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ECOLOGICAL EVALUATION OF PROPOSED
DREDGED MATERIAL FROM WILMINGTON
HARBOR AND MILITARY OCEAN TERMINAL,
SUNNY POINT, NORTH CAROLINA

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July 1993

Prepared for the
U.S. Army Corps of Engineers - North Carolina District
Under a Related Services Agreement
with the U.S. Department of Energy
Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Richland, Washington 99352

MASTER *if*

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SUMMARY

Sediment from the navigational channels of Wilmington Harbor and areas near the Military Ocean Terminal, Sunny Point (MOTSU) requires dredging to enable normal shipping traffic to use these areas. Prior to dredging, an environmental assessment was conducted to determine the suitability of the sediment for unconfined open-water disposal. This evaluation is required under Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA). Specific testing techniques are described in *Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual* hereafter referred to as the *1991 Implementation Manual*. The Wilmington, North Carolina District Office of the U.S. Army Corps of Engineers (USACE), requested that the Battelle/Marine Sciences Laboratory (MSL) collect sediment samples and conduct physical/chemical, toxicological, and bioaccumulation evaluations as required in the *1991 Implementation Manual*. In support of the Wilmington Harbor Program, the MSL:

- Characterized sediment samples representing proposed dredged material (test treatments) through physical/chemical analyses.
- Evaluated acute toxicity of test treatments through solid-phase (SP) tests using the amphipods *Ampelisca abdita* and *Rhepoxynius abronius*, as well as the polychaete *Nereis virens*. Toxicological results of test treatments were compared to that observed in the reference treatment WREF.
- Evaluated acute toxicity of test treatments through suspended-particulate-phase (SPP) tests using the mysid *Mysidopsis bahia*, the silverside *Menidia beryllina*, and larvae of the sea urchin *Lytechinus pictus*. Toxicological results of test treatments were compared to that observed in seawater-only controls. An LC_{50} or EC_{50} was calculated when a 50% decrease in survival relative to control was observed.
- Determined bioaccumulation potential of contaminants associated with test treatments through 28-day exposures using the clam *Macoma nasuta* and the polychaete *N. virens*. Bioaccumulation potential was evaluated through comparison of contaminants associated with tissues exposed to test treatments relative to tissues exposed to the reference treatment WREF.
- Performed appropriate comparisons of results through statistical analyses to determine compliance of the proposed dredged material with Section 103 of MPRSA.

The results of physical/chemical analyses indicated that some contaminants of concern were present in test treatments representing dredged material when compared to the reference treatment WREF. Elevated levels of polynuclear aromatic hydrocarbons (PAH), metals, and organotins were observed in these treatments. Other compounds (pesticides, polychlorinated biphenyls (PCB), dioxins, phenols, and phthalates) were either not detected in sediments, detected below the target detection limits, or present in very low levels.

Acute SP toxicological tests showed no evidence of acute toxicity of test sediments to *R. abronius* or *N. virens*. The other amphipod included in SP testing, *A. abdita*, did not exhibit acute toxicity to test sediments, but these data were not considered valid according to the 1991 *Implementation Manual* because of poor control survival. The SPP exposures were not acutely toxic to *M. bahia* or *M. beryllina*, but were acutely toxic to the larvae of *L. pictus* in the SPP prepared with sediment representing MOTMA. In the *L. pictus* exposures, an LC₅₀ of 97.86% SPP was estimated. Under the 1991 *Implementation Manual* guidelines, the limiting permissible concentration for dissolved plus suspended contaminants (represented by the SPP) cannot exceed 0.01 (1%) of the acutely toxic concentration (LC₅₀) at the boundaries of the disposal site after allowing 4 h for initial mixing. This means that a concentration greater than 0.98% SPP would have to be present at the boundary of the disposal site after initial mixing to exceed the acutely toxic concentration if the dredged material was composed of sediment from MOTMA.

Bioaccumulation potential was evaluated through the exposure of *M. nasuta* and *N. virens* to test and reference sediments for 28 days. These evaluations showed statistically significantly elevated levels of PAHs in tissues exposed to test treatments KICMA, MOTMA, and MOTNW with concentrations ranging from two to four times that found in tissues exposed to the reference WHREF. The organotin, tributyltin, was significantly elevated in *M. nasuta* tissues exposed to MOTMA at approximately twice the level observed in WHREF. There was no evidence of significantly elevated levels of PCBs in the test organism tissues relative to WHREF tissues. The results generated by this study can be used by USACE in their decision-making process regarding acceptable disposal options for the sediments from Wilmington Harbor.

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1.0 INTRODUCTION

Sediment from the navigational channels of Wilmington Harbor and areas near the Military Ocean Terminal, Sunny Point (MOTSU), North Carolina, require dredging to enable normal shipping traffic to use these areas. The study area is depicted in Figure 1.1. Prior to dredging, environmental assessments must be conducted to determine the suitability of the sediment for unconfined open-water disposal. These evaluations are required under Section 103 of the marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA). Specific testing techniques are described in *Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual* (USACE/EPA 1991), hereafter referred to as the *1991 Implementation Manual*. The Wilmington, North Carolina District Office of the U.S. Army Corps of Engineers (USACE) requested that the Battelle/Marine Sciences Laboratory (MSL)^(a) collect sediment samples and conduct physical/chemical, toxicological, and bioaccumulation evaluations as required in the *1991 Implementation Manual*. The objectives of the Wilmington Harbor Program were as follow:

- Collect test sediment samples from two areas in Wilmington Harbor (Baldhead Shoal and Keg Island Channel) and two areas near MOTSU (maintenance and new-work dredging). At each of the four areas, five sites were selected for sampling. A vibracore or dart-core sampler equipped with noncontaminating Lexan liner was used in these collections.
- Collect reference sediment from a site east of the Ocean Dredged Material Disposal site (ODMDS) area for use in toxicological and bioaccumulation comparisons. Five sites were sampled to fully characterize this area. A grab sampler or pipe dredge was used to collect the sediment. Sediment samples were stored in steel buckets coated with a non-contaminating epoxy.
- Ship all sediment samples from the project area to MSL in Sequim, Washington, for physical/chemical analysis and toxicological and bioaccumulation testing.
- Composite the sediment collected from an area into a single sample for physical/chemical analysis, toxicological testing, and evaluation of bioaccumulation potential.
- Perform physical/chemical evaluations on the four test sediment composites and the reference area composite.
- Collect or procure test organisms and "native" control sediment for use in solid-phase (SP), suspended-particulate-phase (SPP), and bioaccumulation testing.
- Perform SPP toxicity tests using three species to determine the acute toxicity of the suspended phase of the dredged material. Test species included the Inland Silverside *Menidia beryllina*, the mysid *Mysidopsis bahia*, and larvae of the urchin *Lytechinus pictus*. Test duration was 96-h for the silverside and mysid; 72-h for the larval test.

(a) The Battelle/Marine Sciences Laboratory is part of the Pacific Northwest Laboratory, which is operated for the U.S. Department of Energy by Battelle Memorial Institute.

- Perform SP toxicity tests using three species to determine the acute toxicity of whole sediment representing dredged material. The three species chosen for these tests were the amphipods *Ampelisca abdita* and *Rhepoxynius abronius*, and the polychaete *Nereis virens*. The test design included the four test sediment composites, the reference sediment composite, and a control sediment. *R. abronius* was added to the experimental design, as the reference material was relatively coarse and less suitable for *A. abdita*.
- Conduct 28-day laboratory exposures in support of bioaccumulation testing to determine whether there was a potential for contaminants associated with dredged material to accumulate in test organism tissues. Test organisms chosen for bioaccumulation exposures were the polychaete *N. virens* and the bentnose clam *Macoma nasuta*. The test design included the four test sediment composites, the reference sediment composite, and a control sediment.
- Provide interim results to USACE describing preliminary sediment chemistry and toxicological results as data are available. Calculations of theoretical bioaccumulation potential were also conducted if non-polar organics were present in the dredged sediments.
- Confirm bioaccumulation potential through chemical analysis of the test organism tissues for selected contaminants of concern after discussions with USACE. The USACE selected contaminants of concern by using the sediment chemistry results and calculations of theoretical bioaccumulation potential provided by MSL.
- Provide draft and final reports to USACE that describe all aspects of the study and present the results of field sampling, physical/chemical analyses of sediment, toxicological testing, and bioaccumulation exposures.

This report is intended to provide information required to address potential ecological effects of the proposed disposal of Wilmington Harbor and MOTSU sediments in the ocean. The report is divided into five sections. Section 1.0 is the introduction containing a brief overview of the study and the study objectives. Section 2.0 describes the methods and materials used for sample collection, processing, toxicological and bioaccumulation testing, physical/chemical analysis of sediments and tissues, data analysis, and quality assurance procedures. Section 3.0 presents the results of field collections, sediment chemistry, toxicological testing, and tissue chemistry resulting from bioaccumulation exposures. Section 4.0 presents a discussion of the results and summary conclusions concerning the acceptability of the Wilmington Harbor and MOTSU dredged material for ocean disposal. Section 5.0 lists the literature cited in support of this document. A series of appendixes contain detailed data listings for the following parts of the study:

Appendix A	Field Collection Summary
Appendix B	Sediment Chemistry and Quality Assurance Data
Appendix C-G	Solid Phase Toxicity/Bioaccumulation Test Data
Appendix H-J	Suspended-Particulate-Phase Toxicity Test Data
Appendix K	Tissue Chemistry and Quality Assurance Data for <i>Macoma nasuta</i>
Appendix L	Tissue Chemistry and Quality Assurance Data for <i>Nereis virens</i>

FIGURE 1.1. Study Area Map for the Wilmington Harbor Program

Mileages are measured from the intersection of
Bathhead Shoal and Smith Island Channels.

WILMINGTON HARBOR,
NORTH CAROLINA

SCALE OF MILES

CORPS OF ENGINEERS
MAP REVISED SEPTEMBER 1990

WILMINGTON, N.C.

2.0 MATERIALS AND METHODS

2.1 SEDIMENT AND TEST ORGANISM COLLECTION

Sediment samples were collected from two test sites in Wilmington Harbor, North Carolina; two test sites in the vicinity of MOTSU, the Military Ocean Terminal, Sunny Point, North Carolina; two reference sites in the Atlantic Ocean near the Ocean Dredged Material Disposal Site and Channel (ODMDS) represented by WHREF and WHFINE; and four control sites in California, Maine, and Washington representing sediment native to test organisms: San Pablo Bay, California (*A. abdita* Control), Muscongus Bay, Maine (*N. virens* Control), Whidbey Island, Washington (*R. abronius* Control), and Sequim Bay, Washington, (*M. nasuta* Control). The sediment samples were collected from the USACE Snag Boat *Snell*. San Pablo Bay and Muscongus Bay sediments were supplied by a private contractor. Whidbey Island and Sequim Bay sediment was collected by MSL personnel using a small boat. Field logs were maintained for all test and reference sediment collections. These logs included the date and time of collection, water depth, station position, sampler penetration, and descriptive characteristics of collected sediments. Formal chain-of-custody procedures were maintained for all test, reference, and control sediments used in this study.

2.1.1 Test Sediment Collection

Test sediment was collected from four sites: Baldhead Shoal (BSCMA), Keg Island Channel (KICMA), MOTSU maintenance material (MOTMA), and MOTSU new work material (MOTNW). Sediments were collected June 29 through July 1, 1992. At each site, five stations were sampled and later composited into a single sample representing a test treatment for toxicological testing, sediment chemistry, and bioaccumulation evaluations. Two samplers were used to collect these sediments: a 0.1-m² van Veen grab sampler was used when the depth of sediment to be sampled was 15 cm or less; a 4-in. vibracore equipped with a noncontaminating 3.5-in. lexan liner was used when deeper sediment collections were required. The 0.1 m² van Veen grab sampler was used to collect sediment from stations BSCMA 1, 2, 3, 4, and 5; KICMA 1, 3, 4, and 5; and MOTMA 1, 2, 4, and 5. A small vibracore was also used to collect sediment from stations KICMA 2, MOTMA 3, and MOTNW 1, 2, 3A, 4, and 5. Sediment samples obtained with the van Veen grab sampler were transferred to clean, 5-gal epoxy-coated pails, sealed, and labeled with the study identifier, the station name, date of collection, and the number of buckets representing a station if more than one 5-gal bucket was collected. Vibracore samples were left in the non-contaminating liner, labeled, cut into sections (if necessary), and capped. All samples were maintained at approximately 4°C ± 2°C until they were off-loaded to a waiting refrigerated truck, also maintained at approximately 4°C ± 2°C. Upon arrival at the MSL, sediment samples were transferred to a climate-controlled cold room and maintained at approximately 4°C until they were used.

Station positioning was accomplished through the use of an Ashtech GPS Receiver XII Global Positioning System (GPS) provided and operated by USACE. Depths were recorded using a calibrated fathometer and corrected to mean lower low water (MLLW) either through the use of a tide gauge or tide table.

2.1.2 Reference and Control Sediment Collection

Reference sediments were collected June 29 through July 3, 1992, using an MSL-designed sand dredge, which sampled surficial sediment to a depth of approximately 4 cm. Reference sediments were placed in clean, 5-gal epoxy-coated buckets, sealed, and labeled with the study identifier, the station name, date of collection, and number of buckets representing a station if more than one 5-gal bucket was collected. Control sediments were collected using a variety of samplers. San Pablo Bay sediment (*A. abdita* Control) was collected using a large dip net during the collection of *A. abdita* from San Pablo Bay. It is estimated that this net sampled sediment to a depth of 2 to 4 cm. Sediment was placed directly in clean polyethylene bags that were placed in coolers and maintained at approximately 4°C until they were shipped via overnight mail to the MSL. Muscongus Bay sediment (*N. virens* Control) was collected with a shovel from the intertidal areas of Muscongus Bay, Maine, placed in clean polyethylene bags, packed in coolers, and maintained at approximately 4°C until it arrived at MSL. Whidbey Island sediment (*R. abronius* Control) was collected with the MSL-designed amphipod dredge, which was also used to collect test organisms at Whidbey Island. It is estimated that this dredge sampled sediment to a depth of approximately 4 cm. Collected sediment was placed in seawater-cured coolers, covered with site water, maintained at ambient conditions for the collection site (11°C), and delivered to the MSL on the same day of collection. Sequim Bay sediment (*M. nasuta* Control) was collected using a 0.1-m² van Veen grab sampler, placed in clean, epoxy-coated buckets, and delivered to the MSL within 1 h of collection. All reference and control sediments were stored at the MSL at approximately 4°C ± 2°C until they were used.

Station position for the Atlantic Ocean reference sites was accomplished through the use of the *Snell's* GPS system. Control sediment sampling sites were located through the use of visual range fixes and verified by water depth observations.

2.1.3 Test Organism Collection

Seven species of organisms were used to evaluate sediment samples from the Wilmington Harbor study area:

- the amphipod *Ampelisca abdita*
- the amphipod *Rhepoxynius abronius*
- the polychaete *Nereis virens*
- the bentnose clam *Macoma nasuta*
- the silverside *Menidia beryllina*

- the mysid shrimp *Mysidopsis bahia*
- larvae of the sea urchin *Lytechinus pictus*.

All test organisms with the exception of the mysid and silversides were wild-captured individuals collected either by a commercial supplier or by MSL personnel. All animals were shipped in native sediment or in a way designed to ensure their viability. After receipt at the MSL, test organisms were gradually acclimated to test conditions. Animals acting abnormally or exhibiting stress were not used in toxicological tests. The amphipod *A. abdita* and polychaete *N. virens* were supplied by Brezina and Associates, Dillon Beach, California. The *A. abdita* were collected with a large dip net, carefully removed from their tubes for enumeration, then placed in clean native sediment collected with the amphipods for overnight transport to the MSL. The *N. virens* were collected intertidally from Muscongus Bay, using a bucket and shovel, and transported via overnight mail on moist mats of seaweed in coolers. The amphipod *R. abronius* were collected by MSL personnel from West Beach, Washington, using an MSL-designed amphipod dredge. Amphipods were transported in clean coolers containing approximately 10 cm of sediment and 5 gal of clean seawater at a temperature approximating natural conditions. The *M. nasuta* were collected from intertidal zones in Discovery Bay, Washington, by a commercial supplier using a shovel, bucket, and sieve. Clams were kept cool prior to shipment by placing them in large containers filled with sediment and seawater from the collection site. The *M. beryllina* were supplied by Aquatic Resources, Sebastopol, California. The *M. beryllina* were shipped in large plastic bags containing seawater and maintained at approximately 15°C. Prior to shipment via overnight mail, seawater was supersaturated with oxygen to ensure test organism survival. The *M. bahia* were obtained from Aquatic Biosystems, Fort Collins, Colorado, and were shipped in plastic bags containing oxygen-supersaturated seawater, and maintained at approximately 15°C. The *L. pictus* were purchased from Marinus, Inc., Long Beach, California. These organisms were wrapped in moist paper towels and shipped in hard cardboard containers containing Blue Ice to maintain an ambient temperature of approximately 15°C.

2.2 SEDIMENT SAMPLE PREPARATION

Sediment used for biological testing was prepared within the 6-week holding period as specified in the *1991 Implementation Manual*. During that period, the core, grab, and sand dredge samples were received at the MSL and inventoried against chain-of-custody forms, processed for SP and SPP testing, and used in the biological tests. The following sections describe equipment preparation, compositing strategy, and the preparation of sediments for SP and SPP tests.

2.2.1 Laboratory Glassware and Equipment Preparation

All glassware, stainless-steel utensils, plastic, laboratory containers, and equipment went through stringent cleaning procedures to avoid contaminating sediment samples. Glassware including test containers, aquaria, and sediment transfer equipment, was washed with warm, soapy water, rinsed five times with deionized water, then soaked in a 10% reagent grade nitric acid bath for a minimum of 4 h. After soaking, glassware was rinsed with deionized water five times and allowed to dry. Titanium tools, PVC, Nalgene, and other plastic items such as funnels were also washed and soaked in acid baths in the same manner as glassware.

Stainless-steel bowls, spoons, spatulas, and other utensils were washed with warm, soapy water, rinsed five times with deionized water, and allowed to air dry. They were then rinsed with methylene chloride that was allowed to evaporate under a fume hood before use. Rubber stoppers and other porous materials were washed with warm, soapy water and rinsed five times with deionized water. These items were then "seasoned" by continuous soaking in, or exposure to, 0.45- μ m-filtered seawater for at least 2 days prior to use.

Large pieces of laboratory equipment such as the epoxy-coated mixer used to mix sediment and epoxy-coated boards used to hold cores during core-cutting procedures were washed with a mild soap solution and thoroughly rinsed with tap water followed by deionized water. Equipment used to determine water quality, such as pH, dissolved oxygen (DO), temperature, and refractometers were calibrated according to the manufacturer's specifications and internal MSL procedures.

2.2.2 Compositing Strategy and Sediment Treatment Designation

Table 2.1 presents the compositing strategy for the Wilmington Harbor Project. This table summarizes the composite sample designations, site location, and the stations that contributed to each composite that made up the treatments for chemical and biological testing. A total of 10 treatments were evaluated during the Wilmington Harbor Project: four test treatments (BSCMA, KICMA, MOTMA, and MOTNW); two reference treatments (WHREF and WHFINE); and four control treatments (San Pablo Bay, Muscongus Bay, Whidbey Island, Sequim Bay). Reference treatment WHFINE was not originally included in the scope of work, but was added during the cruise when there was some concern that material comprising reference treatment WHREF might be too coarse for the amphipod *A. abdita*. The reference treatment WHFINE was used in the *A. abdita* and *R. abronius* SP tests only, and was not used in the other toxicological or bioaccumulation tests.

2.2.3 Preparation of Solid-Phase Treatments

Reference and control sediments were press sieved through a 1.0-mm screen to remove predators. After sieving, a reference or control sediment was mixed by placing it in a large, epoxy

TABLE 2.1. Compositing Strategy and Sample Designation for the Wilmington Harbor Program

<u>Composite Sample</u>	<u>Identification</u>	<u>Created from Stations:</u>
BSCMA	Baldhead Shoal Maintenance	BSCMA 1, BSCMA 2, BSCMA 3, BSCMA 4, BSCMA 5
KICMA	Keg Island Channel Maintenance	KICMA 1, KICMA 2, KICMA 3, KICMA 4, KICMA 5
MOTMA	Military Ocean Terminal Sunny Point Maintenance	MOTMA 1, MOTMA 2, MOTMA 3, MOTMA 4, MOTMA 5
MOTNW	Military Ocean Terminal Sunny Point New Work	MOTNW 1, MOTNW 2, MOTNW 3A, MOTNW 4, MOTNW 5
WHREF	Coarse-Grained Ocean Reference	WHREF 1, WHREF 2, WHREF 3, WHREF 4A, WHREF 5
WHFINE	Fine-Grained Ocean Reference	WHFINE 1, WHFINE 2
San Pablo Bay	<i>A. abdita</i> Control San Pablo Bay, CA	NA ^(a)
Muscongus Bay	<i>N. virens</i> Control Newcastle, ME	NA
Whidbey Island	<i>R. abronius</i> Control Whidbey Island, WA	NA
Sequim Bay	<i>M. nasuta</i> Control Sequim Bay, WA	NA

(a) NA Not applicable.

coated cement-type mixer. Test sediment samples were processed by first compositing the sediment from a station until a homogenous color and texture were evident. This was done either by placing the sediment in large stainless-steel bowls and mixing it with stainless-steel utensils, or by placing the sediment in the mixer. After compositing, a subsample was then taken for archival purposes. After all stations representing a test site were processed in this fashion, the remaining composited sediment was combined to create each test treatment by placing all of the sediment in the mixer and creating a homogenous material. All sediment treatments were then either used immediately or placed in 5-gal epoxy-coated pails that were sealed and maintained at 4°C until used.

2.2.4 Preparation of Suspended-Particulate-Phase Treatments

The SPP of test treatments was used to evaluate potential water column effects of unconfined open-water dredged material disposal. The SPP is the liquid that remains after intermixing sediment with seawater and allowing heavier particles to settle to the bottom.

Because SPP preparation does not involve filtration, this phase contains suspended particles as well as dissolved constituents. The SPP tests evaluate effects caused by both the physical presence of the suspended particles and the chemical toxicity of contaminants associated with the particles or dissolved constituents. The process is intended to approximate exposure conditions created as a result of materials being discharged through the water column during dredge material disposal operations.

The first step of SPP preparation was to create a 4:1 (volume:volume) water to sediment slurry in 1-L glass jars with Teflon-lined lids. The jars were marked at 200-mL and 400-mL increments. Sequim Bay seawater passed through a 0.45- μ m filter was added to the 200-mL mark and homogenized sediment was added until the water was displaced to the 400-mL mark. The jar was filled to 1 L with filtered seawater. A set of 12 jars containing sediment and water was placed on a shaker table and agitated for 30 min at a shaking rate of 120 to 150 cycles/min. After shaking, the slurry was poured into 500-mL Teflon containers with tightly fitted lids and placed in a centrifuge and spun for 15 min at approximately 740 x g. The 15-min centrifugation was necessary to ensure that test organisms would be visible at the first observation after exposure to SPP test treatments. After the light centrifugation, the supernatant was poured into clean, 10-gal aquaria for use in the SPP tests as soon as possible. If the SPP test was not performed immediately, the aquaria were stored at 4°C for a maximum of 24 h. The Teflon jars were rinsed after each use, and the above process was continued until an adequate amount of SPP was produced. Between different sediment SPP preparations, all glass and Teflon containers were appropriately cleaned according to procedures described in Section 2.2.1.

2.3 TOXICOLOGICAL TESTING PROCEDURES

A total of eight toxicological/bioaccumulation tests involving seven test species were conducted in support of the Wilmington Harbor Program. These tests included SP and SPP exposures and were designed to assess potential ecological effects of the proposed aquatic disposal of dredged material from selected areas within Wilmington Harbor. The overall experimental design is summarized in Table 2.2. The SP tests were used to assess the acute toxicity and bioaccumulation potential of dredged material after settling at an aquatic disposal site. Three species of marine organisms were exposed to the test sediments from the Wilmington Harbor sites, reference area sediments, and control sediments. Three acute toxicity tests were conducted: 1) a 10-day SP flow-through acute toxicity test using the amphipod *A. abdita*, 2) a 10-day SP static acute toxicity test using the amphipod *R. abronius*, and 3) a 10-day SP flow-through acute toxicity test using the polychaete *N. virens*. The bioaccumulation test was a 28-day SP exposure of *N. virens* and *M. nasuta* (tested separately). The purpose of the 28-day test was to assess the potential for bioaccumulation of contaminants from the sediment into the tissues of the organisms. The bioaccumulation tests and procedures were similar to the 10-day

TABLE 2.2. Experimental Design for the Wilmington Harbor Program

Testing Parameter	BSCMA	KICMA	MOTMA	MOTNW	WHREE	WHFINE	San Pablo Bay	Muscongus Bay	Whidbey Island	Sequim Bay
<u>Toxicity/Bioaccumulation Testing</u>										
10-day <i>A. abdita</i> SP Test	✓	✓	✓	✓	✓	✓	✓	---	---	✓
10-day <i>R. abronius</i> SP Test	✓	✓	✓	✓	✓	✓	---	---	✓	✓
10-day <i>N. virens</i> SP Test	✓	✓	✓	✓	✓	---	---	✓	---	---
28-day <i>M. nasuta</i> SP Test	✓	✓	✓	✓	✓	---	---	✓	---	✓
28-day <i>N. virens</i> SP Test	✓	✓	✓	✓	✓	---	---	---	---	---
96-hour <i>M. beryllina</i> SPP Test	✓	✓	✓	✓	---	---	---	---	---	---
96-hour <i>M. bahia</i> SPP Test	✓	✓	✓	✓	---	---	---	---	---	---
72-hour <i>L. pictus</i> SPP Test	✓	✓	✓	✓	---	---	---	---	---	---
<u>Sediment Chemistry</u>										
Grain Size	✓	✓	✓	✓	✓	---	---	---	---	---
Specific Gravity	✓	✓	✓	✓	✓	---	---	---	---	---
Total Solids	✓	✓	✓	✓	✓	---	---	---	---	---
Total Organic Carbon	✓	✓	✓	✓	✓	---	---	---	---	---
Cyanide	✓	✓	✓	✓	✓	---	---	---	---	---
Sulfides	✓	✓	✓	✓	✓	---	---	---	---	---
Total Kjendahl Nitrogen	✓	✓	✓	✓	✓	---	---	---	---	---
Oil and Grease	✓	✓	✓	✓	✓	---	---	---	---	---
PAH	✓	✓	✓	✓	✓	---	---	---	---	---
PCB/Pesticides	✓	✓	✓	✓	✓	---	---	---	---	---
Phthalate Esters	✓	✓	✓	✓	✓	---	---	---	---	---
Phenols	✓	✓	✓	✓	✓	---	---	---	---	---
Dioxins	✓	✓	✓	✓	✓	---	---	---	---	---
Metals	✓	✓	✓	✓	✓	---	---	---	---	---
Organotins	✓	✓	✓	✓	✓	---	---	---	---	---
<u>Tissue Chemistry</u>										
PAH	✓	✓	✓	✓	✓	---	---	✓	---	✓
PCBs	✓	✓	✓	✓	✓	---	---	✓	---	✓
Metals	✓	✓	✓	✓	✓	---	---	✓	---	✓
Organotins	---	---	---	---	---	---	---	---	---	---

(a) --- No analysis

test except they involved a longer exposure period, larger test population, and a depuration process for surviving *M. nasuta* and *N. virens*. All SP tests consisted of five replicate containers for each treatment tested. All test containers were placed in random positions in the water tables.

The SPP tests were used to assess the potential effects of discharging dredged material through the water column during disposal operations. The SPP tests evaluate 1) effects caused by the physical presence of suspended particles, 2) toxicity of chemical contaminants associated with the particles, or 3) toxicity of chemical contaminants after they have dissolved into the water column. Three SPP tests were conducted: a 4-day exposure using the silverside *M. beryllina*, a 4-day exposure using the mysid *M. bahia*, and a 3-day exposure of larvae of the sea urchin *L. pictus*. The SPP treatments were prepared as described in Section 2.2.4. There were five replicates of each of the four SPP concentrations: 0% (seawater), 10%, 50%, and 100% (SPP). All test containers were placed in random positions on the water tables.

The four test treatments were evaluated for all toxicological tests, with reference and control treatments included in the test design where appropriate (Table 2.2). Because the SPP tests evaluated the difference in test organism survival in 0% (seawater) and 100% SPP exposures, tests of reference and control sediments were not required. Reference toxicant exposures were conducted on selected species and the results compared to the normal range of response observed at the MSL to assess test organism sensitivity. The MSL facilities provided the required conditions for all toxicological tests. Laboratory equipment included a controlled-temperature environment, flow-through seawater supply, lighting control, and air supply.

2.3.1 10-Day Solid-Phase Flow-Through Test with *A. abdita*

The *A. abdita* were held in a large holding tank containing their native sediment under static conditions in 20°C seawater. Organisms were not fed during the holding period, which was less than 2 weeks before test initiation. The *A. abdita* test was conducted in 1-qt flow-through Mason jars that were placed at random positions on a water table maintained at 20°C. Prior to test initiation, sediment was added to the jars to a depth of 2 cm, then each jar was allowed to slowly fill via the flow-through system to a total volume of 750 mL. The flow-through Mason jar was designed to allow a subsurface exit of seawater, thereby reducing the chance of test organism impingement on the screened discharge. The jars were placed on the water table overnight to stabilize the temperature to test conditions. After stabilization, initial water quality parameters were measured in each container and recorded on water quality forms. Gentle aeration was applied to each jar to provide adequate oxygenation of overlying water, and the test was conducted under a continuous light regime as required by ASTM (1990).

The test was initiated by adding 20 *A. abdita* to each test container. The amphipods were gently sieved from the holding tank into clean seawater and counted into small transfer

containers. The number of organisms was then confirmed by a second observer before being transferred into the test container. The date and time of initiation were recorded on data forms and on the lids of the test containers. The *A. abdita* were observed daily during the test and the number of organisms floating on the surface, swimming in the jar, or on the sediment surface were recorded on observation forms. Amphipods floating on the surface were gently pushed below the water surface with a pipette tip and observations were made as to whether they remained on the sediment surface, buried below the sediment, or returned to the surface of the water.

Water temperature, salinity, pH, and DO were measured daily in one replicate of each sediment treatment and in all containers at initiation and termination of the test. Flow rate was measured daily in all test containers. Acceptable ranges for water quality parameters during the experiment were:

DO	≥ 4.0 mg/L
pH	ambient ± 0.5 units
Salinity	30‰ ± 2.0 ‰
Temperature	20°C ± 2.0 °C.
Flow Rate	30 ± 5 mL/min.

At the end of the test (Day 10), the contents of each jar were sieved through a 0.5-mm Nytex screen to collect the *A. abdita*. The organisms were placed in clean seawater in a glass dish labeled with the sediment treatment and replicate number, and the number of live, dead, and missing organisms was determined. If necessary, a dissecting microscope was used to examine moribund organisms for signs of life. The presence or absence of body parts recovered at the end of the test was also noted. The endpoint of this test was death, defined as the absence of pleopod movement in response to gentle probing. At least 10% of the mortality counts were confirmed by a second observer. Test organism sensitivity was assessed through a 96-h reference toxicant test, which included a seawater control and four concentrations of cadmium (0.25, 0.5, 1.0, and 2.0 mg/L).

2.3.2 10-Day Solid-Phase Static Test with *R. abronius*

The *R. abronius* were held in a large holding tank containing their native sediment with flowing 15°C seawater. Organisms were not fed during the holding period, which was less than 2 weeks before test initiation. The *R. abronius* test was conducted in 1-qt static Mason jars, which were placed in random positions on a water table maintained at 15°C. Prior to test initiation, sediment was added to the jars to a depth of 2 cm, then each jar was slowly filled with 0.45- μ m-filtered Sequim Bay seawater to a total volume of 750 mL. The jars were placed on the water table overnight to stabilize the temperature to test conditions. After settling, initial water quality parameters were measured in each container and recorded on water quality forms. Gentle

aeration was applied to each jar to provide adequate oxygenation of overlying water, and the test was conducted under a continuous light regime.

This test was conducted in a similar fashion to the *A. abdita* test, though it was static rather than flow-through, and the reference toxicant concentrations were 0.5, 1.0, 2.0, and 4.0 mg/L (cadmium). Acceptable ranges for water quality parameters for the static *R. abronius* test were:

DO	≥4.0 mg/L
pH	ambient ±0.5 units
Salinity	30‰ ±2.0‰
Temperature	15°C ±2.0°C

2.3.3 10-Day Solid-Phase Flow-Through Test with *N. virens*

Prior to testing, *N. virens* were held in their native sediment in shallow trays covered with well-aerated 15°C seawater from a gravity-fed flow-through system. Temperature, pH, DO, and salinity of water in each holding tank were monitored daily. The organisms were not fed during the holding period. Test containers were aerated, and the test was conducted under a 16 h light, 8 h dark regime.

The 10-day flow-through test with *N. virens* was conducted in 10-gal flow-through aquaria placed in random positions on water tables. Each aquarium was filled with approximately 8 L of sand-filtered seawater via the flow-through system. Sediment was then added to a depth of 3 cm by measuring the required amount (3870 mL) into a glass container and placing the sediment into the aquaria. The sediment was distributed evenly over the bottom of the aquaria using a stainless-steel spoon.

For 4 h, suspended materials in the aquaria settled and the flow-through system was initiated and adjusted to deliver 125 ±10 mL/min of seawater flow to each aquarium. The total water volume was approximately 36 L. The system operated overnight before adding the test organisms.

To initiate the test, 20 *N. virens* were collected from the holding tanks and placed in each aquarium. The label on each test aquaria included initiation time/date and the initials of the examiner who placed the organisms into each aquarium. Water quality parameters (noted below) were measured daily in at least one replicate of each sediment treatment and recorded on water quality data sheets. The water quality parameters and ranges established for the tests were:

DO	≥ 4.0 mg/L
pH	ambient ± 0.5 units
Salinity	30‰ ± 2.0 ‰
Temperature	15.0°C ± 2.0 °C
Flow Rate	125 ± 10 mL/min.

Daily observations of test animal behavior were made and recorded on data forms for each test. The number of *N. virens* on the sediment surface was noted daily in each aquarium. In addition to daily observations of behavior, the number of dead organisms in each aquarium was recorded on daily observation forms. Dead organisms were removed from the aquaria and destroyed by incineration; no replacement of dead organisms occurred during testing. If and when a dead *N. virens* was removed, the specimen was identified as a whole animal or a portion of the animal (head or tail).

At the end of the 10-day test, water quality measurements were performed in all replicates and the contents of each aquarium were gently passed through a 1.0-mm Nytex screen to recover the *N. virens*. The organisms were placed in glass baking dishes labeled with the sediment treatment number, and the number of dead versus live was determined. Death was determined by observing whether the *N. virens* reacted to gentle probing. If there was no movement, the organism was considered dead. The mortality data were recorded on the termination forms and at least 10% of the mortality counts were confirmed by a second observer. No reference toxicant test was run for this species as it is relatively insensitive to standard laboratory reference toxicants.

2.3.4 28-Day Solid-Phase Flow-Through Test with *N. virens*

The procedure for conducting the 28-day, solid-phase flow-through test with *N. virens* was identical to that of the 10-day test with three exceptions: 1) the exposure period was increased from 10 to 28 days, 2) the surviving test organisms were depurated in a flow-through seawater system for 48 h, and 3) tissues were saved for future chemical analysis. The ranges for water quality parameters as well as the test conditions, such as temperature and flow rate, were the same in the 28-day test as for the 10-day test. Water quality parameters were measured and mortality of the test organisms were monitored at the same frequency for both tests.

When the 28-day test was terminated, the *N. virens* were collected for chemical evaluation of bioaccumulation. To ensure that tissue chemistry results would not be biased by contaminants associated with sediment grains in the digestive tract, the test organisms were allowed to depurate (void the digestive tract) for 48 h in a flow-through seawater system following the 28-day exposure. After 48 h of depuration, the *N. virens* were gently washed in clean seawater to remove external sediment grains and put in containers for future chemical analysis. No reference

toxicant test was run for this species, as it is relatively insensitive to standard laboratory reference toxicants.

2.3.5 28-Day Solid-Phase Flow-Through Test with *M. nasuta*

The procedure for conducting the 28-day solid-phase flow-through test with *M. nasuta* was identical to that of the 28-day *N. virens* test. As in the 28-day flow-through SP *N. virens* test, *M. nasuta* were allowed to depurate (void the digestive tract) for 48 h following the 28-day exposure to ensure that tissue chemistry results would not be biased by contaminants associated with sediment grains in the digestive tract. The surviving *M. nasuta* were placed in the depuration aquarium containing seawater only. After 48 h of depuration, the *M. nasuta* shells were cleaned with a scrub-brush and the tissues were removed using titanium knives. The tissues were placed into pre-cleaned jars and submitted for chemical analysis. No reference toxicant test was run for this species as it is relatively insensitive to standard laboratory reference toxicants.

2.3.6 96-h Suspended-Particulate-Phase Static Test with *M. beryllina*

The *M. beryllina* were held prior to testing in a 10-gal glass aquarium and fed <24-h old brine shrimp nauplii (*Artemia salina*) twice daily. Temperature, pH, DO, and salinity of water in the aquaria were monitored daily. This 96-h static SPP test was conducted in 1-qt Mason jars filled to a total volume of 500 mL. Test containers were aerated and the test was conducted under a 16 h light, 8 h dark regime. The test was initiated by adding ten *M. beryllina* to each test container using the wide-bore pipettes. The *M. beryllina* were gently pipetted from the holding tank into clean seawater and counted into small transfer containers. The number of organisms was then confirmed by a second observer before being transferred into the test container. The date and time of initiation were recorded on data forms and on the lids of the test containers. The *M. beryllina* were observed daily during the test, and the number of live and dead organisms was noted on the data forms. Dead animals were removed daily. Water temperature, salinity, pH, and DO were measured daily in one replicate of each sediment treatment and in all containers at initiation and termination of the test. Acceptable ranges for water quality parameters during the experiment were:

DO	≥4.0 mg/L
pH	ambient ±0.5 units
Salinity	30‰ ±2.0‰
Temperature	20°C ±2.0°C

At the end of the test (96 h), final observations were conducted. The endpoint of this test was death, defined as the absence of movement in response to gentle probing. At least 10% of the mortality counts were confirmed by a second observer. Test organism sensitivity was

assessed through a 96-h reference toxicant test, which included a seawater control and four concentrations of copper (16, 64, 160, and 400 µg/L).

2.3.7 96-h Suspended-Particulate-Phase Static Test with *M. bahia*

The *M. bahia* were held prior to testing in a 10-gal glass aquarium and fed <24-h old brine shrimp nauplii (*Artemia salina*) twice daily. Temperature, pH, DO, and salinity of water in the aquaria were monitored daily. This 96-h static SPP test was conducted in 500-mL glass jars filled to a total volume of 300 mL. Test containers were placed in random positions, aerated, and the test was conducted under a 16 h light, 8 h dark regime. The test was initiated by adding 10 *M. bahia* to each test container. The mysids were gently pipetted from the holding tank into clean seawater using large-bore pipettes and counted into small transfer containers. The number of organisms was then confirmed by a second observer before being transferred into the test container. The date and time of initiation were recorded on data forms and the lids of the test containers. The *M. bahia* were observed daily during the test, and the number of live and dead organisms was noted on the data forms. Dead animals were removed daily. Water temperature, salinity, pH, and DO were measured daily in one replicate of each sediment treatment and in all containers at initiation and termination of the test. Acceptable ranges for water quality parameters during the experiment were:

DO	≥4.0 mg/L
pH	ambient ±0.5 units
Salinity	30‰ ±2.0‰
Temperature	20°C ±2.0°C

At the end of the test (96 h), final observations were conducted. The endpoint of this test was death, defined as the absence of movement in response to gentle probing. At least 10% of the mortality counts were confirmed by a second observer. Test organism sensitivity was assessed through a 96-h reference toxicant test, which included a seawater control and four concentrations of copper (50, 100, 200, and 400 µg/L).

2.3.8 72-h SPP Static Test with *L. pictus*

Adult *L. pictus* were obtained from a commercial supplier and used for testing on the day of receipt. The test chambers for the sea urchin larvae test were 1-qt Mason jars in which dilutions of SPP for the larval test (0%, 10%, 50%, and 100%) were directly prepared. The dilution water consisted of offshore Strait of Juan de Fuca, Washington, seawater filtered at 20 µm. This offshore water was collected to reduce the risk of using nearshore water that might have algal blooms. Because algal blooms may affect developing larvae, this precaution was taken. The final volume of test material in each container was 750 mL. Test chambers containing SPP were placed in random positions on a water table and aerated. The light regime for this test was

16 h light, 8 h dark. Once the containers had reached test temperature ($20^{\circ}\text{C}\pm 2^{\circ}\text{C}$), initial water quality parameters were measured in all replicates.

Adult *L. pictus* were induced to spawn by placing each individual (oral side up) over a 250-mL beaker containing clean seawater and injecting approximately 1 mL of 0.5 M potassium chloride into the coelomic cavity through the peristomal membrane. Most animals then shed their sperm or egg directly into the beakers. The remaining spawning broodstock of sea urchins were maintained in 20°C seawater for 45 min during which time DO levels were monitored. If no spawning occurred within 1 h, the adult sea urchins were removed from the water and allowed to air dry for approximately 15 min and then returned to the 20°C seawater.

Most adults spawned within 1 h and were removed from the 20°C holding container and placed in individual baking dishes for the collection of gametes. Sperm from up to three males was pooled and passed through 35- μm mesh to remove debris. The sperm pool was then introduced to containers of egg suspension and allowed to fertilize. The egg suspensions were mixed frequently using a perforated plunger over a period of 90 to 140 min, at which time development of the embryos was assessed. The egg suspensions with a high percentage of embryo development were pooled into a common stock for use in the test. The pooled egg suspension was screened through 75- μm mesh to remove debris and retained on a 20- μm screen to rinse away excess sperm. The eggs were rinsed from the 20- μm screen into a clean container filled with seawater.

To estimate fertilization success and embryo density, a 1-mL sample was removed from the container (after thorough mixing) and diluted to 100 mL with seawater. Three, 1-mL samples were removed from this 100:1 suspension, and the number of developing embryos and non-fertilized eggs was scored using a Sedgewick-Rafter counting chamber on a compound microscope at low magnification. The mean number of embryos from the replicate counts was multiplied by 100 (to correct for the dilution factor) to estimate the density of embryos in the egg stock. The resulting density of embryos/mL was used to calculate percent fertilization and the amount of embryo stock to add to each test container.

To initiate the test, an appropriate amount of sea urchin embryo stock solution was pipetted into each test container to yield a density of 25 embryos/mL in the containers of test material. A perforated plunger was used to thoroughly mix the contents of the stock container before removing each aliquot with the pipettor. The test initiation date and time were recorded on data record forms. Each subsample was placed in a labeled vial, fixed with 1 mL of 50% formalin, and scored for the number of fertilized eggs. Water quality parameters were measured in one replicate of each dilution 24 h after test initiation. Acceptable ranges for water quality parameters during the experiment were:

DO	≥4.0 mg/L
pH	ambient ±0.5 units
Salinity	ambient ±2.0‰
Temperature	16.0°C ±2.0°C.

The sea urchin test was terminated after 72 h, when development of pluteus larvae predominated in control containers. Final water quality measurements were recorded for all replicates. Each chamber was then homogenized with the perforated plunger, and a 10-mL aliquot was removed with a calibrated pipettor and placed in a labeled vial containing 1 mL of 50% formalin. Samples were scored for the appearance of normal pluteus larvae, abnormally developed larvae, blastula-stage larvae, and total number of larvae. At least 10% of the counts were confirmed by a second observer. Test organism sensitivity was assessed through a 72-h reference toxicant test, which included a seawater control and five concentrations of copper (2.9, 9.0, 30, and 100, and 200 µg/L).

2.4 SEDIMENT AND TISSUE CHEMISTRY PROCEDURES

Sediment samples collected in support of the Wilmington Harbor Program were analyzed for conventional and other chemical parameters. Conventional parameters included grain size, specific gravity, total solids, total organic carbon (TOC), cyanide, oil and grease, sulfides, and total Kjeldahl nitrogen (TKN). Sediments were also analyzed for polynuclear aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB)/pesticides, dioxins, phenols and substituted phenols, phthalate esters, metals, and butyltins. Chemical analysis of *M. nasuta* and *N. virens* tissues was also conducted to determine bioaccumulation potential. Selected tissues were analyzed for PAHs, PCBs, metals, and organotins. Table 2.2 presents the experimental design for sediment and tissue analyses; Table 2.3 presents the analytical parameters measured in sediment and tissue samples, the method used to perform the analysis and the target analytical detection limits. Data quality objectives are summarized in Table 2.4. The following sections briefly describe the methods used for analysis of sediments and tissues for the required physical and chemical parameters. Analyses followed established EPA procedures where applicable. Quality control samples included method blanks, matrix spike (MS) and matrix spike duplicate (MSD) analyses, standard reference materials (SRM), and analytical replicates. The MS, MSD, and SRMs were used as a measurement of analytical accuracy. The analytical replicates, MS, and MSD were used to evaluate analytical precision.

2.4.1 Conventional Measurements

Conventional parameters included grain size, specific gravity, total solids, TOC, cyanide, oil and grease, acid volatile sulfides (AVS), TKN, and total lipids (tissues only). Grain size, specific gravity, and total solids analyses were conducted by Soil Technology, Bainbridge

TABLE 2.3. Analytical Parameters and Target Detection Limits^(a) for Sediment and Tissue Samples

<u>Analyte</u>	<u>Reference Method</u>	<u>Detection Limit^(a)</u>
Grain Size (Sediment)	Plumb (1981)	1.0%
Specific Gravity (Sediment)	ASTM D-854 (ASTM 1991)	NA ^(b)
Total Solids (Sediment)	Plumb (1981)	1.0%
Total Organic Carbon (Sediment)	5310 (APHA 1989)	0.1%
Cyanide	335.2 (EPA 1979)	1.0 mg/kg
Oil and Grease	413.2 (EPA 1979)	20 mg/kg
Acid Volatile Sulfides	Cutter and Oatts (1987)	0.2 mg/kg
Total Kjeldahl Nitrogen	351.4 (EPA 1979)	0.1 mg/kg
Total Lipids (Tissue)	8290 (EPA 1990a)	0.1%
PAHs		
Acenaphthene	8270 (EPA 1986)	30 µg/kg
Acenaphthylene	8270 (EPA 1986)	30 µg/kg
Anthracene	8270 (EPA 1986)	30 µg/kg
Benzo(a)anthracene	8270 (EPA 1986)	30 µg/kg
Benzo(a)pyrene	8270 (EPA 1986)	30 µg/kg
Benzo(b)fluoranthene	8270 (EPA 1986)	30 µg/kg
Benzo(g,h,i)perylene	8270 (EPA 1986)	30 µg/kg
Benzo(k)fluoranthene	8270 (EPA 1986)	30 µg/kg
Chrysene	8270 (EPA 1986)	30 µg/kg
Dibenzo(a,h)anthracene	8270 (EPA 1986)	30 µg/kg
Fluoranthene	8270 (EPA 1986)	30 µg/kg
Fluorene	8270 (EPA 1986)	30 µg/kg
Indeno(1,2,3-cd)pyrene	8270 (EPA 1986)	30 µg/kg
Napthalene	8270 (EPA 1986)	30 µg/kg
Methylnapthalene	8270 (EPA 1986)	30 µg/kg
Phenanthrene	8270 (EPA 1986)	30 µg/kg
Pyrene	8270 (EPA 1986)	30 µg/kg
PCBs		
Aroclor 1016	8080 (EPA 1986)	20 µg/kg
Aroclor 1221	8080 (EPA 1986)	20 µg/kg
Aroclor 1232	8080 (EPA 1986)	20 µg/kg
Aroclor 1242	8080 (EPA 1986)	20 µg/kg
Aroclor 1248	8080 (EPA 1986)	20 µg/kg
Aroclor 1254	8080 (EPA 1986)	20 µg/kg
Aroclor 1260	8080 (EPA 1986)	20 µg/kg

TABLE 2.3. (contd)

<u>Analyte</u>	<u>Reference Method</u>	<u>Detection Limit</u>
Pesticides		
Aldrin	8080 (EPA 1986)	10.0 µg/kg
α-BHC	8080 (EPA 1986)	10.0 µg/kg
β-BHC	8080 (EPA 1986)	10.0 µg/kg
D-BHC (Lindane)	8080 (EPA 1986)	10.0 µg/kg
D-BHC	8080 (EPA 1986)	10.0 µg/kg
Chlordane	8080 (EPA 1986)	30.0 µg/kg
4,4'-DDD	8080 (EPA 1986)	10.0 µg/kg
4,4'-DDE	8080 (EPA 1986)	10.0 µg/kg
4,4'-DDT	8080 (EPA 1986)	10.0 µg/kg
Dieldrin	8080 (EPA 1986)	10.0 µg/kg
Endosulfan and derivatives	8080 (EPA 1986)	20.0 µg/kg
Endrin and derivatives	8080 (EPA 1986)	10.0 µg/kg
Heptachlor and derivatives	8080 (EPA 1986)	20.0 µg/kg
Heptachlorocyclohexane and derivatives	8080 (EPA 1986)	10.0 µg/kg
Methoxychlor	8080 (EPA 1986)	20.0 µg/kg
Toxaphene	8080 (EPA 1986)	30 µg/kg
Dioxins		
All congeners	8290 (EPA 1990a)	1.0 ppt
Phenols and Substituted Phenols		
Phenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
2,4-dimethylphenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
2,4,6-trichlorophenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
Para-chloro-meta-cresol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
2-chlorophenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
2,4-dichlorophenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
2-nitrophenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
4-nitrophenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
2,4-dinitrophenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
4,6-dinitro-o-cresol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
Pentachlorophenol	8270 (EPA 1986)	100 µg/kg - 1500 µg/kg
Phthalate Esters		
Bis (2-ethylhexyl) phthalate	8270 (EPA 1986)	100 µg/kg
Butyl benzyl phthalate	8270 (EPA 1986)	100 µg/kg
Di-n-butyl phthalate	8270 (EPA 1986)	100 µg/kg
Di-n-octyl phthalate	8270 (EPA 1986)	100 µg/kg
Diethyl phthalate	8270 (EPA 1986)	100 µg/kg
Dimethyl phthalate	8270 (EPA 1986)	100 µg/kg

TABLE 2.3. (contd)

<u>Analyte</u>	<u>Reference Method</u>	<u>Detection Limit</u>
Metals (Sediment)		
Antimony	ICP/MS (EPA 1990b)	0.1 mg/kg
Arsenic	ICP/MS (EPA 1990b)	0.1 mg/kg
Beryllium	ICP/MS (EPA 1990b), GFAA (EPA 1986)	0.2 mg/kg, 0.1 mg/kg
Cadmium	GFAA (EPA 1986)	0.1 mg/kg
Chromium	ICP/MS (EPA 1990b), GFAA (EPA 1986)	0.6 mg/kg, 0.1 mg/kg
Copper	ICP/MS (EPA 1990b)	0.1 mg/kg
Lead	ICP/MS (EPA 1990b)	0.1 mg/kg
Mercury	CVAA (EPA 1986)	0.01 mg/kg
Nickel	ICP/MS (EPA 1990b)	0.1 mg/kg
Selenium	GFAA (EPA 1986)	0.2 mg/kg
Silver	GFAA (EPA 1986)	0.1 mg/kg
Thallium	ICP/MS (EPA 1990b)	0.1 mg/kg
Zinc	ICP/MS (EPA 1990b)	0.3 mg/kg
Metals (Tissue)		
Antimony	ICP/MS (EPA 1990b)	0.1 mg/kg
Arsenic	ICP/MS (EPA 1990b), GFAA (EPA 1986)	0.1 mg/kg
Beryllium	ICP/MS (EPA 1990b), GFAA (EPA 1986)	0.2 mg/kg, 0.1 mg/kg
Cadmium	ICP/MS (EPA 1990b)	0.1 mg/kg
Chromium	ICP/MS (EPA 1990b), GFAA (EPA 1986)	0.6 mg/kg, 0.1 mg/kg
Copper	ICP/MS (EPA 1990b)	0.1 mg/kg
Lead	ICP/MS (EPA 1990b)	0.1 mg/kg
Mercury	CVAA (EPA 1986)	0.01 mg/kg
Nickel	ICP/MS (EPA 1990b)	1.0 mg/kg
Selenium	ICP/MS (EPA 1990b), GFAA (EPA 1986)	0.3 mg/kg, 0.2 mg/kg
Silver	ICP/MS (EPA 1990b)	0.1 mg/kg
Thallium	ICP/MS (EPA 1990b)	0.1 mg/kg
Zinc	ICP/MS (EPA 1990b)	0.3 mg/kg
Butyltins		
Monobutyltin	Unger et al. (1986)	10 µg/kg
Dibutyltin	Unger et al. (1986)	10 µg/kg
Tributyltin	Unger et al. (1986)	10 µg/kg

- (a) Detection limits are in dry weight for all sediment parameters and for metals in tissues. Detection limits are in wet weight for all organic tissue parameters.
- (b) NA Not applicable.

TABLE 2.4 Data Quality Objectives for Sediment and Tissue Chemistry and Toxicity Tests

<u>Parameter</u>	<u>QC Measurement</u>	<u>Frequency</u>	<u>Acceptable Limits</u>
Organics^(a)			
PAHs, PCBs, Pesticides, Butyltins, Phenols, Phthalate Esters, and Dioxins	Procedural blank Surrogate internal standards (SIS) Matrix spike/matrix spike duplicate (MS/MSD) Laboratory triplicates Standard reference material	1 per 20 samples Each sample 1 per 10 samples 1 per 10 samples 1 per 20 samples	< Method Detection Limit (MDL) 40% - 120%(b) 40% - 120%(b) ≤ 30%(c) between MS/MSD ≤ 30%(d) for analytes > 10 x MDL ≤ 30%(e) from certified value
Metals^(a)			
Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Ti, Zn	Method blank Matrix spike Laboratory triplicates Standard reference material	1 per 20 samples 1 per 10 samples 1 per 10 samples 1 per 20 samples	< DL x 3 75 - 125%(b) ≤ 20%(d) ≤ 30%(e) from certified value
Conventional^(f)			
Grain Size Total Organic Carbon	Laboratory triplicates Laboratory triplicates Standard reference material (g)	1 per 10 samples 1 per 10 samples 1 per 20 samples	≤ 20%(d) ≤ 10%(d) ≤ 20%(e) from established value
Oil and Grease	Method blank Matrix spike/matrix spike duplicates (MS/MSD) Laboratory triplicates	1 per 20 samples 1 per 10 samples 1 per 10 samples	< MDL 50% - 150%(b) ≤ 20%(c) between MS/MSD ≤ 30%(d)

TABLE 2.4 (Continued)

Parameter	QC Measurement	Frequency	Acceptable Limits
Total Sulfides	Method blank Laboratory triplicates	1 per 20 samples 1 per 10 samples	< MDL ≤ 30%(d)
Total Solids	Laboratory triplicates Comparability	1 per 10 samples Batch comparisons	≤ 20%(d) ≤ 20%(c) of surrogate or spike recoveries
Specific Gravity	Laboratory triplicates	1 per 10 samples	≤ 20%(d)
Cyanide	Laboratory triplicates	1 per 10 samples	≤ 20%(d)
Total Kjeldahl Nitrogen	Laboratory triplicates	1 per 10 samples	≤ 20%(d)
Toxicity Tests			
Acute Toxicity Tests	Reference toxicant test	Concurrent with each test	≤ 10% mortality in controls, >50% mortality at high concentration, and a minimum of 2 but preferably 3 partial responses - this criteria would not fail the test but rather would require qualification of the LC50 results
Suspended Particulate Phase Tests (Non-Larval)	Native sediment control 0% Control	Concurrent with each test	≤ 10% mortality
Suspended Particulate Phase Test (Larvae)	0% Control	Concurrent with each test	≤ 10% mortality
Bioaccumulation Studies	Native sediment control	Concurrent with each test	≤ 30% mortality
		Concurrent with each test	≤ 20% mortality

(a) Applies to sediments and tissues.

(b) Percent Recovery.

(c) Relative Percent Difference (RPD).

(d) Relative Standard Deviation (RSD).

(e) Percent Difference (PD).

(f) Applies to sediments only.

(g) SRM used is not certified for TOC (value used to calculate RPD is based on average of historical analysis).

Island, Washington. Grain size and total solids analyses followed the procedures described in Plumb (1981); specific gravity analysis was consistent with ASTM Method D-854. Seventeen grain-size fractions (expressed in microns) were quantified: 4750, 2000, 850, 425, 250, 149, 75, 62.5, 48, 31.2, 23, 15.6, 7.8, 3.9, 1.9, 0.9, and 0.4883. These data are reported as "apparent" grain size, as organic material is included in the analysis. Specific gravity determinations were made on the minus U.S. No. 40 sieve portion of the grain size samples. Total solids, reported as percent, were determined after oven drying at 90°C. Analysis of TOC was performed by Global Geochem, Canoga Park, California, following Method 5310 (APHA 1989).

Total organic carbon is the amount of non-volatile, partially volatile, volatile, and particulate organic carbon compounds in a sample. Each sediment treatment was dried and ball milled to a fine powder. Before combustion, inorganic carbon in the sample was removed by acidification. The TOC in sediment was then determined by measuring the carbon dioxide released during combustion of the sample and reported as percent of dry weight. The AVS analyses were performed by the MSL. Sulfide analysis was conducted on sediment samples following the methodology described in Cutter and Oatts (1987). This technique employs selective generation of hydrogen sulfide, cryogenic trapping, gas chromatographic separation, and photoionization detection. Cyanide, oil and grease, and TKN were measured by Analytical Resources, Inc., Seattle, Washington. Cyanide was measured using a titrimetric/photometric method described in EPA Method 335.2 (EPA 1979). This standard acid reflux distillation measures free cyanide, simple cyanide, and most complexed cyanides. Released cyanides (HCN or CN⁻) are trapped in a basic absorbing medium (1M NaOH), which is then analyzed for cyanide. Total oil and grease includes vegetable oils, animal fats, soaps, waxes, and any other carbon-hydrogen material extractible by the solvent Freon. Infrared spectrophotometry (IR) was used to determine concentrations of oil and grease (Method 413.2, EPA 1979). A 20-g aliquot of sample was dried with anhydrous sodium sulfate and extracted with Freon. For total oil and grease, sample extracts were scanned from 4000 to 600 cm⁻¹ on an IR and the peak height measured at 2930 cm⁻¹. This wavelength represents the -CH₂ configurations of hydrocarbons and was the standard used to determine oil and grease. Total Kjeldahl nitrogen was measured according to EPA Method 351.4 (EPA 1979). This procedure measures nitrogen in the trinegative state (NH₃ and amino N). Organic nitrogen (predominately amino nitrogen) is digested in an acid medium in the presence of potassium sulfate (with or without metal surfactant catalyst) and is converted to ammonium sulfate during the digestion. Following digestion, sulfate is distilled and analyzed directly by Ion Selective Electrode (ISE) analysis.

