

**FINAL**  
**FIELD SAMPLING PLAN**  
**REMEDIAL DESIGN SERVICES**

**Atlantic Wood Industries Superfund Site**  
**Portsmouth, Virginia**

**Version 2**



**June 11, 2008**



**EA Engineering, Science,  
and Technology, Inc.**

**FIELD SAMPLING PLAN**  
**REMEDIAL DESIGN SERVICES**  
**ATLANTIC WOOD INDUSTRIES SUPERFUND SITE**  
**PORTSMOUTH, VIRGINIA**  
**VERSION 2**

**Prepared for**  
**EPA Contract No. EP-S3-07-07**  
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**U.S. Environmental Protection Agency**  
**Region III**  
**Philadelphia, PA**

**Prepared by**  
**EA Engineering, Science, and Technology, Inc.**

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**Prepared by**

**EA Engineering, Science, and Technology, Inc.**

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## LIST OF ACRONYMS AND ABBREVIATIONS

ABM	Abrasive Blast Media
AWI	Atlantic Wood Industries
BaP	Benzo(a)pyrene
bgs	Below Ground Surface
CAB	Cellulose Acetate Butyrate
COC	Contaminant of Concern
CLP	Contract Laboratory Program
DGPS	Differential Global Positioning System
DH	Downhole
DM	Down Hole Magnetometer
DNAPL	Dense Non-Aqueous Phase Liquid
DPT	Direct Push Technology
DQO	Data Quality Objective
DWS	Dynamic Work Strategy
EA	EA Engineering, Science, and Technology, Inc.
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EPA	U.S. Environmental Protection Agency
EAID	Environmental Assessment and Innovation Division
FS	Field Screening
FSP	Field Sampling Plan
ft	Feet/Foot
G	Geotechnical
GPS	Global Positioning System
HSA	Hollow-Stem Auger
HASP	Health and Safety Plan
ID	Identify
IDW	Investigation Derived Wastes
LV	Laboratory Verification
mg/kg	Milligram(s) per Kilogram

### LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

NAD	North American Datum
NAPL	Non-Aqueous Phase Liquid
NIST	National Institute of Standards and Technology
nm	Nanometer
NNSY	Norfolk Naval Shipyard
NPL	National Priorities List
OU	Operable Unit
OU1	Operable Unit #1
OU2	Operable Unit #2
OU3	Operable Unit #2
%	Percent
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PCP	Pentachlorophenol
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective equipment
ppb	Parts per Billion
PPIC	Portsmouth Port and Industrial Commission
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RD	Remedial Design
ROD	Record of Decision (issued by EPA on 21 December 2007)
RPM	Remedial Project Manager
RSCC	Regional Sample Control Coordinator
SAP	Sampling and Analysis Plan
SM	Site Manager
SMO	Sample Management Office
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Scope of Work
SPSA	Southeastern Public Service Authority
SPT	Standard Penetration Test
SSHO	Site Safety and Health Officer

### **LIST OF ACRONYMS AND ABBREVIATIONS (Continued)**

TAL	Target Analyte List
TB	Test Boring
TBD	To Be Determined
TCL	Target Compound List
TEQ	Toxic equivalents
TM	Technical Memorandum
TOC	Total Organic Carbon
tPAH	Total Polynuclear Aromatic Hydrocarbons
U.S.	United States
USCS	Unified Soil Classification System
UXO	Unexploded Ordnance
VA	Virginia
VEPCO	Virginia Electric Power Company
VOC	Volatile Organic Compound
WAF	Work Assignment Form
WP	Work Plan
XRF	X-ray fluorescence

## 1. INTRODUCTION

This Field Sampling Plan (FSP) was prepared for the Atlantic Wood Industries (AWI) Superfund Site (Site) located in Portsmouth, Virginia (VA), and is submitted as documentation of the protocols and procedures to be followed by EA Engineering, Science, and Technology, Inc. (EA) during the field activities of the remedial design (RD) services. This FSP includes the sampling to be completed in order to obtain design information that will form the basis of the RD for the remedial action described in the Record of Decision (ROD) dated December 2007. Applicable Operable Units (OUs) are:

- OU1, contaminated soil and the dense non-aqueous phase liquid (DNAPL) contamination,
- OU2, the contaminated ground water, and
- OU3, the contaminated sediments in the South Branch of the Elizabeth River.

The specific requirements for development of this FSP are outlined in the United States (U.S.) Environmental Protection Agency (EPA) Work Assignment Form (WAF) for RD dated February 2008 (EPA, 2008). Additional information necessary for the development of the FSP was gathered during the site visit on 17 March 2008 and by communications between the EPA and EA during the development and negotiation of the Work Plan for the Site (EA, 2008A). This FSP was prepared by EA for the documentation and explanation of all RD Work Plan field activities, laboratory activities, and contract deliverables related to the acquisition and reporting of data for the project. This FSP should be used in conjunction with the protocols set forth in the Quality Assurance Project Plan (QAPP, EA 2008B) and Health and Safety Plan (HASP, EA, 2008C) for the site.

### 1.1 Site Description and Background

The AWI Site is approximately 48 acres of land on the industrialized waterfront area of Portsmouth, VA and was listed as a National Priorities List (NPL) Site on 21 February 1990. The land is surrounded by the Norfolk Naval Shipyard (NNSY) (also a NPL site), the operations center for the Portsmouth Public School District, the South Branch of the Elizabeth River, and several other small properties. From 1926 to 1992, a wood treating facility operated at the Site using both creosote and pentachlorophenol (PCP). The Site was contaminated from the treatment operation, storage of treated wood, and disposal of wastes. At one time, the Navy leased part of the property from AWI and disposed of waste onsite, including used abrasive blast media (ABM) from the sand blasting of naval equipment. The Navy also disposed of sludge from the production of acetylene in a wetland on the border of the South Annex of the Shipyard

and the AWI property. Sediments in the Elizabeth River contain visible creosote, and the groundwater and soil at the Site are also heavily contaminated with creosote. Creosote contamination previously migrated into a storm sewer and discharged to an inlet of the Elizabeth River at the northeast corner of the AWI property near the Jordan Bridge.

Polynuclear aromatic hydrocarbons (PAHs), PCP, dioxins, and metals contamination (mainly arsenic, chromium, copper, lead and zinc) have been detected in soils, ground water, and sediments. A number of these compounds have also been detected in storm water runoff from the Site.

Currently, AWI operates a pre-stressed concrete products manufacturing facility the site (known as Atlantic Metrocast, Inc.). The eastern portion of the site is leased to Weeks Marine for the storage and maintenance of marine equipment. Approximately 14,000 people work within a ½ mile radius of the Site. The drinking water supply within a three-mile radius is provided by public utilities. Ground water in this area is not used as a drinking water source.

EPA selected a remedy in the December 2007 ROD (EPA, 2007) and established performance standards for each of the three OUs. The selected remedy provides for the following actions: a soil cover over the site, partial DNAPL consolidation and containment, monitored natural attenuation and groundwater monitoring, dredging of contaminated sediments in the river and consolidation behind a new off-shore sheet pile wall at the east side of the site, and monitored natural recovery of the remaining river sediments.

## **1.2 Report Organization**

This FSP presents the methods to be used for the field sampling and data gathering activities and should be reviewed in conjunction with the QAPP. The FSP is organized in the following manner:

- Chapter 1 Includes a discussion of the site background, report organization, and project objectives.
- Chapter 2 Includes a discussion of project objectives with regard to field sampling and analytical methodologies.
- Chapter 3 Discusses the field and analytical programs.
- Chapter 4 Presents the types of documentation to be completed during the field effort.
- Chapter 5 Discusses the site management.
- Chapter 6 Discusses how non-conformance to the FSP will be addressed.
- References

### **1.3 Objectives of Field Sampling Plan**

The FSP ensures that field investigations, tests, and sampling are carried out in a technically acceptable manner. It is the responsibility of the Quality Assurance Manager (QAM) and Site Manager (SM) to verify that all sampling and analysis activities comply with the methods outlined in the FSP and the QAPP.

### **1.4 Project Objectives**

The overall objective of this project is to obtain design criteria information that will form the basis of the remedial design at the AWI Site. To accomplish this, analytical and geotechnical data will be gathered as part of the tasks detailed in the Work Plan. Task-specific objectives that include sampling and analysis activities are the following:

- Task 3.1 – Determine the lateral extent of surface and subsurface NAPL in the area immediately east of the 3975 Elm Avenue property and along the southwest corner of the PPIC property via field screening.
- Task 3.2 – Evaluate the sheet pile wall tie-in to the Jordan Bridge foundation by collecting geotechnical data that will be used to determine design parameters and assess soil conditions.
- Task 3.4 – Determine the need for a sheet pile wall at the eastern end of the PPIC property by the collection of geotechnical data.
- Task 3.5 – Delineate the area to be dredged in the Elizabeth River and characterization of sediments as determined via field screening, analytical laboratory, and geotechnical data.
- Task 3.6 – Evaluate of the bulkhead of the South Annex of NNSY for signs of gross leakage and characterize gross contamination by analytical laboratory data.
- Task 3.8 - Assess the location and physical characteristics of DNAPL on the west side of the AWI property to determine the technical and engineering controls and precautions necessary to protect surrounding properties while DNAPL is being remediated via field screening and geotechnical data.
- Task 3.9 – Delineate areas of contaminated soil beyond the AWI property line that require cleanup via field screening and laboratory analytical data.
- Task 3.13 – Characterize storm drain discharge water to the restored wetland (if storm drains are observed) via laboratory analytical data.

The objective of this FSP and the associated QAPP is to provide the EPA with high quality, legally defensible data for use in obtaining the project objectives.

## **2. PROJECT SCOPE AND OBJECTIVES**

### **2.1 Project Scope of Work**

The scope of work (SOW) for this project is discussed in detail in the Scope of Services section of the Remedial Design (RD) Services Work Plan (EA, 2008). As discussed in Section 1.4, field tasks that involve sampling and analysis include NAPL identification, sheet pile wall evaluation, sediment characterization, bulkhead leakage evaluation, west side DNAPL evaluation, and contamination delineation on adjacent properties. The overall project objective is to gather additional data that will be used as design criteria during the detailed remedial design.

The locations of areas to be investigated and their respective task numbers are illustrated on Figure 1. Table 1 details the sampling and associated analyses for each task.

### **2.2 Field Sampling Tasks**

This section provides a summary of the sampling and analysis activities that will be conducted as part of the tasks outlined on Table 1. Environmental and geotechnical data that is collected during the project activities will be used to form the basis of the RD for the AWI Site.

Sampling activities to be conducted during Site RD activities are:

- Soil sampling for NAPL delineation
- Collection of soil and sediment samples for geotechnical evaluation
- Sediment sampling for further delineation of contamination
- Surface water sampling for assessment of contamination

Sample locations were selected based on the design criteria information needed to execute the RD. It should be noted that it is not certain if previous Navy activities at the Site involved use of ordinance. Therefore, in areas where invasive soil sampling is proposed (Tasks 3.1 and 3.8) an unexploded ordinance (UXO) avoidance survey will be conducted prior to and during soil sampling.

Sampling and decontamination methodologies for all matrices (soil, sediment, and surface water) are provided in Chapter 3. Protocols for handling IDW are provided referenced in Section 5.3 and Appendix A. Quality Assurance/Quality Control (QA/QC) samples will be collected to evaluate whether the data quality objectives outlined in the QAPP have been achieved. The number of QA/QC samples and the proposed analyses are summarized in Section 3.9. A

description of each type of required QA/QC sample and an explanation of how results are used in evaluating data quality is presented in the QAPP.

### **2.2.1 Task 3.1 NAPL Identification, Southwest Corner of PPIC Property**

The purpose of this task is to determine the lateral extent of subsurface NAPL in the area along the southwest corner of the PPIC property and assess the subsurface geology in the NAPL-impacted area (Figure 1). These data will be used to help determine the location of the northern segment of the sheet pile wall that will prevent future NAPL migration from the Wykcoff Inlet.

A geophysical survey for UXO avoidance using a Foerster FEREX 4.032 will be conducted over locations where test borings are to be installed prior to invasive activities (see Section 3.4). The EPA Triad approach will be utilized to delineate NAPL in this area; therefore, the exact number and location of test borings will be determined in the field. Field conditions may require a higher density of borings in some areas and fewer borings in other areas, depending on site-specific observations. Laboratory chemical analysis of total PAH (tPAH) or other organic or inorganic constituents is not necessary to satisfy task objectives. Therefore, qualitative field screening methods will be used as the basis for decision-making and no laboratory analytical samples will be collected or submitted under this task. The methodology for soil sample collection, field decision procedures, QA/QC analysis, and decontamination procedures is provided in Section 3.1.3.

### **2.2.2 Task 3.2 Sheet Pile Wall Evaluation near Jordan Bridge**

The Selected Remedy in the ROD stipulates that the offshore sheet pile wall provide NAPL containment. The sheet pile must be installed near the western abutment of the Jordan Bridge (Figure 1). The RD will assess the best way to tie into or go around the western foundation of the bridge. A geotechnical subcontractor, to be determined (TBD), will execute this task under EA's supervision.

It is anticipated that approximately 17 geotechnical samples (15 sediment and 2 land-based) will be collected. The borings will include continuous Standard Penetration Tests. As indicated in Table 2, select samples will be submitted for geotechnical laboratory analysis of moisture content, natural density, Atterberg Limits, gradations, Triaxial Compression Tests, and consolidation tests. Geotechnical sampling, including required analyses and sampling frequencies, is summarized on Table 2. The methodology for geotechnical sample collection and QA/QC analysis is provided in Chapter 3.

### **2.2.3 Task 3.4 Sheet Pile Wall Evaluation East End PPIC**

Dredging of the sediment off the eastern end of the PPIC property may destabilize the shoreline in that area (Figure 1).

It is anticipated that six sediment samples and three land-based geotechnical samples will be collected. The borings will include continuous Standard Penetration Tests. Samples will be submitted for geotechnical laboratory analysis of moisture content, natural density, Atterberg Limits, gradations, and Triaxial Compression Tests. A geotechnical subcontractor (TBD) will execute this task under EA's supervision. Sediment samples will be collected via a work barge between the shoreline and the western edge of the shipping channel. Geotechnical sampling, including required analyses, is summarized on Table 2. The methodology for geotechnical sample collection and QA/QC analysis is provided in Chapter 3.

### **2.2.4 Task 3.5 Determine Area to be Dredged**

The goal of this task is to refine the delineation of the impacted area to be dredged in order to improve dredging accuracy and to assess whether COCs are located in sediments just beyond this area which may recontaminate the dredged area. Sediment samples will be collected in order to delineate the dredge area both horizontally and vertically. A bathymetric survey and cultural resources survey will be completed to define the depth and configuration of the river bottom within the potential dredge areas prior to delineation activities.

The EPA Triad approach to sampling this area will be utilized. Therefore, the exact number and location of test borings will be ultimately be determined in the field. A total of 15 sample locations (three sample depth intervals) are initially proposed for both vertical and horizontal impact delineation and 26 sample locations (four sample depth intervals) are initially proposed to characterize sediments outside of the PAH-impacted area. All samples will be field screened via tPAH immunoassay (Section 3.7.1), and a subset of immunoassay samples (10%) will be submitted to the EPA Contract Laboratory Program (CLP) for confirmatory laboratory analysis of PAHs via SOM01.1. Samples collected from four depth intervals from the 26 sample locations outside of the dredge area will be submitted for analysis of organics via SOM01.1, inorganic compounds via ILM05.3, and dioxins via DLM02.0. Of these samples, 25 percent (%) will also be submitted for laboratory analysis including grain size (ASTM Method D422) and total organic carbon (TOC) via SW846 9060A. Laboratory analyses and field screening analyses for sediment sampling are summarized on Table 3. The methodology for environmental sample collection and QA/QC analysis procedures is provided in Chapter 3.

