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## Phase II Baseline Ecological Risk Assessment Work Plan for Blows Creek, St. Juliens Creek Annex, Chesapeake, Virginia

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### 1 Introduction

The following memorandum presents samples to be collected during Phase II of the Baseline Ecological Risk Assessment (BERA) for Blows Creek, at the St. Juliens Creek Annex, Chesapeake, Virginia. Consistent with the phased approach presented in the Blows Creek BERA Work Plan (CH2M HILL, 2003a), the objectives of this evaluation are to:

- Address remaining data gaps necessary for completing Steps 7 and 8 of the ERA
- Determine if mercury in Blows Creek sediment represents a potential site-related risk to piscivorous wildlife; and,
- Characterize mercury concentration trends in sediment and the relationship between mercury concentrations in Blows Creek and the adjacent Southern Branch of the Elizabeth River.

The remaining sections of this memorandum are organized as follows:

- Section 2 presents the rationale, objectives, and approach for the Phase II fish tissue and Elizabeth River sediment sampling;
- Section 3 discusses procedures for analyzing and validating the collected data;
- Section 4 outlines the project schedule and personnel; and,
- Section 5 presents references.

## 2. Rationale, Objectives, and Approach for Fish Tissue and Elizabeth River Sediment Sampling

The following sections provide a brief overview and history of ecological risk assessment (ERA) activities conducted for Blows Creek and the surrounding drainage basin, summarize the rationale and objectives of the additional sampling activities discussed within this Memorandum, and provide an overview of the approach for these additional activities.

### 2.1 Investigation Background, Rationale, and Objectives

Steps 1 through 3 of an ecological risk assessment (ERA) were conducted as part of a Remedial Investigation (RI) for Sites 3, 4, and 5/6 to evaluate potential risks associated with historic activities that occurred on sites within the Blows Creek drainage basin (CH2M HILL 2003b). The primary focus of this evaluation was on the upland sites and associated upland drainages to Blows Creek. Only a limited number of samples from Blows Creek were considered within this RI. However, the evaluation conducted as part of this RI indicated the potential for site-related impacts to Blows Creek. In addition to Sites 3, 4, and 5/6, which were evaluated in the RI, there are several other sites (e.g., Site 19 and EPIC AOC 1) which have also been identified as potential chemical sources to Blows Creek. Figure 1 shows the location of Blows Creek relative to the potential source areas, and the relationship between Blows Creek and the Southern Branch of the Elizabeth River.

Based on conclusions made in the RI, it was determined that additional investigation was needed to fully characterize potential ecological risks in Blows Creek. A phased approach is being used for this investigation. The Phase I investigation took place in October 2003. Thirty eight additional surface sediment samples were collected from the Blows Creek system for chemical, physical, and bioassay analyses as part of a Phase I BERA site investigation.

Analysis of the sediment data collected during the Phase I BERA is presented in a technical memorandum entitled *Evaluation of Phase I Baseline Ecological Risk Assessment Sediment Data: Evaluation of Mercury Risks to Aquatic-Based Wildlife and Potential Exposure Pathways to Subsurface Sediment* (CH2M HILL, 2004). The results of literature-based food web models, which were included as part of this evaluation, indicated a potential risk to avian piscivores (represented by belted kingfisher) from the ingestion of mercury that has accumulated from sediment into fish within the Blows Creek system. It is unclear, however, to what extent the mercury concentrations detected in Blows Creek sediment are influenced by non site-related sources within the Southern Branch of the Elizabeth River, and ultimately, to what extent these risks are site-related. As indicated in CH2M HILL (2004), mercury is widespread and at similar concentrations throughout many locations in the Elizabeth River system. Mercury was detected, for example, in a sediment sample (SJBC-SD36) collected from the main body of Blows Creek, immediately adjacent to the mouth of Blows Creek. Although concentrations in this sample were low (< 1 mg/kg) this sample was collected immediately adjacent to the Site 4 upland drainage, which was identified as a likely source of mercury to Blows Creek. However, it is possible that at least a portion of the mercury detected in this and other sediment samples in Blows Creek originates from upstream sources and/or enters Blows Creek via tidal flux from the Southern Branch of the Elizabeth River. Chemical analytical data and sediment physical data will be collected adjacent to the mouth of Blows

Creek to further investigate the potential relationship between mercury concentrations in Blows Creek and the Eastern Branch of the Elizabeth River.

