FINAL

Sampling and Analysis Plan

Project Overview

Evaluation of Dredged Material Proposed for Ocean Placement

Parallel Thimble Shoal Tunnel Project

Volume 1 of 4

Prepared For
Jacobs Engineering Group
4500 Main Street, Suite 310
Virginia Beach, Virginia 23462

On Behalf of
Chesapeake Bay Bridge and Tunnel District
32386 Lankford Highway
Cape Charles, Virginia 23310

February 2015

Prepared By:
EA Engineering, Science, and Technology, Inc., PBC
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Hunt Valley, Maryland 20131

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February 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

ºC	Degrees Celsius
AVS	Acid Volatile Sulfides
CBBT	Chesapeake Bay Bridge Tunnel
CIEE	Craney Island Eastward Expansion
CFR	Code of Federal Regulations
CIEE	Craney Island Eastward Expansion
CIH	Certified Industrial Hygienist
CSP	Certified Safety Professional
cy	Cubic Yard(s)
DGPS	Differential Global Positioning System
DU	Dredging Unit
EA	EA Engineering, Science, and Technology, Inc.
EC50	Median Effective Concentration
EM	Engineer Manual
FSP	Field Sampling Plan
ft	Foot (Feet)
in.	Inch(es)
ITM	Inland Testing Manual
LC50	Median Lethal Concentration
LPC	Limiting Permissible Concentration
mg/L	Milligram(s) Per Liter
MLLW	Mean Lower Low Water
MPRSA	Marine Protection, Research, and Sanctuaries Act
mcy	Million Cubic Yard(s)
NODS	Norfolk Ocean Disposal Site
OTM	Ocean Testing Manual
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PGL	Profile Grade Line
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control

R/V	Research Vessel

LIST OF ACRONYMS AND ABBREVIATIONS

SAP	Sampling and Analysis Plan
SEM	Simultaneously Extracted Metals
STFATE	Short-Term Fate of Dredged Material
SVOC	Semivolatile Organic Compound
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFDA	United States Food and Drug Administration
WQC	Water Quality Criteria

1. PROJECT OVERVIEW

The Thimble Shoal Tunnel is a portion of the Chesapeake Bay Bridge Tunnel (CBBT) system which extends from Wise Point on the Eastern shore of Virginia to the Virginia Beach area. The CBBT is 17.6 miles long and provides a direct connection between southeastern Virginia and the Delmarva Peninsula (Delaware plus the Eastern Shore counties in Maryland and Virginia) (Figure 1-1). The Thimble Shoal Tunnel section of the CBBT runs beneath the Thimble Shoal Channel, one of the main navigation channels that crosses the system.

The proposed project includes the construction of secondary two-lane immersed tunnel which will run parallel to and approximately 250 feet (ft) west of the existing Thimble Shoal Tunnel. The project also includes expansion of the existing portal islands and construction of new trestle crossovers. The proposed project will require the dredging and placement of approximately 1.7 million cubic yards (mcy) of material from the lower Chesapeake Bay prior to construction.

An evaluation of the dredged material is required prior to dredging and placement to ensure that the material is appropriate for available placement options. Placement options for the Parallel Thimble Shoal Tunnel Project include ocean and upland placement. Preliminary geotechnical investigations and environmental sampling/analysis were conducted in 2014 (Fugro Consultants 2014) and supplemental geotechnical investigations are being conducted in early 2015. The purpose of this project is to collect the data that are necessary to document the Tier II (sediment and elutriate) and Tier III (ecotoxicological) characteristics of the sediments to facilitate placement of the dredged material at the Norfolk Ocean Disposal Site (NODS) (Figure 1-2). Data collected for the Parallel Thimble Shoal Tunnel Project will be used to document compliance with Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) for ocean placement at the NODS.

The Parallel Thimble Shoal Tunnel dredged material evaluation will consist of collecting sediment cores from the sediment surface to depths between approximately -29 and -120 ft mean lower low water (MLLW) using sonic drilling; collecting surficial sediment and sediment cores to -20 ft below the sediment surface at the Willoughby Bank reference site; collecting surficial sediment at the Atlantic Ocean reference site; collecting site water and elutriate preparation water; conducting analytical testing of bulk sediment and standard elutriates; conducting ecotoxicological testing of sediment (water column bioassays, whole sediment bioassays, and bioaccumulation studies); conducting analytical testing of aquatic organism tissue (as appropriate); Short-Term Fate of Dredged Material (STFATE) modeling of dredged material placement at the NODS; and evaluating test results with respect to the Ocean Dumping Regulations in Title 40 of the Code of Federal Regulations (CFR), Parts 220-228 (40 CFR 220-228).

1.1 SCOPE OF THE SAMPLING AND ANALYSIS PLAN

This Sampling and Analysis Plan (SAP) documents the activities and protocols associated with conducting a dredged material evaluation for the Parallel Thimble Shoal Tunnel sediments to facilitate the determination of the potential for ocean placement at the NODS. A field sampling plan (FSP), Analytical Chemistry Quality Assurance Project Plan (Analytical-QAPP), and an Ecotoxicology Quality Assurance Project Plan (Ecotox-QAPP) are provided in Attachments I, II,

and III, respectively. The FSP and QAPPs were prepared in accordance with United States Army Corps of Engineers (USACE) Engineer Manual (EM) 200-1-3 *Requirements for the Preparation of Sampling and Analysis Plans (SAP)* (2001) and the United States Environmental Protection Agency's (USEPA's) *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (2001).

1.2 PROJECT BACKGROUND

The CBBT opened to traffic in 1964 as a combined trestle-tunnel structure that included 12 miles of low-level trestle, two 1-mile tunnels, two bridges, and four man-made islands. In 1999, the first parallel bridge was completed to meet the increased traffic demands. During this expansion, the two-lane structure was expanded to a four-lane structure and the existing portal islands were expanded to transition traffic on the new trestles to the existing tunnel approaches (Jacobs 2011).

Construction of a tunnel parallel to the existing Thimble Shoal Tunnel will aim to further alleviate traffic congestion along that portion of the CBBT complex. Dredging for the Parallel Thimble Shoal Tunnel will be required to remove alluvial materials and Norfolk/Yorktown formation material to allow for placement of the parallel tunnel sections.

Preliminary geotechnical and environmental investigations were conducted in the proposed tunnel footprint in 2014. The geotechnical investigations indicated that the geological subsurface profiles were relatively consistent across the project footprint (Fugro Consultants 2014), indicating that the subsurface sediment strata within the dredging footprint are continuous, with little variability in overall physical characteristics. One exception is the dredging footprint area in closest proximity to the south portal island (Island No. 1); this area contains a higher proportion of fine-grained deposits with small areas of artificial fill.

The proposed tunnel alignment will cut through six principle strata. On the southern side of the project area beneath the southern island (Island No. 1), some channel fill deposits (fine-grained) and Baymouth deposits (fine-grained) were observed. However, the majority of the tunnel alignment cuts through five strata under the Thimble Shoal Channel with grain sizes that vary between fine and coarse: (1) fine-grained shoal (Baymouth shoal), (2) coarse-grained channel fill, (3) the Norfolk formation (fine sand deposits with an appreciable amount of fine-grained material), (4) the Yorktown formation fine-grained unit consisting of stiff to very stiff clay which grades to sand with decreasing elevation, and (5) the Yorktown formation coarse-grained unit consisting of silty sand (Fugro Consultants 2014).

Existing water depths across the tunnel footprint in the proposed dredging area range from 7 to 55 ft feet deep. Overall, the dredging depths will range from approximately -29 to -120 ft MLLW, with shallowest dredging depths adjacent to Island No. 1. The proposed tunnel profile grade line (PGL) descends from the south at Island No. 1 and from the north at Island No. 2 with the deepest central point beneath the existing Federal navigation channel (Figure 1-3).

The primary placement alternative for the dredged material is ocean placement the NODS. Upland placement options, such as Port Tobacco at Weanack (Shirley Plantation) and other approved/permitted upland locations will also be assessed. Dredged material from each dredging unit will be tested for both ocean placement and upland placement options. The testing program

for upland placement is addressed in a separate SAP (EA 2015a). If the results of testing indicate that ocean placement is not a viable option for all or a portion of the material, the material will be considered for placement at an approved upland disposal site; in addition, potential beach nourishment or other beneficial uses may also be considered. Shirley Plantation is located on the James River approximately 68 miles from the Parallel Thimble Shoal Tunnel Project area. The NODS is located approximately 20 miles from the project area. Ocean placement of the dredged material would result in significant transportation and placement cost-savings to the overall project.

The NODS is located in the Atlantic Ocean approximately 17 miles east of Cape Henry and is approximately 50 square nautical miles in size (40 CFR Part 228) (Figure 1-2). The site has unlimited capacity and is designated to provide capacity for long-term management of dredged material from the lower Chesapeake Bay and suitable materials from Norfolk Harbor (USEPA Region 3 1992). The designation of the site in 40 CFR Part 228.15 indicates the "site shall be limited to suitable dredged material which passed the criteria for ocean dumping" which are described in Section 103 of the MPRSA.

In this evaluation, approximately 1.7 mcy of dredged material will be considered for ocean placement at the NODS during the approximate timeframe of 2017 to 2020. The exact schedule for dredging and placement will be dependent upon a variety of factors and will be refined after the selection of a Design-Build contractor. The volume of material from the project footprint that could be placed at NODS will be determined based on the results of this evaluation.

1.3 PROJECT PURPOSE AND OBJECTIVES

The purpose of this project is to collect data to characterize the physical, chemical, and ecotoxicological quality of the sediments from the Parallel Thimble Shoal Tunnel Project footprint and to determine if the material is suitable for ocean placement. The overall intent of the program is to determine if ocean placement of the material is a feasible placement option. Ocean placement, if determined to be feasible, would reduce or eliminate the volume of material required to be placed at an approved upland disposal area(s).

The overall objective of the sampling effort is to obtain and analyze sediment and water samples representative of the areas proposed for dredging. The physical composition of the sediment will be described by grain size, specific gravity, Atterberg limits, and total solids determinations. Chemical concentrations of semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), metals (including mercury), polychlorinated biphenyl (PCB) congeners, chlorinated pesticides, organophosphorus pesticides, dioxin and furan congeners, tributyltin, cyanide, ammonia; sulfides, nitrogen, nitrate + nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, total organic carbon (TOC), and acid volatile sulfides (AVS) / simultaneously extracted metals (SEM) will be identified in bulk sediments. Site water, receiving water, and standard elutriate samples will be analyzed for SVOCs, PAHs, metals (including mercury), PCB congeners, chlorinated pesticides, organophosphorus pesticides, dioxin and furan congeners, tributyltin, cyanide, ammonia, sulfides, nitrate + nitrite, total TKN, total phosphorus, and TOC.

Specific objectives of the Parallel Thimble Shoal Tunnel study are:

- Collect the required volume of sediment and site water for physical, chemical, and ecotoxicological analyses.

- Collect sediment cores from four designated dredging areas that comprise fifteen dredging units (DUs) within the footprint of the Thimble Shoal Tunnel within positioning accuracy appropriate for the project objectives.

- Collect sandy surficial sediment and sediment cores from three locations at the Willoughby Bank reference site, and composite into two samples (one silty-sand surface sample and one subsurface fine-grained sample) for physical and chemical testing.

- Collect sandy surficial sediment from the Atlantic Ocean reference site for physical and chemical testing.

- Collect surficial sediment from the USEPA-designated lower Chesapeake Bay control site.

- Collect and transfer sediment to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity.

- Test and characterize sediments in the dredging units from two depth intervals (0 to -10 ft or 0 to -20 ft below the sediment surface and -10 ft or -20 ft below the sediment surface to project depth) with regard to physical, chemical, and ecotoxicological characteristics.

- Test site water and standard elutriates with regard to chemical characteristics and compliance with water quality standards.

- Conduct water column bioassays to assess potential water column impacts related to open water/ocean placement.

- Conduct whole sediment bioassays to assess potential benthic impacts related to open water/ocean placement.

- Conduct 28-day bioaccumulation to assess the potential for uptake of contaminants from sediments into the tissue of benthic organisms.

- Conduct STFATE modeling to assess compliance with the Limiting Permissible Concentration (LPC) as per 40 CFR Part 227.

- Evaluate physical, chemical, and ecotoxicological data for the Parallel Thimble Shoal Tunnel sediments to determine the feasibility of ocean placement for the dredged material.

1.4 PROJECT LOCATION

The existing Thimble Shoal Tunnel is located in the lower Chesapeake Bay and is part of the CBBT system. The proposed new parallel tunnel will be located on the west side of the existing tunnel. The proposed dredging footprint includes approximately 46.5 acres of area between Island No. 1 and Island No. 2 and approximately 13.5 acres adjacent to the west side of Island No. 1. A total of four dredging areas comprised of fifteen dredging units will be sampled for the testing program (Figure 1-1).

Reference sediments will be collected from the Willoughby Bank reference site near Hampton Roads, just north of the city of Norfolk, Virginia and from the Atlantic Ocean reference site (Figure 1-2). These reference sites were chosen because they each provide material with different grain size composition (sands, silty-sand, silt). The appropriate reference samples for test comparisons will be chosen based upon grain size determinations of the actual project site samples following sample collection and compositing. It is important that the reference site be comprised of materials similar to the project sediments to provide a technically appropriate comparison for the results of the analytical and ecotoxicological testing conducted with the Parallel Thimble Shoal Tunnel Project sediments.

The Willoughby Bank reference area has been used for other recent ocean placement evaluations for the NODS (EA Engineering, Science, and Technology, Inc. [EA] EA 2011; EA 2014a, 2014b, 2014c, 2014d, 2015b, 2015c). For this project, two separate reference samples from the Willoughby Bank area will be collected and tested: one representing silty-sand surface materials and one representing fine-grained sub-surface materials. One reference sample from the Atlantic Ocean reference site representing sandy surface materials will be collected and tested. Lower Chesapeake Bay control sediment (for amphipod bioassays) will be collected from a USEPA-designated area in the Lower Chesapeake Bay (Figure 1-2).

1.5 PROJECT SCHEDULE

The proposed project schedule for the Parallel Thimble Shoal Tunnel dredged material evaluation is provided below. Field sampling is scheduled to be conducted in February and March 2015. Analytical and ecotoxicological testing will be conducted in April and May 2015, tissue testing will be conducted in June-July 2015, and draft reports (upland and ocean placement) are planned for submittal to USEPA and USACE in June and August 2015, respectively. Changes or deviations from the proposed project schedule after project initiation will be discussed with, and approved by, the Jacobs Engineering Group Project Manager.

Proposed Parallel Thimble Shoal Tunnel Sampling and Ocean Placement Testing Schedule (2015)

Preparation of Draft Sampling and Analysis Plan (SAP)	September 10, 2014 – January 23, 2015
USEPA/USACE Review of Draft SAP	January 26, 2015 – February 13, 2015

Preparation of Final SAP	February 16, 2015 – February 20, 2015
Field Investigations / Sampling / Core Processing	February 23, 2015 – March 26, 2015
Sediment and Elutriate/Chemical Analysis/ Data Management	March 30, 2015 – May 18, 2015
Water Column Bioassays	April 6, 2015 – May 22, 2015
Whole Sediment Bioassays	April 21, 2015 – May 15, 2015
Bioaccumulation Exposures	April 14, 2015 – May 14, 2015
Tissue Testing	May 26, 2015 – July 1, 2015
Agency Review of Data	July 20, 2015 – July 27, 2015
Draft Data Compilation Report-NODS and Section 103	May 4, 2015 – August 21, 2015
USACE Suitability Determination and USEPA Concurrence Review	August 24, 2015 – October 19, 2015
USEPA Written Concurrence	October 20, 2015
Final Data Compilation Report-NODS and Section 103	October 21, 2015 – October 30, 2015

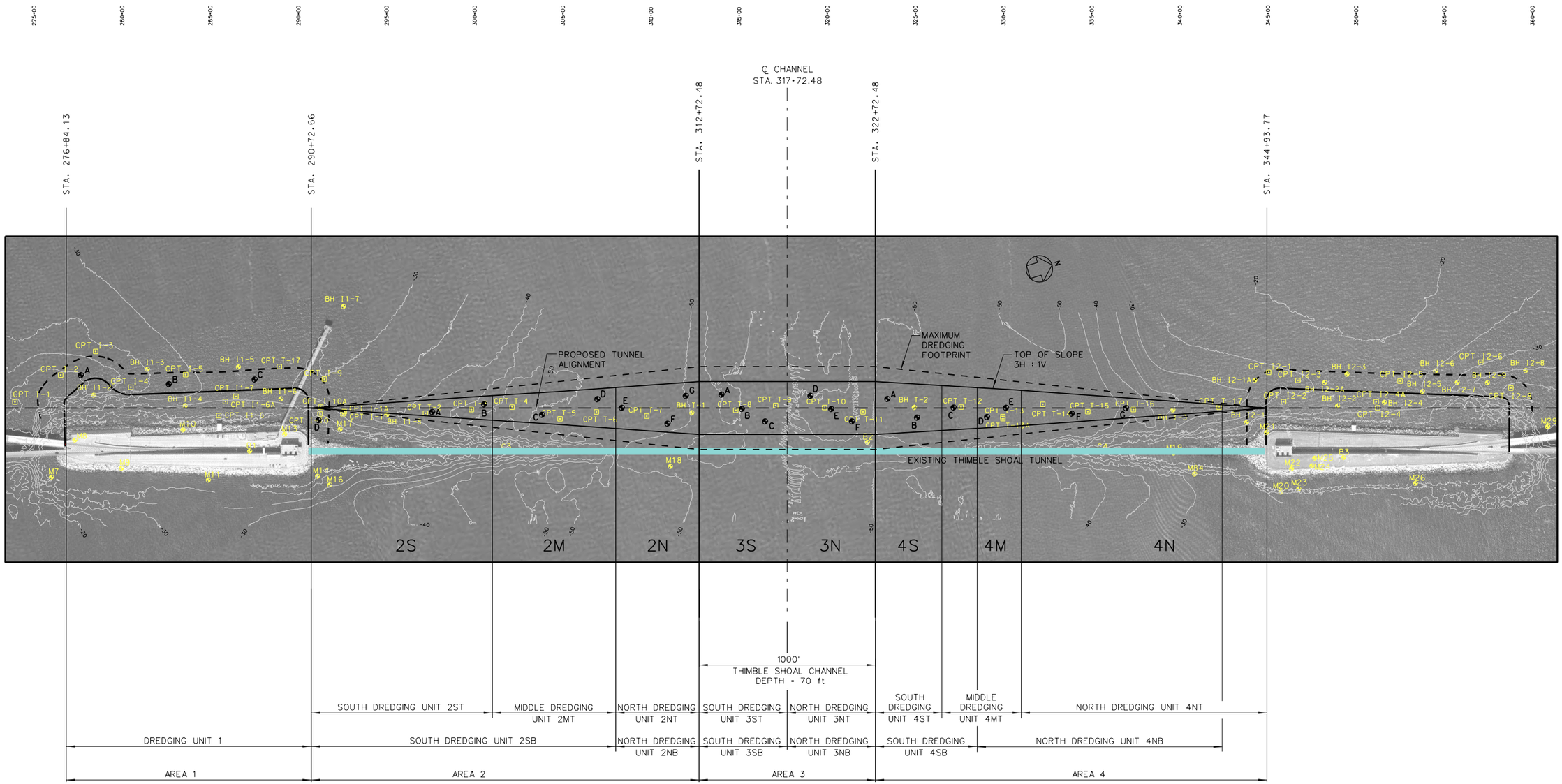


Figure 1-1 Dredging Areas, Dredging Units, and Coring Locations in the Parallel Thimble Shoal Tunnel Footprint

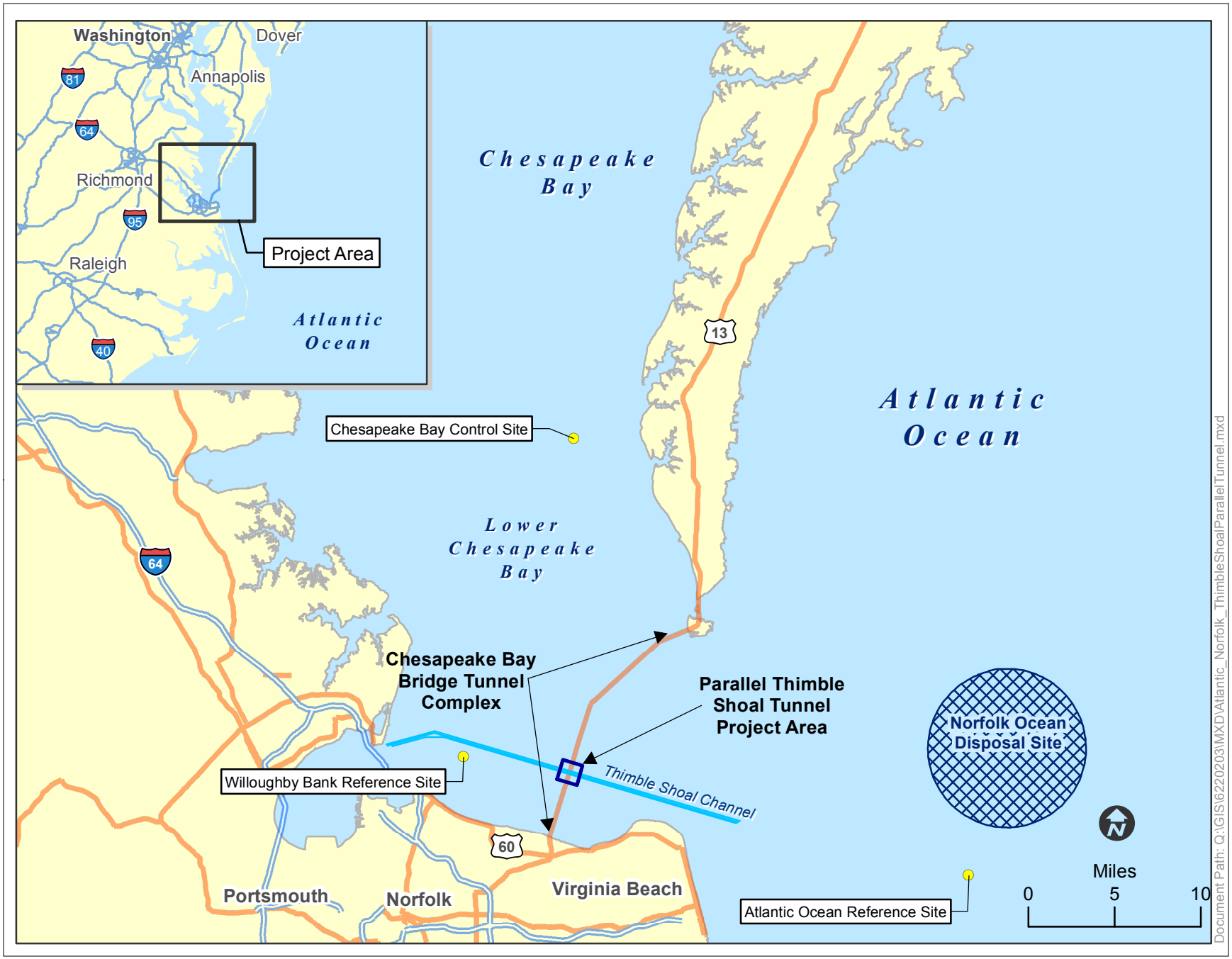
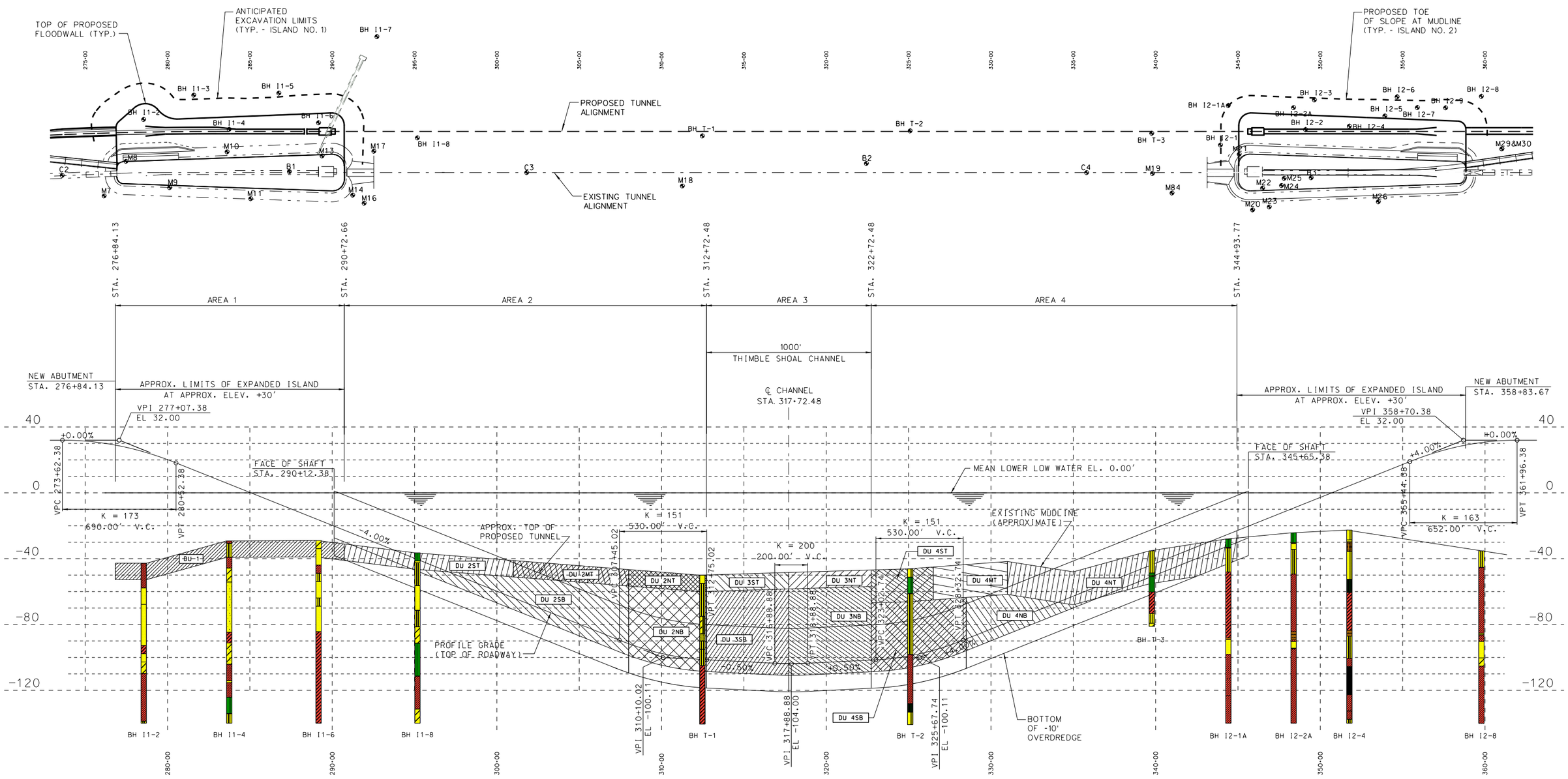


Figure 1-2. Sampling Locations for the Chesapeake Bay Control Site, Norfolk Ocean Disposal Site, the Willoughby Bank Reference Site, and the Atlantic Ocean Reference Site.



NOTE

DU ... INDICATES DREDGING UNIT

COMMONWEALTH OF VIRGINIA

CHESAPEAKE BAY BRIDGE AND TUNNEL DISTRICT

CAPE CHARLES, VIRGINIA 23310-0111

PARALLEL TUNNEL

TO

LUCIUS J. KELLAM,JR. BRIDGE-TUNNEL

JACOBS

FIGURE 2

PLAN AND PROFILE AT

FUTURE THIMBLE SHOAL TUNNEL

Figure 1-3. Parallel Thimble Shoal Plan and Profile

2. TECHNICAL APPROACH

The technical approach for the sampling for Ocean Placement testing includes 24 sampling/coring locations within the dredging footprint (Figure 1-1). Proposed dredging areas, dredging units, and sampling locations are described below.

Dredging Footprint

A total of four dredging areas comprised of fifteen dredging units with a total of 24 sampling/coring locations are proposed for the sampling and testing program (Figure 1-1). The compositing scheme is summarized in Table 2-1. Each proposed dredging unit is described below and testing scheme is summarized in Table 2-2. Cores collected from the locations within each individual dredging unit will be composited into a single sample representative of that dredging unit for ocean placement testing (Table 2-1).

Area 1 is along the south portal island (Island No. 1) of the project footprint. This area includes the west side of Island No. 1 which will be dredged to expand the existing portal island. This area will require removal of approximately 155,000 cubic yards (cy) of *in situ* material. Four discrete sampling locations 1A, 1B, 1C, and 1D will be sampled in this area. Area 1 has a single dredging unit for testing (DU 1). The whole cores collected from each location will be combined into a single composite sample.

Area 2 extends from the northernmost end of the south portal island (Island No. 1) to the south boundary of the Thimble Shoal Channel. This area will require the removal of approximately 510,000 cy of *in situ* material. Area 2 is divided into five dredging units for testing:

- ***2ST***: The top interval (0 to -10 ft below the sediment surface) from the southern portion of Area 2 is comprised of discrete sampling locations 2A and 2B. This dredging unit has a total of 54,000 cy of dredged material.

- ***2MT***: The top interval (0 to -10 ft below the sediment surface) from the middle portion of Area 2 is comprised of discrete sampling locations 2C and 2D. This dredging unit has a total of approximately 67,000 cy of dredged material.

- ***2NT***: The top interval (0 to -10 ft below the sediment surface) from the northern portion of Area 2 is comprised of discrete sampling locations 2E, 2F, and 2G. This dredging unit has a total of approximately 63,000 cy of dredged material.

- ***2SB***: The bottom interval (from -10 ft below the sediment surface to the project depth) from the southern portion of Area 2 is comprised of discrete sampling locations 2A, 2B, 2C, and 2D. This dredging unit has a total of approximately 160,000 cy of dredged material.

- ***2NB***: The bottom interval (from -10 ft below the sediment surface to the project depth) from the northern portion of Area 2 is comprised of discrete sampling locations 2E, 2F, and 2G. This dredging unit has a total of approximately 166,000 cy of dredged material.

Area 3 represents the area extending across the Thimble Shoal Channel. This area will require the removal of approximately 520,000 cy of *in situ* material underlying the channel. Area 3 is divided into four dredging units for testing:

- ***3ST***: The top interval (0 to -10 ft below the sediment surface) from the southern portion of Area 3 is comprised of discrete sampling locations 3A, 3B, and 3C. This dredging unit has a total of approximately 71,000 cy of dredged material.

- ***3NT***: The top interval (0 to -10 ft below the sediment surface) from the northern portion of Area 3 is comprised of discrete sampling locations 3D, 3E, and 3F. This dredging unit has a total of approximately 69,000 cy of dredged material.

- ***3SB***: The bottom interval (from -10 ft below the sediment surface to the project depth) from the southern portion of Area 3 is comprised of discrete sampling locations 3A, 3B, and 3C. This dredging unit has a total of approximately 195,000 cy of dredged material.

- ***3NB***: The bottom interval (from -10 ft below the sediment surface to the project depth) from the northern portion of Area 3 is comprised of discrete sampling locations 3D, 3E, and 3F. This dredging unit has a total of approximately 185,000 cy of dredged material.

Area 4 extends from the northern boundary of the Thimble Shoal Channel to the northern portal island (Island No. 2). This area will require the removal of approximately 547,000 cy of *in situ* material. Area 4 is divided into five dredging units for testing:

- ***4ST***: The top interval (0 to -20 ft below the sediment surface) from the southern portion of Area 4 is comprised of discrete sampling locations 4A and 4B. This dredging unit has a total of approximately 96,000 cy of dredged material.

- ***4MT***: The top interval (0 to -20 ft below the sediment surface) from the middle portion of Area 4 is comprised of discrete sampling locations 4C, 4D, and 4E. This dredging unit has a total of approximately 95,000 cy of dredged material.

- ***4NT***: The top interval (0 to -20 ft below the sediment surface) from the northern portion of Area 4 is comprised of discrete sampling locations 4F and 4G. This dredging unit has a total of approximately 104,000 cy of dredged material.

- ***4SB***: The bottom interval (from -20 ft below the sediment surface to the project depth) from the southern portion of Area 4 is comprised of discrete sampling locations 4A, 4B, and 4C. This dredging unit has a total of approximately 126,000 cy of dredged material.

- ***4NB***: The bottom interval (from -20 ft below the sediment surface to the project depth) from the northern portion of Area 4 is comprised of discrete sampling locations 4D, 4E, 4F, and 4G. This dredging unit has a total of approximately 125,000 cy of dredged material.

The volume of material proposed from dredging unit in each area and the proposed ocean placement testing scheme is summarized in the following table:

Dredging Area	Approximate Volume of *in situ* Dredged Material (cy)	Number of Composite Samples Proposed for Ocean Placement Testing
Area 1	150,000	1
Area 2 – Top	184,000	3
Area 2 – Bottom	326,000	2
Area 3 – Top	140,000	2
Area 3 – Bottom	380,000	2
Area 4 – Top	296,000	3
Area 4 – Bottom	251,000	2
TOTAL	**1,731,000**	**15**

Sediment cores will be collected from a total of 24 sampling locations within the footprint of the Parallel Thimble Shoal Tunnel Project area and three locations at the Willoughby Bank reference site (Figures 1-1 and 1-2, respectively). For this project, two separate reference samples from the Willoughby Bank area will be collected and tested: one representing silty-sand surface materials and one representing fine-grained sub-surface materials. One reference sample from the Atlantic Ocean reference site representing sandy surface materials will be collected and tested. Surficial sediments will also be collected from the lower Chesapeake Bay control site for use in laboratory bioassays (Figure 1-2).

Upon completion of field activities, samples will be composited and submitted to TestAmerica–Pittsburgh for bulk sediment and standard elutriate testing and to EA's Ecotoxicology Laboratory for ecotoxicological testing. Results will be used to characterize the sediments proposed for dredging and to determine the suitability of the dredged material for placement at the NODS.

2.1 PROJECT OBJECTIVES

The general objectives of the project include:

- Collection of sediment cores from each proposed location within the Thimble Shoal Tunnel footprint to depths between -29 and -120 ft MLLW;
- Creation of composite sediment samples from cores collected from multiple locations within each dredging unit to create representative samples of the material to be dredged;
- Collection of surficial sediment and sediment cores from four locations at the Willoughby Bank reference site to depths of -20 ft MLLW;
- Creation of two composite samples from the Willoughby reference site—one sample comprised of the silty-sand surface material and one sample comprised of the subsurface fine-grained material—for physical and chemical testing;

- Collection of sandy surficial sediment from the Atlantic Ocean reference site for physical and chemical testing;

- Collection of surficial sediment samples from the lower Chesapeake Bay control site;

- Collection of site water (from within the project footprint) for analytical testing and elutriate preparation, and collection of receiving water from the ocean placement site for analytical testing;

- Analytical testing of bulk sediment, site water, receiving water, and standard elutriates;

- Ecotoxicological testing of sediment and elutriates—water column bioassays, whole sediment bioassays, and bioaccumulation studies;

- Analytical testing of aquatic organism tissue (as required based on the results of bulk sediment testing);

- STFATE modeling of ocean placement at the NODS; and

- Analysis of chemical and biological data for the Parallel Thimble Shoal Tunnel footprint with respect to ocean placement criteria, and to document compliance with Section 103 of the MPRSA.

2.2 SAMPLE COLLECTION

Samples will be collected from specified locations within each of the designated dredging units. Northing and easting coordinates for the Parallel Thimble Shoal Tunnel Project are provided in Table 1-1 of the FSP (Attachment I). Sampling locations will be located in the field using a differential global positioning system (DGPS). Tide corrections for surface elevations will be based off real-time data from the NOAA station (ID 8638863) located on Island No. 1 of the Chesapeake Bay Bridge Tunnel.

2.2.1 Sediment Cores – Dredging Footprint and Willoughby Bank Reference Site

Sediment cores for the Parallel Thimble Shoal Tunnel locations will be collected using a sonic drilling rig provided by Cascade Drilling. Sonic drilling will be conducted from a jack-up barge (lift boat) provided by Precon Marine. Sediment samples will be obtained using 3.75-inch (in.)-diameter Lexan core liner contained in the core barrel in 5-ft sections. Clean, decontaminated tubing will be inserted into the core barrel prior to each sample interval. Following collection of each 5-ft depth increment, the tubing/liner will be removed from the core barrel, capped, taped, labeled, and placed on ice.

Reference sediment will be collected from the Willoughby Bank using a sonic drill rig provided by Cascade Drilling and will be conducted from a jack-up barge provided by Precon Marine. Approximately equal volumes of sediment will be collected from each of the three target locations to -20 ft MLLW and will be used to create one composite sediment sample for

analytical and ecotoxicological testing. Because the sediment cores will be collected to create a fine-grained reference sample for testing, the top sandy material will not be included in the composite samples created for analytical and ecotoxicological testing (See Section 2.3).

Sediment samples will be obtained using 3.75-in.-diameter Lexan core liner contained in the core barrel in 5-ft sections. Clean, decontaminated tubing will be inserted into the core barrel prior to each sample interval. Following collection of each 5-ft depth increment, the tubing/liner will be removed from the core barrel, capped, taped, labeled, and placed on ice.

After completion of the coring activities, the sediment cores will be transported in a refrigerated truck (cooled to 4 degrees Celsius [ºC]) to EA Engineering, Science, and Technology (EA's) warehouse in Hunt Valley, Maryland, where they will be composited and homogenized for testing. After the cores are processed, samples will be transported to TestAmerica–Pittsburgh for bulk sediment and standard elutriate testing and to EA's Ecotoxicological Laboratory for ecotoxicological testing.

Because sediments will be collected and retained in core liners, holding times for the composite sediment samples from each location will begin when the sediment is composited, homogenized, and placed in the appropriate sample containers.

2.2.2 Grab Sampling – Reference Sediment

A surficial reference site sample representative of a sandy/fine-grained mixture will be collected at the Willoughby Bank reference site and a sandy reference site sample will be collected from the Atlantic Ocean Reference site. Sediment will be collected from either the Old Dominion University *Research Vessel (R/V) Fay Slover* or using a vessel provided by Cape Henry Launch Service. Surficial sediments from each of the Willoughby Bank coring locations and from the Atlantic Ocean reference area locations will be collected with a stainless steel Van Veen grab sampler and composited, homogenized and placed in laboratory certified, pre-cleaned containers on board the work platform using stainless steel spoons and a pre-cleaned, 55-gallon stainless steel holding container. The holding time for the reference samples will begin when the sediment is composited, homogenized, and placed in the appropriate sample containers.

2.2.3 Control Site Sediment

Additional sediment will be collected from the USEPA–designated lower Chesapeake Bay control site (Figure 1-2) for use in the amphipod whole sediment bioassays. Sediment will be collected from the Old Dominion University *R/V Fay Slover* or using a vessel provided by Cape Henry Launch service. Surficial sediments from the control site will be collected with a stainless steel Van Veen grab sampler and composited, homogenized, and placed in laboratory certified, pre-cleaned containers on board the work platform using stainless steel spoons and a pre-cleaned, 55-gallon stainless steel holding container. The holding time for the control site sample will begin when the sediment is composited, homogenized, and placed in the appropriate sample containers.

2.2.4 Site Water / Receiving Water / Equipment Blanks

Site water will be collected for standard elutriate preparation and water column bioassays. Site water / elutriate preparation water will be collected from mid-depth of the water column at one location within the footprint of the Parallel Thimble Shoal Tunnel Project using ISCO pumps. Receiving water from the ocean placement site will be collected from mid-depth of the water column from the *R/V Fay Slover* or Cape Henry Launch service vessel.

Four equipment blanks, one for the core catcher, one for the processing equipment, one for the water pump, and one for the ponar sampler, will be collected for the Parallel Thimble Shoal Tunnel Project by pouring deionized water over sampling equipment that has been decontaminated to determine the extent of contamination, if any, from the sampling equipment used as part of the project. Holding times for the site water, receiving water, and equipment blanks will begin when the samples are collected and placed into the appropriate sample containers.

2.3 SAMPLE PROCESSING

After completion of coring activities, the sediment cores will be transported in a refrigerated truck to EA's laboratory in Hunt Valley, Maryland. Cores will be processed in a designated area at EA's warehouse facility. Sediment samples submitted for analytical and ecotoxicological testing will consist of core composites representative of the depth intervals designated for each dredging unit. Sediments will be extracted from each core, composited, and homogenized in pre-cleaned, 55-gallon stainless steel holding containers. Core samples will be homogenized using stainless steel spoons and mixing rods. Sample processing equipment that comes into direct contact with the sediment will be decontaminated according to the protocols specified in the FSP (Attachment I). When compositing is completed, sub-samples of sediment will be removed for bulk sediment chemistry, standard elutriate testing, and ecotoxicological testing.

Sediment cores from each of the four target locations at the Willoughby Bank reference site will be composited from -5 to -20 ft to create one subsurface sample for analytical and ecotoxicological testing (Table 2-1). Prior to creating the subsurface composite sediment sample, sediment cores will be split lengthwise to determine the predominate grain size in each section of the core. Only sediments with a fine-grained clay matrix will be retained for the subsurface reference composite sample.

2.4 TESTING PROGRAM

Methods for analytical testing of project samples are summarized in Table 2-2. The analytical and ecotoxicological components of the project will follow guidance described in the following documents:

- USEPA/USACE. 1998 (EPA-823-B-98-004). *Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S. – Testing Manual: Inland Testing Manual*.

- USEPA/USACE. 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual* (commonly called "The Green Book").

- USEPA/USACE. 1995 (EPA-823-B-95-001). *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations: Chemical Evaluations.*

- USEPA Region 3. 2000. M*id-Atlantic Regional Implementation Manual: Dredged Material Evaluation for Norfolk and Dam Neck Ocean Disposal Sites.*

- USEPA. 2001. (EPA-823-B-01-002). *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual*.

The testing program will include the following tasks:

- Chemical analysis of bulk sediment and standard elutriates created from sediment composites from each dredging unit;

- Chemical analysis of surface and subsurface sediment samples from the Willoughby Bank reference site;

- Chemical analysis of surface sediment samples from the Atlantic Ocean reference site;

- Chemical analysis of elutriate preparation water from the project footprint and receiving water from the ocean placement site;

- Water column bioassays with *Americamysis bahia* (opossum shrimp), *Menidia menidia* (silverside), and *Mytilus galloprovincialis* (blue mussel);

- Whole sediment bioassays with *Leptocheirus plumulosus* (marine/estuarine amphipod) and *Ampelisca abdita* (marine amphipod);

- 28-day whole sediment bioaccumulation studies with *Nereis virens* (sand worm) and *Macoma nasuta* (blunt-nose clam); and

- Chemical analysis of worm and clam tissue for total lipids, moisture content, metals, and potential organic contaminants of concern (based on results of bulk sediment chemistry and consultation with USACE-Norfolk District and USEPA Region 3).

2.4.1 Analytical Testing of Bulk Sediment

For the Parallel Thimble Shoal Tunnel Project, bulk sediment from each location will be tested for physical and chemical composition. Physical composition of the sediment will be described by grain size, specific gravity, Atterberg limits, and total solids determination. Chemical testing of the bulk sediment will include PAHs, SVOCs, metals (including mercury), PCB congeners, chlorinated pesticides, organophosphorus pesticides, dioxin and furan congeners, tributyltin, cyanide, ammonia, total sulfides, nitrate + nitrite, TKN, total phosphorus, TOC, and AVS / SEM. Analytical methods, target analytes, holding times, reporting limits, and quality assurance/quality

control (QA/QC) protocols are described and addressed in the Analytical-QAPP (Attachment II). Analytical testing of the bulk sediment will be conducted by TestAmerica Laboratories (TestAmerica–Pittsburgh) located in Pittsburgh, Pennsylvania.

2.4.2 Analytical Testing of Site Water, Receiving Water, and Standard Elutriates

For the Parallel Thimble Shoal Tunnel, standard elutriates, which simulate release of metals and organic constituents in the water column during open water placement of material, will be prepared for each of the dredging unit composites. Chemical testing of the site water (elutriate preparation water), receiving water, and standard elutriates will include SVOCs, PAHs, metals (including mercury), PCB congeners, organophosphorus pesticides, organochlorine pesticides, dioxin and furan congeners, tributyltin, cyanide, ammonia, total sulfides, nitrate + nitrite, TKN, total phosphorus, and TOC. Analytical methods, target analytes, holding times, reporting limits, and laboratory QA/QC protocols are described and addressed in the Analytical-QAPP (Attachment II). Analytical testing of the site water, receiving water, and standard elutriates will be conducted by TestAmerica–Pittsburgh located in Pittsburgh, Pennsylvania.

2.4.3 Ecotoxicological Testing

The ecotoxicological testing program will include water column bioassays, whole sediment bioassays, and bioaccumulation studies for composite samples from each of the dredging units in the Parallel Thimble Shoal Tunnel Project footprint. Detailed information regarding test preparation and protocols is described and addressed in the Ecotoxicology Quality Assurance Project Plan (Ecotox-QAPP) (Attachment III).

If ammonia is elevated in the elutriates, two sets of water column bioassays will be conducted (side-by-side) for *M. galloprovincialis*: one test with an elutriate stripped of ammonia (reduced to less than 1 milligram per liter (mg/L) unionized ammonia) prior to test initiation and one test with untreated elutriate. These side-by-side tests will allow for identification of ammonia as the primary toxicant as opposed to other organic or inorganic contaminants.

In previous testing programs, water column toxicity tests conducted on elutriates prepared with sediment samples from similar project locations were very sensitive. Therefore, an additional 1 percent dilution will be added to the dilution series, and will be used to assess the water column toxicity at low concentrations. The goal of this additional dilution is to increase the opportunity of calculating a Median Lethal Concentration/Median Effective Concentration (LC50/EC50).

For the whole sediment bioassays, interstitial ammonia will be measured in the sediment prior to initiation of the tests to determine if the sediments will require ammonia purging prior to test initiation. If necessary, sediments will be purged until the ammonia concentrations are less than 20 mg/L at test initiation.

2.4.4 Analytical Testing of Aquatic Organism Tissue

Organism tissue from 28-day bioaccumulation testing will be submitted for analysis at the conclusion of the exposure period. Target analytes for tissue testing will be based on

concentrations of metals and organics in the bulk sediments and consultation with USEPA Region 3. Tissue analysis information is provided in the Analytical-QAPP (Attachment II).

2.5 DATA ANALYSIS

Data analysis will include the following tasks:

- Chemical concentrations in bulk sediment will be compared to reference site concentrations and to sediment quality guidelines;

- Chemical concentrations in standard elutriate samples will be compared to USEPA saltwater acute Water Quality Criteria (WQC) for aquatic life;

- For the water column bioassays, LC50 and EC50 values will be calculated for survival and effect data, respectively. In addition, results will be statistically analyzed to determine if organism survival in the Parallel Thimble Shoal Tunnel water column bioassays is significantly lower than organism survival in the laboratory control samples;

- STFATE modeling will be conducted for the Parallel Thimble Shoal Tunnel elutriate data to determine if the sediments meet the LPC for water quality criteria and water column toxicity;

- For the whole-sediment bioassays, survival data will be statistically compared to the survival in the reference sediment to determine if survival in the Parallel Thimble Shoal Tunnel sediment is significantly lower than survival in the reference sediment;

- For the 28-day bioaccumulation tests, survival in the Parallel Thimble Shoal Tunnel sediments will be statistically compared to survival in the reference sediment to determine if survival was significantly lower than the reference sediment;

- Concentrations of metals and organics (if analyzed) in the worm and clam tissue will be statistically compared against United States Food and Drug Administration (USFDA) Action/Guidance/Tolerance Levels to determine if analyte concentrations in tissue are significantly higher than USFDA Action/Guidance/Tolerance Levels;

- Chemical concentrations in organisms exposed to Parallel Thimble Shoal Tunnel sediments will be statistically compared to chemical concentrations in organisms exposed to the reference sediment to determine if uptake of contaminants was significantly higher in organisms exposed to the Parallel Thimble Shoal Tunnel sediments; and

- Concentrations of metals and organics (if analyzed) in the worm and clam tissue that statistically exceed reference concentrations will be compared to background concentrations for organisms from the South Atlantic Bight (USEPA/USACE 2008).

2.6 REPORT PERPARATION AND SUBMITTAL

Technical Memorandums will be prepared for each completed phase of the ocean placement sampling and testing program. These technical memoranda will be compiled into a comprehensive report following completion of the last technical memorandum. The following technical memoranda will be prepared:

- Field Sampling and Sample Processing
- Tier II Sediment and Elutriate Chemical Analysis
- Tier III Water Column Bioassays
- Tier III Whole Sediment Bioassays
- Tier III Bioaccumulation Exposures
- Tier III Bioaccumulation Tissue Testing.

If the sediment from the Parallel Thimble Shoal Tunnel dredging units meets the requirements of ocean placement as per CFR 40 Part 227, a separate Section 103 evaluation document will be prepared separately and included as an appendix to the comprehensive compilation report.

TABLE 2-1. SAMPLE COMPOSITING SCHEME FOR OCEAN PLACEMENT TESTING

Dredging Unit (DU)	Core Section	Approximate *in situ* volume (cy) [a]	Compositing Scheme	Sediment Sample IDs	Standard Elutriate Sample IDs	Description
1	Whole Core	154,000	1A+1B+1C+1D	TS-1-SED	TS-1-SET	Composite of 0-10 ft below sediment surface from four locations
2ST	Top	54,000	2A+2B	TS-2ST-SED	TS-2ST-SET	Composite of 0-10 ft below sediment surface from two locations
2SB	Bottom	160,000	2A+2B+2C+2D	TS-2SB-SED	TS-2SB-SET	Composite of 10 ft below sediment surface to project depth [b] from four locations
2MT	Top	67,000	2C+2D	TS-2MT-SED	TS-2MT-SET	Composite of 0-10 ft below sediment surface from two locations
2NT	Top	63,000	2E+2F+2G	TS-2NT-SED	TS-2NT-SET	Composite of 0-10 ft below sediment surface from three locations
2NB	Bottom	166,000	2E+2F+2G	TS-2NB-SED	TS-2NB-SET	Composite of 10 ft below sediment surface to project depth [b] from three locations
3ST	Top	71,000	3A+3B+3C	TS-3ST-SED	TS-3ST-SET	Composite of 0-10 ft below sediment surface from three locations
3SB	Bottom	195,000	3A+3B+3C	TS-3SB-SED	TS-3SB-SET	Composite of 10 ft below sediment surface to project depth [b] from three locations
3NT	Top	69,000	3D+3E+3F	TS-3NT-SED	TS-3NT-SET	Composite of 0-10 ft below sediment surface from three locations
3NB	Bottom	185,000	3D+3E+3F	TS-3NB-SED	TS-3NB-SET	Composite of 10 ft below sediment surface to project depth [b] from three locations
4ST	Top	96,000	4A+4B	TS-4ST-SED	TS-4ST-SET	Composite of 0-20 ft below sediment surface from two locations
4SB	Bottom	126,000	4A+4B+4C	TS-4SB-SED	TS-4SB-SET	Composite of 20 ft below sediment surface project depth [b] from three locations
4MT	Top	95,000	4C+4D+4E	TS-4MT-SED	TS-4MT-SET	Composite of 0-20 ft below sediment surface from three locations
4NT	Top	104,000	4F+4G	TS-4NT-SED	TS-4NT-SET	Composite of 0-20 ft below sediment surface from two locations
4NB	Bottom	125,000	4D+4E+4F+4G	TS-4NB-SED	TS-4NB-SET	Composite of 20 ft below sediment to project depth [b] from four locations
Willoughby Bank Reference Cores						
WBREF	--	--	A+B+C+D	WBREF-B-SED	WBREF-B-SET	Composite of 5-20 ft below sediment surface from four locations

(a) volume includes 10-ft overdepth for all bottom dredging units except Dredging Unit 1.

(b) See Table 1-2 in the FSP for project depth for each core

TABLE 2-2. ANALYTICAL METHODS FOR OCEAN PLACEMENT TESTING

PARALLEL THIMBLE SHOAL TUNNEL PROJECT

Parameters	Method
Sediment	
Semivolatiles and PAHs [(a)]	SW846 8270C
Metals [(b)]	SW846 6020
Mercury	SW846 7471A
PCB Congeners	SW846 8082
Organochlorine Pesticides [(c)]	SW846 8081A
Organophosphorus Pesticides	SW846 8141A
Dioxins/Furans	EPA 1613B
Butyl Tins	Unger Method
Cyanide	SW846 9012A
Nitrogen, Ammonia	EPA 350.1
Sulfide	SW846 9030B/9034
Nitrogen, Nitrate + Nitrite	EPA 353.2
Total Kjedhal Nitrogen	EPA 351.2
Total Phosphorus	EPA 365.2
Total Organic Carbon by Combustion	Lloyd Kahn
AVS/SEM (Metals include Cd, Cu, Pb, Ni, Zn)	EPA Draft 1991
Total Solids	SW846
Specific Gravity	ASTM D854
Unified Soil Classification System (includes Atterberg limits and grain size)	ASTM D2487
Site Water / Receiving Water / Standard Elutriates / Equipment Blanks	
Semivolatiles and PAHs [(a)]	SW846 8270C
Metals (ICP/MS) [(b)]	SW846 6020/7471A
Mercury	SW846 7471A
Methyl Mercury	SW846 7471A
PCB Congeners	SW846 8082
Organochlorine Pesticides [(c)]	SW846 8081A
Organophosphorus Pesticides	SW846 8141A
Dioxins/Furans	EPA 1613B
Butyl Tins	Unger Method
Cyanide	SW846 9012A
Nitrogen, Ammonia	EPA 350.1
Sulfide	SW846 9030B/9034
Chemical Oxygen Demand (COD)	EPA 410.4
Biological Oxygen Demand	EPA 405.1
Nitrogen, Nitrate + Nitrite	EPA 353.2
Total Kjedhal Nitrogen	EPA 351.2
Total Phosphorus	EPA 365.2
Total Organic Carbon by Oxidation	EPA 415.1
Standard Elutriate	Inland Testing Manual (ITM), Appendix B June 1998 (EPA-823-B-98-004)
Clam and Worm Tissue [(d)]	
Metals	SW846 6020
Mercury	SW846 7471A
Percent Moisture	TestAmerica SOP
Lipids	TestAmerica SOP

(a) PAHs include both HMW and LMW constituents and Total PAHs

(b) Metals list includes: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Hg, Ni, K, Se, Ag, Na, Th, V, Zn

(c) Chlorinated pesticides include clordane and total DDT

(d) organic constituents targeted for tissue testing will be determined based on consultation with USACE-Norfolk and USEPA Region 3 and the results of the bulk sediment analyses

Further details provided in Analytical QAPP (Attachment II)

3. PROJECT ORGANIZATION AND PERSONNEL

The Parallel Thimble Shoal Tunnel Project team is organized to provide professional expertise in each of the major components necessary for the completion of the dredged material evaluation. A project team organization chart is provided as Figure 3-1. Summaries of key EA technical staff credentials and resumes are provided in Appendix A of the SAP.

Jacobs Engineering Group is responsible for direct coordination and communications with the project owner – the CBBT District. The Field Team will consist of EA, Cascade Drilling, and Precon Marine personnel. Precon Marine will be responsible for vessel operations. Cascade Drilling personnel will be responsible for mobilization and demobilization of coring equipment; coring equipment operations; and equipment decontamination. EA personnel will provide sampling oversight, assist with labeling and recording coring, tide and local project information, site water/elutriate preparation water/receiving water collection, surface sediment collection at the reference and control sites, homogenization and compositing of samples, labeling and packing of cores and samples, transport of samples to appropriate testing laboratories, and direct coordination with analytical and ecotoxicological laboratories.

Table 3-1 provides a list of key personnel, project roles, telephone numbers, cellular numbers (if applicable), and email addresses. Additional personnel will/may assist with various tasks related to the project on an as-needed basis.

Jacobs Engineering Group

The Lead for this investigation is *Mr. James McCarty, P.E.*, of Jacobs Virginia Beach office. As project lead for this investigation, *Mr. McCarty* is responsible for the overall coordination and development of the project's plans and documents. The technical documents for this investigation include SAP and Technical Memoranda. *Mr. McCarty* is also responsible for ensuring that work and work products meet contract and schedule requirements.

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

Overall responsibility for ensuring that all technical and financial objectives of the proposed project are met will be assumed by the EA Project Manager, *Ms. Peggy Derrick***.** *Ms. Derrick* is an aquatic scientist with 23 years of experience conducting and managing aquatic investigations and dredged material evaluations. She is skilled in planning, scheduling, costing, and implementing dredged material testing programs. She will be responsible for testing program coordination with USEPA and USACE, reviewing the SAP, coordinating the analytical testing, and reviewing the data report. She has extensive experience writing and reviewing Project Work Plans, SAPs, QAPPs, and Site Safety and Health Plans for dredged material testing programs for federal, industrial, and private sector clients. She is familiar with physical, chemical, and biological testing requirements for dredged material placement in inland and open water, and has coordinated testing programs for the USACE Norfolk, Mobile, Baltimore, Savannah, Galveston, and New York Districts. She served as the project manager for the Midtown Tunnel and for the Craney Island Eastward Expansion (CIEE) ocean placement evaluations.

Dr. Jeffrey Boltz, PhD serves as the Principal-in-Charge and EA's Chief Scientist and will administer corporate oversight and review work plans for this project. He has more than 20 years of experience and management of multidisciplinary projects. He will be responsible for assessing

EA's performance of the project and instituting any necessary program changes to ensure project success and client satisfaction.

Dr. Frank Barranco, PhD, PG, PE will administer QA/QC for this project. He will conduct quarterly reviews of the project in relation to EA standards operating procedures for field, laboratory, data management, and reporting. He has participated in project reviews and provided Senior Technical Review for numerous sediment-related projects.

Mr. Peter Garger will serve as the project Health and Safety Manager. He is a Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP) with expertise in health and safety audits involving chemical, physical, and biological agents. He will be responsible for review of the Health and Safety Plan for the field activities.

Each of the technical components of the project (project work plan development, sampling, analytical testing, and report preparation) will be coordinated by professionals in the field. *Mr. John Morris* will serve as the EA Field Lead and *Ms. Morgan Gelinas* and *Ms. Courtney Pacelli* will be responsible for development of the SAP, data analysis, and report preparation. *Ms. Carrie Gamber*, TestAmerica Laboratories, will serve as the Analytical Project Manager. *Mr. Michael Chanov* will serve as the Ecotoxicological Project Manager. Task Managers will oversee the logistics and technical aspects for each task under the direction of *Ms. Derrick*.

Mr. Morris will be responsible for overseeing the collection of the sediment cores with respect to their sample integrity. He is an oceanographer with extensive experience conducting sediment investigations. He has participated in numerous sediment investigations for industrial and private sector clients as well as sediment sampling programs for the USACE Districts in Norfolk, Mobile, Baltimore, and New Jersey. *Mr. Morris* has conducted numerous studies involving sediment grab and vibracore sampling to analyze chemical and biological constituents; maintenance and operation of various oceanographic field equipment and instrumentation, DGPS, and boat and marine vessel equipment. *Mr. Morris* will provide daily field progress updates to *Ms. Derrick* throughout the sample collection process.

Ms. Morgan Gelinas and *Ms. Courtney Pacelli* will lead the development of the Project SAP, data analysis, and report preparation. Their responsibilities for the Parallel Thimble Shoal Tunnel Project will also include: coordination with laboratory personnel; planning and coordination of field efforts; sample coordination and management; core processing; data analysis; and writing technical reports. *Ms. Gelinas* is a marine geologist with experience providing field support, core logging, sample management/processing, laboratory coordination, data analysis and report preparation. *Ms. Pacelli* is an environmental scientist with experience providing field support, laboratory coordination, data analysis and report preparation.

Test America

TestAmerica-Pittsburgh will provide EA with analytical and physical chemistry support for the project and will be responsible for the preparation of the project-specific analytical QAPP in accordance with USEPA Region 3 requirements, the Inland Testing Manual (ITM) (USEPA/USACE 1998), and Ocean Testing Manual (OTM) (USEPA/USACE 1991). *Ms. Carrie Gamber* will serve as the Analytical Laboratory Project Manager. She manages analytical

laboratory projects for a variety of port, USACE, private sector, and utility clients. She is experienced with sample management, laboratory subcontracting activities, and USEPA specified guidance. She will be responsible for tracking the project samples through the analytical testing process, and she will provide progress reports on bulk sediment, elutriate, and site water analyses to *Ms. Derrick.*

The majority of analytical testing will be conducted at TestAmerica–Pittsburgh, with support from Burlington, North Canton, and Knoxville laboratories. The TestAmerica–Pittsburgh laboratory provides analytical support for sediment programs nationwide and provided analytical support to EA for previous dredged material projects.

TestAmerica is certified by all 50 states and is also USACE-certified. TestAmerica has provided chemistry as well as physical testing support for sediment projects nationwide including sites in New England, the Mid-Atlantic, Southeast, Gulf Coast, Great Lakes, Puget Sound, Willamette River, and San Francisco Bay. USACE District clients have included: New England, New York, Philadelphia, Baltimore, Norfolk, Savannah, New Orleans, Tulsa, Buffalo, Kansas City, and Detroit.

TestAmerica will provide the full spectrum of analytical chemistry services required for the ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) including: preparation of standard and modified/effluent elutriates; and analysis of sediment, site water, elutriate, and biological tissue for organic, inorganic, and nutrient compounds. TestAmerica routinely meets the target detection limit requirements and data quality objectives of the USEPA Region 3 Regional Implementation Manual (2000), the ITM (USEPA/USACE 1998), and the OTM (USEPA/USACE 1991).

Cascade Drilling

Cascade Drilling will conduct the sonic drilling to collect the sediment cores for the Parallel Thimble Shoal Tunnel Project. Cascade Drilling offers effective drilling solutions and a wide variety of drilling applications and expertise throughout the United States and worldwide. Their drilling services include reverse circulation, sonic, percussive, and underground and surface coring. Cascade Drilling (formerly a division of Boart Longyear) successfully and cost-effectively performed the sonic drilling operations for the Craney Island Eastward Expansion (CIEE) and the Midtown Tunnel dredged material testing programs.

Precon Marine

Precon Marine, Inc. will provide a jack-up barge to serve as the drilling platform and will provide crew boat service from Little Creek to the offshore project site. *Precon Marine* is a marine contractor that specializes in diverse heavy marine and waterfront construction. *Precon Marine* owns a diverse equipment inventory with an experienced marine workforce. *Precon's* main yard is located in Portsmouth, VA, and they also operate a satellite office with yard and mooring facility in Little Creek Harbor.

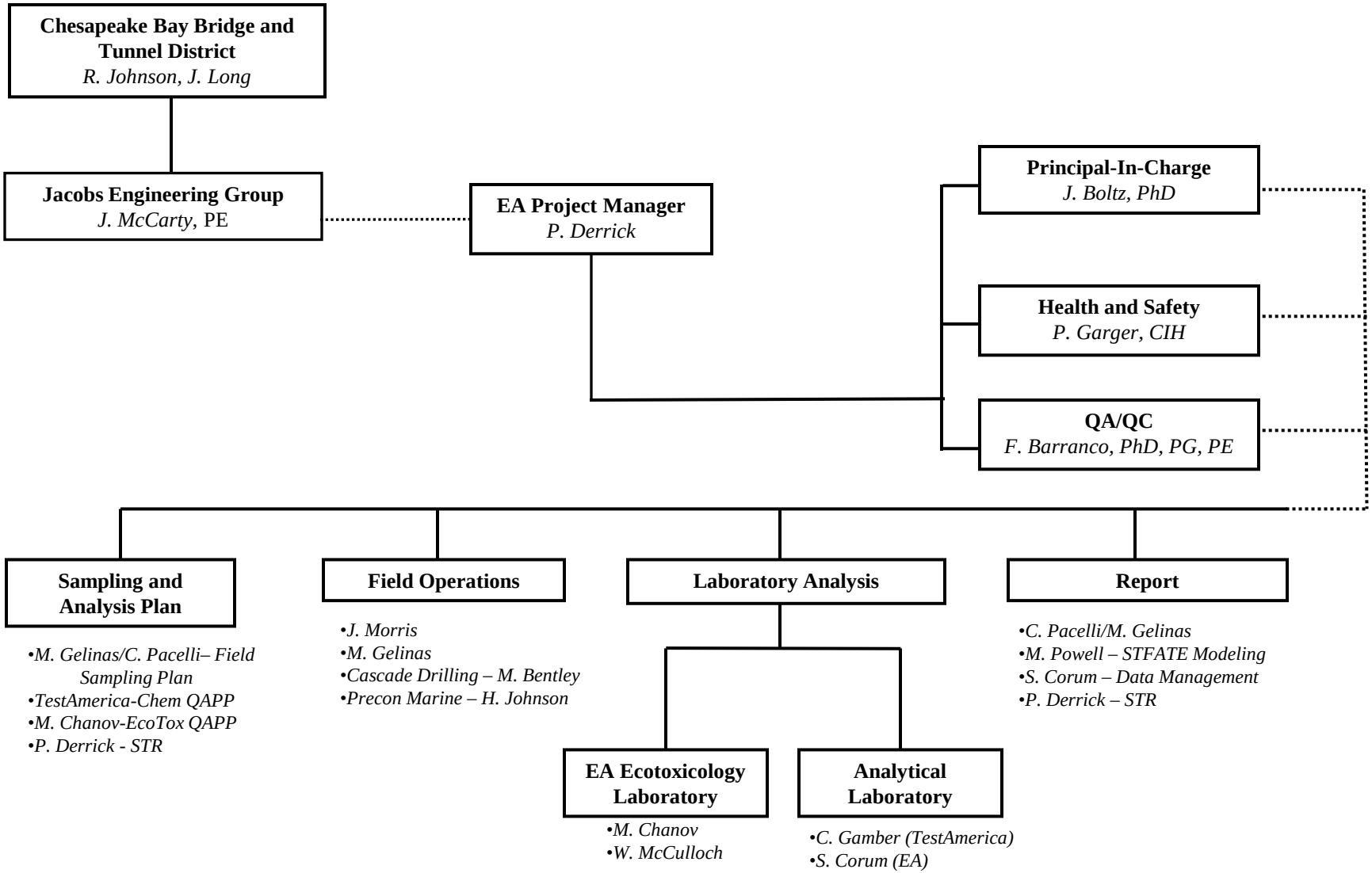


FIGURE 3-1. PROJECT TEAM ORGANIZATION

Evaluation of Dredged Material, Parallel Thimble Shoal Tunnel Project, Ocean Placement Testing Program

TABLE 3-1. PROJECT TEAM CONTACTS

Technical Expert	Project Role	Affiliation	Telephone Number	Mobile Number	Fax Number	E-mail Address
Frank Barranco, PhD, PG, PE	QA/QC Officer	EA	(410) 329-5137	(410) 286-8974	(410) 771-1625	fbarranco@eaest.com
Mike Bentley	Operations Manager - Sonic Drilling	Cascade Drilling	(740) 373-3970	(740) 350-8508	(740) 373-3877	mbentley@cascadedrilling.com
Jeffrey Boltz, PhD	Principal-In-Charge	EA	(410) 329-5179	(410) 804-9230	(410) 771-1625	jboltz@eaest.com
Michael Chanov	EA Ecotoxicology - Project Manager	EA	(410) 584-7000	--	--	mchanov@eaest.com
Andrew Chapman	Geotechnical Lead	Jacobs Engineering Group	(314) 335-5031	(314) 698-9440	(314) 335-5141	andrew.chapman@jacobs.com
Sanita Corum	Data Manager	EA	(410) 584-7000	(443) 243-8601	(410) 771-1625	scorum@eaest.com
Peggy Derrick	EA Project Manager	EA	(410) 329-5126	(717) 578-5323	(410) 771-1625	pderrick@eaest.com
Carrie Gamber	Analytical Laboratory - Project Manager	TestAmerica Laboratories	(412) 963-2428	--	(412) 963-2468	carrie.gamber@testamericainc.com
Peter Garger, CIH, CSP	Health and Safety Officer	EA	(410) 527-2425	(410) 790-6338	(410)771-1625	pgarger@eaest.com
Morgan Gelinas	Environmental Scientist	EA	(410) 584-7000	(860) 287-0745	(410) 771-1625	mgelinas@eaest.com
Bob Hunt	Marine Transportation Specialist	US Navy	(757) 445-8371	--	--	robert.p.hunt@navy.mil
George Janek	USACE - Norfolk District - Regulatory	USACE - Norfolk District	(757) 201-7135	--	--	george.a.janek@usace.army.mil
Herb Johnson	Marine Operation Managaer	Precon Marine	(757) 545-4400 x305	(757) 449-3196	(757) 545-2832	hcjohnson@preconmarine.com
Robert Johnson	Project Director	CBBT	(757) 331-8974	--	(410) 331-1583	rjohnson@CBBT.com
James Long, PE	Project Engineer	CBBT	(757) 331-2960	(757) 350-1575	(757) 331-4565	jlong@CBBT.com
James McCarty, PE	Regional Construction Manager	Jacobs Engineering Group	(757) 490-6140	(757) 576-3772	(757) 490-6173	james.mccarty@jacobs.com
Wayne McCulloch	EA Ecotoxicology Laboratory Manager	EA	(410) 584-7000	--	--	wmcculloch@eaest.com
John Morris	Field Operations Leader	EA	(410) 329-5164	(401) 439-1031	(410) 771-1625	johnmorris@eaest.com
Courtney Pacelli	Environmental Scientist	EA	(410) 584-7000	(410) 984-6083	(410) 771-1625	cpacelli@eaest.com
Mike Powell	STFATE Modeler / Statistician	EA	(410) 584-7000	(443) 629-3173	(410) 771-1625	mpowell@eaest.com
Robert Pruhs	USACE - Norfolk District - Operations	USACE - Norfolk District	(757) 201-7130	(757) 477-9979	--	robert.s.pruhs@usace.army.mil
Renee Searfoss	Ocean and Dredged Material Disposal Lead	USEPA Region III	(215) 814-2137	(856) 371-6215	--	searfoss.renee@epa.gov

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EA Engineering, Science, and Technology, Inc. 2011. *Final Data Compilation Report – Norfolk ODMDS, Midtown Tunnel/Downtown Tunnel/MLK Extension Project*. Prepared for PB Americas, Inc. August..

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———. 2015b. *Evaluation of Dredged Material Norfolk Harbor Approach Channels: Atlantic Ocean Channel*. Prepared for USACE-Norfolk District. February.

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———. 2014c. *Evaluation of Dredged Material Langley-DLA Fuel Pier Replacement Joint Base Langley/Ft. Eustis, Back River, Hampton, Virginia*. Prepared for USACE-Norfolk District. June.

———. 2014d. *Evaluation of Dredged Material Skiffe's Creek Channel, Fort Eustis, Newport News, Virginia*. Prepared for USACE-Norfolk District. June.

Fugro Consultants. 2014. *Geotechnical Site Characterization, Chesapeake Bay Bridge and Tunnel, New Thimble Shoal Tunnel Project, Chesapeake Bay, Offshore Virginia*. Prepared for: Jacobs Engineering Group. August. Draft.

Jacobs. 2011. *Parallel Thimble Shoal Tunnel for the Lucius J. Kellam Bridge-Tunnel, Conceptrual Study and Conceptual Construction Cost Estimate.* Prepared for: Chesapeake Bay Bridge and Tunnel District. February.

United States Army Corps of Engineers (USACE). 2001. *Engineering and Design Manual – Requirements for the Preparation of Sampling and Analysis Plans.* USACE Engineer Manual (EM) 200-1-3. 01 February 2001.

United States Environmental Protection Agency (USEPA). 2001. *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual*. EPA-823-B-01-002. October.

United States Environmental Protection Agency (USEPA) Region 3. 1992. *Final Environmental Impact Statement for the Designation of an Ocean Dredged Material Disposal Site Located Offshore, Norfolk, Virginia.* November.

———. 2000. *Mid-Atlantic Regional Implementation Manual: Dredged Material Evaluation for Norfolk and Dam Neck Ocean Disposal Sites.*

United States Environmental Protection Agency (USEPA) / United States Army Corps of Engineers (USACE). 1991. *Evaluation of Dredged Material Proposal for Ocean Disposal, Testing Manual* (commonly called "The Green Book").

———. 1995. *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations: Chemical Evaluations.* EPA-823-B-95-001. EPA Office of Water. April.

———. 1998. *Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S. – Testing Manual: Inland Testing Manual.* EPA-823-B-98-004. February.

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APPENDIX A:

EA RESUMES

Frank T. Barranco, Ph.D., P.E., P.G.

Director of Quality Control/Technical Chief Geologist

Dr. Barranco is a 23-year veteran of the consulting business, including more than 18 years at EA. He plays a central role in the development and implementation of quality assurance (QA)/quality control (QC) systems at EA. As the Director of QC for EA's Quality Management Program, Dr. Barranco authors and implements company-wide QA and QC policies, guidance documents, and standard operating procedures. In this role, Dr. Barranco is heavily involved in the quality monitoring associated with QC systems across EA, including the Senior Technical Review Program, Project and Program Reviews, and oversight of the Technical Chiefs. Dr. Barranco participates in hundreds of Project and Program Reviews and quality audits across the company on a quarterly basis, using these sessions as a project "check up," to mentor staff, to support issue identification (and resolution), and ensure quality work products are delivered to our clients. Quarterly reviews are typically conducted with a Technical Chief and Project Manager present to discuss the influence of scope, schedule, and budget on quality. In addition to this company-wide role, Dr. Barranco serves as QA Officer on individual Programs and large Indefinite Delivery/Indefinite Quantity contracts across EA. In this role, Dr. Barranco serves as the interface between the project team and the EA Principal-in-Charge, reporting independently on quality performance. Dr. Barranco also serves as Technical Chief Geologist, with roles including: (1) preparing quality-related protocol relating to geologic aspects of EA work, (2) participation in hydrogeology-related Project and Program Reviews, (3) assisting in proposal development and client service, and (4) providing technology transfer to geologic staff, and tracking geologic licensure requirements.

Qualifications

Education

Ph.D.; Colorado School of Mines; Environmental Science and Engineering; 1998
M.S.; University of Texas Arlington; Geology; 1988
B.S.; Duke University; Geology; 1984

Registration/Certifications

Registered Professional Engineer—MD (No. 43120)
Registered Professional Geologist—TN (No. 005603)

Specialized Training and Experience

OSHA Hazardous Waste Operations and Emergency Response Site Worker
OSHA 40-Hour Hazardous Waste Operations Training and 8-Hour Annual Refresher
CPR and First Aid Training
ASTM E50 Committee Member (Green and Sustainable Remediation)
Sustainable Remediation Forum Member
Scientific Advisory Board, AEHS Foundation Annual Conference
Society of Military Engineers Student Mentoring Program
Johns Hopkins University Instructor for Environmental Program for Professionals

Experience

Years with EA: 18 Total Years: 24

Professional Experience

***Corporate Quality Assurance and Quality Control*—**Responsible for the overall QC Program at EA, including but not limited to maintaining and updating the Corporate Quality Management Plan and related documents (e.g., Program-specific Quality Management Plans, Standard Operating Procedures, and other technical-related documents); managing the Technical Chiefs in engineering, science, geology, and information technology; and overseeing and leading the development of standard operating procedures, QC procedures, and related quality materials. In conjunction with this role, he serves as the Programmatic QA/QC Officer for major programs Dr. Barranco participates in the majority of project and program reviews for hundreds of reviews with project managers and staff on a quarterly basis.

***Programmatic Quality Assurance Officer*—**In charge of Programmatic QA and QC on several major federal contracts. Responsibilities include development of various programmatic quality-related work plans, monitoring of work quality (performed by EA and subcontractors) on all project tasks and program-related activities, implementing corrective actions and lessons learned when issues arise, and upward reporting of the performance on work quality to the Program Manager and Principal-in-Charge.

Dr. Barranco serves as the QA Manager or Deputy QA Manager on EA contracts with the U.S. Environmental Protection Agency (EPA) Region 3, EPA Region 6, U.S. Air Force Civil Engineer Center, as well as for state, municipal, and commercial programs.

Analytical Quality Assurance/Quality Control Activities—Development of QA Project Plans to specify project, analytical, or construction requirements. Additionally, responsibilities include monitoring analytical subcontractor quality, including documentation of the subcontractor's quality management program. Multiple QA Project Plans developed for EPA Region 3, U.S. Army Corps of Engineers (Baltimore, Kansas City, and New England districts), and Maryland Department of Transportation utilizing G-5 guidance for Superfund fund-led, Potentially Responsible Party-led, and State-led sites throughout Mid-Atlantic and Northeast. Provided management and oversight of independent third party data validation for a range of projects with strict data quality requirements. Provide quality training and record documentation for EA personnel regarding Professional Geologist's certifications and requirements.

Selected Peer-Review Publications

Barranco, F.T., S.L. Saalfield, F.J. Tenbus, and B.P. Shedd. 2013. Subsurface Fate and Transport of Chemicals, Chapter in Encyclopedia of Sustainability Science and Technology, editor: R Meyers, Springer Publishing.

Dai, D., F.T. Barranco, and T.H. Illangasekare. 2002. *Partitioning and Interfacial Tracers for Differentiating NAPL Entrapment Configuration: Column-Scale Investigation*. Environ. Science & Tech., 35(24). pp. 4894-4899.

Barranco, F.T. and H.E. Dawson. 1999. *Influence of Aqueous pH on the Interfacial Properties of Coal Tar Dense Non-Aqueous Phase Liquid*. Environ. Science & Tech., 33(10). pp. 1598-1603.

Barranco, F.T., H.E. Dawson, J.M. Christener, and B.D. Honeyman. 1997. *Influence of Aqueous pH and Ionic Strength on the Wettability of Quartz in the Presence of Dense Non-Aqueous Phase Liquids.* Environ. Science & Tech., 31(3). pp. 676-681.

