ENGINEERING EVALUATION/COST ANALYSIS
BEAR CREEK SEDIMENTS SITE
BALTIMORE, MARYLAND

Superfund Technical Assessment and Response Team
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Final

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CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirements
BAF	Bioaccumulation factor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
EA	EA Science and Technology, Inc. (PBC)
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
ITRC	Interstate Technology and Regulatory Council
LOAEL	Lowest-observed-adverse-effect level
MDE	Maryland Department of the Environment
mgd	Million gallon(s) per day
mg/kg	milligram per kilogram
MSC	Maximum Specific Concentration
µg/kg	microgram per kilogram
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
NTCRA	Non-Time Critical Removal Action
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PRG	Preliminary removal goal
RAO	Removal action objective
RGO	Removal goal objective
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act of 1986
SWAC	Surface Area-Weighted Average Concentration
SOP	Standard operating procedure
SPF	Sparrows Point Facility
TBC	To Be Considered (advisories, criteria, or guidance “to be considered”)
TRV	Toxicity reference value
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) Region 3, tasked Tetra Tech, Inc. (Tetra Tech) to support completion of this engineering evaluation/cost analysis (EE/CA) for the Bear Creek Sediments Site, located at Sparrows Point Peninsula, Baltimore County, MD (the Site) (**Figure 1-1**). This EE/CA was initiated by EA Engineering, Science, and Technology, Inc (EA) for EPA Region 3; this document builds on the work previously conducted by EA. Tetra Tech supported this work under its Superfund Technical Assessment and Response Team (START) VI contract with Region 3.

The EE/CA identifies and evaluates removal action alternatives for contaminated sediments in Bear Creek (offshore of the outfall from Tin Mill Canal), as delineated in **Figure 1-1**. The sediment removal action will be conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as well as EPA's guidance document, *Conducting Non-Time-Critical Removal Actions under CERCLA* (EPA 1993).

The goals of this EE/CA are to identify the objectives of the removal action; identify removal alternatives that may be used to satisfy these objectives; and analyze and compare these alternatives in terms of their cost, effectiveness, and implementability.

This report has been organized into the following sections:

- Section 2 - Site Characterization: provides a description of the Site and background information including site history, previous work at the Site, a summary of the conceptual site model, and results of the streamlined risk evaluation.
- Section 3 - Identification of Removal Action Objectives (RAOs): presents the RAOs and preliminary removal goals (PRGs) for the Site, applicable or relevant and appropriate requirements (ARARs), statutory limits on the removal action, determination of removal scope, and the projected schedule.
- Section 4 - Identification and Development of Removal Action Alternatives: presents the initial screening and development of the removal action alternatives.
- Section 5 – Analysis of Removal Action Alternatives: evaluates the identified removal action alternatives in terms of effectiveness, implementability, and costs.
- Section 6 - Comparative Analysis of Removal Action Alternatives: compares the alternatives using non-time critical removal action (NTCRA) criteria.
- Section 7 - Recommended Removal Action Alternative: provides the recommended removal action alternative and the rationale for its selection.
- Section 8 – References: lists the references cited in the EE/CA.

2.0 SITE CHARACTERIZATION

This section provides the Site description and background, describes the Sparrows Point Facility (which impacted the Site), and summarizes previous investigations at the Site.

2.1 SITE DESCRIPTION AND BACKGROUND

The Bear Creek Sediments Site (Site) is comprised of an approximately 61-acre area of contaminated sediments in Bear Creek, located south of the Baltimore Beltway bridge (also known as the Francis Scott Key bridge on Route 695) and adjacent to the western shoreline of the Sparrows Point Facility (SPF or Facility) (see **Figure 2-1**). The SPF is located on an approximately 3,100-acre peninsula in Baltimore Harbor, generally bounded by the Back River, Bear Creek, and the Northwest Branch of the Patapsco River. More than 100 years of steelmaking and related activities conducted by various owners at SPF resulted in releases of hazardous substances into the environment, including Bear Creek.

<u>SPF Enforcement/RCRA Activities</u>

In 1997, EPA and the Maryland Department of the Environment (MDE) entered into a Consent Decree under Section 3008(h) of the Resource Conservation and Recovery Act (RCRA), 42 U.S. Code (U.S.C.) § 6928(h), and state law with the then SPF owner, Bethlehem Steel Corporation (BSC). The Consent Decree required BSC to undertake certain RCRA Corrective Action activities including: (1) completing a Site-Wide Investigation and a Corrective Measures Study, and (2) implementing Interim Measures to address Solid Waste Management Units (SWMUs) and Areas of Concern at the SPF. SWMUs and Areas of Concern at SPF include building and process areas where releases of hazardous substances and petroleum products may have occurred. BSC filed for bankruptcy protection in 2003. After 2003, steelmaking continued at the SPF under a series of new owners that continued the work required under the Consent Decree. In September 2014, EPA and MDE entered into a Settlement Agreement and Covenant Not to Sue (SA) and an Administrative Order on Consent (AOC) with Sparrows Point Terminal, LLC (SPTLLC), which had purchased the SPF. In 2016, SPTLLC changed its name to Tradepoint Atlantic (Tradepoint or TPA). Together, the agreements provide for the cleanup of the SPF under RCRA Corrective Action and Maryland law.

Although EPA's RCRA program is overseeing the cleanup of the SPF, sediment contamination at the Bear Creek Sediments Site has been deferred to the Superfund program. On March 16, 2022, EPA added the Site to the National Priorities List, a list of the sites eligible for long-term cleanup financed under the federal Superfund Program.

2.2 SPARROWS POINT FACILITY

Areas located within the SPF that have contributed to the release of hazardous substances at the Site include the Tin Mill Canal, the Rod and Wire Mill Area, and Greys Landfill. Based on site investigations, the Tin Mill Canal appears to be the primary source of the release of hazardous substances at the Site, as discussed further below.

As mentioned above, steelmaking activities occurred on the Sparrows Point peninsula from approximately 1887 until 2012. The highest concentrations of hazardous substances in Bear Creek are located near the outfall of the Tin Mill Canal. The Tin Mill Canal is a drainage feature on Sparrows Point and lies in approximately the same location as a previous drainage feature, called "Humphrey's Creek." Before 1970, stormwater runoff and industrial wastewater from Sparrows Point was discharged to Humphrey's Creek, which drained into Bear Creek. From 1950 to about 1970, the Tin Mill Canal was created by filling in Humphrey's Creek with slag material, and then excavating the canal into the placed slag. When the Tin Mill Canal was completed in approximately 1970, stormwater and industrial wastewater discharges were routed through the "Humphrey's Creek Wastewater Treatment Plant," which was completed in about 1970. In about 1972, after the establishment of the Clean Water Act, 33 U.S.C. 1252 et seq., BSC received a National Pollutant Discharge Elimination System (NPDES) permit to discharge from the treatment plant into Bear Creek. Therefore, after 1970, the Tin Mill Canal no longer discharged directly to Bear Creek; rather, the Tin Mill Canal was physically separated from Bear Creek by an earthen structure, and industrial wastewater and stormwater from the Tin Mill Canal was routed through the wastewater treatment plant before being discharged into Bear Creek. In summary, based on available information, industrial wastewater and stormwater were discharged from the SPF through Humphreys' Creek, or Tin Mill Canal, into Bear Creek with limited and/or unknown pollution prevention measures from potentially the late 1800s to about 1970 (when the wastewater treatment plant was constructed and began operation). The historical discharge of hazardous substances, and oil and grease, from Humphrey's Creek/Tin Mill Canal is believed to be the main source of contamination at the Site.

The Rod and Wire Mill Area is near the northern extent of the contamination at the SPF, and Greys Landfill is to the north of the Beltway Bridge (also, known as the Francis Scott Key, Route 695).

The Tin Mill Canal, the Rod and Wire Mill Area, and Greys Landfill are currently in various stages of evaluation, remediation, and redevelopment by TPA, pursuant to the SA and AOC.

The removal action alternatives described in this EE/CA assume releases or threats of releases of hazardous substances from the SPF to the Site have been controlled. Therefore, this EE/CA focuses exclusively on a removal action to address contaminated sediments at the Site. The costs and schedule implications associated with other ongoing work at the SPF and the control of sources of contamination from SPF to the Site are not included as part of this EE/CA. However, the long-term performance of the removal action in Bear Creek will depend upon adequate control of SPF sources of contamination to the Site.

2.3 PREVIOUS SITE INVESTIGATION

This section provides information on previous investigations of the Site.

2.3.1 Subaqueous Survey, Sediment Lithology, and Streamflow Investigations (2014)

In 2014, EA performed bathymetric and side scan sonar surveys in the shallow waters of Bear Creek, addressing about 1,000 feet of the SPF shoreline and a portion of Bear Creek extending north of the Site. These surveys were used to (1) determine water depths, (2) indicate the presence of benthic habitats, (3) estimate the boundary between sandy and fine-grained sediment, and (4) detect and map debris and potential sub-sea utilities within the removal area. Water depth along the shoreline ranged between 2 to 4 feet and increased to 12 feet within the navigational channel. These results are consistent with the current National Oceanic and Atmospheric Administration (NOAA) navigational chart (**Figure 2-2**). Generally, sandy sediments were present in the shallower waters near the SPF shoreline, while finer sediments were detected near the outlet of Tin Mill Canal and toward the middle of Bear Creek. The side scan identified debris (including both anthropogenic and natural materials, as well as a large diameter flexible conduit or fluid transfer line). More in-depth results of the bathymetric and side scan surveys are provided in the EA 2014 Technical Memorandum – Subaqueous Survey Results (EA 2014a).

2.3.2 Shoreline Survey (2014)

EA also conducted a visual shorelines survey of Bear Creek to assess the immediate (intertidal zone) and upper shorelines. Most of the immediate shoreline along the southern portion of the survey area consists of slag and rock that appear to be from the historical operations onshore. The areas of slag and rock were typically found along steeper slopes of the shoreline and provide some protection of the shoreline from erosion. Little habitat is available within the slag and rock. The observed diversity of plant species and wildlife were observed low, except for a small wetland dominated by common reed (*Phragmites australis*), which provides habitat for birds, mammals, and frogs. The upper shoreline in the southern area is primarily deciduous uplands, with paved roads transecting these areas. One wooden structure, which is identified as “Ruins” on **Figure 2-2**, appears to have been an old bulkhead or seawall near the outlet of the Tin Mill Canal. Although deteriorated and missing portions, this structure and pilings to the southwest provide a perch area for shorebirds. EA identified one stormwater outfall along the shoreline on the south side of the site. The stormwater outfall will likely not be affected by any of the removal alternatives evaluated in this EE/CA. The outfall will be identified on the design drawings and protected during construction.

2.3.3 Offshore Investigation of the Site Sediments (2014 to 2015)

EA conducted a Phase I offshore investigation of Bear Creek sediments from 2014 to 2015 (EA 2016b). EA collected sediment samples near the outfall of Tin Mill Canal to delineate offshore impacts to Bear Creek from the SPF; samples were also collected to the north and south of the Beltway Bridge (also known as the Francis Scott Key bridge on Route 695), which crosses Bear Creek near the Site (see **Figure 2-3**). Sediment sampling included surface sediment grab sampling (0 to 6 inches deep) in Bear Creek near the outfall of the Tin Mill Canal, and sediment coring (maximum depth of approximately 6 feet). Pore water samples were collected from selected surface sediment grab sampling locations near the shoreline.

Findings indicated that fine-grained sediments near the outlet of the Tin Mill Canal and extending past the center of Bear Creek contained elevated concentrations of certain constituents (for example, metals, polycyclic aromatic hydrocarbons [PAHs], bis[2-ethylhexyl] phthalate, and polychlorinated biphenyl compounds [PCBs]). Based on groundwater and stormwater samples also collected, historical discharges from the Tin Mill Canal are the most likely source of Site-related sediment contamination. Metals, total PAHs, bis(2-ethylhexyl) phthalate, and PCB exceedances of the Biological Technical Assistance Group (BTAG) freshwater sediment benchmark and Probable Effects Concentrations (PEC) in samples collected from the Tin Mill Canal effluent area, include:

- <u>Cadmium</u> exceeded the BTAG freshwater sediment benchmark of 0.68 milligrams per kilogram (mg/kg) and PEC of 4.98 mg/kg at concentrations ranging from 2.5 mg/kg to 45 mg/kg in grab samples, and concentrations ranging from 0.73 mg/kg to 110 mg/kg in core samples.
- <u>Chromium</u> exceeded the BTAG freshwater sediment benchmark of 52.3 mg/kg and PEC of 111 mg/kg at concentrations ranging from 800 mg/kg to 2,700 mg/kg in grab samples, and concentrations ranging from 66 mg/kg to 7,300 mg/kg in core samples.
- <u>Copper</u> exceeded the BTAG freshwater sediment benchmark of 18.7 mg/kg and PEC of 149 mg/kg at concentrations ranging from 110 mg/kg to 470 mg/kg in grab samples, and concentrations ranging from 35 mg/kg to 940 mg/kg in core samples.
- <u>Nickel</u> exceeded the BTAG sediment benchmark of 15.9 mg/kg and PEC of 48.6 mg/kg at concentrations ranging from 63 mg/kg to 170 mg/kg in grab samples, and concentrations ranging from 19 mg/kg to 220 mg/kg in core samples.
- <u>Zinc</u> exceeded the BTAG freshwater sediment benchmark of 124 mg/kg and PEC of 459 mg/kg at concentrations ranging from 1,100 mg/kg to 10,000 mg/kg in grab samples, and concentrations ranging from 190 mg/ kg to 17,000 mg/kg in core samples.
- <u>Total PAHs</u> exceeded the BTAG freshwater sediment benchmark of 2,900 micrograms per kilogram (µg/kg) and PEC of 22,800 µg/kg at concentrations ranging from 2,920 µg/kg to 14,330 µg/kg in grab samples, and concentrations ranging from 6,737 µg/kg to 82,800 µg/kg in core samples.

- Bis(2-ethylhexyl) phthalate exceeded the BTAG freshwater sediment benchmark of 182.16 µg/kg and PEC of 2,647 µg/kg at concentrations ranging from 3,300 µg/kg to 33,000 µg/kg in grab samples, and concentrations ranging from 220 µg/kg to 54,000 µg/kg in core samples.
- PCBs exceeded the BTAG freshwater sediment benchmark of 40 µg/kg and PEC of 676 µg/kg at concentrations ranging from 230 µg/kg to 1,910 µg/kg in grab samples, and concentrations ranging from 57 µg/kg to 13,200 µg/kg in core samples.

The results of this investigation were used to perform human health and ecological risk assessments. The human health risk assessment did not reveal unacceptable risk to human health. The ecological risk assessment concluded that that aquatic and benthic organisms are potentially at risk from metals, PAHs, PCBs, and bis(2-ethylhexyl)phthalate in sediment and cyanide from surface water only during storm events, and wildlife that consume aquatic and benthic organisms are potentially at risk from selenium and total PCBs in sediment in the Tin Mill Canal samples.

2.3.4 Sediment Delineation and Toxicity Testing (2018)

In 2018, EA conducted delineation sampling and toxicity testing at the Site to further delineate the extent of oil and grease and other contaminants to inform decisions regarding the appropriate extent of the removal action. The delineation sampling and toxicity testing were conducted to address gaps in the available data and identify areas where sediments are toxic to benthic organisms. Sixteen sediment samples were collected from the 0- to 0.5-foot and 0.5- to 1-foot depth intervals. Samples were analyzed for physical and chemical parameters including grain size, moisture, total organic carbon, metals, PCBs, cyanide, semi-volatile organic compounds, and oil and grease. Nine of the 16 samples were also submitted for 10-day solid phase toxicity tests to measure survival rates for the amphipod *Leptocheirus plumulosus (L. plumulosus)*. Toxicity testing revealed significant lethality to amphipod benthic macroinvertebrates (EA 2018). Toxicity results for each sample location are shown on **Figure 2-4**. The 2018 findings and information, the current delineation of sediment contamination at the Site, and results of the human health and ecological risk assessments are summarized in Section 2.5.

2.4 EXTENT OF SEDIMENT CONTAMINATION

As stated earlier in this EE/CA, findings to date indicate that historical discharges from the Tin Mill Canal to Bear Creek are the primary, historical source of sediment contamination. The impacts of these contaminants have been partially delineated in sediment, as discussed below.

PCBs - The highest concentrations of total PCBs (up to 13,200 µg/kg) in sediment samples were identified near the center of the Site (as shown on **Figure 2-5**). Although no clear spatial trend was identified for the PCB concentrations, the highest reported PCB concentrations were collected from core samples farther offshore from the outfall of the Tin Mill Canal. Vertically, the highest PCB concentrations were identified primarily in subsurface core samples. Relatively low PCB concentrations (below screening levels) were identified in the deeper samples of the gray clay layer that generally underlies the contaminated sediments in Bear Creek.

Oil and Grease - Oil and grease concentrations exceeding 80,000 mg/kg (that is, 8 percent) were reported in samples near the Tin Mill Canal outfall (as shown of **Figure 2-6**). In most locations near outfall, a strong petroleum odor and/or a sheen were documented throughout the column of silty sediments, but these were not noted for the underlying gray clay. When these sediments were disturbed, sheens were observed on the overlying water. Oil and grease concentrations generally decrease with distance from the mouth of Tin Mill Canal. Vertically, oil and grease were generally higher in the 0.5- to 1.0-foot interval, with a lower concentration in the top 6 inches and minimal concentrations in the gray clay layer underlying the silt. The distribution of oil and grease appear to indicate historical impacts from the Tin Mill Canal.

Metals - Concentrations of cadmium, chromium, copper, nickel, silver, and zinc were generally highest in samples collected closest to the Tin Mill Canal. Concentrations of these metals generally decreased with distance from the shoreline and from the outfall of the Tin Mill Canal. In most coring locations, concentrations of the target metals generally decreased with depth within the silty sediments. However, at some locations, the impacts of these metals were more pronounced in deeper sediments (which suggests burial of the most impacted sediments at these locations). Relatively low metal concentrations (from approximately one-fifth to one-hundredth of the concentrations near the surface) were reported in samples of the gray clay that underlies the impacted silty sediments.

Delineation of Hazardous Substances in Sediment - As mentioned above, the lithology of the sediment cores indicated that the bottom of Bear Creek in the Site vicinity consists of silty sediments underlain by a low permeability, natural gray clay layer. The clay layer was encountered at depths as shallow as 3 feet, and in some areas was not encountered to the depth of the 6 foot core. Throughout the Site, vertical delineation of the Site-related hazardous substances was achieved where the relatively unimpacted gray clay layer was encountered. However, more complete contamination delineation (for example, in areas where the gray clay layer was not encountered) would require additional coring, using equipment capable of reaching the depth of clay throughout the area.

2.5 Risk Assessment/Threat Assessment

This section summarizes the risk assessment, toxicity and food chain results, focusing on the primary lines of evidence and drivers for the proposed removal action for the Site.

Human Health and Ecological Risk Assessment Findings - Human health and ecological risk assessments were performed as part of the "Phase I Offshore Investigation Report" (EA 2016b). The human health risk assessment did not reveal clear evidence of unacceptable human health risk from exposure to contaminated sediment, or exposure to contaminated aquatic organisms.

The ecological risk assessment for exposure of ecological receptors to contaminated sediment identified the following concerns:

- Wildlife that consume aquatic and benthic organisms are potentially at risk from selenium and total PCBs in sediment based on reasonable maximum exposure scenario dose exceedances of lowest-observed-adverse-effect level (LOAEL)-based toxicity reference values (TRVs). Doses for selenium exceed LOAEL-based TRVs when exposure point concentrations (EPCs) are derived from both bioaccumulation factors (BAFs) and field-collected tissue, while total PCBs exceed LOAEL based TRVs only when EPCs are derived from BAFs.
- Aquatic and benthic organisms are potentially at risk from cadmium, chromium, copper, lead, nickel, silver, zinc, PAHs, PCBs, and bis(2-ethylhexyl) phthalate in sediment, and from cyanide in surface water (during storm events). Benthic organisms are likely also at risk from oil and grease.

Toxicity Testing - Toxicity testing in 2015 by the Chesapeake Bay Foundation and toxicity testing in 2018 by EPA demonstrated that contaminated sediments at the Site pose a direct threat to ecological receptors. In 2018, EPA tested the toxicity of Site-related sediments to determine the impact on benthic macroinvertebrates (specifically, *Leptocheirus plumulosus* [an amphipod]). During toxicity testing, 0% of organisms survived in 8 of the 9 sediment samples collected from the Site; in the ninth sediment sample, 84% of organisms survived. By comparison, 91% of organisms survived exposure to a sediment sample which had not been contaminated by the Site.[1] These 2018 results are consistent with the results of toxicity testing of Bear Creek sediments performed by the Chesapeake Bay Foundation.[2] Both rounds of toxicity testing demonstrate that contaminated sediment from the Site poses a direct threat (lethality) to ecological receptors, specifically benthic macroinvertebrates.

Fish Consumption Advisory (food chain)- Sediment samples collected at the Site exhibit PCB concentrations above BTAG Screening Benchmarks, with several sediment samples exceeding the benchmarks by two orders of magnitude (see **Figure 3-1**).[3] MDE Fish Consumption Advisories are in-place for crab and multiple fish species in the "Patapsco River-Baltimore Harbor," which is adjacent to Bear Creek. MDE issued these Fish Consumption Advisories to address the presence of PCBs in crab and fish species. The Fish Consumption Advisories describe the fish/crab species that should not be eaten by

[1] "Technical Memorandum", prepared for EPA, prepared by EA Engineering, Science, and Technology, Inc. (EA). PBC, dated July 10, 2019.

[2] "2015 Toxicity Testing of Baltimore Harbor Sediments," prepared for Chesapeake Bay Foundation, prepared by University of Maryland, dated November 30, 2015.

[3] "Phase I Offshore Investigation Report for the Sparrows Point Site", prepared for Sparrows Point Environmental Trust, prepared by EA Engineering, Science, and Technology Inc., PBC, dated March 2016.

people and the maximum quantities of different fish/crab species which may be consumed to limit human exposure to PCBs.[4] PCBs do not readily break down in the environment and are capable of bioaccumulating in the food chain (for example, from benthic macroinvertebrates (like worms, crustaceans, immature forms of aquatic insects), to fish and crabs, and ultimately to people.[5] PCB contamination of sediments at the Site represents a source of PCBs within the Fish Consumption Advisory Area identified by MDE as "Patapsco River-Baltimore Harbor", which includes Bear Creek and the site area.

2.6 CHEMICAL SOURCES AND TRANSPORT MECHANISMS

Potential sources of chemicals that have affected the Site include equipment, waste, and facilities associated with past steel-making activities at the SPF, including at the Greys Landfill, the Rod and Wire Mill, and the Tin Mill Canal (as discussed in Section 2.1).

The offshore investigation indicated that historical discharges (specifically, those associated with the Tin Mill Canal) appear to be the cause of most of the contamination observed in Site sediments (EA 2016b). Sediment characterization results indicate that water and/or sediments containing metals, PCBs, oil and grease, and possibly other constituents entered Bear Creek from Tin Mill Canal. As mentioned above, the direct discharge from the Tin Mill Canal ceased in about 1970, when the Humphrey's Creek Wastewater Treatment Plant was constructed. Since approximately 1972, the wastewater from Tin Mill Canal has been routed through the wastewater treatment plant before discharge into Bear Creek; this surface water discharge is subject to effluent limits in a NPDES permit. Current sources of environmental contamination from SPF to Bear Creek are minimal. Current groundwater discharge from SPF to Bear Creek, and stormwater/wastewater runoff from SPF to Bear Creek are not considered to be significant ongoing sources of contamination and are not addressed with this removal action and EE/CA.

Once constituents have entered the offshore environment, the partitioning of chemicals between sediments and surface water is determined by the properties of the chemical and the surrounding geochemistry. Chemicals such as PAHs and PCBs demonstrate variable dissolution. Metals vary in their solubility based on pH, concentration, and the presence of oxygen. Reducing conditions in brackish, permanently submerged sediments tend to produce forms of most cationic metals (for example, copper, lead, nickel, and zinc) that remain bound in sediment; however, these same reducing conditions may favor solubilization of anionic metals (for example, arsenic).