2.4.2 Polynuclear Aromatic Hydrocarbons

Analyses for 18 PAHs in the Wilmington Harbor sediment samples and tissues were performed by Battelle Ocean Sciences (BOS) in Duxbury, Massachusetts. Analysis of these

compounds followed EPA SW- 846 Method 8270 (EPA 1986). Sediment and tissue samples were extracted two to three times consecutively using a roller technique. The extracts were dried over sodium sulfate, passed through a cleanup column, and concentrated in preparation for further cleanup by liquid chromatography. Tissue extracts were run through gel permeation chromatography (GPC) prior to analysis to remove any additional interferences. The PAHs in sample extracts were analyzed via high resolution capillary gas chromatography/mass spectrophotometry (GC/MS). A data system provided for the identification and measurement of the selected PAHs listed in Table 2.3 in a selective ion mode (SIM). In the SIM mode, each PAH compound was monitored simultaneously for the presence of a parent ion and a confirming second ion.

2.4.3 Chlorinated Pesticides and PCBs

The PCB and pesticide analyses for the Wilmington Harbor sediment and tissue samples were performed by BOS in Duxbury, Massachusetts. Chlorinated pesticides and PCBs in sediments (PCBs only were analyzed in tissues) were quantified by gas chromatography/electron capture detection (GC/ECD) following EPA SW-846 Method 8080 (EPA 1986).

Chlorinated pesticides and PCBs were extracted simultaneously with the PAH compounds using the roller technique as described for PAHs. The procedure involved a multiple methylene chloride extraction. A portion of the methylene chloride extract was solvent exchanged to hexane, and interferences were removed by passing the extract through a column packed with 10 g of 2% deactivated alumina and 20 g of 2% deactivated silica. Most samples required an additional cleanup treatment using High Performance Liquid Chromatography (HPLC) to remove other interferences. Analytical quantification was performed using GC/ECD analysis. Tetrachlorometaxylene (TCMX) and Octachloronaphthalene (OCN) were added to each sample before extraction to assess extraction efficiency.

2.4.4 Dioxins

Dioxin analysis in sediment samples was performed by Battelle Columbus Operations, Columbus, Ohio, following the procedures summarized in EPA SW846, Method 8290 (EPA 1990a). This analytical method uses high-resolution gas chromatography and high resolution mass spectrometry (HRGC/HRMS) on purified sample extracts. Samples were spiked with a solution containing nine isotopically labeled PCDD/PCDF compounds, and extracted according to a matrix-specific procedure. Sediment and soil samples underwent a toluene or benzene Soxhlet extraction; tissue samples underwent a hexane/methylene chloride Soxhlet extraction. The extracts are subjected to an acid-base washing and then dried. Following a solvent-exchange step, the residues were cleaned up by column chromatography, and were spiked with $^{13}\text{C}_{12}$ -1,2,3,4-TCDD to determine percent recoveries of tetra- and pentachlorinated PCDD/PCDF

congeners, and with $^{13}\text{C}_{12}$ -1,2,3,7,8,9-HxCDD to determine percent recoveries of hexa-, hepta-, and octachlorinated PCDD/PCDF congeners. The extracts were injected into a HRCG/HRMS system capable of performing in the SIM mode. Significant revisions to Method 8290 were as follows:

- Use of additional $^{13}\text{C}_{12}$ -labelled internal standards so that each 2,3,7,8-substituted PCDD/PCDF isomer could be related to an internal standard for identification and quantification purposes. Use of a complete range of internal standards provided better accuracy than afforded by current Method 8290 procedures.
- Use of $^{37}\text{C}_{14}$ -labelled 2,3,7,8-tetra-CDD as a cleanup recovery standard. This cleanup recovery standard was added to sample extracts prior to cleanup to evaluate analyte recovery through cleanup procedures. Procedures similar to EPA Method 1613 were followed for this cleanup recovery standard. This cleanup recovery standard provided an additional measure of quality control.
- Routine calibration at only the beginning of the analytical period rather than at the beginning and end of the analytical period. This did not appear to affect data quality.

2.4.5 Phenols, Substituted Phenols, and Phthalate Esters

Phenols, substituted phenols, and phthalate esters in sediment were analyzed by BOS in Duxbury, Massachusetts, following EPA Method 8270 (EPA 1986). This method is appropriate for the extraction of semivolatile priority pollutants from sediment and tissue samples for analysis by GC. In this procedure, approximately 100 g of sediment was extracted using 2:1 (V:V) dichloromethane/methanol in a Soxhlet extractor. The extract was partitioned with water, then dried through a column of anhydrous sodium sulfate. Elemental sulfur was removed using metallic mercury. Biological macromolecules were removed by cleanup with GPC. A portion of the extract underwent alumina column chromatography to separate polar compounds from pesticides and PCBs prior to capillary GC/ECD analysis. The remaining extract underwent reverse phase column chromatography (bonded C_{18} solid phase) to reduce interferences from unresolved paraffinic hydrocarbons prior to capillary GC/MS analysis for acid, base, and neutral compounds.

2.4.6 Metals

Metals in sediment and tissue samples were analyzed at the MSL. Three techniques were used for the analysis of sediment: inductively coupled plasma/mass spectroscopy (ICP/MS), Graphite Furnace Atomic Absorption (GFAA), and Cold Vapor Atomic Absorption (CVAA). The ICP/MS procedure follows EPA 200.8 (EPA 1990b). The GFAA methodology is summarized in EPA SW846, 7000 Series, which was adapted into MSL SOP MSL-M-033. The CVAA methodology is summarized in EPA SW846, 7000 series, which was adapted into MSL SOP MSL-M-031. Sediments were analyzed for a total of 13 metals: Antimony (Sb), Arsenic

(As), Beryllium (Be), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Selenium (Se), Silver (Ag), Thallium (Tl), and Zinc (Zn). The analytical techniques used for these analyses are summarized in Table 2.5.

To prepare sediment and tissues for analysis, samples were freeze-dried and blended in a Spex mixer-mill. Approximately 5 g of mixed sample was ground in a ceramic ball mill. For ICP/MS, GFAA, and CVAA analyses, 0.2- to 0.5-g aliquots of dried homogenous sample went through an acid digestion process to separate and isolate the metals from the matrix.

2.4.7 Organotins

Organotins in sediment and tissues were analyzed at the MSL in Sequim, Washington. Butyltin compounds in sediment and tissues were analyzed using gas chromatography/flame photometric detection (GC/FPD) following the methods of Unger et al. (1986).

Wet samples were extracted with methylene chloride and tropolone. Propyltin and triphenyltin were added before extraction as a surrogate compound to assess extraction efficiency. The mono-, di-, and tributyltin compounds extracted from the sediment and tissues were derivatized to a less volatile, more thermally stable form (nonionic n-hexyl/or n-pentyl derivatives).

The extracts were passed through a florisil liquid chromatography column for cleanup and the butyltins were quantified by GC/FPD.

2.5 DATA ANALYSIS AND INTERPRETATION

Several statistical analyses were conducted to determine the magnitude and significance of toxicity and bioaccumulation in test treatments relative to reference treatments.

TABLE 2.5. Analytical Method for Analyzing Metals in Sediment and Tissue Matrices

<u>Sediment</u>			<u>Tissue</u>		
<u>ICP/MS</u>	<u>GFAA</u>	<u>CVAA</u>	<u>ICP/MS</u>	<u>XRF</u>	<u>GFAA</u>
Be	As	Hg	As	Cr	Be
Cd	Sb		Ag	Ni	Hg
Cr	Se		Cd	Se	Sb
Cu	Ag		Cu		
Pb			Pb		
Ni			Zn		
Tl			Tl		
Zn					

Each statistical test was based on a completely random design that allowed unbiased comparison between treatments. The *1991 Implementation Manual* recommends Dunnett's Test for comparing test treatments to a single reference treatment. This test was used to evaluate all SP tests, including toxicological and bioaccumulation exposures. Test design and specific statistical analysis procedures are discussed in the following sections.

2.5.1 Randomization

All SP and SPP toxicity tests were designed as completely random tests. Organisms were randomly allocated to treatments, and treatments were randomly positioned on water tables. To determine the randomization, a random number table was generated for each toxicity test using the discrete uniform random number generator in the Lotus 123 spreadsheet software. For the SPP tests, *M. beryllina*, *M. bahia*, and larval *L. pictus* tests were randomly allocated to SPP replicates for all concentrations.

2.5.2 Statistical Analysis of Solid-Phase Tests

Solid-phase toxicity of all sediment treatments was compared by analysis of variance (ANOVA) tests on the arcsine square-root of the proportion of organisms surviving the test. The arcsine square-root transformation stabilizes the within-class variances to meet the assumptions of the ANOVA. All treatments were compared using the Dunnett's Test for comparison of all test treatments to the reference WREF using an experiment-wise error rate of $\alpha = 0.05$.

2.5.3 Statistical Analysis of Suspended-Particulate-Phase Tests

Two statistical tests are presented in the *1991 Implementation Manual* for the interpretation of SPP tests. The first test is a one-sided t-test between survival in control replicates and survival in the 100% SPP replicates. This test is to be performed only when survival in the 100% SPP is less than control (0% SPP) survival and when control survival is greater than 90% for non-larval tests and 70% for larval tests (indicating test validity). Prior to conducting the t-test, angular transformation (arcsine of the square root) of the proportion surviving in test replicates is performed to reduce possible heterogeneity of variance between control and 100% SPP mean survivals. The second test required by the *1991 Implementation Manual* is an LC_{50} calculation, the concentration of SPP that is lethal to 50% of the individuals tested. The LC_{50} values for these tests are calculated using the Trimmed Spearman-Kärber Method (Finney 1971). The Spearman-Kärber estimator is appropriate only if there is increasing mortality with increasing concentration and if 50% or greater mortality is observed in test solutions when normalized to control survival. If 50% mortality does not occur in the 100% SPP dilutions for any treatments, then LC_{50} values are reported as >100% SPP. The same method was used

to calculate EC₅₀ values (the concentration where 50% of the test individuals show a certain effect) for the sea urchin SPP test and LC₅₀ values for all reference toxicant tests.

2.5.4 Statistical Analysis of Bioaccumulation

Before statistical analysis of *M. nasuta* and *N. virens* tissue concentrations, a visual inspection of the tissue chemistry data was performed. If visual inspection showed that a compound was undetected in the majority of replicate samples in test treatments or that the mean tissue concentration in the reference treatments was greater than that in the test treatments, no further analysis was performed. If the detected concentration of a compound exceeded that of the reference treatment, statistical analysis was performed. In all cases, detection limits were used in numerical calculations when a compound was undetected.

Treatments where contaminants of concern were detected were compared to all reference treatments using ANOVA and Dunnett's Test for comparison of test treatments to the reference WREF. Analytical detection limit values were used for replicates where the compound was not detected. If all replicates of a test treatment were flagged with U, J, or UJ qualifications by the analytical laboratory, the data comprising that treatment were not analyzed. Significant bioaccumulation of a contaminant was determined by the statistical results of Dunnett's Test at $\alpha = 0.05$.

2.6 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

The QA/QC procedures followed for these studies were consistent with the 1991 *Implementation Manuals* and the EPA protocols (PSEP 1986). The procedures followed were documented by Pacific Northwest Laboratory (PNL) Quality Engineering Division as a QA Plan. A member of PNL's quality engineering staff was present throughout each phase of these studies to ensure that accepted procedures were followed. Laboratory Record Books (LRB) were assigned to each portion of the study and served as records of day-to-day activities during the research. All entries in the laboratory notebooks were signed, dated, and reviewed by both the project manager and the quality assurance engineer. The following discussion summarizes QA/QC procedures followed for sediment sampling, biological testing, and chemical testing.

2.6.1 Sample Tracking and Storage

All sediment samples were accompanied by chain-of-custody forms from the time of collection to receipt at MSL. After sample selection and compositing, a new set of custody forms was initiated for the sediment subsamples requiring chemical analyses. These accompanied the samples to the appropriate laboratory where the forms were signed and returned to the MSL project manager. Custody forms were also initiated for all tissue samples upon completion of the

biological testing. These forms accompanied the samples to the appropriate laboratory for chemical analyses.

All sediment collected for these studies was stored in glass, cellulose acetate butyrate containers, or steel drums lined with 9-C-4-A-phenolic epoxy, a noncontaminating coating. Sediment cores and grab samples were stored at 4°C prior to biological testing. Subsamples of sediment for chemical analyses and archival were obtained prior to biological testing. These subsamples were stored frozen (-20°C) until chemical analyses were performed. Samples for organic analyses were stored frozen up to 2 months (PSEP 1986). Samples for metals were freeze dried upon receipt at the laboratory and held up to 6 months (PSEP 1986; USACE 1990).

Tissue samples were frozen immediately upon completion of the bioaccumulation tests. Samples for organic analyses were stored in precleaned glass jars with Teflon-lined lids. Samples for metals analyses were stored in precleaned plastic jars. Samples for organic analyses were held up to 2 months prior to analysis. Samples for metals were held up to six months prior to analysis.

2.6.2 Sediment and Tissue Chemistry Quality Control Procedures

Chemical testing procedures require that specific QA/QC protocols be followed. The QA/QC guidelines specific to this project are provided in the PNL Quality Assurance Plan. These guidelines include the following:

- analysis of a method blank with each batch of 20 samples
- analysis of surrogate internal standards with each sample
- analysis of matrix spikes on 10% of the samples (where applicable) with appropriate compounds to assess accuracy
- triplicate analyses on at least 5% of the samples (triplicate analyses where possible) to assess analytical precision
- analysis of SRMs at a frequency of 5%, if available for the analytes of interest and sample matrix
- archival of all instrument printouts (e.g., raw data and chromatograms from AA and GC analyses) for future review.

In actual practice, some of the specific guidelines listed in the QA Plan for analytical precision and accuracy were modified to apply to the most current methods employed by laboratories. The guidelines for detection limits, range of recovery, and relative precision are listed in the Wilmington Harbor Project QA Plan provided to USACE by MSL.

Measurements of accuracy can be determined by analyzing MS of known concentrations and SRMs that have been certified for the presence of specific parameters. The MS were analyzed for metals and organic parameters and are generally made up of a subset of the analytes of interest. Percent recoveries were calculated based on the differences between the amount spiked and the amount recovered in the sample. Metal spikes were analyzed at a frequency of 5% and organic compound spikes were generally analyzed at 5%. Analytical accuracy is measured through the analysis of SRMs. In sediment, SRMs were analyzed for metals, PAHs, and organic compounds; in tissues, SRMs were analyzed for metals only. Surrogate compounds were added in known amounts to samples analyzed for PCBs, pesticides, PAHs, dioxins, and butyltins. Surrogate compounds were added to samples prior to extraction and their recoveries were a measurement of the efficiency or procedural accuracy of the analysis.

Measurements of precision were obtained through replicate analysis of selected sediment treatments. Analysis of replicates shows the precision and repeatability of the results. The measurements of precision are the industrial statistic (I-stat) and relative percent difference (RPD) for duplicate analyses, and the relative standard deviation (RSD) for triplicate analyses. The I-stat is defined as the absolute value of the difference between duplicate measurements divided by the sum of the duplicates. The RPD is defined as the absolute value of the difference between two duplicate measurements, divided by the mean of the duplicates, multiplied by 100. The RSD is defined as the sample standard deviation, divided by the mean, multiplied by 100. All instrument printouts and other raw data generated using MSL analytical instruments are filed at MSL for future reference. Procedures and related data were written into the appropriate LRB. Copies of data generated by offsite analytical facilities are maintained at the MSL.

2.6.3 Toxicological Testing Quality Control Procedures

Appropriate procedures for organism care were maintained from collection through testing. Organisms shipped to MSL were gradually equilibrated to ambient surroundings and kept in their native sediment whenever possible. Animals were fed if necessary before biological testing. Information on the collecting and handling of each test species is included in Section 2.1.3. Selection of species was consistent with the *1991 Implementation Manual* and involved the use of juvenile forms, burrowing invertebrates, deposit feeding organisms, and a larval (planktonic) form. Representatives of all test organisms were taxonomically identified by qualified experts at MSL before use in testing. During testing, water quality parameters were measured to ensure that acceptable experimental conditions were maintained. These conditions included a stable temperature ($\pm 2.0^{\circ}\text{C}$), minimum DO representing at least 60% saturation and controlled levels of light each day. Salinity was permitted to vary $\pm 2.0\%$, and pH was allowed to vary ± 0.5 units within each test container during the testing period. These limits and values are consistent with

those outlined in the *1991 Implementation Manual*. Water quality instruments were calibrated according to the manufacturer's specification or PNL protocols.

3.0 RESULTS

3.1 FIELD COLLECTIONS

Table 3.1 summarizes the test and reference sediment collection information for the Wilmington Harbor Program. Sediment samples were collected June 29 through July 1, 1992. Three samplers were used in support of this study: an MSL-designed sand dredge, a 0.1-m² van Veen grab, and a small vibracore. The sand dredge was used at the WHREF and WHFINE stations where surficial sediment was required and penetration to deeper sediment depths was not necessary. The van Veen grab sampler was used when the thickness of sediment to be sampled was less than 1 ft, and the vibracore was used to obtain sediment samples deeper than 1 ft. The vibracore was extremely effective at collecting sediment at stations representing new-work dredging at the Military Ocean Terminal, Sunny Point (designated MOTNW). At these locations, the vibracore collected sediment representing new-work dredging material to a maximum depth of -41.2 ft. MLLW. Figures 3.1 through 3.5 show the sampling locations for test and reference sediment collections.

3.2 SEDIMENT CHEMISTRY

Sediment representing test treatments BSCMA, KICMA, MOTMA, MOTNW, and reference treatment WHREF were analyzed for a variety of contaminants. Included in these analyses were measurements of conventional sediment parameters, PAHs, chlorinated pesticides, PCBs, dioxins, phenols, phthalates, metals, and organotins. The purpose of these measurements was to provide an accurate characterization of contaminants associated with the sediments, and use the resulting data to assess which contaminants might potentially bioaccumulate into biota, represented in this study by the clam *M. nasuta* and the polychaete *N. virens*. Tissues of *M. nasuta* and *N. virens* were then analyzed for contaminants of concern and statistically evaluated to determine whether there was a potential for bioaccumulation. Contaminants of concern to be analyzed in tissue samples were decided upon jointly by USACE and EPA Region IV representatives after examination of sediment chemistry results. Technical assistance in sediment chemistry data interpretation was provided by MSL.

3.2.1 Conventional Measurements

Conventional parameters measured in sediment are summarized in Table 3.2 and Table 3.3. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, Tables B.1 to B.5, B.28, and B.29. Quality control evaluations presented in Appendix B indicate that holding times were met, blanks were uncontaminated, detection limits goals were achieved, and surrogate standard, matrix spike, replication, and SRM

TABLE 3.1. Field Collection Summary for the Wilmington Harbor Program

<u>Station</u>	<u>Date Sampled</u>	<u>MLLW Water Depth, ft</u>	<u>Sampler</u>	<u>Penetration Depth, ft</u>	<u>Depth Range Sampled, ft</u>
BSCMA 1	30-Jun-92	35.7	van Veen Grab	0.5	-35.7 to -36.2
BSCMA 2	30-Jun-92	34.1	van Veen Grab	0.5	-34.1 to -34.6
BSCMA 3	30-Jun-92	34.6	van Veen Grab	0.5	-34.6 to -35.1
BSCMA 4	30-Jun-92	36.2	van Veen Grab	0.5	-36.2 to -36.7
BSCMA 5	30-Jun-92	39.2	van Veen Grab	0.5	-39.2 to -39.7
KICMA 1	29-Jun-92	33.2	van Veen Grab	0.5	-33.2 to -33.7
KICMA 2	29-Jun-92	32.1	Vibracore	6.3	-32.1 to -38.4
KICMA 3	29-Jun-92	33.8	van Veen Grab	0.5	-33.8 to -34.3
KICMA 4	29-Jun-92	33.1	van Veen Grab	0.5	-33.1 to -33.6
KICMA 5	29-Jun-92	34.0	van Veen Grab	0.5	-34.0 to -34.5
MOTMA 1	1-Jul-92	35.2	van Veen Grab	0.5	-35.2 to -35.7
MOTMA 2	1-Jul-92	34.4	van Veen Grab	0.5	-34.4 to -34.9
MOTMA 3	1-Jul-92	27.1	Vibracore	7.7	-27.1 to -34.8
MOTMA 4	1-Jul-92	21.6	van Veen Grab	0.5	-21.6 to -22.1
MOTMA 5	1-Jul-92	36.5	van Veen Grab	0.5	-36.5 to -37.0
MOTNW 1	1-Jul-92	34.2	Vibracore	4.0	-34.2 to -38.2
MOTNW 2	1-Jul-92	35.9	Vibracore	5.3	-35.9 to -41.2
MOTNW 3A	1-Jul-92	30.8	Vibracore	7.8	-30.8 to -38.6
MOTNW 4	1-Jul-92	3.2	Vibracore	9.7	-3.2 to -12.9
MOTNW 5	1-Jul-92	2.4	Vibracore	8.0	-2.4 to -10.4
WHPREF 1	30-Jun-92	45.7	Sand Dredge	0.1	surface
WHPREF 2	30-Jun-92	46.2	Sand Dredge	0.1	surface
WHPREF 3	30-Jun-92	46.8	Sand Dredge	0.1	surface
WHPREF 4A	30-Jun-92	45.4	Sand Dredge	0.1	surface
WHPREF 5	30-Jun-92	42.7	Sand Dredge	0.1	surface
WHFINE 1	30-Jun-92	20.5	van Veen Grab	0.3	-20.5 to -20.8
WHFINE 1	30-Jun-92	20.2	van Veen Grab	0.3	-20.2 to -20.5
WHFINE 2	30-Jun-92	20.1	van Veen Grab	0.3	-20.1 to -20.4
WHFINE 2	30-Jun-92	20.0	van Veen Grab	0.3	-20.0 to -20.3

FIGURE 3.1. Baldhead Shoal Channel (BSCMA) Sediment Sampling Locations

FIGURE 3.2. Keg Island Channel (KICMA) Sediment Sampling Locations

FIGURE 3.3 MTSU Basin 1 Sediment Sampling Locations (MOTMA, MOTNW)

FIGURE 3.4. MTSU Basin 2 Sediment Sampling Locations (MOTMA, MOTNW)

FIGURE 3.5. Reference Sediment Sampling Locations (WHREF, WHFINE)

criteria were generally within QA limits. The overall assessment of these analyses indicate that these data are acceptable for use in evaluating sediment-bound contaminants.

Table 3.2 shows that percent solids ranged from 30% to 82%, with the highest value recorded in the WHREF reference treatment. Specific gravity was relatively consistent, ranging from 2.57 to 2.78. The grain size results summarized in Table 3.2 show that sediment treatments BSCMA and MOTMA were composed primarily of silt and clay, while KICMA and MOTNW were more than 50% sand. The reference treatment WHREF was almost entirely composed of sand.

Table 3.3 summarizes TOC, AVS, oil and grease, cyanide, and TKN in sediment samples. The TOC levels ranged from 2.26% to 3.31% and were highest in test treatment MOTNW. The AVS ranged from 0.019 $\mu\text{mol/g}$ in reference treatment WHREF to 24.90 $\mu\text{mol/g}$ in test treatment MOTMA. Oil and grease concentrations ranged from 184.0 mg/kg in WHREF to over 700 mg/kg in MOTMA. Cyanide was undetected in all treatments; TKN ranged from 55.0 mg/kg N in treatment WHREF to over 3000 mg/kg in treatment BSCMA. These data suggest that elevated levels of AVS, oil and grease, and TKN are present in test treatments relative to the reference treatment WHREF. The AVS was 800 to 1300 times higher in test treatments relative to the reference treatment WHREF. Oil and grease concentrations were approximately two to four times higher in test treatments relative to reference treatment WHREF; TKN levels were 17 to 55 times higher.

3.2.2 Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic hydrocarbon concentrations are summarized in Table 3.4. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, Tables B.6 to B.11. Quality control evaluations for PAHs indicate that holding times were met, blanks showed no evidence of contamination (with the exception of low levels of

TABLE 3.2. Summary of Percent Solids, Specific Gravity, and Grain Size in Sediment Samples

<u>Compound</u>	<u>BSCMA</u>	<u>KICMA</u>	<u>MOTMA</u>	<u>MOTNW</u>	<u>WHREF</u>
Percent Solids	31.0	40.0(a)	30.0	47.0	82.0
Specific Gravity	2.78	2.57	2.65	2.67(a)	2.67
Percent Gravel ($\geq 2000 \mu\text{m}$)	0.0	0.0	0.0	0.0(a)	0.0
Percent Sand (62.5 to $2000 \mu\text{m}$)	16.0	56.0	30.0	58.0(a)	98.0
Percent Silt (3.0 to $62.5 \mu\text{m}$)	41.0	21.0	25.0	14.0(a)	0.0
Percent Clay ($< 3.9 \mu\text{m}$)	43.0	23.0	45.0	28.0(a)	2.0

(a) Mean of replicate measurements.

TABLE 3.3. Summary of Total Organic Carbon (TOC), Acid Volatile Sulfides (AVS) , Oil and Grease, Cyanide, and Total Kjeldahl Nitrogen (TKN) in Sediment Samples (dry weight)

Compound	BSCMA	KICMA	MOTMA	MOTNW	WHREF
TOC (%)	2.26	2.95(a)	3.18	3.31	2.44
AVS (μmol/g dry)	16.70(a)	20.80	24.90	19.00	0.019
Oil and Grease (mg/kg)	372.0(a)	453.0	705.0	317.0	184.0
Cyanide (mg/kg Cn)	0.032 U(b)	0.024 U	0.033 U	0.021 U	0.011 U
TKN (mg/kg N)	3060.0	941.0(a)	2200.0	1020.0	55.0

(a) Mean of replicate measurements.

(b) U Analyte was not present above the level of associated value.

naphthalene), surrogate recoveries were appropriate, and there was relatively good precision in replicate analysis. Matrix spike recovery was generally higher than QA limits, and analyses of SRMs indicated an overestimate of certified concentrations. These data suggest that PAH concentrations were probably overestimated in these sediments. The overall assessment of the PAH analyses suggests that despite some data quality exceedences, these data are acceptable for use in evaluating sediment-bound contaminants.

Table 3.4 summarizes the low molecular weight PAHs (LPAH), high molecular weight PAHs (HPAH) and total PAH. This table shows that the highest observed total PAH concentrations occurred in the KICMA and MOTMA test treatments, where total PAH levels were 799.38 and 683.82 μg/kg, respectively. The lowest levels (4.06 μg/kg) were observed in the reference treatment WHREF. Treatments BSCMA and MOTNW were approximately the same, at 298.15 and 286.93 μg/kg, respectively. In most cases, the majority of the measured PAHs were HPAH. These data indicate that elevated levels of PAHs were present in all test treatments relative to the WHREF reference treatment. Observed total PAH levels in the test treatments were 71 to 200 times higher than those measured in WHREF. Because elevated levels of PAHs were observed in all test treatments relative to WHREF, it was decided that tissues of *M. nasuta* and *N. virens* should be analyzed for these compounds.

TABLE 3.4. Summary of Total LPAH, HPAH, and Total PAH in Sediment Samples

Compound	Concentration, μg/kg dry weight				WHREF
	BSCMA	KICMA	MOTMA	MOTNW(a)	
Total LPAH	52.86	85.98	100.23	38.06	2.11
Total HPAH	245.29	713.40	583.59	248.87	1.95
Total PAH	298.15	799.38	683.82	286.93	4.06

(a) Mean of replicate measurements.

3.2.3 Chlorinated Pesticides and PCBs

Chlorinated pesticide and PCB concentrations are summarized in Table 3.5. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, Tables B.12 through B.18. Quality control evaluations for pesticides presented in Appendix B show that holding time limits were met, blank contamination was not observed, detection limit goals were met, and replicate results were within QA/QC limits. Matrix spike recovery was generally higher than QA limits, and analyses of SRMs indicated an overestimate of certified concentrations. Quality assurance data associated with PCB analyses was similar to that observed for pesticides, though detection limits were approximately two to three times higher than those specified in the QA Plan because of matrix interferences and the fact that each of these analytes are represented by multiple GC peaks.

The overall assessment of the pesticide/PCB analyses suggests that despite some data quality exceedences, these data are appropriate for use in evaluating sediment-bound contaminants. Because of elevated detection limits, however, the PCB data are less useful in assessing sediment contaminants.

Table 3.5 shows that all pesticide and PCBs were undetected in the test and reference sediment treatments. Elevated detection limits were observed for the pesticides chlordane and toxaphene and all of the Aroclor congeners. These data suggest that there is no evidence of elevated levels of pesticides relative to the WHEF reference treatment, though the high detection limits associated with two of the compounds indicate that they could be present above the target detection limit of 30 µg/kg. The PCB results show evidence of elevated levels of these compounds may also be present in the test treatments relative to the reference treatment, though matrix interferences and elevated detection limits reduce our confidence in these data. Because elevated detection levels associated with PCBs made it difficult to assess whether elevated levels were present in test sediment relative to WHEF, *M. nasuta* and *N. virens* tissues were analyzed for these compounds. Pesticide analysis was not performed, as all were undetected and most were below the target detection limit.

3.2.4 Dioxins

Dioxin concentrations are summarized in Table 3.6. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, Tables B.30 through B.33. Quality control evaluations for dioxins presented in Appendix B show that holding time limits were met, significant blank contamination was not observed, detection limit goals were met, and surrogate recoveries were generally within acceptable ranges. Matrix spike/matrix spike duplicates showed acceptable recovery for all congeners except OCDD, and triplicate analysis showed excellent precision. Analytical accuracy determination through the

TABLE 3.5. Summary of Pesticide and PCB Concentrations in Sediment Samples

Compound	Concentration, $\mu\text{g/kg}$ dry weight				
	BSCMA	KICMA	MOTMA	MOTNW ^(a)	WHREF
Aldrin	1.625 U ^(b)	1.325 U	1.867 U	1.109 U	0.646 U
A-BHC	0.776 U	0.633 U	0.892 U	0.530 U	0.308 U
B-BHC	0.776 U	0.633 U	0.892 U	0.530 U	0.308 U
D-BHC	0.776 U	0.633 U	0.892 U	0.530 U	0.308 U
Lindane	0.776 U	0.633 U	0.892 U	0.530 U	0.308 U
Chlordane	78.056 U	63.670 U	89.712 U	53.283 U	31.020 U
4,4'-DDE	0.994 U	0.811 U	1.142 U	0.679 U	0.395 U
4,4'-DDD	2.283 U	1.862 U	2.624 U	1.558 U	0.907 U
4,4'-DDT	2.434 U	1.985 U	2.797 U	1.662 U	0.967 U
Diekdin	1.558 U	1.271 U	1.790 U	1.064 U	0.619 U
Endosulfan I	7.806 U	6.367 U	8.971 U	5.328 U	3.102 U
Endosulfan II	7.806 U	6.367 U	8.971 U	5.328 U	3.102 U
Endosulfan Sulfate	7.806 U	6.367 U	8.971 U	5.328 U	3.102 U
Endrin	4.441 U	3.623 U	5.105 U	3.032 U	1.765 U
Endrin Aldehyde	7.806 U	6.367 U	8.971 U	5.328 U	3.102 U
Endrin Ketone	7.806 U	6.367 U	8.971 U	5.328 U	3.102 U
Heptachlor	2.113 U	1.724 U	2.429 U	1.443 U	0.840 U
Heptachlor Epoxide	1.796 U	1.465 U	2.065 U	1.227 U	0.714 U
Methoxychlor	7.806 U	6.367 U	8.971 U	5.328 U	3.102 U
Toxaphene	78.056 U	63.670 U	89.712 U	53.283 U	31.020 U
Aroclor 1221	78.056 U	63.670 U	89.712 U	53.283 U	31.020 U
Aroclor 1232	78.056 U	63.670 U	89.712 U	53.283 U	31.020 U
Aroclor 1242/1016	78.056 U	63.670 U	89.712 U	53.283 U	31.020 U
Aroclor 1248	78.056 U	63.670 U	89.712 U	53.283 U	31.020 U
Aroclor 1254	78.056 U	63.670 U	89.712 U	53.283 U	31.020 U
Aroclor 1260	78.056 U	63.670 U	89.712 U	53.283 U	31.020 U

(a) Mean of replicate measurements.

(b) U Analyte was not present above the level of the associated value.

analysis of SRMs was within quality control guidelines. The overall assessment of the dioxin analyses suggests that these data are acceptable for use in evaluating sediment-bound contaminants. Table 3.6 shows that many dioxin congeners were undetected or detected at sub-part per trillion (ng/kg) levels. The dioxin congener 2378-TCDD, considered the most toxic by EPA based on its Toxicity Equivalent Factors (TEF) (EPA 1988) was not detected in the test or reference treatments. Two other dioxin congeners considered one-half as toxic based on TEF rankings (12378-PeCDD and 23478 PeCDF) were either not detected or detected at less than the 1.0 ng/kg detection limit goal. Other dioxin congeners were detected and appeared in elevated concentrations relative to the reference treatment WHREF, but are considered much less toxic based on TEFs. The two test treatments with the most incidents of detected dioxin congeners were KICMA and MOTNW. Based on these data, it appears that there is some evidence of

TABLE 3.6. Summary of Dioxin Concentrations in Sediment Samples

Compound	Concentration, ng/kg dry weight				
	BSCMA	KICMA	MOTMA	MOTNW	WHREF(a)
2378-TCDD	0.40 U(b)	0.50 U	0.40 U	0.30 U	0.40 U
12378-PECDD	0.90 U	0.80 U	0.23	0.70 U	0.20 U
123478-HXCDD	0.40	0.31	0.47	0.35	0.23 U
123678-HXCDD	2.40 U	1.19	0.90	0.91	0.19 U
123789-HXCDD	2.04	1.89	1.64	2.17	0.21
1234678-HPCDD	23.40	30.17	24.26	30.84	1.69
OCDD	343.26	667.53	456.87	806.34	22.91
2378-TCDF	0.90 U	0.32	0.70 U	0.50 U	0.23 U
12378-PECDF	0.40 U	0.30 U	0.40 U	0.40 U	0.17 U
23478-PECDF	0.30 U	0.15	0.30 U	0.30 U	0.13 U
123478-HxCDF	1.10 U	0.33	0.40 U	0.12	0.20 U
123678-HxCDF	0.10	0.16	0.30 U	0.14	0.17 U
123789-HxCDF	1.10 U	0.48	0.90 U	0.45	0.36
234678-HxCDF	0.10 U	0.20 U	0.20 U	0.20 U	0.10 U
1234678-HpCDF	5.90 U	20.61	4.87	3.37	0.73 U
1234789-HpCDF	0.40 U	0.80 U	0.50 U	0.60 U	0.20 U
OCDF	2.61	18.13	6.23	5.08	0.44

(a) Mean of replicate measurements.

(b) U Analyte was not present above the level of the associated value.

elevated dioxin levels in test treatments relative to the reference WHREF, but in all cases, the elevated levels were represented by dioxin/furan congeners other than 2,3,7,8-TCDD. The most toxic forms of dioxin were not present and the less toxic congeners were present at sub part-per-trillion levels. After discussion with EPA Region IV and USACE, tissue analysis for dioxins was not performed.

3.2.5 Phenols, Substituted Phenols, and Phthalate Esters

Phenol and phthalate concentrations are summarized in Tables 3.7 and 3.8. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, Tables B.19 through B.23. Quality control evaluations for phenols presented in Appendix B show that holding time limits were met, significant blank contamination was not present, detection limit goals were met, and surrogate recoveries were generally within acceptable limits. Matrix spike/matrix spike duplicate analyses showed low recovery for three of the phenolic compounds. Replicate analyses yielded higher variability for five phenolic compounds than generally acceptable. Because this variability was represented by concentrations near the analytical detection limit, it is of minor importance. Quality assurance data associated with phthalate analyses was similar, though target detection limit goals were exceeded for the majority of the compounds. Analytical accuracy could not be assessed for either phenols or phthalates as

a SRM was not available. The overall assessment of the phenol and phthalate analyses suggests that these data are acceptable for use in evaluating sediment-bound contaminants, though low spike recoveries for both classes of compounds suggest an underestimate of contaminant concentration.

Concentrations of phenols and substituted phenols in sediment are presented in Table 3.7. Most phenolic compounds were not detected in test and reference treatments, or quantified below the analytical detection limit, indicated by a "J" flag on the data. There is evidence of elevated levels of only two phenolic compounds in test treatments relative to the reference treatment WHREF. Phenol was present in test treatments at levels ranging from 3 to 18 times the level observed in WHREF; 2,4-dimethyl phenol was observed in test treatments at levels ranging from 2 to 3 times that observed in WHREF. Both Phenol and 2,4-dimethyl phenol were quantified below the detection limit. Phthalate concentrations in sediment are summarized in Table 3.8. The data in this table suggest that enhanced levels of phthalates may be present in test treatments relative to the reference WHREF, but at concentrations that were quantified below the method detection limit or were undetected. Because most phenol and phthalate compounds were either not detected or detected below the target detection limit, tissues were not analyzed for these compounds.

3.2.6 Metals

The concentration of metals in sediment are summarized in Table 3.9. All data associated with these summaries and related quality assurance measurements may be found in Appendix B,

TABLE 3.7. Summary of Phenols and Substituted Phenols in Sediment Samples

Compound	Concentration, $\mu\text{g/kg}$ dry weight				
	BSCMA	KICMA	MOTMA	MOTNW ^(a)	WHREF
Phenol	168.00 J ^(b)	127.31 J	805.97 J	170.23 J	45.96 J
2,4-dimethyl phenol	5.09 J	7.51 J	7.39 J	6.46 J	2.42 J
2,4,6-trichlorophenol	756.81 U ^(c)	8.54 J	9.20 J	7.77 J	300.76 U
Parachloro 2-meta creosol	5.25 J	5.78 J	12.01 J	10.76 J	300.76 U
2-chlorophenol	756.81 U	617.33 U	869.84 U	5.21 J	300.76 U
2,4-dichlorophenol	756.81 U	8.00 J	4.79 J	6.62 J	300.76 U
2-nitrophenol	756.81 U	617.33 U	869.84 U	516.63 U	300.76 U
4-nitrophenol	3.30 J	617.33 U	4.95 J	1.73 J	300.76 U
2,4-dinitrophenol	756.81 U	617.33 U	869.84 U	516.63 U	300.76 U
2,4-dinitrocreosol	756.81 U	617.33 U	869.84 U	516.63 U	300.76 U
Pentachlorophenol	756.81 U	617.33 U	27.48 J	25.23 J	300.76 U

(a) Mean of replicate measurements.

(b) J Analyte detected below method detection limit, but above instrument detection limit.

(c) U Analyte was not present above the level of associated value.

TABLE 3.8. Summary of Phthalates in Sediment Samples

Compound	Concentration, $\mu\text{g/kg}$ dry weight				
	BSCMA	KICMA	MOTMA	MOTNW (a)	WREF
Dimethylphthalate	756.81 U(b)	1.65 J(c)	2.11 J	516.63 U	0.69 J
Diethylphthalate	756.81 U	2.50 J	4.51 J	6.51 J	0.27 J
Di-n-butylphthalate	7.09 J	341.33 J	3.88 J	4.83 J	1.67 J
Butylbenzylphthalate	3.19 J	4.42 J	5.05 J	3.45 J	1.72 J
Bis-(2-ethylhexyl)phthalate	7.07 J	10.35 J	11.10 J	6.64 J	5.52 J
Di-n-octylphthalate	756.81 U	617.33 U	869.84 U	516.63 U	300.76 U

(a) Mean of replicate measurements.

(b) U Analyte was not present above the level of associated value.

(c) J Analyte detected below method detection limit, but above instrument detection limit.

TABLE 3.9. Summary of Metals Concentrations in Sediment Samples

Compound	Concentration, mg/kg dry weight				
	BSCMA	KICMA	MOTMA(a)	MOTNW	WREF
Silver	0.03 U(b)	0.09	0.10	0.04	0.03
Arsenic	24.30	9.97	18.50	9.51	2.71
Beryllium	1.10	1.43	1.48	0.89	0.16
Cadmium	0.36	0.33	0.16	0.01 U	0.01 U
Chromium	63.2	59.3	66.8	39.3	12.1
Copper	13.60	9.65	18.15	11.50	1.34
Mercury	0.046	0.064	0.082	0.031	0.001 U
Nickel	15.60	14.10	18.30	9.25	1.05
Lead	20.40	17.10	22.40	14.80	4.28
Antimony	0.27	0.27	0.43	0.18	0.16 U
Selenium	0.50	0.36	0.51	0.29	0.13 U
Thallium	0.31	0.28	0.28	0.19	0.07
Zinc	60.3	69.4	97.6	66.6	8.92

(a) Mean of replicate measurements.

(b) U Analyte was not present above the level of the associated value.

Tables B.24 and B.25. Quality control evaluations for metals presented in Appendix B show that holding time limits were met and significant blank contamination was not present, though Cu and Zn were detected above the target detection limit. Detection limit goals were met with the exception of Cr, Cu, Zn, and Pb. Because these metals were observed at levels above the detection limit, this is not considered a problem. Matrix spike/matrix spike duplicate analyses indicated acceptable precision for most metals, and replicate analyses yielded acceptable precision for most metals except Zn, Ag, Cd, and Hg. Analytical precision was assessed through the analysis of a SRM, and was generally within QA/QC limits. The overall assessment of the

metals analyses suggests that these data are acceptable for use in evaluating sediment-bound contaminants.

The data summarized in Table 3.9 suggest elevated levels of nearly all metals in test treatments relative to the reference WHREF. Test treatment MOTMA exhibited the highest metals concentrations overall, with the highest observed concentrations of 10 of 13 metals associated with sediment from that site. In some cases, the levels of elevated metals were quite high in MOTMA sediment relative to the reference WHREF. For instance, Hg in MOTMA sediment was 82 times higher than WHREF, Cd was 16 times higher, and Ni was 17 times higher. Test treatment MOTNW produced the lowest metals concentrations of the four test treatments. Levels of metals in MOTNW were generally less than 4 times higher than WHREF. Because metals were detected in elevated levels in all test treatments relative to WHREF, metals analyses were conducted on the tissues of *M. nasuta* and *N. virens*.

3.2.7 Organotins

Organotin concentrations are summarized in Table 3.10. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, Tables B.26 and B.27. Quality control evaluations for organotins presented in Appendix B show that holding time limits were exceeded by approximately 2 weeks relative to sample extraction, but the holding time limits for analyses after extraction were met. Method blanks were uncontaminated, and detection limit goals were met in all sediment samples. Matrix spike/matrix spike duplicate analyses indicated low percent recovery for mono- and dibutyltin; replication showed precision within acceptable limits for tributyltin. The overall assessment of organotin analyses indicates that these data are acceptable for use in evaluating sediment-bound contaminants, though the mono- and dibutyltin concentrations may be underestimated given the low recoveries associated with matrix spikes.

Table 3.10 shows that mono- and dibutyltin were not detected in any sediment samples, and that tributyltin was detected in the KICMA and MOTMA test treatments at approximately two to three times the levels associated with WHREF. Based on these data, it was decided to evaluate the tissues of *M. nasuta* and *N. virens* exposed to treatments KICMA, MOTMA, and WHREF for organotins.

3.3 TOXICOLOGICAL TESTING

3.3.1 10-Day Solid-Phase Flow-Through Test with *A. abdita*

The results of the 10-day solid-phase flow-through test with *A. abdita* are presented in Table 3.11. Data related to the test are presented in Appendix C, Tables C.1 through C.4. The water quality data presented in Appendix C, Table C.2 indicate that all parameters except

TABLE 3.10. Summary of Organotins Concentrations in Sediment Samples

Compound	Concentration, µg/kg dry weight				
	BSCMA	KICMA	MOTMA	MOTNW	WHREF
Monobutyltin	4.60 U ^(a)	4.60 U	3.40 U	3.70 U	4.00 U
Dibutyltin	2.60 U	2.60 U	1.90 U	2.10 U	2.20 U
Tributyltin	3.20 U	9.40	4.80	2.60 U	2.80 U

(a) U Analyte was not present above the level of associated value.

flow rate in one treatment remained within range during the test. The flow-rate deviation did not appear to affect test organism survival. The reference toxicant exposure produced an LC₅₀ to Cd of 0.72 µg/L, with a 95% confidence interval of 0.61 to 0.85 µg/L. This is within the normal MSL range of 0.5 to 1.5 µg/L and indicates appropriate test organism sensitivity, though test organism survival in the seawater control was low. Test organism survival in the control treatment (San Pablo Bay) was 44.0%, less than the 90% required for test validity. Statistical analyses were performed on the data, and the results are summarized in Table 3.11. This table shows that *A. abdita* survival ranged from 39% to 63%. There were no significant differences between test organism survival in test treatments relative to the reference WHREF.

3.3.2 10-Day Solid-Phase Static Test with *R. abronius*

The results of the 10-day solid-phase static test with *abronius* are presented in Table 3.12. Data related to the test are presented in Appendix D, Tables D.1 through D.4. The water

TABLE 3.11. Summary Results of the 10-Day Solid-Phase Flow-Through Test with *A. abdita*

<u>Sediment Treatment</u>	<u>Percent Survival</u>	<u>Statistical Significance^(a)</u>
BSCMA	41.0	No
KICMA	39.0	No
MOTMA	38.0	No
MOTNW	42.0	No
WHREF	47.0	NA ^(b)
WHFINE	57.0	No
Sequim Bay	63.0	No
San Pablo Bay	44.0	No

(a) Survival is significantly lower than the reference WHREF ($\alpha = 0.05$) and at least 10% lower than that reference.

(b) NA Not applicable.

TABLE 3.12. Summary Results of the 10-Day Solid-Phase Flow-Through Test with *R. abronius*

<u>Sediment Treatment</u>	<u>Percent Survival</u>	<u>Statistical Significance^(a)</u>
BSCMA	90.0	No
KICMA	97.0	No
MOTMA	93.0	No
MOTNW	92.0	No
W href	99.0	NA ^(b)
WHFINE	99.0	No
Sequim Bay	88.0	No
Whidbey Island	100.0	No

(a) Survival is significantly lower than the reference W href ($\alpha = 0.05$) and at least 20% lower than that reference.

(b) NA Not applicable.

quality data presented in Table D.2 show that most parameters remained within range during the test. The validity of this test is indicated by $\geq 90\%$ survival of *R. abronius* in its native sediment (Whidbey Island). The reference toxicant test produced an LC_{50} to cadmium of 0.66 mg/L, with a 95% confidence limit of 0.63 to 0.70 mg/L. This LC_{50} is within the normal MSL range of 0.56 to 2.36 mg/L for this organism and indicates appropriate test organism sensitivity. Table 3.12 shows that test organism survival was greater than 90% in all treatments and that there was no significant difference in *R. abronius* survival in test treatments relative to the reference W href.

3.3.3 10-Day Solid-Phase Flow-Through Test with *N. virens*

The results of the 10-day solid-phase flow-through test with *N. virens* are presented in Table 3.13. Data related to the test are presented in Appendix E, Tables E.1 and E.2. The water quality data presented in Appendix E, Table E.2 indicate that all parameters remained within range during the test. This test is considered valid because of the greater than 90% survival of *N. virens* in its native sediment (Muscongus Bay). A reference toxicant was not run for this species as it is relatively insensitive to standard laboratory reference toxicants. Table 3.13 shows greater than 90% survival in all treatments and no significant difference in test organism survival in test treatments when compared to the reference W href.

3.3.4 28-Day Solid-Phase Flow-Through Test with *N. virens*

The results of the 28-day solid-phase flow-through test with *N. virens* are presented in Table 3.14. Data related to the test are presented in Appendix F, Tables F.1 and F.2. The water quality data presented in Appendix F, Table F.2 indicate that most parameters were within acceptable ranges. These deviations did not appear to affect test organism survival. This test is validated by the $>80\%$ survival of *N. virens* in its native sediment (Muscongus Bay). A

TABLE 3.13. Summary Results of the 10-Day Solid-Phase Flow-Through Test with *N. virens*

<u>Sediment Treatment</u>	<u>Percent Survival</u>	<u>Statistical Significance^(a)</u>
BSCMA	97.0	No
KICMA	94.0	No
MOTMA	99.0	No
MOTNW	97.0	No
WHREF	96.0	NA ^(b)
Muscongus Bay	93.0	No

(a) Survival is significantly lower than the reference WHREF ($\alpha = 0.05$) and at least 10% lower than that reference.

(b) NA Not applicable.

reference toxicant was not run for this species as it is relatively insensitive to standard laboratory reference toxicants. The results of the test, presented in Table 3.14, show that survival was high, ranging from 83% to 93%. Statistical analysis was not conducted on these data as these exposures were designed to evaluate bioaccumulation potential, not to measure acute toxicity.

3.3.5 28-Day Solid-Phase Flow-through Test with *M. nasuta*

The results of the 28-day solid-phase flow-through test with *M. nasuta* are presented in Table 3.14. Supporting data related to the test are presented in Appendix G, Tables G.1 and G.2. Examination of water quality data indicates that all parameters except pH in one treatment

TABLE 3.14. Summary Results of the 28-Day Solid-Phase Flow-Through Test with *N. virens* and *M. nasuta*

<u>Sediment Treatment</u>	<u><i>N. virens</i> Percent Survival</u>	<u><i>M. nasuta</i> Percent Survival</u>
BSCMA	90.0	97.6
KICMA	88.0	96.8
MOTMA	83.0	98.4
MOTNW	93.0	95.2
WHREF	90.0	94.4
Muscongus Bay	88.0	NA ^(a)
Sequim Bay	NA	92.8

(a) NA Not applicable.

remained within target ranges. The deviation in pH did not appear to affect test organism survival. This test was validated by a >80% survival of *M. nasuta* in its native sediment (Sequim Bay). A reference toxicant was not run for this species as it is relatively insensitive to standard laboratory reference toxicants. Test organism survival was over 90% in all treatments. Statistical analyses were not conducted on these data as these exposures were designed to evaluate bioaccumulation potential, not to measure acute toxicity.

3.3.6 96-h Suspended-Particulate-Phase Static Test with *M. beryllina*

The results of the 96-h SPP static test with *M. beryllina* is summarized in Table 3.15. Supporting data related to this test are presented in Appendix H, Tables H.1 through H.4. The water quality data presented in Appendix H, Table H.2 show that all parameters except pH remained within acceptable ranges during the test. Elevated pH was observed in some of the treatments, but did not appear to influence test organism survival. The test was validated through a greater than 90% survival of *M. beryllina* in the seawater controls (0% SPP). The reference toxicant test produced an LC₅₀ to Cu of 99.61 µg/L, with a 95% confidence limit of 96.5 to 102.8 µg/L. This LC₅₀ is within the normal MSL range of 63.6 to 137.9 µg/L and indicates appropriate test organism sensitivity.

Table 3.15 shows that test organism survival was over 90% in all treatments and SPP concentrations except KICMA and MOTMA 100% SPP. Because a 50% reduction in test organism survival relative to control was not observed, an LC₅₀ could not be calculated. As a result, there is no evidence of acute toxicity of SPP prepared from test sediment to this species.

3.3.7 96-h Suspended-Particulate-Phase Static Test with *M. bahia*

The results of the 96-h SPP static test with *M. bahia* are presented in Table 3.16. Supporting data related to the test are presented in Appendix I, Tables I.1 through I.4. The water quality summary presented in Appendix I, Table I.2 show that most parameters remained within range during this test. The exceptions are elevated pH in a few treatments and a few instances of salinity, which were beyond the targeted upper range. These deviations did not appear to influence test organism survival. The reference toxicant exposure produced an LC₅₀ to Cu of 248.5 µg/L, with a 95% confidence interval of 193.2 to 319.6 µg/L. This response is within the normal MSL range of 115.9 to 228.9 µg/L and indicates appropriate test organism sensitivity. This test is validated by greater than 90% survival observed in the control seawater (0% SPP) exposures. The summary information presented in Table 3.16 shows that survival was greater than 90% in all test treatments. Because there was not a 50% decrease in survival in SPP treatments relative to the seawater control, an LC₅₀ is not calculable. Thus, there is no evidence of acute toxicity of SPP prepared from test treatments to this species.

TABLE 3.15. Summary Results for 96-h Suspended-Particulate-Phase Static Test with *M. beryllina*

<u>Sediment Treatment</u>	<u>Percent SPP</u>	<u>Percent Survival</u>
BSCMA	0	100.0
BSCMA	10	100.0
BSCMA	50	100.0
BSCMA	100	100.0
KICMA	0	100.0
KICMA	10	100.0
KICMA	50	98.0
KICMA	100	78.0
MOTMA	0	98.0
MOTMA	10	98.0
MOTMA	50	98.0
MOTMA	100	76.0
MOTNW	0	98.0
MOTNW	10	98.0
MOTNW	50	100.0
MOTNW	100	98.0

TABLE 3.16. Summary Results for 96-h Suspended-Particulate-Phase Static Test with *M. bahia*

<u>Sediment Treatment</u>	<u>Percent SPP</u>	<u>Mean Percent Survival</u>
BSCMA	0	100.0
BSCMA	10	100.0
BSCMA	50	98.0
BSCMA	100	94.0
KICMA	0	100.0
KICMA	10	98.0
KICMA	50	94.0
KICMA	100	98.0
MOTMA	0	100.0
MOTMA	10	100.0
MOTMA	50	94.0
MOTMA	100	98.0
MOTNW	0	98.0
MOTNW	10	96.0
MOTNW	50	98.0
MOTNW	100	94.0

3.3.8 72-h Suspended-Particulate-Phase Static Test with *L. pictus*

The results of the 72-h SPP static test with *L. pictus* is summarized in Table 3.17. Supporting data associated with this test are presented in Appendix J, Tables J.1 through J.4. The water quality data summarized in Appendix J, Table J.2 show that all parameters except pH were within acceptable ranges. Elevated pH was observed in the MOTMA 100% SPP concentration. Because low survival was observed in this treatment, it is conceivable that pH could have contributed to test organism mortality. The LC₅₀ for the reference toxicant was 143.5 µg/L as Cu, with a 95% confidence interval of 138.5 to 148.6 µg/L. The MSL has not yet determined a normal LC₅₀ for this species, but a normal dose-response to the reference toxicant was observed. This response indicates appropriate test organism sensitivity. The summary information presented in Table 3.17 shows that test organism survival and percent of normal larvae were high (>80%) in all treatments except in the MOTMA 100% SPP and MOTNW 100% SPP. In those exposures, percent survival (expressed as total pluteus, gastrula, and abnormal larvae) was significantly lower than the associated seawater control. In the case of MOTMA, percent survival in the 100% SPP treatment was depressed by over 50%, producing an LC₅₀ of 97.86%, with a 95% confidence interval of 80.66% to 118.70%. These data indicate that there is evidence of acute toxicity of SPP produced from MOTMA to the larvae of the sea urchin *L. pictus*. There also appears to be a sublethal effect of MOTMA and MOTNW SPP relative to the percent SPP, which causes a 50% reduction in normal larval development (EC₅₀). The EC₅₀ for MOTMA was 64.79%; the EC₅₀ for MOTNW was 68.83%.

3.4 TISSUE CHEMISTRY

Tissues of *M. nasuta* and *N. virens* exposed for 28-days to test and reference treatments were analyzed for contaminants of concern based on examination of sediment chemistry results (Section 3.2). Based on these results, four classes of compounds were analyzed in tissue samples: PAHs, PCBs, metals, and organotins. Statistical analyses were performed to determine whether there was a significant elevation of contaminants in tissues exposed to a test treatment relative to the tissues exposed to the reference treatment WREF. Tissues exposed to control treatments were also analyzed to determine the concentrations of contaminants associated with the wild-caught populations exposed to their native sediment. This served as an additional comparison of contaminant levels observed after exposure to test and reference treatments.

3.4.1 Polynuclear Aromatic Hydrocarbons

Mean concentrations of PAHs in the tissues of *M. nasuta* and *N. virens* are summarized in Tables 3.18 and 3.19. All data associated with these summaries and related quality assurance measurements may be found in Appendix K, Tables K.1 through K.9 (*M. nasuta*) and Appendix L, Tables L.1 through L.9 (*N. virens*). Quality control evaluations for PAHs in *M. nasuta* and

TABLE 3.17. Summary Results for 72-h Suspended-Particulate-Phase Static Test with *L. pictus*

<u>Sediment Treatment</u>	<u>Percent SPP</u>	<u>Mean Percent Survival</u>	<u>Mean Percent Normal</u>
BSCMA	0	91.0	89.8
BSCMA	10	91.2	84.2
BSCMA	50	96.8	95.3
BSCMA	100	80.9	74.0
KICMA	0	86.1	85.2
KICMA	10	89.2	86.0
KICMA	50	92.5	76.5
KICMA	100	87.1	84.0
MOTMA	0	93.7	92.2
MOTMA	10	98.1	96.1
MOTMA	50	78.3	76.3
MOTMA	100	46.2	1.3
MOTNW	0	95.4	95.2
MOTNW	10	87.5	88.0
MOTNW	50	88.3	88.0
MOTNW	100	56.4	2.2

N. virens tissue presented in these appendixes show that tissue holding times prior to extraction were exceeded by approximately 2 weeks, but holding times relative to analysis after extraction were met. This exceedence is not considered a problem, as tissues were frozen at -20°C until extracted. All other quality assurance data indicated acceptable procedures, accuracy, and precision. As a result, these data are considered acceptable for use in determining bioaccumulation potential.

Table 3.18 shows that there were significantly elevated PAHs in the tissues of *M. nasuta* exposed to test treatments relative to those exposed to the reference treatment WHREF. Seven PAH compounds including anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, and benzo(k)fluoranthene were detected at significantly elevated levels in at least one test treatment. Significantly elevated levels of PAHs occurred in test treatments KICMA, MOTMA, and MOTNW, but not in BSCMA. Generally, mean concentrations of PAHs in tissues exposed to test treatments were two to four times higher than the mean concentrations observed in the reference treatment WHREF.