Peck, T.J., J.E. Lige, I.D. MacFarlane, and F.T. Barranco. 1996. *Characterizing In Situ Dense Non-Aqueous Phase Liquid Distribution, Mobility State, and Dissolution" in Non-Aqueous Phase Liquids in Subsurface Environments: Assessment and Remediation* (L.N. Reddi, ed.). American Society of Chemical Engineers, New York, New York. pp. 103-114.

Barranco, F.T., J.L. Kocornik, I.D. MacFarlane, N.L. Durant, and L.P. Wilson. 1994. *Subsurface Sampling Techniques Used for a Microbiological Investigation" in Bioremediation of Chlorinated and Polycyclic Aromatic Hydrocarbons*. R.E. Hinchee, A. Leeson, L. Semprini, and S.K. Ong, (eds.). Lewis Publishers, Boca Raton, Florida. pp. 474-479.

MacFarlane, I.D., F.T. Barranco, C.W. Houlik, S.L. Pattison, and H.L. Hoffman. 1990. *Characterization of Coal Tar Occurrence at the Baltimore Gas and Electric Spring Gardens Facility*. Edison Electric Institute Groundwater Task Force Symposium on Technology and Policy Developments Affecting Electric Utility Groundwater Management, Washington, D.C. July.

Barranco, F.T., W.L. Balsam, and B.C. Deaton. 1989. *Quantitative Reassessment of Brick Red Lutites: Evidence from Reflectance Spectrophotometry*. Marine Geology, 72(5). pp. 890-897.

Jeffrey M. Boltz, Ph.D.
Vice President/Business Unit Director

Dr. Boltz is a Senior Aquatic Ecologist with a specialty in fisheries science and aquatic ecology and restoration. He has 30 years of experience, including 23 years of experience managing and performing environmental assessments related to water resource development projects such as hydroelectric power, fossil and nuclear generating plants, and wastewater treatment projects. In addition, Dr. Boltz leads the ecosystem restoration program at EA. As part of these projects and programs, he collaborates with other ecologists, hydrologists, water quality experts, and environmental and engineering professionals in multidisciplinary studies.

Qualifications

Education
Ph.D.; Pennsylvania State University; Ecology/Ichthyology; 1988
B.S.; Lock Haven State College; Biology/Aquatic Sciences; 1983

Registrations/Certifications
National Association of Underwater Instructors Certified Scuba Diver

Specialized Training
Essentials of Management – Wharton Business School; 2007
EA Writing Workshop; 1994
Project Management; 1993

Professional Affiliations/Appointments
Society of American Military Engineers

Experience
Years with EA: 22 Total Years: 30

Professional Experience

***Program Management*—**Has significant experience managing large multidisciplinary programs for federal, state, and local as well private clients. Programs included large single award contracts for fully funded multi-year projects to federal Indefinite Delivery/Indefinite Quantity task order contracts. Contract types have included cost plus, firm fix price, and time and materials with the contract size from $5 to $10 million.

***Ecosystem Restoration*—**Leads the ecosystem restoration practice, resulting in ecosystem restoration experience throughout the eastern half of the United States. Ecosystem restoration projects to date have included tidal and non-tidal wetland restoration, stream restoration, dam removal, lake restoration, and new habitat creation including construction of lost habitat. These projects have been conducted for both government and private clients and often involve site selection, feasibility analysis, and design.

Fish Passage—Significant experience in evaluating upstream and downstream fish passage at old mill dams as well as existing and proposed hydroelectric projects. Upstream fish passage structures have included denial fish ladders and natural step–pool (rough ramp) fish passage technologies. For six hydroelectric sites in the United States, performed downstream fish passage studies and feasibility evaluations involving multidisciplinary teams of engineers and fisheries biologists. Several of the projects involved conceptual design, hydraulic models, construction oversight, and evaluation of the completed facility. Evaluated potential fish passage alternatives, recommended design criteria, conducted agency consultation, prepared plans of study, conducted field studies, and prepared final reports.

Fisheries Science—Conducted numerous fish surveys throughout the eastern United States for utilities, state agencies, and private industry; recognized as an expert on eastern North American fishes and is co-author of a book, *Fishes of West Virginia* (1995). Several of these surveys were directed at identifying the range and population status of state-and-federally listed endangered species. Managed several large 316(b) studies for utilities in Virginia, Maryland, New York, and Wisconsin. Conducted habitat-use studies of warmwater stream fishes and the effects of flow modifications (increase and decrease) on these communities. Co-authored a paper for the U.S. Fish and Wildlife Service addressing the research needs and problems associated with habitat use in regulated warm-water streams. Conducted radiotelemetry studies of the migration paths of Atlantic salmon molts through conventional and pumped storage hydroelectric facilities. Conducted numerous temperature-preference and tolerance studies on a wide variety of fish species. Conducted numerous additional fisheries assignments related to water development projects.

Hydropower—Experienced in preparing Federal Energy Regulatory Commission (FERC) licensing documents and in negotiation of study plans with federal and state natural resource agencies. Licensing experience has included both the relicensing of existing projects and obtaining the original license for proposed projects. Has managed and conducted a wide variety of site specific environmental studies to support hydroelectric licensing including, Instream Flow Incremental Methodology and other minimum flow studies, upstream and downstream fish passage, fish entrainment and mortality, endangered fish and mussel surveys, general baseline data collection, and development of site-specific habitat suitability criteria and recreational fisheries plans.

International—Successfully completed a 20-month assignment in Alexandria, Egypt, under contract with the U.S. Agency for International Development Alexandria Wastewater Project, Phase II. As part of this assignment, provided expertise on a risk-based environmental assessment evaluating the appropriate level of wastewater treatment and effluent disposal alternatives including inland and coastal alternatives. Also provided institutional strengthening support as director of the project biology laboratory that processed a wide variety of biological samples from fresh, brackish, and marine environments. Conducted a large soil sampling program at Howard Air Force Base in Panama, as part of an environmental compliance assessment. Data were compared against U.S. Environmental Protection Agency standards for human health risk. Additional experience related to international studies include describing a new species of fish from Lake Malawi, Africa, and evaluating the effects of mining on a fishery resource in Southeast Asia.

Selected Publications and Presentations

Connelly, R.A., W.J. Rue, J.M. Boltz, and J. Slater. 2006. Wastewater Treatment Plant Effluent Effects on a Cold Water Stream Benthic Community: Is it Temperature? Presented at the North American Benthological Society. Anchorage, Alaska. June.

Rue, W.J. and J.M. Boltz. 2005. How much water do you need to leave behind? Invited presentation on instream flow methods at the Virginia Water Resources Workshop- A Workshop for Local Government Officials. Hosted by McGuire Woods, Richmond, Virginia. 20 September.

Mayhew, D., J. Boltz, P. Derrick, C. Papageorgis, D. Hinckley, A. Walker, and H. Karimi. 2003. Application of Ecological Risk Assessment to Support Habitat Restoration. Presented at the 24th Annual Meeting of SETAC, Austin, Texas. November.

Powell, M.W. S. Koser, and J. Boltz. 2002. A Stormwater Management Model for the Moores Run Watershed in the City of Baltimore. Presented at the 8th Annual Conference of the Maryland Water Monitoring Council. Linthicum, Maryland. 16 November.

Powell, M.W. J. Boltz, D. Mayhew, R. Connelly, and W. Stack. 2001. The Urban Reference Index: An Index of Biotic Integrity for Urban Watersheds. Presented at the 7th Annual Conference of the Maryland Water Monitoring Council. Linthicum, Maryland. 16 November.

Boltz, J. M., et al. 2000. Scoping Study on Sedimentation Issues at Hydroelectric Projects. Electric Power Research Institute, Palo Alto, California. TR 114008.

Rue, W.J., J.M. Boltz, J.A. Boraczek, W. Dey, L.D. Jensen, D.A. Mayhew, P.H. Muessig, and E. Perry. 1999. Catalog of Assessment Methods for Evaluating Power Plant Operations on Aquatic Communities. Final Report for the Electric Power Research Institute TR-112013. 299 pp.

Boltz, J.M. and D.A. Hinckley. 1998. Establishing baseline conditions in a highly contaminated lake in the Arab Republic of Egypt. Proceedings WEFTEC 1998. Vol. 4. pp. 85-96.

Kellog, K.A., J.R. Stauffer, Jr., E.S. van Snik, and J.M. Boltz. 1997. Interpopulation variation in darter oocyte production. J. Freshwater Ecology 12:329-337.

Michael K. Chanov II
Scientist

Mr. Chanov has over 8 years of experience in toxicology laboratories and has conducted a numerous toxicity evaluations with wastewaters, sediments, and surface waters. His responsibilities include active participation and supervision of toxicity tests, development of testing strategies, and interpretation of results. He serves as a Project Manager within EA's Ecotoxicology Group as well as Culture Facility Supervisor and Chemical Hygiene Officer for EA Ecotoxicology and Biology Laboratories. Mr. Chanov provides laboratory oversight of toxicity testing for EA's Toxicity Identification Evaluation and Toxicity Reduction Evaluation service line.

Qualifications

Education
M.S.; Virginia Tech, Blacksburg, Virginia; Biological Sciences; 2009
B.S.; Virginia Tech, Blacksburg, Virginia; Biological Sciences; 2006

Specialized Training
Project Manager Training Course; 2012
CPR and First Aid Training; 2012

Professional Affiliations/Appointments
American Water Resources Association
Society for Freshwater Science
Society of Environmental Toxicology and Chemistry

Experience
Years with EA: 5.5 Total Years: 8.5

Mr. Chanov has experience with the review and interpretation of toxicology, and chemistry lab results. He is experienced in conducting toxicology tests required for evaluating industrial and municipal wastewaters, dredge materials, sediment, soil, new chemical products, and solid waste leachate performed under strict corporate quality assurance/quality control. He is also experienced with the culture, maintenance, and testing of a large number of vertebrate, invertebrate, and plant species in evaluating freshwater, marine, estuarine, and terrestrial situations. Mr. Chanov was an integral part of designing and supervising the construction of EA's new laboratory facilities.

Professional Experience

Project Management—Managed toxicity testing programs conducted in the Ecotoxicology Laboratory, including effluent biomonitoring for industrial and municipal clients; bioassay evaluations of proposed ocean-dumped wastes; Toxicity Identification Evaluations; bioaccumulation studies; sediment toxicity testing; and soil toxicity testing using freshwater, saltwater, and terrestrial organisms.

Field Environmental Surveys—Conducted benthic macroinvertebrate sampling/identification and taxonomy. Has calculated qualitative and quantitative methods and utilized biological integrity metrics such as the VASCI. Successfully conducted in situ Asian clam chronic survival/growth rate studies, habitat assessments using U.S. Environmental Protection Agency Rapid Bioassessment Protocols in Virginia and conducted porewater (interstitial water) collection using porewater samplers (peepers, Hesslein, 1976).

Aquatic Toxicology—Performed acute and chronic toxicity tests on freshwater and marine organisms evaluating the effects of various effluents, chemicals, sediments, and dredged materials. Calibrated and maintained water quality instruments. Responsible for data analysis and water quality measurements. Performed toxicity reduction evaluations and toxicity identification evaluations on municipal and industrial wastewaters. Responsible for development of protocols for performance of toxicity testing.

Toxicity Identification and Reduction Evaluations—Performed over 70 individual toxicity identification and reduction evaluations for industrial and municipal facilities. Responsibilities include characterization and identification of the various components causing toxicity in effluent samples using fractionation procedures such as those outlined U.S. Environmental Protection Agency's *Toxicity Identification Evaluation Procedure Manuals,* as well as the interpretation and summarization of laboratory results.

Sediment Toxicity—Evaluated the acute and chronic toxicity of various sediment and dredged material samples to both fresh water and saltwater organisms. Test organisms included *Hyalella azteca*, *Chironomus tentans*, *Macoma nasuta*, *Neries virens*, *Ampelisca abdita*, and various other species.

Soil Toxicity—Evaluated the toxicity of soils using the terrestrial plants. Test organisms included *Lactuca sativa* and *Echinochloa crusgalli.* Also evaluated the acute and chronic toxicity, and bioaccumulation of soils using the redworm, *Eisenia foetida*.

Quality Control—Responsible for management of annual U.S. Environmental Protection Agency's Discharge Monitoring Report quality assurance performance evaluations. Also reviewed and evaluated procedures used in sample handling and organism culturing and acclimation, as well as laboratory techniques employed in toxicity testing, to ensure that established quality control standards are maintained. Performed revisions of the quality assurance/quality control manual, methods manual and chemical hygiene plan for Ecotoxicology Laboratory.

Organism Culturing—Responsible for the culturing of fish, invertebrates, and algae used for toxicity testing. Maintained cultures in static and flow-through systems for both fresh and salt water organisms, as well as developing and maintaining earthworm cultures. Performed reference toxicant tests for health evaluation of cultures.

Selected Publications and Presentations

Chanov, M.K., W.L. McCulloch, R.A. Connelly, and W.L. Goodfellow. 2013. Zebra Mussel (*Dreissena polymorpha*) Embryonic Testing as a Freshwater Biomonitoring Tool in the United States. SETAC, 34th Annual Meeting, Nashville, Tennessee. November.

McCulloch, W.L., M.K. Chanov, and W.L. Goodfellow. 2012. Laboratory Toxicity Testing Using Three Species to Evaluate Ion Toxicity Thresholds in Industrial Wastewaters. Presented at Major Ion Toxicity Workshop, Chicago, Illinois. 2-4 April.

Goodfellow, W.L., W.L. McCulloch, and M.K. Chanov. 2011. Case Study of Effluent Discharged in Transition Zone of Freshwater and Estuaries. SETAC, 32nd Annual Meeting, Boston, Massachusetts. November.

Chanov, M.K., V.A. Sohn, and W.L. McCulloch. 2010. Preliminary Results of Food Variability with *Hyalella azteca* in 42 Day Water Only Exposures. Platform Presentation – SETAC North America 31st Annual Meeting. Portland, Oregon. 9 November.

Chanov, M.K., W.L. Goodfellow, and W.L. McCulloch. 2010. Toxicant Identification Evaluations as an Effective Tool for Managing Effluents that are only Sublethally Toxic. Poster Presentation – SETAC North America 31st Annual Meeting. Portland, Oregon. 10 November.

Chanov, M.K., D.S. Cherry, and C.E. Zipper. 2008. Ecotoxicological Recovery of the Ely Creek Watershed Five Years after Extensive Remediation of Acid Mine Drainage Seeps. Poster Presentation – Virginia Tech Department of Biological Sciences Research Day 2008, Blacksburg, Virginia. 23 February.

Chanov, M.K., D.S. Cherry, B.S. Echols, and C.E. Zipper. 2008. Ecotoxicological Recovery of the Black Creek Watershed after Remediation of Acid Mine Drainage Seeps. Poster Presentation – Virginia Academy of Science 2008 Annual Meeting, Hampton, Virginia. 22 May.

Chanov, M.K. 2009. Potential Coal Slurry Toxicity to Laboratory and Field Test Organisms in the Clinch River Watershed and the Ecotoxicological Recovery of Two Remediated Acid Mine Drainage Streams in the Powell River Watershed, Virginia. M.S. Thesis. Virginia Tech.

Chanov, M.K. 2009. The Ecotoxicological Recovery of Two Acid Mine Drainage Impacted Subwatersheds. Presented at Virginia Tech, Blacksburg, Virginia. 24 March.

Cherry, D.S., M.K. Chanov, B.S. Echols, R.J. Currie, and C.E. Zipper. 2008. Determining the Ecotoxicological Recovery of Black Creek (Wise County) and Ely Creek (Lee County) after Watershed Restoration of Abandoned Mine Lands and Acid Mine Drainage: Final Report. Report submitted to Virginia Department of Mines, Minerals, and Energy. 122 pp.

Sanita A. Corum

Environmental Scientist / Data Management

Ms. Corum is an Environmental Scientist with 26 years of environmental laboratory, aquatic toxicology and ecotoxicology, database management, and programming experience. She has experience in developing and maintaining Access, EQuIS and SQL databases that support environmental applications and projects.

Ms. Corum's project responsibilities include data management, database management, generating statistics for risk assessment, dredge material evaluation, benthic and fishery projects, development of site-specific risk calculation spreadsheets, report writing, and working with various software programs and programming.

Qualifications

Education
B.S.; Strayer University; Washington, D.C.; Information Systems; 2009

Specialized Training
Environmental Restoration Information System Training, 2010
EA Project Manager Training, 2010
Primavera Contract Management Training, 2012

Professional Affiliations/Appointments
Maryland Water Monitoring Council Information Management and Communication Committee

Experience
Years with EA: 17 Total Years: 26

Professional Experience

Computer Programming—Expertise in C/C++, Visual Basic, and SQL. Experience with SAS programming and statistical analysis software. Proficiency with Microsoft Excel, Microsoft Access and Microsoft Project.

Database Management—Experience in database design and management. Proficiency in Microsoft Access, Microsoft Excel, Microsoft Project, SAS, ProUCL, SQL, EarthSoft EQuIS Chemistry and Environmental Restoration Information System. Experience developing and maintaining Access and SQL databases that support environmental projects.

Statistics—Performs statistics for human health and ecological risk assessments, dredge material evaluations, benthic, and fishery projects.

Ecological Risk Assessment—Manages site-specific soil, sediment and water sampling data, compares results against applicable screening criteria and performs statistical analysis.

Task and Project Management—Performed task management and assisted in project management of Harford County Department of Public Works, Anacostia Wetland Water Quality and Biological Monitoring, and Cecil County Government projects through planning and tracking task budgets. Supervises and trains personnel working on stormwater sampling, water quality monitoring projects, and data and database management projects. Prepares invoices, monthly progress reports, and provided rapid client response and project updates.

Chemistry and Aquatic Toxicology/Ecotoxicology—Served as a Project Manager for toxicity testing programs. Conducted data analyses and interpretations, and prepared client reports. Developed study plans, interpreted data, generated reports, and submitted to reports to client. Performed acute and chronic toxicity tests with estuarine, marine, and freshwater organisms using various effluents and other specific toxicants and products. Experienced in the handling, culturing, and testing of fresh and saltwater organisms and proficient in the analytical measurement of water quality parameters.

Peggy A. Derrick

Senior Project Manager/ Profit Center Manager/Vice President

Ms. Derrick is a Senior Scientist and Senior Project Manager with 23 years of experience conducting environmental assessments and evaluations. She manages sediment, water, and biological monitoring and testing programs; prepares Environmental Impact Statements (EIS) and Environmental Assessments related to port and harbor navigation projects, dredged materials placement, and restoration initiatives; conducts environmental baseline surveys and pre-feasibility assessments; performs habitat characterizations; analyzes ecological data; and writes and reviews technical documents.

Her project work includes physical, chemical, and ecotoxicological evaluations for dredged material; sediment remediation (remedial investigations/feasibility studies); environmental impact assessment; sediment characterization; ecological sampling plan development; and implementation of monitoring programs for federal and private sector construction and restoration projects. Her areas of expertise include sediment characterization and dredged material placement studies; sediment remediation; permitting; estuarine and marine ecology; impact analysis; and design, coordination, and implementation of aquatic resource studies.

In addition to her technical responsibilities, Ms. Derrick serves as a senior project manager and is responsible for proposal development, project budgets, staff scheduling, client communications, and senior technical review of environmental documents. She also serves as the Profit Center Manager for the Water, Natural Resources, and Ecotoxicology Business Unit in the Hunt Valley Maryland office and Ann Arbor, Michigan office. Currently, Ms. Derrick serves as a program manager for multiple environmental contracts totaling more than $12 million for Maryland Environmental Service and the Maryland Port Administration (MPA). She also serves as a southeast regional coordinator for a nationwide contract with National Oceanic and Atmospheric Administration's Restoration Center, as well as a Chief Scientist for a Great Lakes National Program Office/Great Lakes Legacy Act sediment remediation/restoration contract with the U.S. Environmental Protection Agency (EPA) Region 5.

Qualifications

Education
M.S.; University of Maryland; Marine Estuarine Environmental Science; College Park, MD; 1994
B.A.; Goucher College; Biology; Towson, MD; 1991

Registrations/Certifications
Transportation Worker Identification Credential

Specialized Training
Wharton Executive Education Program – Essentials of Management
The Dale Carnegie Course
EA Project Manager Training
OSHA 40-Hour Hazardous Materials Site Worker Training Course
OSHA 8-Hour Hazardous Waste Site Worker Refresher Courses
CPR and First Aid Training

Professional Affiliations/Appointments
Coastal and Estuarine Research Federation – Member; 1998 – Present
Atlantic Estuarine Research Society – Member; 1992 – Present
Society of Environmental Toxicology and Chemistry – Member; 2000 – Present
Society of American Military Engineers – Member; 2002 – Present
National Association of Environmental Professionals – Member; 2006 – Present
Western Dredging Association – Member; 2006 – Present
Western Dredging Association Environmental Commission; 2006 – Present
Western Dredging Association – Eastern Chapter – Program Manager; 2013-Present
Sediment Management Work Group

Experience
Years with EA: 19.5 Total Years: 23.5

Professional Experience

Dredged Material Management and Sediment Characterization—Designs, manages, and coordinates projects that involve sampling, chemical analysis, and ecotoxicological evaluations of sediments proposed for beneficial use, innovative use, upland, open water, and ocean placement. Has managed and implemented sediment and navigation-related projects in Upper Chesapeake Bay (Maryland), Lower Chesapeake Bay (Virginia), Baltimore Harbor (Maryland), Newark Bay (New York/New Jersey), Sandy Hook (New Jersey), Potomac River (Maryland/Virginia), Kings Bay (Georgia), Savannah River (Georgia), Mobile Bay (Alabama), Dog River (Alabama), Pascagoula Harbor (Mississippi), Gulfport Harbor (Mississippi), Pensacola Harbor (Florida), Port St. Joseph (Florida), Charleston Harbor (South Carolina), Elizabeth River (Virginia), Norfolk Harbor (Virginia), York River (Virginia), Little Creek

(Virginia), Back River (Virginia), Skiffes Creek (Virginia), Escambia River (Florida), Panama City (Florida), Wilmington Harbor (North Carolina), Patapsco River (Maryland), Maurice River (New Jersey), Muskegon River/Lake (Michigan), St. Louis River (Minnesota), Maumee River (Ohio), and Rouge River (Michigan). Has successfully coordinated sediment and dredged material investigations for the U.S. Army Corps of Engineers (USACE)–New York, Baltimore, Philadelphia, Galveston, Mobile, Savannah, Norfolk, and Wilmington districts. In addition, has conducted work for MPA, Port Authority of New York and New Jersey, and South Carolina State Ports Authority. Develops and reviews work plans, field sampling plans, quality assurance plans, and site safety and health plans in accordance with U.S. Army Corps of Engineers Manual 200-1-3 (1994) and Engineer Manual 385-1-1 (2003). In addition, coordinates project-specific testing programs with federal and state regulatory agencies. Is familiar with the Clean Water Act of 1977 Section 404(b)(1) Guidelines; Section 10 of the Rivers and Harbors Act; Section 103 of the MPRSA; EPA guidelines for dredged material placement in inland waters (*Inland Testing Manual* 1998); EPA guidelines for dredged material proposed for ocean placement (EPA, *the Green Book*, 1991); EPA guidelines for dredged material proposed for island, nearshore, or upland confined placement (*Upland Testing Manual*, 2003); EPA quality assurance guidelines for collection and analysis of sediments, water, and tissue for dredged material evaluations (EPA/USACE 1995), and Regional Implementation Manuals (for EPA Regions 2, 3, 4, and 6). Experience developing work plans, budgeting and scheduling projects, coordinating with subcontractors, preparing and reviewing technical reports, coordinating with regulatory and resource agencies, and serving as a client contact.

Sediment Remediation/Habitat Restoration—Serves as Chief Scientist and Senior Technical Advisor for EPA Region V contract for sediment remediation projects funded under the Great Lakes Legacy Act. Develops plans and provides Senior Technical Review for sediment characterization studies, remedial investigation studies, feasibility studies, treatability studies, and habitat restoration initiatives. Ares of Concern project sites include: Zephyr Oil Refinery and Ryerson Creek (Muskegon, Michigan); Spirit Lake (St. Louis River, Minnesota); Lincoln Park (Milwaukee River, Wisconsin); West Branch Grand Calumet River (Illinois); Maumee River (Ohio); St. Clair River (Michigan); Manistique River (Michigan); Detroit River (Michigan); and Rouge River (Michigan). Project deliverables and documentation include: Field Sampling Plan and Quality Assurance Project Plans for sediment characterization and treatability studies; remedial technology screening; alternative analysis for remediation and habitat restoration; remedial design and habitat design, and permitting packages.

Dredging, Compliance Monitoring, Permitting, and Mitigation Planning—Serves as Project Manager for multi-faceted dredged material management programs for in-water transportation/infrastructure projects and for Federal and private sector navigation projects. Managed comprehensive dredged material evaluation and dredged material management plan for new Midtown Tunnel in Portsmouth, VA. Developed water quality monitoring program, negotiated waiver for time-of-year restriction, and developed Habitat Conditions Analysis (HCA) to assess potential mitigation requirements for impacts to bottom and aquatic habitat. Managed comprehensive risk assessment related to proposed remedial dredging and construction of a dredged material containment facility (DMCF) at a former steel-making facility in Baltimore Harbor. Served as Project Manager for Supplemental Environmental Impact Statement (SEIS) for expansion of the Poplar Island Environmental Restoration Project (a beneficial use project in the Chesapeake Bay that uses dredged material for island and habitat reconstruction). Managed exterior monitoring program that included monitoring of physical, chemical, and biological conditions (water quality, sediment quality, benthic community, and tissue chemistry) to assess changes that could result from facility operations and project conditions. Managed exterior monitoring studies at the Masonville and Cox Creek DMCFs. Provides technical support to the MPA and State of Maryland's Dredged Material Management Program. Coordinates testing of dredged material from the Upper Chesapeake Bay approach channels and Baltimore Harbor channels, and Lower Chesapeake Bay channels for the USACE–Baltimore and Norfolk Districts.

Aquatic Resource Assessment and Characterization—Scientific expertise in the field of aquatic ecology and biology, specifically estuarine and marine systems. Responsible for developing sampling plans and quality assurance/quality control plans for fish and benthic community assessments, fish-tissue studies, and sediment characterization studies for federal, municipal, and private sector clients. Designs and implements water quality, benthos, fish, ichthyoplankton, and submerged aquatic vegetation surveys in freshwater, estuarine, and marine systems. Experience includes benthos and fisheries sampling methodology, sediment collection techniques, sediment profile imaging, habitat characterization, electronic water quality monitoring devices, fish and invertebrate taxonomy, and ecological data analysis.

Peter Garger, CIH, CSP
Corporate Health and Safety Director

Mr. Garger has more than 34 years of experience managing and conducting industrial hygiene services including hazardous materials surveys and assessments, health and safety inspections and oversight on both environmental remediation projects as well as industrial operations.

During his career, he has performed sampling and evaluation of numerous occupational environments for airborne contaminants and made recommendations for their control. In addition, Mr. Garger has been involved in Occupational Safety and Health Program development in both the private sector and in the federal government arena. He has extensive experience in technical report preparation, regulatory interpretation and technical briefing to all levels within an organization.

Qualifications

Education
ScM; Johns Hopkins University School of Hygiene and Public Health; 1981
B.A.; Hofstra University; Chemistry; 1978

Registrations/Certifications
Certified Safety Professional—2008 (No. 20560)
Certified Industrial Hygienist—ABIH No. 3118; 1985

Specialized Training
OSHA Construction Outreach Trainer for 10- and 30-Hour Construction Safety Training
OSHA Hazardous Waste Supervisor, 1989 – Present
Investigating and Mitigating Microbial Contamination in Buildings; 1995
U.S. Army Corps of Engineers – Unexploded Ordnance Training; 1994
Department of Transportation Hazmat Training; 1994
National Institute for Occupational Safety and Health 582 Microscopic Evaluation of Fibers; 1993
Asbestos Building Inspector/Management Planner; 1993
X-Ray Fluorescence Testing Operator – Lead Paint Analysis; 1992

Professional Affiliations/Appointments
American Board of Industrial Hygiene
American Industrial Hygiene Association
Board of Certified Safety Professionals

Experience
Years with EA: 8.5 Total Years: 34

Professional Experience

Occupational Safety and Health Program Development—Held the position of Corporate Health and Safety Director for several private firms over the last 17 years. In addition, held the position of Chief of the Industrial Hygiene and Chemistry Section at the U.S. Army Corps of Engineers–Baltimore District. These positions involved the coordination of training activities, development and maintenance of the medical surveillance programs including the drug testing programs, providing overall coordination of all safety and health related project activities, as well as providing health and safety auditing of field activities during project execution. These field activities typically included soil sampling, groundwater monitoring and well installation, contaminated soil remediation and removal and hazardous waste disposal.

Industrial Hygiene/Asbestos/Lead Evaluation—Project experience has involved providing comprehensive industrial hygiene services to a 350-man chromium chemicals manufacturing plant that was followed by assignment as a regional Industrial Hygiene Manager for a complete business unit of a major chemical manufacturer. Held positions within the federal government and the private sector that involved the development and implementation of comprehensive testing programs for both asbestos-containing materials and lead-based paint. Was involved in the development of operations and maintenance plans for these materials as well as in the design of asbestos and lead abatement projects

Munitions and Explosives of Concern/Chemical Warfare Materials—Project experience has included providing safety and health services for the evaluation, decontamination, and demolition of several moth-balled Army Ammunition Plants. The contaminants of concern included trinitrotoluene, cyclotrimethylenetrinitraniine, nitrocellulose, and nitroglycerin as well as ordnance-related items and scrap associated with these plants. Was involved in the preparation and execution of an Open Burn Permit in the State of Illinois to allow for the controlled thermal degradation of numerous process buildings at an old Army site. Project experience also included work for the U.S. Army Corps of Engineers at the Chemical Agent cleanup project in the Spring Valley section of Washington, D.C.

Morgan E. Gelinas
Environmental Scientist

Ms. Gelinas is an environmental scientist specializing in marine geology and hydrodynamic processes. Her responsibilities include active participation in field sampling investigations and data analysis/reporting tasks.

Her project experience at EA has focused on navigation projects and maintenance and new work dredging projects in urbanized and offshore environments, specifically the sampling and testing and placement of dredged material, marine bathymetric surveys, and aquatic site characterizations.

Qualifications

Education
M.S.; State University of New York at Stony Brook; Stony Brook, New York; Marine and Atmospheric Sciences; 2011
B.S.; The College of William and Mary; Williamsburg, Virginia; Geology; 2009

Specialized Training
OSHA Hazardous Materials Site Worker 40-hour Training, 2014
PADI SCUBA Certification, Open Water Diver, 2009
Connecticut Certificate of Personal Watercraft Operation, 2001
CPR and First Aid Training, 2014

Professional Affiliations/Appointments
CERF, Coastal Estuarine Research Federation, 2014

Experience
Years with EA: 3.5 Total Years: 5.5

Professional Experience

Technical Writing/Reviewing/Editing— Experience in reviewing and editing technical documents and writing technical reports. Familiar with the Southeast Regional Implementation Manual regarding requirements and procedures for evaluation of Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters; Inland Testing Manual and Upland Testing Manual. Prepared and reviewed reports for projects in U.S. Environmental Protection Agency Regions 2, 3, 4, and 5.

Field Data Collection—Experience collecting water, soil, sediment, and benthic samples for chemical and biological analyses using a variety of techniques and equipment in marine, aquatic and terrestrial habitats. Competent maneuvering boats and associated trailers, refrigerated trucks, and all terrain vehicles for data collection. Navigation experience using Hypack to create, execute, and process bathymetric surveys. Experience deploying and interpreting mounted side-scan sonar and Acoustic Doppler Current Profilers, multi-beam sensors, magnetometers and sub-bottom profilers. Experience utilizing *in situ* monitoring equipment, including Acoustic Doppler Current Profilers, ADVs, pressure sensors, and HOBOs.

Sediment Sampling—Experience in sediment sampling and physical characterization of sediment quality to support a variety of environmental projects, including tidal marsh health; harbor sedimentation rates; beneficial use of dredged material; potential for aquatic organism and plant bioaccumulation of sediment contaminants; sediment plume modeling; and navigation channel maintenance. Completed sediment sampling projects that included gravity coring, vibracoring, direct-push coring, drilling, and surface grab collection techniques. Investigated sediment characteristics in the Great Lakes (Lake Superior, Lake Erie), Baltimore Harbor, Chesapeake Bay (Virginia/Maryland), Gulfport Harbor (Mississippi), Pensacola Harbor (Florida), Raritan Bay (New Jersey), Venice Lagoon (Italy), Delaware's tidal marshes and Long Island's coastal bays. Experience using radioactive geochronology, specifically analyzing sediment samples using alpha counting of Pb-210 and Cs-137.

Water Quality Sampling—Experienced in the collection of water quality samples for laboratory analysis. Performed water quality water quality (salinity, dissolved oxygen, pH, turbidity and temperature) measurements in coastal areas, the Gulf of Mexico, Chesapeake Bay, Delaware Bay and the Venice Lagoon, Italy.

Publications and Presentations

Gelinas, M., J. Rapaglia, H. Bokuniewicz, and K. Lwiza. 2012. Accepted to Journal of Coastal Research. Sediment Resuspension by Ship Wakes in the Venice Lagoon.

Gelinas, M. 2011. Industrial Ships' Wake Propagation and Associated Sediment Resuspension in the Venice Lagoon, Italy. Unpublished master's thesis. Stony Brook University, Stony Brook, New York.

Rapaglia, J., L. Zaggia, K. Ricklefs, M. Gelinas, and H. Bokuniewicz. 2011. Characteristics of ships' depression waves and associated sediment resuspension in Venice Lagoon, Italy. *J. of Marine Systems*, 85, 45-56.

Gelinas, M. 2008. The Spring Nor'easter of 2008: Influence on Flow and Sediment Transport in Blackbird Creek Marsh, Delaware. Poster session presented at American Geophysical Union Fall Conference, San Francisco, California. December.

John T. Morris
Senior Marine Scientist

Mr. Morris is a Senior Marine Scientist and Project Manager offering EA clients nearly 25 years of experience in conduct and management of marine environmental sampling, oceanographic instrument deployment, and advanced geophysical surveys, including unexploded ordnance/munitions detection. For the past 16 years, he has served in a project and program management capacity requiring oversight of major field programs, as well as the completion of over 40 independent task orders for U.S. Army Corps of Engineers (USACE), U.S. Coast Guard, U.S. Navy, and National Oceanic and Atmospheric Administration (NOAA) clients. His multi-disciplinary experience includes involvement in wide array of shallow water, coastal and deep ocean projects conducted on all coasts of North America. As a result, Mr. Morris holds a great deal of insight into the resources available to EA and its clients in terms of research vessels, equipment suppliers, as well as the selection, coordination, and direct oversight of specialty subcontractors towards the efficient completion of data collection operations. His projects have included seafloor and deeper seabed characterization, benthic habitat assessments, as well as comprehensive physical, chemical and biological oceanographic investigations at marine, estuarine and aquatic sites along the east coast of the United States and Canada, as well as in the Great Lakes, Gulf of Mexico and the waters of California, Pacific Northwest, and Alaska.

Qualifications

Education
B.S.; Richard Stockton College of New Jersey; Pomona, NJ; Marine Sciences Coastal Resource Management; 1990

Specialized Training
EA Project Manager Training; 2012
CPR and First Aid Training; 2001-2014
OSHA 40-Hour Hazardous Materials Site Worker Course; 2012
OSHA 30-Hour Construction Supervisor Course; 2012
Confined Space Operations Training; 2012
Offshore Water Survival with Helicopter Underwater Egress Training (HUET); 2014
SCUBA Certification; Open Water Diver; 1984

Experience
Years with EA: 3 Total Years: 24

Professional Experience

Dredged Material Disposal Site Management—Between 1993 and 2004, served in a lead technical and program management capacity in support of the USACE-New England District's Disposal Area Monitoring System (DAMOS) Program. His duties included study design, costing, and implementation of field sampling and survey activity performed at multiple open water dredged material disposal sites along the coast of New England regulated by Section 404 of the Clean Water Act and/or Section 103 of the Marine Protection, Research, and Sanctuaries Act. Coordinated and directly oversaw all data processing, analysis, and reporting activities, as well as prepared detailed reports; peer-reviewed, scientific articles and papers for publication. Worked directly with the USACE–New England District client to determine the best management practices for each disposal site and subsequently direct disposal activity in a manner that would maximize the capacity and/or fulfill the site management objectives (confined aquatic disposal cell construction, capping, etc.).

During that same time period, also supported marine environmental work performed over the New York Mud Dump Site and Historic Area Remediation Site (HARS) off the coast of New Jersey on behalf of the USACE-New York District, eventually assuming the role of Program Manager in 2007. Following many years of performing single-beam bathymetry, sediment sampling, physical oceanographic programs and benthic habitat investigations, oversaw the completion of a several high-resolution, multi-beam bathymetric survey of the entire HARS, as well as performed comprehensive tidal analysis to confirm the accuracy of water level correctors generated for this large-scale, open water site.

Dredged Material Disposal Site Monitoring—For the past 22 years, has regularly performed marine geophysical, sediment chemistry, benthic habitat characterization and oceanographic studies at open water dredged material disposal sites to examine changes in seafloor topography, disposal mound stability and rates of benthic infaunal recolonization over new and historic dredged material deposits. Survey techniques often included single- and multi-beam bathymetry; side scan sonar, sub-bottom profiling, various types of coring and surface grab sampling,

sediment-profile imaging, underwater video, sediment tracers, dredged material disposal plume fate and transport measurements, bottom-boundary layer investigations and numerous special studies. As described above, this work was regularly performed in support of USACE–New England and New York Districts via longer-term Indefinite Delivery/Indefinite Quantity-type contracts. However, his skills and experience were also employed to support distinct monitoring projects at sites within the jurisdiction of the USACE-Baltimore, Los Angeles, San Francisco, and Seattle districts and the Engineer Research and Development Center.

Site Assessments—Has a great deal of experience in the performance and management of comprehensive marine and estuarine site assessments as part of pre-construction design and National Environmental Policy Act related studies. He has performed numerous hydrographic surveys and seabed characterization efforts in coastal waters and on the continental shelf on behalf of the U.S. Navy to aid in determining impacts of planned facility improvements at established bases, as well as determining the best routes for buried undersea cables. The experience with the U.S. Navy projects is supplemented by other comprehensive site assessments performed in support of the USACE-Norfolk and Louisville districts, which required bathymetric and geophysical surveys, as well as precision navigation, physical oceanographic measurements, plus deep and shallow sediment collections for geotechnical characteristics and benthic habitat assessments.

Physical/Chemical Oceanographic Studies—For nearly two decades, has conducted long and short-term physical oceanographic measurement programs for many state, federal, and commercial clients throughout North America as stand-alone projects or as part of larger disposal site monitoring or site characterization programs. These current, water-level, wave and meteorological data sets were often used to establish boundary conditions, serve as forcing mechanisms, or as validation of hydrodynamic models. However, these data were also employed to assess tidal current regimes, examine large-scale circulation patterns, as well as measure erosional forcing mechanisms at the sediment-water interface. Is well versed in the use of bottom-mounted, moored, and underway instrumentation, including various types of electro-magnetic, mechanical and acoustic single-point current meters, current profilers, current-following drogues, drifters, wave and tide recorders, salinity and temperature recorders, turbidity meters, and alike. In addition to remote sensing capabilities, offers expertise in deep ocean profiling and hydrocasts to examine chemical composition and contamination of seawater with advanced Conductivity, Temperature and Depth probes, transmissometers, fluorometers, individual Niskin and GO-FLO type water sampling bottles, as well as Rosette and Carousel-type profiling arrays.

Search and Rescue/Recovery Operations—Employing his background in remote sensing and marine survey, often supports large and small-scale operations associated with underwater and/or open-waters search and recovery operations for the U.S. Coast Guard, U.S. Navy, and National Transportation and Safety Board. Experience with side scan and sector scanning sonar, as well as Laser Line Scan and underwater video has afforded him with opportunities to rapidly mobilize and participate in at-sea operations to locate and recover downed planes, sunken vessels, and various types of U.S. Navy test objects. In addition, he has contributed to the development of several modeling routines employed by the U.S. Coast Guard Search and Rescue Operations software that prioritizes search areas for U.S. Coast Guard rescue teams responding to at-sea emergencies.

Underwater Munitions Detection—Taking advantage of recent innovations in marine geophysics and precision navigation, has developed a strong capability in the detection and mapping of underwater munitions and explosives of concern, as well as unexploded ordnance in inland and open waters. Has supported projects sponsored by the USACE-Louisville District, demonstrating the capability to utilize commercial-off-the shelf solutions, as well as incorporate recently developed, specialized sensors in his approach to detect, precisely locate and effectively recover metallic items from areas of seafloor impacted by recent and historic military activity. Has submitted proposals and participated in several projects funded by the Department of Defense via the Environmental Security Technology Certification Program to develop, test, and validate new sensors and equipment, as well as new applications for existing tools.

Courtney L. Pacelli
Environmental Scientist

Qualifications

Education
M.S.; Texas A&M University; Oceanography; 2011
B.S.; University of Maryland-Baltimore County; Environmental Science; 2007

Specialized Training
OSHA 40-Hour Hazardous Waste Operations Safety Training; 2014

Experience
Years with EA: 3.5 Total Years: 3.5

Ms. Pacelli is a Scientist in EA's Water, Natural Resources, and Ecotoxicology group; her primary background is in biology, oceanography, and ecology. She has experience writing environmental impact statements, environmental assessments, and ecological risk assessments. Ms. Pacelli participates in field efforts to collect data to support those assessments and consults with regulatory agencies and subcontractors for various projects. Her field experience with EA has focused on sediment and water sampling for dredging projects and sediment sampling for ecotoxicological studies. She is responsible for the development of alternatives and impacts analysis for environmental assessments/environmental impact statements and for technical edits, client consultations, and preparation of the draft and final documents. She frequently manages and analyzes data to develop ecological risk assessments.

Ms. Pacelli has a strong background in biology and oceanography and has participated in several research cruises. Her previous field experience focused water column and benthic sampling. Additionally, she has experience with processing laboratory samples. Her research background involves the investigation of phytoplankton community dynamics at the Flower Garden Banks National Marine Sanctuary in the Northern Gulf of Mexico. Previously, she worked on water column sampling, sample processing and analysis, and phytoplankton and benthic invertebrate identification while completing her M.S. at Texas A&M University.

Professional Experience

Technical Writing/Reviewing/Editing**—**Experience writing environmental impact statements, environmental assessments, site characterization reports, and ecological risk assessments as well as experience in reviewing and editing technical documents. Prepared ecological risk assessments and environmental assessments for Aberdeen Proving Ground and other areas. Prepared site characterization reports for areas of concern within the Great Lakes Region and has provided oversight and minor technical review for other site characterization reports. Served as a contributing author on an environmental impact statement for the Deepwater Horizon oil spill in the Gulf of Mexico.

Field Data Collection—Collected water and sediment samples on the York River in Virginia analysis and sediment samples from the Lower Darby Folcroft Superfund site for bulk sediment chemistry and ecotoxicology analysis. Conducted turbidity monitoring for drilling operations on the Anacostia River in Washington, D.C. Previously conducted research in the Gulf of Mexico assessing phytoplankton community responses to coral spawning. Participated in stream surveys and led groups in performing wetland delineations in various marsh environments. Experience in collecting water, sediment, and benthic samples for chemical and biological analyses using a variety of techniques and equipment in habitats. Performed water quality (salinity, dissolved oxygen, pH, and temperature) measurements in the Gulf of Mexico and Galveston Island wetlands. .

Sample Analysis—Performed analyses on water samples including, but not limited to, chlorophyll *a*, total organic and inorganic carbon, and total nitrogen.

Data Analysis—Performed independent data analysis and created appropriate tables and figures for ecological risk assessments. Analyzed sediment chemical data and discussed data trends and drawn conclusions and recommendations from the data in various reports.

Selected Publications and Presentations

DeLeo, P., M. Ciarlo, C. Horne (Pacelli), S. Williams, and B. Greggs. 2013. What Ingredients are present in everyday home cleaning products? Preliminary findings and trends from the Cleaning Product Ingredient Safety Initiative. Presented at SETAC Meeting. Nashville, Tennessee. 17-22 November.

Horne (Pacelli), C.L., A.S. Quigg, E.L. Hickerson, and G.T. Rowe. 2010. Phytoplankton Responses to Mass Coral Spawning at the Flower Garden Banks, NW Gulf of Mexico. Presented at the American Society of Limnology and Oceanography Meeting. Portland, Oregon. 16-22 February.

Michael W. Powell
Senior Scientist

Mr. Powell is an environmental scientist with 19 years of experience in managing and conducting water quality studies, statistical analysis of environmental data, and chemical fate and transport modeling.

He has expertise in National Pollutant Discharge Elimination System (NPDES) reporting, preparing Environmental Impact Statements, remedial investigation/feasibility studies, and corrective actions.

Mr. Powell has developed stormwater models for urban watersheds using Stormwater Management Model (SWMM) and has hydrodynamic and water quality models using HEC-RAS, QUAL2E, Water Quality Simulation Model, BASINS, and HSPF. He has experience in NPDES permitting and toxicity studies, and dredged material placement modeling.

His areas of expertise include the statistical analysis of environmental data, database design, and computer programming. He is proficient in Microsoft Excel/Access, Microsoft Visual Studio, Fortran, SAS programming, and statistical analysis software.

Qualifications

Education
M.S.; Johns Hopkins University; Environmental Engineering; 2005
M.S.; University of Maine; Zoology; 1997
B.S.; University of Wisconsin; Zoology; 1990

Specialized Training
EA Project Management Training; 2007
Society of Environmental Toxicology and Chemistry Course on Geographic Information System-Based Modeling; 2001
Principles of Water Quality Modeling with EPA Water Quality Analysis and Simulation Program; AsCI Corp.; 1999
Emergency Medical Technician
CPR and First Aid Training

Professional Affiliations/Appointments
Society of Environmental Toxicology and Chemistry
Water Environment Federation

Experience
Years with EA: 14 Total Years: 19

Professional Experience

Hydrology, Hydrodynamic, and Water Quality Modeling—Developed models of fecal coliform fate and transport using U.S. Environmental Protection Agency's (EPA's) Water Quality Simulation Model that simulates advection, settling, resuspension, and die-off. Developed water quality models for biological oxygen demand dissolved oxygen, metals, and organic contaminants. Analyzed hydrological and water quality data. Developed and calibrated an EPA Stormwater Management Model-RUNOFF/TRANSPORT model to simulate stormwater runoff, constituent buildup/washoff, and pollutant transport. Applied the calibrated models to compute peak flows and estimate constituent loadings during storm conditions. Developed a hydraulic model using HEC-RAS to evaluate stream reaches vulnerable to flooding and bank erosion. Applied EPA hydrodynamic/water quality models RIVMOD and Water Quality Simulation Model to the Wissahickon Creek and Brodhead Creek in support of the total maximum daily load process for nitrogen, phosphorus, and fecal coliform.

Dredged Material Management Modeling—Managed and conducted numerical modeling of dredged material in open water being discharged from a barge or hopper using the ADDAMS evaluation system. Developed and applied STFATE models for evaluating dredged material placement events, and assessment of data in relation to compliance with Section 103 of the Marine Protection Research and Sanctuaries Act. Conducted STFATE modeling for numerous ODMDS sites including Norfolk, Mobile, Pascagoula, Pensacola, and Gulfport East/West, and Savannah.

Aquatic Ecology—Managed and conducted bacterial source tracking investigations for several clients. Member of Baltimore Harbor Total Maximum Daily Load Stakeholders Group. Critically reviewed water quality criteria for dissolved oxygen, chlorophyll, and water clarity for the Chesapeake Bay. Served as a field scientist for the Lake Mendota Trophic Cascade Project. Conducted fish population studies and researched the effects of a walleye-stocking program on fish communities. Conducted water quality analysis, fish sampling, and zooplankton identification. Designed and participated in sampling of macrophyte and fish communities using SCUBA, gill nets, and electroshocking. Performed water quality analysis and sediment studies. Participated in remote tracking of smallmouth bass. Conducted experiments to determine how management of aquatic macrophytes can improve water

quality and benefit fish production by increasing the amount of productive edge habitat and intensifying predator-prey interactions. Experience using fish bioenergetics and fish population models. Designed a fish bioenergetics model used to explore stocking strategies for brook trout in Bradley Pond, Maine.

Hazardous Waste Investigations—Participated in numerous environmental impact statements, preliminary assessment/site investigations, and remedial investigation/feasibility studies. Responsible for statistical analysis of environmental data and for developing technical materials for reports. Projects include Department of Defense sites and dredge material placement (inland and ocean).

Statistics and Experimental Design—Experience with multivariate statistical data analysis, power analysis, optimal experimental design, geospatial data analysis, and resampling statistics (e.g., bootstrap and Monte Carlo). Served as lead statistician for numerous risk assessment and dredge material evaluation projects that required the determination of statistically based exposure concentrations and statistical means comparisons.

Computer Programming—Expertise in C/C++, Visual Basic, and Fortran. Experience with SAS programming and statistical analysis software. Proficiency with Microsoft Excel/Access, Microsoft Visual Studio, Digital Visual Fortran, and Lahey Fortran.

Environmental Chemistry—Experience in collecting and preparing precipitation, stream water, soil, sediment, and biological samples for mercury analysis. Analyzed mercury using a cold vapor atomic fluorescence spectrophotometer and Jerome Gold Film Mercury Analyzer.

Database Management—Experience in database design and management. Proficiency in Microsoft Access/Excel, SAS, and Systat. Experience developing relational databases for environmental applications.

FINAL
Attachment I:
Field Sampling Plan
Evaluation of Dredged Material Proposed for Ocean Placement

Parallel Thimble Shoal Tunnel Project

Volume 2 of 4

Prepared For
Jacobs Engineering Group
4500 Main Street, Suite 310
Virginia Beach, Virginia 23462

On Behalf of
Chesapeake Bay Bridge and Tunnel District
32386 Lankford Highway
Cape Charles, Virginia 23310

February 2015

Prepared By:

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle
Suite 400
Hunt Valley, Maryland 21031

FINAL

Field Sampling Plan

Evaluation of Dredged Material Proposed for Ocean Placement

Parallel Thimble Shoal Tunnel Project

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Prepared by:

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February 2015

Peggy Derrick 2/24/15

Peggy A. Derrick, Date
Project Manager, EA Engineering, Science, and Technology, Inc., PBC

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1-2	Sampling Locations for the Chesapeake Bay Control Site, Norfolk Ocean Disposal Site, Atlantic Ocean Reference Site, and the Willoughby Bank Reference Site
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LIST OF ACRONYMS AND ABBREVIATIONS

ºC	Degrees Celsius
AVS	Acid Volatile Sulfides
CBBT	Chesapeake Bay Bridge Tunnel
CFR	Code of Federal Regulations
COC	Chain of Custody
cy	Cubic Yard(s)
DGPS	Differential Global Positioning System
DU	Dredging Unit
EA	EA Engineering, Science, and Technology, Inc.
EM	Engineer Manual
FSP	Field Sampling Plan
ft	Foot (Feet)
ID	Identification
MLLW	Mean Lower Low Water
MPRSA	Marine Protection, Research, and Sanctuaries Act
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NODS	Norfolk Ocean Disposal Site
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
R/V	Research Vessel
SAP	Sampling and Analysis Plan
SEM	Simultaneously Extracted Metals
STFATE	Short-Term Fate of Dredged Material
SVOC	Semivolatile Organic Compound
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon

LIST OF ACRONYMS AND ABBREVIATIONS

USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency

1. PROJECT OVERVIEW

The Thimble Shoal Tunnel is a portion of the Chesapeake Bay Bridge Tunnel (CBBT) system which extends from Wise Point on the Eastern shore of Virginia to the Virginia Beach area. The CBBT is 17.6 miles long and provides a direct connection between southeastern Virginia and the Delmarva Peninsula (Delaware plus the Eastern Shore counties in Maryland and Virginia) (Figure 1-1). The Thimble Shoal Tunnel section of the CBBT runs beneath the Thimble Shoal Channel, one of the main navigation channels that crosses the system.

The proposed project includes the construction of a secondary two-lane immersed tunnel which will run parallel to and approximately 250 feet (ft) west of the existing Thimble Shoal Tunnel. The project also includes expansion of the existing portal islands and construction of new trestle crossovers. The proposed project will require the dredging and placement of approximately 1.7 million cubic yards of material from the lower Chesapeake Bay prior to construction.

An evaluation of the dredged material is required prior to dredging and placement to ensure that the material is appropriate for available placement options. Placement options for the Parallel Thimble Shoal Tunnel project include ocean and upland placement. Preliminary geotechnical investigations and environmental sampling/analysis were conducted in 2014 (Fugro Consultants 2014) and supplemental geotechnical investigations are being conducted in early 2015. The purpose of this project is to collect the data that are necessary to document the Tier II (sediment and elutriate) and Tier III (ecotoxicological) characteristics of the sediments to facilitate placement of the dredged material at the Norfolk Ocean Disposal Site (NODS) (Figure 1-2). Data collected for the Parallel Thimble Shoal Tunnel Project will be used to document compliance with Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) for ocean placement at the NODS.

The Parallel Thimble Shoal Tunnel dredged material evaluation will consist of collecting sediment cores from the sediment surface to depths between approximately -29 and -120 ft mean low lower water (MLLW) using sonic drilling; collecting surficial sediment and sediment cores to -20 ft below the sediment surface at the Willoughby Bank reference site and surficial sediment at the Atlantic Ocean reference site; collecting site water and elutriate preparation water; conducting analytical testing of bulk sediment and standard elutriates; conducting ecotoxicological testing of sediment (water column bioassays, whole sediment bioassays, and bioaccumulation studies); conducting analytical testing of aquatic organism tissue as appropriate; Short-Term Fate of Dredged Material (STFATE) modeling of dredged material placement at the NODS; and evaluating test results with respect to the Ocean Dumping Regulations in Title 40 of the Code of Federal Regulations (CFR), Parts 220-228 (40 CFR 220-228).

1.1 SCOPE OF THE FIELD SAMPLING PLAN

This field sampling plan (FSP) describes the field sampling and data-gathering methods for the Parallel Thimble Shoal Tunnel Project. The scope of this FSP follows guidance provided by the United States Army Corps of Engineers (USACE) Engineer Manual (EM) 200-1-3 *Requirements for the Preparation of Sampling and Analysis Plans* (2001) and the United States Environmental Protection Agency's (USEPA's) *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (2001).

1.2 PROJECT PURPOSE AND OBJECTIVES

The purpose of this project is to collect data to characterize the physical, chemical, and ecotoxicological quality of the sediments from the Parallel Thimble Shoal Tunnel Project footprint and to determine if the material is suitable for ocean placement. The overall intent of the program is to determine if ocean placement of the material is a feasible placement option. Ocean placement, if determined to be feasible, would reduce or eliminate the volume of material required to be placed at an approved upland disposal area(s).

The overall objective of the sampling effort is to obtain and analyze sediment and water samples representative of the areas proposed for dredging. The physical composition of the sediment will be described by grain size, specific gravity, Atterberg limits, and total solids determinations. Chemical concentrations of semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), metals (including mercury), polychlorinated biphenyl (PCB) congeners, chlorinated pesticides, organophosphorus pesticides, dioxin and furan congeners, tributyltin, cyanide, ammonia, sulfides, nitrogen, nitrate + nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, total organic carbon (TOC), and acid volatile sulfides (AVS) / simultaneously extracted metals (SEM) will be identified in bulk sediments. Site water, receiving water, and standard elutriate samples will be analyzed for SVOCs, PAHs, metals (including mercury), PCB congeners, chlorinated pesticides, organophosphorus pesticides, dioxin and furan congeners, tributyltin, cyanide, ammonia, sulfides, nitrate + nitrite, total TKN, total phosphorus, and TOC.

Specific objectives of the Parallel Thimble Shoal Tunnel study are:

- Collect the required volume of sediment and site water for physical, chemical, and ecotoxicological analyses.

- Collect sediment cores from four designated dredging areas that comprise fifteen dredging units within the footprint of the Parallel Thimble Shoal Tunnel within positioning accuracy appropriate for the project objectives.

- Collect surficial sediment and sediment cores from three locations at the Willoughby Bank reference site, and composite into two samples (one silty-sand surface sample and one subsurface fine-grained sample) for physical and chemical testing.

- Collect sandy surficial sediment at the Atlantic Ocean reference site for physical and chemical testing.

- Collect surficial sediment from the USEPA-designated lower Chesapeake Bay control site.

- Collect and transfer sediment to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity.

- Test and characterize sediments from two depth intervals (top and bottom) with regard to physical characteristics, chemical characteristics, ecotoxicological characteristics, and potential for bioaccumulation.

- Test site water and standard elutriates with regard to chemical characteristics and compliance with water quality standards.

- Conduct water column bioassays to assess potential water column impacts related to open water/ocean placement.

- Conduct whole sediment bioassays to assess potential benthic impacts related to open water/ocean placement.

- Conduct 28-day bioaccumulation to assess the potential for uptake of contaminants from sediments into the tissue of benthic organisms.

- Conduct STFATE modeling to assess compliance with the Limiting Permissible Concentration as per 40 CFR Part 227.

- Evaluate physical, chemical, and ecotoxicological data for the Parallel Thimble Shoal Tunnel sediments to determine the feasibility of ocean placement for the dredged material.

1.3 PROJECT LOCATION

The existing Thimble Shoal Tunnel is located in the lower Chesapeake Bay and is part of the CBBT system. The proposed new parallel tunnel will be located on the west side of the existing tunnel. The proposed dredging footprint includes approximately 46.5 acres of area between Island No. 1 and Island No. 2 and approximately 13.5 acres adjacent to the west side of Island No. 1 (Figure 1-1). A total of four dredging areas comprised of fifteen dredging units will be sampled for the testing program (Figure 1-3).

Reference sediments will be collected from the Willoughby Bank reference site near Hampton Roads, just north of the city of Norfolk, Virginia and from the Atlantic Ocean reference site (Figure 1-2). These reference sites were chosen because they each provide material with different grain size composition (sands, silt/sand, silt). The appropriate reference samples for test comparisons will be chosen based upon grain size determinations of the actual project site samples following sample collection and compositing. It is important that the reference site be comprised of materials similar to the project sediments to provide a technically appropriate comparison for the results of the analytical and ecotoxicological testing conducted with the Parallel Thimble Shoal Tunnel Project sediments.

The Willoughby Bank reference area has been used for other recent ocean placement evaluations for the NODS (EA Engineering, Science, and Technology, Inc. [EA] EA 2011; EA 2014a, 2014b, 2014c, 2014d, 2015a, 2015b). For this project, two separate reference samples from the Willoughby Bank area will be collected and tested: one representing sandy surface materials and

one representing fine-grained sub-surface materials. One reference sample from the Atlantic Ocean reference site representing surface materials will be collected and tested. Lower Chesapeake Bay control sediment (for amphipod bioassays) will be collected from a USEPA-designated area in the Lower Chesapeake Bay (Figure 1-2).

1.4 TECHNICAL APPROACH

A total of four dredging areas comprised of fifteen dredging units with a total of 24 sampling/coring locations are proposed for the sampling and testing program (Figure 1-1). Target coordinates and elevations for each sample location are presented in Table 1-1. Each proposed dredging unit is described below and the sampling and testing scheme is summarized in Table 1-2. Cores collected from the locations within each individual dredging unit will be composited into a single sample representative of that dredging unit for ocean placement testing (Table 1-3).

Area 1 is along the south portal island side (Island No. 1) of the project footprint. This area includes the west side of Island No. 1 which will be dredged to expand the existing portal island. This area will require removal of approximately 155,000 cubic yards (cy) of *in situ* material. Four discrete sampling locations 1A, 1B, 1C, and 1D will be sampled in this area. Area 1 has a single dredging unit for testing (DU 1). The whole cores collected from each location will be combined into a single composite sample.

Area 2 extends from the northernmost end of the south portal island (Island No. 1) to the south boundary of the Thimble Shoal Channel. This area will require the removal of approximately 510,000 cy of *in situ* material. Area 2 is divided into five dredging units for testing:

- ***2ST***: The top interval (0 to -10 ft below the sediment surface) from the southern portion of Area 2 is comprised of discrete sampling locations 2A and 2B. This dredging unit has a total of 54,000 cy of dredged material.

- ***2MT***: The top interval (0 to -10 ft below the sediment surface) from the middle portion of Area 2 is comprised of discrete sampling locations 2C and 2D. This dredging unit has a total of approximately 67,000 cy of dredged material.

- ***2NT***: The top interval (0 to -10 ft below the sediment surface) from the northern portion of Area 2 is comprised of discrete sampling locations 2E, 2F, and 2G. This dredging unit has a total of approximately 63,000 cy of dredged material.

- ***2SB***: The bottom interval (from -10 ft below the sediment surface to the project depth) from the southern portion of Area 2 is comprised of discrete sampling locations 2A, 2B, 2C, and 2D. This dredging unit has a total of approximately 160,000 cy of dredged material.

- ***2NB***: The bottom interval (from -10 ft below the sediment surface to the project depth) from the northern portion of Area 2 is comprised of discrete sampling locations 2E, 2F, and 2G. This dredging unit has a total of approximately 166,000 cy of dredged material.

Area 3 represents the area extending across the Thimble Shoal Channel. This area will require the removal of approximately 520,000 cy of *in situ* material underlying the channel. Area 3 is divided into four dredging units for testing:

- ***3ST***: The top interval (0 to -10 ft below the sediment surface) from the southern portion of Area 3 is comprised of discrete sampling locations 3A, 3B, and 3C. This dredging unit has a total of approximately 71,000 cy of dredged material.

- ***3NT***: The top interval (0 to -10 ft below the sediment surface) from the northern portion of Area 3 is comprised of discrete sampling locations 3D, 3E, and 3F. This dredging unit has a total of approximately 69,000 cy of dredged material.

- ***3SB***: The bottom interval (from -10 ft below the sediment surface to the project depth) from the southern portion of Area 3 is comprised of discrete sampling locations 3A, 3B, and 3C. This dredging unit has a total of approximately 195,000 cy of dredged material.

- ***3NB***: The bottom interval (from -10 ft below the sediment surface to the project depth) from the northern portion of Area 3 is comprised of discrete sampling locations 3D, 3E, and 3F. This dredging unit has a total of approximately 185,000 cy of dredged material.

Area 4 extends from the northern boundary of the Thimble Shoal Channel to the northern portal island (Island No. 2). This area will require the removal of approximately 547,000 cy of *in situ* material. Area 4 is divided into five dredging units for testing:

- ***4ST***: The top interval (0 to -20 ft below the sediment surface) from the southern portion of Area 4 is comprised of discrete sampling locations 4A and 4B. This dredging unit has a total of approximately 96,000 cy of dredged material.

- ***4MT***: The top interval (0 to -20 ft below the sediment surface) from the middle portion of Area 4 is comprised of discrete sampling locations 4C, 4D, and 4E. This dredging unit has a total of approximately 95,000 cy of dredged material.

- ***4NT***: The top interval (0 to -20 ft below the sediment surface) from the northern portion of Area 4 is comprised of discrete sampling locations 4F and 4G. This dredging unit has a total of approximately 104,000 cy of dredged material.

- ***4SB***: The bottom interval (from -20 ft below the sediment surface to the project depth) from the southern portion of Area 4 is comprised of discrete sampling locations 4A, 4B, and 4C. This dredging unit has a total of approximately 126,000 cy of dredged material.

- ***4NB***: The bottom interval (from -20 ft below the sediment surface to the project depth) from the northern portion of Area 4 is comprised of discrete sampling locations 4D, 4E, 4F, and 4G. This dredging unit has a total of approximately 125,000 cy of dredged material.

Sediment cores will be collected from a total of 24 sampling locations within the footprint of the Parallel Thimble Shoal Tunnel Project area and three locations at the Willoughby Bank reference site (Figures 1-1 and 1-2, respectively). For this project, two separate reference samples from the Willoughby Bank area will be collected and tested: one representing silty-sand surface materials and one representing fine-grained sub-surface materials. One reference sample from the Atlantic Ocean reference site representing sandy surface materials will be collected and tested. Surficial sediments will also be collected from the lower Chesapeake Bay control site for use in laboratory bioassays (Figure 1-2).

Upon completion of field activities, samples will be composited and submitted to TestAmerica–Pittsburgh for bulk sediment and standard elutriate testing and to EA's Ecotoxicology Laboratory for ecotoxicological testing. Results will be used to characterize the sediments proposed for dredging and to determine the suitability of the dredged material for placement at the NODS.

1.5 ANALYTICAL AND ECOTOXICOLOGICAL TESTING

Target analytes, target detection limits, methodologies, elutriate preparation procedures, and sample holding times will be consistent with previous sediment studies conducted for previous ocean placement testing programs in the Norfolk area (EA 2011, 2014a, 2014b, 2014c, 2014d, 2015a, 2015b). Analytical testing of the bulk sediment, standard elutriates, and aquatic organism tissues will be conducted by TestAmerica Laboratories (TestAmerica–Pittsburgh) located in Pittsburgh, Pennsylvania. The list of target analytes, target detection limits, methodologies, elutriate preparation procedures, and sample holding times are derived from the following guidance documents:

- USEPA/USACE. 1998 (EPA-823-B-98-004). *Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S. – Testing Manual: Inland Testing Manual*.

- USEPA/USACE. 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual* (commonly called "The Green Book").

- USEPA/USACE. 1995 (EPA-823-B-95-001). *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations: Chemical Evaluations.*

- USEPA Region 3. 2000. M*id-Atlantic Regional Implementation Manual: Dredged Material Evaluation for Norfolk and Dam Neck Ocean Disposal Sites.*

Physical testing of the bulk sediment samples will include: grain size determination, Atterberg limits, total solids, and specific gravity. Chemical testing of the bulk sediment samples will include: metals (including mercury), PAHs, SVOCs, PCB congeners, chlorinated pesticides, organophosphorus pesticides, dioxin and furan congeners, tributyltin, cyanide, total sulfides, AVS/SEM, ammonia, TKN, total phosphorus, nitrate + nitrite, and total TOC. Analytical methods, target analytes, holding times, reporting limits, and laboratory quality assurance/ quality control (QA/QC) protocols are described and addressed in the Analytical Chemistry –

Quality Assurance Project Plan (QAPP). [Attachment II to the Sampling and Analysis Plan (SAP)]

Standard elutriates, which simulate release of metals and organic constituents in the water column during open water placement of material, will be prepared from sediment from each of the sampling locations. Chemical testing of the site water (elutriate preparation water), receiving water, and standard elutriates will include: metals, PAHs, PCB congeners, chlorinated pesticides, organophosphorus pesticides, SVOCs, dioxin and furan congeners, tributyltin, cyanide, total sulfides, ammonia, total TKN, total phosphorus, nitrate + nitrite, TOC. Analytical methods, target analytes, holding times, reporting limits, and laboratory QA/QC protocols are described and addressed in the Analytical Chemistry – QAPP [Attachment II to the SAP].

Target analytes for tissue testing will be selected based on concentrations of metals and organic constituents detected in the bulk sediments and discussions with USACE-Norfolk District and USEPA Region 3. Tissue analysis information is provided in the Analytical Chemistry-QAPP (Attachment II to the SAP).

The ecotoxicological testing program will include water column bioassays, whole-sediment bioassays, and bioaccumulation studies. Detailed information regarding test preparation and protocols are described and addressed in the Ecotoxicology Quality Assurance Project Plan (Ecotox-QAPP). [Attachment III to the SAP]

1.6 SITE-SPECIFIC SAMPLING AND ANALYSIS PROBLEMS

Sampling problems could include submerged utility cables, vessel traffic, and access difficulties. Potential site-specific problems include the following:

- Vessel traffic (ships, tugs/barges, pleasure craft),
- Weather (high winds, wave heights, fog) related delays,
- Submerged obstructions (pilings, rock, debris), and
- Core refusal, partial penetration, or insufficient sediment recovery due to hard substrate/sub-surface materials.

The field operations crew is experienced with the logistics associated with coring activities in busy ports and harbors. The field operations staff is prepared to handle logistical challenges that may arise during the project. The Field Operations Manager will report unanticipated logistical problems to the EA Project Manager and will provide recommendations and/or modifications to the sampling program to achieve the project goals while adhering to the proposed schedule.

Potential chemical analysis problems associated with the project include:

- Matrix interferences, and
- Moisture content of the sediment.

TestAmerica–Pittsburgh is experienced with conducting analytical testing of sediments. Matrix spike (MS) and matrix spike duplicate (MSD) samples will be run with each batch of samples to measure potential matrix interferences caused by the salts or the sediments. Sediments are adjusted for moisture content (up to 50 percent moisture) prior to analysis to achieve the lowest possible detection limits. In addition, TestAmerica is prepared and committed to achieving the project-required turn-around-time for the sample results. The laboratory is prepared to "trouble-shoot" and report any problems during the testing process to the EA Project Manager.

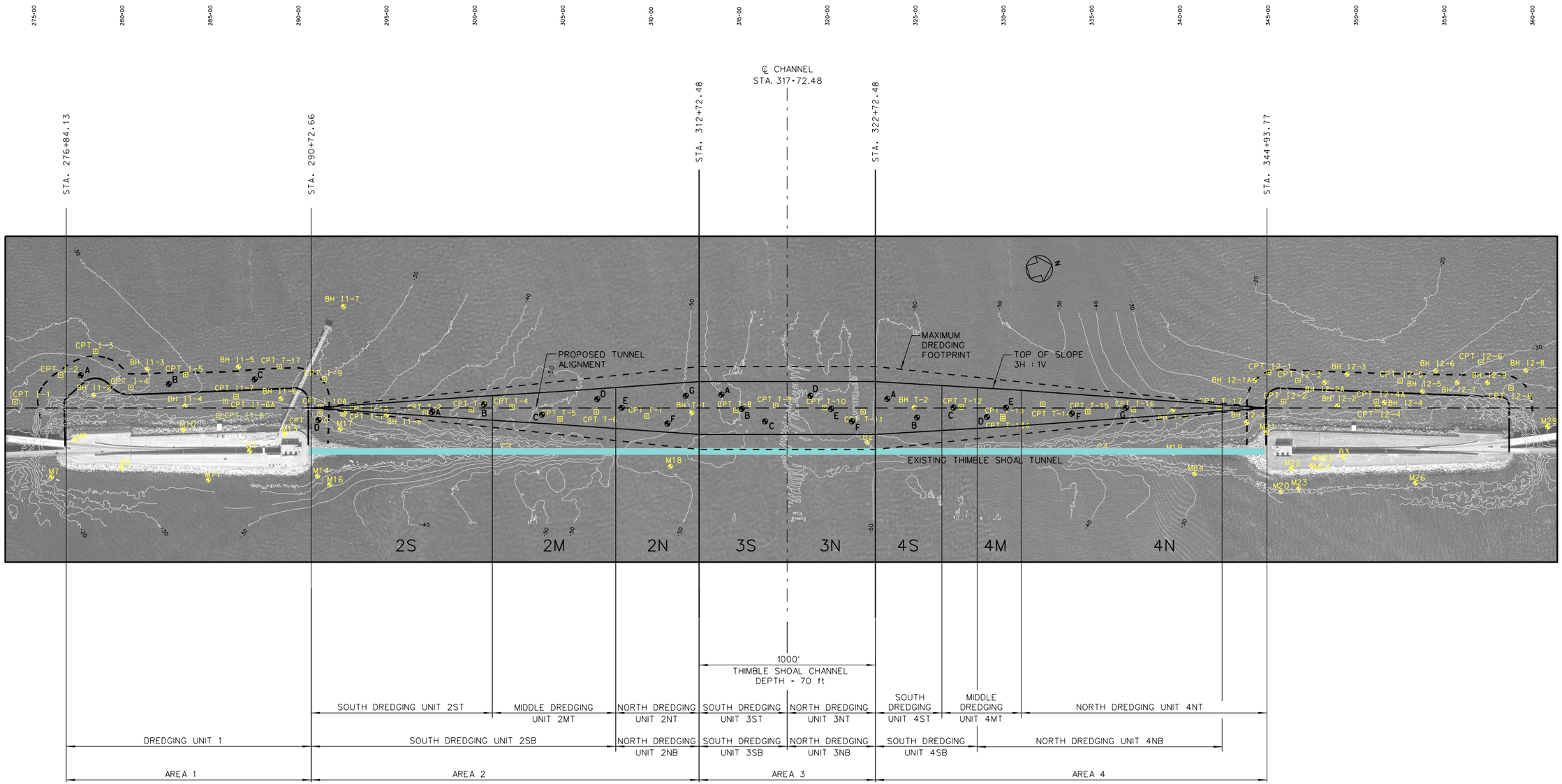


Figure 1-1 Dredging Areas, Dredging Units, and Coring Locations in the Parallel Thimble Shoal Tunnel Footprint

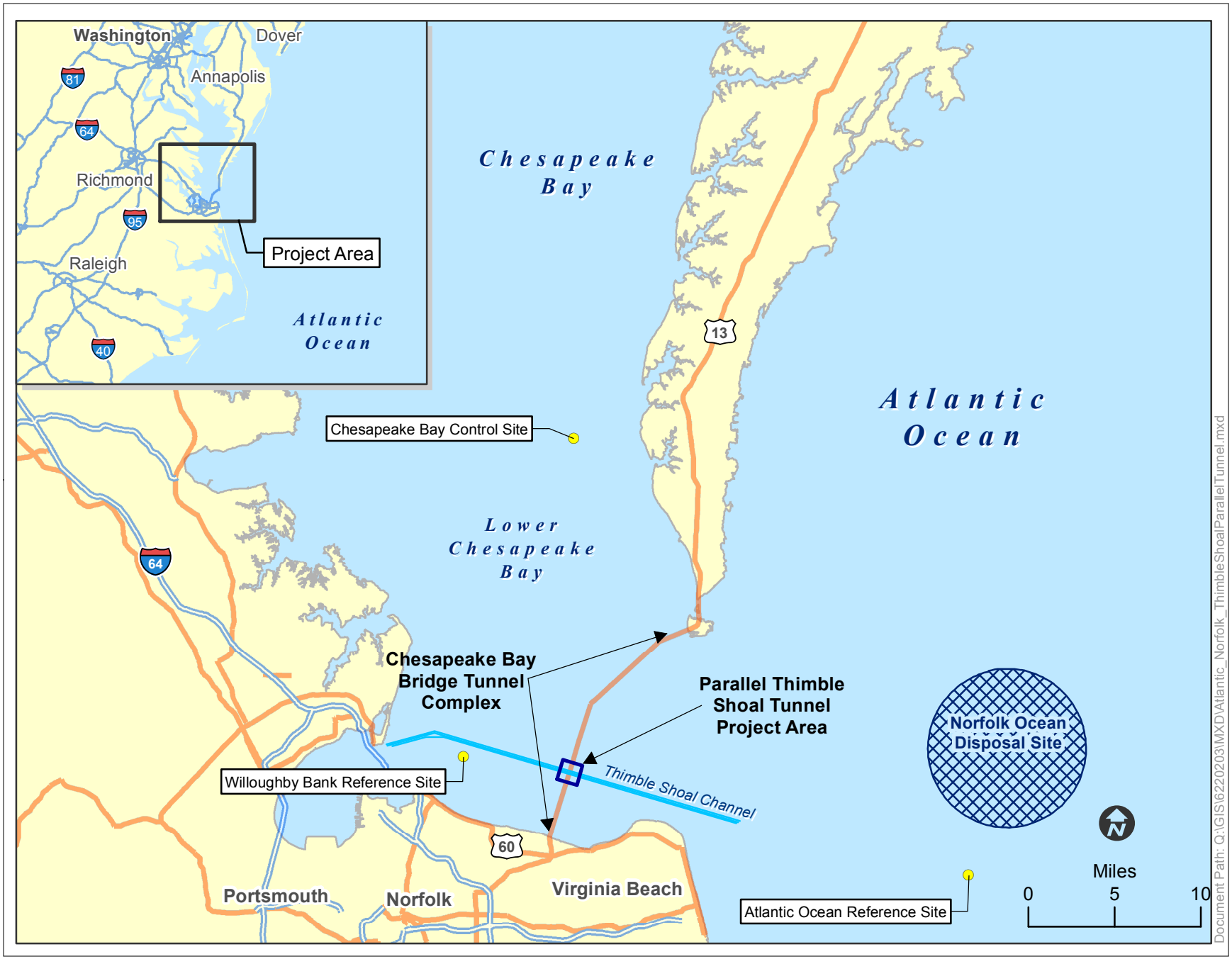
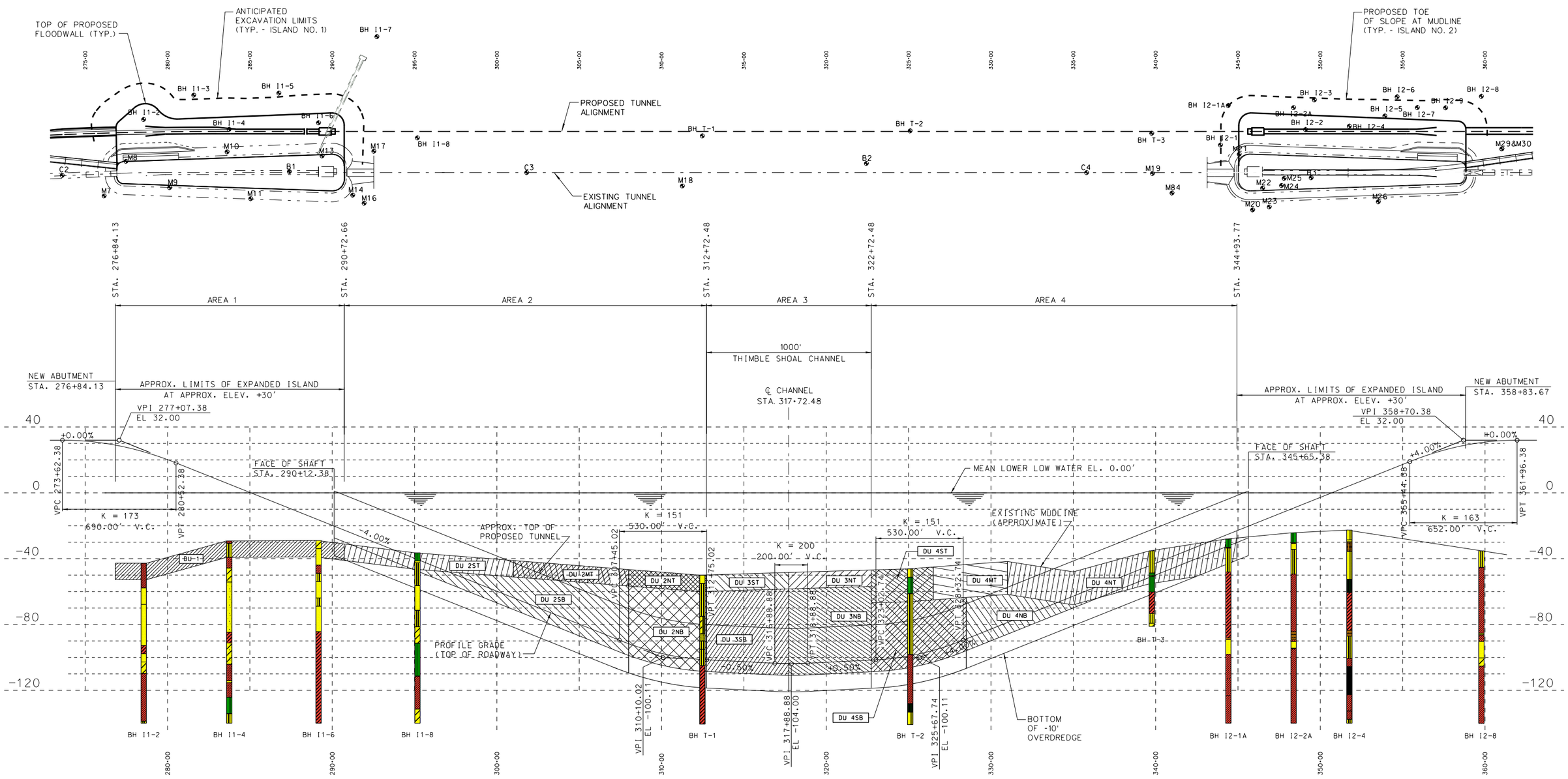


Figure 1-2. Sampling Locations for the Chesapeake Bay Control Site, Norfolk Ocean Disposal Site, the Willoughby Bank Reference Site, and the Atlantic Ocean Reference Site.



