred sampling methodology for risk assessment, as it provides high quality, reproducible, and accurate estimates of the mean in each DU.
- *Exposure areas.* Risks were estimated on DU-by-DU basis. Because the DUs are generally small, it is highly unlikely the entirety of the Site exposure time for a given receptor would occur in only a single DU. Thus, the DU-specific exposure and risk estimates are likely overestimated.
- *Human exposure parameters.* Many of the required exposure parameters are not known with certainty and must be estimated from limited data or knowledge. Exposure parameters were chosen to be conservative and values selected are likely to overestimate exposure and risk.
- *Chemical absorption.* With the exception of lead and arsenic, the risk assessment assumed 100% of the chemical ingested was absorbed, which is likely to result in an overestimation of exposure and risk, especially for metals in soil and sediment.
- *Lack of toxicity data.* Chemicals without toxicity data cannot be quantitatively evaluated in the risk assessment. The absence of toxicity information for a chemical is most often because toxicological concern over that chemical is low; however, it is possible risks are underestimated due to the exclusion of these chemicals.
- *Toxicity study extrapolation*. Use of toxicity studies to establish human health thresholds often requires extrapolation - from animals to humans, from high doses to low doses, from continuous exposure to intermittent exposure. Because of the conservative methods used to develop RfDs, RfC, CSFs, and IURs, quantitative risk characterization is likely to overestimate potential risks.
- *Cumulative risk.* When risks and HQs are combined across chemicals and exposure pathways, the values are summed. This assumes that responses are approximately additive and may not account for synergistic or antagonistic effects.

Because of these uncertainties, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment.

3.2. Ecological Risk Assessment

The SLERA comprises the first of two steps in the ERA process. The objective of the SLERA is to identify and document conditions that may warrant further evaluation (i.e., potential unacceptable risk). The goal is to eliminate insignificant hazards while identifying contaminants whose concentrations are sufficiently high to potentially pose unacceptable risks to ecological receptors. A SLERA is a simplified risk assessment that can be conducted with limited data where Site-specific information is lacking and assumed values are used to evaluate potential exposure and effects (USEPA 1997). For a SLERA, it is important to minimize the chances of concluding that there is no risk when in fact a risk exists. Thus, selected exposure and toxicity values and assumptions are consistently biased toward overestimating risk. This ensures sites that might pose an ecological risk are studied further, i.e., a SLERA is deliberately designed to be protective in nature, not predictive of effects.

The SLERA includes the identification of Contaminants of Potential Ecological Concern (COPECs), based on a comparison of maximum concentrations to lowest ecological screening levels. It is important to note the results of the COPEC selection are neither designed nor intended "to provide definitive estimates of actual risk or generate cleanup goals and, in general, are not based upon site-specific assumptions" (USEPA 2001). If any potentially significant exposure pathways are indicated from the SLERA, then these pathways are further evaluated in a more refined BERA, which employs modified but still conservative exposure and effect assessment methods to determine potential risks. The level of refinement and evaluation in the BERA will depend upon the complexity of the Site. It can range from a "initial" BERA, which characterizes potential ecological risks based only on refined HQ estimates, to a "detailed" BERA, which employs multiple lines of evidence (e.g., refined HQs, toxicity tests, ecological community evaluations) to determine if the weight of evidence indicates the potential for unacceptable ecological risks.

An ERA (both a SLERA and a BERA) includes the following components (described in detail in the SLERA/BERA report; Appendix E):

- Problem formulation
- Exposure and effects assessment
- Risk characterization (including an uncertainty analysis)

3.2.1. *Problem Formulation*

The Site is in the Cuyahoga River drainage basin. Primary surface water features in the Study Area are the Cuyahoga River and one of its tributaries, Brandywine Creek. Both the Cuyahoga River and Brandywine Creek have been known to flood portions of the Site. The Cuyahoga River generally flows north along the western edge of the Site Prior to installation of a bank stabilization structure there was active erosion along the northern bank of the river adjacent to the Dump site. Other surface water features within the Study Area include a small, on-site stream, three constructed ponds/wetlands, and various other wetlands

There are a variety of flora and fauna present at the Site, including terrestrial invertebrates, birds, mammals, aquatic invertebrates, fish, amphibians, and reptiles, characteristic of terrestrial, aquatic, and palustrine/riverine wetland habitats. Species present (or potentially present) at the

Site include several federally- and state-listed species of concern. Nesting bald eagles and peregrine falcon have been reported within one mile of the Site. A recent bat egress study identified areas on the Site that may be used by Indiana bats and other bats. Aquatic invertebrates are likely present in all water resources—rivers, ponds, wetlands, and on-site creeks/streams. Fish are also present in the Cuyahoga River and Brandywine Creek, although the fish communities are generally experiencing impairment throughout the lower portions of the Cuyahoga River and Brandywine Creek. It is unknown whether fish are present in the on-site ponds, wetlands, or small stream, but given the small size and intermittent nature of the stream and one of the on-site ponds, it is unlikely that these water resources support significant numbers of fish, if any.

Chemicals may initially enter Study Area soil, surface water, and/or sediment from dumping, disposal, spills, discharges, or leaching. The list of chemicals that have been detected at least once in Site media includes several analytical groups, including metals, pesticides, SVOCs, VOCs, PCBs (as aroclors and congeners), and dioxins/furans. In the ERA, waste piles and the Dump site were considered potentially viable ecological habitat and assessed as part of the surface soil evaluation.

Figure 3-2 illustrates the ecological pathway-receptor diagram for the Site. This diagram is a visual representation of predicted relationships between ecological entities and the stressors to which they may be exposed. In this figure, complete exposure pathways that may be significant are presented with a black dot (●); these pathways are the focus of the ERA. Pathways that are complete but judged to be minor compared to other exposure pathways are presented with an open square (□). Incomplete pathways are also indicated in the diagram; these pathways are not evaluated in the ERA.

During the problem formulation, the goals, breadth, and focus of the ERA are established through the selection and description of site-specific assessment and measurement endpoints. Measurement endpoints are quantifiable environmental or ecological characteristics that can be measured, interpreted, and related to the valued ecological components chosen as the assessment endpoints (USEPA 1997). The selected assessment and measurement endpoints for each ecological receptor type are described in Appendix E.

3.2.2. *Screening-Level Ecological Risk Assessment*

In the SLERA, COPECs are determined by comparing the maximum concentrations of contaminants in environmental media (water, sediment, soil) to corresponding medium-specific Ecological Screening Value (ESV) as provided in the *NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes* (herein referred to as the "*NPS ESV*

Protocol"; NPS 2018). The COPEC Selection ESVs, which are the lowest ESVs across multiple NPS-approved toxicity value sources, are used to identify COPECs.

Ohio EPA has state-specific surface water criteria for the protection of aquatic life (Ohio Administrative Code 3745-1-35[3]). In some instances, the Ohio EPA water criteria, based on "Outside the Mixing Zone Average" (OMZA) values, are more stringent than the federal criterion selected as the basis of the NPS ESV. Therefore, in consultation with NPS, the lower of the NPS ESV or the Ohio EPA OMZA is used when identifying surface water COPECs for aquatic life. In accordance with the *NPS ESV Protocol*, the ESVs for hardness-dependent metals are derived based on the minimum Site hardness (16 mg/L as calcium carbonate).

The *NPS ESV Protocol* does not provide surface water or sediment ESVs specific to birds and mammals. However, two of the NPS-approved sources for wildlife ESVs – the Los Alamos National Laboratory (LANL) ECORISK Database (LANL 2017) and the Oak Ridge National Laboratory (ORNL) toxicity benchmarks (Sample et al. 1996) – provide sediment and surface water ESVs, respectively. In addition, Ohio EPA also provides surface water criteria for the protection of piscivorous wildlife for a subset of bioaccumulative chemicals (i.e., 4,4'-DDT, mercury, PCBs, TCDD). The lowest no-effect ESVs (across all wildlife receptors) from these sources were used to identify sediment and surface water COPECs for wildlife.

Ecological COPECs were identified separately for each environmental medium by comparing the maximum concentration across all DUs to its respective screening level (NPS 2018). Table 3-5 presents the results of the COPEC selection for ecological receptors. As shown, for soil/waste piles, the list of COPECs includes most metals (including chromium and mercury), several pesticides, PCBs (as aroclors), a few VOCs, several PAHs and phthalates, and dioxin/furan and dioxin-like PCB congeners. For sediment, the types of COPECs are generally similar to soil, with COPECs including metals, pesticides, PCBs, VOCs, PAHs, phthalates, and dioxins/furans. For surface water, the list of COPECs includes most metals, but only two organic chemicals, including gamma-chlordane and pyrene. These COPECs were the focus of the BERA.

3.2.3. *Baseline Ecological Risk Assessment*

In the BERA, COPECs identified in the SLERA undergo further refinement in an initial BERA as directed by the *NPS ESV Protocol* (NPS 2018). Further refinement can include comparing media-specific concentrations to background to determine potential non-Site-related concentrations of COPECs (both natural and anthropogenic) and/or comparing species-specific estimated exposure doses to toxicity reference values for select receptors of concern.

[3] https://www.epa.ohio.gov/portals/35/rules/01-35.pdf

If the initial BERA shows one or more COPECs have the potential to result in unacceptable risks, a more detailed BERA may be performed to further refine the HQs (e.g., incorporating Site-specific bioaccumulation factors, revised toxicity values) and evaluate other lines of evidence as part of the risk characterization. Examples of other lines of evidence may include, but are not limited to, laboratory or in situ toxicity tests, field-based assessments of community density and diversity, habitat evaluations, and tissue burden estimates.

For this Site, an initial BERA was completed and is provided in Appendix E. In the BERA, risks were evaluated separately for the following ecological receptor groups and exposure scenarios:

- Terrestrial plants and soil invertebrates from direct contact with COPECs in soil at the Site.
- Aquatic receptors (i.e., aquatic plants, fish, water column-dwelling aquatic invertebrates) from direct contact with COPECs in surface water at the Site.
- Amphibians from direct contact with COPECs in surface water at the Site.
- Sediment-dwelling aquatic invertebrates from direct contact with COPECs in sediment at the Site.
- Wildlife from ingestion of COPECs in soil, sediment, surface water, and dietary items derived from the Site. This evaluation includes risk estimates for both terrestrial-feeding and aquatic-feeding wildlife.

<u>Terrestrial Plants and Soil Invertebrates from Soil</u>

The structure and function of the terrestrial plant and soil invertebrate community is important because it provides a significant portion of the energy, organic matter, and nutrient inputs for terrestrial systems. Plant communities also provide habitat and forage for a variety of wildlife species. Terrestrial plants and soil organisms are good indicators of soil condition because they reside directly in the soil and have limited mobility.

Exposure Assessment

Exposure areas are defined based on the receptor, home range, and area use. The exposure area is the geographical area in which a receptor is randomly exposed to the contaminated medium for the assumed exposure duration. In the initial BERA evaluation of plant and invertebrate exposures, each soil/waste pile DU was evaluated as a potential exposure area (see Figures 2-7 and 2-12). Soil was limited to those samples collected from 0 to 0.5 feet bgs, as this is the zone where plant roots would be expected and soil invertebrate communities would be present. However, plants with deeper roots and soil organisms that burrow deeper into the soil (e.g., ants) could be exposed to soils deeper than 6 inches under current conditions. In addition, it is possible that future activities at the Site (e.g., excavation, removals) could unearth subsurface soils and terrestrial receptors could be exposed to these materials under future site conditions. Therefore, subsurface soils (ISM samples from 0.5 to 3 feet bgs and ISM boring samples from 0 to 6 feet bgs) for each soil DU are also evaluated for terrestrial plants and soil invertebrates.

Although it is not expected most ecological receptors will come into contact with sub-slab soils under current conditions (because these soils are beneath the concrete), receptors could come into contact with these soils under future Site conditions (e.g., if foundations are removed or breached). Thus, sub-slab soils collected from 0 to 0.5 feet bbc were also included in the BERA (see Figure 2-8).

Based on the assumption of random exposure within an exposure area, risk from a chemical is related to the arithmetic mean concentration of that chemical averaged over the entire exposure area (i.e., DU). As recommended in the Interstate Technology Regulatory Council (ITRC) ISM guidance (ITRC 2012), EPCs for each DU were calculated from the triplicate ISM results using the 95UCL Chebyshev calculation method. If triplicate ISM results were not available for a DU, the EPC was set equal to the maximum detected concentration. If the COPEC was not detected in a DU, the EPC was set equal to one-half the reported MDL.

Effects Assessment

Refined soil ESVs for terrestrial plants and soil invertebrates are presented in the *NPS ESV Protocol* (NPS 2018b) and represent no-effect levels. This means that soil concentrations below the NPS ESV are not expected to result in observable adverse effects; however, concentrations above the NPS soil ESV may not necessarily result in adverse effects. For this reason, the initial BERA risk characterization also evaluated potential exposures and risks for terrestrial plants and soil invertebrates based on low-effect Ecological Screening Levels (ESLs) as provided in the LANL ECORISK Database[4] (2017).

Risk Characterization

Refined HQs were calculated separately for terrestrial plants and soil invertebrates for each COPEC in each soil/waste pile DU based on the no-effect ESV and the low-effect ESL. The refined HQs for terrestrial plants and invertebrates from direct contact exposures to COPECs in surface soil are presented in Attachment B of Appendix E. The frequency of HQ exceedances and maximum HQ values (across all Site DUs) are summarized in Table 3-6. This table shows several metals, including arsenic, barium, copper, lead, mercury, selenium, thallium, and zinc, chromium VI, and PAHs have low-effect-based HQs greater than 1 for plant and/or invertebrates across several DUs, which indicates these COPECs have the potential to adversely impact these receptors at the Site.

The HQ results suggest elevated COPEC concentrations of several metals and PAHs in surface soil are likely due to Site-related impacts and have the potential to adversely impact terrestrial plant and/or soil invertebrate communities.

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[4] https://lanl.gov/environment/protection/eco-risk-assessment.php

Aquatic Receptors from Surface Water

Aquatic receptors evaluated in the initial BERA include aquatic plants, water column-dwelling invertebrates, and fish. For most aquatic receptors, the chief exposure pathway of concern is direct contact with surface water that has been impacted by Site releases.

Exposure Assessment

For aquatic receptors, the exposure area was assumed to be equal to the surface water DU (see Figure 2-13). Surface water DUs include the unnamed stream, Brandywine Creek, and the Cuyahoga River, with each DU encompassing approximately 100-200 linear feet of stream. There are also surface water DUs for two of the on-Site aeration ponds (Pond 1 and Pond 3), with each DU representing the entire pond. It is unknown whether fish are present in the ponds or the small on-Site stream, however, these DUs were conservatively evaluated as viable fish habitat.

There is general consensus that metal toxicity to aquatic receptors is dominated by the level of dissolved chemicals (Prothro 1993), since chemicals adsorbed onto particulate matter may be less toxic than the dissolved forms. Therefore, in the BERA, the exposure estimates for aquatic receptors were restricted to filtered surface water samples only[5]. Because only one or two filtered water samples were collected from each surface water DU, 95UCLs cannot be calculated and the EPC used in the BERA for each surface water DU was set equal to the maximum detected concentration. If the COPEC was not detected in the surface water DU, the EPC was set equal to one-half the MDL.

Effects Assessment

As recommended in the *NPS ESV Protocol* (NPS 2018b), in the refined risk estimates, aquatic receptor exposures to surface water were further evaluated using refined ESVs developed to consider both acute (short-term maximum) and chronic (long-term average) exposures to present a range of potential risks. These acute and chronic ESVs are protective of a broad range of aquatic receptors, including fish, water column-dwelling invertebrates, aquatic plants, and amphibians, as well as sensitive aquatic species. Refined surface water ESVs for hardness-dependent metals were derived using the average measured hardness level for each exposure reach.

Risk Characterization

Refined HQs for aquatic receptors were calculated based on both acute and chronic effects. The refined HQs for aquatic receptors from direct contact exposures to COPECs in surface water are

[5] The one exception is aluminum. For aluminum, the USEPA toxicity values are specific to total recoverable concentrations; thus, unfiltered surface water samples were used for making comparisons to the aluminum toxicity values.

presented in Attachment C of Appendix E. The frequency of HQ exceedances and maximum HQ values (across all Site DUs) are summarized in Table 3-7. This table shows with the exception of aluminum, all COPECs have acute HQs less than 1, which indicates short-term exposures of aquatic receptors to contaminants in surface water are unlikely to result in adverse impacts. Acute HQs for aluminum were above 1 in most onsite river and creek DUs.

Chronic HQs are less than 1 for most metals (arsenic, cadmium, Chromium VI, cobalt, nickel, selenium, silver, thallium, and zinc) and pyrene, which indicates aquatic receptors are unlikely to be adversely impacted from long-term exposures to these contaminants in surface water. However, chronic HQs are greater than 1 for several metals, including aluminum, beryllium, iron, lead, and manganese, and gamma-chlordane, which indicates these COPECs have the potential to adversely impact aquatic receptors at the Site.

The HQ results suggest elevated COPEC concentrations of several metals in surface water in the ponds and unnamed stream and gamma-chlordane in the Cuyahoga River and Brandywine Creek are likely due to Site-related impacts and have the potential to adversely affect aquatic receptors under a chronic exposure scenario.

Amphibians from Surface Water

Exposure of amphibians is similar to other aquatic organisms (i.e., via direct contact with surface water). Although amphibians may be exposed by dermal contact with contaminated soils or sediments, this pathway is suspected to be relatively minor compared to direct contact with water exposures, and methods are not currently available to support reliable quantitative evaluation of the soil/sediment dermal contact pathway for amphibians.

Exposure and Effects Assessment

The same EPCs as were used in the aquatic receptor surface water evaluation were also used in the amphibian risk evaluation. With the exception of pyrene, the aquatic receptor acute and chronic ESVs for surface water are derived either from NRWQCs or GLWQI Tier II values, which are the two ESV sources identified for amphibians in the *NPS ESV Protocol*. Thus, the aquatic receptor surface water ESVs are also applicable to (and protective of) amphibians.

Risk Characterization

Because the EPCs and the ESVs for the evaluation of amphibian exposures to surface water are the same as those used in the evaluation of aquatic receptor exposures to surface water, the resulting HQs would be the same as those presented in Table 3-7 and described above. In brief, with the exception of aluminum, acute HQs were less than 1 for all COPECs, which indicates amphibians are not likely to be adversely impacted due to acute exposures to contaminants in surface water. Acute HQs for aluminum were above 1 in most on-site river and creek DUs. Chronic HQ results suggest elevated COPEC concentrations of several metals (aluminum, beryllium, iron, lead, and manganese) in surface water in the ponds and unnamed stream and gamma-chlordane in the Cuyahoga River and Brandywine Creek are likely due to Site-related impacts and have the potential to adversely affect amphibians under a chronic exposure scenario.

Aquatic Invertebrates from Sediment

Benthic invertebrates are intimately associated with sediment and sediment porewater (i.e., the interstitial water between sediment particles). Several lines of evidence were employed in the evaluation of benthic invertebrate direct contact exposures to sediment. These lines of evidence include: 1) an HQ evaluation performed using ESVs based on exposures to bulk sediment, 2) a refined evaluation for a mixture of metals using Site-specific SEM/AVS results, and 3) a refined cumulative assessment of exposures to PAHs. The approach and outcome for each line of evidence is discussed further below.

HQ Evaluation

Aquatic invertebrates generally have a relatively low mobility, so the exposure area was assumed to be equal to the sediment DU (see Figure 2-7).

With few exceptions (discussed below), there is only a single ISM sample from each sediment DU, which is representative of the entire DU. It is not possible to compute upper confidence limits for a single sample, therefore, the sediment EPC used in the BERA was equal to the reported concentration in the ISM sample. If the COPEC was not detected in the ISM sample, the EPC was set equal to one-half the MDL. For one DU in Brandywine Creek (BC-01) and Pond 3 (P3-01), ISM samples were collected in triplicate. As recommended in ITRC's ISM guidance (ITRC 2012), 95UCLs were calculated from the triplicate sediment ISM results using the Chebyshev calculation method.

As recommended in the *NPS ESV Protocol* (NPS 2018b), in the refined risk estimates, aquatic invertebrate exposures to sediment were further evaluated using refined ESVs that consider both threshold effect concentrations (TECs) and Probable Effects Concentrations (PECs) to present a range of potential risks. Sediment toxicity should be observed only rarely below the TEC and should be frequently observed above the PEC. If sediment concentrations are between the TEC and PEC, then unacceptable risks are possible, but would generally be expected to be of limited severity.

Refined HQs were calculated for both TEC and PEC effects. The refined HQs for aquatic invertebrates from direct contact exposures to COPECs in sediment are presented in Attachment D of Appendix E. The frequency of HQ exceedances and maximum HQ values (across all Site DUs) are summarized in Table 3-8. This table shows several metals (chromium, copper, lead), pesticides (chlordane), PCBs (as aroclor-1254), SVOCs (butyl benzyl phthalate, di-n-butyl phthalate), and PAHs have PEC HQs greater than or equal to 1, which indicates these COPECs have the potential to adversely impact sediment-dwelling aquatic invertebrates at the Site. With few exceptions, exceedances of the PEC ESV are limited to sediments collected from the three on-Site ponds, and sediment concentrations are consistently highest in Pond 2. For PAHs, the PEC HQ is equal to 1 in one DU in the Cuyahoga River (IL-CR-03) and in one DU in Brandywine Creek (IL-BC-02).

Because of the inherent uncertainties in the HQ approach, the BERA includes two additional risk evaluations – the SEM/AVS evaluation for metals and cumulative PAH evaluation – to assess potential exposures to sediment-dwelling aquatic invertebrates and inform overall risk conclusions.

SEM/AVS Evaluation for Metals

For sediment-dwelling aquatic invertebrates, the primary risk driver for metals in sediment is the concentration of dissolved metals in the sediment porewater rather than the bulk sediment concentration. Researchers have found the tendency of metals in sediment to dissolve into the porewater is determined in large part by the amount of sulfide present in the sediment. The most important factor controlling the partitioning (and thus the bioavailability) of metals availability is AVS. Site-specific measurements of AVS and SEM concentrations can be used to provide an estimate of the bioavailable concentrations of mixtures of these metals (USEPA 2000a, 2005b). If the concentration of AVS is greater than the total concentration of SEM in sediment (on a molar basis), the metals are not likely to be present in the porewater and will not cause toxicity (Ankley et al. 1996; USEPA 2005b).

In 2005 SEM/AVS approach was refined to address the role of TOC as a secondary factor controlling the bioavailability of heavy metals in sediments where SEM concentrations exceed the concentrations of AVS. If the excess SEM level is less than 130 micromoles per gram of organic carbon (µmol/goc), there is 90% confidence that sediment toxicity will not occur. Similarly, if the excess SEM level exceeds 3,000 µmol/goc, there is 90% confidence that sediment toxicity will occur. The likelihood of toxicity associated with values between 130 and 3,000 µmol/goc is uncertain.

The SEM/AVS evaluation shows no sediment samples have normalized excess SEM levels greater than 3,000 µmol/goc, but eight sediment samples have levels higher than 130 µmol/goc, including samples from the Cuyahoga River (IL-CR-03, IL-CR-04), Brandywine Creek (IL-BC-01, IL-BC-02), and Pond 2, as well as one of the Cuyahoga River reference areas (IL-CR-R2). With the exception of Pond 2 (IL-P2-01), if AVS had been detected at relatively low concentrations (e.g., 0.4 µmol/g) or if TOC were slightly higher than was measured (e.g., increased by 0.3%), the effects benchmark would not have been exceeded. This suggests that, while toxicity is possible in some DUs within Cuyahoga River and Brandywine Creek due to metals in sediment, environmental conditions in the river/creek may limit bioavailability and any impacts to sediment dwelling aquatic invertebrates would likely be minimal. This conclusion is consistent with the HQ results, which show PEC HQs for metals are less than 1 in all Cuyahoga River and Brandywine Creek DUs.

For Pond 2, despite the fact that measured TOC levels were highest in this DU, the SEM/AVS evaluation indicates excess SEM levels are greater than the 130 µmol/goc effects benchmark, and SEM levels are dominated by copper and lead. Although the excess SEM levels do not approach the 3,000 µmol/goc effects benchmark, these results suggest toxicity to sediment-dwelling aquatic invertebrates has a higher potential to occur in Pond 2 relative to the other sediment DUs. This conclusion is also supported by the HQ results, which shows PEC HQs for copper and lead are greater than 1 in Pond 2.

Cumulative PAH Evaluation

PAHs are a large class of organic compounds that include unsubstituted compounds as well as those with alkyl, oxygen, or nitrogen substituents. Since PAH compounds have similar effects on biological organisms, it is appropriate to evaluate these chemicals cumulatively. The likelihood of cumulative toxicity due to PAHs in sediment is evaluated according to the USEPA sediment guidelines for PAH mixtures using an equilibrium partitioning approach (USEPA 2003b).

The equilibrium partitioning approach uses the chemical-specific partition coefficient between water and Koc and the mass fraction of organic carbon in sediment (foc) to calculate the organic carbon-normalized Sediment Quality Benchmark (SQB). The SQBs are applied to PAH mixtures through the calculation of toxic unit (TU) values for each sediment sample. Aquatic invertebrates should be protected from the narcotic effects of PAH mixtures in sediments if the TU is less than or equal to 1.0. If the TU is greater than 1.0, sensitive benthic organisms may be adversely affected (USEPA 2003b).

The TU is less than or equal to 1.0 for all sediment DUs in the unnamed stream and on-Site ponds, but greater than 1.0 for all sediment DUs in Brandywine Creek and the Cuyahoga River, including the reference areas. The TU values are highest in several on-Site sediment DUs in Brandywine Creek and the Cuyahoga River, which suggests sensitive sediment-dwelling aquatic invertebrates in these locations may be adversely impacted by exposures to PAHs in sediment.

The TU exceedances are supported by the PEC HQ results for total PAHs. The Cuyahoga River DU IL-CR-03 and in the Brandywine Creek DU IL-BC-02 had the PEC HQs greater than 1, which supports the conclusion that sediment-dwelling aquatic invertebrates have the potential to be adversely impacted in these two areas. In addition, the reference data suggests PAHs in sediment are due to, at least in part, Site-related contributions.

Wildlife Ingestion Exposures

Birds and mammals may be exposed to Site-related contaminants by three primary ingestion pathways: (1) ingestion of contaminants in or on food items, (2) incidental ingestion of soil or sediment while feeding, preening, or digging, and (3) ingestion of drinking water. Direct contact (i.e., dermal exposure) of birds and mammals to environmental media may occur in some cases, and inhalation exposure to volatile contaminants and airborne dusts is possible for all birds and mammals, but these exposure pathways (i.e., dermal and inhalation) are usually considered to be minor in comparison to exposures from ingestion (USEPA 2005a).

A variety of wildlife receptors may be present at the Site, but it is not feasible to evaluate exposures and risks for every bird and mammal species potentially present at the Site. For this reason, surrogate species are selected to serve as representatives of several different bird and mammal feeding guilds. Because the dietary items ingested by terrestrial-feeding wildlife and aquatic-feeding wildlife differ, surrogate receptors are evaluated separately for each feeding environment. Surrogate receptors represent herbivores (i.e., ingesting plants), terrestrial insectivores (i.e., ingesting soil invertebrates and insects), omnivores (i.e., ingesting both plants and invertebrates), carnivores (i.e., ingesting small mammals and birds), aquatic insectivores (i.e., ingesting emerging insects), and piscivores (i.e., ingesting fish).

Exposure Assessment
The surrogate receptors identified above represent a range of different home range sizes. For the purposes of the initial BERA risk calculations, wildlife exposures were evaluated on a DU-specific basis; see Figure 2-7 (soil/sediment/surface water DUs), Figure 2-8 (sub-slab soil DUs), Figure 2-12 (waste piles). In general, soil DUs are usually about 0.25 acres in size and sediment/surface water DUs represent about 100 linear feet of river/stream or the entirety of the on-Site pond. Thus, the DU-specific exposure and risk estimates are most representative of wildlife with small home ranges (e.g., shrew, robin) but may be overly conservative for wildlife with larger home ranges (e.g., mink, fox, hawk) as it is unlikely such receptors would spend a majority of their time in a single DU.

When triplicate ISM soil samples were available for the DU, EPCs were calculated using the Chebyshev 95UCL calculation method, as recommended in ITRC's ISM guidance (ITRC 2012). When only one ISM sample was collected (e.g., waste piles, sediment), the EPC was equal to the reported concentration. For DUs where all samples were non-detect, the EPC was set equal to one-half the MDL.

It is assumed only burrowing mammals (e.g., shrew) would be exposed to subsurface soil under current conditions. However, it is possible that future activities at the Site (e.g., excavation, removals) could unearth subsurface soils and terrestrial wildlife receptors could be exposed to these materials under future site conditions. Therefore, subsurface soils were also evaluated for all terrestrial wildlife receptors. A separate set of risk estimates were calculated using subsurface soil ISM samples collected from 0.5 to 3 feet bgs, sub-slab soils collected from 0.5 to 3 feet bbc, and soil boring ISM samples collected from 0 to 6 feet bgs to represent a future site condition where subsurface soils have become surface soils (e.g., due to soil excavation and removal activities). A separate set of risk estimates were calculated using subsurface soil ISM samples collected from 0.5 to 3 feet bgs, sub-slab soils collected from 0.5 to 3 feet bbc, and soil boring ISM samples collected from 0 to 6 feet bgs to represent a future site condition where subsurface soils have become surface soils (e.g., due to soil excavation and removal activities).

Ingestion of surface water by wildlife is best represented by unfiltered water samples. Usually, there is only a single ISM sample from each surface water DU; therefore, the surface water EPC was equal to the reported concentration in the sample. If the COPEC was not detected in the sample, the EPC was set equal to one-half the MDL.

Effects Assessment
For wildlife, two types of Toxicity Reference Values (TRVs) are often identified in the literature. The first TRV is an estimate of the exposure that is not associated with any adverse effects and is referred to as the NOAEL TRV. The second TRV is an estimation of the lowest exposure that causes an observable adverse effect and is referred to as the LOAEL TRV. The true threshold for adverse effects lies between the NOAEL and LOAEL TRVs. If a NOAEL TRV is used to derive the medium-specific ESL, the resulting screening level represents a no-effect level. If a LOAEL TRV is used to derive the medium-specific ESL, the resulting screening level represents a low-effect level.

Refined ESVs for wildlife were selected in accordance with the *NPS ESV Protocol* (NPS 2018). In the initial BERA, both no-effect and low-effect screening levels were used to provide a range of potential risks. The *NPS ESV Protocol* does not provide ESVs for sediment specific to wildlife; however, the LANL ECORISK Database does include sediment-specific ESLs intended to be protective of semi-aquatic wildlife. Similarly, the *NPS ESV Protocol* does not provide ESVs for surface water; however, ORNL provides surface water screening benchmarks intended to be protective of piscivorous wildlife[6].

Risk Characterization
Refined HQs were calculated separately for terrestrial-feeding wildlife, aquatic-feeding wildlife, and piscivorous wildlife. Refined HQs were also calculated separately for birds and mammals. A no-effect-based HQ less than 1 indicates that adverse impacts are considered unlikely and further evaluation is not necessary. A no-effect-based on HQ greater than or equal to 1 indicates that adverse impacts are possible and were further evaluated using the low-effect-based HQ values. A low-effect-based HQ greater than or equal to 1 indicates that adverse impacts have the potential to occur, with the magnitude of the impact increasing as the HQ increases. If the no-effect-based HQ is greater than 1 but the low-effect-based HQ is less than 1, this suggests adverse impacts, while possible, are unlikely to occur or would have limited effects. While low-effect-based HQs may be better predictors of potential risks to wildlife community structure and function, no-effect-based HQs would be more protective for species of interest within sensitive environments, such as threatened or endangered species.

[6] In addition, Ohio EPA also provides surface water criteria for a subset of bioaccumulative chemicals (i.e., DDT, mercury, PCBs, and TCDD) for the protection of piscivorous wildlife. However, these chemicals were either not detected (DDT, mercury, PCBs) or not analyzed (TCDD) in surface water and could not be quantitatively evaluated.

In Appendix E, the detailed attachments present information on the by-receptor risks for each COPEC. The following tables summarize the frequency of HQ exceedances and maximum HQ values:

- Table 3-9 – Risk estimates for terrestrial-feeding wildlife from ingestion of terrestrial food items and surface soil (under current conditions)
- Table 3-10 – Risk estimates for terrestrial-feeding wildlife from ingestion of terrestrial food items and surface soil (under potential future conditions where subsurface soils are present on the surface)
- Table 3-11 – Risk estimates for aquatic-feeding wildlife from ingestion of emerging insects and sediment
- Table 3-12 – Risk estimates for piscivorous wildlife from ingestion of fish and surface water

The HQ results suggest elevated concentrations of several COPECs in soil (surface and subsurface), sediment, and surface water have the potential to adversely impact wildlife at the Site. The potential chemicals of concern include several metals, PAHs, pesticides, phthalates, VOCs, PCBs, and dioxins/furans. In general, dietary exposures (i.e., from food items) tend to contribute most to total exposures and insectivorous wildlife tend to have higher exposures than other terrestrial feeding guilds. Risk estimates for subsurface soil show, with the exception of VOCs in sub-slab soil, COPEC contamination tends to be higher in the surface soil than the subsurface soil.

3.2.4. *Uncertainty*

There are a variety of sources of uncertainty in the BERA that need to be evaluated and considered when making risk management decisions. The uncertainty assessment presented in the BERA (see Appendix E) discusses the uncertainties associated with the HQ evaluations, including uncertainties that impact the nature and extent evaluation, the exposure assessment, the toxicity assessment, and the risk characterization. Uncertainties can lead to either an overestimation or an underestimation of risk. However, because of the inherent conservatism in the derivation of many of the exposure estimates and toxicity values, risk estimates presented in the BERA should generally be viewed as being more likely to be high than low. The conclusions presented in the BERA should be viewed in light of these inherent uncertainties, and risk management decisions based on the risk assessment conclusions should be interpreted accordingly.

3.3. Development of Preliminary Risk-Based Removal Goals

The purpose of this section is to identify risk-based PRGs. PRGs generally establish the concentrations of contaminants for each exposure medium that will not present unacceptable risk to human health or ecological receptors based on site-specific conditions.

3.3.1. *Selection of Human Health Risk-Based Preliminary Removal Goals*

The NCP establishes a risk range for excess cancer risk of between 1E-06 and 1E-04 and sets a threshold value for cumulative non-cancer adverse effects at an HI of 1. PRGs related to carcinogenic compounds are initially established at the 1E-06 level. Final RGs can deviate from this "point of departure," if necessary, based on compelling site-specific factors relevant to risk management decisions. Risk-based PRGs are established using the same exposure parameters and toxicity values used in the HHRA, but reversing the risk equation to solve for the EPC. Generally, PRGs are only developed for those chemicals that are identified as COCs in the risk assessment. COCs are defined as those chemicals for which the estimated cancer risk greater than 1E-06 and/or the HQ greater than 1. The HHRA identified the following COCs that present unacceptable risk to human receptors at the Site:

- Arsenic (soil/waste pile; sediment; surface water)
- Manganese (soil/waste pile)
- Chromium VI (soil/waste pile; sediment)
- Lead (soil/waste pile; sediment)
- Carcinogenic PAHs (soil)
- DEHP (soil)
- Dioxins/furans (soil)
- Dioxin-like PCBs (soil)

The Organic Act and CUVA enabling legislation does not allow the permanent or long-term prohibition of public access to the Site as a component of the selected removal action. In addition, numerous laws, regulations, and policies require the NPS to ensure safe conditions for park visitors and workers. Assumptions introduced into the HHRA process were conservative in nature and are likely to have overestimated the potential impacts of exposure to the Site COCs.

