PNL - 8893
UC-000

ECOLOGICAL EVALUATION OF PROPOSED DREDGED MATERIAL FROM WINYAH BAY, SOUTH CAROLINA

J.A. Ward
W.W. Gardiner
M.R. Pinza
J.Q. Word

October 1993

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

Pacific Northwest Laboratory
Richland, Washington 99352

SUMMARY

The navigational channels of Winyah Bay, Georgetown Harbor, South Carolina require dredging to enable normal shipping traffic to use these areas. Before dredging, environmental assessments must be conducted to determine the suitability of this dredged 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 Charleston, South 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 the required physical/chemical, toxicological, and bioaccumulation evaluations required in the *1991 Implementation Manual*. Sediment samples representing dredged material were collected from three areas: the Sampit River (SR-1, SR-2, SR-3, and SR-4), the Inner Harbor area of Winyah Bay (IH-1, IH-2, and IH-3), and the Entrance Channel to Winyah Bay (EC-1, EC-2, and EC-3). Reference sediments were also collected and compared to test sediments, as required in the *1991 Implementation Manual*. Reference sediment treatments IHR1 and IHR2 were compared to Inner Harbor treatments; reference treatment EC Ref-Comp was compared to Entrance Channel treatments. Sampit River sediments did not require a reference as they are not destined for ocean disposal. In support of the Winyah Bay Program, MSL:

- Characterized sediment samples representing proposed dredged material (test treatments) and appropriate reference sediment samples (reference treatments) through physical/chemical analyses.
- Evaluated acute toxicity of test treatments EC-1, EC-2, and EC-3 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 EC Ref-Comp.
- Evaluated acute toxicity of test treatments EC-1, EC-2, and EC-3 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 treatment composite IH-2/IH-3 Comp through 28-day exposures using the clam *Macoma nasuta* and the polychaete *N. virens*. Bioaccumulation potential was evaluated by comparing contaminants associated with tissues exposed to test treatments to tissue levels after exposure to the reference treatments IHR1 and IHR2.
- 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 treatments EC Ref-Comp, IHR1, and IHR2. Elevated levels of polynuclear aromatic hydrocarbons (PAHs) were observed in test treatments IH-2, IH-3, and Sampit River treatments; pesticides were detected only in test treatment SR-1. Dioxin congeners were present in all test treatments, though the most toxic forms such as 2,3,7,8-TCDD were absent. Metals were present in all treatments, but only elevated in the Sampit River test treatments. Inner Harbor test treatments were not analyzed for metals as data from previous studies were available. Organotins were present only in test treatment SR-1.

Acute SP toxicological tests showed no evidence of acute toxicity of test sediments to *A. abdita*, *R. abronius*, or *N. virens*, although both *A. abdita* and *N. virens* toxicological tests were not considered valid because of a <90% control survival. The SPP exposures were not acutely toxic to *M. bahia*, *M. beryllina*, or *L. pictus*. Bioaccumulation potential was evaluated through the exposure of *M. nasuta* and *N. virens* to test treatment IH-2/IH-3 Comp and reference treatments IHR1 and IHR2 for 28 days. Statistical analyses of these data showed no evidence of significantly elevated levels of PAHs, dioxins, or organotins in the tissues of these organisms. The results of this study indicate that, based on the acute toxicity and bioaccumulation tests, dredged material represented by these test treatments is in compliance with the benthic bioassay criteria of Section 227.13(c) as well as Appendixes A and B of the *1991 Implementation Manual.* The results generated by this study can be used by USACE in their decision-making process regarding acceptable disposal options for the sediments from Winyah Bay.

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1.0 INTRODUCTION

The navigational channels of Winyah Bay, Georgetown Harbor, South Carolina require dredging to enable normal shipping traffic to use these areas. Before dredging, environmental assessments must be conducted to determine the suitability of this dredged 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 Charleston, South 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 the required physical/chemical, toxicological, and bioaccumulation evaluations as required in the *1991 Implementation Manual.* The objectives of the Winyah Bay Project were as follows:

- Collect test sediment samples from selected sites in three areas of Winyah Bay (the Entrance Channel, the Inner Harbor area, and the Sampit River area).
- Collect reference sediment samples from selected sites for use in toxicological and bioaccumulation comparisons.
- Ship all sediment samples from the project area to MSL in Sequim, Washington, for physical/chemical analysis, toxicological, and bioaccumulation testing.
- Perform physical/chemical evaluations on test sediment and composites from each reference area.
- 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 sensitive marine species (*Menidia beryllina*, *Mysidopsis bahia*, and *Lytechinus pictus*) to determine the acute toxicity of the SPP of the dredged material.
- Perform SP toxicity tests using three sensitive species (*Ampelisca abdita*, *Rhepoxynius abronius*, and *Nereis virens)* to determine the acute toxicity of the whole sediment that represents dredged material.
- Conduct 28-day laboratory exposures, using *Macoma nasuta* and *N.virens*, in support of bioaccumulation testing to determine whether there is a potential for contaminants associated with dredged material to accumulate in test organism tissues.

This report is intended to provide information required to address potential ecological effects of the Entrance Channel and Inner Harbor sediments proposed disposal in the ocean. The report is divided into five sections. Section 1.0 is the introduction and provides project objectives. Section 2.0 describes methods and materials used for sample collection, processing,

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toxicological and bioaccumulation testing, physical/chemical analysis of sediments and tissues, data analysis, and quality assurance requirements. 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 Entrance Channel and Inner Harbor 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 this study:

Appendix A	Field Collection Summary
Appendix B	Sediment Chemistry Data 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 *Macoma nasuta*
Appendix L	Tissue Chemistry and Quality Assurance Data for *Nereis virens*

2.0 MATERIALS AND METHODS

2.1 SEDIMENT AND TEST ORGANISM COLLECTION

Sediment samples were collected from three sites representing the Entrance Channel to Winyah Bay (EC-1, EC-2, and EC-3), three sites representing the Inner Harbor (IH-1, IH-2, and IH-3), and four sites at the mouth of the Sampit River (SR-1, SR-2, SR-3, and SR-4). These areas are designated by USACE as Segments 1, 2, and 3, respectively. Reference and control samples were also collected. The reference sediment for the Entrance Channel was collected from an area just east of a current Ocean Dredged Material Disposal Site (ODMDS) and designated as EC-Ref Comp. The reference sediment for the Inner Harbor was near Clam Bank Creek (IHR1), and south of Hare Island (IHR2). Sediment collection locations are presented in Figures 2.1 through 2.3. All samples were collected from the *R/V Anita*, which is owned and operated by the South Carolina Department of Wildlife and Marine Resources Division. Also, an ocean reference site sample was collected from the vicinity of an ODMDS disposal site in North Carolina. This reference was included in the *A. abdita* and *R. abronius* tests, as its grain size was more similar to the sediment samples from the Entrance Channel than the EC-Ref Comp sediment. Control sediments were also collected to validate organism survival for the toxicity and bioaccumulation tests. Control sediments included 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). San Pablo Bay and Muscongus Bay sediments were supplied by a private contractor. Whidbey Island and Sequim Bay sediment was collected by MSL personnel. 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, when possible. Formal chain-of-custody procedures were maintained for all test, reference, and control sediments used.

2.1.1 Test Sediment Collection

Sediments from the three test sites were sampled from June 23 through 25, 1992. Station positioning was accomplished using Loran C and visual range markers, then confirmed by water depth observations. Depths were recorded using a calibrated fathometer and corrected to mean lower low water (MLLW) through the use of a tide table. Entrance Channel samples were obtained with an MSL-designed sand dredge that sampled to a depth of approximately 4 cm. Inner Harbor and Sampit River stations were sampled with a 0.1-m^2 van Veen grab, which penetrated into the sediment 8 to 15 cm depending upon sediment type. Sediment samples obtained with the 0.1-m^2 van Veen grab sampler and the sand dredge were

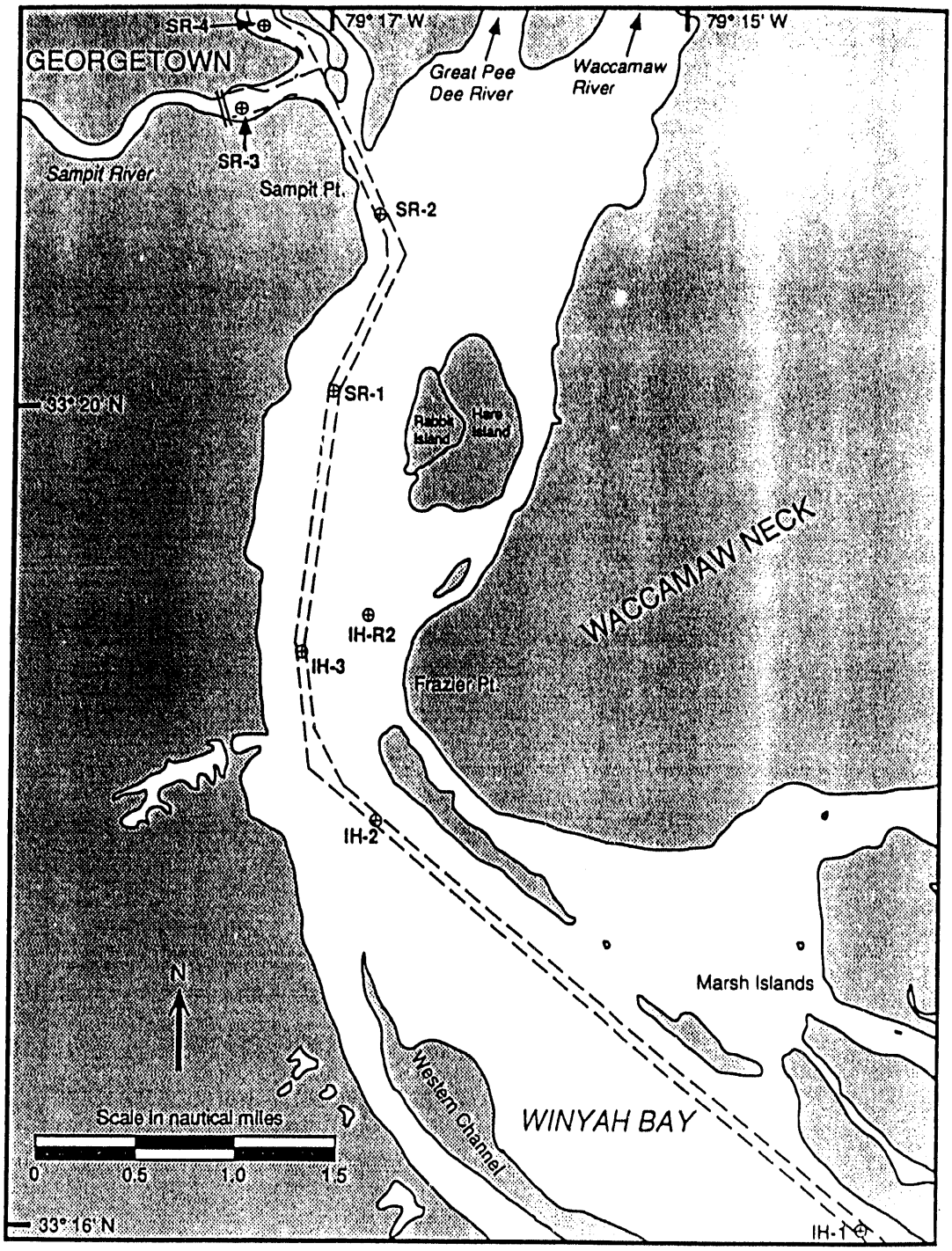

FIGURE 2.1. Inner Harbor and Sampit River Study Areas and Sampling Sites (See text Section 2.1 for explanation of sampling site codes)

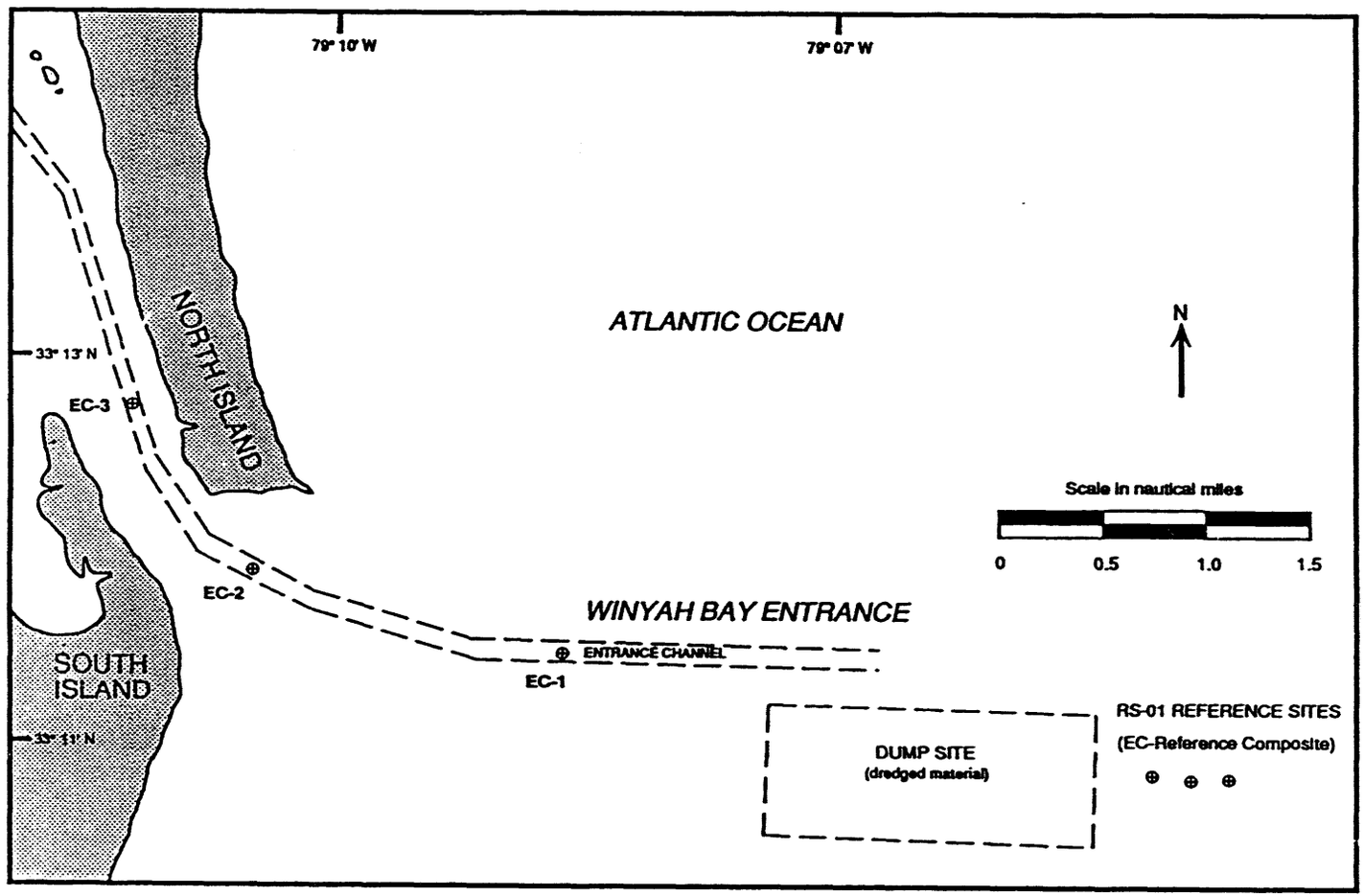

FIGURE 2.2. Entrance Channel Study Area and Sampling Sites (See text Section 2.1 for explanation of sampling site codes.)

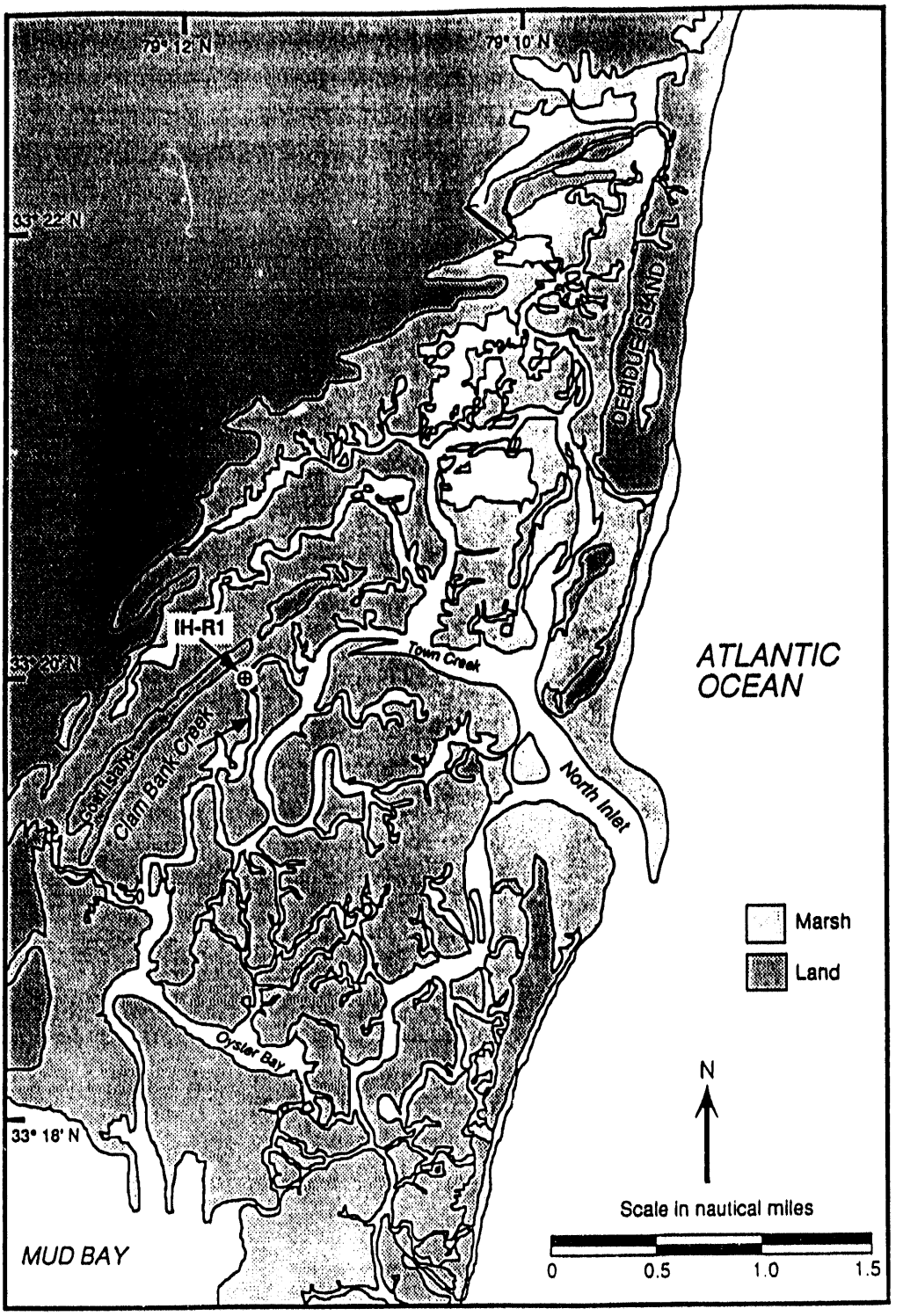

FIGURE 2.3. Inner Harbor Area Showing Reference Site, IHR1

transferred to clean, epoxy-coated 5-gal pails, sealed, and labeled with the study identifier, the station name, date of collection, and number of pails. All samples were maintained at approximately 4°C until transferred to a refrigerated truck, also maintained at approximately 4°C. Upon arrival at the MSL, sediment samples were transferred to a 4°C cold-room until needed for testing.

2.1.2 Reference and Control Sediment Collection

Reference sediments were collected from June 23 to 25, 1992, using either an MSL designed sand dredge or the van Veen grab. Station position for the reference sites was accomplished using a Loran C or visual range fix. Control sediment sampling sites were located using visual range fixes and water depth. Reference sediments were placed in clean, epoxy-coated 5-gal pails, sealed, and labeled with the study identifier, the station name, date of collection, and number of buckets representing a station. Control sediments were collected using a variety of samplers. San Pablo Bay sediment (*A. abdita* control) was collected concurrently with the test organisms using a large dip-net. It is estimated that this net sampled to a depth of 2 to 4 cm. Sediment was placed directly into clean polyethylene bags, then placed in coolers and maintained at approximately 4°C until shipment via overnight mail to the MSL. Muscongus Bay sediment (*N. virens* control) was collected with a shovel from the intertidal areas inhabited by *N. virens*, and treated in a similar fashion to the San Pablo Bay sediment. Whidbey Island sediment (*R. abronius* control) was collected concurrently with the test organisms using an MSL-designed amphipod dredge. This dredge was estimated to sample 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 the same day. Sequim Bay sediment (*M. nasuta* control) was collected with a 0.1-m^2 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 until needed for testing.

2.1.3 Test Organism Collection

Seven species of organisms were used to evaluate sediment samples from the Winyah Bay study area:

- the amphipod *Ampelisca abdita*
- the amphipod *Rhepoxynius abronius*
- the polychaete *Nereis virens*
- the bent-nose clam *Macoma nasuta*
- the silverside *Menidia beryllina*
- the mysid shrimp *Mysidopsis bahia*
- larvae of the sea urchin *Lytechinis pictus*.

All test organisms, except the mysid shrimp and silversides, were wild-captured and 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. Tube-dwelling amphipods, *A. abdita*, were supplied by Brezina and Associates of Dillon Beach, California. *Ampelisca abdita* were collected with a large dip-net, carefully removed from their tubes for enumeration, then placed in clean, native sediment for overnight transport to the MSL. *Nereis virens* were supplied by two sources. The first source provided animals that died shortly after introduction into test, reference, and control sediments. The second supplier, Brezina and Associates, provided animals that performed well in testing. *Nereis virens* were collected intertidally from Muscongus Bay, using a bucket and shovel. Organisms were transported via overnight mail on moist mats of seaweed in coolers. The amphipods, *R. abronius*, were collected by MSL personnel from West Beach, Whidbey Island, using an MSL-designed amphipod dredge and transported in clean coolers containing approximately 10 cm of sediment and 5 gal of clean seawater at ambient temperature. *Macoma nasuta* were collected from intertidal zones in Discovery Bay, Washington, by a commercial supplier using a shovel, bucket, and sieve. Bent-nose clams were kept cool before shipment by placing them in large containers filled with sediment and seawater from the collection site. *Menidia beryllina* were supplied by Aquatic Resources of Sebastopol, California. The silversides were shipped in large plastic bags containing seawater and maintained at approximately 15°C. Before shipment via overnight mail, seawater was supersaturated with oxygen to ensure test organism survival. *Mysidopsis bahia* were obtained from Aquatic Biosystems of Fort Collins, Colorado, and were shipped in plastic bags containing oxygen-supersaturated seawater and maintained at approximately 15°C. *Lytechinus pictus* were purchased from Marinus, Inc. of Long Beach, California. White urchins 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 grab and sand dredge samples were received at the MSL and inventoried against chain-of-custody forms, processed for solid-phase (SP) and suspended-particulate-phase (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 contamination of 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, polyvinyl chloride (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 under a fume hood, and the methylene chloride was allowed to evaporate under the 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-µm-filtered seawater for at least 2 days before use.

Large pieces of laboratory equipment, such as the epoxy-coated mixer used to mix sediment, 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 Winyah Bay Project. This table summarizes the composite sample designations, site location, and the stations that contributed to each composite. A total of 19 test sediment treatments were evaluated during the Winyah Bay Project: 11 test treatments (EC-1, EC-2, EC-3, IH-1, IH-2, IH-3, IH-2/IH-3 Comp, SR-1, SR-2, SR-3, and SR-4); 4 reference treatments (EC-Ref Comp, IHR1, IHR2, and Ocean Reference); and 4 control treatments (San Pablo Bay, Muscongus Bay, Whidbey Island, and Sequim Bay). One to three replicates were collected at each station. The Ocean Reference treatment, collected during the USACE Wilmington Program, was not originally included in the scope of work, but was added after the sample expedition, as it was similar in grain size to the Entrance Channel samples. This treatment was run as a composite as per agreement and under recommendation of the U.S. Environmental Protection Agency (EPA) and evaluated only in bioassays with species known to be sensitive to sediment grain-size (*A. abdita* and *R. abronius*). It was not used in other toxicological or bioaccumulation exposures.