NOTE

DU ... INDICATES DREDGING UNIT

COMMONWEALTH OF VIRGINIA

CHESAPEAKE BAY BRIDGE AND TUNNEL DISTRICT

CAPE CHARLES, VIRGINIA 23310-0111

PARALLEL TUNNEL

TO

LUCIUS J. KELLAM,JR. BRIDGE-TUNNEL

JACOBS

FIGURE 2

PLAN AND PROFILE AT

FUTURE THIMBLE SHOAL TUNNEL

Figure 1-3. Parallel Thimble Shoal Plan and Profile

TABLE 1-1. TARGET LOCATIONS FOR OCEAN PLACEMENT SAMPLING/ TESTING

Dredging Area	Dredging Unit (DU)	Coring Location	Easting	Northing
			NAD 83, Virginia South State Plane (ft)	
1	1	1A	12179605	3519054
		1B	12179763	3519567
		1C	12179888	3520061
		1D	12180226	3520337
2	2S(T,B)	2A	12180352	3520976
		2B	12180397	3521247
	2M(T)	2C	12180540	3521567
		2D	12180585	3521866
	2N(T,B)	2E	12180639	3521974
		2F	12180793	3522230
		2G	12180706	3522377
3	3S(T,B)	3A	12180728	3522552
		3B	12180845	3522653
		3C	12180943	3522754
	3N(T,B)	3D	12180901	3523021
		3E	12180987	3523127
		3F	12181062	3523245
4	4S (T,B)	4A	12181048	3523426
		4B	12181160	3523573
	4M(T)	4C	12181186	3523782
		4D	12181281	3523970
		4E	12181270	3524061
	4N(T,B)	4F	12181392	3524429
		4G	12181473	3524731
Willoughby Bank Reference Site	WBREF(T,B)	A and Surface	12144083	3529629
		B and Surface	12149373	3527616
		C and Surface	12154941	3526023
Atlantic Ocean Reference Site	OCREF	Surface Samples Only	12303603.2	3491375.4
NODS Receiving Water	NODS	Water Collected Only	12315760.64*	3540750.84*

* = approximate, will be collected within NODS boundaries (Figure 1-2)

NAD 83 = North American Datum of 1983

TABLE 1-2 CORING SUMMARY AND NUMBER OF CORES REQUIRED FOR TESTING

Dredging Area	Dredging Unit (DU)	Coring Location	Water Depth (ft MLLW)	Boring Depth (ft MLLW)	Core Depth (ft) Below Sediment Surface	Linear Feet (LF) per Core	Number of Cores	Total LF per Sample Location	Approximate Volume to be Composited* (gallons)
1	1	1A	-44	-54	0-10 ft	10	3	30	69
		1B	-33	-43	0-10 ft	10	3	30	
		1C	-32	-42	0-10 ft	10	3	30	
		1D	-19	-29	0-10 ft	10	3	30	
2	2ST	2A	-42	-70	0-10 ft	10	5	50	57
		2B	-45	-80	0-10 ft	10	5	50	
	2SB	2A	-42	-70	10-28 ft	18	1	18	68
		2B	-45	-80	10-35 ft	25	1	25	
		2C	-50	-91	10-41 ft	31	1	31	
		2D	-50	-105	10-55 ft	45	1	45	
	2MT	2C	-50	-91	0-10 ft	10	5	50	57
		2D	-50	-105	0-10 ft	10	5	50	
	2NT	2E	-50	-110	0-10 ft	10	4	40	69
		2F	-50	-115	0-10 ft	10	4	40	
		2G	-50	-120	0-10 ft	10	4	40	
	2NB	2E	-50	-110	10-60 ft	50	1	50	95
		2F	-50	-115	10-65 ft	55	1	55	
		2G	-50	-120	10-70 ft	60	1	60	
3	3ST	3A	-55	-120	0-10 ft	10	4	40	69
		3B	-55	-120	0-10 ft	10	4	40	
		3C	-55	-120	0-10 ft	10	4	40	
	3SB	3A	-55	-120	10-65 ft	55	1	55	95
		3B	-55	-120	10-65 ft	55	1	55	
		3C	-55	-120	10-65 ft	55	1	55	
	3NT	3D	-55	-120	0-10 ft	10	4	40	69
		3E	-55	-120	0-10 ft	10	4	40	
		3F	-55	-120	0-10 ft	10	4	40	
	3NB	3D	-55	-120	10-65 ft	55	1	55	95
		3E	-55	-120	10-65 ft	55	1	55	
		3F	-55	-120	10-65 ft	55	1	55	
4	4ST	4A	-45	-120	0-20 ft	20	3	60	69
		4B	-45	-115	0-20 ft	20	3	60	
	4SB	4A	-45	-120	20-75 ft	55	1	55	86
		4B	-45	-115	20-70 ft	50	1	50	
		4C	-45	-110	20-65 ft	45	1	45	
	4MT	4C	-45	-110	0-20 ft	20	2	40	69
		4D	-45	-105	0-20 ft	20	2	40	
		4E	-45	-100	0-20 ft	20	2	40	
	4NT	4F	-48	-82	0-20 ft	20	3	60	69
		4G	-42	-75	0-20 ft	20	3	60	
	4NB	4D	-45	-105	20-60 ft	40	1	40	57
		4E	-45	-100	20-55 ft	35	1	35	
		4F	-48	-82	20-34 ft	14	1	14	
		4G	-42	-75	20-31 ft	11	1	11	
Reference Sediment									
Willoughby Bank Reference	WBREF-T	A	-30	Surficial Sediment Collected Only					
		B	-30						
		C	-30						
	WBREF-B	A	-30	-50	5-20 ft	15	3	45	77
		B	-30	-50	5-20 ft	15	3	45	
		C	-30	-50	5-20 ft	15	3	45	
Atlantic Ocean Reference	OCREF	OCREF	-67	Surficial Sediment Collected Only					
Control Sediment									
Lower Chesapeake Bay Control Site	CBCON	CBCON	-20	Surficial Sediment Collected Only					

*Based on 3.75-inch inner diameter lexan liner

TABLE 1-3 COMPOSITING SCHEME FOR CORE PROCESSING AND SAMPLE IDs

Dredging Area	Dredging Unit (DU)	Individual Core Samples	Depth Interval	Sediment Chemistry Sample ID	Standard Elutriate Sample ID	Site Water/Elutriate Preparation Water Sample ID
1	1	1A	0-10 ft	TS-1-SED	TS-1-SET	TS-WAT
		1B	0-10 ft			
		1C	0-10 ft			
		1D	0-10 ft			
2	2ST	2A	0-10 ft	TS-2ST-SED	TS-2ST-SET	
		2B	0-10 ft			
	2SB	2A	10-28 ft	TS-2SB-SED	TS-2SB-SET	
		2B	10-35 ft			
		2C	10-41 ft			
		2D	10-55 ft			
	2MT	2C	0-10 ft	TS-2MT-SED	TS-2MT-SET	
		2D	0-10 ft			
	2NT	2E	0-10 ft	TS-2NT-SED	TS-2NT-SET	
		2F	0-10 ft			
		2G	0-10 ft			
	2NB	2E	10-60 ft	TS-2NB-SED	TS-2NB-SET	
		2F	10-65 ft			
		2G	10-70 ft			
3	3ST	3A	0-10 ft	TS-3ST-SED	TS-3ST-SET	
		3B	0-10 ft			
		3C	0-10 ft			
	3SB	3A	10-65 ft	TS-3SB-SED	TS-3SB-SET	
		3B	10-65 ft			
		3C	10-65 ft			
	3NT	3D	0-10 ft	TS-3NT-SED	TS-3NT-SET	
		3E	0-10 ft			
		3F	0-10 ft			
	3NB	3D	10-65 ft	TS-3NB-SED	TS-3NB-SET	
		3E	10-65 ft			
		3F	10-65 ft			
4	4ST	4A	0-20 ft	TS-4ST-SED	TS-4ST-SET	
		4B	0-20 ft			
	4SB	4A	20-75 ft	TS-4SB-SED	TS-4SB-SET	
		4B	20-70 ft			
		4C	20-65 ft			
	4MT	4C	0-20 ft	TS-4MT-SED	TS-4MT-SET	
		4D	0-20 ft			
		4E	0-20 ft			
	4NT	4F	0-20 ft	TS-4NT-SED	TS-4NT-SET	
		4G	0-20 ft			
	4NB	4D	20-60 ft	TS-4NB-SED	TS-4NB-SET	
		4E	20-55 ft			
		4F	20-34 ft			
		4G	20-31 ft			
Reference Sediment						
Willoughby Bank Reference	WBREF-T	A	Surface	WBREF-T-SED	N/A	
		B				
		C				
	WBREF-B	A	5-20 ft	WBREF-B-SED	N/A	
		B	5-20 ft			
		C	5-20 ft			
Atlantic Ocean Reference	OCREF	--	Surface	OCREF-SED	N/A	
Control Sediment						
Lower Chesapeake Bay Control Site	CBCON	--	Surface	CBCON-SED	N/A	
Receiving Water						
Norfolk Offshore Disposal Site	NODS	--	Water	NODS-WAT	N/A	

* Mudline elevation approximate (may vary from -18 ft to -30 ft MLLW)

2. PROJECT ORGANIZATION AND PERSONNEL

The project team is organized to provide professional expertise in each of the major components necessary for the completion of the project. A project team organization chart and the project team contact information are provided in Figure 3-1 and Table 3-1, respectively, of the SAP.

The Field Team will consist of Cascade Drilling, Precon Marine, and EA personnel. Cascade Drilling personnel will be responsible for mobilization and demobilization of sonic drilling equipment and operations, and equipment decontamination. Precon Marine will provide a vessel captain for the jack-up barge. In addition, Precon Marine will provide daily crew boat transportation for Cascade and EA personnel to and from the project staging area (Little Creek) to the project site. EA personnel will provide sampling oversight, assist with drilling, and site water/elutriate preparation water collection, homogenization and compositing of samples, labeling and packing of cores and samples, transport of samples to appropriate testing laboratories, and direct coordination with analytical and ecotoxicological laboratories.

3. FIELD ACTIVITIES

The field investigation will consist of obtaining sediment cores from a total of 24 sampling locations within the dredging footprint for the Parallel Thimble Shoal Tunnel Project (Figure 1-1) and from 3 locations at the Willoughby Bank Reference Site. Surficial sediments will be collected with a grab sampler from the Willoughby Bank reference site and Atlantic Ocean reference site (Figure 1-2). Surficial sediments will also be collected from the Lower Chesapeake Bay control sediment for use in the amphipod bioassays (Figure 1-2). Approximately equal volumes of sediment from each location will be used to create a composite samples from each location for analytical and ecotoxicological testing.

Workdays will be approximately 10 hours in duration (dock to dock), with approximately 8 hours of sampling each day. The sequence of sample collection in any given area will be dependent upon anticipated vessel traffic in the Thimble Shoal Channel and auxiliary channels and local site and weather conditions. The day-to-day sequence of sampling will be determined at the discretion of the Field Operations Manager in consultation with Precon Marine, US Coast Guard (USCG), The Virginia Pilot Association, and other maritime interests. An operational plan and communication plan were specifically developed for this project, and are provided as appendices A and B, respectively, to this FSP. Copies of sampling permits are provided in Appendix C. Upon completion of field activities, samples will be submitted to TestAmerica–Pittsburgh for bulk sediment and standard elutriate testing and to EA's Ecotoxicology Laboratory for ecotoxicological testing.

EA, Precon Marine, and Cascade Drilling personnel will mobilize from Little Creek each morning, located next to the Joint Expeditionary Base Little Creek-Fort Story. They will be transported out to the drill rig each morning and back to shore each evening on a crew boat, owned and operated by Precon Marine. The mobilization address is:

Precon Marine
2465 Ferry Rd.
Virginia Beach, VA 23455

3.1 SAMPLING OBJECTIVES

The general objectives of the field sampling and sample processing include:

- Collect sediment cores from 24 individual locations from the four designated dredging areas within the footprint of the Parallel Thimble Shoal Tunnel within positioning accuracy appropriate for the project objectives;

- Homogenize sediment from each individual location according to Table 1-3 to create fifteen dredging unit composite Parallel Thimble Shoal Tunnel samples that will be submitted for bulk sediment, standard elutriate preparation, and ecotoxicological testing;

- Collect surficial sediment from the Willoughby Bank reference site and the Atlantic Ocean reference site;

- Collect sediment cores from three locations at the Willoughby Bank reference site to depths of -20 ft mean lower low water (MLLW);

- Homogenize sediment from each Willoughby Bank surficial reference location, each Willoughby Bank sediment core (from -5 to -20 ft), and each Atlantic Ocean surficial reference location to create three reference samples;

- Collect surficial sediment samples from the Chesapeake Bay control sediment site;

- Collect the required volume of site water from one location from within the project footprint for chemical analysis and standard elutriate preparation;

- Collect the required volume of receiving water from the NODS for chemical analysis;

- Measure and record water quality information (temperature, salinity, pH, dissolved oxygen, and turbidity) at each sampling location;

- Collect and transfer water and sediment to appropriate laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity;

- Complete appropriate chain-of-custody (COC) documentation; and

- Provide chemical and biological data for the Parallel Thimble Shoal Tunnel to assess potential impacts related to ocean placement, and to document compliance with Section 103 of the MPRSA.

3.2 SAMPLING LOCATION DETERMINATION

Samples will be collected from specified locations within the Parallel Thimble Shoal Tunnel dredging footprint. Northing and easting coordinates for the sampling locations, Willoughby Bank reference locations, Atlantic Ocean reference site, and the Chesapeake Bay control site are provided in Table 1-1 and are shown in Figure 1-1. Sampling locations will be located in the field using a differential global positioning system (DGPS).

Tide corrections for surface elevations will be based off real-time data from the NOAA station (ID 8638863) located on Island No. 1 of the Chesapeake Bay Bridge Tunnel.

3.3 SAMPLE VOLUME REQUIREMENTS

For each sample submitted for analytical and ecotoxicological testing, a total of approximately 2 gallons of sediment will be required for bulk sediment analysis, approximately 3 gallons of sediment will be required for the standard elutriate preparation, and approximately 25 gallons of sediment will be required for ecotoxicological testing. Therefore, a minimum of approximately 30 gallons of sediment will be required for each composite sample. Additional sediment volume will be collected from one location for MS and MSD analyses. Additional sediment volume, up

to approximately 35 additional gallons, will also be archived for each dredging unit to allow for re-analysis of physical, chemical, or ecotoxicological testing if needed.

From one sampling location, a total of approximately 80 gallons of site water will be required for chemical testing and standard elutriate preparation, and approximately 225 gallons of site water will be required for ecotoxicological testing. A total of approximately 300 gallons of site water will be collected from one location in the Parallel Thimble Shoal Tunnel dredging area. Approximately 2 gallons of water will be required from the NODS for receiving water analysis.

3.4 *IN SITU* WATER QUALITY MEASUREMENTS

Water quality measurements will be recorded *in situ* at each coring location, reference location, and water sampling location using a YSI water quality probe. Water temperature, salinity, and dissolved oxygen profiles (5-ft increments) will be recorded at each sampling location. EA will document calibration procedures and QC checks for the YSI water quality probe. The following parameters will be recorded in the field log book:

- Location number
- Sampling data and time
- Water depth
- Water temperature [degrees Celsius (ºC)]
- Salinity (parts per thousand)
- Dissolved oxygen, milligrams per liter
- pH
- Turbidity.

3.5 SAMPLE COLLECTION, STORAGE, AND TRANSPORT

3.5.1 Sediment Cores

Sediment cores will be collected to a depth ranging from -29 to -120 ft MLLW using sonic drilling. Sonic drilling uses high frequency mechanical vibration to take continuous core samples. A sonic drill rig with a specially designed hydraulically powered drill head will be connected to the rod or casing string. The frequency of vibration will be varied according to material type to achieve optimum drilling rates. When the frequency of vibration coincides with the natural frequency of the material being drilled, resonance occurs and produces maximum penetration rates. The sonic drill head can simultaneously vibrate and rotate the drill rods during advancement into the hole. The combination of vibration, rotation, and thrust can produce a continuous, relatively undisturbed core sample and a uniform borehole.

During drilling, the core barrel will be advanced ahead of the outer casing in 5-ft increments. The outer casing will then be advanced over the inner drill rods and core barrel, forming a protective sleeve through which the core barrel can be extracted. The outer casing will hold the boring hole open during the core removal process, preventing cross-contamination of groundwater and permitting drilling to resume at the bottom of the sample hole.

Sediment sampling within the Parallel Thimble Shoal Tunnel dredging footprint and at the reference site will be conducted using sonic drilling provided by Cascade Drilling. Sonic drilling will be conducted from a jack-up barge provided by Precon Marine. Sediment samples will be obtained using 3.75-inch-diameter Lexan tubing/liner contained in the core barrel in 5-ft sections. Clean, decontaminated tubing will be inserted into the core barrel prior to each sample interval. Once the sample has been collected and brought back on deck, the tubing/liner will be removed, capped, taped, and labeled.

Cores collected during each work day will be stored onboard the barge or sampling platform. Cores will be transferred to a refrigeration unit (cooled to 4ºC) at the onshore staging area at the end of each workday. The refrigeration unit at the staging area will be secured with a padlock when unattended. After completion of the coring activities, the sediment cores will be transported in a refrigerated truck (cooled to 4ºC) to EA in Hunt Valley, Maryland, where they will be composited and homogenized for testing. The cores will be stored in a secured refrigeration unit at EA (cooled to 4ºC) until they are processed. After the cores are processed, grain size samples will be shipped via overnight delivery to TestAmerica-Pittsburgh to determine appropriate reference samples, and all other samples will be hand delivered to either TestAmerica–Pittsburgh for bulk sediment and standard elutriate testing or to EA's Ecotoxicological Laboratory for ecotoxicological testing.

The sample containers, preservatives, and holding time requirements for sediment samples are provided in Table 3-1. Because sediments will be collected in core liners, holding times for the composite sediment samples from each location will begin when the sediment is composited, homogenized, and placed in the appropriate sample containers.

3.5.2 Field Duplicate

A field duplicate is a separate sample collected in the field at the same time and place as a normal sample. Duplicates are utilized to determine the precision of field sampling and laboratory analytical activities. Field duplicates are also indicative of sample homogeneity. For this project one field duplicate from one dredging unit composite will be submitted for analysis.

3.5.3 Willoughby Bank and Atlantic Ocean Reference Sediment

Surficial sediment will also be collected at the Willoughby Bank Reference Area and Atlantic Ocean reference sites using a stainless steel Van Veen grab sampler. Sediment will be collected from either the Old Dominion University *Research Vessel (R/V) Fay Slover* or from a vessel provided by Cape Henry Launch Service. Multiple grabs will be collected from each location to obtain the necessary sample volume for bulk sediment and ecotoxicological analyses. Sample composites will be created on board the work platform using stainless steel spoons and a pre-cleaned, 55-gallon stainless steel holding container. Because sediments will be collected using a grab sampler, holding times for the reference sediment samples will begin at the time of sample collection.

Reference sediment cores will also be collected from Willoughby Bank using a sonic drill rig provided by Cascade Drilling and will be conducted from a jack-up barge provided by Precon Marine. The method described above for the sediment core collection will be utilized.

Approximately equal volumes of sediment will be collected from each of the four target locations and will be used to create one composite sediment sample for analytical and ecotoxicological testing.

Cores collected during each workday will be stored onboard the barge or sampling platform. Cores will be transferred to a refrigeration unit (cooled to 4°C) at the on-shore staging area at the end of each workday. After completion of coring activities, the sediment cores will be transported in a refrigeration truck (cooled to 4°C) to EA in Hunt Valley, Maryland, where they will be logged, composited, and homogenized for testing. The cores will be stored in a secured refrigeration unit at EA (maintained at 4°C) until they are processed. 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 3-1. Because sediments will be collected in core liners, holding times for the composite sediment samples from each location will begin when the sediment is composited, homogenized, and placed in the appropriate sample containers.

3.5.4 Chesapeake Bay Control Sediment

Surficial sediment will be collected from the lower Chesapeake Bay control site for use in the amphipod whole sediment bioassays using a stainless steel Van Veen grab sampler. Sediment will be collected from the Old Dominion University *R/V Fay Slover* or from a vessel provided by Cape Henry Launch Service. Multiple grabs will be collected from each location to obtain the necessary sample volume for bulk sediment and ecotoxicological analyses. Sample composites will be created on board the work platform using stainless steel spoons and a pre-cleaned, 55-gallon stainless steel holding container. The sample containers, preservatives, and holding time requirements for sediment samples are provided in Table 3-1. Because sediments will be collected using a grab sampler, holding times for the reference sediment samples will begin at the time of sample collection.

3.5.5 Site Water/Elutriate Preparation Water/Receiving Water

Site water and elutriate preparation water will be collected from one location within the dredging footprint. Receiving water from the ocean placement site will be collected from mid-depth of the water column from the *R/V Fay Slover* or from a vessel provided by Cape Henry Launch Service. Site water/elutriate preparation water/receiving water will be collected from mid-depth of the water column using ISCO pumps with dedicated Tygon tubing, and will be stored at 4°C in 1-gallon certified cleaned, amber glass bottles. Site water targeted for use in ecotoxicological testing will be stored in 5-gallon high density polyethylene carboys. Elutriate preparation water and ecotoxicological testing water will be transported to a refrigeration unit at each staging area at the end of each work day and hand-delivered to TestAmerica–Pittsburgh and EA's Ecotoxicology Laboratory, respectively, for analyses at the completion of the core processing.

The sample containers, preservatives, and holding time requirements for site water, receiving water, and elutriate preparation water are provided in Table 3-2. Holding times for the site water

samples will begin when the samples are collected and placed into the appropriate sample containers.

3.5.6 Equipment Blanks

Equipment blanks are collected to determine the extent of contamination, if any, from the sampling equipment used as part of the project. Four equipment blanks will be collected—one for the core catcher, one for the sample processing equipment, one for the grab sampler and one for the peristaltic pump used to collect the site water. Equipment blanks are collected by pouring deionized water, which is provided by EA's Ecotoxicology Laboratory, 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 sediments and site water. Equipment blanks will be sent to TestAmerica–Pittsburgh via overnight delivery.

The sample containers, preservatives, and holding time requirements for equipment blanks are provided in Table 3-2. Holding times for the equipment blanks will begin when the samples are collected and placed into the appropriate sample containers.

3.6 EQUIPMENT DECONTAMINATION PROCEDURES

3.6.1 Core Collection

Between sample locations, coring equipment will be power washed or steam cleaned to remove all trace of sediment. Phthalate-free nitrile gloves will be used to prevent phthalate contamination of the sampling equipment or the samples.

3.6.2 Reference and Control Sediment, Site Water/Elutriate Preparation Water and Receiving Water Collection

Equipment that will come into direct contact with sediment during sampling will be decontaminated prior to deployment in the field and between each sampling location to minimize cross-contamination. This includes the Van Veen grab sampler, and stainless steel processing equipment (spoons, knives, bowls, etc.). While performing the decontamination procedure, phthalate-free nitrile gloves will be used to prevent phthalate contamination of the sampling equipment or the samples.

The decontamination procedure is described below:

- Rinse equipment using site water
- Rinse with 10 percent nitric acid
- Rinse with distilled or de-ionized water
- Rinse with methanol followed by hexane
- Rinse with distilled or de-ionized water
- Air dry (in area not adjacent to the decontamination area).

Waste liquids will be contained during decontamination procedures and transferred to EA's facility in Hunt Valley, Maryland, for disposal (see Section 6).

3.6.3 Core Processing

Equipment that will come into direct contact with sediment during sampling will be decontaminated prior to processing each composite sample to minimize cross-contamination. This includes the stainless steel processing equipment (spoons, knives, bowls, etc.) and stainless steel holding containers. While performing the decontamination procedure, phthalate-free nitrile gloves will be used to prevent phthalate contamination of the sampling equipment or the samples.

The decontamination procedure is described below:

- Rinse equipment using site water
- Rinse with 10 percent nitric acid
- Rinse with distilled or de-ionized water
- Rinse with methanol followed by hexane
- Rinse with distilled or de-ionized water
- Air dry (in area not adjacent to the decontamination area).

Waste liquids will be contained during decontamination procedures and transferred to EA's facility in Hunt Valley, Maryland, for disposal (see Section 6).

3.7 CORE PROCESSING

Cores will be processed in a designated area at EA's warehouse facility. Prior to processing, cores will be sorted and checked against the COC form. Sediments will be extracted from each core using a stainless steel extrusion rod, composited, and homogenized in cleaned, 55-gallon stainless steel holding containers. Samples submitted for testing will consist of a composite from either one or multiple cores from each dredging unit.

Prior to processing, cores from each location will be separated into those cores that represent the top 10 ft below the sediment surface, and those cores that represent the material from -10 ft to the project depth (In Dredging Area 4, cores will be separated into cores that represent the top 20 ft below the sediment surface and cores that represent material from -20 ft to the project depth) (Table 1-3). Samples from each section will be processed separately and will be composited and homogenized according to the scheme in Table 1-3. The composited samples will be homogenized using pre-cleaned, 55-gallon stainless steel holding containers. Each sample will be homogenized until the sediment is thoroughly mixed and of uniform consistency.

Sediment cores from each of the four target locations at the Willoughby Bank reference site will be composited from -5 ft to -20 ft to create one subsurface sample for analytical and ecotoxicological testing (Table 1-3). Prior to creating the subsurface composite sediment sample, sediment cores will be split lengthwise to determine the predominate grain size in each section of

the core. Only sediments with a fine-grained clay matrix will be retained for the subsurface reference composite sample.

Sample processing equipment that comes into direct contact with the sediment will be decontaminated according to the protocols specified in Section 3.6.3. When compositing is completed, sub-samples of sediment will be removed for bulk chemistry testing, standard elutriate testing, and ecotoxicological testing. Sediment to be used for ecotoxicological testing will be sieved through a 1-millimeter mesh screen to remove plant debris, predators, and shell and rock fragments prior to testing.

3.8 SAMPLING CONTINGENCIES

Sampling will be dependent upon daily vessel traffic, weather conditions (including heavy rain, high winds, lightning and/or fog), and severe weather forecasts may preclude sampling. The EA Project Manager will be notified of vessel traffic, weather-related delays by the Field Operations Manager. Weather contingency information is detailed in the Operational Plan (Appendix A).

If core refusal, limited recovery, obstructions, or limited sampling location access are encountered during sampling operations, the Field Operations Manager and EA Project Manager will determine the appropriate corrective actions (e.g., number of coring attempts and/or re-location of a station).

Precon Marine will provide divers to assist with emergency corrective actions for lift boat mechanical issues, stuck legs, or drill casing breaks. The Operational Plan (Appendix A) outlines the situations and corrective actions that may require diving operations.

TABLE 3-1. REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SEDIMENT SAMPLES[a] FOR THE PARALLEL THIMBLE SHOAL TUNNEL PROJECT

Parameter	Volume Required [b]	Container[c]	Preservative	Holding Time
Inorganics				
Metals (including Mercury)	32 oz.	G	4°C	6 months (28 days for Hg)
Cyanide	(d)	G	4°C	14 days
Ammonia	(d)	G	4°C	28 days
Sulfide	(d)	G	4°C	7 days
Total Solids	(d)	G	4°C	N/A
AVS/SEM	4 oz	G	4°C (no headspace)	14 days
Nitrogen (Nitrate, Nitrate)	(d)	G	4°C	28 days after leach
Nitrogen (Total Kjeldahl), Total Phosphorus	4 oz	G	4°C	28 days
Physical Parameters				
Standard Elutriate Test	3x1 gallon	G	4°C	14 days until elutriate creation
Unified Soil Classification System, Grain Size, Specific Gravity, Atterberg Limits,	32 oz	G	4°C	6 months
Organics				
Total Organic Carbon	(d)	G	4°C	14 days
Pesticides (Organochlorine and Organophosphorus), Semivolatile Organics (SVOCs), and Polynuclear Aromatic Hydrocarbons (PAHs), PCB Congeners	(d)	G	4°C	14 days until extraction, 40 days after extraction
Butyltins	(e)	G	4°C	14 days until extraction, 40 days after extraction
Dioxin/Furans	4 oz	G	4°C	1 year to analysis

a) From time of sample collection.

b) Additional volume will need to be provided for samples designated as MS/MSD/MDs.

c) G = glass.

d) Sufficient volume is provided from the 32 oz noted under Metals.

e) Sufficient volume is provided from the 32 oz. noted under Grain Size.

TABLE 3-2. REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES FOR SITE WATER, RECEIVING WATER, AND STANDARD ELUTRIATE PREPARATION WATER[(a)] FOR THE PARALLEL THIMBLE SHOAL TUNNEL PROJECT

Parameter	Volume Required [(b)]	Container[(c)]	Preservative	Holding Time
Inorganics				
Metals (including Mercury)	250 mls	P	pH <2 with HNO3 Cool, 4°C	6 months (28 days for Hg)
Cyanide	250 mls	P,G	NaOH to pH >12 Cool, 4°C	14 days
Sulfide	250 mls	P,G	NaOH/Zinc Acetate to pH >9 Cool, 4°C	7 days
Ammonia, Nitrogen, Nitrate & Nitrite	250 mls	P,G	H2SO4 to pH <2 Cool, 4°C	28 days
Total Phosphorus, Nitrogen (Total Kjeldahl)	500 mls (2x250 mls)	P,G	H2SO4 to pH <2 Cool, 4°C	28 days
Elutriate Testing				
Standard Elutriate Test	1x5 gallon cube	P	Cool, 4°C	14 days until elutriate creation
Organics				
Total Organic Carbon	2-40 mls	G,teflon-lined, septa cap	H2SO4 to pH <2; Cool, 4°C	28 days
Pesticides (Organochlorine and Organophosphorus), Semivolatile Organics (SVOCs) and Polynuclear Aromatic Hydrocarbons (PAHs), PCB Congeners	6 liters	G, teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
Dioxin/Furans	2 Liters	G, teflon-lined cap	Cool, 4°C	1 year to analysis
Butyltins	2 Liters	G, teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction

(a) From time of sample collection.

(b) Additional volume will need to be provided for samples designated as MS/MSD/MDs

(c) P = plastic; G = glass.

4. SAMPLE CHAIN-OF-CUSTODY AND DOCUMENTATION

Field notes will be recorded in a permanently bound, dedicated field logbook. A log of sampling activities, location coordinates, and water depths will be recorded in the log in indelible ink. In addition, water temperature, salinity, dissolved oxygen, turbidity, and pH profiles (5-ft increments) measurements will be recorded at each sampling location.

Personnel names, local weather conditions, and other information that may impact the field sampling program will also be recorded. Similar appropriate information will be recorded in this logbook as samples are processed and submitted to the laboratories for analyses. Each page of the logbook will be numbered and dated by the personnel entering information. Corrections to documentation will be made with a single line through the error with the author's initials and date. Copies of the logbooks will be filed at EA's office in Hunt Valley, Maryland. Full copies of the project logbooks will be submitted as an appendix to the project report.

4.1 NUMBERING SYSTEM

The sample numbering system will be used to communicate sample location and sample type between the field crew, sample processing crew, and the laboratories. The sampling locations are designated by dredging area (numbers 1 through 4), dredging unit (designated by geographic location and by core section), and individual location (letters A thorough F or A through G), according to the following scheme:

Dredging Area	Dredging Unit	Sample Designation
1	1	1A
		1B
		1C
		1D
2	2ST	2A
		2B
	2MT	2C
		2D
	2NT	2E
		2F
		2G
	2SB	2A
		2B
		2C
		2D
	2NB	2E
		2F
		2G
3	3ST	3A
		3B
		3C
	3NT	3D
		3E
		3F
	3SB	3A
		3B

Dredging Area	Dredging Unit	Sample Designation
		3C
	3NB	3D
		3E
		3F
4	4ST	4A
		4B
	4MT	4C
		4D
		4E
	4NT	4F
		4G
	4SB	4A
		4B
		4C
	4NB	4D
		4E
		4F
		4G

Sample identifications (IDs) will reflect the composite sediment samples that will be comprised of the samples within each individual dredging unit. Each composite sample ID submitted for physical, chemical, and ecotoxicological testing will contain information to indicate which dredging unit the sample was collected from, and whether or not the sample represents material from the top (from the sediment surface to 10 or 20 ft) or bottom (10 or 20 ft below the sediment surface to project depth) of the core.

An example of a sample ID is:

- TS-2ST-SED

where the set of letters denotes the site designation (TS=Thimble Shoal, WBREF = Willoughby Bank reference site, CBCON = Chesapeake Bay Control site, or AO= Atlantic Ocean reference site). The next three digits detail where the sample was collected—the dredging unit (numbers 1 through 4), the geographic location within that dredging unit (either "S" for south, "M" for middle, or "N" for north), the top or bottom of the core (T=top and B=bottom). In this example, this composite sample for dredging unit 2ST is comprised of samples collected from the two locations within dredging unit 2ST. The last three letters of the sample ID will indicate the type of sample collected:

- SED – sediment sample to be submitted for chemical and physical analyses
- WAT – water to be submitted for chemical/ecotoxicological analyses
- SET – water collected that will be used in the standard elutriate testing procedure.
- EQB – equipment blank sample to be submitted for chemical analysis
- FD – field duplicate
- MS/MSD – matrix spike/matrix spike duplicate

4.2 SAMPLE DOCUMENTATION

4.2.1 Core Labels

Upon collection, each core will be capped at either end and secured with duct tape. Each cap will be labeled with the sample designation, date, time, and depth interval of collection, and designated as top or bottom. This same information will be written on the core tube, as well. An example of a labeled core tube is as follows:

← TOP	TS-4A 0-5 ft 11/12/14 1440	BTM→

4.2.2 Sample Labels

Sample containers for the processed sediment and water samples will be labeled with the following information:

- Client name
- Project number
- Sample ID
- Sampling location
- Date and time of collection
- Sampler's initials
- Type of analyses required.

4.2.3 Chain-of-Custody Records

Sediment and site water samples collected in the field will be documented on a COC. COCs will accompany the samples to TestAmerica–Pittsburgh and EA's Ecotoxicology Laboratory for sample analysis.

5. SAMPLE PACKING AND SHIPPING

Sediment samples, site water/receiving water samples, equipment blanks, and standard elutriate preparation water will be stored in ice-filled coolers on the work platform until the end of each sampling day. Reference sediment, site water, receiving water, and equipment blanks will be packaged in bubble wrap, secured individually in ziplock bags, placed in an ice-filled cooler, and shipped via overnight express to TestAmerica–Pittsburgh in Pittsburgh. Reference sediment, site water, receiving water, and equipment blank samples for chemical analysis will be sent directly to the following addresses:

TestAmerica–Pittsburgh
301 Alpha Drive
Pittsburgh, PA 15238
(412) 963-7058
Attn: Ms. Carrie Gamber

Sediment samples and site water samples for ecotoxicological testing, sediment cores, and the standard elutriate preparation water will be stored in a secured walk-in refrigeration unit at the staging area at the end of each sampling day. After core processing is complete, grain size samples will be shipped to Test America via overnight delivery on a five day turn-around time (TAT) to determine appropriate reference samples. All other analyses will be performed on a standard 21-day TAT. Sediment composites and standard elutriate preparation water will be hand delivered to TestAmerica–Pittsburgh. Coolers (both shipped and hand-delivered) will have a copy of the COC form taped to the inside of the top lid.

Sediment samples and site water samples for ecotoxicological testing will be hand delivered to EA's Ecotoxicology Laboratory at the following address:

EA Ecotoxicology Lab
231 Schilling Circle
Hunt Valley, MD 21031
(410) 584-7000
Attn: Mr. Wayne McCulloch/Mr. Mike Chanov

6. INVESTIGATION-DERIVED WASTES

6.1 SAMPLE COLLECTION

During sample collection, waste liquids produced during decontamination procedures will be contained at the areas of decontamination. Decontamination waste liquid produced on-board the work platform or vessel will be collected in 5-gallon buckets with lids and transferred to a 55-gallon secure drum at the end of the project.

6.2 CORE PROCESSING

Decontamination waste liquid generated at the sample processing area and excess processed sediment will be contained directly in a secure drum located at EA's warehouse facilities in Hunt Valley, Maryland. The contents of the drums will be tested, characterized, and disposed of by a subcontractor.

Other consumables such as core tubes, personal protective equipment, and disposable sampling equipment will be bagged for disposal and managed as a solid waste and discarded with general trash (municipal waste). Core tubes will be wiped with a paper towel prior to disposal in order to remove excess sediment.

7. CORRECTIVE ACTIONS

Corrective actions or deviations from the work plan that are deemed necessary during field operations will be verbally approved by the Field Operations Manager and the EA Project Manager, or their designated representatives and Jacobs Engineering Group (if applicable). Any corrective actions taken during field activities will be documented in the field logbook and filed at EA's office in Hunt Valley, Maryland. Corrective actions will be discussed in the project report.

8. REFERENCES

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———. 2008. *Southeast Regional Implementation Manual (SERIM): Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern U.S. Atlantic and Gulf Coast Waters.* EPA 904-B-08-001.

APPENDIX A

Operational Plan

November 26, 2014

Operational Summary for Dredged Material Sampling/Additional Geotechnical Drilling Within and Adjacent to Thimble Shoal Channel

Project Purpose

EA Engineering, Science, and Technology, Inc. (EA), on behalf of the Chesapeake Bay Bridge and Tunnel District (CBBTD), will be conducting in-water drilling at 24 locations within and adjacent to the Thimble Shoal Channel in the vicinity of the Thimble Shoal Tunnel (Figure 1 and Table 1). The purpose of the project is to collect sediment cores representative of the material that will be dredged for the construction of a new Parallel Thimble Shoal Tunnel which is expected to occur in the 2016 through 2020 timeframe. The material in the sediment cores will be tested as per U.S Environmental Protection Agency (USEPA) Region III and US Army Corps of Engineers (USACE) requirements to determine if the material meets the criteria for placement at the Norfolk Ocean Disposal Site (NODS), which is located approximately 17 miles offshore.

Six of the 24 drilling locations (3A through 3F) for dredged material sampling are located within the boundary of the main Thimble Shoal Channel (Figure 2). Drilling within the main channel is necessary to comply with regulatory requirements for the evaluation of the dredged material. The drilling in the channel will extend to a maximum depth of -120 feet (ft) Mean Lower Low Water (MLLW), or approximately 65 ft below sediment surface. The drilling has been authorized by Virginia Marine Resources Commission (VMRC) Permit No. 14-0976 and Corps Nationwide Permit 6 for Survey Activities (US Army permit application number NAO-1214-1229). The CBBTD is the permit holder.

In addition to collecting material at 24 locations to evaluate ocean placement, deep geotechnical borings (to approximately -250 ft MLLW) will be conducted at six additional locations (Figure 3 and Table 1). These six additional locations are not located within the channel boundary, but are within the same project footprint as the dredged material drilling. The CBBTD will be requesting a modification to the existing VMRC and USACE permits for the dredged material sampling to include the additional geotechnical drilling.

This operational summary provides a schedule and timeframe for the drilling work, detail on vessels and equipment to be used, procedures for daily operations and communications, vessel mobility limitations, and contingency plans for work to be conducted within the Thimble Shoal Channel. It is the intent of the CBBTD to implement operational practices that will either avoid or minimize impacts to navigation within the channel and will allow for safe passage of vessels and safe conditions for work-related vessels.

Schedule/Timeframe for Work

The proposed drilling work is expected to be initiated in early January 2015 and will continue into March 2015. Drilling at the six additional geotechnical locations (outside of Thimble Shoal Channel) will be completed first, followed by the dredged material sampling/drilling. A Notice to Mariners will be issued by the US Coast Guard (USCG) following verification of the geotechnical drilling start date. Completion of the six additional geotechnical borings is expected to require approximately 4 to 6 weeks.

The dredged material sampling/drilling is expected to start in the early to mid-February 2015 time period and will continue for approximately 4 to 6 weeks. Drilling within the channel boundary will be intermittent throughout this period (mid-February through March), will be targeted during periods with limited or low expected vessel traffic, and will be dependent upon weather conditions. A notification will be issued when drilling activities within the channel are complete.

Vessels and Equipment

Drilling Platform – Capt. Ray, self-propelled Jack-up Barge (see attached Photo 1)
Owned and Operated by Precon Marine (Chesapeake, VA)
Dimensions: 64ft x 32ft x 7ft; Lift leg length 98.5ft; pads 12ft x 24ft
Navigation and Communication Equipment: Differential Global Positioning System (DGPS) with HYPACK navigational software, Automatic Identification System (AIS), VHF, and Radar.

Crew Boat – 45ft, *Bay Surveyor*
Owned and operated by Precon Marine (Chesapeake, VA)
Passenger Occupancy – 6
Navigation and Communication Equipment: Differential Global Positioning System, VHF, and Radar.

Drilling Equipment – Sonic Drill Rig (see attached Photo 2)
Owned and operated by Cascade Drilling (Marietta, OH)

Daily Operations and Communications

Drilling at each location in the channel will require approximately 8 hours to reach the maximum target drilling depth of -120 feet MLLW. Drilling operations will be conducted during daylight hours only. Although a continuous 8-hr work window is optimal, operations at each in-channel location will be completed (as necessary based on channel use limitations and anticipated vessel traffic) in multiple, shorter work segments to achieve the total target drilling depth. It is anticipated that the overall drilling program (24 total locations) will require a minimum of 24 working days (working Monday thru Saturday, as available), dependent upon weather and vessel traffic. The six in-channel locations and 18 locations outside of the channel can be drilled in any order, providing flexibility for tide, anticipated vessel traffic, and weather conditions.

Drilling activities in the channel will not take place on days when deep-draft vessels are scheduled for passage during drilling work hours or if a sufficient drilling window is not available. With regard to passage for non-deep draft vessels, locations 3A and 3F (see Figure 2) provide sufficient in-channel clearance (approximately 800-850 ft) to allow for drilling to continue during non-deep-draft vessel passage. Drilling holes in the central portion of the channel (locations 3B, 3C, 3D, 3E in Figure 2) will be vacated, as necessary, to accommodate passage of non-deep-draft vessels. A drilling hole within the channel will be vacated to accommodate vessel traffic needs with 1.5-hours advance notification, and drilling will be resumed and completed at a later day and/or time to avoid navigation-related impacts.

Precon Marine will be responsible for the daily vessel operations of the *Capt. Ray*. The vessel captain will navigate to pre-determined locations, monitor ship traffic, communicate with local vessels via VHF radio, and coordinate with designated channel vessel/traffic authorities (USCG, VA Pilot Association, US Navy, Virginia Maritime Association (VMA), and/or other entities, as required). One representative from EA will be on the drilling platform each day to oversee operations performed by Precon Marine and Cascade Drilling. The *Capt. Ray* will jack-up each night at a location outside of the channel, and a crew will remain onboard the *Capt. Ray* 24 hours a day. A crew boat will transport daily drilling and oversight personnel (up to maximum of 6 support staff) from Little Creek, VA to/from the *Capt. Ray* each day.

The sequence of sampling will be determined on a day-by-day basis and will be dependent upon weather and anticipated in-channel vessel traffic. Channel availability will be jointly determined by EA and Precon Marine each day based on direct communication with the USCG, US Navy Port Operations, VA Pilot Association, and VMA. Each evening, Precon Marine and EA will coordinate with the USCG, US Navy, VA Pilot Association, and VMA to receive notification of the expected traffic schedule for the following day. Drilling at the in-channel locations will be prioritized so that windows of expected low traffic use are utilized. The USCG, US Navy, VA Pilot Association, and VMA will be notified each morning jointly by EA and Precon Marine prior to crew transit from Little Creek to confirm daily schedule/location for in-channel drilling, allowing for

communication of vessel traffic changes since the previous evening and allowing for changes to the schedule for in-channel drilling (as necessary). Precon Marine will be notified of outbound traffic prior to vessels departing port and inbound traffic/arrivals at the offshore CB buoy.

In addition to daily verbal communications, a project-specific website will be established to provide maritime users with updated information on the drilling operations schedule, daily anticipated drilling locations, status of completion for each drilling location, weather or equipment delays, and equipment being utilized. The website will be updated by EA each evening and the following morning (as needed) following daily communications with the USCG, the US Navy, VA Pilot Association, and VMA and prior to crew departure from Little Creek. The website will be maintained and updated throughout the duration of the drilling project (both additional geotechnical and dredged material sampling). The USCG, US Navy, VA Pilot Association, and VMA will be provided password access to the website.

Work Platform/Equipment Set-up and Mobility

The jack-up barge and drill rig will be immobile during drilling operations. The sequence and timing for vessel and equipment set-up and demobilization is detailed below. A minimum 1.5-hour advance notification time is required to safely vacate or abandon a location within the channel. The procedure for vacating the channel with 1.5 hours advance notification is provided in the *Contingency Planning* section of this plan.

Set-up on Target Location:

- When the barge is positioned on the target drilling location, the port and starboard legs will deploy first, followed by the stern leg. Port and starboard leg deployment and adjustments require approximately 20 minutes, and stern leg deployment requires approximately 20 minutes, for a total of approximately 40 minutes for rig setup on target location. All attempts will be made to set up and position the barge to minimize the amount of equipment that will be in the central portion of the channel. The channel clearance at locations 3A and 3F is approximately 800-850 ft; the channel clearance at locations 3B and 3E is approximately 700 ft, and the channel clearance at locations 3C and 3D is approximately 600 ft.
- Drilling operations at each location will commence after the platform is jacked up and stabilized. Drilling involves lowering steel casing through the water column to the seafloor at approximately 5-7 ft per minute. Based on approximate 55ft water depth in the channel, it is estimated that lowering the casing through the water column to sediment surface will require approximately 10 minutes.
- The drill will advance within the casing by five-foot sections using 50-150 Hz vibration. It is estimated that, on average, two to three, 5-ft sections will be advanced each hour (for a total of 10-15 linear ft per hour). Each consecutive five-foot section will be retrieved and stored on the work platform. The time to retrieve each 5-ft core section increases as the hole depth increases.

Demobilization from or Abandonment of Drilling Location:

- Once the target drilling depth is reached, the drill casing will be retrieved at the same rate it was deployed. Approximately 20-25 minutes will be required for drill casing retrieval at deepest drilling locations in the channel (-120 ft MLLW).
- After the drill casing is above the seafloor + jacked-up barge height, *Capt. Ray* will begin jacking down. This process includes lowering the barge to the water surface level and raising the legs to a navigable height, which will require approximately 20-30 minutes, if positioned at the deepest locations.

Contingency Planning

Weather

Weather forecasts will be reviewed each morning prior to drilling crew departure from Little Creek, and weather and tide conditions will be monitored throughout each work day. Drilling operations will not take place under the following weather conditions: winds exceeding 20 miles per hour (mph), maximum wave heights exceeding 3-4 feet, and/or poor/reduced visibility conditions (such as fog). Work will be conducted during rain and/or snow events, if wind and wave heights are optimal and visibility is not reduced. If drilling is underway and weather conditions and/or visibility are forecasted to deteriorate, drilling activities will be suspended, drilling equipment will be retrieved, the barge will be jacked-down, and crew will be transported back to Little Creek prior to worsening conditions. The barge will remain offshore with operational crew and will be moved to the lee side of Island 1 or 2, depending upon wind and tide conditions. If several continuous/sequential days of unfavorable weather are forecasted, the jack-up barge may be moved to Little Creek until optimal weather conditions resume. The USCG, US Navy, VA Pilot Association, and VMA will be notified if work in the channel is suspended due to weather and will also be notified if the barge is temporarily re-located to Little Creek.

Vacating/Abandoning Drilling Location in Channel to Allow Vessel Passage (minimum of 1.5 hrs advance notification)

Assuming a channel water depth of 55 ft with the drill casing deployed to -120 MLLW (approximately 65 ft below sediment surface):

1) Drill and casing will be retrieved at approximately 3-4 ft per minute to 10 ft above the sediment surface (approximately 75 ft of retrieval) = requires approximately 20-25 minutes
2) Once drilling equipment is approximately 10 ft above the sediment surface, *Capt. Ray* will jack down and raise legs to a navigable height = requires approximately 20-30 minutes
3) *Capt. Ray* will depart the channel at 5-7 kts. Transit time across the entire 1,000 ft wide Thimble Shoal Channel is approximately 3-5 minutes. Transit time to vacate the channel will be dependent upon the exact drilling location.
4) Total time to vacate the channel is expected to range from 43-60 minutes.

Unanticipated Vessel Passage in Channel

Due to continuous monitoring of vessel traffic using AIS and communications with the USCG, US Navy, and VA Pilots Association, it is not expected that unanticipated deep-draft or US Navy vessels will be encountered during drilling operations in the channel. The channel will not be vacated for transit of smaller commercial, recreation, or fishing vessels that are able to transit safety outside of the main channel. Drilling operations are not expected to impact or impede passage of these vessels, and sufficient clearance for these vessels will remain within the channel while drilling operations are underway. A Notice to Mariners will be broadcast by the USCG to notify all vessels of the work activities inside and outside the channel boundaries. Any smaller vessel(s) approaching in the vicinity of the *Capt. Ray* either within or outside of the channel will be contacted by Precon Marine using VHF radio.

Vessel, Equipment, or Mechanical Failure During In-Channel Work

Should any vessel, equipment, or mechanical issues occur during work activities within the channel, the USCG, US Navy, VA Pilot Association, and VMA will be notified immediately. Corrective actions and contingency plans to remedy the issue will be implemented, and the USCG, US Navy, VA Pilot Association, and VMA will be updated hourly regarding remedy status and any mobility limitations. Divers and diving equipment will be available onboard *Capt. Ray* during in-channel work to expedite corrective actions. The time required for completion of each corrective action may be greater than 1.5 hours and will dependent upon the actual situation and weather conditions at the time of occurrence. Possible failures and corrective actions (with estimated time requirements) are outlined below:

Drill Casing Failure

Although not a frequent occurrence, should a drill casing become disconnected or broken while drilling in the channel water column, the casing will remain lodged in the sediment column but the drill will be retrieved. Although it is not anticipated that the broken casing will be a hazard to deep-draft vessels, divers will be mobilized to the fracture location within a 10-20 minute time period. Divers will cut the casing off at the seafloor, and the water column portion of the casing will be retrieved onboard the *Capt. Ray*. The drilling company will maintain a suite of fishing tools onboard to attempt an expedited casing rescue procedure. Dependent upon weather conditions, it is expected that cutting and retrieving a broken casing may require 2-3 hours. Retrieval/recovery of the cut casing may be performed at a later time if the channel must be vacated. If drill casing failure should occur, the estimated time required to vacate the channel will be jointly determined by Precon Marine and Cascade Drilling based upon the site-specific conditions. The estimated time required to vacate will be communicated to the USCG, US Navy, VA Pilot Association, and VMA.

Stuck Jack-up Leg or Mechanical Failure of Jack-up Leg

Although not expected within the boundary of the Thimble Shoal Channel, soft sediment can cause jack-up barge legs to become stuck, hindering mobility and increasing the time necessary to vacate the channel. Precon Marine is experienced in these situations and can usually avoid this situation by adjusting the legs during setup. If active drilling poses no safety risk to divers, divers will be deployed during drilling (after leg set-up and settling), to inspect the pads for evidence/indication of a stuck leg/pad. Should a stuck leg/pad be confirmed during drilling operations, divers will prepare in advance for deployment after completion of drilling activities to jet water around the stuck pad. If divers cannot be deployed during active drilling operations for safety reasons, indication of a stuck leg/pad will occur when the barge attempts to jack-down and move offsite. Diver deployment time is expected to require 10 to 20 minutes and the water jetting could take up to 2 hours depending on the severity. If a mechanical failure occurs for a jack-up leg and the mechanical failure cannot be corrected, divers will be deployed to cut the leg. Diver deployment time is expected to require 10 to 20 minutes and cutting the leg may take up to 2-3 hours. Retrieval/recovery of the cut leg may be performed at a later time if the channel must be vacated. If a jack-up leg is stuck or if mechanical failure should occur, the estimated time required to vacate the channel will be determined by Precon Marine based upon the site-specific conditions. The estimated time required to vacate will be communicated to the USCG, US Navy, VA Pilot Association, and VMA.

Hydraulic Failure or Catastrophic Mechanical Failure

Although not likely to occur, should a hydraulic failure or catastrophic mechanical failure occur for the sonic drill rig while the casing is deployed, divers will be deployed to cut the drill casing. The estimated time to deploy divers, cut a drill casing and vacate the channel is approximately 2-3 hours. Should a hydraulic failure or catastrophic mechanical failure occur for the jack-up barge, divers will be deployed to cut the legs. The estimated time to deploy divers and cut each leg is approximately 3 hours, for an estimated total of 9 or more hours.

Propulsion System Failure for Jack-Up Barge

The *Capt Ray* is equipped with two separate propulsion engines. If one engine should fail, the second engine would be utilized to transit, maneuver, and vacate the channel as necessary. In addition, the *Bay Surveyor* (45-ft crew boat) will be available to assist, if needed, within a 1-hour timeframe. Failure of both propulsion engines for the *Capt. Ray* at the same time is not likely to occur. If catastrophic failure of both engines occurs, the *Bay Surveyor* would be available within a 1-hour timeframe to assist with moving the barge from the channel. A tug would be required to move the jack-up barge to a land-based facility for engine repairs. It is anticipated that the response time for a tug to arrive in the project area would be approximately 2-3 hours.

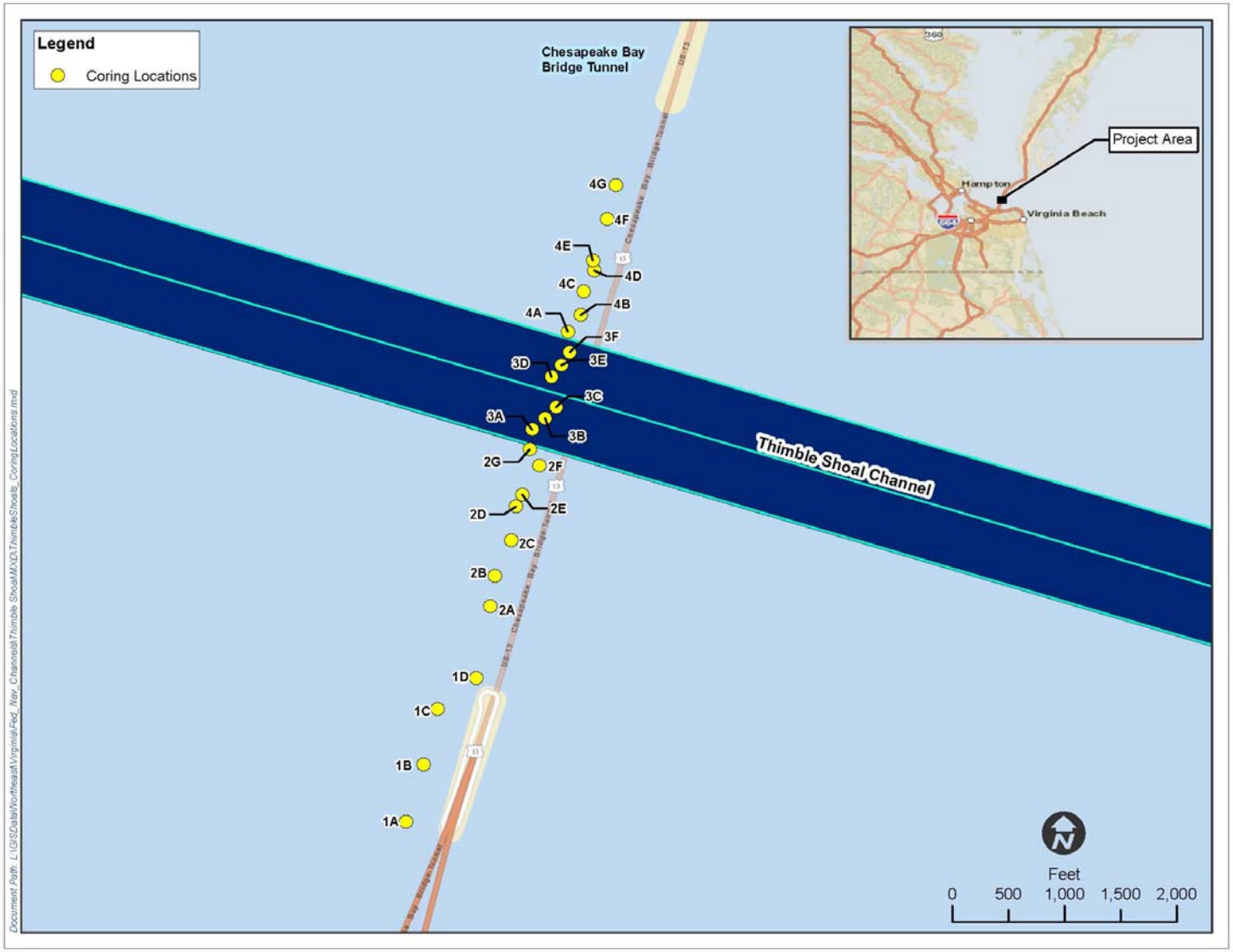


Figure 1. Drilling locations for Parallel Thimble Shoal Tunnel dredged material evaluation.

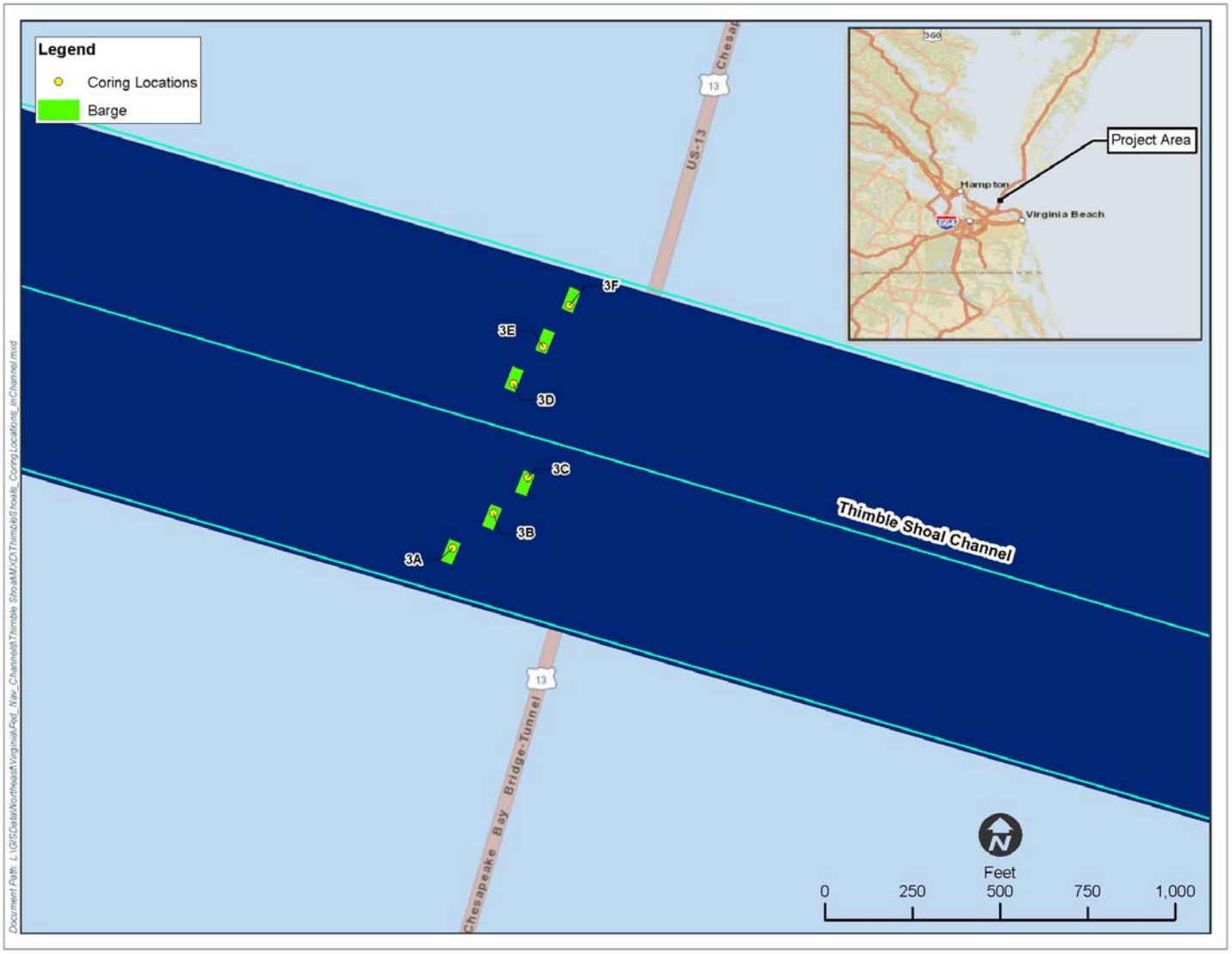


Figure 2. Drilling locations within Thimble Shoal Channel.

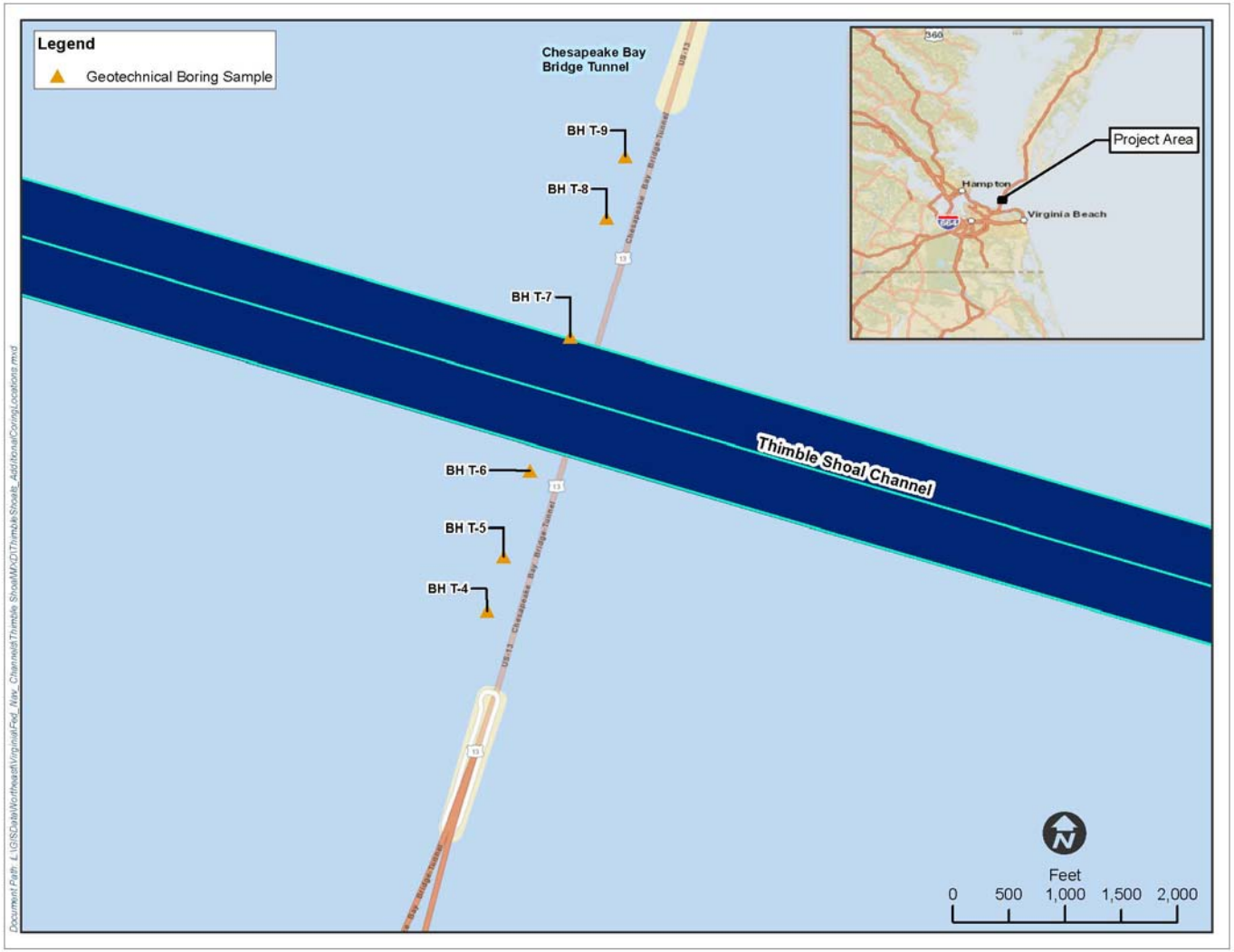


Figure 3. Additional geotechnical drilling locations to be completed prior to start of dredged material sampling/drilling.

Photo 1: *Capt. Ray* Jack-Up Barge

Photo 2. Sonic Drill Rig

Table 1. Drilling Locations and Coordinates

Drilling Location	Easting	Northing	Latitude (N)	Longitude (W)
	NAD 83, Virginia South State Plane (ft)		NAD83	
Dredged Material Evaluation Cores				
1A	12179605	3519054	36 57.807	76 06.909
1B	12179763	3519567	36 57.891	76 06.875
1C	12179888	3520061	36 57.972	76 06.846
1D	12180226	3520337	36 58.016	76 06.776
2A	12180352	3520976	36 58.121	76 06.746
2B	12180397	3521247	36 58.165	76 06.736
2C	12180540	3521567	36 58.217	76 06.705
2D	12180585	3521866	36 58.267	76 06.694
2E	12180639	3521974	36 58.284	76 06.682
2F	12180793	3522230	36 58.326	76 06.649
2G	12180706	3522377	36 58.350	76 06.666
3A	12180728	3522552	36 58.379	76 06.661
3B	12180845	3522653	36 58.395	76 06.636
3C	12180943	3522754	36 58.411	76 06.616
3D	12180901	3523021	36 58.456	76 06.623
3E	12180987	3523127	36 58.473	76 06.605
3F	12181062	3523245	36 58.492	76 06.589
4A	12181048	3523426	36 58.522	76 06.591
4B	12181160	3523573	36 58.545	76 06.567
4C	12181186	3523782	36 58.579	76 06.561
4D	12181281	3523970	36 58.610	76 06.540
4E	12181270	3524061	36 58.625	76 06.542
4F	12181392	3524429	36 58.685	76 06.515
4G	12181473	3524731	36 58.735	76 06.497
Additional Geotechnical Borings				
BH T-4	12180327	3520938	36 58.115	76 06.752
BH T-5	12180472	3521422	36 58.194	76 06.719
BH T-6	12180703	3522188	36 58.319	76 06.668
BH T-7	12181064	3523381	36 58.514	76 06.588
BH T-8	12181386	3524445	36 58.688	76 06.516
BH T-9	12181555	3524994	36 58.778	76 06.478

Indicates locations are within Thimble Shoal Channel (Figure 2)

APPENDIX B

Communication Plan

January 12, 2015
FINAL

Chesapeake Bay Bridge Tunnel
Parallel Tunnel at the Thimble Shoal Channel
Thimble Shoal Channel Dredged Material Sampling and Geotechnical Drilling

Communication Plan

EA Engineering, Science, and Technology, Inc., PBC (EA) has coordinated with multiple stakeholders to determine the most efficient and effective methods to exchange relevant information on field activities related to the Parallel Thimble Shoal Tunnel Drilling field effort. This communication plan provides an outline of the prescribed approach to disseminating information regarding project status, planned efforts, location of the drilling platform relative to the boundaries of Thimble Shoal Channel, and other pertinent information.

As part of the maritime coordination process, EA corresponded directly with the US Navy, VA Pilot Association (VPA), Military Sealift Command–Atlantic (MSCLANT), US Dept. of Transportation – Maritime Administration (MARAD), and the United Stated Coast Guard (USCG). This communication plan incorporates feedback received throughout the coordination process regarding type of information required, as well as the method of conveyance, distribution network, and frequency of communication within the stakeholder group. It is important to understand that full implementation of this plan will require two-way exchange of accurate information between the field operations team and the stakeholders listed above in a timely manner to maximize efficacy. This will be imperative as sampling encroaches upon or is performed within the Thimble Shoal Channel.

Members of the field operations team will receive the Daily Movement Report issued by Naval Station Norfolk, which will provide daily updates on anticipated naval vessel movements in the region. Additionally, the field operations team will gather and synthesize information from the following sources as a means of evaluating military and commercial vessel activity in the region.

- Port Operations Tower - Naval Station Norfolk
- Port Operations Tower - Joint Expeditionary Base - Little Creek
- VPA Cape Henry Control Tower
- VPA Dispatch Office
- MSCLANT Port Operations
- MARAD

It is anticipated that information flow will be achieved through a combination of daily telephone conversations and email exchanges with the end result being the development and implementation of an optimal sampling plan that minimizes impacts to vessel navigation in proximity to Thimble Shoal Channel and maximizes the safety of the operation each work day.

The overall drilling program is expected to require 12 weeks of work to complete, with multiple days of drilling likely at each of the 30 sampling locations. The actual schedule of drilling operations in a given week will be variable and tightly tied to expected conditions on-site, but typically limited to approximately 10 hours during periods of daylight and offering appropriate visibility (1-2 nmi). The drilling platform (L/B *Capt'N Ray*) will be moved away from the work site and moor well-outside traffic areas at night and when conditions degrade below minimum requirements.

The daily communication plan will be implemented as described below the evening before a given work day following a review of forecast weather conditions and sea state. Favorable or marginal conditions will result in the field crew moving forward with plans for the next work day. A forecast displaying obvious inclement weather and/or sea state that would prevent safe movement of the work platform or

transfer of personnel to and from the support vessel (e.g. gale warning) would result in a NO WORK notification and brief explanation of rationale.

Daily Communication Protocol

A. Evening Preceding Field Operations

1) 15:00 - EA Field Team Leader (Morris/Gelinas) will initiate the daily communications protocol in cooperation with key field operations staff (i.e., vessel captains, drill rig operator, etc.) following updated weather forecast.

2) 16:00 - EA Field Team Leader (Morris/Gelinas) shall request information from stakeholder Primary Contacts (US Navy, VPA, MSCLANT, MARAD) via telephone or email to evaluate military and commercial vessel activity in the region if conditions are forecast to be favorable or marginal. If conditions are forecast to be unfavorable, a NO WORK notification will be issued.

3) 16:30 - Each stakeholder source shall respond to requests for vessel traffic schedule/patterns using the most up-to-date information available.

4) 17:00 - The field crew shall identify a primary and secondary location to conduct sampling that support the project objectives and minimizes/negates the potential for space conflicts or meeting situations in navigable waters based on best professional judgment.

5) 18:00 – The EA Field Team Leader (Morris/Gelinas) shall notify the broader stakeholder distribution list in Table 1 (Primary and Courtesy Contacts) of intended primary and secondary locations (including chartlet) and provide a brief rationale via email (see Example 1).

6) 20:00 – Stakeholders shall confirm receipt of notice via email and concur. Those identifying known/potential conflicts or requesting adjustment of plans (i.e., use of secondary location) due to updated schedules, emergency actions, etc. are asked reply and disclose information as necessary or appropriate.

B. Morning Communication

1) 07:00 - EA Field Team Leader (Morris/Gelinas) will make telephone calls to the 24-hour manned facilities of the maritime stakeholders (Control Towers, Dispatch Centers, Port Operations Centers) and re-state intended sampling plan or communicate changes based on conditions on-site. Objections will be noted and adjustments made to the daily sampling activity (move to secondary location) if necessary. A final call will be made to the USCG Command Center to re-state findings of stakeholder discussions and finalize daily activity plan.

2) 07:30 - EA Field Team Leader (Morris/Gelinas) will issue a single email to the broader stakeholder distribution list (Primary and Courtesy Contacts) in Table 1 confirming the intended sampling location(s) for that day. An example email message is provided as Example 2. The L/B *Capt'N Ray* will then move to and jack up on the agreed upon location. If necessary, a NO WORK notification may be issued if conditions are unfavorable or sea state prevents L/B *Capt'N Ray* from mooring on the desired/agreed upon location or secondary location.

C. Real-Time Communication

1) The L/B *Capt'N Ray* is equipped with an Automatic Identification System (AIS), providing vessel location and status in real-time to commercial vessels in the region. The captain or mate

will monitor VHF channels 13 and 16 throughout the day in order to communicate with concerned inbound and outbound traffic as necessary.

2) In addition, the vessel crew shall provide periodic updates on position/intentions to stakeholder Control Towers, Dispatch Centers, Port Operations Centers and USCG Command Center via VHF radio as necessary throughout and at the conclusion of the work day.

3) Stakeholders and the USCG are requested to provide emergency updates on vessel traffic to the L/B *Capt'N Ray* as necessary via VHF radio transmissions and/or cellular phone.

   *** Please note that the L/B *Capt'N Ray* requires a 1.5 hour minimum notice to vacate a location, should vessel traffic patterns/schedule change and the lift boat represents an obstruction to navigation. This notice should be communicated via VHF radio and cell phone of the EA Field Team Leader (Morris/Gelinas).

Weekly Progress Updates
Weekly progress updates summarizing work conducted and anticipated activities for the upcoming week will be developed by the EA Field Team Leader (Morris/Gelinas). The reports shall be circulated throughout the project team and stakeholder group (Primary and Courtesy Contacts) via email each Sunday throughout the project period of performance. These weekly updates will also include a table of drilling locations that have been completed or partially completed, updated chartlet(s), as well as a weather forecast synopsis and potential impacts on schedule.

Marine Weather Monitoring
Real-time weather monitoring and forecasting will be performed with the use of information published and broadcast by NOAA – National Weather Service. Marine forecasts consisting of wind speed, direction, and sea state at the worksite (Chesapeake Bay from Little Creek VA to Cape Henry VA including the Chesapeake Bay Bridge Tunnel), as well as adjacent zones will serve as the primary source of weather information. Updates for this area of Chesapeake Bay and adjacent coastal waters are typically issued every four hours and are accessible via the internet at the website provided below.
http://forecast.weather.gov/

In addition, the NOAA weather radio band on each VHF radio aboard the L/B *Capt'N Ray* and supporting crew boat will serve as an alternate means of monitoring the marine weather forecast for changes over the course of each work day. Each VHF radio will be equipped with the Specific Area Message Encoding (SAME) function which allows the NOAA weather radio band to actively broadcast emergency notices or alerts if a significant storm cell or front approaches the region and safe harbor is required.