Table 3.19 summarizes the mean concentrations of PAHs found in the tissues of *N. virens* after the 28-day bioaccumulation exposure. This table shows fewer incidences of significant elevations of PAHs than were observed in the tissues of *M. nasuta*. The three PAH

TABLE 3.18. Mean Concentrations of Polynuclear Aromatic Hydrocarbons in the Tissues of *M. nasuta* After 28-Day Bioaccumulation Exposure. Bold and Underline Indicates Compound is Significantly Elevated Relative to the Reference WHREF.

Compound	Concentration, ug/kg dry weight					
	BSCMA	KICMA	MOTMA	MOTNW	WHREF	Sequim Bay
Naphthalene	24.57	19.66	21.61	21.08	17.95	15.81
2-methylnaphthalene	22.96	17.96	20.26	22.40	17.57	16.01
1-methylnaphthalene	12.15	9.80	10.62	11.78	9.92	8.98
Acenaphthylene	1.03 J(a)	1.27 J	2.05 J	1.40 J	0.99 J	1.54 J
Acenaphthene	2.90 J	2.67 J	3.99 J	3.45 J	3.07 J	3.13 J
Fluorene	5.64	5.77 J	7.61	6.62	5.76	5.36
Phenanthrene	19.35	18.83	24.44	18.18	18.15	14.96
Anthracene	3.04 J	3.32 J	8.76	4.38	2.35	2.94
Fluoranthene	29.36	42.60	62.95	44.71	25.44	36.49
Pyrene	17.76	39.71	51.93	42.64	15.60	23.30
Benzo(a)anthracene	5.96 J	11.58	15.96	10.93	5.85	6.74
Chrysene	11.84	21.04	23.07	19.08	15.09	12.22
Benzo(b)fluoranthene	7.13	15.37	12.29	10.24	5.17	9.72
Benzo(k)fluoranthene	3.97	10.33	10.00	7.89	3.42 J	6.85
Benzo(a)pyrene	2.33 J	4.18 J	5.32 J	3.75	2.16 J	2.82 J
Indeno(1,2,3-c,d)pyrene	10.28 U(b) J	10.20	7.74 UJ	10.91 UJ	8.21 UJ	8.84 UJ
Dibenzo(a,h)anthracene	7.54 U	6.35 UJ	5.55 UJ	7.39 UJ	5.60 UJ	5.88 UJ
Benzo(g,h,i)perylene	15.77	12.34 UJ	11.31 UJ	14.72 UJ	8.60 UJ	9.68 UJ
Total PAH(c)	185.76	252.98	305.46	261.55	170.90	191.27

(a) J Analyte detected below method detection limit, but above instrument detection limit.

(b) U Analyte was not present above the level of associated value.

(c) Excluding all "U" flagged data.

compounds observed in the highest concentrations in *M. nasuta* tissues (fluoranthene, pyrene, and chrysene) were also detected in significantly elevated levels in *N. virens* tissues relative to tissue exposed to the reference treatment WHREF. In most cases, the PAHs in test treatment tissues were approximately twice the concentration observed in WHREF. As in the *M. nasuta* exposures, test treatments KICMA, MOTMA, and MOTNW produced significantly elevated PAH levels; test treatment BSCMA did not produce significantly elevated levels. Significantly elevated levels of PAHs were also observed in *N. virens* exposed to the control treatment (Muscongus Bay) relative to WHREF. Compounds found at elevated levels in tissues were acenaphthene, fluoranthene, pyrene, and chrysene. These compounds were 1.3 to 2.6 times higher than WHREF.

TABLE 3.19. Mean Concentrations of Polynuclear Aromatic Hydrocarbons in the Tissues of *N. virens* After 28-Day Bioaccumulation Exposure. Bold and Underline Indicates Compound is Significantly Elevated Relative to the Reference WHPREF.

Compound	Concentration, $\mu\text{g/kg}$ dry weight					
	BSCMA	KICMA	MOTMA	MOTNW	WHPREF	Muscongus Bay
Naphthalene	26.43	28.62	18.73	23.16	29.38	38.58
2-methylnaphthalene	17.82	19.51	11.93	13.85	21.60	27.83
1-methylnaphthalene	13.76	15.79	10.45	11.27	16.42	19.99
Acenaphthylene	4.54 U(a)J(b)	1.56 J	1.07 J	1.20 J	0.95 J	13.20 UJ
Acenaphthene	6.66	7.28	6.65	7.14	5.91 J	<u>7.79</u>
Fluorene	4.83 J	5.08	4.10 J	4.50 J	4.61 J	7.05 J
Phenanthrene	11.85	12.10	9.23	11.62	11.57	17.92
Anthracene	1.22 J	1.48 J	1.06 J	1.21 J	1.92 UJ	1.86 J
Fluoranthene	6.43	<u>9.36</u>	<u>8.57</u>	<u>9.08</u>	4.93	<u>10.64</u>
Pyrene	4.37 J	<u>8.44</u>	<u>6.52</u>	<u>7.11</u>	3.58 J	<u>8.12</u>
Benzo(a)anthracene	6.17 UJ	2.33 J	1.01 J	4.57 UJ	2.42 UJ	2.81 J
Chrysene	2.76 J	<u>3.58</u>	2.60 J	2.75 J	1.71 J	<u>4.46 J</u>
Benzo(b)fluoranthene	1.70 J	1.65 J	1.12 J	1.32 J	2.58 UJ	2.80 J
Benzo(k)fluoranthene	1.09 J	1.21 J	0.76 J	0.81 J	1.80 UJ	1.70 J
Benzo(a)pyrene	8.89 UJ	4.45 UJ	2.46 UJ	6.42 UJ	9.94 UJ	10.35 UJ
Indeno(1,2,3-c,d)pyrene	11.32 UJ	8.01 UJ	8.11 UJ	11.18 U	12.68 U	20.03 U
Dibenzo(a,h)anthracene	7.68 UJ	6.35 U	6.35 U	7.61 U	8.62 U	13.65 U
Benzo(g,h,i)perylene	15.33 UJ	8.55 UJ	9.32 UJ	12.49 UJ	17.18 UJ	14.30 UJ
Total PAH(c)	148.31	139.00	110.04	118.50	149.18	189.40

(a) U Analyte was not present above the level of associated value.

(b) J Analyte detected below method detection limit, but above instrument detection limit.

(c) Excluding all "U" flagged data.

3.4.2 PCBs

Mean concentrations of PCBs in the tissues of *M. nasuta* and *N. virens* are summarized in Tables 3.20 and 3.21. All data associated with these summaries and related quality assurance measurements may be found in Appendix K, Tables K.10 through K.13 (*M. nasuta*) and Appendix L, Tables L.10 through L.13 (*N. virens*). Quality control evaluations for PCBs in *M. nasuta* and *N. virens* tissue presented in these appendices show that tissue holding times prior to extraction were exceeded by approximately 2 weeks, but holding times relative to analysis after extraction were met. This exceedence is not considered a problem, as tissues were frozen at -20°C until extracted. All other quality assurance data indicated acceptable procedures, accuracy, and precision. As a result, these data are considered acceptable for use in determining bioaccumulation potential.

TABLE 3.20. Mean Concentrations of PCBs in the Tissues of *M. nasuta* After 28-Day Bioaccumulation Exposure. Bold and Underline Indicates Compound is Significantly Elevated Relative to the Reference WHREF.

<u>Compound</u>	<u>Concentration $\mu\text{g/kg dry weight}$</u>					
	<u>BSCMA</u>	<u>KICMA</u>	<u>MOTMA</u>	<u>MOTNW</u>	<u>WHREF</u>	<u>Sequim Bay</u>
Aroclor 1016	24.896 U(a)	22.388 U	23.536 U	26.521 U	20.592 U	20.466 U
Aroclor 1221	24.896 U	22.388 U	23.536 U	26.521 U	20.592 U	20.466 U
Aroclor 1232	24.896 U	22.388 U	23.536 U	26.521 U	20.592 U	20.466 U
Aroclor 1248	24.896 U	22.388 U	23.536 U	26.521 U	20.592 U	20.466 U
Aroclor 1254	34.963	37.121	36.142	38.357	52.248	36.635
Aroclor 1260	24.896 U	22.388 U	23.536 U	26.521 U	20.592 U	20.466 U

(a) U Analyte was not present above the level of associated value.

TABLE 3.21. Mean Concentrations of PCBs in the Tissues of *N. virens* After 28-Day Bioaccumulation Exposure. Bold and Underline Indicates Compound is Significantly Elevated Relative to the Reference WHREF.

<u>Compound</u>	<u>Concentration $\mu\text{g/kg dry weight}$</u>					
	<u>BSCMA</u>	<u>KICMA</u>	<u>MOTMA</u>	<u>MOTNW</u>	<u>WHREF</u>	<u>Muscongus Bay</u>
Aroclor 1016	30.256 U(a)	20.984 U	20.978 U	25.111 U	28.441 U	45.026 U
Aroclor 1221	30.256 U	20.984 U	20.978 U	25.111 U	28.441 U	45.026 U
Aroclor 1232	30.256 U	20.984 U	20.978 U	25.111 U	28.441 U	45.026 U
Aroclor 1248	30.256 U	20.984 U	20.978 U	25.111 U	28.441 U	45.026 U
Aroclor 1254	75.995	79.130	77.418	78.194	75.932	88.851
Aroclor 1260	30.256 U	20.984 U	20.978 U	25.111 U	28.441 U	45.026 U

(a) U Analyte was not present above the level of associated value.

Table 3.20 presents the mean concentrations of PCBs in the tissues of *M. nasuta*. This table shows that all of the Aroclor compounds except Aroclor 1254 were undetected. Aroclor 1254 concentrations in tissues ranged from 34.963 to 52.248 $\mu\text{g/kg}$. There were no significant elevations between tissues exposed to test treatments relative to those exposed to the reference WHREF. Table 3.21 presents the mean concentration of PCBs in the tissues of *N. virens*. These data show a similar pattern to that observed in *M. nasuta* tissues. All PCB compounds except Aroclor 1254 were undetected. Aroclor 1254 concentrations in tissues ranged from 75.932 to 88.851 $\mu\text{g/kg}$, with no significant elevations between test and reference treatment tissues. The highest concentrations of Aroclor 1254 in tissues were observed in WHREF (*M. nasuta* exposure) and Muscongus Bay (*N. virens* exposure).

3.4.3 Metals

Mean concentrations of metals in the tissues of *M. nasuta* and *N. virens* are summarized in Tables 3.22 and 3.23. All data associated with these summaries and related quality assurance measurements may be found in Appendix K, Tables K.14 through K.16 (*M. nasuta*) and Appendix L, Tables L.14 through L.16 (*N. virens*). Quality control evaluations for metals presented in these appendixes show that holding times were exceeded by approximately two weeks, and blanks were generally uncontaminated with the exception of Zn, which was detected above the method detection limit. Detection limit goals were met for most metals, matrix spike recoveries were good, precision measured by replicate analysis was generally within QA limits, and analysis of SRMs yielded acceptable accuracy. As a result, these data are considered acceptable for use in determining bioaccumulation potential.

Table 3.22 summarizes the mean concentrations of metals in the tissues of *M. nasuta* reported in dry weight. Test treatment BSCMA produced the highest levels of Be, Cd, and Se; test treatment MOTMA produced the highest levels of Zn. The highest levels of Hg were observed in tissues exposed to the reference treatment WHREF. The control sediment for *M. nasuta*, Sequim Bay, produced the highest levels of As, Cr, Cu, Ni, and Pb. Statistical comparison of metals concentrations in tissues exposed to test treatments showed no significant elevations relative to the reference WHREF. Significantly elevated levels of Cu and Pb were observed in the *M. nasuta* exposed to their control sediment (Sequim Bay) when compared to WHREF.

Table 3.23 summarizes the mean concentrations of metals observed in the tissues of *N. virens* expressed in dry weight concentrations. Test treatment BSCMA produced the highest levels of Ni, and Se; treatment MOTNW produced the highest levels of Be; reference treatment WHREF produced the highest levels of Ag, Cr, Cu, Hg, Tl, and Zn. The *N. virens* native control sediment, (Muscongus Bay) produced the highest levels of Cd, and Pb. Statistical comparison of tissues exposed to test treatments showed no significantly elevated levels of metals in any test treatment relative to WHREF.

3.4.4 Organotins

Mean concentrations of organotins in the tissues of *M. nasuta* and *N. virens* are summarized in Tables 3.24 and 3.25. All data associated with these summaries and related quality assurance measurements may be found in Appendix K, Table K.17 (*M. nasuta*) and Appendix L, Table L.17 (*N. virens*). Quality control evaluations for PCBs in *M. nasuta* and *N. virens* tissue presented in these appendixes show that tissue holding times prior to extraction were exceeded by approximately 2 weeks, but analysis after extractions was within

TABLE 3.22. Mean Concentrations of Metals in the Tissues of *M. nasuta* After 28-Day Bioaccumulation Exposure. Bold and Underline Indicates Compound is Significantly Elevated Relative to the Reference WHPREF.

<u>Compound</u>	<u>Concentration, mg/kg dry weight</u>					
	<u>BSCMA</u>	<u>KICMA</u>	<u>MOTMA</u>	<u>MOTNW</u>	<u>WHPREF</u>	<u>Sequim Bay</u>
Silver	0.139	0.158	0.135	0.173	0.136	0.162
Arsenic	26.2	25.7	25.2	24.7	24.3	29.9
Beryllium	0.073	0.011	0.017	0.008	0.004	0.007
Cadmium	0.261	0.240	0.252	0.175	0.220	0.208
Chromium	3.8 U(a)	4.2 U	4.2	4.0	3.8 U	5.5
Copper	9.46	10.16	9.11	9.40	7.09	<u>11.20</u>
Mercury	0.094	0.098	0.092	0.094	0.103	0.092
Nickel	3.42	3.28	3.733	3.14	3.11	4.31
Lead	1.171	1.096	1.094	0.903	0.872	<u>1.502</u>
Antimony	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
Selenium	2.00	1.55	1.88	1.60	1.72	1.81
Thallium	0.009	0.005	0.009	0.006	0.006	0.007
Zinc	82.9	75.6	84.5	70.3	73.6	75.4

(a) U Analyte was not present above the level of associated value.

TABLE 3.23. Mean Concentrations of Metals in the Tissues of *N. virens* After 28-Day Bioaccumulation Exposure. Bold and Underline Indicates Compound is Significantly Elevated Relative to the Reference WHPREF.

<u>Compound</u>	<u>Concentration, mg/kg dry weight</u>					
	<u>BSCMA</u>	<u>KICMA</u>	<u>MOTMA</u>	<u>MOTNW</u>	<u>WHPREF</u>	<u>Muscongus Bay</u>
Silver	0.093	0.092	0.087	0.082	0.146	0.076
Arsenic	22.9	20.2	17.9	17.8	23.6	22.1
Beryllium	0.004	0.003	0.006	0.009	0.002	0.007
Cadmium	0.335	0.281	0.276	0.279	0.364	0.464
Chromium	3.3 U(a)	3.3 U	3.3 U	3.4 U	3.6	3.3 U
Copper	8.90	8.08	8.29	7.81	9.62	9.03
Mercury	0.092	0.086	0.099	0.086	0.109	0.068
Nickel	1.16	0.99 U	1.16	1.14	1.10	1.02
Lead	1.066	0.818	0.910	1.030	0.925	1.127
Antimony	0.06 U	0.06 U	0.05 U	0.05	0.06 U	0.04 U
Selenium	1.44	1.18	1.12	1.30	1.18	1.26
Thallium	0.002	0.003	0.002	0.001	0.005	0.002
Zinc	131.5	112.9	71.7	112.0	156.8	154.2

(a) U Analyte was not present above the level of associated value.

TABLE 3.24. Mean Concentrations of Organotins in the Tissues of *M. nasuta* After 28-Day Bioaccumulation Exposure. Bold and Underline Indicates Compound is Significantly Elevated Relative to the Reference WHREF.

Compound	Concentration, $\mu\text{g/kg}$ dry weight			
	KICMA	MOTMA	WHREF	Sequim Bay
Monobutyltin	22.2 U(a)	23.4	22.1 U	19.9 U
Dibutyltin	14.2 UJ(b)	21.0	16.8 UJ	10.8 UJ
Tributyltin	29.1	<u>46.9</u>	23.6 U	17.9 U

(a) U Analyte was not present above the level of associated value.

(b) J Analyte detected below method detection limit, but above instrument detection limit.

TABLE 3.25. Mean Concentrations of Organotins in the Tissues of *N. virens* After 28-Day Bioaccumulation Exposure. Bold and Underline Indicates Compound is Significantly Elevated Relative to the Reference WHREF.

Compound	Concentration, $\mu\text{g/kg}$ dry weight			
	KICMA	MOTMA	WHREF	Muscongus Bay
Monobutyltin	21.7 U(a)	20.4 U	22.2 U	22.8 U
Dibutyltin	16.5 UJ(b)	16.9	19.6 UJ	15.3 UJ
Tributyltin	13.9 U	13.0 U	13.9 U	14.5 U

(a) U Analyte was not present above the level of associated value.

(b) J Analyte detected below method detection limit, but above instrument detection limit.

recommended holding times. Blanks were uncontaminated and detection limit goals were met. Analysis of surrogate standards showed acceptable recovery, and MS/MSD recovery was within QA limits for most samples. Measurements of precision were very good and holding times relative to analyses were met. As a result, these data are considered acceptable for use in determining bioaccumulation potential.

Table 3.24 summarizes the mean organotin concentrations in the tissues of *M. nasuta* expressed in dry weight. This table shows that mono- and dibutyltin were undetected in all samples except those exposed to the test treatment MOTMA, where tissue levels of 23.4 and 21.0 $\mu\text{g/kg}$ were measured. Tributyltin was detected at KICMA (29.1 $\mu\text{g/kg}$) and at MOTMA (46.9 $\mu\text{g/kg}$). Tissues exposed to MOTMA showed significant elevations of tributyltin relative to tissues exposed to the reference WHREF. Table 3.25 summarizes the mean organotin concentrations in the tissues of *N. virens*. This table shows that compounds were undetected or detected below the analytical detection limit with the exception of dibutyltin in tissues exposed to

MOTMA. Statistically significant elevations of organotins in tissues exposed to test treatments relative to the reference WREF were not observed.

4.0 DISCUSSION AND CONCLUSIONS

This section presents a discussion of the data pertinent to the Wilmington Harbor Program, including an evaluation of sediment contamination, toxicological testing, and determination of bioaccumulation potential. In this discussion, test treatments represented by BSCMA, KICMA, MOTMA, and MOTNW composites are statistically compared to the reference treatment WREF to determine if significant differences occurred. For the purposes of this discussion, the term "significant acute toxicity" indicates that the test treatment does not comply with the benthic bioassay criteria for ocean disposal as defined under 40 CFR, Section 227.13(c). The primary comparisons required are related to acute toxicity and the potential for bioaccumulation of contaminants of concern. Sediment chemistry results are discussed here and used in support of toxicological testing results, and also as justification for evaluating contaminants of concern in tissue samples.

4.1 SEDIMENT CHEMISTRY

According to the *1991 Implementation Manual*, sediment chemistry results are intended to provide information about chemical contaminants of concern that could potentially cause toxicity or bioaccumulation. What follows is a brief discussion of the results of physical/chemical analyses of the four test treatments (BSCMA, KICMA, MOTMA, and MOTNW) and the reference site WREF. Analyses of conventional parameters showed that BSCMA and MOTMA were composed primarily of silt and clay, while KICMA and MOTNW were more than 50% sand. The reference treatment WREF was composed primarily of sand. Total organic carbon was highest in treatments MOTMA and MOTNW, AVS was highest in MOTMA, and oil and grease concentrations were highest in MOTMA. Cyanide was undetected in all treatments, while maximum TKN concentrations were observed in BSCMA. The PAHs were detected in all treatments, with the highest concentrations associated with KICMA and MOTMA. The high molecular weight PAHs predominated. Pesticides and PCBs were not detected in any of the treatments. Dioxin/furan congeners were present in all treatments, although the most toxic forms were absent. Phenols and phthalates were either undetected or detected below the target detection limit in all treatments. Metals were detected in all treatments, with the highest levels associated with the test treatment MOTMA. Organotins were undetected in all treatments with the exception of tributyltin in KICMA and MOTMA. These physical/chemical evaluations served as a way to characterize these sediments, and to provide guidance relative to tissue analyses.

4.2 TOXICOLOGY AND BIOACCUMULATION POTENTIAL

The test treatments evaluated in the Wilmington Harbor Program that produced significant acute toxicity or bioaccumulation are discussed in this section. Acute toxicity was evaluated

through water column exposures (SPP) and deposited sediment (SP) tests. Acute toxicity in SPP tests is defined by the *1991 Implementation Manual* as a 50% reduction in survival in SPP relative to the seawater control (0% SPP). If an SPP test produces acute toxicity, the concentration of SPP that produces the 50% reduction in test organism survival relative to control water can be derived and is expressed as an LC₅₀. Acute toxicity in solid-phase tests is defined by the *1991 Implementation Manual* as a significantly lower survival of organisms in a test treatment relative to a reference treatment, with at least a 10% lower survival observed in the test treatment relative to the reference (20% for amphipods).

Evaluation of bioaccumulation took two forms. First, levels of contaminants of concern in tissues exposed to test treatments were statistically compared to levels associated with tissues exposed to the reference treatment. These comparisons were done on a dry weight basis. Significantly elevated levels of contaminants were noted, and reported in Section 3.4. In Table 4.1, these data are presented as the highest observed enhancement of a PAH, PCB, metal, or organotin compound detected in test tissues relative to reference tissues. For example, in test treatment KICMA, benzo(k)fluoranthene was significantly elevated relative to tissue exposed to the reference WHREF. Dividing the concentration observed in KICMA (15.37 µg/kg dry weight) by that observed in WHREF (5.17 µg/kg dry weight) produced an elevation of 3.0, which is reported in the table. Second, levels of contaminants in tissues exposed to test treatments were compared to Food and Drug Administration (FDA) action limits to determine whether these limits were exceeded. These comparisons were done on a wet-weight basis, as directed by the *1991 Implementation Manual*. The only comparison to action limits possible with this data set was in relation to PCBs. According to the *1991 Implementation Manual*, FDA limits for these compounds are 2.0 mg/kg (wet weight). The highest tissue value observed in the Wilmington Harbor Program was 14.953 µg/kg (0.015 mg/kg) in *N. virens* tissues exposed to KICMA, Replicate 2. This is well below FDA limits.

4.2.1 Water-Column Tests

Water column toxicity was evaluated by exposing three species of test organisms to three concentrations of SPP: 10%, 50%, and 100%. A seawater control (0% SPP) was included with each test. Suspended-particulate-phase test organisms were *M. beryllina*, *M. bahia*, and larvae of *L. pictus*. The results of the water column tests are presented in Table 4.1 and show that significant water column toxicity was observed only for the test treatment MOTMA. The calculated LC₅₀ for this test treatment was 97.86%, with a 95% confidence interval of 80.66% to 118.70%. This indicates that nearly 100% SPP was necessary to produce a 50% reduction in survival. The other three test treatments did not produce significant acute toxicity in SPP tests.

TABLE 4.1. Summary of Significant Acute Toxicity and Bioaccumulation for Test Treatments Relative to the Reference WREF

Sediment Treatment	Acute Toxicity	<u>M. nasuta Bioaccumulation</u>				<u>N. virens Bioaccumulation</u>			
		PAH	PCB	Metals	Organotins	PAH	PCB	Metals	Organotins
BSCMA	—(a)	—	—	—	NA(b)	—	—	—	NA
KICMA	—	3.0(c)	—	—	—	2.4	—	—	—
MOTMA	<i>L. Pictus</i> SPP	3.7	—	—	2.0	1.7	—	—	—
MOTNW	—	2.7	—	—	NA	1.8	—	—	NA

(a) --- Not significant.

(b) NA Not applicable.

(c) Value represents the highest elevation of a test treatment relative to the reference WREF.

4.2.2 Deposited Sediment Tests

Deposited sediment toxicity was evaluated through solid-phase tests involving three test organisms: *A. abdita*, *R. abronius*, and *N. virens*. The results of the solid-phase tests are presented in Table 4.1. There was no evidence of acute toxicity in any of the test treatments for the three species, though the results of the *A. abdita* test cannot be used for decision-making, as control survival was poor. The requirements of the 1991 *Implementation Manual* were met through the use of another sensitive amphipod, *R. abronius*.

4.2.3 Bioaccumulation Potential

Bioaccumulation potential was evaluated two ways. First, the concentrations of contaminants in tissues exposed to test treatments were statistically compared to tissues exposed to a reference treatment to determine whether significant elevations were present. The results of these comparisons are presented in Table 4.1. This table shows that significant elevations of PAHs were observed in the tissues of *M. nasuta* and *N. virens* exposed to test treatments KICMA, MOTMA, and MOTNW. In all cases, the elevated levels of the test treatments relative to the reference WREF was less than four. The PCBs were not elevated in any test treatment. The organotin tributyltin was elevated only in *M. nasuta* exposed to test treatment MOTMA at a level of two times that observed in WREF. The second comparison performed with these data was to determine whether observed tissue levels exceeded FDA action limits. The only comparison possible with this data set involved the PCB Aroclor 1254. In *M. nasuta* tissue, the concentration of this PCB in tissue was less than 10 µg/kg (wet weight). In *N. virens* tissues the concentrations never exceeded 20 µg/kg (wet weight). These concentrations are well below the FDA limits of 2000 µg/kg (2 mg/kg).

4.3 CONCLUSIONS

The tiered approach to evaluating potential impacts of ocean disposal of dredged material is presented in the *1991 Implementation Manual*. This approach consists of a series of activities (tests) and decision modules (determination of compliance) that aid in interpreting physical, chemical, and biological data related to the evaluation of proposed dredged sediment. In this study, water column toxicity, deposited sediment toxicity, and deposited sediment bioaccumulation potential were evaluated. The following summarizes the tests conducted using the determination of compliance definitions provided by the *1991 Implementation Manual*.

4.3.1 Water-Column Toxicity

The toxicity of dredged material to the water column toxicity was estimated by exposing three sensitive marine species (*M. beryllina*, *M. bahia*, and *L. pictus*) to three concentrations of SPP and a seawater-only control. The SPP tests showed no acute toxicity in the *M. beryllina* and *M. bahia* tests, and an observed LC₅₀ for *L. pictus* of 97.86% for SPP created from MOTMA sediment. Under the *1991 Implementation Manual* guidelines, the limiting permissible concentration for dissolved plus suspended contaminants (represented by the SPP) cannot exceed 0.01 of the acutely toxic concentration (LC₅₀) at the boundaries of the disposal site after allowing 4 h for initial mixing. This means that a concentration greater than 0.98% SPP would have to be present at the boundary of the disposal site after initial mixing to exceed the acutely toxic concentration if the dredged material was composed of sediment from MOTMA.

4.3.2 Deposited Sediment Toxicity

Deposited sediment toxicity was determined by exposing three species of marine organisms (*A. abdita*, *R. abronius*, and *N. virens*) to test sediment treatments. The *1991 Implementation Manual* guidelines concerning determination of compliance for deposited sediment toxicity are based on whether the mortality of organisms exposed to test treatments (dredged material) is statistically significantly different from reference and whether test organism mortality in test treatment exceeds the reference treatment by 20% (*A. abdita* and *R. abronius*) or 10% (*N. virens*). If mortality in test treatments is statistically significantly different from the reference and mortality exceeds the reference by the above percentages, the proposed dredged material does not comply with the benthic bioassay criteria of Section 227.13(c) and Appendix A and B of the *1991 Implementation Manual*. The results of this study show that there was no evidence of acute toxicity of sediment treatments representing dredged material to the three species tested.

4.3.3 Bioaccumulation Potential

The potential for bioaccumulation of contaminants was evaluated through 28-day solid-phase flow-through tests with *M. nasuta* and *N. virens*. The concentrations of contaminants were

compared to existing FDA limits and also compared through Dunnett's Test to determine whether statistically significant elevations in tissues were present ($\alpha = 0.05$) relative to the reference treatment WHREF. The results of these comparisons showed the significant elevations of PAHs were observed in test treatments KICMA, MOTMA, and MOTNW relative to WHREF. In all cases, the elevated levels associated with the test treatment tissues were less than four times the levels observed in WHREF. The organotin tributyltin was elevated in *M. nasuta* tissues at 2.0 times the WHREF level in test treatment MOTMA. The FDA action limits were not exceeded for the PCB Aroclor 1254 in any tissues.

When the bioaccumulation of contaminants in dredged material tests statistically exceeds that in the reference material tests, the *1991 Implementation Manual* requires the following factors be considered when determining compliance with paragraph 227.13(c)(3):

- The number of species in which bioaccumulation from the dredged material is statistically greater than bioaccumulation from the reference material
- The number of contaminants for which bioaccumulation from the dredged material is statistically greater than bioaccumulation from the reference material
- The magnitude by which bioaccumulation from the dredged material exceeds bioaccumulation from the reference material
- The toxicological importance of the contaminants whose bioaccumulation from the dredged material statistically exceeds that from the reference material
- The phylogenetic diversity of the species in which bioaccumulation from the dredged material statistically exceeds bioaccumulation from the reference material
- The propensity for the contaminants with statistically significant bioaccumulation to biomagnify within aquatic food webs
- The magnitude of toxicity and number and phylogenetic diversity of species exhibiting greater mortality in the dredged material than in the reference material
- The magnitude by which contaminants whose bioaccumulation from the dredged material exceeds that from the reference material also exceed the concentrations found in comparable species living in the vicinity of the proposed disposal site.

According to the *1991 Implementation Manual*, further evaluation of the test sediments and the dredged material they represent may be necessary to determine whether these materials can be disposed of in the ocean. The results of this study suggest that this decision may in part be based on the magnitude of observed bioaccumulation, since bedded sediment toxicity was not observed, and water column toxicity (represented by SPP) was either not observed or observed only in the highest (100%) SPP concentration. If further evaluations of this dredged material are necessary, they may take the form of numerical modeling, case-specific testing, or other management actions as defined by the *1991 Implementation Manual* and developed by the

District Engineer and Regional Administrator. The summary results and discussion presented in this report should aid in this decision and policy making.

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APPENDIX A

FIELD SAMPLING INFORMATION

TABLE A.1. Sediment Field Sampling Information, Wilmington Harbor Project

<u>Station</u>	<u>Replicate</u>	<u>Date Sampled</u>	<u>Corrected Depth (ft)</u>	<u>Latitude (Deg Min)</u>	<u>Longitude (Deg Min)</u>	<u>Sampler</u>	<u>Sediment Collection Depth</u>
BSCMA 1	1	30-Jun-92	35.7	33° 50.5738	78° 02.5183	van Veen Grab	15 cm
BSCMA 2	1	30-Jun-92	34.1	33° 50.4135	78° 02.6735	van Veen Grab	15 cm
BSCMA 3	1	30-Jun-92	34.6	33° 50.3583	78° 02.7638	van Veen Grab	15 cm
BSCMA 4	1	30-Jun-92	36.2	33° 50.1674	78° 03.0103	van Veen Grab	15 cm
BSCMA 5	1	30-Jun-92	39.2	33° 49.7630	78° 03.3968	van Veen Grab	15 cm
KICMA 1	1	29-Jun-92	33.2	34° 06.4120	77° 56.2161	van Veen Grab	15 cm
KICMA 2	1	29-Jun-92	32.8	34° 06.5716	77° 56.1489	van Veen Grab	15 cm
KICMA 2	1	29-Jun-92	32.8	34° 06.5830	77° 56.1396	Vibracore	6.33 ft
KICMA 2	2	29-Jun-92	32.1	34° 06.5830	77° 56.1396	Vibracore	6.00 ft
KICMA 3	1	29-Jun-92	33.8	34° 06.5909	77° 56.1460	van Veen Grab	15 cm
KICMA 4	1	29-Jun-92	33.1	34° 06.6371	77° 56.1406	van Veen Grab	15 cm
KICMA 5	1	29-Jun-92	34.0	34° 07.2206	77° 56.1574	van Veen Grab	15 cm
KICMA 5	2	29-Jun-92	34.0	34° 07.2206	77° 56.1574	van Veen Grab	15 cm
WHFINE 1	1	30-Jun-92	20.5	33° 50.7560	78° 02.9202	van Veen Grab	10 cm
WHFINE 1	2	30-Jun-92	20.2	33° 50.7552	78° 02.9207	van Veen Grab	10 cm
WHFINE 2	1	30-Jun-92	20.1	33° 50.9265	78° 03.1187	van Veen Grab	10 cm
WHFINE 2	2	30-Jun-92	20.0	33° 50.9293	78° 03.1175	van Veen Grab	8 cm
WHREF 1	1	30-Jun-92	45.7	33° 46.0398	78° 03.4715	Sand Dredge	4 cm
WHREF 2	1	30-Jun-92	46.2	33° 46.5970	78° 03.6236	Sand Dredge	4 cm
WHREF 3	1	30-Jun-92	46.8	33° 46.2240	78° 04.0226	Sand Dredge	4 cm
WHREF 4A	1	30-Jun-92	45.4	33° 03.2514	78° 03.2514	Sand Dredge	4 cm
WHREF 5	1	30-Jun-92	42.7	33° 46.4365	78° 03.6695	Sand Dredge	4 cm
MOTMA 1	1	01-Jul-92	35.2	33° 59.7340	77° 57.3120	van Veen Grab	15 cm
MOTMA 2	1	01-Jul-92	34.4	34° 00.0675	77° 57.1477	van Veen Grab	15 cm
MOTMA 3	1	01-Jul-92	27.0	34° 01.2961	77° 56.8300	Vibracore	7.00 ft
MOTMA 3	2	01-Jul-92	27.1	34° 01.2961	77° 56.8300	Vibracore	7.67 ft
MOTMA 4	1	01-Jul-92	21.6	33° 58.8569	77° 57.1656	van Veen Grab	15 cm
MOTMA 5	1	01-Jul-92	36.5	33° 59.7340	77° 56.8136	van Veen Grab	15 cm
MOTNW 1	1	01-Jul-92	34.2	33° 59.7373	77° 57.3131	Vibracore	4.00 ft
MOTNW 1	2	01-Jul-92	34.3	33° 59.7384	77° 57.3145	Vibracore	3.50 ft
MOTNW 1	3	01-Jul-92	36.5	33° 59.7383	77° 57.3164	Vibracore	4.33 ft
MOTNW 1	4	01-Jul-92	35.5	33° 59.7383	77° 57.3164	Vibracore	3.50 ft
MOTNW 2	1	01-Jul-92	35.9	34° 00.4516	77° 57.1335	Vibracore	4.58 ft
MOTNW 2	2	01-Jul-92	35.9	34° 00.4516	77° 57.1335	Vibracore	5.33 ft
MOTNW 3A	1	01-Jul-92	30.8	33° 56.8460	77° 57.1575	Vibracore	7.17 ft
MOTNW 3A	1	01-Jul-92	30.8	33° 56.8460	77° 57.1575	Vibracore	7.83 ft
MOTNW 4	1	01-Jul-92	3.2	33° 00.1760	77° 56.9660	Vibracore	9.67 ft
MOTNW 5	1	01-Jul-92	2.4	34° 00.2750	77° 57.0580	Vibracore	7.17 ft
MOTNW 5	1	01-Jul-92	2.4	34° 00.2750	77° 57.0580	Vibracore	8.00 ft

APPENDIX B

SEDIMENT CHEMISTRY AND QUALITY CONTROL DATA

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Grain Size
Laboratory	Soil Technology, Inc
Matrix	Sediment
Holding Times	All samples were analyzed within the specified 6-month holding period.
Blanks	Not applicable in these analyses.
Detection Limits	The detection limit of 1.0% was met for all samples.
Surrogate Internal Standards	Not applicable in these analyses.
Matrix Spike/Matrix Spike Duplicate	Not applicable in these analyses.
Replication	The requirement of triplicate analyses for every 10 samples was met. Gravel, sand, silt, and clay fractions all produced RSDs less than or equal the 20% limit specified in the QA plan.
SRMs	Not applicable in this analyses.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Specific Gravity, Total Organic Carbon (TOC), Total Solids (TS), and Acid Volatile Sulfides (AVS)
Laboratory	Specific Gravity: Soil Technology TOC: Global Geochemistry Total Solids: Analytical Resources, Inc. Acid Volatile Sulfides: Battelle/Marine Sciences Laboratory
Matrix	Sediment
Holding Times	All samples were analyzed within the specified holding periods: 60 days for specific gravity, 6 months for TOC, 30 days for AVS, and no holding times for specific gravity.
Blanks	The requirement of 1 blank per 20 samples was met for TOC, TS, and AVS. Blanks are not a part of specific gravity measurements. Three blanks were run for TOC; all below MDL of 0.1%. Percent solids blank less than MDL of 1%. AVS undetected in blank at 0.01 $\mu\text{mol/g}$.
Detection Limits	Detection limit goals were met for TOC (0.1%), TS (1%), and AVS (0.01 $\mu\text{mol/g}$). Detection limits are not applicable for specific gravity measurements.
Surrogate Internal Standards	Not applicable for these analyses.
Matrix Spike/Matrix Spike Duplicate	Not applicable for these analyses.
Replication	The requirement of 1 triplicate analysis per 10 samples was met for all measurements except AVS, where a duplicate analysis was performed. RSD results were within the QA limits of $\leq 20\%$ (specific gravity), $\leq 10\%$ (TOC), and $\leq 20\%$ (TS). The RPD for AVS was 14%, slightly above the QA limit $\leq 10\%$.
SRMs	Not applicable for these analyses with the exception of TOC. For TOC, uncertified SRM MESS 1 was analyzed twice. Observed values were within 20% of estimated value of 2.3%

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	PAHs
Laboratory	Battelle Ocean Sciences
Matrix	Sediment
Holding Times	Sediment samples were collected from June 29 to July 1, 1992. Samples were received by the laboratory on July 14, extracted from July 16 to 17, and analyzed on July 28 to July 31, 1992. The 30 day holding time prior to extraction was not exceeded; the 40-day holding time between extraction and analysis was not exceeded.
Blanks	The requirement of 1 blank per 20 samples was met. HPAHs and LPAHs were not detected above the target detection limit of 30 μ g/kg, though the compound naphthalene was detected in the procedural blank in concentrations above the MDL.
Detection Limits	The detection limit goal of 30 μ g/kg was met for all HPAH and LPAH compounds.
Surrogate Internal Standards	The requirement of one surrogate standard per sample was met. Three surrogate standards were evaluated: d8 naphthalene, d10 acenaphthalene, and d12 benzo[a]pyrene. Surrogate recoveries were within the QA goals of 40% to 120% with the exception of d8 naphthalene in four of six samples. Recoveries for this surrogate ranged from 36% to 39%.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was not met. Initially, a matrix spike/matrix spike duplicate was processed, but the matrix spike was lost during extraction breakage. For HPAH compounds, percent recoveries in five of nine compounds were outside the QC limits of 40% to 120%. These compounds were fluoranthene, pyrene, benzo[b]fluoranthene, indeno[123-c,d]pyrene, and dibenzo[a,h]anthracene. For LPAH compounds, four of seven compounds exceeded QC limits (acenaphthylene, fluorene, phenanthrene, and anthracene).
Replication	The requirement of 1 triplicate analysis per 10 samples was not met. One duplicate analysis was performed per 10 samples. For HPAH compounds, the QA limit for RPDs ($\leq 30\%$) was exceeded for 3 of 10 compounds (benzo[a]anthracene, chrysene, and benzo[k]fluoranthene). For LPAH compounds, RPD QC limits were met.

SRMs

SRM material was available for selected LPAH and HPAH compounds. Observed concentrations for the following PAHs were out of certified range of $\leq 30\%$: fluoranthene (46%), pyrene (40%), benzo[b]fluoranthene (60%), benzo[k]-fluoranthene (91%), and indeno[1,2,3-cd]pyrene (39%).

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Pesticides
Laboratory	Battelle Ocean Sciences
Matrix	Sediment
Holding Times	Sediment samples were collected from June 29 to July 1, 1992. Samples were received by the laboratory on July 14, extracted from July 16 to 17, and analyzed on July 31 to August 2, 1992. The 30-day holding time prior to extraction was not exceeded; the 40-day holding time between extraction and analysis was not exceeded.
Blanks	The requirement of 1 blank per 20 samples was met. All compounds except toxaphene were undetected in the method blank at levels below the MDL. Toxaphene was undetected at 48.33 $\mu\text{g/kg}$, above the MDL of 30 $\mu\text{g/kg}$.
Detection Limits	Target detection limits of 10 to 30 $\mu\text{g/kg}$ (depending on the compound) were met for all compounds except chlordane and toxaphene. Detection limits for those compounds were approximately 1.6 times the target levels.
Surrogate Internal Standards	The requirement of one surrogate standard for each sample was met. Surrogate recoveries were within the acceptable range of 40% to 120%.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was not met. Initially a matrix spike/matrix spike duplicate was processed, but the matrix spike was lost during extraction to breakage. The percent recovery range of 40% to 120% was met for all compounds except A-BHC, B-BHC, D-BHC, lindane, 4,4-DDD, dieldrin (interfering peak), endosulfan I, endrin, heptachlor, and heptachlor epoxide.
Replication	The requirement of 1 triplicate analysis per 10 samples was not met. One duplicate analysis was performed per 10 samples. RPDs could not be calculated for duplicates, as all compounds were undetected. The RPD for surrogates associated with duplicates was 8% and 5%.
SRMs	No SRM material was available for these analyses.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	PCBs
Laboratory	Battelle Ocean Sciences
Matrix	Sediment
Holding Times	Sediment samples were collected from June 29 to July 1, 1992. Samples were received by the laboratory on July 14, extracted from July 16 to 17, and analyzed on July 31 to August 2, 1992. The 30-day holding time prior to extraction was not exceeded; the 40-day holding time between extraction and analysis was not exceeded.
Blanks	The requirement of 1 blank per 20 samples was met. Compounds were detected in the blanks at approximately twice the MDL.
Detection Limits	Observed detection limits were approximately two to three times the 20 $\mu\text{g/kg}$ target level.
Surrogate Internal Standards	The requirement of one surrogate standard per sample was met. All surrogate recoveries were within the acceptable levels of 40% to 120%.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was not met. Initially a matrix spike/matrix spike duplicate was processed, but the matrix spike was lost during extraction to breakage. The percent recovery range of 40% to 120% was slightly exceeded for aroclor 1254 (124%).
Replication	The requirement of 1 triplicate analysis per 10 samples was not met. One duplicate analysis was performed per 10 samples. RPDs could not be calculated for duplicates, as all compounds were undetected.
SRMs	No SRM material was available for these analyses.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Phenols and Phthalates
Laboratory	Battelle Ocean Sciences
Matrix	Sediment
Holding Times	Sediment samples were collected from June 29 to July 1, 1992. Samples were received by the laboratory on July 14, extracted from July 16 to 17, and analyzed on July 31 to August 2, 1992. The 30-day holding time prior to extraction was not exceeded; the 40-day holding time between extraction and analysis was not exceeded.
Blanks	The requirement of 1 blank per 20 samples was met. One method blank was run with all compounds below detection. Some phenols were detected, but below MDL.
Detection Limits	The detection limit goals of 100 $\mu\text{g/kg}$ to 1500 $\mu\text{g/kg}$ for phenols was met. The detection limit goals of 100 $\mu\text{g/kg}$ was not met for some measurements of dimethylphthalate, diethyl phthalate, di-n-butyl phthalate, and all measurements of di-n-octylphthalate.
Surrogate Internal Standards	The requirement of one surrogate standard for each sample was met. The surrogate recoveries for the phenolic compound 2-fluorophenol were not within the acceptable range of 40% to 120% with the exception of the sample WHREF. No surrogates were used for phthalate analyses.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was not met due to the breakage of the matrix spike sample. For phenols, matrix spike duplicate recoveries were lower than the specified range of 40% to 120% were observed for 2,4-dimethylphenol, 2,4-dinitrophenol, and pentachlorophenol. Low recoveries relative to these ranges were also observed for di-n-butylphthalate, butylbenzylphthalate, bis-2-ethylhexyl phthalate, and di-n-octylphthalate.
Replication	The requirement of 1 triplicate analysis per 10 samples was not met. One duplicate analysis was performed per 10 samples. For phenols, RPDs in excess of the criteria of $\leq 30\%$ difference between replicates were observed for 2-chlorophenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, and

pentachlorophenol. For phthalates, RPD limits were exceeded for diethylphthalate, di-n-butylphthalate, and butyl-benzylphthalate.

SRMs

No SRM material was available for these analyses.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Metals
Laboratory	Battelle/Marine Sciences Laboratory Pacific Northwest Laboratory (Richland)
Matrix	Sediment
Holding Times	All samples were analyzed within the specified 6-month holding period (30 days for Hg).
Blanks	The requirement of 1 blank per 20 samples was met. Three blanks were run for the metals. Two metals were observed in method blanks above the MDL: Cu (0.19 to 0.87 mg/kg), and Zn (1.4 to 29.2 mg/kg). These metals were detected in samples in levels much higher than the observed detection limit.
Detection Limits	Detection limit goals were met for all metals except Cr, Cu, Zn, and Pb. The Cr detection limit in blanks was 1.0 mg/kg, slightly above the goal of 0.6 mg/kg. Cu was two to nine times higher than the MDL goal; Zn was significantly higher. Pb was nine times higher than the target detection limit.
Surrogate Internal Standards	Not applicable for these analyses.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike per 10 samples was met. Acceptable matrix spike recoveries were 75% to 125%. These recoveries were met for all metals except Ag (145%) and Tl (138%).
Replication	Laboratory triplicates were required for every 10 samples. This requirement was not met, though 1 laboratory duplicate was analyzed for every 10 samples. According to the QA Plan, the relative percent difference between duplicates should be $\leq 20\%$. This requirement was met for all metals except Zn, Ag, Cd, and Hg.
SRMs	QA requirements for SRMs included 1 SRM analyses per 20 samples. This requirement was exceeded, for two SRMs were analyzed: MESS-1, and SRM 1646. Each SRM was analyzed three times. In all but 5 cases, observed values were within 30% of the certified value. SRMs out of range were associated with the metals Be, and Cd.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Organotins
Laboratory	Battelle/Marine Sciences Laboratory
Matrix	Sediment
Holding Times	Sediment samples were collected from June 29 to July 1, 1992. Samples were received on July 13, 1992, extracted on July 30, and analyzed from August 12, to August 19, 1992. The 30-day holding time prior to extraction was exceeded; the 40-day holding time between extraction and analysis was not exceeded.
Blanks	The requirement of 1 blank per 20 samples was met. Two method blanks were run with all compounds below detection.
Detection Limits	The detection limit goals of 10 $\mu\text{g/kg}$ were met in the blanks and all samples except the uncertified SRM PACS-1, where monobutyltin was undetected at 17.4 $\mu\text{g/kg}$.
Surrogate Internal Standards	The requirement for one surrogate standard for each sample was met. All three butyltin surrogates (tripentyltin, propyltin, and pentylbutyltin) were within the 40% to 120% range required for all samples.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was met. The requirement of 40% to 120% recovery on spikes was not met for di- or monobutyltin. The requirement of $\leq 30\%$ RPD between the matrix spike and matrix spike duplicate was not met for di- or monobutyltin.
Replication	The requirement of 1 triplicate analysis per 10 samples was not met. One duplicate (matrix spike/matrix spike duplicate) was analyzed per 10 samples. The RPD for duplicate analysis was within the acceptable range of $< 30\%$ for tributyltin, but beyond the acceptable range for dibutyltin and monobutyltin.
SRMs	Certified SRM not available. Uncertified PACS analyzed. Results will be reported later.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Dioxins
Laboratory	Battelle Ocean Sciences
Matrix	Sediment
Holding Times	Samples were extracted within 30 days of sample collection and run within 40 days of extraction, meeting specified holding time requirements.
Blanks	The requirement of 1 blank per 20 samples was met. The congeners 12378-PeCDD, 1234678-HpCDD, 1234789-HpCDF, 123789-HxCDF, and OCDF were detected at sub part-per trillion levels, as were total TCDD, total PeCDD, total HpCDD, total HxCDF, and total HpCDF. The only congener present above the MDL was OCDD, at 1.9 ppt.
Detection Limits	The detection limit goal of 1.0 ppt was met for all congeners with the exception of OCDD.
Surrogate Internal Standards	The requirement of one internal surrogate standard per sample was met. All samples were spiked with an internal standard. Only 9 of 112 surrogate recoveries were outside the 40% to 120% recovery criteria. Surrogate recoveries out of range were associated with the surrogate standards 13C12 12378-PeCDD, 13C12 OCDD, 13C12 12378-PeCDF, and 13C12 23478-PeCDF.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was met. The percent recovery range of 40% to 120% was met for all congeners except OCDD. The OCDD peak was saturated; producing low recoveries and a relative percent difference between the MD/MSD greater than the 30% acceptable limit.
Replication	The requirement of 1 triplicate analysis per 10 samples was met. The results of triplicate analyses show that all but three relative standard deviations between triplicates were within the QA limits of <30% difference. Those measurements out of range were associated with OCDD, total TCDD, and total HpCDF.
SRMs	Standard reference material from Cambridge Isotope Laboratories was analyzed with these samples. Results were within quality control guidelines of <30% difference from the certified value.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Total Kjendahl Nitrogen (TKN), Cyanide, and Oil & Grease
Laboratory	Analytical Resources, Inc.
Matrix	Sediment
Holding Times	All samples were analyzed within the specified 30-day holding period.
Blanks	The requirement of 1 blank per 20 samples was met. No compounds were detected in the method blank.
Detection Limits	The detection limit goals of 0.1 mg/kg (TKN) 1.0 mg/kg (cyanide), and 20 mg/kg (oil and grease) were met.
Surrogate Internal Standards	Not required for these analyses.
Matrix Spike/Matrix Spike Duplicate	TKN analyses did not require a matrix spike, but one was analyzed. Percent spike recovery was acceptable at 94%. Cyanide analyses did not require a matrix spike, but a matrix spike/matrix spike duplicate was analyzed. Matrix spike/matrix spike duplicate recoveries were within the range of 40% to 120%; RPD between matrix spike/matrix spike duplicate was less than control limits of $\leq 30\%$. Matrix spike/matrix spike duplicate data for oil and grease produced recoveries within the specified QA range of 50% to 150%; Matrix spike/matrix spike duplicate RPD was acceptable at $\leq 20\%$ difference.
Replication	The requirement of 1 triplicate analysis per 10 samples was met for all three parameters. Triplicate analysis of TKN data produced an RSD slightly above the QA limit of $\leq 20\%$. For cyanide analysis, an RSD could not be calculated, as two of the measurements were at the analytical detection limit. The RSD for oil and grease triplicates was within the QA limit of $\leq 30\%$.
SRMs	Not required for these analyses.

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TABLE B.1. Summary of Grain Size Results, Dry Weight, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Total Percent</u>			
	<u>Gravel ≥2000 μm</u>	<u>Sand 62.5 2000 μm</u>	<u>Silt 3.9- 62.5 μm</u>	<u>Clay ≤3.9 μm</u>
BSCMA	0	16	41	43
KICMA	0	56	21	23
MOTMA	0	30	25	45
MOTNW Replicate 1	0	59	14	27
MOTNW Replicate 2	0	58	14	28
MOTNW Replicate 3	0	58	14	28
WREF	0	98	0	2

TABLE B.2. Quality Control Data for Sediment Grain Size Analysis,
Dry Weight, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Total Percent</u>			
	<u>Gravel ≥2000 μm</u>	<u>Sand 62.5 2000 μm</u>	<u>Silt 3.9- 62.5 μm</u>	<u>Clay ≤3.9 μm</u>
<u>Analytical Replicates</u>				
MOTNW Replicate 1	0	59	14	27
MOTNW Replicate 2	0	58	14	28
MOTNW Replicate 3	0	58	14	28
RSD	0%	1%	0%	2%

TABLE B.3. Sediment Grain Size Analysis, Dry Weight, Wilmington Harbor Project

Sediment Treatment	Percent Dry Weight in Size Fraction														
	Phi: /mm: >4750	4750- 2000	2000- 850	850- 425	425- 250	250- 106	106- 75	75- 62.5	62.5- 31.2	31.2- 15.6	15.6- 7.8	7.8- 3.9	3.9- 1.9	1.9- 0.9	0.9- <0.9
Target DL ^(a)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	NA ^(b)
Achieved DL	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	NA
BSCMA	0	0	0	1	1	7	5	2	6	16	10	9	8	9	24
KICMA	0	0	1	4	7	31	10	3	5	5	6	5	5	4	13
MOTMA	0	0	2	3	3	17	4	1	3	6	8	8	9	9	27
MOTNW Replicate 1	0	0	2	5	6	36	8	2	2	4	5	3	4	5	18
MOTNW Replicate 2	0	0	2	4	7	36	8	1	2	5	4	3	4	4	20
MOTNW Replicate 3	0	0	2	4	7	34	10	1	3	3	5	3	4	4	20
WHEF	0	0	5	30	40	20	2	1	0	0	0	0	0	0	2

(a) DL Detection limit.
(b) NA Not applicable.

TABLE B.4. Sediment Results for Specific Gravity, Total Organic Carbon (TOC), Total Solids, and Acid Volatile Sulfides (AVS), Dry Weight, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Specific Gravity</u>	<u>TOC (%)</u>	<u>Total Solids (%)</u>	<u>AVS $\mu\text{mol/g}$</u>
Target DL ^(a)	NA ^(b)	0.1	1.0	0.009 μmol
Achieved DL	NA	0.01	1.0	0.009 μmol
BSCMA	2.78	2.26	31.35	17.90
BSCMA Duplicate	ND ^(c)	ND	ND	15.50
KICMA Replicate 1	2.57	3.01	40.64	20.80
KICMA Replicate 2	ND	2.91	39.39	ND
KICMA Replicate 3	ND	2.94	40.74	ND
MOTMA	2.65	3.18	30.05	24.90
MOTNW Replicate 1	2.69	3.31	46.66	19.00
MOTNW Replicate 2	2.65	ND	ND	ND
MOTNW Replicate 3	2.67	ND	ND	ND
WHPREF	2.67	2.44	82.38	0.019

(a) DL Detection limit.

(b) NA Not applicable.

(c) ND No data.

TABLE B.5. Quality Control Summary for Specific Gravity, Total Organic Carbon (TOC), Total Solids, and Acid Volatile Sulfides (AVS), Dry Weight, in Sediment, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Specific Gravity</u>	<u>TOC (%)</u>	<u>Total Solids (%)</u>	<u>AVS $\mu\text{mol/g}$</u>
<u>Method Blanks</u>				
Blank 1	ND ^(a)	0.01	1 U ^(b)	<0.009 μmol
Blank 2	ND	0.01	ND	ND
Blank 3	ND	0.01 U	ND	ND
<u>Standard Reference Material</u>				
No certified value for these analytes				
MESS 1 Replicate 1	ND	2.65	ND	ND
MESS 1 Replicate 2	ND	2.61	ND	ND
No certified value for these analytes				
1646 Replicate 1	ND	1.46	ND	ND
1646 Replicate 2 Replicate 1	ND	1.43	ND	ND
1646 Replicate 2 Replicate 2	ND	1.48	ND	ND
1646 Replicate 2 Replicate 3	ND	1.48	ND	ND
<u>Analytical Duplicates</u>				
BSCMA	NA ^(c)	NA	NA	17.90
BSCMA Duplicate	ND	ND	ND	15.50
RPD	NA	NA	NA	14% ^(d)
I-Stat	NA	NA	NA	0.07
<u>Analytical Replicates</u>				
KICMA Replicate 1	NA	3.01	40.64	NA
KICMA Replicate 2	ND	2.91	39.39	ND
KICMA Replicate 3	ND	2.94	40.74	ND
RSD	NA	2%	2%	NA
MOTNW Replicate 1	2.69	NA	NA	NA
MOTNW Replicate 2	2.65	ND	ND	ND
MOTNW Replicate 3	2.67	ND	ND	ND
RSD	1%	NA	NA	NA

(a) ND No data.

(b) U Analyte was not present above the level of associated value.

(c) NA Not applicable.

(d) Value exceeds relative standard deviation range $\leq 10\%$.

TABLE B.6. Total Polynuclear Aromatic Hydrocarbons (PAH),
Dry Weight, in Sediment, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>PAH ($\mu\text{g/kg}$ dry weight)</u>		
	<u>Total LPAH</u>	<u>Total HPAH</u>	<u>Total PAH</u>
BSCMA	52.86	245.29	298.15
KICMA	85.98	713.40	799.38
MOTMA	100.23	583.59	683.82
MOTNW Replicate 1	39.52	273.42	312.94
MOTNW Replicate 2	36.60	224.32	260.92
WHPREF	2.11	1.95	4.06

TABLE B.7. Sediment Results for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAH), Dry Weight, Wilmington Harbor Project

Sediment Treatment	LPAHs ($\mu\text{g/kg}$ dry weight)							
	Napth-alene	2-methyl naptha-lene	1-methyl naptha-lene	Acenaph-thylene	Acenaph-thene	Fluorene	Phenan-threne	Anthra-cene
Target DL ^(a)	30	30	30	30	30	30	30	30
Achieved DL	≤ 30	≤ 30	≤ 30	2	1	1	≤ 30	≤ 30
BSCMA	6.90	4.84	2.83 J ^(b)	3.50 J	4.09 U ^(c)	3.45	17.41	13.93
KICMA	7.02	5.85	5.85	15.25	1.92 J	6.05	23.84	20.20
MOTMA	9.52	7.33	4.20	7.70	3.67 J	8.96	33.84	25.01
MOTNW Replicate 1	4.55	3.13	2.00 J	3.92	1.54 J	3.84	11.3	9.24
MOTNW Replicate 2	4.14	3.05	1.57 J	3.11 J	1.38 J	3.89	10.85	8.57
WHREF	0.83	0.45 J	0.33 J	2.11 U	1.63 U	1.29 U	0.37 J	0.13 J

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the level of associated value.