TABLE 2.1. Compositing Strategy and Sample Designation for the Winyah Bay Project

Composite Sample	Location	Created from Stations
EC-1	Entrance Channel Segment 1	EC-1, Replicates 1 and 2
EC-2	Entrance Channel Segment 1	EC-2, Replicate 1
EC-3	Entrance Channel Segment 1	EC-3, Replicate 1
IH-1	Inner Harbor Segment 2	IH-1, Replicates 1, 2, and 3
IH-2	Inner Harbor Segment 2	IH-2, Replicates 1, 2, and 3
IH-3	Inner Harbor Segment 2	IH-3, Replicates 1, 2, and 3
IH-2/IH-3 Comp	Inner Harbor Segment 2	IH-2 and IH-3
SR-1	Sampit River Segment 3	SR-1, Replicate 1
SR-2	Sampit River Segment 3	SR-2, Replicate 1
SR-3	Sampit River Segment 3	SR-3 , Replicate 1
SR-4	Sampit River Segment 3	SR-4, Replicate 1
EC-Ref Comp	Entrance Channel Reference	RS01, Replicates 1, 2, and 3
IHR1	Inner Harbor Reference Clam Bank Creek	IHR1, Replicates 1, 2, 3, and 4
IHR2	Inner Harbor Reference Hare Island	IHR2, Replicates 1, 2, 3, and 4
Ocean Reference	Ocean Reference ODMDS, North Carolina	WHFINE 1, Replicates 1 and 2 WHFINE 2, Replicates 1 and 2
San Pablo Bay	*A. abdita* Control San Pablo Bay, CA	NA[a]
Muscongus Bay	*N. virens* Control Newcastle, ME	NA

TABLE 2.1. (contd)

Composite Sample	Location	Created from Stations
Whidbey Island	*R. abronius* Control Whidbey Island, WA	NA
Sequim Bay	*M. nasuta* Control Sequim Bay, WA	NA

(a) NA Not applicable.

2.2.3 Preparation of Solid-Phase Samples

The SP of sediment and sediment composite samples was used to evaluate the benthic effects of open water dredged material disposal. Reference and control sediments were press-sieved through a 1.0-mm screen to remove predators, then mixed in a large, epoxy-coated cement mixer. Test sediment samples were processed by homogenizing the sediment from a station until a uniform color and texture was achieved. Homogenization was accomplished by either placing the sediment in large stainless steel bowls and mixing it with stainless steel utensils, or by placing the sediment in the mixer. After mixing, a subsample was taken for archival purposes. After sediments from each station were processed, the remaining material from IH-2 and IH-3 was combined to create an IH-2/IH-3 composite and all three RS-01 replicates were combined to make the EC-Reference composite. Composites were prepared by placing all of the sediment in the mixer and creating a homogenous material. Homogenized and composited sediments were 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 Samples

The SPP of test sediment composite samples was used to evaluate water column effects of 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 fractions. The process is intended to approximate exposure conditions created as a result of materials being discharged through the water column during dredge-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 the 200-mL and 400-mL

volumes. Seawater 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 then 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. Then, the slurry was placed in a centrifuge and spun for 15 min at approximately 1750 rpm. The 15-min centrifugation ensured that test organisms would be visible at the first observation after exposure to SPP test treatments. After centrifugation, the supernatant was poured into clean, 10-gal aquaria for use in the SPP tests within 24 h of preparation. The remaining sludge mixture was discarded. The Teflon jars were rinsed after each use, and the above process was continued until an adequate amount of SPP for each test sediment 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 Winyah Bay Project. These tests included SP and SPP exposures and were designed to assess distinct ecological effects of proposed aquatic disposal of dredged material from the selected areas of Winyah Bay. 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 acute toxicity tests were conducted: a 10-day SP flow-through acute toxicity test using the amphipod, *A. abdita*; a 10-day SP static test using the amphipod, *R. abronius*; and a 10-day SP flow-through acute toxicity test using the polychaete, *N. virens*. Two bioaccumulation tests were conducted with test and reference sediments, including a 28-day SP exposure of both *N. virens* and *M. nasuta*. The 28-day test assessed the potential for bioaccumulation of contaminants from the sediment into the tissues of the organisms. The test treatments and procedures were similar to the 10-day 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 sediment tested, placed in random positions on 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 the effects caused by the physical presence of suspended particles and the toxicity of chemical contaminants associated with the particles or 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 using urchin larvae, *L. pictus*. The SPP treatments were prepared as described in Section 2.2.4. For each SPP treatment, there were five replicates

TABLE 2.2. Experimental Design for the Winyah Bay Project

Testing Parameter	EC-1	EC-2	EC-3	IH-1	IH-2	IH-3	IH-2, IH-3 Comp	SR-1	SR-2	SR-3	SR-4
Toxicity/Bioaccumulation Testing											
10-day *A. abdita* SP Test	√	√	√	-	-	-	-	-	-	-	-
10-day *R. abronius* SP Test	√	√	√	-	-	-	-	-	-	-	-
10-day N. virens SP Test	√	√	√	-	-	-	-	-	-	-	-
28-day *M. nasuta* SP Test	√	√	√	√	-	-	√	-	-	-	-
28-day *N. virens* SP Test	√	√	√	√	-	-	√	-	-	-	-
4-day *M. beryllina* SPP Test	√	√	√	-	-	-	-	-	-	-	-
4-day *M. bahia* SPP Test	√	√	√	-	-	-	-	-	-	-	-
3-day *L. pictus* SPP Test	√	√	√	-	-	-	-	-	-	-	-
Sediment Chemistry											
Grain Size	√	√	√	√	√	√	-	√	√	√	√
Specific Gravity	√	√	√	√	√	√	-	√	√	√	√
Settling Rates	-	-	-	-	-	-	-	-	-	-	-
Atterburg Limits	√	√	√	√	√	√	-	√	√	√	√
Total Solids	√	√	√	√	√	√	-	√	√	√	√
Total Organic Carbon	√	√	√	√	√	√	√	√	√	√	√
Ammonia	√	√	√	-	-	-	-	-	-	-	-
Sulfides	√	√	√	-	-	-	-	-	-	-	-
PAH	√	√	√	√	√	√	-	√	√	√	√
PCB/Pesticides	√	√	√	√	√	√	-	√	√	√	√
Phthalate Esters	√	√	√	√	√	√	-	√	√	√	√
Phenols	√	√	√	√	√	√	-	√	√	√	√
Methylene Chloride	√	√	√	√	√	√	-	√	√	√	√
Dioxins	√	√	√	√	√	√	-	√	√	√	√
Metals	√	√	√	-	-	-	-	√	√	√	√
Butyltins	√	√	√	√	√	√	√	√	√	√	√
Tissue Chemistry											
PAH	-	-	-	-	-	-	√	-	-	-	-
Organotins	-	-	-	-	-	-	√	-	-	-	-
Dioxins	-	-	-	-	-	-	√	-	-	-	-

TABLE 2.2. (contd)

Testing Parameter	EC-Ref Comp	IHR1	IHR2	Ocean Reference	San Pablo Bay	Muscongus Bay	Whidbey Island	Sequim Bay
Toxicity/Bioaccumulation Testing								
10-day *A. abdita* SP Test	√	-	-	√	√	-	-	√
10-day *R. abronius* SP Test	√	-	-	√	-	-	√	√
10-day *N. virens* SP Test	√	-	-	-	-	√	-	-
28-day *M. nasuta* SP Test	√	√	√	-	-	-	-	√
28-day *N. virens* SP Test	√	√	√	-	-	√	-	-
4-day *M. beryllina* SPP Test	-	-	-	-	-	-	-	-
4-day *M. bahia* SPP Test	-	-	-	-	-	-	-	-
3-day *L. pictus* SPP Test	-	-	-	-	-	-	-	-
Sediment Chemistry								
Grain Size	√	√	√	-	-	-	-	-
Specific Gravity	√	√	√	-	-	-	-	-
Atterburg Limits	√	√	√	-	-	-	-	-
Total Solids	√	√	√	-	-	-	-	-
Total Organic Carbon	√	√	√	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-
Acid-Volatile Sulfides	√	√	√	-	-	-	-	-
PAH	√	√	√	-	-	-	-	-
PCB/Pesticides	√	√	√	-	-	-	-	-
Phthalate Esters	√	√	√	-	-	-	-	-
Phenols	√	√	√	-	-	-	-	-
Methylene Chloride	√	√	√	-	-	-	-	-
Dioxins	√	√	√	-	-	-	-	-
Metals	√	-	-	-	-	-	-	-
Organotins	√	√	√	√	√	√	-	√
Tissue Chemistry								
PAH	-	-	√	-	-	-	-	-
Organotins	-	-	√	-	-	-	-	-
Dioxins	-	√	√	-	-	-	-	-

(a) Analysis completed for sample.
(b) Analysis not completed for sample.

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.

Table 2.2 shows all Entrance Channel sediment treatments were evaluated for all toxicological tests, with reference and control sediment included where appropriate. Because the SPP tests evaluated the difference in test organism survival in 0% (seawater) and 100% SPP exposures, testing of reference and control sediment composites was not required. The MSL facilities provided the required conditions for flow-through SP tests, static SP tests, and static SPP tests. Laboratory equipment included a controlled temperature water table, 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 at 20°C. 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 (Figure 2.4) that were placed in random positions on a water table maintained at 20°C. Before test initiation, sediment was added to the jars to a depth of 2 cm, then each jar was allowed to slowly fill to a total volume of 750 mL via the flow-through water system. The flow-through Mason jar allows a sub-surface exiting of seawater, thereby reducing the chance of test organism impingement on the screened discharge. Three replicate jars were prepared for each treatment and 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.

Before being transferred into a test container, amphipods were gently sieved from the holding tank into clean seawater and counted into small transfer containers, and the number of organisms was confirmed by a second observer. The test was initiated by adding 20 *A. abdita* to each 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 was recorded on observation forms. Amphipods floating on the surface were gently pushed below the water surface with a pipet tip, and observations were made as to whether they buried below the sediment or returned to the surface. 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 as follows:

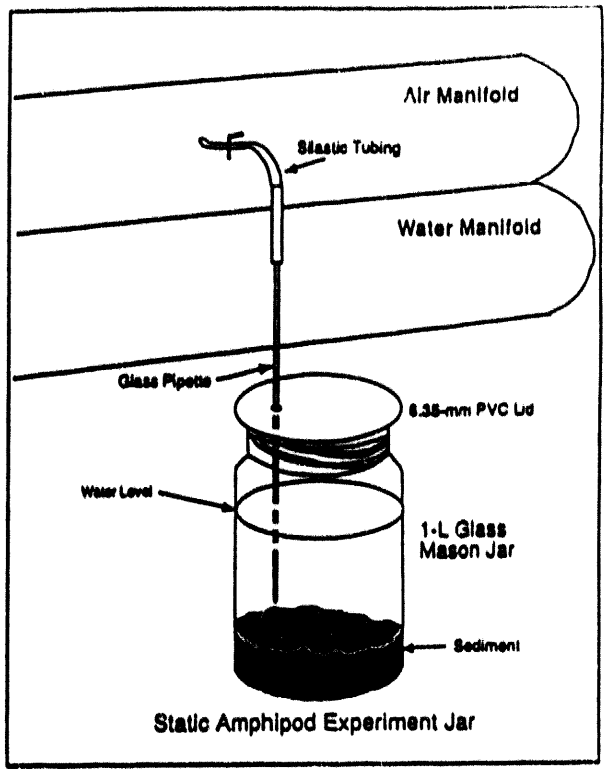

FIGURE 2.4. Flow-Through Testing Amphipod Jar

Dissolved Oxygen	≥5.0 mg/L
pH	7.8 ±0.5 units
Salinity	30‰ ±2.0‰
Temperature	20°C ±2.0°C.
Flow Rate	40 ±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. The endpoint of this test was death, defined as the absence of pleopod movement in response to gentle probing. The number of live, dead, and missing organisms was determined and noted on termination forms. 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. At least 10% of the mortality counts were confirmed by a second observer. Test organism sensitivity was assessed through a 4-day reference toxicant test that 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 (Figure 2.5), which were placed in random positions on a water table and maintained at 15°C. Before test initiation, sediment was added to the jars to a depth of 2 cm, then each jar was slowly filled with 0.45-µm-filtered 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.

The amphipods were gently sieved from the holding tank into clean seawater, counted, and placed into small transfer containers. The number of organisms was then confirmed by a second observer before being transferred into the test container. The test was initiated by adding 20 *R. abronius* to each test container. The date and time of initiation were recorded on data forms and on the lids of the test containers. The *R. abronius* were observed daily during the test and the number of organisms floating on the surface, swimming in the jar, or on the sediment surface was recorded on observation forms. Amphipods floating on the surface were gently pushed below the water surface with a pipet tip, and observations were made as to whether they buried below the sediment or returned to the surface.

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 as follows:

Dissolved Oxygen	≥5.0 mg/L
pH	7.8 ±0.5 units
Salinity	30‰ ±2.0‰
Temperature	15°C ±2.0°C.

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 *R. abronius*. The organisms were placed in clean seawater in a glass dish labeled with the sediment treatment and replicate number. The endpoint of this test was death, defined as the absence of pleopod movement in response to gentle probing. The number of live, dead, and missing organisms was determined and recorded on termination forms. 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. At

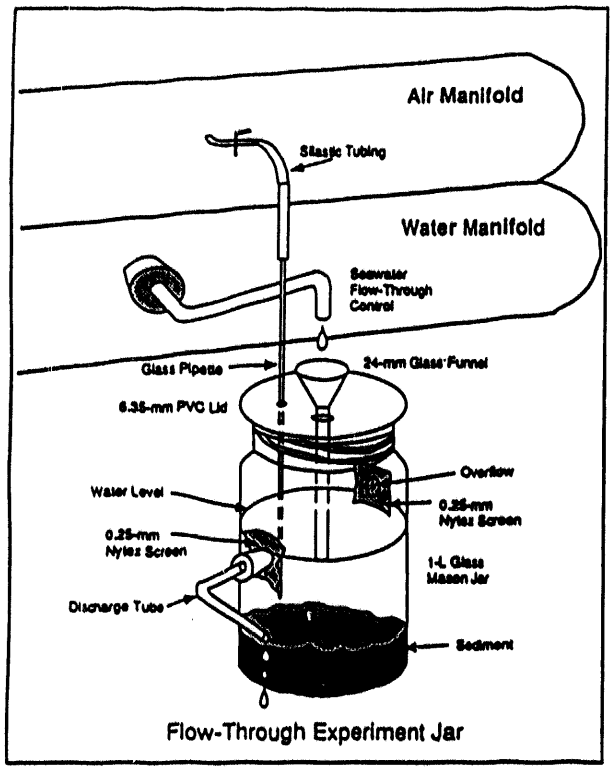

FIGURE 2.5. Static Amphipod Testing Jar

least 10% of the mortality counts were confirmed by a second observer. Test organism sensitivity was assessed through a 4-day reference toxicant test that included a seawater control and four concentrations of cadmium (0.5, 1.0, 2.0, and 4.0 mg/L).

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

Before 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 aquaria placed in random positions on water tables. Figure 2.6 shows the system used for flow-through tests. 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 pouring the sediment into the aquaria. The sediment was distributed evenly over the bottom of the aquaria with stainless steel utensils and allowed to settle for 4 h. The flow-through system was initiated and aquaria were allowed to fill to a total volume of approximately 36 L. The flow-through system was adjusted and calibrated to deliver 125 ±10 mL/min of seawater flow to each aquarium. The system operated overnight before adding the test organisms.

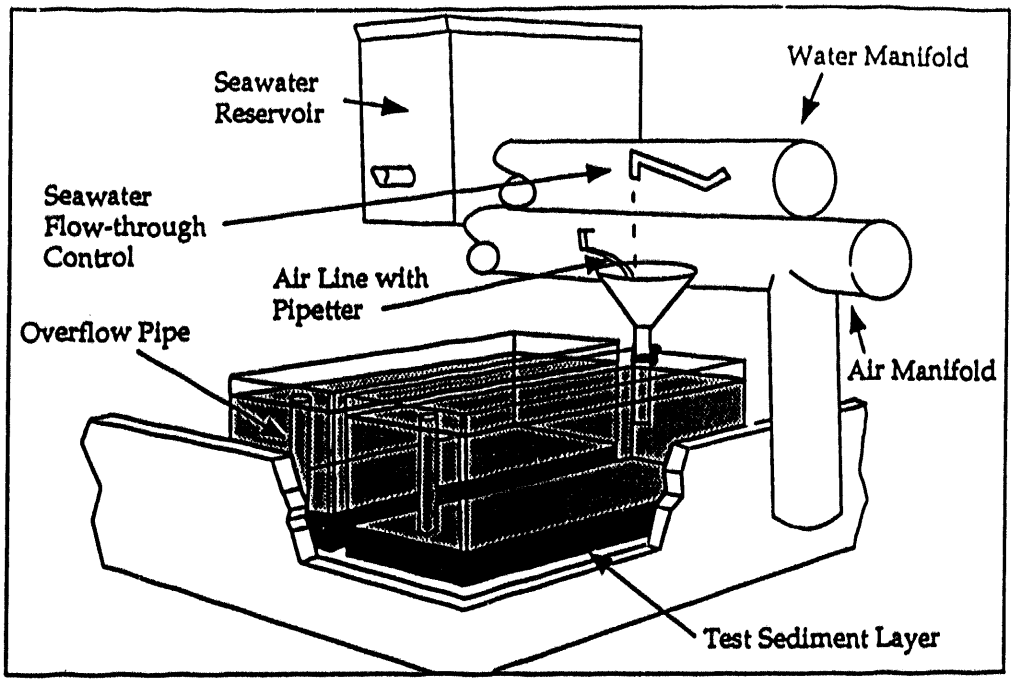

FIGURE 2.6. Flow-Through Aquarium

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 and date as well as the initials of the examiner who placed the organisms into each chamber. 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 as follows:

Dissolved Oxygen	≥4.0 mg/L
pH	7.8 ±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 and the number of dead organisms were noted daily in each aquaria. Dead organisms were removed from the aquaria and incinerated. Dead organisms were not replaced during testing. When a dead *N. virens* was removed, the specimen was identified as a whole animal or a portion of the animal (head or tail). During the first three days of this test, a high level of mortality of *N. virens* in test, reference, and control treatments was observed. The reason for poor test organism survival is not known. Test organisms appeared in relatively good health upon arrival, acclimated themselves well to test conditions, but began to die after introduction to test, reference, and control containers. Because

there was insufficient sediment available to completely reinitiate this test, all test organisms were carefully removed from the aquaria with minimal sediment disturbance. A new batch of test organisms was procured and placed in these aquaria, and the test was reinitiated as described above.

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. Death was determined by observing whether the *N. virens* reacted to gentle probing. If there was no movement, the organism was considered dead. The number of dead versus live was determined and recorded on termination forms. At least 10% of the mortality counts were confirmed by a second observer. No reference toxicant test was run for this species.

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

The procedure for conducting the 28-day SP flow-through test with *N. virens* was identical to that of the 10-day test except that: 1) the exposure period was increased from 10 to 28 days, and 2) the surviving test organisms were depurated in flowing seawater and tissues were saved for future chemical analysis. The ranges for water quality parameters such as temperature and flow rate and the test conditions 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 was monitored at the same frequency for both tests.

When the 28-day test ended, 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 following the 28-day exposure. After 48 h of depuration, the *N. virens* were gently washed in clean seawater to remove external sediment grains, put in containers, and frozen at -20°C for future chemical analysis. No reference toxicant test was run for this species.

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

The procedure for conducting the 28-day SP flow-through test with *M. nasuta* was identical to that of the 28-day *N. virens* test, except 25 *M. nasuta* were introduced into each aquaria to ensure adequate tissue for chemical analyses. As in the 28-day flow-through SP *N. virens* test, *M. nasuta* were allowed to depurate for 48 h following the 28-day exposure. The surviving *M. nasuta* were placed in the depuration aquarium containing only seawater. 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, frozen at -20°C, and submitted for chemical analysis.

2.3.6 4-Day Suspended-Particulate-Phase Static Test with *M. beryllina*

The *M. beryllina* were held before 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 4-day 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 10 *M. beryllina* to each test container. Fish 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. Date and time of initiation were recorded on data forms and on the lids of the test containers. *Menidia beryllina* were observed in the test chambers daily throughout the test. The endpoint of this test was death, determined by observing inactivity, pale discoloration, a lack of gill movement, and a lack of response to gentle probing. The number of live and dead organisms was noted on the data forms, and 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 as follows:

Dissolved Oxygen	≥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 (Day 4), final observations were conducted. At least 10% of the mortality counts were confirmed by a second observer. Test organism sensitivity was assessed through a 4-day reference toxicant test that included a seawater control and four concentrations of copper (16, 64, 160, and 400 µg/L). This test was conducted in the same manner as the SPP tests.

2.3.7 4-Day Suspended-Particulate-Phase Static Test with *M. bahia*

Mysidopsis bahia were held before testing in a 10-gal glass aquarium and fed <24-h old brine shrimp nauplii twice daily. Temperature, pH, DO, and salinity of water in the aquaria were monitored daily. This 4-day 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 and aerated. The test was conducted under a 16-h light, 8-h dark regime.

Mysids were gently pipetted from the holding tank into clean seawater and counted into small transfer containers, with the number of organisms being confirmed by a second observer before being transferred into the test container. The test was initiated by adding 10 *M. bahia* to each test container. Date and time of initiation were recorded on data forms, and the lids of the test containers. *Mysidopsis bahia* were observed in the test chambers daily throughout the test. The endpoint of this test was death, defined as the absence of movement in response to gentle probing. Number of live and dead organisms was noted on the data forms and 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 as follows:

Dissolved Oxygen	≥4.0 mg/L
pH	7.8 ±0.5 units
Salinity	30‰ ± 2.0‰
Temperature	20°C ±2.0°C.

At the end of the test (Day 4), final observations were conducted. At least 10% of the mortality counts were confirmed by a second observer. Test organism sensitivity was assessed through a 4-day reference toxicant test that included a seawater control and four concentrations of copper (50, 100, 150, and 300 µg/L). This test was conducted in the same manner as the SPP tests.

2.3.8 3-Day Suspended-Particulate-Phase Static Test with *L. pictus*

The test chambers for the 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 seawater filtered at 20 µm. Offshore water was used to prevent effects from algal blooms, sometimes associated with nearshore water, which may or may not affect the larvae. The final volume of test material in each container was 750 mL. Chambers containing SPP were placed in random positions on a water table and aerated. The test was conducted on a 16-h light, 8-h dark regime. When the containers reached test temperature (20°C±2°C), initial water quality parameters were measured in all replicates.

Adult *L. pictus* were obtained from a commercial supplier and used for testing on the day of receipt. Adult *L. pictus* were induced to spawn by injecting approximately 1 mL of 0.5 M potassium chloride into the coelomic cavity through the peristomal membrane. Animals then shed their sperm or eggs. Females, shedding orange-yellowish eggs, were inverted and placed in 250–mL beakers filled with raw seawater. Males, releasing whitish sperm, were inverted on dry petri dishes, and sperm were collected "dry." Eggs from at least two females were rinsed to remove feces and debris. Sperm from up to three males was pooled, "activated" in seawater, and then introduced into containers of egg suspension and allowed to fertilize. The egg suspensions were mixed frequently, over a 60-min period, using a perforated plunger. Then

fertilization of the embryos was assessed. To estimate fertilization success and embryo density, a 1-mL sub-sample was removed from each container (after thorough mixing), and the number of developing embryos and non-fertilized eggs was scored using a compound microscope (4x and 10x). The egg suspensions with a high percentage (>90%) of embryos that had undergone first cell division were pooled into a common stock for use in the test. 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 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 a pipette. The test initiation date and time were recorded on data record forms. Following initiation, 10-mL sub-samples were removed from each test chamber and fixed in 5% formaldehyde. These samples were used to determine chamber-specific stocking densities.

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 as follows:

Dissolved Oxygen	≥5.0 mg/L
pH	7.8 ±0.5 units
Salinity	30 ±2.0‰
Temperature	20.0°C ±2.0°C.

The sea urchin test was terminated after 72 h, when development of pluteus larvae was greater than 90% 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 pipette 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, gastrula/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 that included a seawater control and five concentrations of copper (2.9, 9, 30, 100, and 200 µg/L). This test was conducted in the same manner as the SPP tests.

2.4 SEDIMENT AND TISSUE CHEMISTRY PROCEDURES

Sediment samples collected in support of the Winyah Bay Project were analyzed for conventional and other chemical parameters. Conventional parameters included grain size, specific gravity, Atterburg limits, total solids, total organic carbon (TOC), ammonia, and acid-volatile sulfides. Sediments were also analyzed for polynuclear aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB)/pesticides, dioxins, phenols and substituted phenols, phthalate

esters, methylene chloride, 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, dioxins, 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 limit.

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. Data quality objectives for each analysis are summarized in Table 2.4.

2.4.1 Conventional Measurements

Conventional parameters included grain size, specific gravity, Atterburg limits, total solids, TOC, ammonia, and acid-volatile sulfides. Grain size, specific gravity, Atterburg limits, and total solids analyses were conducted by Soil Technology of Bainbridge Island, Washington. Grain size and total solids analyses followed the procedures described in Plumb (1981), specific gravity analysis was consistent with ASTM Method D-854-91 (ASTM 1991), and Atterburg limits were consistent with ASTM Method 4318. Fifteen grain size fractions (expressed in microns) were quantified: 4750, 2000, 850, 425, 250, 106, 75, 62.5, 31.2, 23, 15.6, 7.8, 3.9, 1.9, and ≤0.9. 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 portion of the grain size samples. Total solids, reported as a percent, were determined after oven drying at 90°C.