The Memorandum concluded that fish tissue residue and additional sediment data are needed to more fully characterize potential mercury risks to piscivorous birds foraging in Blows Creek. The following specific objectives were identified:

- To quantify mercury residue concentrations in fish tissue from Blows Creek for use in the further evaluation of potential risks to piscivorous birds; and,
- To quantify mercury concentrations in the Southern Branch of the Elizabeth River sediments immediately adjacent to the mouth of Blows Creek to characterize concentration trends and the relationship between mercury concentrations in Blows Creek and the adjacent Southern Branch of the Elizabeth River.

The following sections outline the fish and sediment sampling programs that have been developed for the Phase II BERA investigation to fulfill these objectives. The Phase II BERA investigation is scheduled for fall of 2004.

## 2.2 Overview and Approach to Sample Collection and Analysis

This section provides an overview of the proposed approach for the Phase II BERA investigation and the approach for further evaluating ecological risks with these additional data.

### 2.2.1 Fish Tissue

Fish tissue residue data collected during this site investigation will be used in the ERA to further evaluate risks to piscivorous birds. The same food web model that was used to evaluate risks to piscivorous birds following the collection of the Phase I data will be used to evaluate the fish tissue residue data. However, fish tissue residue data will be directly used within the food web models instead of the concentrations modeled from sediment chemical analytical data.

*Fundulus heteroclitus* (*Mummichog*) were selected as the target fish species for collection during this investigation. *Fundulus heteroclitus* were selected to estimate potential ecological risks because they:

- Are expected to be resident species in Blows Creek and would have chemical body burdens that reflect accumulation from the surface water and sediments of this water body;
- Forage and frequently burrow in sediments, and thus represent conservative indicators of chemical accumulation from both sediment and surface water;
- Have summer ranges of a few hundred feet or less (Lippson and Lippson 1997) and can be used to indicate accumulation potential in localized areas of Blows Creek; and,
- Represent important prey items for both avian and mammalian piscivorous wildlife.

Up to three composite fish samples will be collected from Blows Creek using minnow traps. Multiple minnow traps may be placed at each fish sample location. Fish traps will be placed

in shallow water (<2 feet deep) close to the edge of the waterline in the sloping shoreline areas, which is the habitat type preferred by *Fundulus heteroclitus* (Lippson and Lippson, 1997). As shown in Figure 1, fish samples will be collected from the upper reaches of Blows Creek and adjacent to the mouth of Blows Creek, where some of the highest mercury concentrations were detected in Blows Creek sediment. The objective of this placement is to bias sample locations towards areas expected to have the highest mercury concentrations. A sample will also be collected from the middle portion of Blows Creek. Although very little mercury was detected in sediment samples collected from the middle reaches of Blows Creek, the tissue residue sample collected from this area will be used along with the other data to help define the range of mercury concentrations expected to occur in fish throughout the Blows Creek drainage.

Minnow traps will be checked at least every 24 hours during the field sampling effort. *Fundulus heteroclitus* will be removed each time the traps are checked. Non-target species also will be documented and released. The size and wet weight of each *Fundulus* will be measured and recorded immediately following removal from the traps. Observations about general physical condition of fish collected will be recorded (e.g., fin erosion, tumors). All *Fundulus heteroclitus* collected at each location will be retained for a location-specific composite sample. A minimum of 20 grams of biomass is required for mercury analysis, to insure that the minimum amount of biomass arrives at the lab a minimum of 50 grams of biomass will be collected at each location. If more than 50 grams of biomass is collected the entire amount will be sent to the lab when reasonable. If more biomass is collected than is necessary for a sample, the largest *Fundulus* will be preferentially retained for the sample. All fish collected will be composited at the lab. *Fundulus heteroclitus* from each sample location will be placed into separate sample containers provided by the analytical laboratory and put onto wet ice. Samples will be transferred to an onsite freezer until completion of the sampling event, at which time all collected *Fundulus heteroclitus* will be sorted by sample location, composited, and sent to the laboratory for chemical analysis.