### **2.2.5 Task 3.6 South Annex Bulkhead Leakage Evaluation**

The bulkhead of the South Annex of NNSY will be inspected for signs of gross leakage. A visual inspection will be conducted along the bulkhead each of the five docking bays, above the low tide water line. If gross contamination (based on visual evaluation) is observed discharging from a breach in the bulkhead, a grab sample of the discharged soil will be collected. The soil sample will be submitted to the EPA CLP and analyzed for PAH, PCP, PCBs, dioxins, arsenic, chromium (total), copper, lead, zinc, pending approval of the Remedial Project Manager (RPM). Laboratory analyses, which are summarized on Table 5, include analysis of PAH and PCP via SOM01.1, inorganic metal compounds via ILM05.3, and dioxins via DLM02.0. The methodology for soil sample collection and QA/QC analysis is provided in Chapter 3.

### **2.2.6 Task 3.8 DNAPL Delineation**

The purpose of this task is to assess the location and physical characteristics of DNAPL at two locations on the west side of the AWI property to determine the technical and engineering controls and precautions necessary to protect surrounding properties while DNAPL is being remediated. This task will focus on delineating areas where DNAPL was previously reported. The areas targeted for test borings will include the eastern portion of the historical waste disposal area (where deep DNAPL may be present) and other areas along the east-west oriented DNAPL body in the historical disposal area and the smaller DNAPL body in the central portion of the wood storage area (see Figure 1) on the western portion of the AWI property.

The sampling approach for this task includes 12 to 15 hollow stem auger (HSA) borings and continuous standard penetration test (SPT) sampling to a nominal depth of 50 ft or to the top of the Columbia Formation where deep-seated DNAPL has been reported, and at shallower depths where DNAPL is reportedly not as deep. All borings will be terminated when the Yorktown Clay is encountered to avoid spreading contamination to the underlying Yorktown Formation.

Each 2-ft split spoon samples will undergo a qualitative screening for DNAPL via a Sudan IV dye shake test (see Section 3.6). Laboratory chemical analysis of total PAH or other organic or inorganic constituents is not necessary to satisfy Task 3.8 objectives. Therefore, qualitative methods will be used as the basis for decision-making and no laboratory analytical samples will be submitted. Field screening analyses are summarized on Table 5. The methodology for soil sample collection, field decision procedures and QA/QC analysis is provided in Chapter 3. Geotechnical samples will also be collected to support engineering soil parameters for excavations and in preparing earthwork recommendations. Geotechnical samples will be submitted for geotechnical laboratory analysis of moisture content, natural density, Atterberg

Limits, gradations, specific gravity, and permeability tests. A geotechnical subcontractor (TBD) will execute this task under EA's supervision. Geotechnical sampling, including required analyses, is summarized on Table 2. The methodology for geotechnical sample collection and QA/QC analysis is provided in Chapter 3.

UXO avoidance field screening will be conducted using a Foerster FEREX 4.032 prior to soil boring activities due to the uncertainty of Naval operations involving ordinance at the Site. Down hole magnetometry will also be utilized during soil boring activities until native soil is reached.

### **2.2.7 Task 3.9 Delineate Areas of Contaminated Soil Beyond AWI Property Line Requiring Cleanup**

The purpose of this task is to define any areas off of the AWI property along the Southern Public Service Authority of Virginia (SPSA) boundary and along the northern boundary of the former wood storage area (Elm Avenue) where clean up goals are exceeded in soil (see Figure 1).

EA will use surface soil sampling and direct push sampling along the boundaries to collect soil samples for field screening using immunoassay for dioxin toxic equivalent (TEQ) and tPAHs and X-ray Fluorescence (XRF) with subsequent submittal of selected samples for laboratory analysis. It is anticipated that approximately 50 surface soil samples and 10 to 12 subsurface soil samples will be collected. Additional subsurface samples may be collected, at the direction of EPA, to adequately characterize the site. Since there is no reliable benzo(a)pyrene (B(a)P)-specific immunoassay test, tPAH will be used as a surrogate screening. A subset (20%) will be submitted to EPA CLP for PAH, TAL metals, PCP, and dioxin analysis. Samples submitted for lab verification will include a range of high, medium, and low concentrations to establish the correlation between field and lab analysis. Field screening and laboratory analyses are summarized on Table 5. The methodology for soil sample collection, field decision rationale/procedures, field screening procedures, and QA/QC analysis are provided in Chapter 3.

### **2.2.8 Task 3.10 Storm Drain Discharge Determination**

A thorough site walk along the southern perimeter fence of the AWI property will be conducted to visually determine if any storm drains exist on the U.S. Navy property which discharge to the restored acetylene sludge wetland area.

If found, the outfalls of the storm drain pipe(s) will be located via hand-held global positioning system (GPS) and aqueous samples coming from the storm drain(s) will be collected and submitted to the EPA CLP laboratory for PAH, PCP, dioxin, arsenic, chromium (total), copper,

lead, zinc, and oil and grease. Two sampling events shall be conducted, once during both dry and wet conditions. Monitoring of one pipe discharge via a grab sample for two events (wet and dry conditions) is assumed. Laboratory analyses are summarized on Table 4. The methodology for aqueous sample collection, field decision rationale/procedures, and QA/QC analysis are provided in Chapter 3.

### **2.3 Analytical Task**

Chemical analytical laboratory services will be provided by an EPA CLP laboratory(ies). Geotechnical laboratory services will be provided by a subcontractor(s) to EA.

### **2.4 Data Validation Task**

A data quality evaluation of the laboratory results and field data will be performed prior to their use for conducting the evaluation of Site contaminant distributions and magnitudes. EA will coordinate with the EPA Sample Management Office (SMO), Regional Sample Control Coordinator (RSCC), and the Environmental Assessment and Innovation Division (EAID) as required to obtain analytical support and data validation services using EPA Region 3 data validation guidance.

### **2.5 Data Types**

#### **2.5.1 Laboratory Analytical Data**

Information to be obtained during RD sampling activities will include analytical results for the chemical parameters or group of parameters, depending on the proposed analytical program for each specific sample. Table 6 summarizes laboratory analytical methods for each matrix.

#### **2.5.2 Geotechnical Analytical Data**

Information to be obtained during RD sampling activities will include analytical results for the geotechnical parameters, depending on the proposed analytical program for each specific task. Table 7 summarizes geotechnical analytical methods for each matrix.

#### **2.5.3 Field Sampling Data**

During RD sampling activities, field screening data will also be collected. Soils will be field screened for volatile organic compounds with a photoionization detector (PID), DNAPL using a

Sudan IV dye test, tPAHs and dioxins via immunoassay, and metals via XRF analysis. This data will be used to direct further delineation of constituents of concern.

## **2.6 Data Uses**

Data uses will depend on the specific data objective for each task. The primary use of data will be as the basis of the remedial design for the AWI Superfund site. Laboratory and field screening sample results will be compared to the cleanup criteria developed in the ROD as discussed in Section 2.5.4.

Sample results for the calibration of the XRF are to be utilized to demonstrate effectiveness of the XRF as a screening tool for target metals. A least squares linear regression will be the basis for a correlation equation for each to more closely predict fixed XRF results from laboratory results.

### **2.6.1 Data Usage Needs**

Data usage needs are determined by the data quality objectives (DQOs) developed for the analytical methods used. DQOs are discussed in the QAPP. Reporting limits will be below cleanup or screening criteria, where practicable. Reporting limits are discussed in the QAPP. Required field QC samples are discussed in Section 3.9.

### **2.6.2 Applicable Regulations and Standards**

The ROD set the cleanup objectives and criteria for soil and sediment based on human and ecological risks. Table 8 presents the soil and sediment cleanup criteria for contaminants of concern (COCs). EPA developed soil cleanup criteria for arsenic, benzo(a)pyrene (BaP), and dioxin TEQ. For sediment, since PAHs related to creosote are more pervasive in the river than the other identified contaminants (metals and dioxin), EPA developed sediment cleanup criteria for only one COC, tPAHs at 45 ppm. For immunoassay screening, an action level of 100 ppm tPAH, will be used to determine if more delineation of the area to be dredged is necessary for sediments. When sediments of 100 ppm tPAH are encountered, the delineation will continue until sediments below 45 ppm are reached.

### **3. FIELD, SAMPLING, AND ANALYSIS ACTIVITIES**

The general soil, sediment, and water sampling protocol and the sampling schemes to be used during the remedial action are summarized below.

#### **3.1 Surface and Subsurface Soil Sampling**

Surface and/or subsurface soil sampling will be conducted in association with Tasks 3.1, 3.2, 3.4, 3.8, and 3.9. The following sections discuss task specific objectives for soil sampling, sampling rationale, methodology, and sample designations.

##### **3.1.1 Objectives**

The overall objective of soil sampling is to gather geotechnical and environmental data in support of the RD. The following presents soil sampling objectives related with each task:

- The objective of Task 3.1 is to determine the lateral extent of surface and subsurface NAPL in the southwest corner of the PPIC property and assess the subsurface geology in the NAPL-impacted area. This objective will be met by using field screening and in-field decision-making processes to determine the extent of NAPL. Additionally, geotechnical data will be collected to provide data for the design of the proposed sheet pile in this area as part of Task 3.2.
- The objective of Task 3.2 is to assess the best way to tie the sheet pile wall into or go around the pier foundation of the western side of the Jordan Bridge. This objective will be met by collecting two soil geotechnical samples (see Section 3.2.2.1 for sediment geotechnical sampling associated with this task), which are to be collected during the Task 3.1 sampling event.
- The objective of Task 3.4 is to determine stability of the shoreline in the vicinity of the proposed dredging of contaminated sediments off the eastern end of the PPIC property. This objective will be met by collecting three geotechnical samples (see Section 3.2.2.1 for sediment geotechnical sampling associated with this task).
- The objective of Task 3.9 is to define any areas where clean up goals are exceeded in soil beyond the AWI property along the SPSA boundary along the northern boundary of the wood storage area (Elm Avenue), and along the west side of the wood storage area (VEPCO Easement). This objective will be met by using field screening, in-field decision-making processes, and laboratory analytical data to determine the extent of contamination.

- The objective of Task 3.6 is to inspect the bulkhead of the South Annex of NNSY for signs of gross leakage. If gross contamination is observed a sample will be collected to characterize the impact.

### **3.1.2 Sampling Rationale and Sample Locations**

#### **3.1.2.1 NAPL Delineation (Tasks 3.1 and 3.8)**

Tasks 3.1 and 3.8 involve the delineation of NAPL impacted areas. The EPA Triad approach to sampling will be utilized in these areas. Therefore, the exact number and location of test borings will be determined in the field. Field conditions may require a higher density of borings in some areas and fewer borings in other areas, depending on site-specific observations.

To meet the project objectives for these tasks, it is necessary that areas of NAPL be identified. Precise analytical laboratory chemical analysis of tPAH or other organic or inorganic constituents is not necessary to satisfy task objectives; therefore, qualitative methods will be used as the basis for decision-making. Initial boring locations for Tasks 3.1 and 3.8 are shown in Figures 2 and 3, respectively. Field decisions on where subsequent borings will be advanced will be based on field screening results. The methods that will be used for field screening are provided in Table 9. Figures 4 and 5 present decision trees for determining the extent of NAPL areas for Tasks 3.1 and 3.8, respectively.

#### **Task 3.1**

Presently, there are no soil boring data for the area of interest depicted on Figure 2. Soil borings and other data presented in the FS indicate estimated DNAPL areas on the 3975 Elm Avenue property immediately north of the Wyckoff Inlet. EA will collect soil/NAPL samples (surface and subsurface) for rapid qualitative assessment of NAPL and lithology in these areas.

Initially, a series of test borings will be installed in a northeast-southwest direction, parallel to the shore line at a nominal lateral spacing of 75 ft, which is consistent with the approximate spacing used in the previous investigation at the adjacent property. Direct push technology (DPT) will be utilized to advance a 2-inch diameter, 48-inch long Geoprobe macro core sampler, fitted with a disposable acetate liner, to collect soil samples. Based on the decision tree presented in Figure 4, subsequent borings will be advanced and qualitatively evaluated until the lateral extent of NAPL has been defined. The process will optimize the use of borings without sacrificing data quality or quantity. Figure 4 illustrates the procedures for selecting subsequent

test boring locations using the decision process and using the semi-qualitative and quantitative assessment methods.

The lateral extent of NAPL in a northeast-southwest direction, parallel to the shore line, is very important as it will be used to position the sheet pile along the current shoreline. Lateral extent of NAPL further to the north (away from the shore line) will not likely impact the positioning of sheet pile unless isolated NAPL is identified further away from the shore that could be a potential PAH source or migration concern. From a vertical perspective, based on prior test boring results and available information, a nominal depth of 25 ft per boring (or to the top of Columbia Clay formation) is considered to positively identify or rule out the presence of NAPL in soil at a particular boring location.

### **Task 3.8**

The sampling rationale for Task 3.8 includes approximately 12 to 15 HSA borings and continuous SPT sampling to a nominal depth of 50 ft or to the top of the Yorktown Clay formation where deep-seated DNAPL has been reported, and at shallower depths where DNAPL is reportedly not as deep. All borings will be terminated when the Yorktown Clay is encountered so that any contamination that may be present is not spread to the underlying Yorktown Formation. The areas targeted for test borings include the southern edge of the historical waste disposal area (where deep DNAPL may be present) and the smaller DNAPL body in the central portion of the wood storage area. Figure 3 presents the proposed initial boring locations for this task. Subsequent borings will be placed based on results of the initial borings. In addition to SPT sampling, each 2-ft split spoon sample will undergo qualitative screening for DNAPL. Based on the decision tree presented in Figure 5, subsequent borings will be advanced and qualitatively evaluated until the lateral extent of NAPL has been defined. The process will optimize the use of borings without sacrificing data quality or quantity. Figure 5 illustrates the procedures for selecting subsequent test boring locations using the decision process and using the semi-qualitative and quantitative assessment methods. In addition, a total of 10 soil samples will be selected from borings that are considered representative of the material that overlies the DNAPL where remedial excavation may potentially occur. These soil samples will be analyzed for geotechnical parameters as indicated in Table 2.

#### **3.1.2.2 Adjacent Property Contamination Delineation (Task 3.9)**

Surface soil sampling and direct push sampling along the boundaries will be utilized to collect soil samples for Task 3.9. The general protocol will consist of collecting up to 50 surface soil

samples along the boundary between the AWI property and adjacent properties on a biased grid. Figure 6 presents the proposed initial surface sample locations for this task. Based on the decision tree presented in Figure 7, subsequent samples will be collected and qualitatively evaluated until the lateral extent of NAPL has been defined. The initial locations are biased to areas immediately adjacent to high locations on the AWI property where past sampling has indicated surface PAH contamination or in obvious accumulation areas, such as swales or local depressions. Samples will be field screened using immunoassays for dioxin TEQ and PAH and XRF for arsenic. Field results of the immunoassay, XRF, or other in-field observations will dictate the locations for subsequent surface soil samples. A subset of samples will be submitted for laboratory analysis of PAHs, PCP, TAL metals, and dioxins. Procedures for immunoassay are discussed in Section 3.8, and procedures for XRF analysis are discussed in Section 3.9.