Analysis of TOC was performed by Global Geochem in Canoga Park, California, following Method 5310 (APHA 1989). The TOC 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.

Ammonia analyses were performed by the University of Washington on 100% SPP water samples from the biological tests following the procedures described in Plumb (1981).

Acid-volatile sulfide analysis was performed on sediment samples by the MSL following the methodology described in Cutter and Oates (1987). This technique employs selective generation of hydrogen sulfide, cryogenic trapping, gas chromatographic separation, and photoionization detection.

TABLE 2.3 Analytical Parameters and Target Detection Limits for Sediment and Tissue Samples

Analyte	Reference Method	Detection Limit
Grain Size (Sediment)	Plumb 1981	1.0%
Specific Gravity (Sediment)	ASTM D-854-91 (ASTM 1991)	NA
Total Solids (Sediment)	Plumb 1981	1.0%
Total Organic Carbon (Sediment)	5310 (APHA 1989)	0.1%
Ammonia	Plumb 1981	0.1 mg/kg
Total Sulfides	Plumb 1981	0.2 mg/kg
PAHs		
Acenapthene	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
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)

Analyte	Reference Method	Detection Limit
Pesticides		
Aldrin	8080 (EPA 1986)	10.0 µg/kg
α-BHC	8080 (EPA 1986)	10.0 µg/kg
ß-BHC	8080 (EPA 1986)	10.0 µg/kg
γ-BHC (Lindane)	8080 (EPA 1986)	10.0 µg/kg
δ-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 & derivatives	8080 (EPA 1986)	20.0 µg/kg
Endrin & derivatives	8080 (EPA 1986)	10.0 µg/kg
Heptachlor & derivatives	8080 (EPA 1986)	20.0 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 - 1500 µg/kg
2,4-dimethylphenol	8270 (EPA 1986)	100 - 1500 µg/kg
2,4,6-trichlorophenol	8270 (EPA 1986)	100 - 1500 µg/kg
Para-chloro-meta-cresol	8270 (EPA 1986)	100 - 1500 µg/kg
2-chlorophenol	8270 (EPA 1986)	100 - 1500 µg/kg
2,4-dichlorophenol	8270 (EPA 1986)	100 - 1500 µg/kg
2-nitrophenol	8270 (EPA 1986)	100 - 1500 µg/kg
4-nitrophenol	8270 (EPA 1986)	100 - 1500 µg/kg
2,4-dinitrophenol	8270 (EPA 1986)	100 - 1500 µg/kg
4,6-dinitro-o-cresol	8270 (EPA 1986)	100 - 1500 µg/kg
Pentachlorophenol	8270 (EPA 1986)	100 - 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)

Analyte	Reference Method	Detection Limit
Methylene Chloride	8010 (EPA 1986)	10µg/kg
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, 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
Organotins		
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 paramoters and for metals in tissues. Detection limits are in wet weight for all organic tissue parameters.

2.4.2 Polynuclear Aromatic Hydrocarbons (PAHs)

Analyses for 16 PAHs in the Winyah Bay sediment samples and tissues were performed by the 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

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

Parameter	QC Measurement	Frequency	Acceptable Limits
Organics[a]			
PAH/PCB Pesticide Butyltins Phenols Phthalate Esters Volatile Organics Dioxins	Procedural Blank	1 per 20 Samples	< MDL[b]
	Surrogate Internal Standards (SIS)	Each Sample	40 - 120%[d]
	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	1 per 20 Samples	40 - 120%[d] ≤ 30%[d] between MS/MSD
	Laboratory Duplicates	1 per 10 Samples	≤ 30%[d] for analytes >10 x MDL
	Standard Reference Material	1 per 20 Samples	≤ 30%[d] from Certified Value
Metals[a]			
Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn	Method Blank	1 per 20 Samples	< DL[c] x 3
	Matrix Spike	1 per 20 Samples	75 - 125%[d]
	Laboratory Duplicates	1 per 10 Samples	≤ 20%[d]
	Standard Reference Material	1 per 20 Samples	≤ 30%[d] from Certified Value
Conventionals[f]			
Grain Size	Laboratory Duplicates	1 per 10 Samples	≤ 20%[d]
Total Organic Carbon	Laboratory Duplicates	1 per 10 Samples	≤ 10%[d]
	Standard Reference Material [e]	1 per 20 Samples	≤ 20%[d] from Established Value
Ammonia	Method Blank	1 per 20 Samples	< MDL
	Laboratory Duplicates	1 per 10 Samples	≤ 30%[d]

TABLE 2.4 (contd)

Parameter	QC Measurement	Frequency	Acceptable Limits
Acid Volatile Sulfides	Method Blank	1 per 20 Samples	<MDL
	Laboratory Duplicates	1 per 10 samples	≤ 30%[d]
Total Solids	Laboratory Duplicates	1 per 10 samples	≤ 20%[d]
Specific Gravity	Laboratory Duplicates	1 per 10 samples	≤ 20%[d]
Atterburg Limits	Laboratory Duplicates	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 LC_{50} results
	Native Sediment Control	Concurrent with Each Test	≤ 10% mortality
Suspended Particulate Phase Tests (Non-Larval)	0% Control	Concurrent with Each Test	≤ 10% mortality
Suspended Particulate Phase Test (Larvae)	0% Control	Concurrent with Each Test	≤ 30% mortality
Bioaccumulation Studies	Native Sediment Control	Concurrent with Each Test	≤ 20% mortality

(a) Applies to sediments and tissues
(b) MDL–Mean Detected Limit
(c) Percent Recovery
(d) Relative percent difference (RPD)
(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)

sulfate, passed through a cleanup column, and concentrated in preparation for further cleanup by liquid chromatography. Tissue extracts were then run through gel permeation chromatography (GPC) before analysis to remove any additional interferences. The PAHs in sample extracts were analyzed by high-resolution capillary gas chromatography/mass spectrophotometry (GC/MS). A data system identified and measured the selected PAHs listed in Table 2.3 in a selective ion mode (SIM). In the SIM, each PAH compound was monitored simultaneously for the presence of a parent ion and a confirming second ion.

2.4.3 PCB and Pesticides

The PCB and pesticide analyses for the Winyah Bay sediment samples were performed by the BOS Laboratory. Chlorinated pesticides and PCBs in sediments 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 signal. 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. Dibromooctafluorobiphenyl (DBOFB) and the PCB congener, Cl_5 (112), were added to each sample before extraction to assess extraction efficiency.

2.4.4 Dioxins

Dioxin analysis in sediment and tissue samples was performed by Battelle Columbus, Columbus, Ohio, following the procedures summarized in EPA SW-846, 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 undergo a toluene or benzene Soxhlet extraction. Tissue samples undergo 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 are cleaned up by column chromatography. Then, the residues are spiked with $^{13}C_{12}$-1,2,3,4-TCDD to determine percent recoveries of tetra- and pentachloronated PCDD/PCDF congeners, and with $^{13}C_{12}$-1,2,3,7,8,9-HxCDD to determine percent recoveries of hexa-, hepta-, and octachloronated PCDD/PCDF congeners. The extracts are injected into a HRCG/HRMS system capable of performing in the SIM. Significant revisions to Method 8290 are as follows:

- Use of additional $^{13}C_{12}$-labeled internal standards so that each 2,3,7,8-substituted PCDD/PCDF isomer can 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 $^{37}C_{14}$-labeled 2,3,7,8-tetra-CDD as a cleanup recovery standard. This cleanup recovery standard was added to sample extracts before cleanup to evaluate analyte recovery through cleanup procedures. 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 sediments were analyzed by the BOS Laboratory following Method 8270 (EPA 1986). This method is appropriate for the extraction of semivolatile priority pollutants from sediment and tissue samples for analysis by gas chromatography (GC). In this procedure, approximately 100 g of sediment is extracted using 2:1 (volume:volume) dichloromethane/methanol in a Soxhlet extractor. The extract is partitioned with water and then dried through a column of anhydrous sodium sulfate. Elemental sulfur is removed using metallic mercury. Biological macromolecules are removed by cleanup with GPC. A portion of the extract undergoes alumina column chromatography to separate polar compounds from pesticides and PCBs before capillary GC with electron capture detection (GC-ECD) analysis. The remaining extract undergoes reverse phase column chromatography (bonded C_{18} solid phase) to reduce interferences from unresolved paraffinic hydrocarbons before GC/MS analysis for acid, base, and neutral compounds.

2.4.6 Methylene Chloride

Methylene chloride in samples was analyzed at the BOS Laboratory using Method 8010 (EPA 1986). Sediment samples were analyzed by GC (Tremetrics Model 9000) with a Hall detector operated in the halogen-specific mode. A purge-and-trap technique (Method 5030) was used for sample introduction onto the GC column.

Before sample analysis, samples were transferred from I-Chem jars to (VOA) vials and then mixed with distilled water and the appropriate surrogate compounds. The sediment samples were then heated and purged in an inert gas. The volatile components of the aqueous phase were transferred to the vapor phase, swept through a sorbent column, and adsorbed onto the sorbent column. When the purging was completed, the volatile components were introduced onto the GC column by heating the sorbent column and backflushing it with an inert gas. The GC oven temperature was programmed to resolve all volatile halocarbons.

2.4.7 Metals

Sediment samples from Sampit River and Entrance Channel stations as well as reference sediments were analyzed for metals at the MSL (AA) and Pacific Northwest Laboratoy (PNL) (ICP/MS). Inner Harbor sediment samples were not analyzed for metals per agreement with EPA because the analysis was run 6 months earlier in January 1992. These results are available in, *Water and Sediment Quality Analyses from Winyah Bay, Georgetown County, South Carolina* (Dames and Moore 1992). Three techniques were used for the analysis of sediment: inductively coupled plasma/mass spectroscopy (ICP/MS), graphite furnace atomic absor ɔtion (GFAA), and cold vapor atomic absorption (CVAA). The ICP/MS procedure follows procedures summarized in the EPA 200.8 (EPA 1990b). The GFAA methodology is summarized in EPA SW-846 (EPA 1986), 7000 series which was adapted into MSL Standard Operating Procedure (SOP) MSL-M-033. The CVAA methodology is summarized in EPA SW-846, 7000 series, which was adapted into a MSL SOP MSL-M-031. Sediments were analyzed for a total of 13 metals. Beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), thallium (Tl), and zinc (Zn) were analyzed by ICP/MS; arsenic (As), antimony (Sb), selenium (Se), and silver (Ag) were analyzed by GFAA, and mercury (Hg) was analyzed by CVAA.

To prepare sediments 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.

2.4.8 Organotins

Organotins in sediment and tissues were analyzed at the MSL. 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 tri-pentyltin were added before extraction as a surrogate compound to assess extraction efficiency. The mono-, di-, tri-, and tetra-butyltin 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. Each statistical test was based on a completely random design (CRD) allowing 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, includingtoxicological and bioaccumulation exposures. Test design and specific statistical analysis procedures are discussed in the following sections.

2.5.1 Randomization

Organisms were randomly allocated to treatments, and treatments were randomly positioned on water tables. 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 a reference ($\alpha = 0.05$).

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 ($\alpha = 0.05$) between survival in control replicates and survival in the 100% SPP replicates. This test is performed only when survival in the 100% SPP is less than control (0% SPP) survival and when control survival is greater than 90% (indicating test validity). Before 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 were calculated using the Trimmed Spearman-Karber Method (Finney 1971). The Spearman-Karber 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, LC_{50} values are reported as >100% SPP. The same method was used to calculate EC_{50} values (the concentration where 50% of the test individuals show a certain effect) for the sea urchin SPP test and LC_{50} values for all reference toxicant tests.

2.5.4 Statistical Analysis of Bioaccumulation

Test treatments and background tissues were compared to all reference treatments using ANOVA and Dunnett's Test for comparison of test treatments to a reference. 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 from that treatment was not analyzed. Significant bioaccumulation of a contaminant was determined by the statistical results of the Dunnett's Test ($\alpha = 0.05$).

2.6 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) 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 the PNL Quality Engineering Division as a QA Plan. The following discussion summarizes QA/QC procedures followed for the three main portions of this study: sediment sampling, biological testing, and chemical testing (all QA/QC evaluations are contained in Appendixes B, K, and L).

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 before biological testing. Subsamples for chemical analyses were obtained before biological testing. These subsamples were stored frozen 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/EPA 1991).

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 before analysis. Samples for metals were held up to 6 months before analysis.

2.6.2 Sediment and Tissue Chemistry Quality Control Procedures

Chemical testing procedures require that specific QA/QC protocols be followed. QA/QC guidelines specific to this project are provided by the PNL Quality Assurance Division as a QA 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 5% of the samples (where applicable) with appropriate compounds to assess accuracy
- duplicate analysis on at least 10% of the samples 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 atomic absorption (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 Winyah Bay QA Plan provided to USACE by MSL.

Measurements of accuracy can be determined by analyzing MS of known concentrations and standard reference materials 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 and organic compounds; in tissues, SRMs were analyzed for metals and PAHs only.

Surrogate compounds were added in known amounts to samples analyzed for PCBs, pesticides, PAHs, phenols, substituted phenols, phthalates, and butyltins. Surrogate compounds are added to samples before extraction and their recoveries are 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. 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 (±2.0°C), minimum DO of 4.0 to 6.0 mg/L, and continuous light or 16 h of light per day. Salinity was allowed to vary ±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 Winyah Bay Project. Sediment samples were collected from June 23 to 25, 1992. Two samplers were used in support of this study: an MSL-designed sand dredge and a 0.1 m^2 van Veen grab. The sand dredge was used at stations EC-1, EC-2, EC-3, EC-Ref Comp, and IHR2. The van Veen grab was used to collect sediment from the remaining stations. Penetration depth varied with sampler type. The sand dredge sampled surficial sediment to a depth of approximately 4 cm, while the van Veen grab sampled depths from 8 to 15 cm. The use of a vibratory coring device was attempted in this study, but was ineffective because of the relatively thin layer of sediment overlying the hard river bottom. In addition, the fine silt that was present in Winyah Bay would not stay in the vibratory coring device.

3.2 SEDIMENT CHEMISTRY

Sediment samples representing test treatments EC-1, EC-2, EC-3, IH-1, IH-2, IH-3, SR-1, SR-2, SR-3, SR-4, and reference treatments EC-Ref Comp, IHR1, and IHR2 were analyzed for a variety of contaminants. Included in these analyses were measurement of conventional sediment parameters, PAHs, chlorinated pesticides and PCBs, methylene chloride, dioxins, phenols and phthalates, metals, and organotins. The purpose of these measurements was to provide a characterization of contaminants associated with the sediments. This information was then used to assess contaminants that could potentially bioaccumulate into biota, represented in

TABLE 3.1. Summary of Test and Reference Sediment Collection

Station	Date Sampled	Depth (m)	Sampler	Penetration Depth (cm)
EC-1	24-Jun-92	7.0	Sand Dredge	4
EC-2	24-Jun-92	7.3	Sand Dredge	4
EC-3	24-Jun-92	7.2	Sand Dredge	4
EC-Ref Comp	24-Jun-92	8.8	Sand Dredge	4
IH-1	25-Jun-92	8.8	van Veen Grab	10
IH-2	25-Jun-92	7.8	van Veen Grab	15
IH-3	25-Jun-92	7.7	van Veen Grab	15
IHR1	23-Jun-92	0.7	van Veen Grab	8
IHR2	23-Jun-92	0.9	Sand Dredge	4
SR-1	23-Jun-92	7.7	van Veen Grab	15
SR-2	23-Jun-92	6.6	van Veen Grab	15
SR-3	23-Jun-92	7.2	van Veen Grab	15
SR-4	23-Jun-92	7.2	van Veen Grab	15

this study by the solid-phase test organisms *M. nasuta* and *N. virens*. Tissues of *M. nasuta* and *N. virens* were analyzed for contaminants of concern and statistically evaluated to determine bioaccumulation potential. Contaminants to be analyzed in tissue samples were decided upon jointly by USACE and EPA Region IV representatives, with technical assistance provided by MSL personnel.

3.2.1 Conventional Measurements

Conventional parameters measured in sediment included percent solids, specific gravity, grain size,TOC, acid-volatile sulfides (AVS), and Atterburg limits. These measurements are summarized in Tables 3.2 and 3.3. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, Tables B.1 through B.5 and B.28 through B.29. Quality control evaluations presented in Appendix B indicate that holding times, detection limits, replication, and SRMs (when applicable) were within acceptable QA/QC limits. The 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 19% to 84%, with all Sampit River stations, IH-2, and IH-3 being less than 30%. All Entrance Channel sediments and IH-1, IHR1 and IHR2 had percent solids ≥60%. Specific gravity measurements are also summarized in Table 3.2. Specific gravity was relatively consistent among sediment treatments, ranging from 2.38 to 2.82. The sediment grain size summary presented in Table 3.2 shows that sand dominated the Entrance Channel test treatments, test treatment IH-1, and reference treatments IHR1 and IHR2. The Inner Harbor test treatments IH-2 and IH-3, and all Sampit River test treatments were composed primarily of silts and clays. These data indicate that, with respect to sediment grain size, the reference EC-Ref Comp was similar to the Entrance Channel treatment. The Inner Harbor references (IHR1 and IHR2) were not similar to the Inner Harbor stations IH-2, and IH-3.

Table 3.3 summarizes the TOC, AVS, and Atterburg limits associated with the sediment treatments. This table shows that TOC ranged from undetected values (0.01%) in the Entrance Channel treatments to approximately 6% in the Sampit River stations (treatment SR-2). The AVS concentrations ranged from undetected (0.004 µmoles/g) in Entrance Channel treatments to 125 µmoles/g in treatment SR-1. Atterburg limits, calculable only in sediments composed primarily of silt and clay, were relatively similar, with liquid limits ranging from 44 to 228, plastic limits ranging from 20 to 55, and the plasticity index ranging from 23 to 174.

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

Sediment Treatment	Percent Solids	Specific Gravity	Percent Gravel	Percent Sand	Percent Silt	Percent Clay
EC-1	78.0	2.66	1.0	97.0	0.0	2.0
EC-2	79.0	2.64	0.0	99.0	0.0	1.0
EC-3	81.0	2.66	2.0	97.0	0.0	1.0
EC-Ref Comp	84.0	2.62	0.0	100.0	0.0	0.0
IH-1	75.0	2.67	1.0	90.0	3.0	6.0
IH-2	24.0	2.60	0.0	8.0	53.0	39.0
IH-3	21.0	2.82	0.0	5.0	65.0	30.0
IHR1	60.0(a)	2.68(a)	0.0(a)	76.0(a)	6.0(a)	18.0(a)
IHR2	82.0	2.66	0.0	96.0	1.0	3.0
SR-1	26.0	2.74	0.0	17.0	33.0	50.0
SR-2	19.0	2.38	0.0	7.0	73.0	20.0
SR-3	23.0	2.66	0.0	11.0	44.0	45.0
SR-4	19.0(a)	2.46(a)	0.0(a)	2.0(a)	71.0(a)	26.0(a)

(a) Mean of replicate measurements.

TABLE 3.3. Summary of TOC, Acid Volatile Sulfides (AVS), and Atterburg Limits for Sediment Samples

Sediment Treatment	TOC (%)	AVS (µmoles/g dry)	Atterburg Limits		
			Liquid Limit	Plastic Limit	Plasticy Index(a)
EC-1	0.01 U(b)	0.023	ND(c)	ND	ND
EC-2	0.01 U	0.007 U	ND	ND	ND
EC-3	0.01 U	0.004 U	ND	ND	ND
EC-Ref Comp	0.01 U	0.007 U	ND	ND	ND
IH-1	0.46	0.024	ND	ND	ND
IH-2	4.21	30.200	181.0	42.0	139.0
IH-3	4.51	13.300	213.0	39.0	174.0
IH-2/H-3 Comp	4.18	20.400	ND	ND	ND
IHR1	0.84	9.79(d)	44.0	20.0	23.0
IHR2	0.22	0.205	ND	ND	ND
SR-1	3.82	125.00	194.0	44.0	130.0
SR-2	5.86(d)	4.545(d)	203.0	52.0	151.0
SR-3	5.23	30.700	193.0	46.0	147.0
SR-4	5.65	12.500	228.0	55.0	174.0

(a) Liquid Limit /Plastic Limit.
(b) U Analyte not present above the level of associated value.
(c) ND No data, sample was primarily sand.
(d) Mean of replicate measurements.

3.2.2 Polynuclear Aromatic Hydrocarbons

Polynuclear aromatic hydrocarbon concentrations are summarized in Table 3.4. All data associated with these characterizations and related quality assurance summaries are found in Appendix B, Tables B.6 through B.11. Quality control evaluations for PAHs indicate that holding time limits were met, blanks were uncontaminated with the exception of low levels of naphthalene, detection limit goals were met, and surrogate recoveries were within acceptable limits except for d8 napthalene. Matrix spike/matrix spike duplicate analyses exhibited acceptable precision and accuracy, replicate analysis produced data within QA/QC limits, and analysis of standard reference material (SRMs) was generally acceptable. The assessment of the PAH analyses suggests that these data are acceptable for use in evaluating sediment-bound contaminants.

Table 3.4 summarizes the measured concentrations of PAHs expressed as total low molecular weight PAH (LPAH), total high molecular weight PAH (HPAH), and total PAH. The lowest concentrations were associated with the Entrance Channel test treatments and the corresponding reference site, EC-Ref Comp. Inner Harbor test treatments produced PAH levels ranging from 19.22 µg/kg in treatment IH-1 to 299.70 µg/kg in treatment IH-3. The corresponding references, IHR1 and IHR2, produced levels of 198.37 µg/kg and 30.62 µg/kg, respectively. Comparison of the treatments IH-2 and IH-3 to the IHR2 reference showed that the test treatment concentrations were approximately 8 to 10 times higher. The Sampit River test treatments had the highest levels of PAHs, ranging from 303.86 µg/kg to 449.81 µg/kg. Given the low levels of PAHs in the Entrance Channel sediment treatments, no PAH analysis was conducted on tissues exposed to these sediment treatments. A PAH analysis was, however, conducted on tissues exposed to the composite of sediment treatments IH-2 and IH-3 (IH-2/IH-3 Comp) and the IHR2 reference treatment. Background, or pre-exposure, tissue samples were also analyzed to establish background levels of PAHs in wild-captured animals. Tissues exposed to test treatments representing the Sampit River were not analyzed for PAHs because those sediments were not scheduled for unconfined open-ocean disposal. The PAH tissue results were analyzed statistically to determine whether significant elevations of PAHs were associated with tissues exposed to test treatments.

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

Sediment Treatment	Concentration (ug/kg dry weight) Total LPAH	Total HPAH	Total PAH
EC-1	1.80	6.87	8.67
EC-2	2.09	4.25	6.34
EC-3	1.02	0.40	1.42
EC-Ref Comp	1.20	0.91	2.11
IH-1(a)	2.46	16.76	19.22
IH-2	33.65	224.03	257.68
IH-3	33.57	266.13	299.70
IHR1	18.34	180.03	198.37
IHR2	4.03	26.59	30.62
SR-1	36.07	267.79	303.86
SR-2	61.00	295.36	356.36
SR-3	89.04	360.77	449.81
SR-4	66.22	348.14	414.36

(a) Mean of replicate measurements.

3.2.3 Chlorinated Pesticides and PCBs

Chlorinated pesticide and PCB concentrations are summarized in Tables 3.5 through 3.9. 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 times were met, blanks were uncontaminated, detection limits were generally met, and surrogate recoveries were within acceptable ranges. Matrix spike/matrix spike duplicate analyses indicate that recoveries were outside target limits for approximately one-half of the compounds, though relative percent differences between spikes and duplicates were within acceptable limits. The PCB quality control information indicated compliance with holding times, uncontaminated blanks, and elevated detection limits for some compounds because of matrix interferences. Matrix spike/matrix spike duplicate data showed percent recovery within allowable limits and acceptable precision and accuracy. The assessment of PCB/pesticide analyses suggests that these data are acceptable for use in evaluating sediment-bound contaminants.

Tables 3.5 through 3.8 summarize pesticide concentrations observed in the test and reference sediment treatments. Pesticides were undetected in all sediment treatments except test treatment SR-1, where Delta BHC, 4,4'-DDD, and 4,4'-DDE were detected at approximately 3 µg/kg (dry wt.). Table 3.9 summarizes the PCB concentrations in sediment and shows that PCBs were undetected in all sediment treatments. Elevated detection limits were observed in 5 of 13 samples because of matrix interferences. Based on the results of these analyses, PCB and pesticide analyses of tissue samples were not necessary.