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[4] https://mde.maryland.gov/programs/marylander/fishandshellfish/pages/fishconsumptionadvisory.aspx

[5] Polychlorinated Biphenyls – TOXFAQs, prepared by Agency for Toxic Substances and Disease Registry (ATSDR), dated July 2014. https://www.atsdr.cdc.gov/toxfaqs/tfacts17.pdf

As described in Section 2.3.1, the Site appears to be a primarily depositional environment for sediment, with flow velocities less than 0.5 foot per second under non-storm conditions, and flows driven primarily by tidal currents. Therefore, the contaminated sediments historically deposited from the Tin Mill Canal may undergo gradual burial by less impacted sediments from upstream or downstream. Transport of sediments from the Site into other portions of Bear Creek and the Patapsco River may occur under flow conditions (potentially during storm conditions); however, sediment transport evaluations have not been completed for the Site. Based on sediment sampling activities completed to date, the removal action discussed in this EE/CA will address most if not all of the contaminated sediment associated with the Site. A Remedial Investigation/Feasibility Study is planned to follow the removal action to verify if contaminated sediments requiring remediation extend beyond the removal action area.

Bioaccumulation is also a relevant transport pathway. Plants and animals that come in contact with elevated concentrations of chemicals in sediment or water may uptake chemicals, and depending on the chemical and the organism, these chemicals may accumulate in tissue. Several metals (for example, arsenic and lead) and PCBs are known bioaccumulators. PAHs may bioaccumulate in crustaceans and other organisms. Threats to the food chain are also discussed in Section 2.5.

2.7 MEDIA OF CONCERN

The primary medium of concern for this Site is sediment; sediment pore water and surface water are related media of potential concern. Surface sediments are the primary concern because these are most likely to impact fish, wildlife, and other receptors (for example, through direct contact). The biologically active habitat layer in the surface sediment is assumed to be 6-inches (EA 2017b).

2.8 LAND AND WATERWAY USE

The Site is in a recreational area with a low frequency of use. Other areas that present a more attractive area for recreational use are nearby, but not directly adjacent to, the SPF. The shoreline of the Site is largely covered by slag, rock, and Phragmites, making it generally unattractive for recreational use. The SPF is being developed for a variety of commercial and industrial uses. Access to the land area adjacent to the Site is difficult, with parts of the SPF restricted to unauthorized uses. Access by boat is made more difficult by shallow water and a lack of boat ramps or docking facilities. Based on these factors, people will likely visit the shoreline of the Site infrequently and for short periods of time (EA 2016a).

During field sampling for the offshore investigation, fishing from the shore was observed to the north of the Site (where nearby road access and nearshore deep water are present). The offshore environments of the Site are not controlled, and access to these areas is not limited. The land across Bear Creek from the

Site includes residential properties (some with private boat piers), and several attractive shoreline parks. Activities along this shoreline include boating, swimming, and fishing (EA 2016a).

A channel frequently used by recreational boat traffic lies to the west of the removal area. During the offshore investigation, bottom trawling from vessels was observed in the channel at the Site. There is limited commercial shipping traffic near the Site. The closest federally authorized navigation channel is approximately 2 miles southwest of the Site.

2.9 CULTURAL RESOURCES

There are no known cultural resources in, or adjacent to, the Site; however as shown in **Figure 2-2**, "Ruins," pier structures, and cable crossings have been noted in the proposed work area. EPA and MDE have consulted with the Maryland State Historic and Preservation Office, which determined that the removal action project would not impact historic properties.

2.10 POTENTIALLY SENSITIVE ECOSYTEMS

The removal action area consists primarily of open water habitat within the estuarine portion of the Patapsco River and its tributaries. The area includes essential fish habitat (EFH) for summer flounder (*Paralicthys dentatus*) and bluefish (*Pomatomus saltatrix*), regulated under the Magnusen Stevens Fishery Conservation and Management Act.

The estuarine portion of the Patapsco River also provides potential habitat for two federally listed species: Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*). There is no designated critical habitat or known spawning habitat in the removal action area. Within the nearby mainstem of the Chesapeake Bay, several species of federally listed sea turtles are also transients during the warmer months. MDE Fish Consumption Advisories are in-place for crab and multiple fish species in the "Patapsco River-Baltimore Harbor," which is adjacent to Bear Creek.

The SPF, adjacent to the Site, is primarily industrial in nature and associated with a former steel making facility. Much of the shoreline along the SPF has been hardened and provides low quality habitat. No sensitive ecosystems and endangered species are known to occur in the areas where SPF is located.

2.11 UTLITIES AND DEBRIS

As shown in **Figure 2-2**, a cable crossing area is present in the southern portion of the Site. Coordination with Baltimore Gas and Electric (a local utility) was documented during the 2018 sampling effort, but it is not clear if the cable is active (EA 2018). The cable corridor runs southeast to northwest from a former substation on the SPF to the Maryland Transportation Authority office building on the opposite side of the channel. The cable corridor crosses the dredged recreational channel, which is dredged to approximately 14 feet below the mean lower low-level water (MLLW) elevation.

As described in Section 2.3.2, apparent anthropogenic and natural debris were identified during the side scan survey. The debris includes tires and other metallic objects including a large-diameter flexible conduit or fluid transfer line that is exposed above the water line. The natural debris consists primarily of submerged logs.

2.12 SUMMARY OF SITE CONTAMINATION

Based on investigations and toxicity testing at the Site, Site sediments have been contaminated with hazardous substances (including, PCBs and metals), and oil and grease, which were released from the SPF (primarily through Tin Mill Canal discharges). Ecological receptors, and especially benthic macroinvertebrates, are threatened or directly adversely impacted by Site-related sediment contamination. The results of this investigation provide a basis to evaluate the objectives and potential approaches to address SPF-related impacts to the Bear Creek sediments. Specific chemical constituents that will drive the RAOs are discussed in Section 3.0.

In addition to CERCLA hazardous substances, sediment at the Site is also contaminated with "oil and grease;" this petroleum material is excluded from the definition of hazardous substance in CERCLA § 9601(14). Oil and grease concentrations up to 14% have been identified in Bear Creek sediments near the Tin Mill Canal outfall. Sediment samples collected near the Tin Mill Canal outfall, document that oil and grease impacts are co-located with hazardous substance concentrations (metals and PCBs), which exceed BTAG screening benchmarks and PECs. Review of EPA Guidance 9838.1, titled "*Scope of the CERCLA Petroleum Exclusion Under Sections 101(14) and 104(a)(2)*," dated July 31, 1987, states, "…if the petroleum product and an added hazardous substance are so comingled that, as a practical matter, they cannot be separated, then the entire oil spill is subject to CERCLA response authority." The removal action addressed by this EE/CA will address the threat posed to ecological receptors by exposure to hazardous substances (including metals and PCBs) and comingled oil and grease that cannot be separated in a practical manner from site-related hazardous substances.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

RAOs form the basis for developing removal action alternatives and selecting a preferred alternative. RAOs consider statutory limits, the ability to attain ARARs to the extent practicable, and the ability to meet cleanup levels. In developing RAOs, EPA considered statutory limits, risk assessment findings, available information regarding background contamination in Bear Creek and the vicinity, and other applicable information.

Tetra Tech, EPA Region 3's START contractor, is supporting EPA in developing the removal action scope (area and volume of removal based on the extent of contamination). EPA established the RAOs, and Tetra Tech has worked with EPA to establish cleanup levels consistent with the RAOs. Tetra Tech has helped delineate targeted sediment volumes for the removal action alternatives and prepared drawings of the targeted areas and sediment volumes for the removal action alternatives.

3.1 STATUTORY LIMITS ON REMOVAL ACTION

Section 104(c)(1) of CERCLA generally stipulates that Fund-financed removal actions should not exceed a cost of $2,000,000 and should be completed within 12 months. These limitations on the time and cost of removal actions may be waived in certain circumstances, including when EPA determines that: (1) continued response actions are immediately required to prevent, limit, or mitigate an emergency, and (2) a continued response action is otherwise appropriate and consistent with any remedial action to be taken ("the consistency waiver"). For this Site, based on initial cost-scoping of the removal alternatives discussed in this EE/CA, EPA determined that that the cost of the NTCRA will likely exceed $6,000,000. Consequently, consultation with EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) was necessary before signing this EE/CA's Approval Memorandum (per relevant EPA guidance, *Use of Non-Time-Critical Removal Authority in Superfund Response Actions* [February 14, 2000]). Consistent with this guidance, the EPA Region 3 team consulted with, and received the approval and concurrence of the Director of OSRTI, to perform a NTCRA exceeding Section 104(c)(1)(A)'s statutory limit of $2,000,000. In addition, EPA believes that construction of the NTCRA may exceed the 12-month limit under Section 104(c)(1) and that a consistency waiver may be appropriate to allow more time to abate a foreseeable threat and to prevent further migration of contaminants at the Site.

3.1.1 Removal Action Objectives

RAOs were developed considering the known nature and extent of contamination at the Site, the conclusions of the human health and ecological risk assessments/toxicity testing/and food chain threats, potential logistical limitations to and constructability issues with remediation given the location of the Site, statutory limits, the ability to attain ARARs to the extent practicable, the ability to meet cleanup levels, and the anticipated scope of the NTCRA for the Site. RAOs were developed with input from project stakeholders (including MDE and EPA Region 3) and include:

- Rapidly and substantially reduce threats to human health and the environment by decreasing the potential for exposure to surface sediment contaminants that are believed to be associated with the outfall from Tin Mill Canal.
- Minimize the potential for highly contaminated sediments near the outfall from the Tin Mill Canal to be transported into other portions of Bear Creek or the Patapsco River.

Based on the results of the Phase I Offshore Assessment (EA 2016b) and supplemental investigations, PCBs and oil and grease have been identified as key (primary) indicators of the extent of Site contamination attributed to Tin Mill Canal. Secondary contaminants also originating from the outfall of Tin Mill Canal and contributing to sediment-related risk at the Site include cadmium, chromium, copper, nickel, silver, zinc, and bis(2-ethylhexyl) phthalate. Generally, "secondary contaminants" are co-located with "key (primary) indicators" (PCBs and oil and grease). By performing a removal action to address the "key (primary) indicators," the removal action will also address "secondary contaminants."

Media Specific Concentrations (MSCs) are the initial or proposed cleanup goals for contaminants of concern and have been developed to support this EE/CA's analysis of removal alternatives. MSCs were developed for the key (primary) indicator compounds (PCBs and oil and grease) based upon a review of acceptable federal and state standards and MSCs and clean up goals applied for similar sites. MSCs in surface sediment that address RAOs are presented in **Table 3-1** for key indicator (primary) contaminants and **Table 3-2** for secondary contaminants. As needed, MSCs may be modified or refined based on the collection of additional site-specific information and/or during actual planning of the response action. While MSCs are used to support this EE/CA, an EPA Action Memorandum will specify the Removal Action Levels for the Site.

The MSCs include a concentration goal for each contaminant (above which specific sediments will be targeted for the removal action), and a surface area-weighted average concentration (SWAC) goal to be achieved across the Site following the removal action. SWACs are valuable to assess reduced threats to human health and the environment because they provide an estimate of the average concentrations that an organism is exposed to across a Site. Site MSCs were developed to focus the removal action on the most heavily contaminated media and address the area of major impacts associated with the Tin Mill Canal.

Based on the MSCs for key (primary) indicator contaminants (PCBs and oil and grease) and available site information, an estimated 61-acre area of sediment in Bear Creek adjacent to Tin Mill Canal is targeted for the removal action (see **Figures 3-1**). For key indicator (primary) and secondary contaminants, pre- and post-removal SWACs were calculated to estimate the decrease in average concentrations following the removal action in the targeted area. The removal action will decrease the average concentrations for both the key (primary) indicator and secondary contaminants.

The proposed MSCs for this EE/CA represent achievable reductions in the potential for exposure to PCBs and oil and grease as shown in **Table 3-1**. A removal action will reduce the estimated maximum concentration of PCBs in the surface sediment from 13 mg/kg to 5 mg/kg and the SWAC from 1.6 mg/kg to 1.0 mg/kg. Oil and grease concentrations in the surface sediment would be reduced from an estimated maximum of 110,000 mg/kg to 3,500 mg/kg and the SWAC from 27,743 mg/kg to 700 kg/kg. The post-removal concentrations of the key (primary) indicator contaminants should decrease the potential exposure of people and animals to Site-related contamination and decrease the contaminant mass available for potential mobilization and transport during erosional events, such as storms. They also address the RAOs for the removal action (see Section 3.1.1). Use of the proposed MSCs, resulting in a decrease in the SWAC for PCBs to approximately 1 mg/kg, also will help address the elevated PCB concentrations in sediment in the Baltimore Harbor/Patapsco River-area that drive the current fish consumption advisories in the area. Use of a PRG of 3,500 mg/kg for oil and grease, resulting in a post removal action SWAC of approximately 700 mg/kg, should greatly reduce exposure to the separate-phase product that is harmful to aquatic animals, including benthic macroinvertebrates.

The proposed MSCs for the secondary contaminants (see **Table 3-2**) present a reduction in the maximum surface sediment concentrations for these secondary contaminants. The average percent reduction in the maximum surface sediment concentration is approximately 69 percent. The SWAC for the secondary contaminants is also expected to be significantly lower following the removal action.

3.1.2 Applicable or Relevant and Appropriate Requirements

In addition to determining RAOs, EPA must also identify any ARARs under federal environmental law or more stringent ARARs promulgated under state environmental or facility-siting laws that must be attained while implementing the remedy to achieve RAOs.

The NCP distinguishes *applicable* requirements from *relevant and appropriate* ones as follows:

> *Applicable requirements* . . . [are] those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

> *Relevant and appropriate requirements* . . . [are] those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility-siting laws that, while not "applicable" to

a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

Pursuant to Section 300.415(j) of the NCP, a Superfund-financed removal action selected under CERCLA §104 must, to the extent practicable, considering the exigencies of the situation, attain ARARs. In determining whether compliance with ARARs is practicable during a removal action, EPA will consider appropriate factors, including (1) the urgency of the situation and (2) the scope of the removal action to be conducted. Other non-promulgated federal and state advisories, criteria, or guidance may, as appropriate, also be considered by EPA in formulating the removal action. Such advisories, criteria, or guidance are often referred to as "To Be Considered" (TBC) material. Once selected by EPA as a protective requirement, a TBC must be met during a response action. EPA policy provides that the development and evaluation of an NTCRA in an EE/CA must include removal alternatives that meet ARARs or TBCs and ensure the protection of public health and the environment.

As defined by the NCP, ARARs (and TBCs) are divided into three categories: (1) chemical-specific (federal or state promulgated requirements that specifically address a hazardous substance, pollutant or contaminant found at a site); (2) location-specific (federal or state promulgated requirements that specifically address location or other circumstance found at a site); and (3) action-specific (federal or state promulgated requirements that specifically address the remedial or removal action at a site). EPA requested potential ARARs from MDE on January 30, 2023 and received MDE's input on February 13, 2023. This correspondence is included in the Administrative Record file. ARARs or TBCs for this NTCRA are identified in .

4.0 IDENTIFICATION AND DEVELOPMENT OF REMOVAL ACTION ALTERNATIVES

This section presents the initial screening and development of the removal action alternatives for the Site.

4.1 INITIAL SCREENING

The initial screening of removal actions for the Site was based on site-specific conditions, contaminants, and RAOs identified for the Site. In accordance with the NTCRA guidance, the screening process focused on those technologies that have been proven effective at similar sites and could be accomplished in accordance with the statutory limits.

Table 4-1 presents the screening of technology types and process options. **Table 4-2** includes a screening of supporting technologies for removal and containment activities. Each technology was screened based on overall effectiveness, implementability, and relative cost. The effectiveness of a technology refers to its ability to meet the RAOs within the scope of the removal action. Implementability addresses the technical and administrative feasibility of implementing an alternative considering the ability to access materials and services necessary to execute the removal action.

4.2 DEVELOPMENT OF ALTERNATIVES

Removal alternatives have been developed consistent with accepted standards of practice and in accordance with sediment remediation guidance (ITRC 2014; EPA 1987). The analysis presented in **Tables 4-1 and 4-2** indicates that capping or limited removal and capping technologies will generally be most effective at meeting the Site RAOs in a reasonable time-period. These technologies were combined with the retained process and supporting technologies (as described in **Table 4-3**) into four alternatives for the site, as follows:

- Alternative 1 – No Action
- Alternative 2 – Sediment Containment (Capping)
- Alternative 3 – Capping with Sediment Removal and Offsite Disposal
- Alternative 4 – Capping with Partial Sediment Removal and Offsite Disposal (Dredging from 0 to 6 Feet Below MLLW)

The following subsections describe the approach assumed for each removal alternative, in accordance with EPA's guidance for conducting EE/CAs for NTRCAs (EPA 1987) to include identification and screening of technologies that have been demonstrated effective for similar contaminants and site conditions (**Tables 4-1 and 4-2)**. Retained technologies and process options are assembled into the four removal alternatives. **Figures 4-2 to 4-4** show the removal alternatives, with major remedy components; they provide a general perspective of key logistical considerations for each alternative (for example, relative size and separation distance for the remedy area compared to staging areas, transportation routes, and potential disposal on Sparrows Point). Other considerations include Site and area features that pose challenges, such as the utility crossing and existing relict structures ("Ruins", the water treatment plant system, and other existing active structures). Finally, removal alternative evaluation includes considering surrounding areas that will influence aspects of the remedy such as transportation of contaminated materials to the disposal location or import of clean materials to the site; these include the active docks to the south and west of the Site associated with the navigation channels and shoreline piers. Appropriate planning and coordination for remedy implementation may include working with adjacent facilities and businesses. The three sediment remedies would use approximately the same staging area shown in **Figure 4-1**.

Alternatives 2 through 4 include common remedy implementation components. Rather than repeating these common components for each removal alternative description, they are explained in the **Table 4-4**. This table provides the rationale to identify these components as common across removal alternatives. The remedy components, approaches to address various logistical factors for construction, and assumptions related to numerous challenges presented by Site conditions and/or Site location are included in the removal alternative cost estimates provided in **Tables 4-5 to 4-7**. The evaluation of alternative options uses average sand cap and dredge depths for the analysis as well as a sand cap with no amendments. During the design phase small areas may be identified for an amended cap or a deeper dredge depth to address localized site conditions.

The existing electrical cable utility represents a project risk that must be managed. Therefore, Alternatives 2 through 4 include offsets from the utility alignment for removal or subaqueous capping in the area of the utility. During the design phase of the removal action, additional investigations should be completed to map the location of the utility and establish accurate offsets. The owner of the utility should be consulted during the design to verify the cable is inactive, and determine whether the cable needs to be protected, or if the cable can be removed as part of the removal action.

4.2.1 Alternative 1: No Action

Alternative 1 is "no action." This alternative assumes no further action at the Site. The No Action alternative is retained as a baseline for comparison to other alternatives, consistent with CERCLA guidance and the NCP.

4.2.2 Alternative 2: Sediment Containment (Capping)

Alternative 2 provides for a subaqueous sand cap to be placed on existing sediment surface to contain sediment solids impacted by PCBs, oil and grease, and metals and to isolate contaminated sediment from human and ecological receptors. **Figure 4-2** is a plan view illustrating the main features of Alternative 2. The subaqueous cap will be composed of commercially available granular materials such as sand (conventional capping). Larger stone will be placed closer to the mouth of Tin Mill Canal and other near shore areas to minimize cap erosion.

EA evaluated the effectiveness of a capping remedy using data collected during the supplemental offshore investigation in combination with historical data collected at the site to evaluate this alternative with respect to the following design elements: stabilization/erosion protection, chemical isolation, habitat, and settlement. The evaluation concluded that a 2-foot sand cap without amendments would be adequate to satisfy the design elements (EA 2017b).

Other sources of cap material could be used; the actual source of material is not currently known and therefore, cannot be evaluated as part of this EE/CA. Assuming offsite material is available, it would need to meet minimum chemical concentration limits and geotechnical requirements. Offsite material is best evaluated during the design phase of the removal action, when additional information on other sources may be available.

Placement of the subaqueous cap will change bathymetric elevations and associated water depths over the entire footprint of the capping remedy, though some long-term consolidation of the existing soft sediments is expected that will reduce, but not eliminate, this impact over time. Placement of the subaqueous cap could reduce the open water habitat by approximately 6 acres, with the shallower near shore area transformed into a more permanent mudflat area.

Alternative 2 integrates the following technologies retained from **Table 4-3**:

- Containment – placement of a subaqueous cap on existing sediment surface using a commercially available sand to isolate contaminants from the surrounding environment.
- Transportation – transport of sand and other construction materials to the Site (expected to be primarily barge transportation for the source sand and truck transport for other equipment, supplies, and materials).
- Placement – implementation of technologies to address the soft, low strength condition of sediment (for example, techniques for minimal disturbance of the sediment substrate during construction and placement of sand in uniform thin layers initially on the order of 1 to 2 inches thick for uniform loading [uniform application of weight]); these techniques support uniform consolidation and lower risk of cap bearing instability or mud-waving (creating movement, or waves of mud) within the underlying sediment.

Consistent with EPA guidance for containment remedies and standard practice for subaqueous capping, long-term monitoring and maintenance of the cap will be included (EPA 1998). Additional features of Alternative 2 necessary to achieve RAOs and provide long-term performance and protectiveness of the cap are described below.

Alternative 2 places an estimated 2-foot sand thickness over the 61.6-acre Site. Generalized areas of erosion protection have been assumed within the estimated cost for the Tin Mill Canal discharge area and areas of eroding shorelines, pending additional data collection and evaluations. This alternative is estimated to require about 7 months to construct. The text below describes major phases and actions required to implement Alternative 2 to achieve RAOs.

Pre-construction and Baseline Phase

This phase would include pre-investigation/ design activities and pre-construction activities, which may include activities to address the existence of any utilities, to facilitate placement of the cap.

Remedy Construction Phase

Remedy construction for Alternative 2 is primarily associated with placement of the subaqueous cap to provide containment of underlying sediment to meet RAOs.

Post-remedy Phase

EPA CERCLA guidance typically includes a 30-year period of monitoring for cost estimating with provisions that allow for changes to monitoring activities and/or frequency based on the cumulative results of monitoring and maintenance. EPA will determine post-remedy responsibilities during design phase.

Alternative 2 Cost Estimate

Table 4-5 provides a breakdown of the estimated design and implementation cost of Alternative 2 ($30,670,500).

Estimated costs include direct capital costs for construction; indirect capital costs for pre-design investigations, treatability studies, and design; and post-remedy costs for long-term maintenance and monitoring adjusted to net present value. The cost estimate was developed in accordance with EPA guidance (EPA 1987, 1993, and 2000) and total project costs are estimated within a range of +50%/-30%. Estimated costs are based on experience from similar construction activities, discussions with local contractors, and technical support from manufacturers and vendors.

Important assumptions that influence costs include:

- 12.7% sand over-placement and miscellaneous sand losses
- Barge delivery of locally purchased sand
- Installation of 25% of the cap using very thin layer placement techniques
- Limited debris removal activities

4.2.3 Alternative 3: Capping with Sediment Removal and Offsite Disposal

Alternative 3 places a subaqueous sand cap after removal of approximately the same thickness of sediment so that post-capping bathymetry is similar to pre-removal action conditions. During implementation of Alternative 3, sediment would be removed first, and a sediment cap would then be placed. During implementation of Alternative 3, no significant loss of water depth will occur; this optimizes habitat and further reduces erosive forces on the cap. Sediments likely would be dredged hydraulically. Hydraulic dredging is the preferred technology for Alternative 3 because this type of dredging minimizes the amount of contaminated sediment which is not successfully removed from the environment.