Based on the results of the surface soil sampling, a limited number of subsurface borings (approximately 10 to 12) will be advanced to a nominal 5 ft depth bgs for additional field screening and laboratory analysis for arsenic, tPAH, and dioxins. This depth corresponds to reasonable depths where offsite property improvements or utility extensions or upgrades may extend vertically. For each boring, if field screening results are below screening criteria at 5 ft bgs, the boring will be terminated; if field screening results exceed screening criteria at 5 ft bgs, the boring will be advanced until clean soil is identified. A subset of the subsurface samples are planned to be submitted for EPA CLP laboratory analysis of PAHs, PCP, TAL metals, and dioxins.

#### **3.1.2.3 Bulkhead Evaluation (Task 3.6)**

If, during the inspection associated with Task 3.6, gross contamination (based on visual evaluation) is observed discharging from a breach in the bulkhead, a grab soil sample will be collected and may be submitted for laboratory analysis of tPAH, PCP, dioxins, arsenic, chromium (total), copper, lead, and zinc, pending approval of the RPM.

#### **3.1.2.4 Geotechnical Samples (Tasks 3.2 and 3.4)**

Geotechnical samples collected in association with Tasks 3.2 and 3.4 will be collected from areas pertinent to the RD. Samples will be collected using the geotechnical subcontractor's established protocol.

### 3.1.3 Surface and Subsurface Soil Sampling Methodology

Soil samples will be collected following the approved EA Standard Operating Procedure (SOP) 025 (Soil Sampling – Revision 4) and SOP 047 (Direct-Push Technology Sampling – Revision 2). Soil borings will be abandoned following SOP 028 (Well and Boring Abandonment – Revision 4). EA SOPS are included in Appendix A.

Borings will be continuously logged and described for grain size, composition percentages, relative sorting, color, and classified in accordance with the Unified Soil Classification system (USCS). Samples will be screened for headspace using a PID, and the readings will be recorded on the boring log.

A listing of the samples undergoing immunoassay and XRF analysis will be maintained in the project logbook as indicated in Chapter 4. Samples will be held for determination of submission to the contract laboratory for confirmatory analysis. These samples will be stored in the field until submission to the analytical laboratory or until proper disposal. If samples are to be submitted for organics, the samples will be stored in a refrigerator/freezer in the field trailer in order to maintain the proper temperature. A sample custody record will be maintained to document the sample collection for all samples selected for laboratory analysis (see Section 3.10.2). Samples that are to be submitted for analytical laboratory analysis will be placed into the proper laboratory bottles, after field screening analysis is complete, as outlined in Table 9.

### 3.1.4 Sample Designations for Soil

The sample designation will consist of the task number, sample number (to be sequentially numbered), and the depth interval from which the sample was collected. Each location shall be noted in field notes and on the sampling diagram. The following table presents a guide for sample identification where “X” represents the task number, “N” represents the sequential sample number, and “D” indicates the sample end depth in feet, respectively. An example designation would be “Task 3.9-10-1”, which would indicated a sample collected from the area associated with Task 3.9, at location 10, and from 0-1 ft bgs.

<b>Task Number</b>	<b>Sample Number</b>	<b>Depth Interval</b>
X	N	D-D

## **3.2 Sediment Sampling**

Sediment sampling will be conducted in association with Tasks 3.2 (geotechnical), 3.4 (geotechnical), and 3.5 (environmental). The following sections discuss task specific objectives for sediment sampling, sampling rationale, methodology, and sample designations.

### **3.2.1 Objectives**

The overall objective of soil sampling is to gather geotechnical and environmental data in support of the RD. The following presents soil sampling objectives related with each task:

- The objective of Task 3.2 is to assess methods to tie the sheet pile wall into or go around the pier foundations of the western side of Jordan Bridge. This objective will be met by collecting approximately 15 sediment geotechnical samples (see Section 3.1.1 for soil geotechnical samples associated with this task).
- The objective of Task 3.4 is to determine stability of the shoreline in the vicinity of the proposed dredging area off the eastern end of the PPIC property. This objective will be met by collecting approximately six sediment geotechnical samples (see Section 3.1.1 for soil geotechnical samples associated with this task).
- The objective of Task 3.5 is to delineate the area to be dredged. The horizontal and vertical extent of the tPAH contamination will determine the areas to be dredged. Sediments that are south of the AWI site will be characterized (in accordance with PS 11.2.3.1.4 of the ROD). This objective will be met by collecting approximately 194 samples from 56 locations.

### **3.2.2 Sampling Rationale**

#### **3.2.2.1 Geotechnical Sampling (Tasks 3.2 and 3.4)**

Geotechnical samples collected in association with Tasks 3.2 and 3.4 will be collected from areas pertinent to the RD. Samples will be collected using the geotechnical subcontractor's established protocol.

#### **3.2.2.2 Determination of Area to be Dredged (Task 3.5)**

The tPAH immunoassay data collected during the remedial investigation was used to delineate the approximate boundaries of the tPAH contamination within the Elizabeth River sediments. However, additional sediment samples are necessary to more precisely define both the outer perimeter and vertical extent of tPAH so that dredging cut lines can be determined. The

selection of those samples to be analyzed for tPAH analysis will follow the decision trees presented in Figures 8 and 9. The decision trees were developed as part of the EPA Triad Approach that follows a Dynamic Work Strategy (DWS). The DWS allows for a flexible field sampling design that will maximize efficiency in the field while minimizing uncertainties. For this effort, immunoassay analyses for tPAH will be used to define the boundaries of contamination. Immunoassays are suited for this effort because the speed with which data become available fits into the DWS and decisions about additional samples can be made while the field effort is ongoing.

#### **3.2.2.2.1 Determination of the Horizontal Extent of tPAH Contamination**

An orthogonal grid with a 100-ft spacing will be utilized to more precisely define the outer horizontal extent of tPAH contamination (Figure 10). The southern extent of borings shown in this figure may be moved further south depending on the results of the tPAH screening. The borings will continue south until there is no further evidence of creosote contamination above the action level of 100 ppm. For determining the outer boundary, the sediment samples will be analyzed from the sediment-water interface downwards. The samples collected will be analyzed following the Triad Approach using a decision tree to satisfactorily define the outer boundary (Figure 8). Initially, 15 sample locations are proposed to determine the horizontal extent of PAH contamination using immunoassay. As the results become available, the RPM will be consulted daily to direct future sampling throughout the grid, as needed, to determine the horizontal extent of contamination. The DWS for this effort allows for flexible decision-making to move outward or inward from the AWI shoreline to best define the outer boundary.

Samples will be field screened for tPAH via immunoassay (Section 3.8). The target immunoassay concentration for defining the contamination boundary will be 100 ppm tPAH. When 100 ppm tPAH is encountered, analysis of the archived samples will continue to locate the depth at which the 45 ppm tPAH is encountered, which will define the depth to which dredging will be necessary.

#### **3.2.2.2.2 Determination of the Vertical Extent of tPAH Contamination**

To further define the vertical extent of contamination within known areas of PAH contamination, as presented in the RI report, vibracores will be collected using an orthogonal grid with a 150-ft spacing (Figure 10). At the majority of the sampling locations, the cores will be driven to a target depth of 20 ft below the sediment surface or until refusal. Potentially, some areas will require collecting cores greater than 20 ft below the sediment surface.

Samples will be collected at two-foot intervals along the length of the core and will be analyzed using tPAH immunoassay from the bottom of the core first. Those depth interval samples (deeper) not immediately analyzed will be archived for future analysis, if warranted.

Approximately 15 sample locations are initially proposed for determination of the vertical extent of contamination via immunoassay. The results of these samples, along with the results of previous samples, will be evaluated by the RPM and the next set of sample locations will be selected to best determine the vertical extent of the dredge cut lines. The samples collected will be analyzed following the Triad Approach using a decision tree to satisfactorily define the vertical extent of tPAH. The decision tree developed for this effort is presented in Figure 9. The DWS allows flexibility to move among the grid and vertically throughout each core to select samples that best reduce uncertainty of the dredging cut lines. The goal of these samples is to define the deepest area of contamination that will be dredged. From the data generated during the RI, the areas within the zone to be removed are known to exceed 100 ppm tPAH, therefore the 45 ppm tPAH concentration will be a criterion for establishing the dredging depth.

### **3.2.2.3 Characterization of Sediments South of AWI Site (in accordance with PS 11.2.3.1.4 of the ROD) (Task 3.5)**

Areas within the Elizabeth River that lie south of the AWI Site are potential sources of sediment contamination that could reintroduce contaminants to the dredged areas if those sediments are mobilized. The area extending from south of the AWI property to the mouth of Paradise Creek and east to the navigation channel will be sampled using a vibracoring unit. The grid sampling design will utilize a 300-ft spacing and will include approximately 26 sampling locations extending from the AWI property southward to the mouth of Paradise Creek to characterize the presence of contamination outside of the area to be dredged in accordance with PS 11.2.3.1.1 (Figure 11).

Initially, five locations (spread throughout the South Annex study area) will be sampled to a depth of 25-ft to determine the approximate depth of native materials and materials that were recently deposited in the study area (within the past ~100 years). The 25-ft cores will be divided into four depth intervals for analysis based on visual inspection of the cores and consultation with the RPM. Up to 50% (13) of the 26 coring locations may be sampled to a depth of 25 ft. The remaining cores (13) will be collected to a depth of 15 ft or native material, whichever is less. If the approximate depth of native material cannot be determined, all remaining cores will be sampled to a depth of 15 ft. Each 15-ft core will be divided into four depth interval sub-samples (i.e., 0-2 ft, 2-5 ft, 5-10 ft, and 10-15 ft.). Each sub-sample will be analyzed for dioxins, PCP, PCBs, and TAL metals, and immunoassays will be performed for tPAH. As quality

assurance, 20% of the tPAH immunoassay samples will also have a split sample sent for laboratory analysis and verification. Grain size and TOC samples will be determined for 25% of the samples (26 samples total) to characterize the physical properties of the sediments.

The decision-tree used to guide this effort is presented in Figure 12. The immunoassay data will be reported to the EPA RPM in tabular form as they are available. In the technical memorandum (TM), the data will be reported and evaluated with respect to contaminants that could potentially recontaminate the dredged area near the AWI property. The screening criteria for the data will be determined in consultation with the EPA RPM.

### **3.2.3 Sample Location Positioning**

Positioning will be determined in the field using a Trimble ProXRS Differential Global Positioning System (DGPS). The ProXRS uses either the United States Coast Guard Differential Beacon System or the Omnistar<sup>®</sup> Satellite Differential System to obtain differential accuracy of 3-5 meters.

### **3.2.4 Sediment Core Sample Collection**

Sediment samples for will be collected using a vibracoring system supplied by a subcontractor (TBD). Coring operations will be conducted from an 80-ft spud barge positioned with a tugboat. The barge will be outfitted with a crane to lift the core barrel during coring operations. Barge, tugboat, and crane equipment will be provided and operated by the subcontractor. Staging for the project will take place at a location to be determined.

Prior to vibracoring, a buoy will be placed at a target sampling location by EA personnel to assist with the barge/tug positioning. After the barge is in position, a buoyant boom will be deployed to prevent potential dispersion of product on the surface water from the vibracore barrel.

The vibracoring system uses a stainless steel core barrel capable of holding a core liner with an outside diameter of 3.0 in. Cellulose acetate butyrate (CAB) core liners with an inner diameter of 2.87 in. will be used. Vibracoring will be conducted by placing a clean CAB liner into the stainless steel barrel. The barrel will be lowered to the sediment surface and vibrated to the required depth. After the core has penetrated to a sufficient depth, the core barrel will be retrieved and brought onto the barge deck. The core liner will be removed from the steel barrel, capped at both ends, sealed, and labeled.

Sediment samples for analysis will be collected from the appropriate depth as indicated in Sections 3.2.2.2 and 3.2.2.3. The designated samples will be analyzed, and samples from the remainder of the core will be stored (in a refrigerator) for future analysis, if necessary.

Cores collected from each location will be transported to the AWI property immediately after collection and transferred to personnel stationed onshore. Samples from the cores will be transferred to a refrigeration unit (cooled to 4°C) at the on-shore staging area at the end of each workday. The samples will be stored in a secured refrigeration unit at the Site (maintained at 4°C) until they are analyzed. The refrigeration unit at the staging area will be secured with a padlock when unattended.

The sample containers, preservatives, and holding time requirements for sediment samples are provided in Table 9. Holding times for the sediment samples will begin when the sediment is removed from the core liner, composited, homogenized, and placed in the appropriate sample containers.

### **3.2.5 Sediment Sample Packing**

Samples processed from the cores will be placed in the appropriate holding containers, packaged with bubble wrap, secured individually in ziplock bags, placed in an ice-filled cooler, analyzed for tPAH immunoassay, and delivered via overnight carrier to the EPA CLP laboratory as required.

### **3.2.6 Core Processing**

Cores will be processed in a designated area at EA's on-site trailer. Prior to processing, cores will be sorted and checked against the chain-of-custody form. Cores will be opened by cutting the plastic liner on opposite sides. Sediments will be extracted from specific depth intervals using a stainless steel spoon and placed into the appropriate pre-cleaned laboratory containers.

Sample processing equipment that comes into direct contact with the sediment will be decontaminated according to the protocols specified in the Attachment A.

### 3.2.7 Sampling Contingencies

Sampling will be dependent upon daily weather conditions (including heavy rain, high winds, lightning, and/or fog). Severe weather forecasts may preclude sampling. EA's Project Manager and the EPA RPM will be notified of weather-related delays by the Field Operations Manager.

If core refusal or limited recovery is encountered during coring operations, a limited number of additional attempts will be made to obtain sufficient sample volume. Three additional attempts will be conducted at a single location if refusal or limited recovery is encountered. After three attempts, the corer will be repositioned approximately 3-5 meters parallel to the axis of the channel (in an area equally representative of material to be dredged) and penetration will be attempted again. If sufficient recovery cannot be attained after repositioning the corer three times, the Field Operations Manager will contact the EA Project Manager. The EA Project Manager will contact the EPA RPM to discuss re-locating the sampling station.

### 3.2.8 Sample Designations for Sediment

Two separate but related sample numbering systems will be used. One will apply to the cores, the other to the samples. The core numbering system will be used to communicate between the field crew and the sampling processing crew, and will indicate which cores were collected from each station. The sample numbering system will provide communication between the sample processing operation and the laboratories performing the desired analyses.

#### 3.2.8.1 Core Numbering

The core designation will consist of the location, sample number (to be sequentially numbered), and sample type. Each location shall be noted in field notes and on the sampling diagram. The following table presents a guide for sample identification where "ER" represents Elizabeth River, "N" represents the sequential core number, and "V or H" indicates whether the sample is vertical or horizontal delineation, respectively. An example designation would be "ER-01-V" which indicates a vertical delineation sample collected from the Elizabeth River at Sample Location 01.

Core Location	Sample Number	Sample Type
ER	N	V or H

### 3.2.8.2 Sample Numbering

The sample designation will consist of the location, sample number (to be sequentially numbered), sample type, and the depth interval from which the sample was collected. Each location shall be noted in field notes and on the sampling diagram. The following table presents a guide for sample identification where “ER” represents Elizabeth River, “N” represents the sequential core number, and “V or H” indicates whether the sample is vertical or horizontal delineation, and “N-N” indicates the sample interval, respectively. An example designation would be “ER-01-V-10-14” indicates a vertical delineation sample collected from the Elizabeth River at Sample Location 01 from the 10 to 14 ft interval.