The field sampling event is scheduled to occur over a period of approximately 8-10 days. During this time, minnow traps will be regularly checked and re-deployed at a sample location until either: 1) adequate fish biomass has been collected, or 2) it is determined that adequate fish biomass cannot be collected from a location. If it is determined that adequate fish tissue cannot be collected from a sample location, alternate methods will first be used to try and collect the tissue needed for chemical analysis. Alternate approaches to sample analysis also will be considered, if necessary. The following general approaches will be considered:

- Minnow traps will be re-deployed to alternate sample locations. Samples will be initially located in areas where *Fundulus heteroclitus* are expected to occur. However, it is possible these organisms are not present at some of the selected sample locations or are not present in adequate numbers to allow collection of a viable sample. *Fundulus heteroclitus* have a patchy distribution (Lippson and Lippson 1997) and may not be present at all of the selected sample locations, even within their preferred habitat. If it is determined during the sampling event that adequate *Fundulus heteroclitus* biomass cannot be collected from one or more sample locations, trap position will be altered to a location that, based on observations made in the field, is considered to be a more viable point of

collection. An effort will be made to select an alternate sample location that is close to the original sample location.

- Alternate methods will be used to collect samples if the minnow traps are not effective in collecting adequate biomass from one or more sample locations. Alternate baits and trapping methods will be considered. A seine and/or cast net, for example, may be used as an alternate capture method for the collection of *Fundulus heteroclitus* if they are observed at a location but cannot be captured with a minnow trap. To the extent possible, samples will be collected using these alternate methods at approximately the same locations as the original traps were deployed.
- Fish samples from more than one sample location may be composited if necessary to create adequate biomass for chemical analysis. Compositing of multiple sample locations will be considered only if adequate fish tissue biomass cannot be obtained using the alternate sampling approaches described above.

Sample collection will cease at the end of the approximately 8 day period at which time the availability of sample organisms at each location will be documented. Information on organism abundance and ease of capture will be used in the risk assessments as a line of evidence when evaluating the potential importance of these exposure pathways.

Upon termination of the sampling event, frozen samples will be shipped to a contracted analytical laboratory for chemical analysis. Upon arrival at the laboratory, whole body *Fundulus* composite samples will be homogenized for analysis. All tissue samples will be analyzed for mercury.

### 2.2.2 Elizabeth River Sediment Collection and Analysis

This section provides an overview of the proposed approach for collecting sediment samples from the Southern Branch of the Elizabeth River adjacent to the mouth of Blows Creek. Chemical analyses conducted on sediment samples collected from these locations will be used in the ERA to further characterize concentration trends and the relationship between mercury concentrations in Blows Creek and the adjacent Southern Branch of the Elizabeth River.

Thirteen surface sediment (0 to 6 inches) grab samples will be collected from the Southern Branch of the Elizabeth River, adjacent to the mouth of Blows Creek. Sediment samples will be collected at increasing distances along three transect lines that move out from the mouth of Blows Creek. Figure 2 shows the proposed sample locations for the Southern Branch of the Elizabeth River.

Discreet samples will be collected from each selected sample location using a Ponar grab sampler or comparable device. Surface water quality parameters (conductivity, dissolved oxygen, hardness, pH, redox potential, salinity, temperature, and turbidity) will be measured at each sample location. Immediately following collection, samples will be shipped to a contracted analytical laboratory for mercury analysis. All sediment samples will be analyzed for grain size and total organic carbon (TOC).

## 2.3 Sample Designation

Sampling locations and sampled media collected during the investigation will be assigned unique designations to allow the sampling information and analytical data to be entered into the Geographic Information System (GIS) and Data Management system for SJCA.

Each sample will be designated by an alphanumeric code that identifies the site and matrix sampled and contains a sequential sample number. Quality assurance/quality control (QA/QC) samples will have a unique sample designation. The first two letters indicate the Installation (St. Juliens Creek Annex) and the next two indicate the unique site (Blows Creek watershed). The two letters following the dash indicate the type of sample taken and the last two digits indicate the sample number. Surface sediment samples will be designated in a similar manner beginning with SJBC-SD01, sample dates and duplicate qualifiers will follow. The guide for sample identification is documented in the St. Juliens Creek Annex Master Project Plans (CH2M HILL, 2003c). A summary of the sample identification scheme is presented in Table 1.

A listing of the sample identification numbers will be maintained by the field team leader, who will be responsible for enforcing the use of the standardized numbering system during all sampling activities.

## 2.4 Surveying

Proceeding the sampling portions of the work, CH2M HILL will survey all staked/flagged locations for incorporation into the global information system (GIS) database. All locations will be surveyed using a hand-held or backpack type global positioning system (GPS) unit. Items to be surveyed include trenches, sampling locations, hand auger locations, utility locations not in the existing GIS database.

