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TREATABILITY STUDY WORK PLAN
FINAL

Benning Road Facility
3400 Benning Road, NE
Washington, DC 20019

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Washington, DC 20019

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List of Acronyms

AC	activated carbon
AECOM	AECOM Technology Services, Inc.
ARSP	Anacostia River Sediment Study
BAZ	Bioactive Zone
BERA	Baseline Ecological Risk Assessment
BHHRA	Baseline Human Health Risk Assessment
BMP	Best Management Practice
Bss	below sediment surface
cm	centimeters
COPC	Constituents of Potential Concern
CTE	Central Tendency Exposure
District	District of Columbia
DOEE	District Department of Energy and Environment
EMNR	Enhanced Monitored Natural Recovery
ft	feet
FS	Feasibility Study
GAC	granulated activated carbon
GPS	Global Positioning System
HI	Hazard Index
In	inches
LOI	Loss on Igintion
M	meters
µg/kg	micrograms per kilogram
MLLW	mean lower-low water
MTL	mean tide level
MNR	Monitored Natural Recovery
NPS	National Park Service
NWP	Nationwide Permits
pg/l	picograms per liter
ppb	parts per billion
PAC	powdered activated carbon
PCB	Polychlorinated Biphenyl
Pepco	Potomac Electric Power Company and Pepco Energy Services, Inc.
POM	polyoxymethylene
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasbility Study
RME	Reasonable Maximum Exposure
SPME	Solid Phase Microextraction
TS	Treatability Study
TSWP	Treatability Study Work Plan
UMBC	University of Maryland Baltimore County
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
Yr	year

1 Introduction

The Potomac Electric Power Company (Pepco) is performing a Remedial Investigation/Feasibility Study (RI/FS) at Pepco's Benning Road facility (the Site), located at 3400 Benning Road NE, Washington, DC, and a segment of the Anacostia River (the River) adjacent to the Site, under the oversight of the District Department of Energy and Environment (DOEE) (formerly the District Department of the Environment). The location of the Site is depicted in Figure 1-1.

The Study Area for the RI/FS consists of a "Landside Investigation Area" focused on the Site itself, and a "Waterside Investigation Area" focused on the shoreline and sediments in the segment of the Anacostia River adjacent to and immediately downstream of the Site. The areas encompassed by the investigation are shown on Figure 1-2.

The purpose of the Benning Road facility RI/FS is to: (a) characterize environmental conditions within the Study Area, (b) investigate whether and to what extent past or current conditions at the Site have caused or contributed to contamination of the River, (c) assess current and potential risk to human health and the environment posed by conditions within the Study Area, and (d) develop and evaluate potential remedial actions, as may be warranted. The revised Draft Final Remedial Investigation Report (Draft Final RI Report) for the Benning Road Site was submitted to the DOEE on September 20, 2019. The Draft Final RI Report addresses the first three objectives outlined above, and the forthcoming FS Report will address the development and evaluation of potential remedial actions.

As part of the FS process, Pepco has identified the need for a Treatability Study (TS) involving both field data collection and bench-scale studies to support the evaluation of potential remedial alternatives to address sediments in the Waterside Investigation Area. No such need was identified for the Landside Investigation Area to date (however, additional pre-design sampling will be performed to determine PCE plume sourcing and migration in the Landside Investigation Area and a final determination regarding the need for a landside treatability study will be made based on the results of this sampling).

The Waterside Investigation Area treatability studies will be focused on the following key FS data needs:

- Analysis of the effectiveness of sequestration agents (the use of amendments to reduce bioavailability of contaminants by sorption) and other active and inert capping materials;
- Hydrologic/hydraulic data collection and outfall assessment to understand how these data may affect design and performance of remedial alternatives, including restoration;
- Geotechnical evaluations to determine the feasibility of capping systems and ex-situ sediment dewatering; and
- Sedimentation studies to evaluate the effect of ongoing upstream sources on the performance of remedial alternatives.

In November 2018, a Draft TS Work Plan (TSWP) for the Waterside Investigation Area was submitted to the DOEE. The Draft TSWP was updated to reflect these comments and provided to the DOEE in December 2019 as a Draft Final document. In January 2020 the DOEE provided comments on the

Draft Final TSWP. This Final TSWP has been updated to reflect this second round of DOEE comments.

The TSWP outlines the scope of work for TS in the Waterside Investigation Area. The TS will focus on the approximately 4.2-acre cove of the River which is located just north of the Site beyond the National Park Service (NPS) Kenilworth Maintenance Yard property (the Cove). The Cove receives storm water conveyed from the Site via outfall 013 and multiple other sources via additional outfalls, and is depicted in Figures 1-1 and 1-2.

1.1 Site Setting

The 77-acre Site is entirely fenced and access is controlled at all times. The former Benning Road Power Plant was located in the western portion of the Site until it was permanently shut down in 2012. Demolition and removal of the power plant building and related infrastructure was completed in 2015. Most of the Site is currently occupied by the Benning Service Center, which supports activities related to construction, operation and maintenance of Pepco's electric power transmission and distribution system serving the Washington, DC area. Three substations serving Pepco's transmission and distribution system are also located on this Site. The Site is separated from the Anacostia River by a thin strip of land that is part of Anacostia Park. The River is an urban tidal estuarine river corridor with multiple historical and current sources of contamination, both up- and down-stream of the Site.

1.2 Remedy Framework

The remedy framework proposed by Pepco for addressing areas of elevated COPC sediment concentrations within the Waterside Investigation Area is intended to fit within the adaptive management strategy for the Anacostia River Sediment Project (ARSP), in which the first phase of response actions will focus on eliminating exposure to sediment "hot spots," addressing uncontrolled upstream sources, allowing for continued natural recovery, and considering additional data to reduce uncertainties and asses the need for further remedial action. As the Cove is one of the locations in the Anacostia River with concentrations sufficiently elevated to warrant its designation as a "hot spot," this treatability study evaluates potential early actions that could address this contamination. Consistent with the adaptive management framework for the ARSP, other portions of the Waterside Investigation Area may be considered for additional actions, depending on the results of ARSP performance monitoring results obtained after the first phase of response actions.

A substantial portion of the RI focused on field sampling and data analysis to define the nature and extent of constituents of potential concern (COPCs) in groundwater, soils, and Anacostia River sediment and surface water. Extensive RI data were collected during two phases of investigation, extending from 2013 to 2018, to document the presence and general distribution of COPCs. A number of different organic and inorganic constituents were detected in these environmental media, and potential risks associated with exposure to these constituents were evaluated in a Site-specific Baseline Human Health Risk Assessment (BHHRA) and a Site-specific Baseline Ecological Risk Assessment (BERA). Potential risks to multiple human and environmental receptors were evaluated using conservative risk analysis tools and an extensive Site-specific data set in accordance with U.S. Environmental Protection Agency (USEPA) and DOEE guidance. The human health risk assessment also evaluated fish consumption pathways, relying on fish tissue data collected by DOEE and others from the broader Anacostia River.

Within the Landside Investigation Area, the BERA and BHHRA determined that exposure to environmental media at the Site posed no unacceptable ecological risk and only limited potential risks to human health as a result of potential future exposure to contaminated soil within the Site, given appropriate institutional controls (e.g., restricted access to subsurface soils and to uncharacterized portions of the site, such as switchyards). Although remedial action is potentially warranted within portions of the Landside Investigation Area, no treatability studies were deemed necessary at this time for the evaluation of remedial alternatives to address these Landside conditions.

Within the Waterside Investigation Area, potential risks to human health posed by exposure to water and surface sediments are all within EPA's acceptable risk ranges, and ecological risks posed by conditions in the Waterside Investigation Area are relatively low and not substantively different from risks at reference areas considered in the RI. The RI found that concentrations of polychlorinated biphenyls (PCBs) and other COPCs were elevated in surficial sediment in the Cove compared to background, and the BERA findings indicate a low to indeterminate potential for risks to benthic receptors exposed to surficial sediments in this area. The BERA determined that the bioactive zone (BAZ) in the Waterside Investigation Area ranges from 0 to 6 inches (typically 4 inches or less) and in the Cove, ranges from 0.16 to 4.76 inches in depth.

None of the potential cumulative receptor carcinogenic risks evaluated in the RI exceed the upper end of USEPA's target risk range of 10^{-6} to 10^{-4} for consumption of Upper Anacostia River fish for the reasonable maximum exposure (RME) scenario (for the purpose of the RI, the Upper Anacostia was operationally defined as the River reach that is upstream of the CSX bridge.). Noncarcinogenic hazards exceed USEPA's target HI of 1 for consumption of Upper Anacostia River fish. Fish consumption hazards estimated using data collected by DOEE throughout the Anacostia and Potomac Rivers exceed the noncancer target HI of 1; these findings suggest multiple sources of PCBs and other urban contaminants, including upstream of the extent of the tidal influence of the Waterside Investigation Area. The RI further concluded that considerable uncertainties remain relative to the relationship between sediment COPCs in the Waterside Investigation Area and Anacostia River fish tissue residues.

The FS will evaluate remedial alternatives to control exposure to soil at the Site and to address sediment conditions in the Waterside Investigation Area. In particular, eliminating exposures within the Cove is expected to reduce the overall surface weighted average of PCBs within the Waterside Investigation Area to a level consistent with existing currently-measured local background conditions. Background threshold values (BTVs) of 182 parts per billion (ppb) for PCB Aroclors and 423 ppb for PCB Congeners were established in the Draft Final RI (AECOM, 2019). The pre-remedial Surface Weighted Average Concentration (SWAC) of PCBs in the Waterside Investigation Area is estimated to be 334 ppb (measured as PCB Aroclors). A preliminary analysis indicated that active remediation of the surface sediment in the 4.2-acre Cove through capping or removal would reduce the SWAC in the overall Waterside Investigation Area to 195 ppb (measured as Aroclors), in line with the upstream currently-measured background conditions. Given the source control measures that will be undertaken for the ARSP, it is possible that upstream background concentrations are expected to decline in future years, resulting in a new baseline for comparison.