Core Location	Sample Number	Sample Type	Sample Interval
ER	N	V or H	N-N

### 3.3 Surface Water Sampling

Surface water sampling will be conducted in association with Task 3.13 (evaluation of storm drain discharge), if deemed necessary based on field observations. The following sections discuss task specific objectives for surface water sampling, sampling rationale, methodology, and sample designations.

#### 3.3.1 Objectives

The overall objective of surface water sampling is to gather environmental data in support of the RD. The objective of Task 3.13 is to visually determine if any storm drains exist on the U.S. Navy property that discharge to the north to the restored acetylene sludge wetland area. If such drains are discovered, the discharge (if any) will be sampled for environmental characterization.

#### 3.3.2 Sampling Rationale

If discharging drains are discovered during the inspection associated with Task 3.13, aqueous samples of discharge coming from the storm drain(s) will be collected and analyzed for PAHs, PCP, dioxin, PCBs, arsenic, chromium (total), copper, lead, zinc, and oil and grease. If field conditions permit, two sampling events (from one pipe discharge) shall be conducted, once during both dry and wet conditions.

### 3.3.3 Methodology

Surface water samples (i.e. discharge water) will be collected in accordance with SOP 007 (Surface Water Sampling Procedures – Revision 3). This SOP is included in Appendix A.

### 3.3.4 Sample Designations for Surface Water

The sample designation will consist of the task number, sample matrix, and sample number (to be sequentially numbered). Each location shall be noted in field notes and on the sampling diagram. The following table presents a guide for sample identification where “X” represents the task number, “W” represents the sample matrix, “N” represents the sequential sample number, and “W” or “D” indicates whether the site conditions were wet or dry, respectively. An example designation would be “Task 3.13-W-1-D”, which indicates that water sample 01 was collected in association with Task 3.13 during dry conditions.

<b>Task Number</b>	<b>Sample Matrix</b>	<b>Sample Number</b>	<b>Field Condition</b>
Task X	W	N	W or D

### 3.4 Unexploded Ordnance (UXO) Field Screening

A surface geophysical survey using a surface geophysical method (e.g., Foerster FEREX 4.032) will be conducted over locations where test borings are to be installed in areas associated with Task 3.1, Task 3.8, and Task 3.9. Down hole magnetometry will also be conducted in areas associated with Task 3.8 until native soil is reached or until the water table is encountered, whichever is first.

### 3.5 Procedures for PID Field Screening

Soil samples will be initially screened for organic vapors in the field using a MiniRae<sup>®</sup> equipped with a PID. PID measurements will follow SOP 011 (Photoionization Detector [MiniRae] – Revision 3), as provided in Appendix A.

### 3.6 Procedures for Sudan IV Dye Field Screening

Soils samples associated with Tasks 3.1 and 3.8 will be screened using a hydrophobic Sudan IV dye test. This quantitative screening method identifies the presence of NAPL in soil. The protocol for NAPL field screening is provided in the SOP (NAPL Field Screening Using Sudan IV), which is provided in Appendix A.

### **3.7 Procedures for Immunoassay Field Screening Analyses**

Soil samples associated with Task 3.9 (see Table 5) and sediment samples associated with Task 3.5 (see Table 3) will be field screened for tPAH using immunoassay. Soil samples associated with Task 3.9 will also be field screened for dioxins (by a subcontractor) using an immunoassay as indicated on Table 5.

#### **3.7.1 tPAH Immunoassay**

Following collection, soil samples will be field-screened for total PAHs using an Ohmicron RPA-I RaPID Analyzer spectrophotometer. Visibly wet samples will be dried in the work trailer to reduce moisture content. Once dry, samples will be homogenized with a mortar and pestle. First a ten-gram sample will be measured and a methanol extraction solution will be added to a sample aliquot. The samples are then shaken for 1 minute and allowed to settle for 5 minutes. Next, the clear extract remaining over the settling soil is siphoned off, and filtered into a vial for storage. After filtration, the filtered extractants are added to diluents.

After the appropriate amount of standards, controls, and samples are added to the test tubes, the reagents are added and procedures are followed according to the manufacturer's protocol. After a 20-minute incubation period, stopping solution is added, and the results are read at a 450 nanometers (nm) wavelength within 15 minutes of stopping the reaction. The spectrophotometer creates a printout with calibrator data, a calibration curve, control data, and sample data.

The method detection limit (based on information from the manufacturer) using this field screening method are 200 parts per billion (ppb) for PAHs. These field screening analyses correspond to EPA method SW846 4035 for analysis of PAHs. The SOP for immunoassay analysis is provided in Appendix A and test specifications are provided in Appendix B.

#### **3.7.2 Dioxin Immunoassay**

Following collection, soil samples will be screened by the subcontracted vendor for dioxins using an Ohmicron RPA-I RaPID Analyzer spectrophotometer. Samples are prepared by first weighing a five-gram sample and adding anhydrous sodium sulfate and dimethylformamide to the sample aliquot. The samples are then shaken for 4 hours at 350 rpm on orbital platform shaker. Hexane is added and shaken for 15 minutes. The hexane supernatant is then removed, a keeper solution is added and then the solvent is evaporated. The sample is then diluted with methanol and the enzyme immunoassay analysis can be completed.

After sample preparation, the filtered extractants are added to diluents (a single filtered extractant could be used for all analyses). The standards, control, and diluents are added to empty test

tubes. After the appropriate amount of standards, controls, and samples are added to the test tubes, the reagents are added and procedures are followed according to the manufacturer's protocol. After a 30-minute incubation period, stopping solution is added, and the results are read at a 450 nanometers (nm) wavelength within 15 minutes of stopping the reaction. The spectrophotometer creates a printout with calibrator data, a calibration curve, control data, and sample data.

The method detection limit (based on information from the manufacturer) for dioxin using this field screening method are 1000 pg/g (TEQ). These field screening analyses correspond to EPA methods SW846 4025 for analysis of dioxins. The SOP for immunoassay analysis is provided in Appendix A and test specifications are provided in Appendix B.

### **3.7.3 Immunoassay Verification**

A subset of 10% of the samples associated with immunoassay field screening for Task 3.5 will be submitted for laboratory analysis for tPAH via SOM01.1 and a subset of 20% of the samples associated with immunoassay field screening for Task 3.9 will be submitted for laboratory analysis for PAH via SOM01.1 and dioxins via DLM02.0. To ensure samples from the complete concentration range, the verification samples will include a range of low, medium, and high concentrations of tPAH and dioxins. The correlation between the laboratory results and the immunoassay results will be evaluated through a least-squares regression analysis.

### **3.7.4 Duplicate Immunoassay Analysis**

Analysis of duplicate samples will be performed at a frequency of 10% for both tPAH and dioxins during the sampling event. The duplicate sample will be a separately prepared extract of the parent sample.

## **3.8 Procedures for XRF Field Screening Analyses**

For metals analysis, an Innov-X Multi-Element Analyzer will be used to perform the XRF analysis in support of the RD activities, specifically for Task 3.9. The XRF analyses will be performed by certified EA personnel. The manufacturer's instructions will be followed for conducting the sample analysis. Sample results will be recorded in a field logbook and will include:

- XRF model and serial number (per log book)
- Excitation time (60 seconds per sample)
- Sample designation

- Sample result (for arsenic and lead)
- Sample time
- XRF analyst

Full metals suite data saved internally on the XRF device will also be downloaded daily and incorporated into a database of field screening results.

Prior to XRF analysis, soil will be placed into plastic bags or laboratory-cleaned jars. Soil will be homogenized in plastic bags by rolling the soil until thoroughly homogenized. If soil cannot be homogenized in a plastic bag, the soil will be homogenized in a stainless steel bowl using the coning and quartering method.

### **3.8.1 XRF Quality Assurance/Quality Control**

In order to obtain consistent analytical data from the XRF screening apparatus, it is important QA/QC samples be analyzed as part of the analytical regime, and that normal maintenance checks be performed. The QA/QC methods explained in this section are a summary of the procedures described within the instrument instruction manual and EPA Method 6200. Results of these checks and maintenance will be recorded in the laboratory logbook. Data quality objectives for precision, accuracy, and comparability to results obtained by ILM05.2 are discussed in the QAPP. These data quality indicators will be calculated (as discussed in the QAPP) from the calibration samples collected during the sampling event.

A subset of 20% of the samples will be submitted for confirmatory laboratory analysis during the field sampling event. Blank sample analysis, reference material sample analysis, and precision assessments will be performed throughout the screening analytical program at the frequencies discussed in the sections below.

### **3.8.2 XRF Calibration**

The Innov-X XRF will be factory calibrated annually and will not require additional internal calibration during the field activities. However, calibration with respect to correlation with laboratory data will be performed after the field event using a subset of 20% of the samples associated with XRF field screening for Task 3.9. To ensure samples from the correct concentration range, the calibration samples will include a range of low, medium, and high concentrations of arsenic. The correlation between the laboratory results and the XRF results will be evaluated through a least-squares regression analysis. The regression equation will be

used to determine the XRF concentration equating to 76 milligrams per kilogram (mg/kg) for arsenic, which is the cleanup criteria specified in the ROD.

### **3.8.3 Site-Based Detection Limits**

Site-based method detection limits for the XRF analyzer used during this evaluation will be obtained by collecting 10 replicate measurements on a sample with a target arsenic concentration of approximately 30 mg/kg (approximately 3 times the assumed detection limit of the XRF for arsenic). The standard deviation of the 10 replicated analyses will be calculated. The method detection limit will be set at three times the standard deviation. The method quantitation limit is defined as ten times the standard deviation of the same results.

### **3.8.4 Blank Samples**

An instrument blank or method blank (clean sand) will be analyzed at the beginning and end of each day, and additionally at the discretion of the analyst. Instrument blanks ensure that no contamination exists on the probe window. The instrument blank testing material provided by the manufacturer will be used for this test and consists of inert material with no measurable quantities of arsenic. An excitation time of 60 seconds will be used for the blank analyses.

### **3.8.5 Precision Measurements**

A minimum of one precision measurement calculation will be run each day. Since the PRG for this project is 76 mg/kg for arsenic, a sample with a concentration close to these concentrations will typically be used. The precision sample will be analyzed using the same excitation time as the normal environmental samples (60 seconds). Ten to twelve replicate analysis of the precision sample will be performed per day. The relative standard deviation (RSD) of the sample mean will be used to assess method precision. The RSD should not exceed 20%.

The equation for calculating RSD is as follows:

$$\text{RSD} = (\text{SD}/\text{Mean Concentration}) \times 100$$

where:

RSD = Relative standard deviation for the precision measurement for the analyte  
SD = Standard deviation of the reported lead concentrations for the precision sample  
Mean Concentration = Mean lead concentration of the 12 replicate analysis.

Non-conformance in obtaining this data quality objective will result in notification of the QAM and Project Manger, review of data usability, and possible factory re-calibration of the XRF.

### **3.8.6 Duplicate XRF Analysis**

Analysis of duplicate samples using the XRF will be performed at a frequency of 10% during the sampling event. The duplicate sample will be collected from the same interval of the normal sample in the soil boring.

### **3.8.7 Standard Reference Material Analysis**

Accuracy of the XRF analyses will be assessed through evaluation of the percent recovery between a known standard reference material (SRM) concentration and the reported XRF concentrate. The objective for percent recovery is between 80% and 120%. The SRMs proposed for use during XRF analyses were certified by the National Institute of Standards and Technology (NIST) and are designated NIST SRM 2709 (arsenic concentration of 17.7 mg/kg), NIST SRM 2710 (arsenic concentration of 626 mg/kg), NIST SRM 2586 (arsenic concentration of 8.7 mg/kg), and NIST SRM 2711 (arsenic concentration of 105 mg/kg).

SRMs will be analyzed at the beginning and end of each day of XRF use. If the SRM analyses results are less than 80% or more than 120% of the expected concentration, the Project Manager will be notified, and a review of the potential impact to data will be performed.

## **3.9 EPA CLP Laboratory Analysis**

Tables 3, 4, and 5 present a summary of the media to be sampled for fixed laboratory analysis. Container requirements along with preservation procedures and holding times are presented in Table 9. Samples will be preserved and shipped to EPA CLP laboratory(ies) where they will be analyzed for some or all of the following: organics (tPAH, PCP, or PCB) via SOM01.1, metals via ILM05.3, TOC via EPA 415.1, grain size via ASTM D422-63, and dioxins via DLM02.0.

A subset (10%) of Task 3.5 sediment samples field screened via immunoassay will be submitted to the lab for PAH confirmatory analysis. A subset (20%) of Task 3.9 soil samples field-screened via immunoassay and XRF will be submitted to the lab for PAH, TAL metals, PCP, and dioxin analysis. Samples submitted for lab verification will include a range of high, medium, and low concentrations to establish relative correlation between field and lab analysis.

## **3.10 Required QA Samples**

QA/QC samples are only required for field-screening and samples submitted for CLP laboratory analyses. Separate QA/QC samples are not required for geotechnical samples.

### **3.10.1 Calibration Samples**

As described in Sections and 3.7.4 and 3.8.2, on-site samples will be used to calibrate and determine the site specific method detection limit, precision, accuracy (as compared to a standard reference material [SRM] or analytical standard), and comparability (as compared to analytical laboratory results) of the XRF and immunoassay for tPAH and dioxin. The data quality objectives for these indicators will be calculated using the procedures described in the QAPP.

### **3.10.2 Duplicate Samples**

Duplicate samples will be collected at a rate of 10% (1 in 10) for both XRF and immunoassay field screening analysis and laboratory analysis. The duplicate sample for XRF and immunoassay analysis will be collected from the homogenized sample aliquot remaining after analysis of the parent sample. Duplicate samples for contract laboratory analysis will also be obtained from the field-screening sample as a split aliquot. Duplicates for proposed analysis with no field screening will be collected from the homogenized aliquot of the parent sample. Table 10 summarizes the expected number of duplicate samples.

For aqueous samples, a field duplicate is collected by alternating between the “parent” and field duplicate sample bottles during the filling of the bottles for each analysis. Aqueous duplicates will be analyzed for the same analysis as the parent sample.

A field duplicate sample will be collected for each matrix at a frequency of 10% (one for every 10 samples collected per matrix). Soil duplicates will be collected by homogenizing the soil prior to splitting the soil between jars in the “parent” and duplicate sample. Soil duplicates will be analyzed for the same parameters as the parent sample. The identity of duplicates will be withheld from the laboratory by using a specific sample identification code described below. The field duplicate sample will be recorded with the “parent” sample identification code in the field log book.

#### **3.10.2.1 Duplicate Sample Designation**

Unidentified (i.e., “blind”) duplicate samples will be submitted to the CLP laboratory and will therefore be assigned a different designation from the “parent” sample. Duplicates will be numbered sequentially, e.g., DUP-1, and will be recorded, with the parent sample designation, in the field and/or laboratory logbook.

For XRF analysis, duplicate samples will not be blind duplicates and will have the “parent” sample name appended with a “-D” at the end to demonstrate that the XRF analysis result is a

duplicate. For example: Task 3.1-B-2-D which indicates a duplicate sample associated with sample Task 3.1-B-2.