For non-lead COCs, PRGs were developed for a range of target cancer risk levels (1E-06, 1E-05, and 1E-04) and non-cancer HQs (0.1, 1, and 3) to provide risk managers flexibility in determining the appropriate action limits for the Site. The human health PRGs for non-lead COCs are summarized in Text Table 3.1. For lead, PRGs are derived based on a target PbB of 5 µg/dL. The PRG is derived through iterative IEUBK and ALM model runs, adjusting the Site EPC input until the resulting P5 value is equal to 5%. The human health PRGs for lead are summarized in Text Table 3.2. As shown, PRGs are calculated for each receptor; the PRGs for the most stringent receptor are shown in bold.

Text Table 3.1 Summary of Human Health PRGs						
COC	PRG Based on Target Cancer Risk Level Shown			Human Health PRG Based on Target HQ Shown		
	1 x 10^{-6}	1 x 10^{-5}	1 x 10^{-4}	0.1	1	3
Soil and Waste: Recreational Visitor/Trespasser (mg/kg)						
Arsenic	*7.0*	*70*	*703*	-	-	-
Chromium VI	*3.6*	*36*	*358*	-	-	-
Benzo(a)anthracene	*4.7*	*47*	*467*	-	-	-
Benzo(a)pyrene	***0.47***	***4.7***	***47***	-	-	-
Benzo(b)fluoranthene	***4.7***	***47***	***467***	-	-	-
Dibenzo(a,h)anthracene	***0.47***	***4.7***	***47***	-	-	-
Indeno(1,2,3-cd)pyrene	*4.7*	*47*	*467*	-	-	-
Dioxin/Furan (TEQ)	*5.3E-05*	*5.3E-04*	*5.3E-03*	-	-	-
Soil: NPS Worker (mg/kg)						
Arsenic	***3.7***	***37***	***375***	-	-	-
Chromium VI	*7.9*	*79*	*792*	-	-	-
Benzo(a)pyrene	*2.6*	*26.4*	*264*	-	-	-
Benzo(b)fluoranthene	*26*	*264*	*2,637*	-	-	-
Dibenzo(a,h)anthracene	*2.6*	*26.4*	*264*	-	-	-
bis(2-ethylhexyl) phthalate	*205*	*2,052*	*20,516*	-	-	-
Dioxin/Furan (TEQ)	***2.8E-05***	***2.8E-04***	***2.8E-03***	-	-	-
PCB TEQ	*2.8E-05*	*2.8E-04*	*2.8E-03*	-	-	-
Soil: Construction worker (mg/kg)						
Arsenic	*26*	*263*	*2631*	*5*	*158*	*158*
Chromium VI	***3.5***	***35***	***352***	-	-	-
Manganese	-	-	-	*22*	*216*	*649*
Benzo(a)pyrene	-	-	-	*0.81*	*8.1*	*24*
Sediment: Recreational Visitor/Trespasser (mg/kg)						
Arsenic	*9.0*	*90*	*901*	-	-	-
Chromium VI	*3.6*	*36*	*359*	-	-	-
Surface Water: Recreational Visitor/Trespasser (mg/L)						
Arsenic (unfiltered)	*0.0043*	*0.043*	*0.43*	-	-	-

Notes
- = Chemical of Concern (COC) was not identified as a risk driver
When a COC is identified for multiple receptors, the most stringent PRG is shown in bold.
COC = Chemical of Concern
PRG = Preliminary Removal Goal
HQ = Hazard Quotient
mg/kg = milligrams per kilogram
mg/L = milligrams per liter

Text Table 3.2 Lead PRGs			
Medium	**COC**	**Receptor**	**Risk-based PRGs[a] (ppm)**
Soil/ Sediment	Lead	Recreational Visitor/Trespasser (child)	1,092[b]
		Recreational Visitor/Trespasser (adult)	3,834[b]
		NPS Worker	920[b]
		Construction Worker	481[b]

Notes
COC = Chemical of Concern
PRG = Preliminary Removal Goal
ppm = parts per million
[a]*Based on a target blood level of 5 µg/dL*
[b]*Assumes minimal contribution from other media (sediment, subsurface soil) to total exposures.*

In the HHRA, risk evaluations are conducted on an exposure area basis. For each exposure area, risk estimates were developed based on an EPC, which was usually computed as the 95UCL on the mean and encompassed the entire exposure area. Likewise, application of the risk-based PRG also should be applied on an exposure area basis and evaluated in terms of the 95UCL on the mean (or the arithmetic mean for lead). This means the risk-based PRG should not be interpreted as a not-to-exceed threshold or applied to individual samples, which are not representative of the entire exposure area. Likewise, any post-removal confirmation sampling, collected to demonstrate successful achievement of the risk-based PRG, will need to select an appropriate sampling design that considers these risk-based objectives.

3.3.2. *Selection of Ecological Risk-Based Preliminary Removal Goals*

Ecological risk-based PRGs were derived using the same exposure parameters and toxicity values used in the BERA, but reversing the risk equation to solve for the EPC. Generally, PRGs are only developed for those chemicals that are identified as COECs in the risk assessment. COECs are defined as those chemicals for which the estimated HQ is greater than or equal to 1. The HQ results suggest elevated concentrations of several contaminants in soil, sediment, and surface water have the potential to adversely impact wildlife at the Site. The potential COECs include several metals, PAHs, pesticides, phthalates, VOCs, PCBs, and dioxins/furans.

For both mammals and birds, PRGs were developed based on the lowest ESV across feeding guilds. Although risk estimates in the initial BERA presented HQs based on both no-effect and low-effect levels, for the purposes of developing PRGs, a single PRG was calculated based on an estimate of the effects threshold, which was estimated as the geometric mean of the no-effect and low-effect levels.

For aquatic receptors exposed to surface water (e.g., fish, water column-dwelling invertebrates, amphibians), the surface water PRG was set equal to chronic ESV.

For sediment-dwelling invertebrates, the sediment PRG was selected in consideration of all supporting lines of evidence (i.e., HQs, SEM/AVS evaluation, cumulative PAH evaluation). Although the HQ results have the highest uncertainty, the PEC HQ results were supported by both the SEM/AVS evaluation and the cumulative PAH evaluation. Therefore, the sediment PRG was set equal to the PEC-based ESV.

Based on the approaches described above, the resulting risk-based ecological PRGs for each COEC and each exposure scenario are presented in Text Table 3.3. Notice that the aquatic receptor PRGs for lead in surface water are dependent on hardness, which varies by location. Chronic PRGs for dissolved lead in surface water range from 0.59 to 8.41 µg/L depending upon the location.

Text Table 3.3 Ecological PRGs

COEC	Ecological PRG	PRG Basis
Soil/Waste Piles: Direct Contact		
Terrestrial Plants (mg/kg)		
Arsenic	*40*	*Threshold Based Soil PRG Low effect HQ ≥ 1*
Barium	*169*	
Chromium (total)	*2.0*	
Chromium VI	*2.0*	
Copper	*185*	
Lead	*262*	
Manganese	*492*	
Selenium	*1.2*	
Zinc	*360*	
Acenaphthene	*0.7*	
Anthracene	*7.8*	
Naphthalene	*3.2*	
Soil Invertebrates (mg/kg)		
Arsenic	*64*	*Threshold Based Soil PRG Low effect HQ ≥ 1*
Chromium (total)	*1.2*	
Chromium VI	*1.2*	
Copper	*206*	
Mercury	*0.2*	
Zinc	*334*	
Fluoranthene	*15*	
Phenanthrene	*8.1*	
Pyrene	*14*	
Surface Water: Direct Contact		
Aquatic Receptors[1] (µg/L)		
Aluminum	*87*	*Chronic Surface Water PRG[5] Chronic HQ ≥ 1*
Barium	*4.0*	
Beryllium	*0.7*	
Iron	*1,000*	
Lead	*H-dep*	
Manganese	*120*	
gamma-Chlordane	*0.0043*	
Sediment: Direct Contact		

Text Table 3.3 Ecological PRGs			
COEC	**Ecological PRG**		**PRG Basis**
Aquatic Invertebrates[2] (mg/kg)			
Chromium (total)	*111*		*PEC-based Sediment PRG[6]* *PEC HQ ≥ 1* *SEM/AVS Eval.* *Cum. PAH Eval.*
Copper	*149*		
Lead	*128*		
alpha-Chlordane	*0.017*		
Chlordane (total)	*0.018*		
gamma-Chlordane	*0.017*		
Aroclor-1254	*0.34*		
Benz(g,h,i)perylene	*0.25*		
Butyl benzyl phthalate	*1.0*		
Di-n-butyl phthalate	*0.11*		
Total LMW PAHs	*1.2*		
Total HMW PAHs	*2.3*		
Soil/Waste Pile: Ingestion and Terrestrial Diet[3]			
Terrestrial Feeding Wildlife (mg/kg)			
	Mammals	***Birds***	
Antimony	*2.5*	*NA*	*Threshold-based Soil PRG* *Low-effect HQ ≥ 1*
Arsenic	*24*	*80*	
Barium	*4,171*	*930*	
Cadmium	*1.1*	*1.1*	
Chromium (total)	*630*	*41*	
Copper	*59*	*35*	
Lead	*98*	*16*	
Manganese	*4,648*	*1,873*	
Mercury	*5.4*	*0.041*	
Nickel	*14*	*40*	
Selenium	*0.79*	*1.0*	
Vanadium	*413*	*8.6*	
Zinc	*278*	*74*	
Dieldrin	*0.0066*	*0.12*	
Aroclor-1248	*0.023*	*0.13*	
Aroclor-1254	*1.0*	*0.13*	
Benzo(a)anthracene	*11*	*2.3*	
Chrysene	*10*	*NA*	
bis(2-ethylhexyl) phthalate	*1.9*	*0.063*	
Di-n-butyl phthalate	*285*	*0.035*	
Tetrachloroethene	*0.4*	*NA*	
Xylenes (total)	*2*	*130*	
Dioxin/Furan TCDD-TEQ	*7.4E-07*	*1.2E-05*	
PCB TCDD-TEQ	*7.4E-07*	*1.2E-05*	
Sediment: Ingestion and Aquatic Diet[3]			
Aquatic Feeding Wildlife[4] (mg/kg)			
	Mammals	***Birds***	
Cadmium	*0.95*	*1.2*	*Threshold-based Sediment, PRG* *Low-effect HQ ≥ 1*
Copper	*63*	*40*	
Lead	*156*	*37*	

Text Table 3.3 Ecological PRGs			
COEC	**Ecological PRG**		**PRG Basis**
Mercury	*6.3*	*0.054*	
Nickel	*17*	*98*	
bis(2-ethylhexyl) phthalate	*2.1*	*0.082*	
Di-n-butyl phthalate	*321*	*0.044*	
Dioxin/Furan TCDD-TEQ	*8.5E-07*	*NA*	
Surface Water and Fish Ingestion			
Piscivorous Wildlife (µg/L)			
	Mammals	*Birds*	
Aluminum	*57*	*936*	*Threshold-based Surface Water PRG[7] Low-effect HQ ≥ 1*
Selenium	*0.30*	*0.54*	

Notes:
[1]Includes fish, water,-column-dwelling invertebrates, aquatic plants, and amphibians.
[2]Includes sediment dwelling invertebrates.
[3]Terrestrial dietary items include terrestrial plants, soil invertebrates, and small mammals.
[4]Aquatic dietary items include emerging aquatic insects.
[5]Applicable to the dissolved fraction for metals.
[6]PEC was selected as the appropriate PRG basis based on the two supporting lines of evidence (i.e. SEM/AVS evaluation, cumulative PAH evaluation).
[7]Applicable to the total recoverable fraction for metals.
COEC = Chemical of Ecological Concern
PRG = Preliminary Removal Goal
H-dep: PRG is dependent on hardness, which varies by location. Chronic PRGs range from 0.59 to 8.41 µg/L.
NA: No toxicity data available.
mg/kg: milligrams per kilogram
µg/L: micrograms per liter

Similar to human health, in the ERA, risk evaluations are conducted on an exposure area basis. For each exposure area, risk estimates were developed based on an EPC, which was usually computed as the 95UCL on the mean and encompassed the entire exposure area. Likewise, the risk-based ecological PRG also should be applied on an exposure area basis and evaluated in terms of the 95UCL on the mean (i.e., the risk-based PRG should not be interpreted as a not-to-exceed threshold) and any post-removal confirmation sampling will need to consider these risk-based objectives.

4. Identification and Analysis of Applicable or Relevant and Appropriate Requirements

The purpose of Section 4 is to identify ARARs for the Site. ARARs include standards, requirements, criteria, or limitations under federal, or more stringent State, environmental law, CERCLA Section 121 (d)(2)(A), which states that a remedial action selected for a CERCLA site shall attain a degree of cleanup which assures protection of human health and the environment and attains “legally applicable or relevant and appropriate standard(s), requirement(s), criteria, or limitation(s).” The NCP also compels attainment of ARARs during removal actions to the extent practicable, considering the exigencies of the situation. See 40 CFR § 300.415(i) and § 300.435(b)(2).

To be adopted as an ARAR at an NPS CERCLA site, NPS must determine that the requirement is either “applicable” to conditions at the Site or, if not applicable, that it is both “relevant” and “appropriate” based on Site conditions. Applicable requirements are cleanup obligations, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or more stringent state laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a site. Relevant and appropriate requirements are requirements, criteria, or limitations that, while not “applicable,” address problems or situations sufficiently similar to those encountered at a site that their use is well suited to the site. Any requirement, or portion thereof, that is determined by the lead agency to be a relevant and appropriate requirement must be attained by a selected remedy to the same degree as if it were determined to be an applicable requirement. In addition, State requirements are ARARs only if they are identified by the State in a timely manner.

The identification of ARARs is a prerequisite to evaluating and selecting a cleanup action (USEPA 1992b). “Under circumstances where a non-time-critical removal action is expected to be the first and final action at the Site, the selected removal action must satisfy all adopted ARARs” (USDOI 2016). The ARARs for the Jaite Site are federal and Ohio laws and regulations that will be used to: (1) evaluate the appropriate and necessary extent of Site cleanup; (2) define and formulate removal action alternatives; and (3) govern implementation and operation of the selected response action. Only the substantive requirements of these ARARs must be attained for on-Site response actions. Compliance with administrative, procedural, and permitting requirements is not required for on-Site actions.

Other factors “to be considered” (TBCs) are non-promulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments that may provide useful information or recommended procedures. TBCs are not enforceable and a response action is not required to attain TBCs, but TBCs may be appropriate in shaping or guiding the development or implementation of a response action in certain circumstances, for example, where ARARs do not provide sufficient direction. Chemical-specific TBC values, such as health advisories and reference doses, are used in the absence of ARARs or where ARARs are not sufficiently protective to develop cleanup levels.

There are four basic criteria that define ARARs (NPS 2015; USEPA 1988). ARARs are (1) substantive rather than administrative, (2) applicable or relevant and appropriate, (3) promulgated, and (4) categorized as one of the following.

- **Chemical-specific ARARs and TBCs -** Define health- or risk-based numerical values or methodologies that represent cleanup standards or processes that are used to establish numerical values for specific hazardous substances, pollutants, or contaminants. Chemical-specific ARARs often drive the magnitude and extent of the removal action.

- **Location-specific ARARs and TBCs -** Restrict (1) the concentrations of hazardous substances, pollutants, or contaminants (e.g., Resource Conservation and Recovery Act land disposal restrictions prohibiting disposal of hazardous waste into landfills) or (2) the conduct of activities in sensitive areas (e.g., floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present). Location-specific ARARs often focus on protecting resources in a specific area; therefore, NPS-specific ARARs fall within this category.

- **Action-specific ARARs and TBCs -** Technology- or activity-based requirements or limitations on actions conducted relative to specific hazardous substances, pollutants, or contaminants (i.e., restrictions on specific removal action alternatives or how those alternatives are implemented). Action-specific ARARs do not determine the removal action alternative; rather, they indicate how a selected alternative must be implemented.

Chemical-specific ARARs apply to specific chemicals and their concentrations in specific media in the environment. Thus they are used when developing clean-up levels. Location-specific ARARs are applicable or relevant and appropriate due to the location of the site, so do not provide standards for clean-up concentrations, although the location in some cases would determine which chemical-specific ARAR to apply. For example, the location of a site may dictate what groundwater classification applies which therefore determines the chemical-specific concentration that would be the applicable standard. Action-specific ARARs relate to the physical actions that will be required to implement the remedial action. There will be situations where a particular requirement could fall into two or more categories.

Pursuant to its delegated CERCLA lead agency authority, NPS has identified ARARs and TBCs for the former Jaite Paper Mill EE/CA. The results of the ARARs analysis, including state ARARs, are summarized in the following Text Tables 4.1, 4.2, and 4.3.

4.1. Chemical-Specific ARARs

The potential chemical-specific ARARs identified for the Site (listed in Text Table 4.1) are typically numerical values or methodologies that establish, or contribute to the establishment of, the acceptable amount or concentration of a contaminant that may be found in, discharged to, or left remaining in the ambient environment. NPS has identified potential chemical-specific ARARs that might pertain to any of the removal action alternatives under consideration.

Text Table 4.1 Chemical-Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
FEDERAL				
1	**Standards for Polychlorinated Biphenyl (PCB) storage and disposal (Toxic Substances Control Act [TSCA]) – Cleanup Levels and Decontamination Standards**	15 USC § 2601 *et seq;* 40 CFR Part 761, Subpart D	PCBs have been detected in Site soil at the Jaite Paper Mill Site. 40 CFR §761.61 specifies cleanup and disposal options for PCB remediation waste. The term "bulk PCB remediation waste" includes the following non-liquid PCB remediation waste: soil, sediments, dredged materials, and muds. 40 CFR §761.61(a)(4)(i). 40 CFR §761.61(a)(4)(i) specifies cleanup levels for bulk remediation waste based on land use occupancy and PCB concentration levels. In high occupancy areas, the cleanup level for bulk PCB remediation waste is less than or equal to 1 mg/kg without further conditions. High occupancy areas where bulk PCB remediation waste remain at concentrations greater than 1 mg/kg and less than or equal to 10 mg/kg must be covered with a cap that meets TSCA requirements [40 CFR §761.61(a)(4)(i)(A)]. 40 CFR §761.61(a)(4)(vi) provides that more stringent cleanup levels may be required based on proximity to areas such as national parks, wetlands, and endangered species habitats.	Applicable
2	**PCB spill cleanup policy under the TSCA**	40 CFR §761.125	PCBs have been detected in Site soil at the Jaite Paper Mill Site. 40 CFR §761.125 contains decontamination limits that apply to PCB cleanups.	TBC
3	**Federal Ambient Water Quality Criteria**	Clean Water Act 33 U.S.C § 1314, 40	Sets criteria for water quality based on toxicity to aquatic organisms and humans.	Applicable except where Ohio standards are more stringent.

Text Table 4.1 Chemical-Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		CFR Part 131		
4	**Water Quality Criteria for the Great Lakes System**	33 U.S.C. § 1251 *et seq.*; 40 CFR Part 132	Sets criteria to evaluate the Great Lakes States (including Ohio) water quality programs and to require Great Lakes States to adopt provisions consistent with this regulation to waters in the Great Lakes System.	Applicable
5	**National Primary Drinking Water Standards, Maximum Contaminant Levels (MCLs)**	Safe Drinking Water Act 42 U.S.C. §§ 300f *et seq.*, 40 CFR Part 141	Human health-based drinking water standards, MCLs for public water systems.	Relevant and Appropriate
6	**National Secondary Drinking Water Standards, Secondary MCLs**	Safe Drinking Water Act, 42 U.S.C. §§ 300f *et seq.*, 40 CFR Part 143	Establishes aesthetic drinking water standards (secondary MCLs) for public water systems.	Relevant and Appropriate
7	**Federal Water Pollution Control Act (CWA)**	33 USC § 1251-1387; 40 CFR 132	The Clean Water Act promulgates Water Quality Standards for surface waters. Such water quality standards include criteria for contaminants of concern at the Jaite Paper Mill Site. In addition, Section 118 outlines Great Lakes Water Quality guidance and remedial action plans for identified areas of concern (33 USC 1268).	Applicable
8	**NPS guidance on ecological screening values for soil, sediment, groundwater, and surface water.**	NPS Protocol for Selection and Use of Ecological Screening Values for Non-radiological Analytes	Risk-based screening values to be used for screening level ecological risk assessments.	TBC

Text Table 4.1 Chemical-Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
9	**USEPA regional screening levels for chemical contaminants**	https://www.epa.gov/risk/regional-screening-levels-rsls	Risk-based screening levels to be used for contaminant screening of environmental media in USEPA Region 5.	TBC
10	**USEPA guidance on role of ARARs in establishing Remediation Goals**	"Clarification of the Role of ARARs in Establishing Preliminary Remediation Goals Under CERCLA," OSWER Directive No. 9200.4-23 (August 22, 1997)	Clarifies that the lead agency may establish remediation goals at levels more protective than required by ARARs, after considering the level of risk associated with application of the ARAR, the soundness of the technical basis for the ARAR, and other factors relating to the ARAR or to its application at an individual site.	TBC
STATE				
11	**Division of Surface Water (DSW) - Analytical Methods and availability of documents**	OAC 3745-1-03	Specifies analytical methods and collection procedures for surface water discharges. Applies to both discharges to surface waters as a result of remediation and any on-Site surface waters affected by Site conditions.	Applicable
12	**DSW – Beneficial use designations and biological criteria**	OAC 3745-1-07 (C)	Establishes water quality criteria for pollutants which do not have specific numerical or narrative criteria identified in Tables 7.1 through 7.15 of this rule. Applies to both discharges to surface waters as a result of remedial action and any surface waters affected by Site conditions.	Applicable
13	**DSW – Cuyahoga River drainage basin**	OAC 3745-1-26	Establishes water use designations for stream segments within the Cuyahoga River basin. Applicable because the Cuyahoga River and Brandywine Creek are on-Site and either affected by Site conditions or if the selected remedy	Applicable

Text Table 4.1 Chemical-Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
			includes direct discharge.	
14	**DSW – Water quality criteria for water supply use designations.**	OAC 3745-1-33 (A-E)	Establishes water quality standards for bodies of water draining into Lake Erie Basin. Used by DSW to establish discharge limits from the Cuyahoga River and Brandywine Creek.	Applicable
15	**HW – Alternative land disposal restriction treatment standards for contaminated soil**	OAC 3745-270-49 (A-E)	Specifies standards for soil treatment where contaminated soils are generated.	Applicable
16	**VAP – Generic numerical standards for soils**	OAC 3745-300-08	Generic Numerical standards for hazardous substances and petroleum cleanups of soil.	Applicable where Ohio standards are more stringent than federal or risk based standards.
17	**APC -- Asbestos Emission Control**	OAC 3745-20-03 through 3745-20-05	Asbestos emission control standards for the removal of asbestos containing materials.	Applicable
18	**DSW – Lake Erie Drainage Basin**	OAC 3745-1-33	Establishes water use designations for stream segments within the Lake Erie drainage basin.	Applicable

Notes:
OAC = Ohio Administration Code

4.2. Location-Specific ARARs

The potential location-specific ARARs identified for the Site (listed in Text Table 4.2) are levels or standards of control related to Site hazardous substances, the design or implementation of response activities, or the specific location of the Site. Federal and state laws and regulations often exist to protect the resources in certain kinds of locations, such as national parks, wilderness areas, historic and cultural resource areas, wetlands, and other areas with sensitive species, ecosystems, and floodplains. Because the Site is located in the Cuyahoga Valley National Park, many of the location-specific ARARs presented in this section are derived from the laws and regulations of NPS.

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site

Item No.	Standard requirement, criteria, or limitation	Citation	Requirement Description	Applicable, Relevant and Appropriate, or To Be Considered (TBC)
FEDERAL				
1	**National Park Service (NPS) Organic Act of 1916, as amended** **Non-impairment Mandate**	54 USC §100101(a), et seq.	The NPS Organic Act of 1916 (54 USC § 100101(a) (2015) (recodified in 2014)) (the "Organic Act") created the NPS and remains the fundamental legal authority guiding NPS land management decisions. The Organic Act mandates that NPS manage units of the national park system so as "to conserve the scenery, natural and historic objects, and wildlife in the [national park system] units and to provide for the enjoyment of the scenery, natural and historic objects, and wildlife in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." This non-impairment mandate is additionally codified at 36 CFR 1.1(b), which states "[t]hese regulations will be utilized to……conserve scenery, natural and historic objects, and wildlife, and to provide for the enjoyment of those resources in a manner that will leave them unimpaired for the enjoyment of future generations."	Applicable
2	**National Park System General Authorities Act, as amended**	54 USC §100101(b)	The General Authorities Act further provides that "the protection, management, and administration of the System units shall be conducted in light of the high public value and integrity of the System and shall not be exercised in derogation of the values and purposes for which the System units have been established" The Organic Act and the statute or statutes establishing CVNP do not allow permanent or long-term restrictions on public access to NPS resources as a component of the selected response	Applicable

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
			action.	
3	**National Park Service regulations – non-impairment**	36 CFR §§1.1	The NPS regulation at 36 CFR §1.1 incorporates the non-impairment mandate into all of the NPS regulations. "§ 1.1 (a) The regulations in this chapter provide for the proper use, management, government, and protection of persons, property, and natural and cultural resources within areas under the jurisdiction of the National Park Service. (b) These regulations will be utilized to fulfill the statutory purposes of units of the National Park System: to conserve scenery, natural and historic objects, and wildlife, and to provide for the enjoyment of those resources in a manner that will leave them unimpaired for the enjoyment of future generations."	Applicable
4	**NPS policy on implementation of the non-impairment mandate**	2006 NPS Management Policies §1.4 Find at: https://www.nps.gov/policy/mp2006.pdf	NPS management policies (MP) to implement the Organic Act: **NPS MP §1.4.3: The NPS Obligation to Conserve and Provide for Enjoyment of Park Resources and Values -** "The fundamental purpose of all parks ... includes providing for the enjoyment of park resources and values by the people of the United States." **NPS MP §1.4.4: The Prohibition on Impairment of Park Resources and Values –** NPS discretion to allow impacts is "limited by the statutory requirement" that NPS must "leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise." **NPS MP §1.4.5: What Constitutes Impairment of Park Resources and Values --** "The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that . . . would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
			impact in question and other impacts..." "An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is: • Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park, or • Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park, or • Identified in the park's general management plan or other relevant NPS planning documents as being of significance. An impact would be less likely to constitute an impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or values and it cannot be further mitigated." (NPS 2006, § 1.4.5). **NPS MP §1.4.6** describes the "park resources and values" subject to non-impairment. **NPS MP §1.4.7** provides that "[b]efore approving a proposed action that could lead to an impairment of park resources and values, an NPS decision-maker must consider the impacts of the proposed action and determine, in writing, that the activity will not lead to an impairment of park resources and values. If there would be an impairment, the action must not be approved" (NPS 2006, § 1.4.7). "If it determined that there is, or will be, an impairment, the decision-maker must take appropriate action, to the extent possible within the Service's authorities and available resources, to eliminate the impairment . . . as soon as reasonably possible. . . " *Id.*	
5	**Legislation Establishing Cuyahoga Valley National Park (CUVA)**	Public Law 93-555	Establishes the Cuyahoga Valley National Park and sets forth its purpose of "preserving and protecting for public use and enjoyment, the historic, scenic, natural, and recreational values of the Cuyahoga River and the adjacent lands of the Cuyahoga Valley and for the purpose of providing for the maintenance of needed recreational open space necessary to the urban environment… In the management of the recreation area, the Secretary of	Applicable

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
			the Interior…shall utilize the recreation area resources in a manner which will preserve its scenic, natural, and historic setting while providing for the recreational and educational needs of the visiting public."	
6	**Restrictions on Solid Waste Disposal Sites in National Parks**	54 USC §100903	This statute prohibits operation of any solid waste disposal site that was not in operation on September 1, 1984, except for sites used only for disposal of wastes generated within that System unit, so long as such site will not degrade any natural or cultural resources of the System unit. Applies to the creation and operation of any solid waste disposal site within the Park's boundaries (including on-Site disposal of Site remediation waste).	Applicable
7	**Solid Waste disposal regulations in National Parks**	36 CFR Part 6	36 CFR § 6.4 specifies 12 conditions that must be met before a new solid waste disposal site may be authorized in a National Park, including the conditions that "[t]here is no reasonable alternative site outside the boundaries of the unit suitable for solid waste disposal;" and that there will be no disposal at the site of solid waste containing hazardous waste or polychlorinated biphenyls (PCBs)."	Applicable
8	**National Park Service regulations – notice and access**	36 CFR §§1.5 and 1.7	36 CFR §1.5 regulates when and how NPS may impose Park closures and public access limitations, and 36 CFR §1.7 sets forth NPS public notice requirements for such closures and access limitations.	Applicable
9	**NPS Restrictions of Public Use and Recreation Activities to Protect National Park Resources**	36 CFR Part 2 Special Regulations, Areas of the National Park System	NPS 36 CFR Part 2 regulations prohibit specific public use and recreational activities in national parks in order to protect park resources. 36 CFR 2.1(a) prohibits "(1) Possessing, destroying, injuring, defacing, removing, digging, or disturbing from its natural state: (i) . . . wildlife or fish. . . . (ii) Plants or the parts or products thereof. . . . [or] (2) Introducing . . . plants . . . into a park area ecosystem." Section 2.2(a)(2) prohibits "feeding, touching, teasing, frightening or intentional disturbing of wildlife nesting, breeding or other activities." Section 2.14(a) prohibits "(1) Disposing of refuse in other than refuse receptacles . . . and (6) Polluting or contaminating park area waters or water courses."	Relevant and appropriate

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
10	**Restrictions of Public Use and Recreation Activities at CUVA**	36 CFR Part 7.17	CUVA-specific public use and recreational rules. 36 CFR Part 7.17 states, among other things, that "(3) The Superintendent may open or close authorized trails, or portions thereof, or impose conditions or restrictions for bicycle use after taking into consideration public health and safety, natural and cultural resource protection, and other management activities and objectives. (i) The Superintendent will provide public notice of all such actions through one or more of the methods listed in § 1.7 of this chapter. (ii) Violating a closure, condition, or restriction is prohibited."	Applicable
11	**Cuyahoga Valley National Park General Management Plan**	16 U.S.C. §§ 460ff-460ff-5 Subchapter XC	Establishes requirements for management of CUVA. Does not allow permanent or long-term prohibition of public access to Site. Also contains requirements regarding erosion, ecological degradation, and restoration.	Applicable
12	**NPS Policies for Restoration of Natural Systems**	2006 NPS MP §4.1.5 Find at: https://www.nps.gov/policy/mp2006.pdf	Section 4.1.5 provides: "The Service will reestablish natural functions and processes in parks unless otherwise directed by Congress. Landscapes disturbed by natural phenomena, such as landslides, earthquakes, floods, hurricanes, tornadoes, and fires, will be allowed to recover naturally unless manipulation is necessary to protect other park resources, developments, or employee and public safety. Impacts on natural systems resulting from human disturbances include the introduction of exotic species; the contamination of air, water, and soil; changes to hydrologic patterns and sediment transport; the acceleration of erosion and sedimentation; and the disruption of natural processes. The Service will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology, within available resources, to restore the biological and physical components of these systems, accelerating both their recovery and the recovery of the landscape and biological community structure and function."	TBC
13	**NPS Policies for Managing Wildlife and Plant Resources**	2006 NPS MP §4.4.1 https://www.nps.gov/policy/mp2	Section 4.4.1 provides that the NPS "…will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems…" by "….preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		006.pdf	and the communities and ecosystems in which they occur; restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them."	
14	**NPS Policies for Managing Species of Special Concern**	2006 NPS MP §4.4.2.3 https://www.nps.gov/policy/mp2006.pdf	Section 4.4.2.3 requires that the NPS "…inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible." The NPS is also required to "…inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or unique species and their habitats) and manage them to maintain their natural distribution and abundance."	TBC
15	**NPS Policies Concerning Surface Water and Ground Water Quality**	2006 NPS MP §4.6.3 https://www.nps.gov/policy/mp2006.pdf	Section 4.6.3 states that NPS will, *inter alia*, "take all necessary actions to maintain or restore the quality of surface waters and groundwaters within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations...."	TBC
16	**Avoiding adverse impacts to floodplains**	Executive Order No. 11988	Executive Order No. 11988 requires that federally-funded or authorized actions within the 100-year floodplain avoid, to the maximum extent possible, adverse impacts associated with development of a floodplain.	TBC
17	**NPS Policies Concerning Floodplains**	2006 NPS MP §4.6.4 https://www.nps.gov/policy/mp2006.pdf NPS DO #77-2: Floodplain Management; https://www.nps	Section 4.6.4, DO #77-2, and Procedural Manual #77-2 implement E.O 11988. Section 4.6.4 provides that NPS will "protect, preserve, and restore the natural resources and functions of floodplains; avoid the long-and short-term environmental effects associated with the occupancy and modification of floodplains; and avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks."	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		.gov/policy/DOrders/DO_77-2.pdf NPS Procedural Manual #77-2: Floodplain Management https://www.nature.nps.gov/rm77/floodplain.cfm		
18	**Protection of Wetlands**	Executive Order No. 11990	Requires consideration of impacts to wetlands in order to minimize their destruction, loss or degradation and to preserve/enhance wetland values. The Jaite Paper Mill Site contains wetlands, and impacts must be considered when selecting a response action for the Site.	TBC
19	**NPS Policies Concerning Wetlands**	2006 NPS MP §4.6.5 https://www.nps.gov/policy/MP2006.pdf NPS DO #77-1: Wetland Protection; https://www.nps.gov/policy/DOrders/DO77-1- Reissue.html NPS Procedural Manual #77-1:	Section 4.6.5, DO #77-1, and Procedural Manual (PM) #77-1 implement Executive Order No. 11990 concerning the protection of wetlands. Among other important things, in PM #77-1, NPS adopts the "*Classification of Wetlands and Deepwater Habitats of the United States*" (FWS/OBS-79/31; Cowardin et al. 1979) standards for defining, classifying, and inventorying wetlands. These standards encompass more aquatic habitat types than the definition and delineation manual used by the Army Corps of Engineers for identifying wetlands subject to Section 404 of the Clean Water Act. DO #77-1 directs NPS to avoid direct or indirect support of new construction in wetlands unless there are no practicable alternatives to such construction and the proposed action includes all practicable measures to minimize harm to wetlands, with the goal of no net loss of wetlands. The Jaite Paper Mill Site contains wetlands, and impacts must be considered when selecting a response action for the Site.	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		Wetland Protection (January 2012) https://www.nature.nps.gov/water/wetlands/Wetlands_Protection_Manuals.cfm		
20	**NPS Policies for Importation of Soil During Site Restoration**	2006 NPS MP §4.8.2.4 https://www.nps.gov/policy/mp2006.pdf	Section 4.8.2.4 allows importation of off-site soil or soil amendments to restore damaged sites. It provides that "off-site soil normally will be salvaged soil, not soil removed from pristine sites, unless the use of pristine site soil can be achieved without causing any overall ecosystem impairment. Before using any off-site materials, parks must develop a prescription and select the materials that will be needed to restore the physical, chemical, and biological characteristics of original native soils without introducing exotic species."	TBC
21	**NPS Policies for Managing Cultural Resources**	2006 NPS MP §5f https://www.nps.gov/policy/mp2006.pdf	Section 5f addresses research on cultural resources and traditional associated peoples; planning to ensure that management processes "integrate information about cultural resources and provide for consultation and collaboration with outside entities;" and preservation, protection, and the making available for public understanding of cultural resources.	TBC
22	**NPS Policies Concerning Revegetation and Landscaping**	2006 NPS MP §9.1.3.2 https://www.nps.gov/policy/mp2006.pdf	Section 9.1.3.2 requires that, to the maximum extent possible, plantings selected for revegetation will consist of species that are native to the park, and that low water use practices should be employed. This provision also addresses use of fertilizers and other soil amendments.	TBC
23	**NPS Policies Concerning Waste Management and Contaminant Issues**	2006 NPS MP §9.1.6- https://www.nps	Section 9.1.6.1 (Waste Management) states that all disposal of solid waste on lands and waters within the boundaries of a park system unit must comply with the regulations in 36 CFR Part 6 (see above), and further states	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		.gov/policy/mp2006.pdf	that NPS will "remove landfill operations and associated impacts from parks where feasible." Section 9.1.6.2 (NPS Response to Contaminants) provides that NPS "will make every reasonable effort to prevent or minimize the release of contaminants on or that will affect NPS lands or resources, and ….. will take all necessary actions to control or minimize such releases when they occur." This section further provides that NPS "will identify, assess and take response actions as promptly as possible to address releases and threatened releases of contaminants into the environment." Contaminants are broadly defined to include "any substance that may pose a risk to NPS resources or is regulated or governed by statutes referenced in this subsection."	
24	**NPS Policies Concerning Climate Change**	NPS Policy Memorandum (PM) 15-01, "Addressing Climate Change and Natural Hazards" (Jan. 20, 2015) and accompanying Level 3 Handbook PM 12-02, "Applying NPS Management Policies in the Context of Climate Change" (March 6, 2012) https://www.nps	**NPS Policy Memorandum (PM) 15-01** and its accompanying Handbook provide guidance on the design of facilities in national parks to incorporate impacts of climate change and natural hazards.PM 15-01 is the third "policy pillar" of the Service-wide climate change response, joining **NPS PM 12-02** addressing the implications of climate change on the guiding principles of NPS natural resource management, and **NPS PM 14-02** providing guidance on the stewardship of cultural resources in relation to climate change. PM 15-01 specifically references **NPS MP Section 9.1.1.5**, which directs NPS to "strive to site facilities where they will not be damaged or destroyed by natural physical processes," and also discusses siting considerations in areas where dynamic natural processes cannot be avoided.	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		.gov/policy/MPandCC.pdf PM 14-02, "Climate Change and Stewardship of Cultural Resources" https://www.nps.gov/policy/PolMemos/PM-14-02.htm 2006 NPS MP §9.1.1.5 https://www.nps.gov/policy/MP2006.pdf		
25	**NPS Employee Guidance for Managing Cultural Resources**	NPS DO #28: Cultural Resource Management NPS-28: Cultural Resource Management Guideline	DO #28 provides that: "[t]he NPS will protect and manage cultural resources in its custody through effective research, planning, and stewardship and in accordance with the policies and principles contained in the NPS *Management Policies[,]*" (Section 3.1) and requires that the NPS comply with the Secretary of the Interior's Standards and Guidelines for Archeology [stet] and Historic Preservation (Section 3.2). "NPS-28: Cultural Resource Management Guideline" addresses park cultural resource management programs, compliance with Section 106 of the National Historic Preservation Act, and issues related to archaeological resources, cultural landscapes, structures, museum objects, and ethnographic resources. "Cultural resources" are defined as "the material evidence of past human activities" (NPS-28, Introduction).	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
26	**NPS Employee Guidance for Managing Natural Resources**	NPS Reference Manual (RM) #77 Find at: https://www.nature.nps.gov/rm77	NPS RM #77 offers comprehensive guidance to NPS employees responsible for managing, conserving, and protecting the natural resources found in park units. It addresses management of natural resources (including air; disturbed land; endangered, threatened and rare species; geologic resources; vegetation; etc.), resource uses, and planning (e.g., emergency management, and environmental compliance).	TBC
27	**National Historic Preservation Act (NHPA)**	54 USC § 300101, Chapters 3021 and 3023 (2015), and NPS Regulations at 36 CFR Parts 63 and 800	This statute and the implementing regulations direct federal agencies to consider the effects of their undertakings on historic properties included in or eligible for inclusion in the National Register of Historic Places, including the Jaite Mill Historic District and Jaite Paper Mill, and to consult with certain parties before moving forward with the undertaking. The agency must determine, based on consultation, if an undertaking's effects would be adverse and consider feasible and prudent alternatives that could avoid, mitigate, or minimize such adverse effects on a National Register or eligible property. The agency must then specify how adverse effects will be avoided or mitigated or acknowledge that such effects cannot be avoided or mitigated. These provisions would be applicable to removal action activities such as excavation or soil disturbance that could impact resources of historical or archaeological significance, including Native American cultural and historical resources.	Applicable
28	**Protection and Enhancement of the Cultural Environment**	Executive Order No. 11593 (1971)	The Jaite Mill Historic District and Jaite Paper Mill properties are on the National Register of Historic Places. Among other things, where federal action would substantially alter or demolish properties listed on the National Register of Historic Places, Executive Order No. 11593 directs federal agencies to take steps to make records of the property, and to deposit the records in the Library of Congress	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
			as part of the Historic American Buildings Survey (HABS) or Historic American Engineering Record (HAER).	
29	**Historic Sites, Buildings, and Antiquities Act of 1935, as amended, and Implementing Regulations**	54 USC §§320101 and 320102 36 CFR Part 65	The Jaite Mill Historic District and Jaite Paper Mill properties are on the National Register of Historic Places. The Act requires the consideration of the existence and location of historic and prehistoric sites, buildings, objects, and properties of historical and archeological significance when evaluating response action alternatives. 36 CFR Part 65 addresses the national Historic Landmarks Program, which aims to identify and designate National Historic Landmarks, and encourages the long range preservation of nationally significant properties that illustrate or commemorate the history and prehistory of the United States (36 CFR §65.1). These provisions would be applicable to response action activities that could impact resources of historical or archaeological significance (e.g., activities involving soil disturbance).	Applicable
30	**Archaeological and Historic Preservation Act of 1974, as amended**	54 USC Chapter 3125	The Jaite Mill Historic District and Jaite Paper Mill properties are on the National Register of Historic Places. This Act provides for the recovery, protection, and preservation of significant scientific, prehistoric, historic, and archaeological data that may be lost or destroyed through alteration of terrain as a result of federal action. May require a site survey, prior to or during field activities, for scientific, prehistoric, historic, or archaeological artifacts covered by these requirements, and preserve data related to such artifacts, should such artifacts be encountered. These provisions would be applicable to response action activities that could impact resources of historical or archaeological significance (e.g., activities involving soil disturbance).	Applicable
31	**Archaeological Resources Protection Act of 1979, as amended, and Implementing**	16 USC §470aa, §470ee	Provides for the protection of archaeological resources and sites that are at least 100 years old and located on public or tribal lands; including the establishment of criteria which must be met for the land manager's approval	Applicable