1.3 Remedial Options to be considered in the Feasibility Study

In accordance with USEPA guidance and regulations, the FS for the Waterside Investigation Area will include an initial screening of a wide range of potential remedial options followed by a detailed evaluation of the most promising options. Technologies to be considered in the FS and the data needed to evaluate these technologies in the FS are summarized in Table 1-1**.**

Table 1-1: Remedial Options to be Considered in the Feasibility Study

Remedial Approach	Description	Site Conditions Favoring	Data Need(s)
Monitored Natural Recovery (MNR)	Uses un-enhanced naturally-occurring processes to transform, immobilize, isolate, or otherwise remove COPCs	Where natural recovery processes are expected to continue at rates similar to existing conditions; Where human exposure is limited or can be limited by institutional controls; Where COPC exposures to biota are already approaching remedial cleanup levels; Where the sediment bed is stable and likely to remain stable after remedial actions are completed.	Sediment stability: deposition rate, erosion potential, water depth/bathymetry, in-water and shoreline infrastructure, sediment hardness and slope conditions, and groundwater/surface water interactions Sediment characteristics: Physical properties (grain size, density, consolidation), benthic community, and bioturbation COPC characteristics: Horizontal and vertical distribution, COPC type and concentration in sediment and in surface water/outfalls, exposure pathways, mobility mechanisms, bioavailability and bioaccumulation potential, transformation, and degradation Hydrodynamic assessment: groundwater/surface water interactions; tidal water fluctuation; surface water flowrates and velocities; outfall discharge
Enhanced Monitored Natural Recovery (EMNR)	Relies on one or more technologies (i.e., thin layer capping; reactive amendments) to enhance ongoing natural recovery processes while minimizing the effects on the aquatic environment	Same as MNR except can be applied where ongoing natural processes are slow as the technology will hasten recovery	*Same as MNR with the following additions*: Constituent sequestration assessment: effectiveness of various types of amendment, dose rate of effective amendments (as function of sediment grain size and TOC)
Capping	Placement of granular material over sediments to reduce direct exposure; cap materials can be amended to attenuate contaminant flux	Where hydrodynamic conditions are not likely to compromise the cap Where long-term risk reduction outweighs habitat disruption Where sediment has sufficient strength to support the cap materials	*Same as MNR and EMNR with the following additions*: Bathymetric characteristics: complete delineation of bathymetry for area/volume computations Sediment bearing capacity: measure in situ sediment physical characteristics to assess strength COPC isolation assessment: theoretical and empirical data used in modeling assessment to predict COPC mobility

Table 1-2: Remedial Options to be Considered in the Feasibility Study (continued)

Remedial Approach	Description	Site Conditions Favoring	Data Need(s)
Dredging/ Excavation	Removal of sediment to either the depth of constituent impact or a shallower depth that meets the remedial goal	Where contaminant mass and risk of erosion make cap placement impractical Where required to accommodate for placement of cap materials Where long-term risk reduction outweighs habitat disruption	*Same as MNR, EMNR and Cap with the following additions*: Sediment dewatering characteristics for mechanical and/or hydraulic dredging: grain size distribution with hydrometer; solids content and moisture content; TOC; various gravity, mechanical and centrifugal dewatering assessments; filtrate water quality assessment; amendment dewatering study
Restoration	Restoration of habitat disrupted by dredging and/or placement of cap	Where remedial activities disrupt habitat Where existing habitat is compromised due to contamination which remedial activities ameliorate Where integrating remediation and restoration activities provides value relative to regulatory framework	*Same as MNR, EMNR and Permeable Cap with the following additions*: Plant community assessment: observation of plant species on and adjacent to restoration site; observation of substrate characterization with depth Invertebrate community assessment will rely on benthic invertebrate data collected during the RI, supplemented by data to be collected as part of this TSWP

Sources of information:
U.S. EPA, 2005.
ITRC, 2014.

2 Scope of Work

The proposed scope of work for the Waterside Investigation Area TS is presented below. The work will be conducted in accordance with US EPA's *Guidance for Conducting Treatability Studies under CERCLA* (EPA, 1992). Data quality objectives, or DQOs, have been established for each task in the scope of work. DQOs are summarized in Table 2-1.

2.1 Contaminant Sequestration Assessment

The results of the RI indicate that concentrations of several COPCs in sediment, particularly in the Cove, pose a potential risk to benthic receptors, and that concentrations of COPCs such as PCBs are higher in the Cove than elsewhere in the Waterside Investigation Area. Therefore, EMNR technologies that reduce the bioavailability of PCBs and other COPCs through sequestration will be considered in the FS.

Contaminant sequestration assessment data, using site-specific sediment and a range of activated carbon (AC) products, is needed for the evaluation of EMNR. In addition, enhancement of capping systems through addition of amendments (e.g., AC) to help sequester COPCs may also be evaluated in the FS and in future design efforts. Therefore, this TSWP includes evaluation of amendment addition to support EMNR and/or capping systems for FS analyses. The results of the TS will be used to establish comparative effectiveness of amendment material type(s) and approximate application rate(s). The contaminant sequestration assessment will be used to identify the AC concentration and form (powdered activated carbon [PAC] vs granulated activated carbon [GAC]) that best achieves the remedial objectives, and will be used to refine dosage as well as delivery and application.

2.1.1 Bench-Scale Assessment

Bench-scale laboratory testing will be conducted to (a) determine the effectiveness of a variety of demonstrated AC amendments to sequester and to reduce the bioavailability of PCBs in sediment obtained from the Waterside Investigation Area, and (b) select effective dose(s) of a subset of amendments. Amendment effectiveness will be determined by evaluating pore water concentrations of PCBs via passive sampling methods, which target freely dissolved concentrations. Pore water analysis is an effective and demonstrated means of predicting the bioavailability of hydrophobic compounds, such as PCBs (Ghosh et al., 2014). Supplemental bioaccumulation studies on the best performing amendment will be performed to verify the reduction in bioavailability. The results from this assessment will be incorporated into the FS remedial evaluation. While a field demonstration project is not proposed at this time, the results from this assessment could be used to develop a future field-scale project to demonstrate and validate the selected amendment.

Pepco has selected a set of AC amendment types to be evaluated in laboratory batch experiments. While the success of bulk AC materials, such as GAC or PAC, is well documented for in-situ treatment of hydrophobic organic compounds such as PCBs, the delivery of bulk AC in submerged aquatic environments can be challenging. Therefore, various AC dry broadcast delivery products, such as SediMite™ and permeable AquaGate+® products have been included in this assessment. A description of these products and their applications is provided below.

- **Bulk Activated Carbon (GAC/PAC)**: Bulk AC, including PAC and GAC, can be applied directly to in-situ sediments for sequestration of hydrophobic organic compounds, such as PCBs, or these materials can be mixed with sand to form a sorbent permeable thin layer cap system. There are substantial delivery challenges associated with use of PAC as a stand-alone remedy in a system such at the Anacostia River; therefore, this TSWP focuses on use of bulk GAC, which can be applied directly to sediment or mixed with capping materials to enhance performance of the cap. When used as a stand-alone technology, GAC relies on bioturbation and other natural processes to distribute AC throughout the BAZ.

- **SediMite**™: SediMite™ is a patented pelletized material containing high doses of AC (50% by dry weight) that is designed to deliver AC to in-situ sediments. Once deployed, SediMite™ pellets sink, forming a thin, permeable layer on the sediment surface. SediMite™ pellets break down over a period of time (which can be engineered to range from one week to several months, depending on the site characteristics and project requirements) releasing AC into the aquatic environment. Over time, the AC becomes incorporated into the sediment BAZ via natural process such as bioturbation, further stabilizing the material into the surface of the sediment. SediMite™ can be deployed either as a stand-alone response action, or can be mixed with sand or other inert materials as part of a capping system. When used as a stand-alone technology, SediMite™ relies on bioturbation and other natural processes to distribute AC throughout the BAZ.
- **AquaBlok® Delivery Products:** AquaBlok® delivery products include AquaGate®+PAC (powdered activated carbon), a patented AC delivery product that is manufactured by AquaBlok®, Ltd. AquaGate®+PAC is a composite-aggregate material comprised of a dense aggregate core surrounded by a mixture of clay or clay-sized particles, polymers for binding, and PAC (5%, 10%, or custom concentration by dry weight). AquaGate®+PAC sinks, to form a thin layer of AC-rich material on the sediment surface. AquaGate®+PAC can be deployed either as a stand-alone response action, or can be mixed with sand or other inert materials as part of a capping system. When used as a stand-alone technology, AquaGate®+PAC relies on bioturbation and other natural processes to distribute AC throughout the BAZ.

Although the purpose of this program is to evaluate AC sequestration of PCBs in cove area sediment (and not to evaluate the efficacy of AC from different sources), it is recognized that AC can be sourced from a variety of raw materials (e.g., coal-based AC, coconut shell-based AC, etc.). Prior to initiating the pilot studies, the pelletized material vendors (i.e., the producers of AquaBlok® and SediMite™) will be contacted to provide product specification data, including the source of the AC used in their products, With respect to the bulk-activated carbon studies, Pepco will review technical and scientific literature with our sub-contractor (Dr. Upal Ghosh, University of Maryland Baltimore County); if there are differences in AC PCB sorptive capacity that should be accounted for in the pilot studies, Pepco will attempt to conduct these pilot studies with the type of AC with the highest affinity for PCBs, assuming that use of this material on a full scale is practicable (e.g., cost-effective and available in quantity that could be scaled to full scale remediation).