EPA estimates that approximately 190,000 cubic yards (cy) of sediment will be removed by hydraulic dredging. The dredged sediment slurry will be pumped into geotextile tubes for dewatering. The dewatered dredged materials will be permanently disposed offsite, at an approved RCRA Subtitle D, non-hazardous solid waste landfill if waste characterization samples collected do not have concentrations exceeding hazardous levels for site contaminants. Additional waste characterization sampling may be completed as part of the design phase to confirm the sediment disposition and any additional treatment requirements. The removal contractor will collect waste characterization samples to complete the waste disposal profile prior to disposal. Samples that exceed the waste acceptance criteria at the RCRA Subtitle D landfill may need to be treated prior to disposal and potentially sent to a RCRA Subtitle C landfill. Treating the sediment after dredging and disposing of material at a RCRA Subtitle C facility would increase the disposal cost. The nearest commercial landfill that will accept dredged material is the King George Landfill in King George, Virginia. Dewatered sediment will be transported by truck to the landfill. **Figure 4-3** shows the main features of Alternative 3. This alternative is equivalent to Alternative 2 with respect to containment of underlying sediment solids and impacted porewater, but removal of existing sediment before cap placement provides the following advantages:

- Avoids shoreline changes to the existing sediment surface, which raises bathymetry and alters shorelines and water depths for future habitat conditions (that is, nearshore shallow zones are maintained to reestablish benthic ecology and aquatic plants);
- Increases cap stability and long-term cap integrity by embedding cap rather than raising cap above existing surface; and
- Removes contaminated materials from the Site. While the contamination may not be completely removed, any remaining will be contained by the subaqueous cap.

Alternative 3 integrates the following technologies retained from **Table 4-3**:

1. Technologies from Alternative 2 that are described above:
    - Containment
    - Transportation
    - Placement
2. Technologies for Alternative 3 for dredging and dredged material management:
    - Removal – hydraulic dredging, with some localized, diver-assisted or mechanical dredging in difficult to access areas
    - Transportation – using a hydraulic pipeline to convey dredged material slurry to geotextile tubes

- Sediment Management – dewatering within geotextile tubes, with enhanced settling from polymers; following dewatering, conditioning sediment as needed for suitability of geotechnical characteristics of the dewatered dredged material
- Water Treatment – with hydraulic dredging, a significant volume of water is generated, requiring a temporary treatment plant integrating multiple unit processes to remove oil/grease/sheen, solids, and dissolved PCBs and metals from water so that ARARs for effluent discharge to Bear Creek are achieved
- Disposal – disposing sediment at an approved RCRA Subtitle D non-hazardous solid waste landfill. The nearest commercial landfill that will accept dredged material identified is the King George Landfill in King George, Virginia

The following text describes the implementation of the three phases of Alternative 3 with the objective of achieving RAOs (only additions or modifications to Alternative 2 are discussed).

Pre-construction and Baseline Phase

These activities include the following additions/modifications compared to Alternative 2. The identification of approximately 10.5 acres of available land is required to support geotextile tube dewatering, processing, and loadout before offsite disposal. Access to land on Sparrows Point is necessary to establish required staging areas. Greater regulatory agency coordination is also necessary given the onsite management of dredged materials.

Remedy Construction Phase

These activities include the following additions/modifications compared to Alternative 2:

- The subaqueous cap implementation is assumed to be the same as for Alternative 2; however, by embedding the cap, other construction techniques, such as hydraulic placement of sand slurry from a pipeline and diffuser, are potentially feasible, and higher productivity methods that may reduce construction costs.

- An 8-inch hydraulic dredge, either cutter-suction, plain suction, or similar self-propelled dredge, operating at a production rate of 1,500 to 3,000 gallons per minute would provide most of the dredging for removal within the 61.6-acre cap footprint. The area below and east of the Tin Mill Canal bridge may be mechanically dredged.

- Hydraulic dredging of the approximately 196,000 cubic yards (cy) of in-place sediment volume creates a dredged material slurry of much greater volume (that is, the slurry may range from 8 to 15 percent solids by mass, compared to the in-situ condition, which is closer to 25 percent solids by mass); this could result in millions of gallons of slurry. The pipeline to the geotextile tubes dewatering area will likely be approximately 1 mile. If additional pipeline length is needed beyond the 1 mile assumed, added costs for booster pumps and for the pipeline are expected. The pipeline can traverse over land along existing streets or within Bear Creek. An overland pipeline will require landowner approvals and access. A Bear Creek pipeline would create the least impact to Bear Creek users and include additional protections in the event of leaks. In addition, pipeline route approvals may include access consent and other approvals so that segments of submerged pipeline are anchored close to the bottom and cross only in an area with ample water depth for clearance for vessels.

- Additional management of debris is required for the staging and handling area assumed to be near the Site. This affects both the size of the area for managing debris and the activities for debris removal. Unlike Alternative 2, additional debris would be exposed during dredging. Additional equipment with attachments such as a grapple will be required to remove this debris, place it on a separate small barge, and offload it at the adjacent staging and debris management area.

- Hydraulically dredged sediment would be transported to a designated dewatering area of approximately 8.5 acres. The dewatering area would be lined with a geomembrane and graded to provide a 1-acre, or larger, filtrate water pond for storage prior to water treatment. Slurry is placed in multiple tubes through a header and distribution piping system with control valves to fill tubes incrementally. Prior to the discharge of the slurry into geotextile tubes, a polymer feed system applies a designed suite of polymers at optimized dosages to promote more rapid dewatering by flocculating particles and coagulating the solids such that most solids settle out of the suspension. As the height of the settled solids increases, the self-weight of the solids increases the drainage of water. Due to the significant volume of slurry, approximately 29,000 linear feet of 80-feet circumference geotextile tubes would be required. The dewatering area eventually would include three layers of geotextile tubes, providing an estimated 16 feet of fill height for dewatering.

- Once geotextile tubes have dewatered and dried sufficiently to meet the landfill waste acceptance criteria, the material will be excavated, loaded on to trucks, and sent to an approved RCRA Subtitle D landfill. The wheels of the trucks will be decontaminated before each truck leaves the site, and the truck beds will be tarped to prevent dispersion of material during transit.

Post Remedy Phase

Post remedy activities are the same as Alternative 2.

Alternative 3 Cost Estimate

Table 4-6 provides the estimated cost breakdown for design and implementation of Alternative 3 ($68,663,900).

Important assumptions that influence costs for this alternative include:

- 61.6 acres of cap, with a 2-foot-thickness
- 12.7% sand over-placement and miscellaneous sand losses
- Barge delivery of locally purchased sand
- Installation of 25% of the cap using very thin layer placement techniques
- Moderate debris removal activities
- 29,000 linear feet of 80-feet circumference geotextile tubes for dewatering
- Post-dewatering sediment processing and stabilization using 2.5% Portland cement

- Transportation and disposal of stabilized material to a RCRA Subtitle D landfill; pricing based on disposal in King George, Virginia

4.2.4 Alternative 4: Capping with Partial Sediment Removal and Offsite Disposal

Alternative 4 is similar to Alternative 3, except dredging is not planned in deep water areas farther from the shore. Alternative 4 is similar to Alternative 3 in nearshore areas and is similar to Alternative 2 in water depths greater than 6 feet. Alternative 4 includes the dredging of 2-feet of sediment between 0 and 6 feet MLLW elevation.

Dredging of the near-shore sediments will help to preserve the shoreline area bathymetry and conserve shallow water depths for habitat considerations. Only capping the deep-water areas of the creek will significantly reduce the costs associated with implementation of the removal action. The estimated volume of dredged material is approximately 86,000 cy for Alternative 4 versus 190,000 cy for Alternative 3. **Figure 4-4** shows the main features of Alternative 4.

Alternative 4 Cost Estimate

Table 4-7 provides the estimated cost breakdown for design and implementation of Alternative 4 ($46,404,093.13).

Important assumptions that influence costs for Alternative 4 include:

- 61.6 acres of cap, with a 2-foot-thickness, 26.6 of these acres cover shoreline areas that will be dredged before placement of the cap
- 12.7% sand over-placement and miscellaneous sand losses
- Barge delivery of locally purchased sand
- Installation of 25% of the cap using very thin layer placement techniques
- Moderate debris removal activities
- 5,500 linear feet of 80-feet circumference geotextile tubes for dewatering
- Post-dewatering sediment processing and stabilization using 2.5% Portland cement
- Transportation and disposal of stabilized material to a RCRA Subtitle D landfill; pricing based on disposal in King George, Virginia

4.2.5 Commentary on an All-Dredging Removal Alternative

A separate conceptual removal alternative involving dredging and disposal without capping, that focuses on mass removal of the PCB and metals impacts (versus containment), was considered. This alternative was eliminated from further evaluation for several reasons, including:

- The technical and administrative feasibility is considered much lower than for other alternatives and would require additional site investigation and technical evaluations to confirm. This is because of the significant volume of material generated by dredging over 61.6 acres at removal depths up to 5 feet (the conservative depth assumed for this evaluation).
- This alternative also requires impacts to existing structures and slope stability of shoreline areas during dredging would be major design challenges given the scope of an all-dredge alternative at the Site.
- The all-dredging approach increases the estimated dredging volume to at least 500,000 cy. For this analysis, a sand cover to contain contaminated sediment residuals from dredging is assumed for most of the 61.6 acres, as is a nearshore backfilled wedge to re-establish stable shoreline areas. The estimated costs of this conceptual and preliminary alternative are expected to be $80 million or more.

Based on costs, logistical considerations, and the overall impact to protectiveness, the all-dredging removal alternative was not further considered.

5.0 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Following initial screening, four removal alternatives were further analyzed. Alternatives were evaluated for effectiveness, implementability, and cost. This includes consideration of RAOs and EPA guidance for conducting EE/CAs for NTCRAs and (EPA 1987 and 1993), which stipulates the following detailed objectives/criteria:

- **Effectiveness** – Effectiveness was evaluated in terms of the protectiveness of the removal action and the ability to achieve removal objectives. Protectiveness considers the protection of public health and community, workers during implementation, and the environment. The removal action also shall, to the extent practicable considering the exigencies of the situation, comply with ARARs. ARAR waivers, that is, as described in the NCP, may also be used, as necessary, for removal actions. The ability of the removal action to achieve removal objectives was evaluated with respect to the level of treatment/containment expected, residual effects and/or to maintain control until a longer-term solution can be implemented. The effectiveness evaluation does not include long-term climate change possibilities since the removal actions would be followed by a longer-term solution. Although significant climate change analysis has not been included in the effectiveness evaluation, climate change impacts and adaptation tactics for the selected removal action alternative will be included during the design phase.
- **Implementability** – The technical feasibility of each alternative was evaluated to assess construction and operational considerations as well as the demonstrated performance/useful life of each alternative. Implementability for each alternative was evaluated with respect to the unique conditions at the Site. The ability of the removal action to contribute to overall removal performance at the Site and the ability to complete the removal action within a one-year time period were also evaluated for each alternative. The implementability of each removal action was assessed considering the availability of equipment, personnel, and services. Offsite treatment and disposal capacity and post-removal site control were also considered.
- Each alternative was evaluated with respect to administrative feasibility, considering ARARs, easements or rights of way required, and the potential impacts to adjoining properties. The ability to impose institutional controls was considered. Given the extent of impacts and size of the Site it

is likely that all active removal actions will require an exemption from the statuary limit of 1 year to complete removal, and the likelihood of this exemption was considered in consultation with EPA.

- **Cost** – For each alternative, Tetra Tech developed feasibility study-level cost estimates, including an evaluation of capital costs, post-removal site costs, and present worth costs.

The four alternatives were evaluated against the NTCRA criteria as presented in **Tables 5-1 to 5-4**. Feasibility study-level costs were estimated for each alternative, including capital costs and post-removal site control costs, based on published values, vendor estimates, and/or unit costs from similar projects. Conceptual illustrations of the staging area and each alternative are presented in **Figures 4-1 through 4-4**. All figures are conceptual and are not intended to be used for design purposes.

5.1 ALTERNATIVE 1 – NO ACTION

5.1.1 Effectiveness

The no action alternative will not reduce to human health and the environment threats rapidly and substantially; therefore, it will not achieve RAOs or reduce risks at the site. The concentration of oil and grease is too high to expect natural recovery as natural deposition of cleaner materials will sink through the oil and grease layer.

This alternative also will not decrease the potential for exposure to surface sediment contaminants believed to be associated with the outfall from Tin Mill Canal. Alternative 1 would not minimize the potential for highly contaminated sediments near the outfall from the Tin Mill Canal to be transported into other portions of Bear Creek or the Patapsco River.

Alternative 1 would not be effective in reducing risks present at the Site. The “no action” alternative provides no reduction of toxicity, mobility, or volume. This alternative does not involve construction or any other form of active work at the Site; therefore, the evaluation of short-term effectiveness is not applicable for this alternative.

5.1.2 Implementability

The “no action” alternative is feasible from a technical and administrative perspective because there are no restrictions on the ability to implement a no action alternative.

5.1.3 Cost

There are no costs required to implement Alternative 1, since no action is required.

5.2 ALTERNATIVE 2 – SEDIMENT CONTAINMENT (SUBAQUEOUS CAPPING)

5.2.1 Effectiveness

Alternative 2 would be protective of human health and the environment. A cap reduces contaminant flux to the water column and reduces concentrations in pore water and solids at the sediment surface in the benthic habitat zone. Capping is an established technology, and the action would be designed to achieve RAOs and PRGs at the site. Both the hydrodynamic and hydrogeological environment at the Site are amenable to capping (quiescent hydrodynamic environment, relatively low groundwater upwelling, absence of mobile non-aqueous phase liquids). Site contaminants are strongly sorbed to sediment solids, and the sand cap will provide reducing conditions resulting in positive conditions for contaminant retention and containment. The cap will be designed to prevent bioturbating benthic organisms from reaching the chemical isolation layer.

Cap placement would physically and chemically isolate contaminated sediments and provide long-term control of the human health and ecological risks associated with contaminated sediments. Long-term monitoring and regular maintenance would be required, including repairs of damaged areas following infrequent storm events; permanence is increased by armoring areas susceptible to erosion along shorelines, around structures, and at stream discharge areas. Contaminated sediments would remain on site; however, cap placement would control risks and prevent exposure. This alternative does not offer a reduction in volume of sediments remaining below the cap; however, cap placement would reduce the mobility and toxicity of contaminated sediments.

Potential risks to the community during construction would be limited because most of the work would be performed on the water, with a limited staging area on the up-land industrial site. Minor, but increased levels of traffic, noise, and potential turbidity in the water column may occur as the cap is placed; these would be temporary impacts during construction. Engineering controls and best management practices would mitigate most potential impacts.

Potential risks to the environment during construction include effects on the ecological habitat; these risks are expected to be minimal and short in duration and the implementation approach would minimize these to the degree feasible.

With regard to hazards associated with general construction, material would be placed from the water surface over existing sediments, so there would be limited or no contact or exposure to contaminated sediment. Residual impacts within the sediment surface are anticipated to be low following construction. Long-term monitoring would be required to manage the integrity of the cap.

5.2.2 Implementability

Capping is a proven, technically feasible alternative. Specialized construction considerations may be required for the low-strength sediments present at the site. Cap placement over the power cable utility may not be allowed by its owner and will need to be addressed during the design phase.

The cap will be designed to conform with best engineering practices for sub-aqueous sediment caps. The cap will be designed with independent layers to physically isolate contaminated sediment from, at a minimum, a 100-year storm event. The cap will be designed to chemically isolate contaminated sediments, such that concentrations in the bio-active zone of the cap do not exceed the MSCs presented in **Tables 3-1 and 3-2** for a minimum of 100-years. A long-term monitoring program will be required to verify that the cap is meeting long-term performance objectives.

Both the hydrodynamic and hydrogeological environment at the Site are amenable to capping (quiescent hydrodynamic environment, relatively low groundwater upwelling). The cap will be designed to prevent bioturbating benthic organisms from reaching the chemical isolation layer. Geotechnical conditions at the Site, the low solids content of the sediment and in water structure, and utilities will result in numerous difficulties and challenges related to removing a large volume of material. Site sediments are generally cleaner at the surface and the addition of a cap on top of the existing site sediments will further protect surficial sediments and prevent exposure of deeper more highly contaminated sediments that would be exposed during a large scale-removal operation. The cap area is outside the navigational channel, which reduces the impact due to potential water depth reductions.

This alternative can be implemented within approximately 1 year. Additional design investigation will be required before construction. Detailed survey information (in-water and shoreline) will be required during design to produce a high-resolution, existing conditions base map to be used in preparing drawings for the removal action. Detailed information on debris in water structures, utilities, and cultural resources may be required during design to refine assumptions on removal and capping. If mobility indicators suggest evidence of oil and grease mobility or visual evidence of ebullition is observed, advanced testing may be recommended during the Pre-Design Investigation (PDI) including tests such as: wettability, capillary pressure versus saturation testing, seepage induced consolidation testing, and ebullition experiments. Discharge rates from Tin Mill Canal will also need to be measured to establish potential impacts to the cap. To verify assumptions related to the need for an erosion control layer (acoustic doppler current profiling, turbidity studies), limited hydrodynamic modeling may be appropriate following decisions on the extent, thickness, and material for the cap.

In-water debris and remnant structures pose challenges for implementation, though capping technologies can achieve placement around and below structures. Soft, compressible sediment may consolidate significantly below a cap placed on the existing substrate; therefore, the utility crossing the site will require further study to develop an approach to avoid impacts. Implementation will require coordination with adjacent landowners. Permanent institutional controls will be required to sustain the long-term effectiveness and permanence of the cap.

5.2.3 Cost

The estimated capital cost to implement Alternative 2 is $30,670,500. Alternative 2 is the least expensive of the active remedies with only the No Action alternative being less expensive. Long-term performance monitoring is expected to cost $200,000 over the 30-year monitoring period.

5.3 ALTERNATIVE 3 – CAPPING WITH SEDIMENT REMOVAL AND OFFSITE DISPOSOAL

5.3.1 Effectiveness

Alternative 3 would be protective of human health and the environment. Under this alternative, a sub-aqueous sediment cap will be designed to meet ARARs and site RAOs. Cap placement would be enhanced by dredging surface sediments over the entire cap placement area. Dredging is an established technology. The removal action would be designed to achieve RAOs and PRGs at the site. This alternative reduces the volume of contaminated sediments remaining below the cap; however, cap placement would be required to control and further reduce the mobility and toxicity of remaining contaminated sediments.

Potential risks to the community during construction derive from increased levels of traffic, noise, odors, vapors, potential turbidity, and resuspension of contaminants in the water as sediment is removed and managed before offsite disposal. Engineering controls and best management practices would mitigate potential risks such that the alternative can be safely implemented. Potential risks to the environment during construction include effects on the ecological habitat during construction and resuspension of soft sediments during removal. These risks are expected to be minimal and short in duration; engineering controls and best management practices would mitigate most potential risks.

Hazards associated with Alternative 3 include general construction, potential exposure, and direct contact with sediment, odors, and vapors. Mitigation would be available through engineering controls and best management practices, compliance with health and safety plans and procedures, and use of personal protective equipment. In contrast to Alternative 2, dredging will remove a portion of the contaminated sediment from the Site. Some of this benefit may be offset due to resuspension of contaminated sediment during construction. Cap placement following sediment removal would physically and chemically isolate remaining contaminated sediments and provide long-term control of the human health and ecological risks associated with contaminated sediments.

5.3.2 Implementability

Dredging, sediment dewatering/stabilization, and offsite disposal will be added as construction activities, in addition to cap placement. Removing low density surface sediment that tends to have higher concentrations of contaminants will enhance cap placement and useful life. All construction tasks are proven sediment remediation approaches. Several dredging contractors are in the mid-Atlantic region, including the greater Baltimore metropolitan area. Coordination may be required with adjacent property owners for staging and pre-disposal activities.

Capping following removal is viable alternative for the Site. Removing low bulk density sediment prior to cap placement will enhance cap stability over the remaining aqueous sediment. The geotechnical conditions at the site, low solids content of the sediment, and in-water structure and utilities will result in numerous difficulties and challenges related to removing a large volume of material.

Overall, the removal action will take approximately 24 months with dredging anticipated to occur in Year 1 and capping in Year 2. Alternative 3 may require coordination with adjacent landowners for sediment staging and processing prior to offsite disposal, and permanent institutional controls will be required to sustain the long-term effectiveness and permanence of the sediment cap.

5.3.3 Cost

The capital cost to implement Alternative 3 is $68,663,900. Alternative 3 is the most expensive of the active remedies because of the large volume of dredge spoils. The long-term performance monitoring is expected to cost $200,000 over the 30-year monitoring period. The present value cost is $67,935,000.

5.4 ALTERNATIVE 4 – CAPPING WITH PARTIAL SEDIMENT REMOVAL AND OFFSITE DISPOSAL

5.4.1 Effectiveness

Alternative 4 would be protective of human health and the environment. Cap placement would be enhanced by nearshore dredging of surface sediments where the highest contaminant concentrations are located. The removal action would be designed to achieve RAOs and MSCs at the site. This alternative offers a reduction in the volume of contaminated sediments remaining below the cap near the shore and removes low density sediments that may adversely affect cap placement and effectiveness. After nearshore dredging, cap placement would be required to control and further reduce the mobility and toxicity of remaining contaminated sediments.

Hazards associated with general construction, potential exposure and direct contact with sediment, travel and transportation risks, odors and vapors are similar to those discussed in Alternatives 2 and 3. Mitigation would be available through engineering controls and best management practices, compliance with health and safety plans and procedures, and use of personal protective equipment.

Under this alternative, a sub-aqueous sediment cap will be designed to meet the ARARs and Site RAOs. The smaller dredge area will yield lower residual effects than Alternative 3. Resuspension controls, such as turbidity curtains, are easier to install for nearshore dredging only.

5.4.2 Implementability

Implementation will be similar to Alternatives 2 and 3. All technologies and processes are standard and available in the greater Baltimore area. An approach that limits removal to nearshore sediments may be easier to implement because of the proximity to the upland staging area, less debris removal, and less interaction with other vessels in the center of the Bear Creek channel.

Partial sediment removal allows the remedy to adapt to existing Site conditions more effectively, such as the utility power line and wood structures in the deeper water. The removal action will take approximately 18 months with dredging anticipated to occur in Year 1 and capping in Year 2. The partial sediment dredging will maintain existing water depths over the near shore areas with a reduction in water depth only in deeper areas where the cap is less susceptible to disturbance by anthropogenic or natural phenomenon.

5.4.3 Cost

The capital cost to implement Alternative 4 is $46,404,093.13. The long-term performance monitoring is expected to cost $200,000 over the 30-year monitoring period. The present value cost is $45,854,000.

6.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section compares the removal alternatives developed in Section 4.0 and evaluated in Section 5.0. Comparative analyses were performed for the alternatives based on the RAOs and the 1993 EPA CERCLA EE/CA Guidance criteria of effectiveness, implementability, and cost.

Costs for each removal alternative are preliminary. Actual costs for selected alternatives may range from 30 percent lower to 50 percent higher than the comparative costs estimated in this EE/CA. The results of the comparative analysis of the four alternatives are summarized in **Table 6-1.**

6.1 EFFECTIVENESS

Alternative 1 is the least effective since the RAOs are not achieved, and no protection is provided for human health or the environment. Although the remaining three alternatives all achieve the RAOs and protect human health and the environment, Alternative 3 is the most effective since it removes a significant mass of contaminated sediment and leaves a cap elevation least susceptible to future disturbance. Alternative 4 is the second most effective option as it removes the worst of the surface sediment contamination in the nearshore area with the final cap elevation the same as the pre-dredge sediment surface in shallow areas. Alternative 2 is more effective than no action but does not remove any contaminant mass and exposes the cap to disturbance in shallow water near the shore.

6.2 IMPLEMENTABILITY

Alternative 1 has no technical constraints on implementation as no action is planned, but this option is the least likely to be implemented since the RAOs are not achieved. Alternative 3 uses readily available dredging and capping technologies, but a land area large enough to handle the dredged sediment volume may not be available. Alternative 3 would also significantly increase truck traffic in the area to ship the dewatered sediment to an offsite landfill. This alternative takes the longest of all removal options with an expected implementation schedule of 24 months. Alternative 2 relies exclusively on a sediment cap, which may settle through low bulk density sediments near the mouth of Tin Mill Canal. The final sediment surface will also be 2 feet higher across the site, converting a large area of shallow water into more of a tidal marsh. The loss of shallow water depth is not viewed favorably by state agencies.