The field team will also maintain real-time access to meteorological stations and buoys in the area in order to examine conditions prior to and during the work day. NOAA Station CBBV2 - 8638863 (co-located with the water level gauge at Island 1 of the Chesapeake Bay Bridge Tunnel) will be used as the primary station to monitor actual conditions, as well as trends in air temperature, wind speeds and barometric pressure based on observations updated on a six-minute interval. NOAA Buoy 44046, located approximately three nautical miles east of the work site, will provide a secondary source of meteorological information that is also updated on a six-minute basis, plus offer hourly observations of significant wave height.
http://www.ndbc.noaa.gov/station_page.php?station=cbbv2

http://www.ndbc.noaa.gov/station_page.php?station=44064

Table 1. Points of Contact to be included in the AM and/or PM Communications for the duration of the Parallel Thimble Shoal Tunnel Drilling

Stakeholder	Contact	Primary/Courtesy	Contact Information	Afternoon Information Request	Evening Communications	Morning Information Request	Morning Confirmation	Real-time Communications
US Navy	Naval Station Norfolk Port Operations Tower (24 hour / 7 days)	Primary	757-444-2351 VHF Channels 12, 13, and 16	Yes	No	Yes	Yes	Yes
	Joint Expeditionary Base Little Creek Port Operations Tower (24 hour / 7 days)	Primary	757-462-7791 VHF Channels 12, 13, and 16	Yes	No	Yes	Yes	Yes
	Mr. Robert Hunt CNRMA Port Operations	Courtesy	Robert.P.Hunt@navy.mil (757) 445-8371	No	Yes	No	Yes	No
	Mr. Robert Miller	Courtesy	Robert.W.Miller1@navy.mil	No	Yes	No	Yes	No
VA Pilot Association	Cape Henry Tower	Primary	757-233-3020 VHF Channels 11 and 16	Yes	No	Yes	Yes	Yes
	Dispatch Office	Primary	757-233-3014	Yes	No	Yes	Yes	Yes
	Capt. Whiting Chisman	Courtesy	vicepres@vapilotassn.com	No	Yes	No	Yes	No
Military Sealift Command	CDR Rick Trevisan Operations Officer	Primary	richard.trevisan@navy.mil 757-443-5631	Yes	Yes	Yes	Yes	Yes
	Ms. Judy Lee Deputy Operations	Primary	judy.lee@navy.mil 757-443-5650	Yes	Yes	Yes	Yes	Yes
	CDR Christopher Anderson	Courtesy	christopher.d.ander4@navy.mil 757-443-5857	No	Yes	No	Yes	No
US Dept. of Transportation -- Maritime Administration	Steve Jackson	Primary	steve.jackson@dot.gov 757-322-5822	Yes	Yes	Yes	Yes	Yes
	Drew Hendley	Primary	andrew.hendley@dot.gov 757-322-5832	Yes	Yes	Yes	Yes	Yes
	Calvin Ferguson	Primary	calvin.ferguson@dot.gov 757-887-3233 extension 13	Yes	Yes	Yes	Yes	Yes
US Coast Guard Hampton Roads	Sector Hampton Roads Command Center (24 hour / 7 days)	Primary	757-638-6635 or 6637	Yes	No	Yes	Yes	Yes
	BOSN Carlos Hernandez	Primary	Carlos.A.Hernandez@uscg.mil 757-848-7140 (cell)	No	Yes	No	Yes	No
	LCDR Gregory Knoll	Courtesy	Gregory.J.Knoll@uscg.mil	No	Yes	No	Yes	No
	MSSD2 Dana Fleming	Courtesy	Dana.L.Fleming@uscg.mil	No	Yes	No	Yes	No
	MST1 Jae Ramirez	Courtesy	Jae.L.Ramirez@uscg.mil	No	Yes	No	Yes	No
US Army Corps of Engineers, Norfolk District	Stephen Powell	Courtesy	Stephen.J.Powell@usace.army.mil	No	Yes	No	Yes	No
	George Janek	Courtesy	George.A.Janek@usace.army.mil	No	Yes	No	Yes	No
Chesapeake Bay Bridge Tunnel District	Robert Johnson	Courtesy	rjohnson@cbbt.com	No	Yes	No	Yes	No
	Jim Long	Courtesy	jlong@cbbt.com	No	Yes	No	Yes	No
Jacobs Engineering Group	Jim McCarty	Courtesy	James.McCarty@jacobs.com 757-490-6140	No	Yes	No	Yes	No
	Carolyn Keeler	Courtesy	Carolyn.Keeler@jacobs.com 804-254-9620	No	Yes	No	Yes	No
EA Engineering, Science and Technology Inc.	John Morris	Primary	johnmorris@eaest.com 401-439-1031 (cell) VHF Channels 13 and 16	Initiate	Initiate	Initiate	Initiate	Initiate/Receive
	Morgan Gelinas	Primary	mgelinas@eaest.com 860-287-0745 (cell) VHF Channels 13 and 16	Initiate	Initiate	Initiate	Initiate	Initiate/Receive
	Peggy Derrick	Courtesy	pderrick@eaest.com 717-578-5323 (cell)	No	Yes	No	Yes	No

Example 1.

PM Email Template:

From: John Morris,
Sent: Wednesday, January 14, 2015 5:00 PM
To: Primary Contacts
Cc: Courtesy Contacts
Subject: RE: Marine Drilling Project - Thimble Shoal Channel 15 January Planned Activity

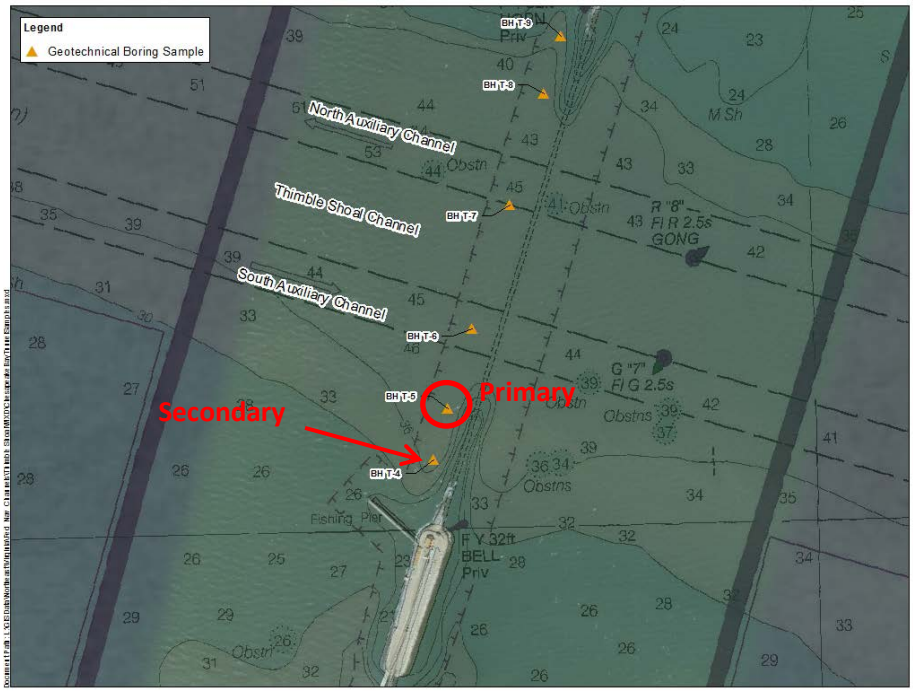
All,

Based on forecasted weather and sea state, as well as anticipated military and commercial traffic patterns/density, the field operations team has targeted the following primary and secondary locations at which to begin work on 15 January 2015.

<u>Primary Location</u>
BH T-5 (36°58.194'N; 76°06.719' W), approximately 1,000 ft SSW of Green Toe of Main Channel.

<u>Secondary Location</u>
BH T-4 (36°58.115' N; 76° 06.752' W), approximately 1,500 ft SSW of Green Toe of Main Channel.

The L/B *CaptN Ray* shall be on site from 07:30 through 17:00 and standing by on VHF Channels 13 and 16 for any concerned traffic. Please advise vessels to transit through area at minimal safe speed for maneuverability based on conditions.



Please confirm receipt and contact me at johnmorris@eaest.com or via cell phone (401-439-1031) by 20:00 today, 14 January with any significant objections.

Thanks,
John T. Morris
Sr. Marine Scientist
EA Engineering, Science, and Technology, Inc., PBC

Example 2.

AM Email Template:

From: John Morris,
Sent: Thursday, January 15, 2015 7:30 AM
To: Primary Contacts
Cc: Courtesy Contacts
Subject: RE: Marine Drilling Project - Thimble Shoal Channel 15 January Planned Activity

All,

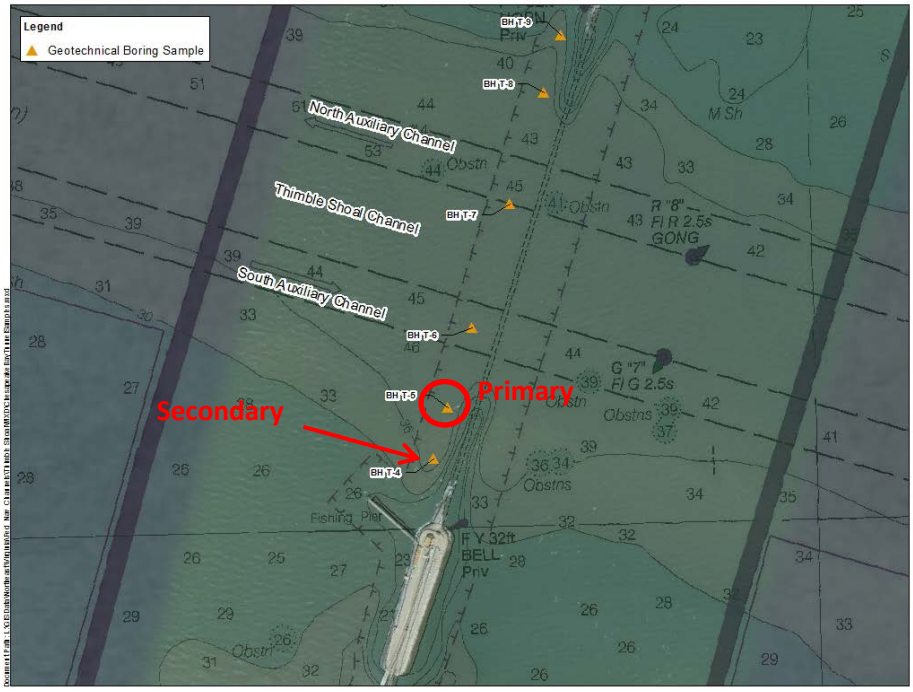
Based on actual weather and sea state, as well as input and concurrence from the project stakeholders and US Coast Guard, the field operations team will execute the sampling plan as proposed in our 14 January email. This email confirms that the L/B *CaptN Ray* will hold station at the Primary Location listed below and remain on site from 07:30 through 17:00. Vessel crew will monitor VHF Channels 13 and 16 for any concerned traffic. I will be available at johnmorris@eaest.com or via cell phone (401-439-1031).

Please advise vessels to transit through area at minimal safe speed for maneuverability based on conditions.

In the event site conditions or project objectives for the day change, the L/B *CaptN Ray* will re-locate to our selected Secondary Location or a position outside the project area. Stakeholders and the US Coast Guard will be advised as required.

Primary Location
BH T-5 (36°58.194'N; 76°06.719' W), approximately 1,000 ft SSW of Green Toe of Main Channel.

Secondary Location
BH T-4 (36°58.115' N; 76° 06.752' W), approximately 1,500 ft SSW of Green Toe of Main Channel.



Thanks,
John T. Morris
Sr. Marine Scientist
EA Engineering, Science, and Technology, Inc., PBC

APPENDIX C

Project Permits

Permit # 14-0967

Commonwealth of Virginia
Marine Resources Commission
Authorization

A Permit has been issued to:

Chesapeake Bay Bridge and Tunnel District
32386 Lankford Highway
Cape Charles, VA 23310

The Permittee is hereby authorized to:

Perform exploratory geotechnical borings as part of an overall geotechnical investigation for future improvements to the Chesapeake Bay Bridge and Tunnel within an area approximately 3000 feet wide by 18,300 feet long in the vicinity of the Thimble Shoals tunnel section and Islands #1 and #2 with the northernmost coordinates at N36°59'50", W76°06'01" and the southernmost coordinates at N36°56'58", W76°07'09". Additional sampling is authorized within an approximate 800 acre area of the Chesapeake Bay at the Willoughby Bank Reference Site (center coordinates of N36°59'59", W76°12'50") and also within an approximate 502 acre area at the Chesapeake Bay Control Site (center coordinates of N37°15'04", W76°05'38").

Issuance Date: August 4, 2014 Expiration Date: August 31, 2017

Tony Watt

Commissioner or Designee

This Notice Must Be Conspicuously Displayed At Site Of Work

COMMONWEALTH OF VIRGINIA
MARINE RESOURCES COMMISSION
PERMIT

The Commonwealth of Virginia, Marine Resources Commission, hereinafter referred to as the Commission, on this 4th day of August 2014 hereby grants unto:

Chesapeake Bay Bridge and Tunnel District
32386 Lankford Highway
Cape Charles, VA 23310

hereinafter referred to as the Permittee, permission to:

X Encroach in, on, or over State-owned subaqueous bottoms pursuant to Chapter 12, Subtitle III, of Title 28.2 of the Code of Virginia.

___ Use or develop tidal wetlands pursuant to Chapter 13, Subtitle III, of Title 28.2 of the Code of Virginia.

Permittee is hereby authorized to perform exploratory geotechnical borings as part of an overall geotechnical investigation for future improvements to the Chesapeake Bay Bridge and Tunnel within an area approximately 3000 feet wide by 18,300 feet long in the vicinity of the Thimble Shoals tunnel section and Islands #1 and #2 with the northernmost coordinates at N36°59'50", W76°06'01" and the southernmost coordinates at N36°56'58", W76°07'09". Additional sampling is authorized within an approximate 800 acre area of the Chesapeake Bay at the Willoughby Bank Reference Site (center coordinates of N36°59'59", W76°12'50") and also within an approximate 502 acre area at the Chesapeake Bay Control Site (center coordinates of N37°15'04", W76°05'38"). All activities authorized herein shall be accomplished in conformance with the plans and drawings dated received July 7, July 8, and July 10, 2014, which are attached and made a part of this permit.

This permit is granted subject to the following conditions:

(1) The work authorized by this permit is to be completed by **August 31st, 2017.** The Permittee shall notify the Commission when the project is completed. The completion date may be extended by the Commission in its discretion. Any such application for extension of time shall be in writing prior to the above completion date and shall specify the reason for such extension and the expected date of completion of construction. All other conditions remain in effect until revoked by the Commission or the General Assembly.

(2) This permit grants no authority to the Permittee to encroach upon the property rights, including riparian rights, of others.

(3) The duly authorized agents of the Commission shall have the right to enter upon the premises at reasonable times, for the purpose of inspecting the work being done pursuant to this permit.

(4) The Permittee shall comply with the water quality standards as established by the Department of Environmental Quality, Water Division, and all other applicable laws, ordinances, rules and regulations affecting the conduct of the project. The granting of this permit shall not relieve the Permittee of the responsibility of obtaining any and all other permits or authority for the projects.

(5) This permit shall not be transferred without written consent of the Commissioner.

(6) This permit shall not affect or interfere with the right vouchsafed to the people of Virginia concerning fishing, fowling and the catching of and taking of oysters and other shellfish in and from the bottom of acres and waters not included within the terms of this permit.

(7) The Permittee shall, to the greatest extent practicable, minimize the adverse effects of the project upon adjacent properties and wetlands and upon the natural resources of the Commonwealth.

(8) This permit may be revoked at any time by the Commission upon the failure of the Permittee to comply with any of the terms and conditions hereof or at the will of the General Assembly of Virginia.

(9) There is expressly excluded from the permit any portion of the waters within the boundaries of the Baylor Survey.

(10) This permit is subject to any lease of oyster planting ground in effect on the date of this permit. Nothing in this permit shall be construed as allowing the Permittee to encroach on any lease without the consent of the leaseholder. The Permittee shall be liable for any damages to such lease.

(11) The issuance of this permit does not confer upon the Permittee any interest or title to the beds of the waters.

(12) All structures authorized by this permit, which are not maintained in good repair, shall be completely removed from State-owned bottom within three (3) months after notification by the Commission.

(13) The Permittee agrees to comply with all of the terms and conditions as set forth in this permit and that the project will be accomplished within the boundaries as outlined in the plans attached hereto. Any encroachment beyond the limits of this permit shall constitute a Class 1 misdemeanor.

(14) This permit authorizes no claim to archaeological artifacts that may be encountered during the course of construction. If, however, archaeological remains are encountered, the Permittee agrees to notify the Commission, who will, in turn notify the Department of Historic Resources. The Permittee further agrees to cooperate with agencies of the Commonwealth in the recovery of archaeological remains if deemed necessary.

(15) The Permittee agrees to indemnify and save harmless the Commonwealth of Virginia from any liability arising from the establishment, operation or maintenance of said project.

The following special conditions are imposed on this permit:

(16) The yellow placard accompanying this permit document must be conspicuously displayed at the work site.

(17) Permittee agrees to notify the Commission a minimum of 15 days prior to the start of the activities authorized by this permit.

(18) Permittee must first contact the the United States Coast Guard to coordinate all survey activities.

Description of Fees	Amount	Unit of Measure	Rate	Total	Frequency	After-The-Fact
Permit Fee				$100.00	One-Time	
Total Permit Fees				**$100.00**		

This permit consists of 6 Pages

PERMITTEE

Permittee's signature is affixed hereto as evidence of acceptance of all of the terms and conditions herein.

In cases where the Permittee is a corporation, agency or political jurisdiction, please assure that the individual who signs for the Permittee has proper authorization to bind the organization to the financial and performance obligations which result from activity authorized by this permit.

PERMITTEE
Accepted for Chesapeake Bay Bridge and Tunnel District

4th day of Aug, 20 14

By _____
(Name) (Title)

MOLLY O. SHACKELFORD
NOTARY PUBLIC
Commonwealth of Virginia
Reg. #234864
My Commission Expires 7-31-15

State of Virginia
City (or ~~County~~) of Newport News, to-wit:

I, Molly O. Shackelford a Notary Public in and for said City ~~(or County)~~ and State hereby certify that Robert Johnson, Permittee, whose name is signed to the foregoing, has acknowledged the same before me in my City ~~(or County)~~ and State aforesaid.

Given under my hand this 4th day of Aug, 20 14
My Commission Expires:

Notary Public Molly O. Shackelford

COMMISSION

IN WITNESS WHEREOF, the Commonwealth of Virginia, Marine Resources Commission has caused these presents to be executed in its behalf by TONY WATKINSON, CHIEF HABITAT MANAGEMENT
(Name) (Title) Marine Resources Commission

4th day of AUGUST, 20 14

By _____

State of Virginia
City of Newport News, to-wit:

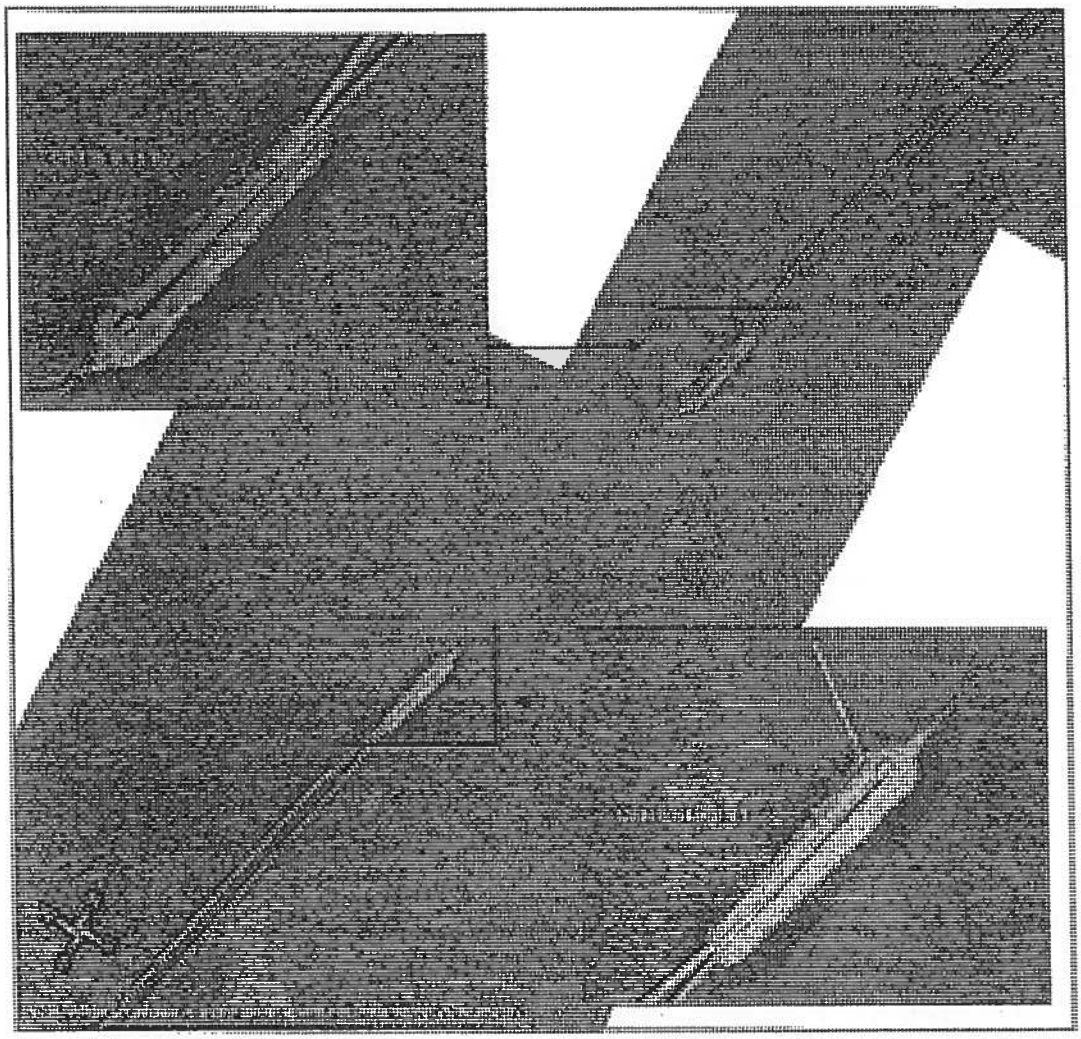
I, MOLLY O. SHACKELFORD, a Notary Public within and for said City, State of Virginia, hereby certify that TONY WATKINSON, whose name is signed to the foregoing, bearing the 4th day of August 2014, has acknowledged the same before me in City aforesaid.

Given under my hand this 4th day of AUGUST, 20 14
My Commission Expires:

Notary Public Molly O. Shackelford

JULY 31, 2015

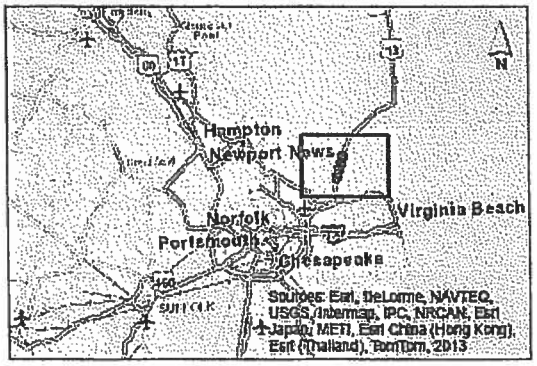
MOLLY O. SHACKELFORD
NOTARY PUBLIC
Commonwealth of Virginia
Reg. #234864
My Commission Expires 7-31-15



Overall Project Area
Chesapeake Bay Bridge Tunnel District
Thimble Shoal Parallel Tunnel

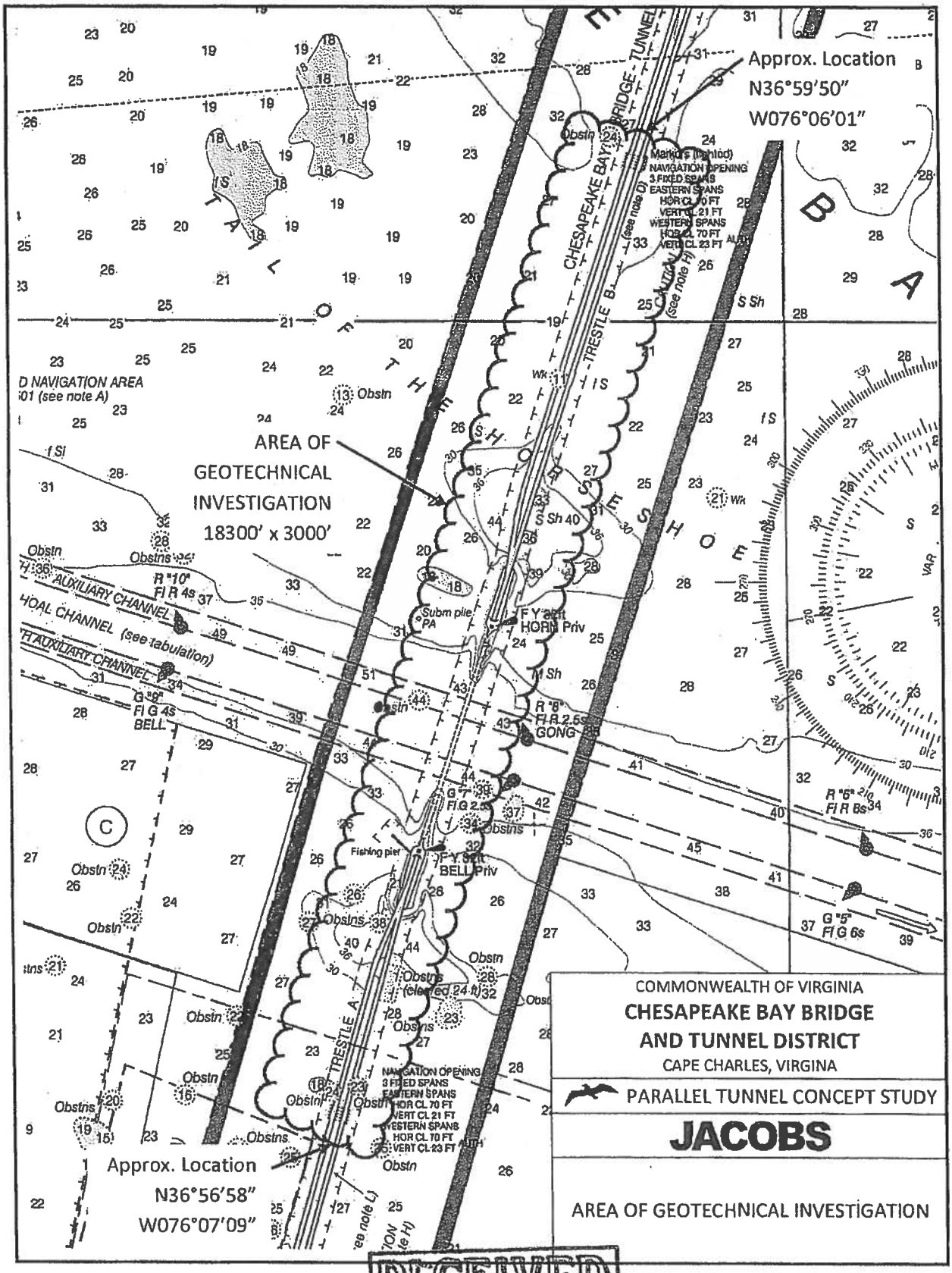
JACOBS

0 0.5 1 Miles

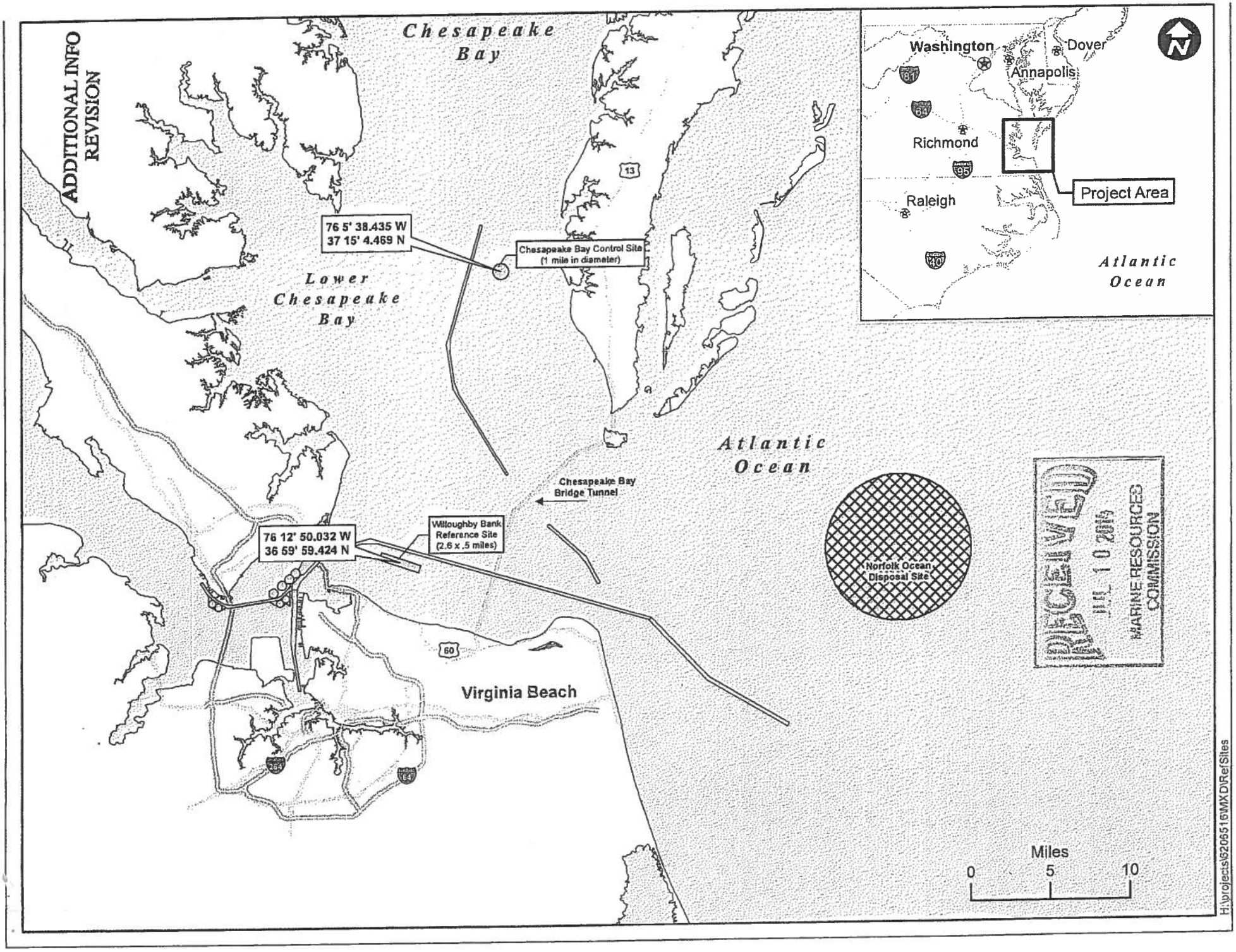


RECEIVED
JUL 07 2014
MARINE RESOURCES COMMISSION

ADDITIONAL INFO
REVISION



RECEIVED
JUL 08 2014
MARINE RESOURCES
COMMISSION


ADDITIONAL INFO
REVISION
Chesapeake
Bay
Lower
Chesapeake
Bay
76 5' 38.435 W
37 15' 4.469 N
Chesapeake Bay Control Site
(1 mile in diameter)
Chesapeake Bay
Bridge Tunnel
Atlantic
Ocean
Willoughby Bank
Reference Site
(2.6 x .5 miles)
76 12' 50.032 W
36 59' 59.424 N
Norfolk Ocean
Disposal Site
Virginia Beach
13
60
264
64
Washington
Dover
Annapolis
Richmond
Raleigh
95
Project Area
Atlantic
Ocean
Miles
0
5
10
RECEIVED
JUL 10 2015
MARINE RESOURCES
COMMISSION
H:\projects\6206516\MXD\RefSites

COMMONWEALTH of VIRGINIA

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

Molly Joseph Ward
Secretary of Natural Resources

John M.R. Bull
Commissioner

August 4, 2014

Chesapeake Bay Bridge and Tunnel District
Attn: Robert Johnson
c/o Jacobs Engineering Group, Inc.
Attn: Carolyn Keeler
2108 West Laburnum Avenue, Suite 100
Richmond, VA 23227

RE: VMRC #14-0967

Dear Mr. Johnson:

Enclosed is the Marine Resources Commission permit for your proposal to perform exploratory geotechnical borings as part of an overall geotechnical investigation for future improvements to the Chesapeake Bay Bridge and Tunnel within an area approximately 3000 feet wide by 18,300 feet long in the vicinity of the Thimble Shoals tunnel section and Islands #1 and #2 with the northernmost coordinates at N36°59'50", W76°06'01" and the southernmost coordinates at N36°56'58", W76°07'09". Additional sampling is authorized within an approximate 800 acre area of the Chesapeake Bay at the Willoughby Bank Reference Site (center coordinates of N36°59'59", W76°12'50") and also within an approximate 502 acre area at the Chesapeake Bay Control Site (center coordinates of N37°15'04", W76°05'38").

A yellow placard is also enclosed. This placard reflects the authorized activities for inspection purposes and must be conspicuously displayed at the work site throughout the construction phase. Failure to properly post the placard in a prominent location will be considered a violation of your permit conditions.

YOU ARE REMINDED THAT ANY DEVIATION FROM THE PERMIT OR ATTACHED DRAWINGS REQUIRES PRIOR AUTHORIZATION FROM THE MARINE RESOURCES COMMISSION. FAILURE TO OBTAIN THE NECESSARY MODIFICATION WILL BE CONSIDERED A VIOLATION AND COULD SUBJECT YOU TO CIVIL CHARGES IN AMOUNTS NOT TO EXCEED $10,000 PER VIOLATION.

The work authorized by this permit is to be completed by August 31, 2017. Please note that in conformance with Special Condition 17 of your permit you are to notify the Commission prior to commencement of your permitted project. The enclosed self-addressed, stamped postcard is to be used for this purpose. All other conditions of the permit will remain in effect.

Please be advised that you may also require issuance of a U. S. Army Corps of Engineers permit before you begin work on this project. You may wish to contact them directly to verify any permitting requirements.

Sincerely,

Tony Watkinson
Chief, Habitat Management

TW/and
HM
Enclosures
cc: Virginia Beach Wetlands Board
Agent

COMMONWEALTH of VIRGINIA

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

Molly Joseph Ward
Secretary of Natural Resources

John M.R. Bull
Commissioner

August 4, 2014

Chesapeake Bay Bridge and Tunnel District
Attn: Robert Johnson
c/o Jacobs Engineering Group, Inc.
Attn: Carolyn Keeler
2108 West Laburnum Avenue, Suite 100
Richmond, VA 23227

RE: VMRC #14-0967

Dear Mr. Johnson:

The enclosed permit will be issued to you after the necessary signatures are affixed and notarized.

1. Please review these documents.
2. Sign **both** copies before a Notary Public.
3. Return **both** copies to this office in the enclosed self-addressed envelope.
4. A check or money order for $100.00 should be made payable to the Marine Resources Commission and enclosed with the signed copies.

Upon receipt of the above signed documents bearing the proper signatures, the Marine Resources Commission will execute your permit and return it to you.

The permit is not valid until signed by the Permittee(s), a Notary Public, and the Commissioner. Be sure to include the title of the person accepting the financial and performance obligations explicit in the permit.

If for any reason you cannot return these documents within sixty days, please inform me of the reasons for the delay.

Sincerely,

Tony Watkinson
Chief, Habitat Management

TW/and
HM
Enclosures
cc: Agent

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
FORT NORFOLK
803 FRONT STREET
NORFOLK VA 23510-1096

Reply to
Attention of

AUGUST 5, 2014

Eastern Virginia Regulatory Section
NAO-2014-1229; VMRC #14-V0967 (Chesapeake Bay)

Chesapeake Bay Bridge and Tunnel District
Robert Johnson
Chesapeake Bay Bridge-Tunnel
32386 Lankford Highway
Cape Charles, Virginia 23310

Dear Mr. Johnson:

This is in regard to your Department of the Army permit application number NAO-2014-1229 (VMRC #14-0967) to impact approximately 38 square feet of subaqueous bottom in the Chesapeake Bay with the geotechnical borings associated with the improvements to Chesapeake Bay bridge-tunnel. The work will occur near latitude 37.0411 and longitude -76.0700, in and around the Thimble Shoal Channel and the two tunnel islands along the Chesapeake Bay Bridge-Tunnel in Virginia. These impacts are detailed on the enclosed drawings entitled "Chesapeake Bay Bridge and Tunnel District, Parallel Tunnel Concept Study, Area of Geotechnical Investigation," and "Figure 1 Dredging Locations at Thimble Shoal Channel" prepared and submitted on behalf of the applicant by Jacobs Engineering Group and date stamped as received by this office on July 8, 2014 and July 23, 2014 (attached).

Your proposed work as outlined above satisfies the criteria contained in the Corps Nationwide Permit 6 for Survey Activities, attached. The Corps Nationwide Permits were published in the February 21, 2012 Federal Register notice (77 FR 10184) and the regulations governing their use can be found in 33 CFR 330 published in Volume 56, Number 226 of the Federal Register dated November 22, 1991.

This nationwide permit verification is contingent upon the following project specific conditions:

1. You and/or your contractor shall vacate the channel to the extent necessary to provide safe passage for all approaching vessels.

2. You shall coordinate with the U.S. Coast Guard as required such that a notification for the permitted work is published in the Local Notice to Mariners a minimum of 10 calendar days prior to commencing work within the channel.

3. You will coordinate your drilling schedule with the U.S. Navy, the Virginia Pilot's Association, and other navigational interests a minimum of 30 days before

beginning work, and adjust your drilling schedule as practicable to minimize impacts to navigation.

The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

Provided the project specific conditions (above) and the Nationwide Permit General Conditions (enclosed) are met, an individual Department of the Army Permit will not be required. In addition, the Virginia Department of Environmental Quality has provided an unconditional §401 Water Quality Certification for Nationwide Permit Number 6. A permit may be required from the Virginia Marine Resources Commission and/or your local wetlands board, and this verification is not valid until you obtain their approval, if necessary. This authorization does not relieve your responsibility to comply with local requirements pursuant to the Chesapeake Bay Preservation Act (CBPA), nor does it supersede local government authority and responsibilities pursuant to the Act. You should contact your local government before you begin work to find out how the CBPA applies to your project.

Enclosed is a "compliance certification" form, which must be signed and returned within 30 days of completion of the project, including any required mitigation. Your signature on this form certifies that you have completed the work in accordance with the nationwide permit terms and conditions.

This verification is valid until the NWP is modified, reissued, or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 18, 2017. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this nationwide permit unless discretionary authority has been exercised on a case-by-case basis to modify, suspend, or revoke the authorization in accordance with 33 CFR 330.4(e) and 33 CFR 330.5 (c) or (d). Project specific conditions listed in this letter continue to remain in effect after the NWP verification expires, unless the district engineer removes those conditions. Activities completed under the authorization of an NWP which was in effect at the time the activity was completed continue to be authorized by that NWP.

If you have any questions, please contact me at (757) 201-7135 or by email at george.a.janek@usace.army.mil.

Sincerely,

George Janek
Project Manager, Eastern Virginia Regulatory Section

Enclosures

Cc: Justin Worrell, VMRC
Larissa Ambrose, DEQ
Carolyn Keeler, Jacobs Engineering

U.S. Army Corps
Of Engineers
Norfolk District

CERTIFICATE OF COMPLIANCE
WITH
ARMY CORPS OF ENGINEERS PERMIT

Permit Number: NAO-2014-1229
VMRC Number: 14-V0967

Corps Contact: George Janek

Name of Permittee: Chesapeake Bay Bridge and Tunnel District c/o Robert Johnson

Date of Issuance: August 5, 2014

Permit Type: Nationwide permit 6

Within 30 days of completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

US Army Corps of Engineers - Norfolk District
CENAO-WR-RE
Attn: George Janek
803 Front Street
Norfolk, VA 23510-1096

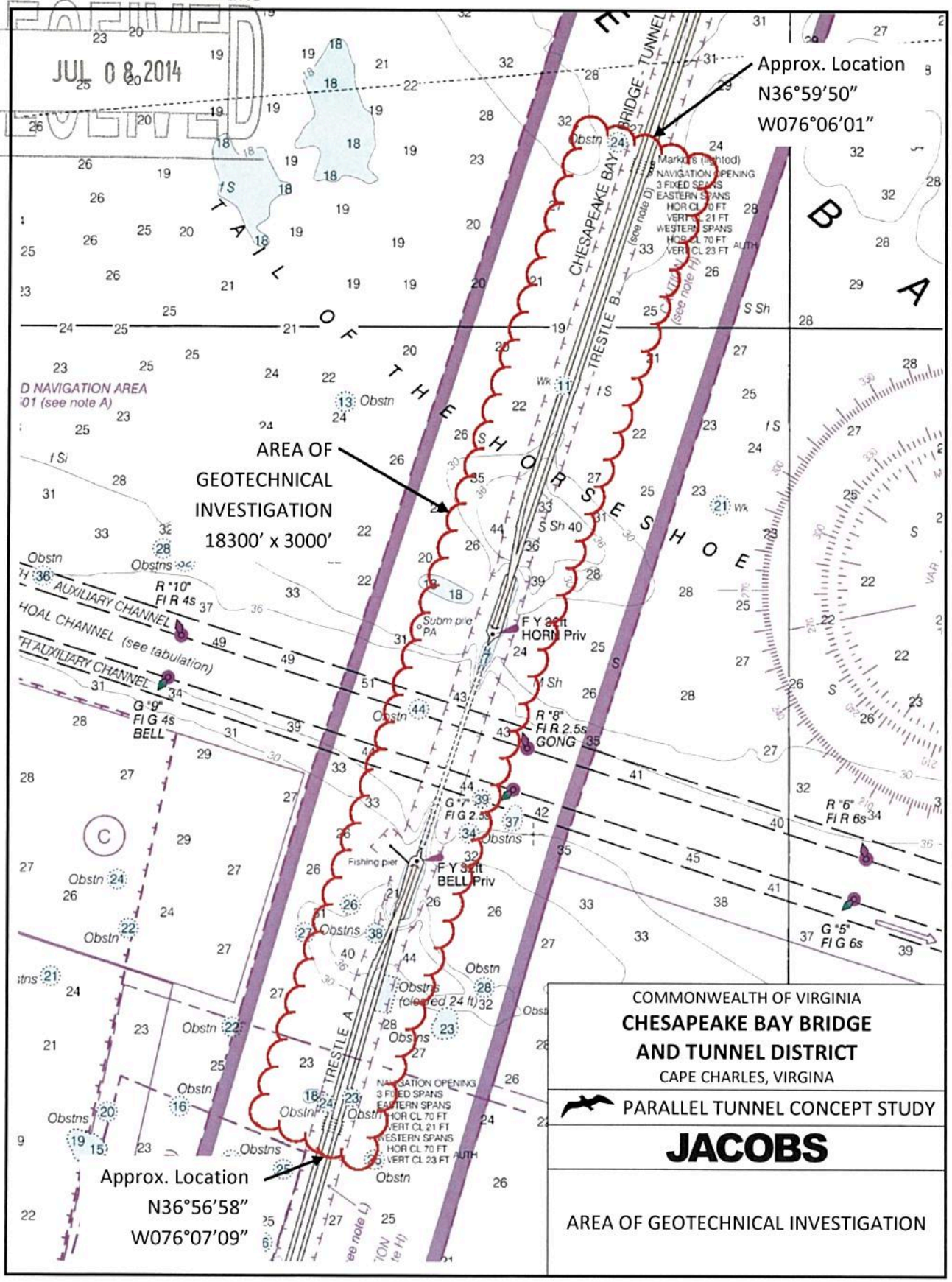
Or scan and send via email to george.a.janek@usace.army.mil

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation has been completed in accordance with the permit conditions.

_____ _____
Signature of Permittee Date

U.S. ARMY CORPS OF ENGINEERS
RECEIVED
JUL 0 8 2014
BY



Nationwide Permit (6) Survey Activities (3/19/2012)

Survey activities, such as core sampling, seismic exploratory operations, plugging of seismic shot holes and other exploratory-type bore holes, exploratory trenching, soil surveys, sampling, sample plots or transects for wetland delineations, and historic resources surveys. For the purposes of this NWP, the term "exploratory trenching" means mechanical land clearing of the upper soil profile to expose bedrock or substrate, for the purpose of mapping or sampling the exposed material. The area in which the exploratory trench is dug must be restored to its pre-construction elevation upon completion of the work and must not drain a water of the United States. In wetlands, the top 6 to 12 inches of the trench should normally be backfilled with topsoil from the trench. This NWP authorizes the construction of temporary pads, provided the discharge does not exceed 1/10-acre in waters of the U.S. Discharges and structures associated with the recovery of historic resources are not authorized by this NWP. Drilling and the discharge of excavated material from test wells for oil and gas exploration are not authorized by this NWP; the plugging of such wells is authorized. Fill placed for roads and other similar activities is not authorized by this NWP. The NWP does not authorize any permanent structures. The discharge of drilling mud and cuttings may require a permit under Section 402 of the Clean Water Act. (Sections 10 and 404)

REGIONAL CONDITIONS:

1. Conditions for Waters Containing Submerged Aquatic Vegetation (SAV) Beds: A pre-construction notification (PCN) is required if work will occur in areas that contain submerged aquatic vegetation (SAVs). Information about SAVs can be found at the Virginia Institute of Marine Science's website: http://www.vims.edu/bio/sav/. Additional avoidance and minimization measures, such as relocating a structure or time-of-year (TOYR) restrictions may be required to reduce impacts to SAVs.

2. Conditions for Anadromous Fish Use Areas: To ensure that activities authorized by this Nationwide Permit (NWP) do not impact waterways documented to provide spawning habitat or a migratory pathway for anadromous fish, a check for anadromous fish use areas must be conducted via the Norfolk District's Regulatory GIS (for reporting permits) and/or the Virginia Department of Game and Inland Fisheries (VDGIF) Information System (by applicant for non-reporting permits) at http://vafwis.org/fwis/ . If the project is located in an area documented as an anadromous fish use area (confirmed or potential), a time-of-year restriction (TOYR) prohibiting all in-water work will be required from February 15 to June 30 of any given year or any TOYR specified by VDGIF and/or Virginia Marine Resources Commission (VMRC). For permits requiring a PCN, if the Norfolk District determines that the work is minimal and the TOYR is unnecessary, informal consultation will be conducted with NOAA Fisheries Service (NOAA) to obtain concurrence that the TOYR would not be required for the proposed activity.

3. Conditions for Federally Listed Species and Designated Critical Habitat: Notification for this NWP will be required for any project that may affect a federally listed threatened or endangered species or designated critical habitat. The U.S. Fish and Wildlife Service (Service) has developed an online system that allows users to find information about sensitive resources that may occur within the vicinity of a proposed project. This system is named "Information, Planning and Conservation System," (IPaC), and is located at: http://ecos.fws.gov/ipac/ . This system provides information regarding federally listed and proposed candidate, threatened, and endangered species, designated critical habitats, and Service refuges that may occur in the identified areas, or may be affected by the proposed activities. The applicant may use this system to determine if any federally listed species or designated critical habitat may be affected by their proposed project, ensuring compliance with the Endangered Species Act.

4. Conditions for Waters with Federally Listed Endangered or Threatened Species, Waters Federally Designated as Critical Habitat, and One-mile Upstream (including tributaries) of Any Such Waters: A pre-construction notification (PCN) is required for work in the areas listed below for the Counties of Lee, Russell, Scott, Tazewell, Wise, and Washington in Southwestern Virginia within the following specific waters and reaches:
   1) Powell River - from the Tennessee-Virginia state line upstream to the Route 58 Bridge in Big Stone Gap and one mile upstream of the mouth of any tributary adjacent to this portion of the River.
   2) Clinch River - from the Tennessee-Virginia state line upstream to Route 632 at Pisgah in Tazewell County and one mile upstream of the mouth of any tributary adjacent to this portion of the River, the Little River to its confluence with Maiden Spring Creek, and one mile upstream of the mouth of any tributary adjacent to this portion of Little River.
   3) North Fork Holston River - from the Tennessee-Virginia state line upstream to the Smyth County/Bland County line and one mile upstream of any tributary adjacent to this portion of the River.
   4) Copper Creek - from its junction with the Clinch River upstream to the Route 58 bridge at Dickensonville in Russell County and one mile upstream of any tributary adjacent to this portion of the Creek.
   5) Indian Creek - from its junction with the Clinch River upstream to the fourth Norfolk and Western Railroad bridge at Van Dyke in Tazewell County and one mile upstream of the mouth of any tributary adjacent to this portion of the Creek.
   6) Middle Fork Holston River - from the Tennessee-Virginia state line to its junction with Walker Creek in Smyth County near Marion, Virginia.
   7) South Fork Holston River - from its junction with Middle Fork Holston River upstream to its junction with Beech Creek in Washington County.

   For activities requiring a PCN to work in specific waters and reaches, as described above, in the counties of Lee, Russell, Scott, Smyth, Tazewell, Wise, and Washington in southwestern Virginia, it is recommended that the prospective permittee first contact the applicable Norfolk District Field Office, found at this web link: http://www.nao.usace.army.mil/Missions/Regulatory/SouthwestContacts.aspx to determine if the PCN procedures would apply. If required, the PCN must be submitted in writing and include the following information (the Joint Permit Application may also be used – be sure to mark it with the letters PCN at the top of the first page):
   - Name, address, and telephone number of the prospective permittee.
   - Location of the proposed project.
   - Vicinity map and project drawings on 8.5-inch by 11-inch paper (including a plan view, profile, & cross-sectional view).
   - Brief description of the proposed project and the project purpose.
   - Where required by the terms of the NWP, a delineation of affected special aquatic sites, including wetlands.

   When all required information is received by the appropriate field office, the Corps will notify the prospective permittee within 45 days whether the project may proceed under the NWP permit or whether an individual permit is required. If, after reviewing the notification, the District Commander determines that the proposed activity would have more than a minimal individual or cumulative adverse impact on the aquatic environment or otherwise may be contrary to the public interest, then he/she will either condition the nationwide permit authorization to reduce or eliminate the adverse impacts, or notify the prospective permittee that the activity is not authorized by the nationwide permit and provide the prospective permittee with instructions on how to seek authorization under an individual permit.

Non-federal applicants shall notify the District Commander if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the District Commander that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the PCN must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that utilize the designated critical habitat that may be affected by the proposed work. The District Commander will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete PCN. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed.

5. Conditions for Designated Trout Waters: Notification is required for work in the areas listed below for this NWP. This condition applies to activities occurring in two categories of waters: Class V (Put and Take Trout Waters) and Class VI (Natural Trout Waters), as defined by the Virginia State Water Control Board Regulations, Water Quality Standards (VR-680-21-00), dated January 1, 1991, or the most recently updated publication. The Virginia Department of Game and Inland Fisheries (VDGIF) designated these same trout streams into six classes. Classes I-IV are considered wild trout streams. Classes V and VI are considered stockable trout streams. Information on designated trout streams can be obtained via their Virginia Fish and Wildlife Information Service's (VAFWIS's) Cold Water Stream Survey database. Basic access to the VAFWIS is available via http://vafwis.org/fwis/.

   The waters, occurring specifically within the mountains of Virginia, are within the following river basins:
   1) Potomac-Shenandoah River Basins
   2) James River Basin
   3) Roanoke River Basin
   4) New River Basin
   5) Tennessee and Big Sandy River Basins
   6) Rappahannock River Basin

   VDGIF recommends the following time-of-year restrictions (TOYR) for any in-stream work within streams identified as wild trout waters in its Cold Water Stream Survey database. The recommended TOYR for trout species are:
   - Brook Trout: October 1 through March 31
   - Brown Trout: October 1 through March 31
   - Rainbow Trout: March 15 through May 15

   This condition applies to the following counties and cities: Albemarle, Allegheny, Amherst, Augusta, Bath, Bedford, Bland, Botetourt, Bristol, Buchanan, Buena Vista, Carroll, Clarke, Covington, Craig, Dickenson, Floyd, Franklin, Frederick, Giles, Grayson, Greene, Henry, Highland, Lee, Loudoun, Madison, Montgomery, Nelson, Page, Patrick, Pulaski, Rappahannock, Roanoke City, Roanoke Co., Rockbridge, Rockingham, Russell, Scott, Shenandoah, Smyth, Staunton, Tazewell, Warren, Washington, Waynesboro, Wise, and Wythe.

   Any discharge of dredged and/or fill material authorized by this NWP, which would occur in the designated waterways or adjacent wetlands of the specified counties, requires notification to the appropriate Corps of Engineers field office, and written approval from that office prior to performing the work. The Norfolk District recommends that prospective permittees first contact the appropriate field office by telephone to determine if the notification procedures would apply. The notification must be in writing and include the following information (the standard Joint Permit Application may also be used):
   - Name, address, and telephone number of the prospective permittee.
   - Location of the proposed project.
   - Vicinity map and project drawings on 8.5-inch by 11-inch paper (plan view, profile, & cross-sectional view).
   - Brief description of the proposed project and the project purpose.
   - Where required by the terms of the nationwide permit, a delineation of affected special aquatic sites, including wetlands.

   When all required information is received by the appropriate field office, the Corps will notify the prospective permittee within 45 days whether the project can proceed under the NWP or whether an individual permit is required. If, after reviewing the notification, the District Commander determines that the proposed activity would have more than minimal individual or cumulative adverse impacts on the aquatic environment or otherwise may be contrary to the public interest, then he/she will either condition the nationwide permit authorization to reduce or eliminate the adverse impacts, or notify the prospective permittee that the activity is not authorized by the NWP and provide instructions on how to seek authorization under an individual permit. If the prospective permittee is not notified otherwise within the 45-day period the prospective permittee may assume that the project can proceed under the NWP.

6. Conditions Regarding Invasive Species: Plant species listed by the most current *Virginia Department of Conservation and Recreation's Invasive Alien Plant List* shall not be used for re-vegetation for activities authorized by any NWP. The list of invasive plants in Virginia may be found at: http://www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf .

GENERAL CONDITIONS:

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR §§ 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR § 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. Navigation.
   a) No activity may cause more than a minimal adverse effect on navigation.
   b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
   c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions

caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. Aquatic Life Movements. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. Spawning Areas. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. Migratory Bird Breeding Areas. Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. Shellfish Beds. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. Suitable Material. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Water Supply Intakes. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. Adverse Effects From Impoundments. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. Management of Water Flows. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. Fills Within 100-Year Floodplains. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. Equipment. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. Soil Erosion and Sediment Controls. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. Removal of Temporary Fills. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. Proper Maintenance. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. Single and Complete Project. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. Wild and Scenic Rivers. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

17. Tribal Rights. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. Endangered Species.
    a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.
    b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.
    c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide web pages at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.noaa.gov/fisheries.html respectively.

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

20. Historic Properties.

a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. Discovery of Previously Unknown Remains and Artifacts. If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. Designated Critical Resource Waters. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. Mitigation. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal.

a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

"When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the

property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

_____
(Transferee)

_____
(Date)

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:
   a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions.
   b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and
   c) The signature of the permittee certifying the completion of the work and mitigation.

31. Pre-Construction Notification.
   a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:
      (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
      (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).
   b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:
      (1) Name, address and telephone numbers of the prospective permittee;
      (2) Location of the proposed project;
      (3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);
      (4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;
      (5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.
      (6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and
      (7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.
   c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.
   d) Agency Coordination:
      (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

DISTRICT ENGINEER'S DECISION:

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. For a linear project, this determination will include an evaluation of the individual crossings to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a waiver of the 300 linear foot limit on impacts to intermittent or ephemeral streams or of an otherwise applicable limit, as provided for in NWPs 13, 21, 29, 36, 39, 40, 42, 43, 44, 50, 51 or 52, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in minimal adverse effects. When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

2. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

3. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (a) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (c) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period, with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

FURTHER INFORMATION:

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project.

SECTION 401 WATER QUALITY CERTIFICATION (4/18/12):

The State Water Control Board has provided unconditional §401 Water Quality Certification for all of the Norfolk District Regional Conditions and for the following Nationwide Permits, as meeting the requirements of the Virginia Water Protection Permit Regulation, which serves as

the Commonwealth's §401 Water Quality Certification: Nationwide Permits 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 15, 20, 22, 23, 28, 30, 31, 33, 34, 35, 36, 37, 38, 45, 46, 49, and 50.

COASTAL ZONE MANAGEMENT ACT CONSISTENCY DETERMINATION (4/19/12):
Based on the comments submitted by the agencies administering the enforceable policies of the Virginia Coastal Zone Management Program (VCP), the Virginia Department of Environmental Quality (DEQ) concurs that the reissuance of the 2012 NWPs and Virginia Regional Conditions, as proposed, is consistent with the VCP provided that the following conditions, discussed below, are satisfied:

1. Prior to construction, applicants shall obtain all required permits and approvals not yet secured for the activities to be performed that are applicable to the VCP's enforceable policies and that applicants also adhere to all the conditions contained therein.
   - The Virginia Marine Resources Commission's (VMRC) concurrence of consistency with the subaqueous lands management enforceable policy is based on the recognition that prospective permittees may be required to obtain additional state and/or local approvals prior to commencement of work in waters of the United States from the VMRC and/or the local wetlands board. Such approvals must precede implementation of the projects.
   - Similarly, the Department of Conservation and Recreation, Division of Stormwater Management, Local Implementation (formerly the Division of Chesapeake Bay Local Assistance) concurs that the proposed action is consistent with the coastal lands management enforceable policy provided projects are designed and constructed in a manner consistent with all state and local requirements pursuant to the Chesapeake Bay Preservation Act ("the Act") (Virginia Code §10.1-2100 et seq.) and the Chesapeake Bay Preservation Area Designation and Management Regulations (9 VAC 10-20 et seq.). Applicable projects must receive local approval to be consistent with the coastal lands management enforceable policy.
2. The State Water Control Board has provided §401 Clean Water Act Water Quality Certification for the NWPs and Virginia Regional Conditions. Therefore, the activities that qualify for the NWPs meet the requirements of DEQ's Virginia Water Protection Permit Regulation, provided that the permittee abides by the conditions of the NWP. As to the exceptions for activities that would otherwise qualify for one of these Nationwide Permits, the State will continue to process applications for individual §401 Certification through a Virginia Water Protection General or Individual Permit pursuant to 9 VAC 25-210-10 *et seq.* The Commonwealth requests that the Corps forward to DEQ pre-construction notifications for any activities that fall into an excepted category for individual review of certain activities.

In accordance with the *Federal Consistency Regulations* at 15 CFR Part 930, section 930.4, this conditional concurrence is based on the applicants demonstrating to the Corps that they have obtained, or will obtain, all necessary authorizations prior to implementing a project which qualifies for a NWP. If the requirements of section 930.4, sub-paragraphs (a)(1) through (a)(3) are not met, this conditional concurrence becomes an objection under 15 CFR Part 930, section 940.43.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
TIDEWATER REGIONAL OFFICE
5636 Southern Boulevard, Virginia Beach, Virginia 23462
(757) 518-2000 Fax (757) 518-2009
www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

Maria R. Nold
Regional Director

July 17, 2014

Mr. Robert Johnson
Chesapeake Bay Bridge and Tunnel District
c/o Ms. Carolyn Keeler
Jacobs Engineering Group, Inc.
2108 West Laburnum Avenue, Suite100
Richmond, VA 23227

RE: Notification of No Permit Required
Joint Permit Application Number 14-0967
CBBT Exploratory Geotechnical Investigation
Chesapeake Bay Bridge-Tunnel

Dear Mr. Johnson:

The Department of Environmental Quality (DEQ) received your above-referenced Joint Permit Application (JPA) on July 7, 2014 to conduct investigative borings to obtain samples that represent material proposed for dredging and placement as part of future potential improvements to the bridge-tunnel. As proposed, your project will impact approximately 38 square feet of subaqueous bottom.

Provided you receive a Nationwide or Regional permit for your project from the U.S. Army Corps of Engineers, on which DEQ has provided § 401 Certification, a Virginia Water Protection (VWP) permit will not be required by the DEQ for this project. Should the size and scope of the project change, a permit from DEQ may be required. You are advised that this does not give you the authority to violate the State's Water Quality Standards.

If you have any questions, please do not hesitate to contact me at (757) 518-2124 or Larissa.Ambrose@deq.virginia.gov.

Sincerely,

Larissa Ambrose
Project Manager

cc: George Janek, U.S. Army Corps of Engineers
Hank Badger, Virginia Marine Resources Commission

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
FORT NORFOLK
803 FRONT STREET
NORFOLK VA 23510-1096

Reply to
Attention of

December 22, 2014

Eastern Virginia Regulatory Section
NAO-2014-1229 / VMRC #14-V0967 (Chesapeake Bay)

Chesapeake Bay Bridge and Tunnel District
Robert Johnson
32386 Lankford Highway
Cape Charles, Virginia 23310

Dear Mr. Johnson:

This is in reference to the Department of the Army application (NAO-2014-1229/ VMRC #14-V0967) you have submitted to impact 38 square feet of subaqueous bottom in the Chesapeake Bay with approximately 30 geotechnical borings associated with the improvements to the Chesapeake Bay Bridge-Tunnel. The work will occur near latitude 37.0411 and longitude -76.0700, in and around the Thimble Shoal Channel and the two tunnel islands along the Chesapeake Bay Bridge-Tunnel in Virginia. These impacts are detailed on the enclosed drawings entitle "Figure 1 Dredging Locations at Thimble Shoal Channel" date stamped as received by this office on December 5, 2014 (attached).

Your proposed work as outlined above satisfies the criteria contained in the Corps Nationwide Permit (6) for Survey Activities, attached. The Corps Nationwide Permits were published in the February 21, 2012 Federal Register notice (77 FR 10184) and the regulations governing their use can be found in 33 CFR 330 published in Volume 56, Number 226 of the Federal Register dated November 22, 1991.

This nationwide permit verification is contingent upon the following project specific conditions:

1. You and/or your contractor shall vacate the channel to the extent necessary to provide safe passage for all approaching vessels.

2. You shall coordinate with the U.S. Coast Guard as required such that a notification for the permitted work is published in the Local Notice to Mariners a minimum of 10 calendar days prior to commencing work within the channel.

3. You will coordinate your drilling schedule with the U.S. Navy, the Virginia Pilot's Association, and other navigational interests a minimum of 30 days before beginning work, and adjust our drilling schedule as practicable to minimize impacts to navigation.

The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

Provided the project specific conditions (above) and the Nationwide Permit General Conditions (enclosed) are met, an individual Department of the Army Permit will not be required. In addition, the Virginia Department of Environmental Quality has provided an unconditional §401 Water Quality Certification for Nationwide Permit Number 6. A permit may be required from the Virginia Marine Resources Commission and/or your local wetlands board, and this verification is not valid until you obtain their approval, if necessary. This authorization does not relieve your responsibility to comply with local requirements pursuant to the Chesapeake Bay Preservation Act (CBPA), nor does it supersede local government authority and responsibilities pursuant to the Act. You should contact your local government before you begin work to find out how the CBPA applies to your project.

Enclosed is a "compliance certification" form, which must be signed and returned within 30 days of completion of the project, including any required mitigation. Your signature on this form certifies that you have completed the work in accordance with the nationwide permit terms and conditions.

This verification is valid until the NWP is modified, reissued, or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 18, 2017. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this nationwide permit unless discretionary authority has been exercised on a case-by-case basis to modify, suspend, or revoke the authorization in accordance with 33 CFR 330.4(e) and 33 CFR 330.5 (c) or (d). Project specific conditions listed in this letter continue to remain in effect after the NWP verification expires, unless the district engineer removes those conditions. Activities completed under the authorization of an NWP which was in effect at the time the activity was completed continue to be authorized by that NWP.

If you have any questions, please contact me at (757) 201-7135 or by email at george.a.janek@usace.army.mil).

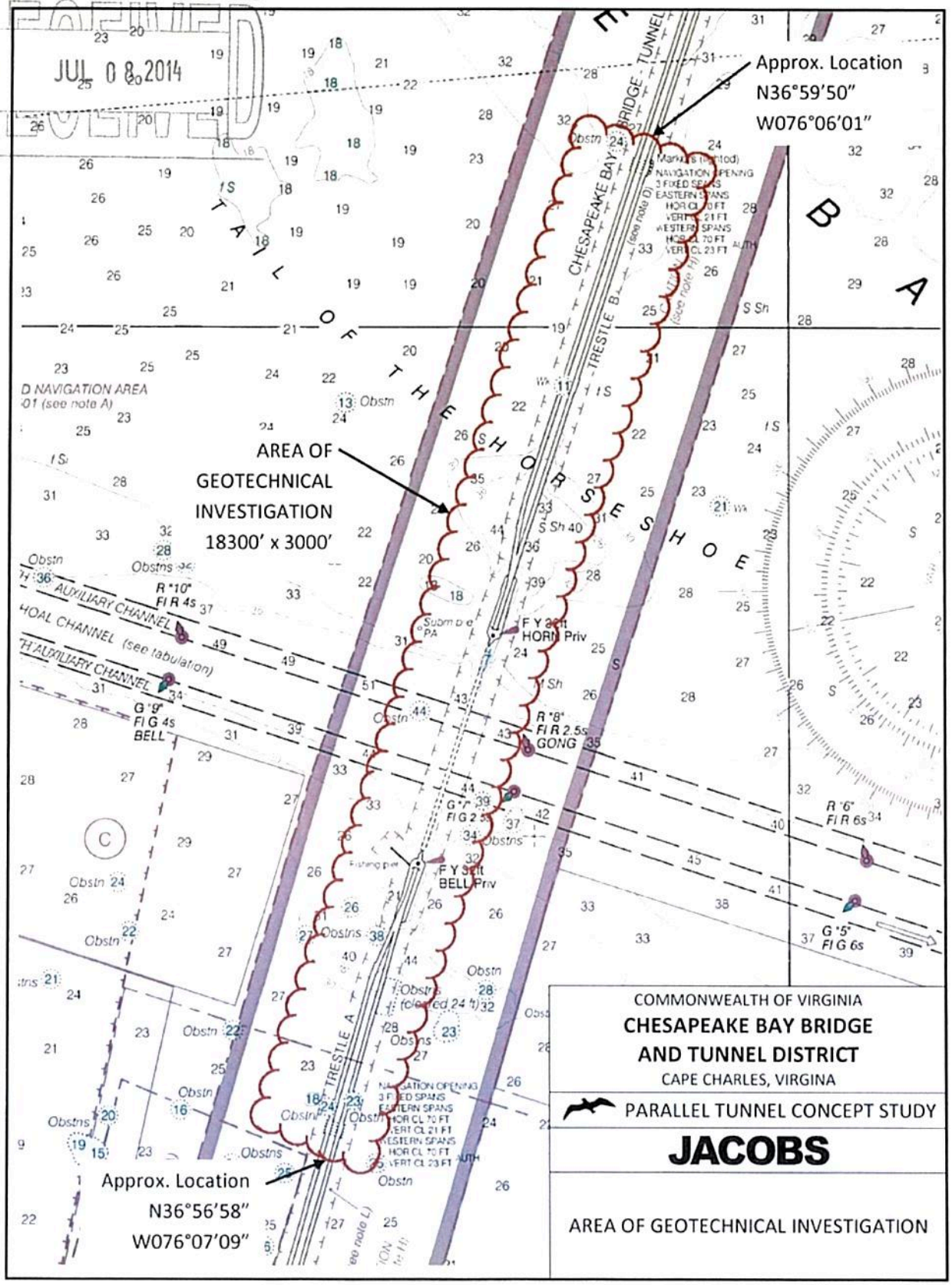
Sincerely,

George Janek
Project Manager, Eastern Virginia
Regulatory Section

Enclosures

Cc: Larissa Ambrose, DEQ
Justin Worrell, VMRC
Carolyn Keeler, Jacobs Engineering

U.S. ARMY CORPS OF ENGINEERS
RECEIVED
JUL 08 2014



U.S. Army Corps
Of Engineers
Norfolk District

CERTIFICATE OF COMPLIANCE
WITH
ARMY CORPS OF ENGINEERS PERMIT

Permit Number: NAO-2014-1229
VMRC Number: 14-V0967

Corps Contact: George Janek

Name of Permittee: Chesapeake Bay Bridge and Tunnel District c/o Robert Johnson

Date of Issuance: December 22, 2014

Permit Type: Nationwide permit 6

Within 30 days of completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

US Army Corps of Engineers - Norfolk District
CENAO-WR-RE
Attn: George Janek
803 Front Street
Norfolk, VA 23510-1096

Or scan and send via email to george.a.janek@usace.army.mil

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation has been completed in accordance with the permit conditions.

_____ _____
Signature of Permittee Date

Nationwide Permit (6) Survey Activities (3/19/2012)

Survey activities, such as core sampling, seismic exploratory operations, plugging of seismic shot holes and other exploratory-type bore holes, exploratory trenching, soil surveys, sampling, sample plots or transects for wetland delineations, and historic resources surveys. For the purposes of this NWP, the term "exploratory trenching" means mechanical land clearing of the upper soil profile to expose bedrock or substrate, for the purpose of mapping or sampling the exposed material. The area in which the exploratory trench is dug must be restored to its pre-construction elevation upon completion of the work and must not drain a water of the United States. In wetlands, the top 6 to 12 inches of the trench should normally be backfilled with topsoil from the trench. This NWP authorizes the construction of temporary pads, provided the discharge does not exceed 1/10-acre in waters of the U.S. Discharges and structures associated with the recovery of historic resources are not authorized by this NWP. Drilling and the discharge of excavated material from test wells for oil and gas exploration are not authorized by this NWP; the plugging of such wells is authorized. Fill placed for roads and other similar activities is not authorized by this NWP. The NWP does not authorize any permanent structures. The discharge of drilling mud and cuttings may require a permit under Section 402 of the Clean Water Act. (Sections 10 and 404)

REGIONAL CONDITIONS:

1. Conditions for Waters Containing Submerged Aquatic Vegetation (SAV) Beds: A pre-construction notification (PCN) is required if work will occur in areas that contain submerged aquatic vegetation (SAVs). Information about SAVs can be found at the Virginia Institute of Marine Science's website: http://www.vims.edu/bio/sav/. Additional avoidance and minimization measures, such as relocating a structure or time-of-year (TOYR) restrictions may be required to reduce impacts to SAVs.

2. Conditions for Anadromous Fish Use Areas: To ensure that activities authorized by this Nationwide Permit (NWP) do not impact waterways documented to provide spawning habitat or a migratory pathway for anadromous fish, a check for anadromous fish use areas must be conducted via the Norfolk District's Regulatory GIS (for reporting permits) and/or the Virginia Department of Game and Inland Fisheries (VDGIF) Information System (by applicant for non-reporting permits) at http://vafwis.org/fwis/ . If the project is located in an area documented as an anadromous fish use area (confirmed or potential), a time-of-year restriction (TOYR) prohibiting all in-water work will be required from February 15 to June 30 of any given year or any TOYR specified by VDGIF and/or Virginia Marine Resources Commission (VMRC). For permits requiring a PCN, if the Norfolk District determines that the work is minimal and the TOYR is unnecessary, informal consultation will be conducted with NOAA Fisheries Service (NOAA) to obtain concurrence that the TOYR would not be required for the proposed activity.

3. Conditions for Federally Listed Species and Designated Critical Habitat: Notification for this NWP will be required for any project that may affect a federally listed threatened or endangered species or designated critical habitat. The U.S. Fish and Wildlife Service (Service) has developed an online system that allows users to find information about sensitive resources that may occur within the vicinity of a proposed project. This system is named "Information, Planning and Conservation System," (IPaC), and is located at: http://ecos.fws.gov/ipac/ . This system provides information regarding federally listed and proposed candidate, threatened, and endangered species, designated critical habitats, and Service refuges that may occur in the identified areas, or may be affected by the proposed activities. The applicant may use this system to determine if any federally listed species or designated critical habitat may be affected by their proposed project, ensuring compliance with the Endangered Species Act.

4. Conditions for Waters with Federally Listed Endangered or Threatened Species, Waters Federally Designated as Critical Habitat, and One-mile Upstream (including tributaries) of Any Such Waters: A pre-construction notification (PCN) is required for work in the areas listed below for the Counties of Lee, Russell, Scott, Tazewell, Wise, and Washington in Southwestern Virginia within the following specific waters and reaches:
   1) Powell River - from the Tennessee-Virginia state line upstream to the Route 58 Bridge in Big Stone Gap and one mile upstream of the mouth of any tributary adjacent to this portion of the River.
   2) Clinch River - from the Tennessee-Virginia state line upstream to Route 632 at Pisgah in Tazewell County and one mile upstream of the mouth of any tributary adjacent to this portion of the River, the Little River to its confluence with Maiden Spring Creek, and one mile upstream of the mouth of any tributary adjacent to this portion of Little River.
   3) North Fork Holston River - from the Tennessee-Virginia state line upstream to the Smyth County/Bland County line and one mile upstream of any tributary adjacent to this portion of the River.
   4) Copper Creek - from its junction with the Clinch River upstream to the Route 58 bridge at Dickensonville in Russell County and one mile upstream of any tributary adjacent to this portion of the Creek.
   5) Indian Creek - from its junction with the Clinch River upstream to the fourth Norfolk and Western Railroad bridge at Van Dyke in Tazewell County and one mile upstream of the mouth of any tributary adjacent to this portion of the Creek.
   6) Middle Fork Holston River - from the Tennessee-Virginia state line to its junction with Walker Creek in Smyth County near Marion, Virginia.
   7) South Fork Holston River - from its junction with Middle Fork Holston River upstream to its junction with Beech Creek in Washington County.

   For activities requiring a PCN to work in specific waters and reaches, as described above, in the counties of Lee, Russell, Scott, Smyth, Tazewell, Wise, and Washington in southwestern Virginia, it is recommended that the prospective permittee first contact the applicable Norfolk District Field Office, found at this web link: http://www.nao.usace.army.mil/Missions/Regulatory/SouthwestContacts.aspx to determine if the PCN procedures would apply. If required, the PCN must be submitted in writing and include the following information (the Joint Permit Application may also be used – be sure to mark it with the letters PCN at the top of the first page):
   - Name, address, and telephone number of the prospective permittee.
   - Location of the proposed project.
   - Vicinity map and project drawings on 8.5-inch by 11-inch paper (including a plan view, profile, & cross-sectional view).
   - Brief description of the proposed project and the project purpose.
   - Where required by the terms of the NWP, a delineation of affected special aquatic sites, including wetlands.

   When all required information is received by the appropriate field office, the Corps will notify the prospective permittee within 45 days whether the project may proceed under the NWP permit or whether an individual permit is required. If, after reviewing the notification, the District Commander determines that the proposed activity would have more than a minimal individual or cumulative adverse impact on the aquatic environment or otherwise may be contrary to the public interest, then he/she will either condition the nationwide permit authorization to reduce or eliminate the adverse impacts, or notify the prospective permittee that the activity is not authorized by the nationwide permit and provide the prospective permittee with instructions on how to seek authorization under an individual permit.

Non-federal applicants shall notify the District Commander if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the District Commander that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the PCN must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that utilize the designated critical habitat that may be affected by the proposed work. The District Commander will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete PCN. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed.

5. Conditions for Designated Trout Waters: Notification is required for work in the areas listed below for this NWP. This condition applies to activities occurring in two categories of waters: Class V (Put and Take Trout Waters) and Class VI (Natural Trout Waters), as defined by the Virginia State Water Control Board Regulations, Water Quality Standards (VR-680-21-00), dated January 1, 1991, or the most recently updated publication. The Virginia Department of Game and Inland Fisheries (VDGIF) designated these same trout streams into six classes. Classes I-IV are considered wild trout streams. Classes V and VI are considered stockable trout streams. Information on designated trout streams can be obtained via their Virginia Fish and Wildlife Information Service's (VAFWIS's) Cold Water Stream Survey database. Basic access to the VAFWIS is available via http://vafwis.org/fwis/.

The waters, occurring specifically within the mountains of Virginia, are within the following river basins:

1) Potomac-Shenandoah River Basins
2) James River Basin
3) Roanoke River Basin
4) New River Basin
5) Tennessee and Big Sandy River Basins
6) Rappahannock River Basin

VDGIF recommends the following time-of-year restrictions (TOYR) for any in-stream work within streams identified as wild trout waters in its Cold Water Stream Survey database. The recommended TOYR for trout species are:

- Brook Trout: October 1 through March 31
- Brown Trout: October 1 through March 31
- Rainbow Trout: March 15 through May 15

This condition applies to the following counties and cities: Albemarle, Allegheny, Amherst, Augusta, Bath, Bedford, Bland, Botetourt, Bristol, Buchanan, Buena Vista, Carroll, Clarke, Covington, Craig, Dickenson, Floyd, Franklin, Frederick, Giles, Grayson, Greene, Henry, Highland, Lee, Loudoun, Madison, Montgomery, Nelson, Page, Patrick, Pulaski, Rappahannock, Roanoke City, Roanoke Co., Rockbridge, Rockingham, Russell, Scott, Shenandoah, Smyth, Staunton, Tazewell, Warren, Washington, Waynesboro, Wise, and Wythe.

Any discharge of dredged and/or fill material authorized by this NWP, which would occur in the designated waterways or adjacent wetlands of the specified counties, requires notification to the appropriate Corps of Engineers field office, and written approval from that office prior to performing the work. The Norfolk District recommends that prospective permittees first contact the appropriate field office by telephone to determine if the notification procedures would apply. The notification must be in writing and include the following information (the standard Joint Permit Application may also be used):

- Name, address, and telephone number of the prospective permittee.
- Location of the proposed project.
- Vicinity map and project drawings on 8.5-inch by 11-inch paper (plan view, profile, & cross-sectional view).
- Brief description of the proposed project and the project purpose.
- Where required by the terms of the nationwide permit, a delineation of affected special aquatic sites, including wetlands.

When all required information is received by the appropriate field office, the Corps will notify the prospective permittee within 45 days whether the project can proceed under the NWP or whether an individual permit is required. If, after reviewing the notification, the District Commander determines that the proposed activity would have more than minimal individual or cumulative adverse impacts on the aquatic environment or otherwise may be contrary to the public interest, then he/she will either condition the nationwide permit authorization to reduce or eliminate the adverse impacts, or notify the prospective permittee that the activity is not authorized by the NWP and provide instructions on how to seek authorization under an individual permit. If the prospective permittee is not notified otherwise within the 45-day period the prospective permittee may assume that the project can proceed under the NWP.