TABLE 3.5. Summary of Pesticides in Sediment Samples (Alpha BHC to 4,4'-DDD)

Sediment Treatment	Concentration (ug/kg dry weight)					
	Aldrin	Alpha BHC	Beta BHC	Delta BHC	Chlordane	4,4'-DDD
EC-1	0.635 U[a]	0.303 U	0.303 U	0.303 U	30.496 U	0.892 U
EC-2	0.679 U	0.324 U	0.324 U	0.324 U	32.615 U	0.954 U
EC-3	0.632 U	0.302 U	0.302 U	0.302 U	30.376 U	0.888 U
EC-Ref Comp	0.605 U	0.289 U	0.289 U	0.289 U	29.072 U	0.850 U
IH-1[b]	0.693 U	0.331 U	0.331 U	0.331 U	33.317 U	0.974 U
IH-2	2.593 U	1.239 U	1.239 U	1.239 U	124.579 U	3.643 U
IH-3	3.020 U	1.443 U	1.443 U	1.443 U	145.082 U	4.243 U
IHR1	0.969 U	0.463 U	0.463 U	0.463 U	46.552 U	1.361 U
IHR2	0.656 U	0.313 U	0.313 U	0.313 U	31.504 U	0.921 U
SR-1	1.787 U	0.854 U	0.854 U	3.442	85.866 U	3.396
SR-2	2.523 U	1.206 U	1.206 U	1.206 U	121.220 U	3.545 U
SR-3	2.574 U	1.230 U	1.230 U	1.230 U	123.663 U	3.616 U
SR-4	2.593 U	1.239 U	1.239 U	1.239 U	124.559 U	3.643 U

(a) U Analyte not present above the level of associated value.
(b) Mean of replicate measurements.

TABLE 3.6. Summary of Pesticides in Sediment Samples (4,4'-DDE to Endosulfan Sulfate)

Sediment Treatment	Concentration (ug/kg dry weight)					
	4,4'-DDE	4,4'-DDT	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan Sulfate
EC-1	0.388 U[a]	0.951 U	0.609 U	3.050 U	3.050 U	3.050 U
EC-2	0.415 U	1.017 U	0.651 U	3.262 U	3.262 U	3.262 U
EC-3	0.387 U	0.947 U	0.606 U	3.038 U	3.038 U	2.907 U
EC-Ref Comp	0.370 U	0.906 U	0.580 U	2.907 U	2.907 U	2.907 U
IH-1[b]	0.424 U	1.039 U	0.665 U	3.332 U	3.332 U	3.332 U
IH-2	1.586 U	3.884 U	2.486 U	12.458 U	12.458 U	12.458 U
IH-3	1.847 U	4.524 U	2.895 U	14.508 U	14.508 U	14.508 U
IHR1	0.593 U	1.452 U	0.929 U	4.655 U	4.655 U	4.655 U
IHR2	0.401 U	0.982 U	0.629 U	3.150 U	3.150 U	3.150 U
SR-1	3.131	2.667 U	1.713 U	8.587 U	8.587 U	8.587 U
SR-2	1.543 U	3.780 U	2.419 U	12.122 U	12.122 U	12.122 U
SR-3	1.574 U	3.856 U	2.468 U	12.366 U	12.366 U	12.366 U
SR-4	1.586 U	3.884 U	2.486 U	12.456 U	12.456 U	12.456 U

(a) U Analyte not present above the level of associated value.
(b) Mean of replicate measurements.

TABLE 3.7. Summary of Pesticides in Sediment Samples (Endrin to Heptachlor Epoxide)

Sediment Treatment	Concentration (ug/kg dry weight) Endrin	Endrin Aldehyde	Endrin Ketone	Heptachlor	Heptachlor Epoxide
EC-1	1.735 U[a]	3.050 U	3.050 U	0.826 U	0.702 U
EC-2	1.856 U	3.262 U	3.262 U	0.883 U	0.751 U
EC-3	1.728 U	3.038 U	3.038 U	0.822 U	0.699 U
EC-Ref Comp	1.654 U	2.907 U	2.907 U	0.787 U	0.669 U
IH-1[b]	1.896 U	3.332 U	3.332 U	0.902 U	0.767 U
IH-2	7.089 U	12.458 U	12.458 U	3.373 U	2.867 U
IH-3	8.255 U	14.508 U	14.508 U	3.928 U	3.339 U
IHR1	2.649 U	4.655 U	4.655 U	1.260 U	1.071 U
IHR2	1.793 U	3.150 U	3.150 U	0.853 U	0.725 U
SR-1	4.886 U	8.587 U	8.587 U	2.325 U	1.976 U
SR-2	6.897 U	12.122 U	12.122 U	3.282 U	2.790 U
SR-3	7.036 U	12.366 U	12.366 U	3.348 U	2.846 U
SR-4	7.087 U	12.456 U	12.456 U	3.372 U	2.867 U

(a) U Analyte not present above the level of associated value.
(b) Mean of replicate measurements.

TABLE 3.8. Summary of Pesticides in Sediment Samples (Lindane to Toxaphene)

Sediment Treatment	Concentration (ug/kg dry weight) Lindane	Methoxy-chlor	Toxaphene
EC-1	0.303 U[a]	3.050 U	30.496 U
EC-2	0.324 U	3.262 U	32.615 U
EC-3	0.302 U	3.038 U	30.376 U
EC-Ref Comp	0.289 U	2.907 U	29.072 U
IH-1[b]	0.331 U	3.332 U	33.317 U
IH-2	1.239 U	12.458 U	124.579 U
IH-3	1.443 U	14.508 U	145.082 U
IHR1	0.463 U	4.655 U	46.552 U
IHR2	0.313 U	3.150 U	31.504 U
SR-1	0.854 U	8.587 U	85.866 U
SR-2	1.206 U	12.122 U	121.220 U
SR-3	1.230 U	12.366 U	123.663 U
SR-4	1.239 U	12.456 U	124.559 U

(a) U Analyte not present above the level of associated value.
(b) Mean of replicate measurements.

TABLE 3.9. Summary of PCBs in Sediment Samples

Sediment Treatment	Concentration (ug/kg dry weight) Aroclor 1221	Aroclor 1232	Aroclor 1242/1016	Aroclor 1248	Aroclor 1254	Aroclor 1260
EC-1	30.496 U(a)	30.496 U	30.496 U	30.496 U	30.496 U	30.496 U
EC-2	32.615 U	32.615 U	32.615 U	32.615 U	32.615 U	32.615 U
EC-3	30.376 U	30.376 U	30.376 U	30.376 U	30.376 U	30.376 U
EC-Ref Comp	29.072 U	29.072 U	29.072 U	29.072 U	29.072 U	29.072 U
IH-1(b)	33.317 U	33.317 U	33.317 U	33.317 U	33.317 U	33.317 U
IH-2	124.579 U	124.579 U	124.579 U	124.579 U	124.579 U	124.579 U
IH-3	145.082 U	145.082 U	145.082 U	145.082 U	145.082 U	145.082 U
IHR1	46.552 U	46.552 U	46.552 U	46.552 U	46.552 U	46.552 U
IHR2	31.504 U	31.504 U	31.504 U	31.504 U	31.504 U	31.504 U
SR-1	85.866 U	85.866 U	85.866 U	85.866 U	85.866 U	85.866 U
SR-2	121.220 U	121.220 U	121.220 U	121.220 U	121.220 U	121.220 U
SR-3	123.663 U	123.663 U	123.663 U	123.663 U	123.663 U	123.663 U
SR-4	124.559 U	124.559 U	124.559 U	124.559 U	124.559 U	124.559 U

(a) U Analyte not present above the level of associated value.
(b) Mean of replicate measurements.

3.2.4 Dioxins and Furans

Dioxin and furan concentrations are summarized in Tables 3.10 through 3.12. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, Tables B.32 through B.36. Quality control evaluations for dioxins presented in Appendix B show that holding time limits were met, blank contamination was not observed, detection limits goals were met, and surrogate recoveries were generally within acceptable ranges. Matrix spike/matrix spike duplicate results showed acceptable precision. Analytical accuracy determination through the analysis of matrix spike recoveries was within QA/QC limits for all congeners, except OCDD. The overall assessment of the dioxin and furan analyses indicates that these data are acceptable for use in evaluating sediment-bound contaminants.

Tables 3.10 through 3.12 summarize the dioxin concentrations in the test and reference sediment treatments. The dioxin congener 2378-TCDD, considered the most toxic by EPA, based on its Toxicity Equivalent Factor (TEF) (EPA 1988), was detected in only two sediment treatments, IHR2 (0.29 ng/kg dry) and SR-1(1.69 ng/kg dry). Two other dioxin/furan 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 less toxic congeners were detected in test and reference sediment treatments. The highest levels were associated with OCDD, which is considered ubiquitous (1987). Based on these data, it was decided that tissues of *M. nasuta* and *N. virens* exposed to the composite sample IH-2/IH-3 Comp, and the reference treatments IHR1 and IHR2 should be analyzed for dioxins. In addition,

TABLE 3.10. Summary of Dioxins in Sediment Samples (2378-TCDD to 1234678 OCDD)

Sediment Treatment	Concentration (ng/kg dry weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
EC-1	0.3 U[a]	0.1 U	0.2 U	0.09	0.4 U	2.19	46.37
EC-2	0.4 U	0.1 U	0.2 U	0.1 U	0.4 U	1.03	20.63
EC-3	0.4 U	0.3 U	0.3 U	0.3 U	0.5 U	1.29	31.88
EC-Ref Comp	0.3 U	0.2 U	0.2 U	0.2 U	0.4 U	0.52	10.44
IH-1	0.4 U	0.3 U	0.20	0.27	0.96	10.73	208.90
IH-2	1.1 U	0.7 U	0.31	0.74	3.6 U	25.30	796.51
IH-3	0.6 U	0.4 U	0.31	0.56	1.36	25.47	692.11
IHR1	0.3 U	0.28	0.59	0.87	2.17	25.34	359.81
IHR2	0.29	0.4 U	0.4 U	0.36	1.7 U	9.37	252.96
SR-1	1.69	2.2 U	2.6 U	1.10	2.87	53.11	1635.64
SR-2	1.0 U	0.32	0.44	0.91	2.21	38.88	1029.00
SR-3	0.6 U	0.22	0.28	0.40	1.27	17.54	453.89
SR-4	1.1 U	0.9 U	1.2 U	1.32	4.90	37.74	1033.36

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

TABLE 3.11. Summary of Furans in Sediment Samples (2378-TCDF to 123789 HxCDF)

Sediment Treatment	Concentration (ng/kg dry weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF
EC-1	0.3 U[a]	0.2 U	0.2 U	0.2 U	0.1 U	0.32
EC-2	0.2 U	0.1 U	0.1 U	0.1 U	0.1 U	0.32
EC-3	0.05	0.2 U	0.2 U	0.2 U	0.2 U	0.90 U
EC-Ref Comp	0.3 U	0.3 U	0.3 U	0.1 U	0.1 U	0.32
IH-1	0.18	0.2 U	0.2 U	0.1 U	0.1 U	0.8 U
IH-2	1.7 U	0.5 U	0.5 U	0.4 U	0.4 U	0.43
IH-3	0.67	0.3 U	0.2 U	1.6 U	0.08	0.42
IHR1	0.26	0.2 U	0.2 U	0.3 U	0.3 U	0.37
IHR2	0.56	0.4 U	0.13	0.14	0.3 U	0.31
SR-1	6.98	3.0 U	2.2 U	5.4 U	1.4 U	1.3 U
SR-2	1.22	0.6 U	0.4 U	0.27	0.4 U	0.41
SR-3	0.68	0.4 U	0.3 U	0.3 U	0.3 U	0.38
SR-4	1.71	1.1 U	1.4 U	0.9 U	0.8 U	1.0 U

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

TABLE 3.12. Summary of Furans in Sediment Samples (234678 HxCDF to OCDF).

Sediment Treatment	Concentration (ng/kg dry weight) 234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
EC-1	0.1 U[a]	0.21	0.2 U	0.25
EC-2	0.1 U	0.5 U	0.2 U	0.17
EC-3	0.2 U	0.6 U	0.4 U	0.76
EC-Ref Comp	0.2 U	0.6 U	0.2 U	0.5 U
IH-1	0.1 U	0.8 U	0.1 U	0.60
IH-2	0.2 U	1.45	0.4 U	2.54
IH-3	0.1 U	3.2 U	0.3 U	2.87
IHR1	0.1 U	0.92	1.2 U	1.18
IHR2	0.2 U	1.7 U	0.4 U	0.93
SR-1	0.9 U	7.5 U	1.8 U	7.45
SR-2	0.2 U	6.0 U	0.4 U	5.06
SR-3	0.1 U	2.2 U	0.2 U	1.86
SR-4	0.4 U	7.0 U	0.9 U	5.43

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

pre-exposure samples of *M. nasuta* and *N. virens* were analyzed to determine background concentrations.

3.2.5 Phenols, Substituted Phenols, Phthalate Esters

Phenols, substituted phenols, and phthalate esters are summarized in Tables 3.13 through 3.15. 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, substituted phenols, and phthalates, presented in Appendix B, show that holding time limits were met and significant blank contamination was not observed. Detection limit goals were met, with the exception of one sample analyzed for phthalates. Surrogate recovery for phenols was generally low, and matrix spike/matrix spike duplicates were within acceptable QA goals for phenols, but generally not for phthalates. Replicate results showed acceptable precision in approximately half of the samples analyzed. The assessment of the phenol and phthalate analysis suggests that these data are acceptable for use in evaluating sediment-bound contaminants, though the low surrogate recoveries associated with the phthalates suggest a potential underestimate of phthalate compounds in sediments from Winyah Bay.

Concentrations of phenols, substituted phenols, and phthalates in sediment treatments are presented in Table 3.13 through 3.15. Most phenolic and phthalate compounds were either not detected in test and reference sediments, or quantified below the analytical detection limit, indicated by a "J" flag on the data. Because most phenolic and phthalate compounds were either not detected or detected below the target detection limit, tissues were not analyzed for these compounds.

TABLE 3.13. Summary of Phenols and Substituted Phenols in Sediment Samples (Phenol to 2,4,6-trichlorophenol)

Sediment Treatment	Phenol	2-chloro-phenol	2-nitro-phenol	2,4-dimethyl-phenol	2,4-dichloro-phenol	2,4,6-trichloro-phenol
EC-1	19.31 J[a]	295.69 U[b]	295.69 U	295.69 U	295.69 U	295.69 U
EC 2	38.90 J	1.84 J	316.23 U	1.76 U	38.54 J	1.73 J
EC-3	22.56 J	294.52 U	294.52 U	1.21 J	294.52 U	294.52 U
EC-Ref Comp	7.37 J	0.77 J	281.88 U	281.88 U	281.88 U	281.88 U
IH-1[c]	32.17 U	113.66 U	323.04 U	210.93 U	219.68 U	219.78 U
IH-2	189.30 U	1207.90 U	1207.90 U	10.10 J	7.19 J	5.67 J
IH-3	199.92 J	1406.69 U	1406.69 U	17.54 J	21.28 J	18.71 J
IHR1	85.11 J	451.36 U	451.36 U	451.36 U	451.36 U	451.36 U
IHR2	61.62 J	305.46 U	305.46 U	1.37 J	305.46 U	305.46 U
SR-1	129.28 J	832.55 U	832.55 U	9.16 J	832.55 U	832.55 U
SR-2	138.47 J	10.26 J	1175.33 U	16.82 J	21.42 J	14.07 J
SR-3	338.38 J	18.87 J	1199.02 U	10.03 J	1199.02 U	1199.02 U
SR-4	294.26 J	1207.71 U	1207.71 U	14.83 J	1207.71 U	1207.71 U

(a) J Analyte detected below method detection limit but above instrument detection limit.
(b) U Analyte not present above the level of associated value.
(c) Mean of replicate measurements.

TABLE 3.14. Summary of Phenols and Substituted Phenols and Sediment Samples (2,4-dinitrophenol to 4,6-dinitro-o-creosol)

Sediment Treatment	2,4-dinitro-phenol	4-nitro-phenol	Para-chlorometa-creosol	Penta-Chloro-phenol	4,6-dinitro-o-creosol
EC-1	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U
EC-2	316.23 U	316.23 U	5.24 J	316.23 U	316.23 U
EC-3	294.52 U	294.52 U	0.81 J	218.53 J	294.52 U
EC-Ref Comp	281.88 U	281.88 U	281.88 U	2.28 J	281.88 U
IH-1[c]	323.04 U	323.04 U	210.74 U	3.76 J	323.04 U
IH-2	1207.90 U	1207.90 U	12.27 J	46.67 J	1207.90 U
IH-3	1406.69 U	1406.69 U	25.15 J	205.82 J	1406.69 U
IHR1	451.36 U	451.36 U	1.69 J	56.34 J	451.36 U
IHR2	305.46 U	305.46 U	1.05 J	5.15 J	305.46 U
SR-1	832.55 U	832.55 U	6.20 J	17.16 J	832.55 U
SR-2	1175.33 U	1175.33 U	22.14 J	251.11 J	1175.33 U
SR-3	1199.02 U	1199.02 U	12.30 J	41.78 J	1199.02 U
SR-4	1207.71 U	3.64 J	11.31 J	24.02 J	1207.71 U

(a) J Analyte detected below method detection limit but above instrument detection limit.
(b) U Analyte not present above the level of associated value.
(c) Mean of replicate measurements.

TABLE 3.15. Summary of Phthalate Compounds in Sediment Samples (Butylbenzylphthalate to di-n-butylphthalate)

Sediment Treatment	Butyl benzyl phthalate	Bis(2-ethylhexyl)-phthalate	di-n-octyl phthalate	dimethyl phthalate	diethyl phthalate	di-n-butyl phthalate
EC-1	1.88 J[a]	2.08 J	0.23 J	295.69 U[b]	0.92 J	1.46 J
EC 2	1.50 J	2.08 J	316.23 U	1.04 J	0.99 J	1.87 J
EC-3	1.13 J	2.26 J	294.52 U	294.52 U	0.39 J	0.96 J
EC-Ref Comp	0.88 J	1.94 J	0.31 J	281.88 U	3.03 J	0.58 J
IH-1[c]	1.65 J	3.69 J	323.04 U	219.55 U	0.53 J	2.03 J
IH-2	8.94 J	12.66 J	1207.90 U	1207.90 U	5.00 J	6.87 J
IH-3	7.94 J	14.30 J	1406.69 U	1406.69 U	11.79 J	6.84 J
IHR1	2.02 J	5.10 J	451.36 U	1.21 J	1.14 J	451.36 U
IHR2	1.42 J	2.53 J	0.43 J	305.46 U	0.34 J	1.45 J
SR-1	9.53 J	11.51 J	832.55 U	832.55 U	2.74 J	4.04 J
SR-2	10.07 J	23.96 J	1175.33 U	1175.33 U	4.01 J	6.23 J
SR-3	1199.02 U	1199.02 U	1199.02 U	1199.02 U	1.91 J	6.52 J
SR-4	10.23 J	14.76 J	1207.71 U	1207.71 U	13.98 J	1207.71 U

(a) J Analyte detected below method detection limit but above instrument detection limit.
(b) U Analyte not present above the level of associated value.
(c) Mean of replicate measurements.

3.2.6 Methylene Chloride

All data associated with methylene chloride concentrations in sediment samples are summarized in Appendix B, Tables B.30 and B.31. The concentrations of methylene chloride for all samples were below the detection limit of 2.0 mg/kg in all samples.

3.2.7 Metals

The concentration of metals in sediment are summarized in Tables 3.16 and 3.17. All data associated with these summaries and related quality assurance measurements may be found in Appendix B, 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 copper (Cu) and zinc (Zn) were detected above the target detection limit. Detection limit goals were met with the exception of arsenic (As), chromium (Cr), lead (Pb), antimony (Sb), and Zn. Since these metals were observed at levels above the detection limit, this is not considered a problem. Matrix spike analysis indicated acceptable precision for most metals, and replicate analyses yielded acceptable precision for most metals except Cu, Zn, thallium (Tl), and Pb. Analytical precision was assessed by analysis of a SRM, and was generally within QA/QC limits. The assessment of the metals analyses suggests that these data are acceptable for use in evaluating sediment-bound contaminants.

TABLE 3.16. Summary of Metals in Sediment Samples (Ag to Hg)

Sediment Treatment	Concentration (mg/kg dry weight)						
	Ag	As	Be	Cd	Cr	Cu	Hg
EC-1	0.03 U[a]	4.06	0.98	0.01 U	9.11	1.33	0.001
EC-2	0.03 U	2.40	0.13	0.01 U	4.18	1.05	0.001 U
EC-3[b]	0.03 U	5.30	0.36	0.04 U	7.03	1.08	0.001 U
EC-Ref Comp	0.03 U	2.71	0.25	0.01 U	10.30	2.49	0.001 U
IH-1	NA[c]	NA	NA	NA	NA	NA	NA
IH-2	NA	NA	NA	NA	NA	NA	NA
IH-3	NA	NA	NA	NA	NA	NA	NA
IHR1	NA	NA	NA	NA	NA	NA	NA
IHR2	NA	NA	NA	NA	NA	NA	NA
SR-1	0.07	20.70	2.37	0.12	91.1	28.00	0.80
SR-2	0.12	23.10	2.58	0.25	91.9	23.90	0.106
SR-3	0.12	24.40	2.35	0.07	94.30	18.20	0.88
SR-4	0.15	25.00	2.76	0.19	103.00	29.80	0.108

(a) U Analyte not present above the level of associated value.
(b) Mean of replicate measurements.
(c) NA Analysis not requested.

TABLE 3.17. Summary of Metals in Sediment Samples (Ni to Zn)

Sediment Treatment	Concentration (mg/kg dry weight)					
	Ni	Pb	Tl	Sb	Se	Zn
EC-1	1.68	6.08	0.07	0.16 U[a]	0.13 U	16.4
EC-2	0.75	3.69	0.02	0.16 U	0.13 U	8.6
EC-3[b]	1.59	6.84	0.08	0.16 U	0.13 U	24.2
EC-Ref Comp	2.38	7.53	0.14	0.16 U	0.13 U	16.7
IH-1	NA[c]	NA	NA	NA	NA	NA
IH-2	NA	NA	NA	NA	NA	NA
IH-3	NA	NA	NA	NA	NA	NA
IHR1	NA	NA	NA	NA	NA	NA
IHR2	NA	NA	NA	NA	NA	NA
SR-1	28.5	29.0	0.43	0.55	0.50	88.4
SR-2	33.3	35.2	0.61	0.73	0.72	104.0
SR-3	30.5	32.0	0.51	0.73	0.72	96.7
SR-4	36.4	34.5	0.57	0.73	0.72	129.0

(a) U Analyte not present above the level of associated value.
(b) Mean of replicate measurements.
(c) NA Not Applicable: Analysis not requested.

The data summarized in Tables 3.16 and 3.17 indicate that Entrance Channel stations EC-1 and EC-3 have slightly elevated levels of As, Be, and Zn (EC-3 only), when compared to EC-Ref Comp sediment. Concentrations of all other metals in the Entrance Channel test treatments were less than or equal to the level of metals found in the reference. Test treatments SR-2 and SR-4 exhibited the highest metal concentrations overall, with Be, Cd, Cr, Cu, Hg, and Ni being ≥ 10 times reference sediment levels. Magnification factors for Ag, As, Pb, Tl, Sb, Se, and Zn were all between 4 and 10 in Sampit River sediments. No Inner Harbor stations were tested for metals in sediments. Although Sampit River stations showed high levels of metals, they were not being considered for dredge disposal, and therefore no tissue analysis for metals were conducted.

3.2.8 Organotins

Organotin concentrations are summarized in Table 3.18. 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.

No detectable concentrations of mono- and dibutyltin were found in the sediment treatments. Stations IH-2, IH-3, and SR-1 had detectable tributyltin concentrations (4.8 mg/kg dry wt.). All other sediment treatments had TBT concentrations below detection limits.

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 3.19. Supporting data related to the test are presented in Appendix C, Tables C.1 through C.4. The water quality data presented in Appendix Table C.2 indicate that all parameters remained within range during the test. Test organism survival in control sediment was 66%, less than the 90% required for test validity. The results of the reference toxicant exposures showed a calculated LC_{50} of 0.46 mg/L cadmium with a 95% confidence interval of 0.32 mg/L to 0.66 mg/L. This is similar to previous results at MSL observed for this species and demonstrates appropriate test organism sensitivity.

TABLE 3.18. Summary of Organotins in Sediment Samples

Sediment Treatment	Concentration (µg/kg dry weight) Monobutyltin	Dibutyltin	Tributyltin
EC-1[a]	3.5 U[b]	2.0 U	2.4 U
EC-2	19.6 U	11.1 U	13.7 U
EC-3	2.7 U	1.5 U	1.9 U
EC-Ref Comp	2.4 U	1.4 U	1.7 U
IH-1	1.8 U	1.0 U	1.3 U
IH-2	4.6 U	2.6 U	9.4
IH-3	10.3 U	5.8 U	9.6
IH-2, IH-3 Comp[a]	8.7 U	4.9 U	6.0 U
IHR1	6.3 U	3.5 U	4.4 U
IHR2	7.0 U	4.0 U	4.9 U
SR-1	3.4 U	1.9 U	4.8
SR-2	4.0 U	2.2 U	2.8 U
SR-3	3.7 U	2.1 U	2.6 U
SR-4	4.6 U	2.6 U	3.2 U

(a) Mean of replicate measurements.
(b) U Analyte not present above the level of associated value.

Statistical analyses were performed on the data and the results are summarized in Table 3.19. Table 3.19 shows that *A. abdita* survival ranged from 43% to 80%. There were no significant differences between test organism survival in test treatments relative to the reference EC-Ref Comp.