Alternative 4 is the most implementable option. Partial sediment dredging in the near shore area removes the softer sediment with the highest contaminant concentrations, enhancing placement, long-term performance, and useful life of the cap. A staging area close to the site is available to process the smaller dredge volume compared to Alternative 3. Maintaining the depth of shallow water in near shore areas will also be viewed favorably by state agencies.

6.3 COST

The estimated costs to implement the sediment removal action at the Bear Creek Sediments site ranges from no cost for Alternative 1 to $67.4 million for Alternative 3. Construction and materials costs associated with Alternative 2 are the lowest at $29.9 million of the active removal options since only sediment capping is planned to achieve the Site RAOs. Alternative 4 construction and material costs are $45.5 million since the partial dredging increases costs beyond Alternative 2; but partial dredging is less expensive than the full dredging planned with Alternative 3.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

The recommended alternative, based on an evaluation of effectiveness, implementability, and cost is Alternative 4: Capping with Partial Sediment Removal and Offsite Disposal. This alternative will successfully achieve RAOs, can be successfully implemented, and is cost effective.

8.0 REFERENCES

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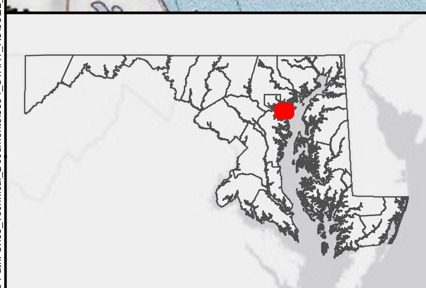
FIGURES



Legend

Project Area

N

2,000 0 2,000

Feet

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Bear Creek EE/CA
Baltimore County, Maryland

Figure 1-1

Site Location

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By:Tetra Tech

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

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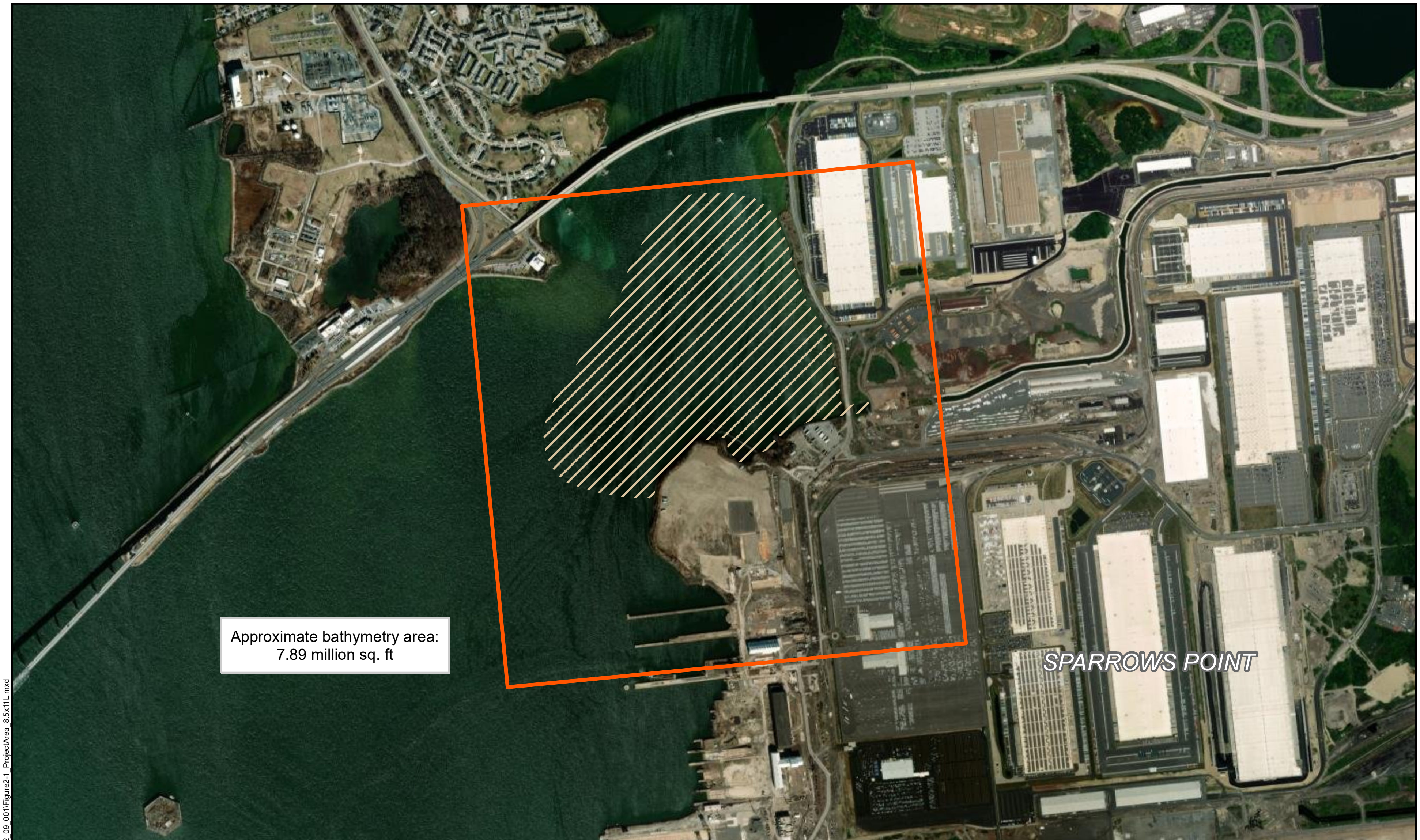

Legend

Project Area

Approximate Bathymetry Area

N

1,000 0 1,000

Feet

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Bear Creek EE/CA
Baltimore County, Maryland

Figure 2-1

Project Area

TETRA TECH

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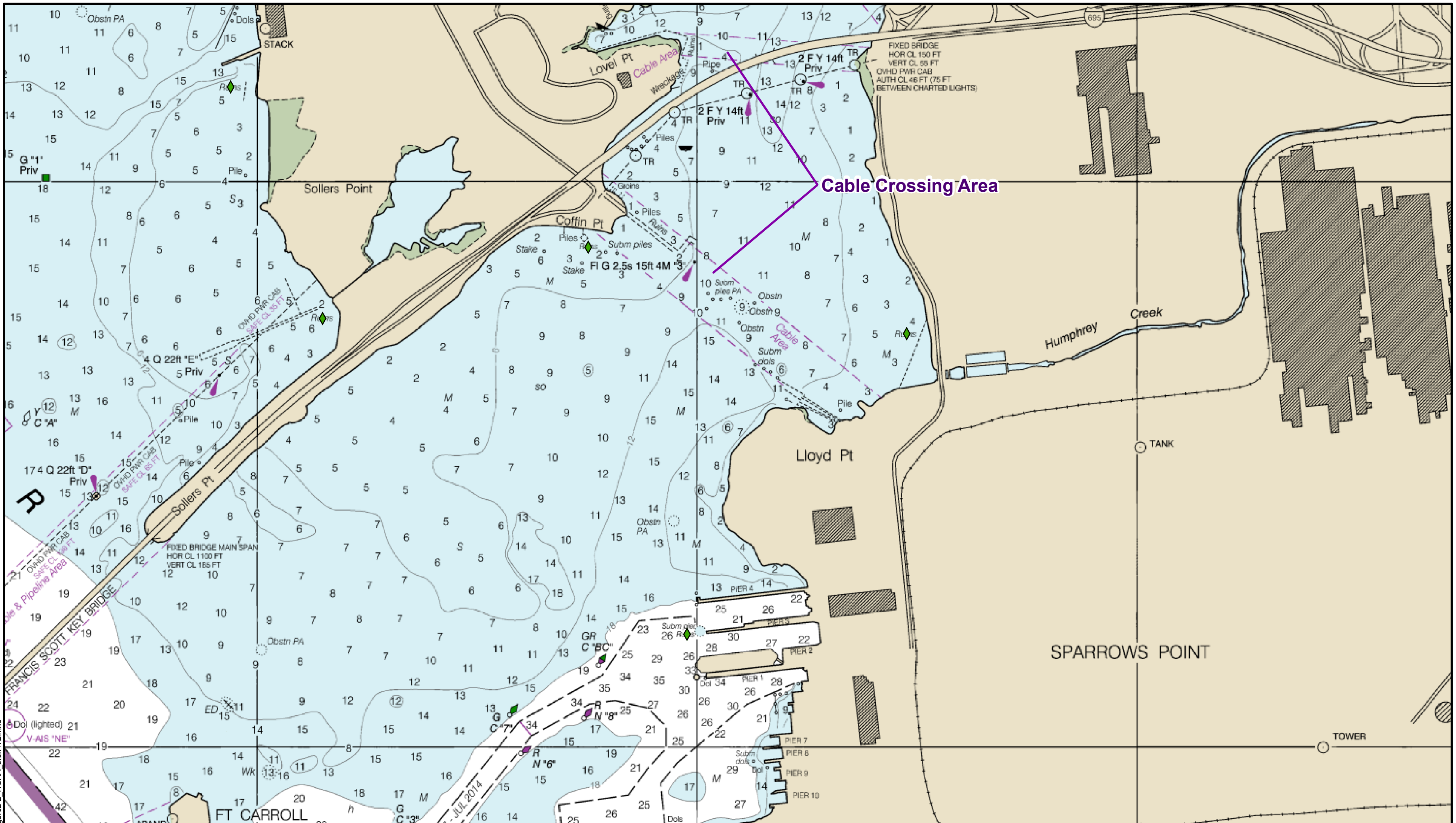
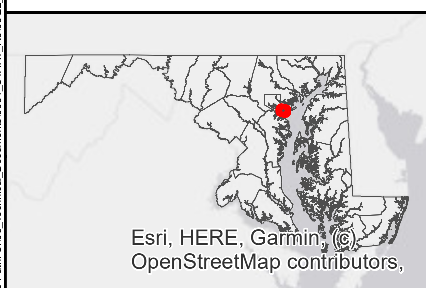
EPA Contract No: 68-HE-032-D0003 TD No: T605-22-09-001

Coordinate System: NAD 1983 2011 StatePlane Maryland FIPS 1900 Ft US





Ruins

Source: NOAA

N

1,000 0 1,000

Feet

Bear Creek EE/CA
Baltimore County, Maryland

Figure 2-2

NOAA Navigational Chart

TETRA TECH

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Prepared By: Tetra Tech

Coordinate System: NAD 1983 2011 Contiguous USA Albers

Date Saved: 07/17/23

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TD No: T605-22-09-001

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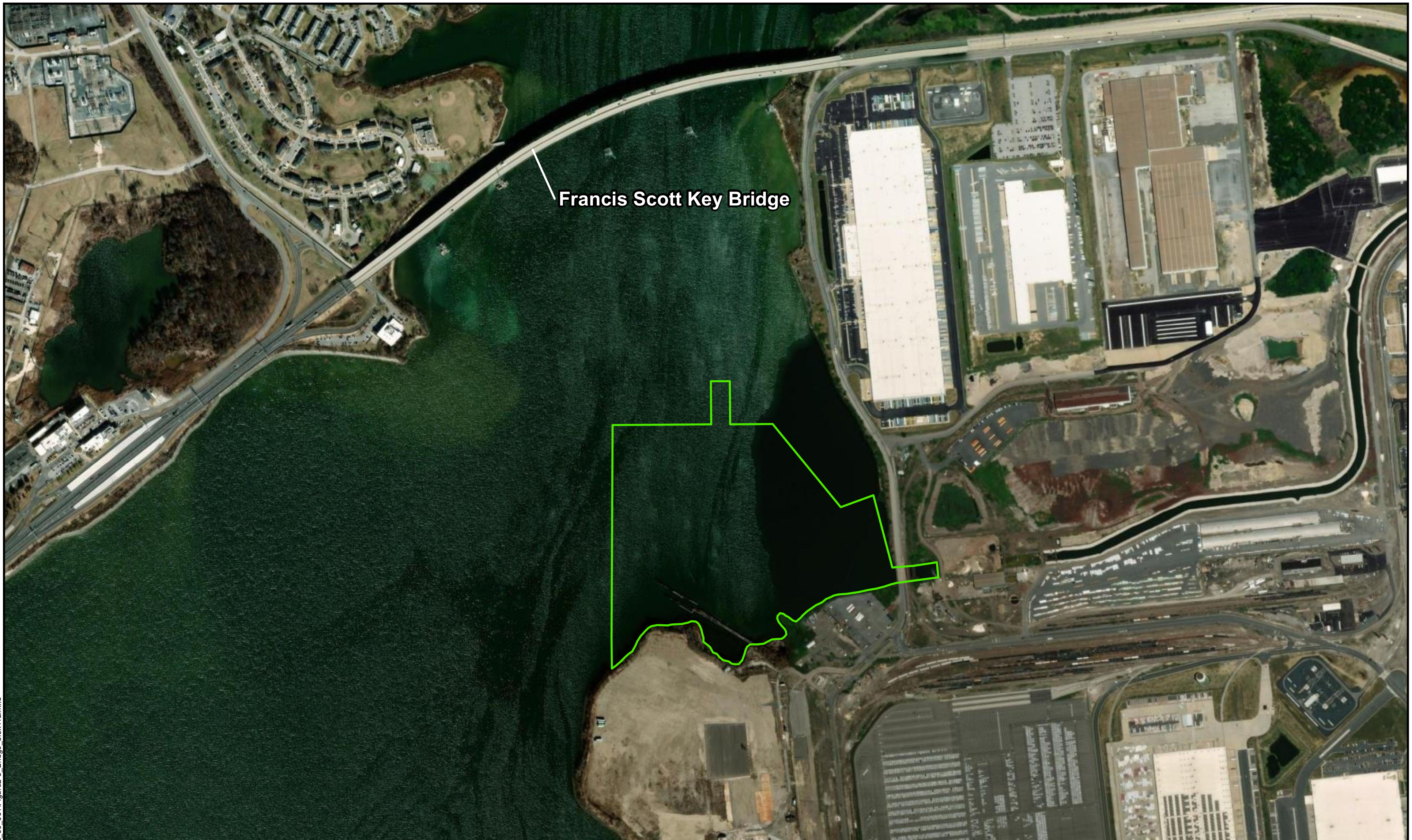

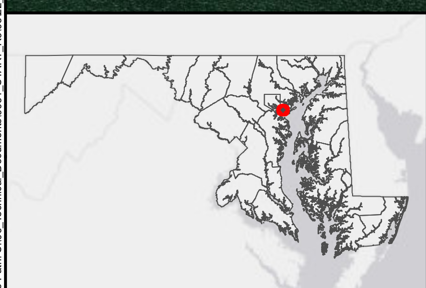

Proposed Removal Boundary

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N

600 0 600

Feet

Bear Creek EE/CA
Baltimore County, Maryland

Figure 2.3

Bridge

TETRA TECH

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Date Saved: 09/26/23

EPA Contract No: 68-HE-032-D0003 TD No: T605-22-09-001

Coordinate System: NAD 1983 2011 StatePlane Maryland FIPS 1900 Ft US

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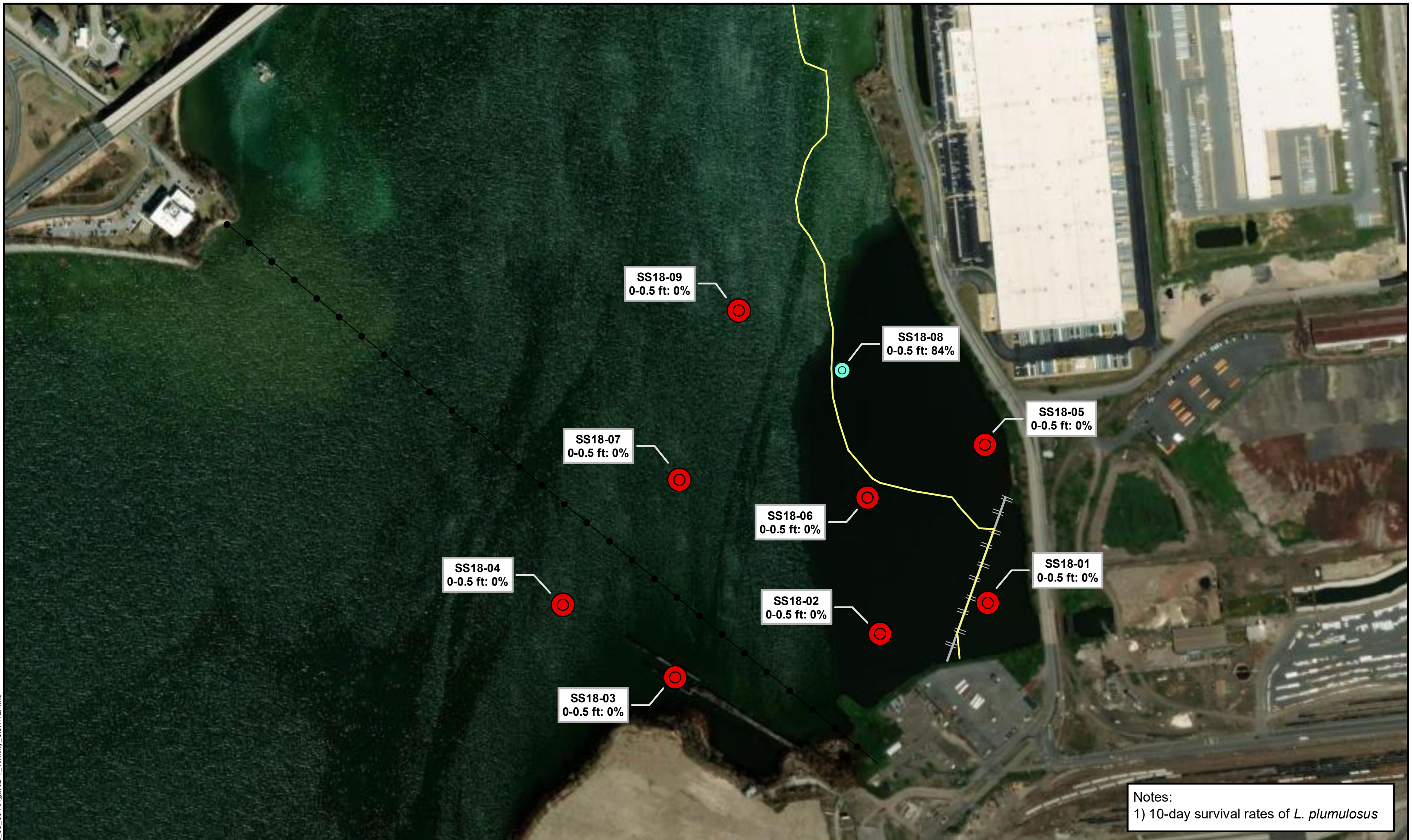

Survival Percentage

- 0-25%
- 25-50%
- 50-75%
- 75-100%

Breakwater

Boundary Between Sand and Fine Grained Sediment

Underwater Powerline

N

300 0 300

Feet

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Bear Creek EE/CA
Baltimore County, Maryland

Figure 2-4
Toxicity Testing Results

TETRA TECH

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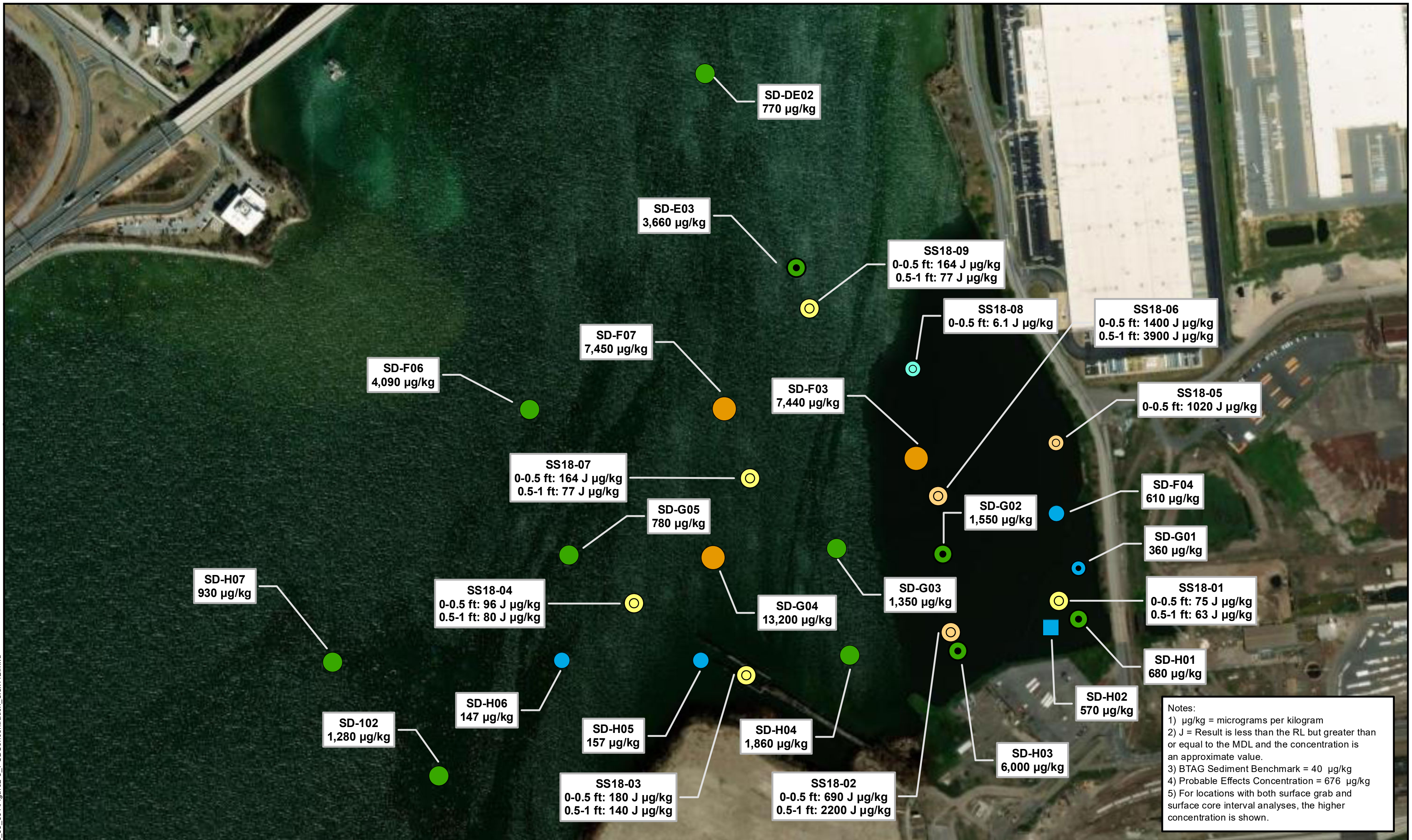
Coordinate System: NAD 1983 2011 StatePlane Maryland FIPS 1900 Ft US



Notes:
1) µg/kg = micrograms per kilogram
2) J = Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
3) BTAG Sediment Benchmark = 40 µg/kg
4) Probable Effects Concentration = 676 µg/kg
5) For locations with both surface grab and surface core interval analyses, the higher concentration is shown.