6. Conditions Regarding Invasive Species: Plant species listed by the most current *Virginia Department of Conservation and Recreation's Invasive Alien Plant List* shall not be used for re-vegetation for activities authorized by any NWP. The list of invasive plants in Virginia may be found at: http://www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf .

GENERAL CONDITIONS:

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR §§ 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR § 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. Navigation.
   a) No activity may cause more than a minimal adverse effect on navigation.
   b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
   c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions

caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. Aquatic Life Movements. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. Spawning Areas. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. Migratory Bird Breeding Areas. Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. Shellfish Beds. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. Suitable Material. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Water Supply Intakes. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. Adverse Effects From Impoundments. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. Management of Water Flows. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. Fills Within 100-Year Floodplains. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. Equipment. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. Soil Erosion and Sediment Controls. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. Removal of Temporary Fills. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. Proper Maintenance. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. Single and Complete Project. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. Wild and Scenic Rivers. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

17. Tribal Rights. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. Endangered Species.
    a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.
    b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.
    c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide web pages at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.noaa.gov/fisheries.html respectively.

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

20. Historic Properties.

a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. Discovery of Previously Unknown Remains and Artifacts. If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. Designated Critical Resource Waters. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. Mitigation. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal.

a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

"When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the

property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

_____
(Transferee)

_____
(Date)

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:
   a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions.
   b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and
   c) The signature of the permittee certifying the completion of the work and mitigation.

31. Pre-Construction Notification.
   a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:
      (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
      (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).
   b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:
      (1) Name, address and telephone numbers of the prospective permittee;
      (2) Location of the proposed project;
      (3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);
      (4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;
      (5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.
      (6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and
      (7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.
   c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.
   d) Agency Coordination:
      (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

DISTRICT ENGINEER'S DECISION:

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. For a linear project, this determination will include an evaluation of the individual crossings to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a waiver of the 300 linear foot limit on impacts to intermittent or ephemeral streams or of an otherwise applicable limit, as provided for in NWPs 13, 21, 29, 36, 39, 40, 42, 43, 44, 50, 51 or 52, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in minimal adverse effects. When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

2. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

3. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (a) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (c) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period, with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

FURTHER INFORMATION:

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project.

SECTION 401 WATER QUALITY CERTIFICATION (4/18/12):

The State Water Control Board has provided unconditional §401 Water Quality Certification for all of the Norfolk District Regional Conditions and for the following Nationwide Permits, as meeting the requirements of the Virginia Water Protection Permit Regulation, which serves as

the Commonwealth's §401 Water Quality Certification: Nationwide Permits 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 15, 20, 22, 23, 28, 30, 31, 33, 34, 35, 36, 37, 38, 45, 46, 49, and 50.

COASTAL ZONE MANAGEMENT ACT CONSISTENCY DETERMINATION (4/19/12):
Based on the comments submitted by the agencies administering the enforceable policies of the Virginia Coastal Zone Management Program (VCP), the Virginia Department of Environmental Quality (DEQ) concurs that the reissuance of the 2012 NWPs and Virginia Regional Conditions, as proposed, is consistent with the VCP provided that the following conditions, discussed below, are satisfied:

1. Prior to construction, applicants shall obtain all required permits and approvals not yet secured for the activities to be performed that are applicable to the VCP's enforceable policies and that applicants also adhere to all the conditions contained therein.
   - The Virginia Marine Resources Commission's (VMRC) concurrence of consistency with the subaqueous lands management enforceable policy is based on the recognition that prospective permittees may be required to obtain additional state and/or local approvals prior to commencement of work in waters of the United States from the VMRC and/or the local wetlands board. Such approvals must precede implementation of the projects.
   - Similarly, the Department of Conservation and Recreation, Division of Stormwater Management, Local Implementation (formerly the Division of Chesapeake Bay Local Assistance) concurs that the proposed action is consistent with the coastal lands management enforceable policy provided projects are designed and constructed in a manner consistent with all state and local requirements pursuant to the Chesapeake Bay Preservation Act ("the Act") (Virginia Code §10.1-2100 et seq.) and the Chesapeake Bay Preservation Area Designation and Management Regulations (9 VAC 10-20 et seq.). Applicable projects must receive local approval to be consistent with the coastal lands management enforceable policy.
2. The State Water Control Board has provided §401 Clean Water Act Water Quality Certification for the NWPs and Virginia Regional Conditions. Therefore, the activities that qualify for the NWPs meet the requirements of DEQ's Virginia Water Protection Permit Regulation, provided that the permittee abides by the conditions of the NWP. As to the exceptions for activities that would otherwise qualify for one of these Nationwide Permits, the State will continue to process applications for individual §401 Certification through a Virginia Water Protection General or Individual Permit pursuant to 9 VAC 25-210-10 *et seq.* The Commonwealth requests that the Corps forward to DEQ pre-construction notifications for any activities that fall into an excepted category for individual review of certain activities.

In accordance with the *Federal Consistency Regulations* at 15 CFR Part 930, section 930.4, this conditional concurrence is based on the applicants demonstrating to the Corps that they have obtained, or will obtain, all necessary authorizations prior to implementing a project which qualifies for a NWP. If the requirements of section 930.4, sub-paragraphs (a)(1) through (a)(3) are not met, this conditional concurrence becomes an objection under 15 CFR Part 930, section 940.43.

FINAL
Attachment II:
Analytical Quality Assurance Project Plan
Evaluation of Dredged Material Proposed for Ocean Placement

Parallel Thimble Shoal Tunnel Project

Volume 3 of 4

Prepared For
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On Behalf of
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February 2015

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Analytical Project Plan

Parallel Thimble Shoal Tunnel

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Date: February 2015

Quality Assurance Project Plan

Thimble Shoal Parallel Tunnel

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Phone: 412-963-7058

Date: February 2015

Carrie L. Gamber Date
TestAmerica Pittsburgh

2/24/15

Peggy Derrick Date
EA Project Manager

Virginia Zusman Date
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Introduction

1.1 Project Description

On behalf of EA Engineering, Science, and Technology, Inc., PBC (EA), TestAmerica Laboratories, Inc. (TestAmerica Pittsburgh) will perform or coordinate the sediment for Thimble Shoal Parallel Tunnel. Target analytes, target detection limits, holding times, and QA/QC requirements for the project follow guidance in the following documents:

USEPA/USACE, 1998 (EPA-823-B-98-004). Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (Inland Testing Manual).

USEPA, 1995 (EPA-823-B-95-001). QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations.

1.2 Analytical Project Plan

TestAmerica Pittsburgh has prepared this Analytical Project Plan (APP) to identify the policies, organization, objectives, functional activities, and specific activities designed to achieve the desired quality goals for analytical chemistry support.

This Analytical Project Plan includes the following:

Descriptions of all technical procedures for sample custody control and traceability from sample delivery to results reported to clients, laboratory analyses, data reduction, data validation and data reporting.

Analytical Methods used in support of this program.

QA objectives

Policy and procedures for the conduct of performance and systems audits.

Corrective Action procedures.

2 Project Organization and Contacts

2.1 Project Organization and Responsibilities

The project organization is presented in the project Work Plan and shows the lines of communication and responsibility. TestAmerica Pittsburgh will provide the majority of the analytical support on this project. Additional analytical services will be provided by TestAmerica Burlington, TestAmerica North Canton and TestAmerica Knoxville and A&L Laboratories. This section describes the organization and responsibilities of TestAmerica Pittsburgh.

2.2 TestAmerica Pittsburgh Organization and Responsibilities

The objective of the Analytical Project Plan is to provide analytical data that are valid and defensible, and that meet the user's needs. Accordingly, the management of TestAmerica Pittsburgh encourages excellence in analytical testing and provides the necessary resources and environment to meet that objective. The laboratory quality assurance guidelines are included within this APP and identify the policies, organization, objectives, functional activities, and specific activities designed to achieve the desired quality goals set forth by the laboratory for this project.

The organizational positions of TestAmerica Pittsburgh personnel can be found in Figure 2-1. The Laboratory Director, Debbie Lowe, ensures that the laboratory data are produced in a compliant and timely manner and meets the project data quality objectives. Virginia Zusman is the laboratory's Quality Assurance Manager. Through the maintenance of an independent quality assurance staff, Ms. Zusman provides oversight of the processes, which monitor the production of quality data. The Laboratory Project Manager, Carrie Gamber, serves as the principal client point of contact throughout the project duration and works interactively with laboratory personnel to coordinate all aspects of the production of data packages to support the specific needs of this project. As the Pittsburgh Laboratory Project Manager, Ms. Gamber, will also act as the liaison between EA and other TestAmerica Labs serving EA on this project. Ms. Gamber also provides a final review of the laboratory report against project requirements.

This project will also have analytical support provided by TestAmerica Laboratories in Burlington, VT, Knoxville, TN, North Canton, OH and A&L Laboratories. Ms. Gamber will work closely with her counterparts at the other TestAmerica laboratories (listed in 2.3). They will direct any project communication directly to Ms. Gamber. The email communication will be followed up with a phone call to Ms. Derrick to verify receipt and discuss any necessary resolution.

Within the Operations Group, each Section Supervisor or Department Manager is responsible for implementation and operation of the analytical programs in their laboratory, and is responsible for technical and project compliance for all analytical work in their section. TestAmerica Pittsburgh's Sample Management staff is responsible for receiving, logging, and maintaining internal custody of all samples during their residence in the laboratory.

2.3 Project Contacts

The following persons are identified as contacts for this project:

Contact	Function	Company	Phone #	Email
Peggy Derrick	Project Manager	EA Engineering	410-584-7000	pderrick@eaest.com
Sanita Corum	Data Manager	EA Engineering	410-584-7000	scorum@eaest.com
Carrie Gamber	Project Manager	TestAmerica Pittsburgh Lab	412-963-2428	carrie.gamber@testamericainc.com
Amy McCormick	Project Manager	TestAmerica North Canton Lab	330-497-9396	amy.mcmormick@testamericainc.com
Don Dawicki	Project Manager	TestAmerica Burlington Lab	802-660-1990	don.dawicki@testamericainc.com
Bruce Wagner	Project Manager	TestAmerica Knoxville Lab	865-291-3000	bruce.wagner@testamericainc.com

2.4 Document Control, Revision, and Distribution

The Final Document will be distributed as a pdf document. The pdf will be considered a controlled document in the electronic version, becoming uncontrolled when printed. The document will have a unique identifier (PT-PAP-0100), meaning Pittsburgh document, Project Analysis Plan, with a sequential numerical identifier. The header will contain the document number, revision number, and revision date. The controlled document will be maintained by the Pittsburgh Laboratory Quality Assurance Manager. The distribution list is below. The laboratory project managers will be responsible for distributing the document to operations. EA will be responsible for distributing the document to Jacobs Engineering Group and to the Chesapeake Bay Bridge and Tunnel District. Document revisions will be coordinated through the TestAmerica Pittsburgh Quality Assurance Manager.

3 Quality Assurance Objectives for Measurement Data

3.1 Data Uses

The purpose of the Analytical Project Plan is to provide a standard for control and review of measurement data to ensure they are scientifically sound, defensible, and of known acceptable quality. The data will be used to evaluate the physical and chemical attributes of sediments proposed for dredging. The project objective for analytical testing is to characterize sediments, elutriates, site water/receiving water and tissues representative of the proposed dredging activities with regard to physical characteristics and chemical constituents.

3.2 Data Quality Objectives

3.2.1 Characteristics of Data Quality

The PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters are the characteristics of data quality.

Precision is the mutual agreement among individual measurements of the same property and is a measure of the random error component of the data collection process. The overall precision of the data is the sum of that due to sampling and analysis. To determine the analytical precision of the method and/or laboratory analyst, a routine program of replicate analyses is performed. The results of the replicate analyses are used to calculate the relative percent difference (RPD), which is the governing quality control parameter for precision.

Precision is represented as the RPD between measurement of an analyte in duplicate samples or in duplicate spikes. RPD is defined as follows:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2) / 2} \; x \; 100$$

Where:

C_1 = first measurement value

C_2 = second measurement value

The %RSD is calculated by the standard deviation of the analytical results of the replicate determinations relative to the average of those results for a given analyte. This method of precision measurement can be expressed by the formula:

$$\%RDS = \frac{Standard \;\; Deviation}{Mean} \; x \; 100 = \frac{\left|\sum (X_1 - X_{mean})^2 / (n-1)^{1/2}\right|}{(X_1 + X_2 + X_n) \;\; / n} \; x \; 100$$

The % D is calculated by expressing as a percentage, the difference between the

original value and new value relative to the original value. This method for precision measurement can be expressed by the formula:

$$Percent\ Difference\,(\%D) = \frac{|C_1 - C_2|}{C_1}\ x100$$

Where:

C_1 = concentration of analyte in the initial aliquot of the sample

C_2 = concentration of analyte in replicate

Accuracy is the agreement between a measurement and the true value. It is a measure of the bias or systematic error of the entire data collection process. Sampling accuracy is assessed by evaluating the results of field and trip blanks. To determine the accuracy of an analytical method, a periodic program of laboratory control sample spiking is conducted. The results of sample spiking are used to calculate the quality control parameter for accuracy evaluation, the percent recovery (%R).

Percent recovery is defined as follows:

$$\%R = \frac{(A_T - A_O)}{A_F}\ x100$$

Where:

A_T = Total amount recovered in fortified sample

A_O = Amount recovered in unfortified sample

A_F = Amount added to sample

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a quantitative parameter that is most concerned with the proper design and implementation of the sampling program. The sampling program has been designed so that the samples collected are as representative as possible of the medium being sampled and that a sufficient number of samples will be collected. Representativeness is addressed by the description of the sampling techniques and the rationale used to select the sampling locations.

Completeness is the adequacy in quantity of valid measurements to prevent misinterpretation and to answer important questions. For this project, the data completeness objective is 90 percent.

$$Completeness = \frac{Number\ of\ acceptable\ reported\ QC\ data}{Total\ number\ of\ QC\ data}\ x100\%$$

Interbatch Comparability is the extent to which comparisons among different measurements of

the same quantity or quality will yield valid conclusions. For this project, comparability among measurements will be achieved through the use of control limits for Laboratory Control Samples (LCS). Establishment and evaluation of control limits are discussed in Section 9 of this APP.

In addition to the PARCC parameters, project objectives have been established for quantitation limits, which are discussed in Section 7.2 of this APP.

3.2.2 Measurement Quality Objectives for Precision and Accuracy

The objectives for precision and accuracy for each chemical are based on the capabilities of the approved EPA analytical method with respect to laboratory performance. Table 7.1 presents the quantitative objectives for accuracy and precision for the various parameter groups for laboratory performance and evaluation of sample measurement bias.

4 Sampling Procedures

Sampling procedures will be conducted by EA Engineering, Science, and Technology, Inc., PBC and are addressed separately in the Field Sampling Plan (FSP).

5 Sample Custody

5.1 Chain-of-Custody Operations

Samples are physical evidence and will be handled according to certain procedural safeguards. For the purposes of legal proceedings, a showing to the court that the laboratory is a secure area may be all that is required for the analyzed evidence to be admitted. However, it is anticipated that in some cases, the court may require a showing of the hand-to-hand custody of the samples from sampling through disposal.

Although TestAmerica Pittsburgh is not involved in sampling activities, in the event that the court requires such a comprehensive chain-of-custody demonstration, the laboratory is prepared to produce documentation that traces the in-house custody of the samples from the time of receipt to the completion of the analysis.

The National Enforcement Investigations Center (NEIC) of U.S. EPA defines custody of evidence in the following ways:

- It is in your actual possession: or
- It is in your view, after being in your physical possession; or
- It was in your possession and then you placed it in a secure area to prevent tampering; or
- It is in a secure area.

5.1.1 Sample Bottle Preparation

The chain-of-custody procedure begins with the preparation of the sample containers and preservatives to be used in sample collection. For this program, TestAmerica Pittsburgh purchases and distributes pre-cleaned sample containers with chemical preservatives. Vendors are required to provide documentation of analysis for each lot of containers, and the documentation is kept on file in the Sample Management Office. Tables 5-1, 5-2 and 5-3 define the type of containers required for specific analyses and matrix, preservation techniques and holding times for sediment, water/elutriate and tissue samples. Sample kits, which are coolers containing chain-of custody forms, custody seals, sample containers, preservatives, and packing material, are prepared by the Sample Receiving Department.

5.1.2 Sampling

For this program, samples will be collected by EA Engineering following procedures specified in the program Sampling and Analysis Plan (SAP). After the samples are collected, they are sub-sampled as necessary among preserved containers appropriate to the parameters to be analyzed. Each container is provided with a sample label that is filled out at the time of collection. At the time of collection, a chain-of-custody form is initiated. The collected samples are kept on ice or in a refrigerated truck, as needed to maintain temperature protocols, and returned to the laboratory by the most expedient means to ensure that holding times will be met.

The chain-of custody form is signed and dated when the samples pass from the collectors to those persons responsible for their transportation.

5.1.3 Sample Labeling

The importance of sample labeling is critical to the success of this program. Improperly labeled samples lead to questions with regard to location, project, sampling station, date sampled and sampler. All of this information is essential for proper sample handling. The following information, at a minimum, is required on each sample label:

Client	Data collected
Project number	Time collected
Location	Collected by
Station	Preservative(s)

After the label has been completed and has been affixed to the sample container, the label is covered with clear tape. Pre-printed pressure-sensitive labels are supplied by EA Engineering.

5.2 TestAmerica Pittsburgh Sample Management Operations

The laboratory has a designated Sample Receiving Department Manager. This individual is responsible for over seeing receiving samples in the laboratory, opening the coolers and checking the sample integrity and the custody seal, logging samples into the laboratory system, and controlling the handling and storage of samples while in the laboratory.

5.2.1 Sample Receipt and Logging

After samples have been collected, labeled and the chain-of-custody forms initiated, the sampler completes the chain-of-custody form. This form provides sample-specific information and a listing of the parameters required on each samples. The chain-of-custody and appropriate field data sheets are sealed in a water-tight plastic bag and shipped with the samples to the laboratory.

Upon receipt at the laboratory, the Sample Receiving Department Manager or designated custodian inspects the samples for integrity and checks the shipment against the chain-of-custody. Cooler temperatures are checked and documented in TestAmerica Laboratory's Information Management System (TALS). The pH of preserved samples is measured and documented on the Log-In Container Summary Report, which is maintained in TALS. The pH of sample vials submitted for aqueous volatile organics determinations are checked by the analyst during analysis, and the pH is recorded in TALS. Discrepancies are addressed at this point, documented on the Log-In Sample Receipt Checklist, and resolved prior to laboratory analysis. When the shipment and the chain-of-custody are in agreement, the custodian enters the sample and analysis information into the laboratory computer system (LIMS) and assigns each sample a unique laboratory number.

This number is affixed to each sample bottle. The original of the chain-of-custody form is

scanned into TALS under the particular log-in. These log-in procedures are documented in the Laboratory's sample management SOP.

5.2.2 Sample Storage and Security

While in the laboratory, the samples and aliquots that require storage at approximately 4º C are maintained in a secured refrigerator unless they are being used for analysis. Samples for purgeable organics determinations are stored in a secure refrigerator separate from other samples, sample extracts, and standards. All of the refrigerators in the laboratory used for storage of samples have restricted access, are numbered, and the actual storage location is indicated in the LIMS system. In addition, there are dedicated refrigerators designated for extracts and analytical standards. Samples (e.g. tissue) that are required to be frozen, are stored in a freezer. The sample storage areas are within the laboratory to which access is limited to laboratory chemists. Specific requirements for sample storage are the following:

- Samples are removed from the shipping container and stored in their original containers unless damaged.
- Damaged samples are disposed in an appropriate manner and this disposal is documented. EA will be notified whenever samples arrive damaged at the laboratory.
- Samples and extracts are stored in a secure area designed to comply with the storage method(s) defined in the contract.
- The storage area is kept secure at all times. The sample custodian controls access to the storage area.
- All transfers of samples into and out of storage are documented in an internal chain-of-custody record in TALS. These internal custody records are maintained in TALS.
- Samples for Volatiles Organic Analysis are stored separately from the other samples.
- Standards are not stored with samples or sample extracts.

So that the laboratory may satisfy sample chain-of-custody requirements, the following procedures for laboratory/sample security are implemented:

- Samples are stored in a secure area.
- Access to the laboratory is through a monitored area. Other outside-access doors to the laboratory are kept locked.
- Visitors sign a visitor's log and are escorted while in the laboratory.
- Refrigerators, freezers, and other sample storage areas are securely maintained.

5.2.3 Project Specific Sample Storage and Disposal Procedures

Upon receipt, a sample receipt confirmation will be submitted to the client POC. The confirmation will include the client ID, lab ID, sample date, receipt date, report due date, matrix, and a list of requested parameters.

	INITIAL ANALYSIS		ARCHIVAL	
	Container1	**Storage Location**	**Container**	**Storage Location**
Bulk Sediment	Refer to Table 5-1	Onsite refrigeration	Volume remaining after analysis	Onsite refrigeration (for 30 days from time of invoicing)
Site Water (not for elutriate generation) Equipment Blank	Refer to Table 5-2	Onsite refrigeration	Volume remaining after analysis	Onsite refrigeration (for 30 days from time of invoicing)

1 Volume needed for analysis can vary from project to project and is based on a typical scope of work. A typical SOW may include, but is not limited to: metals, cyanide, ammonia, nitrate, nitrite, sulfide, ammonia, pH, TKN, total phosphorus, semivolatiles, pesticides, PCB congeners, and butyltins.

- Bulk sediment and site water samples will be disposed of per standard laboratory procedures. Samples will be retained in on-site cold storage for a period of 30 days from the time of invoicing. If longer cold storage for project samples is required, a fee may apply. EA Engineering will be notified prior to the start of the project of any potential applicable fees should long-term cold storage be required. EA Engineering will be notified prior to sample disposal or moved out of cold storage.

- EA Engineering will archive sufficient sediment volume to re-analyze target organic and inorganic sediment parameters (with the exception of physical parameters) in cold storage at EA's office in Hunt Valley, Maryland.

- Please refer to Tables 5.1, 5.2 and 5.3 for Container, Preservation Technique and Holding Time requirements.

Table 5.1 Required Containers, Preservation Technique, and Holding Times for Sediment Samples [a]

Parameter	Volume Required [b]	Container[c]	Preservative	Holding Time
Inorganics				
Metals (including Mercury)	32 oz.	G	4°C	6 months (28 days for Hg)
Cyanide	(d)	G	4°C	14 days
Ammonia	(d)	G	4°C	28 days
Sulfide	(d)	G	4°C	7 days
Total Solids	(d)	G	4°C	NA
AVS/SEM	4 oz	G	4°C (no headspace)	14 days
Nitrogen (Nitrate, Nitrate)	(d)	G	4°C	28 days after leach
Nitrogen (Total Kjeldahl), Total Phosphorus	4 oz	G	4°C	28 days
Paint Filter	(f)	G	4°C	NA
pH	(f)	G	4°C	7 days
Ignitability	(f)	G	4°C	NA
EOX	(g)	G	4°C	28 days
TCLP metals	32 oz	G	4°C	14 days to TCLP leach then 6 months (28 days for Hg), 14 days, 7 days
Physical Parameters				
Standard Elutriate Test	3x1 gallon	G	4°C	14 days until elutriate creation
Grain Size, Specific Gravity, Atterberg Limits,	32 oz	G	4°C	6 months
Calcium Carbonate Equivalence, Pyritic Sulfur, PPA – Potential Acidity, saturated Paste pH and EC, Neutralization Potential	8 oz	G	4°C	NA

Table 5.1 Required Containers, Preservation Technique, and Holding Times for Sediment Samples [a]

Parameter	Volume Required [b]	Container[c]	Preservative	Holding Time
Organics				
Total Organic Carbon	(d)	G	4°C	14 days
BTEX	4 oz	G	4°C (no headspace)	14 days
Pesticides (Organochlorine and Organophosphorus), Semivolatile Organics, and Polynuclear Aromatic Hydrocarbons, PCB Congeners, PCB Aroclors	(d)	G	4°C	14 days until extraction, 40 days after extraction
Organotins	(e)	G	4°C	14 days until extraction, 40 days after extraction
Dioxin	4 oz	G	4°C	1 year to analysis
DRO/ORO	4 oz	G	4°C	14 days to extraction, 40 days to analysis
GRO	4 oz	G	4°C (no headspace)	14 days to analysis
TCLP Volatiles	4 oz	G	4°C (no headspace)	14 days to TCLP leach, 14 days to analysis
TCLP (semivolatiles, pesticides, herbicides)	(f)	G	4°C	14 days to TCLP leach, 7 days to extraction then 40 days to analysis

a) From time of sample collection.

b) Additional volume will need to be provided for samples designated as MS/MSD/MDs.

c) G = glass.

d) Sufficient volume is provided from the 32 oz noted under Metals.

e) Sufficient volume is provided from the 32 oz. noted under Grain Size.

f) Sufficient volume is provided from the 32 oz. noted under TCLP metals

g) Sufficient volume is provided from the 4 oz. noted under Nitrogen (Total Kjeldahl), Total Phosphorus

Table 5.2 Required Containers, Preservation Techniques, and Holding Times for Aqueous Samples [a]

Parameter	Volume Required [b]	Container[c]	Preservative	Holding Time
Inorganics				
Metals (including Mercury)	250 mls	P	pH <2 with HNO_3 Cool, 4°C	6 months (28 days for Hg)
Cyanide	250 mls	P,G	NaOH to pH >12 Cool, 4°C	14 days
Sulfide	250 mls	P,G	NaOH/Zinc Acetate to pH >9 Cool, 4°C	7 days
Ammonia, Nitrogen, Nitrate & Nitrite	250 mls	P,G	H_2SO_4 to pH <2 Cool, 4°C	28 days
Total Phosphorus, Nitrogen (Total Kjeldahl)	500 mls (2x250 mls)	P,G	H_2SO_4 to pH <2 Cool, 4°C	28 days
Elutriate Testing				
Standard Elutriate Test	1x5 gallon cube	P	Cool, 4°C	14 days until elutriate creation
Organics				
Total Organic Carbon	2-40 mls	G, teflon-lined, septa cap	H_2SO_4 to pH <2; Cool, 4°C	28 days
Pesticides (Organochlorine and Organophosphorus), Semivolatile Organics and Polynuclear Aromatic Hydrocarbons, PCB Congeners	6 liters	G, teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
Dioxins	2 Liters	G, teflon-lined cap	Cool, 4°C	1 year to analysis
Organotins	2 Liters	G, teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction

a) From time of sample collection.

b) Additional volume will need to be provided for samples designated as MS/MSD/MDs

c) P = plastic; G = glass.

Table 5.3 Required Containers, Preservation Techniques, and Holding Times for Tissue Samples [a]

Parameter	Volume Required [b]	Container[c]	Preservative	Holding Time
Inorganics				
Metals (including Mercury)	8 oz	G, teflon-lined, septa cap	Cool, 4°C	6 months from sample thaw (28 days for Hg from date sampled)
Organics				
Lipids	(d)	G, teflon-lined, septa cap	Cool, 4°C	14 days from sample thaw to extraction 40 days to analysis
Pesticides (Organochlorine), Polynuclear Aromatic Hydrocarbons, PCB Congeners	(d)	G, teflon-lined cap	Cool, 4°C	14 days from sample thaw to extraction 40 days to analysis
Dioxins	(d)	G, teflon-lined cap	Cool, 4°C	1 year to analysis

a) From time of tissue thaw.

b) Additional volume will need to be provided for samples designated as MS/MSD/MDs

c) P = plastic; G = glass

d) Sufficient volume is provided from the 8 oz noted under Metals.

6 Calibration Procedures

6.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in this document.

Equipment is only operated by authorized and trained personnel. Manufacturers instructions for equipment use are readily accessible to all appropriate laboratory personnel.

6.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Scheduled routine maintenance is described in Pittsburgh Laboratory's Quality Assurance Manual (PT-LQAM) and applicable Pittsburgh SOPs. It is the responsibility of each Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may be / are also outlined in analytical SOPs or instrument manuals. Further detail for equipment maintenance is included in SOP No. PT-QA-022. (Note: for some equipment, the log used to monitor performance is also the maintenance log.

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventative maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control, e.g. CCV run on 'date' was accepted or instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.
- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to the pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that the page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

6.3 Supporting Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

Weights and Balances:

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified

ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded and the recalibration/recertification certificates are kept on file. Refer to SOP No. PT-QA-012 for balance and weight calibration.

pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to + 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The NIST thermometer is recalibrated every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be

found in the thermometer calibration SOP No. PT-QA-008.

Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0ºC and < 6 ºC.

Specific temperature settings/ranges for other refrigerators, ovens, waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks or electronically. Refer to SOP No. PT-QA-008 for temperature monitoring.

Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices (except Class A Glassware) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis. Glass micro-syringes are considered the same as Class A glassware.

For those dispensers that are not used for analytical measurements, a label is / can be applied to the device stating that it is not calibrated. Any device not regularly verified can not be used for any quantitative measurements. Pipette calibration is described in Pittsburgh SOP No. PT-QA-017.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an “Accuracy and Precision Statement of Conformance” from Hamilton attesting established accuracy.

6.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument

responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually (the annual requirement does not apply to Isotope dilution).

Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

Calibration Verification

The calibration relationship established during the initial calibration must be verified at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i. e., RPD, per 2009 TNI Std. EL-V1M4 Sec 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after every 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis

of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions: and reported based upon discussion and approval of the client:

- when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or
- when the acceptance criteria for the CCV are exceeded low (i.e., low bias), samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs.) Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.
- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be

analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

6.5 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 6-1. Summary of Periodic Calibration Requirements

Instrument	Calibration Frequency		Corrective Actions
Analytical Balances	Daily:	Sensitivity (with a Class S-verified weight)	Adjust sensitivity
	Annually:	Calibrated by outside vendor against certified Class S weights	Service balance
Thermometers	Annually:	Calibrated against certified NIST thermometers	Tag and remove from service
Automatic Pipettors	Quarterly:	Gravimetric check	Service or replacement

7 Laboratory Procedures

This section details the types of documentation required to ensure the integrity of the data produced. Analytical support for these projects will be provided by TestAmerica Pittsburgh, TestAmerica Burlington (tributyltin, specific gravity, and Unified Soil Classification), TestAmerica North Canton (TPH GRO/DRO/ORO, total phosphorus and TKN), TestAmerica Knoxville (dioxins/furans) and A&L Laboratories (calcium carbonate equivalence, pyritic sulfur, potential acidity, saturated paste pH&EC, neutralization potential).

7.1 Analytical Methods

All inorganic and organic compounds for this project are determined using the methods listed in Table 7-1, as described in the laboratory's analytical SOPs. To meet program specific regulatory requirements for chemicals of concern, all methods/SOPs are followed as stated with some specific requirements noted below:

7.1.1 Total Organic Carbon (TOC)

TOC in sediments will be determined using the 1988 EPA Region II combustion oxidation procedure (referred to as Lloyd Kahn procedure), with the average of 2 burns reported.

7.1.2 Metals

For sediment and water, metals will be determined utilizing Inductively Coupled Plasma/ Mass Spectrophotometry (ICP/MS) according to the methodology specified, to meet the project criteria limit and due to the expected salinity content. The mercury will be analyzed by Cold Vapor Atomic Absorption (CVAA) method (SW846 7470A – aqueous & SW846 7471A – solid).

7.1.3 Acid Volatile Sulfides (AVS) and Simultaneously Extracted Metals (SEM)

The AVS and SEM determinations will be performed following the procedures specified in the EPA April 1991 *Draft Analytical Method for the Determination of Acid Volatile Sulfide in Sediment*. The SEMs that will be determined are cadmium, copper, lead, nickel, and zinc. The reported values for both AVS and SEM will be in ug/kg and umoles/gram.

7.1.4 Cyanide

Total Cyanide will be determined by method SW846 9014. This method represents the best available technology for total cyanide determination and, therefore, the lowest possible reporting limit.

7.2 Detection Limits

The detection limit is a statistical concept that corresponds to the minimum concentration of an analyte above which the net analyte signal can be distinguished with a specified probability from the signal due to the noise inherent in the analytical system. The method detection limit (MDL)

was developed by the EPA, and is defined as "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero" (40 CFR 136, Appendix B). Quantitation limits applicable to this project are listed in Table 7-1 for sediment and aqueous samples. Target Detection Limits (TDLs) referenced in the QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations – Chemical Evaluations (EPA 823-B-95-001, April 1995) and Southeastern Regional Implementation Manual (SERIM) are included in Table 7.2. All analytical parameters, except Wet Chemistry parameters and geotechnical parameters, will be quantitated to the MDL. All detected values ≥ the MDL but < the laboratory reporting limit will be qualified as estimated. Wet Chemistry parameters and geotechnical parameters will be quantitated to the laboratory RL.

The laboratory RL & MDL exceeds the requested TDL for the following compounds in sediment: 1,2,4-Trichlorobenzene, Ammonia, Sulfide, Metals, and Acid Volatile Sulfide. The laboratory RL & MDL exceeds the requested TDL for the following compounds in aqueous matrices: Ammonia, Sulfide, Metals.

For sediment analyses, sample weight will be adjusted for percent moisture (assuming 50% moisture) for the following parameters prior to extraction or digestion to achieve the lowest possible reporting limits: Semivolatiles/PAHs, PCB Aroclors, Organochlorine Pesticides, Organophosphorus Pesticides, Metals (6020A), Mercury (7471B).

7.3 Standard Operating Procedures

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory. The Laboratory SOPs for this project are listed in Table 7-5. The most current list of SOPs is maintained in the QA SOP directory in PT-QA-W-002.

All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.

Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002 or the laboratory's SOP No. PT-QA-010, Preparation and Management of Standard Operating Procedures (SOPs) and Other Controlled Documents.

SOPs are reviewed at a minimum of every 2 years and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Analysis Group Description	Method Description	Method Code
Sediment	Percent Moisture	Moisture

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Percent Moisture	STL00177	0.100	%																	

Sediment	Semivolatile Organic Compounds by GC/MS - Low Level	8270D_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Benzidine	92-87-5	335	ug/Kg	69.9	ug/Kg	10	150	%	30	%	10	150	%	30	%			%		
1,2-Dichlorobenzene	95-50-1	16.5	ug/Kg	1.75	ug/Kg	40	102	%	25	%	40	102	%	25	%			%		
1,3-Dichlorobenzene	541-73-1	16.5	ug/Kg	1.30	ug/Kg	41	100	%	32	%	41	100	%	32	%			%		
1,4-Dichlorobenzene	106-46-7	16.5	ug/Kg	1.19	ug/Kg	41	101	%	32	%	41	101	%	32	%			%		
Benzoic acid	65-85-0	85.0	ug/Kg	6.92	ug/Kg	10	93	%	36	%	10	93	%	36	%			%		
Bis(2-chloroethyl)ether	111-44-4	3.35	ug/Kg	0.448	ug/Kg	40	100	%	33	%	40	100	%	33	%			%		
Bis(2-	111-91-1	16.5	ug/Kg	1.10	ug/Kg	42	103	%	35	%	42	103	%	35	%			%		
Bis(2-ethylhexyl)	117-81-7	33.4	ug/Kg	2.70	ug/Kg	41	121	%	31	%	41	121	%	31	%			%		
4-Bromophenyl phenyl	101-55-3	16.5	ug/Kg	1.45	ug/Kg	43	111	%	20	%	43	111	%	20	%			%		
Butyl benzyl phthalate	85-68-7	16.5	ug/Kg	2.28	ug/Kg	40	117	%	34	%	40	117	%	34	%			%		
4-Chloro-3-methylphenol	59-50-7	16.5	ug/Kg	1.54	ug/Kg	43	110	%	31	%	43	110	%	31	%			%		
2-Chloronaphthalene	91-58-7	3.35	ug/Kg	0.348	ug/Kg	40	104	%	34	%	40	104	%	34	%			%		
2-Chlorophenol	95-57-8	16.5	ug/Kg	1.36	ug/Kg	40	105	%	37	%	40	105	%	37	%			%		
4-Chlorophenyl phenyl	7005-72-3	16.5	ug/Kg	1.85	ug/Kg	42	111	%	37	%	42	111	%	37	%			%		
Di-n-butyl phthalate	84-74-2	16.5	ug/Kg	2.09	ug/Kg	44	120	%	34	%	44	120	%	34	%			%		
3,3'-Dichlorobenzidine	91-94-1	16.5	ug/Kg	1.76	ug/Kg	24	113	%	30	%	24	113	%	30	%			%		
2,4-Dichlorophenol	120-83-2	3.35	ug/Kg	0.335	ug/Kg	44	110	%	27	%	44	110	%	27	%			%		
Diethyl phthalate	84-66-2	16.5	ug/Kg	1.82	ug/Kg	44	113	%	32	%	44	113	%	32	%			%		
4,6-Dinitro-2-	534-52-1	85.0	ug/Kg	6.70	ug/Kg	28	130	%	35	%	28	130	%	35	%			%		
2,4-Dimethylphenol	105-67-9	16.5	ug/Kg	2.61	ug/Kg	39	106	%	42	%	39	106	%	42	%			%		
Dimethyl phthalate	131-11-3	16.5	ug/Kg	1.82	ug/Kg	44	111	%	34	%	44	111	%	34	%			%		
2,4-Dinitrophenol	51-28-5	85.0	ug/Kg	19.9	ug/Kg	19	140	%	43	%	19	140	%	43	%			%		
2,4-Dinitrotoluene	121-14-2	16.5	ug/Kg	1.35	ug/Kg	48	118	%	33	%	48	118	%	33	%			%		
2,6-Dinitrotoluene	606-20-2	16.5	ug/Kg	1.72	ug/Kg	47	119	%	30	%	47	119	%	30	%			%		
1,2-Diphenylhydrazine(as Azobenzene)	122-66-7	16.5	ug/Kg	2.14	ug/Kg	29	110	%	33	%	29	110	%	33	%			%		
Di-n-octyl phthalate	117-84-0	16.5	ug/Kg	1.76	ug/Kg	35	129	%	33	%	35	129	%	33	%			%		
Hexachlorobenzene	118-74-1	3.35	ug/Kg	0.355	ug/Kg	42	110	%	29	%	42	110	%	29	%			%		
Hexachlorobutadiene	87-68-3	3.35	ug/Kg	0.373	ug/Kg	40	114	%	25	%	40	114	%	25	%			%		
Hexachloroethane	67-72-1	16.5	ug/Kg	1.20	ug/Kg	40	102	%	34	%	40	102	%	34	%			%		
Hexachlorocyclopentadie	77-47-4	16.5	ug/Kg	1.80	ug/Kg	10	150	%	33	%	10	150	%	33	%			%		
Isophorone	78-59-1	16.5	ug/Kg	1.26	ug/Kg	39	114	%	33	%	39	114	%	33	%			%		
2-Methylphenol	95-48-7	16.5	ug/Kg	1.17	ug/Kg	41	104	%	37	%	41	104	%	37	%			%		
Methylphenol, 3 & 4	106-44-5	16.5	ug/Kg	1.63	ug/Kg	43	107	%	36	%	43	107	%	36	%			%		
Nitrobenzene	98-95-3	33.4	ug/Kg	1.39	ug/Kg	40	109	%	31	%	40	109	%	31	%			%		
2-Nitrophenol	88-75-5	16.5	ug/Kg	1.84	ug/Kg	45	112	%	30	%	45	112	%	30	%			%		
4-Nitrophenol	100-02-7	85.0	ug/Kg	6.08	ug/Kg	27	131	%	33	%	27	131	%	33	%			%		
N-Nitrosodiphenylamine	86-30-6	16.5	ug/Kg	1.54	ug/Kg	41	110	%	32	%	41	110	%	32	%			%		
N-Nitrosodimethylamine	62-75-9	16.5	ug/Kg	1.43	ug/Kg	33	116	%	30	%	33	116	%	30	%			%		
N-Nitrosodi-n-	621-64-7	3.35	ug/Kg	0.391	ug/Kg	42	108	%	32	%	42	108	%	32	%			%		
2,2'-oxybis[1-	108-60-1	3.35	ug/Kg	0.360	ug/Kg	37	105	%	31	%	37	105	%	31	%			%		
Pentachlorophenol	87-86-5	16.5	ug/Kg	1.49	ug/Kg	18	125	%	34	%	18	125	%	34	%			%		
Phenol	108-95-2	3.35	ug/Kg	0.394	ug/Kg	39	105	%	40	%	39	105	%	40	%			%		
1,2,4-Trichlorobenzene	120-82-1	16.5	ug/Kg	0.923	ug/Kg	41	105	%	36	%	41	105	%	36	%			%		
2,4,6-Trichlorophenol	88-06-2	16.5	ug/Kg	2.50	ug/Kg	43	111	%	36	%	43	111	%	36	%			%		
2-Methylnaphthalene	91-57-6	3.35	ug/Kg	0.300	ug/Kg	43	105	%	34	%	43	105	%	34	%			%		
1-Methylnaphthalene	90-12-0	3.35	ug/Kg	0.356	ug/Kg	10	140	%	30	%	10	140	%	30	%			%		
Naphthalene	91-20-3	3.35	ug/Kg	0.288	ug/Kg	42	104	%	25	%	42	104	%	25	%			%		
Acenaphthylene	208-96-8	3.35	ug/Kg	0.382	ug/Kg	43	117	%	36	%	43	117	%	36	%			%		
Acenaphthene	83-32-9	3.35	ug/Kg	0.320	ug/Kg	42	104	%	34	%	42	104	%	34	%			%		
Fluorene	86-73-7	3.35	ug/Kg	0.440	ug/Kg	43	110	%	37	%	43	110	%	37	%			%		
Phenanthrene	85-01-8	3.35	ug/Kg	0.531	ug/Kg	41	107	%	20	%	41	107	%	20	%			%		
Anthracene	120-12-7	3.35	ug/Kg	0.326	ug/Kg	43	111	%	35	%	43	111	%	35	%			%		
Fluoranthene	206-44-0	3.35	ug/Kg	0.357	ug/Kg	40	118	%	23	%	40	118	%	23	%			%		
Pyrene	129-00-0	3.35	ug/Kg	0.337	ug/Kg	39	113	%	28	%	39	113	%	28	%			%		
Benzo[a]anthracene	56-55-3	3.35	ug/Kg	0.418	ug/Kg	45	110	%	31	%	45	110	%	31	%			%		
Chrysene	218-01-9	3.35	ug/Kg	0.397	ug/Kg	44	108	%	31	%	44	108	%	31	%			%		
Benzo[b]fluoranthene	205-99-2	3.35	ug/Kg	0.524	ug/Kg	37	108	%	28	%	37	108	%	28	%			%		
Benzo[k]fluoranthene	207-08-9	3.35	ug/Kg	0.674	ug/Kg	39	115	%	42	%	39	115	%	42	%			%		
Benzo[a]pyrene	50-32-8	3.35	ug/Kg	0.334	ug/Kg	42	114	%	31	%	42	114	%	31	%			%		
Indeno[1,2,3-cd]pyrene	193-39-5	3.35	ug/Kg	0.344	ug/Kg	34	130	%	30	%	34	130	%	30	%			%		
Dibenz(a,h)anthracene	53-70-3	3.35	ug/Kg	0.371	ug/Kg	34	131	%	32	%	34	131	%	32	%			%		
Benzo[g,h,i]perylene	191-24-2	3.35	ug/Kg	0.332	ug/Kg	35	127	%	21	%	35	127	%	21	%			%		
2-Fluorobiphenyl	321-60-8		ug/Kg		ug/Kg			%		%			%		%	28	108	%		
2-Fluorophenol (Surr)	367-12-4		ug/Kg		ug/Kg			%		%			%		%	28	107	%		
2,4,6-Tribromophenol	118-79-6		ug/Kg		ug/Kg			%		%			%		%	21	116	%		
Nitrobenzene-d5 (Surr)	4165-60-0		ug/Kg		ug/Kg			%		%			%		%	27	110	%		
Phenol-d5 (Surr)	4165-62-2		ug/Kg		ug/Kg			%		%			%		%	30	112	%		
Terphenyl-d14 (Surr)	1718-51-0		ug/Kg		ug/Kg			%		%			%		%	21	130	%		
Benzyl alcohol	100-51-6	16.5	ug/Kg	2.02	ug/Kg	18	129	%	41	%	18	129	%	41	%			%		
Dibenzofuran	132-64-9	16.5	ug/Kg	1.64	ug/Kg	42	106	%	33	%	42	106	%	33	%			%		

Sediment	Automated Soxhlet Extraction (Low Level)	3541_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Sediment	Metals (ICP/MS)	6020A

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Aluminum	7429-90-5	1.50	mg/Kg	0.142	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Antimony	7440-36-0	0.100	mg/Kg	0.00130	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Arsenic	7440-38-2	0.0500	mg/Kg	0.00905	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Barium	7440-39-3	0.500	mg/Kg	0.00535	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Beryllium	7440-41-7	0.0500	mg/Kg	0.00375	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Cadmium	7440-43-9	0.0500	mg/Kg	0.00350	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Chromium	7440-47-3	0.100	mg/Kg	0.00305	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Cobalt	7440-48-4	0.0250	mg/Kg	0.00075	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Calcium	7440-70-2	5.00	mg/Kg	0.663	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Copper	7440-50-8	0.100	mg/Kg	0.0165	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Iron	7439-89-6	2.50	mg/Kg	0.177	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Lead	7439-92-1	0.0500	mg/Kg	0.00190	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Nickel	7440-02-0	0.0500	mg/Kg	0.00565	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Selenium	7782-49-2	0.250	mg/Kg	0.0251	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Potassium	7440-09-7	5.00	mg/Kg	0.679	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Magnesium	7439-95-4	5.00	mg/Kg	0.0935	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Silver	7440-22-4	0.0500	mg/Kg	0.00195	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Thallium	7440-28-0	0.0500	mg/Kg	0.00100	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Sodium	7440-23-5	5.00	mg/Kg	0.685	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Zinc	7440-66-6	0.250	mg/Kg	0.0324	mg/Kg	80	120	%	20	%	75	125	%	20	%					

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Sediment	Preparation, Metals	3050B
Sediment	Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)	7471B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Mercury	7439-97-6	0.0165	mg/Kg	0.00545	mg/Kg	80	120	%	20	%	75	125	%	20	%					

Sediment	Preparation, Mercury	7471B_Prep
Sediment	PCB Congeners (GC)	8082A_Con

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
PCB-8	34883-43-7	1.00	ug/Kg	0.0882	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-18	37680-65-2	1.00	ug/Kg	0.0752	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-28	7012-37-5	1.00	ug/Kg	0.107	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-44	41464-39-5	1.00	ug/Kg	0.0658	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-49	41464-40-8	1.00	ug/Kg	0.0734	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-52	35693-99-3	1.00	ug/Kg	0.164	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-66	32598-10-0	1.00	ug/Kg	0.170	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-77	32598-13-3	1.00	ug/Kg	0.200	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-87	38380-02-8	1.00	ug/Kg	0.0626	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-101	37680-73-2	1.00	ug/Kg	0.0620	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-105	32598-14-4	1.00	ug/Kg	0.179	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-118	31508-00-6	1.00	ug/Kg	0.149	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-126	57465-28-8	1.00	ug/Kg	0.187	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-128	38380-07-3	1.00	ug/Kg	0.0724	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-138	35065-28-2	1.00	ug/Kg	0.0907	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-153	35065-27-1	1.00	ug/Kg	0.139	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-156	38380-08-4	1.00	ug/Kg	0.148	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-169	32774-16-6	1.00	ug/Kg	0.127	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-170	35065-30-6	1.00	ug/Kg	0.139	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-180	35065-29-3	1.00	ug/Kg	0.154	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-183	52663-69-1	1.00	ug/Kg	0.105	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-184	74472-48-3	1.00	ug/Kg	0.0961	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-187	52663-68-0	1.00	ug/Kg	0.0921	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-195	52663-78-2	1.00	ug/Kg	0.119	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-206	40186-72-9	1.00	ug/Kg	0.0664	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
DCB Decachlorobiphenyl	2051-24-3	1.00	ug/Kg	0.147	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
Tetrachloro-m-xylene	877-09-8		ug/Kg		ug/Kg			%		%			%		%	35	140	%		
PCB-205 (Surr)	74472-53-0		ug/Kg		ug/Kg			%		%			%		%	35	140	%		

Sediment	Sulfur Cleanup	3660B
Sediment	Sulfuric Acid/Permanganate Cleanup	3665A
Sediment	Automated Soxhlet	3541

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Sediment	Organochlorine	8081B_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Aldrin	309-00-2	0.0417	ug/Kg	0.00745	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
alpha-BHC	319-84-6	0.0417	ug/Kg	0.00680	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
beta-BHC	319-85-7	0.0417	ug/Kg	0.0108	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
delta-BHC	319-86-8	0.0417	ug/Kg	0.00640	ug/Kg	20	124	%	20	%	20	124	%	20	%			%		
gamma-BHC (Lindane)	58-89-9	0.0417	ug/Kg	0.00730	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
Chlordane (technical)	57-74-9	0.417	ug/Kg	0.0184	ug/Kg			%		%			%		%			%		
Chlorobenside	103-17-3	0.0417	ug/Kg	0.0218	ug/Kg			%		%			%		%			%		
DCPA	1861-32-1	0.0417	ug/Kg	0.00635	ug/Kg			%		%			%		%			%		
4,4'-DDD	72-54-8	0.0417	ug/Kg	0.00545	ug/Kg	15	150	%	20	%	15	150	%	20	%			%		
4,4'-DDE	72-55-9	0.0417	ug/Kg	0.00630	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
4,4'-DDT	50-29-3	0.0417	ug/Kg	0.00625	ug/Kg	10	150	%	37	%	10	150	%	37	%			%		
Dieldrin	60-57-1	0.0417	ug/Kg	0.00695	ug/Kg	20	150	%	20	%	20	150	%	20	%			%		
Endosulfan I	959-98-8	0.0417	ug/Kg	0.00785	ug/Kg	20	150	%	23	%	20	150	%	23	%			%		
Endosulfan II	33213-65-9	0.0417	ug/Kg	0.00735	ug/Kg	10	150	%	33	%	10	150	%	33	%			%		
Endosulfan sulfate	1031-07-8	0.0417	ug/Kg	0.00435	ug/Kg	13	140	%	26	%	13	140	%	26	%			%		
Endrin	72-20-8	0.0417	ug/Kg	0.00810	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
Endrin aldehyde	7421-93-4	0.0417	ug/Kg	0.00810	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
Heptachlor	76-44-8	0.0417	ug/Kg	0.00925	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
Heptachlor epoxide	1024-57-3	0.0417	ug/Kg	0.00810	ug/Kg	10	150	%	20	%	10	150	%	20	%			%		
Methoxychlor	72-43-5	0.0833	ug/Kg	0.00870	ug/Kg	10	150	%	26	%	10	150	%	26	%			%		
Mirex	2385-85-5	0.0417	ug/Kg	0.00385	ug/Kg			%		%			%		%			%		
Toxaphene	8001-35-2	1.67	ug/Kg	0.278	ug/Kg			%		%			%		%			%		
Tetrachloro-m-xylene	877-09-8		ug/Kg		ug/Kg			%		%			%		%	10	140	%		
DCB Decachlorobiphenyl	2051-24-3		ug/Kg		ug/Kg			%		%			%		%	10	140	%		

Sediment	Gel-Permeation Cleanup	3640A
Sediment	Automated Soxhlet Extraction (Low Level)	3541_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Sediment	Organophosphorous Compounds by Gas Chromatography, Capillary Column Technique	8141B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Azinphos-methyl	86-50-0	16.5	ug/Kg	1.56	ug/Kg	40	150	%	30	%	40	150	%	30	%			%		
Demeton, Total	8065-48-3	33.0	ug/Kg	3.00	ug/Kg	10	150	%	30	%	10	150	%	30	%			%		
Malathion	121-75-5	16.5	ug/Kg	1.57	ug/Kg	50	135	%	20	%	50	150	%	30	%			%		
Methyl parathion	298-00-0	16.5	ug/Kg	1.45	ug/Kg	43	146	%	30	%	41	148	%	30	%			%		
Parathion	56-38-2	16.5	ug/Kg	1.32	ug/Kg	52	133	%	30	%	56	125	%	21	%			%		
Tributyl phosphate	126-73-8		ug/Kg		ug/Kg			%		%			%		%	47	130	%		
Triphenylphosphate	115-86-6		ug/Kg		ug/Kg			%		%			%		%	55	125	%		
Bolstar	35400-43-2	16.5	ug/Kg	1.56	ug/Kg	10	150	%	30	%	50	150	%	30	%			%		
Chlorpyrifos	2921-88-2	16.5	ug/Kg	1.62	ug/Kg	50	130	%	25	%	50	130	%	25	%			%		
Coumaphos	56-72-4	16.5	ug/Kg	1.58	ug/Kg	10	150	%	30	%	50	150	%	30	%			%		
Diazinon	333-41-5	16.5	ug/Kg	1.63	ug/Kg	50	150	%	30	%	50	150	%	30	%			%		
Dichlorvos	62-73-7	16.5	ug/Kg	1.47	ug/Kg	10	150	%	30	%	30	150	%	30	%			%		
Dimethoate	60-51-5	16.5	ug/Kg	1.59	ug/Kg	40	143	%	30	%	26	136	%	22	%			%		
Disulfoton	298-04-4	16.5	ug/Kg	1.77	ug/Kg	31	136	%	30	%	45	124	%	30	%			%		
EPN	2104-64-5	16.5	ug/Kg	1.44	ug/Kg	10	150	%	30	%	50	150	%	30	%			%		
Mocap	13194-48-4	16.5	ug/Kg	1.62	ug/Kg	10	150	%	30	%	40	150	%	30	%			%		
Famphur	52-85-7	16.5	ug/Kg	1.61	ug/Kg	54	137	%	30	%	52	131	%	24	%			%		
Fensulfothion	115-90-2	16.5	ug/Kg	1.28	ug/Kg	10	150	%	30	%	38	150	%	30	%			%		
Fenthion	55-38-9	16.5	ug/Kg	1.57	ug/Kg	10	150	%	30	%	10	150	%	30	%			%		
Mevinphos	7786-34-7	16.5	ug/Kg	1.57	ug/Kg	10	150	%	30	%	30	150	%	30	%			%		
Phorate	298-02-2	16.5	ug/Kg	1.67	ug/Kg	41	143	%	30	%	41	135	%	24	%			%		
Ronnel	299-84-3	16.5	ug/Kg	1.56	ug/Kg	10	150	%	30	%	50	150	%	30	%			%		
Stirophos	22248-79-9	16.5	ug/Kg	1.67	ug/Kg	10	150	%	30	%	50	150	%	30	%			%		
Sulfotepp	3689-24-5	16.5	ug/Kg	1.60	ug/Kg	48	126	%	28	%	56	128	%	23	%			%		
Thionazin	297-97-2	16.5	ug/Kg	1.62	ug/Kg	48	126	%	27	%	44	128	%	21	%			%		
Tokuthion	34643-46-4	16.5	ug/Kg	1.63	ug/Kg	10	150	%	30	%	50	150	%	30	%			%		
Trichloronate	327-98-0	16.5	ug/Kg	1.95	ug/Kg	10	150	%	30	%	10	150	%	30	%			%		
O,O,O-Triethyl	126-68-1	16.5	ug/Kg	3.20	ug/Kg	45	130	%	30	%	31	131	%	30	%			%		

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Sediment	Automated Soxhlet	3541_7d
Sediment	General Sub Contract	SUBCONTRA
Sediment	Organotins (GC/FPD)	Organotins_G

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Tetrabutyltin	1461-25-2	1.70	ug/Kg			30	160	%	30	%	30	160	%	30	%			%		
Tributyltin	688-73-3	1.50	ug/Kg			30	160	%	30	%	30	160	%	30	%			%		
Dibutyltin	1002-53-5	1.30	ug/Kg			30	160	%	30	%	30	160	%	30	%			%		
Tripentyltin	STL00386		ug/Kg					%		%			%		%	30	120	%		
Monobutyltin	2406-65-7	20.7	ug/Kg			10	48	%	30	%	10	48	%	30	%			%		
Tetra-n-propyl tin	2176-98-9		ug/Kg																	

Sediment	Ultrasonic Extraction	3550C
Sediment	Cyanide, Total andor	9012B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Cyanide, Total	57-12-5	0.250	mg/Kg	0.0734	mg/Kg	38	162	%	30	%	75	125	%	20	%					

Sediment	Cyanide, Total and/or Amenable, Distillation	9012B_Prep

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Sediment	Nitrogen, Ammonia	350.1

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Ammonia, distilled	7664-41-7	5.00	mg/Kg	3.22	mg/Kg	90	110	%	20	%	90	110	%	20	%					

Sediment	Distillation, Ammonia	Distill_Ammon
Sediment	Sulfide, Acid soluble and Insoluble (Titrimetric)	9034_Calc

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Sulfide	18496-25-8	30.0	mg/Kg	6.00	mg/Kg	85	115	%	20	%	75	125	%	20	%				15.0	mg/Kg

Sediment	Sulfide, Distillation (Acid Soluble and Insoluble)	9030B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Sediment	Nitrogen, Nitrate-Nitrite	353.2_Pres

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Nitrate Nitrite as N	STL00217	0.100	mg/L	0.0140	mg/L	90	110	%	20	%	90	110	%	20	%					

Sediment	Deionized Water Leaching Procedure	DI_LEACH
Sediment	Phosphorus	4500_P_E

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Total Phosphorus as P	7723-14-0	10.0	mg/Kg	0.910	mg/Kg	75	125	%	20	%	75	125	%	20	%				2.50	mg/Kg

Sediment	Phosphorus, Total	365_Prep
Sediment	Nitrogen, Total Kjeldahl	SM4500Norg_

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Nitrogen, Kjeldahl	STL00296	150	mg/Kg	51.0	mg/Kg	70	133	%	50	%	50	120	%	50	%					

Sediment	Preparation, Nitrogen -	SM4500Norg_
Sediment	Organic Carbon, Total	Lloyd_Kahn_

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Total Organic Carbon - Duplicates	7440-44-0	1000	mg/Kg	88.7	mg/Kg	75	125	%	20	%	75	125	%	20	%				500	mg/Kg

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Sediment	Specific Gravity	D854

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Specific Gravity	STL00157																			
Specific Gravity at 20 deg Celsius	STL00526																			

Sediment	Metals (ICP)	6010B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Cadmium SEM	7440-43-9	0.125	mg/Kg	0.00410	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Copper SEM	7440-50-8	0.625	mg/Kg	0.0561	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Lead SEM	7439-92-1	0.250	mg/Kg	0.0495	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Nickel SEM	7440-02-0	1.00	mg/Kg	0.0287	mg/Kg	80	120	%	20	%	75	125	%	20	%					
Zinc SEM	7440-66-6	2.50	mg/Kg	0.185	mg/Kg	80	120	%	20	%	75	125	%	20	%					

Sediment	Preparation, Acid Volatile Sulfide (AVS) and Simultaneously Extracted Metals (SE	AVSSEM_Prep
Sediment	Sulfide, Acid soluble and Insoluble (Titrimetric)	9034_Calc

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Acid Volatile Sulfides	18496-25-8	30.0	mg/Kg	6.00	mg/Kg	85	115	%	20	%	75	125	%	20	%				15.0	mg/Kg

Sediment	Preparation, Acid Volatile Sulfide (AVS) and Simultaneously Extracted Metals (SE	AVSSEM_Prep
Sediment	Metals, Simultaneously Extracted Metals (SEM)	SEM

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
SEM/AVS Ratio	STL00343	0.00100	NONE	0.00100	NONE															
Cadmium SEM	7440-43-9	0.00111	umol/g	0.00003	umol/g															
Copper SEM	7440-50-8	0.00984	umol/g	0.00088	umol/g															
Nickel SEM	7440-02-0	0.0170	umol/g	0.00049	umol/g															
Lead SEM	7439-92-1	0.000724	umol/g	0.00023	umol/g															
SEM Summary	STL00344	0.00100	umol/g	0.00100	umol/g															
Zinc SEM	7440-66-6	0.0382	umol/g	0.00283	umol/g															
Mercury SEM	7439-97-6	0.000062	umol/g	0.00000	umol/g															
Acid Volatile Sulfides	18496-25-8	0.499	umol/g	0.155	umol/g															

Sediment	Classification of Soils for Engineering Purposes	D2487

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Group Name	STL00546																			
Group Symbol	STL00547																			

Sediment	Liquid Limit, Plastic Limit and Plasticity Index of Soils	D4318

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Liquid Limit	STL00543																			
Plastic Limit	STL00544																			
Plasticity Index	STL00545																			

Sediment	Grain Size	D422

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Sieve Size 3 inch - Percent Finer	STL01283																			
Sieve Size 2 inch - Percent Finer	STL01282																			
Sieve Size 1.5 inch - Percent Finer	STL01281																			
Sieve Size 1 inch - Percent Finer	STL01280																			
Sieve Size 0.75 inch - Percent Finer	STL01279																			
Sieve Size 0.375 inch - Percent Finer	STL01278																			
Sieve Size #4 - Percent	STL01274																			
Sieve Size #10 - Percent	STL01268																			
Sieve Size #20 - Percent	STL01271																			
Sieve Size #40 - Percent	STL01275																			
Sieve Size #60 - Percent	STL01276																			
Sieve Size #80 - Percent	STL01277																			
Sieve Size #100 -	STL01269																			
Sieve Size #200 -	STL01272																			
Hydrometer Reading 1 - Percent Finer	STL01284																			
Hydrometer Reading 2 - Percent Finer	STL01285																			
Hydrometer Reading 3 - Percent Finer	STL01286																			
Hydrometer Reading 4 - Percent Finer	STL01287																			
Hydrometer Reading 5 - Percent Finer	STL01288																			
Hydrometer Reading 6 - Percent Finer	STL01290																			
Hydrometer Reading 7 - Percent Finer	STL01291																			

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Sediment	Grain Size	D422

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Gravel	STL00581																			
Sand	STL00582																			
Coarse Sand	STL00583																			
Medium Sand	STL00584																			
Fine Sand	STL00585																			
Silt	STL00586																			
Clay	STL00587																			

Site Water	Semivolatile Organic Compounds by GC/MS - Low Level	8270D_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Benzidine	92-87-5	20.0	ug/L	3.47	ug/L	10	150	%	30	%	10	150	%	30	%			%		
1,2-Dichlorobenzene	95-50-1	1.00	ug/L	0.0749	ug/L	34	95	%	38	%	34	95	%	38	%			%		
1,3-Dichlorobenzene	541-73-1	1.00	ug/L	0.0743	ug/L	33	93	%	38	%	33	93	%	38	%			%		
1,4-Dichlorobenzene	106-46-7	1.00	ug/L	0.0744	ug/L	34	93	%	41	%	34	93	%	41	%			%		
Benzoic acid	65-85-0	5.00	ug/L	0.562	ug/L	10	114	%	59	%	10	114	%	59	%			%		
Bis(2-chloroethyl)ether	111-44-4	0.200	ug/L	0.0251	ug/L	33	95	%	38	%	33	95	%	38	%			%		
Bis(2-	111-91-1	1.00	ug/L	0.0581	ug/L	33	98	%	46	%	33	98	%	46	%			%		
Bis(2-ethylhexyl)	117-81-7	2.00	ug/L	1.25	ug/L	20	116	%	40	%	20	116	%	40	%			%		
4-Bromophenyl phenyl	101-55-3	1.00	ug/L	0.0635	ug/L	37	104	%	40	%	37	104	%	40	%			%		
Butyl benzyl phthalate	85-68-7	1.00	ug/L	0.142	ug/L	36	108	%	40	%	36	108	%	40	%			%		
4-Chloro-3-methylphenol	59-50-7	1.00	ug/L	0.0754	ug/L	35	104	%	42	%	35	104	%	42	%			%		
2-Chloronaphthalene	91-58-7	0.200	ug/L	0.0151	ug/L	34	96	%	39	%	34	96	%	39	%			%		
2-Chlorophenol	95-57-8	1.00	ug/L	0.165	ug/L	31	99	%	39	%	31	99	%	39	%			%		
4-Chlorophenyl phenyl	7005-72-3	1.00	ug/L	0.0503	ug/L	34	103	%	38	%	34	103	%	38	%			%		
Di-n-butyl phthalate	84-74-2	1.00	ug/L	0.125	ug/L	37	111	%	38	%	37	111	%	38	%			%		
3,3'-Dichlorobenzidine	91-94-1	1.00	ug/L	0.112	ug/L	10	89	%	56	%	10	89	%	56	%			%		
2,4-Dichlorophenol	120-83-2	0.200	ug/L	0.0334	ug/L	34	104	%	41	%	34	104	%	41	%			%		
Diethyl phthalate	84-66-2	1.00	ug/L	0.146	ug/L	36	109	%	39	%	36	109	%	39	%			%		
4,6-Dinitro-2-	534-52-1	5.00	ug/L	0.220	ug/L	24	124	%	41	%	24	124	%	41	%			%		
2,4-Dimethylphenol	105-67-9	1.00	ug/L	0.0852	ug/L	33	97	%	40	%	33	97	%	40	%			%		
Dimethyl phthalate	131-11-3	1.00	ug/L	0.0765	ug/L	37	106	%	42	%	37	106	%	42	%			%		
2,4-Dinitrophenol	51-28-5	5.00	ug/L	0.613	ug/L	10	130	%	53	%	10	130	%	53	%			%		
2,4-Dinitrotoluene	121-14-2	1.00	ug/L	0.0536	ug/L	37	115	%	39	%	37	115	%	39	%			%		
2,6-Dinitrotoluene	606-20-2	1.00	ug/L	0.0797	ug/L	39	113	%	40	%	39	113	%	40	%			%		
1,2-Diphenylhydrazine(as Azobenzene)	122-66-7	1.00	ug/L	0.0660	ug/L	31	107	%	41	%	31	107	%	41	%			%		
Di-n-octyl phthalate	117-84-0	1.00	ug/L	0.207	ug/L	11	127	%	44	%	11	127	%	44	%			%		
Hexachlorobenzene	118-74-1	0.200	ug/L	0.0183	ug/L	35	102	%	35	%	35	102	%	35	%			%		
Hexachlorobutadiene	87-68-3	0.200	ug/L	0.0166	ug/L	35	100	%	41	%	35	100	%	41	%			%		
Hexachloroethane	67-72-1	1.00	ug/L	0.0628	ug/L	32	94	%	39	%	32	94	%	39	%			%		
Hexachlorocyclopentadie	77-47-4	1.00	ug/L	0.0518	ug/L	36	115	%	47	%	36	115	%	47	%			%		
Isophorone	78-59-1	1.00	ug/L	0.0644	ug/L	38	102	%	43	%	38	102	%	43	%			%		
2-Methylphenol	95-48-7	1.00	ug/L	0.0862	ug/L	33	98	%	38	%	33	98	%	38	%			%		
Methylphenol, 3 & 4	106-44-5	1.00	ug/L	0.0902	ug/L	32	100	%	41	%	32	100	%	41	%			%		
Nitrobenzene	98-95-3	2.00	ug/L	0.0843	ug/L	37	100	%	42	%	37	100	%	42	%			%		
2-Nitrophenol	88-75-5	1.00	ug/L	0.171	ug/L	34	107	%	41	%	34	107	%	41	%			%		
4-Nitrophenol	100-02-7	5.00	ug/L	0.647	ug/L	29	115	%	42	%	29	115	%	42	%			%		
N-Nitrosodiphenylamine	86-30-6	1.00	ug/L	0.0853	ug/L	32	102	%	36	%	32	102	%	36	%			%		
N-Nitrosodimethylamine	62-75-9	1.00	ug/L	0.0735	ug/L	31	107	%	40	%	31	107	%	40	%			%		
N-Nitrosodi-n-	621-64-7	0.200	ug/L	0.0308	ug/L	34	101	%	43	%	34	101	%	43	%			%		
2,2'-oxybis[1-	108-60-1	0.200	ug/L	0.0197	ug/L	30	99	%	42	%	30	99	%	42	%			%		
Pentachlorophenol	87-86-5	1.00	ug/L	0.0663	ug/L	15	111	%	42	%	15	111	%	42	%			%		
Phenol	108-95-2	0.200	ug/L	0.0581	ug/L	32	95	%	39	%	32	95	%	39	%			%		
1,2,4-Trichlorobenzene	120-82-1	1.00	ug/L	0.0712	ug/L	34	96	%	45	%	34	96	%	45	%			%		
2,4,6-Trichlorophenol	88-06-2	1.00	ug/L	0.175	ug/L	36	103	%	39	%	36	103	%	39	%			%		
2-Methylnaphthalene	91-57-6	0.200	ug/L	0.0122	ug/L	34	98	%	42	%	34	98	%	42	%			%		
1-Methylnaphthalene	90-12-0	0.200	ug/L	0.0138	ug/L	10	140	%	30	%	10	140	%	30	%			%		
Naphthalene	91-20-3	0.200	ug/L	0.0140	ug/L	35	97	%	43	%	35	97	%	43	%			%		
Acenaphthylene	208-96-8	0.200	ug/L	0.0152	ug/L	37	107	%	40	%	37	107	%	40	%			%		
Acenaphthene	83-32-9	0.200	ug/L	0.0144	ug/L	35	99	%	41	%	35	99	%	41	%			%		
Fluorene	86-73-7	0.200	ug/L	0.0216	ug/L	34	104	%	40	%	34	104	%	40	%			%		
Phenanthrene	85-01-8	0.200	ug/L	0.0427	ug/L	32	104	%	36	%	32	104	%	36	%			%		
Anthracene	120-12-7	0.200	ug/L	0.0154	ug/L	35	105	%	37	%	35	105	%	37	%			%		
Fluoranthene	206-44-0	0.200	ug/L	0.0162	ug/L	32	112	%	39	%	32	112	%	39	%			%		
Pyrene	129-00-0	0.200	ug/L	0.0157	ug/L	35	106	%	42	%	35	106	%	42	%			%		
Benzo[a]anthracene	56-55-3	0.200	ug/L	0.0147	ug/L	38	101	%	36	%	38	101	%	36	%			%		
Chrysene	218-01-9	0.200	ug/L	0.0140	ug/L	37	99	%	42	%	37	99	%	42	%			%		
Benzo[b]fluoranthene	205-99-2	0.200	ug/L	0.0157	ug/L	29	98	%	46	%	29	98	%	46	%			%		
Benzo[k]fluoranthene	207-08-9	0.200	ug/L	0.0547	ug/L	28	107	%	31	%	28	107	%	31	%			%		
Benzo[a]pyrene	50-32-8	0.200	ug/L	0.0134	ug/L	26	108	%	40	%	26	108	%	40	%			%		
Indeno[1,2,3-cd]pyrene	193-39-5	0.200	ug/L	0.0199	ug/L	22	115	%	54	%	22	115	%	54	%			%		
Dibenz(a,h)anthracene	53-70-3	0.200	ug/L	0.0155	ug/L	19	118	%	44	%	19	118	%	44	%			%		
Benzo[g,h,i]perylene	191-24-2	0.200	ug/L	0.0151	ug/L	20	115	%	44	%	20	115	%	44	%			%		
2-Fluorobiphenyl	321-60-8		ug/L		ug/L			%		%			%		%	19	107	%		
2-Fluorophenol (Surr)	367-12-4		ug/L		ug/L			%		%			%		%	10	111	%		
2,4,6-Tribromophenol	118-79-6		ug/L		ug/L			%		%			%		%	16	122	%		
Nitrobenzene-d5 (Surr)	4165-60-0		ug/L		ug/L			%		%			%		%	23	112	%		
Phenol-d5 (Surr)	4165-62-2		ug/L		ug/L			%		%			%		%	15	112	%		
Terphenyl-d14 (Surr)	1718-51-0		ug/L		ug/L			%		%			%		%	10	132	%		
Benzyl alcohol	100-51-6	1.00	ug/L	0.215	ug/L	10	68	%	20	%	10	68	%	20	%			%		
Dibenzofuran	132-64-9	1.00	ug/L	0.0617	ug/L	34	101	%	39	%	34	101	%	39	%			%		

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Site Water	Liquid-Liquid Extraction (Continuous)	3520C_LL
Site Water	Metals (ICP/MS)	6020A

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Aluminum	7429-90-5	30.0	ug/L	2.57	ug/L	80	120	%	20	%	75	125	%	20	%					
Arsenic	7440-38-2	1.00	ug/L	0.291	ug/L	80	120	%	20	%	75	125	%	20	%					
Barium	7440-39-3	10.0	ug/L	0.0980	ug/L	80	120	%	20	%	75	125	%	20	%					
Beryllium	7440-41-7	1.00	ug/L	0.0367	ug/L	80	120	%	20	%	75	125	%	20	%					
Cadmium	7440-43-9	1.00	ug/L	0.114	ug/L	80	120	%	20	%	75	125	%	20	%					
Calcium	7440-70-2	100	ug/L	2.84	ug/L	80	120	%	20	%	75	125	%	20	%					
Chromium	7440-47-3	2.00	ug/L	0.543	ug/L	80	120	%	20	%	75	125	%	20	%					
Cobalt	7440-48-4	0.500	ug/L	0.0263	ug/L	80	120	%	20	%	75	125	%	20	%					
Copper	7440-50-8	2.00	ug/L	0.244	ug/L	80	120	%	20	%	75	125	%	20	%					
Iron	7439-89-6	50.0	ug/L	6.09	ug/L	80	120	%	20	%	75	125	%	20	%					
Silver	7440-22-4	1.00	ug/L	0.0362	ug/L	80	120	%	20	%	75	125	%	20	%					
Potassium	7440-09-7	100	ug/L	5.82	ug/L	80	120	%	20	%	75	125	%	20	%					
Magnesium	7439-95-4	100	ug/L	1.17	ug/L	80	120	%	20	%	75	125	%	20	%					
Sodium	7440-23-5	100	ug/L	3.81	ug/L	80	120	%	20	%	75	125	%	20	%					
Nickel	7440-02-0	1.00	ug/L	0.175	ug/L	80	120	%	20	%	75	125	%	20	%					
Lead	7439-92-1	1.00	ug/L	0.0192	ug/L	80	120	%	20	%	75	125	%	20	%					
Antimony	7440-36-0	2.00	ug/L	0.0187	ug/L	80	120	%	20	%	75	125	%	20	%					
Selenium	7782-49-2	5.00	ug/L	0.422	ug/L	80	120	%	20	%	75	125	%	20	%					
Thallium	7440-28-0	1.00	ug/L	0.0152	ug/L	80	120	%	20	%	75	125	%	20	%					
Zinc	7440-66-6	5.00	ug/L	0.961	ug/L	80	120	%	20	%	75	125	%	20	%					

Site Water	Preparation, Total Recoverable or Dissolved Metals	3005A
Site Water	Mercury (CVAA)	7470A

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Mercury	7439-97-6	0.200	ug/L	0.0384	ug/L	80	120	%	20	%	75	125	%	20	%					

Site Water	Preparation, Mercury	7470A_Prep
Site Water	PCB Congeners (GC)	8082A_Con

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
PCB-8	34883-43-7	1.00	ng/L	0.124	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-18	37680-65-2	1.00	ng/L	0.159	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-28	7012-37-5	1.00	ng/L	0.158	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-44	41464-39-5	1.00	ng/L	0.178	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-49	41464-40-8	1.00	ng/L	0.192	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-52	35693-99-3	1.00	ng/L	0.197	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-66	32598-10-0	1.00	ng/L	0.205	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-77	32598-13-3	1.00	ng/L	0.236	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-87	38380-02-8	1.00	ng/L	0.236	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-101	37680-73-2	1.00	ng/L	0.176	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-105	32598-14-4	1.00	ng/L	0.177	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-118	31508-00-6	1.00	ng/L	0.208	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-126	57465-28-8	1.00	ng/L	0.207	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-128	38380-07-3	1.00	ng/L	0.236	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-138	35065-28-2	1.00	ng/L	0.192	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-153	35065-27-1	1.00	ng/L	0.225	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-156	38380-08-4	1.00	ng/L	0.173	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-169	32774-16-6	1.00	ng/L	0.189	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-170	35065-30-6	1.00	ng/L	0.144	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-180	35065-29-3	1.00	ng/L	0.238	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-183	52663-69-1	1.00	ng/L	0.210	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-184	74472-48-3	1.00	ng/L	0.206	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-187	52663-68-0	1.00	ng/L	0.203	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-195	52663-78-2	1.00	ng/L	0.214	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-206	40186-72-9	1.00	ng/L	0.171	ng/L	40	140	%	35	%	40	140	%	35	%			%		
DCB Decachlorobiphenyl	2051-24-3	1.00	ng/L	0.134	ng/L	40	140	%	35	%	40	140	%	35	%			%		
Tetrachloro-m-xylene	877-09-8		ng/L		ng/L			%		%			%		%	35	140	%		
PCB-205 (Surr)	74472-53-0		ng/L		ng/L			%		%			%		%	35	140	%		