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

The results of the 10-day solid-phase flow-through test with *R. abronius* are presented in Table 3.20. Supporting data related to the test are presented in Appendix D, Tables D.1 through D.4. The water quality data presented in Table D.2 show that most parameters remained within range during the test. The target upper temperature range of 17.0°C was exceeded by 0.7°C for the Ocean Reference exposure; pH was observed above the upper target limit of 8.30 in the Whidbey Island and Sequim Bay exposures. The validity of this test is indicated by ≥90% survival of *R. abronius* in its native sediment (Whidbey Island). Reference toxicant results produced an LC_{50} of 0.66 mg/L cadmium, with a 95% confidence interval of 0.63 mg/L to 0.70 mg/L. This is within control limits for this species and indicates appropriate test organism sensitivity. Test organism survival was over 90% in all treatments and there was no significant difference in survival in test treatments relative to the reference EC-Ref Comp.

TABLE 3.19. Summary Results of the 10-Day Solid-Phase Flow-Through Test with *A. abdita*

Sediment Treatment	Percent Survival	Statistical Significance[a]
EC-1	48.0	No
EC-2	49.0	No
EC-3	65.0	No
EC-Ref Comp	43.0	NA[b]
Ocean Reference	54.0	No
San Pablo Bay	66.0	No
Sequim Bay	80.0	No

(a) Survival is significantly lower than the reference EC-Ref Comp ($\alpha = 0.05$) and at least 10% lower than that reference.
(b) NA Not applicable

TABLE 3.20. Summary Results of the 10-Day Solid-Phase Flow-Through Test with *R. abronius*

Sediment Treatment	Percent Survival	Statistical Significance[a]
EC-1	99.0	No
EC-2	98.0	No
EC-3	97.0	No
EC-Ref Comp	95.0	NA[b]
Ocean Reference	97.0	No
Whidbey Island	99.0	No
Sequim Bay	96.0	No

(a) Survival is significantly lower than the reference EC-Ref Comp ($\alpha = 0.05$) and at least 20% lower than that reference.
(b) NA Not applicable

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 3.21. Supporting 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 indicates that all parameters except salinity remained within range during the test. Upper salinity ranges exceeded the target by only 0.5‰. There is no evidence that these elevated levels affected test organism survival, which ranged from 44% to 73%. This test is not considered a valid evaluation of acute toxicity, as survival of *N. virens* in its native sediment (Muscongus Bay) was 57%, less than the required 90%. This appeared to be related to test organism condition during shipment. As a result, a separate set of test organisms was used in the 28-day exposure. Statistical analyses of these data were conducted and indicated no significant difference between *N. virens* survival in test treatments and the reference treatment EC-Ref Comp.

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 3.22. Supporting 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 indicates that all parameters, except flow rate, were within acceptable ranges. Flow rate was slightly below the target rate in only a few aquaria and did not appear to affect test organism survival. This test is validated by the >80% survival of *N. virens* in its native sediment (57%) (Muscongus Bay). Though this is not a standard toxicological test, we have chosen to perform statistical analyses on these data in lieu of an unacceptable 10-day *N. virens* test. Since the exposure period was 28 instead of 10 days, this test should be considered a worst-case scenario for solid-phase sediment toxicity to *N. virens*. The results of the test, presented in Table 3.22, show that survival ranged from 89% to 98%. There was no significant difference between *N. virens* survival in test treatments relative to the reference EC-Ref Comp.

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 3.23. 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 remained within target ranges. This test was validated by a >80% survival of *M. nasuta* in its native sediment (Sequim Bay). Test organism survival ranged from 74% to 96%. The 96% survival observed in the native control sediment for *M. nasuta* exceeded the required survival of 80% and validated the test. Statistical analysis was not required for the test treatments as these exposures were designed for bioaccumulation evaluations only.

TABLE 3.21. Summary Results of the 10-Day Solid-Phase Flow-Through Test with *N. virens*

Sediment Treatment	Percent Survival	Statistical Significance[a]
EC-1	55.0	No
EC-2	73.0	No
EC-3	69.0	No
EC-Ref Comp	44.0	NA[b]
Muscongus Bay	57.0	No

(a) Survival is significantly lower than the reference EC-Ref Comp ($\alpha = 0.05$) and at least 10% lower than that reference.
(b) NA Not applicable

TABLE 3.22. Summary Results of the 28-Day Solid-Phase Flow-Through Test with *N. virens*

Sediment Treatment	Percent Survival	Statistical Significance[a]
EC-1	98.0	No
EC-2	89.0	No
EC-3	95.0	No
EC-Ref Comp	93.0	NA[b]
IH-1	96.0	NA
IH-2, IH-3 Comp	89.0	NA
IHR1	99.0	NA
IHR2	93.0	NA
Muscongus Bay	98.0	No

(a) Survival is significantly lower than the reference EC-Ref Comp ($\alpha = 0.05$) and at least 10% lower than that reference.
(b) NA Not applicable

TABLE 3.23. Summary Results of the 28-Day Solid-Phase Flow-Through Test with *M. nasuta*

Sediment Treatment	Percent Survival	Statistical Significance[a]
EC-1	83.2	NA[b]
EC-2	82.4	NA
EC-3	74.4	NA
EC-Ref Comp	74.4	NA
Sequim Bay	96.0	NA
IH-1	79.2	NA
IH-2, IH-3 Comp	92.0	NA
IHR1	93.6	NA
IHR2	89.6	NA

(a) Survival is significantly lower than the reference EC-Ref Comp ($\alpha = 0.05$) and at least 10% lower than that reference.
(b) NA Not applicable

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

The results of the 96-h suspended-particulate-phase static test with *M. beryllina* are presented in Table 3.24. Supporting data related to the test are presented in Appendix H, Tables H.1 through H.4. All water quality parameters remained within range during the test with the exception of salinity in two treatments. Salinity exeeded the maximum target of 32.0‰ by only 0.5‰ and did not appear to affect the test results. The results of the reference toxicant test produced an LC_{50} of 216.7 µg/L (copper) with a 95% confidence interval of 179.0 µg/L to 262.3 µg/L. This is similar to other studies with this species, demonstrating appropriate test organism sensitivity. Table 3.24 shows that test organism survival in the seawater (0% SPP) controls exceeded 90% for all treatments, validating the test. *M. beryllina* survival exceeded 90% in all treatments and SPP concentrations, thus there is no evidence of acute toxicity to this species of SPP produced from the test treatments.

TABLE 3.24. Summary Results for 96-h Suspended-Particulate-Phase Static Test with *M. beryllina*

Sediment Treatment	Percent SPP	Percent Survival
EC-1	0	98.0
EC-1	10	100.0
EC-1	50	96.0
EC-1	100	100.0
EC-2	0	100.0
EC-2	10	96.0
EC-2	50	96.0
EC-2	100	90.0
EC-3	0	100.0
EC-3	10	94.0
EC-3	50	96.0
EC-3	100	100.0

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

The results of the 96-h suspended-particulate-phase static test with *M. bahia* are presented in Table 3.25. Supporting data related to the test are presented in Appendix I, Tables I.1 through I.4. All water quality parameters remained within range during the test with the exception of salinity in four treatments. Salinity exceeded the maximum target of 32.0‰ by only 0.5‰ and did not appear to affect the test results. The results of the reference toxicant test produced an LC_{50} of 236.4 µg/L (copper) with a 95% confidence interval of 204.2 to 273.7 µg/L. This is similar to other studies conducted at MSL with this species and demonstrates appropriate test organism sensitivity. The results presented in Table 3.25 show that *M. bahia* survival in seawater control exposures (0% SPP) exceeded our minimum of 90%, validating the test. Test organism survival in all treatments and SPP concentrations exceeded 88%. Since 50% mortality relative to control was not observed, an LC_{50} was not calculable and there is no evidence of acute toxicity to this species of SPP produced from test sediments.

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

The results of the *L. pictus* tests are presented in Table 3.26. Supporting data related to the test are presented in Appendix J, Tables J.1 through J.4. All water quality parameters remained within range during the test. The reference toxicant exposure produced an LC_{50} of 160.7 µg/L (copper) with a 95% confidence interval of 151.5 to 170.4 µg/L. This is slightly higher than normal limits for this species and indicates the test organisms used in this test may be slightly less sensitive than is normally found in this test. Examination of the data presented in Table 3.26 shows that mean percent normal larvae in seawater controls relative to stocking density ranged from 77.6% to 93.1%. This validates the test, since it exceeds the

TABLE 3.25. Summary Results for 96-h Suspended-Particulate-Phase Static Test with *M. bahia*

Sediment Treatment	Percent SPP	Mean Percent Survival
EC-1	0	94.0
EC-1	10	90.0
EC-1	50	92.0
EC-1	100	90.0
EC-2	0	96.0
EC-2	10	90.0
EC-2	50	90.0
EC-2	100	88.0
EC-3	0	94.0
EC-3	10	92.0
EC-3	50	88.0
EC-3	100	92.0

TABLE 3.26. Summary Results for 72-h Suspended-Particulate-Phase Static Test with *L. pictus*

Sediment Treatment	Percent SPP	Mean Percent Survival	Mean Percent Normal
EC-1	0	93.9	93.1
EC-1	10	81.8	77.6
EC-1	50	90.2	84.8
EC-1	100	83.0	80.4
EC-2	0	90.5	89.4
EC-2	10	87.5	84.7
EC-2	50	89.5	85.8
EC-2	100	86.1	84.7
EC-3	0	79.4	78.7
EC-3	10	82.9	81.3
EC-3	50	92.3	89.6
EC-3	100	90.9	85.8

minimum percent normal larvae relative to stocking density of 70%. Table 3.26 also shows that the mean percent survival and mean percent normal of larvae in test exposures exceeded 77% in all treatments and SPP concentrations. Since a 50% decrease in survival and normal larvae was not observed relative to the seawater control, an LC_{50} is not calculable, and there is no evidence to suspect acute toxicity of SPP produced from test sediments to the larval form of this species.

3.4 TISSUE CHEMISTRY

Tissues of *M. nasuta* and *N. virens*, exposed to test and reference sediments for a period of 28 days, were analyzed for contaminants of concern based on examination of sediment chemistry results (Section 3.2). Three classes of contaminants were examined for tissue chemistry: PAHs, dioxins, and organotins. Statistical analyses were performed to detect significant elevations of contaminants in tissues exposed to IH-2/IH-3 composite sediments, relative to the reference treatment IHR2 (PAHs and organotins) or IHR1 and IHR2 (dioxins). Background (pre-exposure) tissues were also analyzed to determine the concentrations of contaminants associated with the wild-captured populations. These background levels were also included in the statistical analyses.

3.4.1 Polynuclear Aromatic Hydrocarbons

Mean concentrations of PAHs in the tissues of *M. nasuta* and *N. virens* are summarized in Tables 3.27 and 3.28, respectively. Quality control evaluations for PAHs in *M. nasuta* and *N. virens* tissue, presented in Appendix K and L, show that tissue holding times before extraction and those relative to analysis after extraction were met. 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 3.27 shows that there were no significantly elevated PAHs in the tissues of *M. nasuta* exposed to test treatments relative to the reference sediment IHR2; however, chrysene concentrations in *M. nasuta* pre-exposure samples were significantly elevated relative to the reference IHR2. All other background levels were not significantly elevated.

Table 3.28 summarizes the mean concentrations of PAHs in tissues of *N. virens* after the 28-day bioaccumulation exposure. As in *M. nasuta* tissues, there were no significantly elevated PAHs in the *N. virens* exposed to IH-2/IH-3 test treatments. Elevated levels of fluoranthene, pyrene, and chrysene were detected in pre-exposure *N. virens* tissues relative to the IHR2 reference sediment.

TABLE 3.27. 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 IHR2.)

Compound	Concentration (ug/kg dry weight) IH-2/IH-3	IHR2	Pre-exposure
Napthalene	23.91	23.26	16.96J[a]
2-methylnapthalene	23.79	24.93	17.88
1-methylnapthalene	16.14	16.12	11.27
Acenanapthalene	22.94U[b]	24.73U	14.27UJ
Acenapthene	9.85UJ	6.21J	9.45UJ
Fluorene	10.46	10.65J	6.77J
Phenanthrene	23.64	23.47	15.52
Anthracene	3.76	3.88J	1.96J
Fluoranthene	19.33	20.76	29.00
Pyrene	14.03	13.30	14.65
Benz(a)anthracene	3.69J	2.94J	3.15J
Chrysene	7.72	5.18J	8.54
Benzo(b)fluoranthene	5.24J	6.39UJ	3.90J
Benzo(k)fluoranthene	2.78J	4.51UJ	2.14J
Benzo(a)pyrene	15.02	16.21U	8.41UJ
Indeno(1,2,3-c-d)pyrene	18.06U	19.45U	15.37U
Dibenzo(a,h)anthracene	12.29U	13.25U	10.46U
Benzo(g,h,i)perylene	24.48U	26.43U	20.84U

(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.

3.4.2 Dioxins and Furans

Mean concentrations of dioxins and furans in the tissues of *M. nasuta* and *N. virens* are summarized in Tables 3.29 and 3.30. All data associated with these summaries and related quality assurance measurements may be found in Appendixes K and L. Quality control evaluations for dioxins and furans in *M. nasuta* and *N. virens* tissues show that tissue holding times prior to extraction were met and blanks were uncontaminated, with the exception of OCDD. Detection limit goals were met for the majority of dioxin and furan congeners. Matrix spike/matrix spike duplicate recovery was within QA limits for dioxin and furan congeners in most samples. Measurements for precision were considered acceptable. As a result, these data are considered acceptable for use in determining bioaccumulation potential.

Table 3.29 shows that most dioxins and all furans were not significantly elevated in the tissues of *M. nasuta*, when compared to IHR1 or IHR2. Significant elevations were found for OCDD (407.02 ng/kg dry weight) in *M. nasuta* tissues exposed to IH-2/IH-3 composite sediments relative to both references. OCDD is considered to be both innocuous and ubiquitous.

TABLE 3.28. 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 IHR2.)

Compound	Concentration (µg/kg dry weight) IH-2/IH-3	IHR2	Pre-exposure
Napthalene	12.64	14.02	7.95J[a]
2-methylnapthalene	6.11	6.78	5.13J
1-methylnapthalene	7.07	8.23	4.95J
Acenanapthalene	13.77U[b],J	3.42U,J	3.60J
Acenapthene	6.02	6.47	5.89J
Fluorene	2.44J	2.61J	1.92J
Phenanthrene	6.54	5.98	7.10
Anthracene	6.85U,J	5.20U,J	2.09J
Fluoranthene	5.71	3.60	**45.87**
Pyrene	3.54	2.18J	**38.52**
Benz(a)anthracene	10.46U,J	7.35U,J	2.72J
Chrysene	1.16J	1.94U,J	**16.44**
Benzo(b)fluoranthene	11.74U,J	10.28U	2.49J
Benzo(k)fluoranthene	9.79U,J	8.58U	2.61J
Benzo(a)pyrene	10.09U,J	8.93U	1.23J
Indeno(1,2,3-c-d)pyrene	13.73U	10.72U	12.11U
Dibenzo(a,h)anthracene	9.33U	7.31U	8.24U
Benzo(g,h,i)perylene	18.61U	14.56U	13.82U,J

(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.

TABLE 3.29. Mean Concentrations of Dioxins and Furans in the Tissues of *M. nasuta* After 28-day Bioaccumulation Exposure (Bold and underline indicates compound is significantly elevated relative to the references IHR1 and IHR2.)

Compound	Concentration (ng/kg dry weight) IH-2/IH-3	IHR1	IHR2	Pre-exposure
2378-TCDD	5.32U[a]	4.14U	6.78U	2.62U
12378-PeCDD	3.06U	4.10U	4.42U	1.78U
123478-HxCDD	1.96U	4.46U	4.18	1.32U
123678-HxCDD	4.76	4.83U	3.88	1.08U
123789-HxCDD	3.94	6.30U	5.44	1.64U
1234678-HpCDD	19.92	16.53	16.06	5.00
OCDD	**407.02**[b]	167.64	305.28	43.98
2378-TCDF	4.06	2.97	5.72	2.00
12378-PeCDF	2.36	4.83U	3.82U	1.74U
23478-PeCDF	1.24U	3.90U	3.62U	1.46U
123478-HxCDF	1.46U	4.03U	4.02U	1.62U
123678-HxCDF	3.88U	4.26U	3.50U	1.05U
123789-HxCDF	3.60	5.44	5.28	3.68U
234678-HxCDF	1.44U	3.49U	3.42U	1.42U
1234678-HpCDF	14.04U	10.73U	16.16U	8.48U
1234789-HpCDF	1.96U	6.06U	5.50U	2.46U
OCDF	7.10	12.76	9.44	4.28

(a) U Analyte was not present above the level of associated value.
(b) Value is significantly greater than both IHR1 and IHR2.

Table 3.30 shows that dioxins and furans were not significantly elevated in the tissues of *N. virens* exposed to the IH-2/IH-3 composite test sediments when compared to IHR1 or IHR2. Significant elevations were found for both 123678-HxCDD and 2378-TCDF (5.16 ng/kg and 9.36 ng/kg dry weight) in *N. virens* pre-exposure tissues.

3.4.3 Organotins

Mean concentrations of organotins in the tissues of *M. nasuta* and *N. virens* are summarized in Tables 3.31 and 3.32. All data associated with these summaries and related quality assurance measurements may be found in Appendixes K and L. Quality control evaluations for organotins in *M. nasuta* and *N. virens* tissues show that tissue holding times prior to extraction were met, blanks were uncontaminated, and detection limit goals were met. Analysis of surrogate standards demonstrated acceptable recovery, and matrix spike/matrix spike duplicate recovery was within QA limits for tri- and dibutyltin in most samples. Measurements for precision were considered acceptable. As a result, these data are considered acceptable for use in determining bioaccumulation potential.

Table 3.31 summarizes the mean organotin concentrations for *M. nasuta*. This table shows that dibutyltin levels were undetected in tissues from all sediment treatments. Mono- and tributyltin levels in *M. nasuta* tissues were not significantly elevated in the IH-2/IH-3 composite and pre-exposure treatments relative to the reference sediment treatment IHR2. Table 3.32 summarizes the mean organotin concentrations of *N. virens*. This table shows that mono-, di-, and tributyltin levels were below the analytical detection limits for tissues from all treatments. There were no significant elevations of organotins in *N. virens* tissues for the IH-2/IH-3 composite or background samples relative to the IHR2 reference sediment.

TABLE 3.30. Mean Concentrations of Dioxins and Furans in the Tissues of *N. virens* After 28-day Bioaccumulation Exposure (Bold and underline indicates compound is significantly elevated relative to the references IHR1 and IHR2.)

Compound	Concentration (ng/kg dry weight) IH-2/IH-3	IHR1	IHR2	Pre-exposure
2378-TCDD	5.04U[a]	2.26U	2.49U	2.90
12378-PeCDD	6.68U	1.77U	1.61U	3.12U
123478-HxCDD	5.84U	2.56U	1.31U	1.88U
123678-HxCDD	3.38U	2.63U	1.15U	**5.16U**[b]
123789-HxCDD	4.80U	3.65U	1.66U	2.02U
1234678-HpCDD	15.52	10.61	6.22	7.78
OCDD	197.92	74.98	79.76	34.26
2378-TCDF	4.68	2.69	2.75	**9.36**[c]
12378-PeCDF	3.98U	1.40U	1.23U	2.66U
23478-PeCDF	4.10U	1.45U	1.61U	3.20
123478-HxCDF	6.12U	2.40U	1.43U	2.46U
123678-HxCDF	6.12U	1.96U	1.39U	2.38U
123789-HxCDF	4.90U	4.73	3.61U	2.90
234678-HxCDF	5.48U	4.00U	1.39U	1.44U
1234678-HpCDF	17.60	9.26U	7.41U	9.52U
1234789-HpCDF	8.30U	2.98U	1.50U	1.30U
OCDF	35.84U	9.17	8.25	18.02

(a) U Analyte was not present above the level of associated value.
(b) Significantly greater than IHR2, only.
(c) Significantly greater than both IHR1 and IHR2.

TABLE 3.31. Mean Concentration of Organotins in the Tissues of *M. nasuta* After 28-Day Bioaccumulation Exposure (Bold and underline indicates compound is significantly elevated to the reference IHR2.)

Compound	Concentration (ug/kg dry weight) IH-2/IH-3	IHR2	Pre-exposure
Monobutyltin	37.58	36.88	19.13U[a,J][b]
Dibutyltin	21.67U	22.23U	19.27U
Tributyltin	59.00	64.88	50.52

(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 3.32 Mean Concentrations of Organotins in the Tissues of *N. virens* After 28-Day Bioaccumulation Exposure (Bold and underline indicates compound is significantly elevated to the reference IHR2.)

Compound	Concentration (µg/kg dry weight) IH-2/IH-3	IHR2	Pre-exposure
Monobutyltin	24.66U[a]	18.92U	15.38U
Dibutyltin	19.70U	15.09U	12.28U
Tributyltin	26.79UJ[b]	20.99UJ	10.88U

(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.

4.0 DISCUSSION AND CONCLUSIONS

The following section presents a discussion of data pertinent to the Winyah Bay Project, including an evaluation of sediment contamination, toxicological testing, and determination of bioaccumulation potential. For this discussion, test treatments from the Entrance Channel and the Inner Harbor were compared to the reference treatments EC-Ref Comp, IHR1, and IHR2. Sampit River test sediments were analyzed for sediment chemistry only. For toxicity tests involving *R. abronius* and *A. abdita*, test treatments were also compared to the Ocean Reference composites, representing a fine-grained sediment reference. 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 CFR 40, 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 in support of toxicological testing results, and also as justification for contaminants of concern evaluated in tissue samples.

4.1 SEDIMENT CHEMISTRY

Entrance Channel treatments, EC Ref-Comp, IH-1, and both IHR1 and IHR2 were predominantly sand. Inner Harbor treatments IH-2 and IH-3, and all Sampit River treatments were composed of fine-grained sediments (silt and clay), with less than 20% sand. The fine-grained-dominated sediments also exhibited higher levels of TOC and AVS.

The majority of sediment samples had detectable levels of PAHs. The highest levels of low, high, and total PAHs were found in treatments from IH-2, IH-3, and the Sampit River treatments, dominated by high molecular weight PAHs. The Entrance Channel sediments consistently had the lowest levels of PAHs. Pesticide analysis showed that only station SR-1 had detectable levels of three pesticides: Delta BHC, 4,4' DDD, and 4,4' DDE at approximately 3 µg/kg (dry wt.). All other treatments had no detectable levels of pesticides and none of the sediment treatments had detectable levels of PCBs. Dioxin/furan congeners were present in all treatments, although the most toxic forms, such as 2378-TCDD, were absent. Although phenols and phthalates were found at elevated levels when compared to the reference sediments, all concentrations were below detection limits. Metals were present in all treatments, with the highest levels in the Sampit River treatments. Metals with the highest concentrations, relative to reference treatments, were As, Cr, Cu, Ni, Pb, and Zn. Measurable amounts of Be and Tl were found in both Entrance Channel and Sampit River treatments, while Ag, Cd, Hg, Sb, and Se were detected in only the Sampit River treatments. Metals analysis was not requested for Inner

Harbor treatments. All treatments, except IH-2, IH-3, and SR-1 [9.4 mg/kg TBT (dry weight), 9.6 mg/kg TBT (dry weight), and 4.8 mg/kg TBT (dry weight)], had undetectable levels of organotins.

4.2 TOXICOLOGY AND BIOACCUMULATION POTENTIAL

The sediment treatments evaluated in the Winyah Bay Project that produced significant acute toxicity or bioaccumulation potential are discussed in this section. Acute toxicity was evaluated through water column exposures (SPP) and deposited sediment (SP) tests. Acute toxicity 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). If an SPP test produces acute toxicity, the concentration producing a 50% reduction in test organism survival, relative to the control water, is derived and expressed as an LC_{50}.

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. Second, levels of contaminants in tissues exposed to test treatments were compared to 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.*

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 filtered-seawater control (0% SPP) was included with each test. The SPP test organisms were *M. beryllina*, *M. bahia*, and the larvae of *L. pictus*. None of the water column tests produced significant acute toxicity.

4.2.2 Deposited Sediment Tests

Deposited sediment toxicity was evaluated through SP tests involving three test organisms: *A. abdita*, *R. abronius*, and *N. virens*. The *N. virens* bioassay was performed as a 28-day acute test. This is not a standard duration for this test, and results should be viewed as a "worst case scenario." Control survival for *A. abdita* was 66%, which may have affected results in this bioassay. The results of the SP tests indicated no toxicity associated with any of the test treatments.