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
	Regulations	43 CFR §§7.4, 7.7, 7.18, and 7.21	of any excavation or removal of archaeological resources. 16 USC §470ee prohibits the unauthorized excavation, removal, damage, etc. of archaeological resources and the trafficking of archaeological resources. The regulations in 43 CFR Part 7 implement provisions of the Archaeological Resources Protection Act of 1979, as amended (16 USC §470aa-mm) and provide direction for Federal Land Managers. These provisions would be applicable to removal action activities that could impact or result in the excavation, damage, removal, or alteration of archaeological resources.	
32	**Native American Graves Protection and Repatriation Act (NAGPRA), as amended, and Implementing Regulations**	25 USC §3002 43 CFR §§10.3, 10.4, 10.5, 10.6	These laws and related federal authorities protect Native American graves from desecration and protect religious, ceremonial, and burial sites and the free practice of religions by Native American groups. If a site activity results in the discovery of a Native American burial site, human remains, or cultural items, the activity must be halted immediately while appropriate NPS cultural resource managers and appropriate Indian tribes are notified of the discovery; and a reasonable effort must be made to protect the Native American human remains or related objects encountered. The response activity may later resume once specified requirements are met. These laws are potentially applicable to ground-disturbing activities such as soil grading and removal.	Applicable
33	**American Indian Religious Freedom Act of 1978, as amended**	42 USC §1996	Provides for the protection and preservation for American Indians their access to sacred sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. Any response action selected for the Site shall not infringe on these rights.	Relevant and Appropriate
34	**Indian Sacred Sites**	Executive Order No. 13007	In managing federal lands, the United States "shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and (2) avoid adversely affecting the	TBC

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
			physical integrity of such sacred sites."	
35	**Fish and Wildlife Coordination Act of 1934, as amended**	16 USC §§ 661-667e 40 CFR 6.302(g)	This Act requires that any federally-funded or authorized modification of a stream or other water body must provide adequate provisions for conservation, maintenance, and management of wildlife resources and their habitat. Necessary measures should be taken to mitigate, prevent, and compensate for project-related losses of wildlife resources. Any response action selected for the Jaite Site that includes any modification of a water body will be subject to these requirements. Compliance with this ARAR necessitates NPS consultation with the U.S. Fish and Wildlife Service (USFWS). The purpose of consultation is to develop measures to prevent, mitigate, or compensate for project-related losses to fish and wildlife.	Applicable
36	**Migratory Bird Treaty Act of 1918, as amended**	16 USC §§703, 704, 705 50 CFR §10.13	This Act makes it unlawful to "take, capture, kill," or otherwise impact a migratory bird or any nest or egg of a migratory bird. Response action activities at CUVA may not take, capture, kill or otherwise impact migratory birds, such as the Cerulean Warbler and Kirtland Warbler, and associated resources.	Applicable
37	**Responsibilities of Federal Agencies to Protect Migratory Birds**	Executive Order 13186; 66 Federal Register (FR) 3853 (Jan. 10, 2001)	This Order directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act, including supporting the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions.	TBC
38	**Endangered Species Act (ESA) of 1973, as amended, and Implementing Regulations**	16 USC §§1536 and 1538 50 CFR §§17.21, 17.31 to 17.47, 17.61, 17.71, 17.94 to 17.96,	The ESA makes it unlawful to remove or "take" threatened and endangered plants and animals and protects their habitats by prohibiting certain activities. Based on NPS consultation with the United States Fish and Wildlife Service, several species within the two Ohio counties that are part of the Jaite Paper Mill Site are endangered, threatened, or species of concern. They include: Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E), rufa red knot (T), and bald eagle	Applicable

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		and §§402.10 to 402.16	(SC). Any response action selected for the Jaite Site shall not result in the taking of, or adverse impacts to, threatened and endangered species or their habitats, as determined based on consultation with the Fish and Wildlife Service under Section 7 of the ESA.	
39	**Bald and Golden Eagle Protection Act of 1940, as amended**	16 USC §668, §668a 50 CFR §22.2, §22.12	The Eagle Act identifies criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Eagle Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." Bald Eagles and their nests are frequently observed at CUVA. Any response action selected for the Site shall not result in the violation of this Act.	Applicable
40	**Resource Conservation and Recovery Act (RCRA) restrictions on Location of Solid Waste Disposal Sites (Siting Requirements)**	40 CFR §§257.3 to 257.3-8 40 CFR §§258.10 to 258.16	40 CFR Part 257 prohibits solid waste disposal facilities from adversely impacting floodplains, endangered or threatened species or their habitat, surface water quality, and underground drinking water quality. 40 CFR §§258.10 - 258.15 require waste management units to be constructed and maintained to avoid fault areas, seismic impact zones, and unstable areas; and prohibit the location of new facilities within 61 meters (200 feet) of a fault which has had displacement in Holocene time. Applicable to on-site management of solid waste (Subtitle D). May be relevant and appropriate to activities that involve on-site placement or disposal of waste, where these activities are not regulated under these sections and where the type of substances regulated by the requirement and the substances affected by the CERCLA action are the same or similar.	Applicable
41	**Rivers and Harbors Act of 1899**	33 U.S.C. §401 *et. seq.;* 33 CFR Parts	Section 10 of the Rivers and Harbors Act prohibits unauthorized obstruction or alteration of navigable waters. Regulated activities include the placement/removal of structures, work involving dredging, disposal of	Applicable

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		114,115,116,321, 322, and 333. Section 404/Section 10	dredged material, filling, excavation, or any other disturbance of soils/sediments or modification of a navigable waterway. The Cuyahoga River is a navigable waterway. Any response action must not result in an unauthorized obstruction or alteration of the River.	
42	**Section 404 of the Clean Water Act**	33 U.S.C. § 1344(b)(1) 40 CFR Parts 230 and 231	Prohibits the discharge of dredged or fill material into waters of the United States. The selection and design of a response action must comply with these restrictions.	Applicable
43	**Clean Water Act – discharges into wetlands or surface water**	33 U.S.C. § 1251 et seq.; 40 CFR Part 122.21	The objective of 33 U.S.C. §1251 et seq. is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. 40 CFR 122.21 requires a National Pollutant Discharge Elimination System (NPDES) permit for discharging any pollutant into surface waters, including wetlands. An on-site discharge from a CERCLA site to surface waters must meet the substantive NPDES requirements; an off-site discharge from a CERCLA site must meet both the substantive and procedural NPDES requirements.	Applicable
STATE				
44	**ODNR – Injuring or removing endangered or threatened plant**	ORC 1518.02	Endangered plant species – prohibits removal or destruction of threatened or endangered plant species. Establishes that receptor plant species must be considered in risk assessments. This act may require consideration of endangered species in a response action that involves movement or displacement of large volumes of surface soil.	Applicable
45	**ODNR – List of endangered and threatened species of native Ohio wild plants**	OAC 1501:18-1 (03,A)	List of Endangered and Threatened Species of Native Ohio Wild Plants. If, based on NPS consultation with Ohio and FWS, endangered or threatened plant species are identified at the Jaite Paper Mill Site, response action selection and design must take into consideration.	Applicable
46	**ODNR – Protection of species threatened with statewide**	ORC 1531.25	Ohio Endangered animal species -- Establishes that receptor animal species must be considered in risk assessments.	Applicable

Text Table 4.2 Location Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
	extinction			
47	**ODNR – List of endangered Ohio wild animals**	OAC 1501:31-23 (01, A-B)	List of Ohio animal species considered endangered. Based on NPS consultation with the United States Fish and Wildlife Service, several species within the two Ohio counties that are part of the Jaite Paper Mill Site are endangered, threatened, or species of concern. They include: Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E), rufa red knot (T), and bald eagle (SC).	Applicable
48	**DSW – Criteria applicable to all waters**	OAC 3745-1-04 (A,B,C,D,E)	All surface waters of the state shall be free from A) objectionable suspended solids; b) floating debris, oil and scum; C) materials that create a nuisance; D) toxic, harmful or lethal substances; E) nutrients that create nuisance growth; F) public health nuisances associated with raw or poorly treated sewage. Applies to any discharges to surface waters as a result of remediation and any on-Site surface waters affected by Site conditions.	Applicable
49	**DSW - Wetlands**	OAC 3745-1-51 (A-C)	Impacts to wetlands - Lists criteria to be protected in wetland environments.	Applicable
50	**DSW – Wetland antidegradation**	OAC 3745-1-54 (A-D)	Impacts to wetlands - Requires that all wetlands be assigned a category classification and gives criteria for classification. Discusses requirements for avoidance and minimization of wetlands damage as well as compensatory mitigation.	Applicable
51	**HW – Solid waste prohibited acts.**	OAC 3734.11(C)	Prohibits the siting of any solid waste facilities within state, national park, or national recreation areas.	Applicable

Notes:
OAC = Ohio Administration Code

4.3. Action-Specific ARARs

The potential action-specific ARARs identified for the Site (listed in Text Table 4.3) are technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances. These requirements would pertain at the Site should these specific activities be considered during evaluation of a removal action alternative or implementation of a removal action. The potential Site action-specific ARARs are discussed below.

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
FEDERAL				
1	**Criteria for solid waste disposal facilities and practices**	USEPA regulations under Resource Conservation and Recovery Act (RCRA) Subtitle D 40 CFR §§ 257.1-.3, particularly §2573.2.	These regulations set out criteria for solid waste disposal facilities and practices for avoiding adverse effects on health or the environment. The 40 CFR §257.3-2 criterion is that the facilities or practices may not cause or contribute to the taking of any endangered or threatened species. Applicable to on-site disposal of solid (non-hazardous) waste. May be relevant and appropriate to activities that involve on-site placement or disposal of waste, where these activities are not regulated under these sections and where the type of substances regulated by the requirement and the substances affected by the CERCLA action are the same or similar.	Applicable
2	**NPS Policies Concerning Waste Management and Contaminant Issues**	2006 MP §9.1.6- https://www.nps.gov/policy/mp2006.pdf	Section 9.1.6.1 (Waste Management) states that all disposal of solid waste on lands and waters within the boundaries of a park system unit must comply with the regulations in 36 CFR Part 6 (see above), and further states that NPS will "remove landfill operations and associated impacts from parks where feasible." Section 9.1.6.2 (NPS Response to Contaminants) provides that NPS "will make every reasonable effort to prevent or minimize the release of contaminants on or that will affect NPS lands or resources, and ... will take all necessary actions to control or minimize such releases when they occur." This section further provides that NPS "will identify, assess and take response actions as promptly as possible to address releases and	TBC

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	Standard requirement, criteria, or limitation	Citation	Requirement Description	Applicable, Relevant and Appropriate, or To Be Considered (TBC)
			threatened releases of contaminants into the environment." "Contaminants" are broadly defined to include "any substance that may pose a risk to NPS resources or is regulated or governed by statutes referenced in this subsection."	
3	**RCRA regulations for hazardous waste generators**	40 CFR Part 262, Subparts A to F	Persons who generate a waste must determine whether it is a hazardous waste. If RCRA-defined hazardous waste is managed at the Site, there are requirements for hazardous waste packaging, labeling, manifesting, and storage. Where Site waste is not RCRA "hazardous waste," but has hazardous constituents, discrete Subtitle C provisions may be required if the type of substances regulated by the requirement and the substances managed at the Site are the same or similar.	Applicable
4	**RCRA regulations for transporting hazardous waste**	40 CFR Part 263	Specifies requirements for transporters of hazardous waste (e.g., manifest procedures and spill response requirements).	Applicable.
5	**Regulations for managing staging piles at remediation sites.**	RCRA Subtitle C 40 CFR § 264.554	Regulations governing use of staging piles at remediation sites that are designated as corrective action management units (CAMUs). See 40 CFR § 264.552(a) for the definition of "staging pile."	Applicable
6	**Regulations for land disposal-restricted hazardous waste**	RCRA Subtitle C, 42 USC § 6924 40 CFR Part 268	Sets out prohibitions and establishes treatment standards for hazardous wastes that are subject to land disposal restrictions. Applicable to activities involving hazardous wastes that are land disposal-restricted. May be relevant and appropriate to activities that involve generation or land disposal of waste that is not regulated as hazardous but that contains hazardous constituents if the type of substances regulated by the requirement and the substances at the Site are the same or similar.	Applicable
7	**Requirements for transporting hazardous materials**	U.S. Department of Transportation	Establishes classification, packaging and labeling requirements for shipments of hazardous materials, including details on package surface	Applicable

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		(USDOT) regulations under the Hazardous Materials Transportation Act 49 CFR Parts 171 through 180	contamination and dose rate limits. Applicable to preparation of hazardous materials for transport off site, and to shipment of material, including samples, off site. May be relevant and appropriate to activities that involve transportation of materials that are not hazardous but that contain hazardous constituents, if the type of substances regulated by the requirement and the substances to be transported are the same or similar.	
8	**Regulations limiting point-source discharges of pollutants into waters of the United States**	National Pollutant Discharge Elimination System, 40 CFR Part 122	Standards for discharge of pollutants from any point source into waters of the U.S. to maintain quality consistent with public health and recreation, propagation, and protection of aquatic life and other beneficial uses of water.	Applicable
9	**Regulations limiting the discharge of storm water from industrial and construction sites**	CWA, 33 USC § 1342 40 CFR § 122.26	Regulates, among other things, the discharge of storm water from industrial and construction sites into waters of the U.S. or municipal separate storm sewer systems. Requires implementation of best management practices (BMPs), including run-on and run-off controls, sedimentation basins, etc.	Applicable
10	**Regulations limiting air emissions of particulates and dust**	42 USC §§ 7409 and 7410 National Ambient Air Quality Standards (NAAQS) – Particulates, 40 CFR Part 50	Establishes maximum concentrations for particulates and fugitive dust emissions, including standards for sulfur oxides, particulate matter, carbon monoxide, ozone, oxides of nitrogen, and lead.	Relevant and appropriate

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
11	**Regulations for limiting emissions of asbestos-containing material when managing such material**	National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR §§61.145 and 61.150	Requirements applicable to demolition where ACM may be found, as well as requirements for the collection, packaging, manifesting, and transportation of asbestos and asbestos-containing waste.	Applicable
12	**Polychlorinated biphenyl (PCB) management**	Toxic Substances Control Act (TSCA), 15 USC § 2601 40 CFR Part 761, Subpart D (Storage and disposal) particularly 40 CFR §§ 761.50(b), 761.61, 761.64, 761.79	TSCA Subpart D regulations address generation, management, and disposal of PCB waste. 40 CFR §761.50(b)(7) addresses storage and disposal of PCB, 40 CFR §761.64, storage for disposal; and 40 CFR §761.79, decontamination standards and procedures. The definition of PCB includes PCBs regulated for disposal under Subpart D.	Applicable
13	**PCB spill cleanup policy under the Toxic Substances and Control Act (TSCA)**	40 CFR Part 761, Subpart G (40 CFR §761.120 - .135)	This policy establishes guidelines for cleanup of PCB spills that occurred after May 4, 1987 and resulted from the release of materials containing PCBs in concentrations of 50 parts ion (ppm) or greater.	TBC
14	**NPS Policies Concerning Revegetation and Landscaping**	2006 MP §9.1.3.2 https://www.nps.gov/policy	This provision requires that, to the maximum extent possible, plantings selected for revegetation will consist of species that are native to the Park, and that low water use practices should be employed. This provision also	TBC

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
			addresses use of fertilizers and other soil amendments.	
STATE				
15	**DSIWM – disposal of construction and demolition debris and asbestos**	ORC 3714.13	Prohibits violations of any section of Chapter 3714 concerning construction and demolition debris disposal facilities or any rule or order issued pursuant to it. Disposal of asbestos is specifically prohibited without prior authorization. Should be considered where construction and demolition debris facilities where hazardous waste or hazardous constituents have come to be located.	Applicable
16	**HW – Prohibition on filling or grading where a hazardous waste facility was operated**	ORC 3734.02 (H)	Filling, grading, excavating, building, drilling or mining on land where hazardous waste or solid waste facility was operated is prohibited without prior authorization from the director of the Ohio EPA.	Applicable
17	**APC – Restriction of emission of fugitive dust**	OAC 3745-17-08 (A1, A2, B, D)	All emissions of fugitive dust shall be controlled at sites which will undergo grading, loading operations, demolition, clearing and grubbing and construction; utilize incineration or fuel recovery (waste fuel recovery) and may have fugitive emissions of dust.	Applicable
18	**DSIWM – Excavation onland where a hazardous waste facility was operated**	OAC 3745-27-13 (A,C)	Requires that a detailed plan be provided to describe how any proposed filling, grading, excavating, building, drilling, or mining will be accomplished on land where a hazardous waste facility or solid waste facility formerly operated. This information must demonstrate that the proposed activities will not create a nuisance or adversely affect public health or the environment. Special terms to conduct such activities may be imposed by the Director to protect the public and environment. This requirement applies to any site at which hazardous or solid waste has been managed, either intentionally or otherwise but does not pertain to areas that have had one-time leaks or spills.	Applicable
19	**HW – requirements for recyclable materials**	OAC 3745-51-	Defines recycled hazardous wastes and establishes specific exemptions for these wastes from the hazardous waste regulations. This requirement	Applicable

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	Standard requirement, criteria, or limitation	Citation	Requirement Description	Applicable, Relevant and Appropriate, or To Be Considered (TBC)
		06 (A,B,C(1))	applies to any site at which recycling of hazardous wastes may take place, at which the following materials are present: industrial ethyl alcohol, used batteries, used oil, scrap metal, petroleum products, K087 coal and coke tar sludge.	
20	**HW – Hazardous waste generation determination**	OAC 3745-52-11 (A-D)	Any person generating waste of any type (both solid and hazardous) must determine if that waste is a hazardous waste (either through listing or by characteristic).	Applicable
21	**HW APC – air pollution during hazardous waste facility operation**	ORC 3734.02 (I)	No hazardous waste facility, in the operation of the facility, shall emit any particulate matter, dust, fumes, gas, mist, smoke, vapor or odorous substance that interferes with the comfortable enjoyment of life or property or is injurious to public health.	Applicable
22	**Air Pollution Control Rules**	ORC 3704.05 (A-I)	Prohibits emission of an air contaminant in violation Sec. 3704 or any rules, permit, order or variance issued pursuant to that section of the ORC. May pertain to any site where emissions of an air contaminant occurs either as a pre-existing condition of the site or as a result of remedial activities. Should be considered for virtually all sites that require the management of solid/hazardous wastes.	Applicable
23	**Air Emissions From Hazardous Waste Facilities**	ORC 3734.02(I)	No hazardous waste facility shall emit any particulate matter, dust, fumes, gas, mist, smoke, vapor or odorous substance that interferes with the comfortable enjoyment of life or property or is injurious to public health. Pertains to any site at which hazardous waste will be managed such that air emissions may occur. Consider for sites that will undergo movement of earth or incineration.	Applicable
24	**Prohibition of Open Dumping Or Burning**	ORC 3734.03	Prohibits open burning or open dumping of solid waste or treated or untreated infectious waste. Pertains to any site at which solid waste has come to be located or will be generated during a response action.	Applicable

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
25	**Acts Of Pollution Prohibited**	ORC 6111.04	Pollution of waters of the state is prohibited. Pertains to any site which has contaminated on-site ground or surface water or will have a discharge to on-site surface or ground water.	Applicable
26	**Testing, Tracking, And Recordkeeping Requirements**	OAC 3745-270-07 (A-E)	Testing, tracking, and recordkeeping requirements for generators, treaters, and disposal facilities. For sites at which wastes are generated, stored, disposed, or treated.	Applicable
27	**Applicability Of Treatment Standards**	OAC 3745-270-40 (A-J)	Detailed listing of chemical specific land treatment standards or required treatment technologies. For sites that generate wastes or with wastes disposed on-site.	Applicable
28	**Treatment Standards Expressed As Specified Technologies**	OAC 3745-270-42 (A-D)	Lists specific treatment technologies required for specific wastes. For sites generating wastes or with on-site disposal.	Applicable
29	**Universal Treatment Standards**	OAC 3745-270-48 (A)	Gives contaminant chemical specific standards for land disposal. For sites with waste generation or on-site disposal.	Applicable
30	**Land Disposal Restriction For Contaminated Soils**	OAC 3745-270-49 (A-E)	Specifies standards for soil treatment. For sites where contaminated soils are generated.	Applicable
31	**Evaluation Of Wastes**	OAC 3745-52-11 (A-D)	Any person generating a waste must determine if that waste is a hazardous waste (either through listing or by characteristic). Pertains to sites at which wastes of any type (both solid and hazardous) are located.	Applicable
32	**Generator Identification Number**	OAC 3745-52-12 (A-C)	A generator must not store, treat dispose or transport hazardous wastes without a generator number. Pertains to sites where hazardous waste will be transported off-site for treatment, storage or disposal.	Applicable

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
33	**Hazardous Waste Manifest - General Requirements, Copies & Use**	OAC 3745-52-20, 22, 23	Requires a generator who transports or offers for transportation hazardous waste for off-site treatment, storage or disposal to prepare a uniform hazardous waste manifest. Also specifies number of copies and procedures for the use of the manifests. Pertains to sites where hazardous waste will be transported off-site for treatment, storage or disposal.	Applicable
34	**Hazardous Waste Packaging, Labeling, Marking & Placarding**	OAC 3745-52-30, 31, 32, 33 & 34	Requires a generator to package, label, mark, and placard hazardous waste in accordance with U.S. DOT regulations for transportation off-site. Also identifies maximum time periods that a generator may accumulate a hazardous waste without being considered an operator of a storage facility, and establishes standards for management of hazardous wastes by generators.	Applicable
35	**Recordkeeping Requirements, Three Year Retention**	OAC 3745-52-40 (A-D)	Specifies records that shall be kept for three years.	Applicable
36	**Annual Report**	OAC 3745-52-41 (A,B)	Requires generators to prepare annual report to Ohio Environmental Protection Agency (OEPA) for sites generating wastes for off-site shipment.	Applicable
37	**General Analysis Of Hazardous Waste**	OAC 3745-54-13 (A)	Prior to any treatment, storage or disposal of hazardous wastes, a representative sample of the waste must be chemically and physically analyzed. Pertains to any site at which hazardous waste is to be treated, stored or disposed of (or has been disposed of).	Applicable
38	**Security For Hazardous Waste Facilities**	OAC 3745-54-14 (A,B,C)	Hazardous waste facilities must be secured so that unauthorized and unknowing entry are minimized or prohibited.	Applicable
39	**Personnel Training**	OAC 3745-54-	Establishes requirements for training of personnel at hazardous waste	Applicable

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Requirement Description**	**Applicable, Relevant and Appropriate, or To Be Considered (TBC)**
		16	facilities.	
40	**Required Equipment For Hazardous Waste Facilities**	OAC 3745-54-32 (A-D)	All hazardous waste facilities must be equipped with emergency equipment, such as an alarm system, fire control equipment and a telephone or radio.	Applicable
41	**Testing & Maintenance Of Equipment; Haz Waste Facilities**	OAC 3745-54-33	All hazardous waste facilities must test and maintain emergency equipment to assure proper operation.	Applicable
42	**Access To Communications Or Alarm System; Haz Waste Fac**	OAC 3745-54-34	Whenever hazardous waste is being handled, all personnel involved shall have immediate access to an internal alarm or emergency communication device.	Applicable
43	**Arrangements/ Agreements With Local Authorities**	OAC 3745-54-37 (A,B)	Arrangements or agreements with local authorities, such as police, fire department and emergency response teams must be made. If local authorities will not cooperate, documentation of that non-cooperation should be provided.	Applicable
44	**Content Of Contingency Plan; Haz Waste Facilities**	OAC 3745-54-52 (A-F)	Hazardous waste facilities must have a contingency plan that addresses any unplanned release of hazardous wastes or hazardous constituents into the air, soil or surface water. This rule establishes the minimum required information of such a plan.	Applicable
45	**Emergency Coordinator; Hazardous Waste Facilities**	OAC 3745-54-55	At all times there should be at least one employee either on the premises or on call to coordinate all emergency response measures.	Applicable
46	**Emergency Procedures; Hazardous Waste Facilities**	OAC 3745-54-56 (A-I)	Specifies the procedures to be followed in the event of an emergency.	Applicable

Text Table 4.3 Action Specific ARARs and TBCs Former Jaite Paper Mill Site				
Item No.	Standard requirement, criteria, or limitation	Citation	Requirement Description	Applicable, Relevant and Appropriate, or To Be Considered (TBC)
47	**Additional Reports**	OAC 3745-54-77 (A)	Requires facilities to report fires, explosions or other mishaps.	Applicable
48	**Disposal/ Decon Of Equipment, Structures & Soils**	OAC 3745-55-14	Requires that all contaminated equipment, structures and soils be properly disposed of or decontaminated. Removal of hazardous wastes or constituents from a unit may constitute generation of hazardous wastes.	Applicable
49	**Staging Piles**	OAC 3745-57-74 (A-K)	Design requirements for temporary waste staging piles.	Applicable
50	**Abandon Well Sealing**	OAC 3745-09-10 (A, B, C)	Procedures for closing and sealing wells. Pertains to all groundwater wells on the Site that either will be installed or have been installed since February 15, 1975. Groundwater monitoring wells and piezometers were installed and will need to be abandoned/closed during or after removal action prior to Site closure.	Applicable
51	**Monitoring Well**	OAC 3745-09-03 (A-C)	Standards for design and closure of wells, compliance with DDAGW guidance. Pertains to all groundwater wells on the Site that either will be installed or have been installed since February 15, 1975. Would pertain if new wells were to be installed during removal action.	Applicable

Notes:
OAC = Ohio Administration Code

4.4. To be considered (TBC's)

TBCs are federal or state advisories, criteria, or guidance documents that are not promulgated and so cannot be ARARs, but that in appropriate circumstances may be considered in formulating a response action. Some of the NPS-specific TBCs pertaining to the development of the removal action alternatives for the Site were mentioned earlier in this section. For example, NPS *Management Policies* § 1.4 (NPS 2006), which provides guidance on implementation of the Organic Act non-impairment mandate, is a TBC. Other NPS-specific TBCs include the NPS Director's Orders Nos. 28 (NPS 2002a), 41 (NPS 2013), and 77-1 (NPS 2002b); and NPS *Management Policies 2006* (NPS 2006) regarding Restoration of Natural Systems, Wildlife and Biota, Species of Special Concern, Soil Resource Management, Cultural Resource Management, and NPS Clean Fill Criteria.

5. Removal Action Objectives and Removal Goals

The purpose of Section 5 is to present the RAOs and scope for the non-time-critical removal action (NTCRA). For example, remove contaminated soils that pose unacceptable risk to human health and the environment. The RAOs should be as specific as possible, but not so specific that the range of alternatives that can be developed is unduly limited. RAOs define what the removal action is intended to accomplish. Specific RAOs are presented in Section 1.1. Other aspects of the RAOs are described therein and in Section 5.2.1, Background and Reference Concentrations. The RAOs apply an understanding of the CSM (Section 2), the risk levels (Section 3), and the ARARs (Section 4) to the scope of the NTCRA, as defined in Section 5.1.1, Determination of Removal Action Scope.

5.1. Identification of Removal Action Objectives

Removal action objectives provide a general description of what the cleanup would be designed to accomplish. The RAOs for this Site have been developed based on analysis of the sources, nature and extent of contamination; the results of the HHRA, SLERA; and the ARARs that have been identified. The RAOs for this EE/CA are as follows:

- Eliminate, or reduce to the extent practicable, unacceptable cancer risks and non-cancer hazards for human receptor populations of interest at the Site from exposures to site-related non-lead COCs in soil, sediment, and surface water.
- Eliminate, or reduce to the extent practicable, unacceptable blood lead levels for human receptor populations of interest at the Site from exposures to lead in Site soil and sediment.
- Eliminate, or reduce to the extent practicable, unacceptable risks to terrestrial ecological receptors at the Site from exposures to Site-related contaminants in soil.
- Eliminate, or reduce to the extent practicable, unacceptable risks to aquatic ecological receptors from exposures to Site-related contaminants in sediment and surface water.
- Eliminate, or reduce to the extent practicable, levels of COCs and COECs in aboveground or buried waste materials at the Site that present unacceptable risk to human receptor populations and animals.
- Eliminate the uncontrolled discharge of waste material into waters of the US from waste piles susceptible to active erosion.
- Eliminate contaminant-related constraints to the full enjoyment and utilization of park resources consistent with NPS mandates.
- Attain all other federal and state ARARs.

5.1.1. *Determination of Removal Action Scope*

To achieve the RAOs listed in Section 5.1 above, the scope of the removal action will focus on reducing impacts to human health and ecological receptors. The environmental media of the scope will focus on surface and subsurface soil, sediment, waste piles, and surface water. These areas contain COCs and COECs that exceed the RGs and do not comply with the location ARARs that prohibit impairment of use.

The removal action described in this EE/CA Report is anticipated to be the last of several earlier non-time critical and time critical removal actions completed at the Site as described in detail in Section 2.9.

5.2. Risk Management: Removal Action Goals Selection

Removal Action Goals (RGs) are selected by comparing all PRGs and selecting the most stringent. To ensure cleanup will be technically feasible and cost effective, the PRGs also are compared to background for naturally-occurring COCs and COECs, as well as reference locations for anthropogenic COCs and COECs, in all media at the Site.

5.2.1. *Reference and Background Concentrations*

To ensure cleanup will be technically feasible and cost effective and to reduce the potential for recontamination of clean areas from surrounding sources, the PRGs must be compared against background values for naturally occurring constituents (e.g., metals) in all media at the Site and compared to reference values for environmentally ubiquitous anthropogenic constituents (e.g., polycyclic aromatic hydrocarbons). As stated previously, the term "background" is typically used to describe naturally occurring chemicals, whereas the term "reference" is used to describe chemicals that are ubiquitous because of anthropogenic (but not site-related) impacts. For simplicity, the term reference will be used herein, but should be interpreted as meaning "reference/background." Only reference concentrations for COCs and COECs for the Site will be discussed in this subsection.