2.1.2 Experimental Design – Evaluation of Amendment Effectiveness

This evaluation includes laboratory batch experiments using sediment collected from the Cove within the BAZ (0 to 10 cm) to determine the effectiveness of selected sequestration agents. A composite surface sediment sample will be collected from two Cove locations (Figure 2-2) that represent the highest PCB surficial bulk sediment concentration (1,900 micrograms per kilogram [µg/kg] at SED7.5E) and dissolved phase PCB pore water concentration (10,000 picograms per liter [pg/L] at SED7E) within the Waterside Investigation Area. Pepco currently plans to engage Dr. Upal Ghosh from the University of Maryland Baltimore County (UMBC) to support this effort in a sub-contract capacity. Dr. Ghosh is an internationally recognized expert on PCB bioavailability and use of AC amendments to manage PCBs in sediment settings, and has previously evaluated flux and bioavailability of hydrophobic organic constituents (including PCBs) as part of the ARSP.

It is anticipated that sediment collection permits will be required from the U.S. Army Corps of Engineers (USACE), the District Department of Energy and Environment (DOEE), and the National Park Service (NPS). It is expected that the required authorization from the USACE will be provided under one or more Nationwide Permits (NWP) with a water quality certification from DOEE. In order to streamline the process and expedite the schedule, PEPCO will explore the possibility of amending the permits previously obtained for RI field activities.

Amendment effectiveness will be determined based on the reduction of pore water dissolved phase PCB concentrations in amended surficial sediments compared to pre-treatment conditions. Sediment samples will be homogenized prior to collecting subsamples to be used in amendment batch reactors. Subsamples will be collected for bulk sediment PCB concentrations prior to the addition of amendment. Batch reactors will receive various treatments (i.e., application of a specific amendment type and concentration) including an un-amended control. Each treatment will be performed in triplicate. Amendments will be well mixed by hand or low impact ribbon-type mixer to represent ideal mixing, and then allowed to equilibrate for a minimum period of 28-days prior to porewater and bioaccumulation testing. Following this incubation period, oligochaete worms (*Lumbriculus variegatus)* will be added to all batch reactors including the controls. Table 2-2 presents the experimental design including the number of replicates for each treatment. The objective is to determine the overall effectiveness of the various amendments. Therefore, the amendments will be applied directly to the sediment in the lab and mixed within the top 10 cm to achieve the target concentrations. Data collected in these studies will be used in computer modeling to evaluate scenarios involving use of amendment applied directly to the sediment surface as well as potential mixing of amendments into the capping materials.

Control and amended batch reactors will be sampled after 28 days of treatment or at the end of curing/incubation period. Pore water from subsamples collected from batch reactors will be analyzed for dissolved-phased PCBs using passive sampling methods, such as polyoxymethylene (POM) or polyethylene (PE) passive sampling devices and in accordance with USEPA (2012) and U.S. EPA/SERDP/ESTCP (2017) guidance. POM or PE passive samplers will be pre-loaded with performance reference compounds and added to sediment samples to sorb freely dissolved PCBs. These samplers will be allowed to equilibrate for one month, whereupon passive sampler devices will be removed from sediment samples and PCBs will be extracted from the sampling membrane. PCBs will be analyzed using high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) in accordance with EPA method 1668 or similar method as determined in the final experimental design.

This evaluation will also aid in optimization of amendment concentration by determining the concentration-response relationship and confirming the most effective amendment and AC delivery product. A range of amendment concentrations will be evaluated for the selected amendment to find the optimal point where equilibrium is reached and further addition of the amendment would be ineffective. Observation of toxic levels of carbon content have been reported at concentrations as low as 5% by weight (Beckingham et al, 2013). The approach in this study is to evaluate concentrations in 1 to 5% range.

Evaluation of the pore water data will be focused on determining whether there is a significant decrease in PCB bioavailability in amended surficial sediment samples (i.e., decrease in dissolved phase PCB pore water concentrations) compared to the controls. Results of these analyses will be used to determine amendment effectiveness and to help identify the best performing amendment and dosage.

Table 2-2: Phase 1 Experimental Design to Evaluate PCB Bioavailability Using Different Amendments

Amendment	AC Concentration in Test Samples (% Dry Weight)	AC Content of Amendment Material as Supplied (% Dry Weight)	Number of Replicates
NA (Laboratory Control)	0	NA	3
NA (un-amended control batch)	0	NA	3
Activated Carbon (GAC)	1	100	3
	3	100	3
	5	100	3
SediMite™	1	50	3
	3	50	3
	5	50	3
AquaBlok® Delivery Product	1	10	3
	3	10	3
	5	10	3
Total Number of Batches			**33**

All reactors will also be set up to facilitate the collection of bioavailability data. Bioaccumulation studies will be conducted to evaluate whether decreases in PCB tissue residues are observed in laboratory organisms exposed to amended sediments compared to organisms exposed to unamended sediments. Sediment samples used for the laboratory bioaccumulation evaluation will be obtained from the composite samples described above.

Bioaccumulation testing will be performed by the University of Maryland Baltimore County laboratory. Testing will be conducted in accordance with methods presented in EPA's *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates: Second Editio*n. Each sample will be tested using *Lumbriculus variegatus* (Test Method 100.3). Laboratory control sediments will be provided by the laboratory. Tests will be considered acceptable when conditions in the laboratory control treatment meets test acceptability criteria presented in the EPA guidance manual. In the event that the laboratory control treatment fails to meet acceptability criteria, corrective action to identify the source of the problem will be implemented.

Tissue from laboratory control replicates, unamended sample of cove sediment, and the replicates of the best performing amendment (based on pore water data) will be used for bioaccumulation testing at test termination. Tissue samples will be analyzed for lipid content and total PCBs as congeners by EPA or similar methods used by UMBC laboratory consistent with the Anacostia River Sediment Project (ARSP) methods.

2.2 Hydrologic/Hydraulic, Sedimentation Assessment

Hydrologic and hydraulic data are needed to evaluate multiple components of various remedial scenarios. For MNR and EMNR remedial scenarios, hydrologic data are needed to assess the physical stability of in situ sediment. The physical data required for assessment of MNR and EMNR will also be used to confirm capping system material stability. Updated bathymetric data are also needed to support MNR, EMNR, capping system, and dredging remedial scenario evaluations, as well as restoration planning.

Hydrologic/hydraulic parameters which warrant further study include, (a) flood levels and seasonal flow conditions (e.g., velocities and shear stress during major flood events), (b) tidal fluctuation/inundation levels in relation to surface elevations, (c) quality, volume, and velocities of flows into the Cove from existing discharge outfalls under proposed scenarios, and (d) effects on riverine hydrodynamics from surface contour and hydrology changes in the Cove. This information is needed to assess the suitability and sustainability of the remediated Site to support wetland plant species given the tidal fluctuation/inundation and various hydrologic inputs to the system. In addition to collecting accurate bathymetry and flow data, there is a need to better understand groundwater hydrology flux into the overlying sediment within the Cove. This information will help inform the need for amendments as well as the selection of granular backfill materials.

Information is also needed on the sedimentation characteristics of the Cove. A radiochemistry core collected by Pepco at sampling location SED7E (Figure 2-1) in the Cove indicates that depositional rates are approximately 1 centimeter per year (cm/yr), and the grain size analysis in the Cove indicates that the area is largely depositional; percent fines (the sum of silt and clay fraction) in bulk sediment in the Cove range up to 82% (AECOM, 2019). In addition, several cores collected by DOEE as part of the ARSP (Tetra Tech, 2018) indicate that there are high rates of sedimentation in the vicinity of the Waterside Investigation Area, with well-defined 137Cs peaks and corresponding sedimentation rates that range from 1 to 3 cm/yr. Downstream of the CSX Bridge, Velinsky (2011) measured sedimentation rates up to 3 cm/yr. There is a need to assess depositional rates in other areas of the Cove to verify the stability of amendments placed for purposes of EMNR as well as for capping system design.

2.2.1 Cove Bathymetry

Bathymetric and side scan sonar data for the Waterside Investigation Area were last collected in 2013 via hydrographic survey. These data are referenced to the Mean Lower-Low Water (MLLW) datum and the North American Vertical Datum of 1988 (NAVD 88), and provide good coverage in the river channel and into the western part of the Cove. Available bathymetry data as depicted on Figure 2-4 shows the transects that were completed during the RI in order to complete bathymetric mapping. Due to limitations in the technologies used in the RI, and the shallow water depths in the Cove, these transects do not span the entire Cove in either direction. Therefore, additional higher resolution and focused data are needed to expand coverage in the Cove. Updated bathymetric data will be used to support FS alternatives analysis and to support evaluation of the need for and design of support structures (i.e., temporary sheet pile) during remedy implementation. River tidal elevation data relative to tidal wetland conditions are also available from other nearby studies, such as the Anacostia River Fringe Wetlands Restoration Project.

A qualified DC-licensed surveyor will be engaged to complete the detailed survey of the Cove, which has not been surveyed in the past. The remaining portion of the Waterside Investigation Area will be re-surveyed at the same time, since the previous survey of this area was conducted over 5 years ago. Given the limited water depth in the area, the Cove survey will most likely be conducted at low tide using upland topographical survey techniques. The limit of the proposed survey is depicted in Figure 2-4**.** Data will be collected to verify the current grades in the Cove relative to tidal stages, including Mean High Water (MHW), Mean Tide Level (MTL), and MLLW, as these are critical stages affecting tidal wetland development, and to determine the change in grades required to establish appropriate tidal inundation/flushing for freshwater emergent marsh vegetation. These data are also needed assess the suitability and design of a temporary sheet pile barrier to isolate activities in the Cove during remedial construction. This information will be useful in evaluating MNR, EMNR, capping system, and dredging remedial alternatives in the FS and to support future remedial design efforts.