Site Water	Liquid-Liquid Extraction (Separatory Funnel)	3510C
Site Water	Organochlorine	8081B_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Aldrin	309-00-2	0.00130	ug/L	0.00083	ug/L	62	113	%	22	%	62	113	%	22	%			%		
alpha-BHC	319-84-6	0.00130	ug/L	0.00066	ug/L	58	114	%	20	%	58	114	%	20	%			%		
beta-BHC	319-85-7	0.00130	ug/L	0.00100	ug/L	37	133	%	24	%	37	133	%	24	%			%		
delta-BHC	319-86-8	0.00130	ug/L	0.00038	ug/L	20	137	%	26	%	20	137	%	26	%			%		
gamma-BHC (Lindane)	58-89-9	0.00130	ug/L	0.00080	ug/L	57	120	%	21	%	57	120	%	21	%			%		
Chlordane (technical)	57-74-9	0.0125	ug/L	0.00165	ug/L			%		%			%		%			%		
Chlorobenside	103-17-3	0.00320	ug/L	0.00148	ug/L			%		%			%		%			%		
DCPA	1861-32-1	0.00250	ug/L	0.00034	ug/L			%		%			%		%			%		
4,4'-DDD	72-54-8	0.00130	ug/L	0.00067	ug/L	48	120	%	24	%	48	120	%	24	%			%		
4,4'-DDE	72-55-9	0.00130	ug/L	0.00079	ug/L	47	120	%	20	%	47	120	%	20	%			%		
4,4'-DDT	50-29-3	0.00130	ug/L	0.00074	ug/L	39	131	%	24	%	39	131	%	24	%			%		
Dieldrin	60-57-1	0.00130	ug/L	0.00082	ug/L	51	121	%	20	%	51	121	%	20	%			%		
Endosulfan I	959-98-8	0.00130	ug/L	0.00094	ug/L	53	117	%	22	%	53	117	%	22	%			%		
Endosulfan II	33213-65-9	0.00130	ug/L	0.00098	ug/L	44	122	%	21	%	44	122	%	21	%			%		
Endosulfan sulfate	1031-07-8	0.00130	ug/L	0.00057	ug/L	42	122	%	21	%	42	122	%	21	%			%		
Endrin	72-20-8	0.00130	ug/L	0.00096	ug/L	31	138	%	24	%	31	138	%	24	%			%		
Endrin aldehyde	7421-93-4	0.00130	ug/L	0.00090	ug/L	41	116	%	25	%	41	116	%	25	%			%		
Heptachlor	76-44-8	0.00130	ug/L	0.00099	ug/L	63	120	%	25	%	63	120	%	25	%			%		
Heptachlor epoxide	1024-57-3	0.00130	ug/L	0.00097	ug/L	60	120	%	20	%	60	120	%	20	%			%		
Methoxychlor	72-43-5	0.00250	ug/L	0.00091	ug/L	35	137	%	27	%	35	137	%	27	%			%		
Mirex	2385-85-5	0.00130	ug/L	0.00048	ug/L			%		%			%		%			%		
Toxaphene	8001-35-2	0.100	ug/L	0.0186	ug/L			%		%			%		%			%		
Tetrachloro-m-xylene	877-09-8		ug/L		ug/L			%		%			%		%	60	111	%		
DCB Decachlorobiphenyl	2051-24-3		ug/L		ug/L			%		%			%		%	45	122	%		

Site Water	Liquid-Liquid Extraction (Separatory Funnel)	3510C_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Site Water	Organophosphorous Compounds by Gas Chromatography, Capillary Column Technique	8141B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Azinphos-methyl	86-50-0	1.00	ug/L	0.113	ug/L	40	150	%	30	%	40	150	%	30	%			%		
Demeton, Total	8065-48-3	2.00	ug/L	0.165	ug/L	10	150	%	30	%	10	150	%	30	%			%		
Malathion	121-75-5	1.00	ug/L	0.110	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Methyl parathion	298-00-0	1.00	ug/L	0.111	ug/L	41	148	%	30	%	41	148	%	30	%			%		
Parathion	56-38-2	1.00	ug/L	0.162	ug/L	56	125	%	21	%	56	125	%	21	%			%		
Tributyl phosphate	126-73-8		ug/L		ug/L			%		%			%		%	49	122	%		
Triphenylphosphate	115-86-6		ug/L		ug/L			%		%			%		%	45	145	%		
Bolstar	35400-43-2	1.00	ug/L	0.110	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Chlorpyrifos	2921-88-2	1.00	ug/L	0.102	ug/L	50	130	%	25	%	50	130	%	25	%			%		
Coumaphos	56-72-4	1.00	ug/L	0.149	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Diazinon	333-41-5	1.00	ug/L	0.0942	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Dichlorvos	62-73-7	1.00	ug/L	0.0849	ug/L	30	150	%	30	%	30	150	%	30	%			%		
Dimethoate	60-51-5	1.00	ug/L	0.117	ug/L	26	136	%	22	%	26	136	%	22	%			%		
Disulfoton	298-04-4	1.00	ug/L	0.101	ug/L	45	124	%	30	%	45	124	%	30	%			%		
EPN	2104-64-5	1.00	ug/L	0.115	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Mocap	13194-48-4	1.00	ug/L	0.101	ug/L	40	150	%	30	%	40	150	%	30	%			%		
Famphur	52-85-7	1.00	ug/L	0.124	ug/L	52	131	%	24	%	52	131	%	24	%			%		
Fensulfothion	115-90-2	1.00	ug/L	0.165	ug/L	38	150	%	30	%	38	150	%	30	%			%		
Fenthion	55-38-9	1.00	ug/L	0.0846	ug/L	10	150	%	30	%	10	150	%	30	%			%		
Mevinphos	7786-34-7	1.00	ug/L	0.0979	ug/L	30	150	%	30	%	30	150	%	30	%			%		
Phorate	298-02-2	1.00	ug/L	0.0924	ug/L	41	135	%	24	%	41	135	%	24	%			%		
Ronnel	299-84-3	1.00	ug/L	0.102	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Stirophos	22248-79-9	1.00	ug/L	0.0957	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Sulfotepp	3689-24-5	1.00	ug/L	0.0947	ug/L	56	128	%	23	%	56	128	%	23	%			%		
Thionazin	297-97-2	1.00	ug/L	0.100	ug/L	44	128	%	21	%	44	128	%	21	%			%		
Tokuthion	34643-46-4	1.00	ug/L	0.0937	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Trichloronate	327-98-0	1.00	ug/L	0.0992	ug/L	10	150	%	30	%	10	150	%	30	%			%		
O,O,O-Triethyl	126-68-1	1.00	ug/L	0.0999	ug/L	31	131	%	30	%	31	131	%	30	%			%		

Site Water	Liquid-Liquid Extraction (Separatory Funnel)	3510C
Site Water	General Sub Contract	SUBCONTRA
Site Water	Organotins (GC/FPD)	Organotins_G

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Tetrabutyltin	1461-25-2	0.0500	ug/L			30	150	%	30	%	30	150	%	30	%			%		
Tributyltin	688-73-3	0.0450	ug/L			30	150	%	30	%	30	150	%	30	%			%		
Dibutyltin	1002-53-5	0.0390	ug/L			30	150	%	30	%	30	150	%	30	%			%		
Tripentyltin	STL00386		ug/L					%		%			%		%	15	150	%		
Monobutyltin	2406-65-7	0.620	ug/L			10	48	%	30	%	10	48	%	30	%			%		
Tetra-n-propyl tin	2176-98-9		ug/L																	

Site Water	Liquid-Liquid Extraction (Separatory Funnel)	3510C_14d
Site Water	Cyanide, Total andor	9012B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Cyanide, Total	57-12-5	10.0	ug/L	3.20	ug/L	85	115	%	20	%	75	125	%	20	%				4.00	ug/L

Site Water	Cyanide, Total and/or Amenable, Distillation	9012B_Prep

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Site Water	Nitrogen, Ammonia	350.1

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Ammonia, distilled	7664-41-7	0.100	mg/L	0.0864	mg/L	90	110	%	20	%	90	110	%	20	%					

Site Water	Distillation, Ammonia	Distill_Ammon
Site Water	Sulfide, Acid soluble and Insoluble (Titrimetric)	9034_Calc

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Sulfide	18496-25-8	3.00	mg/L	0.590	mg/L	85	115	%	20	%	75	125	%	20	%				1.50	mg/L

Site Water	Sulfide, Distillation (Acid Soluble and Insoluble)	9030B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Site Water	Nitrogen, Nitrate-Nitrite	353.2_Pres

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Nitrate Nitrite as N	STL00217	0.100	mg/L	0.0140	mg/L	90	110	%	20	%	90	110	%	20	%					

Site Water	Phosphorus	4500_P_E

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Total Phosphorus as P	7723-14-0	0.100	mg/L	0.0500	mg/L	53	134	%	20	%	10	199	%	20	%				0.100	mg/L

Site Water	Phosphorus, Total	365_Prep
Site Water	Nitrogen, Total Kjeldahl	SM4500Norg_

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Nitrogen, Kjeldahl	STL00296	5.00	mg/L	1.70	mg/L	65	144	%	20	%	10	200	%	20	%				5.00	mg/L

Site Water	Preparation, Nitrogen - Total Kjeldahl	SM4500Norg_C_P
Site Water	TOC	5310C

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Total Organic Carbon - Duplicates	7440-44-0	1.00	mg/L	0.189	mg/L	80	120	%	20	%	75	125	%	20	%				0.400	mg/L

Standard Elutriate Generation	Standard Elutriate Test, Dissolved	SED_SET_Diss

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Elutriate Generated	STL01538																			

Standard Elutriate Dissolved Analytical	Semivolatile Organic Compounds by GC/MS - Low Level	8270D_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Benzidine	92-87-5	20.0	ug/L	3.47	ug/L	10	150	%	30	%	10	150	%	30	%			%		
1,2-Dichlorobenzene	95-50-1	1.00	ug/L	0.0749	ug/L	34	95	%	38	%	34	95	%	38	%			%		
1,3-Dichlorobenzene	541-73-1	1.00	ug/L	0.0743	ug/L	33	93	%	38	%	33	93	%	38	%			%		
1,4-Dichlorobenzene	106-46-7	1.00	ug/L	0.0744	ug/L	34	93	%	41	%	34	93	%	41	%			%		
Benzoic acid	65-85-0	5.00	ug/L	0.562	ug/L	10	114	%	59	%	10	114	%	59	%			%		
Bis(2-chloroethyl)ether	111-44-4	0.200	ug/L	0.0251	ug/L	33	95	%	38	%	33	95	%	38	%			%		
Bis(2-	111-91-1	1.00	ug/L	0.0581	ug/L	33	98	%	46	%	33	98	%	46	%			%		
Bis(2-ethylhexyl)	117-81-7	2.00	ug/L	1.25	ug/L	20	116	%	40	%	20	116	%	40	%			%		
4-Bromophenyl phenyl	101-55-3	1.00	ug/L	0.0635	ug/L	37	104	%	40	%	37	104	%	40	%			%		
Butyl benzyl phthalate	85-68-7	1.00	ug/L	0.142	ug/L	36	108	%	40	%	36	108	%	40	%			%		
4-Chloro-3-methylphenol	59-50-7	1.00	ug/L	0.0754	ug/L	35	104	%	42	%	35	104	%	42	%			%		
2-Chloronaphthalene	91-58-7	0.200	ug/L	0.0151	ug/L	34	96	%	39	%	34	96	%	39	%			%		
2-Chlorophenol	95-57-8	1.00	ug/L	0.165	ug/L	31	99	%	39	%	31	99	%	39	%			%		
4-Chlorophenyl phenyl	7005-72-3	1.00	ug/L	0.0503	ug/L	34	103	%	38	%	34	103	%	38	%			%		
Di-n-butyl phthalate	84-74-2	1.00	ug/L	0.125	ug/L	37	111	%	38	%	37	111	%	38	%			%		
3,3'-Dichlorobenzidine	91-94-1	1.00	ug/L	0.112	ug/L	10	89	%	56	%	10	89	%	56	%			%		
2,4-Dichlorophenol	120-83-2	0.200	ug/L	0.0334	ug/L	34	104	%	41	%	34	104	%	41	%			%		
Diethyl phthalate	84-66-2	1.00	ug/L	0.146	ug/L	36	109	%	39	%	36	109	%	39	%			%		
4,6-Dinitro-2-	534-52-1	5.00	ug/L	0.220	ug/L	24	124	%	41	%	24	124	%	41	%			%		
2,4-Dimethylphenol	105-67-9	1.00	ug/L	0.0852	ug/L	33	97	%	40	%	33	97	%	40	%			%		
Dimethyl phthalate	131-11-3	1.00	ug/L	0.0765	ug/L	37	106	%	42	%	37	106	%	42	%			%		
2,4-Dinitrophenol	51-28-5	5.00	ug/L	0.613	ug/L	10	130	%	53	%	10	130	%	53	%			%		
2,4-Dinitrotoluene	121-14-2	1.00	ug/L	0.0536	ug/L	37	115	%	39	%	37	115	%	39	%			%		
2,6-Dinitrotoluene	606-20-2	1.00	ug/L	0.0797	ug/L	39	113	%	40	%	39	113	%	40	%			%		
1,2-Diphenylhydrazine(as Azobenzene)	122-66-7	1.00	ug/L	0.0660	ug/L	31	107	%	41	%	31	107	%	41	%			%		
Di-n-octyl phthalate	117-84-0	1.00	ug/L	0.207	ug/L	11	127	%	44	%	11	127	%	44	%			%		
Hexachlorobenzene	118-74-1	0.200	ug/L	0.0183	ug/L	35	102	%	35	%	35	102	%	35	%			%		
Hexachlorobutadiene	87-68-3	0.200	ug/L	0.0166	ug/L	35	100	%	41	%	35	100	%	41	%			%		
Hexachloroethane	67-72-1	1.00	ug/L	0.0628	ug/L	32	94	%	39	%	32	94	%	39	%			%		
Hexachlorocyclopentadie	77-47-4	1.00	ug/L	0.0518	ug/L	36	115	%	47	%	36	115	%	47	%			%		
Isophorone	78-59-1	1.00	ug/L	0.0644	ug/L	38	102	%	43	%	38	102	%	43	%			%		
2-Methylphenol	95-48-7	1.00	ug/L	0.0862	ug/L	33	98	%	38	%	33	98	%	38	%			%		
Methylphenol, 3 & 4	106-44-5	1.00	ug/L	0.0902	ug/L	32	100	%	41	%	32	100	%	41	%			%		
Nitrobenzene	98-95-3	2.00	ug/L	0.0843	ug/L	37	100	%	42	%	37	100	%	42	%			%		
2-Nitrophenol	88-75-5	1.00	ug/L	0.171	ug/L	34	107	%	41	%	34	107	%	41	%			%		
4-Nitrophenol	100-02-7	5.00	ug/L	0.647	ug/L	29	115	%	42	%	29	115	%	42	%			%		
N-Nitrosodiphenylamine	86-30-6	1.00	ug/L	0.0853	ug/L	32	102	%	36	%	32	102	%	36	%			%		
N-Nitrosodimethylamine	62-75-9	1.00	ug/L	0.0735	ug/L	31	107	%	40	%	31	107	%	40	%			%		
N-Nitrosodi-n-	621-64-7	0.200	ug/L	0.0308	ug/L	34	101	%	43	%	34	101	%	43	%			%		
2,2'-oxybis[1-	108-60-1	0.200	ug/L	0.0197	ug/L	30	99	%	42	%	30	99	%	42	%			%		
Pentachlorophenol	87-86-5	1.00	ug/L	0.0663	ug/L	15	111	%	42	%	15	111	%	42	%			%		
Phenol	108-95-2	0.200	ug/L	0.0581	ug/L	32	95	%	39	%	32	95	%	39	%			%		
1,2,4-Trichlorobenzene	120-82-1	1.00	ug/L	0.0712	ug/L	34	96	%	45	%	34	96	%	45	%			%		
2,4,6-Trichlorophenol	88-06-2	1.00	ug/L	0.175	ug/L	36	103	%	39	%	36	103	%	39	%			%		
2-Methylnaphthalene	91-57-6	0.200	ug/L	0.0122	ug/L	34	98	%	42	%	34	98	%	42	%			%		
1-Methylnaphthalene	90-12-0	0.200	ug/L	0.0138	ug/L	10	140	%	30	%	10	140	%	30	%			%		
Naphthalene	91-20-3	0.200	ug/L	0.0140	ug/L	35	97	%	43	%	35	97	%	43	%			%		
Acenaphthylene	208-96-8	0.200	ug/L	0.0152	ug/L	37	107	%	40	%	37	107	%	40	%			%		
Acenaphthene	83-32-9	0.200	ug/L	0.0144	ug/L	35	99	%	41	%	35	99	%	41	%			%		
Fluorene	86-73-7	0.200	ug/L	0.0216	ug/L	34	104	%	40	%	34	104	%	40	%			%		
Phenanthrene	85-01-8	0.200	ug/L	0.0427	ug/L	32	104	%	36	%	32	104	%	36	%			%		
Anthracene	120-12-7	0.200	ug/L	0.0154	ug/L	35	105	%	37	%	35	105	%	37	%			%		
Fluoranthene	206-44-0	0.200	ug/L	0.0162	ug/L	32	112	%	39	%	32	112	%	39	%			%		
Pyrene	129-00-0	0.200	ug/L	0.0157	ug/L	35	106	%	42	%	35	106	%	42	%			%		
Benzo[a]anthracene	56-55-3	0.200	ug/L	0.0147	ug/L	38	101	%	36	%	38	101	%	36	%			%		
Chrysene	218-01-9	0.200	ug/L	0.0140	ug/L	37	99	%	42	%	37	99	%	42	%			%		
Benzo[b]fluoranthene	205-99-2	0.200	ug/L	0.0157	ug/L	29	98	%	46	%	29	98	%	46	%			%		
Benzo[k]fluoranthene	207-08-9	0.200	ug/L	0.0547	ug/L	28	107	%	31	%	28	107	%	31	%			%		
Benzo[a]pyrene	50-32-8	0.200	ug/L	0.0134	ug/L	26	108	%	40	%	26	108	%	40	%			%		
Indeno[1,2,3-cd]pyrene	193-39-5	0.200	ug/L	0.0199	ug/L	22	115	%	54	%	22	115	%	54	%			%		
Dibenz(a,h)anthracene	53-70-3	0.200	ug/L	0.0155	ug/L	19	118	%	44	%	19	118	%	44	%			%		
Benzo[g,h,i]perylene	191-24-2	0.200	ug/L	0.0151	ug/L	20	115	%	44	%	20	115	%	44	%			%		
2-Fluorobiphenyl	321-60-8		ug/L		ug/L			%		%			%		%	19	107	%		
2-Fluorophenol (Surr)	367-12-4		ug/L		ug/L			%		%			%		%	10	111	%		
2,4,6-Tribromophenol	118-79-6		ug/L		ug/L			%		%			%		%	16	122	%		
Nitrobenzene-d5 (Surr)	4165-60-0		ug/L		ug/L			%		%			%		%	23	112	%		
Phenol-d5 (Surr)	4165-62-2		ug/L		ug/L			%		%			%		%	15	112	%		
Terphenyl-d14 (Surr)	1718-51-0		ug/L		ug/L			%		%			%		%	10	132	%		
Benzyl alcohol	100-51-6	1.00	ug/L	0.215	ug/L	10	68	%	20	%	10	68	%	20	%			%		
Dibenzofuran	132-64-9	1.00	ug/L	0.0617	ug/L	34	101	%	39	%	34	101	%	39	%			%		

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Standard Elutriate Dissolved Analytical	Liquid-Liquid Extraction (Continuous)	3520C_LL
Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Metals (ICP/MS)	6020A

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Aluminum	7429-90-5	30.0	ug/L	2.57	ug/L	80	120	%	20	%	75	125	%	20	%					
Arsenic	7440-38-2	1.00	ug/L	0.291	ug/L	80	120	%	20	%	75	125	%	20	%					
Barium	7440-39-3	10.0	ug/L	0.0980	ug/L	80	120	%	20	%	75	125	%	20	%					
Beryllium	7440-41-7	1.00	ug/L	0.0367	ug/L	80	120	%	20	%	75	125	%	20	%					
Cadmium	7440-43-9	1.00	ug/L	0.114	ug/L	80	120	%	20	%	75	125	%	20	%					
Calcium	7440-70-2	100	ug/L	2.84	ug/L	80	120	%	20	%	75	125	%	20	%					
Chromium	7440-47-3	2.00	ug/L	0.543	ug/L	80	120	%	20	%	75	125	%	20	%					
Cobalt	7440-48-4	0.500	ug/L	0.0263	ug/L	80	120	%	20	%	75	125	%	20	%					
Copper	7440-50-8	2.00	ug/L	0.244	ug/L	80	120	%	20	%	75	125	%	20	%					
Iron	7439-89-6	50.0	ug/L	6.09	ug/L	80	120	%	20	%	75	125	%	20	%					
Silver	7440-22-4	1.00	ug/L	0.0362	ug/L	80	120	%	20	%	75	125	%	20	%					
Potassium	7440-09-7	100	ug/L	5.82	ug/L	80	120	%	20	%	75	125	%	20	%					
Magnesium	7439-95-4	100	ug/L	1.17	ug/L	80	120	%	20	%	75	125	%	20	%					
Sodium	7440-23-5	100	ug/L	3.81	ug/L	80	120	%	20	%	75	125	%	20	%					
Nickel	7440-02-0	1.00	ug/L	0.175	ug/L	80	120	%	20	%	75	125	%	20	%					
Lead	7439-92-1	1.00	ug/L	0.0192	ug/L	80	120	%	20	%	75	125	%	20	%					
Antimony	7440-36-0	2.00	ug/L	0.0187	ug/L	80	120	%	20	%	75	125	%	20	%					
Selenium	7782-49-2	5.00	ug/L	0.422	ug/L	80	120	%	20	%	75	125	%	20	%					
Thallium	7440-28-0	1.00	ug/L	0.0152	ug/L	80	120	%	20	%	75	125	%	20	%					
Zinc	7440-66-6	5.00	ug/L	0.961	ug/L	80	120	%	20	%	75	125	%	20	%					

Standard Elutriate Dissolved Analytical	Preparation, Total Recoverable or Dissolved Metals	3005A
Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Mercury (CVAA)	7470A

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Mercury	7439-97-6	0.200	ug/L	0.0384	ug/L	80	120	%	20	%	75	125	%	20	%					

Standard Elutriate Dissolved Analytical	Preparation, Mercury	7470A_Prep
Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	PCB Congeners (GC)	8082A_Con

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
PCB-8	34883-43-7	1.00	ng/L	0.124	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-18	37680-65-2	1.00	ng/L	0.159	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-28	7012-37-5	1.00	ng/L	0.158	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-44	41464-39-5	1.00	ng/L	0.178	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-49	41464-40-8	1.00	ng/L	0.192	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-52	35693-99-3	1.00	ng/L	0.197	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-66	32598-10-0	1.00	ng/L	0.205	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-77	32598-13-3	1.00	ng/L	0.236	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-87	38380-02-8	1.00	ng/L	0.236	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-101	37680-73-2	1.00	ng/L	0.176	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-105	32598-14-4	1.00	ng/L	0.177	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-118	31508-00-6	1.00	ng/L	0.208	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-126	57465-28-8	1.00	ng/L	0.207	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-128	38380-07-3	1.00	ng/L	0.236	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-138	35065-28-2	1.00	ng/L	0.192	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-153	35065-27-1	1.00	ng/L	0.225	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-156	38380-08-4	1.00	ng/L	0.173	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-169	32774-16-6	1.00	ng/L	0.189	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-170	35065-30-6	1.00	ng/L	0.144	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-180	35065-29-3	1.00	ng/L	0.238	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-183	52663-69-1	1.00	ng/L	0.210	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-184	74472-48-3	1.00	ng/L	0.206	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-187	52663-68-0	1.00	ng/L	0.203	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-195	52663-78-2	1.00	ng/L	0.214	ng/L	40	140	%	35	%	40	140	%	35	%			%		
PCB-206	40186-72-9	1.00	ng/L	0.171	ng/L	40	140	%	35	%	40	140	%	35	%			%		
DCB Decachlorobiphenyl	2051-24-3	1.00	ng/L	0.134	ng/L	40	140	%	35	%	40	140	%	35	%			%		
Tetrachloro-m-xylene	877-09-8		ng/L		ng/L			%		%			%		%	35	140	%		
PCB-205 (Surr)	74472-53-0		ng/L		ng/L			%		%			%		%	35	140	%		

Standard Elutriate Dissolved Analytical	Liquid-Liquid Extraction (Separatory Funnel)	3510C
Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Organochlorine Pesticides (GC)	8081B_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Aldrin	309-00-2	0.00130	ug/L	0.00083	ug/L	62	113	%	22	%	62	113	%	22	%			%		
alpha-BHC	319-84-6	0.00130	ug/L	0.00066	ug/L	58	114	%	20	%	58	114	%	20	%			%		
beta-BHC	319-85-7	0.00130	ug/L	0.00100	ug/L	37	133	%	24	%	37	133	%	24	%			%		
delta-BHC	319-86-8	0.00130	ug/L	0.00038	ug/L	20	137	%	26	%	20	137	%	26	%			%		
gamma-BHC (Lindane)	58-89-9	0.00130	ug/L	0.00080	ug/L	57	120	%	21	%	57	120	%	21	%			%		
Chlordane (technical)	57-74-9	0.0125	ug/L	0.00165	ug/L			%		%			%		%			%		
Chlorobenside	103-17-3	0.00320	ug/L	0.00148	ug/L			%		%			%		%			%		
DCPA	1861-32-1	0.00250	ug/L	0.00034	ug/L			%		%			%		%			%		
4,4'-DDD	72-54-8	0.00130	ug/L	0.00067	ug/L	48	120	%	24	%	48	120	%	24	%			%		
4,4'-DDE	72-55-9	0.00130	ug/L	0.00079	ug/L	47	120	%	20	%	47	120	%	20	%			%		
4,4'-DDT	50-29-3	0.00130	ug/L	0.00074	ug/L	39	131	%	24	%	39	131	%	24	%			%		
Dieldrin	60-57-1	0.00130	ug/L	0.00082	ug/L	51	121	%	20	%	51	121	%	20	%			%		
Endosulfan I	959-98-8	0.00130	ug/L	0.00094	ug/L	53	117	%	22	%	53	117	%	22	%			%		
Endosulfan II	33213-65-9	0.00130	ug/L	0.00098	ug/L	44	122	%	21	%	44	122	%	21	%			%		
Endosulfan sulfate	1031-07-8	0.00130	ug/L	0.00057	ug/L	42	122	%	21	%	42	122	%	21	%			%		
Endrin	72-20-8	0.00130	ug/L	0.00096	ug/L	31	138	%	24	%	31	138	%	24	%			%		
Endrin aldehyde	7421-93-4	0.00130	ug/L	0.00090	ug/L	41	116	%	25	%	41	116	%	25	%			%		
Heptachlor	76-44-8	0.00130	ug/L	0.00099	ug/L	63	120	%	25	%	63	120	%	25	%			%		
Heptachlor epoxide	1024-57-3	0.00130	ug/L	0.00097	ug/L	60	120	%	20	%	60	120	%	20	%			%		
Methoxychlor	72-43-5	0.00250	ug/L	0.00091	ug/L	35	137	%	27	%	35	137	%	27	%			%		
Mirex	2385-85-5	0.00130	ug/L	0.00048	ug/L			%		%			%		%			%		
Toxaphene	8001-35-2	0.100	ug/L	0.0186	ug/L			%		%			%		%			%		
Tetrachloro-m-xylene	877-09-8		ug/L		ug/L			%		%			%		%	60	111	%		
DCB Decachlorobiphenyl	2051-24-3		ug/L		ug/L			%		%			%		%	45	122	%		

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Standard Elutriate Dissolved Analytical	Liquid-Liquid Extraction (Separatory Funnel)	3510C_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Organophosphorous Compounds by Gas Chromatography, Capillary Column Technique	8141B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Azinphos-methyl	86-50-0	1.00	ug/L	0.113	ug/L	40	150	%	30	%	40	150	%	30	%			%		
Demeton, Total	8065-48-3	2.00	ug/L	0.165	ug/L	10	150	%	30	%	10	150	%	30	%			%		
Malathion	121-75-5	1.00	ug/L	0.110	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Methyl parathion	298-00-0	1.00	ug/L	0.111	ug/L	41	148	%	30	%	41	148	%	30	%			%		
Parathion	56-38-2	1.00	ug/L	0.162	ug/L	56	125	%	21	%	56	125	%	21	%			%		
Tributyl phosphate	126-73-8		ug/L		ug/L			%		%			%		%	49	122	%		
Triphenylphosphate	115-86-6		ug/L		ug/L			%		%			%		%	45	145	%		
Bolstar	35400-43-2	1.00	ug/L	0.110	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Chlorpyrifos	2921-88-2	1.00	ug/L	0.102	ug/L	50	130	%	25	%	50	130	%	25	%			%		
Coumaphos	56-72-4	1.00	ug/L	0.149	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Diazinon	333-41-5	1.00	ug/L	0.0942	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Dichlorvos	62-73-7	1.00	ug/L	0.0849	ug/L	30	150	%	30	%	30	150	%	30	%			%		
Dimethoate	60-51-5	1.00	ug/L	0.117	ug/L	26	136	%	22	%	26	136	%	22	%			%		
Disulfoton	298-04-4	1.00	ug/L	0.101	ug/L	45	124	%	30	%	45	124	%	30	%			%		
EPN	2104-64-5	1.00	ug/L	0.115	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Mocap	13194-48-4	1.00	ug/L	0.101	ug/L	40	150	%	30	%	40	150	%	30	%			%		
Famphur	52-85-7	1.00	ug/L	0.124	ug/L	52	131	%	24	%	52	131	%	24	%			%		
Fensulfothion	115-90-2	1.00	ug/L	0.165	ug/L	38	150	%	30	%	38	150	%	30	%			%		
Fenthion	55-38-9	1.00	ug/L	0.0846	ug/L	10	150	%	30	%	10	150	%	30	%			%		
Mevinphos	7786-34-7	1.00	ug/L	0.0979	ug/L	30	150	%	30	%	30	150	%	30	%			%		
Phorate	298-02-2	1.00	ug/L	0.0924	ug/L	41	135	%	24	%	41	135	%	24	%			%		
Ronnel	299-84-3	1.00	ug/L	0.102	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Stirophos	22248-79-9	1.00	ug/L	0.0957	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Sulfotepp	3689-24-5	1.00	ug/L	0.0947	ug/L	56	128	%	23	%	56	128	%	23	%			%		
Thionazin	297-97-2	1.00	ug/L	0.100	ug/L	44	128	%	21	%	44	128	%	21	%			%		
Tokuthion	34643-46-4	1.00	ug/L	0.0937	ug/L	50	150	%	30	%	50	150	%	30	%			%		
Trichloronate	327-98-0	1.00	ug/L	0.0992	ug/L	10	150	%	30	%	10	150	%	30	%			%		
O,O,O-Triethyl	126-68-1	1.00	ug/L	0.0999	ug/L	31	131	%	30	%	31	131	%	30	%			%		

Standard Elutriate Dissolved Analytical	Liquid-Liquid Extraction (Separatory Funnel)	3510C
Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	General Sub Contract Method	SUBCONTRACT
Standard Elutriate Dissolved Analytical	Organotins (GC/FPD)	Organotins_GC

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Tetrabutyltin	1461-25-2	0.0500	ug/L			30	150	%	30	%	30	150	%	30	%			%		
Tributyltin	688-73-3	0.0450	ug/L			30	150	%	30	%	30	150	%	30	%			%		
Dibutyltin	1002-53-5	0.0390	ug/L			30	150	%	30	%	30	150	%	30	%			%		
Tripentyltin	STL00386		ug/L					%		%			%		%	15	150	%		
Monobutyltin	2406-65-7	0.620	ug/L			10	48	%	30	%	10	48	%	30	%			%		
Tetra-n-propyl tin	2176-98-9		ug/L																	

Standard Elutriate Dissolved Analytical	Liquid-Liquid Extraction (Separatory Funnel)	3510C_14d
Standard Elutriate Dissolved Analytical	Cyanide, Total andor Amenable	9012B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Cyanide, Total	57-12-5	10.0	ug/L	3.20	ug/L	85	115	%	20	%	75	125	%	20	%				4.00	ug/L

Standard Elutriate Dissolved Analytical	Cyanide, Total and/or Amenable, Distillation	9012B_Prep

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Nitrogen, Ammonia	350.1

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Ammonia, distilled	7664-41-7	0.100	mg/L	0.0864	mg/L	90	110	%	20	%	90	110	%	20	%					

Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Sulfide, Acid soluble and Insoluble (Titrimetric)	9034_Calc

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Sulfide	18496-25-8	3.00	mg/L	0.590	mg/L	85	115	%	20	%	75	125	%	20	%				1.50	mg/L

Standard Elutriate Dissolved Analytical	Sulfide, Distillation (Acid Soluble and Insoluble)	9030B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Nitrogen, Nitrate-Nitrite	353.2_Pres

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Nitrate Nitrite as N	STL00217	0.100	mg/L	0.0140	mg/L	90	110	%	20	%	90	110	%	20	%					

Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Nitrogen, Total Kjeldahl	SM4500Norg_C

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Nitrogen, Kjeldahl	STL00296	5.00	mg/L	1.70	mg/L	65	144	%	20	%	10	200	%	20	%				5.00	mg/L

Standard Elutriate Dissolved Analytical	Preparation, Nitrogen - Total Kjeldahl	SM4500Norg_C_P
Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Phosphorus	4500_P_E

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Total Phosphorus as P	7723-14-0	0.100	mg/L	0.0500	mg/L	53	134	%	20	%	10	199	%	20	%				0.100	mg/L

Standard Elutriate Dissolved Analytical	Phosphorus, Total	365_Prep
Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Standard Elutriate Dissolved Analytical	Organic Carbon, Dissolved (DOC)	SM5310_DOC_C

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Dissolved Organic Carbon - Duplicate	7440-44-0	1.00	mg/L	0.140	mg/L	80	120	%	20	%	75	125	%	20	%					mg/L

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Standard Elutriate Dissolved Analytical	Sample Filtration	Filtration_AC
Sediment Shirley Plantation	Polychlorinated Biphenyls (PCBs) (GC)	8082A_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
PCB-1016	12674-11-2	0.417	ug/Kg	0.0620	ug/Kg	50	120	%	30	%	50	120	%	30	%			%		
PCB-1221	11104-28-2	0.417	ug/Kg	0.0795	ug/Kg			%		%			%		%			%		
PCB-1232	11141-16-5	0.417	ug/Kg	0.0713	ug/Kg			%		%			%		%			%		
PCB-1242	53469-21-9	0.417	ug/Kg	0.0679	ug/Kg			%		%			%		%			%		
PCB-1248	12672-29-6	0.417	ug/Kg	0.0394	ug/Kg			%		%			%		%			%		
PCB-1254	11097-69-1	0.417	ug/Kg	0.0593	ug/Kg			%		%			%		%			%		
PCB-1260	11096-82-5	0.417	ug/Kg	0.0592	ug/Kg	50	120	%	30	%	50	120	%	30	%			%		
DCB Decachlorobiphenyl	2051-24-3		ug/Kg		ug/Kg			%		%			%		%	20	150	%		
Tetrachloro-m-xylene	877-09-8		ug/Kg		ug/Kg			%		%			%		%	30	150	%		

Sediment Shirley Plantation	Sulfur Cleanup	3660B
Sediment Shirley Plantation	Sulfuric Acid/Permanganate Cleanup	3665A
Sediment Shirley Plantation	Automated Soxhlet Extraction (Low Level)	3541_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Sediment Shirley Plantation	Paint Filter	9095B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Free Liquid	STL00028																			

Sediment Shirley Plantation	Organic Halides, Extractable (EOX)	9023

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Halogens, Extractable	STL00198	200	mg/Kg	34.0	mg/Kg	75	125	%	20	%	75	125	%	20	%				100	mg/Kg

Sediment Shirley Plantation	Preparation, EOX	9023_Prep
Sediment Shirley Plantation	Volatile Organic Compounds by GC/MS	8260C

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Benzene	71-43-2	5.00	ug/Kg	0.675	ug/Kg	77	120	%	20	%	77	120	%	20	%			%		
Toluene	108-88-3	5.00	ug/Kg	0.730	ug/Kg	78	124	%	21	%	78	124	%	21	%			%		
Ethylbenzene	100-41-4	5.00	ug/Kg	0.643	ug/Kg	78	125	%	21	%	78	125	%	21	%			%		
Xylenes, Total	1330-20-7	15.0	ug/Kg	2.24	ug/Kg	83	126	%	20	%	83	126	%	20	%			%		
m-Xylene & p-Xylene	179601-23-1	10.0	ug/Kg	1.47	ug/Kg	75	126	%	21	%	75	126	%	21	%			%		
o-Xylene	95-47-6	5.00	ug/Kg	0.779	ug/Kg	83	127	%	20	%	83	127	%	20	%			%		
1,2-Dichloroethane-d4	17060-07-0		ug/Kg		ug/Kg			%		%			%		%	52	124	%		
4-Bromofluorobenzene	460-00-4		ug/Kg		ug/Kg			%		%			%		%	63	120	%		
Dibromofluoromethane	1868-53-7		ug/Kg		ug/Kg											68	121	%		
Toluene-d8 (Surr)	2037-26-5		ug/Kg		ug/Kg			%		%			%		%	72	127	%		

Sediment Shirley Plantation	Purge and Trap	5030C_Solid_NAC
Sediment Shirley Plantation	Volatile Organic Compounds by GC/MS	8260C

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Benzene	71-43-2	250	ug/Kg	49.5	ug/Kg	77	120	%	20	%	77	120	%	20	%			%		
Toluene	108-88-3	250	ug/Kg	42.3	ug/Kg	78	124	%	21	%	78	124	%	21	%			%		
Ethylbenzene	100-41-4	250	ug/Kg	31.0	ug/Kg	78	125	%	21	%	78	125	%	21	%			%		
Xylenes, Total	1330-20-7	750	ug/Kg	98.5	ug/Kg	83	126	%	20	%	83	126	%	20	%			%		
m-Xylene & p-Xylene	179601-23-1	500	ug/Kg	64.0	ug/Kg	75	126	%	21	%	75	126	%	21	%			%		
o-Xylene	95-47-6	250	ug/Kg	36.7	ug/Kg	83	127	%	20	%	83	127	%	20	%			%		
1,2-Dichloroethane-d4	17060-07-0		ug/Kg		ug/Kg			%		%			%		%	52	124	%		
4-Bromofluorobenzene	460-00-4		ug/Kg		ug/Kg			%		%			%		%	63	120	%		
Dibromofluoromethane	1868-53-7		ug/Kg		ug/Kg											68	121	%		
Toluene-d8 (Surr)	2037-26-5		ug/Kg		ug/Kg			%		%			%		%	72	127	%		

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Sediment Shirley Plantation	Purge and Trap	5030C_H
Sediment Shirley Plantation	Volatile Organic Compounds by GC/MS	8260C

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
1,2-Dichloroethane	107-06-2	5.00	ug/L	0.959	ug/L	63	140	%	25	%	63	140	%	25	%			%		
2-Butanone (MEK)	78-93-3	5.00	ug/L	1.08	ug/L	31	139	%	35	%	31	139	%	35	%			%		
Benzene	71-43-2	5.00	ug/L	0.989	ug/L	80	120	%	20	%	80	120	%	20	%			%		
Carbon tetrachloride	56-23-5	5.00	ug/L	1.08	ug/L	63	139	%	25	%	63	139	%	25	%			%		
Chlorobenzene	108-90-7	5.00	ug/L	0.526	ug/L	83	120	%	20	%	83	120	%	20	%			%		
Chloroform	67-66-3	5.00	ug/L	1.01	ug/L	77	119	%	20	%	77	119	%	20	%			%		
Tetrachloroethene	127-18-4	5.00	ug/L	0.825	ug/L	78	126	%	25	%	78	126	%	25	%			%		
Trichloroethene	79-01-6	5.00	ug/L	0.801	ug/L	80	120	%	20	%	80	120	%	20	%			%		
Vinyl chloride	75-01-4	5.00	ug/L	1.29	ug/L	57	128	%	26	%	57	128	%	26	%			%		
1,2-Dichloroethane-d4	17060-07-0		ug/L		ug/L	62	123	%		%	62	123	%		%	62	123	%		
4-Bromofluorobenzene	460-00-4		ug/L		ug/L	75	120	%		%	75	120	%		%	75	120	%		
Dibromofluoromethane	1868-53-7		ug/L		ug/L			%		%			%		%	80	120	%		
Toluene-d8 (Surr)	2037-26-5		ug/L		ug/L	80	120	%		%	80	120	%		%	80	120	%		
1,1-Dichloroethene	75-35-4	5.00	ug/L	1.07	ug/L	69	127	%	20	%	69	127	%	20	%			%		

Sediment Shirley Plantation	Purge and Trap	5030C_Leach
Sediment Shirley Plantation	TCLP Extraction	1311_Z
Sediment Shirley Plantation	Semivolatile Organic Compounds (GC/MS)	8270D

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
1,4-Dichlorobenzene	106-46-7	0.0500	mg/L	0.00122	mg/L	37	115	%	35	%	37	115	%	35	%			%		
2,4,5-Trichlorophenol	95-95-4	0.0500	mg/L	0.00130	mg/L	35	115	%	40	%	35	115	%	40	%			%		
2,4,6-Trichlorophenol	88-06-2	0.0500	mg/L	0.00110	mg/L	40	115	%	37	%	40	115	%	37	%			%		
2,4-Dinitrotoluene	121-14-2	0.0500	mg/L	0.00103	mg/L	40	115	%	42	%	40	115	%	42	%			%		
2-Methylphenol	95-48-7	0.0500	mg/L	0.00138	mg/L	43	115	%	47	%	43	115	%	47	%			%		
Methylphenol, 3 & 4	106-44-5	0.0500	mg/L	0.00269	mg/L	30	121	%	35	%	30	121	%	35	%			%		
Hexachlorobenzene	118-74-1	0.0500	mg/L	0.00114	mg/L	45	115	%	22	%	45	115	%	22	%			%		
Hexachlorobutadiene	87-68-3	0.0500	mg/L	0.00127	mg/L	42	115	%	28	%	42	115	%	28	%			%		
Hexachloroethane	67-72-1	0.0500	mg/L	0.00127	mg/L	25	106	%	38	%	25	106	%	38	%			%		
Nitrobenzene	98-95-3	0.0500	mg/L	0.00132	mg/L	40	115	%	26	%	40	115	%	26	%			%		
Pentachlorophenol	87-86-5	0.250	mg/L	0.00218	mg/L	16	140	%	40	%	16	140	%	40	%			%		
Pyridine	110-86-1	0.100	mg/L	0.00082	mg/L	22	105	%	40	%	22	105	%	40	%			%		
2-Fluorobiphenyl	321-60-8		mg/L		mg/L			%		%			%		%	35	115	%		
2-Fluorophenol (Surr)	367-12-4		mg/L		mg/L			%		%			%		%	20	110	%		
2,4,6-Tribromophenol	118-79-6		mg/L		mg/L			%		%			%		%	19	138	%		
Nitrobenzene-d5 (Surr)	4165-60-0		mg/L		mg/L			%		%			%		%	39	115	%		
Phenol-d5 (Surr)	4165-62-2		mg/L		mg/L			%		%			%		%	30	118	%		
Terphenyl-d14 (Surr)	1718-51-0		mg/L		mg/L			%		%			%		%	30	143	%		

Sediment Shirley Plantation	Liquid-Liquid Extraction (Separatory Funnel)	3510C
Sediment Shirley Plantation	TCLP Extraction	1311_T
Sediment Shirley Plantation	Organochlorine Pesticides (GC)	8081B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Chlordane (technical)	57-74-9	0.00500	mg/L	0.00065	mg/L	30	150	%	30	%	30	150	%	30	%			%		
Endrin	72-20-8	0.000500	mg/L	0.00038	mg/L	46	137	%	30	%	46	137	%	40	%			%		
gamma-BHC (Lindane)	58-89-9	0.000500	mg/L	0.00032	mg/L	55	137	%	22	%	55	137	%	22	%			%		
Heptachlor	76-44-8	0.000500	mg/L	0.00039	mg/L	57	124	%	32	%	57	124	%	32	%			%		
Heptachlor epoxide	1024-57-3	0.000500	mg/L	0.00038	mg/L	53	135	%	31	%	53	135	%	31	%			%		
Methoxychlor	72-43-5	0.00100	mg/L	0.00036	mg/L	30	150	%	29	%	30	150	%	29	%			%		
Toxaphene	8001-35-2	0.0200	mg/L	0.00745	mg/L	30	150	%	30	%	40	140	%	30	%			%		
DCB Decachlorobiphenyl	2051-24-3		mg/L		mg/L			%		%			%		%	45	140	%		
Tetrachloro-m-xylene	877-09-8		mg/L		mg/L			%		%			%		%	45	140	%		

Sediment Shirley Plantation	Liquid-Liquid Extraction (Separatory Funnel)	3510C
Sediment Shirley Plantation	TCLP Extraction	1311_T
Sediment Shirley Plantation	Herbicides (GC)	8151A

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
2,4-D	94-75-7	0.0400	mg/L	0.00453	mg/L	32	140	%	30	%	32	140	%	30	%			%		
Silvex (2,4,5-TP)	93-72-1	0.0100	mg/L	0.00107	mg/L	32	140	%	30	%	32	140	%	30	%			%		
2,4-Dichlorophenylacetic	19719-28-9		mg/L		mg/L			%		%			%		%	32	140	%		

Sediment Shirley Plantation	Extraction (Herbicides)	8151A_AP
Sediment Shirley Plantation	TCLP Extraction	1311_T
Sediment Shirley Plantation	Metals (ICP)	6010C

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Arsenic	7440-38-2	0.0500	mg/L	0.00302	mg/L	80	120	%	20	%	75	125	%	20	%					
Barium	7440-39-3	0.200	mg/L	0.00019	mg/L	80	120	%	20	%	75	125	%	20	%					
Cadmium	7440-43-9	0.0500	mg/L	0.00016	mg/L	80	120	%	20	%	75	125	%	20	%					
Chromium	7440-47-3	0.0500	mg/L	0.00102	mg/L	80	120	%	20	%	75	125	%	20	%					
Lead	7439-92-1	0.0500	mg/L	0.00145	mg/L	80	120	%	20	%	75	125	%	20	%					
Selenium	7782-49-2	0.0500	mg/L	0.00171	mg/L	80	120	%	20	%	75	125	%	20	%					
Silver	7440-22-4	0.0500	mg/L	0.00026	mg/L	80	120	%	20	%	75	125	%	20	%					

Sediment Shirley Plantation	Preparation, Total Metals	3010A_L

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Sediment Shirley Plantation	TCLP Extraction	1311T_M
Sediment Shirley Plantation	Mercury (CVAA)	7470A

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Mercury	7439-97-6	0.000200	mg/L	0.00003	mg/L	80	120	%	20	%	75	125	%	20	%					

Sediment Shirley Plantation	Preparation, Mercury	7470A_Prep_L

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Sediment Shirley Plantation	TCLP Extraction	1311T_Hg
Sediment Shirley Plantation	Ignitablity,Solids	7.1.2

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Ignitability	STL00250	1.00	NONE																	

Sediment Shirley Plantation	pH	9045D

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
pH	STL00204	0.100	SU			99	101	%	2	%									0.100	SU

Sediment Shirley Plantation	General Sub Contract Method	SUBCONTRACT
Sediment Shirley Plantation	General Sub Contract Method	SUBCONTRACT
Sediment Shirley Plantation	General Sub Contract Method	SUBCONTRACT
Sediment Shirley Plantation	General Sub Contract Method	SUBCONTRACT
Sediment Shirley Plantation	General Sub Contract Method	SUBCONTRACT
Sediment Shirley Plantation	General Sub Contract Method	SUBCONTRACT
Tissues Metals	Percent Lipids	Percent_Lipids

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Percent Lipids	STL00105	0.100	%	0.0296	%	30	150	%	25	%										

Tissues Metals	Automated Soxhlet Extraction	3541

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Tissues	Tissue Handling and	Tissue_Prep
Tissues	Frozen Sample Storage	Frozen_Stora
Tissues	Metals (ICP/MS)	6020A

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Aluminum	7429-90-5	3.0	ug/L	0.2849	ug/L	80	120	%	20	%	75	125	%	20	%					
Arsenic	7440-38-2	0.1	ug/L	0.0181	ug/L	80	120	%	20	%	75	125	%	20	%					
Barium	7440-39-3	1.0	ug/L	0.0107	ug/L	80	120	%	20	%	75	125	%	20	%					
Beryllium	7440-41-7	0.1	ug/L	0.0075	ug/L	80	120	%	20	%	75	125	%	20	%					
Cadmium	7440-43-9	0.1	ug/L	0.0070	ug/L	80	120	%	20	%	75	125	%	20	%					
Calcium	7440-70-2	10	ug/L	1.3260	ug/L	80	120	%	20	%	75	125	%	20	%					
Chromium	7440-47-3	0.2	ug/L	0.0061	ug/L	80	120	%	20	%	75	125	%	20	%					
Cobalt	7440-48-4	0.05	ug/L	0.0015	ug/L	80	120	%	20	%	75	125	%	20	%					
Copper	7440-50-8	0.2	ug/L	0.0330	ug/L	80	120	%	20	%	75	125	%	20	%					
Iron	7439-89-6	5.0	ug/L	0.3539	ug/L	80	120	%	20	%	75	125	%	20	%					
Silver	7440-22-4	0.1	ug/L	0.0039	ug/L	80	120	%	20	%	75	125	%	20	%					
Potassium	7440-09-7	10	ug/L	1.3583	ug/L	80	120	%	20	%	75	125	%	20	%					
Magnesium	7439-95-4	10	ug/L	0.1870	ug/L	80	120	%	20	%	75	125	%	20	%					
Sodium	7440-23-5	10	ug/L	1.3690	ug/L	80	120	%	20	%	75	125	%	20	%					
Nickel	7440-02-0	0.1	ug/L	0.0113	ug/L	80	120	%	20	%	75	125	%	20	%					
Lead	7439-92-1	0.1	ug/L	0.0038	ug/L	80	120	%	20	%	75	125	%	20	%					
Antimony	7440-36-0	0.2	ug/L	0.0026	ug/L	80	120	%	20	%	75	125	%	20	%					
Selenium	7782-49-2	0.5	ug/L	0.0502	ug/L	80	120	%	20	%	75	125	%	20	%					
Thallium	7440-28-0	0.1	ug/L	0.0020	ug/L	80	120	%	20	%	75	125	%	20	%					
Zinc	7440-66-6	0.5	ug/L	0.0648	ug/L	80	120	%	20	%	75	125	%	20	%					

Tissues	Preparation, Metals	3050B
Tissues	Tissue Handling and	Tissue_Prep
Tissues	Frozen Sample Storage	Frozen_Stora
Tissues Metals	Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)	7471B

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Mercury	7439-97-6	0.0330	mg/Kg	0.0109	mg/Kg	80	120	%	20	%	75	125	%	20	%					

Tissues	Preparation, Mercury	7471B_Prep
Tissues	Tissue Handling and	Tissue_Prep
Tissues	Frozen Sample Storage	Frozen_Stora
Tissues	Percent Moisture	Moisture

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Percent Moisture	STL00177	0.100	%																	

Table 7-1 Project Limits for Sediment, Aqueous, and Tissue Samples

Tissues	General Sub Contract	SUBCONTRA
Tissues Organics	Semivolatile Organic Compounds by GC/MS - Low Level	8270D_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Anthracene	120-12-7	6.70	ug/Kg	0.653	ug/Kg	43	111	%	35	%	43	111	%	35	%			%		
Benzo[a]anthracene	56-55-3	6.70	ug/Kg	0.836	ug/Kg	45	110	%	31	%	45	110	%	31	%			%		
Benzo[b]fluoranthene	205-99-2	6.70	ug/Kg	1.05	ug/Kg	37	108	%	28	%	37	108	%	28	%			%		
Benzo[k]fluoranthene	207-08-9	6.70	ug/Kg	1.35	ug/Kg	39	115	%	42	%	39	115	%	42	%			%		
Benzo[g,h,i]perylene	191-24-2	6.70	ug/Kg	0.664	ug/Kg	35	127	%	21	%	35	127	%	21	%			%		
Benzo[a]pyrene	50-32-8	6.70	ug/Kg	0.668	ug/Kg	42	114	%	31	%	42	114	%	31	%			%		
Chrysene	218-01-9	6.70	ug/Kg	0.794	ug/Kg	44	108	%	31	%	44	108	%	31	%			%		
Dibenz(a,h)anthracene	53-70-3	6.70	ug/Kg	0.742	ug/Kg	34	131	%	32	%	34	131	%	32	%			%		
Fluoranthene	206-44-0	6.70	ug/Kg	0.713	ug/Kg	40	118	%	23	%	40	118	%	23	%			%		
Fluorene	86-73-7	6.70	ug/Kg	0.879	ug/Kg	43	110	%	37	%	43	110	%	37	%			%		
Indeno[1,2,3-cd]pyrene	193-39-5	6.70	ug/Kg	0.687	ug/Kg	34	130	%	30	%	34	130	%	30	%			%		
Phenanthrene	85-01-8	6.70	ug/Kg	1.06	ug/Kg	41	107	%	20	%	41	107	%	20	%			%		
Pyrene	129-00-0	6.70	ug/Kg	0.675	ug/Kg	39	113	%	28	%	39	113	%	28	%			%		
Acenaphthene	83-32-9	6.70	ug/Kg	0.641	ug/Kg	42	104	%	34	%	42	104	%	34	%			%		
Acenaphthylene	208-96-8	6.70	ug/Kg	0.764	ug/Kg	43	117	%	36	%	43	117	%	36	%			%		
Naphthalene	91-20-3	6.70	ug/Kg	0.575	ug/Kg	42	104	%	25	%	42	104	%	25	%			%		
Nitrobenzene-d5 (Surr)	4165-60-0		ug/Kg		ug/Kg			%		%			%		%	27	110	%		
2-Fluorobiphenyl	321-60-8		ug/Kg		ug/Kg			%		%			%		%	28	108	%		
Terphenyl-d14 (Surr)	1718-51-0		ug/Kg		ug/Kg			%		%			%		%	21	130	%		

Tissues	Gel-Permeation Cleanup	3640A
Tissues Organics	Automated Soxhlet Extraction (Low Level)	3541_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Tissues	Tissue Handling and	Tissue_Prep
Tissues	Frozen Sample Storage	Frozen_Stora
Tissues	PCB Congeners (GC)	8082A_Con

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
PCB-8	34883-43-7	1.00	ug/Kg	0.0882	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-18	37680-65-2	1.00	ug/Kg	0.0752	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-28	7012-37-5	1.00	ug/Kg	0.107	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-44	41464-39-5	1.00	ug/Kg	0.0658	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-49	41464-40-8	1.00	ug/Kg	0.0734	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-52	35693-99-3	1.00	ug/Kg	0.164	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-66	32598-10-0	1.00	ug/Kg	0.170	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-77	32598-13-3	1.00	ug/Kg	0.200	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-87	38380-02-8	1.00	ug/Kg	0.0626	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-101	37680-73-2	1.00	ug/Kg	0.0620	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-105	32598-14-4	1.00	ug/Kg	0.179	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-118	31508-00-6	1.00	ug/Kg	0.149	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-126	57465-28-8	1.00	ug/Kg	0.187	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-128	38380-07-3	1.00	ug/Kg	0.0724	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-138	35065-28-2	1.00	ug/Kg	0.0907	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-153	35065-27-1	1.00	ug/Kg	0.139	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-156	38380-08-4	1.00	ug/Kg	0.148	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-169	32774-16-6	1.00	ug/Kg	0.127	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-170	35065-30-6	1.00	ug/Kg	0.139	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-180	35065-29-3	1.00	ug/Kg	0.154	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-183	52663-69-1	1.00	ug/Kg	0.105	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-184	74472-48-3	1.00	ug/Kg	0.0961	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-187	52663-68-0	1.00	ug/Kg	0.0921	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-195	52663-78-2	1.00	ug/Kg	0.119	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
PCB-206	40186-72-9	1.00	ug/Kg	0.0664	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
DCB Decachlorobiphenyl	2051-24-3	1.00	ug/Kg	0.147	ug/Kg	50	140	%	40	%	50	140	%	40	%			%		
Tetrachloro-m-xylene	877-09-8		ug/Kg		ug/Kg			%		%			%		%	35	140	%		
PCB-205 (Surr)	74472-53-0		ug/Kg		ug/Kg			%		%			%		%	35	140	%		

Tissues	Sulfur Cleanup	3660B
Tissues Organics	Sulfuric Acid/Permanganate Cleanup	3665A
Tissues	Automated Soxhlet	3541

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Tissues	Tissue Handling and	Tissue_Prep
Tissues	Frozen Sample Storage	Frozen_Stora
Tissues	Organochlorine	8081B_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Aldrin	309-00-2	0.0833	ug/Kg	0.0149	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
alpha-BHC	319-84-6	0.0833	ug/Kg	0.0136	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
beta-BHC	319-85-7	0.0833	ug/Kg	0.0216	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
delta-BHC	319-86-8	0.0833	ug/Kg	0.0128	ug/Kg	20	124	%	20	%	20	124	%	20	%			%		
gamma-BHC (Lindane)	58-89-9	0.0833	ug/Kg	0.0146	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
Chlordane (technical)	57-74-9	0.833	ug/Kg	0.0367	ug/Kg			%		%			%		%			%		
Chlorobenside	103-17-3	0.0833	ug/Kg	0.0435	ug/Kg			%		%			%		%			%		
DCPA	1861-32-1	0.0833	ug/Kg	0.0127	ug/Kg			%		%			%		%			%		
4,4'-DDD	72-54-8	0.0833	ug/Kg	0.0109	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
4,4'-DDE	72-55-9	0.0833	ug/Kg	0.0126	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
4,4'-DDT	50-29-3	0.0833	ug/Kg	0.0125	ug/Kg	30	150	%	37	%	30	150	%	37	%			%		
Dieldrin	60-57-1	0.0833	ug/Kg	0.0139	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
Endosulfan I	959-98-8	0.0833	ug/Kg	0.0157	ug/Kg	50	150	%	23	%	50	150	%	23	%			%		
Endosulfan II	33213-65-9	0.0833	ug/Kg	0.0147	ug/Kg	50	150	%	33	%	50	150	%	33	%			%		
Endosulfan sulfate	1031-07-8	0.0833	ug/Kg	0.00870	ug/Kg	44	140	%	26	%	44	140	%	26	%			%		
Endrin	72-20-8	0.0833	ug/Kg	0.0162	ug/Kg	30	150	%	20	%	30	150	%	20	%			%		
Endrin aldehyde	7421-93-4	0.0833	ug/Kg	0.0162	ug/Kg	30	150	%	20	%	30	150	%	20	%			%		
Heptachlor	76-44-8	0.0833	ug/Kg	0.0185	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
Heptachlor epoxide	1024-57-3	0.0833	ug/Kg	0.0162	ug/Kg	50	150	%	20	%	50	150	%	20	%			%		
Methoxychlor	72-43-5	0.167	ug/Kg	0.0174	ug/Kg	30	150	%	26	%	30	150	%	26	%			%		
Mirex	2385-85-5	0.0833	ug/Kg	0.00770	ug/Kg			%		%			%		%			%		
Toxaphene	8001-35-2	3.33	ug/Kg	0.556	ug/Kg			%		%			%		%			%		
Tetrachloro-m-xylene	877-09-8		ug/Kg		ug/Kg			%		%			%		%	45	140	%		
DCB Decachlorobiphenyl	2051-24-3		ug/Kg		ug/Kg			%		%			%		%	45	140	%		

Tissues	Gel-Permeation Cleanup	3640A
Tissues Organics	Automated Soxhlet Extraction (Low Level)	3541_LL

Analyte Description	CAS Number	Reference RL - Limit	Reference RL - Units	Reference MDL - Limit	Reference MDL - Units	Reference LCSREC - Recovery Low	Reference LCSREC - Recovery High	Reference LCSREC - Units	Reference LCSRPD - Precision	Reference LCSRPD - Units	Reference MSREC - Recovery Low	Reference MSREC - Recovery High	Reference MSREC - Units	Reference MSRPD - Precision	Reference MSRPD - Units	Reference SUREC - Recovery Low	Reference SUREC - Recovery High	Reference SUREC - Units	Reference LOD - Limit	Reference LOD - Units
Prep Analyte	STL00048																			

Tissues	Tissue Handling and	Tissue_Prep
Tissues	Frozen Sample Storage	Frozen_Stora

Table 7-2 TDL Table

	QA/QC Sediment, Water and Tissue for Dredge Apr 95			Southeast Regional Implementation Manual TDLs		
Name	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**
Aluminum	50,000	1000	40			
Antimony	2500	100	3			
Arsenic	5000	100	1	1000	200	1
Beryllium	2500	100	0.2			
Cadmium	300	100	1	100	100	1
Chromium	5000	100	1	1000	1000	1
Cobalt	100	100	4			
Copper	5000	100	1	1000	1000	1
Hexavalent Chromium			50			1
Iron	50000	10000	10			
Lead	5000	100	1	500	200	1
Manganese	5000	500	1			
Mercury	200	10	0.2	50	20	0.2
Nickel	5000	100	1	1000	1000	1
Selenium	1000	200	2	1000		2
Silver	200	100	1	200	200	1
Thallium	200	100	1			
Tin	500	100	5			
Zinc	15000	2000	1	1000	1000	1
Organotin	10	10	0.01	mono, di tri 10 each		TBT only 0.01
Naphthalene	20	20	10	20	20	
Acenaphthylene	20	20	10	20	20	
Acenaphthene	20	20	10	20	20	
Fluorene	20	20	10	20	20	
Phenanthrene	20	20	10	20	20	
Anthracene	20	20	10	20	20	
1-Methylnaphthalene	20	20	10	20	20	
2-Methylnaphthalene	20	20	10	20	20	
Fluoranthene	20	20	10	20	20	

	QA/QC Sediment, Water and Tissue for Dredge Apr 95			Southeast Regional Implementation Manual TDLs		
Name	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**
Pyrene	20	20	10	20	20	
Benzo(a)anthracene	20	20	10	20	20	
Chrysene	20	20	10	20	20	
Benzo(b and K)fluoranthene	20	20	10	20, 20	20, 20	
Benzo(a)pyrene	20	20	10	20	20	
Indeno(1,2,3-c,d)pyrene	20	20	10	20	20	
Dibenzo(a,h)anthracene	20	20	10	20	20	
Benzo(g,h,I)perylene	20	20	10	20	20	
1,3-Dichlorobenzene	20	20	10			
1,4-Dichlorobenzene	20	20	10			
1,2-Dichlorobenzene	20	20	10			
1,2,4-Trichrobenzene	10	20	10			
Hexachlorobenzene	10	20	10			
Dimethyl phthalate	50	20	10			
Diethyl phthalate	50	20	10			
Di-n-butyl phthalate	50	20	10			
Butyl benzyl phthalate	50	20	10			
Bis(2-ethylhexyl)phthalate	50	20	10			
Di-n-octyl phthalate	50	20	10			
Benzyl alcohol	50	100	50			
Benzoic acid	100	100	50			
Dibenzofuran	50	20	10			
Hexachloroethane	100	40	50			
Hexachlorobutadiene	20	40	50			
N-Nitrosodiphenylamine	20	20	50			
Methylethyl ketone	20	20	50			
Tetrachlorinated furans	0.001	0.001	0.00001			
Pentachlorinated furans	0.0025	0.0025	0.000025			

	QA/QC Sediment, Water and Tissue for Dredge Apr 95			Southeast Regional Implementation Manual TDLs		
Name	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**
Hexachlorinated furans	0.005	0.005	0.00005			
Heptachlorinated furans	0.005	0.005	0.00005			
Octachlorinated furans	0.01	0.01	0.0001			
2,3,7,8-TCDD	0.001	0.001	0.00001			
Other tetrachlorinated dioxins	0.001	0.001	0.00001			
Pentachlorinated dioxins	0.0025	0.0025	0.000025			
Hexachlorinated dioxins	0.005	0.005	0.00005			
Heptachlorinated dioxins	0.005	0.005	0.00005			
Octachlorinted dioxins	0.01	0.01	0.0001			
PCB congeners	1	2	0.01	1.0 ug/kg for each		
Aldrin	10	10	0.04	10	2	0.5
Chlordane and derivatives	10	10	0.14	10	2	0.05
Dieldrin	10	10	0.02	10	2	0.5
4,4-DDD	10	10	0.1	10	2	DDT 0.1
4,4-DDE	10	10	0.1	10	2	
4,4-DDT	10	10	0.1	10	2	
Endosulfan and derivatives	10	10	0.1	10	2	0.03 for I and II
Endrin and derivatives	5	10	0.1	10	2	0.03
Heptachlor and derivatives	10	10	0.1	10	2	0.05
Gamma-hexachlorocyclohexane (lindane)	10	10	0.1	10	2	0.1
Toxaphene	50	50	0.5	50	50	0.2
Methoxychlor	10	10	0.5	10	2	
Chlorbenside	2	2	0.002			
Dacthal	2	2	0.03			
Total chlorinated pesticides	20	20	0.02			

	QA/QC Sediment, Water and Tissue for Dredge Apr 95			Southeast Regional Implementation Manual TDLs		
Name	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**
Malathion	5	5	0.8			
Parathion	6	6	0.8			
Benzene	10	10	5			
Chloroform	10	10	5			
Ethylbenzene	10	10	5			
Toluene	10	10	5			
Trichloroethene	10	10	5			
Tetrachloroethene	10	10	5			
Total xylenes	10	10	5			
Phenol	100	20	10			
2-Methylphenol	50	20	10			
4-Methylphenol	100	20	10			
2,4-Dimethylphenol	20	20	10			
Pentachlorophenol	100	100	50	100		10
Resin Acids and Gualacols	10					
Ammonia	100		30			30
Cyanide	2000	1000	5000			10
Total organic carbon	0.10%		0.10%			
Total petroleum Hydrocarbons	5000	100000	100			
Total recoverable petroleum hydrocarbons	5000		500			
Total phenols	1000	10000	50			
Acid-volatiles sulfides	0.1umole/g					
Total sulfides	100		100			
Grain Size	1%					
Total Suspended Solids			1.0 mg/L			
Total settleable solids			0.05 ml/L			

	QA/QC Sediment, Water and Tissue for Dredge Apr 95			Southeast Regional Implementation Manual TDLs		
Name	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**	**Sediment (ug/kg)**	**Tissue (ug/kg)**	**Water (ug/L)**
Total solids/dry weight	0.10%					
Total volatiles solids	0.10%					
Specific Gravity	0.01 mg/L					
pH	0.1 pH units		0.1 pH			
Total water content of test species		0.10%				
Total lipid		0.10%				

Table 7-3. Laboratory Standard Operating Procedures				
SOP Number	**Title**	**Rev. No.**	**Rev. Date**	**Lab[1]**
Organic – Extraction Cleanup, Leachate and Elutriate				
PT-OP-001	Extraction and Cleanup of Organic Compounds from Waters and Solids, Based on SW-846 3500 Series, 3600 Series, 8151A and 600 Series Methods	14	4/22/2011	Pitt
PT-OP-004	Toxicity Characteristic Leaching Procedure and Synthetic Precipitation Leaching Procedure	5	5/8/2012	Pitt
PT-OP-003	Standard Elutriate Test	3	5/7/2010	Pitt
Organics				
PT-MS-001	GCMS Analysis Based on Method 8270C and 625	13	5/22/2012	Pitt
PT-GC-001	Chromatographic analysis Based on Method 8000B, SW-846 8081A, 8082, 8141A, 8151A, 610 and 8310, 8041, and 604	20	7/2/2012	Pitt
BR-ES-001	Extraction Procedure for Butyltin Analysis	7	4/22/2008	Burl
BR-GC-008	Organotin Compounds	8	1/1/2008	Burl
Metals				
PT-MT-001	Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analyses, SW-846 Method 6010B and EPA Method 200.7	13	5/8/2012	Pitt
PT-MT-002	Analysis of Metals by Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) for Methods 200.8, 6020 & ILM05.2	9	5/8/2012	Pitt
PT-IP-002	Acid Digestion of Soils, SW-846 Method 3050B	9	5/29/2012	Pitt
PT-IP-003	Acid Digestion of Aqueous Samples by SW-846 and MCAWW 200 Series Methods	11	5/8/2012	Pitt
PT-MT-005	Preparation and Analysis of Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW-846 7470A and MCAWW 245.5	13	1/13/2012	Pitt
PT-MT-007	Preparation and Analysis of Mercury in Solid Samples by Cold Vapor Atomic Absorption, SW-846 7471A and MCAWW 245.5	9	6/23/2010	Pitt
Inorganic Nonmetals				
PT-WC-018	Cyanide – Semi-Automated, Pyridine-Barbituric Acid for Total and Amenable, Cyanide in water (Method 335.4/SM4500G_and Soil Analyses (Method 9012A)	14	8/3/2011	Pitt
PT-WC-010	Total Sulfide as Acid Soluble Sulfide, Method 9030B/9034, 376.1	12	12/16/2011	Pitt
PT-GC-010	Total Organic Carbon Analysis, Lloyd Kahn	5	4/27/2012	Pitt
PT-WC-017	Total Organic Carbon (TOC) and Total Inorganic Carbon (TIC)	11	12/23/2011	Pitt
PT-WC-014	Nitrogen, Ammonia (Automated), Method 350.1	7	3/16/2011	Pitt

Table 7-3. Laboratory Standard Operating Procedures				
SOP Number	**Title**	**Rev. No.**	**Rev. Date**	**Lab[1]**
NC-WC-0040	Nitrogen, Total Kjeldahl (TKN) EPA 351.3	2.7	6/20/2008	Ncan
PT-WC-007	Nitrate/Nitrite, Nitrite, EPA Method 353.2	11	5/25/2012	Pitt
NC-WC-0050	Phosphorus: Total, Ortho and Organic – EPA 365.2 / 365.3 / SM4500P	2.7	6/20/2008	Ncan
PT-WC-008	Acid Volatile Sulfides (AVS) and Simultaneously Extracted Metals (SEM) in Sediment	4	11/18/2011	Pitt
BR-GT-006	Particle Size Analysis	5	1/1/2008	Burl
BR-GT-004	Specific Gravity	5	1/1/2008	Burl
BR-GT-011	Liquid Limit, Plastic Limit & Plasticity of Soils	5	1/1/2008	Burl
BR-GT-009	Particle Size Wet Prep	5	1/1/2008	Burl
BR-GT-010	Particle Size Dry Prep	5	1/1/2008	Burl
PT-WC-020	Percent Moisture and Ash	6	1/21/2012	Pitt
PT-QA-008	Thermometer Calibration and Temperature Monitoring	6	5/15/2012	Pitt
PT-QA-010	Preparation and Management of Standard Operating Procedures (SOPs) and Other Controlled Documents	4	pending	Pitt
PT-QA-012	Selection and Calibration of Balances and Weights	5	11/1/2011	Pitt
PT-QA-016	Nonconformance & Corrective Action System	5	11/1/2011	Pitt
PT-QA-017	Aqueous Pipette Calibration – Gravimetric Method	7	5/30/2012	Pitt
PT-QA-018	Technical Data Review Requirements	3	1/21/2012	Pitt
PT-QA-022	Equipment Maintenance	5	4/19/2012	Pitt
CA-Q-S-002	Acceptable Manual Integration Practices	2	5/13/2011	Pitt
CA-Q-S-004	Internal Auditing	2	1/26/2011	Pitt

1 Lab Codes: PITT = TestAmerica Pittsburgh, Burl = TestAmerica Burlington, Ncan = TestAmerica North Canton

Laboratory SOPs are subject to periodic revision

8 Data Reduction, Verification, and Reporting

8.1 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data are reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s). The applicable data/spreadsheet is scanned in LIMS with the batch.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, Acceptable Manual Integration Practices.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

- All raw data must be retained, including computer file (if appropriate), and/or run log. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.
- In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%. Units are defined in each lab SOP. Reporting Conventions and Units: The number of conventions set forth in the figures for reported data will be consistent with standard laboratory procedures. Concentrations in sediment samples are expressed in terms of weight per unit dry weight (e.g., mg/kg (dry), ug/kg (dry)).
- In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to 2 significant figures on the final report.

- For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.
- The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored on the server backed up nightly.
- The final concentrations will be reported on a dry-weight basis for sediments. In order to meet program detection limit requirements for several sediment parameters, an initial sample aliquot equivalent to twice the method initial weight will be used where appropriate. Refer to Section 7.2 for a specific list of parameters.

8.2 Review / Verification Procedures

Data review procedures comprise a set of computerized and manual checks applied at appropriate levels of the measurement process. Technical data review procedures are out lined in Pittsburgh SOP No. PT-QA-018 to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated before data is reported. The laboratory uses the Corporate SOP No. CA-Q-S-002, Acceptable Manual Integration Practices, discussing Manual Integrations to ensure the authenticity of the data. The general review concepts are discussed below, more specific information can be found in the SOPs.

- The data review process at the laboratory starts at the Sample Receiving level. Sample Receiving personnel review chain-of-custody forms and input the sample information and required analyses into a computer LIMS. The Sample Receiving personnel review the transaction of the chain-of-custody forms and the inputted information. The Project Managers perform final review of the chain-of-custody forms and inputted information.
- The next level of data review occurs with the Analysts. As results are generated, analysts review their work to ensure that the results generated meet QC requirements and relevant EPA methodologies. The Analysts transfer the data into the LIMS and add data qualifiers if applicable. To ensure data compliance, a different analyst performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC

check results, initial and continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. Approximately 15% of all sample data from manual methods and from automated methods, all GC/MS spectra and all manual integrations are reviewed. Manual integrations are also electronically reviewed utilizing auditing software to help ensure compliance to ethics and manual integration policies. Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

- Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Assurance Manager, Technical Manager/area Supervisor for further investigation. Corrective action is initiated whenever necessary.
- The results are then entered or directly transferred into the computer database and a hard copy (or .pdf) is printed for the client.
- As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.
- Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The Project Managers also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

8.3 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002) as the guideline.

- The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.
- Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.
- Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.
- All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

8.4 Data Reporting

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and

laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution.

The following report format is used for this project. Level 4 (CLP-like) data package with a EALAB4 edd.

8.4.1 Analytical Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

- A report title (e.g. Analytical Report) on the cover page with a "Result" column header on the sample result page.
- Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.
- A unique identification of the report (e.g. job Number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.
- A copy of the chain of custody (COC).
- The name and address of client and a project name/number, if applicable
- Description and identification of the tested sample(s) including the client identification code.
- Date of receipt of sample, date and time of collection, and date(s) and time of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours
- Date reported or date of revision, if applicable
- Method of analysis including method code (EPA, Standard Methods, etc).
- Reporting Limit.
- Method detection limits (if requested)
- Definition of Data qualifiers and reporting acronyms (e.g. ND).
- Sample results.
- QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits are included unless the client specifies

they do not require reporting the QC.

- Condition of samples at receipt including temperature. This may be accomplished in a narrative. The temperature is documented in TALs .
- A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.
- A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator .
- A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.
- Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.
- When soil samples are analyzed, a specific identification as to whether soils are reported on a “wet weight” or “dry weight” basis.
- Appropriate laboratory certification number for the state of origin of the sample, if applicable.
- If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., preliminary report). A complete report must be sent once all of the work has been completed.
- Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.
- A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory’s accreditation certificates of approval shall be provided when non-accredited tests are included in the report.

9 Internal Quality Control Checks

A quality control program is a systematic process that controls the validity of analytical results by measuring the accuracy and precision of method and matrix, developing expected control limits, using these to detect anomalous events and requiring corrective action techniques to prevent or minimize the recurrence of these events. Quality control measurements for analytical protocols are designed to evaluate laboratory performance, and measurement biases resulting from the sample matrix and field performance.

- *Laboratory method performance:* All quality control criteria for method performance must be met for all target analytes for data to be reported. These criteria generally apply to instrument tune, calibration, method blanks and laboratory control samples (LCS). In some instances where method criteria fail, useable data can be obtained and are reported with client approval. The narrative will then include a thorough discussion of the impact on data quality.
- *Sample performance:* The accuracy and precision of sample analyses are influenced by both internal and external factors. Internal factors are those associated with sample preparation and analysis. Internal factors are monitored by the use of internal quality control samples. Quality control field samples are analyzed to determine any measurement bias due to the sample matrix based on evaluation of matrix spikes (MS), matrix spike duplicates (MSD), and/or matrix duplicates (MD). If acceptance criteria are not met, matrix interferences are confirmed either by reanalysis or by inspection of the LCS results to verify that laboratory method performance is in control. Data are reported with appropriate qualifiers or discussion.
- *Field performance*: Quality control samples are used to evaluate the effectiveness of the sampling program to obtain representative samples, eliminating any cross contamination. These include trip blanks (for volatiles organics), field replicates and field blanks.

9.1 Laboratory Quality Control Samples

Quality control samples specified in the ITM will be analyzed at the frequency stated below for each matrix. Standard Reference Materials (SRMs) will be obtained from National Institute of Standards and Technology (NIST) or a comparable source, if available.

QC Sample	Frequency
Standard Reference Material	1 per 20 project samples
Method Blanks	1 per analytical batch of 1-20 samples
Laboratory Control Sample	1 per analytical batch of 1-20 samples
Surrogates	Spiked into all field and QC samples (organic

QC Sample	Frequency
	analyses, where applicable)
Matrix Spike/Matrix Spike Duplicate or Analytical Duplicate	1 per 20 project samples (as assigned and where adequate sample volume is provided)

9.2 Standard Reference Material

Standard Reference Materials (SRM) represent performance-based QA/QC. A standard reference material is a sediment, tissue, or solution with a certified concentration that is analyzed as a sample and is used to monitor analytical accuracy. SRMs will be analyzed, if available, for the following matrix/fractions:

- Sediment: Organochlorine Pesticides, PCB congeners, Metals and PAHs.
- Water: Organochlorine Pesticides, PCB congeners, PAHs.
- Tissues: Organochlorine Pesticides, PCB congeners and Metals.

The analytical results for the SRMs are evaluated against the certified concentrations. If the certified concentrations are <10 times the MDL established for the method, the SRM result will not be evaluated. The results of the SRMs are included with the associated analytical data.

9.3 Method Blanks

The method blank is used to assess preparation and analysis for possible contamination during the preparation and processing steps The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.)The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.

9.4 Laboratory Control Sample

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch. The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as

in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples. The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

9.5 Matrix Spike/Matrix Spike Duplicate

A fortified sample (matrix spike) is an aliquot of a field sample which is fortified with the analytes of interest and analyzed to monitor matrix effects associated with a particular sample. Samples to be spiked are chosen at random or assigned by the client. Depending on the test, a duplicate fortified sample (matrix spike duplicate) will be performed for every twenty project samples.