### **3.10.3 Matrix Spikes/Matrix Spike Duplicates**

The contract laboratory will be requested to perform matrix spike and matrix spike duplicate (MS/MSD) analysis at frequency of 5% (1 MS/MSD for every 20 normal samples submitted to the CLP laboratory) of the samples received by the lab. Separate samples are not required. However, a minimum of 60 grams of soil or sediment will be submitted to run the normal analysis, the MS, and the MSD, i.e. three times the normal sample volume will be collected for MS/MSD samples. The sample custody technician will make a written request for the MS/MSD on the chain-of-custody and will ensure adequate sample volume for the spiked analyses. Table 11 summarizes the expected number of MS/MSD samples. The EA Project Manager will verify QA/QC requirements (and notify field personnel of changes, if required) when the contract laboratory(s) is identified by EPA.

Matrix spikes will not be performed for the XRF or immunoassay screening analysis.

### **3.10.4 Soil Sampling Equipment Blanks**

Equipment blanks will be collected at a frequency of 5% of the samples submitted for laboratory analysis (1 rinsate sample for every 20 samples submitted to the CLP laboratory) for each type of non-dedicated, decontaminated equipment utilized for sample collection purposes. Rinsate samples will be collected by pouring distilled/deionized water over the decontaminated stainless steel bowl and spoon and collecting it into the appropriate bottles as indicated on Table 9. Rinsate blanks associated with samples collected for waste characterization will not be collected. Rinsate blanks will also not be required to assess efficiency of the decontamination of water sampling equipment since this sampling equipment is dedicated. Table 11 summarizes the expected number of rinsate samples.

### **3.5.3 Sediment Sampling Equipment Blanks**

Equipment blanks are collected to determine the extent of contamination, if any, from the sampling equipment used as part of the project. Three equipment blanks will be collected for each phase of the project. Equipment blanks are collected by pouring distilled/deionized water over sampling equipment that has been decontaminated using the procedure outlined in Section 3.6. The rinsate water is placed in laboratory-prepared containers, submitted to the analytical laboratory, and tested for the same chemical parameters as the sediment and water samples.

Blanks will be collected for the vibracoring equipment, the grab sampling equipment, and the water collection equipment. Equipment blanks will be sent to the EPA CLP laboratory via overnight delivery. Chain-of-custody documentation will be submitted with the blanks. Table 11 summarizes the expected number of rinsate samples.

#### **3.10.4.1 Equipment Blank Sample Designation**

Equipment blank samples will have the Task number along with a “N” to indicate the sequential blank, and “EB” to indicate an equipment blank. For example: Task 3.1-2-EB which indicates the sample is equipment blank 2 collected in association with Task 3.1.

### **3.11 Sample Documentation**

The following subsections describe the required sample documentation and the procedures for completing these documents. These documents will be used for each environmental sample collected for chemical analysis. Referenced SOPs are provided in Appendix A.

#### **3.11.1 Sample Labels**

A sample label or tag will be placed on each sample container submitted for chemical or geotechnical analysis as indicated in SOP 001 (Labels – Revision 3).

#### **3.11.2 Chain-of-Custody Record**

A chain-of-custody record will be completed for each sample collected at the Site as indicated in SOP 002 (Chain-of-Custody Form – Revision 3).

#### **3.11.3 Sample Packaging and Shipping**

Table 9 summarizes the bottle type, preservation requirements, analysis method number, and holding times. Samples will be packed and shipped as indicated in SOP 004 (Sample Packing and Shipping – Revision 4).

#### **3.11.4 Custody Seals**

Custody seals will be used on the shipping containers to ensure the integrity of the samples should they be left unattended or when they are relinquished to a delivery service until the shipping containers are opened by the laboratory. All samples will be shipped in insulated shipping containers, and each shipping container will be sealed with at least two custody seals at opposite corners of the container and covered with clear packing or strapping tape. The seals

will be affixed to each shipping container so that it is necessary to break the seals to open the shipping container.

### **3.12 Sample Location and Surveying**

Sample locations will be referenced to the Virginia South State Plane (NAD83) coordinate system. Sampling locations will be surveyed using a Trimble ProXRS differential global positioning system (GPS) capable of 1-m horizontal resolution. A sketch of the property will also be completed in the field log book, indicating the relative position of sampling locations to permanent structures/features on the property.

## 4. FIELD DOCUMENTATION

A bound field notebook will be maintained by the EA field team members to provide daily records of significant events, observations, and measurements during QA sampling. Each page will be numbered, signed, and dated. These notebooks will be kept as permanent records.

All data recorded in field notebooks will be written in waterproof ink. These accountable, serialized documents are not to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a field book assigned to one person, that individual may make corrections simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered should be corrected by the person who made the entry. All corrections must be initialed and dated.

Information in field notebooks will include, but not be limited to, the following items.

- Names and affiliations of personnel on site;
- General description of each day's field activities;
- Documentation of weather conditions;
- Location of sampling (station number or description);
- Name and address of field contacts;
- Description of accidents involving personnel at the site;
- Records of field equipment malfunction and repair;
- Records of site visitors;
- Records of field and lab equipment calibrations;
- Type of sample matrix (e.g., sediment);
- Date and time of collection;
- Collector's sample identification number(s);
- Sample destination (e.g., laboratory, hauler, etc.);
- Observations of sample or collection environment, if needed;
- Any field measurements made such as pH, temperature, turbidity, etc.;
- Sampler's name;

- Sample type (e.g., grab); and
- Source and types of preservatives used.

At the end of every sampling day, the EA SM will collect and store the logbooks in a safe location.

Photographs will be taken on-site with a digital camera and periodically downloaded for storage and/or printing. Each photograph will have an entry in the field logbook indicating the date and time it was taken, orientation of the photograph, and name or initials of the photographer.

Sampling points will be documented on film and, in some cases, actual photographs of samples will be taken. Photographs taken to document sample locations will have at least two reference points.

## **5. SITE MANAGEMENT**

The following sub-sections outline specific functions of site management which are pertinent to the activities at the Site.

The EA SM will be responsible for daily oversight of the field crew and subcontractor(s). Health and safety practices outlined in the site HASP will be strictly followed.

### **5.1 Equipment Calibration, Operation, and Maintenance**

The equipment used in collecting field data during the sampling effort will include a variety of instruments. Proper maintenance, calibration and operation of each instrument will be the responsibility of the SM.

Instruments and equipment used during and sampling activities will be maintained, calibrated and operated according to the manufacturer's guidelines and recommendations. All instruments will be inspected and calibrated prior at the beginning of each sampling day and additionally as needed, as indicated by changes in instrument performance or weather conditions which could affect instrument performance. A routine schedule and record of instrument calibration will be maintained by the EA SM throughout the field activities.

### **5.2 Site Control**

Maintaining site control during EA sampling events will be the responsibility of the EA SM. A health and safety risk analysis and a description of personal protective equipment to be used can be found in the HASP. This plan also describes decontamination procedures, SOPs for the site, and a site emergency action plan.

### **5.3 Decontamination**

Equipment, sample bottles, and personnel will be decontaminated following EA SOP 005 (Field Decontamination – Revision 4), which is included in Appendix A.

### **5.4 Disposal of Sampling-Derived Wastes**

Various types of investigation derived wastes (IDW) are defined in the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), Chapter 5 (EPA, 1997). Types of IDW anticipated to be generated during this project include:

- Soil and sediment boring cuttings

- Personal protective equipment (PPE)
- Decontamination fluids
- Field screening wastes
- Disposable equipment
- Uncontaminated wastes.

Contaminated IDW will be stored in drums onsite and disposed of within the containment area made by the installation of the proposed sheet pile wall.

## **6. NON-CONFORMANCE**

During field activities, nonconformance events may be identified by the task QAM, SM, Site Safety and Health Officer (SSHO), and field personnel. If a non-conformance event takes place, the Site manger and Task Manager will be notified. If the non-conformance involves safety, the SSHO, and the corporate manager of health and safety will be notified. A memorandum with a description of the non-conformance, an evaluation of whether the non-conformance affects project data quality objectives (or safety of site workers), and the corrective measures that have been taken will be drafted and sent to the EPA.

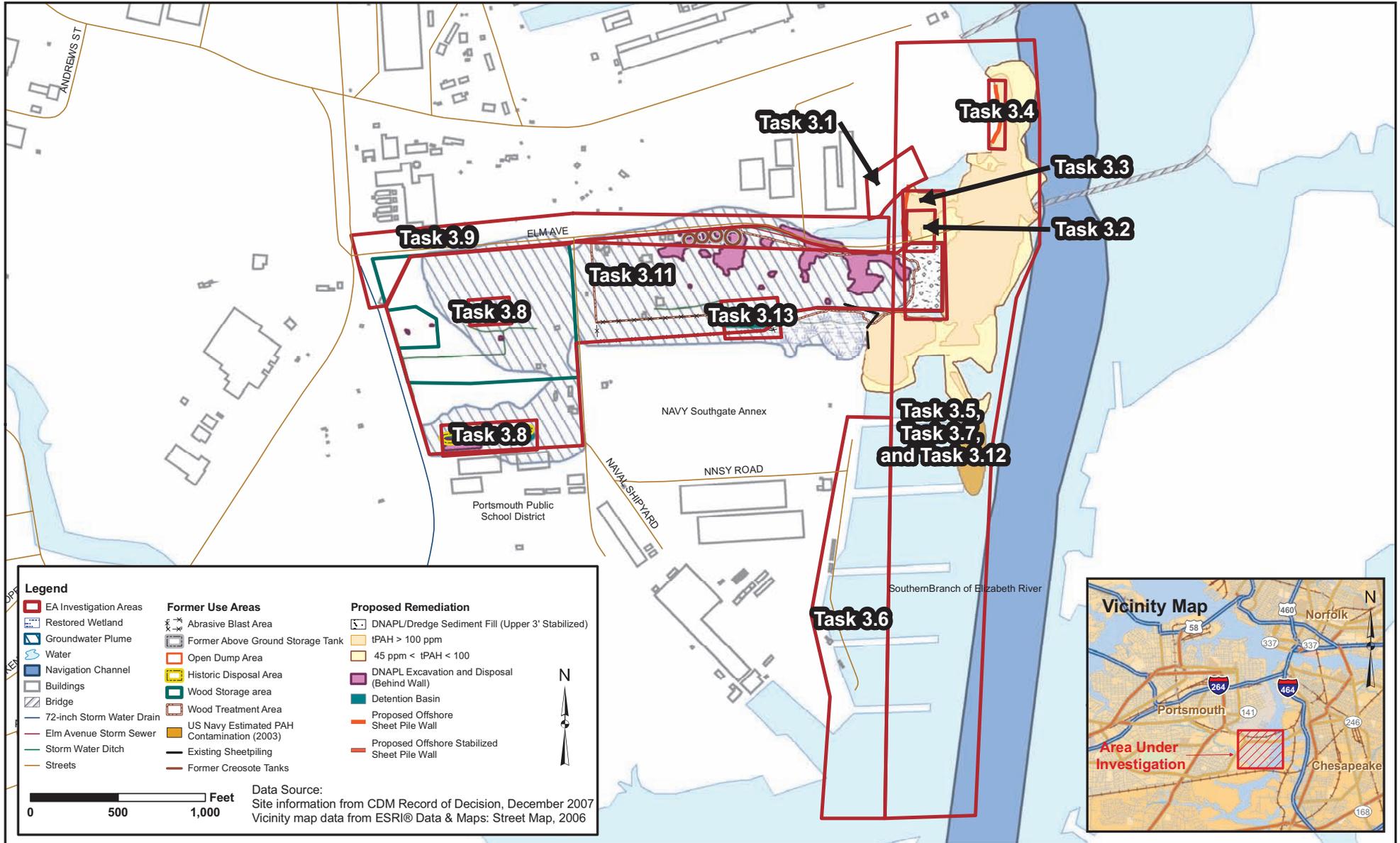
Resampling and/or reanalysis, may be initiated by the project manager after consultation with the QAM and the EPA RPM. Typical examples of what may cause resampling or reanalysis include:

- Failure to meet DQOs
- Improper sampling or sample preparation procedures
- A break or non-conformance in the sample chain-of-custody

## 7. REFERENCES

- EA Engineering, Science, and Technology (EA), 2008A. Remedial Design (RD) Services Work Plan, Atlantic Wood Industries Superfund Site, Portsmouth, Virginia, Version 3. April 2008.
- EA, 2008B. Final Quality Assurance Project Plan (QAPP), Atlantic Wood Industries Superfund Site. Version 1. May 2008.
- EA, 2008C. Final Health and Safety Plan for Atlantic Wood Industries Superfund Site. Version 2. May 2008.
- Environmental Protection Agency (EPA), 1994. USEPA Contract Laboratory Program Region III Modifications to National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration (OLMO1.0-OLM01.9). EPA, 1994.
- EPA, 2000. U.S. Environmental Protection Agency. Guidance for Data Quality Assessment: Practical Methods for Data Analysis. EPA QA/G-9, July 2000.
- EPA. 2005. Multi-Media, Multi-Concentration Dioxin and Furan Analytical Service for Superfund. (DLM)02.0). OSWER Document 9240.1-48FS. EPA Publication 540-F-05-003. September 2005.
- EPA. 2006. Multi-Media, Multi-Concentration, Organic Analytical Service for Superfund (SOM01.1). OSWER Document 9240.1-50FS. EPA Publication 540-F-05-008. January 2006.
- EPA, 2007. U.S. Environmental Protection Agency. Record of Decision, Operable Units 1,2, & 3, Atlantic Wood Industries, Inc. Superfund Site, Portsmouth, Virginia. December 21, 2007.
- EPA, 2007a. Multi-Media, Multi-Concentration, Inorganic Analytical Service for Superfund (ILM05.04). OSWER Document 9200-5-170-FS. EPA Publication 540-FS-07-004. January 2007.
- EPA, 2008. EPA Work Assignment Form (WAF) for RAC. WA Number 011RDRD03L2. February 2008.

## **FIGURES**



**Atlantic Woods Industries, Inc. Superfund Site  
 Portsmouth, Virginia**

**FIGURE 1  
 SITE PLAN/ WORK TASK AREAS**



Location Name	Easting	Northing
3.1-1	12129087.25	3461521.60
3.1-2	12128789.15	3461318.56
3.1-3	12128832.83	3461379.13
3.1-4	12128883.49	3461434.66
3.1-5	12128946.16	3461474.76
3.1-6	12129016.63	3461499.77

Coordinates are in NAD 83 State Plane Virginia South Feet

Data Source:  
 Aerial Orthograph from the National Agriculture Imagery Program, 2003  
 Vicinity map data from ESRI® Data & Maps: Street Map, 2006

**Legend**

- Site Data
  - EA Investigation Areas
  - Proposed Initial Boring Sample Locations
- Sheet Pile
  - Proposed Offshore
  - Sheet Pile Wall
  - Proposed Offshore Stabilized
  - Sheet Pile Wall
  - Existing Sheetpiling
- Roads
  - Easement
  - Driveway
  - Major Road
  - Railroad Track
  - Surface Street

Note: Sample locations are approximate and may be revised based on field conditions.

Scale: 0 50 100 Feet



**FIGURE 2 - PROPOSED INITIAL BORING SAMPLE LOCATIONS FOR TASK AREA 3.1**

**Atlantic Woods Industries, Inc. Superfund Site**  
 Portsmouth, Virginia



**Legend**

**Site Data**

-  EA Investigation Areas
-  Proposed Initial Boring Sample Locations

**Roads**

-  Easement
-  Driveway
-  Major Road
-  Railroad Track
-  Surface Street

0 50 100 Feet

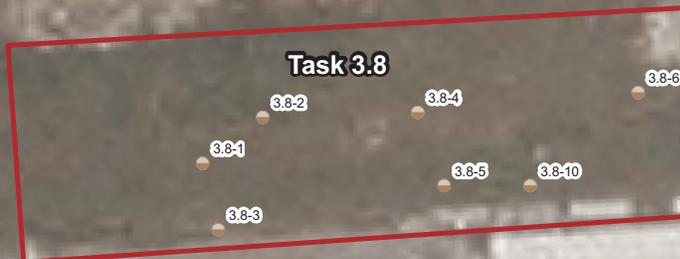
Note: Sample locations are approximate and may be revised based on field conditions.