- 0-0.5 ft Sample <40 µg/kg
- 0-0.5 ft Sample 676-6,6760 µg/kg
- 0-0.5 and 0.5-1 ft Samples 40-676 µg/kg
- 0-0.5 and 0.5-1 ft Samples 676-6,6760 µg/kg
- Surface Grab 40-676 µg/kg
- Coring Location 40-676 µg/kg
- Coring Location 676-6,000 µg/kg
- Coring Location >6,000 µg/kg
- Surface Grab/Coring 40-676 µg/kg
- Surface Grab/Coring 676-6,000 µg/kg

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N

300 0 300

Feet

Bear Creek EE/CA
Baltimore County, Maryland

Figure 2-5

PCB Concentrations

TETRA TECH

Prepared For: EPA R3 START VI | PreparedBy Tetra Tech

File Path: S:\06_Technical_Documents\9034_START_R3\05\22_09_001\Figure2-5_PCBConcentration_8.5x11L.mxd

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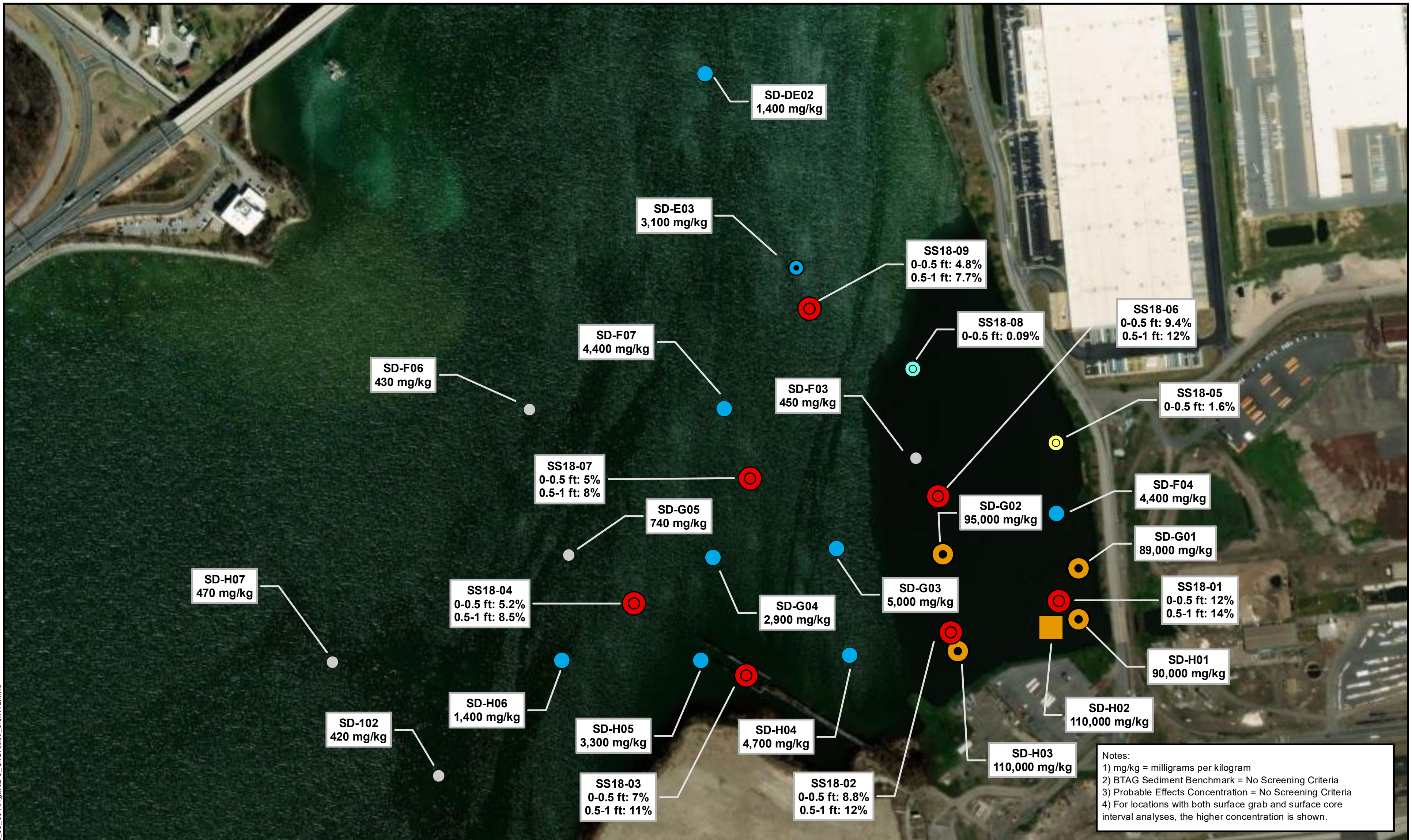

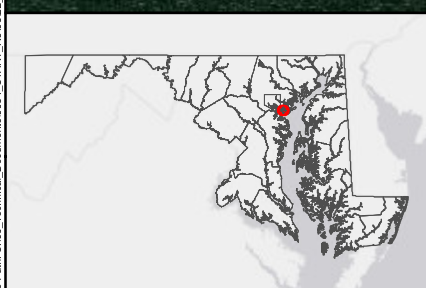

- Concentrations < 0.5%
- Concentrations ≥ 0.5 and < 2%
- Concentrations ≥ 2 and < 4%
- Concentrations ≥ 4%
- Coring Location <1,000 mg/kg
- Coring Location 1,000-10,000 mg/kg
- Surface Grab/Coring >50,000 mg/kg
- Surface Grab >50,000 mg/kg

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N

300 0 300

Feet

Bear Creek EE/CA
Baltimore County, Maryland

Figure 2-6
Oil and Grease Concentrations

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By: Tetra Tech

File Path: S:\06_Technical_Documents\9034_START_R3\05\22_09_001\Figure2-6_OilGrease_8.5x11L.mxd

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EPA Contract No: 68-HE-032-D0003 TD No: T605-22-09-001

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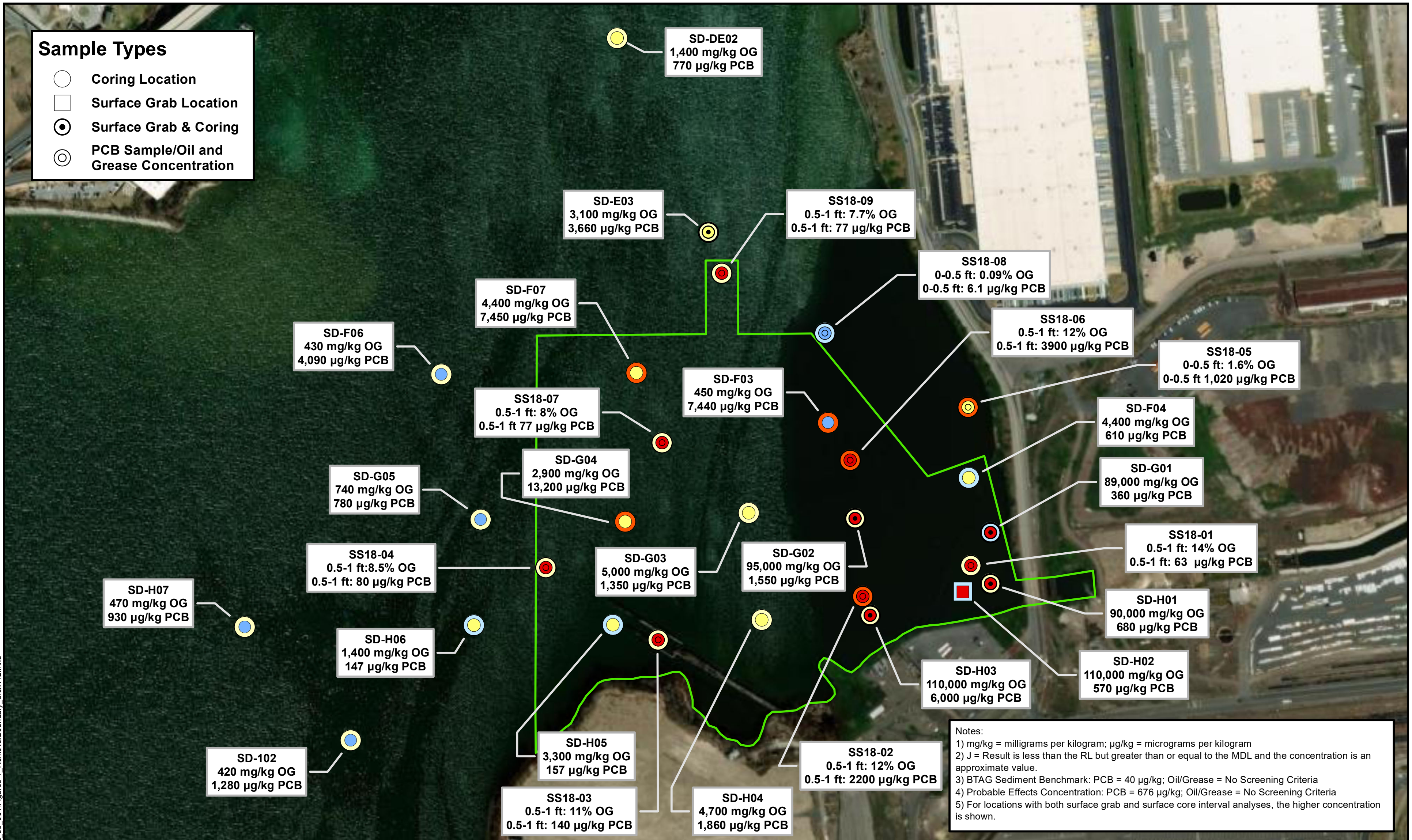
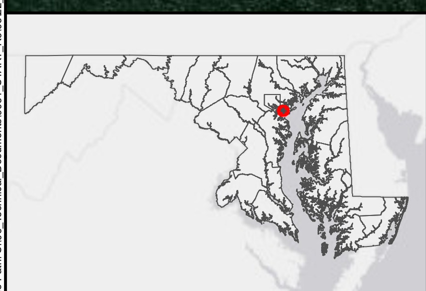


Notes:
1) mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram
2) J = Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
3) BTAG Sediment Benchmark: PCB = 40 µg/kg; Oil/Grease = No Screening Criteria
4) Probable Effects Concentration: PCB = 676 µg/kg; Oil/Grease = No Screening Criteria
5) For locations with both surface grab and surface core interval analyses, the higher concentration is shown.



PCB Concentration
- 40-676 µg/kg Coring
- 676-6,000 µg/kg Coring
- >6,000 µg/kg Coring
- <40 µg/kg Sample
- 40-676 µg/kg Sample
- 676-6,760 µg/kg Sample

Oil & Grease Concentration
- <1,000 mg/kg
- 1,000-10,000 mg/kg
- >50,000 mg/kg
- Concentrations < 0.5%
- Concentrations ≥ 0.5 and < 2%
- Concentrations ≥ 4%
- Proposed Removal Boundary

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N
300 0 300
Feet

Bear Creek EE/CA
Baltimore County, Maryland

Figure 3.1
Proposed Removal Boundary

TETRA TECH

Prepared For: EPA R3 START VI | Prep ared By: Tetra Tech

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Date Saved: 09/26/23 EPA Contract No: 68-HE-032-D0003 TD No: T605-22-09-001 Coordinate System: NAD 1983 2011 StatePlane Maryland FIPS 1900 Ft US

Sediment Slurry to Dewatering Pad
Treated Water Discharge
Proposed EPA Staging Area

N
100 0 100
Feet

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Bear Creek EE/CA
Baltimore County, Maryland

Figure 4-1
Proposed Staging Area

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By: Tetra Tech

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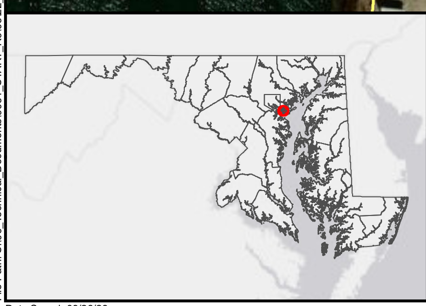

Ruins
Removal Boundary
Sediment Capping Area
Cable Crossing Area
Proposed EPA Staging Area

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N

200 0 200

Feet

Bear Creek EE/CA
Baltimore County, Maryland

Figure 4.2
Alternative 2:
Sediment Containment (Capping)

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By: Tetra Tech

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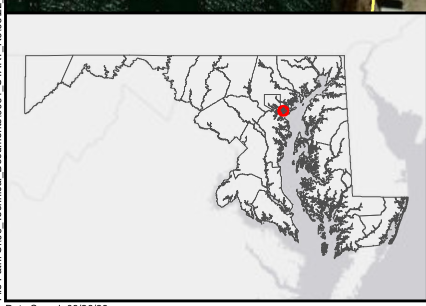
Date Saved: 09/26/23 EPA Contract No: 68-HE-032-D0003 TD No: T605-22-09-001 Coordinate System: NAD 1983 2011 StatePlane Maryland FIPS 1900 Ft US



Ruins
Sediment Capping and Dredging Area
Removal Boundary
Proposed EPA Staging Area
Cable Crossing Area

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N

200 0 200

Feet

Bear Creek EE/CA
Baltimore County, Maryland

Figure 4.3
Alternative 3: Capping with Sediment Removal and Offsite Disposal

TETRA TECH

Prepared For: EPA R3 START VI | Prepared By: Tetra Tech

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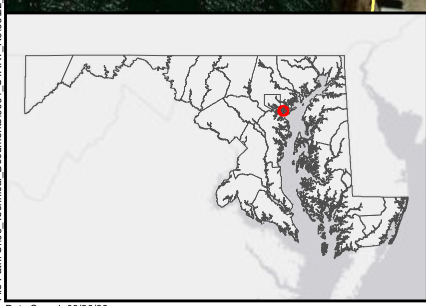
EPA Contract No: 68-HE-032-D0003 TD No: T605-22-09-001

Coordinate System: NAD 1983 2011 StatePlane Maryland FIPS 1900 Ft US



Sample Locations
Ruins
Sediment Capping Area
Sediment Capping and Dredging Area
Removal Boundary
Proposed EPA Staging Area
Cable Crossing Area

N
200 0 200
Feet

Bear Creek EE/CA
Baltimore County, Maryland

Figure 4.4
Alternative 4: Capping with Partial Sediment Removal and Offsite Disposal

TETRA TECH

Source: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Prepared For: EPA R3 START VI | Prepared By: Tetra Tech

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Date Saved: 09/26/23 EPA Contract No: 68-HE-032-D0003 TD No: T605-22-09-001 Coordinate System: NAD 1983 2011 StatePlane Maryland FIPS 1900 Ft US

TABLES

Table 3-1: Media Specific Concentrations for Primary (Key Indicator) Contaminants

Contaminant of Concern	Average/Maximum Concentration in Surface Sediments at the Site (mg/kg)	SWACs in Surface Sediments at the Site (mg/kg)	Preliminary Media Specific Concentration	
			Goal (mg/kg)	SWAC Goal (mg/kg)
Total PCBs	2.8/13	1.6	5	1
Oil and grease*	27,743/110,000	2,071	3,500	700

Notes: *For kriging for oil and grease, the analytical reporting limit was used as the concentration in the one location where this analyte was not detected.

mg/kg = milligram per kilogram
SWAC = surface weighted average concentration

Table 3-2: Media Specific Concentrations for Secondary Contaminants

Contaminant of Concern	Approximate Average Concentration in Surface Sediments at the Site (mg/kg)	Media Specific Concentrations	
		Address maximum concentrations exceeding ___* mg/kg	Decrease the maximum concentration to less than ___* mg/kg
Cadmium	16	30	10
Chromium	200	3,500	1,000
Copper	280	550	150
Nickel	100	170	50
Silver	3	6	2
Zinc	3,700	4,500	1,500
Bis(2-ethylhexyl) phthalate	10.5	17	5

Note: * Numbers in table correspond to the blanks in header row (see Media Specific Concentrations column).
mg/kg = milligrams per kilogram

Table 3-3
ARARs and TBCs
Bear Creek Sediment Site
Baltimore, Maryland

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	I. Chemical Specific				
C-1	Toxic Substances Control Act (TSCA), 15 U.S.C. §§ 2601 *et seq*. Subpart D: Storage and Disposal - PCB Remediation Waste	40 C.F.R. § 761.61(c) - PCB Remediation Waste; 40 C.F.R. § 761.79(b)(1)(ii) - Decontamination standards and procedures	Relevant and Appropriate	Section 761.61 sets forth cleanup and disposal options for PCB remediation waste. Section 761.61(c) sets forth requirements for a risk-based disposal method for PCB remediation waste. Section 761.79(b)(1)(ii) establishes decontamination standards and procedures for removing PCBs, which are regulated for disposal, from water, organic liquids, non-porous surfaces (including scrap metal from disassembled electrical equipment), concrete, and non-porous surfaces covered with a porous surface, such as paint or coating on metal.	Activities performed at the Site that include cleanup or disposal of PCB remediation waste may be subject to substantive cleanup and disposal requirements set forth in Section 761.61, and in particular, Section 761.61(c), and decontamination standards and procedures for removing PCBs as set forth in Section 761.79.(b)(1)(ii).
C-2	Regulations governing Identification and Listing of Hazardous Waste*	COMAR 26.13.02.14 - Toxicity Characteristic (Federal Regulation: 40 C.F.R. § 261.24 – Toxicity Characteristic) COMAR 26.13.02.19D - Discarded Commercial Chemical Products, Off-Specification Species, Containers, and Spill Residues	Applicable	This regulation sets forth the criteria to determine when a solid waste, as defined in COMAR 26.13.02.02, exhibits the characteristic of toxicity. Defines PCBs equal to or greater than 50 mg/kg as hazardous waste that must be disposed of at permitted RCRA Subtitle C or TSCA disposal facility for stabilization and/or disposal.	To the extent that solid waste, as defined in COMAR 26.13.02.02, is generated as part of the response action, it will be analyzed in accordance with the substantive provisions of these regulations.

* The Maryland provisions that are part of Maryland's federally authorized Waste Management Program would apply instead of federal Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §6901, *et seq.* (1976), as amended by the Hazardous and Solid Waste Act (HSWA), regulations. Additionally, any Maryland provision that is not part of the authorized program, but that is more stringent that the federal requirement, may also be an ARAR. Federal citations are included because any federal regulations that are not part of Maryland's authorized program may apply.

Table 3-3
ARARs and TBCs
Bear Creek Sediment Site
Baltimore, Maryland

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	I. Chemical Specific				
C-3	Maryland Surface Water Quality Criteria	COMAR 26.08.02.03 A(1)(b.) and (2) (Applicability); B (General Water Quality Criteria)	Applicable	This regulation establishes criteria, including toxic substance criteria, for ambient surface waters of Maryland to protect human health or aquatic life.	Substantive provisions of these requirements will apply to any response action to be conducted at the Site that includes or may result in discharge(s) to surface water.
		COMAR 26.08.02.03-2.G - Numerical Criteria for Toxic Substances in Surface Water		This regulation establishes numerical surface water criteria for toxic substances discharged into surface water.	Substantive provisions will apply to any response action to be conducted at the Site that may result in a discharge to surface water.
		26.08.02.03-3.C - Water Quality Criteria Specific to Designated Uses		This regulation establishes Water Quality Criteria for Class II Waters - Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting.	Substantive provisions of these requirements may apply setting forth Water Quality Criteria for Class II Waters.
	II. Location Specific				
L-1	Clean Water Act, 33 U.S.C. § 1344 (CWA)	40 C.F.R. § 230.10(b)-(d); 40 C.F.R. §§ 230.11.	Applicable	These regulations provide guidelines under Section 404(b)(1) of the CWA, for specification of disposal sites for dredged or fill material. No discharge of dredged or fill material into an aquatic ecosystem is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if it will cause or contribute to significant degradation of the waters of the U.S. No discharge of dredge or fill material shall occur unless appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.	These regulations will be triggered if the response action results in a discharge of dredged or fill material into an aquatic ecosystem. On-Site activities conducted that fall within the scope of these regulations will comply with the substantive requirements of these regulations.

Table 3-3
ARARs and TBCs
Bear Creek Sediment Site
Baltimore, Maryland

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	II. Location Specific				
L-2	Maryland Tidal Wetlands Mitigation Regulations	COMAR 26.24.05.01 - Mitigation	Applicable	Provides tidal wetlands mitigation standards and requirements. Sets mitigation ratios and requirements to replace lost wetlands for impacts to tidal wetlands and buffers to attain no net overall loss of tidal wetlands. Protects wetlands from dredging, filling, removal, or other alteration.	Activities conducted at the Site that may result in the loss or despoliation of tidal wetlands must comply with the substantive requirements of this provision.
L-3	Regulations under the Endangered Species Act, 16 U.S.C. §§ 1531 *et seq*	50 C.F.R. § 402	Applicable	Requires federal agencies to consult with U.S. Fish and Wildlife Service and/or National Marine Fisheries Service on any action likely to jeopardize the continued existence of any federally listed endangered/ threatened species or result in the destruction or adverse modification of designated critical habitat for listed species.	To the extent that any federally listed endangered/threatened species is found at the Site during the response action, EPA will coordinate with FWS and/or NMFS in accordance with these regulations.
L-4	Migratory Bird Treaty Act, 16 U.SC. § 703	50 C.F.R. § 10.13	Applicable	Prohibits the unlawful taking, possession or sale of any migratory bird, including any part, nest, or egg of any such bird, native to the U.S. or its territories.	To the extent that a response action is performed while migratory birds are present, appropriate actions will be taken to ensure that no on-Site migratory birds, listed at 50 C.F.R. § 10.13, or their nests are adversely affected.

Table 3-3
ARARs and TBCs
Bear Creek Sediment Site
Baltimore, Maryland

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	II. Location Specific				
L-5	Maryland Floodplain Management Program Regulations	COMAR 26.17.04.07 - Changes in Stream Channels or Floodplains COMAR 26.17.04.08 Temporary Construction in a Stream Channel or Floodplain COMAR 26.17.04.10 - General Waterway Construction Permit	Relevant and Appropriate	COMAR 26.17.04.07 sets forth design and specifications related to any changes in a stream channel or floodplain. COMAR 26.17.04.08 sets forth requirements related to temporary construction in a stream channel or floodplain. COMAR 26.17.04.10 sets forth general permit specifications with regard to making changes in the course, current, or cross section of waters of the State.	The substantive requirements of these regulations will be relevant and appropriate with regard to any response action that involves changes in stream channels or flood plains.The substantive requirements of these regulations will be relevant and appropriate with regard to any response action that involves temporary construction in a stream channel or floodplain. The substantive requirements of these regulations will be relevant and appropriate with regard to any response action that involves making changes in the course, current or cross section of waters of the State.
L-6	Maryland Critical Area Act, Maryland Natural Resource Code, Title 8 - Waters Subtitle 18 regulations	COMAR 27.01.02 - (Development in the Critical Area)	TBC	These regulations set forth requirements that apply to, and shall be applied by, a local jurisdiction as minimum standards for a local program sufficient to meet the goals of the Critical Area Program. .	To the extent any development activities are conducted in a Critical Area, as defined at COMAR 27.01.01(B)(18), substantive provisions, and specifically those pertaining to shore erosion and habitat protection, set forth in these regulations will be TBCs.

Table 3-3
ARARs and TBCs
Bear Creek Sediment Site
Baltimore, Maryland

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	II**. Location Specific**				
L-6	Maryland Critical Area Act, Maryland Natural Resource Code, Title 8 - Waters Subtitle 18 regulations (con't)	COMAR 27.01.02(G) (Development in the Critical Area)	TBC	COMAR 27.01.02(G) provides that certain development activities may not be permitted in a Critical Area unless no environmentally acceptable alternative exists outside the Critical Area, and these development activities or facilities are needed in order to correct an existing water quality or wastewater management problem.	To the extent any development activities are conducted in a Critical Area, as defined at COMAR 27.01.01(B)(18), substantive provisions, and specifically those pertaining to shore erosion and habitat protection, set forth in these regulations will be TBCs.
		COMAR 27.01.04 (Shoreline Erosion)	TBC	COMAR 27.01.04 sets forth shoreline erosion criteria that a local jurisdiction shall satisfy when developing and updating its Critical Area program.	
		COMAR 27.01.09.01-1.B. and C. - Buffer Establishment	TBC	COMAR 27.01.09.01-1.B. and C. Buffer Establishment. This regulation sets forth buffer establishment criteria that a local jurisdiction shall satisfy when developing and updating its Critical Area program.	