TABLE B.8. Sediment Results for High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAH), Dry Weight, Wilmington Harbor Project

Sediment Treatment	HPAHs ($\mu\text{g}/\text{kg}$ dry weight)									
	Fluor-anthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluor-anthene	Benzo(k)fluor-anthene	Benzo(a)pyrene	Indeno(123-c,d)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene
Target DL (a)	30	30	30	30	30	30	30	30	30	30
Achieved DL	≤ 30	≤ 30	≤ 30	≤ 30	≤ 30	≤ 30	2	4	2	4
BSCMA	52.97	37.79	18.51	25.54	30.41	23.92	20.00	18.30	2.58 J(b)	15.27
KICMA	127.33	149.17	65.17	63.47	73.62	58.79	69.24	50.72	9.68	46.21
MOTMA	151.16	133.46	43.95	53.41	62.25	43.63	33.92	29.59	4.49 J	27.73
MOTNW Replicate 1	61.22	59.17	27.29	24.09	29.92	24.60	19.22	14.81	3.71 U(c)	13.10
MOTNW Replicate 2	50.69	55.80	17.51	17.17	25.54	15.57	14.18	14.72	1.83 J	11.31
WREF	0.53 J	0.45 J	0.25 J	0.18 J	0.36 J	0.18 J	1.54 U	3.66 U	2.15 U	3.97 U

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the level of associated value.

TABLE B.9. Quality Control Summary for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAH), Dry Weight, in Sediment, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>LPAHs ($\mu\text{g}/\text{kg}$ dry weight)</u>							
	<u>Naphthalene</u>	<u>2-Methylnapthalene</u>	<u>1-Methylnapthalene</u>	<u>Acenaphthylene</u>	<u>Acenaphthene</u>	<u>Fluorene</u>	<u>Phenanthrene</u>	<u>Anthracene</u>
<u>Method Blank</u>								
Blank 1	1.20 B ^(a)	2.10 U ^(b)	2.08 U	3.29 U	2.53 U	2.01 U	0.60 J ^(c)	0.31 J
<u>Matrix Spikes</u>								
WREF	0.83	0.45 J ^(d)	0.33 J	2.11 U	1.63 U	1.29 U	0.37 J	0.13 J
WREF MS	165.42	ND ^(e)	ND	197.8	164.58	200.15	216.06	236.3
Concentration Recovered	164.59	NA	NA	197.8	164.58	200.15	215.69	236.17
Amount Spiked	150.23	NA	NA	150.23	150.23	150.23	150.23	150.23
Percent Recovery	110%	NA	NA	132% ^(f)	110%	133% ^(f)	144% ^(f)	157% ^(f)
<u>Standard Reference Material</u>								
Certified Value	NC ^(g)	NC	NC	NC	NC	NC	577 ±59	202 ±42
NIST 1941	NA	NA	NA	NA	NA	NA	633.58	213.69
<u>Analytical Duplicates</u>								
MOTNW Replicate 1	4.55	3.13	2.00 J	3.92	1.54 J	3.84	11.3	9.24
MOTNW Replicate 2	4.14	3.05	1.57 J	3.11 J	1.38 J	3.89	10.89	8.57
RPD	9%	3%	24%	23%	11%	1%	4%	8%
I-Stat	0.05	0.01	0.12	0.12	0.05	0.01	0.02	0.04

- (a) B Procedural blank ng amount greater than MDL.
(b) U Analyte was not present above the level of associated value.
(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).
(d) ND No data.
(e) NA Not applicable.
(f) Recovery outside quality control range (40%-120%).
(g) NC Not certified.

TABLE B.10. Quality Control Summary High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAH), Dry Weight, in Sediment, Wilmington Harbor Project

Sediment Treatment	HPAHs ($\mu\text{g}/\text{kg}$ dry weight)									
	Fluor-anthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluor-anthene	Benzo(k)fluor-anthene	Benzo(a)pyrene	Indeno (123-c,d)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene
Method Blank										
Blank 1	0.58 J(a)	1.43 J	3.60 U(b)	0.42 J	3.39 U	4.03 U	2.40 U	5.70 U	3.35 U	6.19 U
Matrix Spikes										
WREF	0.53 J	0.45 J	0.25 J	0.18 J	0.36 J	0.18 J	1.54 U	3.66 U	2.15 U	3.97 U
WREF MS	270.88	259.88	ND(c)	159.45	207.13	162.67	169.69	182.88	198.49	172.67
Concentration Recovered	270.35	259.43	NA(d)	159.27	206.77	162.49	169.69	182.88	198.49	172.67
Amount Spiked	150.23	150.23	NA	150.23	150.23	150.23	150.23	150.23	150.23	150.23
Percent Recovery	180%(e)	173%(e)	NA	106%	138%(e)	108%	113%	122%(e)	132%(e)	115%
Standard Reference Material										
Certified Value	1220 ± 240	1080 ± 200	550 ± 79	NC(f)	780 ± 190	444 ± 49	670 ± 130	569 ± 40	NC	516 ± 83
NIST 1941	1776.22	1513.36	632.98	NA	1249.05	846.36	639.67	790.15	NA	597.41
Analytical Duplicates										
MOTNW Replicate 1	61.22	59.17	27.29	24.09	29.92	24.6	19.22	14.81	3.71 U	13.1
MOTNW Replicate 2	50.69	55.8	17.51	17.17	25.54	15.57	14.18	14.72	1.83 J	11.31
RPD	19%	6%	44%(g)	34%(g)	16%	45%(g)	30%	1%	NA	15%
1-Stat	0.09	0.03	0.22	0.17	0.08	0.22	0.15	0.00	NA	0.07

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of associated value.

(c) ND No data.

(d) NA Not applicable.

(e) Recovery outside quality control range (40%-120%).

(f) NC Not certified.

(g) Value exceeds relative precision range $\leq 30\%$.

TABLE B.11. Surrogate Recovery Polynuclear Aromatic Hydrocarbons,
Dry Weight, in Sediment, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Surrogate Percent Recoveries</u>		
	<u>Naph- thalene- d8</u>	<u>Acenaph- thene- d10</u>	<u>Benzo(a)- Pyrene- d12</u>
BSCMA	39.27 ^(a)	53.52	61.26
KICMA	38.10 ^(a)	50.39	59.11
MOTMA	36.44 ^(a)	48.42	56.22
MOTNW Replicate 1	37.94 ^(a)	48.89	50.09
MOTNW Replicate 2	40.77	54.34	59.43
WREF	46.22	52.25	58.79
<u>Quality Control Summary</u>			
<u>Method Blank</u>			
Blank 1	53.83	53.25	52.14
<u>Matrix Spikes</u>			
WREF MS	39 ^(a)	45	59
<u>Standard Reference Material</u>			
NIST 1941	46.75	62.05	58.22
<u>Analytical Duplicates</u>			
MOTNW Replicate 1	37.94 ^(a)	48.89	50.09
MOTNW Replicate 2	40.77	54.34	59.43

(a) Recovery outside quality control range (40%-120%).

TABLE B.12. Sediment Chlorinated Pesticide Results (alphabetical, Aldrin - 4,4'-DDT), Dry Weight, Wilmington Harbor Project

Sediment Treatment	Pesticides (µg/kg dry weight)								
	Aldrin	Alpha-BHC ^(a)	Beta-BHC	Delta-BHC	Lindane	Unlordan	4,4'-DDE	4,4'-DDD	4,4'-DDT
Target DL ^(b)	10	10	10	10	10	30	10	10	10
Achieved DL	≤1	≤1	≤1	≤1	≤1	31	≤1	1	1
BSCMA	1.625 U ^(c)	0.776 U	0.776 U	0.776 U	0.776 U	78.056 U	0.994 U	2.283 U	2.434 U
KICMA	1.325 U	0.633 U	0.633 U	0.633 U	0.633 U	63.670 U	0.811 U	1.862 U	1.985 U
MOTMA	1.867 U	0.892 U	0.892 U	0.892 U	0.892 U	89.712 U	1.142 U	2.624 U	2.797 U
MOTNW Replicate 1	1.115 U	0.533 U	0.533 U	0.533 U	0.533 U	53.564 U	0.682 U	1.566 U	1.670 U
MOTNW Replicate 2	1.103 U	0.527 U	0.527 U	0.527 U	0.527 U	53.002 U	0.675 U	1.550 U	1.653 U
WREF	0.646 U	0.308 U	0.308 U	0.308 U	0.308 U	31.020 U	0.395 U	0.907 U	0.967 U

(a) CL2(08) and A-BHC coelute.

(b) DL Detection limit.

(c) U Analyte was not present above the level of associated value.

TABLE B.13. Sediment Chlorinated Pesticide Results (alphabetical, Dieldrin - Toxaphene), Dry Weight, Wilmington Harbor Project

Sediment Treatment	Pesticides ($\mu\text{g}/\text{kg}$ dry weight)										
	Dieldrin	Endo-Sulfan I	Endo-Sulfan II	Endo-sulfan Sulfate	Endrin	Endrin Aldehyde	Endrin Ketone	Hepta-Chlor	Hepta-chlor-epoxide	Methoxy-chlor	Toxa-phene
Target DL (a)	10	20	20	20	10	10	10	20	20	20	30
Achieved DL	≤ 1	3	3	3	2	3	3	≤ 1	≤ 1	3	31
BSCMA	1.558 U ^(b)	7.806 U	7.806 U	7.806 U	4.441 U	7.806 U	7.806 U	2.113 U	1.796 U	7.806 U	78.056 U
KICMA	1.271 U	6.367 U	6.367 U	6.367 U	3.623 U	6.367 U	6.367 U	1.724 U	1.465 U	6.367 U	63.670 U
MOTMA	1.790 U	8.971 U	8.971 U	8.971 U	5.105 U	8.971 U	8.971 U	2.429 U	2.065 U	8.971 U	89.712 U
MOTNW Replicate 1	1.069 U	5.356 U	5.356 U	5.356 U	3.048 U	5.356 U	5.356 U	1.450 U	1.233 U	5.356 U	53.564 U
MOTNW Replicate 2	1.058 U	5.300 U	5.300 U	5.300 U	3.016 U	5.300 U	5.300 U	1.435 U	1.220 U	5.300 U	53.002 U
WHRFF	0.619 U	3.102 U	3.102 U	3.102 U	1.765 U	3.102 U	3.102 U	0.840 U	0.714 U	3.102 U	31.020 U

(a) DL Detection limit.

(b) U Analyte was not present above level of associated value.

TABLE B.14. Quality Control Summary for Chlorinated Pesticide Results
(alphabetical, Aldrin - 4,4'-DDT), Dry Weight, in Sediment,
Wilmington Harbor Project

Sediment Treatment	Pesticides ($\mu\text{g}/\text{kg}$ dry weight)								
	Aldrin	Alpha- BHC ^(a)	Beta- BHC	Delta- BHC	Lindane	Chlordane	4,4'-DDE	4,4'-DDD	4,4'-DDT
<u>Method Blank^(b)</u>									
Blank 1	1.006 U ^(c)	0.481 U	0.481 U	0.481 U	0.481 U	48.330 U	0.615 U	1.413 U	1.507 U
<u>Matrix Spikes</u>									
WHRF	0.646 U	0.308 U	0.308 U	0.308 U	0.308 U	31.020 U	0.395 U	0.907 U	0.967 U
WHRF MS	6.324	8.213	8.604	8.168	9.171	NA ^(d)	5.408	7.570	5.966
Concentration Recovered	6.324	8.213	8.604	8.168	9.171	NA	5.408	7.570	5.966
Spike Amount	6.018	6.018	6.018	6.018	6.018	NA	6.015	6.022	6.015
Percent Recovery	105%	136% ^(e)	143% ^(e)	136% ^(e)	152% ^(e)	NA	90%	126% ^(e)	99%
<u>Standard Reference Material</u>									
None available									
<u>Analytical Duplicates</u>									
MOTNW Replicate 1	1.115 U	0.533 U	0.533 U	0.533 U	0.533 U	53.564 U	0.682 U	1.566 U	1.670 U
MOTNW Replicate 2	1.103 U	0.527 U	0.527 U	0.527 U	0.527 U	53.002 U	0.675 U	1.550 U	1.653 U
RPD	NA	NA	NA	NA	NA	NA	NA	NA	NA
1-Stat	NA	NA	NA	NA	NA	NA	NA	NA	NA

(a) CL2(08) and A-BHC coelute.

(b) Average dry weight of samples (not including MS, MSD, and SRM).

(c) U Analyte was not present above the level of associated value.

(d) NA Not applicable.

(e) Recovery outside quality control range (40%-120%).

TABLE B.15.

Quality Control Summary for Chlorinated Pesticide Results (alphabetical, Dieldrin - Toxaphene), Dry Weight, in Sediment, Wilmington Harbor Project

Sediment Treatment	Pesticides ($\mu\text{g/kg}$ dry weight)									
	Dieldrin	Endo-Sulfan I	Endo-Sulfan II	Endo-sulfan Sulfate	Endrin Aldehyde	Endrin Ketone	Hepta-Chlor	Hepta-chlor-epoxide	Methoxy-chlor	Toxaphene
Method Blank (a)										
Blank 1	0.964 U ^(b)	4.833 U	4.833 U	4.833 U	4.833 U	4.833 U	1.309 U	1.112 U	4.833 U	48.330 U
Matrix Spikes										
WREF	0.619 U	3.102 U	3.102 U	3.102 U	3.102 U	3.102 U	0.840 U	0.714 U	3.102 U	31.020 U ^(c)
WREF MS	19.41	7.421	6.958	6.978	4.005	6.61	7.634	8.195	3.161	NA
Concentration Recovered	19.41	7.421	6.958	6.978	4.005	6.61	7.634	8.195	3.161	NA
Spike Amount	6.018	6.018	6.018	6.018	6.018	6.018	6.015	6.018	6.015	NA
Percent Recovery	323% ^(d)	123% ^(e)	116%	116%	67%	110%	127% ^(e)	136% ^(e)	53%	NA
Standard Reference Material										
None available										
Analytical Duplicates										
MOTNW Replicate 1	1.069 U	5.356 U	5.356 U	5.356 U	5.356 U	5.356 U	1.450 U	1.233 U	5.356 U	53.564 U
MOTNW Replicate 2	1.058 U	5.300 U	5.300 U	5.300 U	5.300 U	5.300 U	1.435 U	1.220 U	5.300 U	53.002 U
RPD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

(a) Average dry weight of samples (not including MS and SRM).

(b) U Analyte was not present above level of associated value.

(c) NA Not applicable.

(d) I Interfering peak found during analysis.

(e) Recovery outside quality control range (40%-120%).

**TABLE B.16. Sediment Polychlorinated Biphenyls (PCB) Results,
Dry Weight, Wilmington Harbor Project**

Sediment Treatment	PCBs ($\mu\text{g/kg}$ dry weight)					
	Aroclor 1221	Aroclor 1232	Aroclor 1242/1016	Aroclor 1248	Aroclor 1254	Aroclor 1260
Target DL ^(a)	20	20	20	20	20	20
Achieved DL	31	31	31	31	31	31
BSCMA	78.056 U ^(b)	78.056 U	78.056 U	78.056 U	78.056 U	78.056 U
KICMA	63.670 U	63.670 U	63.670 U	63.670 U	63.670 U	63.670 U
MOTMA	89.712 U	89.712 U	89.712 U	89.712 U	89.712 U	89.712 U
MOTNW Replicate 1	53.564 U	53.564 U	53.564 U	53.564 U	53.564 U	53.564 U
MOTNW Replicate 2	53.002 U	53.002 U	53.002 U	53.002 U	53.002 U	53.002 U
WREF	31.020 U	31.020 U	31.020 U	31.020 U	31.020 U	31.020 U

(a) DL Detection limit.

(b) U Analyte was not present above the level of the associated value.

TABLE B.17. Quality Control Summary for Polychlorinated Biphenyls (PCB), Dry Weight, in Sediment, Wilmington Harbor Project

Sediment Treatment	PCBs ($\mu\text{g/kg}$ dry weight)					
	Aroclor 1221	Aroclor 1232	Aroclor 1242/1016	Aroclor 1248	Aroclor 1254	Aroclor 1260
<u>Method Blank (a)</u>						
Blank 1	48.330 U ^(b)	48.330 U	48.330 U	48.330 U	48.330 U	48.330 U
<u>Matrix Spikes</u>						
WHREF	31.020 U ^(c)	31.020 U	31.020 U	31.020 U	31.020 U	31.020 U
WHREF MS	NA	NA	NA	NA	92.918	NA
Concentration Recovered	NA	NA	NA	NA	92.918	NA
Spike Amount	NA	NA	NA	NA	75.229	NA
Percent Recovery	NA	NA	NA	NA	124% ^(d)	NA
<u>Standard Reference Material</u>						
None available						
<u>Analytical Duplicates</u>						
MOTNW Replicate 1	53.564 U	53.564 U	53.564 U	53.564 U	53.564 U	53.564 U
MOTNW Replicate 2	53.002 U	53.002 U	53.002 U	53.002 U	53.002 U	53.002 U
RPD	NA	NA	NA	NA	NA	NA
I-Stat	NA	NA	NA	NA	NA	NA

(a) Average dry weight of samples (not including MS and SRM).

(b) U Analyte was not present above the level of the associated value.

(c) NA Not applicable.

(d) Recovery outside quality control range (40%-120%).

TABLE B.18. Surrogate Recoveries for Chlorinated Pesticides and Polychlorinated Biphenyls (PCB), Dry Weight, in Sediment Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Surrogate Percent Recovery</u>	
	<u>DBOFB</u>	<u>CL5(112)</u>
BSCMA	108	73
KICMA	118	81
MOTMA	102	74
MOTNW Replicate 1	95	74
MOTNW Replicate 2	103	78
WREF	84	85
<u>Quality Control Data</u>		
<u>Method Blank^(a)</u>		
Blank 1	69	78
<u>Matrix Spikes</u>		
WREF MS	70	88
<u>Standard Reference Material</u>		
None available		
<u>Analytical Duplicates</u>		
MOTNW Replicate 1	95	74
MOTNW Replicate 2	103	78

(a) Average dry weight of samples (not including MS and SRM).

TABLE B.19. Sediment Results for Phenols, Dry Weight, Wilmington Harbor Project

Sediment Treatment	Phenols ($\mu\text{g}/\text{kg}$ dry weight)										
	Phenol	2,4-dimethyl-phenol	2,4,6-trichlorophenol	Para-chloro-meta-cresol	2-chlorophenol	2,4-dichlorophenol	2-nitrophenol	4-nitrophenol	2,4-dinitrophenol	4,6-dinitro-cresol	Penta-chlorophenol
Target DL (a)	100-1500	100-1500	100-1500	30	100-1500	100-1500	100-1500	100-1500	100-1500	100-1500	100-1500
Achieved DL	≤ 100	≤ 100	≤ 100	≤ 30	≤ 100	≤ 100	300	300	300	300	300
BSCMA	168.00 J ^(b)	5.09 J	756.81 U ^(c)	5.25 J	756.81 U	756.81 U	756.81 U	3.30 J	756.81 U	756.81 U	756.81 U
KICMA	127.31 J	7.51 J	8.54 J	5.78 J	617.33 U	8.00 J	617.33 U	617.33 U	617.33 U	617.33 U	617.33 U
MOTMA	805.97 J	7.39 J	9.20 J	12.01 J	869.84 U	4.79 J	869.84 U	4.95 J	869.84 U	869.84 U	27.48 J
MOTNW Replicate 1	148.28 J	7.87 J	9.03 J	7.72 J	6.22 J	9.09 J	519.35 U	1.76 J	519.35 U	513.90 U	35.82 J
MOTNW Replicate 2	192.18 J	5.04 J	6.50 J	13.80 J	4.19 J	4.15 J	513.90 U	1.69 J	513.90 U	519.35 U	14.64 J
WHPREF	45.96 J	2.42 J	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U

(a) DL Detection limit.

(b) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the level of associated value.

TABLE B.20. Quality Control Summary for Phenols, Dry Weight, in Sediment, Wilmington Harbor Project

Sediment Treatment	Phenols ($\mu\text{g}/\text{kg}$ dry weight)										
	Phenol	2,4-dimethyl-phenol	2,4,6-trichloro-phenol	Para-chloro-meta-cresol	2-chloro-phenol	2,4-dichloro-phenol	2-nitro-phenol	4-nitro-phenol	2,4-dinitro-phenol	4,6-dinitro-cresol	Penta-chloro-phenol
Method Blank											
Blank 1	105.55 J ^(a)	468.60 U ^(b)	3.39 J	5.59 J	14.96 J	3.60 J	468.60 U	468.60 U	468.60 U	468.60 U	13.90 J
Matrix Spike											
WREF	45.96 J	2.42 J	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U	300.76 U
WREF MSD	668.21	92.66	1195.12	ND ^(c)	1078.08	857.96	1062.57	NA ^(d)	92	ND	14.88
Concentration Recovered	622.25	90.24	1195.12	NA	1078.08	857.96	1062.57	NA	92	NA	14.88
Spike Amount	897.36	924.61	924.61	NA	897.36	897.36	897.36	NA	924.61	NA	897.36
Percent Recovery	69%	10% ^(e)	129% ^(e)	NA	120%	96%	118%	NA	10% ^(e)	NA	2% ^(e)
Standard Reference Material											
No Certified Value	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Analytical Replicates											
MOTNW Replicate 1	148.28 J	7.87 J	9.03 J	13.80 J	6.22 J	9.09 J	519.35 U	1.76 J	519.35 U	519.35 U	35.82 J
MOTNW Replicate 2	192.18 J	5.04 J	6.50 J ^(f)	7.72 J ^(f)	4.19 J ^(f)	4.15 J ^(f)	513.90 U	1.69 J	513.90 U	513.90 U	14.64 J ^(f)
RPD	26%	44% ^(f)	33% ^(f)	57% ^(f)	39% ^(f)	75% ^(f)	1%	4%	NA	NA	84% ^(f)
1-Stat	0.13	0.22	0.16	0.28	0.20	0.37	0.01	0.02	NA	NA	0.42

(a) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of associated value.

(c) ND No data.

(d) NA Not applicable.

(e) Recovery outside quality control range (40%-120%).

(f) Value exceeds relative precision range of $\leq 30\%$.

TABLE B.21. Sediment Results for Phthalates, Dry Weight, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Bis-(2-ethylhexyl) phthalate</u>	<u>Butyl-benzyl-phthalate</u>	<u>Di-n-butyl-phthalate</u>	<u>Di-n-octyl phthalate</u>	<u>Diethyl-phthalate</u>	<u>Dimethyl-phthalate</u>
Target DL ^(a)	100	100	100	100	100	100
Achieved DL	≤100	≤100	≤100	300	≤100	≤100
BSCMA	7.07 J ^(b)	3.19 J	7.09 J	756.81 U ^(c)	756.81 U	756.81 U
KICMA	10.35 J	4.42 J	341.33 J	617.33 U	2.50 J	1.65 J
MOTMA	11.10 J	5.05 J	3.88 J	869.84 U	4.51 J	2.11 J
MOTNW Replicate 1	6.66 J	4.04 J	6.27 J	519.35 U	7.77 J	519.35 U
MOTNW Replicate 2	6.61 J	2.86 J	3.38 J	513.90 U	5.25 J	513.90 U
WREF	5.52 J	1.72 J	1.67 J	300.76 U	0.27 J	0.69 J

(a) DL Detection limit.

(b) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the level of associated value.

TABLE B.22. Quality Control Data for Phthalates, Dry Weight, in Sediment, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Bis-(2-ethylhexyl) phthalate</u>	<u>Butyl-benzyl-phthalate</u>	<u>Di-n-butyl-phthalate</u>	<u>Di-n-octyl-phthalate</u>	<u>Diethyl-phthalate</u>	<u>Dimethyl-phthalate</u>
<u>Method Blank</u>						
Blank 1	5.24 J ^(a)	468.60 U ^(b)	355.75 J	468.60 U	468.60 U	468.60 U
<u>Matrix Spike</u>						
WREF	5.52 J	1.72 J	1.67 J	300.76 U	0.27 J	0.69 J
WREF MSD	18.97	19.39	243.31	10.23	98.71	773.19
Concentration Recovered	13.45	17.67	241.64	10.23	98.44	772.5
Spike Amount	897.36	897.36	897.36	897.36	897.36	897.36
Percent Recovery	1% ^(c)	2% ^(c)	27% ^(c)	1% ^(c)	11% ^(c)	86%
<u>Standard Reference Material</u>						
No Certified Value	ND ^(d)	ND	ND	ND	ND	ND
<u>Analytical Replicates</u>						
MOTNW Replicate 1	6.66 J	4.04 J	6.27 J	519.35 U	7.77 J	519.35 U
MOTNW Replicate 2	6.61 J	2.86 J	3.38 J	513.90 U	5.25 J	513.90 U
RPD	1%	34% ^(e)	60% ^(e)	NA ^(f)	39% ^(e)	NA
I-Stat	0.00	0.17	0.30	NA	0.19	NA

- (a) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).
(b) U Analyte was not present above the level of associated value.
(c) Recovery outside quality control range (40%-120%).
(d) ND No data.
(e) Value exceeds relative precision range of $\leq 30\%$.
(f) NA Not applicable.

TABLE B.23. Surrogate Recoveries for Phenols and Phthalates, in Sediment, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Percent Moisture</u>	<u>Surrogate Percent Recovery 2-fluorophenol</u>
BSCMA	67.331	17 ^(a)
KICMA	60.294	20 ^(a)
MOTMA	71.653	3 ^(a)
MOTNW Replicate 1	52.077	26 ^(a)
MOTNW Replicate 2	52.670	26 ^(a)
WREF	17.438	48
<u>Quality Control Data</u>		
<u>Method Blank</u>		
Blank 1	NA ^(b)	6 ^(a)
<u>Matrix Spike</u>		
WREF MS	17.438	37 ^(a)
<u>Standard Reference Material</u>		
No Certified Value		1
<u>Analytical Replicates</u>		
MOTNW Replicate 1	52.077	26 ^(a)
MOTNW Replicate 2	52.670	26 ^(a)

(a) Recovery outside quality control range (40%-120%).

(b) NA Not applicable.

TABLE B.24. Sediment Results for Metals Analyzed by Graphite Furnace Atomic Absorption Analysis (GFAA), Cold Vapor Atomic Absorption (CVAA), and Inductively Coupled Plasma/Mass Spectroscopy (ICP/MS), Dry Weight, Wilmington Harbor Project

Sediment Treatment	Batch	Metals (mg/kg dry weight)														ICP Zn ^(a)
		GFAA Ag	GFAA As	ICP Be	ICP Cd	ICP Cr	ICP Cu	CVAA Hg	ICP Ni	ICP Pb	GFAA Sb	GFAA Se	ICP Tl			
Target DL ^(b) Achieved DL		0.10	0.1	0.2	0.10	0.6	0.1	0.010	1.0	0.1	0.10	0.20	0.10	0.3		
		0.03	0.2	0.1	0.01	1.0	0.2	0.001	0.1	1.0	0.20	0.10	0.01	1.0		
BSCMA	1	0.03 ^(c)	24.3	1.1	0.36	63.2	13.6	0.046	15.6	20.4	0.27	0.50	0.31	60.3		
KICMA	1	0.09	9.97	1.43	0.33	59.3	9.65	0.064	14.1	17.1	0.27	0.36	0.28	69.4		
MOTMA Replicate 1	1	0.10	18.2	1.52	0.19	65.4	18.9	0.081	18.2	23.6	0.37	0.51	0.29	110		
MOTMA Replicate 2	1	0.10	17.7	1.43 ^(d)	0.12	68.2	17.4	0.083	18.4	21.2	0.37	0.43	0.27	85.2		
MOTMA Replicate 3	1	0.09	19.5	NA ^(d)	NA	NA	NA	0.081	NA	NA	0.55	0.58	NA	NA		
MOTNW	1	0.04	9.51	0.89	0.01 U	39.3	11.5	0.031	9.25	14.8	0.18	0.29	0.19	66.6		
WHREF	1	0.03 U	2.71	0.16	0.01 U	12.1	1.34	0.001 U	1.05	4.28	0.16 U	0.13 U	0.07	8.92		

(a) Results for these elements with the exception of sample 15 are from procedure analysis 2807q.

(b) DL Detection limit.

(c) U Analyte was not present above the level of associated value.

(d) NA Not applicable.

TABLE B.25.

Quality Control Summary for Metals Analyzed by Graphite Furnace Atomic Absorption Analysis (GFAA), Cold Vapor Atomic Absorption (CVAA), and Inductively Coupled Plasma/Mass Spectroscopy (ICP/MS), Dry Weight, in Sediment, Wilmington Harbor Project

Sediment Treatment	Batch	Metals (mg/kg dry weight)												
		Ag	As	Be	Cd	Cr	Cu	Hg	Ni	Pb	Sb	Se	Tl	Zn(a)
Method Blank														
Blank Replicate 1	1	0.03 U(b)	0.21 U	0.1 U	0.01 U	1 U	0.87	0.003 U	0.1 U	1 U	0.16 U	0.13 U	0.01 U	24.5
Blank Replicate 2	1	0.03 U	0.21 U	0.1 U	0.01 U	1 U	0.29	0.001 U	0.1 U	1 U	0.16 U	0.13 U	0.01 U	1.4
Blank Replicate 3	1	0.03 U	0.21 U	0.1 U	0.01 U	1 U	0.19	0.001 U	0.1 U	1 U	0.16 U	0.13 U	0.01 U	29.2
Blank Replicate 4	1	0.03 U	0.21 U	NA(c)	NA	NA	NA	NA	NA	NA	0.16 U	0.13 U	NA	NA
Matrix Spikes														
BSCMA	1	0.03 U	24.30	1.1	0.36	63.2	13.6	0.046	15.6	20.4	0.27	0.50	0.31	60.3
BSCMA MS	1	0.54	54.70	1.6	1.3	116	64.7	0.558	70.2	70.7	1.20	5.22	3.05	168
Concentration Recovered		0.54	30.40	0.5	0.94	52.8	51.1	0.512	54.6	50.3	0.93	4.72	2.74	107.7
Amount Spiked		0.50	25.00	NS(d)	0.99	49.5	49.5	0.5	49.5	49.5	1.00	5.00	1.98	99.10
Percent Recovery		108%	122%	NA	95%	107%	103%	102%	110%	102%	93%	94%	138%(e)	109%
Standard Reference Material														
Certified Value MESS-1		NC(f)	10.6 ±1.2	1.9 ±0.2	0.59 ±0.10	71 ±11	25.1 ±3.8	NC	29.5 ±2.7	34 ±6.1	0.73 ±0.08	0.34 ±0.06	NC	191 ±17
MESS-1 Replicate 1		0.15	18.2	1.95	0.47	62.5	17.9	0.241	26.2	33.5	0.73	0.29	0.67	153
MESS-1 Replicate 2		0.11	10.5	2.88	0.36	62.7	29.5	NA	27.1	33.8	1.48	0.29	0.53	207
MESS-1 Replicate 3		0.10	10.9	1.79	0.59	66.0	26.0	NA	25.4	34.4	0.82	0.29	0.63	189
MESS-1 Replicate 4		0.11	10.6	NA	NA	NA	NA	NA	NA	NA	0.74	0.29	NA	NA
Certified Value 1646		NC	11.6 ±1.3	NC	0.36 ±0.07	76 ±3	18 ±3	0.063 ±0.012	32 ±3	28.2 ±1.8	NC	NC	NC	138 ±6
SRM 1646 Replicate 1		0.09	10.4	2.00	0.54	86.3	17.5	0.079	35.3	27.8	0.46	0.50	0.46	127
SRM 1646 Replicate 2		0.11	11.3	1.41	0.46	78.4	18.3	0.071	33.9	28.2	0.37	0.36	0.63	139
SRM 1646 Replicate 3		0.11	11.3	1.26	0.24	71.4	17.5	0.072	28.2	25.8	0.46	0.36	0.56	140
SRM 1646 Replicate 4		0.11	11.9	NA	NA	NA	NA	NA	NA	NA	0.46	0.44	NA	NA
Certified Value BEST-1		NC	NC	NC	NC	NC	NC	0.092 ±0.009	NC	NC	NC	NC	NC	NC
SRM BEST-1 Replicate 1		NA	NA	NA	NA	NA	NA	0.092	NA	NA	NA	NA	NA	NA

TABLE B.25. (contd)

Sediment Treatment	Batch	(mg/kg dry weight)													Zn (a)
		Ag	As	Be	Cd	Cr	Cu	Hg	Ni	Pb	Sb	Se	Tl		
Analytical Replicates															
MOTMA Replicate 1	1	NA	NA	1.52	0.19	65.4	18.9	NA	18.2	23.6	NA	NA	0.29	110	
MOTMA Replicate 2	1	NA	NA	1.43	0.12	68.2	17.4	NA	18.4	21.2	NA	NA	0.27	85.2	(g)
RPD		NA	NA	6%	45%	(g)	4%	8%	1%	11%	NA	NA	7%	25%	
I-Stat		NA	NA	0.03	0.23	0.02	0.04	NA	0.01	0.05	NA	NA	0.04	0.13	
Analytical Triplicates															
MOTMA Replicate 1	1	0.10	18.2	NA	NA	NA	NA	0.081	NA	NA	0.16 U	0.13 U	NA	NA	
MOTMA Replicate 2	1	0.10	17.7	NA	NA	NA	NA	0.083	NA	NA	0.16 U	0.13 U	NA	NA	
MOTMA Replicate 3	1	0.09	19.5	NA	NA	NA	NA	0.081	NA	NA	0.16 U	0.13 U	NA	NA	
RSD		6%	5%	NA	NA	NA	NA	1%	NA	NA	NA	NA	NA	NA	

(a) Results for these elements with the exception of sample 15 are from procedure analysis 2807q.

(b) U Analyte was not present above the level of associated value.

(c) NA Not applicable.

(d) NS Not spiked.

(e) Recovery outside quality control range (75%-125%).

(f) NC Not certified.

(g) Value exceeds relative precision range $\leq 20\%$.

TABLE B.26. Sediment Butyltins Results, Dry Weight, Wilmington Harbor Project

Sediment Treatment	Batch	Surrogate Percent Recovery				Butyltins ($\mu\text{g}/\text{kg}$ dry weight)		
		Tri-pentyltin	Propyltin	Pentyl-butyltins	Tetra-butyltin	Tri-butyltin	Di-butyltin	Mono-butyltin
Target DL ^(a)		NA ^(b)	NA	NA	NA	10	10	10
Achieved DL		NA	NA	NA	NA	3	2	3
BSCMA	1	73.59	69.69	117.34	50.52	3.20 U ^(c)	2.60 U	4.60 U
KICMA	1	59.40	56.80	105.97	50.12	9.40	2.60 U	4.60 U
MOTMA	1	73.51	66.22	110.11	67.66	4.80	1.90 U	3.40 U
MOTNW	1	44.79	40.73	103.68	61.62	2.60 U	2.10 U	3.70 U
WHREF	1	65.90	67.40	106.68	58.05	2.80 U	2.20 U	4.00 U

(a) DL Detection limit.

(b) NA Not applicable.

(c) U Analyte was not present above the level of associated value.

TABLE B.27. Quality Control Summary for Butyltins, Dry Weight, in Sediment, Wilmington Harbor Project

		Surrogate Percent Recovery				Butyltins ($\mu\text{g/kg}$ dry weight)		
Sediment Treatment	Batch	Tri-pentyltin	Propyltin	Pentyl-butyltins	Tetra-butyltin	Tri-butyltin	Di-butyltin	Mono-butyltin
<u>Method Blank</u>								
Blank 1		21.32 ^(a)	20.56 ^(a)	91.76	49.21	3.30 U ^(b)	2.60 U	4.70 U
Blank 2		18.48 ^(a)	18.56 ^(a)	94.12	69.12	2.30 U	1.90 U	3.30 U
<u>Matrix Spikes</u>								
MOTNW	1	44.79	40.73	103.68	61.62	2.60 U	2.10 U	3.70 U
MOTNW MS	1	67.96	64.81	104.05	51.30	31.60	11.30	9.60
Concentration Recovered						31.60	11.30	9.60
Spike Amount						50.71	50.71	50.71
Percent Recovery						62%	22% ^(a)	19% ^(a)
MOTNW	1	44.79	40.73	103.68	61.62	2.60 U	2.10 U	3.70 U
MOTNW MSD	1	63.88	86.57	108.16	21.04	39.20	16.80	5.30 J
Concentration Recovered						39.20	16.80	5.30
Spike Amount						52.85	52.85	52.85
Percent Recovery						74%	32% ^(a)	10% ^(a)
MS/MSD RPD						17%	37% ^(c)	62% ^(c)
MS/MSD I-Stat						0.09	0.18	0.31
<u>Standard Reference Material</u>								
Certified Value		NC ^(d)	NC	NC	NC	NC	NC	0.28 ± 0.17
PACS -1		54.37	72.66	105.28	13.23	560.10	288.00	17.40 U

(a) Recovery outside quality control range (40%-120%).

(b) U Analyte was not present above the level of associated value.

(c) Value exceeds relative precision range $\leq 30\%$.

(d) NC Not certified.

TABLE B.28. Sediment Results for Total Kjeldahl Nitrogen (TKN), Cyanide, and Oil & Grease, Dry Weight, in Sediment, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>(mg/kg dry weight)</u>		
	<u>TKN</u>	<u>Cyanide</u>	<u>Oil & Grease</u>
Target DL ^(a)	NA ^(b)	1	20
Achieved DL	NA	<1	<20
BSCMA Replicate 1	3060	0.032 U	447
BSCMA Replicate 2	NA	0.032	290
BSCMA Replicate 3	NA	0.032 U	379
KICMA Replicate 1	1100	0.024 U ^(c)	453
KICMA Replicate 2	672	NA	NA
KICMA Replicate 3	1050	NA	NA
MOTMA	2200	0.033 U	705
MOTNW	1020	0.021 U	317
WREF	55.4	0.011 U	184

(a) DL Detection limit.

(b) NA Not applicable.

(c) U Analyte was not present above the level of associated value.

TABLE B.29. Quality Control Summary for Total Kjeldahl Nitrogen (TKN), Cyanide, and Oil & Grease, Dry Weight, in Sediment, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>(mg/kg dry weight)</u>		
	<u>TKN</u>	<u>Cyanide</u>	<u>Oil & Grease</u>
<u>Method Blank</u>			
Blank 1	0.1 U ^(a)	0.0001 U	0.3 U
<u>Matrix Spikes</u>			
KICMA Replicate 1	1100	NA ^(b)	NA
KICMA MS	5530	ND ^(c)	ND
Concentration Recovered	4430	NA	NA
Amount Spiked	4710	NA	NA
Percent Recovery	94.06%	NA	NA
BSCMA	NA	0.032 U	447
BSCMA MS	ND	230	24100
Concentration Recovered	NA	230	23653
Amount Spiked	NA	319	20000
% Recovery	NA	72.10%	118.27%
BSCMA	NA	0.032 U	447
BSCMA MSD	ND	245	19468
Concentration Recovered	NA	245	19021
Amount Spiked	NA	297	18307
Percent Recovery	NA	82.49%	103.90%
MS/MSD RPD	NA	13%	13%
MS/MSD I-Stat	NA	0.07	0.06
<u>Analytical Replicates</u>			
KICMA Replicate 1	1100	NA	NA
KICMA Replicate 2	672	ND	ND
KICMA Replicate 3	1050	ND	ND
RSD	24% ^(d)	NA	NA
BSCMA Replicate 1	NA	0.032 U	447
BSCMA Replicate 2	ND	0.032	290
BSCMA Replicate 3	ND	0.032 U	379
RSD	NA	NA	21%

- (a) U Analyte was not present above the level of associated value.
 (b) NA Not applicable.
 (c) ND No data.
 (d) Value exceeds relative standard deviation range of $\leq 20\%$.

TABLE B.30. Sediment Results for Dioxins (2378-TCDD - OCDD), Dry Weight, Wilmington Harbor Project

Sediment Treatment	Dioxins (ng/kg dry weight)						
	2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
Target DL ^(a)	1	1	1	1	1	1	1
Achieved DL	≤1	≤1	≤1	≤1	≤1	≤1	≤1
BSCMA	0.40 U ^(b)	0.90 U	0.40	2.40 U	2.04	23.40	343.26
KICMA	0.50 U	0.80 U	0.31	1.19	1.89	30.17	667.53
MOTMA	0.40 U	0.23	0.47	0.90	1.64	24.26	456.87
MOTNW	0.30 U	0.70 U	0.35	0.91	2.17	30.84	806.34
WHREF Replicate 1	0.50 U	0.30 U	0.30 U	0.30 U	0.22	1.78	22.72
WHREF Replicate 2	0.40 U	0.10 U	0.20 U	0.20 U	0.18	1.62	25.26
WHREF Replicate 3	0.30 U	0.20 U	0.20 U	0.06	0.24	1.67	20.76

(a) DL Detection limit.

(b) U Analyte was not present above the level of the associated value.

TABLE B.31. Sediment Results for Dioxins (2378-TCDF - OCDF), Dry Weight, Wilmington Harbor Project

Sediment Treatment	Dioxins (ng/kg dry weight)									
	2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HxCDF	1234789-HxCDF	OCDF
Target DL ^(a)	1	1	1	1	1	1	1	1	1	1
Achieved DL	≤1	≤1	≤1	≤1	≤1	≤1	≤1	≤1	≤1	≤1
BSCMA	0.90 U ^(b)	0.40 U	0.30 U	1.10 U	0.10	1.10 U	0.10 U	5.90 U	0.40 U	2.61
KICMA	0.32	0.30 U	0.15	0.33	0.16	0.48	0.20 U	20.61	0.80 U	18.13
MOTMA	0.70 U	0.40 U	0.30 U	0.40 U	0.30 U	0.90 U	0.20 U	4.87	0.50 U	6.23
MOTNW	0.50 U	0.40 U	0.30 U	0.12	0.14	0.45	0.20 U	3.37	0.60 U	5.08
WHPREF Replicate 1	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.42	0.10 U	0.60 U	0.30 U	0.36
WHPREF Replicate 2	0.30 U	0.20 U	0.10 U	0.20 U	0.20 U	0.36	0.10 U	0.90 U	0.10 U	0.64
WHPREF Replicate 3	0.20 U	0.10 U	0.10 U	0.20 U	0.10 U	0.31	0.10 U	0.70 U	0.20 U	0.32

(a) DL Detection limit.

(b) U Analyte was not present above the level of the associated value.

TABLE B.32. Quality Control Summary for Dioxins, Dry Weight, in Sediment, Wilmington Harbor Project

Sediment Treatment	Dioxins (ng/kg dry weight)						
	2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
<u>Method Blank</u>							
Blank 1	0.2 U ^(a)	0.08	0.3 U	0.3 U	0.3 U	0.37	1.9
<u>Matrix Spike</u>							
IH-2	1.1 U	0.7 U	0.31	0.74	3.6 U	25.3	796.51
IH-2 MS	98.15	454.39	453.28	439.66	474.33	459.52	966.6
Concentration Recovered	98.15	454.39	452.97	438.92	474.33	434.22	170.09
Spike Amount	100	500	500	500	500	500	1000
Percent Recovery	98%	91%	91%	88%	95%	87%	17% ^(b)
IH-2	1.1 U	0.7 U	0.31	0.74	3.6 U	25.3	796.51
IH-2 MSD	101.05	447.37	472.78	467.22	510.11	502.84	1170.45
Concentration Recovered	101.05	447.37	472.47	466.48	510.11	477.54	373.94
Spike Amount	100	500	500	500	500	500	1000
Percent Recovery	101%	89%	94%	93%	102%	96%	37% ^(b)
MS/MSD RPD	3%	2%	3%	6%	7%	10%	75% ^(c)
MS/MSD I-stat	0.01	0.01	0.02	0.03	0.04	0.05	0.37
<u>Matrix Reference Material</u>							
Certified Value	500	1000	1000	1000	1000	1500	3500
MRM 1	438	896	911	829	973	1410	3450
<u>Analytical Replicates</u>							
WHREF Replicate 1	0.5 U	0.3 U	0.3 U	0.3 U	0.22	1.78	22.72
WHREF Replicate 2	0.4 U	0.1 U	0.2 U	0.2 U	0.18	1.62	25.26
WHREF Replicate 3	0.3 U	0.2 U	0.2 U	0.06	0.24	1.67	20.76
RSD	NA ^(d)	NA	NA	NA	14%	5%	10%

(a) U Analyte was not present above the level of the associated value.

(b) Value outside quality control range(40-120%).

(c) Value exceeds relative standard deviation range $\leq 30\%$.

(d) NA Not applicable.

TABLE B.33. Quality Control Summary for Dioxins, Dry Weight, in Sediment, Wilmington Harbor Project

Sediment Treatment	Dioxins (ng/kg dry weight)									
	2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HxCDF	1234789-HxCDF	OCDF
<u>Method Blank</u>										
Blank 1	0.2 U(a)	0.2 U	0.2 U	0.2 U	0.2 U	0.37	0.2 U	0.6 U	0.15	0.23
<u>Matrix Spike</u>										
14 IH-2	1.7 U	0.5 U	0.5 U	0.4 U	0.4 U	0.43	0.2 U	1.45	0.4 U	2.54
14 IH-2 MS	94.61	447.50	417.49	408.83	387.20	398.90	418.83	348.93	429.26	645.57
Concentration Recovered	94.61	447.50	417.49	408.83	387.20	398.47	418.83	347.48	429.26	643.03
Spike Amount	100	500	500	500	500	500	500	500	500	1000
Percent Recovery	95%	90%	83%	82%	77%	80%	84%	69%	86%	64%
14 IH-2	1.7 U	0.5 U	0.5 U	0.4 U	0.4 U	0.43	0.2 U	1.45	0.4 U	2.54
14 IH-2 MSD	94.87	446.71	432.25	426.11	429.02	436.87	441.03	414.11	472.81	741.58
Concentration Recovered	94.87	446.71	432.25	426.11	429.02	436.44	441.03	412.66	472.81	739.04
Spike Amount	100	500	500	500	500	500	500	500	500	1000
Percent Recovery	95%	89%	86%	85%	86%	87%	88%	83%	95%	74%
MS/MSD RPD	0%	0%	3%	4%	10%	9%	5%	17%	10%	14%
MS/MSD 1-stat	0.00	0.00	0.02	0.02	0.05	0.05	0.03	0.09	0.05	0.07
<u>Matrix Reference Material</u>										
Certified Value	500	1000	1000	1000	1000	1000	1000	1500	1500	2500
MRM 1	416	861	824	874	865	838	863	1265	1401	2497
<u>Analytical Replicates</u>										
WHREF Replicate 1	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.42	0.1 U	0.6 U	0.3 U	0.36
WHREF Replicate 2	0.3 U	0.2 U	0.1 U	0.2 U	0.2 U	0.36	0.1 U	0.9 U	0.1 U	0.64
WHREF Replicate 3	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.31	0.1 U	0.7 U	0.2 U	0.32
RSD	NA(b)	NA	NA	NA	NA	15%	NA	NA	NA	40%(c)

(a) U Analyte was not present above the level of the associated value.

(b) NA Not applicable.

(c) Value exceeds relative standard deviation range $\leq 30\%$.

APPENDIX C

10-DAY *A. abdita* SOLID-PHASE TEST

TABLE C.1. Results for All Replicates in 10-Day *A. abdita* Solid-Phase Test, Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
BSCMA	1	10	10	50.0	41.0
BSCMA	2	8	12	40.0	
BSCMA	3	7	13	35.0	
BSCMA	4	7	13	35.0	
BSCMA	5	9	11	45.0	
KICMA	1	6	14	30.0	39.0
KICMA	2	9	11	45.0	
KICMA	3	10	10	50.0	
KICMA	4	7	13	35.0	
KICMA	5	7	13	35.0	
MOTMA	1	5	15	25.0	38.0
MOTMA	2	12	8	60.0	
MOTMA	3	7	13	35.0	
MOTMA	4	4	16	20.0	
MOTMA	5	10	10	50.0	
MOTNW	1	10	10	50.0	42.0
MOTNW	2	11	9	55.0	
MOTNW	3	6	14	30.0	
MOTNW	4	6	14	30.0	
MOTNW	5	9	11	45.0	
WHPREF	1	8	12	40.0	47.0
WHPREF	2	10	10	50.0	
WHPREF	3	9	11	45.0	
WHPREF	4	6	14	30.0	
WHPREF	5	14	6	70.0	
WHFINE	1	10	10	50.0	57.0
WHFINE	2	11	9	55.0	
WHFINE	3	13	7	65.0	
WHFINE	4	12	8	60.0	
WHFINE	5	11	9	55.0	
San Pablo Bay	1	7	13	35.0	44.0
San Pablo Bay	2	6	14	30.0	
San Pablo Bay	3	11	9	55.0	
San Pablo Bay	4	10	10	50.0	
San Pablo Bay	5	10	10	50.0	

TABLE C.1. (contd)

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
Sequim Bay	1	14	6	70.0	
Sequim Bay	2	16	4	80.0	
Sequim Bay	3	12	8	60.0	
Sequim Bay	4	12	8	60.0	
Sequim Bay	5	9	11	45.0	63.0

TABLE C.2. Water Quality Summary for 10-Day *A. abdita* Solid-Phase Test, Wilmington Harbor Project

Sediment Treatment	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)		Flow Rates (mL/min)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	18.0	22.0	7.30	8.30	4.0	---	28.0	32.0	35	45
BSCMA	19.8	20.8	7.79	8.12	6.6	7.8	30.0	32.0	36	44
KICMA	19.9	20.8	7.78	8.11	6.5	7.7	30.0	32.0	36	44
MOTMA	19.9	20.8	7.80	8.11	6.4	7.8	30.0	32.0	36	44
MOTNW	19.8	20.8	7.74	8.11	6.5	7.8	30.0	32.0	36	44
WHREF	19.9	20.7	7.78	8.12	6.5	8.0	29.0	32.0	36	44 ^(a)
WHFINE	19.8	20.8	7.76	8.12	6.5	7.8	28.0	32.0	36	48 ^(a)
San Pablo Bay	19.7	20.7	7.85	8.11	6.6	7.7	30.0	32.0	36	44
Sequim Bay	19.6	20.9	7.73	8.13	6.5	7.6	30.0	32.0	36	44

(a) Data point out of range.

TABLE C.3. Results for All Replicates in 96-h *A. abdita* Reference Toxicant Test, Wilmington Harbor Project

<u>Cadmium Concentration (mg/L)</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
0.00	1	3	17	15.0	16.7
0.00	2	2	18	10.0	
0.00	3	5	15	25.0	
0.25	1	2	18	10.0	18.3
0.25	2	5	15	25.0	
0.25	3	4	16	20.0	
0.50	1	1	19	5.0	10.0
0.50	2	4	16	20.0	
0.50	3	1	19	5.0	
1.00	1	2	18	10.0	6.7
1.00	2	0	20	0.0	
1.00	3	2	18	10.0	
2.00	1	0	20	0.0	0.0
2.00	2	0	20	0.0	
2.00	3	0	20	0.0	

TABLE C.4. Water Quality Summary for 96-h *A. abdita* Reference Toxicant Test, Wilmington Harbor Project

Cadmium Concentration (mg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	18.0	22.0	7.30	8.30	4.0	---	28.0	32.0
0.00	19.0	19.6	8.07	8.21	7.0	7.4	30.0	31.0
0.25	19.4	19.6	8.07	8.20	7.0	7.4	30.0	31.0
0.50	19.5	19.7	8.07	8.18	7.0	7.5	30.0	31.0
1.00	19.3	19.6	8.04	8.18	7.0	7.6	30.0	31.0
2.00	19.4	19.6	7.98	8.14	7.1	7.5	30.0	31.0

APPENDIX D

10-DAY *R. abronius* SOLID-PHASE TEST

TABLE D.1. Results for All Replicates in 10-Day *R. abronius* Solid-Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
BSCMA	1	17	3	85.0	90.0
BSCMA	2	18	2	90.0	
BSCMA	3	18	2	90.0	
BSCMA	4	18	2	90.0	
BSCMA	5	19	1	95.0	
KICMA	1	19	1	95.0	97.0
KICMA	2	20	0	100.0	
KICMA	3	20	0	100.0	
KICMA	4	18	2	90.0	
KICMA	5	20	0	100.0	
MOTMA	1	20	0	100.0	93.0
MOTMA	2	17	3	85.0	
MOTMA	3	19	1	95.0	
MOTMA	4	19	1	95.0	
MOTMA	5	18	2	90.0	
MOTNW	1	17	3	85.0	92.0
MOTNW	2	19	1	95.0	
MOTNW	3	18	2	90.0	
MOTNW	4	19	1	95.0	
MOTNW	5	19	1	95.0	
WHREF	1	20	0	100.0	99.0
WHREF	2	20	0	100.0	
WHREF	3	20	0	100.0	
WHREF	4	19	1	95.0	
WHREF	5	20	0	100.0	
WHFINE	1	20	0	100.0	99.0
WHFINE	2	20	0	100.0	
WHFINE	3	20	0	100.0	
WHFINE	4	19	1	95.0	
WHFINE	5	20	0	100.0	
Whidbey Island	1	20	0	100.0	100.0
Whidbey Island	2	20	0	100.0	
Whidbey Island	3	20	0	100.0	
Whidbey Island	4	20	0	100.0	
Whidbey Island	5	20	0	100.0	

TABLE D.1. (contd)

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Number Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
Sequim Bay	1	17	3	85.0	
Sequim Bay	2	14	6	70.0	
Sequim Bay	3	18	2	90.0	
Sequim Bay	4	19	1	95.0	
Sequim Bay	5	20	0	100.0	88.0

TABLE D.2. Water Quality Summary for 10-Day *R. abronius* Solid-Phase Test, Wilmington Harbor Project

Sediment Treatment	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	13.0	17.0	7.30	8.30	4.0	---	28.0	32.0
BSCMA	14.3	15.6	7.68	8.34 ^(a)	5.9	8.2	31.0	32.0
KICMA	14.4	15.2	7.58	8.39 ^(a)	6.8	8.4	28.0	32.0
MOTMA	14.5	15.3	7.65	8.50 ^(a)	7.0	8.6	28.0	32.0
MOTNW	14.4	16.3	7.62	8.40 ^(a)	6.7	8.3	28.0	32.0
WHREF	14.5	15.6	7.67	8.26	5.8	8.4	30.5	32.0
WHFINE	14.1	15.5	7.70	8.20	6.8	8.3	30.0	32.0
Whidbey Island	14.2	15.2	7.63	8.27	6.6	8.4	30.0	32.0
Sequim Bay	14.5	15.2	7.54	8.26	6.0	8.4	30.0	32.0

(a) Data point out of range.

TABLE D.3. Results for All Replicates in 96-h *R. abronius* Reference Toxicant Test, Wilmington Harbor Project

<u>Cadmium Concentration (mg/L)</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
0.0	1	19	1	95.0	96.7
0.0	2	19	1	95.0	
0.0	3	20	0	100.0	
0.5	1	14	6	70.0	78.3
0.5	2	16	4	80.0	
0.5	3	17	3	85.0	
1.0	1	3	17	15.0	5.0
1.0	2	0	20	0.0	
1.0	3	0	20	0.0	
2.0	1	0	20	0.0	0.0
2.0	2	0	20	0.0	
2.0	3	0	20	0.0	
4.0	1	0	20	0.0	0.0
4.0	2	0	20	0.0	
4.0	3	0	20	0.0	

TABLE D.4. Water Quality Summary for 96-h *R. abronius* Reference Toxicant Test, Wilmington Harbor Project

Cadmium Concentration (mg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	13.0	17.0	7.30	8.30	4.0	---	28.0	32.0
0.00	14.2	15.0	8.00	8.14	7.4	8.7	30.0	31.5
0.50	14.2	14.7	8.04	8.15	7.7	8.3	30.0	32.0
1.00	14.1	14.6	8.02	8.13	7.7	8.3	30.0	32.0
2.00	14.1	14.6	7.99	8.10	7.4	8.0	30.0	32.0
4.00	14.2	14.6	7.91	8.00	7.6	8.4	30.0	32.0

APPENDIX E

10-DAY *N. virens* SOLID-PHASE TEST

TABLE E.1. Results for All Replicates in 10-Day *N. virens* Solid-Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
BSCMA	1	20	0	100.0	97.0
BSCMA	2	19	1	95.0	
BSCMA	3	20	0	100.0	
BSCMA	4	19	1	95.0	
BSCMA	5	19	1	95.0	
KICMA	1	19	1	95.0	94.0
KICMA	2	19	1	95.0	
KICMA	3	20	0	100.0	
KICMA	4	20	0	100.0	
KICMA	5	16	4	80.0	
MOTMA	1	20	0	100.0	99.0
MOTMA	2	20	0	100.0	
MOTMA	3	20	0	100.0	
MOTMA	4	19	1	95.0	
MOTMA	5	20	0	100.0	
MOTNW	1	20	0	100.0	97.0
MOTNW	2	19	1	95.0	
MOTNW	3	20	0	100.0	
MOTNW	4	18	2	90.0	
MOTNW	5	20	0	100.0	
WHPREF	1	18	2	90.0	96.0
WHPREF	2	19	1	95.0	
WHPREF	3	20	0	100.0	
WHPREF	4	19	1	95.0	
WHPREF	5	20	0	100.0	
Muscongus Bay	1	20	0	100.0	93.0
Muscongus Bay	2	15	5	75.0	
Muscongus Bay	3	19	1	95.0	
Muscongus Bay	4	20	0	100.0	
Muscongus Bay	5	19	1	95.0	

TABLE E.2. Water Quality Summary for 10-Day *N. virens* Solid-Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Temperature (°C)</u>		<u>pH</u>		<u>Dissolved Oxygen (mg/L)</u>		<u>Salinity (o/oo)</u>		<u>Flow Rates (mL/min)</u>	
	<u>Min</u>	<u>Max</u>	<u>Min</u>	<u>Max</u>	<u>Min</u>	<u>Max</u>	<u>Min</u>	<u>Max</u>	<u>Min</u>	<u>Max</u>
Acceptable Range	13.0	17.0	7.30	8.30	4.0	---	28.0	32.0	115	135
BSCMA	14.3	14.8	7.78	8.12	7.4	7.9	30.0	32.0	116	132
KICMA	14.4	15.0	7.74	8.10	7.4	7.9	30.0	32.0	116	134
MOTMA	13.3	15.4	7.78	8.12	6.7	7.9	30.0	32.0	116	132
MOTNW	14.2	14.8	7.85	8.11	7.3	8.0	30.0	32.0	116	132
WREF	14.2	15.7	7.84	8.12	7.0	8.0	30.0	32.0	116	134
Muscongus Bay	14.2	14.6	7.77	8.11	7.4	8.0	30.0	32.0	116	132

APPENDIX F

28-DAY *N. virens* SOLID-PHASE TEST

TABLE F.1. Results for All Replicates in 28-Day *N. virens* Solid-Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
BSCMA	1	20	0	100.0	90.0
BSCMA	2	18	2	90.0	
BSCMA	3	16	4	80.0	
BSCMA	4	19	1	95.0	
BSCMA	5	17	3	85.0	
KICMA	1	18	2	90.0	88.0
KICMA	2	18	2	90.0	
KICMA	3	20	0	100.0	
KICMA	4	14	6	70.0	
KICMA	5	18	2	90.0	
MOTMA	1	16	4	80.0	83.0
MOTMA	2	13	7	65.0	
MOTMA	3	19	1	95.0	
MOTMA	4	17	3	85.0	
MOTMA	5	18	2	90.0	
MOTNW	1	19	1	95.0	93.0
MOTNW	2	18	2	90.0	
MOTNW	3	18	2	90.0	
MOTNW	4	18	2	90.0	
MOTNW	5	20	0	100.0	
WREF	1	19	1	95.0	90.0
WREF	2	14	6	70.0	
WREF	3	20	0	100.0	
WREF	4	20	0	100.0	
WREF	5	17	3	85.0	
Muscongus Bay	1	16	4	80.0	88.0
Muscongus Bay	2	18	2	90.0	
Muscongus Bay	3	17	3	85.0	
Muscongus Bay	4	18	2	90.0	
Muscongus Bay	5	19	1	95.0	

TABLE F.2. Water Quality Summary for 28-Day *N. virens* Solid-Phase Test, Wilmington Harbor Project

Sediment Treatment	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)		Flow Rates (mL/min)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	13.0	17.0	7.30	8.30	4.0	---	28.0	32.0	115	135
BSCMA	13.9	15.7	7.78	8.11	6.5	8.2	30.0	32.0	116	132
KICMA	14.1	16.1	7.18 ^(a)	8.10	6.1	8.5	30.0	32.0	116	132
MOTMA	14.3	15.9	7.70	8.08	6.0	8.3	30.0	32.0	108 ^(a)	132
MOTNW	14.0	15.8	7.76	8.11	6.0	8.1	30.0	32.0	116	132
WHPREF	14.3	15.5	7.83	8.12	5.9	8.2	30.0	32.0	116	136 ^(a)
Muscongus Bay	14.0	15.9	7.79	8.13	6.1	8.1	30.0	32.0	116	132

(a) Data point out of range.