2.2.2 Surface Water Flow Monitoring

Three surface water stations will be installed to support the hydrodynamic analysis and design of the remediation. One station will be located in the Cove, one located in the river approximately 1,500 to 2,000 feet upstream of the Cove, and one located in the river at the Benning Road Bridge approximately 1,500 to 2,000 feet downstream of the Cove. Each station would be equipped with a staff gauge and a recording pressure transducer (Solinst LTC Leveloger Edge or equivalent). Proposed staff gauge locations are shown on Figure 2-2. The pressure transducer records data on water level (stage), water temperature, and conductivity. To capture the seasonal water level variation, a 12-month monitoring is proposed. It is recognized that the FS will commence prior to completion of the 12-month monitoring period; data gathered from the latter portion of this monitoring will be used to help inform the remedial design. AECOM will visit the Waterside Investigation Area twice per month to download the data from pressure transducers at the three stations. The timing of site visits will be determined by anticipated streamflow conditions, the timing and magnitude of tides, and other project needs (i.e. input for modeling efforts). The installations will be located both for hydraulic considerations (providing optimal data for project requirements) and for security (minimal visibility). While the installations will be secured to the extent reasonably practical, they will not be fully inaccessible. If one or more stations is damaged or destroyed, an evaluation will be made as to whether the stations need to be reestablished. Data from this evaluation will be incorporated into a detailed two-dimensional hydrodynamic model, which will be required as part of the FS to understand the flow patterns under various riverine and tidal conditions.

2.2.3 Surface Water Discharge

The FS will require a better understanding of existing and expected future discharges from the various existing outfalls located in Cove. Determining peak flow rates of these discharges is needed to assess their potential effect on Cove surface sediment stability and remedy implementability, as well as marsh development and growth. The existing Site outfall (Outfall 013) discharges through the Cove in a low-flow channel. This flow may need to be similarly conveyed in a low-flow channel under future conditions after implementation of the remedial action; therefore, the velocity/rate of flow should be understood to ensure an appropriate configuration or alternative conveyance mode such as sheet flow. Similar evaluations are needed for the other outfalls to the extent that the necessary information can be obtained. A discussion of all outfalls within the Waterside Investigation Area is presented in Section 2.5.

2.2.4 Groundwater Hydrology

Up to three seepage meters will be placed within the Cove to determine the groundwater hydrology flux into the overlying sediment. The rate of seepage through the sediment varies in time and with location based on the interaction of tidal fluctuations and groundwater discharge dynamics.

Up to three locations at which seepage is likely to vary and representing different recharge regimes across the Cove will be selected during site inspection. Preliminary locations for these seep meters are presented in Figure 2-2. There are multiple methods and equipment to measure the flux of groundwater to surface water. Traditional methods include a hydraulic potential manometers and other differential devices but alternative methods including buoy mounted and continuous-detection ultrasonic have been used more recently. Keying in on salinity, temperature, and volumetric measurement, Pepco will evaluate these techniques and select the most appropriate approach for this investigation. We anticipate a minimum of one full tidal cycle under both a high and low water regime condition will be required to observe the range of seepage conditions.

Pepco will also collect shallow push cores at each of the locations to assess the physical characteristics of the sediment, including grain size and bulk density, to support seepage meter data evaluation. These data will be used to assess Cove hydrology for remedial design.

2.2.5 Cove Sedimentation

As reported in the RI and depicted in Figure 2-1, radio-isotope dating of one sediment core, collected in the Cove, was completed in the Waterside Investigation Area to assess sediment stability and understand sediment deposition rates. Data from this core indicate a deposition rate of approximately 1 cm/yr in the Cove. These data will be used in the Cove FS hydrology assessment. However, additional data will be collected to verify sediment deposition in the Cove.

For purposes of verification, up to four sediment traps will be placed at locations depicted in Figure 2-2 and left in place for the maximum amount of time permitted under the schedule to implement this TSWP (ideally at least 2 months) to assess sediment accumulation within that time period. Pepco will use a design similar to that used for the New Bedford Harbor Superfund Site consisting of a 1 gallon jug fitted with an entrance funnel and placed inside a drum that is weighted and secured to a tide post (ACOE, 2010). Traps will be left in place the maximum amount of time allowed under the TS schedule (estimated at 2 to 4 months). At termination of the sediment trap deployment period, traps will be capped in the field, recovered, and analyzed under laboratory conditions for further processing. Accumulated sediments will be analyzed for grain size, TOC, and PCBs which collectively requires a minimum of approximately 50 grams of sediment.

Pepco will attempt to place 4 sediment traps in the cove; however, it is recognized that the cove area is subject to the ebb and flow of tide, and that insufficient water depth may be present in some areas to effectively submerge the above-described sediment traps. If this is found to be the case, Pepco will either: (1) re-locate traps to ensure that they are placed in areas that meet minimum water depth requirements (assumed to be greater than 1 to 2 feet in depth at low tide; or (2) employ an alternative sediment trap design in the shallow inter-tidal zones. For instance, artificial turf mats have been previously used in riparian settings for this purpose. These mats have been found to have a surface roughness that limits loss of sediment from flooding events and are readily installed on irregular inter-tidal surfaces.

Data collected during the field work will be used to assess the feasibility of each remedial approach and technology.

2.3 Cove Ecological Survey

To evaluate possible restoration actions as part of the remedial alternatives to be considered in the FS, it will be useful to have a current ecological assessment of conditions within the Cove as well as nearby tidal marsh areas as biological analogs. Therefore, in addition to a review of existing cove benthic community data collected as part of the RI, an ecological survey is proposed to obtain a detailed inventory of the plant community in areas where submergent/floating-leaved plant communities exists within the Cove.

2.3.1 Vegetation Survey

There is currently a discrete area in the north-central portion of the Cove that appears to be slightly shallower and supports a submergent/floating-leaved plant community. A detailed inventory of the plant community within this portion of the Cove, in relation to survey information and surface water flow conditions, will assist in evaluating potential tidal marsh restoration alternatives that consider plant species, surface elevations, and substrate conditions. The evaluation of surrounding tidal emergent marsh communities would also provide biological analogs that would inform design efforts for tidal marsh restoration. These investigations will be conducted during the growing season, preferably late spring.

2.3.2 Supplemental Macroinvertebrate Survey

A focused infaunal macroinvertebrate survey will be conducted to supplement the existing benthic infauna data, which were collected as part of the Benning Road RI. The existing RI data were collected through the use of grab sampling techniques, in order to provide synoptic benthic macroinvertebrate, sediment bulk chemistry, and toxicity testing data for evaluation in the Waterside Investigation Area BERA.

The proposed infaunal study will employ artificial substrates (i.e., Hester Dendy samplers) in order to determine baseline conditions in the cove. These substrates will be deployed in a similar manner as described in the ARSP RI Report (DOEE, 2019). Up to four multi-plate samplers will be anchored with a cinder block in the deeper portions of the Cove. Sample locations that are permanently inundated will be identified prior to deployment. Should this not be feasible within the Cove, alternate locations within the Waterside Investigation Area will be selected. During the survey, samplers will be checked regularly to ensure that they remain below the low tide water line. Following six week deployment, samplers will be retrieved and processed in an identical manner as described in the ARSP RI (2019). A taxonomic laboratory will be engaged to perform taxonomic identification of invertebrates that have colonized the artificial substrates.

2.4 Sediment Stability Assessment

Physical stability is critical to the overall effectiveness and long-term performance of MNR, EMNR, and capping systems, as well as for habitat restoration components. Data are needed to assess the physical stability of sediments in the Cove under existing conditions and potential future remedial scenarios.

2.4.1 Sedflume Study

The physical stability of sediments can impact the overall effectiveness and long-term performance of a remedial solution. Physical stability of sediments is governed by a complex set of factors including, but not limited to, the underlying properties of the sediment, site hydrological conditions, amendment/cap material selection and design, depth of water, bathymetry, biological activity, and the presence of engineered site features such as armor stone and surface water channels. To evaluate the physical stability of sediments within a particular system, key parameters include sediment erosion rates, critical shear stresses, and sediment properties, such as particle size and bulk density. Empirical test methods must be used to measure critical shear stress and erosion rates for cohesive sediments as these parameters cannot be predicted based on sediment characteristics (Zimmerman et al., 2008).

Sedflume studies will be conducted to evaluate physical sediment stability under various laboratory conditions designed to simulate existing conditions in the Cove and potential future remedial scenarios. In addition, ten sediment cores (5 locations) for Sedflume analysis will be collected from the Anacostia River Waterside Investigation Area to the west of the Cove.

Erosion rates determined by Sedflume analysis are a function of shear stress and depth. Critical shear stress, which is defined as the shear stress at which a very small, but measurable, rate of erosion occurs, is a difficult parameter to measure directly, and typically involves the use of interpolative techniques. Sedflume analysis has been used, with demonstrated success, to evaluate the stability of sediments collected from an intertidal bay at Hunters Point Naval Shipyard In San Francisco, California (CA), as well as river sediments in the area of the River adjacent to the Washington Navy Yard (Department of Navy, 2014). Sediments evaluated from Hunters Point were amended with AC to evaluate application of AC amendments as an in situ remediation method to sequester PCBs (Zimmerman et al., 2008). The results of the Hunters Point study indicated that no reduction in surface sediment stability or erosion of treated sediment occurred with the addition of AC amendments (Zimmerman et al., 2008).

Data generated from the Sedflume studies will be used during the FS to evaluate possible remedial solutions, which may include MNR, EMNR, or capping.

A total of ten cores (to a depth of approximately 35 cm to 1 meter [m] will be collected from two locations (5 cores per location) within the Cove for Sedflume analysis; an additional 10 cores (five locations) will be collected from the Waterside Investigation Area to the west of the Cove. . Proposed sediment core sampling locations are shown on Figure 2-2. The locations of the cores have been preliminarily determined on the basis of sediment type and flow regime to make sure the results of the work are representative of the range of conditions in the Cove and the river, including the federal navigational channel, immediately adjacent to the Cove. At each Cove location, a total of 5 cores will be collected for the following purposes: (a) evaluating un-amended conditions; (b) evaluating amended conditions as a thin layer application (SediMite™ and AquaGate®+PAC), (c) evaluating a sand/cap condition. One core from each sampling location will be held as reserve for a repeat analysis should it be needed. Sediment properties of each core including grain size, bulk density, water content, and loss of ignition will also be measured as part of this evaluation.