Reference/Background Studies

Sections of the Cuyahoga River remain on the list of impaired waters under the Clean Water Act and the Site is in an urban environment; thus, establishing reference conditions is important for determining Site-related contamination. The Site investigations have included the collection of data on reference concentrations to distinguish between Site-related contamination and levels consistent with local reference conditions. The human health and ecological risk assessments (see Section 3) present risk estimates based on these Site-specific reference datasets to provide a frame of reference for interpreting Site risks. The risk assessments (Appendix D and Appendix E) also included detailed tabular and graphical presentations of media concentrations to illustrate how DU-specific concentrations relate to reference conditions. In general, the reference evaluation supports the conclusion that soil and sediment concentrations of COCs/COECs are elevated in one or more Site DUs and these impacts appear to be from, at least in part, Site-related activities. However, there are several examples where Site DU concentrations were determined to represent reference concentrations. These concentration comparisons are provided and discussed in Section 2.10.4.

Summary of Relevant Reference/Background Values

Generally, site cleanup levels are not set at concentrations below natural background levels and/or anthropogenic reference levels (USEPA 2002). Eleven soil DUs were identified that provide information on natural background levels and/or anthropogenic reference levels in soil for the

Site. These reference soil DUs consist of the three REF DUs as well as eight Site DUs impacted by the Cuyahoga River and Brandywine Creek flooding, which include the three NTR DUs, three SWP DUs, BLD-09, and BLD-10. Four sediment and surface water reference DUs upstream of the Site provide information on natural background levels and/or anthropogenic reference levels for sediment and surface water, which include two upstream areas in the Cuyahoga River, one upstream area in Brandywine Creek, and one upstream area in the unnamed Site stream.

5.2.2. *Removal Goal Selection*

A comparison of the human health risk-based PRGs, ecological risk-based PRGs, ARAR-based PRGs, and representative background/reference concentrations is presented in Text Tables 5.1, 5.2, and 5.3. When multiple PRGs exist, the lower (i.e., more protective) value was chosen as the RG unless the reference concentration of the contaminant in the medium is greater than the lowest PRG, in which case the reference concentration was selected as the RG. The selected RGs and the basis for selection are included in Text Tables 5.1, 5.2, and 5.3.

Text Table 5.1 Removal Action Goal Selection for Soil									
COC or COEC	Reference/ Background/ Floodplain[1]	Human Health PRG		Ecological PRG		ARAR-Based PRG		Basis for RG	RG
		Value (mg/kg)	Basis	Value (mg/kg)	Basis	Value (mg/kg)	Basis		
Acenaphthene	0.021	---		0.71	Terrestrial Plants; HQ of 1	6,900	OAC 3745-300-08[2]	Eco PRG	**0.71**
Anthracene	0.066	---		7.8	Terrestrial Plants; HQ of 1	34,000	OAC 3745-300-08	Eco PRG	**7.8**
Antimony	0.28	---		2.5	Terrestrial-feeding Mammals; HQ of 1	63	OAC 3745-300-08	Eco PRG	**2.5**
Aroclor-1248	0.0085	---		0.023	Terrestrial-feeding Mammals; HQ of 1	1.0	TSCA[3]	Eco PRG	**0.023**
Aroclor-1254	0.050	---		0.13	Terrestrial-feeding Birds; HQ of 1	1.0	TSCA	Eco PRG	**0.13**
Arsenic	22	3.5	Rec. Visitor/Trespasser; cancer risk of 1E-06	24	Terrestrial-feeding Mammals; HQ of 1	12	OAC 3745-300-08	Eco PRG	**24**
Barium	67	---		169	Terrestrial Plants; HQ of 1	---		Eco PRG	**169**
Benzo(a)anthracene	0.23	2.3	Rec. Visitor/Trespasser; cancer risk of 1E-06	2.3	Terrestrial-feeding Birds; HQ of 1	12	OAC 3745-300-08	Eco PRG	**2.3**
Benzo(a)pyrene	0.25	0.23	Rec. Visitor/Trespasser; cancer risk of 1E-06	---		1.2	OAC 3745-300-08	Reference	**0.25**
Benzo(b) fluoranthene	0.38	2.3	Rec. Visitor/Trespasser; cancer risk of 1E-06	---		12	OAC 3745-300-08	HH PRG	**2.3**

Text Table 5.1 Removal Action Goal Selection for Soil									
COC or COEC	Reference/ Background/ Floodplain[1]	Human Health PRG		Ecological PRG		ARAR-Based PRG		Basis for RG	RG
		Value (mg/kg)	Basis	Value (mg/kg)	Basis	Value (mg/kg)	Basis		
bis(2-Ethylhexyl) phthalate	0.0095	205	NPS Worker; cancer risk of 1E-06	0.063	Terrestrial-feeding Birds; HQ of 1	690	OAC 3745-300-08	Eco PRG	**0.063**
Cadmium	1.2	---		1.1	Terrestrial-feeding Birds; HQ of 1	140	OAC 3745-300-08	Reference	**1.2**
Chromium (total)	19	---		1.2	Soil Invertebrates; HQ of 1	---		Reference	**19**
Chromium VI	1.8	1.8	Rec. Visitor/Trespasser; cancer risk of 1E-06	1.2	Soil Invertebrates; HQ of 1	24	OAC 3745-300-08	Reference	**1.8**
Chrysene	0.26	---		10	Terrestrial-feeding Mammals; HQ of 1	1,200	OAC 3745-300-08	Eco PRG	**10**
Copper	33	---		35	Terrestrial-feeding Birds; HQ of 1	6,300	OAC 3745-300-08	Eco PRG	**35**
Dibenzo(a,h)anthracene	0.057	0.23	Rec. Visitor/Trespasser; cancer risk of 1E-06	---		1.2	OAC 3745-300-08	HH PRG	**0.23**
Dieldrin	8.0E-05	---		0.0066	Terrestrial-feeding Mammals; HQ of 1	0.61	OAC 3745-300-08	Eco PRG	**0.0066**
Di-n-butyl phthalate	0.0075	---		0.035	Terrestrial-feeding Birds; HQ of 1	12,000	OAC 3745-300-08	Eco PRG	**0.035**
Dioxin/Furan TEQ	no data	2.7E-05	Rec. Visitor/Trespasser; cancer risk of 1E-06	7.4E-07	Terrestrial-feeding Mammals; HQ of 1	---		Eco PRG	**7.4E-07**
Fluoranthene	0.54	---		15	Soil Invertebrates;	4,600	OAC 3745-	Eco PRG	**15**

Text Table 5.1 Removal Action Goal Selection for Soil									
COC or COEC	Reference/ Background/ Floodplain[1]	Human Health PRG		Ecological PRG		ARAR-Based PRG		Basis for RG	RG
		Value (mg/kg)	Basis	Value (mg/kg)	Basis	Value (mg/kg)	Basis		
					HQ of 1		300-08		
Indeno(1,2,3-cd)pyrene	0.18	2.3	Rec. Visitor/Trespasser; cancer risk of 1E-06	---		12	OAC 3745-300-08	HH PRG	**2.3**
Lead	33	941	Construction Worker; PbB of 5 µg/dL	16	Terrestrial-feeding Birds; HQ of 1	400	OAC 3745-300-08	Reference	**33**
Manganese	520	216	Construction Worker; non-cancer HQ of 1	492	Terrestrial Plants; HQ of 1	---		Reference	**520**
Mercury	0.12	---		0.041	Terrestrial-feeding Birds; HQ of 1	3.1	OAC 3745-300-08	Reference	**0.12**
Naphthalene	0.082	---		3.2	Terrestrial Plants; HQ of 1	90	OAC 3745-300-08	Eco PRG	**3.2**
Nickel	36	---		14	Terrestrial-feeding Mammals; HQ of 1	3,100	OAC 3745-300-08	Reference	**36**
PCB TEQ	no data	2.8E-05	NPS Worker; cancer risk of 1E-06	7.4E-07	Terrestrial-feeding Mammals; HQ of 1	---		Eco PRG	**7.4E-07**
Phenanthrene	0.29	---		8.1	Soil Invertebrates; HQ of 1	---		Eco PRG	**8.1**
Pyrene	0.40	---		14	Soil Invertebrates; HQ of 1	3,400	OAC 3745-300-08	Eco PRG	**14**
Selenium	0.80	---		0.79	Terrestrial- feeding Mammals; HQ of 1	780	OAC 3745-300-08	Reference	**0.80**
Tetrachloroethene	no data	---		0.41	Burrow Mamm	170	OAC 3745-	Eco PRG	**0.41**

Text Table 5.1 Removal Action Goal Selection for Soil									
COC or COEC	Reference/ Background/ Floodplain[1]	Human Health PRG		Ecological PRG		ARAR-Based PRG		Basis for RG	RG
		Value (mg/kg)	Basis	Value (mg/kg)	Basis	Value (mg/kg)	Basis		
							300-08		
Thallium	0.065	---		0.16	Terrestrial Plants; HQ of 1	---		Eco PRG	**0.16**
Vanadium	21	---		8.6	Terrestrial-feeding Birds; HQ of 1	---		Reference	**21**
Xylenes (total)	no data	---		1.6	Burrow Mamm	260	OAC 3745-300-08	Eco PRG	**1.6**
Zinc	190	---		74	Terrestrial-feeding Birds; HQ of 1	47,000	OAC 3745-300-08	Reference	**190**

Notes:
[1]Reference/Background/Floodplain concentration is one of the following: 1) the maximum of the three reference and eight floodplain DUs 95UCL values obtained from the three replicates from each of the 11 DUs ; 2) the maximum detected value for DUs with less than three replicates of less than three detections; 3) ½ the MDL if all three replicates were non-detect.
[2]Ohio Administrative Code (OAC) 3745-300-08 Appendix Table 1 Generic Numerical Direct Contact soil standards (Residential)May 2016.
[3]Toxic Substance Control Act
--- : No value established for listed analyte.
mg/kg: milligrams per kilogram
RG: Removal Action Goal
PRG: Preliminary Removal Goal
HQ: Hazard Quotient

Text Table 5.2 Removal Action Goal Selection for Sediment									
COC or COEC	Reference/ Background[1] (mg/kg)	Human Health PRG		Ecological PRG		ARAR-Based PRG		Basis for RG	RG
		Value (mg/kg)	Basis	Value (mg/kg)	Basis	Value (mg/kg)	Basis		
alpha-Chlordane	0.0019	---		0.017	Aquatic Invertebrates; HQ of 1	---		Eco PRG	**0.017**
Aroclor-1254	0.0070	---		0.34	Aquatic Invertebrates; HQ of 1	---		Eco PRG	**0.34**
Arsenic	16	4.5	Rec. Visitor/Trespasser; cancer risk of 1E-06	---		---		Reference	**16**
Benzo(g,h,i)perylene	0.19	---		0.25	Aquatic Invertebrates; HQ of 1	---		Eco PRG	**0.25**
bis(2-ethylhexyl)phthalate	0.056	---		0.082	Aquatic-feeding Birds; HQ of 1	---		Eco PRG	**0.082**
Butyl benzyl phthalate	0.0050	---		1.0	Aquatic Invertebrates; HQ of 1	---		Eco PRG	**1.0**
Cadmium	0.37	---		0.95	Aquatic-feeding Mammals; HQ of 1	---		Eco PRG	**0.95**
Chlordane (total)	0.006	---		0.018	Aquatic Invertebrates; HQ of 1	---		Eco PRG	**0.018**
Chromium VI	0.44	1.8	Rec. Visitor/Trespasser; cancer risk of 1E-06	---		---		HH PRG	**1.8**
Copper	24	---		40	Aquatic-feeding Birds; HQ of 1	---		Eco PRG	**40**

Text Table 5.2 Removal Action Goal Selection for Sediment									
COC or COEC	**Reference/ Background[1] (mg/kg)**	**Human Health PRG**		**Ecological PRG**		**ARAR-Based PRG**		**Basis for RG**	**RG**
		Value (mg/kg)	**Basis**	**Value (mg/kg)**	**Basis**	**Value (mg/kg)**	**Basis**		
Di-n-butyl phthalate	0.021	---		0.044	Aquatic-feeding Birds; HQ of 1	---		Eco PRG	**0.044**
Dioxin/Furan TCDD-TEQ	no data	---		8.52E-07	Aquatic-feeding Mammals; HQ of 1	---		Eco PRG	**8.5E-07**
gamma-Chlordane	0.00075	---		0.017	Aquatic Invertebrates; HQ of 1	---		Eco PRG	**0.017**
Lead	20	---		37	Aquatic-feeding Birds; HQ of 1	---		Eco PRG	**37**
Mercury	0.059	---		0.054	Aquatic-feeding Birds; HQ of 1	---		Reference	**0.059**
Nickel	25	---		17	Aquatic-feeding Mammals; HQ of 1	---		Reference	**25**
Total HMW PAHs	2.0	---		2.3	Aquatic Invertebrates; HQ of 1	---		Eco PRG	**2.3**
Total LMW PAHs	0.37	---		1.2	Aquatic Invertebrates; HQ of 1	---		Eco PRG	**1.2**

Notes:
[1]Reference/Background concentration is one of the following: 1) the maximum of the reference DUs 95UCL values obtained from the three replicates from each of the reference ; 2) the maximum detected value for DUs with less than three replicates of less than three detections; 3) ½ the MDL if all three replicates were non-detect.
--- : No value established for listed analyte.
mg/kg: milligrams per kilogram
RG: Removal Action Goal
PRG: Preliminary Removal Goal
HQ: Hazard Quotient

Text Table 5.3 Removal Action Goal Selection for Surface Water									
COC or COEC	**Reference/ Background[1]**	**Human Health PRG**		**Ecological PRG**		**ARAR-Based PRG**		**Basis for RG**	**RG**
		Value (µg/L)	**Basis**	**Value (µg/L**	**Basis**	**Value (µg/L)**	**Basis**		
Aluminum (Filtered)	17	---		57	Piscivorous Mammals; HQ of 1	TBD[2]	Secondary MCL[3]	ECO PRG	**57**
Arsenic (Unfiltered)	4.5	2.2	Rec. Visitor/Trespasser; cancer risk of 1E-06	---		10	Primary MCL[4]	Reference	**4.5**
Barium (filtered)	43	---		4.0	Aquatic Receptors; HQ of 1	---		Reference	**43**
Beryllium (filtered)	0.20	---		0.66	Aquatic Receptors; HQ of 1	4	Primary MCL	Eco PRG	**0.66**
gamma-Chlordane (filtered)	0.0065	---		0.0043	Aquatic Receptors; HQ of 1	2	Primary MCL	Reference	**0.0065**
Iron (filtered)	140	---		1000	Aquatic Receptors; HQ of 1	300	Secondary MCL[b]	ECO PRG	**1,000**
Lead (filtered)	0.23	---		0.59 to 8.41	Aquatic Receptors; HQ of 1	15	Primary MCL		**TBD**
Manganese (filtered)	55	---		120	Aquatic Receptors; HQ of 1	50	Secondary MCL	ECO PRG	**120**
Selenium (filtered)	0.45	---		0.30	Piscivorous Mammals; HQ of 1	50	Primary MCL	Reference	**0.45**

Notes:
[1]Reference/Background concentration is one of the following: 1) the maximum of the three reference 95UCL values obtained from the three replicates from each of the reference ; 2) the maximum detected value for DUs with less than three replicates of less than three detections; 3) ½ the MDL if all three replicates were non-detect.
[2]Aluminum value is pH dependent
[3]USEPA Secondary Maximum Contaminant Levels (40 CFR §143.3)
[4]USEPA Primary Maximum Contaminant Levels (40 CFR §141)
Secondary MCLs are based on aesthetics and are not risk based.
µg/L: micrograms per liter
RG: Removal Action Goal
PRG: Preliminary Removal Goal
HQ: Hazard Quotient
--- : No value established for listed analyte.

5.3. Site-Specific Removal Goal Considerations

Risk assessments provide information on whether there are unacceptable human health or ecological risks as a consequence of site-related exposures. Risk management seeks to determine how to best manage and address those risks in a way best suited to protect human health and the environment and meet the established RAOs.

Specific areas of the Site surrounding the former paper mill operations area have been and continue to be flooded by the Cuyahoga River and Brandywine Creek, which causes COCs in surface water to be continually deposited onto surface and subsurface soils in these areas. Consequently, the surface and subsurface soil within these areas will not be considered for Site removal actions. Text Table 5.4 shows the waste pile and soil DUs for removal action based on the RG exceedances. Figure 5-1 shows all DUs considered for removal action and for exclusion from removal action, including the background/reference and floodplain DUs.

As shown in Text Table 5.5, analytes detected in sediment from all three ponds in the AP area significantly exceed RGs for several analytes. Consequently, the pond sediment DUs in the AP area and are included for removal actions. However, exceedances in Brandywine Creek sediment at locations IL-BC-01 and IL-BC-02 are above but near RGs, and will presumably decrease following removal of contaminated soils acting as Site source areas from erosion runoff adjacent to and upgradient of these sediment sample areas. Therefore, these Brandywine Creek sediment areas will require monitoring following Site removal actions to confirm that Site removal of contaminated soil results in a decrease of sediment contamination in Brandywine Creek sediments.

As shown in Text Table 5.6, analytes detected in surface water from two ponds and the unnamed stream in the AP area exceed RGs for several analytes. The surface water in the Pond P1 is included for removal actions. The surface water in Pond P3 is seasonal and once the sediment is removed, the concentrations will presumably decrease following removal of contaminated sediment. The unnamed stream will also presumably exhibit decreases in concentration once the upgradient contaminated soil at IS-AP-01 and IS-AP-02 are removed.

Text Table 5.4 Soil and Waste Pile Decision Units Considered for Removal Action					
DU ID	**Analyte**	**Result[1,3] (mg/kg)**	**Removal Goal[2,3] (mg/kg)**	**Basis of RG**	**Risk Driver Receptor**
WASTE PILES					
CENTRAL WASTE PILES					
IW-CWP-1N	Chromium (total)	32	19	REF	Soil Invert
	Benzo(a)pyrene	0.29	0.25	REF	Rec/Trespass (1E-06)
	Dioxin/Furan TEQ	8.60E-06	7.4E-07	ECO	Terr Mammal
IW-CWP-1S-A	Arsenic	25	24	ECO	Terr Mammal
	Chromium (total)	48	19	REF	Soil Invert
	Mercury	0.34	0.12	REF	Terr Bird
	Nickel	39	36	REF	Terr Mammal
	Acenaphthene	1.1	0.71	ECO	Plant
	Benzo(a)anthracene	3.2	2.3	ECO	Terr Bird
	Benzo(a)pyrene	3.1	0.25	REF	Rec/Trespass (1E-06)
	Benzo(b)fluoranthene	4.2	2.3	HH	Rec/Trespass (1E-06)
	Dibenz(a,h)anthracene	0.47	0.23	HH	Rec/Trespass (1E-06)
IW-CWP-1S-B	Thallium	0.45	0.16	ECO	Plant
IW-CWP-2N	Arsenic	28	24	ECO	Terr Mammal
	Cadmium	1.3	1.2	REF	Terr Bird
	Chromium (total)	44	19	REF	Soil Invert
	Copper	190	35	ECO	Terr Bird
	Lead	76	33	REF	Terr Bird
	Manganese	1,300	520	REF	Plant
	Mercury	0.32	0.12	REF	Terr Bird
	Nickel	55	36	REF	Terr Mammal
	Vanadium	22	21	REF	Terr Bird
	Zinc	370	190	REF	Terr Bird
	Benzo(a)pyrene	0.27	0.25	REF	Rec/Trespass (1E-06)
	DEHP	2.2	0.063	ECO	Terr Bird
	Di-n-butyl phthalate	0.12	0.035	ECO	Terr Bird
IW-CWP-2S	Arsenic	50	24	ECO	Terr Mammal
	Chromium (total)	150	19	REF	Soil Invert
	Chromium VI	4.6	1.8	REF	Soil Invert
	Copper	130	35	ECO	Terr Bird
	Lead	140	33	REF	Terr Bird
	Nickel	94	36	REF	Terr Mammal
	Selenium	1.7	0.80	REF	Terr Mammal
	Vanadium	32	21	REF	Terr Bird
	Acenaphthene	1.1	0.71	ECO	Plant
	Benzo(a)anthracene	8.1	2.3	ECO	Terr Bird
	Benzo(a)pyrene	7.1	0.25	REF	Rec/Trespass (1E-06)
	Benzo(b)fluoranthene	10	2.3	HH	Rec/Trespass (1E-06)
	Dibenzo(a,h)anthracene	0.59	0.23	HH	Rec/Trespass (1E-06)
	Fluoranthene	19	15	ECO	Soil Invert
	Naphthalene	4.1	3.2	ECO	Plant
	Phenanthrene	19	8.1	ECO	Soil Invert

Text Table 5.4 Soil and Waste Pile Decision Units Considered for Removal Action					
DU ID	**Analyte**	**Result[1,3] (mg/kg)**	**Removal Goal[2,3] (mg/kg)**	**Basis of RG**	**Risk Driver Receptor**
	Pyrene	15	14	ECO	Soil Invert
	DEHP	0.49	0.063	ECO	Terr Bird
	Dioxin/Furan TEQ	1.90E-05	7.4E-07	ECO	Terr Mammal
DUMP SITE					
IW-DS-01	Antimony	50	2.5	ECO	Terr Mammal
	Arsenic	53	24	ECO	Terr Mammal
	Barium	2,200	169	ECO	Plant
	Cadmium	10	1.2	REF	Terr Bird
	Chromium (total)	370	19	REF	Soil Invert
	Chromium VI	25	1.8	REF	Soil Invert
	Copper	1,300	35	ECO	Terr Bird
	Lead	4,700	33	REF	Terr Bird
	Manganese	3,000	520	REF	Plant
	Mercury	0.31	0.12	REF	Terr Bird
	Nickel	120	36	REF	Terr Mammal
	Selenium	4.8	0.80	REF	Terr Mammal
	Vanadium	22	21	REF	Terr Bird
	Zinc	2,100	190	REF	Terr Bird
	Aroclor 1248	1.8	0.023	ECO	Terr Mammal
	DEHP	510	0.063	ECO	Terr Bird
	PCB-TEQ	5.50E-06	7.4E-07	ECO	Terr Mammal
IW-DS-02	Antimony	27	2.5	ECO	Terr Mammal
	Arsenic	34	24	ECO	Terr Mammal
	Barium	330	169	ECO	Plant
	Cadmium	24	1.2	REF	Terr Bird
	Chromium (total)	110	19	REF	Soil Invert
	Chromium VI	2.6	1.8	REF	Soil Invert
	Copper	3,000	35	ECO	Terr Bird
	Lead	3,700	33	REF	Terr Bird
	Manganese	1,600	520	REF	Plant
	Mercury	0.56	0.12	REF	Terr Bird
	Nickel	230	36	REF	Terr Mammal
	Selenium	3.4	0.80	REF	Terr Mammal
	Vanadium	23	21	REF	Terr Bird
	Zinc	24,000	190	REF	Terr Bird
	Benzo(a)pyrene	0.27	0.25	REF	Rec/Trespass (1E-06)
	Aroclor 1248	1.0	0.023	ECO	Terr Mammal
	DEHP	17	0.063	ECO	Terr Bird
	Di-n-butyl phthalate	0.34	0.035	ECO	Terr Bird
	Dioxin/Furan TEQ	2.10E-04	7.4E-07	ECO	Terr Mammal
IW-DS-04	Antimony	8.8	2.5	ECO	Terr Mammal
	Arsenic	34	24	ECO	Terr Mammal
	Barium	470	169	ECO	Plant
	Cadmium	7.9	1.2	REF	Terr Bird
	Chromium (total)	110	19	REF	Soil Invert

Text Table 5.4 Soil and Waste Pile Decision Units Considered for Removal Action					
DU ID	**Analyte**	**Result[1,3] (mg/kg)**	**Removal Goal[2,3] (mg/kg)**	**Basis of RG**	**Risk Driver Receptor**
	Copper	990	35	ECO	Terr Bird
	Lead	890	33	REF	Terr Bird
	Manganese	1,400	520	REF	Plant
	Mercury	0.30	0.12	REF	Terr Bird
	Nickel	140	36	REF	Terr Mammal
	Selenium	2.5	0.80	REF	Terr Mammal
	Zinc	1,200	190	REF	Terr Bird
	Benzo(a)pyrene	0.73	0.25	REF	Rec/Trespass (1E-06)
	DEHP	1.1	0.063	ECO	Terr Bird
	Di-n-butyl phthalate	0.13	0.035	ECO	Terr Bird
SOUTHERN WASTE PILE					
IW-SWP-01	Cadmium	2.6	1.2	REF	Terr Bird
	Chromium (total)	64	19	REF	Soil Invert
	Chromium VI	5.0	1.8	REF	Soil Invert
	Copper	150	35	ECO	Terr Bird
	Lead	140	33	REF	Terr Bird
	Manganese	570	520	REF	Plant
	Mercury	0.14	0.12	REF	Terr Bird
	Nickel	73	36	REF	Terr Mammal
	Selenium	0.86	0.80	REF	Terr Mammal
	Vanadium	28	21	REF	Terr Bird
	Zinc	440	190	REF	Terr Bird
	Benzo(a)pyrene	1.2	0.25	REF	Rec/Trespass (1E-06)
	DEHP	0.31	0.063	ECO	Terr Bird
	Di-n-butyl phthalate	0.090	0.035	ECO	Terr Bird
SOIL					
AERATION POND AREA					
IS-AP-01	Chromium (total)	41	19	REF	Soil Invert
	Chromium VI	8.9	1.8	REF	Soil Invert
	Copper	120	35	ECO	Terr Bird
	Lead	130	33	REF	Terr Bird
	Manganese	650	520	REF	Plant
	Mercury	0.19	0.12	REF	Terr Bird
	DEHP	0.26	0.063	ECO	Terr Bird
	Di-n-butyl phthalate	0.066	0.035	ECO	Terr Bird
	Dioxin/Furan TEQ	1.70E-05	7.4E-07	ECO	Terr Mammal
IS-AP-02	Chromium (total)	39	19	REF	Soil Invert
	Chromium VI	8.8	1.8	REF	Soil Invert
	Copper	73	35	ECO	Terr Bird
	Lead	130	33	REF	Terr Bird
	Mercury	0.21	0.12	REF	Terr Bird
	Aroclor 1254	0.50	0.13	ECO	Terr Bird
	DEHP	0.27	0.063	ECO	Terr Bird
	PCB-TEQ	1.4E-05	7.4E-07	ECO	Terr Mammal

Text Table 5.4 Soil and Waste Pile Decision Units Considered for Removal Action					
DU ID	**Analyte**	**Result[1,3] (mg/kg)**	**Removal Goal[2,3] (mg/kg)**	**Basis of RG**	**Risk Driver Receptor**
IS-AP-03	Chromium (total)	56	19	REF	Soil Invert
	Chromium VI	12	1.8	REF	Soil Invert
	Copper	160	35	ECO	Terr Bird
	Lead	200	33	REF	Terr Bird
	Mercury	0.16	0.12	REF	Terr Bird
	DEHP	1.6	0.063	ECO	Terr Bird
IS-AP-04	Chromium (total)	140	19	REF	Soil Invert
	Chromium VI	4.2	1.8	REF	Soil Invert
	Copper	340	35	ECO	Terr Bird
	Lead	510	33	REF	Terr Bird
	Mercury	0.39	0.12	REF	Terr Bird
	Selenium	0.89	0.80	REF	Terr Mammal
	Vanadium	23	21	REF	Terr Bird
	Aroclor 1254	0.36	0.13	ECO	Terr Bird
	DEHP	4.6	0.063	ECO	Terr Bird
	PCB-TEQ	3.4E-05	7.4E-07	ECO	Terr Mammal
IS-AP-05	Chromium (total)	38	19	REF	Soil Invert
	Copper	84	35	ECO	Terr Bird
	Lead	120	33	REF	Terr Bird
	Aroclor 1248	0.071	0.023	ECO	Terr Mammal
IS-AP-07	Chromium VI	4.9	1.8	REF	Soil Invert
	Lead	38	33	REF	Terr Bird
BUILDING FOUNDATION AREA					
IS-BLD-01	Arsenic	34	24	ECO	Terr Mammal
	Chromium (total)	26	19	REF	Soil Invert
	Chromium VI	15	1.8	REF	Soil Invert
	Copper	60	35	ECO	Terr Bird
	Lead	36	33	REF	Terr Bird
	Selenium	1.0	0.80	REF	Terr Mammal
	Benzo(a)pyrene	0.57	0.25	REF	Rec/Trespass (1E-06)
IS-BLD-03	Antimony	8	2.5	ECO	Terr Mammal
	Arsenic	62	24	ECO	Terr Mammal
	Barium	1382	169	ECO	Plant
	Cadmium	1.65	1.2	REF	Terr Bird
	Chromium (total)	109	19	REF	Soil Invert
	Chromium VI	8.0	1.8	REF	Soil Invert
	Lead	1,212	33	REF	Terr Bird
	Manganese	1,700	520	REF	Plant
	Mercury	4.8	0.12	REF	Terr Bird
	Selenium	1.4	0.80	REF	Terr Mammal
	Vanadium	23	21	REF	Terr Bird
	Zinc	517	190	REF	Terr Bird
	Benzo(a)anthracene	3.8	2.3	ECO	Terr Bird
	Benzo(a)pyrene	3.1	0.25	REF	Rec/Trespass (1E-06)
	DEHP	1.4	0.063	ECO	Terr Bird

Text Table 5.4 Soil and Waste Pile Decision Units Considered for Removal Action					
DU ID	**Analyte**	**Result[1,3] (mg/kg)**	**Removal Goal[2,3] (mg/kg)**	**Basis of RG**	**Risk Driver Receptor**
	PCB-TEQ	2.10E-05	7.4E-07	ECO	Terr Mammal
IS-BLD-04	Copper	110	35	ECO	Terr Bird
	Lead	43	33	REF	Terr Bird
	Mercury	0.13	0.12	REF	Terr Bird
	Nickel	40	36	REF	Terr Mammal
	Selenium	0.89	0.80	REF	Terr Mammal
	Zinc	260	190	REF	Terr Bird
IS-BLD-06	Chromium (total)	26	19	REF	Soil Invert
	Chromium VI	4.2	1.8	REF	Soil Invert
	DEHP	0.77	0.063	ECO	Terr Bird
IS-BLD-P	Copper	150	35	ECO	Terr Bird
	Lead	190	33	REF	Terr Bird
	Mercury	0.46	0.12	REF	Terr Bird
	Nickel	37	36	REF	Terr Mammal
	Zinc	250	190	REF	Terr Bird
	Acenaphthene	1.3	0.71	ECO	Plant
	Benzo(a)anthracene	11	2.3	ECO	Terr Bird
	Benzo(a)pyrene	9.3	0.25	REF	Rec/Trespass (1E-06)
	Benzo(b)fluoranthene	15	2.3	HH	Rec/Trespass (1E-06)
	Chrysene	11	10	ECO	Terr Mammal
	Fluoranthene	27	15	ECO	Soil Invert
	Phenanthrene	19	8.1	ECO	Soil Invert
	Pyrene	22	14	ECO	Soil Invert
CENTRAL WASTE PILE AREA					
IS-CWP-01	Arsenic	30	24	ECO	Terr Mammal
	Chromium (total)	150	19	REF	Soil Invert
	Copper	41	35	ECO	Terr Bird
	Lead	100	33	REF	Terr Bird
	Manganese	1,500	520	REF	Plant
	Mercury	0.14	0.12	REF	Terr Bird
	Nickel	79	36	REF	Terr Mammal
	Vanadium	29	21	REF	Terr Bird
	Acenaphthene	1.6	0.71	ECO	Plant
	Benzo(a)anthracene	7.3	2.3	ECO	Terr Bird
	Benzo(a)pyrene	7.5	0.25	REF	Rec/Trespass (1E-06)
	Benzo(b)fluoranthene	9.9	2.3	HH	Rec/Trespass (1E-06)
	Dibenzo(a,h)anthracene	1.2	0.23	HH	Rec/Trespass (1E-06)
	Fluoranthene	19	15	ECO	Soil Invert
	Indeno(1,2,3-cd)pyrene	5	2.3	HH	Rec/Trespass (1E-06)
	Phenanthrene	13	8.1	ECO	Soil Invert
	Di-n-butyl phthalate	0.061	0.035	ECO	Terr Bird
	Dioxin/Furan TEQ	4.0E-05	7.4E-07	ECO	Terr Mammal
IS-CWP-02	Arsenic	48	24	ECO	Terr Mammal
	Chromium (total)	52	19	REF	Soil Invert
	Copper	63	35	ECO	Terr Bird

Text Table 5.4 Soil and Waste Pile Decision Units Considered for Removal Action					
DU ID	Analyte	Result[1,3] (mg/kg)	Removal Goal[2,3] (mg/kg)	Basis of RG	Risk Driver Receptor
	Lead	120	33	REF	Terr Bird
	Manganese	1,100	520	REF	Plant
	Nickel	37	36	REF	Terr Mammal
	Selenium	1.9	0.80	REF	Terr Mammal
	Vanadium	35	21	REF	Terr Bird
	Aroclor 1248	0.063	0.023	ECO	Terr Mammal
	Benzo(a)pyrene	1.2	0.25	REF	Rec/Trespass (1E-06)
	Naphthalene	8.4	3.2	ECO	Plant
	Dioxin/Furan TEQ	1.80E-05	7.4E-07	ECO	Terr Mammal
	PCB-TEQ	2.1E-06	7.4E-07	ECO	Terr Mammal
RAILROAD TRACK AREA					
IS-RR-01	Arsenic	230	24	ECO	Terr Mammal
	Chromium (total)	39	19	REF	Soil Invert
	Copper	120	35	ECO	Terr Bird
	Lead	110	33	REF	Terr Bird
	Selenium	1.3	0.80	REF	Terr Mammal
	Vanadium	22	21	REF	Terr Bird
	Benzo(a)anthracene	22	2.3	ECO	Terr Bird
	Benzo(a)pyrene	24	0.25	REF	Rec/Trespass (1E-06)
	Benzo(b)fluoranthene	41	2.3	HH	Rec/Trespass (1E-06)
	Dibenzo(a,h)anthracene	6.8	0.23	HH	Rec/Trespass (1E-06)
	Chrysene	26	10	ECO	Terr Mammal
	Fluoranthene	30	15	ECO	Soil Invert
	Indeno(1,2,3-cd)pyrene	17	2.3	HH	Rec/Trespass (1E-06)
	Naphthalene	6.7	3.2	ECO	Plant
	Pyrene	26	14	ECO	Soil Invert
	DEHP	1.4	0.063	ECO	Terr Bird
IS-RR-02	Antimony	3.4	2.5	ECO	Terr Mammal
	Arsenic	100	24	ECO	Terr Mammal
	Chromium (total)	36	19	REF	Soil Invert
	Chromium VI	4.1	1.8	REF	Soil Invert
	Copper	74	35	ECO	Terr Bird
	Lead	420	33	REF	Terr Bird
	Mercury	0.13	0.12	REF	Terr Bird
	Selenium	1.7	0.80	REF	Terr Mammal
	Acenaphthene	5.7	0.71	ECO	Plant
	Anthracene	11	7.8	ECO	Plant
	Benzo(a)anthracene	29	2.3	ECO	Terr Bird
	Benzo(a)pyrene	29	0.25	REF	Rec/Trespass (1E-06)
	Benzo(b)fluoranthene	51	2.3	HH	Rec/Trespass (1E-06)
	Dibenzo(a,h)anthracene	5.98	0.23	HH	Rec/Trespass (1E-06)
	Chrysene	32	10	ECO	Terr Mammal
	Fluoranthene	64	15	ECO	Soil Invert
	Indeno(1,2,3-cd)pyrene	21	2.3	HH	Rec/Trespass (1E-06)
	Naphthalene	18	3.2	ECO	Plant