APPENDIX G

28-DAY *M. nasuta* SOLID-PHASE TEST

TABLE G.1. Results for All Replicates in 28-Day *M. nasuta* Solid-Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
BSCMA	1	25	0	100.0	97.6
BSCMA	2	24	1	96.0	
BSCMA	3	24	1	96.0	
BSCMA	4	25	0	100.0	
BSCMA	5	24	1	96.0	
KICMA	1	24	1	96.0	96.8
KICMA	2	24	1	96.0	
KICMA	3	24	1	96.0	
KICMA	4	25	0	100.0	
KICMA	5	24	1	96.0	
MOTMA	1	25	0	100.0	98.4
MOTMA	2	25	0	100.0	
MOTMA	3	26	1	96.3	
MOTMA	4	24	1	96.0	
MOTMA	5	26	0	100.0	
MOTNW	1	25	0	100.0	95.2
MOTNW	2	23	2	92.0	
MOTNW	3	23	2	92.0	
MOTNW	4	24	1	96.0	
MOTNW	5	24	1	96.0	
WREF	1	25	0	100.0	94.4
WREF	2	24	1	96.0	
WREF	3	24	1	96.0	
WREF	4	22	3	88.0	
WREF	5	23	2	92.0	
Sequim Bay	1	25	0	100.0	92.8
Sequim Bay	2	23	2	92.0	
Sequim Bay	3	23	2	92.0	
Sequim Bay	4	22	3	88.0	
Sequim Bay	5	23	2	92.0	

TABLE G.2. Water Quality Summary for 28-Day *M. nasuta* Solid-Phase Test, Wilmington Harbor Project

Sediment Treatment	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)		Flow Rates (mL/min)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	13.0	17.0	7.30	8.30	4.0	---	28.0	32.0	115	135
BSCMA	14.1	15.7	7.73	8.10	6.9	8.1	30.0	32.0	116	132
KICMA	14.2	16.0	7.60	8.09	6.6	8.2	30.0	32.0	115	132
MOTMA	14.2	16.0	7.73	8.10	6.4	8.1	30.0	32.0	116	132
MOTNW	14.2	15.5	7.10 ^(a)	8.10	6.9	8.1	30.0	32.0	115	132
WREF	14.1	15.8	7.76	8.11	7.0	8.3	30.0	32.0	115	135
Sequim Bay	14.0	15.5	7.69	8.11	6.0	8.3	30.0	32.0	116	135

(a) Data point out of range.

APPENDIX H

96-HOUR *M. beryllina* SUSPENDED-PARTICULATE-PHASE TEST

TABLE H.1. Results for All Replicates in 96-h *M. beryllina* Suspended-Particulate-Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
BSCMA	0	1	10	0	100.0	100.0
BSCMA	0	2	10	0	100.0	
BSCMA	0	3	10	0	100.0	
BSCMA	0	4	10	0	100.0	
BSCMA	0	5	10	0	100.0	
BSCMA	10	1	10	0	100.0	100.0
BSCMA	10	2	10	0	100.0	
BSCMA	10	3	10	0	100.0	
BSCMA	10	4	10	0	100.0	
BSCMA	10	5	10	0	100.0	
BSCMA	50	1	10	0	100.0	100.0
BSCMA	50	2	10	0	100.0	
BSCMA	50	3	10	0	100.0	
BSCMA	50	4	10	0	100.0	
BSCMA	50	5	10	0	100.0	
BSCMA	100	1	10	0	100.0	100.0
BSCMA	100	2	10	0	100.0	
BSCMA	100	3	10	0	100.0	
BSCMA	100	4	10	0	100.0	
BSCMA	100	5	10	0	100.0	
KICMA	0	1	10	0	100.0	100.0
KICMA	0	2	10	0	100.0	
KICMA	0	3	10	0	100.0	
KICMA	0	4	10	0	100.0	
KICMA	0	5	10	0	100.0	
KICMA	10	1	10	0	100.0	100.0
KICMA	10	2	10	0	100.0	
KICMA	10	3	10	0	100.0	
KICMA	10	4	10	0	100.0	
KICMA	10	5	10	0	100.0	
KICMA	50	1	10	0	100.0	98.0
KICMA	50	2	10	0	100.0	
KICMA	50	3	10	0	100.0	
KICMA	50	4	9	1	90.0	
KICMA	50	5	10	0	100.0	

TABLE H.1. (contd)

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Replicate</u>	<u>Number Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
KICMA	100	1	9	1	90.0	
KICMA	100	2	10	0	100.0	
KICMA	100	3	3	7	30.0	
KICMA	100	4	9	1	90.0	
KICMA	100	5	8	2	80.0	78.0
MOTMA	0	1	10	0	100.0	
MOTMA	0	2	9	1	90.0	
MOTMA	0	3	10	0	100.0	
MOTMA	0	4	10	0	100.0	
MOTMA	0	5	10	0	100.0	98.0
MOTMA	10	1	10	0	100.0	
MOTMA	10	2	10	0	100.0	
MOTMA	10	3	10	0	100.0	
MOTMA	10	4	9	1	90.0	
MOTMA	10	5	10	0	100.0	98.0
MOTMA	50	1	10	0	100.0	
MOTMA	50	2	8	2	80.0	
MOTMA	50	3	10	0	100.0	
MOTMA	50	4	10	0	100.0	
MOTMA	50	5	10	0	100.0	96.0
MOTMA	100	1	9	1	90.0	
MOTMA	100	2	6	4	60.0	
MOTMA	100	3	6	4	60.0	
MOTMA	100	4	8	2	80.0	
MOTMA	100	5	9	1	90.0	76.0
MOTNW	0	1	10	0	100.0	
MOTNW	0	2	10	0	100.0	
MOTNW	0	3	9	1	90.0	
MOTNW	0	4	10	0	100.0	
MOTNW	0	5	10	0	100.0	98.0
MOTNW	10	1	10	0	100.0	
MOTNW	10	2	10	0	100.0	
MOTNW	10	3	9	1	90.0	
MOTNW	10	4	10	0	100.0	
MOTNW	10	5	10	0	100.0	98.0

TABLE H.1. (contd)

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Replicate</u>	<u>Number Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
MOTNW	50	1	10	0	100.0	100.0
MOTNW	50	2	10	0	100.0	
MOTNW	50	3	10	0	100.0	
MOTNW	50	4	10	0	100.0	
MOTNW	50	5	10	0	100.0	
MOTNW	100	1	10	0	100.0	98.0
MOTNW	100	2	10	0	100.0	
MOTNW	100	3	10	0	100.0	
MOTNW	100	4	10	0	100.0	
MOTNW	100	5	9	1	90.0	

TABLE H.2. Water Quality Summary for 96-h *M. beryllina* Suspended-Particulate-Phase Test, Wilmington Harbor Project

Sediment Treatment	Concentration (Percent SPP)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
		Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range		18.0	22.0	7.30	8.30	4.0	---	28.0	32.0
BCSMA	0	20.0	20.4	7.98	8.24	6.6	7.5	31.0	31.5
BCSMA	10	20.0	20.4	7.98	8.23	6.6	7.3	30.0	31.5
BCSMA	50	20.0	20.5	7.92	8.25 (a)	6.0	7.2	30.0	32.0
BCSMA	100	20.0	20.7	7.76	8.32 (a)	5.8	7.2	30.5	32.0
KICMA	0	20.0	20.6	8.00	8.24	6.7	7.2	30.5	31.5
KICMA	10	20.0	20.5	7.92	8.27 (a)	6.6	7.3	30.0	31.5
KICMA	50	20.0	20.5	7.69	8.37 (a)	6.7	7.1	30.0	31.0
KICMA	100	20.0	20.5	7.43	8.47 (a)	5.3	7.1	30.0	30.5
MOTMA	0	20.0	20.5	7.95	8.24	6.4	7.1	30.0	31.5
MOTMA	10	20.0	20.5	7.97	8.26 (a)	6.5	7.1	30.0	31.5
MOTMA	50	20.0	20.4	7.89	8.40 (a)	6.5	7.2	30.0	31.0
MOTMA	100	20.0	20.4	7.77	8.50 (a)	6.4	7.0	30.0	31.5
MOTNW	0	20.0	20.4	8.00	8.19	6.7	7.1	30.0	31.5
MOTNW	10	20.0	20.4	8.00	8.19 (a)	6.6	7.0	30.0	31.5
MOTNW	50	20.0	20.4	8.00	8.31 (a)	6.5	7.0	30.0	31.0
MOTNW	100	20.0	20.3	7.84	8.41 (a)	6.4	7.1	30.0	31.0

(a) Data point out of range.

TABLE H.3. Results for All Replicates in 96-h *M. beryllina* Reference Toxicant Test, Wilmington Harbor Project

<u>Copper Concentration ($\mu\text{g/L}$)</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
0	1	10	0	100.0	100.0
0	2	10	0	100.0	
0	3	10	0	100.0	
16	1	10	0	100.0	100.0
16	2	10	0	100.0	
16	3	10	0	100.0	
64	1	9	1	90.0	96.7
64	2	10	0	100.0	
64	3	10	0	100.0	
160	1	0	10	0.0	0.0
160	2	0	10	0.0	
160	3	0	10	0.0	
400	1	0	10	0.0	0.0
400	2	0	10	0.0	
400	3	0	10	0.0	

APPENDIX I

96-HOUR *M. bahia* SUSPENDED-PARTICULATE-PHASE TEST

TABLE I.1. Results for All Replicates in 96-h *M. bahia* Suspended-Particulate-Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
BSCMA	0	1	10	0	100.0	100.0
BSCMA	0	2	10	0	100.0	
BSCMA	0	3	10	0	100.0	
BSCMA	0	4	10	0	100.0	
BSCMA	0	5	10	0	100.0	
BSCMA	10	1	10	0	100.0	100.0
BSCMA	10	2	10	0	100.0	
BSCMA	10	3	10	0	100.0	
BSCMA	10	4	10	0	100.0	
BSCMA	10	5	10	0	100.0	
BSCMA	50	1	10	0	100.0	98.0
BSCMA	50	2	10	0	100.0	
BSCMA	50	3	10	0	100.0	
BSCMA	50	4	10	0	100.0	
BSCMA	50	5	9	1	90.0	
BSCMA	100	1	10	0	100.0	94.0
BSCMA	100	2	9	1	90.0	
BSCMA	100	3	10	0	100.0	
BSCMA	100	4	8	2	80.0	
BSCMA	100	5	10	0	100.0	
KICMA	0	1	10	0	100.0	100.0
KICMA	0	2	10	0	100.0	
KICMA	0	3	10	0	100.0	
KICMA	0	4	10	0	100.0	
KICMA	0	5	10	0	100.0	
KICMA	10	1	10	0	100.0	98.0
KICMA	10	2	9	1	90.0	
KICMA	10	3	10	0	100.0	
KICMA	10	4	10	0	100.0	
KICMA	10	5	10	0	100.0	
KICMA	50	1	10	0	100.0	94.0
KICMA	50	2	9	1	90.0	
KICMA	50	3	9	1	90.0	
KICMA	50	4	9	1	90.0	
KICMA	50	5	10	0	100.0	

TABLE I.1. (contd)

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
KICMA	100	1	10	0	100.0	98.0
KICMA	100	2	9	1	90.0	
KICMA	100	3	10	0	100.0	
KICMA	100	4	10	0	100.0	
KICMA	100	5	10	0	100.0	
MOTMA	0	1	10	0	100.0	100.0
MOTMA	0	2	10	0	100.0	
MOTMA	0	3	10	0	100.0	
MOTMA	0	4	10	0	100.0	
MOTMA	0	5	10	0	100.0	
MOTMA	10	1	10	0	100.0	100.0
MOTMA	10	2	10	0	100.0	
MOTMA	10	3	10	0	100.0	
MOTMA	10	4	10	0	100.0	
MOTMA	10	5	10	0	100.0	
MOTMA	50	1	9	1	90.0	94.0
MOTMA	50	2	10	0	100.0	
MOTMA	50	3	10	0	100.0	
MOTMA	50	4	9	1	90.0	
MOTMA	50	5	9	1	90.0	
MOTMA	100	1	10	0	100.0	98.0
MOTMA	100	2	10	0	100.0	
MOTMA	100	3	9	1	90.0	
MOTMA	100	4	10	0	100.0	
MOTMA	100	5	10	0	100.0	
MOTNW	0	1	10	0	100.0	98.0
MOTNW	0	2	10	0	100.0	
MOTNW	0	3	10	0	100.0	
MOTNW	0	4	10	0	100.0	
MOTNW	0	5	9	1	90.0	
MOTNW	10	1	10	0	100.0	96.0
MOTNW	10	2	9	1	90.0	
MOTNW	10	3	9	1	90.0	
MOTNW	10	4	10	0	100.0	
MOTNW	10	5	10	0	100.0	

TABLE I.1. (contd)

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
MOTNW	50	1	10	0	100.0	
MOTNW	50	2	10	0	100.0	
MOTNW	50	3	10	0	100.0	
MOTNW	50	4	10	0	100.0	
MOTNW	50	5	9	1	90.0	98.0
MOTNW	100	1	10	0	100.0	
MOTNW	100	2	10	0	100.0	
MOTNW	100	3	10	0	100.0	
MOTNW	100	4	9	1	90.0	
MOTNW	100	5	8	2	80.0	94.0

TABLE I.2. Water Quality Data for 96-h *M. bahia* Suspended-Particulate-Phase Test, Wilmington Harbor Project

Sediment Treatment	Concentration (Percent SPP)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
		Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range		18.0	22.0	7.30	8.30	4.0	---	28.0	32.0
BCSMA	0	19.8	20.7	7.98	8.22	6.9	7.2	31.0	32.0
BCSMA	10	19.8	20.7	7.98	8.18	6.9	7.2	31.0	32.5 ^(a)
BCSMA	50	19.9	20.6	7.96	8.25	6.8	7.3	30.0	33.0 ^(a)
BCSMA	100	19.8	20.6	7.87	8.25	6.7	7.2	30.5	32.0
KICMA	0	20.0	20.5	7.96	8.18	7.0	7.4	30.0	32.0
KICMA	10	20.0	20.5	7.66	8.15	4.2	7.2	30.0	31.5
KICMA	50	20.0	20.4	7.63	8.32 ^(a)	6.0	7.6	30.0	32.0
KICMA	100	20.0	20.5	7.44	8.37 ^(a)	5.2	7.2	29.0	32.0
MOTMA	0	19.9	20.6	7.96	8.19	6.9	7.2	31.0	32.0
MOTMA	10	19.7	20.6	7.89	8.20	6.8	7.3	30.5	32.0
MOTMA	50	19.7	20.7	7.93	8.26 ^(a)	6.9	7.3	30.5	32.0
MOTMA	100	19.9	20.6	7.98	8.34 ^(a)	7.0	7.2	30.0	32.0
MOTNW	0	19.9	20.6	8.01	8.18	6.9	7.2	30.0	32.0
MOTNW	10	19.8	20.6	7.99	8.19	6.8	7.3	30.0	32.5 ^(a)
MOTNW	50	19.9	20.6	7.92	8.29 ^(a)	6.8	7.2	30.0	32.5 ^(a)
MOTNW	100	20.0	20.7	7.85	8.31 ^(a)	5.4	7.2	30.0	32.0

(a) Data point out of range.

TABLE I.3. Results for All Replicates in 96-h *M. bahia* Reference Toxicant
Toxicant Test, Wilmington Harbor Project

<u>Copper Concentration ($\mu\text{g/L}$)</u>	<u>Replicate</u>	<u>Live</u>	<u>Dead</u>	<u>Percent Survival</u>	<u>Mean Percent Survival</u>
0	1	10	0	100.0	100.0
0	2	10	0	100.0	
0	3	10	0	100.0	
50	1	10	0	100.0	96.7
50	2	9	1	90.0	
50	3	10	0	100.0	
100	1	10	0	100.0	100.0
100	2	10	0	100.0	
100	3	10	0	100.0	
200	1	7	3	70.0	73.3
200	2	7	3	70.0	
200	3	8	2	80.0	
400	1	0	10	0.0	0.0
400	2	0	10	0.0	
400	3	0	10	0.0	

TABLE I.4. Water Quality Summary for 96-h *M. bahia* Reference Toxicant Test, Wilmington Harbor Project

Copper Concentration (mg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	18.0	22.0	7.30	8.30	4.0	---	28.0	32.0
0	19.9	20.6	7.90	8.12	6.9	7.2	30.5	32.0
50	19.9	20.5	8.04	8.17	7.0	7.3	31.0	32.0
100	19.8	20.5	7.85	8.06	6.7	7.2	31.0	32.0
200	19.8	20.5	7.98	8.12	6.9	7.2	31.0	32.0
400	19.8	20.4	7.91	8.27	6.8	7.3	30.5	32.0

APPENDIX J

72-h *L. pictus* SUSPENDED-PARTICULATE-PHASE TEST

TABLE J.1. Results for All Replicates in 72-h *L. pictus* Suspended-Particulate-Phase Test, Wilmington Harbor Project

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Replicate</u>	<u>Stocking Density</u>	<u>Pluteus</u>	<u>Gastrula</u>	<u>Blastula</u>	<u>Abnormal</u>	<u>Percent Normal</u>	<u>Mean Percent Survival</u>
BSCMA	0	1	246	214	2	0	6	87.0	91.0
BSCMA	0	2	301	251	1	0	3	83.4	
BSCMA	0	3	261	217	0	0	1	83.1	
BSCMA	0	4	272	261	0	0	1	96.0	
BSCMA	0	5	263	262	0	0	3	99.6	
BSCMA	10	1	238	200	0	0	7	84.0	91.2
BSCMA	10	2	276	229	0	0	4	83.0	
BSCMA	10	3	268	155	0	0	64	57.8	
BSCMA	10	4	262	285	0	0	12	108.8	
BSCMA	10	5	268	234	0	0	7	87.3	
BSCMA	50	1	286	247	0	0	2	86.4	96.8
BSCMA	50	2	279	236	0	0	5	84.6	
BSCMA	50	3	223	256	0	0	10	114.8	
BSCMA	50	4	245	245	0	0	2	100.0	
BSCMA	50	5	254	230	0	0	13	90.6	
BSCMA	100	1	261	174	0	0	27	66.7	80.9
BSCMA	100	2	237	257	0	0	3	108.4	
BSCMA	100	3	244	134	0	0	20	54.9	
BSCMA	100	4	263	205	0	0	9	77.9	
BSCMA	100	5	272	169	0	0	35	62.1	
KICMA	0	1	265	239	0	0	3	90.2	86.1
KICMA	0	2	302	242	0	0	7	80.1	
KICMA	0	3	253	213	0	0	2	84.2	
KICMA	0	4	250	215	0	0	2	86.0	
KICMA	0	5	285	243	0	0	0	85.3	
KICMA	10	1	261	223	0	0	17	85.4	89.2
KICMA	10	2	271	231	0	0	5	85.2	
KICMA	10	3	248	219	0	0	4	88.3	
KICMA	10	4	273	220	0	0	2	80.6	
KICMA	10	5	269	244	0	0	14	90.7	
KICMA	50	1	237	73	0	0	151	30.8	92.5
KICMA	50	2	269	257	0	0	4	95.5	
KICMA	50	3	243	176	0	0	21	72.4	
KICMA	50	4	258	215	0	0	3	83.3	
KICMA	50	5	223	224	0	0	14	100.4	
KICMA	100	1	269	215	0	0	6	79.9	87.1
KICMA	100	2	246	239	3	0	3	97.2	
KICMA	100	3	223	160	0	0	14	71.7	
KICMA	100	4	227	220	0	0	1	96.9	
KICMA	100	5	274	203	0	0	15	74.1	
MOTMA	0	1	264	270	0	0	3	102.3	93.7
MOTMA	0	2	285	245	0	0	2	86.0	
MOTMA	0	3	276	209	0	0	10	75.7	
MOTMA	0	4	238	241	3	0	8	101.3	
MOTMA	0	5	246	236	0	0	0	95.9	

TABLE J.1. (contd)

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Replicate</u>	<u>Stocking Density</u>	<u>Pluteus</u>	<u>Gastrula</u>	<u>Blastula</u>	<u>Abnormal</u>	<u>Percent Normal</u>	<u>Percent Survival</u>
MOTMA	10	1	261	265	0	0	8	101.5	
MOTMA	10	2	245	236	0	0	3	96.3	
MOTMA	10	3	270	220	0	0	9	81.5	
MOTMA	10	4	264	251	0	0	5	95.1	
MOTMA	10	5	242	257	0	0	4	106.2	98.1
MOTMA	50	1	239	202	0	0	9	84.5	
MOTMA	50	2	284	199	0	0	1	70.1	
MOTMA	50	3	267	195	0	0	10	73.0	
MOTMA	50	4	266	187	0	0	9	70.3	
MOTMA	50	5	265	222	0	0	0	83.8	78.3
MOTMA	100	1	ND ^(a)	ND	ND	ND	ND	ND	
MOTMA	100	2	259	0	0	0	85	0.0	
MOTMA	100	3	296	2	2	0	79	0.7	
MOTMA	100	4	231	10	17	0	134	4.3	
MOTMA	100	5	280	0	26	0	138	0.0	46.2
MOTNW	0	1	277	295	0	0	0	106.5	
MOTNW	0	2	276	279	1	0	0	101.1	
MOTNW	0	3	286	229	2	0	3	80.1	
MOTNW	0	4	250	252	0	0	1	100.8	
MOTNW	0	5	315	276	0	0	2	87.6	95.4
MOTNW	10	1	272	291	0	0	1	107.0	
MOTNW	10	2	253	264	0	0	4	104.3	
MOTNW	10	3	285	226	0	0	20	79.3	
MOTNW	10	4	289	247	0	0	0	85.5	
MOTNW	10	5	303	156	0	0	18	51.5	87.5
MOTNW	50	1	293	203	0	0	1	69.3	
MOTNW	50	2	244	244	0	0	1	100.0	
MOTNW	50	3	235	228	0	0	7	97.0	
MOTNW	50	4	265	237	0	0	4	89.4	
MOTNW	50	5	256	216	0	0	1	84.4	88.3
MOTNW	100	1	259	13	22	0	110	5.0	
MOTNW	100	2	280	12	11	0	197	4.3	
MOTNW	100	3	271	2	55	0	119	0.7	
MOTNW	100	4	271	0	0	0	85	0.0	
MOTNW	100	5	257	3	11	0	114	1.2	56.4

(a) No data.

TABLE J.2. Water Quality Summary for 72-h *L. pictus* Suspended-Particulate-Phase Test, Wilmington Harbor Project

Sediment Treatment	Concentration (Percent SPP)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
		Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range		18.0	22.0	7.50	8.50	4.0	---	28.0	32.0
BCSMA	0	20.1	20.8	8.02	8.19	7.1	7.6	30.0	31.5
BCSMA	10	20.1	20.8	8.04	8.23	7.0	7.4	30.5	31.5
BCSMA	50	20.3	20.9	8.07	8.29	7.0	7.4	30.0	31.5
BCSMA	100	20.3	20.9	8.05	8.33	6.9	7.3	29.5	32.0
KICMA	0	20.2	20.8	8.02	8.19	6.7	7.3	30.0	31.0
KICMA	10	20.3	20.9	8.04	8.25	7.0	7.4	30.0	31.5
KICMA	50	20.2	20.9	7.94	8.31	6.9	7.4	30.0	31.5
KICMA	100	20.3	21.0	7.85	8.34	7.0	7.3	29.5	31.0
MOTMA	0	20.2	20.9	8.04	8.19	7.0	7.4	30.0	31.0
MOTMA	10	20.3	20.8	8.02	8.26	7.0	7.3	30.0	31.5
MOTMA	50	20.2	20.9	8.04	8.32	7.0	7.4	29.5	31.0
MOTMA	100	20.2	20.9	8.11	8.66 ^(a)	6.9	7.3	30.0	31.5
MOTNW	0	20.2	20.8	8.06	8.19	7.0	7.3	29.5	31.5
MOTNW	10	20.3	20.9	8.06	8.26	6.9	7.4	30.0	31.5
MOTNW	50	20.3	20.9	7.97	8.29	7.0	7.5	30.0	31.5
MOTNW	100	20.3	20.9	8.06	8.39	7.0	7.3	30.0	31.5

(a) Data point out of range.

TABLE J.3. Results for All Replicates in 72-h *L. pictus* Reference Toxicant Toxicant Test, Wilmington Harbor Project

<u>Copper Concentration ($\mu\text{g/L}$)</u>	<u>Replicate</u>	<u>Stocking Density</u>	<u>Pluteus</u>	<u>Gastrula</u>	<u>Blastula</u>	<u>Abnormal</u>	<u>Percent Normal</u>	<u>Mean Percent Survival</u>
0.0	1	259	190	0	0	9	73.4	
0.0	2	233	177	0	0	60	76.0	
0.0	3	275	243	0	0	3	88.4	88.9
2.9	1	289	263	0	0	5	91.0	
2.9	2	316	257	0	0	6	81.3	
2.9	3	263	258	0	0	9	98.1	91.9
9.0	1	282	255	0	0	5	90.4	
9.0	2	250	267	0	0	3	106.8	
9.0	3	283	244	0	0	0	86.2	95.0
30.0	1	262	215	1	0	36	82.1	
30.0	2	274	162	0	0	37	59.1	
30.0	3	266	187	0	0	43	70.3	84.9
100.0	1	258	23	6	0	216	8.9	
100.0	2	261	41	12	0	144	15.7	
100.0	3	274	42	15	0	147	15.3	81.5
200.0	1	278	0	1	0	42	0.0	
200.0	2	256	0	0	0	27	0.0	
200.0	3	277	0	0	0	13	0.0	10.2

TABLE J.4. Water Quality Summary for 72-h *L. pictus* Reference Toxicant Test, Wilmington Harbor Project

Copper Concentration ($\mu\text{g/L}$)	Temperature ($^{\circ}\text{C}$)		pH		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	18.0	22.0	7.50	8.50	4.0	---	28.0	32.0
0.0	20.2	21.0	8.06	8.19	6.9	7.2	30.0	31.5
2.9	20.1	21.0	8.13	8.18	7.0	7.4	30.5	31.5
9.0	20.2	21.1	8.14	8.19	7.0	7.5	30.0	31.5
30.0	20.2	21.1	8.15	8.18	7.0	7.2	30.0	31.5
100.0	20.1	21.1	8.14	8.19	7.0	7.3	30.0	31.5
200.0	20.2	21.1	8.11	8.18	7.0	7.2	30.0	31.5

APPENDIX K

M. nasuta TISSUE CHEMISTRY AND QUALITY CONTROL DATA

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	PAHs
Laboratory	Battelle Ocean Sciences
Matrix	<i>Macoma nasuta</i> Tissue
Holding Times	Tissue samples were obtained from bioaccumulation experiments August 11, 1992, arrived at the laboratory September 25, were extracted between September 29 and October 13, and analyzed between October 5 and October 17, 1992. The 30-day holding time prior to extraction was exceeded, but the 40-day holding time between extraction and analysis was not exceeded. Samples were frozen at -20°C until extracted.
Blanks	The requirement of 1 blank per 20 samples was met. Three blanks were run for 30 samples. HPAHs and LPAHs were not detected above the target detection limit of 30 µg/kg.
Detection Limits	The detection limit goal of 30 µg/kg was met for all HPAH and LPAH compounds.
Surrogate Internal Standards	The requirement of one surrogate standard per sample was met. Three surrogate standards were evaluated: d8 naphthalene, d10 acenaphthalene, and d12 benzo[a]pyrene. All surrogate recoveries were within the QA goals of 40% to 120%.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was met. Three matrix spike/matrix spike duplicates were analyzed for the 30 samples. All percent recoveries were within the 40% to 120% quality assurance criteria. The relative percent difference between matrix spike and matrix spike duplicates ranged from 0% to 6%, well below the QA limit of ≤30%.
Replication	The requirement of 1 triplicate analysis per 10 samples was met. Three triplicate analyses were conducted on the 30 samples. The relative standard deviation requirement of ≤30% was met for all samples and compounds except the compound fluoranthene in the BSCMA triplicate.
SRMs	The requirement of 1 SRM per 20 samples was met. Three SRMs were analyzed for the 30 samples. All compounds were within acceptable limits except anthracene (all three analyses) and benzo[g,h,i]-perylene (two of three analyses).

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	PCBs
Laboratory	Battelle/Marine Sciences Laboratory Pacific Northwest Laboratory (Richland)
Matrix	<i>Macoma nasuta</i> Tissue
Holding Times	Tissue samples were obtained from bioaccumulation experiments August 13, 1992, arrived at the laboratory September 25, were extracted between September 29 and October 13, and analyzed between October 5 and October 17, 1992. The 30-day holding time prior to extraction was exceeded, but the 40-day holding time between extraction and analysis was not exceeded. Samples were frozen at -20°C until extracted.
Blanks	The requirement of 1 blank per 20 samples was met. Three blanks were run for 30 samples. PCBs were not detected above the target detection limit of 20 µg/kg.
Detection Limits	The detection limit goal of 20 µg/kg was met for all PCB compounds.
Surrogate Internal Standards	The requirement of one surrogate internal standard per sample was met. Two surrogate internal standards were evaluated: DBOFB and CL5(112). All surrogate recoveries were within the QA goals of 40% to 120%.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was met. Three matrix spike/matrix spike duplicates were analyzed for the 30 samples. All percent recoveries were within the 40% to 120% quality assurance criteria. The relative percent difference between matrix spike and matrix spike duplicates ranged from 2% to 6%, below the QA limit of ≤30%.
Replication	The requirement of 1 triplicate analysis per 10 samples was met. Three triplicate analyses were conducted on the 30 samples. The relative standard deviation requirement of ≤30% was met for all samples, although most were undetected.
SRMs	SRMs are not available.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Metals
Laboratory	Battelle Marine Sciences Laboratory Pacific Northwest Laboratory (Richland)
Matrix	<i>Macoma nasuta</i> Tissue
Holding Times	Tissue samples were obtained from bioaccumulation experiments August 13, 1992, arrived at the laboratory September 25, were extracted between September 29 and October 13, and analyzed between October 5 and October 17, 1992. The 30-day holding time prior to extraction was exceeded for metals excluding mercury (6-month holding time). Samples were frozen at -20°C until extracted.
Blanks	The requirement of 1 blank per 20 samples was met. Four blanks were run for 30 samples. Metals were undetected in blanks with the exception of zinc, which was elevated in two of four blanks.
Detection Limits	Detection limit goals were met for Ag, As, Cd, Cu, Pb, Ni, Se, Tl, and Zn. Elevated detection limits were observed for Cr, and Hg.
Matrix Spike	The requirement of 1 matrix spike per 10 samples was met. Four matrix spikes were analyzed for the 30 samples. Percent recoveries were all within the QA limit of 75% to 125%.
Replication	The requirement of 1 triplicate analysis per 10 samples was met. Four triplicate analyses were conducted on the 30 samples for Ag, As, Cd, Cu, Pb, Hg, and Zn. Three triplicates were evaluated for Cr, Ni, Se, and Tl. The relative standard deviation requirement of $\leq 20\%$ was exceeded for Ag (two triplicates), Cd (four triplicates), Tl (one triplicate) and Zn (one triplicate).
SRMs	The requirement of 1 SRM per 20 samples was met. Six SRMs were analyzed for the 30 samples. All but seven comparisons were within 30% of the certified value.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Organotins
Laboratory	Battelle/Marine Sciences Laboratory
Matrix	Tissues of <i>Macoma nasuta</i>
Holding Times	Tissue samples were obtained from bioaccumulation experiments August 11, 1992, arrived at the laboratory September 25, were extracted between September 29 and October 13, and analyzed between October 5 and October 17, 1992. The 30-day holding time prior to extraction was exceeded, but the 40-day holding time between extraction and analysis was not exceeded. Samples were frozen at -20°C until extracted.
Blanks	The requirement of 1 blank per 20 samples was met. Two method blanks were run with the 24 samples. Tri-, Di-, and Monobutyltin compounds were undetected in all blanks at levels below the target detection limit of 10 µg/kg.
Detection Limits	The detection limit goals of 10 µg/kg were met in the blanks and all samples.
Surrogate Internal Standards	The requirement for one surrogate standard for each sample was met. Both butyltin surrogates (tripentyltin and propyltin) were within the 40% to 120% range required for all samples.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was met. Two matrix spike/matrix spike duplicates were analyzed for the 20 samples. The requirement of 40% to 120% recovery on spikes was met for all tributyltin and dibutyltin measurements. Spike recoveries were less than 40% for all monobutyltin measurements. The requirement of ≤30% RPD between the matrix spike and matrix spike duplicate was met for all measurements.
Replication	The requirement of 1 triplicate analysis per 10 samples was met. Two triplicate samples were analyzed for 20 samples. The requirement of ≤30% RPD was met for all measurements.
SRMs	Certified SRM not available.

TABLE K.1. Total Polynuclear Aromatic Hydrocarbons (PAHs), Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> ($\mu\text{g/kg}$ wet weight)		
				Total LPAH	Total HPAH	Total PAH
MOTMA	1	1	14.66	14	27	41
MOTMA	2	2	15.11	13	25	37
MOTMA	3	3	14.59	10	25	35
MOTMA	4	1	14.50	16	23	39
MOTMA	5	3	13.43	18	36	55
KICMA	1	3	14.38	10	21	31
KICMA	2	2	13.63	10	20	31
KICMA	3	2	13.75	9	14	23
KICMA	4	1	14.36	12	15	27
KICMA	5	1	13.11	13	32	45
BSCMA	1	1	14.76	24	11	34
BSCMA	2	2	14.16	9	9	18
BSCMA	3	2	14.78	10	17	27
BSCMA	4	3	14.56	8	10	18
BSCMA Replicate 1	5	1	15.86	16	12	28
BSCMA Replicate 2	5	1	15.86	21	23	44
BSCMA Replicate 3	5	1	15.86	15	10	25
MOTNW	2	1	15.74	9	21	30
MOTNW	4	2	14.25	16	17	32
MOTNW	5	2	15.49	11	20	32
MOTNW Replicate 1	1	3	12.64	12	19	30
MOTNW Replicate 2	1	3	12.64	12	21	33
MOTNW Replicate 3	1	3	12.64	12	17	29
MOTNW Replicate 1	3	2	13.72	14	19	33
MOTNW Replicate 2	3	2	13.72	15	25	39
MOTNW Replicate 3	3	2	13.72	18	24	42
WHPREF	1	3	12.87	8	11	19
WHPREF	2	1	14.16	11	6	17
WHPREF	3	3	13.45	12	17	28
WHPREF	4	1	14.52	13	6	19
WHPREF	5	3	13.39	9	10	19
Sequim Bay	1	2	16.72	10	14	25
Sequim Bay	2	2	15.96	12	9	21
Sequim Bay	3	3	13.19	11	19	30
Sequim Bay	4	1	14.31	8	16	24
Sequim Bay	5	3	13.24	9	15	24

TABLE K.2. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs), Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> LPAHs ($\mu\text{g}/\text{kg}$ wet weight)									
				Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene		
Target DL (a)				30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Achieved DL				≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0
MOTNA	1	1	14.66	3.66	2.99	1.59	0.16 J(b)	0.34 J	0.81 J	3.49	1.14		
MOTNA	2	2	15.11	2.86	2.71	1.33	0.14 J	0.47 J	0.91	3.35	1.02		
MOTNA	3	3	14.59	2.07	2.30	1.14	0.12 J	0.41 J	0.78 J	2.75	0.90		
MOTNA	4	1	14.50	3.99	3.65	1.86	0.10 J	0.39 J	0.93 J	3.70	1.12		
MOTNA	5	3	13.43	3.02 J	2.96	1.72	0.90 J	1.21 J	1.98	4.28	2.07		
KICMA	1	3	14.38	1.95 J	2.16	1.28	0.13 J	0.46 J	0.94 J	2.56	0.51 J		
KICMA	2	2	13.63	2.36	2.60	1.39	0.17 J	0.40 J	0.78 J	2.35	0.44 J		
KICMA	3	2	13.75	2.48	2.19	1.20	0.18 J	0.29 J	0.64 J	2.08	0.40 J		
KICMA	4	1	14.36	3.65	2.97	1.46	0.12 J	0.23 J	0.65 J	2.62	0.40 J		
KICMA	5	1	13.11	3.14	2.50	1.44	0.27 J	0.46 J	0.97 J	3.37	0.54 J		
BSCMA	1	1	14.76	7.47	6.11	3.28	0.17 J	0.54 J	1.17 J	4.56	0.47 J		
BSCMA	2	2	14.16	5.19	2.39	1.26	0.18 J	0.37 J	0.62 J	1.81	0.33 J		
BSCMA	3	2	14.78	2.47	2.66	1.39	0.14 J	0.37 J	0.73	2.10	0.34 J		
BSCMA	4	3	14.56	1.49	1.69	0.87	0.11 J	0.47 J	0.72	2.44	0.39 J		
BSCMA	5	1	15.86	4.34	4.28	2.32	0.14 J	0.34 J	0.97 J	2.75	0.56 J		
BSCMA Replicate 1	5	1	15.86	5.35	4.88	2.61	0.20 J	0.49 J	1.17 J	4.61	1.23 J		
BSCMA Replicate 2	5	1	15.86	4.50	3.66	1.84	0.14 J	0.36 J	0.73 J	3.17	0.45 J		
BSCMA Replicate 3	5	1	15.86	4.50	3.66	1.84	0.14 J	0.36 J	0.73 J	3.17	0.45 J		
MOTNW	2	1	15.74	1.92	2.16	1.08	0.10 J	0.29 J	0.66 J	1.87	0.56		
MOTNW	4	2	14.25	4.18	4.47	2.30	0.18 J	0.42 J	0.96 J	2.74	0.52 J		
MOTNW	5	2	15.49	2.53	2.68	1.38	0.13 J	0.46 J	0.82 J	2.60	0.62 J		
MOTNW	1	3	12.64	2.43 J	2.88	1.64	0.14 J	0.52 J	1.03 J	2.62	0.58 J		
MOTNW Replicate 1	1	3	12.64	2.52 J	2.92	1.81	0.11 J	0.52 J	1.04 J	2.79	0.55 J		
MOTNW Replicate 2	1	3	12.64	2.49 J	2.86	1.61	0.12 J	0.52 J	1.02 J	2.59	0.50 J		
MOTNW Replicate 3	1	3	12.64	3.67	3.91	1.97	0.17 J	0.50 J	0.85 J	2.55	0.57 J		
MOTNW Replicate 1	3	2	13.72	3.54	3.63	1.87	0.13 J	0.54 J	1.01 J	3.24	0.71 J		
MOTNW Replicate 2	3	2	13.72	4.28	3.48	1.77	1.06 J	1.17 J	1.73	3.22	1.36		
MOTNW Replicate 3	3	2	13.72	4.28	3.48	1.77	1.06 J	1.17 J	1.73	3.22	1.36		
WREF	1	3	12.87	1.52	1.65	1.03	0.05 J	0.34 J	0.65 J	2.05	0.21 J		
WREF	2	1	14.16	3.30	2.98	1.46	0.07 J	0.23 J	0.58 J	2.27	0.20 J		
WREF	3	3	13.45	2.00	2.15	1.47	0.39 J	0.81 J	1.15	2.86	0.68		
WREF	4	1	14.52	3.80	3.40	1.71	0.07 J	0.26 J	0.73 J	2.79	0.25 J		
WREF	5	3	13.39	1.82	1.95	1.15	0.09 J	0.44 J	0.81 J	2.45	0.26 J		

TABLE K.2. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> LPAHs ($\mu\text{g}/\text{kg}$ wet weight)							
				Naph- thalene	2-methyl- naph- thalene	1-methyl- naph- thalene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
Sequim Bay	1	2	16.72	2.85	2.29	1.20	0.16 J	0.42 J	0.68 J	2.44	0.26 J
	2	2	15.96	3.10	3.14	1.75	0.24 J	0.43 J	0.81 J	2.11	0.43 J
	3	3	13.19	1.93	2.34	1.49	0.50 J	0.72 J	1.11	2.32	0.79
	4	1	14.31	2.01	2.04	1.08	0.10 J	0.26 J	0.53 J	1.59	0.27 J
	5	3	13.24	1.84	1.94	1.05	0.10 J	0.42 J	0.73 J	2.42	0.34 J

(a) DL Detection limit.

(b) J Analyte detected below method detection limit, but above instrument detection limit.

TABLE K.3. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs), Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> HPAHs ($\mu\text{g}/\text{kg}$ wet weight)									
				Fluor- anthene	Pyrene	Benzo(a)- anthra- cene	Chrysene	Benzo[b]- fluor- anthene	Benzo[k]- fluor- anthene	Benzo[a]- pyrene	Indeno- (1,2,3- c,d)- pyrene	Dibenzo- [a,h]- anthra- cene	Benzo- [g,h,i]- perylene
Target DL (a)				30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Achieved DL				≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0	≤ 30.0
MOTMA	1	1	14.66	8.59	7.10	2.74	3.98	1.94	1.61	0.89 J ^(b)	1.22 U ^(c)	0.83 U	1.66 U
MOTMA	2	2	15.11	8.62	6.89	1.58	2.68	1.51	1.06	0.19 J	0.36 J	0.13 J	1.57 J
MOTMA	3	3	14.59	8.95	7.94	2.10	2.89	1.56	1.03 J	0.45 J	1.36 U	0.93 U	1.85 U
MOTMA	4	1	14.50	9.05	6.05	1.83	2.87	1.54	1.17	0.91 J	1.33 U	0.90 U	1.80 U
MOTMA	5	3	13.43	10.13	9.34	3.18	4.15	2.27 J	2.27	1.33 J	1.28 J	1.16 J	1.31 J
KICMA	1	3	14.38	6.87	7.09	1.86	2.49	1.65	0.87 J	0.53 J	1.52 U	1.03 U	2.06 U
KICMA	2	2	13.63	6.50	6.46	1.39	2.84	1.52	1.30	0.39 J	1.24 U	0.84 U	1.68 U
KICMA	3	2	13.75	4.47	3.51	1.16	2.15	1.40	1.08	0.21 J	1.11 U	0.76 U	1.51 U
KICMA	4	1	14.36	4.08	3.96	1.26 J	2.11	1.43 J	1.07 J	0.70 J	1.64 U	1.12 U	2.23 U
KICMA	5	1	13.11	7.42	6.39	2.30	4.81	4.47	2.72	1.04 J	1.55	0.67 J	1.12 J
BSCMA	1	1	14.76	3.49	2.39	0.90 J	1.84 J	1.12 J	0.49 J	0.35 J	3.08 U	2.10 U	4.18 U
BSCMA	2	2	14.16	2.61	1.65	0.59 J	1.05	0.63 J	0.43 J	0.16 J	0.40 J	0.65 U	1.49
BSCMA	3	2	14.78	6.35	3.34	0.89 J	1.97	1.65	0.81	0.38 J	0.98 U	0.67 U	1.68
BSCMA	4	3	14.56	3.90	2.42	0.77 J	1.66	0.84 J	0.40 J	0.17 J	0.97 U	0.66 U	1.32 U
BSCMA Replicate 1	5	1	15.86	3.74	2.39	1.33 J	1.99	1.14 J	1.01 J	0.86 J	2.56 U	1.74 U	3.48 U
BSCMA Replicate 2	5	1	15.86	9.30	5.80	1.70 J	3.37	1.12 J	0.98 J	0.83 J	2.46 U	1.68 U	3.34 U
BSCMA Replicate 3	5	1	15.86	3.59	2.16	0.88 J	1.57	0.91 J	0.51 J	0.40 J	1.84 U	1.25 U	2.50 U
MOTNW	2	1	15.74	6.29	5.97	1.86	3.25	1.69	1.26	0.86	0.97 U	0.66 U	1.32 U
MOTNW	4	2	14.25	5.62	4.63	1.46 J	2.31	1.19 J	0.98 J	0.47 J	2.04 U	1.39 U	2.76 U
MOTNW	5	2	15.49	6.98	6.65	1.29	2.57	1.49	1.24	0.24 J	1.29 U	0.88 U	1.75 U
MOTNW Replicate 1	1	3	12.64	5.48	5.78	1.31 J	2.47	1.31 J	0.97 J	0.63 J	0.30 J	0.12 J	0.27 J
MOTNW Replicate 2	1	3	12.64	6.19	6.73	1.55 J	3.49	1.59 J	1.09 J	0.46 J	1.96 U	1.34 U	2.66 U
MOTNW Replicate 3	1	3	12.64	5.57	5.56	1.21 J	2.10	1.10 J	0.95 J	0.38 J	2.18 U	1.48 U	2.95 U
MOTNW Replicate 1	3	2	13.72	6.40	6.33	1.47 J	2.45	1.27 J	0.92 J	0.21 J	1.94 U	1.32 U	2.63 U
MOTNW Replicate 2	3	2	13.72	8.63	8.33	1.78 J	2.94	1.48 J	0.90 J	0.45 J	2.00 U	1.36 U	2.71 U
MOTNW Replicate 3	3	2	13.72	7.04	6.82	2.31	3.13	2.16	1.73	1.22 J	1.84 U	1.25 U	2.49 U
WHREF	1	3	12.87	3.92	2.45	0.98 J	2.38	0.67 J	0.47 J	0.24 J	1.12 U	0.76 U	0.10 J
WHREF	2	1	14.16	2.22	1.35	0.35 J	1.21	0.48 J	0.41 J	0.34 J	1.31 U	0.89 U	1.78 U
WHREF	3	3	13.45	4.40	2.87	1.64	3.66	1.36	0.94 J	0.54 J	0.55 J	0.39 J	0.53 J
WHREF	4	1	14.52	2.63	1.58	0.36 J	0.97	0.41 J	0.18 J	0.26 J	1.48 U	1.01 U	2.00 U
WHREF	5	3	13.39	4.05	2.30	0.60 J	1.94	0.58 J	0.31 J	0.10 J	1.18 U	0.80 U	1.60 U

TABLE K.3. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> HPAHs ($\mu\text{g}/\text{kg}$ wet weight)									
				Fluor-anthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno-(1,2,3-c,d)-pyrene	Dibenzo[a,h]anthracene	Benzo[g,h,i]perylene
Sequim Bay	1	2	16.72	5.27	3.12	0.87 J	1.73	1.30 J	1.04 J	0.39 J	1.44 U	0.98 U	0.53 J
Sequim Bay	2	2	15.96	3.03	2.05	0.70 J	1.33	1.09 J	0.72 J	0.21 J	1.64 U	1.11 U	2.22 U
Sequim Bay	3	3	13.19	5.32	3.69	1.38	2.18	1.81	1.59	0.70 J	1.01 J	0.61 J	0.97 J
Sequim Bay	4	1	14.31	6.69	4.32	0.83 J	1.68	1.26	0.74 J	0.38 J	1.27 U	0.86 U	1.72 U
Sequim Bay	5	3	13.24	5.94	3.55	1.04 J	1.87	1.52	0.83 J	0.33 J	1.16 U	0.79 U	1.58 U

(a) DL Detection limit.

(b) J Analyte detected below method detection limit, but above instrument detection limit.

(c) U Analyte was not present above the level of associated value.

TABLE K.4. Total Polynuclear Aromatic Hydrocarbons (PAHs), Dry Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> (µg/kg dry weight)		
				Total LPAH	Total HPAH	Total PAH
MOTMA	1	1	14.66	97	183	280
MOTMA	2	2	15.11	85	163	247
MOTMA	3	3	14.59	72	171	243
MOTMA	4	1	14.50	109	161	270
MOTMA	5	3	13.43	135	271	406
KICMA	1	3	14.38	69	149	218
KICMA	2	2	13.63	77	150	227
KICMA	3	2	13.75	69	102	170
KICMA	4	1	14.36	84	102	186
KICMA	5	1	13.11	97	248	345
BSCMA	1	1	14.76	161	72	233
BSCMA	2	2	14.16	65	64	128
BSCMA	3	2	14.78	69	115	184
BSCMA	4	3	14.56	56	70	126
BSCMA Replicate 1	5	1	15.86	99	79	178
BSCMA Replicate 2	5	1	15.86	130	146	275
BSCMA Replicate 3	5	1	15.86	94	63	157
MOTNW	2	1	15.74	55	135	189
MOTNW	4	2	14.25	111	117	228
MOTNW	5	2	15.49	72	132	204
MOTNW Replicate 1	1	3	12.64	94	148	241
MOTNW Replicate 2	1	3	12.64	97	167	264
MOTNW Replicate 3	1	3	12.64	93	133	226
MOTNW Replicate 1	3	2	13.72	103	139	242
MOTNW Replicate 2	3	2	13.72	107	179	285
MOTNW Replicate 3	3	2	13.72	132	178	310
WREF	1	3	12.87	58	87	145
WREF	2	1	14.16	78	45	123
WREF	3	3	13.45	86	126	211
WREF	4	1	14.52	90	44	134
WREF	5	3	13.39	67	74	141
Sequim Bay	1	2	16.72	62	85	147
Sequim Bay	2	2	15.96	75	57	132
Sequim Bay	3	3	13.19	85	146	231
Sequim Bay	4	1	14.31	55	111	166
Sequim Bay	5	3	13.24	67	114	181

TABLE K.5. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs), Dry Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> LPAHs ($\mu\text{g/kg}$ dry weight)							
				Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
MOTMA	1	1	14.66	24.96	20.39	10.84	1.09 J(a)	2.32 J	5.52 J	23.80	7.78
	2		15.11	18.92	17.93	8.80	0.93 J	3.11 J	6.02	22.16	6.75
	3	3	14.59	14.18	15.76	7.81	0.82 J	2.81 J	5.35 J	18.84	6.17
	4	1	14.50	27.51	25.17	12.82	0.69 J	2.69 J	6.41 J	25.51	7.72
	5	3	13.43	22.48 J	22.03	12.80	6.70 J	9.01 J	14.74	31.86	15.41
KICMA	1	3	14.38	13.56 J	15.02	8.90	0.90 J	3.20 J	6.54 J	17.80	3.55 J
	2	2	13.63	17.32	19.08	10.20	1.25 J	2.94 J	5.72 J	17.24	3.23 J
	3	2	13.75	18.04	15.93	8.73	1.31 J	2.11 J	4.65 J	15.13	2.91 J
	4	1	14.36	25.41	20.68	10.17	0.84 J	1.60 J	4.53 J	18.24	2.79 J
	5	1	13.11	23.95	19.07	10.98	2.06 J	3.51 J	7.40 J	25.71	4.12 J
BSCMA	1	1	14.76	50.60	41.38	22.22	1.15 J	3.66 J	7.92 J	30.89	3.18 J
	2	2	14.16	15.47	16.88	8.90	1.27 J	2.61 J	4.38 J	12.79	2.33 J
	3	2	14.78	16.71	17.99	9.40	0.95 J	2.50 J	4.94	14.21	2.30 J
	4	3	14.56	10.23	11.61	5.98	0.76 J	3.23 J	4.95	16.76	2.68 J
	5	1	15.86	27.37	26.99	14.63	0.88 J	2.14 J	6.12 J	17.34	3.53 J
BSCMA Replicate 3	5	1	15.86	33.74	30.78	16.46	1.26 J	3.09 J	7.38 J	29.08	7.76 J
	5	1	15.86	28.38	23.08	11.61	0.88 J	2.27 J	4.60 J	19.99	2.84 J
	2	1	15.74	12.20	13.72	6.86	0.64 J	1.84 J	4.19 J	11.88	3.56
MOTNW	4	2	14.25	29.34	31.37	16.14	1.26 J	2.95 J	6.74 J	19.23	3.65 J
	5	2	15.49	16.33	17.30	8.91	0.84 J	2.97 J	5.29 J	16.78	4.00 J
	1	3	12.64	19.23 J	22.79	12.98	1.11 J	4.11 J	8.15 J	20.73	4.59 J
	1	3	12.64	19.94 J	23.11	14.32	0.87 J	4.11 J	8.23 J	22.08	4.35 J
	1	3	12.64	19.70 J	22.63	12.74	0.95 J	4.11 J	8.07 J	20.50	3.96 J
MOTNW Replicate 3	3	2	13.72	26.74	28.49	14.35	1.24 J	3.64 J	6.19 J	18.58	4.15 J
	3	2	13.72	25.79	26.45	13.63	0.95 J	3.93 J	7.36 J	23.61	5.17 J
	3	2	13.72	31.19	25.36	12.90	7.72 J	8.53 J	12.61	23.46	9.91
WHEFF	1	3	12.87	11.81	12.82	8.00	0.39 J	2.64 J	5.05 J	15.93	1.63 J
	2	1	14.16	23.30	21.04	10.31	0.49 J	1.62 J	4.10 J	16.03	1.41 J
	3	3	13.45	14.87	15.99	10.93	2.90 J	6.02 J	8.55	21.27	5.96
	4	1	14.52	26.17	23.41	11.77	0.48 J	1.79 J	5.03 J	19.21	1.72 J
	5	3	13.39	13.59	14.57	8.59	0.67 J	3.29 J	6.05 J	18.30	1.94 J

TABLE K.5. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> LPAHs ($\mu\text{g}/\text{kg}$ dry weight)							
				Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Sequim Bay	1	2	16.72	17.05	13.70	7.18	0.96 J	2.51 J	4.07 J	14.60	1.56 J
Sequim Bay	2	2	15.96	19.43	19.68	10.97	1.50 J	2.69 J	5.08 J	13.22	2.69 J
Sequim Bay	3	3	13.19	14.63	17.74	11.30	3.79 J	5.46 J	8.42	17.59	5.99
Sequim Bay	4	1	14.31	14.04	14.25	7.55	0.70 J	1.82 J	3.70 J	11.11	1.89 J
Sequim Bay	5	3	13.24	13.90	14.66	7.93	0.76 J	3.17 J	5.52 J	18.28	2.57 J

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit.