## 2.5 Investigation-Derived Waste Management

A minimal amount of investigation-derived waste (IDW), consisting of decontamination fluids and personal protective equipment (PPE), will be generated during this sampling program. Sampling equipment will be decontaminated prior to sampling and between samples. Since the amount of IDW fluids generated will be minimal (less than 2 gallons per day) and no potentially hazardous material will be generated, no IDW will be contained onsite.

# 3 Sample Analysis and Data Validation

CH2M HILL will track sample analyses and obtain results from the laboratory. Following chemical analysis, the analytical data generated during the investigation field program will be validated. This data validation will be conducted by an independent data validation subcontractor according to USEPA standard procedures. A detailed discussion of quality control procedures for field investigations at SJCA is presented in the MWP and in the MQAPP.

### 3.1 Sample Analysis

A standard 28-day turnaround time will be used for all other chemical and all physical analytical samples. All analyses will be conducted at a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and USEPA's Contract Laboratory Program (CLP). A signed certificate of analysis will be provided with each laboratory data package, along with a certificate of compliance certifying that all work was performed in accordance with the applicable federal, state, and local regulations. All analyses will be performed following the highest level of Navy guidance.

### 3.2 Field Quality Control Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process. Quality assurance procedures for laboratory toxicity tests will follow those described by the USEPA (USEPA, 1994). Data will be collected to meet high-level data quality objectives (DQOs) as described in this document.

Three types of blanks can be generated during sampling activities: field blanks, equipment rinsate blanks, and temperature blanks. American Society for Testing Materials (ASTM) Type II water will be used for blanks. A summary of the sample identification scheme is presented in Table 1. The quality control samples to be collected during the investigation are summarized in Table 1.

One field blank will be collected to determine if there is any influence from ambient conditions in the sampling area location imparted to the sample. The field blank will be collected at one location where there is most likely to be ambient air contamination. If windy or dusty conditions are present during sample collection, field blanks will be collected daily.

Equipment blanks give an indication of the efficiency of decontamination procedures. One equipment blank will be collected per day for all non-disposable sampling equipment (hand auger, trowel, bowl, etc.), however; they will not be taken after the first sample collected each day. It is anticipated that the sediment sampling event will require 1 to 2 days, therefore, it is anticipated that only one to two equipment blanks will be collected.

A temperature blank will be included in each cooler containing samples for CLP analyses so that the laboratory can record the temperature without disturbing the samples. The temperature blank will be labeled, but will not be given a sample number nor will be listed as a sample on the Chain or Custody (COC) form.

Field duplicate samples are typically collected at a frequency of 1 per 10 field samples per matrix. The location where the duplicates will be collected will be randomly selected. The duplicate sample will be split evenly into two sample containers and submitted for analysis as two independent samples. Since thirteen samples are anticipated to be collected, two field duplicates will be collected during the sediment sampling.

Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of 1 for every 20 field sediment samples collected. One MS/MSD sample will be collected for this sampling event. Analytical results of these samples indicate the impact the matrix (sediment) has on extracting the analyte for analysis. MS/MSD samples give an indication

of the laboratory's analysis accuracy and precision within the sample matrix. Data validators will use these results to evaluate the accuracy of the analytical data.

### 3.3 Data Validation

CH2M HILL subcontractors approved by the Navy will validate analytical results. Data validators will use USEPA Region III guidance. Data that should be qualified will be appropriately flagged. Results for QA/QC samples will be reviewed and the data will be qualified further, if necessary. Finally, the dataset as a whole will be examined for consistency, anomalous results, reasonableness, and utility.

## 4 Project Personnel and Schedule

The CH2M HILL Activity Manager will be Mr. William Friedmann. Mr. Friedmann will provide office support, subcontractor coordination for the field personnel, and act as the alternate field team member. Ms. Jamie Butler will be the site safety coordinator and field team leader for the field activities and will be the main CH2M HILL employee on site during the field activities. The CH2M HILL Health and Safety Plan for this project is found in the *Final Work Plan for Baseline Ecological Risk Assessment (Step 4) Blows Creek Sites 3, 4, and 5, St. Juliens Creek Annex, Chesapeake, Virginia. August 2003*.