The ten cores (5 locations) from the Anacostia River immediately adjacent to the Cove will be subject to similar baseline analyses (evaluating un-amended condition, grain size, bulk density, water content, and loss of ignition). However, due to the uncertain need for an active response action in these areas, no amended Sedflume studies will be conducted (that is, the river samples will not be subject to Sedflume studies to evaluate capping or amendment addition scenarios). As with the Cove samples, 1 of the 2 core samples from each riverine sampling location will be held in reserve, should repeat analysis be required.

Cores will be collected via push coring technique using specialized core tubes that can be fully integrated into the Sedflume system in the laboratory. Sampling stations will be targeted in the field using global positioning system (GPS). Cores will be collected by hand at low tide, unless it is determined that collection by boat is required. Cores will be properly sealed and secured by field staff and shipped in specialized containers which minimize disruption during shipping and handling. Cores will be inspected upon receipt at the lab and stored at 4ºC.

Processing of cores will be conducted in the laboratory and will involve application of amendment types selected for Sedflume analysis, as presented in Table 2-3 below. No amendments will be applied to controls. Erosional rates will be evaluated via Sedflume at several different shear stresses for each core, starting at low shear stress. The flume will be run at sequentially higher shear stresses over time, with each subsequent stress level twice as high as the previous level.

Subsamples will be collected at periodic intervals from undisturbed sediment and analyzed for bulk density and particle size. The experimental design may be refined based on observations during testing.

Table 2-3: Sediment Core Collection and Experimental Design for Sedflume Study

Sampling Location	Total Number of Cores per Sampling Location	Amendment Types	Concentration or Thickness	Number of Cores
SED7DTS	5	NA (site sediment only)	NA	1
		SediMite™	3%	1
		AquaGate®+PAC	5%	1
		Sand/ Cap Media	6 inches	1
		Reserve	TBD	1
SED7ETS	5	NA (site sediment only)	NA	1
		SediMite™	3%	1
		AquaGate®+PAC	5%	1
		Sand/Cap Media	6 inches	1
		Reserve	TBD	1
Riverine Locations (5 Total)	2	NA (site sediment only)	NA	5
		Reserve	TBD	5
			Total Number of Cores	**20**

Notes:
TBD – To be determined; core to be held as a reserve for a repeat analysis should it be required.

2.5 Sediment Dewatering Study

The objective of this element of the TS is to assess the dewatering properties of Cove sediment that may be removed by dredging (either as a remedial solution or to accommodate the installation of a cap system) and to determine the amount of reagent, if any, needed to dry the sediment for transport and disposal. Removal of sediment in the Cove will most likely be performed by mechanical dredging or excavation in the dry using temporary sheet piling to isolate the river from the Cove; however, depending on the tidal evaluation and other data, it is prudent to look at potential hydraulic removal as well. Consequently, dewatering studies will be targeted on sediment removed by a mechanical dredge or by excavation, but will also include gravity dewatering studies that could inform other dewatering approaches used for hydraulic dredging technologies. These methods minimize additional water entrainment and typically employ post-removal dewatering via gravity draining followed by application of a solidification agent, if necessary. This study will focus on sediment collected from the upper 1 to 2 feet of the sediment column in the Cove.

2.5.1 Sediment Dewatering Properties

Sediment from the Waterside Investigation Area is comprised of a range of particles from silt to sand with silt being predominant in the upper 5 feet (ft) below sediment surface (bss) (AECOM, 2018). Consequently, the sediment that may be removed from different locations within the Waterside Investigation Area has the potential to consist of a wide range of particle sizes. In the Cove, surface water is slow moving, thereby supporting the settling of finer particles. Radiochemistry cores collected by Pepco at sampling location SED7E contain largely depositional materials with fines ranging as high as 82% (AECOM, 2018).

2.5.2 Bench-Scale Assessment

Bench-scale laboratory testing will be conducted using a phased approach to determine: (a) the ability of the sediment to dewater using gravity under the mechanical dredging scenario, (b) the ability of the sediment to dewater by gravity using geotextile tubes, and (c) the optimal dose of selected stabilization reagents should either gravity dewatering approach be insufficient to pass free liquids testing required for hauling and disposal of the sediment offsite. The results from this assessment will be incorporated into the FS to estimate costs. In-lab studies will be conducted at one of AECOM's three in-house laboratories experienced in evaluating dewatering technologies.

Two representative and independent sediment samples collected within the upper 1 to 2 feet will be collected from the Cove and sent to the laboratory for testing. These locations will be selected based on site inspection with the objective of capturing the full range of sediment properties (i.e., particle size distribution, percent solids) that are anticipated on the site. Two 5-gallon buckets of sediment from each sample location will be collected.

The laboratory will receive and log each bucket, recording the consistency, color, and odor of each sample. Each sample will be photographed in an as-received condition to develop a photo log for the dewatering report.

Each sample will be homogenized in the shipping bucket and a subsample will be collected for preliminary physical analyses consisting of the following:

- Solids content/water content
- Total organic content
- Density
- Grain size distribution (including hydrometer)

Following characterization, three aliquots of sample measuring approximately 1 liter (L) will be placed on a filter leaf or similar apparatus and permitted to free drain while the supernatant is collected at established intervals as follows: 1 hour, 12 hours, 24 hours, 48 hours and 72 hours. The supernatant volume will be measured and recorded. At each observed time interval, a subsample will be collected and put through the paint filter test. If the sample does not pass the test, a reagent will be added to the material to promote solidification/stabilization.

A separate aliquot will also undergo conditioning and dewatering assessment using geotextile fabric. A liter of 10% sediment slurry will be prepared and an aliquot of the slurry will be evaluated for chemical conditioning using polymers and coagulants. The best performing additives (based on dose and floc characteristics) will be passed through geotextile fabric. Filtrate volume and clarity will be assessed and based on these results one or more conditioners will be selected to treat the remaining slurry. Approximately 20 gallons of prepared slurry will be pumped through a geotextile pillow and the solids will gravity filter over a 7-day period. Solid samples will be removed over time (approximately 3-5 samples over the 7-day time period) and evaluated for solids content. These data will be used to assess the effectiveness and applicability of geotextile tube dewatering for a slurried sediment from the site.

Stabilization/solidification amendment evaluation will include dosing small aliquots of gravity dewatered sediment with a range of materials that have the potential to take up remaining moisture and strengthen sediment. Ideally the reagents selected will be low cost, low density, and successfully manage sorption of moisture to meet the objective. Reagents such as Portland cement or calciment will be considered. Portland cement is a common reagent and typically applied at 5-10% to address free moisture in silty sediments. For each reagent used, the pre- and post-application weight will be measured per unit volume and a pocket penetrometer will be used to measure relative strength gain over time. A projected cure time is 7 days with measurements made at 0, 1, and 12 hours as well as 1, 3, 5, and 7 days.

Data will be collected to meet several remediation data objectives:

- A plot of water loss over time to aid in determining the most likely staging period needed for mechanically dredged or excavated sediment;
- A table comparing the amount of reagent applied to the results of free liquids testing normalized to mass increase to aid in estimating additional costs for offsite hauling and disposal associated with the use of stabilizing reagents.

2.6 Outfall Evaluation

There are four known outfalls that discharge to the Cove, only one of which is Site-related (Outfall 013). Outfall 013 conveys the majority of stormwater runoff from the Site. It is a 48-inch diameter concrete pipe which becomes a 54-inch pipe prior to discharging into the river. This pipe is estimated to be over 60 years old (AECOM, 2018). There are three additional non-Pepco outfalls located in close proximity to Outfall 013 that also discharge into the Cove. One of these outfalls is believed to convey stormwater from the District of Columbia solid waste transfer station property. The other two outfalls are of unknown origin. Various Best Management Practices (BMPs) are implemented at the Site to control sediments and contaminants in stormwater discharges from Outfall 013 to the Cove, including the use of filters, filter media, screens, and absorbent booms at all storm drain inlets. Outfall locations within the Cove are shown on Figure 1-2 and photographs of the outfalls are shown on Figure 2-3. The objectives of this element of the TS are to: (a) evaluate hydrology at end of pipe for potential disruption of a possible cap system within the Cove, (b) assess the potential for recontamination as the result of discharges from the outfalls, and (c) assess sedimentation contribution from outfalls discharging to the Cove.

2.6.1 Data Collection and Assessment

The evaluation of effectiveness of any sediment remediation in the Cove requires a thorough understanding of the quality and quantity of all ongoing discharges into it. As part of the RI, residue and storm water samples were collected from the on-site storm drain system. PCBs were detected in one storm water sample at a relatively low concentration (0.45 µg/L) and in each of the storm drain residue samples, however, PCBs have not been detected in the storm water discharges at Outfall 013 during the regular monitoring conducted in accordance with the facility's NPDES permit. No such sampling data or other technical information, either current or historic, are available for the discharges from the other non-Pepco outfalls that discharge into the Cove. Pepco has requested these data from DOEE and NPS, including all known sources to these outfalls; receipt of this data/information, if available, is pending. Therefore, potential impacts to the Cove from the remaining three outfalls are not understood at this time.

In addition to evaluating any information that may be available from other sources, Pepco proposes to collect storm water samples during a storm event from the three non-Pepco outfalls and from Outfall 013 for comparison value. The samples will be sent to TestAmerica Laboratories, Inc. of Pittsburgh, PA for analysis of metals, PCBs (congeners), PAHs, and total suspended solids (TSS), at a minimum.

Pepco will employ hydrologic calculations and modeling for estimating the volume and flow rates expected from each of the outfalls using upstream drainage area characteristics. The estimated flow rates and volumes will be used to evaluate the capping/restoration options in the Cove.

3 Schedule and Reporting

In accordance with the RI/FS Project Schedule, sample collection and bench-scale studies presented herein will commence within four weeks following receipt of DOEE's approval of the Final TSWP. Commencement will be contingent upon the receipt of appropriate permits, however, Pepco will request DOEE's approval of the sampling locations in advance of work plan approval in order to expedite the permitting process. A tentative schedule for data collection and analysis is provided in **Table 3-1** below.