TABLE K.6. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs), Dry Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> HPAHs ($\mu\text{g}/\text{kg}$ dry weight)									
				Fluor- anthene	Pyrene	Benzo[a]- anthra- cene	Chrysene	fluor- anthene	Benzo[b]- fluor- anthene	Benzo[a]- pyrene	Indeno (1,2,3- c,d)- pyrene	Dibenzo- [a,h]- anthra- cene	Benzo- [g,h,i]- perylene
MOTMA	1	1	14.66	58.59	48.42	18.69	27.15	13.23	10.98	6.07 J(a)	8.32 U(b)	5.66 U	11.32 U
MOTMA	2	2	15.11	57.03	45.58	10.45	17.73	9.99	7.01	1.26 J	2.38 J	0.86 J	10.39 J
MOTMA	3	3	14.59	61.33	54.41	14.39	19.80	10.69	7.06 J	3.08 J	9.32 U	6.37 U	12.68 U
MOTMA	4	1	14.50	62.40	41.72	12.62	19.79	10.62	8.07	6.27 J	9.17 U	6.21 U	12.41 U
MOTMA	5	3	13.43	75.41	69.53	23.67	30.89	16.90 J	16.90	9.90 J	9.53 J	8.63 J	9.75 J
KICMA	1	3	14.38	47.78	49.31	12.94	17.32	11.48	6.05 J	3.69 J	10.57 U	7.16 U	14.33 U
KICMA	2	2	13.63	47.70	47.40	10.20	20.84	11.15	9.54	2.86 J	9.10 U	6.16 U	12.33 U
KICMA	3	2	13.75	32.51	25.53	8.44	15.64	10.18	7.86	1.53 J	8.07 U	5.53 U	10.98 U
KICMA	4	1	14.36	28.41	27.57	8.77 J	14.69	9.96 J	7.45 J	4.87 J	11.42 U	7.80 U	15.53 U
KICMA	5	1	13.11	56.60	48.74	17.54	36.69	34.10	20.75	7.93 J	11.82	5.11 J	8.54 J
BSCMA	1	1	14.76	23.64	16.19	6.10 J	12.46 J	7.59 J	3.32 J	2.37 J	20.86 U	14.22 U	28.31 U
BSCMA	2	2	14.16	18.44	11.66	4.17 J	7.42	4.45 J	3.04 J	1.13 J	2.83 J	4.59 U	10.52
BSCMA	3	2	14.78	42.95	22.59	6.02 J	13.33	11.16	5.48	2.57 J	6.63 U	4.53 U	11.36
BSCMA	4	3	14.56	26.79	16.62	5.29 J	11.40	5.77 J	2.75 J	1.17 J	6.66 U	4.53 U	9.07 U
BSCMA Replicate 1	5	1	15.86	23.59	15.07	8.39 J	12.55	7.19 J	6.37 J	5.42 J	16.15 U	10.97 U	21.95 U
BSCMA Replicate 2	5	1	15.86	58.66	36.58	10.72 J	21.26	7.06 J	6.18 J	5.23 J	15.52 U	10.60 U	21.07 U
BSCMA Replicate 3	5	1	15.86	22.64	13.62	5.55 J	9.90	5.74 J	3.22 J	2.52 J	11.61 U	7.88 U	15.77 U
MOTNW	2	1	15.74	39.96	37.93	11.82	20.65	10.74	8.01	5.46	6.16 U	4.19 U	8.39 U
MOTNW	4	2	14.25	39.44	32.50	10.25 J	16.21	8.35 J	6.88 J	3.30 J	14.32 U	9.76 U	19.37 U
MOTNW	5	2	15.49	45.06	42.93	8.33	16.59	9.62	8.00	1.55 J	8.33 U	5.68 U	11.30 U
MOTNW Replicate 1	1	3	12.64	43.36	45.74	10.37 J	19.55	10.37 J	7.68 J	4.99 J	2.37 J	0.95 J	2.14 J
MOTNW Replicate 2	1	3	12.64	48.98	53.26	12.27 J	27.62	12.58 J	8.63 J	3.64 J	15.51 U	10.60 U	21.05 U
MOTNW Replicate 3	1	3	12.64	44.08	44.00	9.58 J	16.62	8.70 J	7.52 J	3.01 J	17.25 U	11.71 U	23.34 U
MOTNW Replicate 1	3	2	13.72	46.63	46.12	10.71 J	17.85	9.25 J	6.70 J	1.53 J	14.14 U	9.62 U	19.16 U
MOTNW Replicate 2	3	2	13.72	62.88	60.70	12.97 J	21.42	10.78 J	6.56 J	3.28 J	14.57 U	9.91 U	19.75 U
MOTNW Replicate 3	3	2	13.72	51.30	49.69	16.83	22.81	15.74	12.61	8.89 J	13.41 U	9.11 U	18.14 U
WHREF	1	3	12.87	30.47	19.04	7.62 J	18.50	5.21 J	3.65 J	1.87 J	8.70 U	5.91 U	0.78 J
WHREF	2	1	14.16	15.67	9.53	2.47 J	8.54	3.39 J	2.89 J	2.40 J	9.25 U	6.28 U	12.57 U
WHREF	3	1	13.45	32.72	21.34	12.20	27.22	10.11	6.99 J	4.02 J	4.07 J	2.90 J	3.94 J
WHREF	4	1	14.52	18.11	10.88	2.48 J	6.68	2.82 J	1.24 J	1.79 J	10.1 U	6.95 U	13.77 U
WHREF	5	3	13.39	30.25	17.18	4.48 J	14.49	4.33 J	2.32 J	0.75 J	8.8 U	5.98 U	11.95 U

TABLE K.6. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> HPAHs ($\mu\text{g/kg}$ dry weight)									
				Fluor-anthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno (1,2,3-c,d)-pyrene	Dibenzo-[a,h]-anthracene	Benzo-[g,h,i]-perylene
Sequim Bay	1	2	16.72	31.52	18.66	5.20 J	10.35	7.78 J	6.22 J	2.33 J	8.61 U	5.86 U	3.17 J
Sequim Bay	2	2	15.96	18.99	12.85	4.39 J	8.33	6.83 J	4.51 J	1.32 J	10.28 U	6.96 U	13.91 U
Sequim Bay	3	3	13.19	40.34	27.98	10.46	16.53	13.72	12.06	5.31 J	7.66 J	4.63 J	7.36 J
Sequim Bay	4	1	14.31	46.74	30.18	5.80 J	11.74	8.80	5.17 J	2.65 J	8.87 U	6.01 U	12.02 U
Sequim Bay	5	3	13.24	44.88	26.82	7.86 J	14.13	11.48	6.27 J	2.49 J	8.76 U	5.97 U	11.94 U

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of associated value.

TABLE K.7. Quality Control Summary for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs), Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

<i>M. nasuta</i> LPAHs ($\mu\text{g/kg}$ wet weight)										
Sediment Treatment	Replicate	Batch	Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Method Blank										
Blank 1			0.75 J ^(a)	0.52 J	0.30 J	1.95 U ^(b)	1.05 U	0.12 J	0.19 J	0.04 J
Blank 2			1.27 J	0.44 J	0.31 J	1.74 U	0.94 U	1.02 U	0.71 J	0.77 U
Blank 3			0.45 J	0.41 J	0.20 J	1.78 U	0.96 U	0.09 J	0.16 J	0.05 J
Matrix Spikes										
BSCMA	1	1	7.47	6.11 ^(c)	3.28	0.17 J	0.54 J	1.17 J	4.56	0.47 J
BSCMA MS	1	1	140.87	ND ^(d)	ND	150.36	140.51	143.80	149.16	141.63
Concentration Recovered			133.40	NA ^(e)	NA	144.25	137.23	143.63	148.62	140.46
Spike Amount			142.33	NS ^(e)	NS	142.33	142.33	142.33	142.33	142.33
Percent Recovery			94%	NA	NA	101%	96%	101%	104%	99%
BSCMA	1	1	7.47	6.11	3.28	0.17 J	0.54 J	1.17 J	4.56	0.47 J
BSCMA MSD	1	1	119.04	ND	ND	124.14	118.32	120.14	124.70	123.69
Concentration Recovered			111.57	NA	NA	123.97	117.78	118.97	120.14	123.22
Spike Amount			117.79	NS	NS	117.79	117.79	117.79	117.79	117.79
Percent Recovery			95%	NA	NA	105%	100%	101%	102%	105%
RPD			1%	NA	NA	4%	4%	0%	2%	6%
I-Stat			0.01	NA	NA	0.02	0.02	0.00	0.01	0.03
MOTNW	4	2	4.18	4.47	2.30	0.18 J	0.42 J	0.96 J	2.74	0.52 J
MOTNW MS	4	2	91.26	ND	ND	96.31	89.53	92.59	97.62	91.83
Concentration Recovered			87.08	NA	NA	96.13	89.11	91.63	94.88	91.31
Spike Amount			89.52	NS	NS	89.52	89.52	89.52	89.52	89.52
Percent Recovery			97%	NA	NA	107%	100%	102%	106%	102%
MOTNW	4	2	4.18	4.47	2.30	0.18 J	0.42 J	0.96 J	2.74	0.52 J
MOTNW MSD	4	2	146.26	ND	ND	156.27	141.09	143.73	152.18	138.66
Concentration Recovered			142.08	NA	NA	151.80	138.79	143.55	151.76	137.70
Spike Amount			141.24	NS	NS	141.24	141.24	141.24	141.24	141.24
Percent Recovery			101%	NA	NA	107%	98%	102%	107%	97%
RPD			3%	NA	NA	0%	1%	1%	1%	5%
I-Stat			0.02	NA	NA	0.00	0.01	0.00	0.01	0.02

TABLE K.7. (contd)

<i>M. nasuta</i> LPAHs (<i>Ug/kg</i> wet weight)										
Sediment Treatment	Replicate	Batch	Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
MOTMA	5	3	3.02 J	2.96	1.72	0.90 J	1.21 J	1.98	4.28	2.07
MOTMA MS	5	3	148.80	ND	ND	165.51	151.34	159.77	170.97	153.76
Concentration Recovered			145.78	NA	NA	164.61	150.13	157.79	166.69	151.69
Spike Amount			149.00	NS	NS	149.00	149.00	149.00	149.00	149.00
Percent Recovery			98%	NA	NA	110%	101%	106%	112%	102%
MOTMA	5	3	3.02 J	2.96	1.72	0.90 J	1.21 J	1.98	4.28	2.07
MOTMA MSD	5	3	161.42	ND	ND	186.79	165.15	175.71	186.72	170.38
Concentration Recovered			158.40	NA	NA	185.89	163.94	173.73	182.44	168.31
Spike Amount			163.10	NS	NS	163.10	163.10	163.10	163.10	163.10
Percent Recovery			97%	NA	NA	114%	101%	107%	112%	103%
RPD			1%	NA	NA	3%	0%	1%	0%	1%
I-Stat			0.00	NA	NA	0.02	0.00	0.00	0.00	0.01
Standard Reference Material										
Certified Value			NC (f)	NC	NC	NC	NC	NC	5.6 ±1.4	0.75 ±0.21
NIST 1974			NA	NA	NA	NA	NA	NA	5.9	1.65 J(g)
NIST 1974			NA	NA	NA	NA	NA	NA	5.53	1.45 J(g)
NIST 1974			NA	NA	NA	NA	NA	NA	5.58	1.66 J(g)
Analytical Triplicates										
BSCMA Rep 1	5	1	4.34	4.28	2.32	0.14 J	0.34 J	0.97 J	2.75	0.56 J
BSCMA Rep 2	5	1	5.35	4.88	2.61	0.20 J	0.49 J	1.17 J	4.61	1.23 J
BSCMA Rep 3	5	1	4.50	3.66	1.84	0.14 J	0.36 J	0.73 J	3.17	0.45 J(h)
RSD			11%	14%	17%	22%	21%	23%	28%	57%
MOTNW Rep 1	1	3	2.43 J	2.88	1.64	0.14 J	0.52 J	1.03 J	2.62	0.58 J
MOTNW Rep 2	1	3	2.52 J	2.92	1.81	0.11 J	0.52 J	1.04 J	2.79	0.55 J
MOTNW Rep 3	1	3	2.49 J	2.86	1.61	0.12 J	0.52 J	1.02 J	2.59	0.50 J
RSD			2%	1%	6%	12%	0%	1%	4%	7%

TABLE K.7. (contd)

Sediment Treatment	Replicate	Batch	<i>M. nasuta</i> LPAHs ($\mu\text{g}/\text{kg}$ wet weight)							
			Naph- thalene	2-methyl- naph- thalene	1-methyl- naph- thalene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
MOTNW Rep 1	3	2	3.67	3.91	1.97	0.17 J	0.50 J	0.85 J	2.55	0.57 J
MOTNW Rep 2	3	2	3.54	3.63	1.87	0.13 J	0.54 J	1.01 J	3.24	0.71 J
MOTNW Rep 3	3	2	4.28	3.48	1.77	1.06 J(h)	1.17 J(h)	1.73	3.22	1.36
RSD			10%	6%	5%	116%	51%	39% (h)	13%	48% (h)

- (a) J Analyte detected below method detection limit (MDL), but above instrument detection limit.
 (b) U Analyte was not present above the level of associated value.
 (c) ND No data.
 (d) NA Not applicable.
 (e) NS Not spiked.
 (f) NC Not certified.
 (g) Value exceeds SRM range $\leq 3\%$ certified value.
 (h) Value exceeds relative precision range $\leq 30\%$.

TABLE K.8. Quality Control Summary for High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs), Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

M. nasuta HPAHs (µg/kg wet weight)												
Sediment Treatment	Replicate	Batch	Fluor-anthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno-(1,2,3-c-d)pyrene	Dibenzo-[a,h]-anthracene	Benzo-[g,h,i]-perylene
Method Blank												
Blank 1			0.21 J(a)	0.54 J	1.44 U(b)	0.15 J	1.47 U	1.23 U	1.28 U	1.54 U	1.04 U	2.08 U
Blank 2			0.15 J	0.13 J	1.29 U	0.08 J	0.12 J	0.04 J	1.14 U	1.37 U	0.93 U	1.86 U
Blank 3			0.11 J	0.09 J	1.32 U	0.06 J	0.07 J	0.06 J	1.17 U	1.40 U	0.96 U	1.90 U
Matrix Spikes												
BSCMA	1	1	3.49	2.39	0.90 J	1.84 J	1.12 J	0.49 J	0.35 J	3.08 U	2.10 U	4.18 U
BSCMA MS	1	1	153.23	151.18	155.07	152.36	162.49	180.44	164.38	161.18	174.71	141.14
Concentration Recovered			149.74	148.79	154.17	150.52	161.37	179.95	164.03	161.18	174.71	141.14
Spike Amount			142.33	142.33	142.33	142.33	142.33	142.33	142.33	142.33	142.33	142.33
Percent Recovery			105%	105%	108%	106%	113%	126% (c)	115%	113%	123% (c)	99%
BSCMA	1	1	3.49	2.39	0.90 J	1.84 J	1.12 J	0.49 J	0.35 J	3.08 U	2.10 U	4.18 U
BSCMA MSD	1	1	129.17	125.23	127.84	129.87	139.15	130.32	137.58	131.66	146.95	113.97
Concentration Recovered			125.68	122.84	126.94	128.03	138.03	129.83	137.23	131.66	146.95	113.97
Spike Amount			117.79	117.79	117.79	117.79	117.79	117.79	117.79	117.79	117.79	117.79
Percent Recovery			107%	104%	108%	109%	117%	110%	117%	112%	125% (c)	97%
RPD			1%	0%	1%	3%	3%	14%	1%	1%	2%	2%
I-Stat			0.01	0.00	0.00	0.01	0.02	0.07	0.01	0.01	0.01	0.01
MOTNW	4	2	5.62	4.63	1.46 J	2.31	1.19 J	0.98 J	0.47 J	2.04 U	1.39 U	2.76 U
MOTNW MS	4	2	103.08	102.56	99.48	105.95	100.26	103.48	96.55	100.29	101.80	79.28
Concentration Recovered			97.46	97.93	98.02	103.64	99.07	102.50	96.08	100.29	101.80	79.28
Spike Amount			89.52	89.52	89.52	89.52	89.52	89.52	89.52	89.52	89.52	89.52
Percent Recovery			109%	109%	109%	116%	111%	114%	107%	112%	114%	89%
MOTNW	4	2	5.62	4.63	1.46 J	2.31	1.19 J	0.98 J	0.47 J	2.04 U	1.39 U	2.76 U
MOTNW MSD	4	2	155.07	153.17	153.00	161.65	147.66	162.01	140.88	145.53	154.85	123.93
Concentration Recovered			149.45	148.54	151.54	159.34	146.47	161.03	140.41	145.53	154.85	123.93
Spike Amount			141.24	141.24	141.24	141.24	141.24	141.24	141.24	141.24	141.24	141.24
Percent Recovery			106%	105%	107%	113%	104%	114%	99%	103%	110%	88%
RPD			3%	4%	2%	3%	7%	0%	8%	8%	4%	1%
I-Stat			0.01	0.02	0.01	0.01	0.03	0.00	0.04	0.04	0.02	0.00

TABLE K.8. (contd)

M. nasuta HPAHs ($\mu\text{g}/\text{kg}$ wet weight)												
Sediment Treatment	Replicate	Batch	Fluor-anthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno-(1,2,3-c-d)-pyrene	Dibenzo-[a,h]-anthracene	Benzo-[g,h,i]-perylene
MOTMA	5	3	10.13	9.34	3.18	4.15	2.27 J	2.27	1.33 J	1.28 J	1.16 J	1.31 J
	5	3	180.90	180.15	168.34	170.48	157.85	159.71	149.51	153.03	151.88	137.98
	Concentration Recovered		170.77	170.81	165.16	166.33	155.58	157.44	148.18	151.75	150.72	136.67
	Spike Amount		149.00	149.00	149.00	149.00	149.00	149.00	149.00	149.00	149.00	149.00
	Percent Recovery		115%	115%	111%	112%	104%	106%	99%	102%	101%	92%
MOTMA MSD	5	3	10.13	9.34	3.18	4.15	2.27 J	2.27	1.33 J	1.28 J	1.16 J	1.31 J
	5	3	198.12	198.05	190.26	192.81	181.27	179.67	162.49	174.55	172.05	159.12
	Concentration Recovered		187.99	188.7	187.08	188.66	179.00	177.40	161.16	173.27	170.89	157.81
	Spike Amount		163.10	163.10	163.10	163.10	163.10	163.10	163.10	163.10	163.10	163.10
	Percent Recovery		115%	116%	115%	116%	110%	109%	99%	106%	105%	97%
RPD			1%	1%	3%	4%	5%	3%	1%	4%	4%	5%
I-Stat			0.00	0.00	0.02	0.02	0.02	0.01	0.00	0.02	0.02	0.03
Standard Reference Material												
Certified Value			33.6 ± 5.8	34.1 ± 3.7	NC ^(d)	NC	6.5 ± 1.2	NC	2.29 ± 0.47	1.8 ± 0.33	NC	2.47 ± 0.28
NIST 1974			33.42	34.25	NA ^(f)	NA	6.14	NA	2.13 J	1.51 J	NA	4.91(g)
NIST 1974			34.76	35.59	NA	NA	6.55	NA	1.61 J	1.90 J	NA	2.26 J(g)
NIST 1974			33.76	34.25	NA	NA	6.31	NA	1.77 J	1.91 J	NA	4.64J(g)
Analytical Triplicates												
BSCMA Replicate 1	5	1	3.74	2.39	1.33 J	1.99	1.14 J	1.01 J	0.86 J	2.56 U	1.74 U	3.48 U
BSCMA Replicate 2	5	1	9.30	5.80	1.70 J	3.37	1.12 J	0.98 J	0.83 J	2.46 U	1.68 U	3.34 U
BSCMA Replicate 3	5	1	3.59	2.16	0.88 J	1.57	0.91 J	0.51 J	0.40 J	1.84 U	1.25 U	2.50 U
RSD			59% ^(e)	59% ^(e)	32% ^(e)	41% ^(e)	12%	34% ^(e)	37% ^(e)	NA	NA	NA
MOTNW Replicate 1	1	3	5.48	5.78	1.31 J	2.47	1.31 J	0.97 J	0.63 J	0.30 J	0.12 J	0.27 J
MOTNW Replicate 2	1	3	6.19	6.73	1.55 J	3.49	1.59 J	1.09 J	0.46 J	1.96 U	1.34 U	2.66 U
MOTNW Replicate 3	1	3	5.57	5.56	1.21 J	2.10	1.10 J	0.95 J	0.38 J	2.18 U	1.48 U	2.95 U
RSD			7%	10%	13%	27%	18%	8%	26%	NA	NA	NA

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TABLE K.8. (contd)

Sediment Treatment	Replicate	Batch	M. nasuta HPAHs ($\mu\text{g}/\text{kg}$ wet weight)									
			Fluor- anthrene	Pyrene	Benzo(a) anthra- cene	Chrysene	Benzo[b] fluor- anthrene	Benzo[k] fluor- anthrene	Benzo[a] pyrene	Indenc- (1,2,3- c-d)- pyrene	Dibenzo- [a,h]- anthracene	Benzo- [g,h,i]- perylene
MOTNW Replicate 1	3	2	6.40	6.33	1.47 J	2.45	1.27 J	0.92 J	0.21 J	1.94 U	1.32 U	2.63 U
MOTNW Replicate 2	3	2	8.63	8.33	1.78 J	2.94	1.48 J	0.90 J	0.45 J	2.00 U	1.36 U	2.71 U
MOTNW Replicate 3	3	2	7.04	6.82	2.31	3.13	2.16	1.73	1.22 J	1.84 U	1.25 U	2.49 U
RSD			16%	15%	23%	12%	28%	40% (e)	84% (e)	NA	NA	NA

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of associated value.

(c) Recovery outside quality control range (40%-120%).

(d) NC Not certified.

(e) Value exceeds relative precision range $\leq 30\%$.

(f) NA Not applicable.

(g) Value exceeds SRM range $\leq 30\%$.

TABLE K.9. Surrogate Recoveries for Polynuclear Aromatic Hydrocarbons (PAHs), Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	Surrogate Percent Recoveries		
				Naphthalene-d8	Acenaphthene-d10	Benzo[a]-pyrene-d12
MOTMA	1	1	14.66	68	62	59
MOTMA	2	2	15.11	71	68	68
MOTMA	3	3	14.59	76	70	76
MOTMA	4	1	14.50	70	62	58
MOTMA	5	3	13.43	79	69	74
KICMA	1	3	14.38	78	67	74
KICMA	2	2	13.63	64	65	75
KICMA	3	2	13.75	64	61	65
KICMA	4	1	14.36	63	61	62
KICMA	5	1	13.11	63	58	54
BSCMA	1	1	14.76	66	60	57
BSCMA	2	2	14.16	63	63	67
BSCMA	3	2	14.78	61	60	64
BSCMA	4	3	14.56	77	69	73
BSCMA Replicate 1	5	1	15.86	73	67	63
BSCMA Replicate 2	5	1	15.86	74	67	60
BSCMA Replicate 3	5	1	15.86	63	57	52
MOTNW	2	1	15.74	71	64	61
MOTNW	4	2	14.25	68	65	69
MOTNW	5	2	15.49	73	67	70
MOTNW Replicate 1	1	3	12.64	77	67	74
MOTNW Replicate 2	1	3	12.64	71	68	69
MOTNW Replicate 3	1	3	12.64	77	70	72
MOTNW Replicate 1	3	2	13.72	69	63	65
MOTNW Replicate 2	3	2	13.72	66	55	56
MOTNW Replicate 3	3	2	13.72	70	69	68
WREF	1	3	12.87	75	66	72
WREF	2	1	14.16	63	59	60
WREF	3	3	13.45	75	67	71
WREF	4	1	14.52	67	61	59
WREF	5	3	13.39	72	65	74
Sequim Bay	1	2	16.72	69	61	64
Sequim Bay	2	2	15.96	61	60	61
Sequim Bay	3	3	13.19	74	69	69
Sequim Bay	4	1	14.31	75	68	62
Sequim Bay	5	3	13.24	76	65	72
<u>Quality Control Data</u>						
<u>Method Blank</u>						
Blank 1				82	73	74
Blank 2				78	64	69
Blank 3				85	65	76
<u>Matrix Spikes</u>						
BSCMA	1	1		66	60	57
BSCMA MS	1	1		81	75	75

TABLE K.9. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	Surrogate Percent Recoveries		
				Naph- thalene-d8	Acenaph- thene-d10	Benzo[a]- pyrene-d12
BSCMA	1	1		66	60	57
BSCMA MSD	1	1		79	60	74
MOTNW	4	2		68	65	69
MOTNW MS	4	2		75	65	69
MOTNW	4	2		68	65	69
MOTNW MSD	4	2		72	66	66
MOTMA	5	3		79	69	74
MOTMA MS	5	3		87	70	71
MOTMA	5	3		79	69	74
MOTMA MSD	5	3		82	69	71
<u>Standard Reference Material</u>						
Certified Value				NC ^(a)	NC	NC
NIST 1974				81	73	69
NIST 1974				73	66	68
NIST 1974				85	71	72
<u>Analytical Triplicates</u>						
BSCMA Replicate 1	5	1		73	67	63
BSCMA Replicate 2	5	1		74	67	60
BSCMA Replicate 3	5	1		63	57	52
MOTNW Replicate 1	1	3		77	67	74
MOTNW Replicate 2	1	3		71	68	69
MOTNW Replicate 3	1	3		77	70	72
MOTNW Replicate 1	3	2		69	63	65
MOTNW Replicate 2	3	2		66	55	56
MOTNW Replicate 3	3	2		70	69	68

(a) NC Not certified.

TABLE K.10. Polychlorinated Biphenyls (PCBs), Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> PCBs ($\mu\text{g/kg}$ wet weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1254	Aroclor 1260
Target DL (a)				20.0	20.0	20.0	20.0	20.0	20.0
Achieved DL				≤ 20.0	≤ 20.0	≤ 20.0	≤ 20.0	≤ 20.0	≤ 20.0
MOTMA	1	1	14.66	2.747 U ^(b)	2.747 U	2.747 U	2.747 U	4.279	2.747 U
MOTMA	2	2	15.11	2.683 U	2.683 U	2.683 U	2.683 U	5.494	2.683 U
MOTMA	3	3	14.59	3.056 U	3.056 U	3.056 U	3.056 U	5.321	3.056 U
MOTMA	4	1	14.50	2.982 U	2.982 U	2.982 U	2.982 U	4.530	2.982 U
MOTMA	5	3	13.43	5.729 U	5.729 U	5.729 U	5.729 U	6.853	5.729 U
KICMA	1	3	14.38	3.411 U	3.411 U	3.411 U	3.411 U	6.331	3.411 U
KICMA	2	2	13.63	2.781 U	2.781 U	2.781 U	2.781 U	5.469	2.781 U
KICMA	3	2	13.75	2.499 U	2.499 U	2.499 U	2.499 U	7.079 J(c)	2.499 U
KICMA	4	1	14.36	3.691 U	3.691 U	3.691 U	3.691 U	3.017 J(c)	3.691 U
KICMA	5	1	13.11	3.138 U	3.138 U	3.138 U	3.138 U	3.795	3.138 U
BSCMA	1	1	14.76	6.927 U	6.927 U	6.927 U	6.927 U	3.922 J	6.927 U
BSCMA	2	2	14.16	2.159 U	2.159 U	2.159 U	2.159 U	4.096	2.159 U
BSCMA	3	2	14.78	2.198 U	2.198 U	2.198 U	2.198 U	6.691	2.198 U
BSCMA	4	3	14.56	2.186 U	2.186 U	2.186 U	2.186 U	7.157	2.186 U
BSCMA Replicate 1	5	1	15.86	5.759 U	5.759 U	5.759 U	5.759 U	3.915 J	5.759 U
BSCMA Replicate 2	5	1	15.86	5.531 U	5.531 U	5.531 U	5.531 U	4.480 J	5.531 U
BSCMA Replicate 3	5	1	15.86	4.135 U	4.135 U	4.135 U	4.135 U	3.449 J	4.135 U
MOTNW Replicate 1	1	3	12.64	4.527 U	4.527 U	4.527 U	4.527 U	6.607	4.527 U
MOTNW Replicate 2	1	3	12.64	4.411 U	4.411 U	4.411 U	4.411 U	7.108	4.411 U
MOTNW Replicate 3	1	3	12.64	4.894 U	4.894 U	4.894 U	4.894 U	5.205	4.894 U
MOTNW	2	1	15.74	2.184 U	2.184 U	2.184 U	2.184 U	4.222	2.184 U
MOTNW Replicate 1	3	2	13.72	4.350 U	4.350 U	4.350 U	4.350 U	6.135	4.350 U
MOTNW Replicate 2	3	2	13.72	4.481 U	4.481 U	4.481 U	4.481 U	5.179	4.481 U
MOTNW Replicate 3	3	2	13.72	4.130 U	4.130 U	4.130 U	4.130 U	5.866	4.130 U
MOTNW	4	2	14.25	4.574 U	4.574 U	4.574 U	4.574 U	3.741 J	4.574 U
MOTNW	5	2	15.49	2.891 U	2.891 U	2.891 U	2.891 U	7.292	2.891 U
WHREF	1	3	12.87	2.518 U	2.518 U	2.518 U	2.518 U	9.196	2.518 U
WHREF	2	1	14.16	2.942 U	2.942 U	2.942 U	2.942 U	4.369	2.942 U
WHREF	3	3	13.45	2.688 U	2.688 U	2.688 U	2.688 U	9.397	2.688 U
WHREF	4	1	14.52	3.320 U	3.320 U	3.320 U	3.320 U	4.580	3.320 U
WHREF	5	3	13.39	2.653 U	2.653 U	2.653 U	2.653 U	7.707	2.653 U

TABLE K.10. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> PCBs ($\mu\text{g/kg}$ wet weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1254	Aroclor 1260
Sequim Bay	1	2	16.72	3.236 U	3.236 U	3.236 U	3.236 U	4.857	3.236 U
Sequim Bay	2	2	15.96	3.675 U	3.675 U	3.675 U	3.675 U	5.666	3.675 U
Sequim Bay	3	3	13.19	2.682 U	2.682 U	2.682 U	2.682 U	6.202	2.682 U
Sequim Bay	4	1	14.31	2.841 U	2.841 U	2.841 U	2.841 U	3.452	2.841 U
Sequim Bay	5	3	13.24	2.615 U	2.615 U	2.615 U	2.615 U	6.283	2.615 U

(a) DL Detection limit.

(b) U Analyte was not present above the level of associated value.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE K.11. Polychlorinated Biphenyls (PCBs), Dry Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> PCBs ($\mu\text{g/kg}$ dry weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1254	Aroclor 1260
MOTMA	1	1	14.66	18.736 U(a)	18.736 U	18.736 U	18.736 U	29.184	18.736 U
MOTMA	2	2	15.11	17.751 U	17.751 U	17.751 U	17.751 U	36.348	17.751 U
MOTMA	3	3	14.59	20.942 U	20.942 U	20.942 U	20.942 U	36.463	20.942 U
MOTMA	4	1	14.50	20.561 U	20.561 U	20.561 U	20.561 U	31.235	20.561 U
MOTMA	5	3	13.43	42.646 U	42.646 U	42.646 U	42.646 U	51.012	42.646 U
KICMA	1	3	14.38	23.724 U	23.724 U	23.724 U	23.724 U	44.033	23.724 U
KICMA	2	2	13.63	20.407 U	20.407 U	20.407 U	20.407 U	40.131	20.407 U
KICMA	3	2	13.75	18.176 U	18.176 U	18.176 U	18.176 U	51.487	18.176 U
KICNA	4	1	14.36	25.700 U	25.700 U	25.700 U	25.700 U	21.007 J(b)	25.700 U
KICMA	5	1	13.11	23.936 U	23.936 U	23.936 U	23.936 U	28.947	23.936 U
BSCMA	1	1	14.76	46.918 U	46.918 U	46.918 U	46.918 U	26.565 J	46.918 U
BSCMA	2	2	14.16	15.250 U	15.250 U	15.250 U	15.250 U	28.933	15.250 U
BSCMA	3	2	14.78	14.868 U	14.868 U	14.868 U	14.868 U	45.261	14.868 U
BSCMA	4	3	14.56	15.014 U	15.014 U	15.014 U	15.014 U	49.155	15.014 U
BSCMA Replicate 1	5	1	15.86	36.323 U	36.323 U	36.323 U	36.323 U	24.693 J	36.323 U
BSCMA Replicate 2	5	1	15.86	34.885 U	34.885 U	34.885 U	34.885 U	28.256 J	34.885 U
BSCMA Replicate 3	5	1	15.86	26.080 U	26.080 U	26.080 U	26.080 U	21.753 J	26.080 U
MOTNW Replicate 1	1	3	12.64	35.823 U	35.823 U	35.823 U	35.823 U	52.283	35.823 U
MOTNW Replicate 2	1	3	12.64	34.905 U	34.905 U	34.905 U	34.905 U	56.248	34.905 U
MOTNW Replicate 3	1	3	12.64	38.728 U	38.728 U	38.728 U	38.728 U	41.189	38.728 U
MOTNW	2	1	15.74	13.876 U	13.876 U	13.876 U	13.876 U	26.825	13.876 U
MOTNW Replicate 1	3	2	13.72	31.696 U	31.696 U	31.696 U	31.696 U	44.703	31.696 U
MOTNW Replicate 2	3	2	13.72	32.651 U	32.651 U	32.651 U	32.651 U	37.737	32.651 U
MOTNW Replicate 3	3	2	13.72	30.093 U	30.093 U	30.093 U	30.093 U	42.743	30.093 U
MOTNW	4	2	14.25	32.103 U	32.103 U	32.103 U	32.103 U	26.256 J	32.103 U
MOTNW	5	2	15.49	18.661 U	18.661 U	18.661 U	18.661 U	47.069	18.661 U
WHRF	1	3	12.87	19.569 U	19.569 U	19.569 U	19.569 U	71.470	19.569 U
WHRF	2	1	14.16	20.772 U	20.772 U	20.772 U	20.772 U	30.848	20.772 U
WHRF	3	3	13.45	19.991 U	19.991 U	19.991 U	19.991 U	69.887	19.991 U
WHRF	4	1	14.52	22.860 U	22.860 U	22.860 U	22.860 U	31.536	22.860 U
WHRF	5	3	13.39	19.816 U	19.816 U	19.816 U	19.816 U	57.566	19.816 U

TABLE K.11. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>M. nasuta</i> PCBs (µg/kg dry weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1254	Aroclor 1260
Sequim Bay	1	2	16.72	19.358 U	19.358 U	19.358 U	19.358 U	29.054	19.358 U
Sequim Bay	2	2	15.96	23.029 U	23.029 U	23.029 U	23.029 U	35.506	23.029 U
Sequim Bay	3	3	13.19	20.337 U	20.337 U	20.337 U	20.337 U	47.028	20.337 U
Sequim Bay	4	1	14.31	19.849 U	19.849 U	19.849 U	19.849 U	24.118	19.849 U
Sequim Bay	5	3	13.24	19.757 U	19.757 U	19.757 U	19.757 U	47.469	19.757 U

(a) U Analyte was not present above given concentration.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE K.12. Quality Control Summary for Polychlorinated (PCBs), Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	M. nasuta PCBs (µg/kg wet weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1254	Aroclor 1260
Method Blank									
Blank 1		1		3.448 U(a)	3.448 U	3.448 U	3.448 U	3.448 U	3.448 U
Blank 2		2		3.084 U	3.084 U	3.084 U	3.084 U	3.084 U	3.084 U
Blank 3		3		3.153 U	3.153 U	3.153 U	3.153 U	3.153 U	3.153 U
Matrix Spike									
BSCMA	1	1	14.76	6.927 U(c)	6.927 U	6.927 U	6.927 U	3.922 J(b)	6.927 U
BSCMA MS	1	1	14.76	NA	NA	NA	NA	186.496	NA
Concentration Recovered				NA	NA	NA	NA	182.574	NA
Amount Spiked				NS	NS	NS	NS	207.565	NS
Percent Recovery				NA	NA	NA	NA	88%	NA
BSCMA	1	1	14.76	6.927 U	6.927 U	6.927 U	6.927 U	3.922 J	6.927 U
BSCMA MSD	1	1	14.76	NA	NA	NA	NA	152.234	NA
Concentration Recovered				NA	NA	NA	NA	148.312	NA
Amount Spiked				NS	NS	NS	NS	171.773	NS
Percent Recovery				NA	NA	NA	NA	86%	NA
RPD				NA	NA	NA	NA	2%	NA
I-Stat				NA	NA	NA	NA	0.01	NA
MOTNW	4	2	14.25	4.574 U	4.574 U	4.574 U	4.574 U	3.741 J	4.574 U
MOTNW MS	4	2	14.25	NA	NA	NA	NA	146.484	NA
Concentration Recovered				NA	NA	NA	NA	142.743	NA
Amount Spiked				NS	NS	NS	NS	130.552	NS
Percent Recovery				NA	NA	NA	NA	109%	NA
MOTNW	4	2	14.25	4.574 U	4.574 U	4.574 U	4.574 U	3.741 J	4.574 U
MOTNW MSD	4	2	14.25	NA	NA	NA	NA	216.005	NA
Concentration Recovered				NA	NA	NA	NA	212.264	NA
Amount Spiked				NS	NS	NS	NS	205.982	NS
Percent Recovery				NA	NA	NA	NA	103%	NA
RPD				NA	NA	NA	NA	6%	NA
I-Stat				NA	NA	NA	NA	0.03	NA

TABLE K.12. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	M. nasuta PCBs ($\mu\text{g/kg wet weight}$)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1254	Aroclor 1260
MOTMA	5	3	13.43	5.729 U	5.729 U	5.729 U	5.729 U	6.853	5.729 U
MOTMA MS	5	3	13.43	NA	NA	NA	NA	236.262	NA
Concentration Recovered				NA	NA	NA	NA	229.409	NA
Amount Spiked				NS	NS	NS	NS	217.297	NS
Percent Recovery				NA	NA	NA	NA	106%	NA
MOTMA	5	3	13.43	5.729 U	5.729 U	5.729 U	5.729 U	6.853	5.729 U
MOTMA MSD	5	3	13.43	NA	NA	NA	NA	250.502	NA
Concentration Recovered				NA	NA	NA	NA	243.649	NA
Amount Spiked				NS	NS	NS	NS	237.853	NS
Percent Recovery				NA	NA	NA	NA	102%	NA
RPD				NA	NA	NA	NA	3%	NA
I-Stat				NA	NA	NA	NA	0.02	NA
<u>Analytical Triplicates</u>									
BSCMA Replicate 1	5	1	15.86	5.759 U	5.759 U	5.759 U	5.759 U	3.915 J	5.759 U
BSCMA Replicate 2	5	1	15.86	5.531 U	5.531 U	5.531 U	5.531 U	4.480 J	5.531 U
BSCMA Replicate 3	5	1	15.86	4.135 U	4.135 U	4.135 U	4.135 U	3.449 J	4.135 U
RSD				NA	NA	NA	NA	13%	NA
MOTNW Replicate 1	3	2	13.72	4.350 U	4.350 U	4.350 U	4.350 U	6.135	4.350 U
MOTNW Replicate 2	3	2	13.72	4.481 U	4.481 U	4.481 U	4.481 U	5.179	4.481 U
MOTNW Replicate 3	3	2	13.72	4.130 U	4.130 U	4.130 U	4.130 U	5.866	4.130 U
RSD				NA	NA	NA	NA	9%	NA
MOTNW Replicate 1	1	3	12.64	4.527 U	4.527 U	4.527 U	4.527 U	6.607	4.527 U
MOTNW Replicate 2	1	3	12.64	4.411 U	4.411 U	4.411 U	4.411 U	7.108	4.411 U
MOTNW Replicate 3	1	3	12.64	4.894 U	4.894 U	4.894 U	4.894 U	5.205	4.894 U
RSD				NA	NA	NA	NA	16%	NA

(a) U Analyte was not present above the level of associated value.
 (b) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).
 (c) NA Not applicable.
 (d) NS Not spiked.

TABLE K.13. Surrogate Recoveries for Polychlorinated Biphenyls (PCBs),
Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	Percent Surrogate Recovery	
				DBOFB	CL5(112)
MOTMA	1	1	14.66	69	67
MOTMA	2	2	15.11	76	71
MOTMA	3	3	14.59	86	72
MOTMA	4	1	14.50	70	67
MOTMA	5	3	13.43	79	74
KICMA	1	3	14.38	88	72
KICMA	2	2	13.63	85	68
KICMA	3	2	13.75	72	67
KICMA	4	1	14.36	91	67
KICMA	5	1	13.11	70	61
BSCMA	1	1	14.76	68	68
BSCMA	2	2	14.16	76	65
BSCMA	3	2	14.78	68	63
BSCMA	4	3	14.56	87	74
BSCMA Replicate 1	5	1	15.86	81	73
BSCMA Replicate 2	5	1	15.86	82	76
BSCMA Replicate 3	5	1	15.86	65	64
MOTNW Replicate 1	1	3	12.64	81	77
MOTNW Replicate 2	1	3	12.64	81	68
MOTNW Replicate 3	1	3	12.64	90	71
MOTNW	2	1	15.74	77	68
MOTNW Replicate 1	3	2	13.72	66	71
MOTNW Replicate 2	3	2	13.72	65	62
MOTNW Replicate 3	3	2	13.72	74	68
MOTNW	4	2	14.25	76	68
MOTNW	5	2	15.49	80	71
WHPREF	1	3	12.87	79	75
WHPREF	2	1	14.16	68	66
WHPREF	3	3	13.45	77	73
WHPREF	4	1	14.52	72	64
WHPREF	5	3	13.39	79	72
Sequim Bay	1	2	16.72	76	62
Sequim Bay	2	2	15.96	77	60
Sequim Bay	3	3	13.19	86	76
Sequim Bay	4	1	14.31	82	73
Sequim Bay	5	3	13.24	80	69

TABLE K.13. (contd)

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Batch</u>	<u>Percent Dry Weight</u>	<u>Percent Surrogate Recovery DBOFB</u>	<u>Recovery CL5(112)</u>
<u>Quality Control Summary</u>					
<u>Method Blank</u>					
Blank	1	1		82	75
Blank	2	2		66	71
Blank	3	3		91	79
<u>Matrix Spike</u>					
BSCMA	1	1	14.76	68	68
BSCMA MS	1	1	14.76	87	85
BSCMA	1	1	14.76	68	68
BSCMA MSD	1	1	14.76	86	82
MOTNW	4	2	14.25	76	68
MOTNW MS	4	2	14.25	70	64
MOTNW	4	2	14.25	76	68
MOTNW MSD	4	2	14.25	74	62
MOTMA	5	3	13.43	79	74
MOTMA MS	5	3	13.43	87	75
MOTMA	5	3	13.43	79	74
MOTMA MSD	5	3	13.43	88	76
<u>Analytical Triplicates</u>					
BSCMA Replicate 1	5	1	15.86	81	73
BSCMA Replicate 2	5	1	15.86	82	76
BSCMA Replicate 3	5	1	15.86	65	64
MOTNW Replicate 1	3	2	13.72	66	71
MOTNW Replicate 2	3	2	13.72	65	62
MOTNW Replicate 3	3	2	13.72	74	68
MOTNW Replicate 1	1	3	12.64	81	77
MOTNW Replicate 2	1	3	12.64	81	68
MOTNW Replicate 3	1	3	12.64	90	71

(a) DL Detection limit.

TABLE K.14. Metals X-Ray Fluorescence (XRF), Inductively Coupled Plasma (ICP), and Graphite Furnace Atomic Absorption, Dry Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	<i>M. nasuta</i> Metals (mg/kg dry weight)												
		Ag	As	Be	Cr	Cd	Cu	Hg	Ni	Pb	Sb	Se	Tl	Zn
		ICP	ICP	GFAA	XRF	ICP	ICP	CVA	XRF	ICP	GFAA	XRF	ICP	ICP
Target DL (a)		0.1	0.1	0.2	0.1	0.1	0.1	0.01	1.0	0.1	0.1	0.2	0.1	0.3
Achieved DL		0.1	0.1	0.2	3.3	0.1	0.01	0.09	1.0	0.01	0.06	0.2	0.1	0.2
BSCMA	1	0.144	22.8	0.011	4.0 U ^(b)	0.238	9.19	0.117	2.93	1.150	0.05 U	1.92	0.013	77.0
BSCMA	2	0.075	25.4	0.009	3.9 U	0.389	7.38	0.097	3.16	1.050	0.06 U	1.64	0.004	79.1
BSCMA	3	0.269	29.8	0.007	3.5 U	0.404	10.29	0.081	5.04	1.290	0.06 U	2.25	0.009	105.6
BSCMA	4	0.141	29.3	0.011	3.8 U	0.274	11.23	0.116	3.47	1.330	0.06 U	2.27	0.013	71.0
BSCMA	5	0.131	26.1	0.160	3.7 U	0.128	9.18	0.085	2.52	1.150	0.06 U	1.94	0.009	83.7
BSCMA	5	0.099	25.0	0.180	ND ^(c)	0.165	9.56	0.085	ND	1.090	0.06 U	ND	0.009	81.6
BSCMA	5	0.111	24.8	0.130	ND	0.228	9.40	0.079	ND	1.140	0.06 U	ND	0.004	82.3
KICMA	1	0.062	25.1	0.010	3.7 U	0.151	9.15	0.110	3.63	0.844	0.06 U	1.66	0.004	69.1
KICMA	2	0.266	26.7	0.005	4.5 U	0.275	7.75	0.087	3.29	1.310	0.06 U	1.29	0.009	101.2
KICMA	3	0.188	27.6	0.006	4.4 U	0.230	7.91	0.087	3.35	0.778	0.06 U	1.55	0.004	65.1
KICMA	3	ND	ND	ND	4.4 U	ND	ND	ND	2.34	ND	ND	1.52	ND	ND
KICMA	3	ND	ND	ND	4.5 U	ND	ND	ND	3.01	ND	ND	1.80	ND	ND
KICMA	4	0.118	24.8	0.020	3.7 U	0.285	7.87	0.096	3.63	1.320	0.06 U	1.33	0.014	72.5
KICMA	5	0.157	24.5	0.012	3.9 U	0.199	18.10	0.112	3.68	1.230	0.06 U	1.71	0.014	70.0
MOTMA	1	0.212	22.3	0.013	3.8 U	0.255	10.86	0.088	3.19	1.090	0.06 U	1.59	0.013	90.7
MOTMA	2	0.170	21.1	0.013	3.8 U	0.286	9.86	0.100	4.25	1.350	0.06 U	1.87	0.004	78.8
MOTMA	3	0.161	27.8	0.018	3.5 U	0.282	8.79	0.085	3.39	1.120	0.06 U	2.03	0.004	83.7
MOTMA	3	0.094	23.8	0.020	ND	0.158	8.30	0.094	ND	0.899	0.06 U	ND	0.009	84.2
MOTMA	3	0.130	24.8	0.019	ND	0.199	8.92	0.090	ND	1.010	0.06 U	ND	0.004	84.6
MOTMA	4	0.067	30.1	0.024	3.5 U	0.268	10.21	0.102	3.37	1.330	0.06 U	2.08	0.013	95.1
MOTMA	4	ND	ND	ND	3.7 U	ND	ND	ND	3.82	ND	ND	1.93	ND	ND
MOTMA	4	ND	ND	ND	6.7	ND	ND	ND	4.84	ND	ND	1.95	ND	ND
MOTMA	5	0.111	26.6	0.011	4.6	0.319	6.83	0.084	3.27	0.859	0.06 U	1.71	0.013	74.6
MOTNW	1	0.080	27.0	0.004	4.2	0.227	8.75	0.097	2.74	0.843	0.06 U	1.52	0.004	69.7
MOTNW	2	0.179	22.5	0.008	3.4 U	0.297	9.73	0.097	3.58	0.991	0.06 U	2.12	0.004	63.6
MOTNW	2	0.236	24.6	0.007	ND	0.193	10.38	0.103	ND	0.902	0.06 U	ND	0.004	65.1
MOTNW	2	0.258	23.6	0.006	ND	0.110	10.06	0.100	ND	0.941	0.06 U	ND	0.008	72.0
MOTNW	3	0.163	26.6	0.009	4.5 U	0.097	8.15	0.084	2.88	0.814	0.06 U	1.37	0.009	79.2
MOTNW	4	0.152	24.1	0.007	3.9 U	0.123	9.92	0.094	3.42	0.688	0.06 U	1.39	0.004	70.1
MOTNW	5	0.144	24.8	0.018	4.0	0.180	8.82	0.081	3.10	1.140	0.06 U	1.62	0.009	72.7

TABLE K.14. (contd)

Sediment Treatment	Replicate	<i>M. nasuta</i> Metals (mg/kg dry weight)											
		Ag	As	Be	Cr	Cd	Cu	Hg	Ni	Pb	Sb	Se	Zn
		ICP	ICP	GFAA	XRF	ICP	ICP	CVA	XRF	ICP	GFAA	XRF	ICP
WHREF	1	0.076	23.1	0.003	4.5 U	0.289	6.83	0.111	4.71	0.803	0.06 U	1.65	0.013
WHREF	2	0.129	26.9	0.003	3.3 U	0.217	7.32	0.102	2.17	0.717	0.06 U	1.78	0.004
WHREF	3	0.150	25.2	0.013 U	3.9 U	0.250	7.20	0.096	2.87	0.910	ND	1.74	0.004
WHREF	3	0.110	22.7	0.013 U	ND	0.150	7.50	0.096	ND	0.900	ND	ND	0.004
WHREF	3	0.180	21.1	0.013 U	ND	0.170	5.90	0.094	ND	0.960	ND	ND	0.004
WHREF	4	0.230	24.4	0.013 U	3.6 U	0.150	7.90	0.090	2.28	1.010	0.05	1.47	0.004
WHREF	5	0.076	26.8	0.007	3.8 U	0.314	7.01	0.129	3.54	0.804	0.06 U	1.95	0.009
Sequim Bay	1	0.233	33.0	0.006	3.9 U	0.309	11.49	0.086	4.18	1.680	0.06 U	1.73	0.004
Sequim Bay	2	0.100	29.9	NA	3.6 U	0.210	8.10	0.106	4.51	1.260	NA	2.20	0.004
Sequim Bay	3	0.125	25.4	0.003	3.9 U	0.155	9.39	0.091	3.14	1.120	0.06 U	1.89	0.004
Sequim Bay	4	0.180	33.6	0.009	6.6	0.191	14.63	0.097	5.05	2.040	0.06 U	1.74	0.009
Sequim Bay	5	0.174	27.6	0.010	12.2	0.174	12.38	0.082	4.19	1.410	ND	1.47	0.013
Sequim Bay	5	ND	ND	ND	4.0 U	ND	ND	ND	4.52	ND	ND	1.58	ND
Sequim Bay	5	ND	ND	ND	4.1 U	ND	ND	ND	4.60	ND	ND	2.06	ND

(a) DL Detection limit.

(b) U Analyte was not present above the level of associated value.

(c) ND No data.

TABLE K.15. Metals X-Ray Fluorescence (XRF), Inductively Coupled Plasma (ICP), and Graphite Furnace Atomic Absorption, Wet Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Percent Dry Weight	M. nasuta Metals (mg/kg wet weight)													
			Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl ICP	Zn ICP	
BSCMA	1	14.76	0.021	3.4	0.002	0.6 U ^(a)	0.0	1.36	0.017	0.43	0.170	0.01 U	0.28	0.002	11.4	
BSCMA	2	14.16	0.011	3.6	0.001	0.0 U	0.1	1.04	0.014	0.45	0.149	0.01 U	0.23	0.001	11.2	
BSCMA	3	14.78	0.040	4.4	0.001	0.0 U	0.1	1.52	0.012	0.75	0.191	0.01 U	0.33	0.001	15.6	
BSCMA	4	14.56	0.021	4.3	0.002	0.0 U	0.0	1.64	0.017	0.51	0.194	0.01 U	0.33	0.002	10.3	
BSCMA	5	15.86	0.021	4.1	0.025	0.0 U ^(b)	0.0	1.46	0.013	0.40	0.182	0.01 U	0.31	0.001	13.3	
BSCMA	5	15.86	0.016	4.0	0.029	ND ^(b)	0.0	1.52	0.013	ND	0.173	0.01 U	ND	0.001	12.9	
BSCMA	5	15.86	0.018	3.9	0.021	ND	0.0	1.49	0.013	ND	0.181	0.01 U	ND	0.001	13.0	
KICMA	1	14.38	0.009	3.6	0.001	0.0 U	0.0	1.32	0.016	0.52	0.121	0.01 U	0.24	0.001	9.9	
KICMA	2	13.63	0.036	3.6	0.001	0.0 U	0.0	1.06	0.012	0.45	0.179	0.01 U	0.18	0.001	13.8	
KICMA	3	13.75	0.026	3.8	0.001	0.0 U	0.0	1.09	0.012	0.46	0.107	0.01 U	0.21	0.001	9.0	
KICMA	3	13.75	ND	ND	ND	0.0 U	ND	ND	ND	0.32	ND	ND	0.21	ND	ND	
KICMA	3	13.75	ND	ND	ND	0.0 U	ND	ND	ND	0.41	ND	ND	0.25	ND	ND	
KICMA	4	14.36	0.017	3.6	0.003	0.0 U	0.0	1.13	0.014	0.52	0.190	0.01 U	0.19	0.001	10.4	
KICMA	5	13.11	0.021	3.2	0.002	0.0 U	0.0	2.37	0.015	0.48	0.161	0.01 U	0.22	0.001	9.2	
MOTMA	1	14.66	0.031	3.3	0.002	0.0 U	0.0	1.59	0.013	0.47	0.160	0.01 U	0.23	0.003	13.3	
MOTMA	2	15.12	0.026	3.2	0.002	0.0 U	0.0	1.49	0.015	0.64	0.204	0.01 U	0.28	0.001	11.9	
MOTMA	3	14.59	0.023	4.1	0.003	0.0 U	0.0	1.28	0.012	0.49	0.163	0.01 U	0.30	0.001	12.2	
MOTMA	3	14.59	0.014	3.5	0.003	ND	0.0	1.21	0.014	ND	0.131	0.01 U	ND	0.001	12.3	
MOTMA	3	14.59	0.019	3.6	0.003	ND	0.0	1.30	0.013	ND	0.147	0.01 U	ND	0.001	12.3	
MOTMA	4	14.50	0.010	4.4	0.003	0.0 U	0.0	1.48	0.015	0.49	0.193	0.01 U	0.30	0.002	13.8	
MOTMA	4	14.50	ND	ND	ND	0.0 U	ND	ND	ND	0.55	ND	ND	0.28	ND	ND	
MOTMA	4	14.50	ND	ND	ND	0.0 U	ND	ND	ND	0.70	ND	ND	0.28	ND	ND	
MOTMA	5	13.43	0.015	3.6	0.001	0.0	0.0	0.92	0.011	0.44	0.115	0.01 U	0.23	0.002	10.0	
MOTNW	1	12.64	0.010	3.4	0.001	0.0	0.0	1.11	0.012	0.35	0.107	0.01 U	0.19	0.001	8.8	
MOTNW	2	15.74	0.028	3.5	0.001	0.0 U	0.0	1.53	0.015	0.56	0.156	0.01 U	0.33	0.001	10.0	
MOTNW	2	15.74	0.037	3.9	0.001	ND	0.0	1.63	0.016	ND	0.142	0.01 U	ND	0.001	10.2	
MOTNW	2	15.74	0.041	3.7	0.001	ND	0.0	1.58	0.016	ND	0.148	0.01 U	ND	0.001	11.3	
MOTNW	3	13.72	0.022	3.7	0.001	0.0 U	0.0	1.12	0.011	0.40	0.112	0.01 U	0.19	0.001	10.9	
MOTNW	4	14.25	0.022	3.4	0.001	0.0 U	0.0	1.41	0.013	0.49	0.098	0.01 U	0.20	0.001	10.0	
MOTNW	5	15.49	0.022	3.8	0.003	0.0	0.0	1.37	0.013	0.48	0.177	0.01 U	0.25	0.001	11.3	
WHREF	1	12.87	0.010	3.0	0.000	0.0 U	0.0	0.88	0.014	0.61	0.103	0.01 U	0.21	0.002	8.6	
WHREF	2	14.16	0.018	3.8	0.000	0.0 U	0.0	1.04	0.014	0.31	0.102	0.01 U	0.25	0.001	12.0	
WHREF	3	13.45	0.020	3.4	0.002 U	0.0 U	0.0	0.97	0.013	0.39	0.122	0.00	0.23	0.001	9.7	
WHREF	3	13.45	0.015	3.1	0.002 U	ND	0.0	1.01	0.013	ND	0.121	0.01 U	ND	0.001	8.9	
WHREF	3	13.45	0.024	2.8	0.002 U	ND	0.0	0.79	0.013	ND	0.129	ND	ND	0.001	9.6	
WHREF	4	14.52	0.033	3.5	0.002 U	0.0 U	0.0	1.15	0.013	0.33	0.147	ND	0.21	0.001	10.7	
WHREF	5	13.39	0.010	3.6	0.001	0.0 U	0.0	0.94	0.017	0.47	0.108	ND	0.26	0.001	10.7	

TABLE K.15. (contd)

Sediment Treatment	Replicate	Percent Dry Weight	<i>M. nasuta</i> Metals (mg/kg wet weight)													
			Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVAA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl ICP	Zn ICP	
Sequim Bay	1	16.72	0.039	5.5	0.001	0.0 U	0.1	1.92	0.014	0.70	0.281	0.01 U	0.29	0.001	15.0	
Sequim Bay	2	15.96	0.016	4.8	0.002 U	0.0 U	0.0	1.29	0.017	0.72	0.201	ND	0.35	0.001	11.7	
Sequim Bay	3	13.19	0.016	3.3	0.000	0.0 U	0.0	1.24	0.012	0.41	0.148	0.01 U	0.25	0.001	10.2	
Sequim Bay	4	14.31	0.026	4.8	0.001	0.0	0.0	2.09	0.014	0.72	0.292	0.01 U	0.25	0.001	10.7	
Sequim Bay	5	13.24	0.023	3.7	0.001	0.0	0.0	1.64	0.011	0.55	0.187	ND	0.19	0.002	8.1	
Sequim Bay	5	13.24	ND	ND	ND	0.0 U	ND	ND	ND	0.60	ND	ND	0.21	ND	ND	
Sequim Bay	5	13.24	ND	ND	ND	0.0 U	ND	ND	ND	0.61	ND	ND	0.27	ND	ND	

(a) U Analyte was not present above the level of associated value.
 (b) ND No data.