## 5 References

- CH2M HILL 2004. *Evaluation of Phase I Baseline Ecological Risk Assessment Sediment Data: Evaluation of Mercury Risks to Aquatic-Based Wildlife and Potential Exposure Pathways to Subsurface Sediment*, St. Juliens Creek Annex, Chesapeake, Virginia. May
- CH2M HILL, 2003a. *Final Work Plan for Baseline Ecological Risk Assessment (Step 4) Blows Creek Sites 3, 4, and 5*, St. Juliens Creek Annex, Chesapeake, Virginia. August.
- CH2M HILL, 2003b. *Final Remedial Investigation/Human Health Risk Assessment/Ecological Risk Assessment Report for Sites 3, 4, 5, and 6*, St. Juliens Creek Annex, Chesapeake, Virginia. August.
- CH2M HILL, 2003c. *Final Master Project Plan*, Naval Station Norfolk/St. Juliens Creek Annex, Chesapeake, Virginia. July.
- CH2M HILL, 2002. *Final Site Screening Assessment*, Naval Station Norfolk, St. Juliens Creek Annex, Chesapeake, Virginia. April.
- CH2M HILL, 2001. *Final Background Investigation Report*, St. Juliens Creek Annex, Chesapeake, Virginia. October.
- Lippson, A.J. and R.L. Lippson. 1997. *Life in the Chesapeake Bay*. Second Edition. John Hopkins University Press.