9.6 Sample Duplicates

A sample duplicate is a second aliquot of a field sample, which is analyzed to monitor analytical precision associated with that particular sample. Depending on the test, sample duplicates will be performed for every twenty project samples.

9.7 Surrogates

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromotography, but are not normally found in environmental samples. These compounds are spiked into all blank, standards, samples, and spiked samples prior to analysis for organic parameters. Generally, surrogates are not used for inorganic analyses. Percent recoveries are calculated for each surrogate. Surrogates are spiked into samples according to the requirements of the reference analytical method (Section 7 of this QAPP). Surrogate spike recoveries are evaluated against the limits specified in laboratory SOPs (Table 7-3) and are used to assess method performance and sample measurement bias. If sample dilution causes the surrogate concentration to fall below the quantitation limit, surrogate recoveries will not be evaluated.

9.8 Application of Controls

Quality control sample results are evaluated against the criteria specified in laboratory SOPs (Table 7-3). If the criteria are not met, appropriate corrective action must be taken as specified in laboratory SOPs.

10 Performance and Quality Systems Audits

An individual audit plan will be developed to provide a basis for each audit. This plan will identify the audit scope, activities to be audited, audit personnel, any applicable documents, and the schedule. Checklists will be prepared by the auditors and used to conduct all audits. They will be developed to accomplish the necessary reviews and to document the results of the audit.

Audits may involve on-site visits by the auditor. Items to be examined may include the availability and implementation of approved work procedures; implementation and documentation of health and safety procedures; calibration and operation of equipment; packaging, storage, and shipping of samples obtained; performance documentation; and nonconformance (variance) documentation.

The records of operations will be reviewed to verify that laboratory activities were performed in accordance with the appropriate approved procedures. Items reviewed will include, but will not be limited to, the calibration records of equipment, chain-of-custody documentation, and data resulting from laboratory operations.

10.1 Laboratory Performance and System Audits

Audits are performed routinely to review and evaluate the adequacy and effectiveness of laboratory performance and quality assurance program to ascertain if the APP is being completely and uniformly implemented, to assess the effectiveness of the laboratory quality assurance program, to identify nonconformances, and verify that identified deficiencies are corrected. The laboratory Quality Assurance Manager (QAM) or designee is responsible for such audits and will perform them according to a schedule.

10.2 Performance Audits

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Water Pollution Program, Water Supply Program, Hazardous Waste Program, client supplied PTs and Lab internal PTs.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Where a SRM of similar matrix is available, it will be used.

The results of performance audits are evaluated against acceptance criteria. The results are summarized and maintained by the QAM and distributed to the supervisors who must investigate and respond to the results that are outside the control limits.

10.3 Quality System Audits

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client, and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and

corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

Audit Procedures are further described in TestAmerica Pittsburgh Laboratory Quality Assurance Manual (PIT-QAM) and Corporate SOP CA-Q-S-004, Internal Auditing.

11 Preventive Maintenance

Periodic preventive maintenance is required for all applicable equipment. Instrument manuals will be kept on file for reference if equipment needs repair. The troubleshooting section of factory manuals may be used in assisting personnel in performing maintenance tasks.

Some instruments in the laboratory are covered by annual service contracts with manufacturers. Under these agreements, regular preventive maintenance visits are made by trained service personnel. Maintenance is documented and maintained in permanent records by the individual responsible for each instrument. A laboratory Instrument list is provided in Table 11-1.

The Section Supervisor or Department Manager is responsible for preparation, documentation and implementation of the program. The Quality Assurance Manager reviews implementation to verify compliance during scheduled internal audits.

Specific preventive maintenance practices for laboratory equipment, and their frequency of performance are described in SOP PT-QA-022, Equipment Maintenance.

Table 11-1. TestAmerica Pittsburgh Instrument List				
Instrument Type	**Manufacturer**	**Instrument Software**	**Model Number**	**Serial Number**
GC w/ Dual ECD	Hewlett-Packard Lab ID: GC1	NA	6890	US00024872
GC w/ Dual ECD with EPC	Hewlett-Packard Lab ID: GC2	Real-Time Plot Version 4.1 ZF12	5890A	3235A48356
GC w/ Dual FID	Hewlett-Packard Lab ID: GC3	NA	5890 Series II	2921A23920
GC w/ Dual ECD	Hewlett-Packard Lab ID: GC4	Real-Time Plot Version 4.1 ZF12	5890E	3118A35332
GC w/ Dual NPD	Hewlett-Packard Lab ID: GC5	Chem Station Rev. A 09.03 [1417]	6890A	US00025516
GC w/ Dual FPD	Hewlett-Packard Lab ID: GC6	Chem Station Rev. A 09.03 [1417]	6890N	US10145113
GC w/ Dual ECD	Hewlett-Packard Lab ID: GC8	Chem Station Rev. A 06.03 [509]	6890	US00023401
GC w/ Dual ECD	Hewlett-Packard Lab ID: GC10	Chem Station Rev. A 09.01 [1206]	6890N	US10145114
GC w/ Dual ECD	Hewlett-Packard Lab ID: GC12	Chem Station Rev. A 09.01 [1206]	6890N	US10237038
GC w/ Dual ECD	Hewlett-Packard Lab ID: GC14	Chem Station Rev. A 07.01 [682]	6890	US00026141
HPLC (UV and Fluorescence)	Hewlett-Packard Lab ID: GC7	ThermoQuest Thru-Put Rev. 4.14Build 10 09/16/2003	1100	US53600346
Balance	Mettler	NA	NA	NA
Lab ID: 119696	NA	AE200	119696	NA
Hydrogen Generator	Parker Balston	NA	NA	NA
Hydrogen Generator	Parker Balston	NA	H2-800	H2800104C
Nitrogen Generator	Parker Balston	NA	NA	NA
GC/MS	Hewlett-Packard Lab ID: HP3	Enviroquant Chem Station G1701BA Version B.01.001	6890(GC) 5973 (MSD)	US00009844 (GC) US72020964 (MSD)
Concentrator	OI Analytical	OI Analytical	Eclipse	D617466100P
GC/MS	Hewlett-Packard Lab ID: HP4	Enviroquant Chem Station G1701BA Version B.01.001	6890 (GC) 5973 (MSD)	US00010799 (GC) US72821085 (MSD)
Concentrator	OI Analytical	OI Analytical	Eclipse	D616466032P
GC/MS	Hewlett-Packard Lab ID: HP5	Enviroquant Chem Station G1701BA Version B.01.001	6890 (GC) 5973 (MSD)	US00023292 (GC) US82322212 (MSD)
Concentrator	OI Analytical	OI Analytical	Eclipse	D616466026P
GC/MS	Hewlett-Packard Lab ID: HP6	Enviroquant Chem Station G1701BA Version B.01.001	6890 (GC) 5973 (MSD)	US00030465 (GC) US92522786 (MSD)

Table 11-1. TestAmerica Pittsburgh Instrument List

Instrument Type	Manufacturer	Instrument Software	Model Number	Serial Number
Concentrator	OI Analytical	NA	Eclipse	B414466952P
GC/MS	Hewlett-Packard Lab ID: HP7	Enviroquant Chem Station G1701BA Version B.01.001	6890 (GC) 5973 (MSD)	US00028345 (GC) US91411730 (MSD)
Concentrator	OI Analytical	OI Analytical	Eclipse	D617466098P
Autosampler	EST Analytical	EST Analytical	Centurion: CENT WS	CENTS136020110
GC/MS	Hewlett-Packard Lab ID: HP8	NA	6890 FID	US00001295 (GC) 3526I01420 (Headspace)
Oven	Fisher Scientific Lab ID: VOA Glassware Oven	NA	625G	503N0042
Balance	Sartorius Lab ID: 40019078	NA	B120S	40019078
GC/MS	Hewlett-Packard Lab ID: 71	EnviroQuant Chem Station G1701BA Version B.01.00	6890 (GC) 5973 (MSD)	US00029391 (GC) US91422511 (MSD)
GC/MS	Hewlett-Packard Lab ID: 722	EnviroQuant Chem Station G1701BA Version B.01.00	6890 (GC) 5973 (MSD)	US00029396 (GC) US91922512 (MSD)
GC/MS	Hewlett-Packard Lab ID: 731	EnviroQuant Chem Station G1701BA Version B.01.00	6890 (GC) 5973 (MSD)	US00031329 (GC) US93112052 (MSD)
GC/MS	Hewlett-Packard Lab ID: 732	MSD Chem Station D.01.02.16 06/15/2004	6890N (GC) 5973 (MSD)	CN10426047 (GC) US41746674 (MSD)
GC/MS	Hewlett-Packard Lab ID: 733	EnviroQuant Chem Station G1701BA Version B.01.001	6890 (GC) 5972 (MSD)	US91411735 (MSD) US00028233 (GC)
GC/MS	Hewlett-Packard Lab ID: APEX	EnviroQuant Chem Station G1701BA Version B.01.001	6890 (GC) 5973 (MSD)	US 71410457 (MSD) US00007984 (GC)
GC/MS	Hewlett-Packard Lab ID: MSD7	EnviroQuant Chem Station G1701BA Version B.01.001	6890 (GC) 5972 (MSD)	US80210935 (MSD) DE00020249 (GC)
ICP	Thermo Fisher Lab ID: TRACEICP	Thermo-Spec	61E Trace	209390
ICP	Thermo Fisher Lab ID: 6500	ITEVA	6500	ICP-20074812
ICP/MS	Thermo Electron Lab ID: ICPMS	Plasma Lab	X-Series ICPMS	X0225
ICP/MS	Thermo Electron Lab ID: ICPMS2	Plasma Lab	X Series ICPMS	X0344
Mercury Analyzer	Leeman Labs Lab ID: HGHYDRA	WIN HG	Hydra	3009
Mercury	Leeman Labs	ENVOY	Hydra II	24

Table 11-1. TestAmerica Pittsburgh Instrument List				
Instrument Type	**Manufacturer**	**Instrument Software**	**Model Number**	**Serial Number**
Analyzer				
Waterbath	Fisher Scientific Lab ID: Hg Waterbath	NA	Isotemp 228	011N0286
Metals Digestion Block	Environmental Express Lab ID: H2O #1	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: H2O #2	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: H2O #3	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: H2O #4	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: H2O #5	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: H2O #6	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: Soil #1	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: Soil #2	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: Soil #3	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: Soil #4	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: Soil #5	NA	Hot Block	NA
Metals Digestion Block	Environmental Express Lab ID: Soil #6	NA	Hot Block	NA
Balance	AND Lab ID: P1856709	NA	EK-610I	P1856709
Balance	Lab ID: P1856710	NA	EK-610I	P1856710
Ion Chromatograph (IC2100A)	Dionex	Chromeleon Client 6.80 SP4 Build 2361 (130805) 58031	ICS 2100	11050879
Ion Chromatograph (IC25)	Dionex	Chromeleon Client 6.80 SP4 Build 2361 (130805) 58031	IC 25	40396

Table 11-1. TestAmerica Pittsburgh Instrument List				
Instrument Type	**Manufacturer**	**Instrument Software**	**Model Number**	**Serial Number**
Ion Chromatograph (IC3)	Dionex	Chromeleon Client 6.80 SP4 Build 2361 (130805) 58031	ICS 5000	11020753
Ion Chromatograph (IC2000)	Dionex	Chromeleon Client 6.80 SP4 Build 2361 (130805) 58031	ICS 2000	8050561
Ion Chromatograph (ICS2100B)	Dionex	Chromeleon Client 6.80 SP4 Build 2361 (130805) 58031	ICS 2100	11050258
Astoria 2 Analyzer system	Astoria Pacific International	FASPAC II Flow Analyzer Software Version 2.1.2	200-A100-03	200231
Astoria 2 Analyzer Sampler 311, XYZ, Diluter	NA	NA	311-A100-03	4940A14695
Astoria 2 Analyzer 322 Two Channel Auxiliary Pump	NA	NA	322-A100-00	322199
Astoria Analyzer Diluter Module 312-M2, 5 ml Syringe	NA	NA	312-A200-5ML	4803A12911
Diluter Module: Valve Module, 312 Diluter	NA	NA	312-B002-00	300971
Autoanalyzer (ALPKEM1)	OI Analytical (Test: 350.1)	WINFLOW 4.03	Alpkem Flow Solution IV	928893438
UV/VIS	Milton Roy	Spectronic	Genesys5	3V08239002
UV/VIS	Thermo Electron Corp. (Test: 3060A/7196A)	Thermo Electron	GENESYS 10 335900-000	2D5K278001
Midi Distillation Blocks	Westco Scientific	NA	Easy Dist	NA
Midi Distillation Blocks	Westco Scientific	NA	Easy Dist	NA
Midi Distillation Blocks	Westco Scientific	NA	Easy Dist	NA
Midi Distillation Blocks	Westco Scientific	NA	Easy Dist	NA
pH meter	Fisher Scientific	NA	AR25	AR93315378
pH meter	Fisher Scientific	NA	AR25	AR93312320
pH meter	Fisher Scientific	NA	AR25	AR 81202030
pH meter	Fisher Scientific	NA	XL25	94003394

Table 11-1. TestAmerica Pittsburgh Instrument List				
Instrument Type	**Manufacturer**	**Instrument Software**	**Model Number**	**Serial Number**
Autotitrator	Man-Tech Associates (Test: pH, Specific Conductance, Alkalinity, Hardness, Fluoride, and Acidity	NA	PC-Titration Plus	MS0A3-329
MultiMeter	Myron L Co.	NA	Ultrameter 6P	616555
Oven	Thermolyne	NA	6000	
Oven	Blue M Electric Co. Lab ID: Oven #2	NA	OV-18A	OV1-15300
Oven	Fisher Scientific Lab ID: OV02	NA	Isotemp 630G	001O0035
Oven	Precision Scientific Lab ID: OV08	NA	18EG	10AV-9
Oven	Fisher Lab ID: ZHE Oven	NA	Isotemp Oven Model 301	NA
COD Reactor	HACH	NA	DRB200	1131194
COD Reactor	HACH	NA	45600	20300022933
TOC Analyzer	OI Analytical	NA	NA	NA
Lab ID: 1010	OI Analytical	1010	5108710555	NA
TOC Analyzer	OI Analytical	NA	NA	NA
Lab ID: 1030	OI Analytical	Aurora 1030	E717730273	NA
TOC (Lloyd Khan Method) Analyzer	Thermo Electron Corp.	Eager 300 Version 2.2 9/2004	Flash EA 112 MAS 200R NC Soil Analyzer	20057159-20057135
Autoanalyzer	Thermo Clinical Labsystems Lab ID: KONELAB-1 (Tests:9012/420.2/420.4/9066/SM 4500 CL E/410.4)	KoneLab Workstation Software	Aqua 200	A0619933
Method 1677 Autoanalyzer (ALPKEM2)	OI Analytical FS3000	WINFLOW v 4.03	A0001604	135804017
Method 1677 Autoanalyzer (ALPKEM3)	OI Analytical FS3000	WINFLOW v 4.03	A0001604	120804293
BOD Meter - Automated	YSI	BODAssay PLUS V. 3.0	52	03L0794
BOD Meter - Manual	YSI	YSI	50B	91K033593
Flashpoint Tester	Rapid Tester Lab ID: SETA-1	RT-00001	24149	
Flashpoint	Petrotest Pensky	NA	PMA-4	741043006

Table 11-1. TestAmerica Pittsburgh Instrument List				
Instrument Type	**Manufacturer**	**Instrument Software**	**Model Number**	**Serial Number**
Tester	Martin			
Flashpoint Tester	Fisher Scientific	NA	K-16200	2501
Turbidimeter	HF Scientific Inc.	NA	Micro 100	105034
Speed Vap II	Horizon	Horizon	Speed Vap # 9000	01-0333
Speed Vap II	Horizon	Horizon	Speed Vap # 9000	01-0332
Hotplate	Thermolyne Lab ID: #2	NA	Cimarec 3	611941237080
Hotplate	Thermolyne Lab ID: #3	NA	Cimarec 3	1.07339E+12
Hotplate	Thermolyne Lab ID: #1	NA	Cimarec 3	1.07301E+12
Waterbath	Thermo Electron Corp.	NA	Precision 2872	202471
Centrifuge	Damon/IEC Division Lab ID: CENT-3	NA	CU-5000	33473227
Balance	Mettler Lab ID: 1126472457	NA	PB602	1126472457
Balance	Sartorius Lab ID: 37110039	NA	A210P	37110039
Balance	Mettler Lab ID: G76383	NA	AE240	G76383
Balance	Fisher Lab ID: 25606	NA	S-400	25606
Balance	Mettler Lab ID: AB204S	NA	AB204S	1126020829
Balance	A & D Lab ID: GR-200	NA	GR-200	14224939
Sonicator	Fisher Scientific	NA	550 Sonic Dismembrator	F2099
Concentrator	Meyer	NA	N-Evap 112	5376
Concentrator	Meyer	NA	N-Evap 115	9217
Concentrator	Horizon Lab ID: 1	NA	Dry Vap	227253
Concentrator	Horizon Lab ID: 2	NA	Dry Vap	227254
Concentrator	Horizon Lab ID: 3	NA	Dry Vap	227255
Concentrator	Horizon Lab ID: 4	NA	Dry Vap	227256
Soxtherm Extractor	Gerhardt Lab ID: 1	NA	SE-3A/S306A	4012404
Soxtherm Extractor	Gerhardt Lab ID: 7	NA	SE-3A/S306A	4012399
Soxtherm Extractor	Gerhardt Lab ID: 6	NA	SE-3A/S306A	4012398
Soxtherm Extractor	Gerhardt Lab ID: 5	NA	SE-3A/S306A	4012403
Soxtherm	Gerhardt Lab ID: 4	NA	SE-3A/S306A	4012402

Table 11-1. TestAmerica Pittsburgh Instrument List				
Instrument Type	**Manufacturer**	**Instrument Software**	**Model Number**	**Serial Number**
Extractor				
Soxtherm Extractor	Gerhardt Lab ID: 2	NA	SE-3A/S306A	4012401
Soxtherm Extractor	Gerhardt Lab ID: 3	NA	SE-3A/S306A	4012400
Soxtherm Extractor	Gerhardt Lab ID: 8	NA	SE-3A/S306A	4002039
Soxtherm Extractor	Gerhardt Lab ID: 9	NA	SE-3A/S306A	4020237
Electric Kiln	Cress	NA	FTX-27P	46053
Electric Oven	Wilt Industries	NA	A85	NA
TCLP Tumbler	Associated Design & Manufacturing Co. Lab ID: T-8	NA	6004-0590	1788
ZHE Rotator	Associated Design & Manufacturing Co. Lab ID: Z1	NA	3740-8-BRE	1223
ZHE Rotator	Bodine (Associated Design) Lab ID: Z2	NA	362RA9018	NA
ZHE Rotator	Bodine Electric Co. Lab ID: Z3/Z5	NA	42R5BFC1-E3	NA
ZHE Rotator	Bodine (Associated Design) Lab ID: Z4	NA	34R4BFC1-5R	NA
TCLP Tumbler	Environmental Express Lab ID: T6	NA	NA	3209-12-466
TCLP Tumbler	Environmental Express Lab ID: T7	NA	NA	3209-12-467
TCLP Tumbler	Environmental Express Lab ID: T9	NA	NA	3209-12-463
TCLP Tumbler	Dayton (motor) Lab ID: T1	NA	2Z794D	NA
TCLP Tumbler	Dayton (motor) Lab ID: T2	NA	5K939E	NA
TCLP Tumbler	Dayton (motor) Lab ID: T3	NA	5K939B	NA
TCLP Tumbler	Dayton (motor) Lab ID: T5	NA	5K939B	NA
pH Meter	Thermo Orion	NA	STARA1115	J00634
Balance	A & D Lab ID: 14628771	NA	GF6000	14628771
Balance	A & D Lab ID: 11684	NA	GX4000	14536813
Balance	Mettler Lab ID: 1120122641	NA	PB8001S	1120122641

Table 11-1. TestAmerica Pittsburgh Instrument List

Instrument Type	Manufacturer	Instrument Software	Model Number	Serial Number
Hot Plate	Thermodyne Lab ID: TCLP Hot Plate	NA	2200	NA
Centrifuge	Beckman	NA	J6-M	8749
Centrifuge	Beckman	NA	J6-M	8551
Centrifuge	Thermo Electron Corp. Lab ID: Cent-1	NA	K	71654833
Centrifuge	Thermo Electron Corp Lab ID: Cent-2	NA	K	71654125
Method 1664A UCT Cartridge	Enviro-Clean	NA	ENUCNIOGXF	UCT #1
Oil-Less Vacuum Pump for UCT Cartridge System	Rocker (110V, 60 Hz)	NA	400	TGTJ094
SPE-DEX Extractor System	Horizon Technology	NA	4790	#1 - 09-1208 #2 - 09-1210 #3 - 09-1209 #4 - 09-1207
GPC – AccuPrep (GPC2)	J2 Scientific	J2 Software	MPS	GPC-1022-1.0-DI
GPC - AccuVap Concentrator System	J2 Scientific	J2 Software	FLX	AVM-251-2.5-F
GPC – Autosampler Module	J2 Scientific	J2 Software	PrepLinc AS4	ASA-1045-1.3
Freezer	Kenmore by Sears	NA	253.280528	WB91633867
Digital Barometer	Fisher Scientific	NA	02-401	91116011
Digital Buret	Brand	NA	4761161 TM (catalogue #)	11G38510
IR Thermometer	EXTECH Instruments	NA	42511	SR IR#1
IR Thermometer	EXTECH Instruments	NA	42511	SR IR#2
IR Thermometer	EXTECH Instruments	NA	42511	WC IR#1
IR Thermometer	EXTECH Instruments	NA	42511	OP IR#1

Table 11-1. TestAmerica Pittsburgh Instrument List				
Instrument Type	**Manufacturer**	**Instrument Software**	**Model Number**	**Serial Number**
Gel Permeation Chromatograph – GPC1	J2 Scientific	J2 Software	Prep Linc GPC	GPC-1089-1.0 4340A1855 PLH-1126-1.1
GC w/ Dual ECD	Hewlett-Packard Lab ID: GC15	Chem Station Rev. B 04.03(16)	7890A	10441121
Autosampler	Hewlett-Packard GC15	NA	7693	10390085
Freezer	Kenmore Lab ID: WC Freezer #2	NA	253.2805281	WB02643189
Freezer	Frigidaire Lab ID: Tissue Freezer #3	NA	FKFH21F7WB	WB02442941
Freezer	Frigidaire Lab ID: Tissue Freezer #4	NA	FKCH17F7WC	WB02851917
Freezer	Frigidaire Lab ID: Tissue Freezer #5	NA	253.280928	WB92436406
UV/VIS	Thermo Fisher Scientific	NA	GENESYS 10S Vis Spectrophotometer	2D9P070001
Muffle Furnace	Thermo Fisher	NA	F6010	0152978801110621
pH Meter	Fisher Scientific	NA	Accumet XL15	XL94102132

12 The Corrective Action Process

The Corrective Action Process is the mechanism for identifying and solving nonconformance problems. The objective of the Corrective Action Process is to ensure that recognized nonconformances in the performance of any activity associated with environmental data collection and management lead to effective remedial measures, and the steps taken to correct an existing condition are documented to provide assurance that any deficiencies are recognized in later interpretation and are not recurrent.

The steps comprising the Corrective Action Process are:

- Define the problem
- Investigate
- Determine the cause
- Develop a corrective action plan
- Implement and document the corrective action
- Follow-up to verify that the corrective action has eliminated the problem
- Document the process

Problem solving can be straightforward; however, in many cases the investigation and solution takes time. In cases where an investigation is underway, documentation of the nonconformance and the Corrective Action must include a discussion of the status of the investigation. In addition, there may be instances where a nonconformance is investigated and there is no assignable cause after all quality control checks have been evaluated. In this case, the Corrective Action documentation should state and indicate that the process will be monitored to determine if the nonconformance was isolated or reoccurs.

12.1 Laboratory Nonconformances

12.1.1 Definition of Nonconformance

A nonconforming item or situation is one that has the potential to affect the quality or quantity of data generated by the laboratory or the interpretation or use of the data by the client. These include:

- Deviations or variances from the prescribed requirements in the QAPP, SOP, or Method SOP.
- Out-of-control laboratory performance quality control samples
- Malfunctions of equipment or instruments; or any unusual occurrences or circumstances.

Nonconformances may be identified at any point along the flow of samples and data through the laboratory.

12.1.2 Classifications of Nonconformances

Nonconformances are designated as a deficiency or an anomaly, and are differentiated with respect to the impact on the quality of the sample data for its intended use.

Deficiency: An unplanned deviation from an established protocol or plan, which was the result of TestAmerica's actions.

Anomaly: An unplanned deviation from an established protocol or plan, which was the result of events beyond the control of TestAmerica.

All non-conformances that may affect the use of the analytical data are communicated to the client by the Laboratory PM and summarized in the report narrative.

12.2 Nonconformance and Corrective Action Documentation

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Memos (NCM) in LIMS or the Corrective Action Reports (CAR) using the corrective action database.

Each Nonconformance Memo (NCM) has a unique control number that is used to cross-reference the nonconformance and its resolution to the associated project records.

The issue resolution should be summarized in the report narrative and archived in the project records. The nonconformance and corrective action process is described in Pittsburgh laboratory SOP PT-QA-016, Nonconformance and Corrective Action System.

Project specific communication and any NCM's will be communicated to Ms. Derrick (EA Engineering) via email by the laboratory project manager (Ms. Gamber - TestAmerica Pittsburgh). Project managers at other TestAmerica locations will direct any project communication to Ms. Gamber via email. The email communication will be followed up with a phone call to Ms. Derrick to verify receipt and discuss any necessary resolution.

13 Quality Assurance Reports

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Corporate Quality Director as well as the General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and General Managers.

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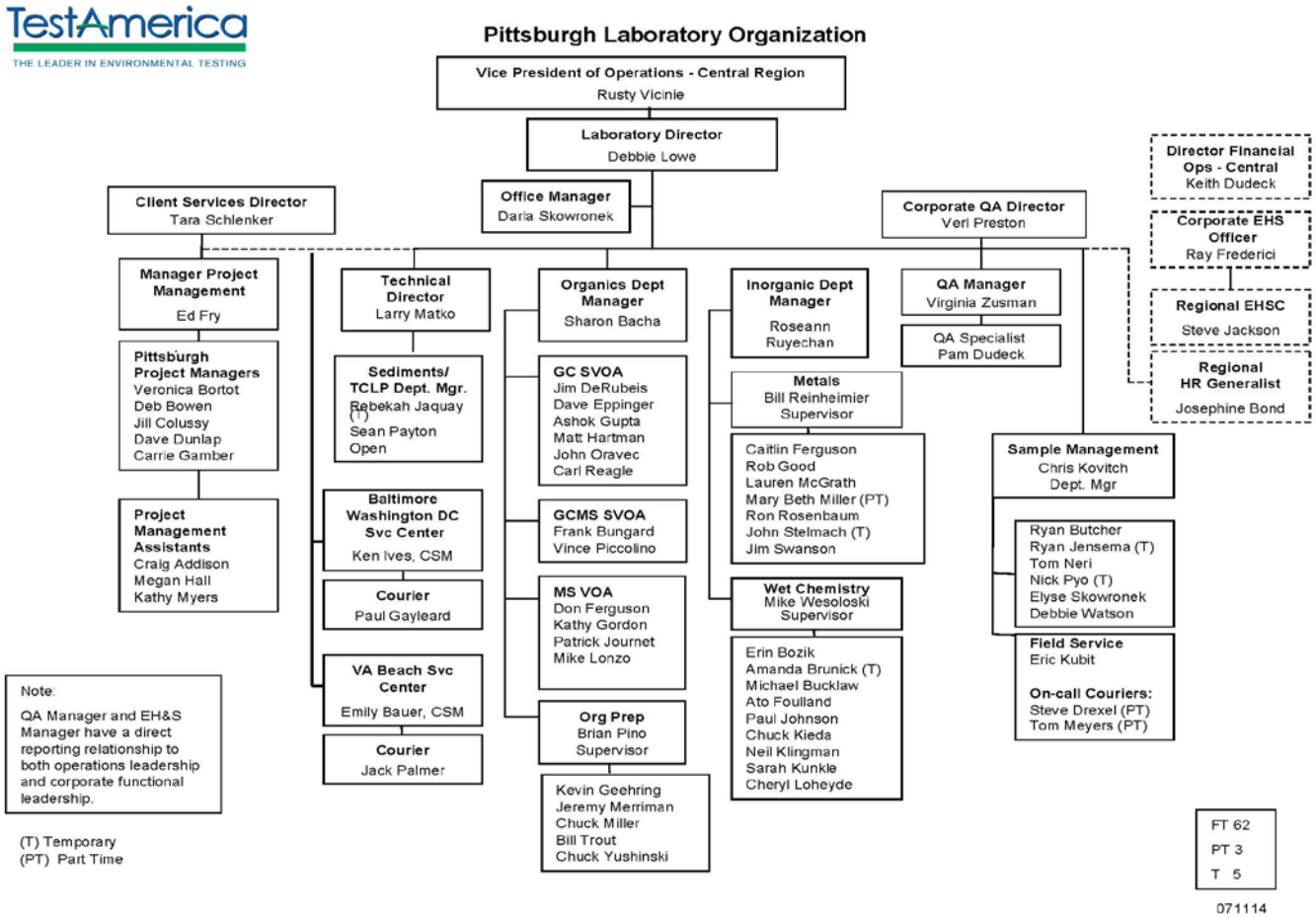
Figure 2.1 Pittsburgh Organizational



FINAL
Attachment III:
Ecotoxicological Quality Assurance Project Plan
Evaluation of Dredged Material
Proposed for Ocean Placement

Parallel Thimble Shoal Tunnel Project

Volume 4 of 4

Prepared For
Jacobs Engineering Group
4500 Main Street, Suite 310
Virginia Beach, Virginia 23462

On Behalf of
Chesapeake Bay Bridge and Tunnel District
32386 Lankford Highway
Cape Charles, Virginia 23310

February 2015

Prepared By:

EA Engineering, Science, and Technology, Inc., PBC
Ecotoxicological Laboratory
231 Schilling Circle
Hunt Valley, Maryland 21031

FINAL

Ecotoxicological Quality Assurance Project Plan

Evaluation of Dredged Material Proposed for Ocean Placement

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February 2015

2/24/15

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Project Manager, EA Engineering, Science, and Technology, Inc., PBC

2/24/15

Wayne McCulloch Date
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LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
APHA	American Public Health Association
AVS	Acid volatile sulfides
CBBT	Chesapeake Bay Bridge Tunnel
$CdCl_2$	Cadmium chloride
CFR	Code of Federal Regulations
COC	Chain-of-custody
EA	EA Engineering, Science, and Technology, Inc.
EC50	Median Effective Concentration
ft	Foot (feet)
g	Gram(s)
ID	Identification
ITM	Inland Testing Manual
$K_2Cr_2O_7$	Potassium dichromate
KCl	Potassium chloride
LC50	Median lethal concentration
mg/L	Milligram(s) per liter
MLLW	Mean lower low water
mm	Millimeter(s)
MPRSA	Marine Protection, Research, and Sanctuaries Act
NA	Not applicable
NaCl	Sodium chloride
NIST	National Institute of Standards and Technology
NODS	Norfolk Ocean Disposal Site
NOEC	No Observed Effect Concentration
OTM	Ocean Testing Manual
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PE	Performance Evaluation
ppt	Parts per thousand

LIST OF ABBREVIATIONS, ACRONYMS, AND UNITS (continued)

QA	Quality assurance
QAO	Quality Assurance Officer
QAP	Quality Assurance Program
QAPP	Quality Assurance Project Plan
QC	Quality control
SAP	Sampling and Analysis Plan
SDS	Sodium dodecyl sulfate
SEM	Simultaneously extracted metals
SOP	Standard Operating Procedure
STFATE	Short-Term Fate of Dredged Materials
SVOC	Semivolatile organic compound
TKN	Total Kjeldahl nitrogen
TOC	Total organic carbon
TRC	Total residual chlorine
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1. PROJECT DESCRIPTION

The Thimble Shoal Tunnel is a portion of the Chesapeake Bay Bridge Tunnel (CBBT) system which extends from Wise Point on the Eastern shore of Virginia to the Virginia Beach area. The CBBT is 17.6 miles long and provides a direct connection between southeastern Virginia and the Delmarva Peninsula (Delaware plus the Eastern Shore counties in Maryland and Virginia) (Figure 1-1). The Thimble Shoal Tunnel section of the CBBT runs beneath the Thimble Shoal Channel, one of the main navigation channels that crosses the system.

The proposed project includes the construction of a secondary two-lane immersed tunnel which will run parallel to and approximately 250 feet (ft) west of the existing Thimble Shoal Tunnel. The project also includes expansion of the existing portal islands and construction of new trestle crossovers. The proposed project will require the dredging and placement of approximately 1.7 million cubic yards of material from the Chesapeake Bay prior to construction.

An evaluation of the dredged material is required prior to dredging and placement to ensure that the material is appropriate for available placement options. Placement options for the Parallel Thimble Shoal Tunnel project include ocean and upland placement. Preliminary geotechnical investigations were conducted in 2014 (Fugro Consultants 2014). Supplemental geotechnical investigations are being conducted in early 2015. The purpose of this project is to collect the data that are necessary to document the Tier II (sediment and elutriate) and Tier III (ecotoxicological) characteristics of the sediments to facilitate placement of the dredged material at the Norfolk Ocean Disposal Site (NODS) (Figure 1-2). Data collected for the Parallel Thimble Shoal Tunnel project will be used to document compliance with Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) for ocean placement at the NODS.

The Parallel Thimble Shoal Tunnel dredged material evaluation will consist of collecting sediment cores from the sediment surface to depths between approximately -29 and -120 ft mean low lower water (MLLW) using sonic drilling; collecting surficial sediment and sediment cores to -20 ft below the sediment surface at the Willoughby Bank reference site and surficial sediment at the Atlantic Ocean reference site; collecting site water and elutriate preparation water; conducting analytical testing of bulk sediment and standard elutriates; conducting ecotoxicological testing of sediment (water column bioassays, whole sediment bioassays, and bioaccumulation studies); conducting analytical testing of aquatic organism tissue (as appropriate); Short-Term Fate of Dredged Material (STFATE) modeling of dredged material placement at the NODS; and evaluating test results with respect to the Ocean Dumping Regulations in Title 40 of the Code of Federal Regulations (CFR), Parts 220-228 (40 CFR 220-228).

1.1 PROJECT PURPOSE AND OBJECTIVES

The purpose of this project is to collect data to characterize the physical, chemical, and ecotoxicological quality of the sediments from the Parallel Thimble Shoal Tunnel project footprint and to determine if the material is suitable for ocean placement. The overall intent of the program is to determine if ocean placement of the material is a feasible placement option.

Ocean placement, if determined to be feasible, would reduce or eliminate the volume of material required to be placed at an approved upland disposal area(s).

The overall objective of the sampling effort is to obtain and analyze sediment and water samples representative of the areas proposed for dredging. The physical composition of the sediment will be described by grain size, specific gravity, Atterberg limits, and total solids determinations. Chemical concentrations of semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), metals (including mercury), polychlorinated biphenyl (PCB) congeners, chlorinated pesticides, organophosphorus pesticides, dioxin and furan congeners, tributyltin, cyanide, ammonia, sulfides, nitrogen, nitrate + nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, total organic carbon (TOC), and acid volatile sulfides (AVS) / simultaneously extracted metals (SEM) will be identified in bulk sediments. Site water, receiving water, and standard elutriate samples will be analyzed for SVOCs, PAHs, metals (including mercury), PCB congeners, chlorinated pesticides, organophosphorus pesticides, dioxin and furan congeners, tributyltin, cyanide, ammonia, sulfides, nitrate + nitrite, total TKN, total phosphorus, and TOC.

Specific objectives of the Parallel Thimble Shoal Tunnel study are:

- Collect the required volume of sediment and site water for physical, chemical, and ecotoxicological analyses.

- Collect sediment cores from four designated dredging areas that comprise fifteen dredging units within the footprint of the Thimble Shoal Tunnel within positioning accuracy appropriate for the project objectives.

- Collect surficial sediment and sediment cores from four locations at the Willoughby Bank reference site, and composite into two samples (one silty-sand surface sample and one subsurface fine-grained sample) for physical and chemical testing.

- Collect sandy surficial sediment from at the Atlantic Ocean reference site for physical and chemical testing.

- Collect surficial sediment from the United States Environmental Protection Agency (USEPA)-designated lower Chesapeake Bay control site.

- Collect and transfer sediment to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity.

- Test and characterize sediments from two depth intervals (top and bottom) with regard to physical characteristics, chemical characteristics, ecotoxicological characteristics, and potential for bioaccumulation.

- Test site water, receiving water, and standard elutriates with regard to chemical characteristics and compliance with water quality standards.

- Conduct water column bioassays to assess potential water column impacts related to open water/ocean placement.

- Conduct whole sediment bioassays to assess potential benthic impacts related to open water/ocean placement.

- Conduct 28-day bioaccumulation to assess the potential for uptake of contaminants from sediments into the tissue of benthic organisms.

- Conduct STFATE modeling to assess compliance with the Limiting Permissible Concentration for water quality criteria and water column toxicity as per 40 CFR Part 227.

- Evaluate physical, chemical, and ecotoxicological data for the Parallel Thimble Shoal Tunnel sediments to determine the feasibility of ocean placement for the dredged material.

1.2 PROJECT LOCATION

The existing Thimble Shoal Tunnel is located in the lower Chesapeake Bay and is part of the CBBT system. The proposed new parallel tunnel will be located on the west side of the existing tunnel. The proposed dredging footprint includes approximately 46.5 acres of area between Island No. 1 and Island No. 2 and approximately 13.5 acres adjacent to the west side of Island No. 1. A total of four dredging areas comprised of fifteen dredging units will be sampled for the testing program (Figure 1-1).

Reference sediments will be collected from the Willoughby Bank reference site near Hampton Roads, just north of the city of Norfolk, Virginia and from the Atlantic Ocean reference site (Figure 1-2). These reference sites were chosen because they each provide material with different grain size composition (sands, silty-sand, silt). The appropriate reference samples for test comparisons will be chosen based upon grain size determinations of the actual project site samples following sample collection and compositing. It is important that the reference site be comprised of materials similar to the project sediments to provide a technically appropriate comparison for the results of the analytical and ecotoxicological testing conducted with the Parallel Thimble Shoal Tunnel project sediments.

The Willoughby Bank reference area has been used for other recent ocean placement evaluations for the NODS (EA Engineering, Science, and Technology, Inc. [EA] EA 2011; EA 2014a, 2014b, 2014c, 2014d, 2015a, 2015b). For this project, two separate reference samples from the Willoughby Bank area will be collected and tested: one representing silty-sand surface materials and one representing fine-grained sub-surface materials. One reference sample from the Atlantic Ocean reference site representing sandy surface materials will be collected and tested. Lower Chesapeake Bay control sediment (for amphipod bioassays) will be collected from a USEPA-designated area in the Lower Chesapeake Bay (Figure 1-2).

1.3 EXPERIMENTAL DESIGN

The ecotoxicological testing for this study follows guidance provided by:

- USEPA/United States Army Corps of Engineers (USACE). 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual* (commonly called "The Green Book").

- USEPA/USACE. 1995 (EPA-823-B-95-001). *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations: Chemical Evaluations.*

- USEPA/USACE. 1998 (EPA-823-B-98-004). *Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S. – Testing Manual: Inland Testing Manual*.

- USEPA Region 3. 2000. M*id-Atlantic Regional Implementation Manual: Dredged Material Evaluation for Norfolk and Dam Neck Ocean Disposal Sites.*

- USEPA. 2002. *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*. Fifth Edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

- Verbal and written communications with USEPA Region 3 and USACE-Norfolk District.

The ecotoxicological testing program includes the following tasks:

- 96-hour water column bioassays with *Americamysis bahia* (opossum shrimp), *Menidia beryllina* (silverside), and *Mytilus galloprovincialis* (blue mussel).

- 10-day whole sediment bioassays with *Leptocheirus plumulosus* (estuarine/marine amphipod) and *Ampelisca abdita* (marine amphipod). *Americamysis bahia* (mysid shrimp) may be substituted in the event *A. abdita* is not available at the time of testing.

- 28-day whole sediment bioaccumulation studies with *Nereis virens* (sand worm) and *Macoma nasuta* (blunt-nose clam).

Tissues will be analyzed for target chemical constituents based on the results of bulk sediment testing and in consultation with USACE-Norfolk and USEPA Region 3.

Protocols for conducting the ecotoxicological tests are provided in Appendix A.

In previous testing programs, water column toxicity tests conducted on elutriates prepared from sediment samples from similar locations were very sensitive. Therefore, an additional 1 percent dilution will be added to the dilution series, and will be used to assess the water column toxicity

at low concentrations. The goal of this additional dilution is to increase the ability to accurately calculate a Median Lethal Concentration/Median Effective Concentration (LC50/EC50).

Based on previous dredged material studies, ammonia will likely be the primary source of toxicity in standard elutriate water column bioassays with *M. galloprovincialis* (EA 2012a and 2012b). Therefore, two sets of water column bioassays will be conducted (side-by-side) for *M. galloprovincialis*: one test with an elutriate stripped of ammonia (reduced to less than 1 milligram per liter [mg/L] un-ionized ammonia) prior to test initiation and one test with untreated elutriate. These side-by-side tests will allow for identification of ammonia as the primary toxicant as opposed to other organic or inorganic contaminants (Appendix A). In addition, an ammonia LC50/EC50 study will be conducted for *M. galloprovincialis.*

Ammonia stripping of the elutriate samples will be accomplished by adjusting an aliquot of each elutriate sample to pH greater than 11.0 using sodium hydroxide, and aerating vigorously in a container with a large surface area to volume ratio. Samples will be aerated for a minimum of 2 hours, and the ammonia reduction will be monitored. At the end of the stripping period, the pH of each elutriate will be adjusted back to the original pH using hydrochloric acid, and ammonia concentrations will be measured. The ammonia concentrations will be reduced to a target concentration of less than 1.0 mg/L total ammonia.

For the whole sediment bioassays, interstitial ammonia will be measured in the sediment prior to initiation of the tests to determine if the sediments will require ammonia purging prior to test initiation. If necessary, sediments will be purged until the ammonia concentrations are less than 20 mg/L at test initiation.

2. ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

The organization of the project team for the Parallel Thimble Shoal Tunnel project and resumes/qualifications of personnel on the project team are provided in the Sampling and Analysis Plan (SAP). Organization and responsibilities of the ecotoxicological laboratory is discussed within the following sections.

EA's Ecotoxicology Laboratory is located in Hunt Valley, Maryland. The organizational structure of the laboratory is depicted in Figure 2-1, and the specific responsibilities of laboratory personnel are outlined below.

2.1 LABORATORY MANAGER

The Manager of the Ecotoxicology Laboratory reports to EA's Business Unit Director for the Water, Natural Resources, and Ecotoxicology business unit. The Laboratory Manager's responsibilities include:

- Assignment of functional responsibilities of staff
- Budget management
- Staffing and administrative duties
- Study design and scheduling of projects
- Proposal development and client interface
- Final report review
- Oversight of Quality Assurance (QA) program development
- Approval of Quality Control (QC)/ Standard Operation Procedure (SOP) Manual (EA 2013a) and Methods Manual (EA 2013b)
- Ensure that corrective actions specified by the Quality Assurance Officer (QAO) are implemented
- Ensure that adequate resources are made available to provide for the safety and health of laboratory employees
- Inventory of laboratory supplies.

Culturist

The Culturist reports to a senior scientific staff member and Laboratory Manager. The Culturist's responsibilities include:

- Culture maintenance
- Acquisition of test organisms from suppliers
- Documentation of health and quality of cultures
- Maintenance of holding facilities
- Management of reference toxicant testing program
- Interaction with laboratory manager and study coordinators on project needs.

Quality Assurance Officer

The QAO acts in a position of oversight to the laboratory. The responsibilities of the QAO include:

- Conduct regular laboratory audits
- Participate in site audits from external sources
- Review of study plans and changes to protocols
- QA/QC review on each project report
- Review of QC/SOP Manual, Methods Manual, and quality assurance plans
- Personnel training on QC requirements and procedures, distribution of quality related information and information on procedural changes (together with Laboratory Manager).

2.2 SAMPLE CUSTODIAN

The Sample Custodian responsibilities are shared among the laboratory technicians who report directly to the Laboratory Manager. The Sample Custodian is responsible for:

- Receipt of samples, assignment of accession numbers, performance of appropriate water quality analyses on samples upon receipt,
- Storage and disposal of samples, and
- Distribution of coolers and sample containers to clients.

2.3 PROJECT MANAGERS/STUDY COORDINATORS

Each Project Manager/Study Coordinator reports to the Laboratory Manager. Responsibilities include:

- Proposal/project development

  — Costing and time estimates
  — Selection/development of methods
  — Facility requirements
  — Proposal writing

- Project coordination

  — Mobilization
  — Client interaction
  — Study plan development
  — Scheduling projects
  — Coordination with lab manager, culturist, and QAO
  — Designating lead technicians for specific projects
  — Training technical staff on new procedures
  — Assisting with oversight of daily testing and operation of laboratory,
  — Project status review (budget and project)
  — Review of data
  — Data analysis
  — Report writing
  — Report production

- Financial management of project

  — Maintaining projects within budget
  — Billing
  — Collection of aged receivables.

2.4 INTERNAL QUALITY CONTROL COORDINATOR

The Internal QC Coordinator who reports directly to the Laboratory Manager is responsible for:

- Coordination of laboratory QC program and certification programs

- Coordination of QC requirements with Laboratory Manager and QAO

- Update and distribution of QC/SOP Manual and Methods Manual

- Coordination of external laboratory audits, follow-up correspondence to address findings, and maintenance of audit records

- Training and informing personnel on QC requirements and procedures, distributing quality related information and information on procedural changes (together with QAO).

3. QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT

The purpose of this Quality Assurance Project Plan (QAPP) is to provide a standard for control and review of measurement data to ensure they are scientifically sound, defensible, and of known quality. The data will be used to help evaluate alternatives in dredged material management decisions. Project objectives are:

- Composite and test sediments representative of the Parallel Thimble Shoal Tunnel Project with regard to water column acute-toxicity testing, whole sediment toxicity testing, and bioaccumulation testing.

- Compare the test sediments to reference sediments and compare elutriates to laboratory controls and determine if they are significantly different statistically.

- Test tissue samples from the 28-day bioaccumulation tests to determine, statistically, if contaminant concentrations in tissues of organisms exposed to test sediments are significantly higher than the contaminant concentrations observed in tissues exposed to the reference sediment.

4. SAMPLING PROCEDURES

EA Engineering, Science, and Technology, Inc., PBC will perform the sampling component of the Parallel Thimble Shoal Tunnel project. Sampling objectives, locations, and methodologies are fully documented in the project FSP (Attachment I of the SAP).

5. SAMPLE CHAIN-OF-CUSTODY PROCEDURES FOR ECOTOXICOLOGICAL TESTING

Following sediment sampling and compositing, samples will be transferred into pre-cleaned 5-gallon polypropylene buckets with lids. Stainless steel spoons and ladles will be used for the transfer of the sediment samples into the storage buckets. After use, the storage buckets will be punctured to prevent re-use and will be disposed of properly.

5.1 SAMPLE CUSTODY

Sample custody begins when a sample is collected or received by EA and ends when the data are delivered to the client. It is important to be able to trace samples from their collection to data reporting so that utmost confidence can be placed in the data. A chain-of-custody (COC) is a mechanism for tracing custody from the time of collection through reporting of results. The chain is initiated by the sampling agent who completes a COC form (Figure 5-1). The sample custodian at the laboratory is responsible for completing the custody form, including recording the sample temperature at receipt, assigning sample numbers, sending samples to other laboratories for analysis via the appropriate transfer system, preparing the samples for storage, and ultimately signing the sheet and placing it in the file. Information regarding the hazard potential of samples is contained in or derived from site plans, client correspondence, or other relevant documents, and noted on COC records prepared in conjunction with acquired samples. Technical staff is notified of these hazards before beginning testing.

5.2 SAMPLE LABELING

The following information, at a minimum, is required on each sample label:

- Client
- Project number
- Sample description
- Station/Location
- Date and time collected
- Sampler's name.

5.3 SAMPLE RECEIPT AND LOGGING

Upon receipt at the ecotoxicology laboratory, the sample custodian inspects the samples for integrity, checks the shipment against the COC form, and signs the form. Discrepancies are addressed at this point and documented on the form. When the shipment and the COC form are in agreement, the custodian enters the samples into the laboratory log (Figure 5-2) and assigns a laboratory number to each sample. Samples are numbered sequentially beginning with 001 the first of each calendar year. Preceding the numbers are the letters AT and a number representing the year (e.g., AT4-075 represents the 75th sample in 2014). Each accession number is written on a color-coded label with a permanent marker. The label is then affixed to the appropriate sample container. The COC form provides an original and two carbon copies. The pink copy is

retained by the sampler, the yellow copy is placed in EA's Laboratory sample custody log, and the original, which is white, is included in the data package and remains in the project file.

For tissue samples submitted to another laboratory for chemical analysis, an additional COC form is initiated by the Ecotoxicology Laboratory sample custodian. The sample description or identification number, collection/preparation time and date, and requested analysis is noted on the COC by the Ecotoxicology Laboratory sample custodian who then signs the COC upon sample collection and relinquishment to the other laboratory sample custodian. A copy of the additional COC is retained at the Ecotoxicology Laboratory.

In addition to the above requirements, adherence to the following precautions is required:

- Shipping containers are opened in a well-ventilated area or beneath a vented hood.
- Technicians receiving samples wear protective clothing and equipment including, at a minimum, disposable nitrile gloves and lab coats.
- Samples that are known or suspected to contain hazardous substances are opened in an operating ventilation hood.
- Sample containers are inspected for integrity and rinsed or wiped clean prior to being stored.

5.4 SAMPLE STORAGE AND SECURITY

While in the laboratory, the samples are maintained in a walk-in cooler, equipped with a lock, in a secured area of the laboratory facility at 4 degrees Celsius (°C) unless otherwise specified by the client. Sample storage specifications and holding times are listed in Table 5-1. Holding times for this project are an optimal holding time of 14 days; however, sample holding will not exceed 8 weeks. Samples will be maintained in the dark at 4°C during holding. Bulk samples will be retained at the laboratory for 60 days after the draft final report is submitted.

While the samples are being used in the laboratory, security is maintained through a computerized fob access system that controls access into the laboratory facility. Only laboratory personnel are issued access fobs that allow entrance into the laboratory. This computerized system records all attempts to access any door into the laboratory and automatically records this information in a centralized database for retrieval.

6. CALIBRATION PROCEDURES AND FREQUENCY

Each instrument or other piece of data-gathering equipment in the laboratory is acquired and/or constructed to perform a specific function. As such, this equipment must be used in the manner in which it is intended. To keep the equipment and instruments operating properly, the appropriate maintenance techniques suggested by the manufacturer must be followed.

6.1 QUALITY CONTROL OF MEASURING AND TEST EQUIPMENT

To assure the accuracy of environmental data collected by the laboratory, specific quality control procedures are established for equipment used to make quantitative measurements. According to this system of quality control, the following guidelines must be adhered to:

- A unique identification (ID) number is assigned to each piece of equipment. This ID number is placed on the instrument and on all appropriate record forms (i.e., calibration, field, laboratory, etc.).

- Written procedures and/or manuals are available for each piece of equipment subject to calibration.

- Calibrations are made against certified standards of accuracy, i.e., traceable to National Institute of Standards and Technology (NIST), or if such standards do not exist the method of calibration shall be documented.

- Pieces of equipment that are defective or out of calibration are tagged or labeled as "OUT OF SERVICE." These pieces of equipment are not used until the defect is corrected or the calibration is performed. Data generated with such equipment may be subject to investigation to determine if quality of the data was compromised.

- Personnel using the equipment have access to written operating and calibration procedures and are knowledgeable in the proper application, handling, troubleshooting, transportation, and storage of each device.

Each piece of laboratory equipment is included on the Listing of EA Ecotoxicology Laboratory's Instrumentation and Equipment (Table 6-1). This list includes the manufacturer, model, and approximate age of the instrument/equipment. In addition, a history file labeled with the type of instrument and serial number is maintained for each piece of equipment. Each history file contains a Log Sheet (Figure 6-1) that has the following information: item, model, manufacturer, Ecotoxicology Laboratory ID number, specifications, and manufacturer's serial number. There is also space on this form to record the date and initials of the individual removing the piece of equipment from service, and the reason for doing so (e.g., calibration or service by manufacturer, malfunction, etc.). When the instrument is returned to service, the date and initials of the person returning the item to service are recorded on the Log Sheet. The original instruction manuals along with Equipment Log Sheets are maintained in the instrument/equipment files located in the office central filing cabinet and are available for use at any time.

For each category of equipment (e.g., pH, dissolved oxygen, conductivity), a bound instrument log book is maintained to record calibration checks, maintenance and inspection, and problems associated with the instrument and adjustments or repairs performed. These notebooks are located in the laboratory. Pieces of equipment that are quantitative by design, but are not used to gather quantitative data (i.e., an automatic pipet used simply for the transfer of material) are not controlled until used quantitatively.

6.2 CALIBRATION PROCEDURES

Detailed step-by-step calibration procedures for the laboratory equipment described below are provided in the EA Ecotoxicology Laboratory Methods Manual (EA 2013b).

6.2.1 Liquid-in-Glass Thermometers

Glass thermometers are calibrated annually against a thermometer traceable to NIST. Thermometers are calibrated by the manufacturer or other service organization or by experienced laboratory personnel, at a minimum of two points, one of which is the ice point. If the calibration is completed by an outside organization, a certificate of calibration is completed by the performing organization and placed in the appropriate history file. Internal calibration is maintained in an appropriate log book.

The following calibration procedure is modified from NBS Monograph 150, Liquid-in-Glass Thermometry (Wise 1976).

Thermometers to be calibrated are first examined for defects such as cracked glass, glass chips in the mercury column, or a separated column. The thermometer is removed from service and discarded if the glass is cracked or chipped. A separated column is remedied following procedures in NBS Monograph 150.

An ice bath, described in NBS Monograph 150, is used in the comparison of ice points of the NIST thermometer and the uncalibrated thermometer. The remaining calibrations are performed in a comparison liquid bath (distilled or deionized water) consisting of an insulated vessel, cooling and/or heating apparatus (if required), and a method of circulating the liquid. Data entered on the Calibration Log (Figure 6-2) include the temperatures of the NIST thermometer and uncalibrated thermometer at each selected data point. No calibration factor is required if the difference between the standard and the uncalibrated thermometer is less than the accuracy of the uncalibrated thermometer.

After the above described calibration procedure is performed on a thermometer, all subsequent calibrations of the thermometer need only involve an ice point determination. The difference between the previous and present-corrected (if required) ice point is reflected throughout the thermometer scale.

6.2.2 Temperature Meters

Temperature meters that are used to measure test temperatures are calibrated quarterly against an NIST calibrated thermometer. The calibration is recorded in the thermometer calibration log.

6.2.3 pH Meters

An initial calibration curve is performed at least annually using NIST traceable standards and is documented in the pH meter logbooks. Each pH meter is calibrated at least once per day to two standard buffers (pH 4 and 7, or pH 7 and 10) which bracket the range expected to be measured in the test material. The calibration is verified using a pH 7 buffer obtained from a second source (either different lot number of different supplier). Calibration information is recorded in the pH meter logbook.

6.2.4 Dissolved Oxygen Meters

Dissolved oxygen meters are air calibrated according to manufacturer's specifications for routine application, at least once per day. Calibration information is recorded in the dissolved oxygen meter log book. Daily calibrations will be conducted using air calibration according to manufacturers' specifications.

6.2.5 Salinity/Conductivity Meters

Salinity meters are calibrated daily to a 50,000 microsiemens per centimeter (µS/cm) (32.8 parts per thousand [ppt] salinity) standard according to manufacturer's recommendations. The calibration procedure is recorded in the salinity logbook. Conductivity meters are calibrated using a 0.01 M potassium chloride standard as stated in American Public Health Association (APHA) et al. (2012) or using a two-point calibration of 0 and 1,413 µS/cm standards before use. Calibration information is recorded in the conductivity logbook. An initial calibration curve is performed at least annually using NIST traceable standards and is documented in the conductivity meter logbook.

6.2.6 Amperometric Titrator

An amperometric titrator is used for total residual chlorine (TRC) analyses. Calibration of the meter is not required. However, the TRC in a sample of chlorinated tap water is measured prior to use in order to condition the electrode and ensure that the titrator is functioning properly. An initial calibration curve is performed at least annually using NIST traceable standards and is documented in the total residual chlorine meter logbook.

6.2.7 Ion Analyzer

Ammonia and other specific ion analyses can be determined using an ion meter and ion-specific probes. The meter requires calibration as described for each ion-specific probe. An initial calibration curve for ammonia is performed at least weekly using NIST traceable standards and is documented in the ammonia logbook.

6.2.8 Volumetric Glassware

Glass pipettes, volumetric flasks, and graduated cylinders used in toxicological studies conform to the standards for NIST Class A glassware and do not require calibration.

6.2.9 Environmental Chambers

Environmental chambers are standardized to the desired test temperature. The temperature within the chamber is set to the desired temperature with the aid of a calibrated thermometer immersed in water in a closed flask. The time and date of temperature standardization as well as the initials of the personnel performing the standardization are recorded in the chamber logbook. After calibration, the temperature in the growth chamber is monitored daily from a calibrated thermometer during use in experiments.

6.2.10 Drying Oven

The temperature within the drying oven is set to the desired temperature with the aid of a calibrated thermometer. The thermometer is submerged in sand inside the oven chamber.

6.2.11 Stage Micrometer and Hemacytometers

Stage micrometers and hemacytometers are certified by the manufacturer for accuracy and traceability to NIST standards. These items do not require calibration.

6.2.12 Micropipettors

The calibrations of micropipettors are checked annually using a gravimetric procedure. The delivery of each micropipettor is checked in increments covering the range of the micropipettor (e.g., 1,000 microliters [µl]; 500 µl; 200 µl checks for a 100-1,000 µl micropipettor). Using deionized water, the weight of each delivered amount of water is determined and compared to acceptable laboratory control limits. The calibration check procedures are documented in the micropipettor equipment files.

6.2.13 Balances

The Ecotoxicology Laboratory utilizes toploading and analytical balances. Prior to each use, the balance is tared to zero and the calibration checked with ASTM Class 2 weights or weights traceable to ASTM Class 2 weights. This check is recorded in the balance logbook. The analytical balances are serviced and calibrated annually by an outside contractor. A certificate of traceability is supplied by the contractor and kept in the balance equipment file. The check weights are verified for accuracy annually by an outside contractor. A record of the verification is maintained in the equipment file.

6.2.14 Temperature Controllers

Temperature controllers in the laboratory are used in conjunction with heaters to maintain temperatures higher than ambient room temperature. These are not calibrated, but are adjusted to the test temperature according to readings taken with calibrated thermometers or temperature meters.

6.2.15 Chiller Units

There are chiller units in the laboratory of various capacities used to maintain systems at temperatures below ambient room temperatures. These are not calibrated, but are adjusted to the test temperature according to readings taken with calibrated thermometers or temperature meters. They are maintained on an “as needed” basis by a contracted service.

6.2.16 Diluter System

The diluter system includes control boxes and temperature regulators for water baths. None of this equipment requires direct calibration. Mixing chambers are calibrated by volumetric procedures.

6.2.17 Lighting and Photoperiod Timers

Ambient lighting is provided in the laboratory and in the environmental chambers. The photoperiod is maintained at 16-hours light/8-hours dark (or 24-hours light, depending on the test protocol) using automatic timers. Light levels for testing are maintained at 50 to 100 foot-candles. Individual environmental chambers may be set to a different photoperiod and/or illuminance depending on specific test requirements. The light intensity and photoperiod is verified and documented at least annually for the testing areas.

7. LABORATORY PROCEDURES

Toxicity testing will be performed at EA's Ecotoxicology Laboratory in Hunt Valley, Maryland, and will follow EA's protocols (EA 2013a) outlined in Appendix A. These protocols are consistent with the following guidance documents:

- USEPA/USACE. 1998 (EPA-823-B-98-004). *Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S. – Testing Manual: Inland Testing Manual* (ITM).

- USEPA/USACE. 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual* (OTM) (commonly called "The Green Book").

- USEPA/USACE. 1995. (EPA-823-B-95-001). *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations: Chemical Evaluations.*

- USEPA Region 3. 2000. M*id-Atlantic Regional Implementation Manual: Dredged Material Evaluation for Norfolk and Dam Neck Ocean Disposal Sites.*

- USEPA. 2002. *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*. Fifth Edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

7.1 WATER COLUMN BIOASSAYS

Dilution water for bioassays will consist of clean, uncontaminated seawater or an artificial sea salt mixture that does not exceed USEPA water quality criteria for marine species. Elutriate preparation procedures using project site water are provided in Appendix A.

As per OTM/ITM guidance, three species of organisms—*Americamysis bahia* (opossum shrimp), *Menidia beryllina* (silverside), and *Mytilus galloprovincialis* (blue mussel)—will be tested in the water column bioassays for the sediment for the Parallel Thimble Shoal Tunnel project. The three species chosen represent different phyla and cover a range of differing species sensitivities (USEPA/USACE 1998). Water column bioassays will be conducted for 96 hours using *A. bahia* and *M. beryllina*. The water column bioassays conducted with the blue mussel (*M. galloprovincialis*) will be 48-hour bioassays.

In the water column tests, survival will be the endpoint for the *A. bahia* and *M. beryllina* tests. The endpoint of the *M. galloprovincialis* test will be normal shell development. As a worst case assessment, all water column tests will be conducted with larval or juvenile tests organisms which are considered the most sensitive life stage. The age ranges as specified by the USEPA/USACE (1998) testing guidelines are: *A. bahia* (1–5 days old), *M. beryllina* (9–14 days old), and *M. galloprovincialis* (less than 4 hour embryos). In water column tests, results for 100 percent test elutriates will be statistically compared (single-point comparison) to results of

the laboratory controls as per ITM evaluation protocols, not to the results for the placement site or reference area.

Water column toxicity tests will be performed on 15 samples. In previous testing programs, water column toxicity tests conducted on elutriates prepared from similar sediment samples have proven to be very sensitive. Therefore, an additional 1 percent dilution will be added to the dilution series (10, 50, and 100 percent elutriate solutions) used to assess the water column toxicity of samples. The goal of this additional dilution is to increase the accuracy of calculating an LC50/EC50. For the site water sample, one additional water column test will be performed with each test species to evaluate the potential for site water toxicity.

Based on previous water column toxicity studies, ammonia will likely be the primary source of toxicity in standard elutriate water column bioassays with the blue mussel, *M. galloprovincialis* (EA 2014c and 2014d). Therefore, two sets of water column bioassays will be conducted (side-by-side) for *M. galloprovincialis*: one test with an elutriate stripped of ammonia (reduced to less than 1 mg/L un-ionized ammonia) prior to test initiation and one test with an untreated elutriate. These side-by-side tests will allow for identification of ammonia as the primary toxicant as opposed to other organic or inorganic contaminants. In addition, an ammonia LC50/EC50 study will be conducted for *M. galloprovincialis*.

Ammonia stripping of the elutriate samples will be accomplished by adjusting an aliquot of each elutriate sample to pH greater than 11.0 using sodium hydroxide, and aerating vigorously in a container with a large surface area to volume ratio. Samples will be aerated for a minimum of 2 hours, and the ammonia reduction will be monitored. At the end of the stripping period, the pH of each elutriate will be adjusted back to the original pH using hydrochloric acid, and ammonia concentrations will be measured. The ammonia concentrations will be reduced to a target concentration of less than 1.0 mg/L un-ionized. Ammonia concentrations will be measured and recorded for the untreated and stripped elutriates.

7.2 SOLID PHASE BIOASSAYS

Bioassays with whole sediment are designed to determine whether the dredged material is likely to produce unacceptable adverse effects on benthic organisms by exposing the organisms to the whole sediment for 10 days. Two organisms—*Leptocheirus plumulosus* (estuarine amphipod) and *Ampelisca abdita* (marine amphipod)—will be used in the whole sediment bioassays.

In the whole sediment tests, survival will be the endpoint for the *A. abdita* and *L. plumulosus* tests. The age ranges as specified by the USEPA/USACE (1998) testing guidelines are: *A. abdita* (mature 3-5 millimeters [mm] mixed sexes) and *L. plumulosus* (mature 2–3 millimeters [mm] mixed sexes). In whole sediment bioassays, results will be statistically compared (single-point comparison) to results of the reference sediment as per OTM/ITM evaluation protocols.

Tests will consist of five replicates per species. Water for bioassays will consist of clean, uncontaminated seawater or an artificial sea salt mixture that does not exceed USEPA water quality criteria for marine species. Standard protocol will be followed with regard to feeding the organisms during the test (organisms will not be fed during the 10-day test) (Appendix A).

Interstitial ammonia will be measured in the sediment prior to initiation of the whole sediment bioassays to determine if the sediments will require ammonia purging prior to test initiation. If necessary, the ammonia will be lowered by replacing the overlying water in the test chambers twice per day prior to introduction of the test organisms to a target interstitial ammonia concentration of <20 mg/L.

Whole sediment bioassays will be conducted on fifteen Parallel Thimble Shoal Tunnel samples. The control sediment for the bioassays will be collected from Lower Chesapeake Bay Control Site in Maryland. Whole sediment bioassays for the three reference site sediments and the control sediment will be performed simultaneously with the testing of the sediment from Parallel Thimble Shoal Tunnel project.

7.3 SOLID PHASE BIOACCUMULATION TESTING

The bioaccumulation studies will consist of 28-day whole sediment assays using *Nereis virens* (sand worm) and *Macoma nasuta* (blunt-nose clam). Aquatic organisms used in the bioaccumulation tests were selected because they ingest sediments and survive equally well in dredged material and control and reference sediments. *N. virens* and *M. nasuta* were chosen for the 28-day bioaccumulation tests for sediments based on the recommendation in the OTM and ITM (USEPA/USACE 1991 and 1998, respectively) identifying these species as the primary benchmark species for near coastal waters that can also be used in estuarine waters down to appropriate low levels of salinity. Standard protocol will be followed with regard to feeding the organisms during the test (Appendix A).

The number of organisms used in the bioaccumulation tests will be dictated by the minimum amount of tissue is required for analysis, and depends on the analytes, matrices, detection limits, and particular analytical laboratory.

Bioaccumulation studies will be performed on fifteen composite samples from the Parallel Thimble Shoal Tunnel Project locations. In addition, bioaccumulation exposures will be conducted on three reference samples (Willoughby Bank surface, Willoughby Bank sub-surface, and Atlantic Ocean Reference Site) and control sediment (native sediment that the organisms are shipped within to the laboratory). Pre-test tissue (tissue from organisms not used in the bioaccumulation exposures) will be retained for chemical analysis to evaluate the concentration of target analytes in the organisms prior to exposure to test sediments.

8. DATA REDUCTION, VALIDATION, AND REPORTING

EA maintains extensive records to ensure that all aspects of the analytical process are adequately documented. Because laboratory records are often used for legal issues or requirements, it is important to consider the format and quality of the records. These records convey what was done, when it was done, who did it, and what was found.

8.1 DATA COLLECTION

8.1.1 Assignment of QC Test Number

At the initiation of a test, a QC test number is assigned and logged into the Toxicology Laboratory Test Logbook (Figure 8-1). This number consists of the prefix identifier TN (standing for test number), the calendar year, and a sequential test number. This number is not to be confused with the sample identification number assigned previously. As an example, TN-14-001 would indicate the first test started in 2014. This test number serves as a reference for tracking and data acquisition.

A reference toxicant test is assigned a similar QC test number with the prefix identifier RT (standing for reference toxicant), the calendar year, and a sequential test number. Each reference toxicant test is logged into the Reference Toxicant Test Logbook (Figure 8-2).

8.1.2 Toxicity Test Data Sheets

All toxicity test information is recorded on data sheets approved by the Laboratory Manager and the QAO. During the performance of a test, these data sheets are under the control of the laboratory manager and staff who are responsible for their security. All data entries are made in permanent, waterproof ink (preferably black). The date of the entry and the identity of the observer are clearly documented. The observer uses his/her full name or initials. An initial and signature log is maintained by the laboratory so that the recorder of every entry can be identified. If a space is not pertinent to the test, it is indicated as NA (not applicable) or left blank. All information is recorded on the data sheets, in a notebook, or on other records at the time the observations are made. Recording information on unauthorized pieces of paper is not allowed. All original data entries must be legible. If a data entry is in error, it is crossed out with a single line, initialed and dated, and the correct information recorded. Obliteration of an incorrect entry or writing over it is not allowed; neither is the use of correction tape or fluid on any laboratory records. Corrections are footnoted and explained on bench sheets. Should the data sheet require transcription due to activities limiting the legible review over time (i.e., spilling of chemical or water on data sheet), the original data sheet is maintained in the project file and a transcribed data sheet is clearly marked as transcribed data with the initials of the individual performing the transcription and the date. In addition, all actions taken during the conduct of a study must be described on bench sheets that accompany the former data sheets and constitute raw data.

8.1.3 Biological Data Observations

Counting and recording of live test organisms is typically conducted at 24-hour or other pre-determined intervals from time of test initiation. For tests using larger specimens [>0.2 grams (g)], average weights and standard lengths to the nearest 0.1 g and 0.5 mm may be determined by measuring a representative sample (30 individuals) of organisms at test termination. Similar observations are made for larger macroinvertebrates. For tests with larval or small juvenile fish, age is reported rather than length/weight data. Smaller test organisms, such as daphnids and mysids, are not routinely measured or weighed; instead, the age of the organisms is reported. Depending on the species tested and the objectives of the test, other test endpoints, including reproduction, fecundity, growth, and/or biomass may be determined during testing or at test termination.

8.1.4 Physical and Chemical Water Quality Monitoring

The source of dilution water and its water quality characteristics are documented and reported. Water quality characteristics of the test concentrations and diluent water controls for acute and chronic tests are typically recorded in the following manner: dissolved oxygen, temperature, specific conductance (or salinity), and pH are measured in a minimum of one replicate of each test concentration and control at test initiation, at 24-hour intervals during testing, and at test termination. If the test is a renewal test, water quality measurements are recorded at 24-hour intervals on both old and new test dilutions and the control. Water quality measurements on the bioaccumulation tests will be recorded at a minimum of three times per week, prior to renewal of overlying water. Analytical methods are conducted according to USEPA (1979) and APHA et al. (2012).

8.2 DATA REDUCTION

For acute water column bioassays, the LC50 values and associated statistics may be derived by the binomial, moving average, or probit methods (Finney 1971; Stephan 1977), as programmed for computer calculation (USEPA 2002). Depending on the nature of specific data sets, other methods may be employed including the trimmed Spearman-Karber (Hamilton et al. 1977), SAS probit analysis (SAS Institute 1985), or graphic interpolation (APHA et al. 2012. The actual method used is specified in the report. When applicable, EC50 values and associated statistics are derived using the ToxCalc statistical software package (Version 5.0, Tidepool Scientific Software).

Upon acquiring a statistical computer program to analyze toxicological data, the results generated by the acquired program are verified against another program using the same data set. Copies of the verified test data remain on file in the Ecotoxicology Laboratory central files. All computer input is verified for accuracy.

8.3 DATA VALIDATION

Throughout the course of testing, there are many quality control checks that are performed to ensure the integrity of the data. Specifically, the sample custodian is responsible for completing

and checking the sample custody record. The laboratory technician is responsible for completing calibration documentation, sample preparation logs, and instrument logs. The QAO verifies through review of the data packet and regular laboratory inspections that the above activities are completed and documented.

Manual calculations are performed by knowledgeable personnel and recorded on computational sheets which contain sufficient information to identify the project, the date, and the persons who originated and verified the calculations. Manual calculations, whether simple or complex, are checked by a minimum of one reviewer other than the person who performed the original calculations.

8.4 DATA REPORTING

All final reports are subjected to QA review before they are sent to clients. Reports are reviewed for completeness, accuracy, and conformance with study plans, EA testing protocols, and approved guidelines and procedures. A QA Report Review form is completed specific to the requirements of each test as part of the review process. A Report Quality Assurance Record (Figure 8-3) accompanies the report to document that QA/QC requirements have been met and the report is approved. Data generated in the laboratory, including bench sheets, reports, tables, and raw data, are stored in the respective client files for a minimum of 5 years.

9. INTERNAL QUALITY CONTROL CHECKS

9.1 INTERNAL REFERENCE TOXICANT TESTING

Reference toxicants serve as internal quality control checks on technical performance, and are used to determine the condition of test organisms at the time of the bioassay. The reference toxicant tests are conducted in a manner that allows for comparison between lots or cultures of organisms. The results of each test are compared with the historical toxicological data generated for the specific combination of test species, test conditions, and reference toxicant. If resistance is reduced or elevated, the test organisms are examined to ascertain problems.

Several chemicals are routinely employed as reference toxicants in EA's Ecotoxicology Laboratory including sodium dodecyl sulfate (SDS), sodium chloride (NaCl), potassium chloride (KCl), Cd as cadmium chloride ($CdCl_2$), and Cr^{+6} as potassium dichromate ($K_2Cr_2O_7$). For in-house cultured stocks of organisms, reference toxicant bioassays are performed concurrently with the effluent toxicity test or at a minimum of once a month if cultures are utilized in testing on a regular basis. The sensitivity of test organisms obtained from outside sources is evaluated with a reference toxicant test following the acclimation period and preferably concurrent with the effluent toxicity test. The reference toxicant tests are performed in the same manner as effluent testing for the species in question, but generally utilize fewer replicate exposures. The requirements for the acute toxicity data can be satisfied by determining the 48-hour and 96-hour LC50. Alternatively, the reference toxicant data can be obtained from the organism vendor if the vendor regularly conducts reference toxicant testing (last five reference toxicant test results are supplied by the vendor).

Acute and chronic reference toxicant testing is routinely conducted by the Ecotoxicology Laboratory. A control chart is prepared for each reference toxicant/organism combination, and successive endpoints (e.g., LC50 or EC50) are plotted and examined to determine if the results are within prescribed limits. The mean and upper and lower control limits (±1 and ±2 standard deviations) are recalculated with each successive point, until the statistics stabilize. Outlier values that fall outside the upper and lower control limits, and trends of increasing or decreasing sensitivity are readily identified. Periodic recalculation of control limits to incorporate recent test results is performed monthly or more frequently, at the discretion of the laboratory manager. For hypothesis testing results, the No Observed Effect Concentration (NOEC) from each successive test is entered on a control chart. The values should fall within one concentration interval above or below the central tendency (mode). Copies of data sheets and results of the reference toxicant tests are maintained by the culturist in the species-specific reference toxicant test files.

In addition to the tabular control charts, results of the acute reference toxicant tests by species are graphed monthly. These control chart graphs visually display the LC50 value, lower confidence limit, and upper confidence limit for each species.

If the result of the reference toxicant test does not fall in the expected range or the test organisms, the sensitivity of the organisms and the overall credibility of the test system are suspect. In this case, the test procedure is examined for defects, and the reference toxicant test

repeated. If no defect can be found in the test procedures, a repeated failure of reference toxicant test may indicate unacceptable organism sensitivity and new stock should be obtained.

9.2 TAXONOMIC VERIFICATIONS

Organisms used for toxicity testing must be of a positively known species. Therefore, on a quarterly basis, taxonomic verifications are conducted by the QAO on all EA-cultured organisms used regularly for testing. Identification of in-house cultures of the cladocerans *Daphnia magna*, *D. pulex*, and *Ceriodaphnia dubia*, and the freshwater amphipod *Hyalella azteca* are included. These organisms are permanently mounted on microslides. Fathead minnows (*Pimephales promelas*) are preserved in jars or vials. Taxonomic specimens are stored onsite for at least 1 year past the identification date. A written record of the findings is kept on file.

Acquired lots of organisms are also verified for taxonomic identity if they are field collected or if they are to be introduced into in-house cultures for genetic diversification. Packing slips that are received with acquired organisms are maintained by the culturist in the species file, as part of the organism receipt and log-in procedures.

10. PERFORMANCE AND SYSTEMS AUDITS

EA maintains a corporate Quality Assurance Unit that is wholly independent of and separate from the personnel engaged in conducting and supervising aquatic toxicological studies. The quality assurance unit has prepared a Quality Assurance Program (QAP) Manual which contains quality assurance policies governing the conducting of technical studies. Specific corporate policies have been designed for the following quality assurance functions and are described in the listed QAP Manual sections:

- Project Manager Duties QAP-203
- Study Plan QAP-300
- Procurement Documents QAP-400
- Work Instruction QAP-500
- Quality Verification QAP 1000
- Project Reports QAP-1000
- Calculation Control Procedures QAP-1000
- Test Programs QAP-1100
- Calibration Records QAP-1200
- Sample Control Records QAP-1300
- Data Control Procedures QAP-1300
- Record Storage QAP-1300
- Nonconformance Reports QAP-1500
- Quality Assurance Records QAP-1700.

The quality assurance practices and procedures designated in the corporate QAP Manual are an integral component of the *Ecotoxicology Quality Control and Standard Operating Procedures Manual* (EA 2013a). Accordingly the items not specifically addressed in this document are followed as prescribed in the QAP Manual.

10.1 PERFORMANCE AUDITS

Audits are systematic checks to determine the quality of some activity or function. Audits are of two types: performance and system.

Performance audits are independent sample checks made by an auditor to arrive at a quantitative measure of the quality of the data produced by one section or the entire measurement process. Performance audits are conducted by introducing control samples, in addition to those used routinely, into the data production process. These control samples may include performance evaluation samples of known concentrations and toxicity.

The laboratory regularly participates in external performance audits as part of its laboratory certification efforts. Performance evaluation (PE) samples from USEPA are analyzed yearly. In addition, other states and agencies require the periodic analysis of their own PE samples.