4.2.3 Bioaccumulation Potential

Bioaccumulation potential was evaluated for test treatment IH-2/IH-3 Comp and reference treatments IHR1 and IHR2 in two ways. The first, a statistical comparison of contaminant concentrations in tissues exposed to test and reference treatments, revealed no significant elevations of PAHs, dioxins, or organotins in the IH-2/IH-3 test composite. Background (pre-exposure) levels of PAHs exceeded the reference samples by a factor of 1.7 for chrysene in *M. nasuta* and 12.7, 17.7, and 8.5 for fluoranthene, pyrene, and chrysene, respectively, in *N. virens*. Background (pre-exposure) levels of 2378-TCDF and 123678-HxCDD exceeded the reference sample IHR1 for *N. virens* by a factor of 2.0 and 3.5, respectively, and exceeded IHR2 by a factor of 3.4 and 4.5, respectively. The absence of significant elevations of PAHs, 2378-TCDF, and 123678-HxCDF in *M. nasuta* and *N. virens* tissues in the IH-2/IH-3 composite treatment indicates that the elevated background levels did not affect bioaccumulation results. Levels of the dioxin congener, OCDD, were elevated 1.3 and 2.4 times those found in IHR2 and IHR1 reference treatments, respectively. CCDD is considered one of the least toxic dioxin/furan congeners, with a Toxicity Equivalency Factor of 0.001 when compared to other dioxin and furan congeners (EPA 1988), and is not a potential source of toxicity.

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 was with dioxins. In *M. nasuta* and *N. virens* tissues, the concentrations of dioxins and furans were well below the FDA limits of .025 µg/kg.

4.3 CONCLUSIONS

The tiered approach to evaluating potential impacts of ocean disposal of dredged materials 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 from exposure of the water column to dredged material was estimated by exposing three sensitive marine species (*M. berylilina, M. bahia, L. pictus*) to three concentrations of SPP prepared from Entrance Channel treatments and a seawater-only control. The SPP tests showed no acute toxicity in all three bioassays. Under the *1991 Implementation Manual* guidelines, the limiting permissible concentration (LPC) for dissolved plus suspended

contaminants (represented by SPP) cannot exceed 0.01% of the acutely toxic concentration (LC_{50}) at the boundaries of the disposal site after allowing 4 h for initial mixing. The SPP tests indicate that disposal of dredged materials from the Entrance Channel, as represented by test treatments EC-1, EC-2, and EC-3, would be acceptable according to the *1991 Implementation Manual* guidelines.

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 the reference treatment by 20% (*A. abdita and R. abronius*) or 10% (*N. virens*). If mortality in test treatments is statistically different from the reference, and mortality exceeds the reference by the above percentages, the proposed material does not comply with the benthic bioassay criteria of Section 227.13 (c) and Appendixes A and B of the *1991 Implementation Manual*. The results from this study indicate that there was no evidence of acute toxicity of sediment treatments EC-1, EC-2, and EC-3 to the three species tested. Therefore, the test treatments are in compliance with benthic bioassay criteria.

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* for the test treatment IH-2/IH-3 composite. The concentration of contaminants was compared to existing FDA action limits, and also compared through Dunnett's Test to determine whether statistically significant elevations in tissues ($\alpha = 0.05$) were present relative to the reference treatment IHR2 (PAHs and organotins) or IHR1 and IHR2 (dioxins and furans). The results of these comparisons showed no significant elevations in tissue-borne contaminants in the IH-2/IH-3 composite treatment, relative to tissues exposed to reference treatments, with the exception of ubiquitous OCDD. The FDA action limits for dioxins were not exceeded for any tissues.

When contaminant concentrations in tissues exposed to test treatments do not exceed FDA action limits, the *1991 Implementation Manual* requires a statistical comparison of contaminant levels in tissues exposed to test sediments to those exposed to reference sediments. If steady-state concentrations in organisms exposed to dredged material do not statistically exceed those in organisms exposed to reference sediments, the dredged material meets the LPC for bio-accumulation and complies with the bioaacumulation aspects of the benthic criteria in paragraph 227.13(c)(3) (Appendix A). The *1991 Implementation Manual* also requires that both benthic and water-column toxicological effects be considered.

The results of this study indicate that Entrance Channel sediments, represented by test treatments EC-1, EC-2, and EC-3, did not contain significant contaminant bioavailability, nor did they cause significant toxicity in water-column or benthic bioassays. Therefore, according to Tier III evaluation, Entrance Channel sediments meet LPC criteria for water-column and benthic impact. Bioaccumulation potential was not evaluated for these treatments.

Sediment chemistry results indicated the potential for bioaccumulation in Inner Harbor test treatments; therefore, bioaccumulation potential was evaluated. Tissues of organisms exposed to Inner Harbor sediments during the Winyah Bay Project did not exceed FDA action limits and did not contain significantly elevated contaminant concentrations relative to the reference treatments IHR1 and IHR2. In addition, no significant toxicity was observed during water-column and benthic bioassays with Inner Harbor test sediments. Tier IV evaluation indicates that Inner Harbor treatments meet both water-column and benthic LPC criteria for dredge material, and should not contribute to tissue bound contaminants.

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APPENDIX A

FIELD SAMPLING INFORMATION

QA/QC SUMMARY

Project:	Winyah Bay
Parameter:	Polynuclear Aromatic Hydrocarbons (PAHs)
Laboratory:	Battelle Ocean Sciences (BOS)
Matrix:	Sediment

Holding Times

Sediment samples were collected from June 23 to 25, 1992. Samples arrived at BOS on July 10, 1992, were extracted on July 16 and 17, and analyzed from July 28 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 criteria of 1 blank per 20 samples was met. HPAHs and LPAHs were not detected above the target detection limit of 30 µg/kg, though the compound naphthalene was detected in the procedural blank at a concentration above the MDL.

Detection Limits

The detection limit goal of 30 µg/kg was met for all HPAH and LPAH compounds.

Surrogate Internal Standards

The criteria of one surrogate standard per sample was met. Three surrogate standards were evaluated: d8 naphthalene, d10 acenapthalene, and d12 benzo(a)pyrene. Surrogate recoveries were within the QA goals of 40% to 120%, except d8 naphthalene in 8 of 15 samples. Recoveries for this surrogate ranged from 26% to 39%.

Matrix Spike/Matrix Spike Duplicate

The criteria of one matrix spike/matrix spike duplicate (MS/MSD) per 20 samples was met. The 40% to 120% criteria for spike recovery was met for the LPAH naphthalene and acenapthene; and the HPAHs benzo(a)pyrene, indeno(1,2,3-cd), and benzo(g,h,i)perylene (MSD only). Other LPAH and HPAH recoveries in the MS and MSD exceeded 120%. The relative percent difference (RPD) between MS and MSD were all less than 5%; well within the QA limit of ≤30%.

Replication

The criteria of one duplicate analysis per 10 samples was not met. Instead, one triplicate analysis was performed per 13 samples. The QA limit for relative standard deviations (RSDs) is ≤30%. This was exceeded for the LPAH compounds anthracene (40%) and HPAH compound benzo(a)anthracene (33%). An RSD was calculable only for the LPAH naphthalene, and was within the QA range at 21%. The RSDs for surrogate recovery in the triplicate was 1%.

SRMs

QA limits specify that the observed value for an SRM must be within 30% of the certified value. SRM data were not available for LPAHs. HPAH SRM data showed all compounds except fluoranthene, benzo(b)fluoranthene, pyrene, and indeno(1,2,3-cd) pyrene, and benzo(k)fluoranthene were within range.

QA/QC SUMMARY

Project:	Winyah Bay/Georgetown Harbor
Parameter:	Polychloronated Biphenyls (PCBs)
Laboratory:	Battelle Ocean Sciences (BOS)
Matrix:	Sediment

Holding Times

Sediment samples were collected from June 23 to 25, 1992. Samples arrived at BOS on July 10, 1992, were extracted on July 16 and 17, and analyzed from July 28 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

PCBs were reported as undetected in procedural blanks, but at levels somewhat elevated from the method detection limit (MDL) established in the study QA plan. The frequency of 1 blank per 20 samples was met.

Detection Limits

Analytes were undetected in all samples, but above the target detection limit of 20 µg/kg. Some of the samples were undetected at over 7 times the MDL because of matrix interferences.

Surrogate Internal Standards

All samples were spiked with two internal standards, as specified in the QA plan. Recoveries were well within the acceptable range (40% to 120%) with the exception of two samples yielding high recoveries wit the surrogate DFOFB.

Matrix Spike/Matrix Spike Duplicate

One matrix spike (MS) and one matrix spike duplicate (MSD) were performed per 20 samples analyzed. Only one PCB was used for MS/MSD spiking: Aroclor 1254. Percent recoveries were within the established range (40% to 120%), and the relative percent difference (RPD) between MS and MSD recoveries was 4%, well within the acceptable range of ≤30%. Precision and accuracy were within the acceptable limits defined in the QA plan.

Replication

A triplicate analysis of the sediment sample IH-1 was analyzed to satisfy the QA plan criteria of duplication every 20 samples. The relative standard deviation (RSD) between replicates gives guidance on the accuracy of the method; however, all PCB analytes were undetected in the triplicated sample and RSDs were not calculable.

SRMs

No SRM material was available for these analyses.

TABLE A.1. Information for Reference Sediment Sampling, Winyah Bay Project

Station	Replicate	Date Sampled	Depth (m)	Latitude (Deg Min)	Longitude (Deg Min)	Loran 1	Loran 2	Sampler	Sediment Collection Depth (cm)
SR-4	1	23-Jun-92	6.6	33° 21.90	79 17.37	45509.2	59989.5	van Veen Grab	15
SR-3	1	23-Jun-92	7.2	33° 21.48	79 17.53	45508.5	59993.8	van Veen Grab	15
SR-2	1	23-Jun-92	7.2	33° 20.95	79 16.74	45503.5	59989.9	van Veen Grab	15
SR-1	1	23-Jun-92	7.7	33° 20.10	79 16.97	45501.4	59997.7	van Veen Grab	15
IHR2	1	23-Jun-92	0.9	33° 19.01	79 16.78	not available	not available	Sand Dredge	4
IHR2	2	23-Jun-92	0.9	33° 19.01	79 16.78	not available	not available	Sand Dredge	4
IHR2	3	23-Jun-92	0.9	33° 19.01	79 16.78	not available	not available	Sand Dredge	4
IHR2	4	23-Jun-92	0.9	33° 19.01	79 16.78	not available	not available	Sand Dredge	4
IHR1	1	23-Jun-92	0.6	33° 20.00	79 11.65	not available	not available	van Veen Grab	8
IHR1	2	23-Jun-92	0.7	33° 20.00	79 11.65	not available	not available	van Veen Grab	8
IHR1	3	23-Jun-92	0.8	33° 20.00	79 11.65	not available	not available	van Veen Grab	8
IHR1	4	23-Jun-92	0.8	33° 20.00	79 11.65	not available	not available	van Veen Grab	8
RS01	1	24-Jun-92	8.8	33° 11.03	79° 04.08	not available	not available	Sand Dredge	4
RS01	2	24-Jun-92	8.6	33° 11.03	79° 04.08	not available	not available	Sand Dredge	4
RS01	3	24-Jun-92	8.4	33° 11.03	79° 04.08	not available	not available	Sand Dredge	4
EC-1	1	24-Jun-92	7.0	33° 11.50	79° 08.06	not available	not available	Sand Dredge	4
EC-1	2	24-Jun-92	6.8	33° 11.50	79° 08.06	not available	not available	Sand Dredge	4
EC-2	1	24-Jun-92	7.3	33° 12.00	79° 10.58	not available	not available	Sand Dredge	4
EC-3	1	24-Jun-92	7.2	33° 12.78	79° 11.20	not available	not available	Sand Dredge	4

APPENDIX B

SEDIMENT CHEMISTRY AND QUALITY CONTROL DATA

TABLE B.1. Summary of Sediment Grain Size, Winyah Bay Project

Sediment Treatment	Total Percent Gravel ≥2000 μm	Sand 62.5-2000 μm	Silt 3.9-62.5 μm	Clay ≤3.9 μm
EC-1	1	97	0	2
EC-2	0	99	0	1
EC-3	2	97	0	1
EC-Ref Comp	0	100	0	0
IH-1	1	90	3	6
IH-2	0	8	53	39
IH-3	0	5	65	30
IHR1 Replicate 1	0	76	6	18
IHR1 Replicate 2	0	76	6	18
IHR1 Replicate 3	0	76	6	18
IHR2	0	96	1	3
SR-1	0	17	33	50
SR-2	0	7	73	20
SR-3	0	11	44	45
SR-4 Replicate 1	0	2	71	27
SR-4 Replicate 2	0	2	72	26
SR-4 Replicate 3	0	2	73	25
Quality Control Data				
Analytical Triplicates				
IHR1 Replicate 1	0	76	6	18
IHR1 Replicate 2	0	76	6	18
IHR1 Replicate 3	0	76	6	18
RSD	0%	0%	0%	0%
SR-4 Replicate 1	0	2	71	27
SR-4 Replicate 2	0	2	72	26
SR-4 Replicate 3	0	2	73	25
RSD	0%	0%	1%	4%

TABLE B.2. Sediment Grain Size Results (percent dry weight), Winyah Bay Project

Sediment Treatment	phi / µm	Percent at Size Fraction													
		4750	4750-2000	2000-850	850-425	425-250	250-106	106-75	75-62.5	4 62.5-31.2	5 31.2-15.6	6 15.6-7.8	7 7.8-3.9	8 3.9-1.9	9 1.9-0.9	10 <0.9
EC-1		1	0	1	3	21	72	0	0	0	0	0	0	1	0	1
EC-2		0	0	1	3	30	65	0	0	0	0	0	0	0	0	1
EC-3		1	1	7	14	52	24	0	0	0	0	0	0	0	0	1
EC-Ref Comp		0	0	15	42	35	8	0	0	0	0	0	0	0	0	0
IH-1		0	1	2	14	30	43	1	0	1	0	1	1	0	1	5
IH-2		0	0	0	2	1	2	2	1	2	14	19	18	11	6	22
IH-3		0	0	0	1	1	2	1	0	4	14	27	20	8	5	17
IHR1 Replicate 1		0	0	0	1	1	54	18	2	1	1	2	2	3	5	10
IHR1 Replicate 2		0	0	0	1	1	54	18	2	1	2	1	2	3	3	12
IHR1 Replicate 3		0	0	0	1	1	54	18	2	1	1	1	3	3	3	12
IHR2		0	0	1	22	43	27	2	1	0	0	1	0	0	1	2
SR-1		0	0	1	3	3	8	2	0	3	7	10	13	10	8	32
SR-2		0	0	1	1	1	3	1	0	2	13	37	21	5	2	13
SR-3		0	0	1	2	1	6	0	1	3	9	14	18	12	8	25
SR-4 Replicate 1		0	0	0	0	1	0	1	0	0	7	12	52	5	2	16
SR-4 Replicate 2		0	0	0	0	1	0	1	0	0	7	11	54	4	2	16
SR-4 Replicate 3		0	0	0	0	1	1	0	0	2	5	12	54	6	0	16

TABLE B.3. Quality Control Data for Sediment Grain Size Analysis, Winyah Bay Project

Sediment Treatment	phi / µm	Percent Size at Fraction														
		>4750	4750-2000	2000-850	850-425	425-250	250-106	106-75	75-62.5	4 62.5-31.2	5 31.2-15.6	6 15.6-7.8	7 7.8-3.9	8 3.9-1.9	9 1.9-0.9	10 ≤0.9
Analytical Replicates																
IHR1 Replicate 1		0	0	0	1	1	54	18	2	1	1	2	2	3	5	10
IHR1 Replicate 2		0	0	0	1	1	54	18	2	1	2	1	2	3	3	12
IHR1 Replicate 3		0	0	0	1	1	54	18	2	1	1	1[a]	3	3	3	12
RSD		0%	0%	0%	0%	0%	0%	0%	0%	0%	43%[a]	43%[a]	25%[a]	0%	31%[a]	10%
SR-4 Replicate 1		0	0	0	0	1	0	1	0	0	7	12	52	5	2	16
SR-4 Replicate 2		0	0	0	0	1	0	1	0	0	7	11	54	4	2	16
SR-4 Replicate 3		0	0	0	0	1	1	0	0	2	5	12	54	6	0	16
RSD		0%	0%	0%	0%	0%	173%[a]	87%[a]	0%	173%[a]	18%	5%	2%	20%	87%[a]	0%

(a) Value exceeds relative standard deviation range of ≤20%.

TABLE B.4. Sediment Results for Total Solids and Specific Gravity in Sediment, Winyah Bay Project

Sediment Treatment	Total Percent Solids	Specific Gravity
EC-1	78	2.66
EC-2	79	2.64
EC-3	81	2.66
EC-Ref Comp	84	2.62
IH-1	75	2.67
IH-2	24	2.60
IH-3	21	2.82
IHR1 Replicate 1	60	2.63
IHR1 Replicate 2	60	2.70
IHR1 Replicate 3	60	2.70
IHR2	82	2.66
SR-1	26	2.74
SR-2	19	2.38
SR-3	23	2.66
SR-4 Replicate 1	19	2.35
SR-4 Replicate 2	19	2.40
SR-4 Replicate 3	19	2.62

TABLE B.5. Quality Control Summary for Total Solids and Specific Gravity in Sediment, Winyah Bay Project

Sediment Treatment	Total Percent Solids	Specific Gravity
Analytical Replicates		
IHR1 Replicate 1	60	2.63
IHR1 Replicate 2	60	2.70
IHR1 Replicate 3	60	2.70
RSD	0%	2%
SR-4 Replicate 1	19	2.35
SR-4 Replicate 2	19	2.40
SR-4 Replicate 3	19	2.62
RSD	0%	6%

TABLE B.6. Total Polynuclear Aromatic Hydrocarbons (PAH) Found in Sediment, Winyah Bay Project

Sediment Treatment	PAH (µg/kg dry weight) Total Low Molecular Weight PAH	Total High Molecular Weight PAH	Total PAH
EC-1	1.80	6.87	8.67
EC-2	2.09	4.25	6.34
EC-3	1.02	0.40	1.42
EC-Ref Comp	1.20	0.91	2.11
IH-1 Replicate 1	1.78	16.43	18.21
IH-1 Replicate 2	2.00	16.42	18.42
IH-1 Replicate 3	3.60	17.42	21.02
IH-2	33.65	224.03	257.68
IH-3	33.57	266.13	299.70
IHR1	18.34	180.03	198.37
IHR2	4.03	26.59	30.62
SR-1	36.07	267.79	303.86
SR-2	61.00	295.36	356.36
SR-3	89.04	360.77	449.81
SR-4	66.22	348.14	414.36

TABLE B.7. Sediment Results for Low Polynuclear Aromatic Hydrocarbons (LPAH), Winyah Bay Project

Sediment Treatment	LPAH (µg/kg dry weight) Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Target DL[a]	30	30	30	30	30	30
Achieved DL	<30	<30	<30	<30	<30	<30
EC-1	0.73	2.08 U[b]	1.60 U	1.27 U	0.51 J[c]	0.56 J
EC-2	0.89	2.22 U	1.71 U	0.41 J	0.50 J	0.29 J
EC-3	0.73	2.07 U	1.59 U	1.26 U	0.17 J	0.12 J
EC-Ref Comp	0.91	1.98 U	1.52 U	1.21 U	0.29 J	1.91 U
IH-1 Replicate 1	0.95	2.37 U	1.83 U	1.45 U	0.60 J	0.23 J
IH-1 Replicate 2	1.14	2.24 U	1.73 U	1.37 U	0.64 J	0.22 J
IH-1 Replicate 3	1.43	0.38 J	1.68 U	0.41 J	0.95 J	0.43 J
IH-2	7.64	3.32 J	6.53 U	4.06 J	13.09	5.54 J
IH-3	8.35	2.93 J	7.60 U	2.60 J	13.71	5.98 J
IHR1	2.47	2.00 J	2.44 U	1.42 J	5.57	6.88
IHR2	1.54	0.50 J	1.65 U	0.31 J	1.20 J	0.48 J
SR-1	8.16	3.84 J	1.28 J	5.72	12.25	4.82 J
SR-2	11.89	4.39 J	2.06 J	5.64	28.97	8.05
SR-3	12.19	4.13 J	5.04 J	13.00	43.50	11.18
SR-4	13.93	4.22 J	2.00 J	6.70	29.47	9.90

(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 B.8. Sediment Results for High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAH), Winyah Bay Project

Sediment Treatment	HPAH (µg/kg dry weight) Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(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	<30	<30	<30	<30
EC-1	1.54 J[b]	4.43	0.21 J	0.22 J	0.34 J	0.13 J	1.51 U[c]	3.60 U	2.11 U	3.90 U
EC-2	0.59 J	0.72 J	0.40 J	0.39 J	0.37 J	0.32 J	0.28 J	3.85 U	2.26 U	1.18 J
EC-3	0.22 J	0.18 J	2.26 U	2.79 U	2.13 U	2.53 U	1.51 U	3.58 U	2.10 U	3.89 U
EC-Ref Comp	0.31 J	0.26 J	0.18 J	0.16 J	2.04 U	2.42 U	1.44 U	3.43 U	2.01 U	3.72 U
IH-1 Replicate 1	3.89 J	10.04	0.35 J	0.60 J	0.78 J	0.40 J	1.73 U	4.12 U	2.42 U	0.37 J
IH-1 Replicate 2	4.62	9.17	0.40 J	0.62 J	0.86 J	0.32 J	1.64 U	3.89 U	2.28 U	0.43 J
IH-1 Replicate 3	4.25 J	8.88	0.64 J	0.80 J	1.12 J	0.57 J	1.59 U	0.54 J	2.22 U	0.62 J
IH-2	56.58	51.90	16.27	18.99	26.70	13.89	12.55	13.36 J	8.63 U	13.79 J
IH-3	52.84	60.10	12.94	60.24	26.05	14.33	10.61	13.80 J	10.05 U	15.22 J
IHR1	14.93	9.48	18.01	44.05	37.07	21.68	19.25	8.96	3.22 U	6.60
IHR2	5.14	5.16	2.66	2.60 J	3.12	2.17 J	2.40	1.80 J	2.18 U	1.54 J
SR-1	60.74	57.23	15.54	23.46	28.41	20.37	13.88	24.66	2.61 J	20.89
SR-2	79.23	75.78	13.54	23.51	31.50	17.19	13.75	19.40	2.80 J	18.66
SR-3	89.75	79.37	23.69	32.38	38.15	27.43	19.71	25.71	2.97 J	21.61
SR-4	81.23	83.73	20.41	32.46	37.43	24.29	18.45	24.33	3.54 J	22.27

(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.9. Quality Control Summary for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAH) in Sediment, Winyah Bay Project

Sediment Treatment	LPAH (µg/kg dry weight) Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Method Blank						
Blank 1	1.20 B[a]	3.29 U[b]	2.53 U	2.01 U	0.60 J[c]	0.31 J
Matrix Spike						
EC-7	0.73	2.08 U	1.60 U	1.27 U	0.51 J	0.56 J
EC-7 MS	173.47	201.74	172.42	204.76	220.1	237.93
Concentration Recovered	172.74	201.74	172.42	204.76	219.59	237.37
Amount Spiked	152.85	152.84	152.84	152.84	152.84	152.84
Percent Recovery	113%	132%[d]	113%	134%[d]	144%[d]	155%[d]
EC-7	0.73	2.08 U	1.60 U	1.27 U	0.51 J	0.56 J
EC-7 MSD	176.65	208.39	176.47	213.27	220.84	238.55
Concentration Recovered	175.92	208.39	176.47	213.27	220.33	237.99
Spiked Amount	152.84	152.84	152.84	152.84	152.84	152.84
Percent Recovery	115%	136%[d]	115%	140%[d]	144%[d]	156%[d]
MS/MSD RPD	2%	3%	2%	4%	0%	0%
MS/MSD I-stat	0.01	0.02	0.01	0.02	0.00	0.00
Standard Reference Material						
Certified Value	NC[e]	NC	NC	NC	577 ±59	202 ±42
Non-certified-Value	1322 ±14	115 ±10	52 ±2	104 ±5	NA[f]	NA
NIST 1941	NA	NA	NA	NA	633.58	213.69
Analytical Replicates						
EC-3 Replicate 1	0.95	2.37 U	1.83 U	1.45 U	0.60 J	0.23 J
EC-3 Replicate 2	1.14	2.24 U	1.73 U	1.37 U	0.64 J	0.22 J
EC-3 Replicate 3	1.43	0.38 J	1.68 U	0.41 J	0.95 J	0.43 J
RSD	21%	NA	NA	NA	26%	40%[g]

(a) B Analyte detected in blank associated with batch of samples.
(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).
(d) Recovery outside quality control range (40%-120%).
(e) NC Not Certified.
(f) NA Not applicable.
(g) Value exceeds relative precision range ≤30%.