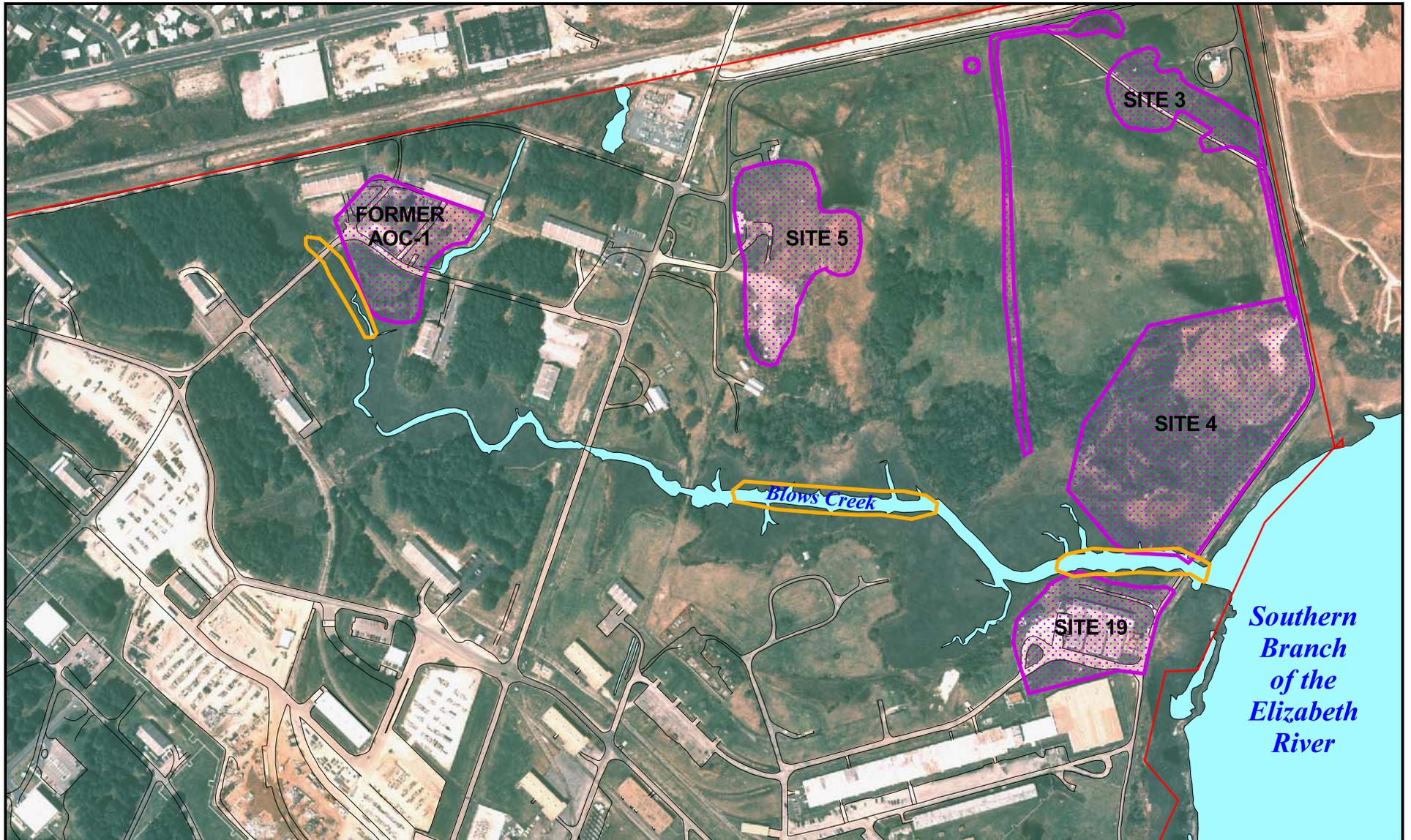
**Table 1**

Analytical Table for the Step 4 Investigation

*St. Juliens Creek Annex, Chesapeake, Virginia*

		Station ID	Sample ID	Sample Media	Analysis/Method							
					Mercury Method CLP ILM04	TOC	Method Lloyd Kahn	Grain Size Method ASTM D422	Mercury Method CLP ILM04	Percent Moisture Method Percent Moisture	Percent Lipids Method Percent Lipids	Percent Lipids Method Percent Lipids
Sediment Sampling	Primary Samples	SJBC-SD200	SJBC-SD200-04D	Sediment	X	X	X					
		SJBC-SD201	SJBC-SD201-04D	Sediment	X	X	X					
		SJBC-SD202	SJBC-SD202-04D	Sediment	X	X	X					
		SJBC-SD203	SJBC-SD203-04D	Sediment	X	X	X					
		SJBC-SD204	SJBC-SD204-04D	Sediment	X	X	X					
		SJBC-SD205	SJBC-SD205-04D	Sediment	X	X	X					
		SJBC-SD205	SJBC-SD205-04D-P	Sediment	X	X	X					
		SJBC-SD206	SJBC-SD206-04D	Sediment	X	X	X					
		SJBC-SD207	SJBC-SD207-04D	Sediment	X	X	X					
		SJBC-SD208	SJBC-SD208-04D	Sediment	X	X	X					
		SJBC-SD209	SJBC-SD209-04D	Sediment	X	X	X					
		SJBC-SD210	SJBC-SD210-04D	Sediment	X	X	X					
		SJBC-SD210	SJBC-SD210-04D-P	Sediment	X	X	X					
SJBC-SD211	SJBC-SD211-04D	Sediment	X	X	X							
SJBC-SD212	SJBC-SD212-04D	Sediment	X	X	X							
Fish Tissue Sampling	Fish Tissue	SJBC-TI01	SJBC-TI01-04D	Whole Body Fish					X	X	X	
		SJBC-TI02	SJBC-TI02-04D	Whole Body Fish					X	X	X	
		SJBC-TI03	SJBC-TI03-04D	Whole Body Fish					X	X	X	
		SJBC-TI03	SJBC-TI03-04D-P	Whole Body Fish					X	X	X	
QA/QC	Field Duplicates	See note <sup>1</sup>			Same analysis as parent sample							
	Field Blank	SJBC-SDFB	SJBC-SDFB-DDMMYY	QA/QC	Same as analysis collected during that week							
	Equipment Blanks	SJBC-SDEB	SJBC-SDEB-DDMMYY	QA/QC	Same as analysis collected during that day							
	MS/MSD	MS/MSD samples collected 1:20 ratio during sampling, or 1 per media unless			Same analysis as parent sample							

<sup>1</sup> Station ID followed by the letter P designates a duplicate sample. Duplicate sample may be collected at alternate locations chosen by the Field Team Leader.



**LEGEND**

-  IR Sites
-  Activity Boundary
-  Fish Tissue Trap Areas



0 200 400 600 Feet

Figure 1  
Blows Creek Watershed and Fish Tissue Trap Areas  
Blows Creek BERA Phase II  
St. Juliens Creek Annex  
Chesapeake, Virginia



**LEGEND**

-  BERA Phase I Sediment Samples (2003)
-  BERA Phase II Sediment Sample Locations
-  HRS Sediment Samples (1999)

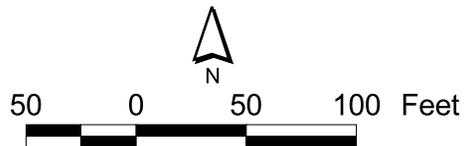


Figure 2  
Sediment Samples Locations  
Blows Creek BERA Phase II  
St. Juliens Creek Annex  
Chesapeake, Virginia