Table 3-1: Treatability Study Schedule

Treatability Study	Preparation/Mobilization (Weeks)	Field Work (Weeks)	Data Collection/Reduction and Reporting (Weeks)	Total (Weeks)
Constituent Sequestration Assessment	2	1	23	26
Hydrologic/Hydraulic Data and Sedimentation Assessment	2	10	4	16
Ecological Assessment	2	8	8	18
Sediment Stability Assessment	2	4	4	10
Sediment Dewatering Study	2	<1	8	11
Outfall Evaluation	2	10	2	16

Following completion of the TS field and lab work, which is anticipated to be July 7, 2020 in accordance with the latest RI/FS Project Schedule, Pepco will compile and evaluate the TS data and prepare a draft TS report for submission to DOEE by August 21, 2020 for review. Following DOEE's review of the draft TS report, Pepco will prepare a final TS report for submission to DOEE by October 6, 2020 for review and approval.

4 References

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Figures

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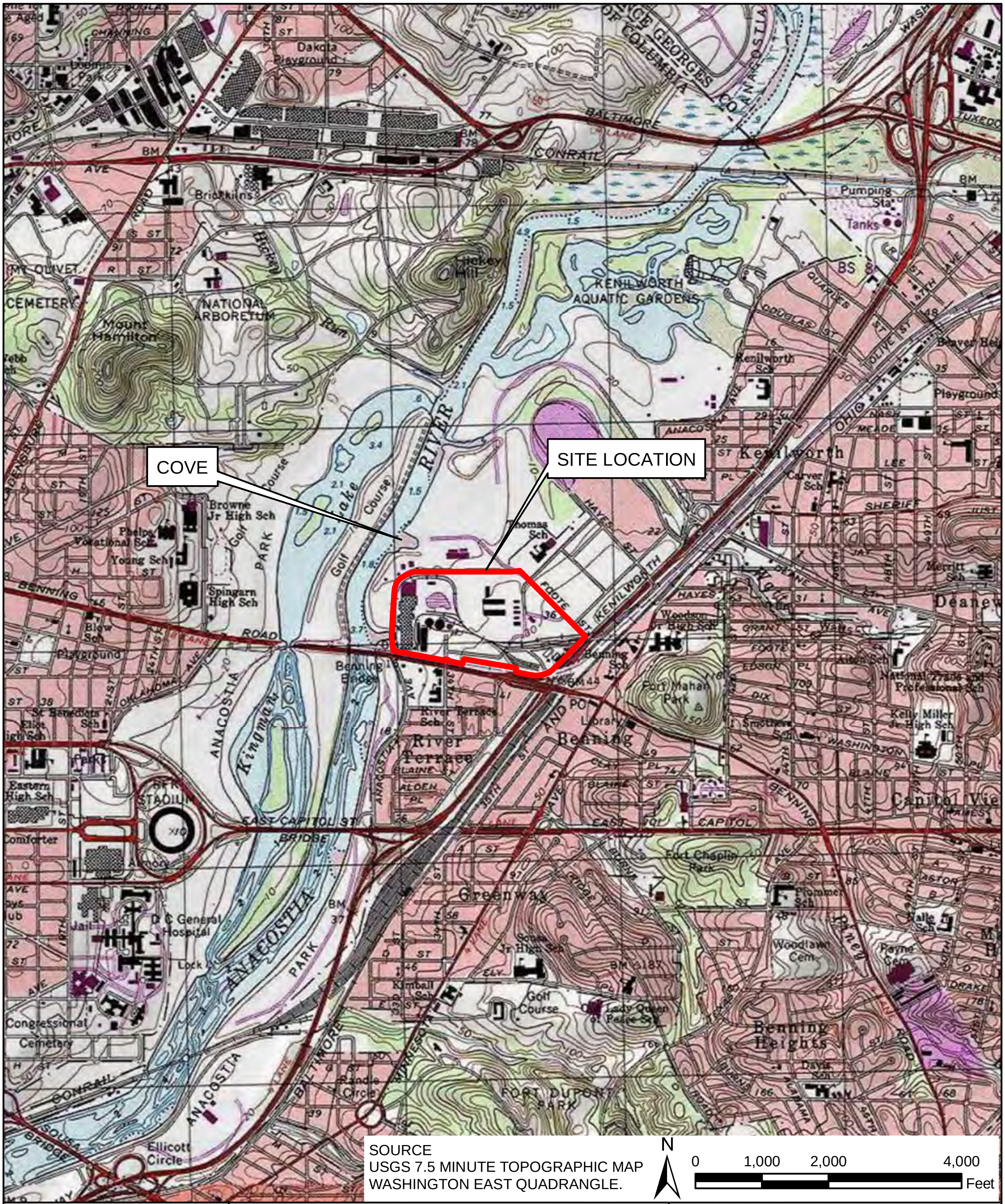
Table