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	III. Action Specific				
	Water				
A-1	National Pollutant Discharge Elimination System Requirements under the Clean Water Act of 1972, as amended, 33 U.S.C. §1342	40 C.F.R. §§ 122.41(a)(1), (d), (e), (h), (i), (j)(1- 4), (k)(1), l(1), (4), (6), (7), and (9), and (m)(2), (3), 122.44(a), (d), (e), and (i), 122.48, 40 C.F.R. Part 423, App. A; 1 § 122.45	Applicable	The NPDES program regulates point sources that discharge pollutants to waters of the U.S. The Site contaminants of concern (COCs) are identified as pollutants by EPA. Establishes effluent limitations for discharges to U.S. waters.	No NPDES permit is required for on-Site response actions. However, any discharges of pollutants from point sources into waters of the United States will comply with the substantive provisions of these requirements.
A-2	Maryland Stormwater Management Regulations	COMAR 26.17.02.06 – Storm Water Minimum Control Requirements COMAR 26.17.02.08 - Stormwater Management Measures	Relevant and Appropriate	These regulations set forth stormwater management minimal control criteria and stormwater management measures for management of stormwater following development activities, as defined at COMAR 26.12.02.02.	Any response action conducted at the Site that includes development activities, as defined at COMAR 26.12.02.02. will comply with the substantive provisions of these regulations.
	Soil				
A-3	Maryland Sediment Control Design Standards and Specifications Guidance	2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control Guidance (incorporated in COMAR 26.17.01.11.A.)	TBC	Sets forth minimum standards and procedures to control the adverse impacts associated with soil erosion and sedimentation during construction.	Substantive standards provided in this guidance will be considered to control soil erosions and sedimentation that may occur as during response actions conducted at the Site.

Table 3-3
ARARs and TBCs
Bear Creek Sediment Site
Baltimore, Maryland

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	III. Action Specific				
	Soil				
A-4	Maryland Soil and Erosion Controls Regulations	COMAR 26.17.01.07 - Erosion and Sediment Control Plans	Relevant and Appropriate	This regulation specifies substantive components to be included when developing an Erosion and Sediment Control Plan.	Substantive provisions of this regulation are relevant and appropriate when developing and Erosion and Sediment Controls pertaining to response activities at the Site.
	Waste				
A-5	Requirements applicable to owners and operators of facilities that treat, store, or dispose of hazardous waste – Use of Containers	COMAR 26.13.05.09 - Use and Management of Containers. (Federal Regulations: 40 C.F.R. Subpart I – Use and Management of Containers, §§ 264.171-.175, .178)	Applicable	These regulations set forth requirements for the condition, management, inspection of, and closure of containers used to store hazardous waste.	Any containers used to store hazardous waste on-Site will be managed in accordance with these regulations.
A-6	Requirements applicable to owners and operators of facilities that treat, store, or dispose of hazardous waste – Use of tank systems for storing or treating hazardous waste.	COMAR 26.13.05.10 - General Requirements for Hazardous Waste Management in Tank Systems (Federal Regulations: 40 C.F.R. Subpart J – Tank Systems, §§ 264.191 - .197)	Applicable	These regulations set forth design, general operating, inspection and closure requirements for hazardous waste management in tank systems.	Response activities that involve the use of tank systems for storing or treating hazardous waste will comply with the substantive requirements of these provisions.

Table 3-3
ARARs and TBCs
Bear Creek Sediment Site
Baltimore, Maryland

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	III. **Action Specific**				
	Waste				
A-7	Requirements applicable to owners and operators of facilities that treat, store, or dispose of hazardous waste – Use of Surface Impoundments	COMAR 26.13.05.11 - Surface Impoundments (Federal Regulations: 40 C.F.R. Subpart K - Surface Impoundments, §§ 264.221, .224, .226 - .228)	Applicable	Applies to owners and operators of facilities that use surface impoundments to treat, store, or dispose of hazardous waste. Sets forth design standards and general operating requirements surface impoundments used to treat, store, or dispose of hazardous waste.	To the extent that surface impoundment will be used to treat, store, or dispose of hazardous waste as part of the response action at the Site, substantive requirements of this regulation may apply.
A-8	Requirements applicable to owners and operators of facilities that store or treat hazardous waste in piles	COMAR 26.13.05.12 – Waste Piles (Federal Regulations: 40 C.F.R. Subpart L – Waste Piles, §§ 264.251 - .254, .258)	Applicable	These regulations set forth design, general operating, containment, and closure requirements applicable to owners and operators of facilities that store or treat hazardous waste in piles.	Response activities that involve the storage or treating of hazardous waste in piles will comply with substantive requirements of these provisions.
A-9	Standards applicable to generators of hazardous waste	COMAR 26.13.03 - Standards Applicable to Generators of Hazardous Waste (Federal Regulations: 40 C.F.R. Subpart B – Manifest Requirements, §§ 262.16, Pre-transport Requirements: 262.20-.27, 262.30-.33, and Recordkeeping Requirements - 262.40 and .44)	Applicable	These regulations establish standards including manifest, pre-transport, and recordkeeping requirements, for generators of hazardous waste, as defined by COMAR 26.13.02	Any on-Site generation of a hazardous waste, as defined by COMAR 26.13.02, during the response action will comply with the substantive requirements of these standards.

Table 3-3
ARARs and TBCs
Bear Creek Sediment Site
Baltimore, Maryland

	Requirement	Citation	Status	Requirement Summary	Relation to Response Action
	III. **Action Specific**				
	Oil				
A-10	Maryland Requirements Relating to Oil Pollution Control and Storage Tank Management	COMAR 26.10.01.04.C. and D(2)	Applicable	This regulation sets forth general provisions and specifically prohibited acts relating to oil, as defined in COMAR 26.10.01.02.B(47).	Any response action conducted at the Site that results in a release of oil as defined in COMAR 26.10.01.02.B(47) will comply with the substantive requirements of this regulation.
	Air				
A-11	National Emissions Standards for Hazardous Air Pollutants	40 C.F.R. Part 63 Subpart GGGGG	Relevant and Appropriate	This subpart establishes national emissions limitations and Maximum Achievable Control Technology standards for hazardous air pollutants emitted from site remediation sources. This subpart also establishes requirements to demonstrate initial and continuous compliance with the emissions limitations and work practice standards.	Any air emissions from response actions will be controlled and monitored in accordance with the substantive provisions of these regulations.
A-12	Maryland Air Emissions Regulations – Particulate Matter	COMAR 26.11.06.03 - Particulate Matter	Applicable	This regulation sets forth emission standards for particulate matter from confined and unconfined sources.	Any response action conducted at the Site that result in air emissions from confined and unconfined sources will be subject to the substantive particulate matter emissions provisions of this regulation.
A-13	Maryland Air Resources Protection regulations	COMAR 26.20.23.01 - Air Resources Protection	Applicable	This regulation provides that exposed surface areas shall be protected and stabilized to effectively control erosion and air pollution attendant to erosion, and identifies fugitive dust control measures that may be taken.	Fugitive dust measures may be implemented if response actions result in exposure of surface areas by air pollutants.

Table 4-1: Technology Screening Table

GRA/ Technology Category		Technology	Effectiveness	Implementability	Ability to Comply with Environmental Regulations	Relative Cost	Results of Screening
No Action		**No Action**	**None**	**High**	**Low**	**Low**	**Retained -** Required for comparison by National Contingency Plan (NCP).
Institutional	Institutional Controls	**Signage, fencing, aquatic barriers, wake zones, restriction on vessel size/draft**	**Low** - Limited effectiveness for providing protection of human health and the environment without other measures. RAOs not likely to be met in a reasonable time period.	**High** - Easily implementable as this requires primarily administrative actions.	**High** - Some items may not require permits/approvals; aquatic barriers would require permits for the U.S. Army Corps of Engineers and State of Maryland and coordination with federal and state resource agencies.	**Low** - Easily accomplished with no specialized equipment.	**Not Retained -** Technology will not meet RAOs in a reasonable time period
Monitored Natural Recovery	MNR/Non-Enhanced	**Using Natural Depositional Processes** - In areas of net deposition and for sediment with contaminant concentrations near the PRGs in surface and subsurface sediment.	**Low** - Effectiveness relies on natural deposition for burial of sediment, as well as degradation of contaminants. Compared to other technologies may not be as effective in reducing toxicity mobility or volume of contaminants. RAOs not likely to be met in a reasonable time period.	**High** - Implementable from both technical and administrative feasibilities. Requires long-term monitoring to demonstrate ongoing deposition, which would decrease implementability.	**High** - No permits required.	**Low** - Costs are involved with Monitored National Remediation (MNR) for periodic monitoring of bathymetry, cores for evaluating deposition rates and sediment quality.	**Not Retained -** Technology will not meet RAOs in a reasonable time period
	MNR/Enhanced	**Supplementing Natural Depositional Processes Using Thin-Layer Clean Material** - Place thin layer of sand or other suitable substrate to provide clean surface. An EMNR alternative may also include placement of thin layer of reactive media to enhance recovery of the system.	**Low/Medium** - Effectiveness relies on the addition of a thin layer of sand or other suitable substrate to enhance natural deposition processes and speed up burial of sediment. Compared to other technologies may not be as effective in reducing toxicity mobility or volume of contaminants. RAOs not likely to be met in a reasonable time period.	**Medium** - Potentially difficult to implement for achieving consistent coverage with a thin layer of sand and/or reactive or other material and requires techniques to disperse material uniformly over area. Shallow areas subject to washout from recreational boating in the area. Requires long-term monitoring to demonstrate ongoing deposition.	**High** - No permits required.	**Low/Medium** - Costs are involved with construction and materials, MNR for periodic monitoring of bathymetry, cores for evaluating deposition rates and sediment quality.	**Not Retained -** Technology will not meet RAOs in a reasonable time period
In-situ Stabilization/ Solidification (ISS)	Stabilization/ Solidification	**Mixing or injection of a solidification agent (for example, Portland cement) to solidify and immobilize contamination**	**Medium -** Able to solidify site COCs to immobilize contaminant concentrations and limit the bioavailability to benthic organisms. The effectiveness of ISS at mitigating contaminant migration into the water column, and the associated accumulation of contaminants in the aquatic environment, would need to be determined through additional testing or a pilot ISS treatability study. In addition, potential impacts on groundwater flow surrounding the ISS area must be considered.	**Medium** - In situ treatment technically implementable. The application is a proven technology that has been implemented at other sites. Specialized equipment, materials, and personnel would need to be available. Implementation would need to consider the anticipated swell of surface sediments often resulting during ISS and whether that might reduce water depths and inhibit navigation.	**Medium** - Permits required from the U.S. Army Corps of Engineers and State of Maryland. Changes in final sediment elevation from swell as well as impermeable condition of final surface likely would be viewed negatively.	**High/Very High -**	**Not Retained**
u Capping	Containment/Capping	**Granular Sand Cap** - Capping includes granular media (for example, sand, providing physical and chemical separation from underlying sediment)	**Medium** - Effective for stabilization of contaminated sediments, reducing the mobility of the contaminants especially the low-mobility contaminants present at the site, chemically isolating contaminated sediments from waterbody and benthic community. Not effective for reducing the volume of contaminated sediment.	**Medium** - Constraints associated with permitting, land ownership issues, and long -term responsibility and logistics. For administrative feasibility, long-term monitoring and maintenance requirements will be required. Capping may be used to enhance habitat types within the footprint of the remedy. Potential changes in water depth may influence permitability and habitat types if grades are modified within the footprint of the remedy. Special design and construction methods may be required to place the cap over low-strength sediments at the site. Capping can be combined with dredging to avoid appreciable grade changes.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation, dredging material management, and transport/disposal; mitigation or best management practices (BMPs) for temporary water quality impacts and disturbance to aquatic habitat and substrate may be required.	**Medium** - Cost of construction and materials. Cost of removal options are largely driven by sediment processing and disposal costs, which are not incurred with capping technology. There is typically a minor offset, due to additional monitoring costs.	**Retained**

Table 4-1: Technology Screening Table

GRA/ Technology Category		Technology	Effectiveness	Implementability	Ability to Comply with Environmental Regulations	Relative Cost	Results of Screening
In-Sit	Reactive Capping	**Reactive Cap** - Capping includes reactive media containing a carbon source, organoclay, or other sorbent where dissolved contaminants in porewater may occur within sediment with higher contaminant concentrations	**Medium** - Enhanced control of contaminant migration and/or stability. Effective for stabilization of contaminated sediments, further reducing the mobility of the contaminant, chemically isolating contaminated sediments from waterbody and benthic community. Not effective for reducing the volume of contaminated sediment.	**Medium** - Reactive amendments added to a cap may allow for a thinner layer of material to be placed in waterways with limitations on filling and maintain water depth. Constraints associated with permitting, land ownership issues, and long -term responsibility and logistics. For administrative feasibility, long-term monitoring and maintenance requirements will be required. Capping may be used to enhance habitat types within the footprint of the remedy. Potential changes in water depth may influence permitability and habitat types if grades are modified within the footprint of the remedy. Capping can be combined with dredging to avoid appreciable grade changes.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation, dredging material management, and transport/disposal; mitigation or BMPs for temporary water quality impacts and disturbance to aquatic habitat and substrate may be required.	**Medium** - Cost of construction and materials. Higher costs can be driven by amendment addition process and material required.	**Retained** - In the event traditional capping is not sufficient
Removal	Excavation	**Excavation with Water Withdrawal** - Eater diversion technology installed to isolate affected area, followed by water withdrawal, and excavation of relatively "dry" sediment.	**High** - Effective in meeting Remedial Action Objectives (RAOs) and Preliminary Remediation Goals (PRGs) by efficiently removing contaminated materials and limiting water quality impacts. Exposing deeper more contaminated sediments during removal may increase risk by increasing the average contaminant concentration in surface sediments. Significant removal volumes would be required to reach native materials. It is unlikely a removal only alternative would address risks at the site, a residual or engineered cap would likely be required.	**Low** - Water depths, discharge from Tin Mill Canal and expansive Removal area would require special engineering considerations complicating implementation and increasing construction duration and cost. Significant debris/in-water at the site will require removal or work arounds prior to removal. Significant material management processing (dewatering, and/or potential amendment addition), material transport, and disposal would be required.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required; may require coordination with the U.S. Coast Guard.	**High** - Significant costs related to flow diversion, higher costs can be driven by required sediment processing and disposal process options.	**Retained** - May be used in combination with other removal technologies for the open water area between the bridge and the Tin Mill dam.
	Mechanical	**Environmental Bucket (Articulated Fixed-Arm Excavator or Crane)**	**High** - Effective for removing sediment above PRGs; well-suited to shallow environments. Turbidity curtains would be required to manage resuspension of sediment and minimize water quality impacts. Debris management would be required through a separate technology. Exposing deeper more contaminated sediments during removal may increase risk by increasing the average contaminant concentration in surface sediments. Significant removal volumes would be required to reach native materials. It is unlikely a removal only alternative would address risks at the site, a residual or engineered cap would likely be required.	**Medium** - Articulation allows precise control of bucket position and orientation enabling removal in more difficult geometries; hydraulically closing bucket provides improved removal and handling of woody debris. Significant debris/in-water at the site will require removal or work arounds prior to removal. Significant material management processing (dewatering, and/or potential amendment addition), material transport and disposal would be required. Water and sediment management requires space in a upland processing area.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required.	**Medium** - Readily available equipment, higher costs can be driven by required sediment processing and disposal process options.	**Retained** - In combination with a residual or engineered cap
		Conventional Clamshell via Crane - Conventional navigational dredging.	**Medium** - This technology would remove some debris (without bucket closure) that an environmental bucket would not be able to; water quality impacts related to not having enclosed bucket or vents for water decanting, resuspension of sediment is significant. Exposing deeper more contaminated sediments during removal may increase risk by increasing the average contaminant concentration in surface sediments. Significant removal volumes would be required to reach native materials. It is unlikely a removal only alternative would address risks at the site, a residual or engineered cap would likely be required.	**Medium** - This technology is implementable but resuspension of sediments is significant. Overall a standard technique that is widely available through multiple contractors and sources. Significant debris/in-water at the site will require removal or work arounds prior to removal. Significant material management processing (dewatering, and/or potential amendment addition), material transport and disposal would be required. Water and sediment management requires space in a upland processing area.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required.	**Medium** - Readily available equipment, higher costs can be driven by required sediment processing and disposal process options.	**Retained** - In combination with a residual or engineered cap
	Hydraulic Dredging	**Cutter-Suction or Plain Suction**	**Medium** - Effective in meeting RAOs and PRGs by removing contaminated materials. Exposing deeper more contaminated sediments during removal may increase risk by increasing the average contaminant concentration in surface sediments. Significant removal volumes would be required to reach native materials. It is unlikely a removal only alternative would address risks at the site, a residual or engineered cap would likely be required.	**Medium** - Debris not easily entrained in the intake can clog or slow productivity. Water and sediment management requires space in a upland processing area. Accessibility may be limited by dredge size and shallow waters. Significant debris/in-water at the site will require removal or work arounds prior to removal.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required.	**Medium** - Larger hydraulic dredges would require higher cost for mobilization and operation; smaller dredges are likely more applicable to the project conditions. Higher costs can be driven by required sediment processing and disposal process options.	**Retained** - In combination with a residual or engineered cap
		Horizontal Auger - Hydraulic pipeline dredge with horizontal auger dredge head (for example, Mudcat).	**Medium** - Effective in meeting RAOs and PRGs by removing contaminated materials; generally smaller hydraulic dredges with positioning using cables or lines. Exposing deeper more contaminated sediments during removal may increase risk by increasing the average contaminant concentration in surface sediments. Significant removal volumes would be required to reach native materials. It is unlikely a removal only alternative would address risks at the site, a residual or engineered cap would likely be required.	**Medium** - Debris not easily entrained in the intake can clog or slow productivity. Water and sediment management requires space in a upland processing area. Accessibility may be limited by dredge size and shallow waters. Significant debris/in-water at the site will require removal or work arounds prior to removal. Significant material management processing (dewatering, and/or potential amendment addition), material transport, and disposal would be required.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required.	**Medium** - Larger hydraulic dredges would require higher cost for mobilization and operation; smaller dredges are likely more applicable to the project conditions. Higher costs can be driven by required sediment processing and disposal process options.	**Retained** - In combination with a residual or engineered cap
		High-Solids Pump via Crane or Articulated Fixed-Arm Excavator	**High** - Effective in meeting RAOs and PRGs by contaminated materials; more precise and able to work with obstructions; therefore, greater effectiveness in mass removal is possible. Exposing deeper more contaminated sediments during removal may increase risk by increasing the average contaminant concentration in surface sediments. Significant removal volumes would be required to reach native materials. It is unlikely a removal only alternative would address risks at the site, a residual or engineered cap would likely be required.	**Medium** - Implementable, woody debris not easily entrained in the intake that can clog or slow production; water and sediment management requires significant space. Significant debris/in-water at the site will require removal or work arounds prior to removal. Significant material management processing (dewatering, and/or potential amendment addition), material transport, and disposal would be required.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required.	**Medium** - Larger hydraulic dredges would require higher cost for mobilization and operation; smaller dredges are likely more applicable to the project conditions. Higher costs can be driven by required sediment processing and disposal process options.	**Retained** - Supporting technology

Table 4-1: Technology Screening Table

GRA/ Technology Category		Technology	Effectiveness	Implementability	Ability to Comply with Environmental Regulations	Relative Cost	Results of Screening
		Diver-Assisted Suction Dredging	**High** - Effective in meeting RAOs and PRGs by removing contaminated materials; precise work, low production rates; ability to remove sediment that would be missed by other technologies is higher. Exposing deeper more contaminated sediments during removal may increase risk by increasing the average contaminant concentration in surface sediments. Significant removal volumes would be required to reach native materials. It is unlikely a removal only alternative would address risks at the site, a residual or engineered cap would likely be required.	**Low** - Woody debris not easily entrained in the intake can clog or slow productivity; requires specialized equipment and personnel; very low production rates, health and safety concerns. Significant debris/in-water at the site will require removal or work arounds prior to removal. Significant material management processing (dewatering, and/or potential amendment addition), material transport, and disposal would be required.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required.	**High** - Specialized removal requires use of dive crew and low production rate for removal increases cost. Higher costs can be driven by required sediment processing and disposal process options.	**Retained** - Supporting technology

Table 4-2: Supporting Technology Screening Table

GRA/Technology Category		Technology	Effectiveness[1]	Implementability	Ability to Comply with Environmental Regulations	Relative Cost	Results of Screening
Sediment Management and Water Treatment	Debris Management	**Debris Segregation and Disposal**	**High** - Effective at reducing the volume of waste requiring disposal as specialized waste; Sediment is processed using static screens, hydrocyclones, and shaker screens to segregate particle sizes; fines are dewatered using filter press; debris is segregated to a minimum size to be determined.	**High** - Easily implementable with proven technologies that can be assembled into a sediment processing "treatment train" to meet project objectives. Sufficient staging area should be present at site for processing, uncertainty exists on sufficient staging areas present at the site required for processing.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or best management practices (BMPs) for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required; if sufficient upland area is available and is required for sediment processing and dewatering, then stormwater management/erosion and sediment control approvals will be required.	**High** - Debris segregation and disposal is typically a high cost component of dredging projects due to the numerous components involved to segregate, manage, transport and dispose of the heterogeneous materials.	**Retained**
		Excavator with Thumb or Crane with Grapple - Selective removal and disposal of large debris not capable of being dredged.	**High** - Effectiveness for removing woody debris from sediment will depend on method of disposal; some benefit may occur by removing debris from sediment.	**High** - Overall a standard technique that is widely available through multiple contractors and sources.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required.	**Medium** - Readily available equipment.	**Retained**
	Dewatering Technologies	**Dewatering Using Geotextile Tubes**	**High** - Effective at reducing the volume of waste requiring specialized disposal; facilitates dewatering to a solids content approximating the in-situ condition of the sediment and allows collection and treatment of the water.	**Medium** - Common approach with hydraulic dredging to allow higher production rates; requires significant space to implement; overall a standard technique that is widely available through multiple contractors and sources. Uncertainty exists on sufficient staging areas present at the site required for processing.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required; if sufficient upland area is available and is required for dewatering, then stormwater management/erosion and sediment control approvals will be required.	**Medium** - Geotextile tubes materials and installation, lined staging area can be high cost, but use of geotextile tubes may provide efficiencies such as reducing or eliminating amendment for transporting dewatered sediment to a landfill.	**Retained**
		Sediment Processing Including Particle Separation, Dewatering (Shaker Screens and Filter Press)	**High** - Effective at reducing the volume of waste requiring disposal as specialized waste; sediment is processed using static screens, hydrocyclones, and shaker screens to segregate particle sizes; fines are dewatered using filter press.	**Medium** - Implementable with proven technologies that can be assembled into a sediment processing "treatment train" to meet project objectives. Uncertainty exists on sufficient staging areas present at the site required for processing.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland; mitigation or BMPs for temporary water quality impacts and disturbance to aquatic habitat and substrate may be required; if sufficient upland area is available and is required for sediment processing and dewatering, then stormwater management/erosion and sediment control approvals will be required.	**High** - Sediment processing is typically a high cost component of dredging projects due to the numerous components involved to transform a slurry with low solids content into segregated materials that are compressed into filter cake in which the segregation and lower weight is intended to reduce overall project costs.	**Retained**
		Amendment Addition to Stabilize for Transport	**Medium** - Not effective for achieving RAOs and PRGs, but is a standard practice to facilitate transport of wet sediment to a landfill to avoid drips and spills during transport.	**High** - Common approach with mechanical dredging to facilitate transport of sediment and meet the paint filter test for acceptance at a landfill; overall a standard technique that is widely available through multiple contractors and sources.	**High** - Stormwater management/erosion and sediment control approvals will be required.	**Medium** - Adds weight to materials requiring landfill disposal and therefore increases cost.	**Retained**
	Water Treatment	**New Water Treatment Plant**	**High** - Effective at reducing the volume of waste generated; process water from hydraulic dredging or decant water from mechanical dredging is treated to remove suspended solids and constituents of concern to meet discharge criteria.	**Medium** - A water treatment plant for hydraulic dredging sized to at or above 500 gallons per minute (gpm) requires considerable space, permitting and design to be implemented. Development of site must be considered - therefore may need to be removed prior to demobilization.	**Medium** - Extensive permitting required for new infrastructure, including an National Pollutant Discharge Elimination System (NPDES) permit, building permit, grading permit, stormwater management approval, and sediment and erosion control approval.	**High** - Cost for processing facility paving or lining, tanks, treatment units, treatment media replacements are high; especially for temporary use.	**Eliminated** - A new water treatment plant should only be pursued if hydraulic dredging is selected and developer allows the potential for treatment system to remain for processing other project needs.
		Leased Water Treatment Plant (Mobile Units Processes)	**High** - Effective at reducing the volume of waste generated; decanted water from mechanical dredging without slurrying for transport would require a smaller sized treatment plant comprised of mobile units for storage, filtration, activated carbon, etc.	**High** - Easily implemented as a standard approach for mechanical dredging projects at contaminated sediment sites; overall a standard technique that is widely available through multiple contractors and sources.	**High** - Avoids many permitting needs associated with developing a new facility; may require a modification or update to the NPDES permit for the facility. Special discharge permit may be possible with the local waste water treatment facility for pre-treated water from the project, as an alternative to direct discharge of treated water from the project.	**Low** - Lease and treatment costs are relatively low compared to hydraulic dredging.	**Retained**
		Retrofit Existing Water Treatment Plant	**High** - Effective at reducing the volume of waste generated; effectiveness is dependent on the existing components of the treatment plant being functional and proven reliable.	**High** - Utilizing existing plant reduces space requirements for footprint; components of the treatment plant must be functional and proven reliable; some additional unit processes for treatment and/or management of sediment and water may be required.	**High** - Avoids many permitting needs associated with developing a new facility; may require a modification or update to the NPDES permit for the facility.	**Medium** - Costs are likely high for new components and modifications to existing components, but less than a new plant.	**Eliminated** - Retrofitting the existing treatment plant should only be pursued if detailed information on the design, operation, and maintenance history is available. A construction contractor would need to be provided an allowable treatment rate for the
		Direct Discharge to Surface Water	**Low** - Not effective at reducing the toxicity, mobility or volume of contaminants; only used in cases when gravity settling removes suspended solids in a CDF and water quality meets discharge criteria.	**High** - Requires a contained disposal facility (CDF) of sufficient size and hydraulic residence time to promote gravity settling sufficiently to meet effluent discharge criteria; this technology does not reduce dissolved contaminant concentrations.	**Low** - May be difficult to meet water quality standards without further treatment to surface water; may require a CDF to use this method.	**Low** - Low cost due to use of the size of the CDF for reducing suspended sediment concentration.	**Eliminated** - Some water treatment is anticipated to be required.