**Data Source:**

Aerial Orthograph from the National Agriculture Imagry Program, 2003  
Vicinity map data from ESRI® Data & Maps: Street Map, 2006

Location Name	Easting	Northing
3.8-1	12126430.33	3459986.35
3.8-2	12126479.17	3460023.56
3.8-3	12126442.99	3459932.59
3.8-4	12126604.53	3460027.63
3.8-5	12126625.84	3459968.28
3.8-6	12126782.60	3460043.61
3.8-7	12126446.24	3460660.01
3.8-8	12126516.26	3460749.81
3.8-9	12126571.05	3460708.71
3.8-10	12126695.49	3459968.32

Coordinates are in NAD83 State Plane Virginia South Feet



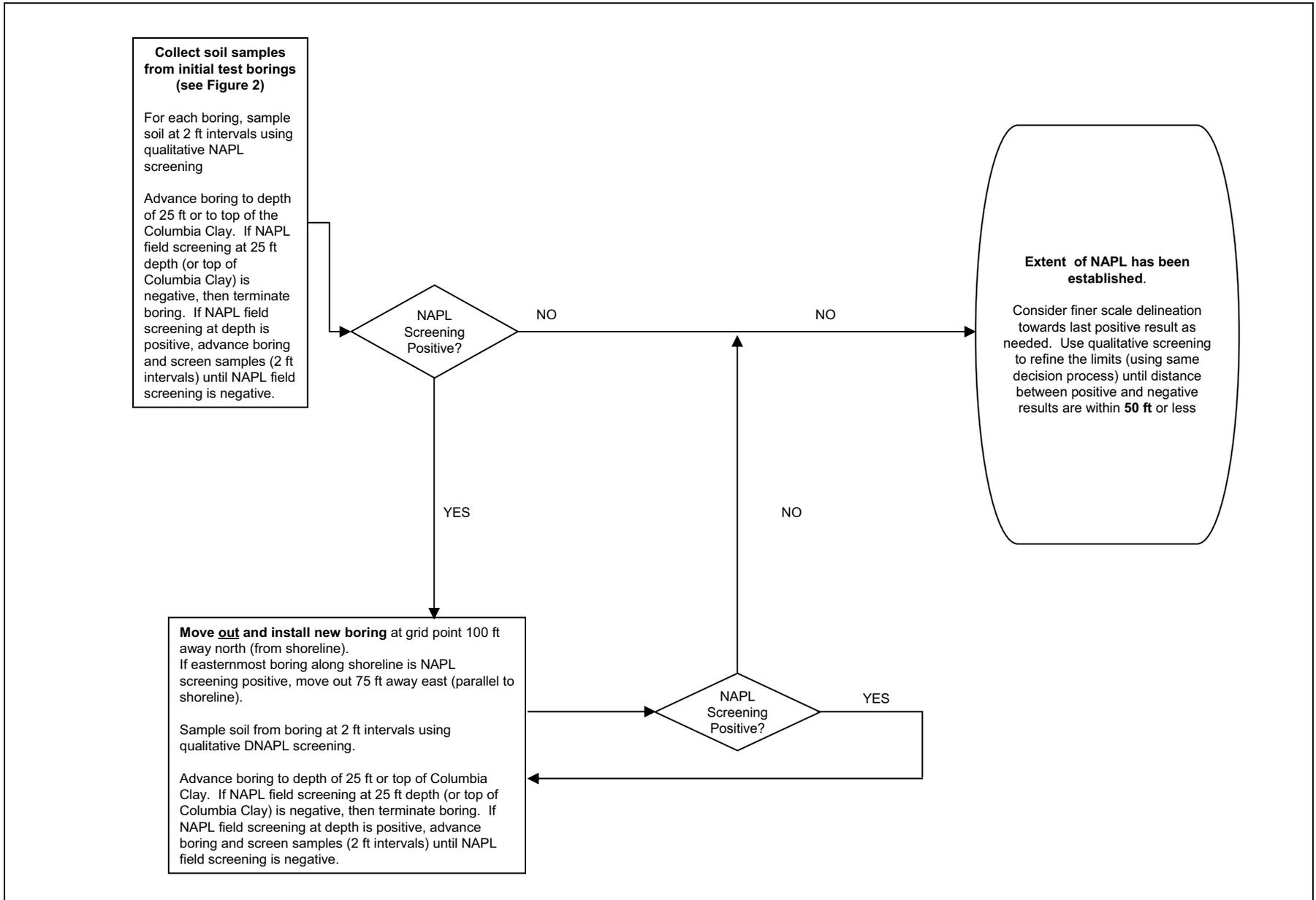
MEPCO Easement

Burton's Point RD



**Atlantic Woods Industries, Inc.  
Superfund Site**  
Portsmouth, Virginia

**FIGURE 3 - PROPOSED INITIAL BORING SAMPLE LOCATIONS FOR TASK AREA 3.8**



**Figure 4. Definition of NAPL Area - Task 3.1**

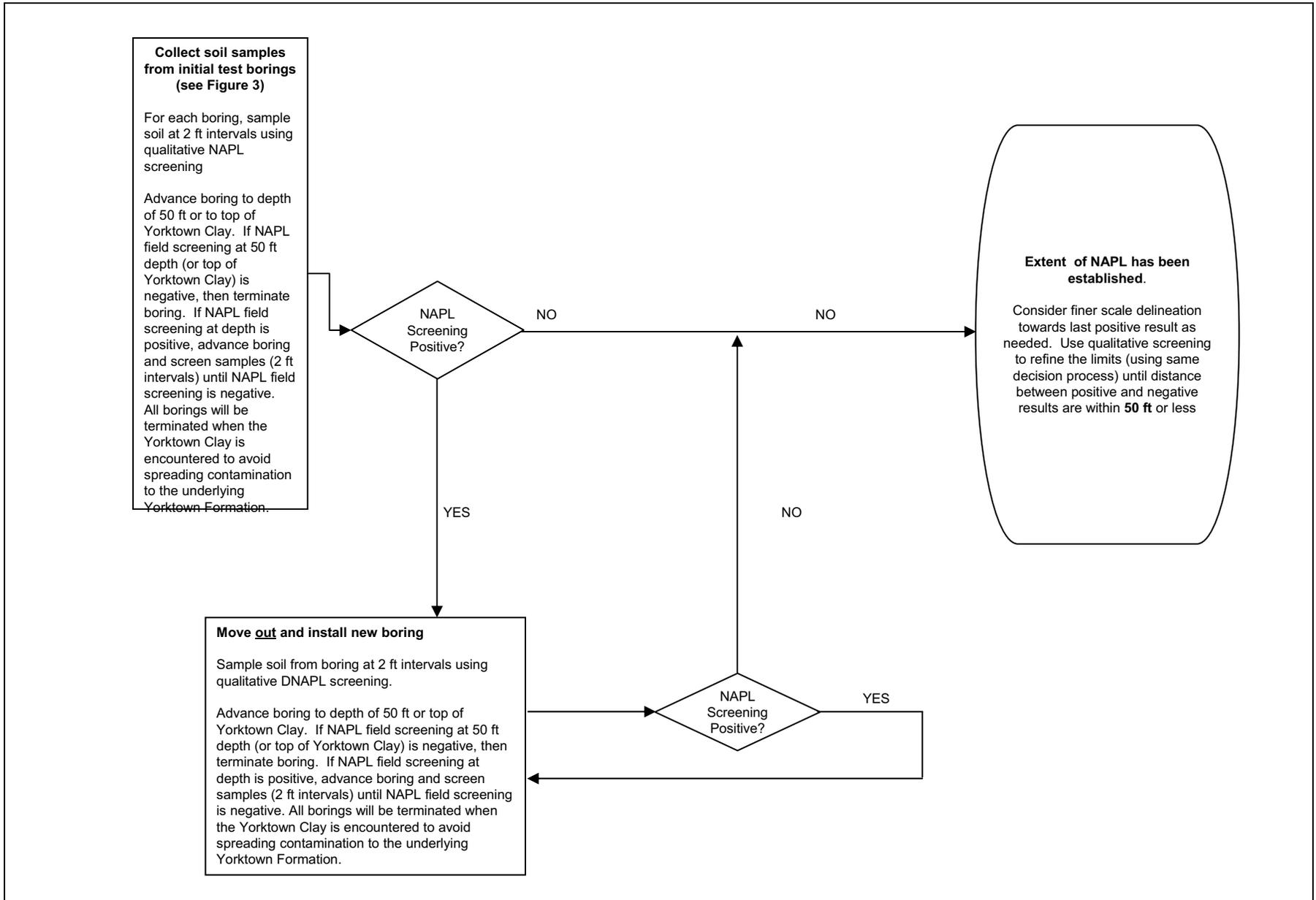