TABLE K.16. Quality Control Summary for Metals X-Ray Fluorescence (XRF), Inductively Coupled Plasma (ICP), and Graphite Furnace Atomic Absorption, Dry Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

		M. nasuta Metals (mg/kg dry weight)												
Sediment Treatment	Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVAA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl ICP	Zn ICP	
Method Blank														
Blank 1	0.001	0.1	0.002 U(a)	NA(b)	0.010	0.01	0.000	NA	0.010	0.06 U	NA	0.001	0.2	
Blank 2	0.001	0.1	0.002 U	NA	0.013	0.01	0.000	NA	0.002	0.06 U	NA	0.000	2.7	
Blank 3	0.001	0.1	0.001(c)	NA	0.006	0.01	0.000	NA	0.004	0.06 U	NA	0.001	0.3	
Blank 4	0.001	0.1	ND	NA	0.010	0.01	ND	NA	0.010	ND	NA	0.001	3.5	
Matrix Spike														
BSCMA Replicate 5	0.131	26.1	0.160	3.7 U	0.128	9.18	0.085	2.52	1.150	0.06 U	1.94	0.009	83.7	
BSCMA MS Replicate 5	1.980	62.7	1.440	ND	2.121	20.83	0.554	ND	3.410	1.65	ND	1.960	316.7	
Concentration Recovered	1.849	36.6	1.280	NA(d)	1.993	11.65	0.469	NA	2.260	1.65	NA	1.951	233.0	
Amount Spiked	2.000	40.0	2.000(e)	NS	2.000	12.00	0.5	NS	2.000	1.81	NS	2.000	220.0	
Percent Recovery	92%	92%	64%	NA	100%	97%	93%	NA	113%	91%	NA	98%	106%	
MOTNW Replicate 2	0.179	22.5	0.008	3.4 U	0.297	9.73	0.097	3.58	0.991	0.06 U	2.12	0.004	63.6	
MOTNW MS Replicate 2	1.730	60.1	1.410	ND	2.050	21.08	0.504	ND	3.230	1.67	ND	1.900	272.9	
Concentration Recovered	1.551	37.6	1.402	NA	1.753	11.35	0.407	NA	2.239	1.67	NA	1.896	209.3	
Amount Spiked	2.000	40.0	2.000(e)	NS	2.000	12.00	0.5	NS	2.000	1.79	NS	2.000	220.0	
Percent Recovery	78%	94%	70%	NA	88%	95%	81%	NA	112%	93%	NA	95%	95%	
MOTMA Replicate 3	0.161	27.8	0.018	3.5 U	0.282	8.79	0.085	3.39	1.120	0.06 U	2.03	0.004	83.7	
MOTMA MS Replicate 3	1.790	62.2	1.430	ND	2.314	19.84	0.573	ND	3.140	1.67	ND	1.800	290.0	
Concentration Recovered	1.629	34.4	1.412	NA	2.032	11.05	0.488	NA	2.020	1.67	NA	1.796	206.3	
Amount Spiked	2.000	40.0	2.000(e)	NS	2.000	12.00	0.5	NS	2.000	1.8	NS	2.000	220.0	
Percent Recovery	81%	86%	71%(e)	NA	102%	92%	98%	NA	101%	93%	NA	90%	94%	
WHREF Replicate 3	0.150	25.2	0.013 U	3.9 U	0.250	7.20	0.096	2.87	0.910	0.08	1.74	0.004	72.4	
WHREF MS Replicate 3	1.770	53.7	ND	ND	1.900	14.00	0.581	ND	3.010	ND	ND	1.950	279.7	
Concentration Recovered	1.620	28.5	NA	NA	1.650	6.80	0.485	NA	2.100	NA	NA	1.946	207.3	
Amount Spiked	2.000	40.0	NS	NS	2.000	12.00(e)	0.5	NS	2.000	NS	NS	2.000	220.0	
Percent Recovery	81%	71%(e)	NA	NA	83%	57%(e)	97%	NA	105%	NA	NA	97%	94%	

TABLE K.16. (contd)

Sediment Treatment	M. nasuta Metals (mg/kg dry weight)												
	Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl ICP	Zn ICP
<u>Standard Reference Material</u>													
Certified Value	1.68 ±0.15	14.0 ±1.2	NC NC	1.43 ±0.46	4.15 ±0.38	66.3 ±4.3	0.0642 ±0.0067	2.25 ±0.44	0.37 ±0.014	NC	2.21 ±0.24	NC	830 ±57
1566A	1.650	16.9	0.008	2.2 U	3.802	70.93	0.066	2.30	0.322	0.06 U	2.42	0.002	814.3
1566B	1.700	15.0	0.008	2.4 U	4.127	70.18	0.068	2.00	0.336	0.06 U	2.37	0.002	884.9
1566C	1.720	15.1	0.008	2.4	4.294	67.08	0.060	2.63	0.338	0.06 U	2.20	0.006	848.5
Certified Value	NC NC	17.7 ±2.1	NC NC	3.60 ±0.40	0.086 ±0.012	5.22 ±0.33	0.731 ±0.060	1.20 ±0.30	0.40 ±0.12	NC	1.62 ±0.12	NC	21.3 ±1.0
RM1A	0.212	19.8	0.002 U	3.8	0.114	5.93	0.922	1.16	0.662	0.06 U	1.51	0.002	19.4
RM1B	0.170	18.9	0.002 U	3.1	0.099	5.60	0.861	0.79 U	0.343	0.06 U	1.72	0.006	21.0
RM1C	0.196	20.1	0.001	2.7	0.081	5.20	0.906	0.98	0.538	0.06 U	1.84	0.002	20.4

Analytical Replicates

MOTMA Replicate 4	0.067	30.1	0.024	3.5 U	0.268	10.21	0.102	3.37	1.330	0.06 U	2.08	0.013	95.1
MOTMA Replicate 4	ND	ND	ND	3.7 U	ND	ND	ND	3.82	ND	ND	1.93	ND	ND
MOTMA Replicate 4	ND	ND	ND	6.7	ND	ND	ND	4.84	ND	ND	1.95	ND	ND
RSD	NA	NA	NA	NA	NA	NA	NA	19%	NA	NA	4%	NA	NA
BSCMA Replicate 5	0.131	26.1	0.16	3.7 U	0.128	9.18	0.085	2.52	1.150	0.06 U	1.94	0.009	83.7
BSCMA Replicate 5	0.099	25.0	0.18	ND	0.165	9.56	0.085	ND	1.090	0.06 U	ND	0.009	81.6
BSCMA Replicate 5	0.111	24.8	0.13	ND	0.228	9.40	0.079	ND	1.140	0.06 U	ND	0.004	82.3
RSD	14%	3%	16%	NA	29%(g)	2%	4%	NA	3%	NA	NA	39%	1%
MOTNW Replicate 2	0.179	22.5	0.008	3.4 U	0.297	9.73	0.097	3.58	0.991	0.06 U	2.12	0.004	63.6
MOTNW Replicate 2	0.236	24.6	0.007	ND	0.193	10.38	0.103	ND	0.902	0.06 U	ND	0.004	65.1
MOTNW Replicate 2	0.258	23.6	0.006	ND	0.110	10.06	0.100	ND	0.941	0.06 U	ND	0.008	72.0
RSD	18%	4%	14%	NA	47%(g)	3%	3%	NA	5%	NA	NA	43%	7%
KICMA Replicate 3	0.188	27.6	0.006	4.4 U	0.290	7.91	0.087	3.35	0.778	0.06 U	1.55	0.004	65.1
KICMA Replicate 3	ND	ND	ND	4.4 U	ND	ND	ND	2.34	ND	ND	1.52	ND	ND
KICMA Replicate 3	ND	ND	ND	4.5 U	ND	ND	ND	3.01	ND	ND	1.80	ND	ND
RSD	NA	NA	ND	NA	NA	NA	NA	18%	NA	ND	9%	NA	NA
MOTMA Replicate 3	0.161	27.8	0.018	3.5 U	0.282	8.79	0.085	3.39	1.120	0.06 U	2.03	0.004	83.7
MOTMA Replicate 3	0.094	23.8	0.020	ND	0.158	8.30	0.094	ND	0.899	0.06 U	ND	0.009	84.2

TABLE K.16. (contd)

Sediment Treatment	M. nasuta Metals (mg/kg dry weight)													
	Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl ICP	Zn ICP	
MOTMA Replicate 3 RSD	0.130 (g) 26%	24.8 (g) 8%	0.019 (g) 5%	ND	0.199 (g) 30%	8.92 (g) 4%	0.090 (g) 5%	ND	1.010 (g) 11%	0.06 (g) NA	ND	0.004 (g) 51%	84.6 (g) 1%	
Sequim Bay Replicate 5	0.174	27.6	0.010	12.2	0.174	12.38	0.082	4.19	1.410	ND	1.47	0.013	61.1	
Sequim Bay Replicate 5	ND	ND	ND	4.0 U	ND	ND	ND	4.52	ND	ND	1.58	ND	ND	
Sequim Bay Replicate 5	ND	ND	ND	4.1 U	ND	ND	ND	4.60	ND	ND	2.06	ND	ND	
Sequim Bay Replicate 5 RSD	NA	NA	NA	NA	NA	NA	NA	5%	NA	ND	18%	NA	NA	
WREF Replicate 3	0.150	25.2	0.013 U	3.9 U	0.250	7.20	0.096	2.87	0.910	0.08	1.74	0.004	72.4	
WREF Replicate 3	0.110	22.7	0.013 U	ND	0.150	7.50	0.096	ND	0.900	0.09	ND	0.004	66.2	
WREF Replicate 3	0.180 (g) 24%	21.1 (g) 9%	0.013 U	ND	0.170 (g) 28%	5.90 (g) 12%	0.094 (g) 1%	ND	0.960 (g) 3%	0.08 (g) 7%	ND	0.004 (g) 0%	71.3 (g) 5%	
WREF Replicate 3 RSD														

(a) U Analyte was not present above the level of associated value.

(b) NA Not applicable.

(c) ND No data.

(d) NS Not spiked.

(e) Recovery outside quality control range (75%-125%).

(f) NC Not certified.

(g) Value exceeds relative precision range of $\leq 20\%$.

TABLE K.17. Butyltins, Wet and Dry Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Surrogate Percent Recovery			<i>M. nasuta</i>				<i>M. nasuta</i>			
			Tri-pentyl-	Propyl-	Pentyl-	Butyltins ($\mu\text{g/kg}$ wet weight)		Percent Dry Weight		Butyltins ($\mu\text{g/kg}$ dry weight)		Tri-butyltin	
			tin	tin	tin	tin	tin	tin	tin	tin	tin	tin	tin
Target DL (a)						10.0	10.0	10.0					
Achieved DL						≤ 10.0	≤ 10.0	≤ 10.0					
KICMA	1	2	103	92	89	88	5.0	1.5 J ^(b)	3.1 U ^(c)	14.38	34.8	10.4 J	21.6 U
KICMA	2	2	108	88	84	85	3.4 U	2.8 U	3.2 U	13.63	24.9 U	20.5 U	23.5 U
KICMA	3	2	103	93	88	92	3.8 U	1.5 J	2.9 U	13.75	27.6 U	10.9 J	21.1 U
KICMA	4	1	81	78	103	87	4.5	1.5 J	3.1 U	14.36	31.3	10.4 J	21.6 U
KICMA Replicate 1	5	1	112	93	102	90	3.8 U	3.4 U	3.0 U	13.11	29.0 U	25.9 U	22.9 U
KICMA Replicate 2	5	1	109	92	102	86	3.4 U	2.1 U	3.2 U	13.11	25.9 U	16.0 U	24.4 U
KICMA Replicate 3	5	1	107	95	102	94	3.3 U	1.8 U	2.9 U	13.11	25.2 U	13.7 U	22.1 U
MOTMA	1	1	82	86	100	86	14.4	6.8	4.3	14.66	98.2	46.4	29.3
MOTMA	2	1	105	95	102	92	4.6	2.6 U	2.9 U	15.11	30.4	17.2 U	19.2 U
MOTMA	3	2	104	93	88	85	5.0	2.3 U	3.2 U	14.59	34.3	15.8 U	21.9 U
MOTMA	4	1	103	88	104	78	5.3 U	1.9 J	3.5 U	14.50	36.5 U	13.1 J	24.1 U
MOTMA	5	2	109	92	91	90	4.7	1.7 J	3.0 U	13.43	35.0	12.7 J	22.3 U
WHEF	1	2	99	93	99	94	2.7 U	3.4 U	2.9 U	12.87	21.0 U	26.4 U	22.5 U
WHEF	2	1	105	92	96	103	3.5 U	1.6 U	2.6 U	14.16	24.7 U	11.3 U	18.4 U
WHEF Replicate 1	3	2	112	93	94	85	3.9 U	4.0 U	3.2 U	13.45	29.0 U	29.7 U	23.8 U
WHEF Replicate 2	3	2	111	94	87	82	3.3 U	2.0 U	3.3 U	13.45	24.5 U	14.9 U	24.5 U
WHEF Replicate 3	3	2	114	94	92	86	4.0 U	2.1 U	3.1 U	13.45	29.7 U	15.6 U	23.1 U
WHEF	4	1	79	72	95	80	2.8 U	1.3 J	3.4 U	14.52	19.3 U	9.0 J	23.4 U
WHEF	5	2	103	94	94	87	3.4 U	2.3 U	3.0 U	13.39	25.4 U	17.2 U	22.4 U
Sequim Bay	1	1	99	91	104	93	2.7 U	1.6 J	2.9 U	16.72	16.2 U	9.6 J	17.3 U
Sequim Bay	2	1	108	96	94	93	3.4 U	1.8 U	2.9 U	15.96	21.3 U	11.3 U	18.2 U
Sequim Bay	3	2	109	93	92	88	2.4 U	1.8 U	3.1 U	13.19	18.2 U	13.6 U	23.5 U
Sequim Bay	4	1	104	92	96	95	2.5 U	1.5 J	2.8 U	14.31	17.5 U	10.5 J	19.6 U
Sequim Bay	5	2	104	92	93	96	2.2 U	1.2 J	2.8 U	13.24	16.6 U	9.1 J	21.2 U

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the level of associated value.

TABLE K.18. Quality Control Summary for Butyltins, Wet and Dry Weight, in Tissue of *M. nasuta*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Surrogate Percent Recovery				<i>M. nasuta</i> Butyltins ($\mu\text{g}/\text{kg}$ wet weight)		
			Tri-pentyltin	Propyltin	Pentyltin	Tetra-butyltin	Tri-butyltin	Di-butyltin	Mono-butyltin
Method Blank									
Blank 1		1	110	92	92	82	2.1 U ^(a)	2.0 U	3.3 U
Blank 2		1	114	91	92	83	2.1 U	1.9 U	3.3 U
Matrix Spike									
MOTMA	4	1	103	88	104	78	5.3 U	1.9 J ^(b)	3.5 U
MOTMA MS	4	1	92	85	94	82	36.1	32.5	8.8
Concentration Recovered							36.1	30.6	8.8
Amount Spiked							33.3	33.3	33.3 (c)
Percent Recovery							108%	92%	26%
MOTMA	4	1	103	88	104	78	5.3 U	1.9 J	3.5 U
MOTMA MSD	4	1	86	88	98	103	30.9	26.5	6.8
Concentration Recovered							30.9	24.6	6.8
Amount Spiked							30.5	30.5	30.5 (c)
Percent Recovery							101%	81%	22%
RPD							7%	13%	17%
I-Stat							0.03	0.06	0.08
WHEF	1	2	99	93	99	94	2.7 U	3.4 U	2.9 U
WHEF MS	1	2	98	88	91	95	34.6	37.0	11.5
Concentration Recovered							34.6	37.0	11.5
Amount Spiked							35.8	35.8	35.8 (c)
Percent Recovery							97%	103%	32%
WHEF	1	2	99	93	99	94	2.7 U	3.4 U	2.9 U
WHEF MSD	1	2	109	93	90	95	38.0	39.1	12.8
Concentration Recovered							38.0	39.1	12.8
Amount Spiked							36.3	36.3	36.3 (c)
Percent Recovery							105%	108%	35%
RPD							8%	4%	9%
I-stat							0.04	0.02	0.05

TABLE K.18. (contd)

Sediment Treatment	Replicate	Batch	Surrogate Percent Recovery				<i>M. nasuta</i> Butyltins ($\mu\text{g/kg}$ wet weight)		
			Tri-pentyltin	Propyltin	Pentyl-butyltin	Tetra-butyltin	Tri-butyltin	Di-butyltin	Mono-butyltin
<u>Analytical Triplicates</u>									
KICMA Replicate 1	5	1	112	93	102	90	3.8 U	3.4 U	3.0 U
KICMA Replicate 2	5	1	109	92	102	86	3.4 U	2.1 U	3.2 U
KICMA Replicate 3	5	1	107	95	102	94	3.3 U NA	1.8 U NA	2.9 U NA
RSD									
WHREF Replicate 1	3	2	112	93	94	85	3.9 U	4.0 U	3.2 U
WHREF Replicate 2	3	2	111	94	87	82	3.3 U	2.0 U	3.3 U
WHREF Replicate 3	3	2	114	94	92	86	4.0 U NA	2.1 U NA	3.1 U NA
RSD									

(a) U Analyte was not present above the level of associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) Recovery outside quality control range (40%-120%).

(d) NA Not applicable.

APPENDIX L

N. virens TISSUE CHEMISTRY AND QUALITY CONTROL DATA

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	PAHs
Laboratory	Battelle/Marine Sciences Laboratory Pacific Northwest Laboratory (Richland)
Matrix	<i>Nereis virens</i> Tissue
Holding Times	Tissue samples were obtained from bioaccumulation experiments August 13, 1992, arrived at the laboratory September 25, were extracted between September 29 and October 13, and analyzed between October 5 and October 17, 1992. The 30-day holding time prior to extraction was exceeded, but the 40-day holding time between extraction and analysis was not exceeded. Samples were frozen at -20°C until extracted.
Blanks	The requirement of 1 blank per 20 samples was met. Three blanks were run for 30 samples. HPAHs and LPAHs were not detected above the target detection limit of 30 µg/kg.
Detection Limits	The detection limit goal of 30 µg/kg was met for all HPAH and LPAH compounds.
Surrogate Internal Standards	The requirement of one surrogate internal standard per sample was met. Three surrogate internal standards were evaluated: d8 naphthalene, d10 acenaphthalene, and d12 benzo[a]pyrene. All surrogate recoveries were within the QA goals of 40% to 120%.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was met. Three matrix spike/matrix spike duplicates were analyzed for the 30 samples. All percent recoveries were within the 40% to 120% quality assurance requirement with the exception of (acenaphthylene) in one sample, indeno[1,2,3-c,d] in two samples, and benzo[g,h,i]perylene in two samples. The relative percent difference between matrix spike and matrix spike duplicates ranged from 0% to 6%, below the the QA limit of ≤30%.
Replication	The requirement of 1 triplicate analysis per 10 samples was met. Three triplicate analyses were conducted on the 30 samples. The relative standard deviation criteria of ≤30% was exceeded for six LPAH comparisons and five HPAH comparisons.
SRMs	The requirement of 1 SRM per 20 samples was met. Three SRMs were analyzed for the 30 samples. All compounds were within the acceptable limits of ≤30% except anthracene (all three analyses), benzo[a]pyrene (one of three analyses), and benzo[g,h,i]perylene (one of three analyses).

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	PCBs
Laboratory	Battelle/Marine Sciences Laboratory Pacific Northwest Laboratory (Richland)
Matrix	<i>Nereis virens</i> Tissue
Holding Times	Tissue samples were obtained from bioaccumulation experiments August 13, 1992, arrived at the laboratory September 25, were extracted between September 29 and October 13, and analyzed between October 5 and October 17, 1992. The 30-day holding time prior to extraction was exceeded, but the 40-day holding time between extraction and analysis was not exceeded. Samples were frozen at -20°C until extracted.
Blanks	The requirement of 1 blank per 20 samples was met. Three blanks were run for 30 samples. PCBs were not detected above the target detection limit of 20 µg/kg.
Detection Limits	The detection limit goal of 20 µg/kg was met for all PCB compounds.
Surrogate Internal Standards	The requirement of one surrogate internal standard per sample was met. Two surrogate internal standards were evaluated: DBOFB and CL5(112). All surrogate recoveries were within the QA goals of 40% to 120%.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was met. Three matrix spike/matrix spike duplicates were analyzed for the 30 samples. All percent recoveries were within the 40% to 120% quality assurance requirement. The relative percent difference between matrix spike and matrix spike duplicates ranged from 1% to 19%, below the QA limit of ≤30%.
Replication	The requirement of 1 triplicate analysis per 10 samples was met. Three triplicate analyses were conducted on the 30 samples. The relative standard deviation requirement of ≤30% was met for all samples, although most were undetected.
SRMs	SRMs are not available.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Metals
Laboratory	Battelle/Marine Sciences Laboratory Pacific Northwest Laboratory (Richland)
Matrix	<i>Nereis virens</i> Tissue
Holding Times	Tissue samples were obtained from bioaccumulation experiments August 13, 1992, arrived at the laboratory September 25, were extracted between September 29 and October 13, and analyzed between October 5 and October 17, 1992. The 30-day holding time prior to extraction was exceeded for metals excluding mercury (6-month holding time). Samples were frozen at -20°C until extracted.
Blanks	The requirement of 1 blank per 20 samples was met. Four blanks were run for 30 samples. Metals were undetected in blanks with the exception of zinc, which was elevated in two of four blanks.
Detection Limits	Detection limit goals were met for Ag, As, Cu, Hg, Ni, Pb, and Zn. Elevated detection limits were observed for Cr, Cd, Se, and Tl.
Matrix Spike	The requirement of 1 matrix spike per 10 samples was not met. Two matrix spikes were analyzed for the 30 samples. Percent recoveries were higher than the QA limits of 75% to 125% for one spike, and within range for the other, with the exception of Zn.
Replication	The requirement of 1 triplicate analysis per 10 samples was met. Five triplicate analyses were conducted on the 30 samples. The relative standard deviation requirement of $\leq 20\%$ was exceeded in one series of replicates, but generally within range for the remaining three.
SRMs	The requirement of 1 SRM per 20 samples was met. Six SRMs were analyzed for the 30 samples. All but four comparisons were within 30% of the certified value.

QA/QC SUMMARY

Project	Wilmington Harbor
Parameter	Organotins
Laboratory	Battelle/Marine Sciences Laboratory
Matrix	Tissues of <i>Nereis virens</i>
Holding Times	Tissue samples were obtained from bioaccumulation experiments August 11, 1992, arrived at the laboratory September 25, were extracted between September 29 and October 13, and analyzed between October 5 and October 17, 1992. The 30-day holding time prior to extraction was exceeded, but the 40-day holding time between extraction and analysis was not exceeded. Samples were frozen at -20°C until extracted.
Blanks	The requirement of 1 blank per 20 samples was met. Two method blanks were run with the 24 samples. Tri-, Di-, and Monobutyltin compounds were undetected in all blanks at levels below the target detection limit of 10 µg/kg.
Detection Limits	The detection limit goals of 10 µg/kg were met in the blanks and all samples.
Surrogate Internal Standards	The requirement for one surrogate standard for each sample was met. All butyltin surrogates were within the 40% to 120% range required for all samples.
Matrix Spike/Matrix Spike Duplicate	The requirement of 1 matrix spike/matrix spike duplicate per 10 samples was met. Two matrix spike/matrix spike duplicates were analyzed for the 20 samples. The requirement of 40% to 120% recovery on spikes was met for all tributyltin measurements, and all but one dibutyltin measurements. Spike recoveries were less than 40% for all monobutyltin measurements. The requirement of ≤30% RPD between the matrix spike and matrix spike duplicate was met for all measurements except one monobutyltin sample (31%) and one tributyltin sample (35%).
Replication	The requirement of 1 triplicate analysis per 10 samples was met. Two triplicate samples were analyzed for 20 samples. The requirement of ≤30% relative percent difference was met for all measurements.
SRMs	Certified SRM not available.

TABLE L.1. Total Polynuclear Aromatic Hydrocarbons (PAHs), Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> PAHs ($\mu\text{g/kg}$ wet weight)		
				Total LPAHs	Total HPAHs	Total PAHs
BSCMA Replicate 1	1	2	14.286	23	4	28
BSCMA Replicate 2	1	2	13.967	18	12	30
BSCMA Replicate 3	1	2	13.891	20	8	27
BSCMA	2	2	14.302	11	2	13
BSCMA	3	1	14.005	9	2	11
BSCMA	4	3	13.661	6	1	7
BSCMA Replicate 1	5	3	15.420	14	2	16
BSCMA Replicate 2	5	3	15.420	13	2	14
BSCMA Replicate 3	5	3	15.420	16	2	18
KICMA	1	1	14.421	14	3	17
KICMA	2	2	13.827	9	4	13
KICMA	3	1	13.120	12	5	17
KICMA	4	1	14.890	16	5	21
KICMA	5	2	15.134	15	4	19
MOTMA	1	3	13.330	7	2	10
MOTMA	2	3	14.492	8	3	11
MOTMA	3	2	15.529	12	3	15
MOTMA	4	3	14.874	8	4	12
MOTMA	5	1	14.333	11	3	14
MOTNW	1	2	13.727	11	2	13
MOTNW	2	1	13.774	12	5	17
MOTNW	3	3	14.200	8	2	10
MOTNW	4	3	13.797	6	2	8
MOTNW Replicate 1	5	1	13.562	12	5	17
MOTNW Replicate 2	5	1	13.748	13	4	17
MOTNW Replicate 3	5	1	13.810	18	6	24
WREF	1	3	20.038	7	1	8
WREF	2	2	14.678	23	3	25
WREF	3	2	13.186	14	2	15
WREF	4	2	15.246	12	2	14
WREF	5	1	13.438	11	3	14
Muscongus Bay	1	3	13.733	7	4	10
Muscongus Bay	2	3	14.479	9	5	14
Muscongus Bay	3	1	13.476	11	3	14
Muscongus Bay	4	1	14.026	24	5	29
Muscongus Bay	5	2	13.118	34	7	41

TABLE L.2. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs), Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> LPAHs ($\mu\text{g/kg}$ wet weight)							
				Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Target DL (a)				30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Achieved DL				<30.0	<30.0	<30.0	<30.0	<30.0	<30.0	<30.0	<30.0
BSCMA Replicate 1	1	2	14.286	7.57	5.80	3.77	4.01 U (b)	1.15 J (c)	1.37 J	3.05	0.40 J
BSCMA Replicate 2	1	2	13.967	5.55	4.18	3.10	0.27 J	1.19 J	1.03 J	2.53	0.43 J
BSCMA Replicate 3	1	2	13.891	6.02	4.75	3.18	0.27 J	1.40 J	1.13 J	2.44	0.31 J
BSCMA	2	2	14.302	3.07	2.31	1.91	0.16 J	0.98	0.64 J	1.34	0.16 J
BSCMA	3	1	14.005	2.80	1.77	1.47	0.12 J	0.86	0.49 J	1.20	0.13 J
BSCMA	4	3	13.661	1.98	1.08	1.03	0.07 J	0.61 J	0.35 J	0.87	0.06 J
BSCMA Replicate 1	5	3	15.420	4.57	2.59	2.30	4.21 U	1.19 J	0.83 J	2.29	0.16 J
BSCMA Replicate 2	5	3	15.420	4.44	2.26	1.74 J	0.11 J	1.08 J	0.79 J	2.01	0.08 J
BSCMA Replicate 3	5	3	15.420	5.26	3.24	2.24	0.10 J	0.95 J	0.80 J	3.08	0.18 J
KICMA	1	1	14.421	4.50	3.07	2.20	0.15 J	0.82 J	0.69 J	1.89	0.20 J
KICMA	2	2	13.827	2.76	1.80	1.65	0.19 J	0.93	0.57 J	1.36	0.13 J
KICMA	3	1	13.120	3.53	2.59	1.96	0.20 J	1.01	0.68 J	1.63	0.24 J
KICMA	4	1	14.890	4.83	3.21	2.64	0.31 J	1.35	0.93	1.97	0.28 J
KICMA	5	2	15.134	4.93	3.32	2.89	0.27 J	1.09	0.77 J	1.80	0.21 J
MOTMA	1	3	13.330	2.43	1.18	1.12	0.14 J	0.80	0.45 J	1.18	0.08 J
MOTMA	2	3	14.492	2.36 J	1.65	1.44	0.15 J	0.93 J	0.54 J	0.80 J	0.17 J
MOTMA	3	2	15.529	3.22	2.48	2.05	0.18 J	1.03	0.69 J	1.64	0.23 J
MOTMA	4	3	14.874	2.05	1.12	1.15	0.15 J	1.14	0.70 J	1.56	0.13 J
MOTMA	5	1	14.333	3.53	2.28	1.86	0.16 J	0.94	0.61 J	1.54	0.17 J
MOTNW	1	2	13.727	3.12	2.31	1.82	0.19 J	0.90 J	0.65 J	1.50	0.16 J
MOTNW	2	1	13.774	3.55	2.46	1.90	0.21 J	1.17	0.74 J	1.72	0.26 J
MOTNW	3	3	14.200	2.59	1.07	1.01	0.10 J	0.87 J	0.48 J	1.42	0.09 J
MOTNW	4	3	13.797	1.85	0.91	1.01	0.13 J	0.95	0.41 J	0.98	0.05 J
MOTNW Replicate 1	5	1	13.562	4.25	1.92	1.50 J	0.28 J	1.10 J	0.73 J	2.29	0.29 J
MOTNW Replicate 2	5	1	13.748	4.87	2.11	1.63 J	0.12 J	0.99 J	0.60 J	2.40	0.18 J
MOTNW Replicate 3	5	1	13.810	5.54	4.39	2.99	0.20 J	1.04 J	1.16 J	2.54	0.36 J
WHREF	1	3	20.038	2.28	1.20	1.24	0.14 J	0.91 J	0.42 J	1.12	0.88 U
WHREF	2	2	14.678	7.55	5.62	4.28	0.21 J	1.08 J	1.09 J	2.60	0.19 J
WHREF	3	2	13.186	4.31	3.35	2.27	0.11 J	0.90 J	0.70 J	1.67	0.23 J
WHREF	4	2	15.246	3.89	3.03	2.30	0.14 J	0.80 J	0.57 J	1.59	0.14 J
WHREF	5	1	13.438	3.48	2.48	1.94	0.12 J	0.75 J	0.60 J	1.54	0.17 J

TABLE L.2. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> LPAHs ($\mu\text{g/kg}$ wet weight)							
				Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Muscongus Bay	1	3	13.733	1.58	0.86	0.94	0.20 J	0.93	0.60 J	1.26	0.17 J
Muscongus Bay	2	3	14.479	2.51	1.33	1.29	0.13 J	1.25	0.56 J	1.55	0.14 J
Muscongus Bay	3	1	13.476	3.36	2.23	1.70	0.17 J	0.85 J	0.54 J	1.49	0.16 J
Muscongus Bay	4	1	14.026	7.82	5.63	3.67	0.22 J	1.19 J	1.29 J	3.31	0.37 J
Muscongus Bay	5	2	13.118	10.94	8.79	5.96	7.98 U	1.15 J	1.81 J	4.60	0.43 J

(a) DL Detection limit.

(b) U Analyte was not present above the level of associated value.

(c) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

TABLE L.3. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs), Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

N. virens HPAHs (μg/kg wet weight)														
Sediment Treatment	Replicate	Batch	Percent Dry Weight	Fluoranthene	Benzo[a]anthracene		Benzo[b]fluoranthene		Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-c,d]pyrene	Dibenzo[a,h]anthracene		Benzo[g,h,i]perylene
					Pyrene	cene	Chrysene	anthene				anthene	cene	
get DL (a)				30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Achieved DL				<30.0	<30.0	<30.0	<30.0	<30.0	<30.0	<30.0	<30.0	<30.0	<30.0	<30.0
BSCMA Replicate 1	1	2	14.286	1.67 J ^(b)	1.06 J	0.45 J	0.72 J	0.33 J	0.16 J	2.63 U ^(c)	3.16 U	2.15 U	4.28 U	4.28 U
BSCMA Replicate 2	1	2	13.967	2.13	1.62 J	1.20 J	1.44 J	1.15 J	0.78 J	0.73 J	0.79 J	0.57 J	1.11 J	1.11 J
BSCMA Replicate 3	1	2	13.891	1.49	1.20 J	0.79 J	1.11 J	0.58 J	0.58 J	0.36 J	0.52 J	0.26 J	0.61 J	0.61 J
BSCMA	2	2	14.302	0.81	0.57 J	0.16 J	0.26 J	0.12 J	0.04 J	0.87 U	1.04 U	0.71 U	1.41 U	1.41 U
BSCMA	3	1	14.005	0.58 J	0.41 J	0.15 J	0.18 J	0.10 J	0.05 J	0.54 J	1.10 U	0.75 U	1.49 U	1.49 U
BSCMA	4	3	13.661	0.59 J	0.33 J	1.23 U	0.17 J	0.10 J	0.07 J	1.09 U	1.31 U	0.89 U	1.78 U	1.78 U
BSCMA Replicate 1	5	3	15.42	0.88 J	0.56 J	3.11 U	0.24 J	0.16 J	0.11 J	2.76 U	3.32 U	2.26 U	4.50 U	4.50 U
BSCMA Replicate 2	5	3	15.42	0.79 J	0.42 J	3.16 U	0.22 J	0.13 J	0.09 J	2.81 U	3.37 U	2.29 U	4.57 U	4.57 U
BSCMA Replicate 3	5	3	15.42	0.85 J	0.54 J	0.13 J	0.31 J	0.18 J	0.12 J	2.67 U	3.21 U	2.19 U	4.36 U	4.36 U
KICMA	1	1	14.421	1.01 J	0.90 J	0.28 J	0.36 J	0.21 J	0.06 J	0.52 J	1.94 U	1.32 U	2.63 U	2.63 U
KICMA	2	2	13.827	1.30	1.11	0.25 J	0.46 J	0.19 J	0.14 J	1.01 U	1.22 U	0.83 U	0.13 J	0.13 J
KICMA	3	1	13.12	1.31	1.33	0.43 J	0.58 J	0.29 J	0.25 J	0.82 J	1.27 U	0.86 U	1.72 U	1.72 U
KICMA	4	1	14.89	1.79	1.44	0.40 J	0.66 J	0.26 J	0.22 J	0.64 J	1.05 U	0.71 U	1.42 U	1.42 U
KICMA	5	2	15.134	1.27	1.23	0.29 J	0.49 J	0.22 J	0.19 J	0.12 J	0.16 J	0.80 U	0.14 J	0.14 J
MOTMA	1	3	13.33	1.05	0.77 J	0.05 J	0.29 J	0.08 J	0.05 J	0.97 U	1.16 U	0.79 U	1.57 U	1.57 U
MOTMA	2	3	14.492	1.13 J	0.90 J	0.16 J	0.44 J	0.23 J	0.19 J	0.11 J	2.21 U	1.50 U	2.99 U	2.99 U
MOTMA	3	2	15.529	1.25	0.91	0.18 J	0.38 J	0.18 J	0.13 J	0.05 J	0.09 J	0.72 U	0.13 J	0.13 J
MOTMA	4	3	14.874	1.66	1.33	0.14 J	0.44 J	0.19 J	0.13 J	0.05 J	0.99 U	0.67 U	0.10 J	0.10 J
MOTMA	5	1	14.333	1.14	0.83 J	0.21 J	0.34 J	0.14 J	0.06 J	0.52 J	1.34 U	0.91 U	1.82 U	1.82 U
MOTNW	1	2	13.727	0.92	0.74 J	0.08 J	0.26 J	0.13 J	0.08 J	1.10 U	1.32 U	0.90 U	1.78 U	1.78 U
MOTNW	2	1	13.774	1.84	1.67	0.26 J	0.58 J	0.24 J	0.13 J	0.67 J	1.04 U	0.71 U	1.42 U	1.42 U
MOTNW	3	3	14.2	1.08	0.64 J	1.39 U	0.28 J	0.18 J	0.12 J	1.24 U	1.49 U	1.01 U	0.11 J	0.11 J
MOTNW	4	3	13.797	0.86	0.60 J	0.98 U	0.22 J	0.05 J	0.05 J	0.87 U	1.04 U	0.71 U	1.42 U	1.42 U
MOTNW Replicate 1	5	1	13.562	1.54 J	1.20 J	0.49 J	0.58 J	0.31 J	0.17 J	0.63 J	3.15 U	2.14 U	4.27 U	4.27 U
MOTNW Replicate 2	5	1	13.748	1.52 J	1.13 J	0.37 J	0.39 J	0.24 J	0.13 J	0.41 J	2.81 U	1.91 U	3.81 U	3.81 U
MOTNW Replicate 3	5	1	13.81	1.68	1.44 J	0.58 J	0.70 J	0.38 J	0.25 J	0.67 J	2.55 U	1.73 U	3.46 U	3.46 U
WHREF	1	3	20.038	0.59 J	0.30 J	1.47 U	0.14 J	1.50 U	1.25 U	1.30 U	1.57 U	1.07 U	2.12 U	2.12 U
WHREF	2	2	14.678	0.88 J	0.89 J	0.18 J	0.36 J	0.28 J	0.13 J	2.24 U	2.70 U	1.83 U	3.66 U	3.66 U
WHREF	3	2	13.186	0.72 J	0.45 J	0.10 J	0.20 J	0.15 J	0.10 J	1.74 U	2.09 U	1.42 U	2.83 U	2.83 U
WHREF	4	2	15.246	0.68 J	0.48 J	0.20 J	0.23 J	0.18 J	0.06 J	1.64 U	1.97 U	1.34 U	2.67 U	2.67 U
WHREF	5	1	13.438	0.78	0.51 J	0.20 J	0.32 J	0.16 J	0.10 J	0.54 J	1.13 U	0.77 U	1.53 U	1.53 U

TABLE L.3. (contd)

		<i>N. virens</i> HPAHs ($\mu\text{g/kg}$ wet weight)														
Sediment Treatment	Replicate	Batch	Percent Dry Weight	Benzo[a] anthra- cene		Benzo[b] fluor- anthene		Benzo[k] fluor- anthene		Benzo[a] pyrene		Indeno- [1,2,3- c,d]- pyrene		Dibenzo- [a,h]- anthra- cene		Benzo- [g,h,i]- perylene
				Pyrene	Fluor- anthene	Chrysene	anthene	anthene	pyrene	pyrene	anthene	anthene	pyrene	pyrene	anthene	
Muscongus Bay	1	3	13.733	1.24	0.77	0.11 J	0.49 J	0.18 J	0.15 J	0.09 J	1.01 U	0.69 U	0.59 J			
Muscongus Bay	2	3	14.479	1.65	1.14 J	0.35 J	0.68 J	0.43 J	0.37 J	0.24 J	1.76 U	1.20 U	2.39 U			
Muscongus Bay	3	1	13.476	1.03	0.71 J	0.18 J	0.40 J	0.17 J	0.10 J	0.58 J	1.38 U	0.94 U	1.88 U			
Muscongus Bay	4	1	14.026	1.61 J	1.28 J	0.50 J	0.72 J	0.45 J	0.19 J	0.74 J	3.15 U	2.15 U	4.28 U			
Muscongus Bay	5	2	13.118	1.79 J	1.67 J	0.78 J	0.78 J	0.69 J	0.36 J	5.23 U	6.29 U	4.28 U	0.82 J			

(a) DL Detection limit.

(b) J analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the level of associated value.

TABLE L.4. Total Polynuclear Aromatic Hydrocarbons (PAHs), Dry Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> PAHs ($\mu\text{g/kg}$ dry weight)		
				Total LPAHs	Total HPAHs	Total PAHs
BSCMA Replicate 1	1	2	14.286	162	31	192
BSCMA Replicate 2	1	2	13.967	131	82	213
BSCMA Replicate 3	1	2	13.891	140	54	194
BSCMA	2	2	14.302	74	14	88
BSCMA	3	1	14.005	63	14	77
BSCMA	4	3	12.661	44	9	54
BSCMA Replicate 1	5	3	15.420	90	13	103
BSCMA Replicate 2	5	3	15.420	81	11	92
BSCMA Replicate 3	5	3	15.420	103	14	117
KICMA	1	1	14.421	94	23	117
KICMA	2	2	13.827	68	26	94
KICMA	3	1	13.120	90	38	128
KICMA	4	1	14.890	104	36	141
KICMA	5	2	15.134	101	27	128
MOTMA	1	3	13.330	55	17	73
MOTMA	2	3	14.492	55	22	77
MOTMA	3	2	15.529	74	21	95
MOTMA	4	3	14.874	54	27	81
MOTMA	5	1	14.333	77	23	100
MOTNW	1	2	13.727	78	16	94
MOTNW	2	1	13.774	87	39	126
MOTNW	3	3	14.200	54	17	71
MOTNW	4	3	13.797	46	13	58
MOTNW Replicate 1	5	1	13.562	91	36	127
MOTNW Replicate 2	5	1	13.748	94	30	124
MOTNW Replicate 3	5	1	13.810	132	41	173
WHREF	1	3	20.038	36	5	42
WHREF	2	2	14.678	154	19	173
WHREF	3	2	13.186	103	13	116
WHREF	4	2	15.246	82	12	94
WHREF	5	1	13.438	82	19	102
Muscongus Bay	1	3	13.733	48	26	74
Muscongus Bay	2	3	14.479	61	34	94
Muscongus Bay	3	1	13.476	78	24	101
Muscongus Bay	4	1	14.026	168	39	207
Muscongus Bay	5	2	13.118	257	53	309

TABLE L.5. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs), Dry Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> LPAHs ($\mu\text{g/kg}$ dry weight)									
				Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene		
BSCMA Replicate 1	1	2	14.29	52.99	40.60	26.39	28.07 U(a)	8.05 J(b)	9.59 J	21.35	2.80 J		
BSCMA Replicate 2	1	2	13.97	39.74	29.93	22.20	1.93 J	8.52 J	7.37 J	18.11	3.08 J		
BSCMA Replicate 3	1	2	13.89	43.34	34.19	22.89	1.94 J	10.08 J	8.13 J	17.57	2.23 J		
BSCMA	2	2	14.30	21.47	16.15	13.35	1.12 J	6.85	4.47 J	9.37	1.12 J		
BSCMA	3	1	14.00	19.99	12.64	10.50	0.86 J	6.14	3.50 J	8.57	0.93 J		
BSCMA	4	3	13.66	14.49	7.91	7.54	0.51 J	4.47 J	2.56 J	6.37	0.44 J		
BSCMA Replicate 1	5	3	15.42	29.64	16.80	14.92	27.30 U	7.72 J	5.38 J	14.85	1.04 J		
BSCMA Replicate 2	5	3	15.42	28.79	14.66	11.28 J	0.71 J	7.00 J	5.12 J	13.04	0.52 J		
BSCMA Replicate 3	5	3	15.42	34.11	21.01	14.53	0.65 J	6.16 J	5.19 J	19.97	1.17 J		
KICMA	1	1	14.42	31.20	21.29	15.26	1.04 J	5.69 J	4.78 J	13.11	1.39 J		
KICMA	2	2	13.83	19.96	13.02	11.93	1.37 J	6.73	4.12 J	9.84	0.94 J		
KICMA	3	1	13.12	26.91	19.74	14.94	1.52 J	7.70	5.18 J	12.42	1.83 J		
KICMA	4	1	14.89	32.44	21.56	17.73	2.08 J	9.07	6.25	13.23	1.88 J		
KICMA	5	2	15.13	32.58	21.94	19.10	1.78 J	7.20	5.09 J	11.89	1.39 J		
MOTMA	1	3	13.33	18.23	8.85	8.40	1.05 J	6.00	3.38 J	8.85	0.60 J		
MOTMA	2	3	14.49	16.28 J	11.39	9.94	1.04 J	6.42 J	3.73 J	5.52 J	1.17 J		
MOTMA	3	2	15.53	20.74	15.97	13.20	1.16 J	6.63	4.44 J	10.56	1.48 J		
MOTMA	4	3	14.87	13.78	7.53	7.73	1.01 J	7.66	4.71 J	10.49	0.87 J		
MOTMA	5	1	14.33	24.63	15.91	12.98	1.12 J	6.56	4.26 J	10.74	1.19 J		
MOTNW	1	2	13.73	22.73	16.83	13.26	1.38 J	6.56 J	4.74 J	10.93	1.17 J		
MOTNW	2	1	13.77	25.77	17.86	13.79	1.52 J	8.49	5.37 J	12.49	1.89 J		
MOTNW	3	3	14.20	18.24	7.54	7.11	0.70 J	6.13 J	3.38 J	10.00	0.63 J		
MOTNW	4	3	13.80	13.41	6.60	7.32	0.94 J	6.89	2.97 J	7.10	0.36 J		
MOTNW Replicate 1	5	1	13.56	31.34	14.16	11.06 J	2.06 J	8.11 J	5.38 J	16.89	2.14 J		
MOTNW Replicate 2	5	1	13.75	35.42	15.35	11.86 J	0.87 J	7.20 J	4.36 J	17.46	1.31 J		
MOTNW Replicate 3	5	1	13.81	40.12	31.79	21.65	1.45 J	7.53 J	8.40 J	18.39	2.61 J		
WHREF	1	3	20.04	11.38	5.99	6.19	0.70 J	4.54 J	2.10 J	5.59	4.39 U		
WHREF	2	2	14.68	51.44	38.29	29.16	1.43 J	7.36 J	7.43 J	17.71	1.29 J		
WHREF	3	2	13.19	32.69	25.41	17.22	0.83 J	6.83 J	5.31 J	12.66	1.74 J		
WHREF	4	2	15.25	25.51	19.87	15.09	0.92 J	5.25 J	3.74 J	10.43	0.92 J		
WHREF	5	1	13.44	25.90	18.46	14.44	0.89 J	5.58 J	4.46 J	11.46	1.27 J		

TABLE L.5. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> LPAHs ($\mu\text{g}/\text{kg}$ dry weight)							
				Naph- thalene	2-methyl- naph- thalene	1-methyl- naph- thalene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthracene
Muscongus Bay	1	3	13.73	11.51	6.26	6.84	1.46 J	6.77	4.37 J	9.17	1.24 J
Muscongus Bay	2	3	14.48	17.34	9.19	8.91	0.90 J	8.63	3.87 J	10.71	0.97 J
Muscongus Bay	3	1	13.48	24.93	16.55	12.62	1.26 J	6.31 J	4.01 J	11.06	1.19 J
Muscongus Bay	4	1	14.03	55.75	40.14	26.17	1.57 J	8.48 J	9.20 J	23.60	2.64 J
Muscongus Bay	5	2	13.12	83.40	67.01	45.43	60.83 U	8.77 J	13.80 J	35.07	3.28 J

(a) U Analyte was not present above the level of associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit.

TABLE L.6. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs), Dry Weight, in Tissue of *N. virens*, Wilmington Harbor Project

N. virens HPAHs (μg/kg dry weight)																		
Sediment Treatment	Replicate	Batch	Percent Dry Weight	Fluor- anthene	Benzo(a) anthra- cene			Benzo[b] fluor- anthene		Benzo[k]- fluor- anthene		Benzo[a]- pyrene		Indeno- [1,2,3- c,d]- pyrene		Dibenzo- [a,h]- anthra- cene		Benzo- [g,h,i]- perylene
					Pyrene	Benzo(a) anthra- cene	Chrysene	Benzo[b] fluor- anthene	Benzo[k]- fluor- anthene	Benzo[a]- pyrene	Benzo[a]- pyrene	Indeno- [1,2,3- c,d]- pyrene	Dibenzo- [a,h]- anthra- cene					
BSCMA Replicate 1 BSCMA Replicate 2 BSCMA Replicate 3 BSCMA BSCMA BSCMA BSCMA BSCMA Replicate 1 BSCMA Replicate 2 BSCMA Replicate 3	1	2	14.29	11.69 J ^(a)	7.42 J	3.15 J	5.04 J	2.31 J	1.12 J	18.41 U ^(b)	22.12 U	15.05 U	29.96 U	23.96 U	7.95 J	4.08 J	4.39 J	
	1	2	13.97	15.25	11.60 J	8.59 J	10.31 J	8.23 J	5.58 J	5.23 J	5.66 J	4.08 J	4.39 J	9.86 U	10.64 U	13.03 U	29.18 U	
	1	2	13.89	10.73	8.64 J	5.69 J	7.99 J	4.18 J	4.18 J	2.59 J	3.74 J	1.87 J	4.39 J	9.86 U	10.64 U	13.03 U	29.18 U	
	2	2	14.30	5.66	3.99 J	1.12 J	1.82 J	0.84 J	0.28 J	6.08 U	7.27 U	4.96 U	9.86 U	10.64 U	13.03 U	29.18 U	29.64 U	
	3	1	14.00	4.14 J	2.93 J	1.07 J	1.29 J	0.71 J	0.36 J	3.86 J	7.85 U	5.36 U	10.64 U	13.03 U	29.18 U	29.64 U	28.27 U	
	4	3	13.66	4.32 J	2.42 J	9.00 U	1.24 J	0.73 J	0.51 J	7.98 U	9.59 U	6.51 U	13.03 U	29.18 U	29.64 U	28.27 U	18.24 U	
	5	3	15.42	5.71 J	3.63 J	20.17 U	1.56 J	1.04 J	0.71 J	17.90 U	21.53 U	14.66 U	29.18 U	29.64 U	28.27 U	18.24 U	0.94 J	
	5	3	15.42	5.12 J	2.72 J	20.49 U	1.43 J	0.84 J	0.58 J	18.22 U	21.85 U	14.85 U	29.64 U	28.27 U	18.24 U	0.94 J	13.11 U	
	5	3	15.42	5.51 J	3.50 J	9.84 J	2.01 J	1.17 J	0.78 J	17.32 U	20.82 U	14.20 U	29.64 U	28.27 U	18.24 U	0.94 J	9.54 U	
KICMA KICMA KICMA KICMA KICMA	1	1	14.42	7.00 J	6.24 J	1.94 J	2.50 J	1.46 J	0.42 J	3.61 J	13.45 U	9.15 U	18.24 U	18.24 U	0.94 J	6.00 U	13.11 U	
	2	2	13.83	9.40	8.03	1.81 J	3.33 J	1.37 J	1.01 J	7.30 U	8.82 U	6.00 U	13.11 U	18.24 U	0.94 J	6.00 U	13.11 U	
	3	1	13.12	9.98	10.14	3.28 J	4.42 J	2.21 J	1.91 J	6.25 J	9.68 U	6.55 U	13.11 U	18.24 U	0.94 J	6.00 U	13.11 U	
	4	1	14.89	12.02	9.67	2.69 J	4.43 J	1.75 J	1.48 J	4.30 J	7.05 U	4.77 U	9.54 U	18.24 U	0.94 J	6.00 U	13.11 U	
	5	2	15.13	8.39	8.13	1.92 J	3.24 J	1.45 J	1.26 J	0.79 J	1.06 J	5.29 U	0.93 J	18.24 U	0.94 J	6.00 U	13.11 U	
MOTMA MOTMA MOTMA MOTMA MOTMA	1	3	13.33	7.88	5.78 J	0.38 J	2.18 J	0.60 J	0.38 J	7.28 U	8.70 U	5.93 U	11.78 U	11.78 U	0.94 J	6.00 U	13.11 U	
	2	3	14.49	7.80 J	6.21 J	1.10 J	3.04 J	1.59 J	1.31 J	0.76 J	15.25 U	10.35 U	20.63 U	11.78 U	0.94 J	6.00 U	13.11 U	
	3	2	15.53	8.05	5.86	1.16 J	2.45 J	1.16 J	0.84 J	0.32 J	0.58 J	4.64 U	0.84 J	11.78 U	0.94 J	6.00 U	13.11 U	
	4	3	14.87	11.16	8.94	0.94 J	2.96 J	1.28 J	0.87 J	0.34 J	6.66 U	4.50 U	0.67 J	11.78 U	0.94 J	6.00 U	13.11 U	
	5	1	14.33	7.95	5.79 J	1.47 J	2.37 J	0.98 J	0.42 J	3.63 J	9.35 U	6.35 U	12.70 U	11.78 U	0.94 J	6.00 U	13.11 U	
MOTNW MOTNW MOTNW MOTNW MOTNW	1	2	13.73	6.70	5.39 J	0.58 J	1.89 J	0.95 J	0.58 J	8.01 U	9.62 U	6.56 U	12.97 U	12.97 U	0.94 J	6.00 U	13.11 U	
	2	1	13.77	13.36	12.12	1.89 J	4.21 J	1.74 J	0.94 J	4.86 J	7.55 U	5.15 U	10.31 U	12.97 U	0.94 J	6.00 U	13.11 U	
	3	3	14.20	7.61	4.51 J	9.79 U	1.97 J	1.27 J	0.85 J	8.73 U	10.49 U	7.11 U	0.77 J	12.97 U	0.94 J	6.00 U	13.11 U	
	4	3	13.80	6.23	4.35 J	7.10 U	1.59 J	0.36 J	0.36 J	6.31 U	7.54 U	5.15 U	10.29 U	12.97 U	0.94 J	6.00 U	13.11 U	
	5	1	13.56	11.36 J	8.85 J	3.61 J	4.28 J	2.29 J	1.25 J	4.65 J	23.23 U	15.78 U	31.49 U	12.97 U	0.94 J	6.00 U	13.11 U	
MOTNW Replicate 1 MOTNW Replicate 2 MOTNW Replicate 3	5	1	13.75	11.06 J	8.22 J	2.69 J	2.84 J	1.75 J	0.95 J	2.98 J	20.44 U	13.89 U	27.71 U	27.71 U	0.94 J	6.00 U	13.11 U	
	5	1	13.81	12.17	10.43 J	4.20 J	5.07 J	2.75 J	1.81 J	4.85 J	18.46 U	12.53 U	25.05 U	25.05 U	0.94 J	6.00 U	13.11 U	
	5	1	13.81	12.17	10.43 J	4.20 J	5.07 J	2.75 J	1.81 J	4.85 J	18.46 U	12.53 U	25.05 U	25.05 U	0.94 J	6.00 U	13.11 U	
WHREF WHREF WHREF WHREF WHREF	1	3	20.04	2.94 J	1.50 J	7.34 U	0.70 J	7.49 U	6.24 U	6.49 U	7.84 U	5.34 U	10.58 U	10.58 U	0.94 J	6.00 U	13.11 U	
	2	2	14.68	6.00 J	6.06 J	1.23 J	2.45 J	1.91 J	0.89 J	15.26 U	18.39 U	12.47 U	24.94 U	24.94 U	0.94 J	6.00 U	13.11 U	
	3	2	13.19	5.46 J	3.41 J	0.76 J	1.52 J	1.14 J	0.76 J	13.20 U	15.85 U	10.77 U	21.46 U	21.46 U	0.94 J	6.00 U	13.11 U	
	4	2	15.25	4.46 J	3.15 J	1.31 J	1.51 J	1.18 J	0.39 J	10.76 U	12.92 U	8.79 U	17.51 U	17.51 U	0.94 J	6.00 U	13.11 U	
	5	1	13.44	5.80	3.80 J	1.49 J	2.38 J	1.19 J	0.74 J	4.02 J	8.41 U	5.73 U	11.39 U	11.39 U	0.94 J	6.00 U	13.11 U	

TABLE L.6. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. viridis</i> HPAHs ($\mu\text{g/kg}$ dry weight)									
				Pyrene	Benzo(a) anthra- cene	Chrysene	anthracene	fluor- anthene	Benzo[k]- fluor- anthene	Benzo[a]- pyrene	Indeno- [1,2,3- c,d]- pyrene	Dibenzo- [a,h]- anthra- cene	Benzo- [g,h,i]- perylene
Muscongus Bay	1	3	13.73	5.61	0.80 J	3.57 J	1.31 J	1.09 J	0.66 J	0.66 J	7.35 U	5.02 U	4.30 J
Muscongus Bay	2	3	14.48	7.87 J	2.42 J	4.70 J	2.97 J	2.56 J	1.66 J	1.66 J	12.16 U	8.29 U	16.51 U
Muscongus Bay	3	1	13.48	5.27 J	1.34 J	2.97 J	1.26 J	0.74 J	4.30 J	4.30 J	10.24 U	6.98 U	13.95 U
Muscongus Bay	4	1	14.03	9.13 J	3.56 J	5.13 J	3.21 J	1.35 J	5.28 J	5.28 J	22.46 U	15.33 U	30.51 U
Muscongus Bay	5	2	13.12	12.73 J	5.95 J	5.95 J	5.26 J	2.74 J	39.87 U	39.87 U	47.95 U	32.63 U	6.25 J

(a) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of associated value.

TABLE L.7. Quality Control Summary for Low Polynuclear Aromatic Hydrocarbons (LPAHs), Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	<i>N. virens</i> LPAHs (μg/kg wet weight)							
			Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Method Blank										
Blank		1	1.59 J(a)	0.67 J	0.43 J	1.94 U(b)	1.05 U	0.14 J	0.61 J	0.06 J
Blank		2	1.25 J	0.65 J	0.35 J	2.21 U	1.20 U	1.29 U	0.61 J	0.98 U
Blank		3	1.33	0.38 J	0.28 J	1.95 U	1.05 U	1.14 U	0.52 J	0.86 U
Matrix Spike										
Muscongus Bay	4	1	7.82	5.63(c)	3.67	0.22 J	1.19 J	1.29 J	3.31	0.37 J
Muscongus Bay MS	4	1	133.02	ND(d)	ND	135.96	133.55	132.57	137.03	132.17
Concentration Recovered			125.20	NA(e)	NA	135.74	132.36	131.28	133.72	131.80
Amount Spiked			138.12	NS(e)	NS	138.12	138.12	138.12	138.12	138.12
Percent Recovery			91%	NA	NA	98%	96%	95%	97%	95%
Muscongus Bay	4	1	7.82	5.63	3.67	0.22 J	1.19 J	1.29 J	3.31	0.37 J
Muscongus Bay MSD	4	1	128.30	ND	ND	136.66	130.80	131.33	135.33	132.62
Concentration Recovered			120.48	NA	NA	136.44	129.61	130.04	132.02	132.25
Amount Spiked			135.67	NS	NS	135.67	135.67	135.67	135.67	135.67
Percent Recovery			89%	NA	NA	101%	96%	96%	97%	97%
RPD			2%	NA	NA	2%	0%	1%	1%	2%
I-Stat			0.01	NA	NA	0.01	0.00	0.00	0.00	0.01
Muscongus Bay	5	2	10.94	8.79	5.96	7.98 U	1.15 J	1.81 J	4.60	0.43 J
Muscongus Bay MS	5	2	450.30	ND	ND	497.56	448.22	441.65	458.09	447.23
Concentration Recovered			439.36	NA	NA	497.56	447.07	439.84	453.49	446.80
Amount Spiked			449.37	NS	NS	449.37	449.37	449.37	449.37	449.37
Percent Recovery			98%	NA	NA	111%	99%	98%	101%	99%
Muscongus Bay	5	2	10.94	8.79	5.96	7.98 U	1.15 J	1.81 J	4.60	0.43 J
Muscongus Bay MSD	5	2	276.10	ND	ND	313.76	277.06	272.31	294.85	278.77
Concentration Recovered			265.16	NA	NA	313.76	275.91	270.50	290.25	278.34
Amount Spiked			275.53	NS	NS	275.53	275.53	275.53	275.53	275.53
Percent Recovery			96%	NA	NA	114%	100%	98%	105%	101%
RPD			2%	NA	NA	3%	1%	0%	4%	2%
I-Stat			0.01	NA	NA	0.01	0.00	0.00	0.02	0.01

TABLE L.7. (contd)

<i>N. virens</i> LPAHs ($\mu\text{g/kg}$ wet weight)										
Sediment Treatment	Replicate	Batch	Naph- thalene	2-methyl- naph- thalene	1-methyl- naph- thalene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
MOTNW	3	3	2.59	1.07	1.01	0.10 J	0.87 J	0.48 J	1.42	0.09 J
MOTNW MS	3	3	72.56	ND	ND	81.50	74.38	73.63	78.00	75.09
Concentration Recovered			69.97	NA	NA	81.40	73.51	73.15	76.58	75.00
Amount Spiked			72.46	NS	NS	72.46	72.46	72.46	72.46	72.46
Percent Recovery			97%	NA	NA	112%	101%	101%	106%	104%
MOTNW	3	3	2.59	1.07	1.01	0.10 J	0.87 J	0.48 J	1.42	0.09 J
MOTNW MSD	3	3	97.26	ND	ND	116.62	98.18	96.93	101.89	97.26
Concentration Recovered			94.67	NA	NA	116.52	97.31	96.45	100.47	97.17
Amount Spiked			96.42	NS	NS	96.42	96.42	96.42	96.42	96.42
Percent Recovery			98%	NA	NA	121%(f)	101%	100%	104%	101%
RPD			2%	NA	NA	8%	1%	1%	1%	3%
I-Stat			0.01	NA	NA	0.04	0.00	0.00	0.01	0.01
Standard Reference Material										
Certified Value			NC(g)	NC	NC	NC	NC	NC	5.6 ±1.4	0.75 ±0.21
SRM 1974	1	1	NA	NA	NA	NA	NA	NA	6.05	1.59(h)
SRM 1974	2	2	NA	NA	NA	NA	NA	NA	5.75	1.56(h)
SRM 1974	3	3	NA	NA	NA	NA	NA	NA	4.62	1.66(h)
Analytical Triplicates										
MOTNW Replicate 1	5	1	4.25	1.92	1.50 J	0.28 J	1.10 J	0.73 J	2.29	0.29 J
MOTNW Replicate 2	5	1	4.87	2.11	1.63 J	0.12 J	0.99 J	0.60 J	2.40	0.18 J
MOTNW Replicate 3	5	1	5.54	4.39 (i)	2.99 (i)	0.20 J	1.04 J	1.16 J	2.54	0.36 J
RSD			13%	49% (i)	40% (i)	40% (i)	5%	35% (i)	5%	33% (i)
BSCMA Replicate 1	1	2	7.57	5.80	3.77	4.01 U	1.15 J	1.37 J	3.05	0.40 J
BSCMA Replicate 2	1	2	5.55	4.18	3.10	0.27 J	1.19 J	1.03 J	2.53	0.43 J
BSCMA Replicate 3	1	2	6.02	4.75	3.18	0.27 J	1.40 J	1.13 J	2.44	0.31 J
RSD			17%	17%	11%	NA	11%	15%	12%	16%

TABLE L.7. (contd)

Sediment Treatment	Replicate	Batch	<i>N. virens</i> LPAHs ($\mu\text{g}/\text{kg}$ wet weight)							
			Naph- thalene	2-methyl- naph- thalene	1-methyl- naph- thalene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
BSCMA Replicate 1	5	3	4.57	2.59	2.30	4.21 U	1.19 J	0.83 J	2.29	0.16 J
BSCMA Replicate 2	5	3	4.44	2.26	1.74 J	0.11 J	1.08 J	0.79 J	2.01	0.08 J
BSCMA Replicate 3	5	3	5.26	3.24	2.24	0.10 J	0.95 J	0.80 J	3.08	0.18 J
RSD			9%	18%	15%	NA	11%	3%	23%	38% ⁽¹⁾

(a) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of associated value.