Table 4-2: Supporting Technology Screening Table

GRA/Technology Category		Technology	Effectiveness[1]	Implementability	Ability to Comply with Environmental Regulations	Relative Cost	Results of Screening
Transportation	Waterside	**Barge -** Option would include transport of dewatered sediment or cap material from/to the site via navigable waterways.	**Medium** - Effective for transporting sediment to disposal sites or cap material to the site. Low likelihood for sediment release during transport. Barge transport may impact recreational boating in the area.	**Medium/Low** - Barges have been used successfully at multiple sediment sites. Multiple transport technologies may be required if disposal facilities cannot accept barges. Barges are readily available; sediment volume and schedule requirements may result in limitation of available barges. The low strength properties of the material will make it difficult to prepare, transport, and manage sediment to strength requirements for both transport and landfill requirements.	**High** - No specific permits/approvals needed for barge transport. Would need to adhere to US Coast Guard requirements regarding marine traffic. Permit/approval only needed if private aids to navigation are installed.	**Low -** Barge transport is typical, more cost effective than truck transport.	**Retained**
		Pipeline (In Combination with Hydraulic Dredge Remedy) -	**Medium** - A slurry pipeline system is effective when combined with a hydraulic dredging operation. It eliminates the need for transfer of material from the dredge to barges, which reduces energy use, noise, and vessel traffic, and keeps the sediment contained. A slurry pipeline can be constructed to deliver material directly to an on-site disposal and/or treatment area.	**Medium** - Pipeline transport is better suited to low strength sediments. Construction of a slurry pipeline requires coordination with marine traffic because these facilities may obstruct navigation. Pipeline transport may require a series of booster pumps. If pipeline transport routes sediment to a treatment facility another mode of transportation may be required to move sediment to an off-site disposal facility.	**High** - Would need to adhere to US Coast Guard requirements regarding marine traffic. Would need to let US Coast Guard and Corps know about hazards to navigation for filing and public release. Permit/approval from US Coast Guard only needed if private aids to navigation are installed. May need additional approvals if booster pumps are needed (e.g., spill prevention plan). Would need to include the pipeline location and any potential anchor points in permit applications to the US Army Corps of Engineers and MDE for approval, but would not need separate permits for transport. This would be included in the Section 404/Section 10 Permit and Tidal Wetlands License for dredging.	**Medium** - Costs are associated with the construction and maintenance of a slurry pipeline.	**Retained**
	Landside	**Rail -** Rail cars can be used to transport sediment or cap material.	**Medium** - Effective for transporting sediments to disposal sites. Low likelihood of sediment releases during rail transport. Rail transport may result in impacts to the surrounding community, these impacts would be minimized to the extent practical during design.	**Low** - Rail is suitable for transporting sediment in intermodal containers. Rail transport has been used at sediment sites. Multiple transport technologies may be required if disposal facilities cannot accept rail cars. Rail equipment and siding are not readily available. In certain areas of the harbor, containers can not be double stacked on rail due to limiting bridges. The low strength properties of the material will make it difficult to prepare, transport, and manage sediment to strength requirements for both transport and landfill requirements.	**High** - Would not need specific permits/approvals from federal or state entities, would likely need to coordinate with rail operators and use sealed rail cars.	**Low -** Rail transport is typically more cost effective than truck transport and less cost effective that barge transport.	**Eliminated**
		Truck - Truck transport would include hauling cap material or sediment in trucks over public roadways to disposal facility.	**Medium** - Moderate to low likelihood of sediment release during truck transport. The potential for release from trucks is greater than rail or barge because the trucks would pass through congested industrial and public roadways with a greater likelihood for traffic accidents. Truck traffic would have a greater impact on the local community given the volume of trucks that would be required, traffic routes would be evaluated during design to minimize impacts on residential communities. A large number of trucks would be required.	**Medium/Low** - Trucks are suitable for transporting sediment in sealed containers. It is a flexible transport technology and can be used with the majority of treatment technologies and disposal facilities. Trucks have been used at a large number of sediments sites and are readily available. The low strength properties of the material will make it difficult to prepare, transport, and manage sediment to strength requirements for both transport and landfill requirements.	**High** - Would need lined trucks in order to use this. May need highway or road access permits if not using only existing roadways.	**Medium -** Generally, truck transport is less cost effective than rail or barge.	**Retained**
	al	**Disposal in Nearby Upland Confined Disposal Facility (CDF) -** This may include hydraulic dredging pipeline transport, mechanical dredging with debris removal and slurrying then pipeline transport, or mechanical dredging with debris removal and truck transportation.	**High** - Effective for containing removed material exceeding PRGs and can be designed for containment using either a sheet pile wall or a containment berm approach.	**Low** - For technical feasibility, this is a demonstrated approach for containing and isolating contaminated sediment from the surrounding environment; however, for administrative feasibility, a nearby upland CDF is not feasible considering the future use of the Bear Creek Sediments Site/Tradepoint Atlantic facility.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation; permitting required for new infrastructure, including an NPDES permit, grading permit, stormwater management approval, and sediment and erosion control approval.	**Medium** - Moderate cost for construction of facility and overall technical implementability.	**Eliminated** - An area for an upland CDF is not available.
		Onsite Disposal in Nearshore CDF - This may include hydraulic dredging pipeline transport, mechanical dredging with debris removal and slurrying then pipeline transport, or mechanical dredging with debris removal and truck transportation.	**High** - Effective for containing removed material exceeding PRGs and can be designed for containment using either a sheet pile wall or a containment berm approach. Placement of island or nearshore CDF could be overtop of contaminated sediments, and reduce the footprint for dredging	**Medium** - For technical feasibility, this is a demonstrated approach for containing and isolating contaminated sediment from the surrounding environment; however, for administrative feasibility, the timeframe for land acquisition and permitting the CDF expected to be extensive. The large volume of sediment at the site and plans for redevelopment in the area may prohibit consideration of this option.	**High** - permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation; mitigation for loss of open water habitat and temporary water quality impacts - permanent disturbance to aquatic habitat and substrate would occur; permitting required for new infrastructure, including an NPDES permit, grading permit, stormwater management approval, and sediment and erosion control approval.	**Medium** - Moderate cost for construction of facility and overall technical implementability.	**Eliminated -** The large volume of sediment at the site, permitting requirements, and plans for redevelopment in the area likely prohibit consideration of this option.

Table 4-2: Supporting Technology Screening Table

GRA/Technology Category		Technology	Effectiveness[1]	Implementability	Ability to Comply with Environmental Regulations	Relative Cost	Results of Screening
Disposal	On-Site Dispos	**Construction of New Regional Confined Disposal Facility Near the Site** - This may include hydraulic or mechanical dredging to a barge for disposal at regional facility.	**High** - Effective for containing removed material exceeding PRGs and can be designed for containment using either a sheet pile wall or a containment berm approach. Placement of CDF could be upland, nearshore, or island but sized for taking additional dredging sediments (for example navigational harbor dredge). Placement of CDF could be overtop of contaminated sediments, and reduce the footprint for dredging	**Low** - For technical feasibility, this is a demonstrated approach for containing and isolating contaminated sediment from the surrounding environment; however, for administrative feasibility, available land and a project partner interested in constructing and operating the facility would need to be identified. The timeframe for land acquisition and permitting the CDF to contain contaminated sediments would also be extensive.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation; mitigation for loss of open water habitat and temporary water quality impacts - permanent disturbance to aquatic habitat and substrate would occur; permitting required for new infrastructure, including an NPDES permit, grading permit, stormwater management approval, and sediment and erosion control approval.	**High** - Moderate cost for construction of facility and overall technical implementability. Project costs would be offset by having a project partner, but CDF would increase in size and permitting scope.	**Eliminated -** Available land and a project partner interested in constructing and operating the facility would need to be identified. The timeframe for land acquisition and permitting the CDF to contain contaminated sediments would also be extensive.
		Onsite Confined Aquatic Disposal (CAD) - Submerged containment of sediment in a dredged cell which may reside in a suitable area of the AOC; technology includes placement of slurry using tremie discharge or direct placement.	**Medium** - Effective method for disposal however relative to other disposal alternatives, placement of dredged material through the water column may involve conditions less compatible with RAOs and meeting PRGs than other approaches, or may require slower construction due to resuspension.	**Low** - For technical feasibility, high solids slurry may not remain within the CAD given fluid state and requires considerable time for solids to settle and consolidate from the slurry; further, very complex fluid dynamics would require further study to avoid impacted suspended solids transporting from the disposal site during placement. For administrative feasibility, the timeframe for planning and permitting the CAD expected to be extensive.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation and work in a navigable waterway; mitigation or BMPs for temporary water quality impacts and disturbance to aquatic habitat and substrate may be required.	**Medium** - Moderate cost anticipated for siting, permitting, and designing a CAD cell in the navigation channel, and slow production time pending resuspension	**Eliminated** - Low productivity would make the approach cost prohibitive, and timeframe for planning and permitting would be incompatible with the project schedule.
	Off-Site Disposal	**Offsite Disposal at Non-Hazardous Subtitle D Landfill** - This may include mechanical dredging to a barge or other staging area, where the material is rehandled to meet transportation standards and then placed in dump trucks or roll-off containers. Sediment is transported to an municipal solid waste or Subtitle D landfill following removal. Dewatering is generally required before transport.	**Medium** - Effective by removing impacted sediments. Transportation includes mitigation of drips or leaks using dewatering techniques, appropriately sealed trucks or roll-off containers.	**Low** - Potentially difficult to implement. The low strength properties of the material will make it difficult to prepare, transport, and manage sediment to strength requirements for both transport and landfill requirements.	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation; mitigation or BMPs for temporary water quality impacts, and disturbance to aquatic habitat and substrate may be required. If sufficient upland area is available and is required for dewatering, then stormwater management/erosion and sediment control approvals will be required. Mitigation for temporary roadway and traffic impacts may be required.	**High** - Sediment processing, handling and transport given the low strength sediments at the site.	**Retained -** In the event that disposal in a nearby upland CDF is not feasible.
		Existing Regional Offsite Confined Disposal Facility - This may include hydraulic dredging pipeline transport or mechanical dredging with debris removal and slurrying then pipeline transport.	**High** - Effective for containing removed material exceeding PRGs.	**Low** - For technical feasibility, this is a demonstrated approach for containing and isolating contaminated sediment from the surrounding environment, and locations are currently permitted to handle material; however, for administrative feasibility a project partner would need to be identified, sampling according to their standards would need to occur, and transportation via barge would need to be utilized due to distance. Extensive coordination would be required with MPA for the use of an existing CDF, presently the availability of space for dredged material from the harbor is extremely limited. Further, depending on permit conditions, additional requirements could be involved (for example, creating a separate lined cell to separate this material from navigation dredged material in the CDF).	**High** - Permits required from the U.S. Army Corps of Engineers and State of Maryland for sediment excavation; mitigation for loss of open water habitat and temporary water quality impacts - permanent disturbance to aquatic habitat and substrate would occur.	**High** - No CDF construction, therefore low design and construction costs, but higher disposal costs due to tipping fee.	**Eliminated** It is unlikely that MPA has available capacity at their existing facilities to manage the volumes of material or levels of contamination that would be generated from a sediment removal alternative at Bear Creek Sediments Site

Notes:
1. Effectiveness screening criterion is primarily based upon the technology's compatibility with meeting Remedial Action Objectives (RAO) and Preliminary Remediation Goals (PRG).
2. Relative cost screening criterion is based upon generalized cost experience, and "High" ranking for relative cost indicates relatively low cost for the technology.
3. Removal and Disposal GRAs include dewatering technologies and water treatment technologies not reflected in the screening table. For hydraulic dredging technology category, dewatering by geotextile tubes, gravity settling and polymer-assisted settling in a CDF will be carried forward along with water treatment. For the mechanical dredging technology category, decanting from barges, gravity dewatering from staging areas and stabilization using amendments for transport, and dewatering using geotextile tubes (for mechanically dredged materials slurried for transport), will be carried forward. Water treatment technologies of using an existing Publicly Owned Treatment Works (POTW) or other existing facility, mobile treatment units, and water treatment plant will be carried forward.

GRA General removal action

Table 4-3: Removal Alternative Assembly Table

	Assemble Alternatives from Technologies and Process Options		
	Technology Category	**Selected Technology**	**Technical/Administrative Feasibility Considerations**
Alternative 1 - No Action	No Action		No further action is taken. Contaminants remain in place.
Alternative 2 - Capping (On Existing Surface)	Containment	Granular cap/reactive cap as needed	Limited draft for barges may require hydraulic conveyance or placement; this alternative may be able to integrate habitat restoration given cost savings of no dredging.
	Transportation	Barge or truck transport of sand; hydraulic off-load barge and pipeline for hydraulic conveyance	Sand barged to site using navigation channel or by truck over public roads, sand conveyed hydraulically for placement to spreader barge.
	Placement	Vibrating shaking screen for thin-layer placement	Methodology has been used successfully for capping soft sediment sites.
Alternative 3 and 4 - Capping and Partial Depth Dredging Off-site Disposal (Option B)	Removal	Hydraulic dredging (smaller areas of diver-assisted dredging or mechanic removal possible)	Sediment conditions generally more compatible with hydraulic removal. Diver-assisted dredging over utilities or near other obstacles. Mechanical removal of wood structures, other debris, and sediment from Tin Mill Creek between bridge and dam.
	Transportation	Barge or truck transport of sand with hydraulic conveyance to screen; pipeline transport of hydraulically dredged material	Regional availability of floating pipeline and hydraulic dredge comparable to mechanical equipment; diver-assisted dredging is a more specialized skill and requires additional coordination with utility owners, complexity higher than Alt 2 with effluent discharge, but will not change water depths as much as Alt 2. Final depth will match original in Alt 3. Alt 4 will maintain original sediment elevation near shore (0-6 feet MLLW), with higher elevation in deeper areas but final elevation remains more than 4 feet below MLLW.
	Sediment Mgmt.	Geotextile tubes with polymers or belt press dewatering (hydraulic); gravity dewatering, air drying/overturning, drying agents (mechanical)	Geotextile tubes would provide containment and dewatering of highly compressible, negligible shear strength sediment; weep water collected in sump prior to treatment; alternatively a belt press dewatering approach may improve dewatering effectiveness and geotechnical suitability of sediment (hydraulic); gravity dewatering and use of drying agents for geotechnical suitability in fill less likely to be effective; approaches require adjacent land for temporary dewatering.
	Water Treatment	Use temporary water treatment facility with sand, activated carbon, and bag filters to remove particulates	Requires adjacent land with available space for treatment components adjacent to dewatering pad sump. Use of existing water treatment facility would require extensive coordination with outside parties, but should be explored if alternative selected for design.
	Disposal	Off-site Subtitle D disposal facility	Load out of dried sediment, placement on trucks for transport to landfill, disposal in a licensed Subtitle D landfill.
	Containment	Granular cap/reactive cap as needed	(similar implementation considerations as above)
	Placement	Vibrating shaking screen coupled with hydraulic conveyance of sand slurry	(similar implementation considerations as above)

Table 4-4: Alternatives 2 through 4 Common Remedy Components

Common Remedy Component	Rationale
Administrative activities related to Applicable or Relevant and Appropriate Requirements (ARAR) requirements, stakeholder agreements, and community outreach; EPA activities related to the administrative record for the site, including a Record of Decision following the EE/CA; also, activities such as selecting and procuring a qualified construction contractor, and establishing EPA's construction management and oversight during implementation.	Activities are typical for establishing the project's administrative record, for negotiating required contracts for remedy implementation, and for community outreach and addressing public concerns
Mobilization and demobilization	Activities are typical regarding transport and setup of the appropriate equipment, personnel, materials and supplies, specialty services, and other project support that the construction contractor has included for constructing the remedy.
Subaqueous capping and long-term monitoring associated with capping	Based on technology screening, identification and review of process options, and development of alternatives, capping technologies were identified as capable of achieving Remedial Action Objectives (RAOs) while being protective of human health and the environment. Remedies involving significant removal, such as full removal of contamination, were screened out because the scale of the remediation project could increase beyond practical limits (for example, potential significant impacts to existing shoreline structures) and the costs were up to about three to four times greater than other alternatives.

Table 4-4: Alternatives 2 through 4 Common Remedy Components

Common Remedy Component	Rationale
Use of adjacent land for temporary facilities during remedy construction	All alternatives will require a designated area on land adjacent to the project Site for the establishment of temporary facilities for construction, staging areas, and debris management. This is a relatively small space of 2-10 acres and used on a temporary basis for construction. Access to the Site was assumed to be available using existing infrastructure without requiring significant improvements.
Resuspension Controls	All alternatives will require the use of resuspension control system (a floating, reefable turbidity curtain anchored with wood piles) to minimize the movement of suspended solids generated during dredging or capping activities and prevent them from leaving the remediation footprint.

Table 4-4: Alternatives 2 through 4 Common Remedy Components

Common Remedy Component	Rationale
Debris removal, management, and disposal	All alternatives involve subaqueous capping. Preliminary data collection, including side-scan sonar, has indicated presence of large debris protruding from the bathymetric surface in shoreline areas. An initial construction activity will likely involve removal of large debris that may affect the integrity of the cap.
Removal of existing wood structure crossing Tin Mill Canal discharge area	All alternatives include subaqueous capping within the discharge area for Tin Mill Canal. The structure currently impedes flow from distributing into the project area unobstructed. If not removed, this structure would be expected to cause local erosion of the cap and affect the longevity of a capping approach, and given it is not providing a critical function, the post-remedy condition will ultimately benefit from a direct hydraulic connection between Tin Mill Canal and Bear Creek once appropriate upstream source controls are accomplished for the canal.

Table 4-4: Alternatives 2 through 4 Common Remedy Components

Common Remedy Component	Rationale
Management of existing electrical cable	The electrical cable is an important consideration for all remedies. All alternatives will involve vessels and personnel in proximity to the existing utility, portions of which are uncovered and floating conduit or are sitting unprotected on the sediment surface at the shoreline. If adequate controls and care are not exercised, the electrical cable can be easily damaged by construction equipment during implementation. Additionally, sediment remediation technologies for dredging or capping will likely create further impacts due to changes in weight near the utility, happening above the compressible subsurface which will consolidate. Management of the cable may include relocation or reconstruction of uncovered segments in coordination with the utility owner, in conjunction with detailed mapping to provide reliable location data during pre-design activities. Additional considerations for the electrical cable are provided in this section.

Table 4-4: Alternatives 2 through 4 Common Remedy Components

Common Remedy Component	Rationale
Performance monitoring during construction and compliance monitoring for applicable ARARs	All alternatives would have aspects of ARARs analysis and coordination with various agencies integrated into design and/or requiring activities such as compliance monitoring both during and after construction to demonstrate ARARs were addressed. In addition, all alternatives would require performance monitoring such as periodic surveys and other monitoring activities that confirm construction is conforming to design specifications and the intent of design.
Project close-out activities to confirm construction is substantially complete	All alternatives will include construction close-out activities.
Long-term maintenance and monitoring	All alternatives, including subaqueous capping, will include development of an Operation, Maintenance, and Monitoring Plan that will be implemented following construction. EPA's directives typically prevent the agency from performing remedy monitoring; therefore, another project stakeholder will be identified to assume these responsibilities.