Text Table 5.4 Soil and Waste Pile Decision Units Considered for Removal Action					
DU ID	Analyte	Result[1,3] (mg/kg)	Removal Goal[2,3] (mg/kg)	Basis of RG	Risk Driver Receptor
	Phenanthrene	46	8.1	ECO	Soil Invert
	Pyrene	49	14	ECO	Soil Invert
	DEHP	1.2	0.063	ECO	Terr Bird
SUB-SLAB SOIL					
IS-SS-03	DEHP	0.24	0.063	ECO	Terr Bird
	Thallium	0.48	0.16	ECO	Plant
IS-SS-04	Chromium (total)	24	19	REF	Soil Invert
	Lead	86	33	REF	Terr Bird
	Selenium	0.9	0.8	REF	Terr Mammal
	Thallium	0.38	0.16	ECO	Plant
	Benzo(a)pyrene	0.45	0.25	REF	Rec/Trespass (1E-06)
	Tetrachloroethene	1.1	0.41	ECO	Burrow Mamm
	Xylenes (total)	3.0	1.6	ECO	Burrow Mamm
IS-SS-06	Copper	58	35	ECO	Terr Bird
	Lead	100	33	REF	Terr Bird
	Mercury	0.50	0.12	REF	Terr Bird
	Thallium	0.47	0.16	ECO	Plant
	Benzo(a)pyrene	0.69	0.25	REF	Rec/Trespass (1E-06)
	DEHP	0.21	0.063	ECO	Terr Bird
IS-SS-07	Copper	55	35	ECO	Terr Bird
	Lead	150	33	REF	Terr Bird
	Thallium	0.48	0.16	ECO	Plant
	Benzo(a)pyrene	0.53	0.25	REF	Rec/Trespass (1E-06)
IS-SS-09	Lead	64	33	REF	Terr Bird
	Thallium	0.40	0.16	ECO	Plant
	Benzo(a)pyrene	0.53	0.25	REF	Rec/Trespass (1E-06)
	DEHP	0.15	0.063	ECO	Terr Bird
IS-SS-10	Thallium	0.31	0.16	ECO	Plant
	Benzo(a)pyrene	0.26	0.25	REF	Rec/Trespass (1E-06)
	DEHP	0.12	0.063	ECO	Terr Bird
IS-SS-13	Lead	68	24	REF	Terr Bird
	Mercury	0.11	0.085	REF	Terr Bird
	Thallium	0.17	0.16	ECO	Plant
	Benzo(a)pyrene	0.38	0.25	REF	Rec/Trespass (1E-06)
FORMER TRANSFORMER AREA					
IS-TR-01	Arsenic	31	24	ECO	Terr Mammal
	Cadmium	4.7	1.2	REF	Terr Bird
	Chromium (total)	39	19	REF	Soil Invert
	Copper	250	35	ECO	Terr Bird
	Lead	160	33	REF	Terr Bird
	Mercury	0.24	0.12	REF	Terr Bird
	Zinc	270	190	REF	Terr Bird
	Acenaphthene	2.7	0.71	ECO	Plant
	Anthracene	7.9	7.8	ECO	Plant

Text Table 5.4 Soil and Waste Pile Decision Units Considered for Removal Action					
DU ID	Analyte	Result[1,3] (mg/kg)	Removal Goal[2,3] (mg/kg)	Basis of RG	Risk Driver Receptor
	Benzo(a)anthracene	20	2.3	ECO	Terr Bird
	Benzo(a)pyrene	18	0.25	REF	Rec/Trespass (1E-06)
	Benzo(b)fluoranthene	27	2.3	HH	Rec/Trespass (1E-06)
	Dibenzo(a,h)anthracene	3.4	0.23	HH	Rec/Trespass (1E-06)
	Chrysene	20	10	ECO	Terr Mammal
	Fluoranthene	47	15	ECO	Soil Invert
	Indeno(1,2,3-cd)pyrene	9.8	2.3	HH	Rec/Trespass (1E-06)
	Naphthalene	4.3	3.2	ECO	Plant
	Phenanthrene	36	8.1	ECO	Soil Invert
	Pyrene	35	14	ECO	Soil Invert
FORMER UNDERGROUND STORAGE TANK AREAS					
IS-UST1-01	Barium	240	169	ECO	Plant
	Copper	42	35	ECO	Terr Bird
	Lead	51	33	REF	Terr Bird
	Mercury	1.3	0.12	REF	Terr Bird
	Selenium	0.85	0.80	REF	Terr Mammal
	Vanadium	25	21	REF	Terr Bird
	Acenaphthene	0.76	0.71	ECO	Plant
	Benzo(a)pyrene	1.5	0.25	REF	Rec/Trespass (1E-06)
IS-UST2-01	Arsenic	26	24	ECO	Terr Mammal
	Chromium (total)	32	19	REF	Soil Invert
	Lead	50	33	REF	Terr Bird
	Manganese	1,500	520	REF	Plant
	Mercury	0.36	0.12	REF	Terr Bird
	Selenium	0.92	0.80	REF	Terr Mammal
	Acenaphthene	0.92	0.71	ECO	Plant
	Benzo(a)anthracene	4.8	2.3	ECO	Terr Bird
	Benzo(a)pyrene	5.4	0.25	REF	Rec/Trespass (1E-06)
	Benzo(b)fluoranthene	7.9	2.3	HH	Rec/Trespass (1E-06)
	Dibenzo(a,h)anthracene	1.0	0.23	HH	Rec/Trespass (1E-06)
	Indeno(1,2,3-cd)pyrene	4.2	2.3	HH	Rec/Trespass (1E-06)
IS-UST3-01	Arsenic	56	24	ECO	Terr Mammal
	Chromium (total)	31	19	REF	Soil Invert
	Copper	99	35	ECO	Terr Bird
	Lead	140	33	REF	Terr Bird
	Mercury	0.16	0.12	REF	Terr Bird
	Selenium	1.7	0.80	REF	Terr Mammal
	Benzo(a)anthracene	2.4	2.3	ECO	Terr Bird
	Benzo(a)pyrene	2.4	0.25	REF	Rec/Trespass (1E-06)
	Dibenzo(a,h)anthracene	0.60	0.23	HH	Rec/Trespass (1E-06)
	Naphthalene	7.3	3.2	ECO	Plant

Notes:
[1]*Results are the EPC based on either the Chebychev 95UCL value of the three ISM incremental samples, the maximum detected value for analytes with at least one replicate or one detection but less than three, or 1/2 the MDL if all*

replicates were non-detect. The EPC will always be higher than the arithmetic mean of three samples. The results are also the highest value from either the surface or subsurface results.
[2]Removal goals are from Text Table 5.1 in Section 5 in the EE/CA report.
[3]RG and result values are listed to two significant figures and may be different than listed in other tables with more significant figures. Values may be slightly different than values listed on one of the risk assessment tables due to significant figure calculation formulas.
EPC : Exposure Point Concentration. The EPC was used in the Human Health and Ecological Risk Assessments to obtain Preliminary Removal Goals. Values may be slightly different than values listed on one of the risk assessment tables because of significant figure estimation variation.
mg/kg: milligrams per kilogram
DEHP: bis(2-ethylhexyl) phthalate
REF: The maximum of the EPC values from the three Reference and eight flood plain DUs.
ECO: Ecological Preliminary Removal Goal (PRG
HH: Human Health Preliminary Removal Goal
Terr Bird: Terrestrial Bird; HQ of 1
Terr Mammal: Terrestrial Mammal; HQ of 1
Soil Invert: Soil Invertebrates; HQ of 1
Plant: Terrestrial Plants; HQ of 1
Rec/Trespass (1E-06): Recreational Visitor/Trespasser; cancer risk of 1E-06

Text Table 5.5 Sediment Decision Units With Analytical Results Exceeding Removal Goals

DU ID	Analyte	Result[1,3] (mg/kg)	Removal Goal[2,3] (mg/kg)	Basis of RG	Risk Driver Receptor
AERATION POND AREA					
IP-P1-01	Cadmium	1.3	0.95	ECO	Aq Mammal
	Copper	130	40	ECO	Aq Bird
	Lead	82	37	ECO	Aq Bird
	Mercury	0.21	0.059	REF	Aq Bird
	Nickel	26	25	REF	Aq Mammal
	DEHP	8.9	0.082	ECO	Aq Bird
	Di-n-butyl phthalate	0.4	0.044	ECO	Aq Bird
	Dioxin/Furan TEQ	3.00E-05	8.50E-07	ECO	Aq Mammal
IP-P2-01	Cadmium	3.5	0.95	ECO	Aq Mammal
	Chromium VI	11	3.6	HH	Rec/Trespass (1E-06)
	Copper	510	40	ECO	Aq Bird
	Lead	970	37	ECO	Aq Bird
	Mercury	0.74	0.059	REF	Aq Bird
	DEHP	16	0.082	ECO	Aq Bird
	Butyl benzyl phthalate	1.3	1	ECO	Aq Invert
	Aroclor 1254	0.49	0.34	ECO	Aq Invert
	Chlordane (total)	0.2	0.18	ECO	Aq Invert
	alpha-Chlordane	0.028	0.017	ECO	Aq Invert
	gamma-Chlordane	0.027	0.017	ECO	Aq Invert
IP-P3-01	Copper	160	40	ECO	Aq Bird
	Lead	120	37	ECO	Aq Bird

Text Table 5.5 Sediment Decision Units With Analytical Results Exceeding Removal Goals					
DU ID	**Analyte**	**Result[1,3] (mg/kg)**	**Removal Goal[2,3] (mg/kg)**	**Basis of RG**	**Risk Driver Receptor**
	Mercury	0.15	0.059	REF	Aq Bird
	Nickel	29	25	REF	Aq Mammal
IL-AP-01	Nickel	27	25	REF	Aq Mammal
BRANDYWINE CREEK (Sediment)					
IL-BC-01	Arsenic	19	16	REF	Rec/Trespass (1E-06)
IL-BC-02	Copper	48	40	REF	Rec/Trespass (1E-06)
	Benzo(g,h,i)perylene	0.27	0.25	ECO	Aq Invert
CUYAHOGA RIVER (Sediment)					
IL-CR-02	DEHP	0.091	0.082	ECO	Aq Bird
IL-CR-03	Total HMW PAHs	3.3	2.3	ECO	Aq Invert

Notes:
[1]Results are the EPC based on either the Chebychev 95UCL value of the three ISM incremental samples, the maximum detected value for analytes with at least one replicate or one detection but less than three, or 1/2 the MDL if all replicates were non-detect. The EPC will always be higher than the arithmetic mean of three samples.
[2]Removal goals are from Text Table 5.2 in Section 5 of the EE/CA report.
[3]RG and result values are listed to two significant figures and may be different than listed in other tables with more significant figures.
EPC: Exposure Point Concentration. The EPC was used in the Human Health and Ecological Risk Assessments to obtain Preliminary Removal Goals. Values may be slightly different than values listed on one of the risk assessment tables due to significant figure formulas.
mg/kg: milligrams per kilogram
DEHP: bis(2-ethylhexyl) phthalate
REF: The maximum of the EPC values from the four Reference DUs
ECO: Ecological Preliminary Removal Goal (PRG)
HH: Human Health Preliminary Removal Goal
Total HMW PAHs: Total high molecular weight polyaromatic hydrocarbons
Aq Bird: Aquatic Bird; HQ of ≥ 1
Aq Mammal: Aquatic Mammals; HQ of ≥ 1
AQ Invert: Aquatic invertebrates; HQ of ≥ 1
Rec/Trespasser (1E-06): Recreation Visitor/Trespasser; cancer risk of (1E-06)

Text Table 5.6 Surface Water Analytical Results Exceeding Removal Goals					
DU ID	**Analyte**	**Result[1,3] (µg/L)**	**Removal Goal[2,3] (µg/L)**	**Basis of RG**	**Risk Driver Receptor**
AERATION POND AREA (Surface Water)					
SW-P1-01	Arsenic (Unfiltered)	5.0	4.5	REF	Rec/Trespass (1E-06)
	Iron (Filtered)	1,100	1,000	ECO	Fish/Aq Inverts
SW-P3-01	Arsenic (Unfiltered	7.9	4.5	REF	Rec/Trespass (1E-06)
	Iron (Filtered)	1,600	1,000	ECO	Fish/Aq Inverts
	Manganese (Filtered)	420	120	ECO	Fish/Aq Inverts
SW-AP-01	Barium (Filtered)	45	43	REF	Fish/Aq Inverts
	Beryllium (Filtered)	3.4	0.66	ECO	Fish/Aq Inverts
	Manganese (Filtered)	360	120	ECO	Fish/Aq Inverts
BRANDYWINE CREEK (Surface Water)					
SW-BC-02	gamma-Chlordane (Filtered)	0.048	0.0065	REF	Fish/Aq Inverts
SW-BC-03	gamma-Chlordane (Filtered)	0.095	0.0065	REF	Fish/Aq Inverts
CUYAHOGA RIVER (Surface Water)					
SW-CR-01	Aluminum (Unfiltered)	5,700	2,900	REF	Pisciv Mammal
	Arsenic (Unfiltered)	6.0	4.5	REF	Rec/Trespass (1E-06)
	Selenium (Unfiltered)	1.6	1.10	REF	Pisciv Mammal
SW-CR-02	gamma-Chlordane (Filtered)	0.018	0.0065	REF	Fish/Aq Inverts
SW-CR-03	gamma-Chlordane (Filtered)	0.049	0.0065	REF	Fish/Aq Inverts

Notes:

[1]*Results are the EPC based on either the Chebychev 95UCL value of the three ISM incremental samples, the maximum detected value for analytes with at least one replicate or one detection but less than three, or 1/2 the MDL if all replicates were non-detect. The EPC will always be higher than the arithmetic mean of three samples. Values may be slightly different than values listed on one of the risk assessment tables due to significant figure calculation formulas.*

[2]*Removal goals are from Text Table 5.3 in Section 5 of the EE/CA report.*

[c]*RG and result values are listed to two significant figures and may be different than listed in other tables with more significant figures.*

EPC: Exposure Point Concentration. The EPC was used in the Human Health and Ecological Risk Assessments to obtain Preliminary Removal Goals. Values may be slightly different than values listed on one of the risk assessment tables due to significant figure formulas.
µg/L: micrograms per liter
REF: The maximum of the three EPC values from the Reference DUs
ECO: Ecological Preliminary Removal Goal (PRG)
HH: Human Health Preliminary Removal Goal
Fish/Aq Inverts: Aquatic Receptors: HQ of 1
Pisciv Mammal: Piscivorous Mammals; HQ of 1
Rec/Trespass (1E-06): Recreation Visitor/Trespasser; cancer risk of 1E-06

6. Identification of Removal Action Alternatives

This section presents the identification and screening of technology types and process options, and development and analysis of removal action alternatives to address Site contamination and meet the removal action objectives and goals discussed in Section 5. The term "technology types" refers to general categories of technologies, such as chemical treatment, thermal destruction, immobilization, capping, or dewatering. The term "technology or process options" refers to specific processes within each technology type. For example, the chemical treatment technology types include such process options as precipitation, ion exchange, and oxidation/reduction. Removal action alternatives were developed to address contaminated surface and subsurface soil, waste material, sediment, and surface water in the DUs and waste piles at the Site.

To begin development of the alternatives, multiple potential technologies and process options were identified and the technology or process options were screened on the basis of effectiveness, implementability, and cost. Remaining and viable technologies and process options were then combined as components of various removal action alternatives. Each removal action alternative is comprehensive and designed to address the COCs and COECs in each of the media of concern (i.e., soil, surface water, waste material, and sediment).

The identification and screening of technologies and process options is presented in Section 6.1. Common components of Alternatives 2 and 3 are presented in Section 6.2. Alternative 1, the No Action alternative is presented in Section 6.3, Alternative 2 is presented in Section 6.4, and Alternative 3 is presented in Section 6.5. The removal action alternatives are compared to each other in Section 7, and the recommended alternative is identified in Section 8.

6.1. Identification and Screening of Technologies and Process Options

This section presents the identification and screening of technologies and process options to directly address three contaminated media: surface and subsurface soil; sediment in limited areas (such as the Pond areas); and waste material that also includes surface concrete foundation materials, the remaining Fourdrinier machine, former railroad spurs, and other remnant Site features. Removal of Site soils, and waste material, will stop the impact of these contaminated media on adjacent surface waters and sediment related to Pond areas. Technologies and process options were identified based on currently available and tested technologies that can address, treat, remove, or contain, the COCs or COECs in the specific media of concern.

Following the screening, one technology or process option was selected to represent each general technology type retained for consideration. These technology or process options were then incorporated as components into removal action alternatives. Site removal action alternatives must include components to address three media by the removal action (i.e., soil, sediment related to Pond areas, and waste material). For this reason, each alternative included several technology or process options, and different alternatives may include some of the same technology or process options to address the same media.

6.1.1. *Identification and Screening of Potential Technologies and Process Options*

This section identifies and then screens the potential technology and process options using the screening factors identified above. Technology and process options were identified, based on a review of technical literature, engineering expertise, and previous experience at similar sites to address the three media included in the Site contaminated soil, waste material, and sediment. A technology or process option suitable to address contamination in one medium will not necessarily address contamination in a different medium. Therefore, technology or process options were evaluated only with respect to the media they are suited to address.

The following technologies were identified for consideration to address contaminated soil, sediment, and waste material:

- No Action (included as required for comparison)
- Institutional Controls/Engineering Controls (ICs/ECs) (e.g., best management practices (BMPs), administrative controls, informational tools, physical barriers/controls such as fencing and signage)
- Containment (e.g., grading, cap/cover, revegetation, surface water/storm water controls, and barriers)
- In-Situ Treatment (e.g., separation/extraction or stabilization/solidification/vitrification)
- Ex-Situ Treatment (e.g., separation, stabilization/solidification, chemical reduction/oxidation or thermal)
- Excavation

When evaluating each technology, consideration was given to what media it addresses and how it could be combined with other components in a removal action alternative. Results of the technology and process option screening are shown in Table 6-1 and Figure 6-1 and discussed in the following subsections.

6.1.2. *Overview of Alternatives*

Removal action alternatives were developed from the retained technologies and process options following the screening process presented in Section 6.1 and summarized on Figure 6-1. No single technology or process option could achieve the RAOs by itself (stand-alone). Therefore, the retained technologies and process options were combined to create the two removal action alternatives (not including No Action) that might best achieve the RAOs of eliminating unacceptable risks to human and ecological receptors by achieving RGs for inorganics (metals), organics (PAHs), VOCs, PCBs, dioxin/furans, and pesticides, and attaining ARARs. Table 6-2 summarizes how the retained technologies and process options were combined and incorporated into alternatives.

There are three impacted media at the Site: contaminated soil, sediment, and waste material. Each removal action alternative includes components that will address the three media, either separately or collectively, and positively affect surface waters as fourth media. More specifically, each of the removal action alternatives is designed to address contaminated soil, sediment, and waste material present in DUs covering an area of approximately 554,000 ft^2 (about 12.5 acres).

The removal action alternatives are:

- Alternative 1 - No action (as required by the NCP)
- Alternative 2 - Contaminated soil, pond sediment, and waste material excavation and off-site disposal with the concrete foundation retained as a cap over the contaminated soil and waste beneath the concrete foundation. Alternative 2 also addresses remnant Site features that are further discussed in Section 6.2.
- Alternative 3 - Contaminated soil, pond sediment, and waste material excavation, removal of the concrete foundation and the underlying contaminated soil and waste, and off-site disposal. Alternative 3 also addresses remnant Site features that are further discussed in Section 6.2.

Alternatives 2 and 3 are composed of both common and unique components. To reduce describing the same components for each alternative, the common components of Alternatives 2 and 3 are presented in Section 6.2. Alternatives 1, 2, and 3, including unique components, are further described in Sections 6.3 through 6.5, and the costs and quantities assumed for the alternatives are summarized in Appendix F. The alternatives are evaluated in Section 7 with respect to effectiveness, implementability, and cost, and finally an alternative is selected in Section 8.

The design of each alternative includes conceptual and engineering assumptions with respect to equipment and materials at a sufficient level to allow development of a cost estimate. These assumptions are subject to modification during the removal action detailed design and implementation phase.

6.2. Common Components of the Alternatives

Alternatives 2 and 3 contain the same common components to address contaminated soil, pond sediment, and waste material in seven waste piles, 19 soil DUs and three sediment DUs, including waste piles, where the existing concrete foundation does not cover the soil or waste. Other common components include the following.

- ICs/ECs to restrict Site access during the removal action
- Biological and archaeological surveys including a bat survey, threatened and endangered species survey, cultural survey, and other surveys as indicated by NPS.
- Railroad spur removal
- Beater tank(s) removal
- Fourdrinier Machine removal

- Transite pipe removal
- Addressing remaining data gaps
- Pond 1 concrete liner and sediment removal
- Ponds P2 and P3 sediment removal
- Storm water controls
- Revegetation efforts
- Air monitoring
- ISM confirmation sampling
- Material excavation
- Transport to disposal facility
- Disposal at an off-site facility
- Site restoration- using NPS approved clean fill material

6.2.1. *Excavation and Disposal of Hazardous Waste - Dump site Contaminated Soil and Waste Material*

The contaminated soil and waste material in the Dump site will be excavated and removed in Alternatives 2 and 3. Material will be removed until all visible waste material is removed and ISM confirmation sampling indicates that remaining concentrations of COC in the underlying soil are at or below RGs. Based on depths identified during the 2016 EE/CA field investigations, the anticipated depth will range from 5 to 8 feet resulting in removal of approximately 33,100 yd^3 (bulked) of hazardous contaminated soil and waste material. Additional details are presented in Sections 6.4 and 6.5.

6.2.2. *Excavation and Disposal of Decision Unit and Waste Pile Contaminated Soil and Waste Materials*

Contaminated soil, pond sediment, and waste material will be excavated and removed in Alternatives 2 and 3. The common DU areas for removal in both alternatives include AP, BLD, CWP, RR, TR, and UST. Material will be removed until all waste material is removed and ISM confirmation sampling indicates that remaining concentrations of COCs are at or below RGs. Based on depths identified during the 2016 EE/CA field investigations, the depths of the excavation are anticipated to range between 4 to 12 feet bgs resulting in the removal of approximately 95,300 yd^3 (bulked) of contaminated soil and sediment material and waste material. The excavation and disposal also includes the sediment from Ponds P2 and P3. Pond P1 is discussed below in Section 6.2.4. Additional details including specific DUs for removal are presented in Sections 6.4 and 6.5.

6.2.3. *Remaining Existing Site Feature Removals*

Remaining existing Site features are shown on Figure 6-2.

Excavation of Backfill Basement Areas

The former building had a basement under a portion of the facility (Figure 6-2). During the TetraTech 2005/2006 building demolition, the basement was cleared and the concrete floor broken to allow drainage, then backfilled with clean construction debris consisting of brick fragments, concrete fragments and soil. During excavation of contaminated soil and waste, the debris will be removed for off-site disposal. After removal of the backfill, the underlying concrete floor will be removed and confirmation ISM sampling will be conducted on the soil beneath the concrete floor. Additional soil will be removed if ISM analytical results for the underlying soil are in exceedance of the Site RGs.

Removal of existing Railroad infrastructure

For Alternatives 2 and 3, the approximately 3,200 linear feet (lf) of railroad tracks will be removed (Figure 6-2). The former mill utilized the railroad to deliver raw material and ship finished product. There are five railroad spurs on the Site totaling approximately 3,200 lf. Approximately 1,750 to 2,200 lf are still visible on the surface or were encountered during the investigation activities. Approximately 950 to 1,050 lf were not visible and may have been removed during previous Site activities, or are buried beneath the waste and soil placed along the former spurs. Electromagnetic surveying will be used to identify and mark the location of the rails and ties for removal. The steel rails and fasteners (i.e. spikes, fish plates, rail tie plates, and bolts) will be removed and recycled in accordance with EPA's green remediation guidance. The wooden rail ties (sleepers) will be removed and recycled if a recycling pathway can be identified and approved by NPS. If an approved recycling pathway is not available, the ties will be transported off Site for disposal in accordance with the Ohio EPA regulations. Given the relative increases in arsenic and PAHs in soil samples collected from the railroad spur DUs, it is possible the rail ties are a source of this arsenic and PAHs as a preservative that was typically used for this purpose. Railroad ties were typically treated with creosote and chromium arsenate pesticides to preserve them. According to studies and rail to trail projects PAHs, arsenic and chromium can leach from the ties and impact the surrounding soils (USEPA 2008, Rails to Trails 2004, and Berkshire 2012). Additional sampling maybe necessary to confirm this assumption, which may result in identification of the rail ties as hazardous waste. OEPA requires the ties be tested to determine whether they are hazardous or non-hazardous (OEPA 2017). If hazardous they will need to be disposed of as hazardous waste at an approved facility. If they are determined to be non-hazardous they can be recycled or disposed of at a construction debris landfill. The railroad bed material consisting of slag will be excavated and disposed of as part of the excavation of the associated DU or waste pile.

Fourdrinier Machine Removal

In Alternatives 2 and 3 the Fourdrinier Machine will be removed. Analytical results from samples of paint and gaskets have identified lead-based paint (LBP) and ACM on the Fourdrinier Machine. The cost estimate in Appendix F is based on removal of the ACM; separating the painted framework from non-painted rollers, gears, bins, and trays; recycling the non-painted items as scrap metal; and disposal of the painted items as hazardous waste at an appropriate disposal facility.

Pond 1, 2, and 3 Removal

Alternatives 2 and 3 include the removal of Pond P1, P2, and P3. The pond water (only in Pond 1) and sediment will be sampled, drained and all sediment removed prior to removal of the concrete liner known only to exist in Pond 1. After removal of the water and sediment, the concrete liner will be sampled to determine disposal options. The water will be disposed of at a licensed liquid disposal facility. If appropriate, the concrete will be recycled at a concrete recycling facility following analysis of concrete. Excavated pond sediment will be disposed of at an off-Site facility. In addition to contamination removal, the Pond 1, 2, and 3 excavation eliminates an impaired condition to future use of the Park. Confirmation ISM sampling will be conducted on the underlying soil after the concrete and sediment has been removed to verify compliance with the Site RGs. The area will be revegetated and regraded to conform to pre-operation topography. The removal of the remaining two ponds and their sediment are included in Section 6.2.2 discussion as part of the excavation and disposal task.

The pond P1 has two aerators located at each end of the pond. These aerators will be removed and any piping or wiring will be removed and properly recycled or disposed of during the concrete removal activities.

Transite Pipe

During the subsurface soil sampling conducted in 2016, transite pipe was encountered in two incremental soil boring locations. One location in DU UST3 area was just north of the railroad tracks. The second location was in DU IS-BLD-03 west of groundwater monitoring well MW-UST1-01. The EE/CA work plan scope of work did not include addressing the full linear extent of transite piping. Transite pipe was reportedly encountered near the former power house during the 2006 building demolition (JCO 2006). Plans prepared by URS Grenier for UST work conducted in 1997 (URS 1997 Figure 3.2) show a sanitary sewer line present in the vicinity of the UST3 location where the transite pipe was encountered during Phase I & II field work. The URS figure shows the sewer line to the west of the building north of the transite pipe encountered in DU BLD-03. The removal of the transite pipe will be addressed as the waste material and slag is excavated. The total linear extent is unknown, however, the URS figure depicts approximately 400 to 500 feet of sewer line accessing the septic tank. A standard protocol will be established to follow for pipe removal and disposal during the removal action. Preliminary procedures will include exposing a predetermined length of piping during soil and waste excavation and using a licensed ACM abatement contractor to remove the exposed section in accordance with all regulation to prevent a release of asbestos fibers to the air or soil. The planned Remedial Action Work Plan (RAWP) will provide detailed procedures to follow based on federal, state and local asbestos abatement regulations. The removed piping will be disposed of at a facility licensed to receive and dispose of asbestos-containing material.

Well Abandonment

The EE/CA Work Plan identified 12 existing groundwater monitoring wells that were installed during previous Site investigations. Six wells were reportedly installed associated with the UST 1 Area and six were installed in the Dump site and Central Waste pile areas. During the EE/CA field activities no existing wells were observed in the UST1 area. Four wells were observed in the Dump site and CWP area. The observed wells consisted of ½-inch diameter polyethylene tubing. During the final removal action these wells will be abandoned in accordance with ODNR regulations and a well closure report will be prepared for submittal to the ODNR website. If additional wells are encountered during removal actions they will be abandoned in accordance with the ODNR.

Twenty two groundwater monitoring wells and 15 groundwater piezometers were installed for the 2106 EE/CA investigation. These monitoring wells and piezometers will be abandoned during the implementation of the final removal actions in abandoned in accordance with ODNR regulations and a well closure report will be prepared for submittal to the ODNR website.

Beater Tanks

During historical operations, two beater tanks were reportedly used on the Site. During the 2016 EE/CA field investigations, one beater tank was encountered adjacent to the concrete foundation just north of concrete DU IS-CONC-10. During the implementation of the removal action, the inside of the beater tank will be sampled prior to removal to determine if they contain any potentially hazardous substances. They will then be disposed of properly and the area beneath and surrounding the tank will be assessed using ISM. If other tank(s) are encountered during the removal action, they will also be sampled and assessed utilizing ISM.

6.2.4. *Data Gaps to be addressed in both Alternatives*

Data gaps will be addressed as common components in both Alternatives 2 and 3. Data gaps can be divided into two general categories: 1) additional soil and waste delineation under the concrete foundation; and 2) additional soil and waste delineation on Site surrounding the concrete foundation. The approximate locations of the data gaps are shown on Figure 6-3.

Sub-slab Data Gaps

The data gaps on the Site beneath the concrete foundation include the following, which are also shown on Figure 6-2.

- The vertical extent of slag under a portion of the concrete foundation was beyond the extent of the EE/CA investigation. In addition, PCE and xylenes above their RGs, slag, and black stained soil waste were discovered under the concrete foundation, but beyond the vertical extent of the EE/CA investigation. These areas are shown on Figure 6-2. Data gaps related to soil and waste contamination beneath the concrete foundation can be addressed at different times depending on the alternative chosen. Further delineation of the nature and extent slag, PCE, and black stained soil detected at DU locations IS-SS-10, IS-SS-11 for slag, IS-SS-04 for VOCs, and IS-SS-06, IS-SS-07, IS-SS-08, and IS-SS-13 for black stained soil can be determined similarly to the Site investigation using ISM sampling techniques beneath the concrete foundation. For Alternative 2, this investigation can be conducted prior to excavation, or concurrent to excavation of the DUs and waste piles. The data gap investigation must be completed prior to finishing excavation of DUs to allow sufficient time to modify the scope if additional remediation is required beneath the concrete foundation. For Alternative 3, the concrete foundation data gap investigation can be conducted after removal of the concrete foundation allowing a more efficient investigation. The results of the investigations will be incorporated into the Alternative 3 scope of removal including the need to excavate additional soil or waste material in impacted areas.

Non Sub-Slab Data Gaps

The data gaps on the Site beyond the concrete foundation include the following items, which are also shown on Figure 6-2.

- The vertical extent of slag in several of the DUs along the northern portion adjacent to Brandywine Creek was beyond the extent of the EE/CA investigation. During the EE/CA investigation, slag and waste material were observed to the total depths of the ISM incremental boring at 3 ft bgs and the risk assessment boring at 6 ft bgs. The total depth of slag in DUs IS-RR-01, IS-RR-02, IS-TR-01, IS-CWP-02, and IS-UST3-01, located south of Brandywine Creek, is unknown. Waste pile delineation borings advanced in the west adjacent CWP1N waste pile identified slag and waste material to depths of 10 to 11 feet bgs. Based on the depth of slag in the adjacent CWP1N waste pile, slag thickness and depth could extend to 7 to 9 feet in some areas of the DUs. In addition, during Site reconnaissance of the adjacent Brandywine Creek bed, slag, asphalt roofing felt, concrete, and other waste materials were observed in the creek bank from east of piezometer PZ-BC-04 to west of MW-UST3-02. The Creek bank height ranged from approximately three feet near PZ-BC-04 to nearly nine feet near MW-UST3-02 and CWP1N. Waste thickness was variable along the reach where the waste was observed, but generally ranged from approximately three up to nine feet within the exposed Creek bank. Further delineation of the nature and extent of the slag and waste can be determined during the excavation of the DUs. To estimate cost, the depth of excavation will be estimated to be 8 to 9 feet based on the adjacent CWP1N and the depth of waste material observed in the Brandywine Creek.

- The EE/CA Work Plan did not include collecting samples from reference locations for analysis for dioxin/furan or VOCs. During the 2016 and 2017 EE/CA investigations, dioxin/furans were detected in seven samples collected from non-reference areas including soil, sediment, and waste media from DUs and waste piles. In addition, VOCs were detected beneath the concrete at IS-SS-04. The analytical testing of the reference areas for dioxin/furans and VOCs was beyond the scope of the EE/CA investigation. However, based on analytical results, additional dioxin/furan and VOC data in the reference areas is required to identify the reference values for these analytes. During the initial Site preparation activities for final removal action, the reference locations for soil and sediment will be resampled and submitted to the laboratory for analytical testing for dioxins/furans and VOCs. Soil samples will be collected from surface and subsurface soils and sediment in the reference areas that were sampled during the EECA investigation. Three replicates will be collected from surface and subsurface soil in each of the three reference locations, IS-REF-01, IS-REF-02, and IS-REF-03. Three replicates will be collected from the sediment reference locations along the Cuyahoga River, Brandywine Creek and the unnamed stream adjacent to the Pond P1. ISM sampling will include 40 incremental samples at each of the reference DUs.

- Soil sampling under the concrete pad of the Fourdrinier Machine was not possible during the 2016 and 2017 EE/CA investigation because of the presence of the Fourdrinier Machine over SS-06, SS-08, SS-09, and SS-11. As a result of the proposed removal of the contaminated Fourdrinier Machine based on these investigations, and because of the historical evidence of PCB detected above action levels in liquid in a trench beneath the Fourdrinier Machine (EMG, 1993), the soil immediately beneath the Fourdrinier Machine under the concrete slab should be sampled. For Alternative 2, this investigation can be conducted prior to excavation, or concurrent to excavation of the DUs and waste piles after the Fourdrinier Machine is removed. The data gap investigation must be completed prior to finishing excavation of DUs to allow sufficient time to modify the scope if additional remediation is required beneath the concrete foundation. For Alternative 3, the soil investigation beneath the Fourdrinier Machine can be conducted after removal of the concrete foundation allowing a more efficient investigation. The results of the investigations will be incorporated into the Alternative 3 scope of removal including the need to excavate additional soil or waste material in impacted areas.

- A significant increase in surface soil arsenic concentrations was detected in the railroad DUs, which includes IS-BLD-03, IS-RR-01, and IS-RR-02. This increase may be the result of once typical rail tie wood preservation methods that included arsenic. Consequently, the rail ties may require disposal as hazardous waste and require material-specific sampling prior to disposal to determine if hazardous waste disposal is required. For Alternative 2 and 3, this sampling should take place prior to any Site excavation to allow removal and disposal of steel rails and rail tie that impede soil disposal underlying the rail lines.

6.2.5. *Confirmation Sampling Approach*

In Alternatives 2 and 3, confirmation ISM soil sampling will be conducted across the excavation base of each DU and waste pile to evaluate whether contamination remains at levels exceeding RGs. Confirmation sampling is assumed in all removal areas following removal of all waste material including slag. The excavation of the underlying soil will be minimized to and approximately 6 to 12 inches or less prior to confirmation sampling.

The confirmation sampling effort will be similar to the 2016 and 2017 soil investigation that included collection of ISM soil samples from each DU and waste pile. Three replicate ISM samples will be collected from each DU and waste pile. Each soil sample will be collected from the bottom of the excavation from approximately 40 incremental locations selected using a systematic random grid design. The ISM samples will be submitted for laboratory analysis of the 35 COCs (Text Table 5.1). The samples will be processed using the current laboratory procedures, which will be reviewed as part of the Removal Action Work Plan documentation to confirm that the methods and results are comparable. Confirmation sampling will begin following the removal of all observed slag waste material in each DU and waste pile.