(c) ND No data.

(d) NA Not applicable.

(e) NS Not spiked.

(f) Value exceeds quality control range (40%-120%).

(g) NC Not certified.

(h) Value exceeds SRM range $\leq 30\%$ certified value.

(i) Value exceeds relative precision range of $\leq 30\%$.

TABLE L.8. Quality Control Summary for High Polynuclear Aromatic Hydrocarbons (HPAHs), Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

N. virens HPAHs (µg/kg wet weight)												
Sediment Treatment	Replicate	Batch	Fluor-anthene		Benzo[a]anthracene		Chrysene	Benzo[b]fluor-anthene		Benzo[k]fluor-anthene	Benzo[a,h,i]perylene	Dibenzo[a,h]anthracene
			Pyrene									
Method Blank												
Blank	1		0.19 J(a)	0.37 J	0.16 J	0.07 J	1.46 U(b)	1.22 U	1.27 U	1.53 U	1.04 U	2.07 U
Blank	2		0.12 J	0.13 J	1.64 U	1.15 U	1.67 U	1.39 U	1.45 U	1.74 U	1.19 U	2.36 U
Blank	3		0.15 J	0.33 J	1.44 U	1.01 U	1.47 U	1.23 U	1.28 U	1.53 U	1.04 U	0.12 J
Matrix Spike												
Muscongus Bay	4		1.61 J	1.28 J	0.50 J	0.72 J	0.45 J	0.19 J	0.74 J	3.15 U	2.15 U	4.28 U
Muscongus Bay MS	4		136.37	134.38	136.02	135.12	136.90	132.61	143.40	180.63	153.88	118.29
Concentration Recovered			134.76	133.10	135.52	134.40	136.45	132.42	142.66	180.63	153.88	118.29
Amount Spiked			138.12	138.12	138.12	138.12	138.12	138.12	138.12	138.12	138.12	138.12
Percent Recovery			98%	96%	98%	97%	99%	96%	103%	131% (c)	111%	88%
Muscongus Bay	4		1.61 J	1.28 J	0.50 J	0.72 J	0.45 J	0.19 J	0.74 J	3.15 U	2.15 U	4.28 U
Muscongus Bay MSD	4		137.33	125.92	140.96	138.85	147.27	134.07	144.40	173.76	147.33	115.94
Concentration Recovered			135.72	134.64	140.46	138.13	146.82	133.88	143.66	173.76	147.33	115.94
Amount Spiked			135.67	135.67	135.67	135.67	135.67	135.67	135.67	135.67	135.67	135.67
Percent Recovery			100%	99%	104%	102%	108%	99%	106%	128% (c)	109%	85%
RPD			2%	3%	5%	5%	9%	3%	2%	2%	3%	0%
I-Stat			0.01	0.01	0.03	0.02	0.05	0.01	0.01	0.01	0.01	0.00
Muscongus Bay	5		1.79 J	1.67 J	0.78 J	0.78 J	0.69 J	0.36 J	5.23 U	6.29 U	4.28 U	0.82 J
Muscongus Bay MS	5		466.75	460.35	457.31	466.16	447.46	460.77	462.38	448.41	451.13	424.46
Concentration Recovered			464.96	458.68	456.53	465.38	446.77	460.41	462.38	448.41	451.13	115.94
Amount Spiked			449.37	449.37	449.37	449.37	449.37	449.37	449.37	449.37	449.37	449.37
Percent Recovery			103%	102%	102%	104%	99%	102%	103%	100%	100%	26% (c)
Muscongus Bay	5		1.79 J	1.67 J	0.78 J	0.78 J	0.69 J	0.36 J	5.23 U	6.29 U	4.28 U	0.82 J
Muscongus Bay MSD	5		291.01	287.43	287.89	283.97	283.31	291.08	289.26	285.31	285.62	261.69
Concentration Recovered			289.22	285.76	287.11	283.19	282.62	290.72	289.26	285.31	285.62	115.94
Amount Spiked			275.53	275.53	275.53	275.53	275.53	275.53	275.53	275.53	275.53	275.53
Percent Recovery			105%	104%	104%	103%	103%	106%	105%	104%	104%	42%
RPD			1%	2%	3%	1%	3%	3%	2%	4%	3%	48% (d)
I-Stat			0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.02	0.02	0.24

TABLE L.8. (contd)

N. viridis HPAHs ($\mu\text{g/kg}$ wet weight)												
Sediment Treatment	Replicate	Batch	Fluor-anthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-c,d]pyrene	Dibenzo[a,h]anthracene	Benzo[g,h,i]perylene
MOTNW	3	3	1.08	0.64 J	1.39 U	0.28 J	0.18 J	0.12 J	1.24 U	1.49 U	1.01 U	0.11 J
MOTNW MS	3	3	79.02	77.92	76.91	75.11	69.10	71.57	69.03	63.30	62.47	51.93
Concentration Recovered			77.94	77.28	76.91	74.83	68.92	71.45	69.03	63.30	62.47	115.94
Amount Spiked			72.46	72.46	72.46	72.46	72.46	72.46	72.46	72.46	72.46	72.46
Percent Recovery			108%	107%	106%	103%	95%	99%	95%	87%	86%	160% (c)
MOTNW	3	3	1.08	0.64 J	1.39 U	0.28 J	0.18 J	0.12 J	1.24 U	1.49 U	1.01 U	0.11 J
MOTNW MSD	3	3	102.71	101.87	99.71	100.80	93.48	96.93	94.98	90.45	91.39	80.01
Concentration Recovered			101.63	101.23	99.71	100.52	93.30	96.81	94.98	90.45	91.39	115.94
Amount Spiked			96.42	96.42	96.42	96.42	96.42	96.42	96.42	96.42	96.42	96.42
Percent Recovery			105%	105%	103%	104%	97%	100%	99%	94%	95%	120%
RPD			2%	2%	3%	1%	2%	2%	3%	7%	9%	28%
I-Stat			0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.04	0.05	0.14
Standard Reference Material												
Certified Value			33.6 ± 5.8	34.1 ± 3.7	NC (e)	NC	6.5 ± 1.2	NC	2.29 ± 0.47	1.8 ± 0.33	NC	2.47 ± 0.28
SRM 1974	1	1	34.33	34.7	NA (f)	NA	6.34	NA	2.16	1.66 J	NA	3.18
SRM 1974	2	2	32.57	32.21	NA	NA	6.05	NA	1.36 J (g)	1.46 J	NA	2.16 J
SRM 1974	3	3	34.87	34.93	NA	NA	5.91	NA	1.75 J	1.54 J	NA	3.39 (g)
Analytical Triplicates												
MOTNW Replicate 1	5	1	1.54 J	1.20 J	0.49 J	0.58 J	0.31 J	0.17 J	0.63 J	3.15 U	2.14 U	4.27 U
MOTNW Replicate 2	5	1	1.52 J	1.13 J	0.37 J	0.39 J	0.2 J	0.13 J	0.41 J	2.81 U	1.91 U	3.81 U
MOTNW Replicate 3	5	1	1.68	1.44 J	0.58 J	0.70 J	0.38 J	0.25 J	0.67 J	2.55 U	1.73 U	3.46 U
RSD			6%	13%	22%	28%	23%	33% (d)	25%	NA	NA	NA
BSCMA Replicate 1	1	2	1.67 J	1.06 J	0.45 J	0.72 J	0.33 J	0.16 J	2.63 U	3.16 U	2.15 U	4.28 U
BSCMA Replicate 2	1	2	2.13	1.62 J	1.20 J	1.44 J	1.15 J	0.78 J	0.73 J	0.79 J	0.57 J	1.11 J
BSCMA Replicate 3	1	2	1.49	1.20 J	0.79 J	1.11 J	0.58 J	0.58 J	0.36 J	0.52 J	0.26 J	0.61 J
RSD			19%	23%	46% (d)	33% (d)	61% (d)	62% (d)	NA	NA	NA	NA

TABLE L.8. (contd)

Sediment Treatment	Replicate	Batch	<i>N. viridis</i> HPAHs ($\mu\text{g/kg}$ wet weight)									
			Fluor-anthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno-[1,2,3-c,d]pyrene	Dibenzo[a,h]anthracene	Benzo[g,h,i]perylene
BSCMA Replicate 1	5	3	0.88 J	0.56 J	3.11 U	0.24 J	0.16 J	0.11 J	2.76 U	3.32 U	2.26 U	4.50 U
BSCMA Replicate 2	5	3	0.79 J	0.42 J	3.16 U	0.22 J	0.13 J	0.09 J	2.81 U	3.37 U	2.29 U	4.57 U
BSCMA Replicate 3	5	3	0.85 J	0.54 J	0.13 J	0.31 J	0.18 J	0.12 J	2.67 U	3.21 U	2.19 U	4.36 U
RSD			5%	15%	NA	18%	16%	14%	NA	NA	NA	NA

(a) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of associated value.

(c) Value exceeds quality control range (40%-120%).

(d) Value exceeds relative precision range $\leq 30\%$.

(e) NC Not certified.

(f) NA Not applicable.

(g) Value exceeds SRM range $\leq 30\%$ certified value.

TABLE L.9. Surrogate Recoveries for Polynuclear Aromatic Hydrocarbons (PAHs), Hydrocarbons (PAHs), Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	Surrogate Percent Recoveries		
				Naph-thalene-d8	Acenaph-thene-d10	Benzo[a]-pyrene-d12
BSCMA Replicate 1	1	2	14.286	72	65	65
BSCMA Replicate 2	1	2	13.967	78	71	77
BSCMA Replicate 3	1	2	13.891	67	59	61
BSCMA	2	2	14.302	73	66	65
BSCMA	3	1	14.005	75	67	62
BSCMA	4	3	13.661	66	65	68
BSCMA Replicate 1	5	3	15.420	74	63	62
BSCMA Replicate 2	5	3	15.420	76	69	69
BSCMA Replicate 3	5	3	15.420	76	71	69
KICMA	1	1	14.421	79	70	68
KICMA	2	2	13.827	80	74	72
KICMA	3	1	13.120	75	66	65
KICMA	4	1	14.890	77	67	66
KICMA	5	2	15.134	69	63	62
MOTMA	1	3	13.330	72	66	68
MOTMA	2	3	14.492	73	69	71
MOTMA	3	2	15.529	65	60	61
MOTMA	4	3	14.874	67	65	66
MOTMA	5	1	14.333	76	69	65
MOTNW	1	2	13.727	69	62	63
MOTNW	2	1	13.774	73	65	64
MOTNW	3	3	14.200	66	62	63
MOTNW	4	3	13.797	71	66	67
MOTNW Replicate 1	5	1	13.562	79	70	68
MOTNW Replicate 2	5	1	13.748	79	69	67
MOTNW Replicate 3	5	1	13.810	79	71	69
WHPREF	1	3	20.038	72	68	65
WHPREF	2	2	14.678	74	71	70
WHPREF	3	2	13.186	77	69	70
WHPREF	4	2	15.246	68	64	64
WHPREF	5	1	13.438	76	69	66
Muscongus Bay	1	3	13.733	68	61	64
Muscongus Bay	2	3	14.479	68	63	60
Muscongus Bay	3	1	13.476	78	68	68
Muscongus Bay	4	1	14.026	74	64	63
Muscongus Bay	5	2	13.118	75	67	68
<u>Quality Control Data</u>						
<u>Method Blank</u>						
Blank		1	NA ^(a)	82	71	73
Blank		2	NA	61	52	53
Blank		3	NA	82	72	74
<u>Matrix Spike</u>						
Muscongus Bay	4	1	14.026	74	64	63
Muscongus Bay MS	4	1	14.026	89	78	82

TABLE L.9. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	Surrogate Percent Recoveries		
				Naph- thalene-d8	Acenaph- thene-d10	Benzo[a]- pyrene-d12
Muscongus Bay	4	1	14.026	74	64	63
Muscongus Bay MSD	4	1	14.026	86	74	75
Muscongus Bay	5	2	13.118	75	67	68
Muscongus Bay MS	5	2	13.118	84	73	76
Muscongus Bay	5	2	13.118	75	67	68
Muscongus Bay MSD	5	2	13.118	81	70	74
MOTNW	3	3	14.200	66	62	63
MOTNW MS	3	3	14.200	78	67	70
MOTNW	3	3	14.200	66	62	63
MOTNW MSD	3	3	14.200	74	69	70
<u>Standard Reference Material</u>						
Certified Value				NC ^(b)	NC	NC
SRM 1974		1	NA	82	71	68
SRM 1974		2	NA	78	71	58
SRM 1974		3	NA	74	68	65
<u>Analytical Triplicates</u>						
MOTNW Replicate 1	5	1	13.562	79	70	68
MOTNW Replicate 2	5	1	13.748	79	69	67
MOTNW Replicate 3	5	1	13.810	79	71	69
BSCMA Replicate 1	1	2	14.286	72	65	65
BSCMA Replicate 2	1	2	13.967	78	71	77
BSCMA Replicate 3	1	2	13.891	67	59	61
BSCMA Replicate 1	5	3	15.42	74	63	62
BSCMA Replicate 2	5	3	15.42	76	69	69
BSCMA Replicate 3	5	3	15.42	76	71	69

(a) NA Not applicable.

(b) NC Not certified.

TABLE L.10. Polychlorinated Biphenyls (PCBs), Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> PCBs ($\mu\text{g}/\text{kg}$ wet weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1240	Aroclor 1254	Aroclor 1260
Target DL (a)				20.0	20.0	20.0	20.0	20.00	20.00
Achieved DL				<20.0	<20.0	<20.0	<20.0	<20.0	<20.00
BSCMA Replicate 1	1	2	14.29	7.096 U ^(b)	7.096 U	7.096 U	7.096 U	11.976	7.096 U
BSCMA Replicate 2	1	2	13.97	7.035 U	7.035 U	7.035 U	7.035 U	11.603	7.035 U
BSCMA Replicate 3	1	2	13.89	5.854 U	5.854 U	5.854 U	5.854 U	10.087	5.854 U
BSCMA	2	2	14.30	2.337 U	2.337 U	2.337 U	2.337 U	10.512	2.337 U
BSCMA	3	1	14.00	2.466 U	2.466 U	2.466 U	2.466 U	10.816	2.466 U
BSCMA	4	3	13.66	2.952 U	2.952 U	2.952 U	2.952 U	10.733	2.952 U
BSCMA Replicate 1	5	3	15.42	7.445 U	7.445 U	7.445 U	7.445 U	10.395	7.445 U
BSCMA Replicate 2	5	3	15.42	7.568 U	7.568 U	7.568 U	7.568 U	11.871	7.568 U
BSCMA Replicate 3	5	3	15.42	7.215 U	7.215 U	7.215 U	7.215 U	10.411	7.215 U
KICMA	1	1	14.42	4.360 U	4.360 U	4.360 U	4.360 U	9.423	4.360 U
KICMA	2	2	13.83	2.734 U	2.734 U	2.734 U	2.734 U	14.953	2.734 U
KICMA	3	1	13.12	2.846 U	2.846 U	2.846 U	2.846 U	10.602	2.846 U
KICMA	4	1	14.89	2.359 U	2.359 U	2.359 U	2.359 U	9.863	2.359 U
KICMA	5	2	15.13	2.630 U	2.630 U	2.630 U	2.630 U	11.368	2.630 U
MOTMA	1	3	13.33	2.605 U	2.605 U	2.605 U	2.605 U	9.075	2.605 U
MOTMA	2	3	14.49	4.960 U	4.960 U	4.960 U	4.960 U	10.978	4.960 U
MOTMA	3	2	15.53	2.361 U	2.361 U	2.361 U	2.361 U	11.262	2.361 U
MOTMA	4	3	14.87	2.218 U	2.218 U	2.218 U	2.218 U	10.868	2.218 U
MOTMA	5	1	14.33	3.011 U	3.011 U	3.011 U	3.011 U	13.999	3.011 U
MOTNW	1	2	13.73	2.955 U	2.955 U	2.955 U	2.955 U	11.068	2.955 U
MOTNW	2	1	13.77	2.346 U	2.346 U	2.346 U	2.346 U	13.062	2.346 U
MOTNW	3	3	14.20	3.336 U	3.336 U	3.336 U	3.336 U	9.580	3.336 U
MOTNW	4	3	13.80	2.346 U	2.346 U	2.346 U	2.346 U	10.316	2.346 U
MOTNW Replicate 1	5	1	13.56	7.074 U	7.074 U	7.074 U	7.074 U	9.519	7.074 U
MOTNW Replicate 2	5	1	13.75	6.308 U	6.308 U	6.308 U	6.308 U	9.532	6.308 U
MOTNW Replicate 3	5	1	13.81	5.725 U	5.725 U	5.725 U	5.725 U	11.090	5.725 U
WHREF	1	3	20.04	3.517 U	3.517 U	3.517 U	3.517 U	13.566	3.517 U
WHREF	2	2	14.68	6.055 U	6.055 U	6.055 U	6.055 U	10.055	6.055 U
WHREF	3	2	13.19	4.683 U	4.683 U	4.683 U	4.683 U	12.312	4.683 U
WHREF	4	2	15.25	4.430 U	4.430 U	4.430 U	4.430 U	13.356	4.430 U
WHREF	5	1	13.44	2.530 U	2.530 U	2.530 U	2.530 U	8.396	2.530 U

TABLE L.10. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> PCBs ($\mu\text{g}/\text{kg}$ wet weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1240	Aroclor 1254	Aroclor 1260
Muscongus Bay	1	3	13.73	2.278 U	2.278 U	2.278 U	2.278 U	11.604	2.278 U
Muscongus Bay	2	3	14.48	3.959 U	3.959 U	3.959 U	3.959 U	16.989	3.959 U
Muscongus Bay	3	1	13.48	3.108 U	3.108 U	3.108 U	3.108 U	10.894	3.108 U
Muscongus Bay	4	1	14.03	7.082 U	7.082 U	7.082 U	7.082 U	12.149	7.082 U
Muscongus Bay	5	2	13.12	14.121 U	14.121 U	14.121 U	14.121 U	9.834	14.121 U

(a) DL Detection limit.

(b) U Analyte was not present above the level of associated value.

TABLE L.11. Polychlorinated Biphenyls (PCBs), Dry Weight, in Tissue *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. virens</i> PCBs ($\mu\text{g/kg}$ dry weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1254	Aroclor 1260
BSCMA Replicate 1	1	2	14.29	49.67 U ^(a)	49.67 U	49.67 U	49.67 U	83.83	49.67 U
BSCMA Replicate 2	1	2	13.97	50.37 U	50.37 U	50.37 U	50.37 U	83.07	50.37 U
BSCMA Replicate 3	1	2	13.89	42.14 U	42.14 U	42.14 U	42.14 U	72.62	42.14 U
BSCMA	2	2	14.30	16.34 U	16.34 U	16.34 U	16.34 U	73.50	16.34 U
BSCMA	3	1	14.00	17.61 U	17.61 U	17.61 U	17.61 U	77.23	17.61 U
BSCMA	4	3	13.66	21.61 U	21.61 U	21.61 U	21.61 U	78.57	21.61 U
BSCMA Replicate 1	5	3	15.42	48.28 U	48.28 U	48.28 U	48.28 U	67.41	48.28 U
BSCMA Replicate 2	5	3	15.42	49.08 U	49.08 U	49.08 U	49.08 U	76.98	49.08 U
BSCMA Replicate 3	5	3	15.42	46.79 U	46.79 U	46.79 U	46.79 U	67.52	46.79 U
KICMA	1	1	14.42	30.23 U	30.23 U	30.23 U	30.23 U	65.34	30.23 U
KICMA	2	2	13.83	19.77 U	19.77 U	19.77 U	19.77 U	108.14	19.77 U
KICMA	3	1	13.12	21.69 U	21.69 U	21.69 U	21.69 U	80.81	21.69 U
KICMA	4	1	14.89	15.84 U	15.84 U	15.84 U	15.84 U	66.24	15.84 U
KICMA	5	2	15.13	17.38 U	17.38 U	17.38 U	17.38 U	75.12	17.38 U
MOTMA	1	3	13.33	19.54 U	19.54 U	19.54 U	19.54 U	68.08	19.54 U
MOTMA	2	3	14.49	34.23 U	34.23 U	34.23 U	34.23 U	75.75	34.23 U
MOTMA	3	2	15.53	15.20 U	15.20 U	15.20 U	15.20 U	72.52	15.20 U
MOTMA	4	3	14.87	14.91 U	14.91 U	14.91 U	14.91 U	73.07	14.91 U
MOTMA	5	1	14.33	21.01 U	21.01 U	21.01 U	21.01 U	97.67	21.01 U
MOTNW	1	2	13.73	21.53 U	21.53 U	21.53 U	21.53 U	80.63	21.53 U
MOTNW	2	1	13.77	17.03 U	17.03 U	17.03 U	17.03 U	94.83	17.03 U
MOTNW	3	3	14.20	23.49 U	23.49 U	23.49 U	23.49 U	67.46	23.49 U
MOTNW	4	3	13.80	17.00 U	17.00 U	17.00 U	17.00 U	74.77	17.00 U
MOTNW Replicate 1	5	1	13.56	52.16 U	52.16 U	52.16 U	52.16 U	70.19	52.16 U
MOTNW Replicate 2	5	1	13.75	45.88 U	45.88 U	45.88 U	45.88 U	69.33	45.88 U
MOTNW Replicate 3	5	1	13.81	41.46 U	41.46 U	41.46 U	41.46 U	80.30	41.46 U
WHEF	1	3	20.04	17.55 U	17.55 U	17.55 U	17.55 U	67.70	17.55 U
WHEF	2	2	14.68	41.25 U	41.25 U	41.25 U	41.25 U	68.50	41.25 U
WHEF	3	2	13.19	35.51 U	35.51 U	35.51 U	35.51 U	93.37	35.51 U
WHEF	4	2	15.25	29.06 U	29.06 U	29.06 U	29.06 U	87.60	29.06 U
WHEF	5	1	13.44	18.83 U	18.83 U	18.83 U	18.83 U	62.48	18.83 U

TABLE L.11. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	<i>N. viridis</i> PCBs ($\mu\text{g/kg}$ dry weight)					
				Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1254	Aroclor 1260
Muscongus Bay	1	3	13.73	16.59 U	16.59 U	16.59 U	16.59 U	84.50	16.59 U
Muscongus Bay	2	3	14.48	27.34 U	27.34 U	27.34 U	27.34 U	117.34	27.34 U
Muscongus Bay	3	1	13.48	23.06 U	23.06 U	23.06 U	23.06 U	80.84	23.06 U
Muscongus Bay	4	1	14.03	50.49 U	50.49 U	50.49 U	50.49 U	86.62	50.49 U
Muscongus Bay	5	2	13.12	107.65 U	107.65 U	107.65 U	107.65 U	74.97	107.65 U

(a) U Analyte was not present above the level of associated value.

TABLE L.12. Quality Control Summary for Polychlorinated Biphenyls (PCBs), Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	N. virens PCBs (µg/kg wet weight)					
			Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1240	Aroclor 1254	Aroclor 1260
Method Blank								
Blank	1		3.427 U(a)	3.427 U	3.427 U	3.427 U	3.427 U	3.427 U
Blank	2		3.915 U	3.915 U	3.915 U	3.915 U	3.915 U	3.915 U
Blank	3		3.446 U	3.446 U	3.446 U	3.446 U	3.446 U	3.446 U
Matrix Spike								
Muscongus Bay	4	1	7.082 U(b)	7.082 U	7.082 U	7.082 U	12.149	7.082 U
Muscongus Bay MS	4	1	NA	NA	NA	NA	190.412	NA
Concentration Recovered			NA(c)	NA	NA	NA	178.263	NA
Amount Spiked			NS	NS	NS	NS	201.430	NS
Percent Recovery			NA	NA	NA	NA	88%	NA
Muscongus Bay	4	1	7.082 U	7.082 U	7.082 U	7.082 U	12.149	7.082 U
Muscongus Bay MSD	4	1	NA	NA	NA	NA	156.892	NA
Concentration Recovered			NA	NA	NA	NA	144.743	NA
Amount Spiked			NS	NS	NS	NS	197.859	NS
Percent Recovery			NA	NA	NA	NA	73%	NA
RPD			NA	NA	NA	NA	19%	NA
I-Stat			NA	NA	NA	NA	0.09	NA
Muscongus Bay	5	2	14.121 U	14.121 U	14.121 U	14.121 U	9.834	14.121 U
Muscongus Bay MS	5	2	NA	NA	NA	NA	768.304	NA
Concentration Recovered			NA	NA	NA	NA	758.470	NA
Amount Spiked			NS	NS	NS	NS	655.342	NS
Percent Recovery			NA	NA	NA	NA	116%	NA
Muscongus Bay	5	2	14.121 U	14.121 U	14.121 U	14.121 U	9.834	14.121 U
Muscongus Bay MSD	5	2	NA	NA	NA	NA	471.125	NA
Concentration Recovered			NA	NA	NA	NA	461.291	NA
Amount Spiked			NS	NS	NS	NS	401.824	NS
Percent Recovery			NA	NA	NA	NA	115%	NA
RPD			NA	NA	NA	NA	1%	NA
I-Stat			NA	NA	NA	NA	0.00	NA

TABLE L.12. (contd)

Sediment Treatment	Replicate	Batch	N. virens PCBs ($\mu\text{g/kg}$ wet weight)				
			Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1240	Aroclor 1254
MOTNW	3	3	3.336 U	3.336 U	3.336 U	3.336 U	3.336 U
MOTNW MS	3	3	NA	NA	NA	NA	NA
Concentration Recovered			NA	NA	NA	NA	NA
Amount Spiked			NS	NS	NS	NS	NS
Percent Recovery			NA	NA	NA	NA	83%
MOTNW	3	3	3.336 U	3.336 U	3.336 U	3.336 U	3.336 U
MOTNW MSD	3	3	NA	NA	NA	NA	NA
Concentration Recovered			NA	NA	NA	NA	NA
Amount Spiked			NS	NS	NS	NS	NS
Percent Recovery			NA	NA	NA	NA	93%
RPD			NA	NA	NA	NA	12%
I-Stat			NA	NA	NA	NA	0.06
<u>Analytical Triplicates</u>							
MOTNW Replicate 1	5	1	7.074 U	7.074 U	7.074 U	7.074 U	7.074 U
MOTNW Replicate 2	5	1	6.308 U	6.308 U	6.308 U	6.308 U	6.308 U
MOTNW Replicate 3	5	1	5.725 U	5.725 U	5.725 U	5.725 U	5.725 U
RSD			NA	NA	NA	NA	9%
BSCMA Replicate 1	1	2	7.096 U	7.096 U	7.096 U	7.096 U	7.096 U
BSCMA Replicate 2	1	2	7.035 U	7.035 U	7.035 U	7.035 U	7.035 U
BSCMA Replicate 3	1	2	5.854 U	5.854 U	5.854 U	5.854 U	5.854 U
RSD			NA	NA	NA	NA	9%
BSCMA Replicate 1	5	3	7.445 U	7.445 U	7.445 U	7.445 U	7.445 U
BSCMA Replicate 2	5	3	7.568 U	7.568 U	7.568 U	7.568 U	7.568 U
BSCMA Replicate 3	5	3	7.215 U	7.215 U	7.215 U	7.215 U	7.215 U
RSD			NA	NA	NA	NA	8%

(a) U Analyte was not present above the level of associated value.

(b) NA Not applicable.

(c) NS Not spiked.

TABLE L.13. Surrogate Recoveries for Polychlorinated Biphenyls (PCBs),
Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	Surrogate Percent Recoveries	
				DBOFB	CL5(112)
BSCMA Replicate 1	1	2	14.29	71	98
BSCMA Replicate 2	1	2	13.97	84	87
BSCMA Replicate 3	1	2	13.89	69	68
BSCMA	2	2	14.30	81	79
BSCMA	3	1	14.00	74	79
BSCMA	4	3	13.66	68	75
BSCMA Replicate 1	5	3	15.42	76	70
BSCMA Replicate 2	5	3	15.42	76	77
BSCMA Replicate 3	5	3	15.42	84	79
KICMA	1	1	14.42	90	87
KICMA	2	2	13.83	79	92
KICMA	3	1	13.12	84	80
KICMA	4	1	14.89	81	74
KICMA	5	2	15.13	73	79
MOTMA	1	3	13.33	77	74
MOTMA	2	3	14.49	84	79
MOTMA	3	2	15.53	70	73
MOTMA	4	3	14.87	78	79
MOTMA	5	1	14.33	79	85
MOTNW	1	2	13.73	68	76
MOTNW	2	1	13.77	79	96
MOTNW	3	3	14.20	74	116
MOTNW	4	3	13.80	79	77
MOTNW Replicate 1	5	1	13.56	79	92
MOTNW Replicate 2	5	1	13.75	79	92
MOTNW Replicate 3	5	1	13.81	75	90
WREF	1	3	20.04	79	76
WREF	2	2	14.68	78	87
WREF	3	2	13.19	79	108
WREF	4	2	15.25	61	79
WREF	5	1	13.44	78	83
Muscongus Bay	1	3	13.73	62	77
Muscongus Bay	2	3	14.48	71	70
Muscongus Bay	3	1	13.48	82	84
Muscongus Bay	4	1	14.03	75	79
Muscongus Bay	5	2	13.12	78	87

TABLE L.13. (contd)

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Batch</u>	<u>Percent Dry Weight</u>	<u>Surrogate DBOFB</u>	<u>Percent Recoveries CL5(112)</u>
<u>Quality Control Data</u>					
<u>Method Blank</u>					
Blank		1	NA ^(a)	75	82
Blank		2	NA	50	63
Blank		3	NA	78	74
<u>Matrix Spike</u>					
Muscongus Bay	4	1	14.03	75	79
Muscongus Bay MS	4	1	14.03	88	87
Muscongus Bay	4	1	14.03	75	79
Muscongus Bay MSD	4	1	14.03	81	87
Muscongus Bay	5	2	13.12	78	87
Muscongus Bay MS	5	2	13.12	80	96
Muscongus Bay	5	2	13.12	78	87
Muscongus Bay MSD	5	2	13.12	75	101
MOTNW	3	3	14.20	74	116
MOTNW MS	3	3	14.20	80	78
MOTNW	3	3	14.20	74	116
MOTNW MSD	3	3	14.20	77	79
<u>Analytical Triplicates</u>					
MOTNW Replicate 1	5	1	13.56	79	92
MOTNW Replicate 2	5	1	13.75	79	92
MOTNW Replicate 3	5	1	13.81	75	90
BSCMA Replicate 1	1	2	14.29	71	98
BSCMA Replicate 2	1	2	13.97	84	87
BSCMA Replicate 3	1	2	13.89	69	68
BSCMA Replicate 1	5	3	15.42	76	70
BSCMA Replicate 2	5	3	15.42	76	77
BSCMA Replicate 3	5	3	15.42	84	79

(a) NA Not applicable.

TABLE L.14. Metals X-Ray Fluorescence (XRF), Inductively Coupled Plasma/Mass Spectrometry (ICP/MS), Graphite Furnace Atomic Absorption (GFAA), and Cold Vapor Atomic Absorption (CVAA), Dry Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	N. virens Metals (mg/kg dry weight)													
		Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVAA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl ICP	Zn ICP	
Target DL (a)		0.1	0.1	0.2	0.6	0.1	0.1	0.01	1.00	0.1	0.1	0.3	0.1	0.3	
Achieved DL		<0.1	0.1	ND	3.0	0.2	0.1	0.01	1.00	0.1	ND	0.5	11.0	0.2	
BSCHA	1	0.098	30.3	0.002	3.3 U (b)	0.429	10.63	0.095	0.96 U	1.260	0.06 U	1.15	0.000	278.2	
BSCHA	2	0.050 (c)	17.3	0.013 U	3.4 U	0.320	8.51	0.084	0.99 U	1.1 U	0.04 U	1.45	0.004	63.6	
BSCHA	2	ND	17.0	ND	3.4 U	ND	8.27	ND	1.00 U	1.1 U	ND	0.97	ND	70.6	
BSCHA	2	ND	17.5	ND	3.4 U	ND	8.14	ND	1.45	1.1 U	ND	1.51	ND	58.5	
BSCHA	3	0.126	34.9	0.002	3.2 U	0.399	11.56	0.088	0.95 U	1.310	0.06 U	1.71	0.000	123.1	
BSCHA	3	ND	ND	ND	2.9 U	ND	ND	ND	1.13	ND	ND	1.66	ND	ND	
BSCHA	3	ND	ND	ND	3.1 U	ND	ND	ND	1.07	ND	ND	1.42	ND	ND	
BSCHA	4	0.062	18.8	0.002	3.7 U	0.218	6.51	0.081	1.20	0.774	0.06 U	1.57	0.004	110.2	
BSCHA	5	0.129	24.5	0.003	3.4 U	0.308	8.69	0.109	1.70	0.820	0.06 U	1.50	0.004	216.1	
KICMA	1	0.057	19.7	0.002 U	3.2 U	0.172	6.42	0.065	0.92 U	0.616	0.06 U	1.24	0.004	125.2	
KICMA	1	0.084	19.0	0.002 U	ND	0.277	6.39	0.061	ND	0.740	0.06 U	ND	0.004	190.5	
KICMA	1	0.114	32.4	0.002 U	ND	0.268	10.09	0.061	ND	1.060	0.06 U	ND	0.000	173.3	
KICMA	2	0.089	17.0	0.002 U	3.5 U	0.381	9.29	0.111	1.00 U	0.634	0.06 U	1.36	0.000	118.8	
KICMA	2	0.126	16.1	0.002 U	ND	0.315	10.18	0.095	ND	0.633	0.06 U	ND	0.000	120.9	
KICMA	2	0.103	18.1	0.002 U	ND	0.313	9.30	0.110	ND	0.698	0.06 U	ND	0.004	60.7	
KICMA	3	0.103	22.0	0.002 U	3.2 U	0.175	7.79	0.099	0.99 U	0.718	NA	1.22	0.004	55.3	
KICMA	4	0.080	17.6	0.013 U	3.2 U	0.230	6.20	0.080	0.94 U	1.1 U	0.04 U	1.02	0.004	92.0	
KICMA	5	0.071	20.2	0.003	3.6 U	0.396	7.09	0.091	1.10 U	1.160	0.06 U	1.05	0.004	79.6	
MOTMA	1	0.035	21.1	0.002	3.3 U	0.282	7.85	0.063	1.01	0.942	0.06 U	0.93	0.004	109.1	
MOTMA	2	0.120	18.8	0.013 U	3.2 U	0.260	8.85	0.150	1.84	1.1 U	0.04 U	1.32	0.000	68.5	
MOTMA	3	0.088	18.1	0.002 U	3.3 U	0.291	9.54	0.117	1.00 U	0.620	NA	0.48 U	0.004	60.0	
MOTMA	4	0.030	18.3	0.001	3.3 U	0.245	7.33	0.056	0.83 U	0.728	0.06 U	1.30	0.000	58.1	
MOTMA	5	0.160	13.3	0.013 U	3.4 U	0.300	7.88	0.111	1.12	1.16	0.04 U	1.58	0.000	59.7	
MOTNW	1	0.053	19.1	0.002 U	3.5 U	0.271	7.08	0.068	1.44	0.957	NA	0.79	0.000	174.4	
MOTNW	2	0.100	18.2	0.013 U	3.4 U	0.260	8.49	0.103	0.93 U	1.0 U	0.04 U	1.44	0.000	51.8	
MOTNW	3	0.060	17.7	0.013 U	3.3 U	0.210	8.75	0.058	1.11	1.1 U	0.04 U	1.34	0.000	109.0	
MOTNW	4	0.115	16.7	0.006	3.4 U	0.412	6.82	0.135	1.10 U	0.891	0.06 U	1.52	0.000	160.5	
MOTNW	5	0.080	17.1	0.013 U	3.3 U	0.240	7.89	0.067	1.11	1.2 U	0.04 U	1.40	0.004	64.2	

TABLE L.14. (contd)

Sediment Treatment	Replicate	N. viridis Metals (mg/kg dry weight)													
		Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVA	Ni XRF	Pb ICP	Sb GFAA	Sc XRF	Tl ICP	Zn ICP	
WREF	1	0.178	22.1	0.002	3.6 U	0.268	8.15	0.116	0.97	0.869	0.06 U	0.80	0.008	180.8	
WREF	1	ND	ND	ND	3.4 U	ND	ND	ND	0.97 U	ND	0.06 U	0.97	ND	ND	
WREF	1	ND	ND	ND	3.4 U	N ^c	ND	ND	0.96 U	ND	0.06 U	0.68	ND	ND	
WREF	2	0.106	22.8	0.002 U	4.2	0.330	7.69	0.082	1.66	0.910	0.06 U	1.78	0.009	59.5	
WREF	3	0.094	18.4	0.003	3.7 U	0.299	8.98	0.106	1.17	0.656	NA	0.78	0.000	155.2	
WREF	4	0.155	28.7	0.002	3.4 U	0.539	14.38	0.108	1.00 U	1.320	NA	1.66	0.000	223.6	
WREF	5	0.195	26.2	0.003	3.3 U	0.384	8.88	0.133	1.06	0.871	0.06 U	1.56	0.008	164.8	
Muscongus Bay	1	0.040	19.3	0.013 U	3.3 U	0.320	8.67	0.044	0.93 U	1.1 U	0.04 U	1.50	0.004	55.7	
Muscongus Bay	2	0.080	15.1	0.013 U	3.3 U	0.760	8.60	0.088	1.18	1.2 U	0.04 U	0.47 U	0.000	185.0	
Muscongus Bay	3	0.142	18.0	0.002	3.0 U	0.255	9.59	0.076	0.93 U	0.856	ND	1.28	0.004	166.9	
Muscongus Bay	4	0.057	23.5	0.002 U	3.3 U	0.392	7.25	0.069	1.05	0.921	ND	1.64	0.000	120.9	
Muscongus Bay	5	0.061	34.4	0.003	3.4 U	0.595	11.05	0.064	1.00 U	1.560	ND	1.42	0.004	242.9	

(a) DL Detection limit.

(b) U Analyte was not given above the level of associated value.

(c) ND No data.

TABLE L.15. Metals X-Ray Fluorescence (XRF) and Inductively Coupled Plasma(ICP), and Graphite Furnace Atomic Absorption, Wet Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Percent Dry Weight	<i>N. virens</i> Metals (mg/kg wet weight)													
			Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl XRF	Zn ICP	
BSCMA	1	14.29	0.01	4.3	0.000	0.5 U ^(a)	0.061	1.52	0.014	0.14 U	0.18	0.01 U	0.16	0.000	39.7	
BSCMA	2	14.30	0.01	2.5	0.002 U	0.5 U	0.046	1.22	0.012	0.14 U	0.16 U	0.01 U	0.21	0.001	9.1	
BSCMA	2	14.30	ND ^(b)	2.4	ND	0.5 U	ND	1.18	ND	0.14 U	0.16 U	ND	0.14	ND	10.1	
BSCMA	2	14.30	ND	2.5	ND	0.5 U	ND	1.16	ND	0.21	0.16 U	ND	0.22	ND	8.4	
BSCMA	3	14.01	0.02	4.9	0.000	0.4 U	0.056	1.62	0.012	0.13 U	0.18	0.01 U	0.24	0.000	17.2	
BSCMA	3	14.01	ND	ND	ND	0.4 U	ND	ND	ND	0.16	ND	ND	0.23	ND	ND	
BSCMA	3	14.01	ND	ND	ND	0.4 U	ND	ND	ND	0.15	ND	ND	0.20	ND	ND	
BSCMA	4	13.66	0.01	2.6	0.000	0.5 U	0.030	0.89	0.011	0.16	0.11	0.01 U	0.21	0.001	15.1	
BSCMA	5	15.42	0.02	3.8	0.000	0.5 U	0.047	1.34	0.017	0.26	0.13	0.01 U	0.23	0.001	33.3	
KICMA	1	14.42	0.01	2.8	0.000 U	0.5 U	0.025	0.93	0.009	0.13 U	0.09	0.01 U	0.18	0.001	18.1	
KICMA	1	14.42	0.01	2.7	0.000 U	ND	0.040	0.92	0.009	ND	0.11	0.01 U	ND	0.001	27.5	
KICMA	1	14.42	0.02	4.7	0.000 U	ND	0.039	1.46	0.009	ND	0.15	0.01 U	ND	0.000	25.0	
KICMA	2	13.83	0.01	2.4	0.000 U	0.5 U	0.053	1.28	0.015	0.14 U	0.09	0.01 U	0.19	0.000	16.4	
KICMA	2	13.83	0.02	2.2	0.000 U	ND	0.044	1.41	0.013	ND	0.09	0.01 U	ND	0.000	16.7	
KICMA	2	13.83	0.01	2.5	0.000 U	ND	0.043	1.29	0.015	ND	0.10	0.01 U	ND	0.001	8.4	
KICMA	3	13.12	0.01	2.9	0.000 U	0.4 U	0.023	1.02	0.013	0.13 U	0.09	ND	0.16	0.001	7.3	
KICMA	4	14.89	0.01	2.6	0.002 U	0.5 U	0.034	0.92	0.012	0.14 U	0.16 U	0.01 U	0.15	0.001	13.7	
KICMA	5	15.13	0.01	3.1	0.000	0.5 U	0.060	1.07	0.014	0.17 U	0.18	0.01 U	0.16	0.001	12.0	
MOTMA	1	13.33	0.00	2.8	0.000	0.4 U	0.038	1.05	0.008	0.13	0.13	0.01 U	0.12	0.001	14.5	
MOTMA	2	14.49	0.02	2.7	0.002 U	0.5 U	0.038	1.28	0.022	0.27	0.16 U	0.01 U	0.19	0.000	9.9	
MOTMA	3	15.53	0.01	2.8	0.000 U	0.5 U	0.045	1.48	0.018	0.16 U	0.10	ND	0.07 U	0.001	9.3	
MOTMA	4	14.87	0.00	2.7	0.000	0.5 U	0.036	1.09	0.008	0.12 U	0.11	0.01 U	0.19	0.000	8.6	
MOTMA	5	14.33	0.02	1.9	0.002 U	0.5 U	0.043	1.13	0.016	0.16	0.17	0.01 U	0.23	0.000	8.6	
MOTNW	1	13.73	0.01	2.6	0.000 U	0.5 U	0.037	0.97	0.009	0.20	0.13	ND	0.11	0.000	23.9	
MOTNW	2	13.77	0.01	2.5	0.002 U	0.5 U	0.036	1.17	0.014	0.13 U	0.14 U	0.01	0.20	0.000	7.1	
MOTNW	3	14.20	0.01	2.5	0.002 U	0.5 U	0.030	1.24	0.008	0.16	0.16 U	0.01 U	0.19	0.000	15.5	
MOTNW	4	13.80	0.02	2.3	0.001	0.5 U	0.057	0.94	0.019	0.15 U	0.12	0.01 U	0.21	0.001	22.1	
MOTNW	5	13.56	0.01	2.3	0.002 U	0.4 U	0.033	1.07	0.009	0.15	0.16 U	0.01 U	0.19	0.000	8.7	
WHREF	1	20.04	0.04	4.4	0.000	0.7 U	0.054	1.63	0.023	0.19	0.17	0.01 U	0.16	0.000	36.2	
WHREF	1	20.04	ND	ND	ND	0.7 U	ND	ND	ND	0.19 U	ND	0.01 U	0.19	ND	ND	
WHREF	1	20.04	ND	ND	ND	0.7 U	ND	ND	ND	0.18 U	ND	0.01 U	0.14	ND	ND	
WHREF	2	14.68	0.02	3.3	0.000 U	0.6	0.048	1.13	0.012	0.24	0.13	0.01 U	0.26	0.000	8.7	
WHREF	3	13.19	0.01	2.4	0.000	0.5 U	0.039	1.18	0.014	0.15	0.09	ND	0.10	0.000	20.5	
WHREF	4	15.25	0.02	4.4	0.000	0.5 U	0.082	2.19	0.016	0.15 U	0.20	ND	0.25	0.001	34.1	
WHREF	5	13.44	0.03	3.5	0.000	0.4 U	0.052	1.19	0.018	0.14	0.12	0.01 U	0.21	0.000	22.1	

TABLE L.15. (contd)

Sediment Treatment	Replicate	Percent Dry Weight	<i>N. virens</i> Metals (mg/kg wet weight)												
			Ag	As	Be	Cr	Cd	Cu	Hg	Ni	Pb	Sb	Se	Tl	Zn
			ICP	ICP	GFAA	XRF	ICP	ICP	CVAA	XRF	ICP	GFAA	XRF	XRF	ICP
Muscongus Bay	1	13.73	0.01	2.7	0.002 U	0.5 U	0.044	1.1S	0.006	0.13 U	0.15 U	0.01 U	0.21	0.000	7.6
Muscongus Bay	2	14.48	0.01	2.2	0.002 U	0.5 U	0.110	1.25	0.013	0.17	0.17 U	0.01 U	0.07 U	0.001	26.8
Muscongus Bay	3	13.48	0.02	2.4	0.000	0.4 U	0.034	1.29	0.010	0.13 U	0.12	ND	0.17	0.000	22.5
Muscongus Bay	4	14.03	0.01	3.3	0.000 U	0.5 U	0.055	1.02	0.010	0.15	0.13	ND	0.23	0.001	17.0
Muscongus Bay	5	13.12	0.01	4.5	0.000	0.4 U	0.078	1.45	0.008	0.13 U	0.20	ND	0.19	0.000	31.9

(a) U Analyte was not given above the level of associated value.

(b) ND No data.

TABLE L.16. Quality Control Summary for Metals X-Ray Fluorescence (XRF), Inductively Coupled Plasma/Mass Spectrometry (ICP/MS), Graphite Furnace Atomic Absorption (GFAA), and Cold Vapor Atomic Absorption (CVAA), Dry Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	<i>N. virens</i> Metals (mg/kg dry weight)												
	Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVAA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl ICP	Zn ICP
Method Blank													
Blank 1	0.001	0.1	0.002 U ^(a)	NA ^(b)	0.010	0.01	0.000	NA	0.010	0.06 U	NA	0.001	0.2
Blank 2	0.001	0.1	0.002 U	NA	0.013	0.01	0.000	NA	0.002	0.06 U	NA	0.000	2.7
Blank 3	0.001	0.1	0.001 ^(c)	NA	0.006	0.01	NA	NA	0.004	0.06 U	NA	0.001	0.3
Blank 4	0.001	0.1	ND	NA	0.010	0.01	ND	NA	0.010	ND	NA	0.001	3.5
Matrix Spike													
KICMA Replicate 1	0.057	19.7	0.002 U	3.2 U	0.172	6.42	0.065	0.92 U	0.616	0.06 U	1.24	0.004	125.2
KICMA MS	3.170	95.4	1.650	ND	3.555	30.13	0.531	ND	4.410	1.61	ND	3.150	446.2
Concentration Recovered	3.113	75.7	1.650	NA	3.383	23.71	0.466	NA	3.794	1.61	NA	3.146	321.0
Amount Spiked	2.000	40.0	2.000	NS ^(d)	2.000	12.00	0.500	NA	2.000	1.80	NS	2.000	220.0
Percent Recovery	156% ^(e)	189% ^(e)	83%	NA	169% ^(e)	198% ^(e)	93%	NA	190% ^(e)	89%	NA	157% ^(e)	146% ^(e)
Standard Reference Material													
Certified Value	1.68 ±0.15	14.0 ±1.2	NC ^(f)	1.43 ±0.46	4.15 ±0.38	66.3 ±4.3	0.0642 ±0.0067	2.25 ±0.44	0.371 ±0.014	NC	2.21 ±0.24	NC	830 ±57
1566A	1.650	16.9	0.008	2.2 U	3.802	70.93	0.064	2.30	0.322	0.06 U	2.42	0.002	814.3
1566B	1.700	15.0	0.008	2.4 U	4.127	70.18	0.066	2.00	0.336	0.06 U	2.37	0.002	884.9
1566C	1.720	15.1	0.008	2.4	4.294	67.08	ND	2.63	0.338	0.06 U	2.20	0.006	848.5
Certified Value	NC	17.7 ±2.1	NC	3.60 ±0.40	0.086 ±0.012	5.22 ±0.33	0.731 ±0.060	1.20 ±0.30	0.40 ±0.12	NC	1.62 ±0.12	NC	21.3 ±1.0
RM1A	0.212	19.8	0.002 U	3.8	0.114	5.93	0.887	1.16	0.662	0.06 U	1.51	0.002	19.4
RM1B	0.170	18.9	0.002 U	3.1	0.099	5.60	0.922	0.79 U	0.343	0.06 U	1.72	0.006	21.0
RM1C	0.196	20.1	0.001	2.7	0.081	5.20	ND	0.98	0.538	0.06 U	1.84	0.002	20.4

WILMINGTON HARBOR

TABLE L.16. (contd)

Sediment Treatment	<i>N. virens</i> Metals (mg/kg dry weight)												
	Ag ICP	As ICP	Be GFAA	Cr XRF	Cd ICP	Cu ICP	Hg CVAA	Ni XRF	Pb ICP	Sb GFAA	Se XRF	Tl ICP	Zn ICP
<u>Analytical Replicates</u>													
KICMA Replicate 1	0.057	19.7	0.002 U	3.2 U	0.172	6.42	0.065	0.92 U	0.616	0.06 U	1.24	0.004	125.2
KICMA Replicate 1	0.084	19.0	0.002 U	ND	0.277	6.39	0.061	ND	0.740	0.06 U	ND	0.004	190.5
KICMA Replicate 1	0.114	32.4 (g)	0.002 U	ND	0.268	10.09	0.061	ND	1.060	0.06 U	ND	0.000 (g)	173.3
RSD	34% (g)	32% (g)	NA	NA	24%	28%	4%	NA	28%	NA	NA	87% (g)	21%
BSCMA Replicate 3	0.126	34.9	0.002 U	3.2 U	0.399	11.56	0.088	0.95 U	1.310	0.06 U	1.71	0.000	123.1
BSCMA Replicate 3	ND	ND	ND	2.9 U	ND	ND	ND	1.13	ND	ND	1.66	ND	ND
BSCMA Replicate 3	ND	ND	ND	3.1 U	ND	ND	ND	1.07	ND	ND	1.42	ND	ND
RSD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10%	NA	NA
BSCMA Replicate 2	0.050	16.8	0.003 U	3.4 U	0.320	5.80	0.084	0.99 U	1.060	0.04 U	1.45	0.004	226.1
BSCMA Replicate 2	ND	ND	NA	3.4 U	ND	ND	ND	1.00 U	ND	ND	0.97	ND	ND
BSCMA Replicate 2	ND	ND	NA	3.4 U	ND	ND	ND	1.45	ND	ND	1.51	ND	ND
RSD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18%	NA	NA
KICMA Replicate 2	0.089	17.0	0.002 U	3.5 U	0.381	9.29	0.111	1.00 U	0.634	0.06 U	1.36	0.000	118.8
KICMA Replicate 2	0.126	16.1	0.002 U	ND	0.315	10.18	0.095	ND	0.633	0.06 U	ND	0.000	120.9
KICMA Replicate 2	0.103	18.1	0.002 U	ND	0.313	9.30	0.110	ND	0.698	0.06 U	ND	0.004 (g)	60.7 (g)
RSD	18%	6%	NA	NA	12%	5%	9%	NA	6%	NA	NA	173% (g)	34% (g)
WREF Replicate 1	0.178	22.1	0.002	3.6 U	0.268	8.15	0.116	0.97	0.869	0.06 U	0.80	0.008	180.8
WREF Replicate 1	ND	ND	ND	3.4 U	ND	ND	ND	0.97 U	ND	ND	0.97	ND	ND
WREF Replicate 1	ND	ND	ND	3.4 U	ND	ND	ND	0.90 U	ND	ND	0.68	ND	ND
RSD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18%	NA	NA

(a) U Analyte was not present above the level of associated value.

(b) NA Not applicable.

(c) ND No data.

(d) NS Not spiked.

(e) Recovery outside of quality control range (75%-125%).

(f) NC Not certified.

(g) Value exceeds relative precision range $\leq 30\%$.

TABLE L.17. Butyltins, Wet and Dry Weight, in Tissue of *N. virens*, Wilmington Harbor Project

Sediment Treatment	Replicate	Batch	Surrogate Percent Recoveries				Butyltins ($\mu\text{g/kg}$ wet weight)				Percent Dry Weight	Butyltins ($\mu\text{g/kg}$ dry weight)			
			Tri-pentyl-tin	Propyl-tin	Pentyl-butyl-tin	Tetra-butyl-tin	Tri-butyltin	Di-butyltin	Mono-butyltin	Tri-butyltin		Di-butyltin	Mono-butyltin		
Target DL (a)							10.0	10.0	10.0						
Achieved DL							<10.0	<10.0	<10.0						
KICMA	1	1	89.35	90.21	102.75	88.99	1.9 U ^(b)	4.0 U ^(c)	3.0 U	14.42		13.2 U	27.7 U	20.8 U	
	2	2	90.53	86.17	100.10	98.81	1.7 U	1.1 J	2.7 U	13.82		12.3 U	8.0 J	19.5 U	
	3	2	87.97	82.22	108.88	86.70	2.0 U	1.9 U	3.1 U	13.12		15.2 U	14.5 U	23.6 U	
	4	1	56.66	62.02	89.82	87.09	2.0 U	1.6 J	3.1 U	14.89		13.4 U	10.7 J	20.8 U	
	5	2	83.51	76.17	96.81	74.19	2.3 U	3.3 U	3.6 U	15.13		15.2 U	21.8 U	23.8 U	
MOTMA	1	2	90.92	82.81	101.47	89.02	1.9 U	1.6 J	3.0 U	13.33		14.3 U	12.0 J	22.5 U	
	2	2	86.82	87.33	96.17	92.18	1.8 U	1.3 J	2.9 U	14.49		12.4 U	9.0 J	20.0 U	
	3	1	108.97	93.26	99.23	82.89	2.1 U	2.0 U	3.3 U	15.52		13.5 U	12.9 U	21.3 U	
	4	2	60.62	69.92	101.73	94.43	1.8 U	4.8 U	2.3 J	14.87		12.1 U	32.3 U	15.5 J	
	4	2	86.39	72.88	98.93	77.08	2.2 U	5.4 U	3.5 U	14.87		14.8 U	36.3 U	23.5 U	
MOTMA Rep 3	4	2	80.70	85.74	105.06	91.03	0.0 U	5.3	0.0 U	14.87		0.0 U	35.6	0.0 U	
	5	1	80.38	71.76	77.90	75.02	2.3 U	2.3 U	3.6 U	14.33		16.0 U	16.0 U	25.1 U	
WHEF	1	2	99.33	87.83	102.75	87.62	1.9 U	1.8 J	3.1 U	20.03		9.5 U	9.0 J	15.5 U	
	2	2	78.50	59.21	101.81	73.13	2.3 U	2.3 U	3.7 U	14.67		15.7 U	15.7 U	25.2 U	
	3	2	113.95	89.02	101.16	76.97	2.2 U	2.2 U	3.5 U	13.18		16.7 U	16.7 U	26.5 U	
	4	1	72.60	71.23	85.66	79.76	2.1 U	3.5 U	3.4 U	15.24		13.8 U	23.0 U	22.3 U	
	5	1	69.48	77.96	83.50	91.71	1.9 U	4.5 U	2.9 U	13.43		14.1 U	33.5 U	21.6 U	
Muscongus Bay	1	1	94.96	91.59	95.57	91.63	1.9 U	2.2 U	2.9 U	13.73		13.8 U	16.0 U	21.1 U	
	2	2	106.55	87.60	94.77	70.88	2.4 U	1.7 J	3.8 U	14.47		16.6 U	11.7 J	26.2 U	
	3	1	73.52	77.47	85.96	88.86	1.9 U	3.0 U	3.0 U	13.47		14.1 U	22.3 U	22.3 U	
	Rep 1	4	91.01	87.89	112.13	76.81	2.2 U	1.5 U	3.5 U	14.02		15.7 U	10.7 U	25.0 U	
	Muscongus Bay Rep 2	4	70.69	79.65	100.41	95.22	1.8 U	1.5 U	2.8 U	14.02		12.8 U	10.7 U	20.0 U	
Muscongus Bay Rep 3	4	1	48.16	52.83	97.08	87.33	1.9 U	2.0 U	3.1 U	14.02		13.5 U	14.3 U	22.1 U	
Muscongus Bay	5	1	94.45	93.37	112.55	93.86	1.8 U	1.9 U	2.9 U	13.11		13.7 U	14.5 U	22.1 U	

(a) DL Detection limit.

(b) U Analyte was not present above the level of associated value.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

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