TABLE B.10. Quality Control Summary for High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAH) in Sediment, Winyah Bay Project

Sediment Treatment	HPAH (µg/kg dry weight) Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a) pyrene	Indeno (1,2,3-cd) pyrene	Dibenzo (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 Spike										
EC-1	1.54 J	4.43	0.21 J	0.22 J	0.34 J	0.13 J	1.51 U	3.60 U	2.11 U	3.90 U
EC-1 MS	273.68	264.96	NA[c]	193.02	204.7	212.67	175.17	163.98	215.42	187.92
Amount Recovered	272.14	260.53	NA	192.8	204.36	212.54	175.17	163.98	215.42	187.92
Amount Spiked	152.84	152.84	NS[d]	152.84	152.84	152.84	152.84	152.84	152.84	152.84
Percent Recovery	178%[e]	170%[e]	NA	126%[e]	134%[e]	139%[e]	115%	107%	141%[e]	123%[e]
EC-1	1.54 J	4.43	0.21 J	0.22 J	0.34 J	0.13 J	1.51 U	3.60 U	2.11 U	3.90 U
EC-1 MSD	269.63	258.58	NA	195.34	197.59	217.74	177.69	168.47	219.58	184.18
Amount Recovered	268.09	254.15	NA	195.12	197.25	217.61	177.69	168.47	219.58	184.18
Spiked Amount	152.84	152.84	NS	152.84	152.84	152.84	152.84	152.84	152.84	152.84
Percent Recovery	175%[e]	166%[e]	NA	128%[e]	129%[e]	142%[e]	116%	110%	144%[e]	120%
MS/MSD RPD	1%	2%	NA	1%	4%	2%	1%	3%	2%	2%
MS/MSD I-stat	0.01	0.01	NA	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Standard Reference Material										
Certified Value	1220 ±240	1080 ±324	550 ±79	NC	780 ±190	444 ±49	670 ±130	569 ±40	NC[f]	516 ±83
Non-certified-Value	NA	NA	NA	449	NA	NA	NA	NA	NA	NA
NIST 1941	1776.2[g]	1513.3[g]	632.98	NA	1249.0[g]	846.36[g]	639.67	790.15[g]	NA	597.41

TABLE B.10. (contd)

Sediment Treatment	HPAH (µg/kg dry weight) Fluor-anthene	Pyrene	Benz(a) anthracene	Chrysene	Benzo(b) fluor-anthene	Benzo(k) fluor-anthene	Benzo(a) pyrene	Indeno (1,2,3-cd) pyrene	Dibenzo (a,h) anthracene	Benzo (g,h,i) perylene
Analytical Replicates										
IH-1 Replicate 1	3.89 J	10.04	0.35 J	0.60 J	0.78 J	0.40 J	1.73 U	4.12 U	2.42 U	0.37 J
IH-1 Replicate 2	4.62	9.17	0.40 J	0.62 J	0.86 J	0.32 J	1.64 U	3.89 U	2.28 U	0.43 J
IH-1 Replicate 3	4.25 J	8.83	0.64 J	0.80 J	1.12 J	0.57 J	1.59 U	0.54 J	2.22 U	0.62 J
RSD	9%	5%	33%(h)	16%	19%	30%	NA	NA	NA	28%

(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) NA Not applicable.
(d) NS Not spiked.
(e) Recovery outside of quality control range (40%-120%).
(f) NC No certified value.
(g) Value exceeds SRM ≤30% of certified value.
(h) Value exceeds relative standard deviation range ≤30%.

TABLE B.11. Surrogate Recoveries for Sediment Polynuclear Aromatic Hydrocarbon (PAH) Results, Winyah Bay Project

Sediment Treatment	Surrogate Percent Recoveries		
	Naph-thalene-D8	Acenaph-thene-D10	Benzo(a) pyrene D12
EC-1	43	56	62
EC-2	49	52	54
EC-3	51	53	51
EC-Ref Comp	52	58	60
IH-1 Replicate 1	40	51	62
IH-1 Replicate 2	36[a]	50	62
IH-1 Replicate 3	39[a]	51	62
IH-2	35[a]	51	61
IH-3	44	58	65
IHR1	44	63	61
IHR2	37[a]	50	57
SR-1	35[a]	51	51
SR-2	26[a]	45	57
SR-3	42	52	54
SR-4	26[a]	53	63
Quality Control Summary			
Method Blank			
Blank 1	54	53	52
Matrix Spike			
EC-1	43	56	62
EC-1 MS	45	52	69
EC-1	43	56	62
EC-1 MSD	46	51	66
Standard Reference Material			
NIST 1941	47	62	58

TABLE B.11. (contd)

Sediment Treatment	Surrogate Percent Recoveries: Naphthalene-D8	Acenaphthene-D10	Benzo(a)pyrene D12
Analytical Replicates			
IH-1 Replicate 1	40	51	62
IH-1 Replicate 2	36[a]	50	62
IH-1 Replicate 3	39[a]	51	62

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

TABLE B.12. Chlorinated Pesticide Results (alphabetical, Aldrin - 4,4'-DDT), Winyah Bay Project

Sediment Treatment	Pesticides (µg/kg dry weight)							
	Aldrin	Alpha-BHC[a]	Beta-BHC	Delta-BHC	Chlordane	4,4'-DDD	4,4'-DDE	4,4'-DDT
Target DL[b]	10	10	10	10	30	10	10	10
Achieved DL	1	1	1	1	30	1	1	1
EC-1	0.635 U[c]	0.303 U	0.303 U	0.303 U	30.496 U	0.892 U	0.388 U	0.951 U
EC-2	0.679 U	0.324 U	0.324 U	0.324 U	32.615 U	0.954 U	0.415 U	1.017 U
EC-3	0.632 U	0.302 U	0.302 U	0.302 U	30.376 U	0.888 U	0.387 U	0.947 U
EC-Ref Comp	0.605 U	0.289 U	0.289 U	0.289 U	29.072 U	0.850 U	0.370 U	0.906 U
IH-1 Replicate 1	0.726 U	0.347 U	0.347 U	0.347 U	34.876 U	1.020 U	0.444 U	1.087 U
IH-1 Replicate 2	0.686 U	0.328 U	0.328 U	0.328 U	32.967 U	0.964 U	0.420 U	1.028 U
IH-1 Replicate 3	0.668 U	0.319 U	0.319 U	0.319 U	32.107 U	0.939 U	0.409 U	1.001 U
IH-2	2.593 U	1.239 U	1.239 U	1.239 U	124.579 U	3.643 U	1.586 U	3.884 U
IH-3	3.020 U	1.443 U	1.443 U	1.443 U	145.082 U	4.243 U	1.847 U	4.524 U
IHR1	0.969 U	0.463 U	0.463 U	0.463 U	46.552 U	1.361 U	0.593 U	1.452 U
IHR2	0.656 U	0.313 U	0.313 U	0.313 U	31.504 U	0.921 U	0.401 U	0.982 U
SR-1	1.787 U	0.854 U	0.854 U	3.442	85.866 U	3.396	3.131	2.677 U
SR-2	2.523 U	1.206 U	1.206 U	1.206 U	121.220 U	3.545 U	1.543 U	3.780 U
SR-3	2.574 U	1.230 U	1.230 U	1.230 U	123.663 U	3.616 U	1.574 U	3.856 U
SR-4	2.593 U	1.239 U	1.239 U	1.239 U	124.559 U	3.643 U	1.586 U	3.884 U

(a) CL2(08) and Alpha-BHC coelute.
(b) DL Detection limit.
(c) U Analyte was not present above the level of associated value.

TABLE B.13. Sediment Chlorinated Pesticides Results (alphabetical, Dieldrin - Toxaphene), Winyah Bay Project

Sediment Treatment	Pesticides (µg/kg dry weight)											
	Dieldrin	Endo-Sulfan I	Endo-Sulfan II	Endo-sulfan Sulfate	Endrin	Endrin Aldehyde	Endrin Ketone	Hepta-chlor	Hepta-chlor Epoxide	Lindane	Methoxy-chlor	Toxaphene
Target DL[a]	10	20	20	20	10	10	20	20	20	10	20	30
Achieved DL	1	3	3	3	2	3	3	1	1	1	3	30
EC-1	0.609 U[b]	3.050 U	3.050 U	3.050 U	1.735 U	3.050 U	3.050 U	0.826 U	0.702 U	0.303 U	3.050 U	30.496 U
EC-2	0.651 U	3.262 U	3.262 U	3.262 U	1.856 U	3.262 U	3.262 U	0.883 U	0.751 U	0.324 U	3.262 U	32.615 U
EC-3	0.606 U	3.038 U	3.038 U	3.038 U	1.728 U	3.038 U	3.038 U	0.822 U	0.699 U	0.302 U	3.038 U	30.376 U
EC-Ref Comp	0.580 U	2.907 U	2.907 U	2.907 U	1.654 U	2.907 U	2.907 U	0.787 U	0.669 U	0.289 U	2.907 U	29.072 U
IH-1 Replicate 1	0.696 U	3.488 U	3.488 U	3.488 U	1.984 U	3.488 U	3.488 U	0.944 U	0.803 U	0.347 U	3.488 U	34.876 U
IH-1 Replicate 2	0.658 U	3.297 U	3.297 U	3.297 U	1.876 U	3.297 U	3.297 U	0.893 U	0.759 U	0.328 U	3.297 U	32.967 U
IH-1 Replicate 3	0.641 U	3.211 U	3.211 U	3.211 U	1.827 U	3.211 U	3.211 U	0.869 U	0.739 U	0.319 U	3.211 U	32.107 U
IH-2	2.486 U	12.458 U	12.458 U	12.458 U	7.089 U	12.458 U	12.458 U	3.373 U	2.867 U	1.239 U	12.458 U	124.579 U
IH-3	2.895 U	14.508 U	14.508 U	14.508 U	8.255 U	14.508 U	14.508 U	3.928 U	3.339 U	1.443 U	14.508 U	145.082 U
IHR1	0.929 U	4.655 U	4.655 U	4.655 U	2.649 U	4.655 U	4.655 U	1.260 U	1.071 U	0.463 U	4.655 U	46.552 U
IHR2	0.629 U	3.150 U	3.150 U	3.150 U	1.793 U	3.150 U	3.150 U	0.853 U	0.725 U	0.313 U	3.150 U	31.504 U
SR-1	1.713 U	8.587 U	8.587 U	8.587 U	4.886 U	8.587 U	8.587 U	2.325 U	1.976 U	0.854 U	8.587 U	85.866 U
SR-2	2.419 U	12.122 U	12.122 U	12.122 U	6.897 U	12.122 U	12.122 U	3.282 U	2.790 U	1.206 U	12.122 U	121.220 U
SR-3	2.468 U	12.366 U	12.366 U	12.366 U	7.036 U	12.366 U	12.366 U	3.348 U	2.846 U	1.230 U	12.366 U	123.663 U
SR-4	2.486 U	12.456 U	12.456 U	12.456 U	7.087 U	12.456 U	12.456 U	3.372 U	2.867 U	1.239 U	12.456 U	124.559 U

(a) DL Detection limit.
(b) U Analyte was not present above the level of associated value.

TABLE B.14. Quality Control Data for Chlorinated Pesticide Results (alphabetical, Aldrin - 4,4'-DDT), Winyah Bay Project

Sediment Treatment	Pesticides (µg/kg dry weight)							
	Aldrin	Alpha-BHC[a]	Beta-BHC	Delta-BHC	Chlordane	4,4'-DDD	4,4'-DDE	4 4'-DDT
Method Blank								
Blank 1	1.006 U[b]	0.481 U	0.481 U	0.481 U	48.330 U	1.413 U	0.615 U	1.507 U
Matrix Spikes								
EC-1	0.635 U	0.303 U	0.303 U	0.303 U	30.496 U	0.892 U	0.388 U	0.951 U
EC-1 MS	6.473	6.949	6.587	7.229	NA[c]	8.137	5.951	6.327
Concentration Recovered	6.473	6.949	6.587	7.229	NA	8.137	5.951	6.327
Amour* Spiked	6.113	6.114	6.114	6.114	NS[d]	6.117	6.111	6.111
Percent Recovery	106%	114%	108%	118%	NA	133%[e]	97%	104%
EC-1	0.635 U	0.303 U	0.303 U	0.303 U	30.496 U	0.892 U	0.388 U	0.951 U
EC-1 MSD	6.369	8.158	7.470	7.775	NA	7.838	6.714	6.977
Concentration Recovered	6.369	8.158	7.470	7.775	NA	7.838	6.714	6.977
Amount Spiked	6.301	6.301	6.301	6.301	NS	6.3048	6.298	6.298
Percent Recovery	101%	129%[e]	119%	123%[e]	NA	124%[e]	107%	111%
RPD	5%	13%	10%	4%	NA	7%	9%	7%
I-Stat	0.02	0.07	0.05	0.02	NA	0.03	0.05	0.03
Analytical Replicates								
IH-1 Replicate 1	0.726 U	0.347 U	0.347 U	0.347 U	34.876 U	1.020 U	0.444 U	1.087 U
IH-1 Replicate 2	0.686 U	0.328 U	0.328 U	0.328 U	32.967 U	0.964 U	0.420 U	1.028 U
IH-1 Replicate 3	0.668 U	0.319 U	0.319 U	0.319 U	32.107 U	0.939 U	0.409 U	1.001 U
RSD	NA	NA	NA	NA	NA	NA	NA	NA

(a) CL2(08) and Alpha-BHC coelute.
(b) U Analyte was not present above the level of assoicated value.
(c) NA Not applicable.
(d) NS Not spiked.
(e) Recovery outside quality control range (40%-120%).

TABLE B.15. Quality Control Data for Chlorinated Pesticide Results (alphabetical, Dieldrin - Toxaphene), Winyah Bay Project

Sediment Treatment	Pesticides (µg/kg dry weight)											
	Dieldrin	Endo-Sulfan I	Endo-Sulfan II	Endo-sulfan Sulfate	Endrin	Endrin Aldehyde	Endrin Ketone	Hepta-chlor	Hepta-chlor Epoxide	Lindane	Methoxy-chlor	Toxaphene
Method Blank												
Blank 1	0.964 U[a]	4.833 U	4.833 U	4.833 U	2.750 U	4.833 U	4.833 U	1.309 U	1.112 U	0.481 U	4.833 U	48.330 U
Matrix Spikes												
EC-1	0.609 U	3.050 U	3.050 U	3.050 U	1.735 U	3.050 U	3.050 U	0.826 U	0.702 U	0.303 U	3.050 U	30.496 U
EC-1 MS	19.690	6.335	7.446	7.959	7.456	4.646	7.075	7.421	6.370	7.278	3.274	NA[b]
Concentration Recovered	19.690	6.335	7.446	7.959	7.456	4.646	7.075	7.421	6.370	7.278	3.274	NA
Amount Spiked	6.114	6.114	6.114	6.114	6.264	6.114	6.114	6.111	6.114	6.114	6.111	NS[c]
Percent Recovery	322%[d]	104%	122%[d]	130%[d]	119%	76%	116%	121%[d]	104%	119%	54%	NA
EC-1	0.609 U	3.050 U	3.050 U	3.050 U	1.735 U	3.050 U	3.050 U	0.826 U	0.702 U	0.303 U	3.050 U	30.496 U
EC-1 MSD	27.671	6.597	7.824	8.442	8.867	5.211	6.859	6.868	6.846	9.842	6.472	NA
Concentration Recovered	27.671	6.597	7.824	8.442	8.867	5.211	6.859	6.868	6.846	9.842	6.472	NA
Amount Spiked	6.301	6.301	6.301	6.301	6.456	6.301	6.301	6.299	6.301	6.301	6.299	NS
Percent Recovery	439%[d]	105%	124%[d]	134%[d]	137%[d]	83%	109%	109%	109%	156%[d]	103%	NA
RPD	31%[e]	1%	2%	3%	14%	8%	6%	11%	4%	27%	63%[e]	NA
I-Stat	0.15	0.01	0.01	0.01	0.07	0.04	0.03	0.05	0.02	0.13	0.31	NA
Analytical Replicates												
IH-1 Replicate 1	0.696 U	3.488 U	3.488 U	3.488 U	1.984 U	3.488 U	3.488 U	0.944 U	0.803 U	0.347 U	3.488 U	34.876 U
IH-1 Replicate 2	0.658 U	3.297 U	3.297 U	3.297 U	1.876 U	3.297 U	3.297 U	0.893 U	0.759 U	0.328 U	3.297 U	32.967 U
IH-1 Replicate 3	0.641 U	3.211 U	3.211 U	3.211 U	1.827 U	3.211 U	3.211 U	0.869 U	0.739 U	0.319 U	3.211 U	32.107 U
RSD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

(a) U Analyte was not present above the level of associated value.
(b) NA Not applicable.
(c) NS Not spiked.
(d) Recovery outside quality control range (40%-120%).
(e) Value exceeds relative precision range of ≤30%.

TABLE B.16. Sediment Polychlorinated Biphenyl (PCB) Results, Winyah Bay Project

Sediment Treatment	PCB (µg/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	30	30	30	30	30	30
EC-1	30.496 U[b]	30.496 U	30.496 U	30.496 U	30.496 U	30.496 U
EC-2	32.615 U	32.615 U	32.615 U	32.615 U	32.615 U	32.615 U
EC-3	30.376 U	30.376 U	30.376 U	30.376 U	30.376 U	30.376 U
EC-Ref Comp	29.072 U	29.072 U	29.072 U	29.072 U	29.072 U	29.072 U
IH-1 Replicate 1	34.876 U	34.876 U	34.876 U	34.876 U	34.876 U	34.876 U
IH-1 Replicate 2	32.967 U	32.967 U	32.967 U	32.967 U	32.967 U	32.967 U
IH-1 Replicate 3	32.107 U	32.107 U	32.107 U	32.107 U	32.107 U	32.107 U
IH-2	124.579 U	124.579 U	124.579 U	124.579 U	124.579 U	124.579 U
IH-3	145.082 U	145.082 U	145.082 U	145.082 U	145.082 U	145.082 U
IHR1	46.552 U	46.552 U	46.552 U	46.552 U	46.552 U	46.552 U
IHR2	31.504 U	31.504 U	31.504 U	31.504 U	31.504 U	31.504 U
SR-1	85.866 U	85.866 U	85.866 U	85.866 U	85.866 U	85.866 U
SR-2	121.220 U	121.220 U	121.220 U	121.220 U	121.220 U	121.220 U
SR-3	123.663 U	123.663 U	123.663 U	123.663 U	123.663 U	123.663 U
SR-4	124.559 U	124.559 U	124.559 U	124.559 U	124.559 U	124.559 U

(a) DL Detection limit.
(b) U Analyte was not present above the level of associated value.

TABLE B.17. Quality Control Summary for Polychlorinated Biphenyl (PCB) Analysis, Winyah Bay Project

Sediment Treatment	PCB (µg/kg dry weight) Aroclor 1221	Aroclor 1232	Aroclor 1242/1016	Aroclor 1248	Aroclor 1254	Aroclor 1260
Method Blank						
Blank 1	48.330 U[a]	48.330 U	48.330 U	48.330 U	48.330 U	48.330 U
Matrix Spikes						
EC-1	30.496 U	30.496 U	30.496 U	30.496 U	30.496 U	30.496 U
EC-1 MS	NA[b]	NA	NA	NA	88.230	NA
Concentration Recovered	NA	NA	NA	NA	88.230	NA
Amount Spiked	NS[c]	NS	NS	NS	76.425	NS
Percent Recovery	NA	NA	NA	NA	115%	NA
EC-1	30.496 U	30.496 U	30.496 U	30.496 U	30.496 U	30.496 U
EC-1 MSD	NA	NA	NA	NA	84.783	NA
Concentration Recovered	NA	NA	NA	NA	84.783	NA
Amount Spiked	NS	NS	NS	NS	78.768	NS
Percent Recovery	NA	NA	NA	NA	108%	NA
RPD	NA	NA	NA	NA	7%	NA
I-Stat	NA	NA	NA	NA	0.04	NA
Analytical Replicates						
IH-1 Replicate 1	34.876 U	34.876 U	34.876 U	34.876 U	34.876 U	34.876 U
IH-1 Replicate 2	32.967 U	32.967 U	32.967 U	32.967 U	32.967 U	32.967 U
IH-1 Replicate 3	32.107 U	32.107 U	32.107 U	32.107 U	32.107 U	32.107 U
RSD	NA	NA	NA	NA	NA	NA

(a) U Analyte was not present above the level of associated value.
(b) NA Not applicable.
(c) NS Not spiked.

TABLE B.18. Surrogate Percent Recoveries for Polychlorinated Biphenyl (PCB) and Chlorinated Pesticide Sediment Results, Winyah Bay Project

Sediment Treatment	Surrogate Percent Recoveries DBOFB	CL5(112)
EC-1	90	93
EC-2	81	87
EC-3	70	76
EC-Ref Comp	77	92
IH-1 Replicate 1	84	81
IH-1 Replicate 2	89	78
IH-1 Replicate 3	91	83
IH-2	107	80
IH-3	126[a]	88
IHR1	118	80
IHR2	87	84
SR-1	111	81
SR-2	104	75
SR-3	112	70
SR-4	134[a]	81
Quality Control Summary		
Method Blank		
Blank 1	69	78
Matrix Spikes		
EC-1	90	93
EC-1 MS	81	88
EC-1	90	93
EC-1 MSD	78	83
Analytical Replicates		
IH-1 Replicate 1	84	81
IH-1 Replicate 2	89	78
IH-1 Replicate 3	91	83

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

TABLE B.19. Sediment Phenol Analysis, Winyah Bay Project

Sediment Treatment	Phenols (µg/kg dry weight)										
	Phenol	2-chloro-phenol	2-nitro-phenol	2,4-di-methyl-phenol	2,4-di-chloro-phenol	2,4,6-tri-chloro-phenol	2,4-dini-trophenol	4-nitro-phenol	Para-chloro-meta-cresol	penta-chloro-phenol	4,6-dinitro-o-cresol
Target DL[a]	100-1500	100-1500	100-1500	100-1500	100-1500	100-1500	100-1500	100-1500	100-1500	100-1500	100-1500
Achieved DL	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
EC-1	19.31 J[b]	295.69 U[c]	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U
EC-2	38.90 J	1.84 J	316.23 U	1.76 J	38.54 J	1.73 J	316.23 U	316.23 U	5.24 J	316.23 U	316.23 U
EC-3	22.56 J	294.52 U	294.52 U	1.21 J	294.52 U	294.52 U	294.52 U	294.52 U	0.81 J	218.53 J	294.52 U
EC-Ref Comp	7.37 J	0.77 J	281.88 U	281.88 U	281.88 U	281.88 U	281.88 U	281.88 U	281.88 U	2.28 J	281.88 U
IH-1 Replicate 1	25.19 J	338.16 U	338.16 U	1.84 J	338.16 U	338.16 U	338.16 U	338.16 U	1.28 J	4.70 J	338.16 U
IH-1 Replicate 2	45.15 J	1.16 J	319.64 U	319.64 U	319.64 U	319.64 U	319.64 U	319.64 U	319.64 U	3.98 J	319.64 U
IH-1 Replicate 3	26.18 J	1.65 J	311.31 U	311.31 U	1.23 J	1.55 J	311.31 U	311.31 U	311.31 U	2.60 J	311.31 U
IH-2	189.30 J	1207.90 U	1207.90 U	10.10 J	7.19 J	5.67 J	1207.90 U	1207.90 U	12.27 J	46.67 J	1207.90 U
IH-3	199.92 J	1406.69 U	1406.69 U	17.54 J	21.28 J	18.71 J	1406.69 U	1406.69 U	25.15 J	205.82 J	1406.69 U
IHR1	85.11 J	451.36 U	451.36 U	451.36 U	451.36 U	451.36 U	451.36 U	451.36 U	1.69 J	56.34 J	451.36 U
IHR2	61.62 J	305.46 U	305.46 U	1.37 J	305.46 U	305.46 U	305.46 U	305.46 U	1.05 J	5.15 J	305.46 U
SR-1	129.28 J	832.55 U	832 55 U	9.16 J	832.55 U	832.55 U	832.55 U	832.55 U	6.20 J	17.16 J	832.55 U
SR-2	138.47 J	10.26 J	1175.33 U	16.82 J	21.42 J	14.07 J	1175.33 U	1175.33 U	22.14 J	251.11 J	1175.33 U
SR-3	338.38 J	18.87 J	1199.02 U	10.03 J	1199.02 U	1199.02 U	1199.02 U	1199.02 U	12.30 J	41.78 J	1199.02 U
SR-4	294.26 J	1207 71 U	1207.71 U	14.83 J	1207.71 U	1207.71 U	1207.71 U	3.64 J	11.31 J	24.02 J	1207.71 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.20. Quality Control Summary for Sediment Phenol Analysis, Winyah Bay Project

Sediment Treatment	Phenols (µg/kg dry weight)										
	Phenol	2-chloro-phenol	2-nitro-phenol	2,4-di-methyl-phenol	2,4-di-chloro-phenol	2,4,6-tri-chloro-phenol	2,4-dini-trophenol	4-nitro-phenol	Para-chloro-meta-cresol	Penta-chloro-phenol	4,6-dinitro-o-cresol
Method Blank											
Blank 1	105.55 J[a]	14.96 J	468.60 U[b]	468.60 U	3.60 J	3.39 J	468.60 U	468.60 U	5.59 J	13.90 J	468.60 U
Matrix Spikes											
EC-1	19.31 J	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U
EC-1 MS	684.21	1079.06	1047.34	1301.08	994.39	1457.36	42.54	1.03	NA[c]	13.53	NA
Concentration Recovered	664.90	1079.06	1047.34	1301.08	994.39	1457.36	42.54	1.03	NA	13.53	NA
Amount Spiked	913.02	913.02	913.02	940.74	913.02	940.74	940.74	913.02	NS[d]	913.02	NS
Percent Recovery	73%	118%	115%	138%[e]	109%	155%[e]	5%[e]	0%[e]	NA	1%[e]	NA
EC-1	19.31 J	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U	295.69 U
EC-1 MSD	839.51	1079.92	1124.41	1111.47	1159.84	1516.45	72.27	15.68	NA	24.26	NA
Concentration Recovered	820.20	1079.92	1124.41	1111.47	1159.84	1516.45	72.27	15.68	NA	24.26	NA
Amount Spiked	941.02	941.02	941.02	969.58	941.02	969.58	969.58	941.02	NS	941.02	NS
Percent Recovery	87%	115%	119%	115%	123%	156%[e]	7%[e]	2%[e]	NA	3%[e]	NA
RPD	18%	3%	4%	19%	12%	1%	49%[f]	175%[f]	NA	54%[f]	NA
I-Stat	0.09	0.01	0.02	0.09	0.06	0.00	0.24	0.87	NA	0.27	NA
Analytical Replicates											
IH-1 Replicate 1	25.19 J	338.16 U	338.16 U	1.84 J	338.16 U	338.16 U	338.16 U	338.16 U	1.28 J	4.70 J	338.16 U
IH-1 Replicate 2	45.15 J	1.16 J	319.64 U	319.64 U	319.64 U	319.64 U	319.64 U	319.64 U	319.64 U	3.98 J	319.64 U
IH-1 Replicate 3	26.18 J	1.65 J	311.31 U	311.31 U	1.23 J	1.55 J	311.31 U	311.31 U	311.31 U	2.60 J	311.31 U
RSD	35%[f]	NA	NA	NA	NA	NA	NA	NA	NA	28%	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) NA Not applicable.
(d) NS Not spiked.
(e) Recovery outside quality control range 40%-120%.
(f) Value exceeds relative standard deviation range of ≤30%.