If confirmation sampling indicates that any RG is exceeded in a DU or waste pile, then an additional approximately 6 to 12 inches will be removed and the DU or waste pile will be sampled again. If additional slag is encountered below removed soil, then all slag will be removed prior to additional confirmation sampling. If confirmation sampling indicates that all COC concentrations are below the RGs, then excavation will be considered complete within the sampled DU or waste pile and no further excavation will be conducted. The DUs and waste piles identified as clean will be marked and closed for access to prevent potential recontamination from activities on other adjacent DUs or waste piles. Once a DU or area has been identified as clean, no truck traffic or equipment will be allowed in the area until regrading with clean equipment and revegetation activities warrant access. Where necessary, the boundaries of these clean DUs will be protected from adjacent contaminated DUs using erosion control measures until the adjacent contaminated DUs is excavated.

6.2.6. *Site Access, Haul Roads, and Transportation*

Trucks will use the maintenance road off of Highland Road to reach the Site. The main Site access gate is currently located at the southeast corner of the Site perimeter fencing. A second access gate is located at the northeast corner of the perimeter fencing. The northern gate was used during the 2005/2006 demolition of the Site buildings for haul trucks. Flooding along Brandywine Creek in 2017 and 2018 damaged the northern access eroding portions of the dirt/gravel ramp that leads to the gate and rendered the gate unusable without structural repairs to the gate and ramp. There are several advantages to using the northern gate for Site access including; 1) eliminating the need for haul trucks to use the Towpath and interfering with path users because the northern gate is accessed from the maintenance road prior to reaching the Towpath; 2) limit the damage and need for repair to the Towpath from heavy traffic volumes; and 3) the north gate access to the Site allows use of larger trucks without modifying the existing southern fence/gate configuration. The entrance ramp and surrounding area can be repaired to allow trucks to enter and exit safely through the northern gate.

Temporary haul roads can be constructed on Site for traffic as needed to facilitate excavation and loadout of excavated material. Initially for areas not accessible by standard vehicles, the contaminated soil and waste can be excavated and placed in articulated or tracked dump trucks capable of driving on the waste material. The dump trucks then place contaminated soil and waste material in temporary stockpiles utilizing the existing concrete foundation. The excavated soil and waste can then be loaded into lined or sealed bed trucks for transport to the disposal facility. Once the excavation is proximal to the concrete foundation, street-appropriate trucks can be loaded directly avoiding temporary stockpiles. It should be noted that the existing concrete foundation is in poor condition and other alternatives may need to be considered during removal.

6.2.7. *Archeological and Biological Monitoring and Working in Sensitive Areas*

For Alternatives 2 and 3, archeological and biological monitoring must be performed before and during activities that involve vegetation or ground disturbance. The floodplain west of the building has been tentatively identified as an area of archeological interest, particularly with respect to Native American historical use. If removal actions include the floodplain to the west of the building, additional surveying may be required in order to comply with the National Historic Preservation Act and Archaeological Resources Preservation Act ARARs. The excavations will be continuously observed for potential cultural objects or other archaeological objects. If discovered, the excavation will be halted until a Region/Park archaeologist can visit the Site and provide direction on the removal action.

A biological survey will be conducted to identify and locate any flora or fauna present on Site that are considered sensitive, threatened, or rare plant or animal populations that could be impacted from Site activities in order to comply with the Endangered Species Act ARAR.

If cultural, archeological or biological resources (e.g., sensitive plants, animals, or historic artifacts) are identified, measures will be taken to protect and preserve those resources to the extent practicable. It is anticipated that an NPS archaeologist and biologist will be available prior to and during the Site removal action activities. This EE/CA assumes that archeological and biological monitoring activities will be conducted throughout the duration of on-site removal action activities.

6.2.8. *Air Monitoring*

For Alternatives 2 and 3, air monitoring will be conducted throughout implementation of the removal action and at multiple locations to evaluate emissions (e.g., airborne dust concentrations) and support public safety, worker safety, and compliance with applicable restrictions. BMPs will be implemented during all Site removal activities to manage potential impacts from emissions of dust particulates. A water truck will be used to apply water for dust suppression along dirt roads and across the Site, where necessary.

6.2.9. *Decontamination*

Decontamination for Alternatives 2 and 3 will consist of a centralized decontamination area equipped with a drive-on drive-off decontamination pad. A staging area will be prepared adjacent to the decontamination area to allow storage of cleaned equipment and materials prepared for use or off-site transport, as well as to stage potable water tanks, fuel and drums of decontamination waste as needed. The decontamination pad will be either a constructed pad or a prefabricated structure (portable). Larger equipment will be decontaminated on the decontamination pad prior to leaving the Site. A steam cleaner will be used to clean larger equipment such as, the excavator and bucket, loader, on-site dump trucks, and any other equipment or vehicle that enters the excavation zone. All equipment will be brought to the Site in a clean decontaminated condition free of soil or other off-site material to prevent cross contamination.

6.2.10. *Placement of Clean Imported Fill*

For Alternatives 2 and 3, following excavation and successful confirmation sampling, clean imported material meeting NPS specifications (NPS 2014) will be placed on the disturbed areas to various specified depths to re-create natural land contours and to provide storm water/erosion controls and to facilitate revegetation.

6.2.11. *Stormwater Controls*

To reduce the likelihood of transport of contaminated soils off-site during removal action activities, Park-approved temporary storm water controls (e.g., silt fencing and coconut-based wattles) and BMPs will be designed and installed to manage surface run-on/run-off. Following the completion of the removal action, temporary controls may be implemented during revegetation to control erosion until vegetation has been established. If determined necessary by the Park or RAWP, Park-approved permanent storm water controls including but not limited to wattles, swales, drainage channels, and ditches will be installed and monitored to reduce erosion.

The configuration of the permanent and temporary storm water controls will be determined during detailed design of the removal action alternative and prior to implementation. Existing drainage patterns will be restored within the areas that are excavated. Storm water controls will be employed to divert storm water around the backfilled areas.

6.2.12. *Reclamation/Revegetation Effort*

Upon completion of excavation and construction activities for Alternatives 2 and 3, a revegetation program will be implemented in the areas of soil disturbance, such as excavation areas to reduce erosion, increase evapotranspiration, and improve aesthetics. Drainage channels or swales used as storm water controls may incorporate vegetation as armoring.

A diverse, effective, and permanent vegetation cover over the entire disturbed area will be established. Seeding and planting of the disturbed area will stabilize the soil surface to prevent erosion. The specified seed mix will meet the specifications on file with the Ohio Department of Agriculture at the time of seeding as to percentage purity, weed, seed, and germination. The seed mix must be approved by NPS. Shrubs and trees native to the area and approved by NPS will also be planted.

Performance standards will be outlined in greater detail once the remedy has been selected and the RAWP is written. It is anticipated that it will take five years for the vegetation to meet the performance standards.

6.2.13. *Other Common Elements*

Reroute of Jaite Loop Trail in accordance with page 68 of the 2013 Trail Plan. Rerouting this trail will provide a connection from the towpath utilizing the existing Jaite Bridge or if needed a new bridge across the River and realign the existing trail a loop trail to the Jaite Historic District. The trail loop and connection would be approximately one mile. The portion related to the Jaite Paper Mill Site is shown in Figure 6-4. Under both alternatives the trail would be realigned beginning at the north end of the existing rail bridge and would not include the bridge itself.

The soil anticipated for removal in the Dump site would not be replaced with clean fill. This area will be graded once it meets all RGs to allow for this area to act as a natural flood outlet as well as potentially provide greater access to visitors for kayak/canoe use along this portion of the Cuyahoga River. This is in compliance with the CUVA Strategic Action Plan (SAP 2017-2021) outlining providing access to the Cuyahoga River and having the river designated as a Scenic River within CUVA.

Sandstone utilized for the TCRA will be utilized as applicable in the remedial design. Stone not needed for the remedial action will be utilized elsewhere in the Park.

Selected portions of the Fourdrinier will be kept and utilized for interpretive purposes on the Site or elsewhere in the park. These portions will be free of all contamination.

Wayside exhibits will be developed and installed to tell the story of returning the area back to its natural state.

The bank portion of the Brandywine Creek AP area will be reclaimed utilizing plans developed by Northeast Ohio Sewer District.

6.3. Alternative 1: No Action

Consistent with the NCP and CERCLA guidance, a “no action” alternative is considered as a baseline for comparison. Under this alternative, no additional monitoring, removal actions, or maintenance would be performed at the Site. Under the No Action alternative there would be no future work to contain or remove contaminated soil or waste material, to reduce exposure of human and ecological receptors to Site contamination, to maintain existing controls, or to reduce future transport or migration of the contaminants. Although portions of the Site are currently closed to public access, a perimeter fence and signs (ECs) are currently present at the Site. No Action assumes no future maintenance, repair, replacement, or enforcement of these protective controls; therefore, these controls are presumed to have no long-term protective value. Since this alternative would not include a mechanism to prevent future exposure to contaminants and would fail to meet the non-impairment ARAR, among others, this alternative would not meet RAOs for the Site. The No Action alternative is the scenario used in the HHRA and ERA to assess risks presented to human health and environmental receptors at the Site (detailed in Section 3). The

NCP requires retention and consideration of the No Action alternative for comparison purposes to other removal action alternatives.

6.4. Alternative 2: Partial Contaminated Soil and Waste Excavation Excluding Concrete Foundation and Underlying Waste

Alternative 2 was developed by incorporating appropriate technological process options to achieve the RAOs. Table 6-2 presents the technology process options and the alternative descriptions. Further details of the alternative processes are presented below.

6.4.1. *Excavation and Off-Site Disposal*

Alternative 2 consists of excavation and off-site disposal of approximately 128,400 yd^3 (bulked) of contaminated soil, sediment, and waste material, including slag not covered by the concrete foundation, present at 19 soil DUs, three sediment DUs, and seven waste piles at the Site and covering a total of approximately 10.5 acres (Appendix F). Contaminated soil and waste beneath the concrete foundation would remain in-place using the existing concrete foundation as a cover. These steps will be further detailed and modified in the Removal Action Work Plan.

Figure 6-5 shows the locations of the DUs where excavation of contaminated materials may be implemented for Alternative 2. In each DU where contaminated soil or waste material is present, the DU will be excavated until all waste material including slag is removed and undisturbed soil is encountered within the entire DU and the area has met RGs. Based on excavation method, 6 to 12 inches of underlying soil may be removed with the waste material. The excavation below the waste material will be minimized as much as the equipment can accommodate. In each DU where the material to be removed is contaminated soil with little to no visible waste material, the soil would be excavated in specified lifts (e.g., approximately 6 to 12 inches) based on the identified depths that exceed RGs. After the removal of waste material or a specified depth of soil, each DU will be sampled and analyzed using ISM to confirm that removal is complete (i.e., COC concentrations are below RGs). In DUs where confirmation ISM results indicate soil concentrations remain above RGs, additional lifts (e.g., approximately 6 to 12 inches) will be removed and resampled until sampling results are below RGs for the Site COCs.

The depth to the bottom of waste material is variable and estimated for portions of the Site. Excavation depths for all waste piles and DUs are estimated. Waste pile CWP1S-B is an aboveground pile placed on plastic and overlying CWP1S-A and will be removed while excavating CWP1S-A. The estimated excavation depths are based on the depth of contaminated soil or waste material identified in the soil borings and test pits advanced within each DU during the 2016 and 2017 EE/CA investigations.

As calculated in Appendix F, the total volume of excavated material for Alternative 2 is estimated at approximately 128,400 yd^3 bulked. This estimate includes: excavated hazardous waste from the Dump site, 33,100 yd^3 bulked; and non-hazardous soil and waste contaminated soil material from non-concrete covered DUs and grubbed material, 95,300 yd^3 bulked.

There are five areas with concrete pads/slabs/walls not associated with the existing concrete foundation that will be removed during Alternative 2. These pads/slabs include the former transformer pad (200 ft^2), the former pathway from the parking lot to the front of the former building (~260 ft^2), and a small concrete pad (~400 to 500 ft^2) encountered covering portions of waste pile CWP1S-A and DU IS-UST2-01 just west of the concrete foundation. These pads/slabs are between four and nine inches in thickness and will be removed during excavation of the underlying soil and waste. The concrete will be transported to a recycling facility for recycling. The fourth miscellaneous concrete is the Pond P1 liner. The liner is estimated to be 16,250 ft^2 The Pond P1 concrete liner will be removed and transported to the recycling facility. The basement floor and basement walls are the fifth area of miscellaneous concrete and is estimated at (11,100 ft^2)The estimate for concrete removal for non-foundation concrete is 900 yd^3 (bulked).

Excavation activities will be performed by tracked excavators, wheeled articulated or track-mounted dump trucks, wheel-mounted front-end loaders, and dozers in most areas. Smaller equipment (e.g., mini-excavator) will be used in areas with sensitive biological features.

Clean imported soil meeting NPS specifications (grading fill) will be placed over the excavated areas and graded using dozers and small equipment to prevent ponding and promote positive drainage. The average thickness of grading fill is estimated to be 3 to 4 foot across most of the Site. Cost estimates assume the grading fill will be trucked to the Site from a source outside the Park. The total volume of grading fill required for the excavated areas (excluding the concrete foundation area) of Alternative 2 is estimated to be approximately 97,600 yd^3 (bulked). The graded areas will be revegetated, and surface water drainages installed.

6.4.2. *Concrete Foundation Structural Repair/Replace for Use as a Cap*

The concrete foundation is in fair to poor condition with areas of the slab in very poor condition. The slab portion of the concrete does not have reinforcing rebar. In addition, several of the foundation walls are failing. In order to use the concrete foundation as a cover to contain the contaminated soil and waste beneath the concrete, the concrete will need to be made structurally sound either by repairing the existing concrete walls and slabs or by removal and replacement of the concrete with a new reinforced concrete slab and wall system. The building foundation concrete covers an area of approximately 160,400 $ft^2$and at thicknesses ranging from 0.5 to over 2 feet. The volume of foundation concrete to be removed and replaced is estimated to be approximately 7,300 yd^3 (bulked) for removal and 2,900 yd^3 to replace with a 6 inch thick rebar reinforced slab.

6.4.3. *Operation and Maintenance*

Annual maintenance under Alternative 2 will include maintaining the concrete foundation, as well as the revegetation efforts including any temporary storm water and erosion controls in the disturbed areas. Site-wide revegetation efforts were assumed to be achieved in 5 years Alternative 2 includes perpetual maintenance and placing of additional soil or grading activities that are associated with concrete maintenance to maintain the concrete foundation as a cap over existing contamination. Annual surface water control maintenance will include repair of channels, including removal of materials and repair of armoring. It is assumed that approximately 5 percent of the storm water controls will require repairs each year. The annual storm water control maintenance are assumed for a 5 to 15-year period or until the vegetation is established and storm water is controlled by the vegetation. Storm water controls will be detailed in the RAWP and may include wattles, swales, channels, silt fences, retention ponds, or combinations of these items. The concrete maintenance activities are assumed for 30 years. The Site will be required to undergo 5 year reviews as contamination will be left in place.

Site-specific restrictions pertaining to the Site (e.g., no intrusive work in the concrete area) will be included in the annual revision of the Superintendent's Compendium.

6.5. Alternative 3 - Comprehensive Site Contaminated Soil and Waste Excavation

Alternative 3 was developed by incorporating appropriate technological process options to achieve the RAOs. Table 6-2 presents the technology process options and the alternative descriptions. Further details of the alternative processes are presented below.

6.5.1. *Excavation and Off-Site Disposal*

Alternative 3 consists of excavation and off-site disposal of approximately 155,600 yd^3 (bulked) of contaminated soil and waste material from 26 soil DUs, three sediment DUs, and seven waste piles at the Site, and 188,700 ft^2 concrete building foundation and other miscellaneous concrete covering a total of approximately 12.5 acres (Appendix F). Alternative 3 includes the removal and off-Site disposal of the concrete foundation and the contaminated soil and waste beneath the concrete foundation not included in Alternative 2. The process steps to complete Alternative 3 will be further detailed and modified in the RAWP.

Figure 6-6 shows the locations of the DUs where excavation of contaminated materials would be implemented. In each DU where contaminated soil or waste material is present, the DU will be excavated until all waste material including slag is removed and undisturbed soil is encountered within the entire DU. The waste material was sampled during the 2016 field investigation and any visible waste material is considered contaminated and needs to be removed. Based on excavation method, 6 to 12 inches of underlying soil may be removed with the waste material. The excavation below the waste material will be minimized as much as the equipment can accommodate. In each DU where the material to be removed is contaminated soil with little to no visible waste material, the soil would be excavated in specified lifts (e.g., approximately 6 to 12 inches) based on the identified depths that exceed RGs. After the removal of waste material or a specified depth of soil, each DU will be sampled and analyzed using ISM to confirm the removal is complete (i.e., COC concentrations below RGs). In DUs where confirmation ISM results indicate soil remains above RGs, additional lifts (e.g., 6-12 inches) will be removed until confirmation ISM sampling results are below RGs for COCs.

The depth to the bottom of waste material is variable and estimated for portions of the Site. Excavation depths for all waste piles and DUs are estimated as shown in Appendix F. Waste pile CWP1S-B is an aboveground pile placed on plastic and overlying CWP1S-A and will be removed while excavating CWP1S-A. The estimated excavation depths are based on the depth of contaminated soil or waste material identified in the soil borings and test pits advanced within each DU during the 2016 and 2017 EE/CA investigations.

As calculated in Appendix F, the total volume of excavated material for Alternative 3 is estimated at approximately 155,600 yd^3 bulked. This estimate includes: excavated hazardous waste from the Dump site, 33,100 yd^3 bulked; non-hazardous soil and waste contaminated soil material from all DUs, the backfill material from the basement, to assess the soil beneath the concrete floor of the basement area that was not sampled in 2005/2006, and grubbed material, 122,500 yd^3 bulked; and concrete, 8,200 yd^3 bulked.

As discussed in Section 6.4.1 excavation, truck access, and clean fill methods will be the same for Alternative 2 except the total volume of grading fill required to implement Alternative 3 is approximately 121,900 yd^3 bulked.

6.5.2. *Concrete Removal*

Approximately 188,700 ft^2 of the Site is covered by concrete including the visible concrete foundation (160,000 ft^2 , pond liner (16,250 ft^2) and the basement floor and basement walls (11,100 ft^2), which were broken but not removed or sampled during the 2005/2006 demolition. An additional approximately 1,000 ft^2 of concrete pad is on Site including: the former transformer pad, the former entrance pathway from the parking lot to the front of the building; and a small pad located west of the concrete foundation covering approximately 400 to 500 ft^2 of waste pile CWP1S-A and DU IS-UST2-01. The concrete foundations will be removed during the implementation of Alternative 3 and the underlying contaminated soil and waste material removed. The concrete varies in thickness from a minimum of approximately 0.5 to more than 2 feet. Text Table 6.1 presents the maximum and average thickness of the 11 concrete DUs identified during the 2017 EE/CA investigation.

Text Table 6.1 Concrete Thickness of Building Foundation

Concrete DU	Maximum Thickness[1,2] (ft)	Average Thickness[3] (ft)	Comments
IS-CONC-01	1.0	0.67	Has exterior wall foundation 1 to 4 feet high. Slab 0.5 feet thick
IS-CONC-03	1.0	0.67	Has exterior wall foundations 1 foot high
IS-CONC-04	1.0	0.67	Southern and western portions comprised of broken discontinuous pieces of concrete. Some exterior walls to 2 feet high. Northern portion is a

Text Table 6.1 Concrete Thickness of Building Foundation			
Concrete DU	**Maximum Thickness[1,2] (ft)**	**Average Thickness[3] (ft)**	**Comments**
			slab.
IS-CONC-06	2.0+	1.5	Northwest portion has layer of concrete over a 2 to 5 foot void area with a concrete lower layer. Thicker concrete near the Fourdrinier Machine. Former basement area.
IS-CONC-07	2.0+	1.5	Areas of thick concrete and voids. Some areas have any upper slab and a lower slab separated by 2 to 3 feet of void space
IS-CONC-08	2.0+	1.5	Northern portion and areas near the Fourdrinier Machine have the thicker concrete.
IS-CONC-09	1.0	0.67	Slab with interior wall foundations
IS-CONC-10	1.0	0.67	Slab with interior and exterior wall foundations to 4 feet high
IS-CONC-11	1.0	0.67	Slab with interior and exterior wall foundations to 4 feet high
IS-CONC-12[4]	1.5	0.75	Two layers of concrete separated by gravel/sand.
IS-CONC-13	2.0+	1.5	Southern edge near exterior wall foundation is thicker with the remaining portions 0.5 foot thick. Exterior wall up to 4 feet high.

Notes:
[1]Maximum depth of concrete measured from the top to the bottom after coring penetrated the concrete. In some locations the coring equipment was unable to penetrate the entire thickness, so the depth is estimated.
[2]Many of the DUs have interior vertical wall foundations. These consist of vertical masonry blocks that were demolished to the concrete floor grade, but may extend to deeper depths than the adjacent concrete floor.
[3]The average depth is based on an average of the 30 incremental sample holes drilled through the concrete in each DU. In some DUs, there were areas of thinner concrete (e.g. 5 to 6 inches) and thicker concrete (e.g., 12 to >24 inches).
[4]The southern half of the concrete at IS-CONC-12 consisted of two, approximately 6 to 9 inch thick, concrete layers with a layer of gravel/sand between them. Refusal was encountered on the second layer in most of the incremental sample locations.
+: maximum thickness of the concrete unknown. Refusal of the equipment was reached at approximately 2 ft below the top of the concrete and concrete was not fully penetrated. The concrete in these DUs was variable and in some locations was less than 2.0 feet.

The total volume of concrete material for Alternative 3 is approximately 8,200 yd^3 bulked. This estimate includes the existing floor, retaining walls, buried foundation elements, basement floor and walls, Pond P1, and the three miscellaneous pads. It is anticipated that the concrete will be loaded and transported to a concrete recycling facility.

The specific removal method may vary depending on the integrity and thickness of the concrete. The thinner slab areas with damage or cracking may be removed using a tracked excavator, and/or a wheeled front end loader. Areas with thicker concrete in good condition may be removed using an excavator equipped with a rock hammer/pick to break the concrete into manageable size for loading and transport.

6.5.3. *Operation and Maintenance*

Annual maintenance under Alternative 3 will be significantly reduced from maintenance under Alternative 2. No concrete maintenance will be required for Alternative 3, as will be required under Alternative 2. Maintenance will likely consist of vegetation surveys to monitor the revegetation efforts for compliance with any requirements (developed in the RAWP). Vegetation performance standards are anticipated to be met in 5 years.

7. Comparative Analysis of Removal Action Alternatives

The purpose of Section 7 is to provide a comparative analysis of the alternatives presented in Section 6 against each of the evaluation criterion. This will identify the advantages and disadvantages of each alternative relative to one another.

Pursuant to the NCP, each alternative described in Section 6 was analyzed using the following evaluation criteria: effectiveness, implementability, and cost. The effectiveness of each alternative was evaluated by each alternative's protectiveness of human health and the environment; compliance with ARARs; reduction of toxicity, mobility, or volume through treatment; long-term effectiveness and permanence; and short-term effectiveness. The implementability criterion addresses technical feasibility (including availability of services and materials), administrative feasibility, and regulatory and community acceptance. Projected costs were calculated using direct capital costs, indirect capital costs, and annual PRSC. Consistent with guidance, the costs presented are estimated using current costs of labor and materials, and actual costs are expected to range from 30 percent below to 50 percent above the costs presented. The projected costs presented for the EE/CA removal action alternatives are estimates only for the sole purpose of comparing alternatives and should not be considered design-level cost estimates. Details that formed the basis for the removal action alternative cost projections are provided in Appendix F.

7.1. Overview of Screening Criteria

Potential technologies and process options were evaluated and screened to eliminate those that do not have the potential to be sufficiently effective or implementable, or that will be significantly more costly or difficult to implement without being more effective than at least one other option. Technology and process options were evaluated against three broad criteria: effectiveness, implementability, and cost. For each evaluation criterion, the technology or process options were rated as low, medium, high, or a combination. For example, a "low" rating for effectiveness and implementability indicates the technology or process option does not adequately address the COCs or COECs in the media and is not acceptable. A "low" rating for cost indicates the technology or process option cost is low and is favorable.

<u>Effectiveness</u>

Effectiveness refers to a technology or process option's ability to achieve or contribute to achievement of RAOs selected for the Site. In this screening phase, the effectiveness evaluation was limited to considering whether a technology or process option can provide an acceptable level of protection to human and ecological receptors (the protectiveness threshold), and whether it can be implemented in a manner that achieves compliance with ARARs (ARAR compliance threshold). A technology or process option was screened out on the basis of the effectiveness factor if it had "low" protectiveness (i.e., did not pass the protectiveness threshold), had "low" ARAR compliance (i.e., did not pass the ARAR compliance threshold), or there was another technology or process option with significantly lower cost that had the same effectiveness or implementability.

Protectiveness Threshold

The protectiveness threshold was reached (protectiveness was "high") if the technology or process option could achieve long-term elimination of unacceptable health risks to human and ecological receptors from exposure to hazardous substances, pollutants, or contaminants released to the environment on or from the Site.

Protectiveness was "medium" if a technology or process option could reasonably be combined with other technology or process options to eliminate unacceptable risks, and "low" if it could not address unacceptable risk, even in combination with other technology or process options. If the technology or process option could not attain or contribute to the attainment of the protectiveness threshold, it was screened out from further consideration.

The protectiveness threshold was defined by site-specific RGs that specify the maximum allowable concentration of identified Site contaminants that can remain on Site to achieve and provide protectiveness to human and ecological receptors. The RGs are discussed in Section 5. The removal action alternative selected for the Site will be designed to achieve the Site RGs. For purposes of this initial screening process, a technology or process option achieved the protectiveness threshold if it had the potential (alone or in combination with other technology or process options) to achieve each of the RGs.

ARAR Compliance Threshold

The ARAR compliance threshold was reached if the considered technology or process option could be implemented in such a way that ARAR compliance can be achieved. For compliance with ARARs, a technology or process option was "high" if it could be implemented in a manner that achieves ARARs, "medium" if it could achieve ARAR compliance in limited circumstances, and "low" if it cannot achieve ARARs. For example, a technology or process option was "low" if it was inconsistent with the NPS Organic Act.

The NCP provides that on-site activities in furtherance of a removal action shall attain ARARs to the extent practicable considering the exigencies of the situation (40 CFR § 300.415(j)). The NCP also offers guidance on factors that may be considered in determining whether ARAR compliance is practicable, including the urgency of the situation and the scope of the removal action. Upon identifying and reviewing the ARARs (further detailed in Section 4) in light of the exigencies of the situation, NPS believes that it is practicable to comply with the identified ARARs as there are sufficient technology or process options available for consideration. NPS has screened out technology or process options that cannot comply with each of the ARARs to focus on development of the best available removal action alternatives.

Three location-specific ARARs unique to NPS that were evaluated in the screening process include the NPS Organic Act non-impairment mandate*,* the NPS regulations of solid waste disposal sites, and NPS requirements for restoration of natural systems sites in National Parks. These ARARs are detailed in Section 4.2.

Central to this discussion was the NPS Organic Act non-impairment mandate. For land management decisions, the Organic Act imposes upon NPS the unique obligation to manage the national park land resources so as to leave them unimpaired for the enjoyment of future generations. At contaminated sites, where resources are already impaired, NPS has an obligation to eliminate impaired conditions to the extent possible within NPS authorities and available resources, or avoid creating a condition that will interfere with the purposes for which the Park was established or with the unimpaired use and enjoyment of Park fundamental resources and values by future generations. At this screening stage, a technology or process option was not deemed inconsistent with the Organic Act non-impairment mandate if there were a possibility that it could be implemented so as to eliminate, or reduce to the extent practicable, impaired conditions. For the Site, NPS has determined that to satisfy the non-impairment mandate, a removal action alternative must be designed to eliminate to the extent practicable or avoid creating a condition that will impair the future use, fundamental resources and values, or the primary purpose of the park.

Section 6.4 of the NPS solid waste disposal site regulations (codified at 36 CFR Part 6), pertains to the creation of new solid waste disposal sites within national park boundaries. NPS has determined that 36 CFR § 6.4 prevents the establishment of a solid waste disposal site within Park boundaries to manage Site waste, because NPS has determined that there are reasonable alternative disposal locations outside Park boundaries on non-federal lands that are suitable for disposing solid waste generated at the Site.

NPS Policies for Restoration of Natural Systems and for Managing Wildlife and Plant Resources in the NPS General Management Plan, § 4.1.5, requires the NPS to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. “The Service will use the best available technology, within available resources, to restore the biological and physical components of these systems, accelerating both their recovery and the recovery of the landscape and biological community structure and function.” (NPS 2006 § 4.1.5). The operations at the former Jaite Mill have disturbed the biological and physical components of the resources with contaminated soil and waste material impacting Site soils and sediment, and physically modifying the original landscape (topography) with waste piles and man-made features. NPS has determined that to satisfy the General Management Plan § 4.1.5, a removal action alternative must be designed to return the disturbed areas of the Site to their natural conditions and processes characteristic of the Site’s ecological zone.

Implementability

Implementability refers to the relative ease with which a technology or process option can be put into practice. It considers the technical aspect (e.g., whether it is possible to implement), the administrative or institutional perspective (e.g., the agency coordination required to implement), and the availability of various resources (e.g., services, materials, equipment, and skilled workers) required during its implementation. For example, a technology or process option is considered to have “high” implementability if services, materials, and skilled workers are readily available to conduct the work, the work can be done with conventional equipment, and the work can be conducted without permitting and minimal agency coordination. A technology or process option has "low" implementability if it cannot be implemented because of administrative and or technical considerations. A technology or process option has "medium" implementability if it can be implemented but it requires specialized equipment, custom-designed materials, permitting, and significant agency involvement. In this screening process, a technology or process option is screened out and eliminated from further consideration if: (i) it cannot be implemented because of administrative and/or technical considerations; or (ii) there is at least one other technology or process option that achieves the effectiveness thresholds and is significantly more favorable from an administrative and/or technical implementation standpoint.

Cost

Cost refers to the capital costs required for initial implementation (construction), as well as routine operation and maintenance (O&M) costs. Relative costs are considered based on engineering judgment for both capital costs (i.e., expenditures required to construct or install a removal action technology) and O&M costs (i.e., costs necessary to provide for or verify the continued effectiveness of a removal action technology), as opposed to utilizing detailed cost estimates at this stage. Each technology or process option was evaluated relative to others within the same technology type. Cost was considered in the screening process to eliminate a technology or process option from further consideration only if there was at least one other technology or process option that achieved the effectiveness thresholds, was at least as favorable in administrative and technical implementability, and was significantly more favorable from a cost standpoint. Cost is considered "high" if the technology or process option was considerably more expensive than another technology or process option within the same technology type.

7.2. Effectiveness

This section evaluates the alternative's ability to meet the RAOs as identified in Section 5.1; in particular, its ability to achieve the criteria of protectiveness of human health and the environment and to comply with ARARs. Other factors that affect the overall protectiveness of a removal action include preference for treatment to reduce contaminant toxicity, mobility, or volume for principal threats, short-term effectiveness, and long-term effectiveness/permanence. Details regarding the effectiveness evaluation criteria are presented in the following subsections.

7.2.1. *Overall Protection of Human Health and the Environment*

Alternative 1: No Action

Alternative 1 does not provide overall protection of human health and the environment. The unacceptable risks to human and ecological receptors posed by exposure to the Site contaminants will remain as documented in the HHRA and ERA. No future response work will be conducted at the Site to contain or protect receptors from exposure to contaminants or to reduce future transport of the contaminants. Although ICs, fences, and signs are present at the Site today, No Action assumes no future maintenance, repair, replacement, or enforcement of these protective controls; therefore, these controls were not presumed to have future protective value.

Alternative 2: Partial Excavation and Off-Site Disposal

Alternative 2 will provide overall protection of human health and the environment, subject to ongoing long-term maintenance of the concrete cap over contaminated soils. Excavation of contaminated soils and waste material will be effective in providing long term and permanent protection to human health and the environment by removing the contaminated soil, sediment, and waste from 19 contaminated soil and three sediment DUs and seven waste piles on Site not covered by the concrete building foundation. With adequate implementation including repair/replacement of the concrete foundation, monitoring, concrete maintenance, and ICs remaining in place in perpetuity, the concrete foundation covering the contaminated materials in seven DUs will provide an effective and protective barrier for potential human and ecological receptors, thereby interrupting exposure pathways and reducing risks. However, contaminated material exceeding RGs will remain on the Site and pose a future potential risk if the concrete foundation is compromised and fails from degradation, erosion, flooding, runoff, and physical activities. Therefore, to be an effective containment and control method, the concrete foundation requires replacement or significant repairs, and continued maintenance to retain or achieve effectiveness to protect human health and the environment. The current condition of the concrete foundation is fair to poor with some areas of the foundation undergoing degradation and collapse including the slab and walls. Foundation repair or partial or full replacement work will be necessary to utilize the foundation as an effective cap to provide protection to human health and the environment.

Alternative 3: Full Excavation and Off-Site Disposal

Alternative 3 provides overall protection of human health and the environment. Excavation and off-site disposal of contaminated soil, sediment, and waste material and the concrete foundation from 26 contaminated soil and three sediment DUs and seven waste piles will provide long-term and permanent protection to human and ecological receptors at the Site, because contaminant source removal eliminates contaminant exposure, transport and migration. Excavation and off-site disposal of the contaminated soil, sediment, and waste material will eliminate exposure risks at the Site as well as the potential for this material to erode into the Cuyahoga River and Brandywine Creek.

Under Alternative 3, there will be no hazardous substances remaining at the Site above levels preventing unlimited use; therefore, there will be no need for site-specific restrictions or long-term monitoring to support ongoing human and ecological protectiveness once the revegetation has been completed. Depending on the need and extent of restoration and revegetation, some access restriction would be anticipated during restoration and revegetation activities to prevent damage to the restored areas until the area has stabilized and meets NPS approval, which is currently assume to require five years of revegetation monitoring. Excavated materials will be managed at an appropriate off-site facility. Surface grading and stormwater controls will be constructed and maintained as needed to reduce erosion and facilitate revegetation in disturbed areas.

7.2.2. *Compliance with ARARs*

Text Tables 7.1 to 7.3 present the list of ARARs identified in Section 4 showing the applicability and compliance to each ARAR for each alternative. If the ARAR applies, and there is more say about how or why the alternative does or does not apply or comply other than a simple statement in the comment field of Text Tables 7.1, 7.2 to 7.3, then that compliance discussion is provided as text in Section 7.1.2 under each alternative.