Figure 5. Definition of NAPL Area - Task 3.8



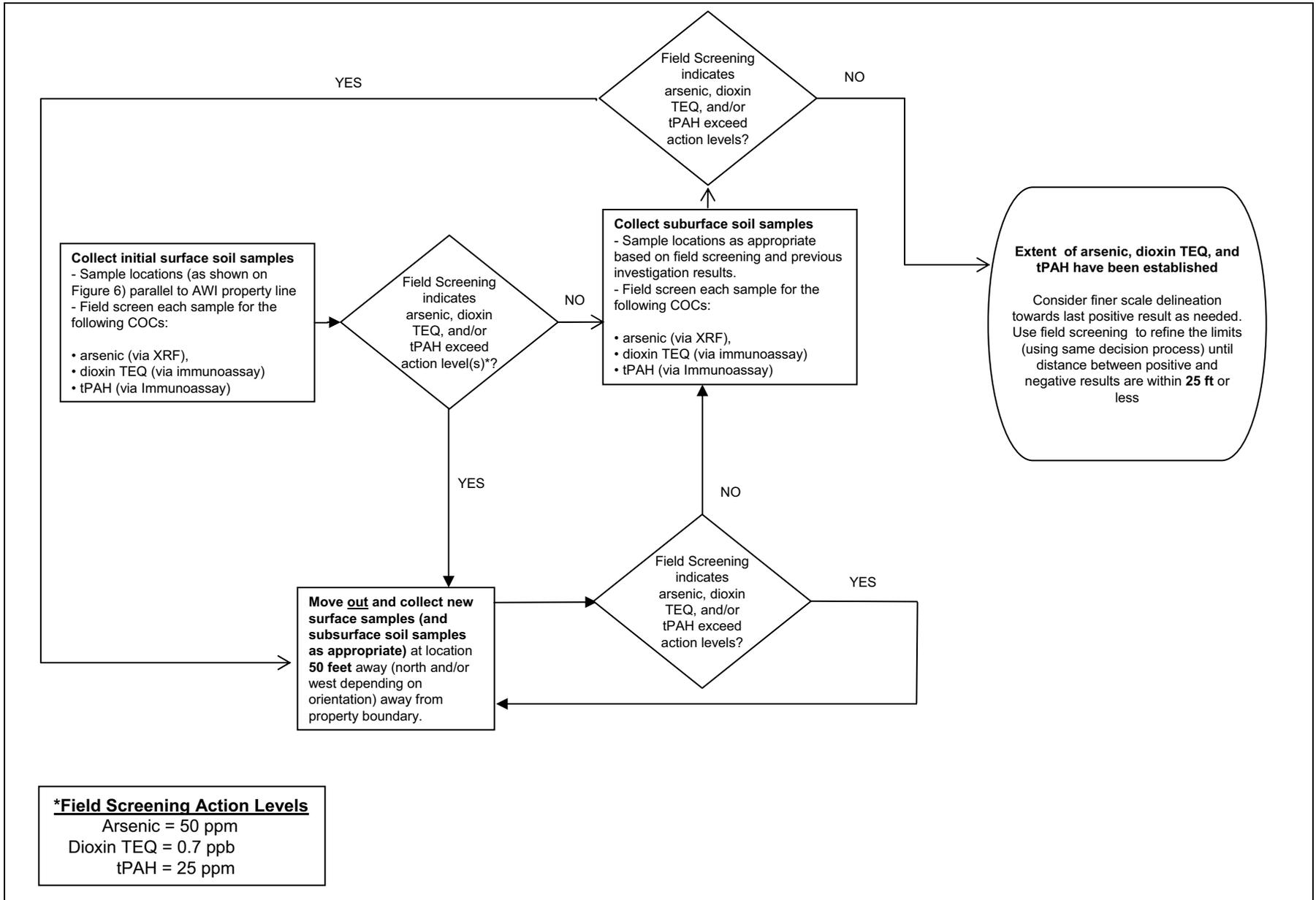


Figure 7. Definition of Offsite Area - Task 3.9

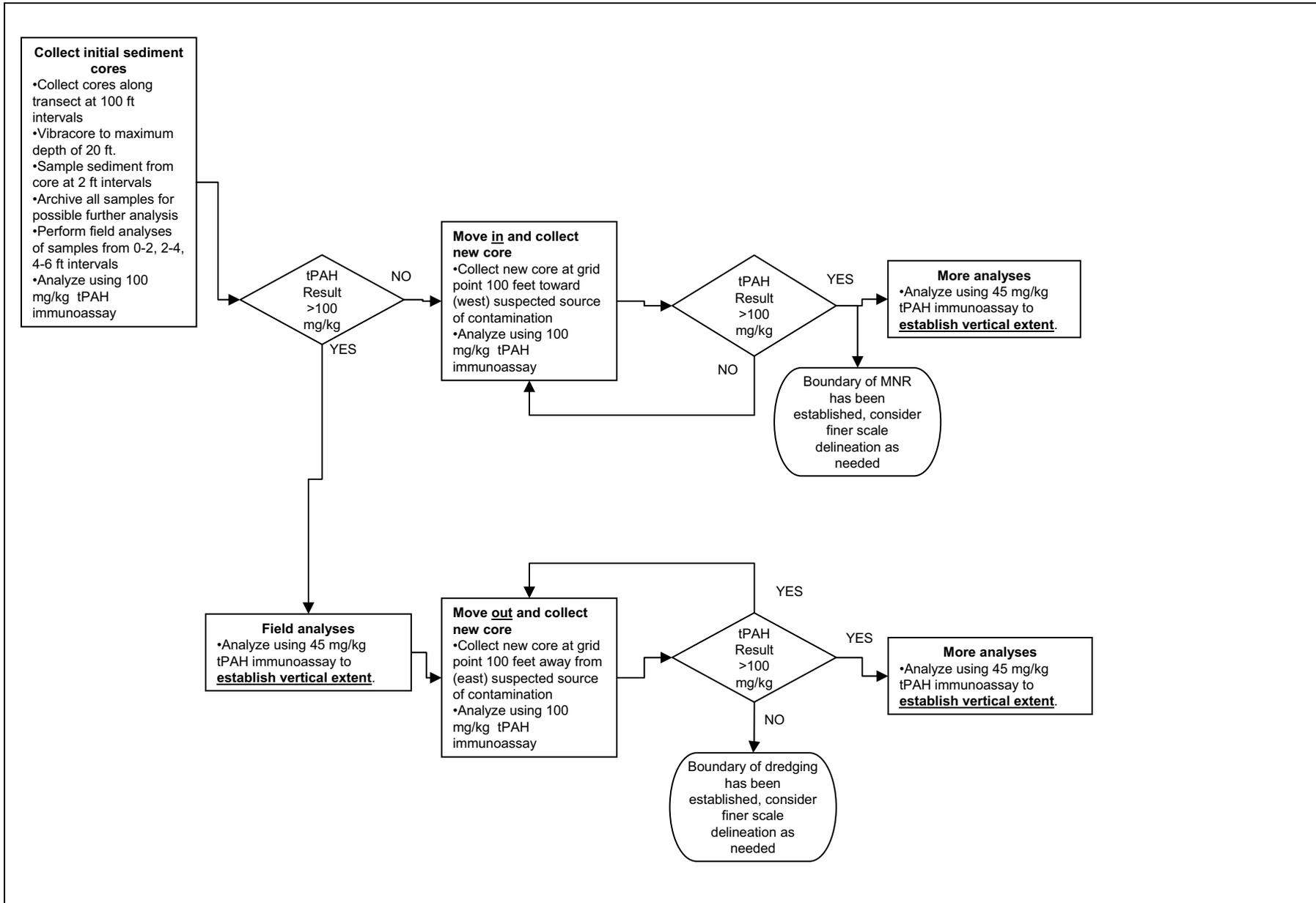
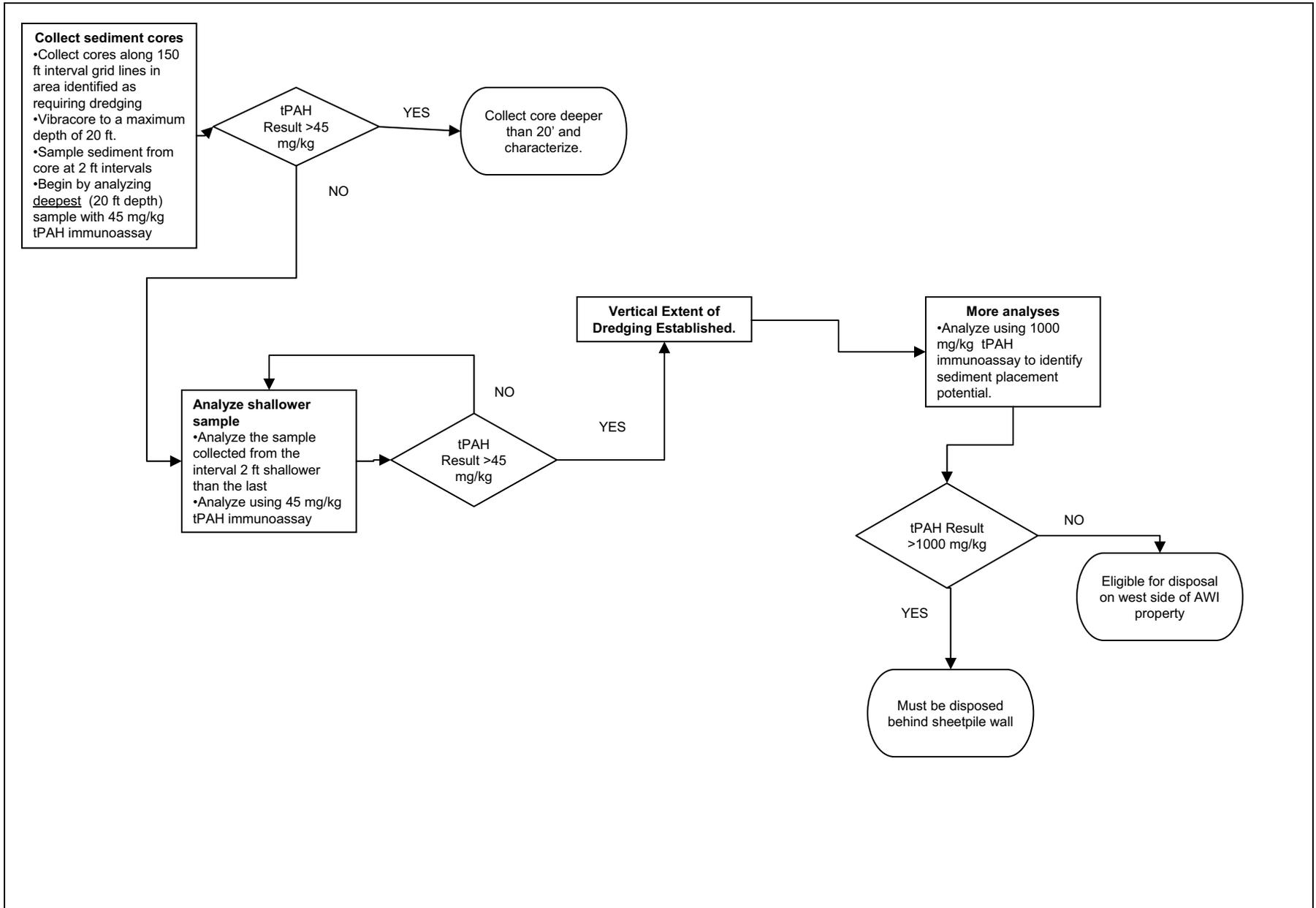
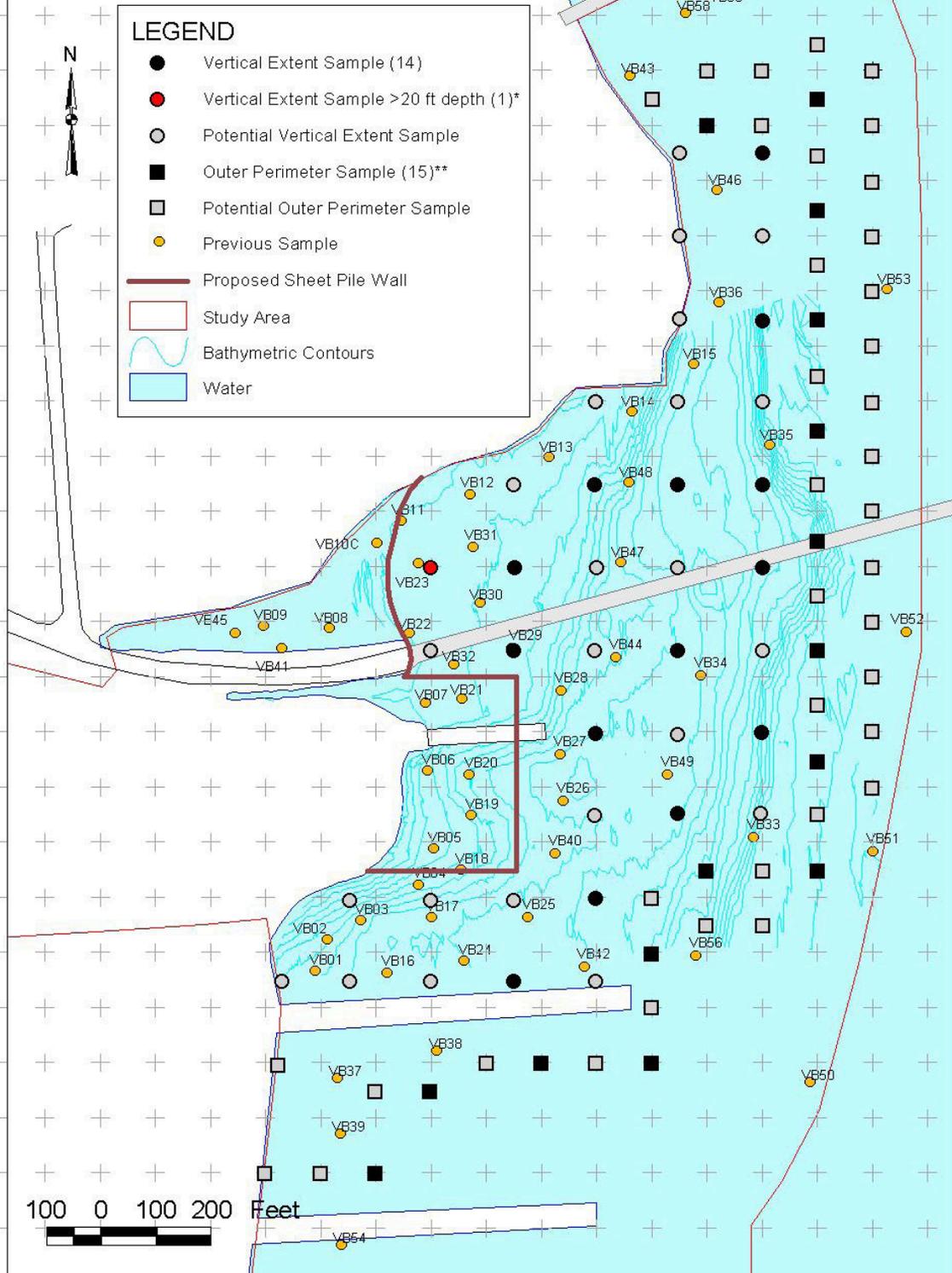


Figure 8. Decision Tree - Definition of Horizontal Extent of tPAH for Dredging and MNR



**Figure 9. Decision Tree - Definition of Vertical Extent of tPAH for Dredging**

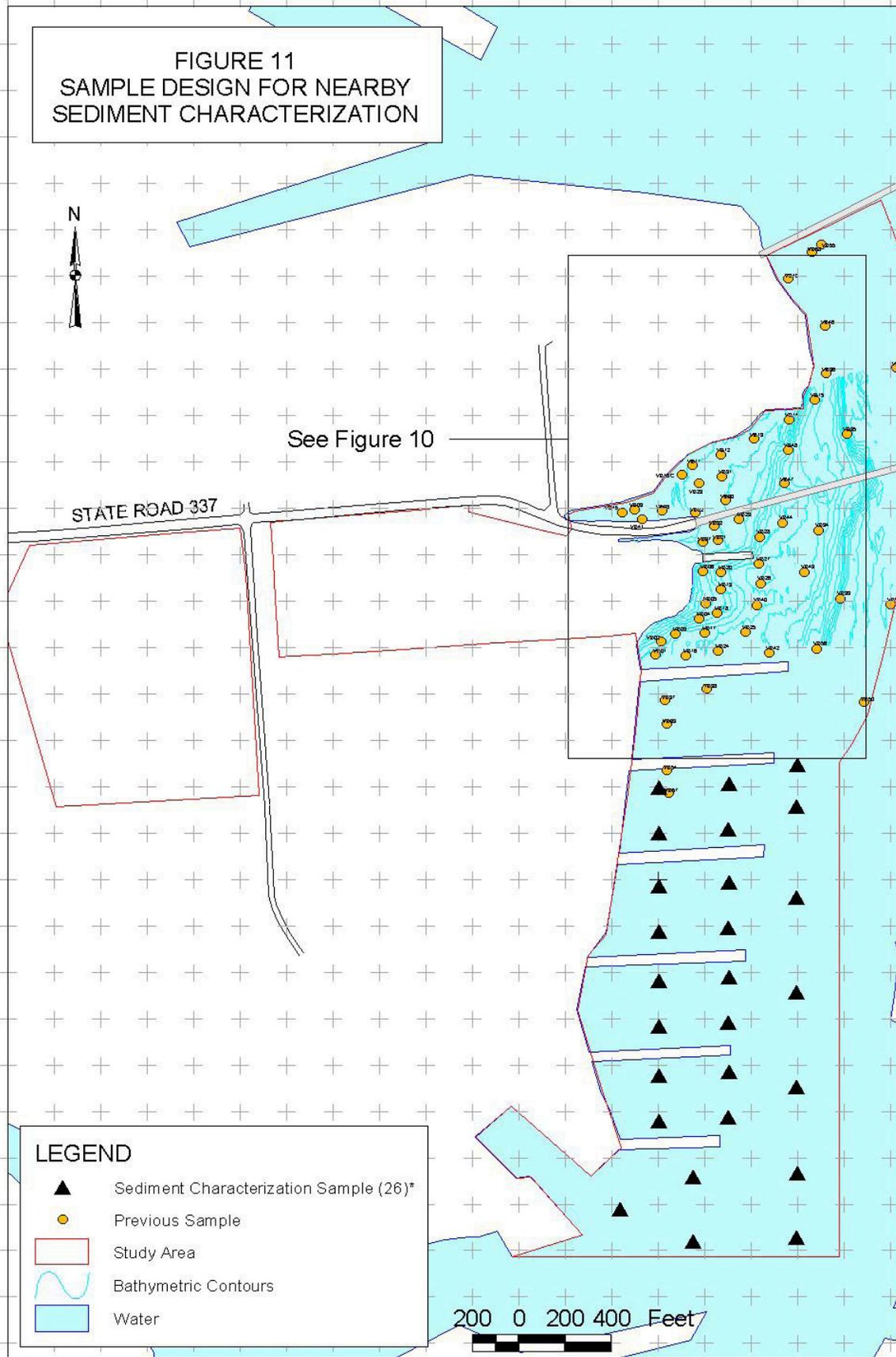
**FIGURE 10**  
**SAMPLE DESIGN FOR DETERMINATION**  
**OF AREA TO BE DREDGED DUE TO THE**  
**EXTENT OF TPAH CONTAMINATION**



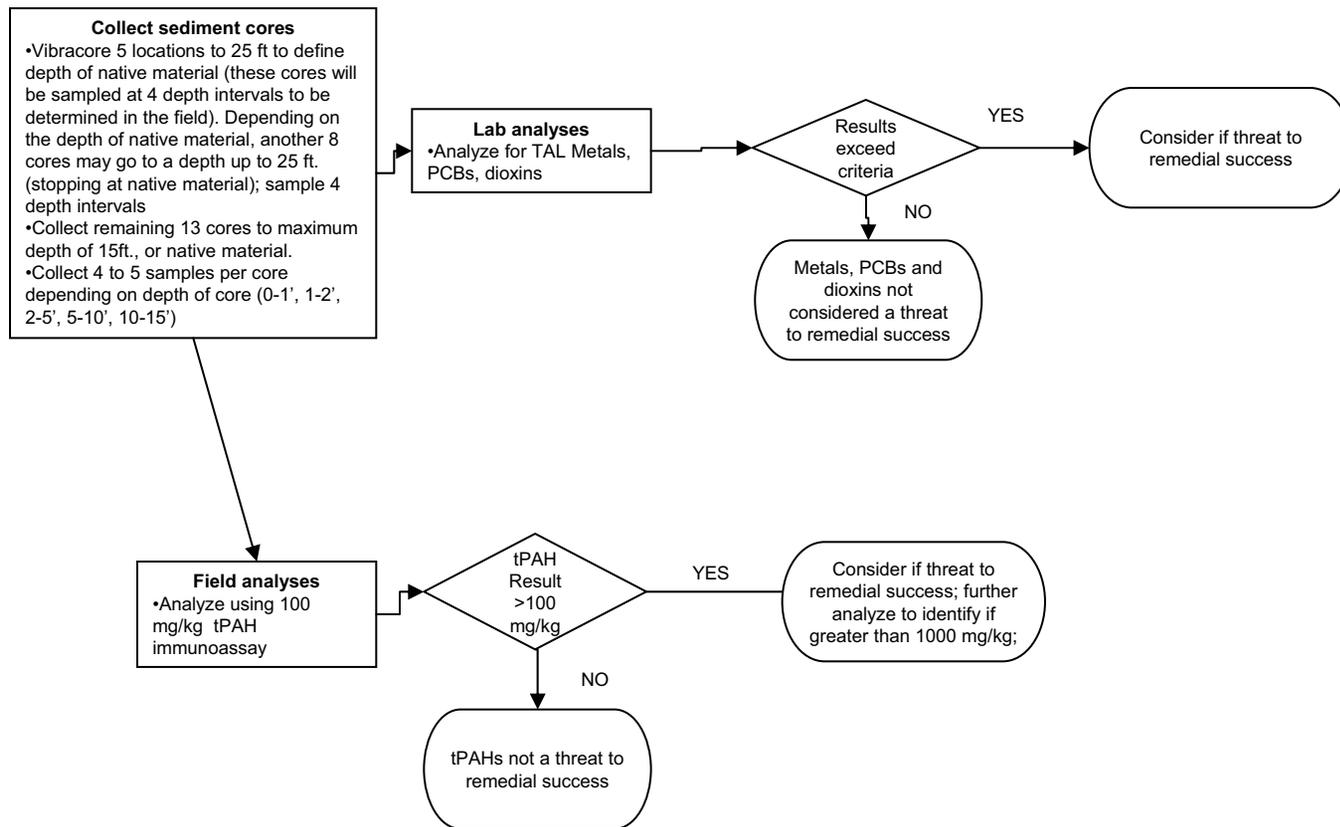
\*Other borings may require deeper than 20 ft pending results of initial core analysis.