Figures

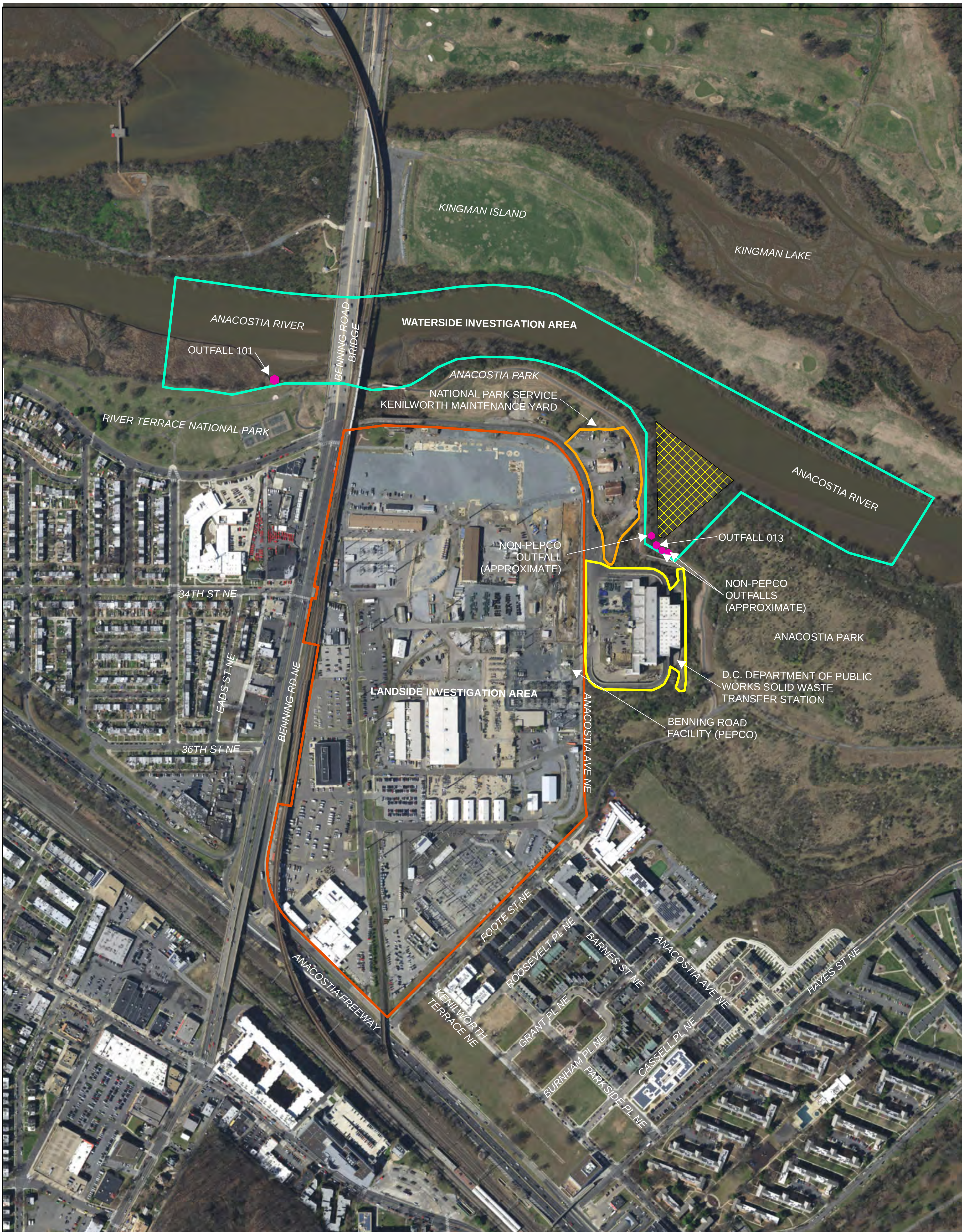


AECOM

BENNING ROAD FACILITY RI/FS PROJECT
3400 BENNING RD., NE
WASHINGTON, DC 20019

SITE LOCATION MAP

FIGURE 1-1



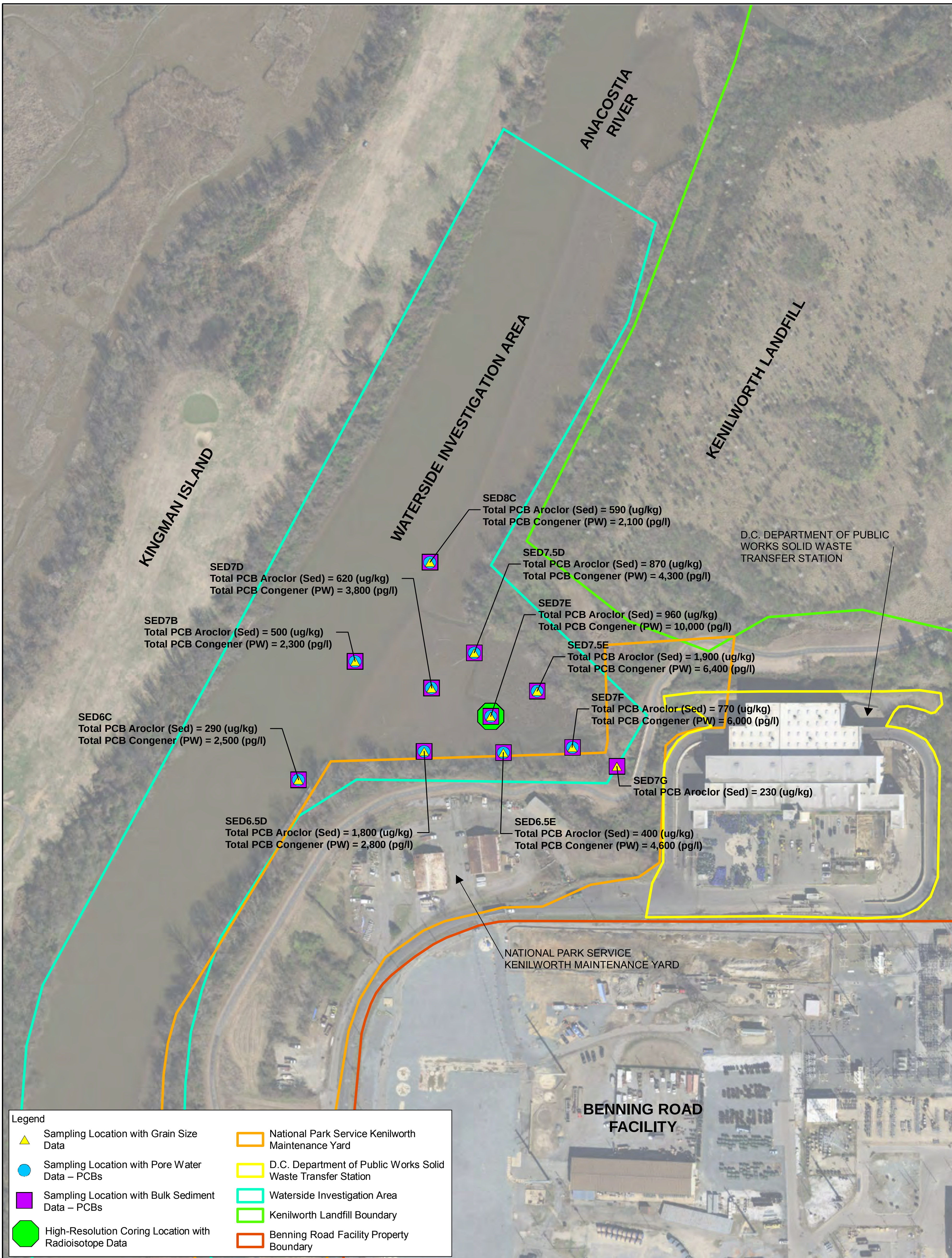
LEGEND

- Outfalls
- National Park Service Kenilworth Maintenance Yard
- D.C. Department of Public Works Solid Waste Transfer Station
- Waterside Investigation Area
- Benning Road Facility Property Boundary
- Cove

AECOM

0 400 Feet

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019			SITE PLAN AND INVESTIGATION AREAS	
Date: 12/16/2019	Drawn By: KNS	Checked By: SED		FIGURE 1-2

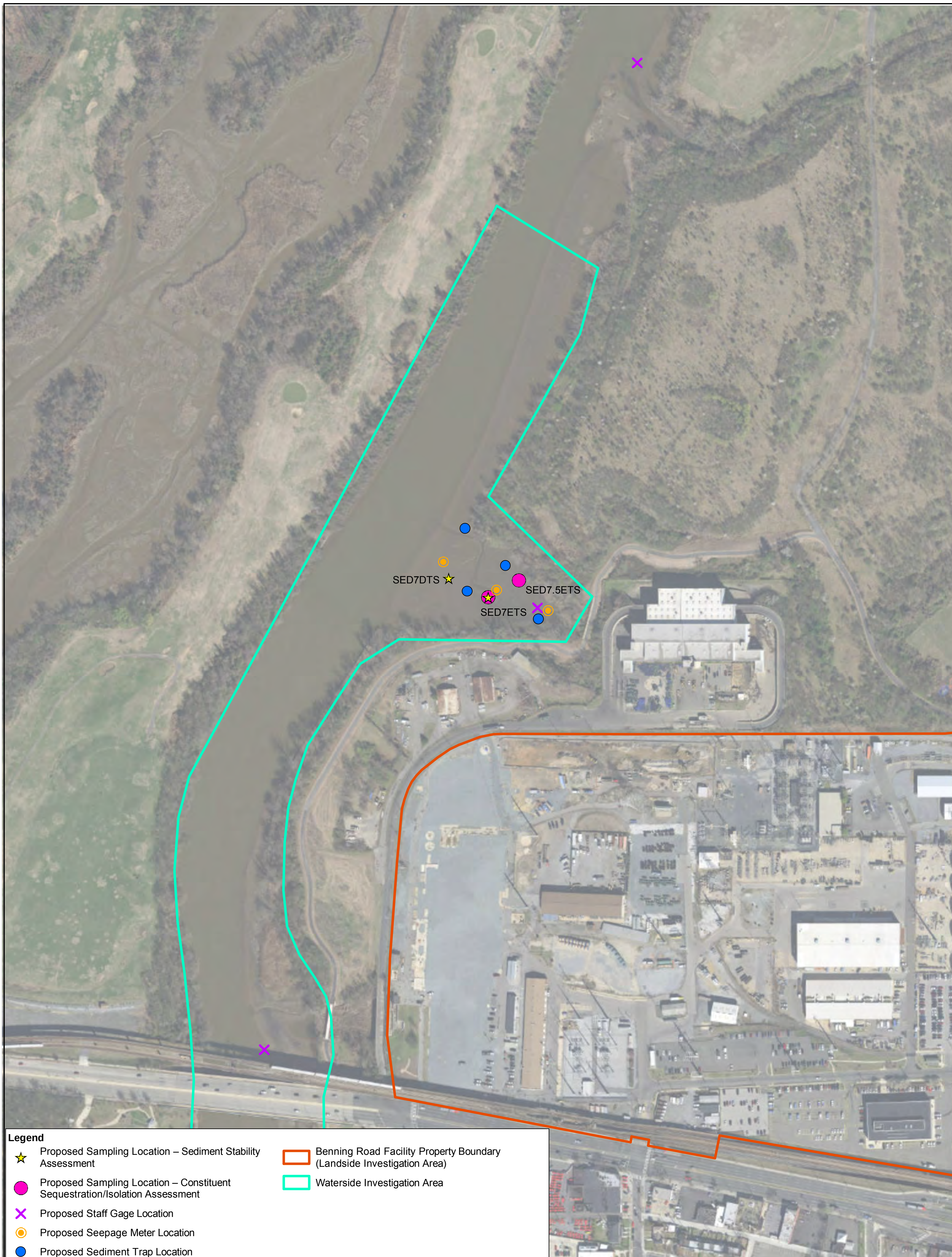


AECOM

BENNING ROAD FACILITY RI/FS PROJECT
3400 BENNING RD., NE
WASHINGTON, DC 20019

PREVIOUS SURFICIAL SEDIMENT SAMPLING LOCATIONS

Date: 11/28/2018	Drawn By: JB	Checked By: SAP		FIGURE 2-1



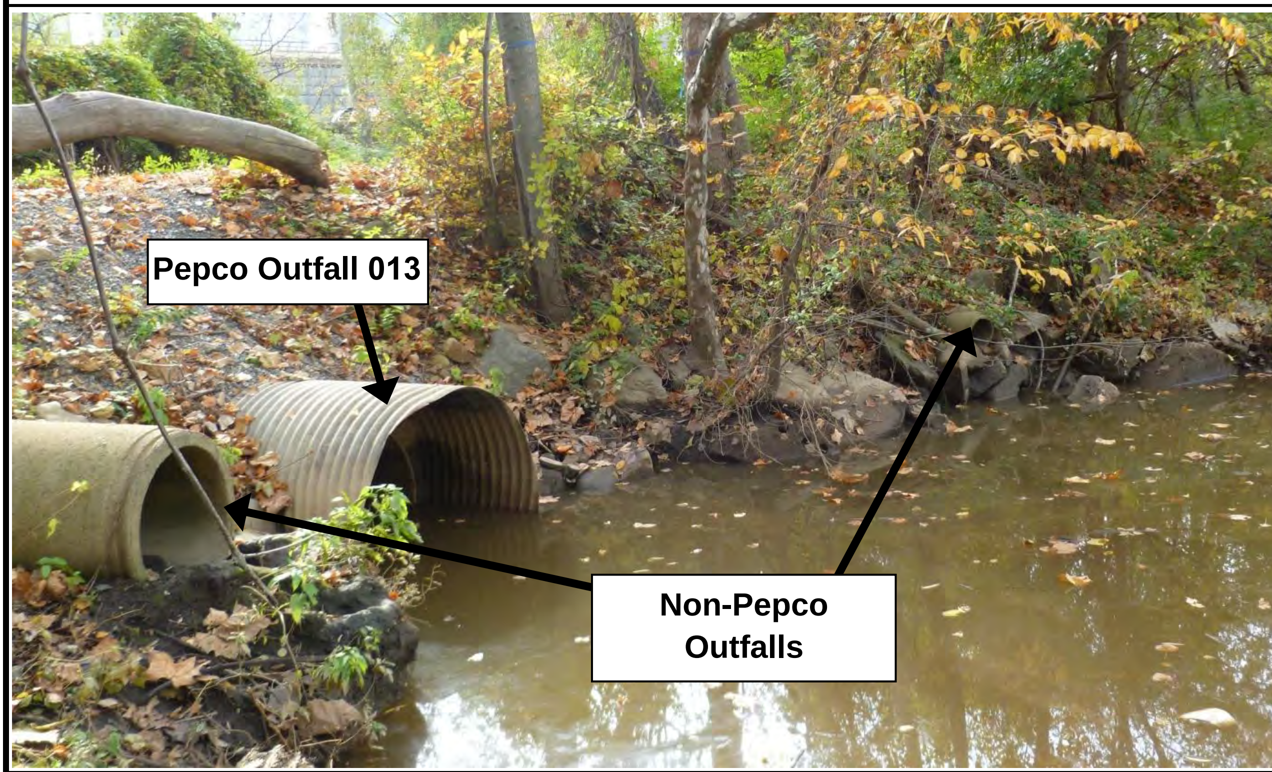
Notes
1. Proposed staff gage locations may vary based on field conditions/accessibility.
2. Sediment sampling locations for sediment dewatering study to be selected based on field inspection.
3. Proposed limits of bathymetric survey update are shown on Figure 2-4.
4. Additional sediment stability/sediment trap locations will be determined during field work activities.