Text Table 7.1 Alternative Compliance with Chemical-Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal and Cover**	**Alternative 3: Full Removal**	**Comments**
FEDERAL							
1	**Standards for Polychlorinated Biphenyl (PCB) storage and disposal (Toxic Substances Control Act [TSCA]) – Cleanup Levels and Decontamination Standards**	15 USC § 2601 *et seq;* 40 CFR Part 761, Subpart D	Applies	Does not comply if PCB ≥ 50 ppm.	Complies only if no PCBs are present beneath the concrete at levels above 50 ppm.	Complies	PCBs were not detected ≥ 50 ppm, but could be detected at these levels once data gaps are addressed, e.g., soil sampling under the Fourdrinier Machine.
2	**PCB spill cleanup policy under the TSCA**	40 CFR §761.125	Applies	Does not comply	Complies	Complies	
3	**Federal Ambient Water Quality Criteria**	Clean Water Act 33 U.S.C § 1314, 40 CFR Part 131	Applies	Does not comply	Complies	Complies	
4	**Water Quality Criteria for the Great Lakes System**	33 U.S.C. § 1251 *et seq.*; 40 CFR Part 132	Applies	Does not comply	Complies	Complies	
5	**National Primary Drinking Water Standards, MCLs**	Safe Drinking Water Act 42 U.S.C. §§ 300f *et seq.*, 40 CFR Part	Applies	Does not comply	Complies	Complies	

Text Table 7.1 Alternative Compliance with Chemical-Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal and Cover**	**Alternative 3: Full Removal**	**Comments**
		141					
6	**National Secondary Drinking Water Standards, Secondary MCLs**	Safe Drinking Water Act, 42 U.S.C. §§ 300f *et seq.*, 40 CFR Part 143	Applies	Does not comply	Complies	Complies	Primary Drinking Water Standards, MCLs, were considered as part of human health risk standards, but secondary standards were not. This standard applies to the Site artesian wells.
7	**Federal Water Pollution Control Act (CWA)**	33 USC § 1251-1387; 40 CFR 132	Applies	Does not comply	Complies	Complies	
8	**NPS guidance on ecological screening values for soil, sediment, groundwater, and surface water.**	NPS Protocol for Selection and Use of Ecological Screening Values for Non-radiological Analytes	Applies	Does not comply	Complies	Complies	
9	**USEPA regional screening levels for chemical contaminants**	https://www.epa.gov/risk/regional-screening-levels-rsls	Applies	Does not comply	Complies	Complies	Used for the human and ecological risk assessments not alternative specific
10	**USEPA guidance on role of ARARs in**	"Clarification of the	Applies	Does not	Complies	Complies	

Text Table 7.1 Alternative Compliance with Chemical-Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal and Cover**	**Alternative 3: Full Removal**	**Comments**
	establishing Remediation Goals	Role of ARARs in Establishing Preliminary Remediation Goals Under CERCLA," OSWER Directive No. 9200.4-23 (August 22, 1997)		comply			
STATE							
11	**Division of Surface Water (DSW) - Analytical Methods and availability of documents**	3745-1-03	Applies	Does not comply	Complies	Complies	Will comply if surface water is sampled in Alt 2 and Alt 3. No sampling in Alt 1, does not comply.
12	**DSW – Beneficial use designations and biological criteria**	3745-1-07 (C)	Applies	Does not comply	Complies	Complies	
13	**DSW – Cuyahoga River drainage basin**	3745-1-26	Applies	Does not comply	Complies	Complies	
14	**DSW – Water quality criteria for water supply use designations.**	3745-1-33 (A-E)	Applies	Does not comply	Complies	Complies	
15	**HW – Alternative land disposal restriction treatment standards for**	3745-270-49 (A-E)	NA	NA	NA	NA	

Text Table 7.1 Alternative Compliance with Chemical-Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal and Cover**	**Alternative 3: Full Removal**	**Comments**
	contaminated soil						
16	**Ohio Voluntary Action Program: Generic Numerical Standards**	OAC 3745-300-08	Applies	Does not comply	Complies	Complies	
17	**APC – Asbestos Emission Control**	OAC 3745-20-03 through 3745-20-05	Applies	Does not comply	Complies	Complies	
18	**DSW – Lake Erie Drainage Basin**	OAC 3745-1-33	Applies	Does not comply	Complies	Complies	

<u>*Notes:*</u>
NA = not applicable

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
FEDERAL							
1	**National Park Service (NPS) Organic Act of 1916, as amended** **Non-impairment Mandate**	54 USC §100101(a), et seq.	Applies	Does not comply	Does not fully comply	Complies	.
2	**National Park System General Authorities Act, as amended**	54 USC §100101(b)	Applies	Does not comply	Does not fully comply	Complies	
3	**National Park Service regulations – non-**	36 CFR §§1.1	Applies	Does not comply	Does not fully comply	Complies	

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
	impairment						
4	**NPS policy on implementation of the non-impairment mandate**	2006 NPS Management Policies §1.4 Find at: https://www.nps.gov/policy/mp2006.pdf	Applies	Does not comply	Does not fully comply	Complies	
5	**Legislation Establishing Cuyahoga Valley National Park (CUVA)**	Public Law 93-555	Applies	Does not comply	Complies if the concrete cover is repurposed.	Complies	
6	**Restrictions on Solid Waste Disposal Sites in National Parks**	54 USC §100903	Applies	Does not comply	Does not comply (waste left on site)	Complies	
7	**Solid Waste disposal regulations in National Parks**	36 CFR Part 6	NA	NA	NA	NA	No solid waste disposal is planned for this Site
8	**National Park Service regulations – notice and access**	36 CFR §1.5 and 1.7	Applies	Does not apply	Complies	Complies	Public notices will be prepared for any closures during remedial actions.
9	**NPS Restrictions of Public Use and Recreation Activities to Protect National Park Resources**	36 CFR Part 2 Special Regulations, Areas of the National Park	NA	NA	NA	NA	

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		System					
10	**Restrictions of Public Use and Recreation Activities at CUVA**	36 CFR Part 7.17	Applies	Does not comply	Complies	Complies	During remediation, if areas are to be closed for remedial actions, this ARAR will be complied with including appropriate notifications as directed by the regulations.
11	**Cuyahoga Valley National Park General Management Plan**	16 U.S.C. §§ 460ff-460ff-5 Subchapter XC	Applies	Does not comply	Complies	Complies	Alternative 2 complies as long as the cap is maintained properly
12	**NPS Policies for Restoration of Natural Systems**	2006 NPS MP §4.1.5 Find at: https://www.nps.gov/policy/mp2006.pdf	Applies	Does not comply	Does not comply	Complies	The concrete cap under Alternative 2 is not natural
13	**NPS Policies for Managing Wildlife and Plant Resources**	2006 NPS MP §4.4.1 https://www.nps.gov/policy/mp2006.pdf	Applies	Does not comply	Does not comply (concrete cover may restrict restoration of plants and animals)	Complies	
14	**NPS Policies for Managing Species of Special Concern**	2006 NPS MP §4.4.2.3 https://www.nps.gov/policy/mp2006.pdf	Applies	Does not comply	Complies	Complies	Inventory of state and local species will be conducted for both Alt 2 and 3.

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
15	**NPS Policies Concerning Surface Water and Ground Water Quality**	2006 NPS MP §4.6.3 https://www.nps.gov/policy/mp2006.pdf	Applies	Does not comply	Complies	Complies	Alt 2 only complies if the cover integrity is maintained to prevent contaminant releases to surface water and groundwater.
16	**Avoiding adverse impacts to floodplains**	Executive Order No. 11988	Applies	Does not comply	Complies	Complies	Remedial actions will reestablish floodplains.
17	**NPS Policies Concerning Floodplains**	2006 NPS MP §4.6.4 https://www.nps.gov/policy/mp2006.pdf NPS DO #77-2: Floodplain Management; https://www.nps.gov/policy/DOrders/DO_77-2.pdf NPS Procedural Manual #77-2: Floodplain Management https://www.	Applies	Does not comply	Complies	Complies	If the concrete foundation remains as a cap, this capped area may potentially obstruct and/or otherwise impact future floodplain development and release contamination to the floodplain if the cap is not maintained.

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		nature.nps.gov/rm77/floodplain.cfm					
18	**Protection of Wetlands**	Executive Order No. 11990	Applies	Does not comply	Complies	Complies	
19	**NPS Policies Concerning Wetlands**	2006 NPS MP §4.6.5 https://www.nps.gov/policy/MP2006.pdf NPS DO #77-1: Wetland Protection; https://www.nps.gov/policy/DOrders/DO77-1- Reissue.html NPS Procedural Manual #77-1: Wetland Protection (January 2012) https://www.nature.nps.gov/water/wetla	Applies	Does not comply	Complies	Complies	

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		nds/Wetlands_Protection_Manuals.cfm					
20	**NPS Policies for Importation of Soil During Site Restoration**	2006 NPS MP §4.8.2.4 https://www.nps.gov/policy/mp2006.pdf	Applies	N/A	Complies	Complies	Any imported off-site soil or soil amendment will be approved by NPS.
21	**NPS Policies for Managing Cultural Resources**	2006 NPS MP §5f https://www.nps.gov/policy/mp2006.pdf	Applies	N/A	Complies	Complies	No known cultural resource on site. Cultural resource inventory will be conducted prior to remedial action implementation. If a cultural resource is identified then the compliance with this ARAR will be discussed in the RAWP.
22	**NPS Policies Concerning Revegetation and Landscaping**	2006 NPS MP §9.1.3.2 https://www.nps.gov/policy/mp2006.pdf	Applies	N/A	Complies	Complies	Revegetation for both Alt 2 and Alt 3 will be conducted in compliance with this ARAR.
23	**NPS Policies Concerning Waste Management and Contaminant Issues**	2006 NPS MP §9.1.6- https://www.nps.gov/policy/mp2006.pdf	Applies	Does not comply	Does not comply	Complies	As part of Alternative 2, waste material will be left in place
24	**NPS Policies Concerning Climate Change**	NPS Policy Memorandum (PM) 15-	Does not apply				No facilities are planned.

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	Standard requirement, criteria, or limitation	Citation	Applicable	Alternative 1: No Action	Alternative 2: Partial Removal	Alternative 3: Full Removal	Comments
		01, "Addressing Climate Change and Natural Hazards" (Jan. 20, 2015) and accompanying Level 3 Handbook PM 12-02, "Applying NPS Management Policies in the Context of Climate Change" (March 6, 2012) https://www.nps.gov/policy/MPandCC.pdf PM 14-02, "Climate Change and Stewardship of Cultural Resources" https://www.nps.gov/polic					

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		y/PolMemos/PM-14-02.htm 2006 NPS MP §9.1.1.5 https://www.nps.gov/policy/MP2006.pdf					
25	**NPS Employee Guidance for Managing Cultural Resources**	NPS DO #28: Cultural Resource Management NPS-28: Cultural Resource Management Guideline	Applies	NA	Complies	Complies	Applies if cultural resources are observed on the Site. No known cultural resource on Site. Cultural resource inventory will be conducted prior to remedial action implementation. If there are resources on Site then this ARAR will apply. Any compliance issues would be addressed in the RAWP.
26	**NPS Employee Guidance for Managing Natural Resources**	NPS Reference Manual (RM) #77 Find at: https://www.nature.nps.gov/rm77	Applies	Does not comply	Complies	Complies	
27	**National Historic Preservation Act (NHPA)**	54 USC § 300101, Chapters 3021 and 3023 (2015),	Applies	NA	Complies	Complies	A cultural resource survey will determine if there are historic properties.

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		and NPS Regulations at 36 CFR Parts 63 and 800					
28	**Protection and Enhancement of the Cultural Environment**	Executive Order No. 11593 (1971)	Applies	Does not comply	Complies	Complies	
29	**Historic Sites, Buildings, and Antiquities Act of 1935, as amended, and Implementing Regulations**	54 USC §§320101 and 320102 36 CFR Part 65	Applies	Complies	Complies	Complies	
30	**Archaeological and Historic Preservation Act of 1974, as amended**	54 USC Chapter 3125	Applies	Complies	Complies	Complies	
31	**Archaeological Resources Protection Act of 1979, as amended, and Implementing Regulations**	16 USC §470aa, §470ee 43 CFR §§7.4, 7.7, 7.18, and 7.21	Applies	N/A	Complies	Complies	
32	**Native American Graves Protection and Repatriation Act (NAGPRA), as amended, and Implementing Regulations**	25 USC §3002 43 CFR §§10.3, 10.4, 10.5, 10.6	Applies	N/A	Complies	Complies	Applies if cultural resources are observed on the Site. No known cultural resource on Site. Cultural resource inventory will be conducted prior to remedial action implementation. If there are resources on Site then this ARAR will apply. Any compliance issues

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
							would be addressed in the RAWP.
33	**American Indian Religious Freedom Act of 1978, as amended**	42 USC §1996	Applies	Complies	Complies	Complies	
34	**Indian Sacred Sites**	Executive Order No. 13007	Applies	Complies	Complies	Complies	
35	**Fish and Wildlife Coordination Act of 1934, as amended**	16 USC §§ 661-667e 40 CFR 6.302(g)	Applies	N/A	Complies	Complies	Under Alt 2 and Alt 3 NPS will coordinate with US Fish and Wildlife as appropriate.
36	**Migratory Bird Treaty Act of 1918, as amended**	16 USC §§703, 704, 705 50 CFR §10.13	Applies	Does not comply	Complies	Complies	Contaminated soil left in place for Alternative 1 may impact birds
37	**Responsibilities of Federal Agencies to Protect Migratory Birds**	Executive Order 13186; 66 Federal Register (FR) 3853 (Jan. 10, 2001)	Applies	Does not comply	Complies	Complies	
38	**Endangered Species Act of 1973, as amended, and Implementing Regulations**	16 USC §§1536 and 1538 50 CFR §§17.21, 17.31 to	Applies	Does not comply-adverse impacts from contaminants	Complies	Complies	Alt 2 complies as long as the contaminated soil beneath the concrete is contained.

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		17.47, 17.61, 17.71, 17.94 to 17.96, and §§402.10 to 402.16					
39	**Bald and Golden Eagle Protection Act of 1940, as amended**	16 USC §668, §668a 50 CFR §22.2, §22.12	Applies	Does not comply	Complies	Complies	
40	**Resource Conservation and Recovery Act (RCRA) restrictions on Location of Solid Waste Disposal Sites (Siting Requirements)**	40 CFR §§257.3 to 257.3-8 40 CFR §§258.10 to 258.16	NA	NA	NA	NA	No RCRA Solid Waste Disposal facility is planned for these alternatives
41	**Rivers and Harbors Act of 1899**	33 U.S.C. §401 *et. seq.;* 33 CFR Parts 114,115,116,321,322, and 333. Section 404/Section 10	Applies	Complies	Complies	Complies	
42	**Section 404 of the Clean Water Act**	33 U.S.C. § 1344(b)(1) 40 CFR Parts 230 and 231	Applies	Does not comply	Complies	Complies	Alt 2 and Alt 3 will be designed to prevent discharge of any material into either the river or creek. Under Alternative 2 should the concrete cap maintenance and repair that is required not be performed adequately, contaminated waste and

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
							fill materials can potentially erode into these surface waters bordering the Site.
43	**Clean Water Act – discharges into wetlands or surface water**	33 U.S.C. § 1251 et seq.; 40 CFR Part 122.21	Applies	Does not comply	Complies	Complies	
STATE							
44	**ODNR – Injuring or removing endangered or threatened plant**	ORC 1518.02	Applies	NA	Complies	Complies	A survey of the Site prior to remedial action implementation will identify any appropriate plants that are considered endangered or threatened.
45	**ODNR – List of endangered and threatened species of native Ohio wild plants**	OAC 1501:18-1 (03,A)	Applies	NA	Complies	Complies	
46	**ODNR – Protection of species threatened with statewide extinction**	ORC 1531.25	Applies	NA	Complies	Complies	
47	**ODNR – List of endangered Ohio wild animals**	OAC 1501:31-23 (01, A-B)	Applies	Complies	Complies	Complies	This ARAR refers to listing endangered species. The EECA lists these species.
48	**DSW – Criteria applicable to all waters**	OAC 3745-1-04 (A,B,C,D,E)	Applies	Does not comply	Complies	Complies	Alt 2 will only comply as long as the proposed cover remains intact.
49	**DSW - Wetlands**	OAC 3745-1-51 (A-C)	Applies	Does not comply	Complies	Complies	
50	**DSW – Wetland antidegradation**	OAC 3745-1-54 (A-D)	Applies	Does not comply	Complies	Complies	

Text Table 7.2 Alternative Compliance with Location Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
51	**HW – Solid waste prohibited acts.**	ORC 3734.11(C)	NA	NA	NA	NA	No solid waste facility will be established for these alternatives

Notes:
NA = not applicable

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
FEDERAL							
1	**Criteria for solid waste disposal facilities and practices**	USEPA regulations under Resource Conservation and Recovery Act (RCRA) Subtitle D 40 CFR §§ 257.1-.3, particularly §2573.2.	NA	NA	NA	NA	
2	**NPS Policies Concerning Waste Management and Contaminant Issues**	2006 MP §9.1.6- https://www.nps.gov/policy/mp2006.pdf	Applies	Does not comply	Does not comply	Complies	Alt 2 has waste left in place.
3	**RCRA regulations for hazardous waste generators**	40 CFR Part 262, Subparts A	Applies	Does not comply	Complies	Complies	

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		to F					
4	**RCRA regulations for transporting hazardous waste**	40 CFR Part 263	Applies	Does not apply	Complies	Complies	
5	**Regulations for managing staging piles at remediation sites.**	RCRA Subtitle C 40 CFR § 264.554	Applies	Does not apply	Complies	Complies	
6	**Regulations for land disposal-restricted hazardous waste**	RCRA Subtitle C, 42 USC § 6924 40 CFR Part 268	Applies	Does not comply	Complies	Complies	
7	**Requirements for transporting hazardous materials**	U.S. Department of Transportation (USDOT) regulations under the Hazardous Materials Transportation Act 49 CFR Parts 171 through 180	Applies	Does not apply	Complies	Complies	
8	**Regulations limiting point-source discharges of pollutants into waters of the United States**	National Pollutant Discharge Elimination	Applies	Does not comply	Complies	Complies	Alternative 2 complies as long as the cap is maintained

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		System, 40 CFR Part 122					
9	**Regulations limiting the discharge of storm water from industrial and construction sites**	CWA, 33 USC § 1342 40 CFR § 122.26	Applies	Does not comply	Complies	Complies	Alt 2 and Alt 3 will be designed to meet this ARAR and use BMPs to prevent discharge to surface water during remedial actions.
10	**Regulations limiting air emissions of particulates and dust**	42 USC §§ 7409 and 7410 National Ambient Air Quality Standards (NAAQS) – Particulates, 40 CFR Part 50	Applies	NA	Complies	Complies	
11	**Regulations for limiting emissions of asbestos-containing material when managing such material**	National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR §§61.145 and 61.150	Applies	NA	Complies	Complies	
12	**Polychlorinated biphenyl (PCB) management**	Toxic Substances Control Act (TSCA),	Applies	Does not comply if PCB ≥ 50 ppm.	Complies only if no PCBs are present beneath the	Complies	PCBs were not detected ≥ 50 ppm, but could be detected at these levels once data gaps are addressed, e.g., soil sampling under the Fourdrinier Machine.

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
		15 USC § 2601 40 CFR Part 761, Subpart D (Storage and disposal) particularly 40 CFR §§ 761.50(b), 761.61, 761.64, 761.79			concrete at levels above 50 ppm.		
13	**PCB spill cleanup policy under the Toxic Substances and Control Act (TSCA)**	40 CFR Part 761, Subpart G (40 CFR §761.120 - .135)	Applies	Does not comply if PCB ≥ 50 ppm.	Complies only if no PCBs are present beneath the concrete at levels above 50 ppm.	Complies	PCBs were not detected ≥ 50 ppm, but could be detected at these levels once data gaps are addressed, e.g., soil sampling under the Fourdrinier Machine.
15	**NPS Policies Concerning Revegetation and Landscaping**	2006 MP §9.1.3.2 https://www.nps.gov/policy	Applies	Does not apply.	Complies	Complies	Revegetation for both Alt 2 and Alt 3 will be conducted in compliance with this ARAR. This ARAR is also in Location Specific ARARs.
STATE							
16	**DSIWM – disposal of construction and demolition debris and asbestos**	ORC 3714.13	Applies (only if concrete, metal and	Does not apply	Complies. If the concrete and metal is	Complies. If the concrete and metal is	May not apply if the concrete is recycled. OAC definitions indicate that if construction and demolition debris including concrete materials

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
			other construction and demolition debris not recycled)		recycled then this ARAR does not apply since there will be no constructio n and demolition debris. Complies for Asbestos	recycled then this ARAR does not apply since there will be no constructio n and demolition debris. Complies for asbestos	are recycled within two years into usable construction material it is not considered construction and demolition debris. Also construction and demolition debris cannot be disposed of off-site "without providing written notice to the board of health of the health district in which the land is located or, if the health district is not on the approved list under section 3714.09 of the Revised Code, to the director of environmental protection at least seven days prior to the first placement of any such materials as fill material at the off-site location (3714.13)." Asbestos will be abated and disposed of as per regulations.
17	**HW – Prohibition on filling or grading where a hazardous waste facility was operated**	ORC 3734.02 (H)	NA	NA	NA	NA	
18	**APC – Restriction of emission of fugitive dust**	OAC 3745-17-08 (A1, A2, B, D)	Applies	Does not apply	Complies	Complies	Alt 2 and Alt 3 removal actions will be designed to comply with this ARAR which is similar to other dust ARARs (both federal and state).
19	**DSIWM – Excavation onland where a hazardous waste facility was operated**	OAC 3745-27-13 (A,C)	Applies	Does not apply	Complies	Complies	The EECA and the RAWP would be developed to meet this ARAR.
20	**HW – requirements for recyclable materials**	OAC 3745-51-06 (A,B,C(1))	Does not apply	Does not apply	Does not apply	Does not apply	No plans to recycle hazardous materials only non-hazardous concrete and metal (after removal of the lead paint and asbestos).

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
21	**HW – Hazardous waste generation determination**	OAC 3745-52-11 (A-D)	Applies	Does not comply	Complies	Complies	Analytical sampling of the generated waste will be conducted to characterize the waste as hazardous or non-hazardous prior to disposal.
22	**HW APC – air pollution during hazardous waste facility operation**	ORC 3734.02 (I)	Applies	Does not apply	Complies	Complies	BMPs will be implemented to prevent dust or other air pollutants during removal actions.
23	**Air Pollution Control Rules**	ORC 3704.05 (A-I)	Applies	Does not apply	Complies	Complies	BMPs will be implemented to prevent dust or other air pollutants during removal actions.
924	**Air Emissions From Hazardous Waste Facilities**	ORC 3734.02(I)	Applies	Does not apply	Complies	Complies	BMPs will be implemented to prevent dust or other air pollutants during removal actions.
25	**Prohibits Open Dumping Or Burning**	ORC 3734.03	Applies	Does not comply	Complies	Complies	Alt 1 has open waste piles (dumping).
26	**Acts Of Pollution Prohibited**	ORC 6111.04	Applies	Does not comply	Complies	Complies	
27	**Testing, Tracking, And Recordkeeping Requirements**	OAC 3745-270-07 (A-E)	Applies	Does not comply	Complies	Complies	Specific recordkeeping to be developed for the RAWP and will comply with federal or state ARARs whichever is more stringent.
28	**Applicability Of Treatment Standards**	OAC 3745-270-40 (A-J)	Applies	Does not comply	Complies	Complies	Alt 2 may not comply if any hazardous waste is left in place beneath the concrete cover.
29	**Treatment Standards Expressed As Specified Technologies**	OAC 3745-270-42 (A-D)	Applies	Does not comply	Complies	Complies	Alt 2 may not comply if any hazardous waste is left in place beneath the concrete cover.

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
30	**Universal Treatment Standards**	OAC 3745-270-48 (A)	NA	NA	NA	NA	
31	**Land Disposal Restriction For Contaminated Soils**	OAC 3745-270-49 (A-E)	NA	NA	NA	NA	
32	**Evaluation Of Wastes**	OAC 3745-52-11 (A-D)	Applies	Does not apply	Complies	Complies	Alt 2 and Alt 3 will include characterization of the generated waste (excavated).
33	**Generator Identification Number**	OAC 3745-52-12 (A-C)	Applies	Does not apply	Complies	Complies	.
34	**Hazardous Waste Manifest - General Requirements, Copies & Use**	OAC 3745-52-20, 22, 23	Applies	Does not apply	Complies	Complies	All waste transport to the offsite disposal facility will have appropriate manifests in accordance with both state and federal regulations.
35	**Hazardous Waste Packaging, Labeling, Marking & Placarding**	OAC 3745-52-30, 31, 32, 33 & 34	Applies	Does not apply	Complies	Complies	All waste transport to the offsite disposal facility will have appropriate labels, markings, and placards in accordance with both state and federal regulations.
36	**Recordkeeping Requirements, Three Year Retention**	OAC 3745-52-40 (A-D)	Applies	Does not apply	Complies	Complies	All documents and records will be retained for at least three years or as per DOI/NPS requirements.
37	**Annual Report**	OAC 3745-52-41 (A,B)	Applies	Does not apply	Complies	Complies	

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
38	**General Analysis Of Hazardous Waste**	OAC 3745-54-13 (A)	Applies	Does not comply	Complies	Complies	
39	**Security For Hazardous Waste Facilities**	OAC 3745-54-14 (A,B,C)	Applies	Does not comply	Complies	Complies	Compliance with numbers 39 to 52 for Alt 2 and Alt 3 will be addressed in the RAWP. The ARARs 39 thru 52 will either not apply or will not comply for Alt 1 since no action will be conducted with regards to generation of, transport of, or disposal of haz waste.
40	**Personnel Training**	OAC 3745-54-16	Applies	Does not comply	Complies	Complies	
41	**Required Equipment For Hazardous Waste Facilities**	OAC 3745-54-32 (A-D)	Applies	Does not comply	Complies	Complies	
42	**Testing & Maintenance Of Equipment; Haz Waste Facilities**	OAC 3745-54-33	Applies	Does not comply	Complies	Complies	
43	**Access To Communications Or Alarm System; Haz Waste Fac**	OAC 3745-54-34	Applies	Does not comply	Complies	Complies	
44	**Arrangements/ Agreements With Local Authorities**	OAC 3745-54-37 (A,B)	Applies	Does not comply	Complies	Complies	
45	**Content Of Contingency Plan; Haz Waste Facilities**	OAC 3745-54-52 (A-F)	Applies	Does not comply	Complies	Complies	

Text Table 7.3 Alternative Compliance with Action Specific ARARs and TBCs Former Jaite Paper Mill Site							
Item No.	**Standard requirement, criteria, or limitation**	**Citation**	**Applicable**	**Alternative 1: No Action**	**Alternative 2: Partial Removal**	**Alternative 3: Full Removal**	**Comments**
46	**Emergency Coordinator; Hazardous Waste Facilities**	OAC 3745-54-55	Applies	Does not comply	Complies	Complies	
47	**Emergency Procedures; Hazardous Waste Facilities**	OAC 3745-54-56 (A-I)	Applies	Does not comply	Complies	Complies	
48	**Additional Reports**	OAC 3745-54-77 (A)	Applies	Does not comply	Complies	Complies	
49	**Disposal/ Decon Of Equipment, Structures & Soils**	OAC 3745-55-14	Applies	Does not comply	Complies	Complies	
50	**Staging Piles**	OAC 3745-57-74 (A-K)	Applies	Does not apply	Complies	Complies	
51	**Abandon Well Sealing**	OAC 3745-09-10 (A, B, C)	Applies	Does not comply	Complies	Complies	
52	**Monitoring Well**	OAC 3745-09-03 (A-C)	Applies	Does not comply	Complies	Complies	

Notes:
NA = not applicable

Alternative 1: No Action

Because the existing manmade structures (i.e. concrete building foundation, Fourdrinier Machine, railroad tracks, above and underground piping, etc.), and waste piles will remain on the Site surface, contaminated soil and subsurface waste will remain in place, and risks to human health and the environment will not be reduced, the No Action Alternative 1 fails to achieve nearly all ARARs, particularly the most critical ARARs. The only ARARs with which Alternative 1 may be considered to be in compliance are related to location-specific ARARs such as protection of archaeological resources or impacts to migratory bird or endangered species habitat. While compliance to these ARARs is based on no action because no excavation will take place that affect habitat or archaeological resources, no action also results in leaving contamination in place causing environmental risks to habitat among many other impacts.

ARARs Common to Alternative 2 and Alternative 3

The removal actions contemplated in Alternatives 2 and 3, achieve many of the same location-, chemical-, and action-specific ARARs. Alternative 2 would not comply with all applicable or TBCs and ARARs because of the fact that some contaminated soils would remain underneath a concrete cap. In comparison, Alternative 3's full excavation and off-Site disposal of all contaminated soil and waste material will comply with all applicable location, chemical and action-specific ARARs. Unlike Alternative 2, Alternative 3 addresses all impaired conditions under the Organic Act's non-impairment directive.

The following ARARs are discussed for Alternatives 2 and 3, with respect to how they will or will not be met by this alternative.

Chemical-Specific ARARs and TBCs

Item 1 - Standards for PCB storage and disposal (Toxic Substances Control Act [TSCA]) – Cleanup Levels and Decontamination Standards 15 USC § 2601 *et seq;* 40 CFR Part 761, Subpart D. This ARAR specifies cleanup and disposal options for PCB remediation waste. Alternative 2 will remove PCB contaminated soil and sediment not covered by the concrete foundation, and off-site disposal at a licensed facility. The decontamination limits listed in the regulation will be met at the Site as all PCB contamination not beneath the concrete and above the RGs will be excavated and disposed of off-site. PCB contaminated soil and waste located beneath the concrete foundation will be contained and not impact human or ecological receptors, as long as the integrity of the concrete foundation is maintained. Alternative 3 will remove all PCB contaminated soil and sediment including any contamination that may be covered by the concrete foundation, and off-site disposal at a licensed facility. The decontamination limits listed in the regulation will be met at the Site as all PCB contamination above the RGs will be excavated and disposed of off-site.

Item 7 – Federal Water Pollution Control Act (CWA), 33 USC § 1251-1387; 40 CFR 132. The Clean Water Act promulgates Water Quality Standards for surface waters. Such water quality standards include criteria for contaminants of concern at the Jaite Paper Mill Site. In addition, Section 118 outlines Great Lakes Water Quality guidance and remedial action plans for identified areas of concern (33 USC 1268). By removing all Site wastes and contaminated soils and maintaining the concrete foundation as a cap, Alternative 2 complies with this ARAR by stopping further erosion of contaminated media from migrating into the Cuyahoga River and Brandywine Creek surface waters and migrating downstream to the Great Lakes. Similarly, by removing all Site wastes and contaminated soils, Alternative 3 complies with this ARAR by preventing further erosion of contaminated media from migrating into the Cuyahoga River and Brandywine Creek surface waters and migrating downstream to the Great Lakes.

Location-Specific ARARs and TBCs
Items 1-4 - NPS Organic Act of 1916, as amended (54 USC § 100101(a) (2015) (recodified in 2014)) (the "Organic Act") mandates that NPS manage units of the national park system so as "to conserve the scenery, natural and historic objects, and wildlife in the [national park system] units and to provide for the enjoyment of the scenery, natural and historic objects, and wildlife in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." This non-impairment mandate is additionally codified at 36 CFR 1.1(b), which states "[t]hese regulations will be utilized to……conserve scenery, natural and historic objects, and wildlife, and to provide for the enjoyment of those resources in a manner that will leave them unimpaired for the enjoyment of future generations." To achieve the non-impairment standard, the concrete foundation proposed in Alternative 2 must be repaired or replaced and maintained in such a manner that it does not require public access restrictions and will not allow contamination to migrate from underneath the concrete cap. The concrete foundation cannot be blended into the surrounding terrain; however, if properly repaired and maintained, the concrete foundation could allow Park visitors access to surrounding woodlands and additional access to the Cuyahoga River or Brandywine Creek. However, a maintained cap will require on-going future Park resources to allow for routine maintenance in perpetuity. There is an underlying risk for impairment by allowing slag and oil waste, and soil COCs above RGs to remain on the Site. If the cap is not maintained properly, cap damage may result in contaminant migration from underneath the cap, particularly during severe erosion due to flooding. Consequently, Alternative 2 does not fully comply with these ARARs (Items 1-3) and TBC (Item 4). Alternative 3 fully complies with the NPS Organic Act and related location-specific ARARs and TBC.

Item 5 - Legislation Establishing Cuyahoga Valley National Park (CUVA) Public Law 93-555. establishes CUVA and sets forth its purpose of "preserving and protecting for public use and enjoyment, the historic, scenic, natural, and recreational values of the Cuyahoga River and the adjacent lands of the Cuyahoga Valley and for the purpose of providing for the maintenance of needed recreational open space necessary to the urban environment… In the management of the recreation area, the Secretary of the Interior…shall utilize the recreation area resources in a manner which will preserve its scenic, natural, and historic setting while providing for the recreational and educational needs of the visiting public." In Alternative 2, there is only minimal compliance with this ARAR because the excavation and off-site disposal of contaminated soil and waste material, including slag, will return the areas not covered by the concrete foundation to natural settings and provide for the recreational and educational needs of the visiting public; however, the area covered by the concrete foundation will not be returned to its natural setting. Alternative 3 fully complies with this ARAR because all contaminated media, including all waste underlying the concrete foundation, will return the entire Site to natural settings and provide for the recreational and educational needs of the visiting public.

Item 6 - Restrictions on Solid Waste Disposal Sites in National Parks 54 USC §100903. This statute prohibits operation of any solid waste disposal site within Park lands. Currently there are several unauthorized waste piles on the Site. Implementation of Alternative 2 would remove these waste piles and comply with this statute only within the area excavated, however, the remaining contaminated soil and waste material located beneath the concrete foundation would not comply with this ARAR. Alternative 3 fully complies with this ARAR.

Item 11 - Cuyahoga Valley National Park General Management Plan 16 U.S.C. §§ 460ff-460ff-5 Subchapter XC. This statute establishes requirements for management of CUVA and prohibits permanent or long-term restriction of public access to Site. The CUVA General Management Plan also contains requirements regarding erosion, ecological degradation, and restoration. Alternative 2 complies with this ARAR by opening currently closed areas, but only if the concrete cap integrity is maintained in perpetuity. However, if the severe flooding that is common to the Site and surrounding area causes degradation to the concrete cap and exposes the underlying contamination, the area may be closed and cause continued risk to human health and the environment resulting in prohibition of public access. Alternative 3 fully complies with this ARAR without restriction.

Items 12 and 13 - NPS Policies for Restoration of Natural Systems 2006 NPS MP §4.1.5, and for Managing Wildlife and Plant Resources MP §4.1.1. Section 4.1.5 of the MP provides: "[t]he Service will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology, within available resources, to restore the biological and physical components of these systems, accelerating both their recovery and the recovery of the landscape and biological community structure and function." Alternative 2 will remove the contaminated soil, waste material, and man-made features and restore the Site to natural conditions allowing restoration of natural biological and physical components of the Site. However, the area covered by the concrete cap will not comply with this ARAR because it will continue to disturb the natural conditions of the ecological zone. Alternative 3 fully complies with this ARAR.

Item 15 – NPS Policies Concerning Surface Water and Ground Water Quality – 2006 NPS MP §4.6.3 states that NPS will, *inter alia*, "take all necessary actions to maintain or restore the quality of surface waters and groundwaters within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations...." Alternative 2 will comply with this ARAR and restore the quality of surface waters and groundwaters by removing all above ground and subsurface waste and contaminated soils, waste piles, and manmade structures, but only if the integrity of the concrete cap is regularly inspected, maintained, and repaired to avoid flooding damage and erosion into surface water. Alternative 3 will restore the quality of surface waters and groundwaters by removing all above ground and subsurface waste and contaminated soils, waste piles, and manmade structures, which fully complies with this ARAR.

Item 16 - Avoiding Adverse Impacts to Floodplains – Executive Order No. 11988 requires that federally-funded or authorized actions within the 100-year floodplain avoid, to the maximum extent possible, adverse impacts associated with development of a floodplain. The Site area where the concrete foundation is located is within the 100-year floodplain and may not only cause adverse impacts to the development of that floodplain, but also contribute contamination to the floodplain should the concrete cap degrade and release the underlying contamination and wastes. Therefore, Alternative 2 has the potential to not comply with this TBC. Alternative 3 complies with this TBC because the removal of all contamination and manmade features on the Site, including returning the Site to a floodplain level topography, will support natural floodplain development.

Item 17 - NPS Policies Concerning Floodplains - 2006 NPS MP §4.6.4, NPS DO #77-2 provides that NPS will "protect, preserve, and restore the natural resources and functions of floodplains; avoid the long-and short-term environmental effects associated with the occupancy and modification of floodplains; and avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks." Alternative 2 would comply with this ARAR by removing the Dump site and restoring that portion of the flood plain to its natural state. However, if the concrete foundation remains as a cap, this capped area may potentially obstruct and/or otherwise impact future floodplain development and release contamination to the floodplain if the cap is not maintained. Alternative 3 complies with this ARAR by removing the Dump site and restoring that portion of the flood plain currently covered by concrete and the entire Site to its natural state.