\*\*Based on the results of the TPAH screening of the proposed borings, the sample design may expand southward if warranted.

FIGURE 11  
SAMPLE DESIGN FOR NEARBY  
SEDIMENT CHARACTERIZATION



\*The northern extent of this sample design will be adjusted as necessary, based on the final sample locations in Figure 10, as well as logistical issues.



**Figure 12. Decision Tree - Characterization of Nearby Sediments**

## **TABLES**

TABLE 1 – FIELD PROGRAM SAMPLING MATRIX

TASK	Total Organic Carbon	Total PAHs	PAH-Specific	TAL Metals	PCP	PCB	Dioxins (TEQ)	ID DNAPL	Geotechnical	UXO Avoidance	Water Sample	Methodologies
<b>3.1 - NAPL Identification PPIC Property</b>								FS		Surf		Estimated 10-12 borings to 25 ft using in field decision to locate borings
<b>3.2 - Sheet Pile Evaluation Near Jordan Bridge</b>									TB/G			Land & water-based borings for geotechnical parameters
<b>3.4 - Sheet Pile Wall Evaluation East PPIC</b>									TB/G			Land & water-based borings for geotechnical parameters
<b>3.5 - Sediment Coring</b>	LV	FS/LV	LV	LV	LV	LV	LV	FS	G			Water-based sediment coring
<b>3.6 - Bulkhead Leakage Evaluation</b>		LV		LV	LV		LV				LV	Visual inspection, sample only if gross contamination is observed in soil breaching wall
<b>3.8 - DNAPL Evaluation on West Side AWI</b>								FS	TB/G	Surf & DH		Test borings for DNAPL evaluation and geotechnical assessment
<b>3.9 - Delineate Adjacent Contamination</b>		FS/LV	LV	FS/LV	LV		FS/LV		TB	Surf		Surface soil & shallow test borings
<b>3.10 - Determine Storm Drain Discharge</b>		LV	LV	LV	LV		LV				LV	Storm drain survey

FS = Field Screening Method (qualitative and/or semi-quantitative)

LV = Laboratory Verification Samples (soil or sediment) to EPA Contract Laboratory

Program (CLP) Lab

TB/G = Test Borings/Geotechnical Parameters

DH = Down Hole Magnetometer

Surf = Surface

TEQ = Toxic equivalents

AWI = Atlantic Wood Industries

ID = Identify only

TABLE 2 - SUMMARY OF GEOTECHNICAL SAMPLING

Task	Area	Minimum Number of Sample Locations	Sediment Samples	Land Samples	Core/Boring Depth (feet)	Field Observation	Geotechnical Analysis - Estimated Number of Samples							
						Standard Penetration Test	Permeability via ASTM D5084 and ASTM D2434	Triaxial Compression (CU/PP) ASTM D4767 and ASTM D2850	Consolidation via ASTM 2435	Atterburg Limits via ASTM D4318	Gradation via ASTM D422 and ASTM D1140	Natural Density via ASTM D2937	Moisture Content via ASTM D2216	Specific Gravity via ASTM C127/C128 /D854
3.2	Near Jordan Bridge	17	15	2	30 - 80	17	NA	21	3	10	10	14	20	NA
3.4	East End PPIC	9	6	3	30 - 80	9	NA	9	NA	5	5	9	15	NA
3.8	DNAPL Delineation	10	NA	10	up to 50	10	2	NA	NA	10	10	2	8	10

Notes:

PPIC - Portsmouth Port and Industrial Commissior

DNAPL - Dense, non-aqueous phase liquid

NA - Not applicable

TABLE 3- SUMMARY OF SEDIMENT SAMPLING

Task	Delineation Type	Number of Sample Locations	Core Depth (feet)	Number of Intervals per Location	Field Screening	Laboratory Analysis - Estimated Number of Samples <sup>a</sup>						
					Estimated Number of tPAH IA Samples	PAHs via SOM01.1	TAL Metals via ILM05.3	PCP via SOM01.1	PCBs via SOM01.1	Dioxins via DLM02.0	Grain Size via ASTM D422-63	TOC via EPA 415.1
3.5	Vertical	15	20	3	45	3	NA	NA	NA	NA	NA	NA
3.5	Horizontal	15	TBD	3	45	3	NA	NA	NA	NA	NA	NA
3.5	Outside Area	13	25	4	52	11	52	52	52	52	13	13
3.5	Outside Area	13	15	4	52	11	52	52	52	52	13	13

Notes:

tPAH - total polynuclear aromatic hydrocarbons

IA - Immunoassay

TAL - Target analyte list

PCBs - Polychlorinated biphenyls

PCP - Pentachlorophenol

PAHs - Polynuclear aromatic hydrocarbons

NA - Not applicable

<sup>a</sup> Minimum number of confirmatory samples needed/estimated number of IA laboratory confirmatory samples (based on submitting 20% of IA screening samples for laboratory analysis), higher number of samples will be submitted for laboratory analysis

TABLE 4 - SUMMARY OF AQUEOUS SAMPLING

Task	Area	Number of Sample Locations	Number of Sampling Events	Laboratory Analysis - Estimated Number of Samples				
				PAHs via SOM01.1	Select Metals <sup>1</sup> via ILM05.3	PCP via SOM01.1	Dioxins via DLM02.0	Oil and Grease via EPA 1664
3.13	Storm Drains	1	2	2	2	2	2	2

Notes:

TAL - Target analyte list

PCB - Polychlorinated biphenyls

PCP - Pentachlorophenol

PAHs - Polynuclear aromatic hydrocarbons v

NA - Not applicable

<sup>1</sup> Select Metals (arsenic, total chromium, copper, lead, and zinc)

TABLE 5 - SUMMARY OF SOIL SAMPLING

Task	Minimum Number of Sample Locations	Surface/ Subsurface/ Subaqueous	Field Screening			Laboratory Analysis - Estimated Number of Samples <sup>a</sup>			
			Qualitative Sudan IV Dye Test NAPL Screening	Estimated Number of tPAH and Dioxin IA Samples	Estimated Number of XRF Samples	Total PAHs and PCP via SOM01.1	TAL Metals via ILM05.3	PCBs via SOM01.1	Dioxin via DLM02.0
3.1	TBD	Subsurface	TBD	NA	NA	NA	NA	NA	NA
3.6	1	Subaqueous	NA	NA	NA	1	1	1	1
3.8	12 to 15	Subsurface	12 to 15	NA	NA	NA	NA	NA	NA
3.9	50	Surface	NA	50	50	10	10	NA	10
3.9	10 to 12	Subsurface	NA	10 to 12	10 to 12	2	2	NA	2

Notes:

tPAH - total polynuclear aromatic hydrocarbons

IA - Immunoassay

TBD - To be determined in field

TAL - Target analyte list

PCP - Pentachlorophenol

PAHs - Polynuclear aromatic hydrocarbons

NAPL - Non-aqueous phase liquid

XRF - X-ray fluorescence

NA - Not applicable

<sup>a</sup> Minimum number of confirmatory samples needed/Estimated number of IA laboratory confirmatory samples (based on submitting 20% of IA screening samples for laboratory analysis), higher number of samples will be submitted for laboratory analysis

TABLE 6 ANALYTICAL METHOD SUMMARY

<b>Description</b>	<b>Methods</b>
<b>Soil</b>	
PAH, PCP, and PCBs	SOM01.1
TAL Metals	ILM 05.3
Dioxins	DLM02.0
Grain Size	ASTM D422-63
<b>Sediment</b>	
PAH, PCP, and PCBs	SOM01.1
TAL Metals	ILM 05.2
Dioxins	DLM 02.0
Total Organic Carbon (TOC)	EPA 415.1
Grain Size	ASTM D422-63
<b>Water</b>	
PAH, PCP, and PCBs	SOM01.1
TAL Metals	ILM 05.2
Dioxins	DLM 02.0
Oil and Grease	EPA 1664

Notes:

Refer to Tables 3 to 5 for matrix sample specific analyses

TABLE 7 - GEOTECHNICAL METHOD SUMMARY

Description	Methods
Permeability - fine grain materials	ASTM D5084
Permeability - coarse grain materials	ASTM D2434
Triaxial Compression	ASTM D4767 and ASTM D2850
Consolidation	ASTM 2435
Atterberg Limits	ASTM 4318
Gradation	ASTM D422 and ASTM D1140
Natural Density	ASTM 2937
Moisture Content	ASTM D2216
Specific Gravity	ASTM C127/C128/D854

Notes:

Refer to Table 2 for matrix sample-specific analyses

TABLE 8. CLEANUP CRITERIA FOR SOIL AND SEDIMENT (EPA, 2007)

<b>Contaminant</b>	<b>Cleanup Criterion</b>
<i>Soil</i>	
Benzo(a)pyrene (BaP)	3 ppm
Arsenic	76 ppm
Dioxin	1 ppb (TEQ)
<i>Sediment</i>	
Total polycyclic aromatic hydrocarbons (tPAHs)	45 ppm <sup>(a)</sup>

(a) To improve cost effectiveness of the remedy, active remediation (i.e., dredging) will occur when sediment concentrations are above 100 ppm tPAHs. Sediment with concentrations between 45 and 100 ppm will be addressed through enhanced monitored natural recovery (MNR).

TEQ - Toxic Equivalent, calculated by looking at all toxic dioxins and furans and measuring them in terms of the most toxic form of dioxin, 2,3,7,8-TCDD.

TABLE 9 – QUALITATIVE METHODS (IN-FIELD OBSERVATIONS)  
FOR NAPL IDENTIFICATION

<p>Indicators of NAPL in soil</p> <ul style="list-style-type: none"><li>• Saturation—soil core saturated, with visual (free-phase) NAPL in sampling device or soil sample</li><li>• Staining—soil is stained with no free-phase NAPL in soil or sample</li><li>• Positive verification of NAPL based on dye-shaker test (using hydrophobic SUDAN IV dye)</li></ul>
<p>Indicators that soil/groundwater is contaminated, but NAPL may not be present</p> <ul style="list-style-type: none"><li>• Odor—odor present, no staining or free-phase product</li></ul>

**Table 10 - Requirements for Containers, Preservation and Holding Times**

Parameter	Analytical Methods	Sample Container		Preservation		Holding Time	
		Aqueous	Solid	Aqueous	Solid	Aqueous	Solid
<b>Extractable Organics</b>							
Total Polynuclear Aromatic Hydrocarbons (tPAH)  Polychlorinated biphenyls (PCBs)  Pentachlorophenol (PCP)	SOM01.1	2 X 1 L amber round glass bottle, 33 mm pour-out neck with Polypropylene or phenolic cap, 33-430 size; 0.015 in. PTFE liner	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish with Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.  <b>Note:</b> All parameters can be taken from same jar	Cool all samples to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples	Cool all samples to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples	7 days	14 days
Dioxins	DLM02.0	2 X 1-Liter amber glass bottles with PTFE-lined lids per parameter	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish with Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.  <b>Note:</b> All parameters can be taken from same jar	<u>No residual chlorine</u> Cool to 4 °C  <u>Residual chlorine</u> 1 mL 10% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> per Liter of water (0.008%), Cool to 4 °C	Cool to 4 °C .DO NOT FREEZE water samples  Cool to 4 °C Store in dark	10 days	10 days
Oil and Grease	EPA 1664	1 L amber round glass bottle, 33 mm pour-out neck with Polypropylene or phenolic cap, 33-430 size; 0.015 in. PTFE liner	NA	Cool to 6 °C Sulfuric or hydrochloric acid to pH<2	NA	28 days	NA

**Table 10 - Requirements for Containers, Preservation and Holding Times**

Parameter	Analytical Methods	Sample Container		Preservation		Holding Time	
		Aqueous	Solid	Aqueous	Solid	Aqueous	Solid
Total Organic Carbon (TOC)	SW846 9060A	NA	50 g of soil, 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish with Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.	NA	None	NA	None
<b><i>Inorganics</i></b>							
Metals	SW6010B SW6020 and SW-846 AA methods	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish with Polyethylene cap, ribbed, 28-410 size; F217 polyethylene liner.	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish with Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.	HNO <sub>3</sub> to pH < 2 Cool to 4 °C	Cool to 4 °C .DO NOT FREEZE water samples	6 months for all metals except Mercury (28 days)	6 months
Grain Size	ASTM D422-63	NA	500 g of soil in a heavy plastic bag or glass jar	NA	Cool to 6 °C	NA	None

PTFE = Polytetrafluoroethylene (Teflon®)

HDPE = high density polyethylene

Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> = sodium thiosulfate

NaHSO<sub>4</sub> = sodium bisulfate

HNO<sub>3</sub> = nitric acid

NA = not applicable

TABLE 11 - SUMMARY OF QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Analyte Group	Number of Discrete Samples	QA/QC Samples				
		MS/MSD <sup>1</sup>	Field Duplicate	Rinsate Blank <sup>2</sup>	Trip Blank	Temperature Blank
<b>Soil</b>						
PAHs and PCP	12	1	2	1	NA	OPC
Metals	12	1	2	1	NA	OPC
Dioxins	12	1	2	1	NA	OPC
<b>Sediment</b>						
PAHs	28	3	3	3	NA	OPC
TAL Metals	104	6	11	6	NA	OPC
PCP	104	6	11	6	OPC	OPC
PCBs	104	6	11	6	NA	OPC
Dioxins	104	6	11	6		OPC
Total Organic Carbon	26	1	2	1	NA	OPC
Grain Size	26	NA	NA	NA	NA	NA
<b>Water</b>						
PAHs and PCP	2	1*	1*	1*	NA	OPC
Select Metals	2	1*	1*	1*	NA	OPC
Dioxins	2	1*	1*	1*	NA	OPC
Oil and Grease	2	1*	1*	1*	NA	OPC

Notes:

TBD - To Be Determined

PSE - Per Sampling Event

NA - Not applicable

OPC - One Per Cooler. For trip blanks, one per cooler with VOC aliquots

<sup>1</sup> MS/MSD requirements to be verified with Project Manager once contract laboratories are selected by EPA

<sup>2</sup> One per twenty samples collected

\* Two sampling events to be conducted. Number of required QA/QC samples applies to each event.

**APPENDIX A**  
**EA STANDARD OPERATING PROCEDURES**