AECOM

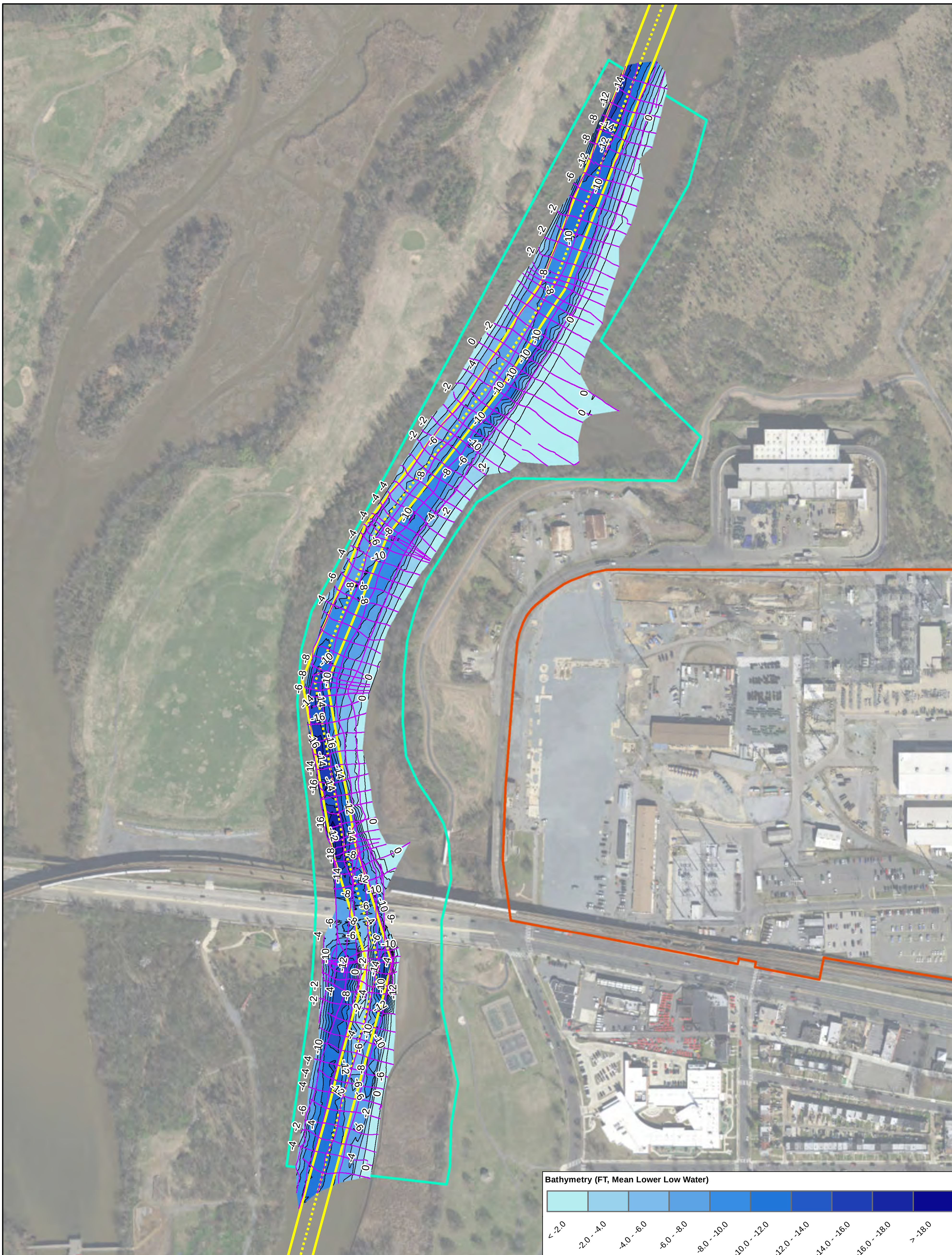
0 300 Feet

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019	PROPOSED TREATABILITY STUDY SAMPLING/INVESTIGATION LOCATIONS

Date: 11/28/2018	Drawn By: JB	Checked By: SAP		FIGURE 2-2



AECOM	Benning Road Facility RI/FS Project 3400 Benning Rd., NE Washington, DC 20019	**Outfall 013 and Adjacent Outfalls** **Figure 2-3**



LEGEND

- Bathymetry Survey Lines
- 2.0 ' Contour
- Navigational Channel (Approx)
- Waterside Investigation Area
- Benning Road Facility Property Boundary

AECOM

0 300 Feet

N W E S

BENNING ROAD FACILITY RI/FS PROJECT
3400 BENNING RD., NE
WASHINGTON, DC 20019

ANACOSTIA RIVER
EXISITNG BATHYMETRY

Date: 11/28/2018	Drawn By: JB	Checked By: SED		FIGURE 2-4

Table

Table 2-1
Data Quality Objectives
Treatability Study Work Plan

Level 1 DQO	Level 2 DQO	Level 3 DQO	Data Needs
Assess effectiveness of several sequestration agents that may be used in remedial alternatives (bulk activated carbon, SediMite and AquaGate+®PAC)	Identify location of representative sediment samples and collect to a depth consistent with amendment application (BAZ). Characterize parameters needed to assess treatability using amendments.	Bracket relative performance of amendments by type, dosage and bioaccumulation potential. Refine dosage for best performing amendment; measure performance over time	• Sediment Physical Parameters – Solids Content – Specific Gravity – Atterberg Limits – Particle Size Distribution • Sediment Chemistry – pH – Total and Dissolved Organic Carbon – PCBs Congeners – Other parameters specified in laboratory means and methods • Pore Water Chemistry – pH – Total and Dissolved Organic Carbon – PCBs Congeners – Other parameters specified in laboratory means and methods • Oligochaete 28-day Bioaccumulation Studies – PCB tissue residues pre/post treatment
Develop an understanding of hydrologic and hydraulic properties of Cove sediment to assess stability of sediment	Measure Cove bathymetry (last measured in 2013) and expand coverage to include previously unmapped areas	Determine sediment accretion/erosion	• Compare to historical bathymetry to assess sediment stability
		Assess tidal stage for use in wetland restoration design and support structures (i.e. sheet pile barriers)	• Tidal stage can be used to assess inundation/flushing of freshwater and suitable species • Tidal stage will inform design of barriers to isolate Cover for remedy implementation
	Collect surface water flowrates	Assess seasonal variations	• Deploy upstream, adjacent and downstream monitors relative to the Cove • Measure flow, stage, temperature and conductivity

Table 2-1
Data Quality Objectives
Treatability Study Work Plan

Level 1 DQO	Level 2 DQO	Level 3 DQO	Data Needs
	Assess contribution of outfall structures	Locate all structures and gather hydrologic data	• Collect stormwater discharge and analyze for COCs (e.g. PCBs, PAHs, metals, TPH) • Measure (or estimate) flowrates
	Assess contribution of flow from groundwater		• Deploy flux/seep meters at multiple locations (see Figure 2-2)) to measure salinity, temperature, volumetric flow • Collect push cores at each location and measure bulk sediment parameters: – Solids Content – Specific Gravity – Atterberg Limits – Particle Size Distribution – Total Organic Carbon
	Assess ongoing rate of sedimentation		• Deploy sediment traps, collect sediment and analyze for COCs • Measure rate of accumulation over time
Conduct ecological inventory survey for plant species as indicator of hydrology of Cove	Develop an understanding of the current vegetative community within the cove relative to restoration objectives		• Review the RI benthic community abundance/ diversity study and incorporate key elements into FS remedial alternatives • Conduct a vegetative survey of cove to map out existing SAV and hydrophytic vegetation communities • Correlate to bathymetry, water elevations, salinity and temperature
Conduct direct measurement of sediment stability	Measure relative stability of sediment, applied amendment and cover materials under varying hydrologic and hydraulic conditions		• Conduct SedFlume analysis of cores obtained from the Cove • Construct amendment material over sediment and concentration selected from concurrent sequestration study • Construct sand/cover consistent with remedy concept planning

Table 2-1
Data Quality Objectives
Treatability Study Work Plan

Level 1 DQO	Level 2 DQO	Level 3 DQO	Data Needs
Develop sediment dewatering properties	Gravity dewatering by mechanical excavation	Verify baseline properties of sediment	• Sediment Physical Parameters – Solids Content – Loss on Ignition (LOI) – Specific Gravity – Atterberg Limits – Particle Size Distribution – Total Organic Carbon (Lloyd Kahn)
		Develop passive dewatering/reagent drying design basis	• Conduct leaf/gravity testing and measure sediment physical parameters over time both with and without drying amendments • Assess free liquids generation
	Gravity dewatering using geotextile tubes	Verify baseline properties of surface water	• pH • Alkalinity • Turbidity
		Produce sediment slurry for testing	• Prepare mixtures of sediment and surface water to simulate dredged and/or processed slurry • Evaluate different chemical conditioning programs and dosages and assess filtrate and solids – Turbidity – Qualitative assessment of solids and filtrate
		Develop sediment pre-treatment design approach	• Quantify geotextile tube performance with targeted chemical conditioning programs using low volume pillow tests (3 time intervals over 24-hour period) – Assess filtrate (volume, turbidity) – Assess filter cake (solids content)
		Develop passive dewatering/reagent drying design basis	• Conduct leaf/gravity testing and measure sediment physical parameters over time both with and without drying amendments • Assess free liquids generation