Items 18 and 19 - Protection of Wetlands Executive Order No. 11990 "mandates that federal agencies and Potentially Responsible Parties (PRPs) avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists. Section 404(b)(1), 33 U.S.C. § 1344(b)(1), also prohibits the discharge of dredged or fill material into waters of the United States. Together, these requirements create a standard of "no net loss" of wetlands." The Alternative 2 and the Alternative 3 removal area will include the excavation and off-site disposal of contaminated soil and sediment and impacting the existing wetlands in the AP area. To achieve a "no net loss" of wetlands, other areas of the Site or in the CUVA may be used for new wetlands equal in size to the aeration pond wetlands. Assuming the removed wetlands in the AP area will be replaced or moved to a different area of the Site, then Alternative 2 and Alternative 3 will comply with this ARAR.

Item 23 – NPS Policies Concerning Waste Management and Contaminant Issues, 2006 NPS MP Section 9.1.6.1 (Waste Management) states that all disposal of solid waste on lands and waters within the boundaries of a park system unit must comply with the regulations in 36 CFR Part 6, and further states that NPS will "remove landfill operations and associated impacts from parks where feasible." Section 9.1.6.2 (NPS Response to Contaminants) provides that NPS "will make every reasonable effort to prevent or minimize the release of contaminants on or that will affect NPS lands or resources, and ….. will take all necessary actions to control or minimize such releases when they occur." This section further provides that NPS "will identify, assess and take response actions as promptly as possible to address releases and threatened releases of contaminants into the environment." Contaminants are broadly defined to include "any substance that may pose a risk to NPS resources or is regulated or governed by statutes referenced in this subsection." Alternative 2 does not remove the waste underneath the concrete foundation, which can provide a source of contamination that can be released to the environment, in particular the Cuyahoga River and Brandywine Creek. Therefore, Alternative 2 does not comply with this ARAR. Alternative 3 removes all wastes, contaminated soils, sediments, and surface water on the Site that have and are currently impacting NPS lands or resources. Therefore, Alternative 3 is in compliance with this ARAR.

Item 42 – Section 404 of the Clean Water Act, 33 U.S.C. § 1344(b)(1) and 40 CFR Parts 230 and 231, prohibits the discharge of dredged or fill material into waters of the United States. Alternative 2 will further address any future potential discharge from the Dump site and the Site soil by stopping any and all discharge of contamination, thereby addressing this ARAR. However, should the concrete cap maintenance and repair that is required for this Alternative 2 not be performed adequately, contaminated waste and fill materials can potentially erode into these surface waters bordering the Site. Alternative 3 will further address any future potential discharge from the Dump site and the Site soil by removing any and all potential sources of contamination, thereby addressing this ARAR.

Action-Specific ARARs and TBCs

Item 5 - Regulations for managing staging piles at remediation sites RCRA Subtitle C 40 CFR § 264.554. Based on the Site conditions, it is assumed that excavated contaminated soil and waste must be temporarily stockpiled on the Site during Alternative 2 or Alternative 3 removal actions for eventual loading, transport, and off-site disposal at a licensed facility. The removal action work plan will provide a detailed plan on the use of temporary stockpiles that complies with this ARAR.

Item 7 - Requirements for transporting hazardous materials USDOT 49 CFR Parts 171 through 180 and Ohio DOT OAC3745-52, 20, 22, 23, 30, 31, 33, & 34. These ARARs require the generator to comply with hazardous waste transportation regulation including manifests, labeling, placards, and transporting off-site for disposal. Alternative 2 and Alternative 3 will include the excavation and transportation for off-site disposal of hazardous waste from identified areas of the Site. The removal action work plan will develop a protocol to comply with all USDOT and ODOT regulations regarding transport and disposal of hazardous and non-hazardous waste.

Item 9 - Regulations limiting the discharge of storm water from industrial and construction sites CWA, 33 USC § 1342 and 40 CFR § 122.26. The removal action work plan will include detailed provisions and designs for storm water run-off controls during excavation for Alternative 2 or Alternative 3. Storm water run-off controls may include but are not limited to swales, silt fences, wattles, and drainage channels.

Item 50 - Staging Piles OAC 3745-57-74 (A-K). During the implementation of Alternative 2 or Alternative 3, there may be a need to stage contaminated soil and waste on Site in temporary stockpiles prior to loading the material into the haul trucks for transport to the disposal facility. The remedial action work plan will include appropriate discussion of where and how contaminated soil and waste material will be temporarily stockpiled in accordance with OEPA regulations.

7.2.3. *Reduction of Toxicity, Mobility, or Volume through Treatment*

Alternative 1: No Action

There would be no reduction in toxicity, mobility or volume under Alternative 1 because no action would be implemented.

Alternative 2: Partial Excavation and Off-Site Disposal

Alternative 2 does not include treatment technology. The technology screening process discussed in Section 6 Table 6-1 was not retained because potential treatment technologies would not address all COCs, and technologies to treat metals would add both volume and weight to the volume to be removed without treatment. While Alternative 2 does not include treatment to reduce toxicity, mobility, or volume, the removal action proposed in the alternative will provide reduction of mobility and volume of the contaminated material through excavation and off-site disposal. The concrete foundation above the remaining contaminated material would reduce the mobility by containing the material. The concrete foundation must be repaired/replaced and maintained to ensure the integrity of the concrete to contain the contaminated material in perpetuity.

Alternative 3: Full Excavation and Off-Site Disposal

While Alternative 3 does not include treatment to reduce toxicity, mobility, or volume, the removal action proposed in the alternative will provide elimination of mobility and volume of the contaminated material through excavation and off-site disposal of all contaminated material.

7.3. Short-Term Effectiveness

Alternative 1: No Action

There will be no short-term impacts or risks to human receptors or the environment associated with the No Action alternative, because no action will be taken at the Site.

Alternative 2: Partial Excavation and Off-Site Disposal

There will be some short-term risks to public health and safety associated with the excavation construction work, materials transport, and off-site disposal in Alternatives 2. Alternative 2 will involve hauling approximately 33,100 yd^3 (bulked) of hazardous contaminated soil and waste materials to an off-site repository and 95,300 yd^3 (bulked) non-hazardous contaminated soil, sediment, and waste material to a local licensed landfill. Alternative 2 will also remove and haul approximately 1,100 tons of concrete to a recycling facility. Assuming use of 20 yd^3 semi-trucks loaded with approximately 23 to 25 tons per truck, this will result in an estimated 5,400 semi-truck (soil and waste material) and 46 semi-truck (concrete) round-trips along the Site access road and on local and state roads to transfer materials between the Site and the disposal facility. In addition, NPS approved clean imported soil will be trucked into the Site along local and state roads from the approved fill source to the Site. This significant amount of truck traffic and the associated potential for accidents, noise, and air emissions during truck hauling activities will pose potential short-term risks to workers, local residents, and Park visitors. The current condition of the concrete foundation may require extensive repairs or replacement to create an appropriate cover to contain the contaminated soil and waste beneath the existing concrete foundation. Depending on the extent of repair or replacement of the concrete foundation, Alternative 2 activities could also include the removal and hauling of up to 8,900 tons (370 semi-truck round-trips) of additional concrete to a local concrete recycling facility.

Alternative 2 will include approximately 18 to 20 months of Site preparation, concrete repair/replacement, excavation, grading, and construction activities. During this time, workers at the Site will be exposed to risks associated with heavy construction equipment and their emissions during the excavation, hauling, and grading activities. BMPs, personal protection equipment (PPE), work zones, health and safety protocols, training, and scheduling will be in place to minimize personnel risks. Dust suppression practices and air monitoring will be conducted throughout construction activities to ensure that particulate emissions will be effectively controlled during construction activities, but these actions will not reduce other emissions (e.g., carbon dioxide from equipment exhaust).

Short-term environmental risks will be associated with the Alternative 2 excavation, which will require clearing and grubbing of approximately 10.5 acres. Following completion of earth moving activities, the Site will be revegetated. Because of the large size of the area requiring revegetation, reestablishing successful vegetation across the Site will likely take several years to achieve.

Alternative 3: Full Excavation and Off-Site Disposal

Short-term risks to public health and safety associated with Alternative 3 will be similar to Alternative 2, except that there may be a greater risk because of the larger volume of material to be removed. Alternative 3 will involve hauling approximately 33,100 yd^3 (bulked) of hazardous contaminated soil and waste materials, to an off-site repository, and approximately 122,500 yd^3 (bulked) non-hazardous contaminated soil and waste material to a local licensed landfill. Alternative 3 will also remove and haul approximately 10,000 tons of concrete to a recycling facility. Transfer of these materials from the Site to the disposal facilities will require an estimated 6,500 20 yd^3 semi-truck (soil and waste material) and 420 truck (concrete) round-trips along the access road and on local and state roads to transfer materials between the Site and the disposal facility. Similar to Alternative 2, NPS approved clean imported soil will be trucked into the Site using local and state roadways. Alternative 3 will involve approximately 20 months of on-site excavation, grading, and construction activities, and will require clearing and grubbing of approximately 12.5 contaminated acres.

7.4. Long-Term Effectiveness

Alternative 1: No Action

The risks to human and ecological receptors posed by exposure to Site contaminants will remain as documented in the HHRA and ERA. Although fences and signs are present at the Site, No

Action assumes no future maintenance, repair, or replacement of these protective controls, so these controls will not have any long-term protective value. Natural attenuation through decay and dispersion is unlikely for all COCs and COECs; rather, it is more likely the sources of elevated metals and SVOCs, known to be environmentally persistent, will not attenuate to concentrations or levels below RGs if left in place. In addition, substantial evidence shows that the ongoing and increasing levels of flooding at the Site will continue to erode contaminated soil and waste from the Site Brandywine Creek.

Alternative 2: Partial Excavation and Off-Site Disposal

Partial excavation and off-site disposal of contaminated soil materials in the 19 soil and three sediment DUs and seven waste piles proposed for Alternative 2 will provide long-term and permanent protection to human and ecological receptors, because contaminant source removal eliminates potential future contaminant exposure, transport, and migration. Excavation and off-site disposal of the contaminated man-made features and waste including the railroad tracks and ties, Fourdrinier Machine, transite piping, and associated material will eliminate exposure risks as well as the potential for this material to erode into the Cuyahoga River or Brandywine Creek. The concrete foundation will be repaired or replaced and used as containment for the contaminated soil and waste not excavated. The concrete foundation will require maintenance to prevent integrity degradation that could lead to exposure and migration of the contaminated soil.

Alternative 2 will have less long-term effectiveness than Alternative 3 because the contamination under the concrete foundation cap will remain in seven DUs over an area of approximately 1.8 acres. Potential for environmental and human health risks remain with Alternative 2 if degradation of the concrete foundation occurs as a result of lack of appropriate maintenance. Contaminated soil with metals, SVOCs, and VOCs above RGs will remain in place under the concrete foundation as a long-term risk and impact to Park visitors, and Park personnel. Alternative 2 can be achieved in less than two years.

Alternative 3: Full Excavation and Off-Site Disposal

Full excavation and off-site disposal of contaminated soil materials in the 26 soil and three sediment DUs and seven waste piles proposed for Alternative 3 will provide long-term and permanent protection to human and ecological receptors, because contaminant source removal eliminates potential future contaminant exposure, transport, and migration. Excavation and off-site disposal of the contaminated man-made features and waste including the railroad tracks and ties, Fourdrinier Machine, transite piping, and associated material will eliminate exposure risks as well as the potential for this material to erode into the Cuyahoga River or Brandywine Creek. No residual risk from the contaminated materials will remain that require maintenance and monitoring, making Alternative 3 the alternative that provides the most long-term effectiveness. Alternative 3 can be achieved in less than two years.

7.5. Implementability

This section provides an evaluation of the technical and administrative feasibility of implementing the alternative and the materials and services that will be required for its implementation.

Alternative 1 will not include construction activities, and therefore is the easiest alternative to implement. Alternatives 2 and 3 will employ similar construction activities, which are readily implementable. The materials and equipment for Alternatives 2 and 3 are readily available. Excavation and off-site disposal are proven and reliable methods, which can be readily achieved at this Site where excavation depths are within the capability of excavation equipment. At this time, multiple licensed off-site disposal facilities are in operation and available to accept the contaminated material. Alternatives 2 and 3 will require similar approvals and coordination with the Park and interested parties such as neighboring properties. Administrative requirements are achievable, and the timeframe to implement Alternative 2 or 3 of 18 to 20 months is also achievable and not overly burdensome. The most difficult task to implement will be permanent ongoing and perpetual monitoring and maintenance of the concrete cap/cover for Alternative 2.

Overall, Alternative 1 will be the easiest to implement, and Alternative 3 will be easier to implement than Alternative 2, because the concrete foundation is in poor to fair condition and will require repair and/or replacement to achieve and maintain the integrity of the concrete foundation, and the concrete will be removed and not replaced for Alternative 3.

7.5.1. *Technical Feasibility*

Technical Implementation Considerations

Alternative 1: No Action

Alternative 1 has no technical considerations, is feasible, and easy to implement because it does not require any materials, planning, or action.

Alternative 2: Partial Excavation and Off-Site Disposal

Alternative 2 is technically feasible. The services, materials, equipment, and expertise necessary to complete the excavation and backfilling work are readily and locally available; although, excavation equipment and haul trucks must be reserved for an extended duration, requiring advanced planning. Further, the materials, equipment and expertise necessary to repair and maintain the concrete foundation is readily and locally available.

The potential depth of excavation will vary with the depth to uncontaminated soil, which ranges from less than 1foot to more than 12 feet. Average excavation depths are anticipated to be 7 feet in the CWP DUs and 8 feet in the CWP waste piles, 6 feet in the Dump site, 5 feet in the BLD DUs, 3 feet in the AP DUs, 8 foot in the RR DUs, 5 feet in the SWP (waste pile), 6 foot in the TR DU, and 4 feet in the UST DUs. The actual excavation depths required will be determined during implementation of the removal action and will be based on confirmation sampling in each DU as discussed in Section 6. These depths are within range of standard excavation equipment and special excavation equipment is not anticipated to be required.

Construction work at the Site and off-site disposal will not be difficult due to the Site's location, accessibility for equipment, distance to an appropriate disposal facility, and unique regulatory framework. Dozers, loaders, articulated dump trucks, and excavators are presumed for most of the construction work.

Some of the approximately 128,400 yd^3 (bulked) of excavated materials may require staging prior to placement in haul trucks in Site areas where truck access will be limited, or not feasible. It is assumed that 20 yd^3 (23 to 25 tons) haul semi-trucks with dump trailers will be used throughout each workday to haul material to the disposal facilities. Excavation, loading, hauling, and unloading the material at the disposal facility is estimated to require approximately 7 to 8 months.

Alternative 2 will also require concrete repair or replacement to restore the integrity of the foundation to be utilized as a cover over the contaminated soil and waste left-in-place. To repair or replace the concrete is estimated to require approximately 3 to 5 months.

Alternative 2 assumes 20 yd^3 haul trucks will be used to deliver the estimated 97,600 yd^3 (bulked) of, NPS approved fill soils, and other miscellaneous fill materials to the Site to regrade the excavated areas to original topographic elevations. Assuming use of approximately 4,100 haul truck loads transportation of fill materials to the Site is estimated to require several months. Alternative 2 also will include approximately 3 months of Site preparation work including removal of manmade features, and an additional 2 months of post excavation activities, which may be accomplished in conjunction with other construction activities. Overall, it is anticipated that implementing Alternative 2, including site preparation, excavation, off-site disposal, concrete foundation repair or replacement, and post excavation activities will require approximately 18 to 20 months to complete. This does not include additional time for revegetation, which is not considered technically complex.

Because maintenance on the concrete foundation must be conducted in perpetuity, fluctuating and extreme weather conditions (increased flooding and erosion) could result in an increase in the frequency and amount of maintenance impacting Park resources.

Alternative 3: Full Excavation and Off-Site Disposal

Alternative 3 is similar to Alternative 2 and is technically feasible varying primarily by the greater volume of material requiring removal because of the concrete foundation and underlying soil removal. Alternative 3 will be less technical than Alternative 2 because removing the concrete is less complicated than repair or replacement.

Availability of Services and Materials

Alternative 1: No Action

Alternative 1 has no services or materials availability issues, and is feasible and easy to implement because it does not require any materials, planning, or action.

Alternative 2: Partial Excavation and Off-Site Disposal

The services, materials, equipment, and expertise necessary to complete the work will be readily and locally available; although, excavation equipment and haul trucks will require reservation for an extended duration, requiring advanced planning. Construction work at the Site and off-site disposal will not be difficult because of the Site’s accessibility to nearby roads, distance to an appropriate disposal facility, and local Park support. Dozers, loaders, and excavators are presumed for most of the construction work, which are readily available. The NPS approved fill material to be used to restore appropriate areas of the Site may be more difficult to obtain and require out-of-state sources, and additional planning and transportation.

Other services required and are easily available in the area include the following:

- laboratory services;
- air monitoring services;
- onsite transportation vehicles;
- equipment and supplies for health and safety and confirmation sampling;
- portable office and sanitary facilities;
- decontamination pad and washing equipment;
- fueling services;
- traffic control services, and
- concrete repair/replacement services.

Alternative 3: Full Excavation and Off-Site Disposal

Alternative 3 requires similar services and materials as Alternative 2. Unlike Alternative 2, which would require concrete repair or replacement services in addition to removal, Alternative 3 would only require the concrete removal because the concrete would not be replaced.

7.5.2. *Administrative Feasibility*

This section provides an evaluation of the activities needed for coordination with other offices and agencies. Under CERCLA, federal, state, and local permits are not required for on-Site CERCLA response actions; however, the substantive requirements of all permits that will otherwise be required must be met (40 CFR, Section 400.300(e)).

Alternative 1: No Action

Alternative 1 has no administrative difficulty, and is feasible and easy to implement because it does not require any materials, planning, or action.

Alternative 2: Partial Excavation and Off-Site Disposal

In the short-term, during on-site work, Park operation, activities, and visitation in the immediate vicinity of the Site will require administrative coordination. It may be necessary to implement temporary closures of the Towpath and access road (equestrian use) and, at a minimum, traffic controls along the access road, exiting and entering Highland Road, and possibly the Towpath. Activities will be scheduled to minimize negative impacts from construction traffic and noise to Park visitors and residents. Removal work to be conducted near the Towpath at the aeration pond area (DUs AP-01 through AP-05, AP-07, and Pond, P1, P2, and P3), may require off-hours work and/or temporary pedestrian and traffic control. Staging areas will be evaluated to minimize impacts to Park operations and visibility to visitors.

Although some level of coordination of traffic patterns will be required, construction and hauling activities are not anticipated to significantly interfere with or disrupt daily Park activities. The truck hauling route approach from the east and departure to the east will be along Highland Road as required by the Park. Simple and brief traffic controls will be effective and feasible with minimal inconvenience to the public. Further, if the north access gate is used for truck and equipment egress and ingress this will reduce potential traffic and restrictions on the Towpath.

Temporary public access restrictions to the Towpath and the equestrian trail along the access road to maintain public safety during nearby Site work will be brief, infrequent, and could be managed with minimal inconvenience to the public with proper planning and implementation. Access restriction will be managed using temporary chain link fencing composed of 10 foot long panels placed along the Towpath, and in other areas as necessary and requested by NPS to restrict access to the Site by the public during implementation. The fencing will be removed after completion of the removal action.

Alternative 2 is a feasible alternative, but will require the Park to commit administrative resources to maintain and repair the concrete foundation in perpetuity to establish and maintain its integrity. In addition, this alternative will require inclusion of the land use restrictions in the Superintendent's Compendium on an annual basis in perpetuity.

Alternative 3: Full Excavation and Off-Site Disposal

With the exception of no requirement to maintain the concrete foundation as a permanent containment structure and land use restriction as required for Alternative 2, Alternative 3 requires the same administrative resources and agency coordination. Alternative 3 also will require the same temporary public access restrictions as Alternative 2 including fencing and signage along the Towpath and at other location designated by NPS.

7.5.3. *State (Support Agency) Acceptance*

The alternatives have not yet been evaluated for "state acceptance" criteria. Evaluation for these criteria will be completed in the form of public response subsequent to the submittal of this EE/CA Report.

7.5.4. *Community Acceptance*

The alternatives have not yet been evaluated for "community acceptance" criteria. Evaluation for these criteria will be completed in the form of public response subsequent to the submittal of this EE/CA Report.

7.6. Cost

This section provides an evaluation of the costs associated with implementing the removal action alternative. Cost estimates are based on currently available costs and approximate time and materials requirements developed for the sole purpose of comparing alternatives. The EE/CA cost estimates should not be considered design-level estimates. They are representative within a range from 30 percent below to 50 percent above the costs presented. Details of the tasks associated with all alternatives are presented in Appendix F.

Alternative 1: No Action

The NPV cost of implementing Alternative 1 is $0. This alternative will allow hazardous substances to remain at the Site above levels that will allow for unlimited use and unrestricted exposure; therefore, if this alternative were selected NPS will review the efficacy of the removal action no less often than every five years to determine whether additional action will be required to facilitate the protection of human health and the environment. No maintenance of the fence, signs, and features is planned; therefore, no costs are anticipated for the future. Cost estimates are provided in Appendix F.

Alternative 2: Partial Excavation and Off-Site Disposal

The total capital cost of Alternative 2 is estimated to be $47,166,100 (current dollar). The direct capital cost is estimated at $39,697,000, which includes a 25% contingency factor. The costs summarized in Appendix F include: Site preparation; excavation, transportation, and off-site disposal of contaminated materials and man-made features; repairing/removing concrete; hauling NPS approved fill and grading materials to the Site, and placement of these materials; monitoring activities during construction; constructing stormwater controls; and performing revegetation.

The indirect capital costs associated with Alternative 2 are estimated at approximately $7,469,100. This cost includes labor and design services associated with performing historic documentation and the design and oversight/management of implementation activities.

Long-term O&M costs for Alternative 2 associated with annual maintenance are estimated at approximately $25,000, which includes annual maintenance of the concrete (inspections, minor repairs, clearing) and sediment and surface water monitoring. In addition, every five years in perpetuity a CERCLA 5-year review will be conducted at an estimated cost of $35,000. This results in a total of approximately $960,000 in long-term O&M costs over a 30-year period, which is an NPV of approximately $385,700 for Alternative 2. The 5-year review requirement applies to remedial actions selected under CERCLA §121 upon completion of which, hazardous substances, pollutants, or contaminants will remain onsite. The 5-year reviews will be required by NPS because contaminated materials will remain on the Site for Alternative 2 above levels that would allow for unlimited use and unrestricted exposure.

Alternative 3: Full Excavation and Off-Site Disposal

The total capital cost of Alternative 3 is estimated to be $45,006,900 million (current dollar). The direct capital cost is estimated at $37,825,400 million, which includes a 25% contingency factor. The costs summarized in Appendix F include: Site preparation; excavation, transportation, and off-site disposal of contaminated materials and man-made features; hauling NPS approved fill and grading materials to the Site, and placement of these materials; monitoring activities during construction; constructing stormwater controls; and performing revegetation.

The indirect capital costs associated with Alternative 3 are estimated at approximately $7,181,500. This cost includes labor and design services associated with performing historic documentation and the design and oversight/management of implementation activities.

Short-term O&M costs for Alternative 3 associated with annual inspections of the revegetation progress are estimated at approximately $2,500, which includes annual inspection of the Site revegetation progress and sediment and surface water monitoring. It is estimated that the revegetation would become established and stabilized within 5 years of removal action completion and initial revegetation activities.

7.7. Summary of the Alternatives Comparative Analysis

Text Table 7.7 summarizes the results of the evaluation of the criterion effectiveness, implementability, and cost for each alternative.

Text Table 7.4 Comparison of Alternatives												
Criterion	**Effectiveness**						**Implementability**				**Cost**
Alternative	**Protective of**		**Complies with ARARs?**	**Reduces Toxicity, Mobility, or Volume**	**Effectiveness Duration**		**Feasibility**		**Acceptance**		**Cost**
	Human Health?	**The Environment?**			**Short Term**	**Long Term**	**Technical**	**Administrative**	**State**	**Community**	
1- Alternative 1: No action	*No. The risk to human receptors from direct exposure to soil and waste contamination will remain unchanged.*	*No. The risk to ecological receptors from direct exposure to soil and waste contamination will remain unchanged.*	*No. Alternative 1 will not eliminate or avoid creating impaired conditions*	*No. Alternative 1 will not reduce toxicity, mobility or volume of the contaminated soil or waste and future risks are unlikely to be reduced from current conditions.*	*No.*	*No.*	*Good. No action is easy to implement because it does not require planning or action.*	*Good. The alternative does not require significant administrative planning or permitting.*	*No. The State is unlikely to accept a no action alternative as a final removal action.*	*No. The community is unlikely to accept a no action alternative that leaves contaminated soil and waste on site and the area inaccessible in perpetuity. .*	*$0*

Text Table 7.4 Comparison of Alternatives												
Criterion	**Effectiveness**						**Implementability**				**Cost**
Alternative	**Protective of**		**Complies with ARARs?**	**Reduces Toxicity, Mobility, or Volume**	**Effectiveness Duration**		**Feasibility**		**Acceptance**		**Cost**
	Human Health?	**The Environment?**			**Short Term**	**Long Term**	**Technical**	**Administrative**	**State**	**Community**	
2- Alternative 2: *Partial Contaminated soil and Waste removal with the concrete foundation and underlying contaminated soil and waste left in place*	*Yes. Alternative 2 is effective with respect to protecting human health by eliminating exposure pathways to human receptors. The concrete foundation provides an effective barrier between contaminated soil and waste material and potential receptors; however, contaminated soil and waste material exceeding RGs will remain on Site and a future potential residual risk will require long-term management.*	*Yes. Alternative 2 is effective with respect to protecting the environment by eliminating exposure pathways to ecological receptors. The concrete foundation provides an effective barrier between contaminated soil and waste material and potential receptors; however, contaminated soil and waste material exceeding RGs will remain on Site and a future potential residual risk will require long-term management.*	*Alternative 2 can be implemented so as to comply with chemical and action specific ARARs. Alternative 2 does not comply with all location ARARs including the NPS Organic Act or the ARARs that do not allow waste within Park boundaries by leaving contaminated soil and waste beneath the concrete foundation*	*Although Alternative 2 does not include treatment, it reduces toxicity, mobility, and volume of contaminated soil and waste material by removing approximately half of the contaminated soil and waste material and leaving the remaining contaminated soil and waste contained beneath the existing concrete foundation reducing potential exposure risks to the public and ecological receptors.*	*Alternative 2 is effective in the short term because it eliminates direct exposure of human and ecological receptors to contaminated soil and waste material; however, this alternative creates short term risks to the environment, workers and the community during implementation of the removal action as heavy equipment will be transported and operated on Site, trucks and equipment will generate air emissions, and trucks will travel designated roads to and from the Site.*	*Alternative 2 is effective in the long-term because it eliminates direct exposure of human and ecological receptors to contaminated soil and waste material; however, the concrete foundation cap will require perpetual maintenance to maintain a barrier between the contaminated soil and waste beneath the concrete and human and ecological receptors.*	*Good. Part excavation with removal of contaminated soils and waste material and utilizing the existing concrete foundation as a cap is technically feasible, as the equipment, and expertise necessary to complete the work are readily and locally available. 64,300 cy bulked excavated. 3 months preparations 7 to 8 months excavation. 4 months restoration and grading. Total 15 months Fair: Source for the NPS approved fill material to be used to restore and revegetate the Site may not be locally available and require an out of state supplier and the added transportation costs.*	*Good. Administrative coordination will be required to set up disposal requirements and for manifesting. Fair: All imported fill material to be used for restoration will require Administrative approval. Will also require administrative approval and coordination for perpetual maintenance on the concrete foundation.*	*The alternatives were not evaluated for "state acceptance" criteria. Evaluation for these criteria will be completed in the form of public response subsequent to the submittal of this EE/CA Report. However, the State is likely to accept the reduction in risk to human and ecological receptors provided by Alternative 2. The State will likely accept the reduction in impacts from soil and waste on the Cuyahoga River.*	*The alternatives have not been evaluated for "community acceptance" criteria. Evaluation for these criteria will be completed in the form of public response subsequent to the submittal of this EE/CA Report. The community is likely to accept Alternative 2 if access to the Site is unrestricted and use of the concrete foundation is included in the access. There may be some potential unacceptability if institutional controls are incorporated and not all the risk are removed.*	*Capital Cost $46,780,400 30-Year O&M: (current) $385,700 Net Present Value: $47,166,100*

Text Table 7.4 Comparison of Alternatives												
Criterion	**Effectiveness**						**Implementability**				**Cost**
Alternative	**Protective of**		**Complies with ARARs?**	**Reduces Toxicity, Mobility, or Volume**	**Effectiveness Duration**		**Feasibility**		**Acceptance**		**Cost**
	Human Health?	**The Environment?**			**Short Term**	**Long Term**	**Technical**	**Administrative**	**State**	**Community**	
3-Alternative 3: Full Removal of contaminated soil and waste including the concrete foundation and the underlying contaminated soil and waste.	*Yes. Alternative 3 is highly effective in protecting human health. Alternative 3 eliminates exposure pathways to human receptors by removing contaminated soil and waste material from the Site.*	*Yes. Alternative 3 is highly effective in protecting the environment. Alternative 3 eliminates exposure pathways to ecological receptors by removing contaminated soil and waste material from the Site.*	*Yes: Alternative 3 complies with chemical-, action-, and location specific ARARs, allowing the Site to be returned to a natural state and eliminates the need for institutional controls and thereby causing no impairment.*	*Yes: Although Alternative 3 does not include treatment, it reduces the toxicity, mobility, and volume of contaminated soil and waste material by removing contaminated soil and waste material.*	*Good: Alternative 3 is effective in the short-term because it eliminates direct exposure of human and ecological receptors to contaminated soil and waste; however, this alternative creates short-term risks to the environment, workers, and the community during implementation as heavy equipment will be transported and operated on Site, trucks and equipment will generate air emissions, and trucks will travel on the access road to reach Highland Road. There may be some short term impacts to local wildlife including disruption of home area and endangerment from equipment operations.*	*Good: Alternative 3 is effective in the long-term because it eliminates direct exposure of human and ecological receptors to contaminated soil and waste. Alternative 3 will provide long-term benefits to wildlife by returning the Site to natural conditions suitable to wildlife for food and shelter.*	*Good: Excavation of contaminated soil and waste is technically feasible as the equipment and expertise necessary to complete the work is readily and locally available. Fair: Source for the NPS approved fill material to be used to restore and revegetate the Site may not be locally available and require an out of state supplier and added transportation costs.*	*Good: Administrative coordination will be required to set up disposal requirements and for manifesting. Fair: All imported fill material to be used for restoration will need Administrative approval.*	*The alternatives were not evaluated for "state acceptance" criteria. Evaluation for these criteria will be completed in the form of public response subsequent to the submittal of this EE/CA Report. However, the State is likely to accept the reduction in risk to human and ecological receptors provided by Alternative 3. The State will likely accept the reduction in impacts from soil and waste on the Cuyahoga River.*	*The alternatives have not been evaluated for "community acceptance" criteria. Evaluation for these criteria will be completed in the form of public response subsequent to the submittal of this EE/CA Report. The community is likely to accept Alternative 2 if access to the Site is unrestricted and use of the concrete foundation is included in the access. There may be some potential unacceptability since this alternative does not remove all risks.*	*Capital Cost $44,978,800* *5-Year O&M: (current) $28,100* *Net Present Value: $45,006,900*

8. Recommended Removal Action Alternative

The purpose of Section 8 is to describe the recommended removal action alternative and the reason for the selection.

Pursuant to the NCP, each alternative described in Sections 6 and 7 was analyzed using the following evaluation criteria: effectiveness, implementability, and cost. The effectiveness of each alternative was evaluated by each alternative's protectiveness of human health and the environment; compliance with ARARs; reduction of toxicity, mobility, or volume through treatment; long-term effectiveness and permanence; and short-term effectiveness. The implementability criterion addresses technical feasibility (including availability of services and materials), administrative feasibility, and regulatory and community acceptance. Projected costs were calculated using direct capital costs, indirect capital costs, and annual PRSC. The costs presented are estimated using current costs of labor and materials, and actual costs are expected to range from 30 percent below to 50 percent above the costs presented. The projected costs presented for the EE/CA removal action alternatives are estimates only for the sole purpose of comparing alternatives and should not be considered design-level cost estimates. Details that formed the basis for the removal action alternative cost projections are provided in Appendix F.

Taking into consideration the evaluation criteria presented in Section 7, the recommended removal action alternative for the Site is Alternative 3. Alternative 3 includes full removal of contaminated soil, sediment, and waste material, removal of the concrete building foundation and the underlying contaminated soil and waste, and off-site disposal. Alternative 3 also addresses contaminated remnant Site features including the Fourdrinier Machine, buried transite piping, railroad spurs; and data gaps including beater tank(s), basement backfill, concrete, and the Pond P1 concrete liner at an estimated cost of $45,006,900.

Alternative 3 is selected as the recommended removal action alternative based on the results of the comparative analysis completed in Section 7 for the following reasons:

- Alternative 3 will have the highest degree of overall protection for human health and the environment, because excavation/off-site disposal will be used to address Site contaminated soil, sediment, and waste material; no contaminated material creating an unacceptable risk to human health or the environment will remain on the Site. Alternative 3 will not require long-term O&M, and only requires short-term O&M to monitor the revegetation results until the vegetation is established.
- Alternative 3 will provide the greatest long-term effectiveness and permanence through removal of contaminated materials, elimination of permanent risk, and elimination of the need for post-removal action Site controls.
- Alternative 3 completely eliminates off-site contaminant transport as the material will be removed and disposed off-site in an existing and appropriately designed and managed facility.
- Alternative 3 will provide short-term effectiveness and will be able to be completed within 18-20 months.

- Alternative 3 is the only alternative that will comply with all chemical-, action-, and location-specific ARARs.
- Alternative 3 is the easiest to implement because it requires only the removal of concrete and does not require constructing a new concrete pad over contaminated soil.
- Alternative 3 will have lower costs than Alternative 2 by approximately $2.2 million (NPV).

Implementation of Alternative 3 will meet all RAOs and accomplish the following:

- Eliminate unacceptable risk to human and ecological receptors from exposure to elevated levels of SVOCs, Dioxin/furans, PCBs, VOCs, and metals on the Site by completely removing all the contaminated material that is the source of this risk.
- Eliminate unacceptable risk to human and ecological receptors from exposure through ingestion, direct contact, and/or inhalation to contaminated soil, waste material, and sediment removal and off-site disposal.
- Eliminate unacceptable risk to human and ecological receptors from direct exposure to contaminants and physical hazards posed by man-made Site features (e.g., Fourdrinier Machine, former railroad spurs, beater tank(s), basement backfill and concrete, transite pipe, Pond P1 liner, and waste piles) by removal and offsite disposal.
- Eliminate the off-site migration and uncontrolled discharge of contaminated soil material and waste via wind, surface water, erosion, and weathering by removing the sources of contaminated soil, sediment, and waste material from the Site.
- Contribute to the unimpaired use and full enjoyment and utilization of park resources consistent with NPS mandates.
- Attain all federal and state ARARs.

In conclusion, the type of contaminants that dominate the Site (metals and PAHs), the extensive variety and number of these contaminants, and their wide distribution and variability across the Site in relatively shallow soils and bounded by active surface water bodies to the north and west, combined with the predominantly fine grained, mostly clay geology at the Site make the Site ideally suited to a thorough and accessible Site-wide cleanup proposed by Alternative 3. In accordance with the nine criteria set forth in 40 CFR 300.430(e), Alternative 3 is the best viable alternative to not only remediate the Site, but to do so quickly, effectively, permanently, in a way that is protective of human health and the environment, complies with ARARs, and is cost effective.

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FIGURES

TABLES

APPENDICES

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Appendix B – Site Investigation Report

Appendix C – Site Photographic Log

Appendix D – Human Health Risk Assessment

Appendix E – Ecological Risk Assessment

Appendix F – Detailed Cost Estimates