The results of performance audits are summarized and maintained by the laboratory QAO and distributed to the laboratory manager who must investigate and respond to any results that are outside the control limits.

10.2 SYSTEM AUDITS

System audits are onsite qualitative inspections and reviews of the quality assurance system used by some part of or the entire measurement system. In support of state certifications and National Environmental Laboratory Accreditation Conference accreditation, the laboratory is routinely audited by several external parties. The frequency of onsite assessments are defined by the individual state or regulatory agency.

Internally, the QAO conducts annual audits of the laboratory and the culture facility. A series of audit checklists are completed which cover all activities and procedures in the toxicology facilities. System audits are conducted by the corporate QA group with the assistance and involvement of field, laboratory, and project personnel. The audits are performed against a set of requirements, which may be a QA project or programs plan, a standard method, or a project statement of work. A checklist is generally generated from the requirements and becomes the basis of the audit. The results of any deficiencies noted during an audit are summarized in correspondence to laboratory manager and staff. An example of an audit checklist is given in Figure 10-1.

10.3 RESPONSIBILITY, AUTHORITY, AND TIMING

The QAO is responsible for the conduct of all internal audits, which include system, performance, and data audits. Audits are conducted at appropriate intervals for each operation and support, but at a minimum on an annual basis. Audits may be conducted more frequently for a specific task or activity. The QAO keeps on record a tentative schedule that details the number and types of audits, both scheduled and unscheduled, for the current year and a current list of the dates of completed audits.

Specific audits are planned, organized, and clearly defined before they are initiated. Procedures for the auditing activities are identified prior to implementation of the audit, and are designed to meet all requirements for the specific audit. In general, auditors identify nonconformances or deficiencies, report and document them, initiate corrective action through appropriate channels, and follow up with a compliance review. Records are kept of all auditing tasks and findings.

10.4 DOCUMENTATION

To ensure that the previously defined scope of the individual audits is accomplished and that the audits follow established procedures, a checklist is completed during each audit. The checklist details the activities to be executed and ensures that the auditing plan is accurate. Audit checklists are prepared in advance and will be available for review.

At a minimum, the checklist will allow space for the following information:

- Data and type of audit
- Name and title of auditor
- Description of group, task or facility being audited
- Checklist of audit items according to scope of audit
- Deficiencies or nonconformances.

Following each performance and data audit, the QAO prepares a report to document the findings of the specific audit. The memorandum is submitted to the Corporate Quality Assurance Director and the Laboratory Manager of the audited group to ensure that objectives of the QA program are met. The format of the audit quality assurance memorandum consists, at a minimum, of the following:

- Description and date of audit
- Name of auditor
- Copies of completed, signed, and dated audit form and/or checklist
- Summary of findings of the audit including and nonconformance or deficiencies
- Date of memorandum
- Description of corrective actions.

A copy of the signed and dated memorandum for each audit is maintained by the QAO, and will also be placed in project files, as necessary.

11. PREVENTIVE MAINTENANCE

Periodic preventive maintenance is required for all sensitive field and laboratory equipment. Instrument manuals will be kept on file for reference if equipment needs repair. The troubleshooting section of factory manuals may be used in assisting personnel in performing maintenance tasks.

Major instruments in the laboratory are covered by annual service contracts with manufacturers. Under these agreements, regular preventive maintenance visits are made by trained service personnel. Maintenance is documented and maintained in permanent records by the individual responsible for each instrument.

The Laboratory Manager is responsible for preparation, documentation, and implementation of the program. The QAO reviews implementation to verify compliance. For each operational group, the preventive maintenance program includes the following:

- Listing of the instruments and equipment that are included in the program
- Frequency of maintenance considering manufacturer's recommendations and/or previous experience with equipment
- For each instrument in the program a file is maintained for the following information:
  - List of spare parts maintained by the laboratory
  - External service contracts
  - Items to be checked and/or serviced during maintenance and directions for performing maintenance (if external service is not provided or if not stated in manufacturer's instrument manuals).

Specific preventive maintenance practices, their frequency of performance, and available spare parts for ecotoxicology laboratory equipment are described in Table 11-1.

12. ECOTOXICOLOGY DATA QUALITY ASSESSMENT

Data assessment is a systematic process of reviewing data against a set of criteria to identify outliers or errors. Laboratory data review is discussed in Section 8 of this QAPP. Each report narrative includes a discussion of the quality control samples and evaluates data usability based on the data.

13. CORRECTIVE ACTIONS

The objectives of the corrective action procedures presented below are to ensure that recognized errors in performance of sample and data acquisition lead to effective remedial measures and that those steps required to correct an existing condition are documented to provide assurance that any data quality deficiencies are recognized in later interpretation and are not recurrent in the course of the project.

Many times corrective measures are undertaken by project staff in a timely and effective fashion but go undocumented. Such incidents may be of a recurrent type that might not be recognized by other staff performing the same activity. In other cases, corrective actions are of a complex nature and may require scheduled interactions between departmental groups. In either case, documentation in a formal or informal sense can reinforce the effectiveness and duration of the corrective measures taken.

13.1 CORRECTIVE ACTION METHODS

13.1.1 Immediate Corrective Actions

Immediate corrective actions are of a minor or routine nature such as correcting malfunctioning equipment, correction of data transcription errors, and other such activities routinely made in the field, laboratory or office by technicians, analysts and other project staff. These should be documented as prescribed in the project quality control procedures, as required. Specific documentation should be limited to notations in logbooks, notebooks, or on data sheets or other such forms. Such notations should be initiated and dated by the person performing the corrective action.

13.1.2 Long-Term Corrective Actions

Long-term corrective action shall be used to identify and eliminate causes of nonconformances which are of a complex nature and that are formally reported between management groups. A formal system for reporting and recording these corrective actions shall use the following procedure.

13.1.3 Corrective Action Steps

For either immediate or long-term corrective actions, steps comprising closed-loop corrective action system are as follows:

- Define the problem
- Assign responsibility for investigating the problem
- Investigate and determine the cause of the problem
- Determine a corrective action to eliminate the problem
- Assign and accept responsibility for implementing the corrective action
- Establish effectiveness of the corrective action and implement the correction
- Verify that the corrective action has eliminated the problem.

13.1.4 Audit-Based Nonconformances

Following audits, corrective action is initiated by documenting the audit finding and recommended corrective action on an Audit Finding Report discussed in Section 10. The corrective action undertaken by the designated responsible party is documented with an implementation schedule and management approval. The implementation is verified by the auditor on the same form which is then made part of the project audit report record. Other means of documenting long-term corrective action are equally acceptable if the seven elements listed above are addressed.

13.2 CORRECTIVE ACTION REPORT REVIEW AND FILING

Immediate and long-term corrective actions require review to assure that, during the time of non-conformance, erroneous data were not generated or that, if possible, correct data were acquired instead. Such confirmation and review is the responsibility of the supervisor of the staff implementing the corrective action. Confirmation shall be acknowledged by notation and dated signature on the affected data record or appropriate form or by memorandum to cognizant project management. Such corrective action forms and memorandum shall be retained on file by responsible task leaders and filed centrally by the project manager.

13.3 CORRECTIVE ACTIONS REPORTS TO MANAGEMENT

The Project QAO shall provide project management with corrective action reports. The project manager is informed verbally of analytical non-conformance events as soon as possible and decisions made after evaluation are documented in the non-conformance report. Copies of each non-conformance report are maintained in the report file, and addressed in the final data report.

14. QUALITY ASSURANCE REPORTS

Fundamental to the success of this project is the active participation of management through awareness of project activities, and during development, review, and operation of the project. Management will be informed of quality central activities through the receipt, review, and/or approval of:

- The QAPP
- Audit reports
- Corrective action reports
- Ecotoxicological report narratives.

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FIGURES

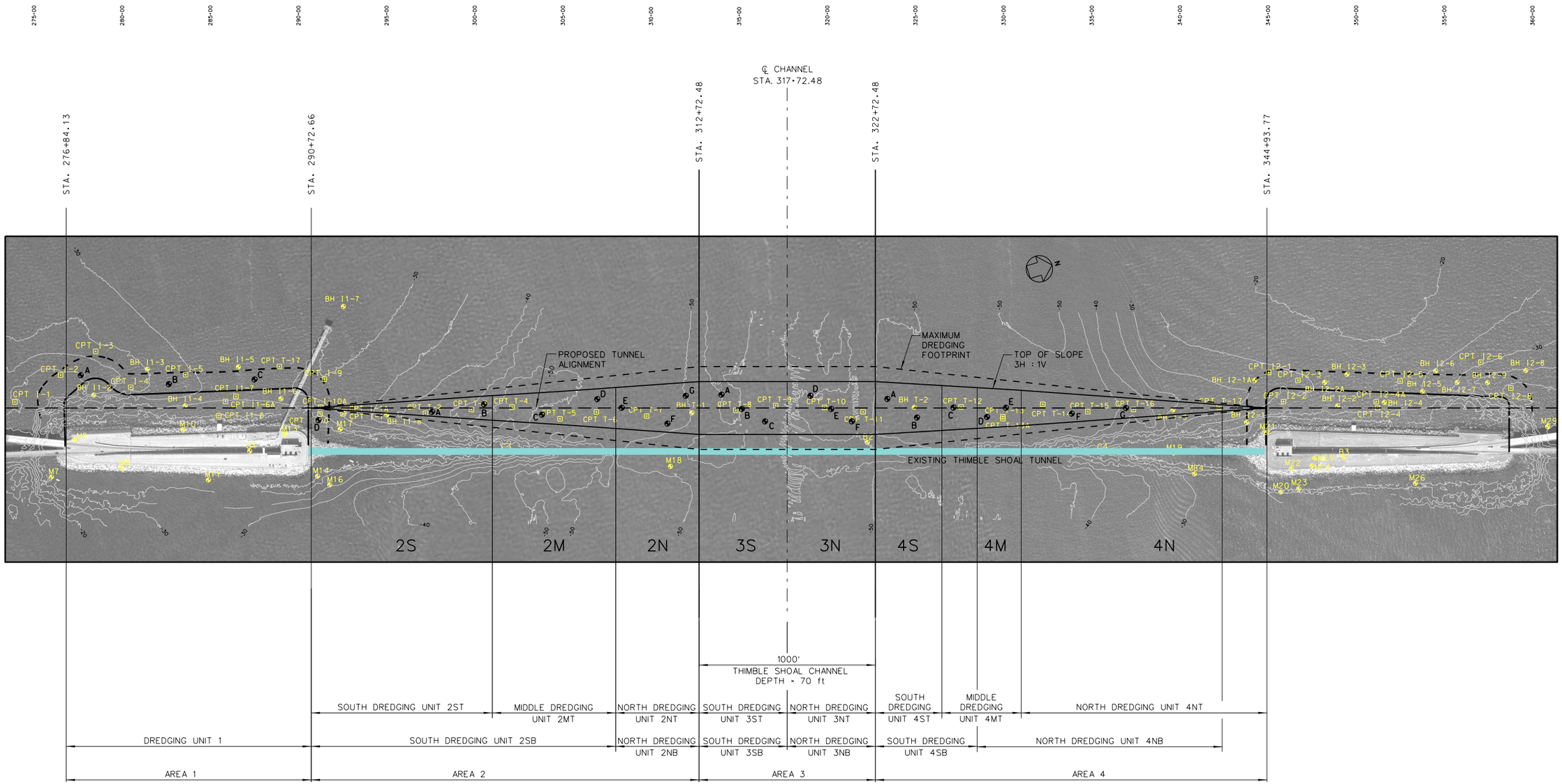

Figure 1-1 Dredging Areas, Dredging Units, and Coring Locations in the Parallel Thimble Shoal Tunnel Footprint

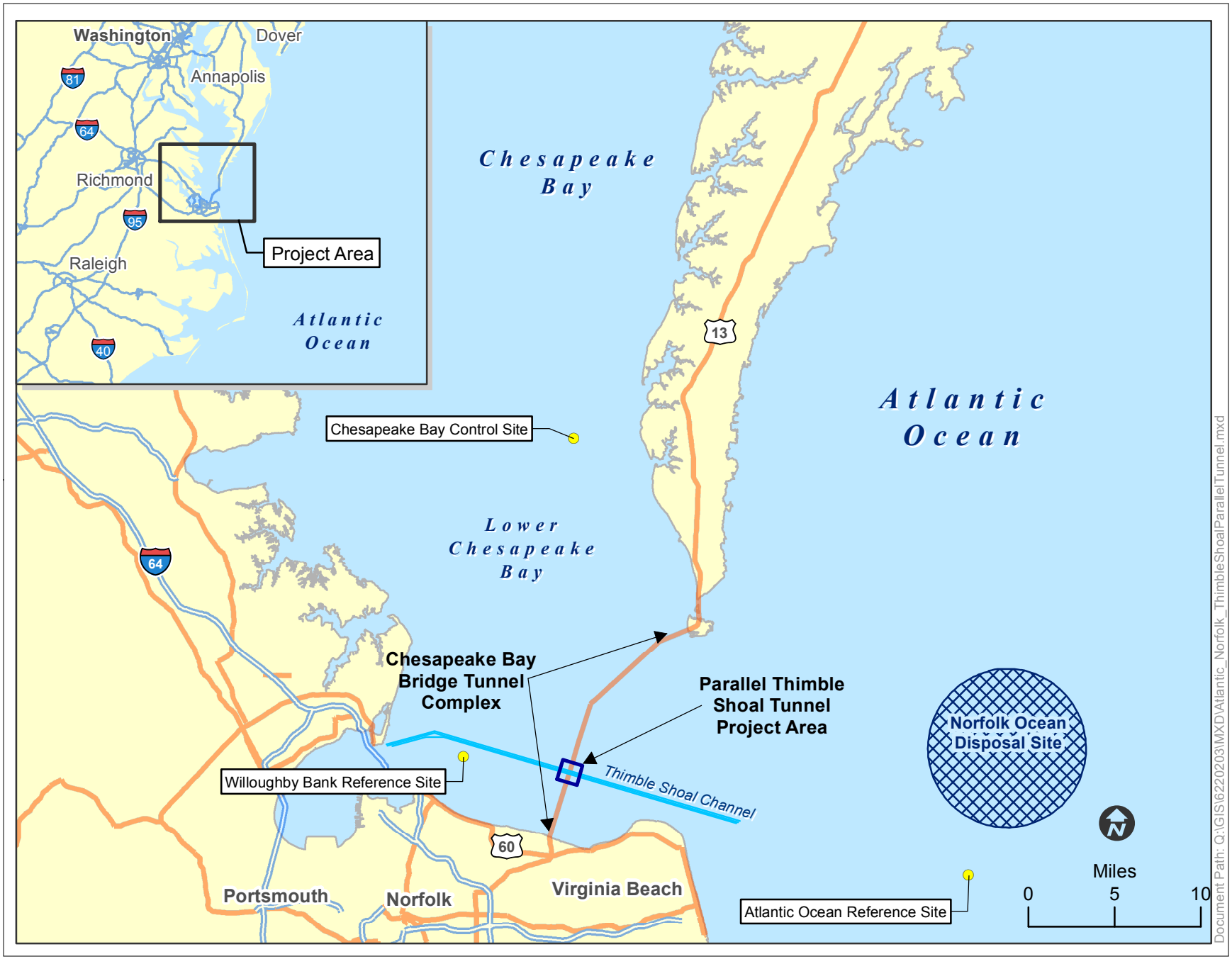

Figure 1-2. Sampling Locations for the Chesapeake Bay Control Site, Norfolk Ocean Disposal Site, the Willoughby Bank Reference Site, and the Atlantic Ocean Reference Site.

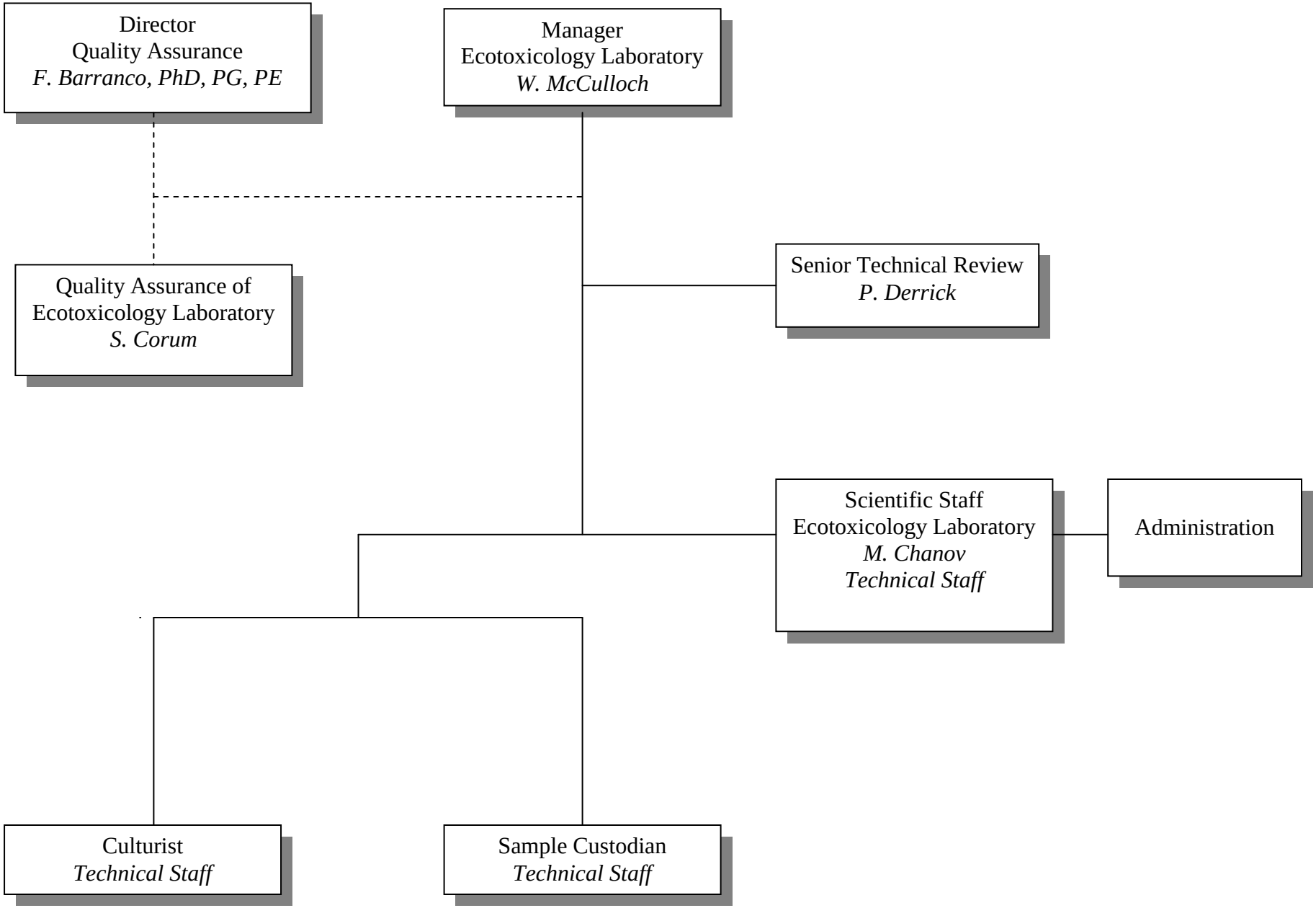

Figure 2-1: EA's Ecotoxicology Laboratory Organization

Chain-of-Custody Record

EA Engineering, Science, and Technology

EA Ecotoxicology Laboratory
231 Schilling Circle
Hunt Valley, Maryland 21031
Telephone: 410-584-7000
Fax: 410-584-1057

Sample Shipped By: (circle)

Fed. Ex. UPS Other: _____

Tracking #: _____

Client: _____ Project No.: _____

NPDES Number: _____ Client Purchase Order Number: _____

City/State Collected: _____

PLEASE READ SAMPLING INSTRUCTIONS ON BACK OF FORM

Accession Number (office use only)	Grab	Composite	Collection		Sample Description (including Site, Station Number, and Outfall Number)	Number/Volume of Container
			Start Date/Time	End Date/Time		

Sampled By:	Date/Time	Received By:	Date/Time
Sampler's Printed Name:	Title:	Relinquished By:	Date/Time
Relinquished By:	Date/Time	Received By Laboratory	Date/Time

Was Sample Chilled During Collection? Yes / No

Comments:

Sample Collection Parameters

Visual Description:

Temperature (°C):

pH:

TRC (mg/L):

Other:

Figure 5-1. EA's Chain-Of-Custody Form

**** Please use ballpoint pen when filling out label(s) and sample custody form(s).**

1. Fill out EA Ecotoxicology sample label with the appropriate information (Client, Station, Sample Description, Collected By, Date, Time, and Comments). Affix label to appropriate container provided by EA.

2. When sample containers are supplied by the client, lead free glass of inert, nontoxic plastic containers that are equipped with screw caps or an equivalent closure may be used. An example of such a container is an HDPE plastic jug from the grocery store that previously contained deionized water. Additionally, sampling equipment must be made of or lined with inert, nontoxic plastic materials, stainless steel, Teflon, or glass.

3. After completing sampling, pour a small volume (e.g., 500 ml) of sample (river water or effluent) into appropriate sampling container(s). Rinse container with sample and discard. Fill container(s) until there is minimal remaining air space. Seal container.

4. Place sample(s) on ice. Our experience has found that the sample temperature is best kept at 4°C by the use of wet ice during shipment. However, blue ice or other ice substitutes may be appropriate if the samples are down to 4°C prior to sample shipment. ***Samples should not be shipped with dry ice.***

5. Fill out Chain-of-Custody Record with client name. Check appropriate block for grab or composite sample and note collection start date/time and end date/time (military time or use am/pm). Fill out section on sample description (including Site, Station Number, and Outfall Number) and number of containers.

Please do not fill in Accession Number as this is for office use only. Sign Chain-of-Custody Record and note date/time. Keep the pink copy of the signed custody sheet for your records. Place original and yellow copy of Chain-of-Custody Record in plastic zip-lock bag to protect from water. Tape cooler shut and ship via overnight carrier (if shipping on Friday for Saturday receipt --- clearly mark weekend delivery) to:

EA Ecotoxicology Laboratory
EA Engineering, Science, and Technology, Inc.
231 Schilling Circle
Hunt Valley, Maryland 21031
Any Questions? 410-584-7000

Saturday Sample Delivery

Samples and coolers to be shipped on ***Friday*** for receipt on ***Saturday*** should be clearly marked for Saturday delivery on the Federal Express, UPS, or other carrier's airbill. It is our experience that an **exaggerated X** that is circled in the Saturday delivery box helps ensure that the samples are delivered on Saturday. In addition, use of the Saturday delivery stickers on the outside of the cooler and ***verbally reporting*** the Airbill Number to the EA Ecotoxicology Laboratory project manager on Friday (410-584-7000) assists us in receiving the samples under the 36-hour holding time duration for toxicity testing.

Figure 5-1. (continued)

Figure 5-2. EA's Sample Custody Log

TOXICOLOGY LABORATORY SAMPLE CUSTODY LOG

Initials	Client	Sample Description	Received:		Custody Form (√)	Accession Number	Volume	Container I.D.	A/H/C Sample Taken (√)
			Date	Time					

Figure 6-1. EA's Equipment Log Sheet

EQUIPMENT LOG SHEET

Item: _____ Ecotoxicology Laboratory No.: _____

Manufacturer: _____ Specifications:_____

Manufacturer Model No._____ Manufacturer Serial No. _____

Originally Put in Service (Date): _____

HISTORY		
Removed from Service Date/Initials	Purpose of Removal from Service	Returned to Service Date/Initials

ATS-QA7
8/29/96

Figure 6-2. EA's Thermometer Calibration Record Form

WORKING THERMOMETER CALIBRATION

NIST Thermometer Control No.: _____ **NIST Thermometer Calibration Date: _____**

Date	Thermometer ID	Target Calibration Temperature	NIST Thermometer		Working Thermometer Reading	Correction Factor	Analyst
			Reading	Corrected			

ATS-Q08
12/4/95

Figure 8-1. EA's Chronological Test Log

TOXICOLOGY LABORATORY CHRONOLOGICAL TEST LOG

QC Test Number	Test Date	Client	Sample Number	Test Species	Endpt(s)*	Test Duration	# Concs. and Control	Test Article	Dilution Water	Renewal Frequency
TN-										

* Endpoints are G = Growth; R = Reproduction; M = Mortality; B = Bioaccumulation; I = TIE; O = Other

ATS-L18
03/01/00

Figure 8-2. EA's Reference Toxicant Test Log

TOXICOLOGY LABORATORY REFERENCE TOXICANT TEST LOG

QC Test Number	Test Date	Species Lot Number	Test Species	Endpt(s)*	Test Duration	Test Article	Dilution Water	Renewal Frequency
RT-								

* Endpoints are G = Growth; R = Reproduction; M = Mortality; B = Bioaccumulation; I = TIE; O = Other

Figure 8-3. EA's Report Quality Assurance Record

REPORT QUALITY ASSURANCE RECORD

Client: _____ Project Number: _____

Author: _____ EA Report Number: _____

REPORT CHECKLIST

QA/QC ITEM	REVIEWER	DATE
1. Samples collected, transported, and received according to study plan requirements.	_____	_____
2. Samples prepared and processed according to study plan requirements.	_____	_____
3. Data collected using calibrated instruments and equipment.	_____	_____
4. Calculations checked:		
- Hand calculations checked	_____	_____
- Documented and verified statistical procedure used.	_____	_____
5. Data input/statistical analyses complete and correct.	_____	_____
6. Reported results and facts checked against original sources.	_____	_____
7. Data presented in figures and tables correct and in agreement with text.	_____	_____
8. Results reviewed for compliance with study plan requirements.	_____	_____

	AUTHOR	DATE
9. Commentary reviewed and resolved.	_____	_____

10. All study plan and quality assurance/control requirements have been met and the report is approved:

_____	_____
PROJECT MANAGER	DATE
_____	_____
QUALITY CONTROL OFFICER	DATE
_____	_____
SENIOR TECHNICAL REVIEWER	DATE

ATS-Q08
1/25/02

Figure 10-1. Example of EA's Ecotoxicology Laboratory Audit Checklist

AUDIT CHECKLIST - INSTRUMENT CARE, CALIBRATION, AND DOCUMENTATION

QA Officer: _____ Date of Review: _____

QUESTIONS	S, U, NA	COMMENTS
SALINITY METERS		
Calibrated daily (when in use)?		
Check reading acceptable?		
DISSOLVED OXYGEN METERS		
Calibrated at least daily?		
Air checks acceptable?		
Membrane changes documented (as needed)?		
pH METERS		
Calibrated at least daily?		
Fresh standards used with each calibration?		
Check reading acceptable (second source)?		
Are maintenance procedures noted in log book?		
TEMPERATURE METERS		
Calibrated quarterly?		
Labeled with date of calibration and correction factors?		
CONDUCTIVITY METERS		
Calibrated at least daily?		
Fresh standards used with each calibration?		
Check reading acceptable?		
BALANCES		
Are they factory-serviced and calibrated annually?		
Zeroed before each use?		
Calibrated with check weights before each use?		
Is the balance clean?		
Check weights re-certified within last 12 months?		
ION SELECTIVE METER (AMMONIA)		
Calibrated with each use?		
Fresh standards prepared with each use?		
Percent recovery acceptable?		
THERMOMETERS (LIQUID IN GLASS)		
Calibrated annually?		
Labeled with date of calibration and correction factors?		
Temperature records complete in 20°C lab, 25°C lab, chambers, and walk-ins?		
NIST thermometer calibrated annually?		

Figure 10-1. (continued)

AUDIT CHECKLIST - INSTRUMENT CARE, CALIBRATION, AND DOCUMENTATION (page 2)

QUESTIONS	S, U, NA	COMMENTS
GENERAL		
Out of service equipment tagged as out of service?		
Equipment list complete?		
Maintenance of equipment/instrument documented?		
Burettes checked quarterly?		
Micropipettors checked quarterly?		
Light meter re-certified annually?		
Desiccant okay in desiccators?		
Are all reagents/standards labeled with receipt date and date opened and expiration/discard date?		
YCT thaw date recorded?		
Side-by-side tests conducted on each new batch of food?		
Light levels documented quarterly?		
Testing light levels 50 – 100 foot candles?		
Photoperiods documented quarterly?		
Management review of lab quality system conducted within last 12 months?		
Annual taxonomic IDs on file for in-house cultured organisms?		
Ceriodaphnia dubia		
Daphnia magna		
Daphnia pulex		
Pimephales promelas		
Hyalella azteca		
Pseudokirchneriella subcapitata		
Annual taxonomic IDs on file for species from organism vendors?		

TABLES

Table 5-1. Required Containers, Preservation Techniques, and Holding Times for Sediment Samples[a]

Parameter	Volume Required (g)	Container[b]	Preservative	Holding Time
Bioassay and Bioaccumulation Testing				
Whole Sediment (Bioassay and Bioaccumulation)	30 L	P	≤ 4°C/dark	Optimum 14 days, maximum 8 weeks
Water Column	10 L	P	≤ 4°C/dark	Elutriate from sediment prepared within 24 hours of test initiation

(a) From time of sample collection per USEPA 1991, *The Green Book*, and USEPA 1995, *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluation.*

(b) Polyethylene (P) or glass (G).

Table 11-1. Preventive Maintenance Procedures for Ecotoxicology Laboratory Equipment

Instrument	Activity	Frequency
Amperometric Titrator	Fill titrant, visually inspect electrode for wear or damage	Before use
	Rinse electrode with lab water	Before use and after each sample
	Clean electrode surfaces	Periodically, as needed
Autoclave	Fill autoclave with deionized water	Before each use
	Monitor temperature & pressure	Recorded during mid-cycle
	Drain autoclave	After each use
	Check gaskets/seals	Each use
	Clean inside chamber	Bi-annually or annually
Balances	Clean weigh-pan	Before and after each use
	Professionally clean/calibrate/align	Annually
Conductivity Meters	Rinse electrode with DI water	Before and after each use
	Clean contact surfaces	Periodically, as needed
Dechlorinator	Backflush System	Weekly
	Replace Gravel/Charcoal	Annually or Bi-annually
Dissolved Oxygen Meters	Rinse probe with DI water	Before and after each use
	Change membranes	Every two weeks (minimum)
	Clean cathode and/or anode	Periodically, as needed
Environmental Chambers	Set temperature controls	As needed
	Monitor temperature	Recorded daily
	Change temperature recording charts, where applicable	Weekly
	Professionally checked	Annually
Ion Analyzer	Reassemble probe and set operator menu for appropriate analyses	Prior to each use and after power failure
	Check probes for damage or wear, replace filter solution, place probe in pH buffer	Before each use
	Rinse probe and store in standard solution (or disassemble completely for indefinite storage)	After each use
Ovens	Check to ensure set temperature is achieved	Each use
pH Meters	Remove probe from storage solution; check for damage or wear; rinse, blot dry with soft tissue	Daily, before each use
	Rinse probes with DI water	Before and after each use
	Store probes in buffer solution	Continuously when in use
	Add or change probe fluid	Weekly
	Replace battery	Periodically, as needed

Table 11-1. (continued)

Instrument	Activity	Frequency
Refrigeration Units	Maintenance check (coils, etc.)	Bi-annually or as required
	Monitor temperature	Recorded daily
Salinity Meters	Check probe connection, check probe for wear & damage	Daily
	Rinse probe with DI water	Before and after use
	Replace batteries, clean probe	Periodically, as needed
Temperature Recorders	Change recorder charts	Weekly
	Replace battery	Periodically, as needed
	Replace recorder pen	Periodically, as needed
Thermometers/Temperature Meters	Remove electrode from storage solution; check for defects	Before use
	Rinse electrode (probe) with DI water	Before and after use
	Replace battery	Periodically

APPENDIX A

TOXICITY TESTING PROTOCOLS

GUIDELINES FOR PERFORMING WATER COLUMN BIOASSAYS, WHOLE SEDIMENT BIOASSAYS, AND WHOLE SEDIMENT BIOACCUMULATION STUDIES WITH DREDGED MATERIAL

1. OVERVIEW

Water column bioassays, whole sediment bioassays, and whole sediment bioaccumulation studies are required for evaluation of dredged material proposed for disposal in ocean waters. These evaluations are required in response to Section 103 of PL 95-532 (Marine Protection, Research, and Sanctuaries Act of 1972) and must follow guidelines established jointly by the Environmental Protection Agency and the Corps of Engineers (COE).

The methods presented generally follow those given in "Evaluation of Dredged Material Proposed for Ocean Disposal-Testing Manual," compiled by the U.S. Environmental Protection Agency and U.S. Army Corps of Engineers (1991), Regional Implementation Manual, Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern Atlantic and Gulf Coastal Waters (USACESAD/EPA Region IV 1993) and Regional Implementation Manual, Guidance for Performing Tests on Dredged Material Proposed for Ocean Disposal (ACENYD/EPA Region II 1992). The methodology used for dredged material evaluations can be amended to conform with any state, regional or project specific guidance, to meet project needs.

2. DREDGED MATERIAL COLLECTION AND PRESERVATION

2.1 Sampling Stations

Sediment and water samples to be collected from designated sampling stations within the dredging area are defined in advance by the COE District. Reference and control sediments are collected at locations specified by the District or US EPA Region.

2.2 Maximum Holding Time

The optimal holding time for dredged material is 14 days from collection. The maximum holding time as allowable in US EPA guidance is six weeks from collection.

2.3 Water Sample Collection

1. Special care must be taken to avoid introducing contaminants from the sampling devices and containers. Prior to use, the sampling devices and containers are cleaned thoroughly with a detergent solution, rinsed with tap water, soaked in

10 percent hydrochloric acid (HCl) for 4 hours, then thoroughly rinsed with de-ionized water.

2. A dredge or reference site water sample is obtained by collecting one-third of the sample volume directly below the water surface, one-third from mid-depth in the water column, and one-third from approximately 1 m above the sediment surface.

3. Dredging site water samples are collected at the time of dredged material collection.

4. Water samples for metals determination and nutrient analysis are placed in acid-rinsed linear polyethylene bottles, while those for pesticides analysis are placed in solvent-rinsed glass bottles with teflon-lined, screw-type lids.

5. The samples are stored at 0-4°C and never frozen.

2.4 Dredged Material Sample Collection for Bioassays and Bioaccumulation Studies

1. Sediment samples are taken with a corer or grab sampler at designated stations. The larger the proposed dredging site, generally the more samples are required for characterization.

2. Samples are stored on ice or in refrigerated storage at 0-4°C. All sample containers must be completely full and void of any air bubbles.

3. The samples must never be frozen or dried.

3. PREPARATION OF TEST MATERIALS FOR BIOASSAYS AND BIOACCUMULATION STUDIES

3.1 Water Column Bioassays

For preparation of the elutriate for bioassay testing, the following procedures are used:

1. Subsample enough homogenized dredged material to make a volumetric sediment-to-water ratio of 1:4 using unfiltered disposal or dredge site water. Volumetric measurements of the sediment are made in a graduated cylinder or Erlenmeyer flask and the contents added to an aquarium. The mixing is performed at room temperature (20±2°C).

2. Insert an air-diffuser tube near the bottom of the aquarium. Aerate the slurry vigorously for 30 minutes. In addition, stir the flasks manually at 10-minute intervals to ensure complete mixing.

3. After mixing with air, allow the suspension to settle for 1 hour.

4. The resulting liquid and material remaining in suspension after the 1-hour settling period is the suspended particulate phase or elutriate. Decant or siphon the elutriate and discard the settled material.

5. The elutriate may be centrifuged if turbidity will interfere with organism observations.

6. The water column bioassay is initiated within 24 hours of elutriate preparation.

3.2 Whole Sediment and Bioaccumulation Studies

For preparing sediment samples for whole sediment bioassay and bioaccumulation studies, the following procedures are used:

1. Remove any live organisms by sieving the sediment through a 1.0-mm screen.

2. Combine and thoroughly mix the reference sediment samples. Combine and thoroughly mix the test sediment samples. Combine and thoroughly mix the control sediment sample.

3. Place sediment into test chamber.

4. Sediment can be used immediately or stored (at 4°C in an air-tight container) until needed.

5. Ammonia in whole sediment toxicity tests is evaluated and controlled according to current US EPA/Corps of Engineers guidance.

4. CALIBRATION

Refer to Section 10 of EA SOP Manual (EA 2013).

5. PHYSICAL AND CHEMICAL TEST CONDITIONS

5.1 Temperature

Test temperatures should be held stable (±1°C) for all testing. Selection of test temperature should be appropriate to the test species.

5.2 Salinity

The salinity in all test vessels is maintained at a salinity appropriate to the test species (±10%) for the duration of the test.

5.3 Dissolved Oxygen

Dissolved oxygen must not fall below 40 percent saturation for warm water species and 60 percent saturation for cold water species.

5.4 Aeration

Aeration should not exceed 100 bubbles of air per minute unless required to maintain dissolved oxygen above 40 percent saturation (60 percent saturation for cold water species). To avoid undue loss of volatile toxicants, diffuser stones are not used in test chambers. Instead, glass tubing (3-mm ID) is used to deliver air to test chambers.

5.5 Recording Frequency

Temperature, salinity, dissolved oxygen, and pH in the test chambers are measured and recorded initially, at test termination, and at 24-hour intervals throughout the test. For the bioaccumulation testing, water quality measurements are recorded at a minimum of three times per week, before overlying waters are renewed.

5.6 Light Duration

Lighting is automatically regulated to provide 16 hours of light and 8 hours of dark every 24 hours, or 24 hours of light, depending on the specific test organism protocol.

6. TEST ORGANISMS

6.1 Organism Handling and Acclimation

Organisms for testing are obtained from a biological supplier or from EA's culture facility (Hunt Valley, Maryland). All organisms to be used in toxicity testing are gradually acclimated to testing conditions. Selection of test species is dependent on test type and purpose.

6.2 Holding

Organisms obtained from biological suppliers are usually held in the laboratory at least 24 hours before use in testing. This holding period allows acclimation to the test temperature and artificial seawater and provides an opportunity to assess the general health of the test populations. Organisms are fed regularly during holding.

6.3 Feeding

For water column testing, fish species are not fed, but *A. bahia* may be fed during testing. Test organisms in the whole sediment and bioaccumulation tests may be fed if appropriate. For the whole sediment and bioaccumulation studies, organisms may be fed on a daily basis at a rate of approximately 1 percent of the total wet weight of all animals in each tank.

6.4 Size

Every attempt is made to test animals of approximately equal size.

6.5 Organism Transfer

Organisms are randomly assigned to the test chambers.

7. GUIDELINES FOR CONDUCTING WATER COLUMN BIOASSAYS

7.1 Test Organisms

Water column bioassays are performed with appropriately sensitive marine organisms. These species will be stipulated to accomplish project-specific objectives.

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7.2 Glassware Cleaning

Glassware used in the tests is cleaned according to the general bioassay laboratory procedures of cleaning test containers and equipment as recommended by US EPA.

7.3 Test Concentration Series

The test organisms are exposed to 100, 50, and 10 percent elutriate with a dilution water control of synthetic seawater. A 1 percent elutriate concentration and a site water control may also be added. Synthetic seawater is prepared by adding dry artificial sea salts (Crystal Sea Bioassay Grade) to laboratory water to the desired salinity.

7.4 Replicates

Five replicates per test concentration and control are typically employed for the water column bioassays. The number of replicates may vary depending on the project study plan.

7.5 Test Chamber/Test Volume

The type of test container and the volumes in the test container are based upon study plan specifications and the species selected for testing.

7.6 Observations and Duration of the Tests

Recommended test duration for the water column bioassays is 48 hours for zooplankton and 96 hours for other organisms. Observations of mortality and water quality measurements are recorded daily at 24-hour intervals.

7.7 Data Recording

Each set of data recorded must be initialed by the person making that entry. The following items are recorded on the laboratory bench sheet:

- Date/time
- Test organism
- Test concentration
- Replicate number
- Temperature (°C)
- Salinity (ppt)

- Dissolved oxygen (mg/L)
- pH
- Number of live test organisms
- Species lot number
- QC test number

7.8 Data Presentation

Survival data for each time period, concentration, and replicate are presented in tabular form.

7.9 Statistical Analyses

Median lethal concentrations (LC50) with 95 percent confidence limits are determined using appropriate statistical procedures (e.g., binomial, moving average, and probit analyses).

8. GUIDELINES FOR CONDUCTING WHOLE-SEDIMENT BIOASSAYS

8.1 Test Organisms

Whole-sediment bioassays are conducted with appropriately sensitive benthic marine organisms. These species will be stipulated to accomplish project-specific objectives.

8.2 Glassware Cleaning

Glassware used in the tests is cleaned according to the general bioassay laboratory procedures for cleaning test containers and equipment as recommended by US EPA.

8.3 Replicates

Five replicates per test treatment and control are typically employed for the whole sediment bioassays. The number of replicates may vary depending on the project study plan.

8.4 Overlying Water

Overlying water for testing is synthetic seawater made by adding Crystal Sea Bioassay Grade sea salts to dechlorinated laboratory water. The source of the dechlorinated tap water is the City of Baltimore municipal water system. Upon entry to the laboratory, the water passes through a high-capacity, activated carbon filtration system to remove chlorine and possible organic contaminants. This water source has proven safe for aquatic organism toxicity testing at EA, as evidenced by maintenance of multigeneration *Hyalella azteca*. and fathead minnow cultures with

no evident loss of fecundity. Batches of synthetic seawater are mixed at least 24 hours prior to use in testing.

8.5 Test Procedures

The day before test initiation, an even layer of homogenized sediment is added to each test chamber. Artificial seawater is added to each chamber, and the test chambers are allowed to settle overnight. The test organisms are then randomly distributed to all of the test chambers. The introduction of the test organisms marks the initiation of the test.

The overlying water may be renewed during the exposure period by siphoning the water from the chamber to a level approximately 2 cm above the sediment surface. Artificial seawater is slowly introduced to each chamber so as not to disturb the sediment surface unnecessarily. Pouring water alongside a glass or plastic plate fitted to the tank dimensions reduces turbulence in the test chamber.

8.6 Observations and Duration of the Tests

Whole sediment bioassays are generally conducted for 10 days for most test species. Observations of obvious mortalities and unusual behavior patterns along with water quality measurements are recorded daily.

8.7 Organism Recovery

At the end of the testing period, organisms are carefully recovered by siphoning the overlying water from the test tanks, then gently hand-combing sediment to remove large test organisms (e.g. clams and polychaetes). Smaller organisms are recovered by sieving sediments through a screen of appropriate mesh size. Organisms should be considered alive if they show any response to gentle probing. Sublethal effects such as partial paralysis, inability to burrow, or inability to excavate burrows are also recorded. Specimens not recovered are considered dead. The number of live organisms at the end of the test is recorded on the laboratory bench sheet.

8.8 Data Recording

Each set of data recorded must be initialed by the person making that entry. The following items are recorded on data sheet for whole-sediment bioassays.

- Date/time
- Test organism
- Treatment—reference, control or test site

- Replicate number
- Temperature (°C)
- Salinity (ppt)
- Dissolved oxygen (mg/L)
- pH
- Number of any dead test organisms observed daily
- Species lot number
- QC test number

8.9 Data Presentation

The data are summarized in tables which include the scientific names of the test species, the number of organisms tested, and the percentage of animals recovered alive from each test chamber.

8.10 Statistical Analysis

The hypothesis is tested that responses observed for organisms exposed to test sediments are not statistically different from the responses observed for organisms exposed to reference or control sediments. Specific methods for calculating significant differences are presented in the 1991 EPA/COE Testing Manual.

9. GUIDELINES FOR CONDUCTING WHOLE-SEDIMENT BIOACCUMULATION STUDIES

9.1 Test Organisms

Consideration must be given to the size and number of test organisms tested. There must be enough tissue in the resulting sample for the chemical analyses to be performed. Relatively immobile species that are fairly large, such as bivalves or large polychaetes, usually are the most desirable organisms for bioaccumulation testing.

9.2 Glassware Cleaning

Glassware used in the tests is cleaned according to the general bioassay laboratory procedures for cleaning test containers and equipment as recommended by US EPA.

9.3 Replicates

Five replicates per test treatment and control are typically employed for the whole sediment bioaccumulation studies. The number of replicates may vary depending on the project study plan.

9.4 Overlying Water

Overlying water for testing is synthetic seawater made by adding Crystal Sea Bioassay Grade sea salts to dechlorinated laboratory water. The source of the dechlorinated tap water is the City of Baltimore municipal water system. Upon entry to the laboratory, the water passes through a high-capacity, activated carbon filtration system to remove chlorine and possible organic contaminants. This water source has proven safe for aquatic organism toxicity testing at EA, as evidenced by maintenance of multigeneration *Hyalella azteca* and fathead minnow cultures with no evident loss of fecundity. Batches of synthetic seawater are mixed at least 24 hours prior to use in testing.

9.5 Test Procedure

The day before test initiation, an even layer of homogenized sediment is added to each test chamber. Artificial seawater is added to each chamber, and the test chambers are allowed to settle overnight. The test organisms are then randomly distributed to all of the test chambers. The introduction of the test organisms marks the initiation of the test.

The overlying water may be renewed during the exposure period by siphoning the water from the chamber to a level approximately 2 cm above the sediment surface. Artificial seawater is slowly introduced to each chamber so as not to disturb the sediment surface unnecessarily. Pouring water along the side of the glass tank reduces turbulence in the tank.

9.6 Observations and Duration of the Tests

Organisms are tested for either 10 or 28 days, depending on the classes of chemicals (i.e., metals, organics) that must be analyzed in tissue samples. Test chambers are observed daily, and obvious mortalities and unusual behavior patterns are recorded. Water quality measurements are recorded at a minimum of three times per week, prior to renewal of overlying water.

9.7 Organism Recovery

At the end of the testing period, organisms are carefully recovered by siphoning the overlying water from the test tanks, then gently hand-combing sediment to remove large test organisms

(e.g. clams and polychaetes). Smaller organisms are recovered by sieving sediments through a screen of appropriate mesh size. Organisms should be considered alive if they show any response to gentle probing. Sublethal effects such as partial paralysis, inability to burrow, or inability to excavate burrows are also recorded. Specimens not recovered are considered dead. The number of live organisms at the end of the test is recorded on the laboratory bench sheet.

The live organisms are transferred to clean saltwater holding tanks with no sediment to purge their digestive tracts at least 24-hours. The organisms are not fed during the depuration period. Organisms that die during the depuration period are removed and discarded. At the end of the depuration period, the organisms are collected and prepared for chemical analyses.

9.8 Data Presentation

The data are summarized in tables which include the scientific names of the test species, the number of organisms tested, and the percentage of animals recovered alive from each test chamber.

9.9 Statistical Analysis

The hypothesis is tested that chemical concentrations analyzed in organisms exposed to test sediments are not statistically different from chemical concentrations analyzed in organisms exposed to reference sediments. Specific statistical procedures are given in the 1991 EPA/COE Testing Manual.

10. QUALITY ASSURANCE

The following is a brief synopsis of the quality assurance program followed by EA's Ecotoxicology Laboratory. A more detailed overview of EA’s QA Program can be found in the laboratory QA manual (EA 2013 or most recent version).

10.1 Quality Assurance Program Applicability

Amendments to the authorized protocol established by EA or by the client will only be made after proper authorization. Such authorization is achieved by completion of the Amendment to Protocol Form by EA after consultation with the client.

10.2 Reference Toxicant Testing

Reference (standard) toxicant tests are performed on each acquired lot of organisms (or monthly on in-house organism cultures) used in the water column bioassays and whole sediment studies

to evaluate the sensitivity and general health of the organisms. An appropriate reference toxicant (e.g., potassium chloride, copper chloride, cadmium chloride, or sodium dodecyl sulfate) is used for each test species. Reference toxicant tests conducted by the organism vendor may also be used. Modifications to the reference toxicant testing methods can be implemented to comply with the specific requirements set forth by the COE and the EPA.

The results of each test are compared with historical, species-specific toxicological information from reference toxicant tests performed at EA, or performed by the organism vendor, to determine if the results are within acceptable limits. Limits are established using the control charts outlined in US EPA (2002).

10.3 Quality Assurance Evaluation

Studies conducted under this protocol are subject to internal audit by EA's Quality Assurance Unit. A quality assurance officer is responsible for monitoring each study to assure the client that the facilities, equipment, personnel, methods, practices, records, and controls are in conformance with EA's QA program.

10.4 Inspection By Regulatory Authorities

In the event of an inspection of EA by an outside authority during the course of the study, the client will be consulted before inspectors are permitted access to any of the project records or the experimental areas.

10.5 Corrective Action

Corrective action is initiated when a quality control measure is determined to be outside of a predetermined acceptance range. Corrective action may result from internal or external activities. Procedures for handling out-of-control data are detailed in Section 11 of the laboratory Quality Assurance and Standard Operating Procedures Manual.

10.6 Archives

Copies of project-specific records shall be transferred to the client promptly after the project is completed or as negotiated and budgeted with each client. Original primary data will be retained at EA for 5 years. Primary data include laboratory data sheets, records, memoranda, notes, photographs, microfilm, and computer printouts that are a result of the original observations and activities of the study and which are necessary for the reconstruction and evaluation of the report of the study.

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10.7 Location

This study is conducted by the Ecotoxicology Laboratory, EA Engineering, Science, and Technology in Hunt Valley, Maryland.

11. HEALTH AND SAFETY

11.1 Safety

All laboratory staff members are required to read EA's laboratory safety manual (EA 2012 or most recent version) prior to working in the laboratory. The safety manual includes general safety rules to be followed in the laboratory, procedures for cleaning up spills and reporting accidents, the location and use of safety equipment, and the safe handling and storage of chemicals. A copy of the safety manual is located in the testing laboratory.

11.2 Pollution Prevention and Waste Management

Wastes generated by the laboratory during toxicity testing must be properly handled and disposed of in accordance with the laboratory safety manual and applicable local, state, and federal regulations. Procedures for water disposal is detailed in the Laboratory Quality Assurance and Standard Operating Procedures Manual.

12. REFERENCES

EA. 2012 (or most recent version). Chemical Hygiene Plan for the EA Ecotoxicology and Biology Laboratories. EA Manual ATB-CHP. Internal document prepared by EA's Ecotoxicology Laboratory, EA Engineering, Science, and Technology, Inc., Hunt Valley, Maryland.

EA. 2013 (or most recent version). EA Ecotoxicology Laboratory Quality Assurance and Standard Operating Procedures Manual. EA Manual ATS-102. Internal document prepared by EA's Ecotoxicology Laboratory, EA Engineering, Science, and Technology, Inc., Hunt Valley, Maryland.

US EPA. 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. Fifth Edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

US EPA and US Army COE. 1991. Evaluation of Dredged Material Proposed for Ocean Disposal - Testing Manual. EPA/503/8-91/001. U.S. Environmental Protection Agency, Office of Marine and Estuarine Protection, Washington, D.C. and Department of the Army, U.S. Army Corps of Engineers, Washington, D.C.

US EPA and US Army COE. 1993. Regional Implementation Manual - Requirements and Procedures for Evaluation of the Ocean Disposal of Dredged Material in Southeastern Atlantic and Gulf Coastal Waters. U.S. Environmental Protection Agency, Region IV and Department of the Army, U.S. Army Corps of Engineers, Mobile District, South Atlantic Division.

US EPA and US Army COE. 1992. Regional Implementation Manual - Guidance for Performing Tests on Dredged Material Proposed for Ocean Disposal. U.S. Environmental Protection Agency, Region II and Department of the Army, U.S. Army Corps of Engineers, New York District.

USEPA-Region 3. Mid-Atlantic Regional Implementation Manual: Dredged Material Evaluation for Norfolk and Dam Neck Ocean Disposal Sites.

SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE BLUE MUSSEL (*Mytilus* sp.) EMBRYO DEVELOPMENT ACUTE TOXICITY WATER COLUMN TEST

1.	Test type:	Static, non-renewal
2.	Test duration:	48 hours
3.	Temperature:	16 ±1°C
4.	Salinity:	30 (± 10%) ppt
5.	Light quality:	Ambient laboratory illumination
6.	Light intensity:	50-100 ft-c
7.	Photoperiod:	16 hours light/8 hours darkness
8.	Test chamber size:	30-ml scintillation vial
9.	Test volume:	10 ml
10.	Renewal of test solutions:	None
11.	Age of test organisms:	<1 hour embryos
12.	No. of organisms per test chamber:	250
13.	No. of replicates per treatment:	4
14.	No. of organisms per treatment:	1,000
15.	Feeding:	None
16.	Test chamber cleaning:	None
17.	Test solution aeration:	None
18.	Dilution water:	Artificial seawater or uncontaminated 1 µm filtered natural seawater
19.	Test concentrations:	100%, 50%, 10% elutriate and control
20.	Endpoint:	Normal embryo development
21.	Test acceptability:	≥70 percent normal development in control

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SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE OPOSSUM SHRIMP (*Americamysis bahia*) ACUTE TOXICITY WATER COLUMN TEST

1.	Test type:	Static, non-renewal
2.	Test duration:	96 hours
3.	Temperature:	20 ±1ºC
4.	Salinity:	30 (± 10%) ppt
5.	Light quality:	Ambient laboratory illumination
6.	Light intensity:	50-100 ft-c
7.	Photoperiod:	16 hours light/8 hours darkness
8.	Test chamber size:	1-L beaker
9.	Test volume:	200 ml
10.	Renewal of test solutions:	None
11.	Age of test organisms:	1-5 days, ± 24 hours
12.	No. of organisms per test chamber:	10
13.	No. of replicates per treatment:	5
14.	No. of organisms per treatment:	50
15.	Feeding:	*Artemia* nauplii daily
16.	Test chamber cleaning:	None
17.	Test solution aeration:	None unless DO concentrations fall below 40% saturation (<100 bubbles/min)
18.	Dilution water:	Artificial seawater or uncontaminated natural seawater
19.	Test concentrations:	100%, 50%, 10% elutriate and control
20.	Endpoint:	Survival
21.	Test acceptability:	≥ 90% survival in control

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SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE INLAND SILVERSIDE (*Menidia beryllina*) ACUTE TOXICITY WATER COLUMN TEST

1.	Test type:	Static, non-renewal
2.	Test duration:	96 hours
3.	Temperature:	20 ±1°C
4.	Salinity:	30 (±10%) ppt
5.	Light quality:	Ambient laboratory illumination
6.	Light intensity:	50-100 ft-c
7.	Photoperiod:	16 hours light/8 hours darkness
8.	Test chamber size:	1-L beaker
9.	Test volume:	200 ml
10.	Renewal of test solutions:	None
11.	Age of test organisms:	9-14 days, ± 24 hours
12.	No. of organisms per test chamber:	10
13.	No. of replicates per treatment:	5
14.	No. of organisms per treatment:	50
15.	Feeding:	*Artemia* nauplii at 48 hours
16.	Test chamber cleaning:	None
17.	Test solution aeration:	None unless DO concentrations fall below 40% saturation (<100 bubbles/min)
18.	Dilution water:	Artificial seawater or uncontaminated natural seawater
19.	Test concentrations:	100%, 50%, 10% elutriate and control
20.	Endpoint:	Survival
21.	Test acceptability:	≥90% survival in control

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SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE POLYCHAETE (*Americamysis bahia)* ACUTE TOXICITY WHOLE SEDIMENT TEST

1.	Test type:	Static, non-renewal
2.	Test duration:	10-days
3.	Temperature:	20 ±1°C
4.	Salinity:	30 (± 10%) ppt
5.	Light quality:	Ambient laboratory illumination
6.	Light intensity:	50-100 ft-c
7.	Photoperiod:	16 hours light/8 hours darkness
8.	Test chamber size:	1-L beaker
9.	Test volume:	175 ml sediment, 700 ml overlying water
10.	Renewal of test solutions:	None
11.	Age of test organisms:	1-5 days, ± 24 hours
12.	No. of organisms per test chamber:	10
13.	No. of replicates per treatment:	5
14.	No. of organisms per treatment:	50
15.	Feeding:	*Artemia* nauplii daily
16.	Test chamber cleaning:	None
17.	Test solution aeration:	Gentle aeration through a 1-ml glass pipet, placed no closer than 2 cm above the sediment surface.
18.	Dilution water:	Artificial seawater or uncontaminated natural seawater
19.	Test concentrations:	None (whole sediment and control)
20.	Endpoint:	Survival
21.	Test acceptability:	≥90% survival in control

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SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE AMPHIPOD (*Ampelisca abdita*) ACUTE TOXICITY WHOLE SEDIMENT TEST

1.	Test type:	Static, non-renewal
2.	Test duration:	10 days
3.	Temperature:	20 ±1°C
4.	Salinity:	30 (± 10%) ppt
5.	Light quality:	Ambient laboratory illumination
6.	Light intensity:	50-100 ft-c
7.	Photoperiod:	24-hour light
8.	Test chamber size:	1 L beaker
9.	Test volume:	175 ml sediment, 700 ml overlying water
10.	Renewal of test solutions:	None
11.	Age of test organisms:	3-5 mm
12.	No. of organisms per test chamber:	20
13.	No. of replicates per treatment:	5
14.	No. of organisms per treatment:	100
15.	Feeding:	None
16.	Test chamber cleaning:	None
17.	Test solution aeration:	Gentle aeration through a 1-ml glass pipet, placed no closer than 2 cm above the sediment surface.
18.	Overlying water:	Artificial seawater or uncontaminated natural seawater
19.	Test concentrations:	None (whole sediment and control)
20.	Endpoint:	Survival

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1.	Test type:	Static, non-renewal
21.	Test acceptability:	≥90% survival in control

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SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE AMPHIPOD (*Leptocheirus plumulosus*) ACUTE TOXICITY WHOLE SEDIMENT TEST

1.	Test type:	Static, non-renewal
2.	Test duration:	10 days
3.	Temperature:	20 ±1°C
4.	Salinity:	20 (±10%) ppt
5.	Light quality:	Ambient laboratory illumination
6.	Light intensity:	50-100 ft-c
7.	Photoperiod:	16 hours light, 8 hours darkness
8.	Test chamber size:	1 L beaker
9.	Test volume:	175 ml sediment, 700 ml overlying water
10.	Renewal of test solutions:	None
11.	Age of test organisms:	2-3 mm
12.	No. of organisms per test chamber:	20
13.	No. of replicates per treatment:	5
14.	No. of organisms per treatment:	100
15.	Feeding:	None
16.	Test chamber cleaning:	None
17.	Test solution aeration:	None unless DO concentrations fall below 40% saturation (<100 bubbles/min)
18.	Overlying water:	Artificial seawater
19.	Test concentrations:	None (whole sediment and control)
20.	Endpoint:	Survival
21.	Test acceptability:	≥90% survival in control

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SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE BIVALVE (*Macoma nasuta*) WHOLE SEDIMENT BIOACCUMULATION TEST

1.	Test type:	Static, renewal
2.	Test duration:	28 days
3.	Temperature:	15 ±1°C
4.	Salinity:	30 (±10%) ppt
5.	Light quality:	Ambient laboratory illumination
6.	Light intensity:	50-100 ft-c
7.	Photoperiod:	16 hours light/8 hours darkness
8.	Test chamber size:	10-gallon aquarium
9.	Test volume:	4 L sediment, 23 L overlying water
10.	Renewal of test solutions:	3 times a week
11.	Age of test organisms:	Adults of same year class
12.	No. of organisms per test chamber:	20, minimum
13.	No. of replicates per treatment:	5
14.	No. of organisms per treatment:	100, minimum
15.	Feeding:	Finely ground Tetramin flake food (or equivalent) at a rate of 1% wet organism weight daily
16.	Test chamber cleaning:	None
17.	Test solution aeration:	<100 bubbles/minute
18.	Overlying water:	Artificial seawater
19.	Test concentrations:	None (whole sediment and control)
20.	Endpoint:	Survival and bioaccumulation
21.	Test acceptability:	≥90% survival in control

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SUMMARY OF TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE SAND WORM (*Nereis virens*) WHOLE SEDIMENT BIOACCUMULATION TEST

1.	Test type:	Static, renewal
2.	Test duration:	28 days
3.	Temperature:	20 ±1°C
4.	Salinity:	30 (±10%) ppt
5.	Light quality:	Ambient laboratory illumination
6.	Light intensity:	50-100 ft-c
7.	Photoperiod:	16 hours light/8 hours darkness
8.	Test chamber size:	10-gallon aquarium
9.	Test volume:	4 L sediment, 23 L overlying water
10.	Renewal of test solutions:	3 times a week
11.	Age of test organisms:	adults of the same year class
12.	No. of organisms per test chamber:	20, minimum
13.	No. of replicates per treatment:	5
14.	No. of organisms per treatment:	100, minimum
15.	Feeding:	Finely ground Tetramin flake food (or equivalent) at a rate of 1% wet organism rate daily
16.	Test chamber cleaning:	None
17.	Test solution aeration:	<100 bubbles/minute
18.	Overlying water:	Artificial seawater
19.	Test concentrations:	None (whole sediment and control)
20.	Endpoint:	Survival and bioaccumulation
21.	Test acceptability:	≥90% survival in control

EA Engineering, Science,
and Technology, Inc.
Protocol Revision 3
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LARVAL DEVELOPMENT TEST WITH MUSSEL OR OYSTER

1. TEST OBJECTIVE

Definitive Assay - To assess the toxicity of a test material to the mussel (*Mytilus* sp.) or oyster (*Crassostrea* sp.) and determine the LC50 and/or EC50 using mortality and/or normal larval development, respectively, as the test endpoints.

Screening Assay - To assess the toxicity of a test material to the mussel (*Mytilus* sp.) or oyster (*Crassostrea* sp.) at a single test concentration (e.g., 100 percent effluent or Instream Waste Concentration).

1.1 Detection Limits

Detection limits of the toxicity of a sediment or chemical are organism dependent.

1.2 Definitions

Refer to Appendix A of EA SOP Manual (EA 2013).

2. INTERFERENCES

Improperly cleaned glassware and sampling equipment can add toxicity to sediment. Improper sample collection, handling and storage also can affect the bioavailability of contaminants in sediment. Sediment grain size and texture may influence the response of test organisms. Test temperature and the addition of water or solvents to the test chambers may alter bioavailability of toxicants. Other naturally occurring chemical characteristics such as ammonia and sulfide can modify organism response.

3. TEST EQUIPMENT

3.1 Environmental chamber capable of maintaining target test temperature, lighting and photoperiod.
3.2 Glassware (graduated cylinders, volumetric flasks, pipettes, Erlenmeyer flasks)
3.3 Meters capable of measuring temperature, pH, dissolved oxygen and salinity
3.4 Oil free air supply to aerate overlying water
3.5 Siphon bulb
3.6 Thermometers, glass or electronic, laboratory grade for measuring water temperatures.
3.7 Oil free air supply to aerate samples with supersaturated dissolved oxygen levels.
3.8 Compound microscope
3.9 Coulter Counter or counting chamber or hemacytometer
3.10 Dissecting Microscope

4. CALIBRATION

Refer to Section 10 of EA SOP Manual (EA 2013).

5. TEST ARTICLE

5.1 Description/Identification

Unless otherwise specified, the test article is supplied by the client. Adequate chemical specifications with special reference to hazardous properties and storage conditions are also supplied by the client.

5.2 Methods of Synthesis

In most cases, the test article is an effluent sample. Information on the methods of synthesis, stability, and composition or other characteristics which define the test article are on file with the client.

6. EXPERIMENTAL DESIGN

6.1 Test Organisms

6.1.1 Species

The test species is the mussel (*Mytilus* sp.) or oyster (*Crassostrea* sp.), as specified in the project study plan and in the final toxicity test report. Gametes are collected and combined, and the resulting fertilized eggs are used in testing.

61.2 Source

The mussels or oysters are obtained from a scientific organism vendor or field collected using techniques specified in the report.

6.1.3 Holding Conditions

Upon receipt at EA's Culture Facility, the adult mussels or oysters are unpacked and examined. Any dead organisms or those shells that remain open when touched are removed and recorded on appropriate log sheets as part of the laboratory quality control program. In addition, any organisms which have spawned during shipment are removed and not used in testing.

Organisms may be transferred to holding tanks that contain salinity-adjusted dechlorinated tap water, synthetic seawater, natural seawater, or other appropriate receiving water at 20ºC for oysters and 12-15ºC for mussels. Prior to being placed into the holding tank, the shells should be

gently scraped to remove barnacles, and rinsed with seawater to remove any gamete contamination from other organisms. Organisms should remain in holding tanks for a minimum of 30 minutes to allow time for them to resume pumping.

6.2 Dilution Water

Natural seawater can be used as dilution water, but must be filtered through a 0.45 µm filter prior to use in testing. Salinity-adjusted dechlorinated tap water, other artificial seawater, or appropriate dilution water may also be used depending on study requirements. The source of the dechlorinated tap water is the City of Baltimore municipal water supply. Upon entry to the laboratory, the tap water passes through a high-capacity, activated carbon filtration system to remove chlorine and possible organic contaminants. This water source has proven safe for aquatic organism toxicity testing at EA, as evidenced by maintenance of multigeneration *Hyalella azteca* and fathead minnow cultures with no evident loss of fecundity.

6.3 Test Concentration Series

The test concentration series consists of a minimum of three dilutions (e.g., 10, 50, and 100 percent elutriate plus a control) and may be determined from a prior screening of the test material. Rangefinding assays utilize more widely spaced test concentrations and a control. Ambient water or effluent samples may also be evaluated as single concentrations and compared to a control.

6.4 Test Concentration Preparation

Test concentrations are prepared using appropriately sized pipets, graduated cylinders, and/or volumetric flasks. Any undissolved materials in the sample are uniformly dispersed by gentle agitation before being added to test containers. A gentle swirl with a glass rod is usually sufficient for mixing.

6.5 Test Vessels and Test Volume

Test vessels are 30-ml scintillation vials equipped with screw caps, with 10-ml test volumes per vial.

6.6 Test Organism Number

Tests are conducted using a minimum of four replicates per concentration and control. More replicates can be added, if appropriate. The target embryo concentration in each replicate is 15 to 30 embryos/ml.

The test should also include a minimum of 10 additional control replicates. Five of the additional control replicates will be counted at test initiation to determine the average initial

embryo density used in the calculation of mortality results. The additional control replicates will be examined at the end of the 48-hour incubation period to determine the appropriate time of test termination based on completeness of development of control organisms.

6.7 Test Environment

The test vessels are maintained in an environmentally controlled laboratory at 16±1°C for mussels, and 20±1°C or 25±1°C ° for oysters (depending on the species), with a 16-hour light, 8-hour dark photoperiod. Temperature in the environmental room is monitored continuously using temperature recorders. At test initiation, the test vessels are capped and randomly placed in an environmental chamber for the duration of the test, or partially immersed in a temperature-controlled water bath. Surrogate vessels (one per test concentration) of test solution are also placed in the environmental chamber or water bath and are reserved for routine water quality analyses.

6.8 Analysis of Test Concentrations for Test Articles

If required, test solution replicates may be analyzed for verification of chemical concentrations. The analytical method and number of analyses are determined after consultation with the client. When chemical analyses are necessary, both nominal and actual measured test solution concentrations are reported.

6.9 Test Organism Preparation and Test Initiation

The adult mussels or oysters are induced to spawn by cycling the temperature several times, as required, through the range of 12-20ºC for mussels, and 20-32ºC for oysters. Mussels and oysters may be removed from the holding tanks and placed in individual containers containing seawater at 20ºC for mussels, or 32ºC for oysters. Organisms that do not spawn within 30 minutes can be returned to the holding temperature, and the procedure repeated as necessary.

Mussels can also be induced to spawn by injection of 0.5 M KCl into the posterior adductor muscle.

Using a compound microscope, gametes from each adult are examined by placing a small amount of eggs or sperm onto a well slide. Sperm should have high motility, and no more than 10 percent of the eggs should show signs of abnormality. After the sperm and eggs are combined, the gamete suspension is examined for fertilization. The suspension must have at least 90 percent fertilization to be acceptable for use in testing. An aliquot of the fertilized egg suspension is delivered to each replicate test chamber to achieve a concentration of 15-30 embryos/ml. The initial embryo density is determined at test initiation using the extra control replicates designated for initial embryo counts.

6.10 Test Observations

Each elutriate sample is analyzed for temperature, pH, dissolved oxygen, conductivity (or salinity). Samples of effluent and receiving water are also analyzed for alkalinity, hardness and total residual chlorine, and may be gently aerated prior to test initiation, if dissolved oxygen is less than 4 mg/L or greater than 100 percent saturation. Water quality measurements (dissolved oxygen, pH, temperature, and salinity) are recorded at test initiation, termination, and the intermediate observation periods on the surrogate vessel reserved for water quality analyses for each concentration. Analytical determinations are conducted according to APHA et al. (2012) and US EPA (1979).

After test initiation, developing embryos are not monitored until test termination. After 48 hours of exposure, one of the remaining extra control replicates is preserved with 0.25 ml of concentrated formalin (37% formaldehyde) and microscopically examined to check for complete shell development of control organisms (prodissoconch or D-hinge stage). If development is complete, the test is terminated at this time. If development is not complete, the test is continued until complete development occurs, but not beyond 54 hours total test duration. The remaining extra control replicates are used to monitor embryo development. The test is terminated by the addition of 0.25 ml of formalin per test chamber.

Preserved embryos are examined under a microscope to determine the proportion of normally and abnormally developed embryos. Depending on the study requirements, mortality counts may be performed.

6.11 Data Analysis

The LC50 and/or EC50 values and associated statistics are calculated using the probit, Spearman-Karber, Trimmed Spearman-Karber, and graphical methods as described by US EPA (2002). Depending on the nature of the data, other methods may be used. The methods used are specified in the final report. For single concentration tests, the treatments are compared against the control using the t-test or other hypothesis testing statistics.

6.12 Test Acceptability

A test is considered acceptable if control survival is at least 70 percent. In addition, at least 90 percent of the surviving control organisms should have normal shell development. An individual test may be conditionally acceptable if temperature, dissolved oxygen, and other specified conditions fall outside specifications, depending on the degree of the departure and the objectives of the tests.

7. FINAL REPORT

The final report is prepared to contain at a minimum the following information:

- Objectives and procedures stated in the approved protocol, including any changes made to the original protocol
- Identity of the test article(s) by name or code number and their strength (i.e., quality/purity) and a description of any pretreatment
- Source of the dilution water, its chemical characteristics, and a description of any pretreatment
- Test concentration series used and duration of the assay
- Water quality characteristics (pH, dissolved oxygen, temperature, etc.) of dilution water and selected test concentrations during testing
- Any unforeseen circumstances which may have affected the quality or integrity of the study
- Signature of the project manager, senior technical reviewer, and quality control officer authorizing release of the report
- The location of all archived data and the original copy of the final report at EA

Items of data to be included in the report consists of experimental design and test performance, effects on general appearance of test organisms, morbidity and mortality, presentation of water quality characteristics, percent abnormalities, and survival data.

8. QUALITY ASSURANCE

8.1 Quality Assurance Program Applicability

Amendments to the authorized protocol where established by EA or by the client are made only after proper authorization. Such authorization is achieved by completion of the Protocol Amendment Form by EA after consultation with the client.

8.2 Standard Operating Procedures

Unless otherwise specified, all procedures specified in the protocol are subject to detailed Standard Operating Procedures (SOPs) which are contained in the SOP manuals of the participating departments. These SOPs and protocols generally follow the types of requirements outlined in the US EPA's Good Laboratory Practice Standards (GLPs) (US EPA 1989).

8.3 Reference Toxicant

A reference toxicant bioassay, utilizing copper chloride ($CuCl_2$) or another appropriate chemical, is used as an internal quality check of the sensitivity of each batch of test embryos. Reference toxicant testing is conducted on each population of embryos used for testing. The results of each test are compared with historical, species-specific toxicological information from reference toxicant tests performed at EA, to determine if the results are within acceptable limits. Limits are established using the control charts outlined in US EPA (2002). Alternatively, reference toxicant data may be provided by the test organism supplier.

8.4 Quality Assurance Evaluation

Studies conducted under this protocol may be subject to internal audit by EA's Quality Assurance Unit. A quality control officer is responsible for monitoring each study to assure the client that the facilities, equipment, personnel, methods, practices, records, and controls are in conformance with EA's QC program and, if applicable, US EPA's GLPs.

8.5 Inspection by Regulatory Authorities

In the event of an inspection of EA by an outside authority during the course of the study, the client whose study is being inspected will be consulted before examiners are permitted access to any of the project records or the experimental areas.

8.6 Corrective Action

Corrective action is initiated when a quality control measure is determined to be outside of a predetermined acceptance range. Corrective action may result from internal or external activities. Procedures for handling out-of-control data are detailed in Section 11 of the Laboratory Quality Assurance and Standard Operating Procedures Manual.

8.7 Archives

Copies of project-specific records shall be transferred to the client promptly after the project is completed or as negotiated and budgeted. Original primary data are retained at EA for 5 years. Primary data include chain-of-custody records laboratory data sheets, records, memoranda, notes, photographs, microfilm, computer printouts that are a result of the original observations and activities of the study and which are necessary for the reconstruction and evaluation of the study report.

8.8 Location

Studies are conducted at the Ecotoxicology Laboratory of EA Engineering, Science, and Technology, Inc. in Hunt Valley, Maryland.

9. HEALTH AND SAFETY

9.1 Safety

All laboratory staff members are required to read EA's laboratory safety manual (EA 2012 or most recent version) prior to working in the laboratory. The safety manual includes general safety rules to be followed in the laboratory, procedures for cleaning up spills and reporting accidents, the location and use of safety equipment, and the safe handling and storage of chemicals. A copy of the safety manual is located in the testing laboratory.

9.2 Pollution Prevention and Waste Management

Wastes generated by the laboratory during toxicity testing must be properly handled and disposed of in accordance with the laboratory safety manual and applicable local, state, and federal regulations. Procedures for water disposal is detailed in the Laboratory Quality Assurance and Standard Operating Procedures Manual.

10. SPECIFICATIONS OF THE LARVAL DEVELOPMENT TEST

10.1 Basic References

American Public Health Association (APHA) American Water Works Association, Water Environment Federation. 2012. Standard Methods for the Examination of Water and Wastewater, 22nd or most recent version. APHA, Washington, D.C.

American Society for Testing and Materials (ASTM). 2012. Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Four Species of Saltwater Bivalve Molluscs. ASTM Designation: E724-98, Philadelphia, Pennsylvania.

EA. 2012 (or most recent version). Chemical Hygiene Plan for the EA Aquatic Toxicology and Biology Laboratories. EA Manual ATB-CHP. Internal document prepared by EA's Ecotoxicology Laboratory, EA Engineering, Science, and Technology, Inc., Hunt Valley, Maryland.

EA. 2013 (or most recent version). EA Ecotoxicology Laboratory Quality Assurance and Standard Operating Procedures Manual. EA Manual ATS-102. Internal document prepared by EA's Ecotoxicology Laboratory, EA Engineering, Science, and Technology, Inc., Hunt Valley, Maryland.

US EPA. 1979. Methods for Chemical Analysis of Water and Wastes. EPA/600/4-79/020. U.S. Environmental Protection Agency, Washington, D.C.

US EPA. 1989. Toxic Substances Control Act (TSCA); Good Laboratory Practice Standards. Title 40 CFR Part 792. Fed. Regist. 54(158): 34034-34074.

US EPA. 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. Fifth Edition. EPA-821-R-02-012. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

10.2 Test Specifications

Test Organism:	Mussel (*Mytilus* sp.) or oyster (*Crassostrea* sp.)
Test Type:	Static, non-renewal
Temperature:	16±1°C, or 20±1°C
Light Quality:	Wide-spectrum fluorescent lights
Light Intensity:	50-100 f.c.
Photoperiod:	16-hour light/8-hour dark
Aeration:	None
Dilution Water:	Salinity-adjusted dechlorinated tap water, synthetic seawater, or appropriate receiving water
Salinity:	30 ppt (±3 ppt)
Test Container:	30-ml scintillation vial

Test Volume:	10 ml
Number of Concentrations:	Definitive assay - Minimum of three test concentrations and control Screening assay - Single test concentration and control
Number of Replicates:	minimum of 4
Number of Organisms per Replicate:	15 - 30 embryos/ml
Test Duration:	48 hours (maximum of 54 hours)
Endpoints:	Mortality and/or normal larval development
Test Acceptability:	Control survival ≥70% for mussels and ≥70% for oysters; ≥90% of the surviving control organisms with normal development to the D-hinge stage

BIOASSAY PROTOCOL AMENDMENTS

Prepared by: EA Engineering, Science, and Technology, Inc., PBC
Hunt Valley, Maryland 21031

Client: CBBT and Jacobs Engineering Group

Project Number: 15204.01

Proposed Study Date: March-May 2015

Authorization Date: February 2015

Amendments:

1. Testing will be conducted in accordance with USEPA/USACE, 1991, *Evaluation of Dredged Material Proposal for Ocean Disposal, Testing Manual (OTM)*; USEPA/USACE (1998), *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – the Inland Testing Manual (ITM)*; USEPA-Region 3. *Mid-Atlantic Regional Implementation Manual: Dredged Material Evaluation for Norfolk and Dam Neck Ocean Disposal Sites*.

2. Interstitial ammonia will be measured in the sediment prior to initiation of the whole sediment bioassays to determine if the sediments will require ammonia purging prior to test initiation.

3. An additional 1 percent dilution will be added to the dilution series for the water column toxicity tests, and will be used to calculate EC50s.

4. Two sets of water column bioassays will be conducted (side-by-side) for the mussel, *Mytilus galloprovincialis*: one test with an elutriate stripped of ammonia (reduced to less than 1 mg/L total ammonia) prior to test initiation and one test with untreated elutriate.

5. An ammonia EC50 study will be conducted for *M. galloprovincialis*.

6. *Americamysis bahia* may be substituted with USEPA approval for *Ampelisca abdita* in whole sediment bioassays if *A. abdita* are not available during the target testing period.

Approved by:

Peggy Derrick	24 February 2015
Project Manager	Date
Wayne McCulloch	24 February 2015
Laboratory Manager	Date