Table 4-5: Cost Estimate: Alternative 2 - Sediment Containment (Capping) Remedy Implementation

COMPONENT DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Direct Cost				
Mobilization/Demobilization	LS	1	$1,731,000.00	$1,731,000
Establish Temporary Facilities	LS	1	$560,000.00	$560,000
Demolish Existing Water Feature	LS	1	$64,000.00	$64,000
Manage Existing Utility	LS	1	$21,000.00	$21,000
Debris Removal	LS	1	$67,000.00	$67,000
Sand Cap Material Import/Placement	Tons	340,000	$61.66	$20,964,400
Cap Armor Material Import/Placement	Tons	5,000	$82.12	$410,600
Indirect Cost				
Pre-Design and Design	LS	1	$1,168,000.00	$1,168,000
Construction Oversight			6%	$1,484,000
Post Remedy Cost				
Long Term Monitoring	LS	1	$200,000.00	$200,000
		Subtotal		$26,670,000
		Contingency	15%	$4,000,500
		Total		**$30,670,500**

Table 4-6. Cost Estimate Alternative 3 - Capping with Sediment Removal and Offsite Disposal Remedy Implementation

COMPONENT DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Direct Cost				
Mobilization/Demobilization	LS	1	$2,913,000.00	$2,913,000
Establish Temporary Facilities	LS	1	$1,999,000.00	$1,999,000
Demolish Existing Water Feature	LS	1	$64,000.00	$64,000
Manage Existing Utility	LS	1	$24,000.00	$24,000
Debris Removal	LS	1	$766,000.00	$766,000
Hydraulic Dredging	CY	190,000	$36.00	$6,840,000
Sand Cap Material Import/Placement	Tons	340,000	$58.98	$20,053,200
Dewater Sediments	CY	190,000	$22.19	$4,216,100
Water Treatment	LS	1	$1,452,000.00	$1,452,000
Supplemental Stabilization	Tons	4,900	$213.60	$1,046,640
Load and Haul Dewatered Sediments	Tons	220,000	$19.91	$4,380,200
Disposal of Sediments	Tons	220,000	$45.60	$10,032,000
Cap Armor Material Import/Placement	Tons	5,000	$82.12	$410,600
Indirect Cost				
Pre-Design and Design	LS	1	$1,966,000.00	$1,966,000
Construction Oversight			6%	$3,345,000
Post-Remedy Cost				
Long Term Monitoring	LS	1	$200,000.00	$200,000
		Subtotal		$59,707,740
		Contingency	15%	$8,363,000
		Total		**$68,663,900**

Table 4-7 Cost Estimate: Alternative 4 - Capping with Partial Sediment Removal and Offsite Disposal Remedy Implementation

COMPONENT DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Direct Costs				
Mobilization/Demobilization	LS	1	$2,236,000.00	$2,236,000
Establish Temporary Facilities	LS	1	$1,297,000.00	$1,297,000
Demolish Existing Water Feature	LS	1	$64,000.00	$64,000
Manage Existing Utility	LS	1	$24,000.00	$24,000
Debris Removal	LS	1	$327,000.00	$327,000
Hydraulic Dredging	CY	80453	$36.00	$2,896,308
Sand Cap Material Import/Placement	Tons	340000	$58.98	$20,053,200
Dewater Sediments	CY	80453	$21.61	$1,738,589.33
Water Treatment	LS	1	$1,452,000.00	$1,452,000
Supplemental Stabilization	Tons	900	$213.60	$192,240
Load and Haul Dewatered Sediments	Tons	87800	$19.91	$1,748,098
Disposal of Sediments	Tons	88000	$45.60	$4,012,800
Cap Armor Material Import/Placement	Tons	5000	$68.43	$342,150
Indirect Costs				
Pre-Design and Design	LS	1	$1,509,000.00	$1,509,000
Construction Oversight			6%	$2,259,000
Post-Remedy Costs				
Long Term Monitoring	LS	1	$200,000.00	$200,000
		Subtotal		$40,351,385.33
		Contingency	15%	$6,052,707.80
		Total		**$46,404,093.13**

Table 5-1: NTCRA Evaluation - Alternative 1 (No Action)

Effectiveness *Ability of the alternative to provide overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness.*			Implementability *Ability to implement the alternative from a technical and an administrative feasibility perspective, with regard to the availability of services and materials and the likelihood of state and community acceptance.*			Cost *Relative cost of the alternative*			Overall Rating
Rationale		Rating	Rationale		Rating		Cost	Rating	
Protectiveness		0	**Technical Feasibility**		0	**Capital Cost**	$0	3	3
· Protective of public health, the community, and the environment	· Does not provide protection of human health and the environment. Neither long- or short-term effectiveness in meeting the RAOs and PRGs would be achieved. Does not reduce toxicity, mobility, or volume of contaminants in sediment.		· Construction and operational considerations			**PRSC Cost**	$0		
· Protective of workers during implementation	· No action would be implemented under this alternative.		· Demonstrated performance/useful life	· No action would be implemented under this alternative; as such, there are no restrictions related to implementation.		**Present Worth Cost**	$0		
· Complies with ARARs	· Does not comply with ARARs.		· Adaptable to environmental conditions						
Ability to achieve removal objectives			· Contributes to removal action performance						
· Level of treatment/containment expected	· No action would be implemented under this alternative, no treatment/containment would occur.		· Can be implemented in 1 year						
· No residual effect concerns	· No action would be implemented under this alternative, existing contaminants would remain in place.		**Availability**						
· Will maintain control until long-term solution is implemented	· Neither long or short term effectiveness in meeting the RAOs and PRGs would be achieved.		· Equipment						
			· Personnel and services	· No action would be implemented under this alternative; as such, there are no restrictions related to implementation.					
			· Outside laboratory testing capacity						
			· Off-site treatment and disposal capacity						
			· PRSC						
			Administrative Feasibility						
			· Permits required	· No permits would be required.					
			· Easements or right-of-way required	· No easements or right-of-way would be required.					
			· Impact in adjoining property	· No impacts on adjoining properties					
			· Ability to impose institutional controls	· No institutional controls would be implemented.					
			· Likelihood of obtaining an exemption from statutory limits	· Alternative would not exceed statutory limits.					
			State (Support Agency) and Community Acceptance	· This alterantive is unlikely to be acceptable to state and community stakeholders.					

Table 5-2: NTCRA Evaluation - Alternative 2 (Sediment Containment - Capping)

Effectiveness			Implementability			Cost			Overall Rating
Ability of the alternative to provide overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness.			*Ability to implement the alternative from an technical and administrative feasibility perspective, with regard to the availability of services and materials and the likelihood of state and community acceptance.*			*Relative cost of the alternative*			
	Rationale	**Rating**		**Rationale**	**Rating**		**Cost (2023 Dollars)**	**Rating**	
Protectiveness		1	**Technical Feasibility**		2	**Capital Cost**	**$29,927,000**	2	5
· Long-term protection of public health, the community and the environment.	· Protective of human health and the environment. A cap reduces contaminant flux to the water column and reduces concentrations in pore-water and solids at the sediment surface in the benthic habitat zone. · Capping is an established technology, the cap would be designed to achieve RAOs and PRGs at the site. Both the hydrodynamic and hydrogeological environment at the site are amenable to capping (quiescent hydrodynamic environment, relatively low groundwater upwelling, absence of mobile NAPL). Site contaminants are strongly sorbed to sediment solids, and the sand cap will provide reducing conditions both resulting in positive conditions for contaminant retention and containment. The cap will be designed to prevent bioturbating benthic organisms from reaching the chemical isolation layer. · Cap placement would physically and chemically isolate contaminated sediments and provide long-term control of the human health and ecological risks associated with contaminated sediments, long-term monitoring and regular maintenance would be required including repairs of damaged areas following infrequent storm events; permanence is increased by armoring areas susceptible to erosion along shorelines, around structures, and at stream discharge areas. Contaminated sediments would remain on site; however, cap placement would control risks and prevent exposure. · This alternative does not offer a reduction in volume of sediments remaining below the cap, however cap placement would reduce the mobility and toxicity of contaminated sediments.		· Construction and operational considerations	· Capping is a proven, technically feasible alternative. Specialized construction considerations may be required for the low-strength sediments observed at the site. Cap placement over power cable utility may not be allowed by owner.		**PRSC Cost (Long Term Monitoring)**	**$200,000**		
· Short-term protection of public health, the community and the environment.	· Potential risks to the community during construction would be limited given that the majority of work would be performed on-water with a limited staging are on the up-land industrial site. Minor, but increased levels of traffic, noise and potential turbidity in the water column as the cap is placed may be observed. Engineering controls and best management practices would mitigate most potential risks. · Potential risks to the environment during construction include effects on the ecological habitat during construction, these risks are expected to be minimal and short in duration.		· Demonstrated performance/useful life	· The cap will be designed to conform with best engineering practices for sub-aqueous sediment caps. The cap will be designed with independent layers to physically isolate contaminated sediment from, at a minimum, a 100-year storm event. The cap will be design to chemical isolate contaminated sediments, such that concentrations in the bio-active zone of the cap do not exceed the removal action criteria for a minimum of 100-years. A long term monitoring program will be required to verify that the cap is meeting long-term performance objectives.		**Present Value Cost**	**30,127,000.00**		
· Protective of workers during implementation	· Hazards associated with general construction, material would be placed from the water surface over existing sediments so there would be limited to no contact or exposure to contaminated sediment.		· Adaptable to environmental conditions	· Capping is viable alternative for the Bear Creek Sediments Site. Both the hydrodynamic and hydrogeological environment at the site are amenable to capping (quiescent hydrodynamic environment, relatively low groundwater upwelling). Site contaminants are strongly sorbed to sediment solids, and the sand cap will provide reducing conditions both resulting in positive conditions for contaminant retention and containment. The cap will be designed to prevent bioturbating benthic organisms from reach the chemical isolation layer. Geotechnical conditions at the site, the low solids content of the sediment, and in water structure and utilities will result in numerous difficulties and challenges related to removing a large volume of material. Site sediments are generally cleaner at the surface, the addition of cap on top of the existing site sediments will further protect surficial sediments and prevent exposure of deeper more highly contaminated sediments that would be exposed during a large scale-removal operation. Cap area is outside of navigational channel which reduces impact due to potential water depth reductions.					
· Complies with ARARs	· Under this alternative a sub-aqueous sediment cap will be designed to meet the ARARs and site RAOs.		**· Contributes to Removal Performance**	· This alternative will be protective of human health and the environment for sediments at the mouth of Tin Mill Canal.					

Table 5-2: NTCRA Evaluation - Alternative 2 (Sediment Containment - Capping)

Effectiveness			**Implementability**			**Cost**			**Overall Rating**
Ability of the alternative to provide overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness.			*Ability to implement the alternative from an technical and administrative feasibility perspective, with regard to the availability of services and materials and the likelihood of state and community acceptance.*			*Relative cost of the alternative*			
	Rationale	**Rating**		**Rationale**	**Rating**		**Cost (2023 Dollars)**	**Rating**	
			· Can be implemented in 1 year	· This alternative can be implemented in 1 year. Additional design investigation will be required prior to construction. Detailed survey information (in-water and shoreline) will be required during design to produce a high-resolution existing conditions basemap to be used in preparing drawings for the removal action. Detailed information on debris, in water structures, utilities and cultural resources may be required during design to refine assumptions on removal and capping. Diver survey and/or Marine Archeologist support may be required following initial conversations with SHPO. If mobility indicators suggest evidence oil and grease mobility or visual evidence of ebullition is observed is identified, advanced testing may be recommended during the PDI including wettability, capillary pressure vs. saturation testing, seepage induced consolidation testing and or ebullition experiments, etc. Discharge rates from Tin Mill Canal. To verify assumptions related to the need for an erosion control layer (ADCP, turbidity studies) limited hydrodynamic modeling following decisions on cap extent, thickness, material may be appropriate.					
Ability to achieve removal objectives									
· Level of treatment/containment expected	. Contaminated sediments would remain on site; however, cap placement would control risk and prevent exposure. · This alternative does not offer a reduction in volume of sediments remaining below the cap, however cap placement would reduce the mobility and toxicity of contaminated sediments. · Capping area over utility cable may not be feasible. · Treatment/containment and the RAOs would be achieved upon completion of construction activities.		**Availability**						
· No residual effect concerns	· Residual impacts within the sediment surface are anticipated to be low following construction. · Long-term monitoring would be required to manage the integrity of the cap.		· Equipment	· Materials and equipment for the cap and cap placement are readily available.					
· Will maintain control until long-term solution is implemented	· The removal action is designed to maintain control of the most-impacted sediments at the mouth of Tin Mill Canal. This alternative will provide physical and chemical isolation of contaminated sediments at the mouth of Tin Mill Canal. Over time the surface of the cap will take on the characteristics of background sediments throughout Bear Creek.		· Personnel and services	· Personnel and services for the cap and cap placement are readily available.					
			· Outside laboratory testing capacity	· Outside laboratory testing capacity will not be required.					
			· Off-site treatment and disposal capacity	· Off-site treatment and disposal capacity will not be required under this alternative.					
			· PRSC	· Long-term monitoring would be required to manage the integrity of the cap. Typically this would include an environmental monitoring program designed to evaluate the physical and chemical integrity of the cap on a routine basis and following extreme weather events. Institutional controls would be required to prevent disturbance of the cap.					
			Administrative Feasibility						
			· Permits required	· Coordination with permitting agencies will be required.					
			· Easements or right-of-way required	· In-water debris and remnant structures pose challenges for implementation, though capping technologies can achieve placement around and below structures. Soft, compressible sediment may consolidate significantly below a cap placed on the existing substrate; therefore, the utility crossing the site will require further study to develop an approach to avoid impacts.					

Table 5-2: NTCRA Evaluation - Alternative 2 (Sediment Containment - Capping)

Effectiveness			**Implementability**			**Cost**			**Overall Rating**
Ability of the alternative to provide overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short-term effectiveness.			*Ability to implement the alternative from an technical and administrative feasibility perspective, with regard to the availability of services and materials and the likelihood of state and community acceptance.*			*Relative cost of the alternative*			
Rationale		**Rating**	**Rationale**		**Rating**		**Cost (2023 Dollars)**	**Rating**	
			· Impact in adjoining property	· Alternative implementation will require coordination with adjacent landowners, permanent institutional controls will be required to sustain the long-term effectiveness and permanence of the cap.					
			· Ability to impose institutional controls	Permanent institutional controls will be required to sustain the long-term effectiveness and permanence of the cap					
			· Likelihood of obtaining an exemption from statutory limits	· An exemption from the $2 million statutory limit will be required for Alternative 2.					
			State (Support Agency) and Community Acceptance	· Capping may be considered an acceptable alternative to the State and community stakeholders. State agencies prefer maintaining areas of shallow (less than 4 feet) and deep water, which Alternative 2 will not fulfill as more area within the site will change from deep to shallow water.					

Table 5-3: NTCRA Evaluation - Alternative 3 (Capping with Sediment Removal and Offsite Disposal)

Effectiveness *Ability of the alternative to provide overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness.*			**Implementability** *Ability to implement the alternative from a technical and an administrative feasibility perspective, with regard to the availability of services and materials and the likelihood of state and community acceptance.*			**Cost** *Relative cost of the alternative*			**Overall Rating**
	Rationale	**Rating**		**Rationale**	**Rating**		**Cost (2023 Dollars)**	**Rating**	
Protectiveness		3	**Technical Feasibility**		1	**Capital Cost**	**$67,462,000**	0	4
· Protective of public health and the community	· Dredging is an established technology, the removal action would be designed to achieve RAOs and PRGs at the site. · This alternative offers a reduction in volume of sediments remaining below the cap; however cap placement would be required to control and further reduce the mobility and toxicity of remaining contaminated sediments. · Releases may occur during dredging, which may cause contamination in nondredged areas · Requires adequate long-term protectiveness in the area where sediments are ultimately disposed.		· Construction and operational considerations	· Less than Alternative 2 as dredging will be added as a construction activity. · Coordination will be required with adjacent property owners for temporary and permanent land for staging and pre-disposal activities. The land area required to dewater 190,000 CY of sediment may not be available.		**PRSC Cost (Long Term Monitoring)**	**$200,000**		
· Short-term protection of public health, the community, and the environment.	· Potential additional risks to the community during construction from increased levels of traffic, noise, odors, vapors, potential turbidity and resuspension of contaminants in the water as sediment is removed. Engineering controls and best management practices would mitigate most potential risks. · Potential risks to the environment during construction include effects on the ecological habitat during construction and resuspension of soft sediments during removal. These risks are expected to be minimal and short in duration, engineering controls and best management practices would mitigate most potential risks.					**Present Value Cost**	**$67,662,000**		
· Protective of workers during implementation	· Hazards associated with general construction, potential exposure and direct contact with sediment, odors, and vapors. Mitigation would be available through engineering controls and best management practices, compliance with health and safety plans and procedures, and use of personal protective equipment.		· Demonstrated performance/useful life	· Removing low density surface sediment that tends to have higher concentrations of contaminants will enhance cap placement and useful life. · Sediment dewatering and off-site disposal are commonly conducted for sediment removal.					
· Protective of the environment	· More than Alternative 2, dredging will remove a portion of the contaminated sediment from the site reducing toxicity, mobility, and volume. There will be an offset for potential residual and resuspension during construction. · Cap placement following removal would physically and chemically isolate remaining contaminated sediments and provide long-term control of the human health and ecological risks associated with contaminated sediments		· Adaptable to environmental conditions	There is a high degree of complexity in removing and processing sediment with low strength and low bulk density (high moisture content). Such sediments are complex to effectively remove, dewater to a manageable solids content for transport, and place at the disposal site. Costs for implementation are typically relatively high. Capping following removal is viable alternative for the Bear Creek Sediments Site. Removing low bulk density sediment prior to cap placement will enhance cap stability over the remaining aqueous sediment. Geotechnical conditions at the site, the low solids content of the sediment, and in water structure and utilities will result in numerous difficulties and challenges related to removing a large volume of material.					
· Complies with ARARs	· Under this alternative, a sub-aqueous sediment cap will be designed to meet the ARARs and site RAOs. The removal of material prior to cap placement may be more favorable if concerns are raised during the permitting process with cap material placement. The act of dredging triggers a number of action-specific ARARs, such as Rivers and Harbors Act, Clean Water Act dredge and fill requirements (USACE, state water quality certifications), and depending on the methods used for processing and disposal, many other requirements (NPDES, TSCA, RCRA, DOT, and others).		· Contributes to remedial performance	· Same as Alternative 2					
Ability to achieve removal objectives			· Can be implemented in 1 year	· Overall removal action will take approximately 24 months with dredging occurring in Year 1 and capping in Year 2.					
· Level of treatment/containment expected	· Same as Alternative 2; dredging will remove a portion of the contaminated sediment from the site reducing toxicity, mobility, and volume. There will be an offset for potential residual and resuspension during construction.		**Availability**						
· No residual effect concerns	· Same as Alternative 2 · Sediment with relatively low bulk density will tend to have greater potential for resuspension and generated residuals and releases, which may be transported to adjacent areas potentially requiring the use of silt curtains during removal for improved protectiveness.		· Equipment	· Same as Alternative 2 · Additional equipment required for processing and disposal operations					
· Will maintain control until long-term solution is implemented	· This alternative offers a reduction in volume of sediments remaining below the cap; however, cap placement would be required to control and further reduce the mobility and toxicity of deeper sediments.		· Personnel and services	· Additional personnel required for dredging, processing, and disposal operations					

Table 5-3: NTCRA Evaluation - Alternative 3 (Capping with Sediment Removal and Offsite Disposal)

Effectiveness *Ability of the alternative to provide overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness.*			Implementability *Ability to implement the alternative from a technical and an administrative feasibility perspective, with regard to the availability of services and materials and the likelihood of state and community acceptance.*			Cost *Relative cost of the alternative*			Overall Rating
Rationale		Rating	Rationale		Rating		Cost (2023 Dollars)	Rating	
			· Outside laboratory testing capacity	· Same as Alternative 2					
			· Off-site treatment and disposal capacity	· Off-site treatment and disposal capacity will be required under this alternative.					
			· PRSC	· Same as Alternative 2					
			Administrative Feasibility						
			· Permits required	· Same as Alternative 2 · Additional coordination with permitting agencies will be required for dredge and sediment management operations.					
			· Easements or right-of-way required	· Same as Alternative 2 · In-water debris and remnant structures pose challenges for implementation, though capping technologies can achieve placement around and below structures. · Dredging and capping over utility power line will require additional coordination					
			· Impact in adjoining property	· Similar to Alternative 2 · Alternative implementation will require additional coordination with adjacent landowners for sediment staging and processing prior to off-site disposal, permanent institutional controls will be required to sustain the long-term effectiveness and permanence of the sediment cap.					
			· Ability to impose institutional controls	· Same as Alternative 2					
			· Likelihood of obtaining an exemption from statutory limits	· Same as Alternative 2					
			State (Support Agency) and Community Acceptance	· This alternative may be preferred over Alternative 2 if stakeholders have a preference to maintain existing water depths over the entire removal area. Alternative 2 may be preferred by community members who have expressed concerns related to dredging in the area.					

Table 5-4: NTCRA Evaluation - Alternative 4 (Capping with Partial Sediment Removal and Offsite Disposal)

Effectiveness *Ability of the alternative to provide overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness.*			**Implementability** *Ability to implement the alternative from a technical and an administrative feasibility perspective, with regard to the availability of services and materials and the likelihood of state and community acceptance.*			**Cost** *Relative cost of the alternative*			**Overall Rating**
	Rationale	**Rating**		**Rationale**	**Rating**		**Cost**	**Rating**	
Protectiveness		2	**Technical Feasibility**		3	**Capital Cost**	**$45,545,000**	1	6
· Protective of public health and the community	· Same as Alternative 2 and 3		· Construction and operational considerations	· Similar to Alternative 2 and 3, coordination will be required with adjacent property owners for temporary land for staging and sediment processing activities.		**PRSC Cost (Long term monitoring)**	**$200,000**		
· Short-term protection of public health, the community, and the environment.	· Similar to Alternative 2 and 3, potential risks to the community during construction would be higher than Alternative 2 as sediment would be transported off-site.					**Present Value Cost**	**$45,745,000**		
· Protective of workers during implementation	· Similar to Alternative 2 and 3, hazards are associated with general construction, potential exposure, direct contact with sediment, travel and transportation risks, odors, and vapors. Mitigation would be available through engineering controls and best management practices, compliance with health and safety plans and procedures, and use of personal protective equipment.		· Demonstrated performance/useful life	· Same as Alternative 3					
· Protective of the environment	· Same as Alternative 2 and 3		· Adaptable to environmental conditions	Partial sediment removal allows the remedy to more effectively adapt to existing site conditions such as the utility power line and wood structures in the deeper water.					
· Complies with ARARs	· Same as Alternative 2 and 3		**· Contributes to Removal performance**	· Same as Alternative 2 and 3					
Ability to achieve removal objectives			· Can be implemented in 1 year	· No, but less than time required for Alternative 3.					
· Level of treatment/containment expected	· Same as Alternative 2 and 3		**Availability**						
· No residual effect concerns	· Similar to Alternative 2 and 3. Smaller dredge area will yield lower residual effects than Alternative 3. Resuspension controls, such as turbidity curtains, are easier to install for nearshore dredging only.		· Equipment	· Same as Alternative 3					
· Will maintain control until long-term solution is implemented	· Same as Alternative 2 and 3		· Personnel and services	· Same as Alternative 3					
			· Outside laboratory testing capacity	· Same as Alternative 2 and 3					
			· Off-site treatment and disposal	· Same as Alternative 3					
			· PRSC	· Same as Alternative 2 and 3					
			Administrative Feasibility						
			· Permits required	· Same as 3					
			· Easements or right-of-way required	· Same as Alternative 3					
			· Impact in adjoining property	· Same as Alternative 3					
			· Ability to impose institutional controls	· Same as Alternative 2 and 3					
			· Likelihood of obtaining an exemption from statutory limits	· Same as 3. Dredging will occur in Year 1 and capping in Year 2.					
			State (Support Agency) and Community Acceptance	· Similar to 3. Retaining shallow water depth is likely positive to stakeholders.					

Table 6-1: Comparative Analysis of Removal Alternatives

Alternative	Effectiveness	Rating	Implementability	Rating	Cost	Rating	Overall Rating
Alternative 1 - No Action	Provides no protection of human health and the environment. Does not achieve removal objectives.	0	No restrictions on implementation since there is no action. The no action alternative is unlikely to be acceptable to state and community stakeholders.	0	Lowest cost at $0 since no action is taken	3	**3**
Alternative 2 - Capping (on existing surface)	Protects human health and the environment. Achieves removal objectives, although significant contaminant mass remains. Low bulk density surface sediment may impair effectiveness of cap.	1	Capping is a proven, technically feasible alternative. Presence of low bulk density surface sediment may adversely affect cap placement. Significant changes to the final sediment surface after cap placement may not be acceptable to state agencies.	2	Second lowest cost at $29.9 million	2	**5**
Alternative 3 - Capping with Sediment Removal and Off-site Disposal	Protects human health and the environment. Achieves removal objectives. Removes a significant contaminant mass. Dredging full area also minimizes potential disturbance to cap after placement.	3	Dredging is technically feasible, but the land area required to dewater and process 190,000 CY of sediment may not be available. This option takes the longest at 24 months and involves a significant amount of truck traffic compared to the other options. Extensive dredging does enhance long-term cap performance.	1	Highest Cost at $67.4 million	1	**5**
Alternative 4 - Capping with Partial Sediment Removal and Off-site Disposal	Protects human health and the environment. Achieves removal objectives. Removes areas of highest surface sediment contamination and low bulk density sediment. Dredging near shore areas mitigates potential disturbance from man-made and natural phenomenon.	2	Partial dredging of the softer sediments with the highest levels of contamination improves cap placement and long-term cap survivability in nearshore areas. The available land area should be adequate to process the reduced sediment dredge volume. Maintaining final water depth equivalent to existing conditions in nearshore areas would be most acceptable to state agencies.	3	Third highest cost at $45.5 million	2	**7**