TABLE B.21. Sediment Phthalate Analysis, Winyah Bay Project

Sediment Treatment	Phthalates (µg/kg dry weight)					
	Butyl benzyl phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	Di-n-butyl phthalate
Target DL[a]	100	100	100	100	100	100
Achieved DL	500	<100	<100	<100	<100	<100
EC-1	1.88 J[b]	2.08 J	0.23 J	295.69 U[c]	0.92 J	1.46 J
EC-2	1.50 J	2.08 J	316.23 U	1.04 J	0.99 J	1.87 J
EC-3	1.13 J	2.26 J	294.52 U	294.52 U	0.39 J	0.96 J
EC-Ref Comp	0.88 J	1.94 J	0.31 J	281.88 U	3.03 J	0.58 J
IH-1 Replicate 1	1.49 J	3.45 J	338.16 U	338.16 U	0.44 J	1.37 J
IH-1 Replicate 2	2.06 J	3.86 J	319.64 U	319.64 U	0.73 J	3.23 J
IH-1 Replicate 3	1.39 J	3.76 J	311.31 U	0.85 J	0.43 J	1.49 J
IH-2	8.94 J	12.66 J	1207.90 U	1207.90 U	5.00 J	6.87 J
IH-3	7.94 J	14.30 J	1406.69 U	1406.69 U	11.79 J	6.84 J
IHR1	2.02 J	5.10 J	451.36 U	1.21 J	1.14 J	451.36 U
IHR2	1.42 J	2.53 J	0.43 J	305.46 U	0.34 J	1.45 J
SR-1	9.53 J	11.51 J	832.55 U	832.55 U	2.74 J	4.04 J
SR-2	10.07 J	23.96 J	1175.33 U	1175.33 U	4.01 J	6.23 J
SR-3	1199.02 U	1199.02 U	1199.02 U	1199.02 U	1.91 J	6.52 J
SR-4	10.23 J	14.76 J	1207.71 U	1207.71 U	13.98 J	1207.71 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.22. Quality Control Summary for Sediment Phthalate Analysis, Winyah Bay Project

Sediment Treatment	Phthalates (µg/kg dry weight) Butyl benzyl phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	Di-n-butyl phthalate
Method Blank						
Blank 1	468.60 U[a]	5.24 J[b]	468.60 U	468.60 U	468.60 U	355.75 J
Matrix Spikes						
EC-1	1.88 J	2.08 J	0.23 J	295.69 U	0.92 J	1.46 J
EC-1 MS	17.04	11.60	5.80	855.37	115.92	230.34
Concentration Recovered	15.16	9.52	5.57	855.37	115	228.88
Amount Spiked	913.018	913.018	913.018	913.0186	935.84	913.018
Percent Recovery	2%[c]	1%[c]	1%[c]	94%	12%[c]	25%[c]
EC-1	1.88 J	2.08 J	0.23 J	295.69 U	0.92 J	1.46 J
EC-1 MSD	18.76	11.99	6.29	978.08	144.00	229.94
Concentration Recovered	16.88	9.91	6.06	978.08	143.08	228.48
Amount Spiked	941.018	941.018	941.018	941.0183	964.54	941.018
Percent Recovery	2%[c]	1%[c]	1%[c]	104%	15%[c]	24%[c]
RPD	8%	1%	5%	10%	19%	3%
I-Stat	0.04	0.00	0.03	0.05	0.09	0.02
Analytical Replicates						
IH-1 Replicate 1	1.49 J	3.45 J	338.16 U	338.16 U	0.44 J	1.37 J
IH-1 Replicate 2	2.06 J	3.86 J	319.64 U	319.64 U	0.73 J	3.23 J
IH-1 Replicate 3	1.39 J	3.76 J	311.31 U	0.85 J	0.43 J	1.49 J
RSD	22%	6%	NA	NA	32%[d]	51%[d]

(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) Recovery outside quality control range 40-120%.
(d) Value exceeds relative standard deviation range ≤30%.

TABLE B.23. Surrogate Percent Recoveries for Sediment Phenol and Phthalate Analysis, Winyah Bay Project

Sediment Treatment	Surrogate Percent Recovery 2-fluoro-phenol
EC-1	41
EC-2	48
EC-3	37[a]
EC-Ref Comp	43
IH-1 Replicate 1	41
IH-1 Replicate 2	35[a]
IH-1 Replicate 3	40
IH-2	20[a]
IH-3	18[a]
IHR1	12[a]
IHR2	14[a]
SR-1	23[a]
SR-2	22[a]
SR-3	12[a]
SR-4	12[a]
Quality Control Data	
Method Blank	
Blank 1	6[a]
Matrix Spikes	
EC-1	41
EC-1 MS	45
EC-1	41
EC-1 MSD	47
NIST 1941	145[a]
Analytical Replicates	
IH-1 Replicate 1	41
IH-1 Replicate 2	35[a]
IH-1 Replicate 3	40
RSD	NA

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

TABLE B.24. Sediment Results for Metals Analyzed by Graphite Furnace Atomic Absorption (GFAA), Cold Vapor Atomic Absorption (CVAA), and Inductively Coupled Plasma/Mass Spectrometry (ICP/MS), Winyah Bay Project

Sediment Treatment	Batch	Metals (mg/kg dry weight) GFAA Ag	GFAA As	ICP Be	ICP Cd	ICP Cr	ICP Cu	CVAA Hg	ICP Ni	ICP Pb	GFAA Sb	GFAA Se	ICP Ti	ICP Zn[a]
Target DL[b]		0.1	0.1	0.2	0.1	0.6	0.1	0.01	0.1	0.1	0.1	0.2	0.1	0.3
Achieved DL		0.03	0.2	0.1	0.01	1.0	0.1	0.001	0.1	1.0	0.2	0.1	0.01	1.0
EC-1	1	0.03 U[c]	4.06	0.98	0.01 U	9.11	1.33	0.001	1.68	6.08	0.16 U	0.13 U	0.07	16.4
EC-2	1	0.03 U	2.40	0.13	0.01 U	4.18	1.05	0.001 U	0.75	3.69	0.16 U	0.13 U	0.02	8.56
EC-3 Replicate 1	1	0.03 U	5.04	0.36	0.01 U	6.87	0.74	0.001 U	1.53	9.34	0.16 U	0.13 U	0.09	12.7
EC-3 Replicate 2	1	0.03 U	5.47	0.31	0.01 U	7.21	1.07	0.001 U	1.74	5.44	0.16 U	0.13 U	0.05	46.7
EC-3 Replicate 3	2	0.03 U	5.40	0.40	0.10 U	7.02	1.43	NA[d]	1.50	5.74	0.16 U	0.13 U	0.09	13.1
EC-Ref Comp	1	0.03 U	2.71	0.25	0.01 U	10.3	2.49	0.001 U	2.38	7.53	0.16 U	0.13 U	0.14	16.7
SR-1	1	0.07	20.7	2.37	0.12	91.1	28	0.800	28.5	29	0.55	0.50	0.43	88.4
SR-2	1	0.12	23.1	2.58	0.25	91.9	23.9	0.106	33.3	35.2	0.73	0.72	0.61	104
SR-3	1	0.12	24.4	2.35	0.07	94.3	18.2	0.880	30.5	32	0.73	0.72	0.51	96.7
SR-4	1	0.15	25.0	2.76	0.19	103	29.8	0.108	36.4	34.5	0.73	0.72	0.57	129

(a) Results for these elements, with the excepton of sediment treatments EC-1 and SR-3, 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 Sediment Metals Analyzed by Graphite Furnace Atomic Absorption (GFAA), Cold Vapor Atomic Absorption (CVAA), and Inductively Coupled Plasma/Mass Spectrometry (ICP/MS), Winyah Bay Project

Sediment Treatment	Batch	Metals (mg/kg) AA Ag	AA As	ICP Be	ICP Cd	ICP Cr	ICP Cu	CVAA Hg	ICP Ni	ICP Pb	AA Sb	AA Se	ICP Ti	ICP Zn[a]
Method Blank														
Blank 1 Replicate 1	1	0.03 U[b]	0.21 U	0.1 U	0.01 U	1 U	0.87	0.001 U	0.1 U	1 U	0.16 U	0.13 U	0.01 U	24.5
Blank 1 Replicate 2	1	NA[c]	NA	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 1 Replicate 3	1	NA	NA	0.1 U	0.01 U	1 U	0.19	0.001 U	0.1 U	1 U	NA	NA	0.01 U	29.2
Blank 2	2	0.03 U	0.21 U	0.1 U	0.1 U	1 U	0.1 U	NA	0.1 U	1 U	NA	NA	0.01 U	1.08 U
Blank 3	3	0.03 U	0.21 U	NA	NA	NA	NA	NA	NA	NA	0.16 U	0.13 U	NA	NA
Blank 4	4	0.03 U	0.21 U	NA	NA	NA	NA	NA	NA	NA	0.16 U	0.13 U	NA	NA
Matrix Spike														
EC-1	1	0.03 U	4.06	0.98	0.01 U	9.11	1.33	0.001	1.68	6.08	0.16 U	0.13 U	0.07	16.4
EC-1 MS	1	0.56	34.10	0.38	0.87	65.20	59.60	0.466	62.00	57.40	1.20	5.00	2.47	137
Concentration Recovered		0.56	30.1	0.6	0.87	56.09	58.27	0.465	60.32	51.32	1.20	5.00	2.40	120.6
Amount Spiked		0.50	25.00	NA	0.99	49.53	49.53	0.50	49.53	49.53	1.00	5.00	1.98	99.06
Percent Recovery		112%	120%	NA	88%	113%	118%	94%	122%	104%	120%	100%	121%	122%
Standard Reference Material														
Certified Value MESS 1		NC[d]	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 ±.08	0.34 ±.06	NC	191 ±17
Mess 1 Replicate 1	1	0.15	18.2[e]	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	1	0.11	10.5	2.88[e]	0.36[e]	62.7	29.5	NA	27.1	33.8	1.48[e]	0.29	0.53	207
Mess 1 Replicate 3	1	0.10	10.9	1.79	0.59	66	26	NA	25.4	34.4	0.82	0.29	0.63	189
Mess 1 Replicate 4	2	0.11	10.6	3.75[e]	0.74	73.9	28.4	NA	29.4	27.1	0.74	0.29	0.56	162
Certified Value SRM 1646	1	NC	11.6 ±1.3	NC	0.36 ±0.07	76 ±3	18 ±3	0.063 ±.012	32 ±3	28.2 ±1.8	NC	NC	NC	138 ±6
SRM 1646 Replicate 1	1	0.09	10.4	2.00	0.54[e]	86.3	17.5	0.075	35.3	27.8	0.46	0.50	0.46	127
SRM 1646 Replicate 2	1	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	1	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	2	0.11	11.9	2.74	0.45	92.9	22.6	NA	34.7	24.5	0.46	0.44	0.46	115

TABLE B.25. (contd)

Sediment Treatment	Batch	Metals (mg/kg) AA Ag	AA As	ICP Be	ICP Cd	ICP Cr	ICP Cu	CVAA Hg	ICP Ni	ICP Pb	AA Sb	AA Se	ICP Ti	ICP Zn[a]
Analytical Replicate														
EC-3 Replicate 1	1	0.03 U	5.04	0.36	0.01 U	6.87	0.74	0.001 U	1.53	9.34	0.16 U	0.13 U	0.09	12.7
EC-3 Replicate 2	1	0.03 U	5.47	0.31	0.01 U	7.21	1.07	0.001 U	1.74	5.44	0.16 U	0.13 U	0.05	46.7
EC-3 Replicate 3	2	0.03 U	5.40	0.40	0.10 U	7.02	1.43	NA	1.5	5.74	0.16 U	0.13 U	0.09	13.1
RSD		NA	4%	13%	NA	2%	32%[f]	NA	8%	32%[f]	NA	NA	30%[f]	81%[f]

(a) Results for these elements, with the exception of sediment treatments EC-1 and SR-3, are from procedure analysis 2807q.
(b) U Analyte was not present above the level of associated value.
(c) NA Not applicable.
(d) NC Not certified.
(e) Value exceeds SRM ≤30% of certified value.
(f) Value exceeds relative standard deviation range of ≤20%.

TABLE B.26. Sediment Butyltin Results, Winyah Bay Project

Sediment Treatment	Percent Surrogate Recovery				Butyltins (µg/kg dry weight)		
	Tri-pentyltin	Propyltin	Pentyl-butyltin	Tetra-butlytin	Tri-butyltin	Di-butyltin	Mono-butyltin
Target DL[a]	NA[b]	NA	NA	NA	10.0	10.0	10.0
Achieved DL	NA	NA	NA	NA	1.0	1.0	2.0
EC-1 Replicate 1	71	70	99	82	2.0 U[c]	1.6 U	2.8 U
EC-1 Replicate 2	35	40	97	78	2.0 U	1.7 U	2.9 U
EC-1 Replicate 3	33	32	110	49	3.3 U	2.7 U	4.7 U
EC-2	45	68	92	12	13.7 U	11.1 U	19.6 U
EC-3	49	54	100	86	1.9 U	1.5 U	2.7 U
EC-Ref Comp	78	61	90	95	1.7 U	1.4 U	2.4 U
Ocean Reference	75	67	107	63	2.5 U	2.1 U	3.7 U
IH-1	66	64	92	126	1.3 U	1.0 U	1.8 U
IH-2	59	57	106	50	9.4	2.6 U	4.6 U
IH-3	59	78	113	22	9.6	5.8 U	10.3 U
IH-2, IH-3 Comp Replicate 1	65	67	105	38	4.2 U	3.4 U	6.1 U
IH-2, IH-3 Comp Replicate 2	69	73	93	43	3.8 U	3.1 U	5.4 U
IH-2, IH-3 Comp Replicate 3	45	59	109	16	10.1 U	8.2 U	14.5 U
IHR1	56	59	105	37	4.4 U	3.5 U	6.3 U
IHR2	37	36	103	33	4.9 U	4.0 U	7.0 U
SR-1	74	66	110	68	4.8	1.9 U	3.4 U
SR-2	66	67	107	58	2.8 U	2.2 U	4.0 U
SR-3	45	41	104	62	2.6 U	2.1 U	3.7 U
SR-4	74	70	117	51	3.2 U	2.6 U	4.6 U
San Pablo Bay Control	83	75	99	71	6.3	1.8 U	3.2 U
Muscongus Bay Control	54	55	85	75	2.1 U	1.7 U	3.1 U
Sequim Bay Control	49	50	104	77	2.1 U	1.7 U	3.0 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 in Sediment, Winyah Bay Project

Sediment Treatment	Percent Surrogate Recovery				Butyltins (µg/kg dry weight)		
	Tri-pentyltin	Propyltin	Pentyl-butyltin	Tetra-butlytin	Tri-butyltin	Di-butyltin	Mono-butyltin
Method Blank							
Blank 1	21[a]	21[a]	92	49	3.3 U[b]	2.6 U	4.7 U
Blank 2	18[a]	19[a]	94	69	2.3 U	1.9 U	3.3 U
Matrix Spike							
EC-3	49	54	100	86	1.9 U	1.5 U	2.7 U
EC-3 MS	55	54	97	49	14.7	10.2	4.0 J
Concentration Recovered					14.7	10.2	4.0
Spike Amount					29.7	29.7	29.7
Percent Recovery					50%	34%[a]	13%[a]
EC-3	49	54	100	86	1.9 U	1.5 U	2.7 U
EC-3 MSD	43	54	105	32	15.1	11.5	3.4 J
Amount Recovered					15.1	11.5	3.4
Spike Amount					27.3	27.3	27.3
Percent Recovery					55%	42%	12%[a]
RPD					11%	20%	8%
I-STAT					0.05	0.10	0.04
SR-3	45	41	104	62	2.6 U	2.1 U	3.7 U
SR-3 MS	68	65	104	51	31.6	11.3	9.6
Concentration Recovered					31.6	11.3	9.6
Spike Amount					50.7	50.7	50.7
Percent Recovery					62%	22%[a]	19%[a]
SR-3	45	41	104	62	2.6 U	2.1 U	3.7 U
SR-3 MSD	64	87	108	21	39.2	16.8	5.3 J
Concentration Recovered					39.2	16.8	5.3
Spike Amount					52.85	52.85	52.9
Percent Recovery					74%	32%[a]	10%[a]
RPD					17%	35%[c]	61%[c]
I-STAT					0.09	0.18	0.31
Standard Reference Material							
Certified Value	NC[d]	NC	NC	NC	1.27 ±0.22	1.16 ±0.18	0.28 ±0.17
PACS 1	54	73	105	13	560.1[e]	288[e]	17.4 U
Analytical Triplicates							
IH-2, IH-3 Comp Rep 1	65	67	104	38	4.2 U	3.4 U	6.1 U
IH-2, IH-3 Comp Rep 2	69	73	93	43	3.8 U	3.1 U	5.4 U
IH-2, IH-3 Comp Rep 3	45	59	109	16	10.1 U	8.2 U	14.5 U
RSD					NA	NA	NA

TABLE B.27. (contd)

Sediment Treatment	Percent Surrogate Recovery				Butyltins (µg/kg dry weight)		
	Tri-pentyltin	Propyltin	Pentyl-butyltin	Tetra-butlytin	Tri-butyltin	Di-butyltin	Mono-butyltin
EC-1 Replicate 1	71	70	99	82	2.0 U	1.6 U	2.8 U
EC-1 Replicate 2	35	40	97	78	2.0 U	1.7 U	2.9 U
EC-1 Replicate 3	33	32	110	49	3.3 U	2.7 U	4.7 U
RSD					NA	NA	NA

(a) Value outside quality control range of 40%-120%.
(b) U Analyte was not present above the level of associated value.
(c) Value exceeds relative precision range of ≤30%.
(d) NC No certified value.
(e) Value exceeds ≤30% from certified value.

TABLE B.28. Sediment Results for Acid Volatile Sulfides (AVS), Total Organic Carbons (TOC), and Ammonia, Winyah Bay Project

Sediment Treatment	AVS (μmoles/g)	TOC (percent dry weight)	Ammonia (μM)
Target DL[a]	0.2	0.10	0.1
Achieved DL	0.004	0.01	0.1
EC-1 Replicate 1	0.023	0.01 U[b]	67.81
EC-1 Replicate 2	ND[c]	ND	247.26
EC-1 Replicate 3	ND	ND	49.64
EC-2 Replicate 1	0.007 U	0.01 U	62.58
EC-2 Replicate 2	ND	ND	232.49
EC-2 Replicate 3	ND	ND	49.17
EC-3 Replicate 1 Replicate 1	0.004 U	0.01 U	30.80
EC-3 Replicate 1 Replicate 2	ND	0.01 U	31.54
EC-3 Replicate 1 Replicate 3	ND	0.01 U	186.00
EC-3 Replicate 2	ND	0.01 U	3.41
EC-Ref Comp	0.007 U	0.01 U	ND
IH-1	0.024	0.46	ND
IH-2	30.200	4.21	ND
IH-3	13.300	4.51	ND
IH-2,IH-3 Comp	20.400	4.18	ND
IHR1	10.100	0.01 U	ND
IHR1 Duplicate	9.480	0.84	ND
IHR2	0.205	0.22	ND
SR-1	125.000	3.82	ND
SR-2 Replicate 1	4.420	5.96	ND
SR-2 Replicate 2	4.670	5.85	ND
SR-2 Replicate 3	ND	5.77	ND
SR-3	30.700	5.23	ND
SR-4	12.500	5.65	ND

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

TABLE B.29. Quality Control Summary for Acid Volatile Sulfides (AVS), Total Organic Carbons (TOC), and Ammonia in Sediment, Winyah Bay Project

Sediment Treatment	AVS (μmoles/g)	TOC (percent dry weight)	Ammonia (μM)
Method Blank			
Blank 1	≤0.009	0.01 U[a]	ND[b]
Blank 2	≤0.009	0.01	ND
Blank 3	ND	0.003	ND
Standard Reference Material			
Certified Value MESS 1	NC[c]	NC	NC
MESS 1 Replicate 1	ND	2.65	ND
MESS 1 Replicate 2	ND	2.61	ND
Certified Value SRM 1646	NC	NC	NC
SRM 1646 Replicate 1	ND	1.46	ND
SRM 1646 Replicate 2 Replicate 1	ND	1.43	ND
SRM 1646 Replicate 2 Replicate 2	ND	1.48	ND
SRM 1646 Replicate 2 Replicate 3	ND	1.48	ND
Analytical Duplicates			
IHR1 Replicate 1	10.10	ND	ND
IHR1 Replicate 2	9.48	ND	ND
RPD	6%	NA[d]	ND
I-stat	0.03	NA	ND
EC-3 Replicate 1	ND	0.01 U	NA
EC-3 Replicate 2	ND	0.01 U	NA
RPD	ND	NA	NA
I-Stat	ND	NA	NA
SR-2 Replicate 1	4.420	5.85	NA
SR-2 Replicate 2	4.670	5.96	NA
RPD	6%	2%	NA
I-Stat	0.03	0.01	NA

TABLE B.29. (contd)

Sediment Treatment	AVS (µmoles/g)	TOC (percent dry weight)	Ammonia (µM)
Analytical Triplicates			
EC-3 Replicate 1 Replicate 1	0.004 U	0.01 U	30.80
EC-3 Replicate 1 Replicate 2	ND	0.01 U	31.54
EC-3 Replicate 1 Replicate 3	ND	0.01 U	186.00
RSD	NA	NA	108%(e)
SR-2 Replicate 1	4.42	5.85	ND
SR-2 Replicate 2	4.67	5.96	ND
SR-2 Replicate 3	ND	5.77	ND
RSD	NA	2%	ND
EC-1 Replicate 1	0.023	0.01 U	67.81
EC-1 Replicate 2	ND	ND	247.26
EC-1 Replicate 3	ND	ND	49.64
RSD	NA	NA	90%(e)
EC-2 Replicate 1	0.007 U	ND	62.58
EC-2 Replicate 2	ND	ND	232.49
EC-2 Replicate 3	ND	ND	49.17
RSD	ND	ND	89%(e)

(a) U Analyte was not present above the level of associated value.
(b) ND No data.
(c) NC Not certified.
(d) NA Not applicable.
(e) Value exceeds relative standard deviation range ≤30%.

TABLE B.30. Sediment Results for Methylene Chloride, Winyah Bay Project

Sediment Treatment	Methylene Chloride (µg/kg wet weight)
Target DL[a]	10
Achieved DL	2
EC-1	2.0 U[b]
EC-2	2.0 U
EC-3	2.0 U
EC-Ref Comp Replicate 1	2.0 U
EC-Ref Comp Replicate 2	2.0 U
EC-Ref Comp Replicate 3	2.0 U
IH-1	2.0 U
IH-2	2.0 U
IH-3	2.0 U
IHR1	2.0 U
IHR2	2.0 U
SR-1	2.0 U
SR-2	2.0 U
SR-3	2.0 U
SR-4	2.0 U

(a) DL Detection limit.
(b) U Analyte was not present above the level of associated value.

TABLE B.31. Quality Control Summary for Methylene Chloride in Sediment, Winyah Bay Project

Sediment Treatment	1,1-Di-chloroethene	Tri-chloroethene	Chlorobenze
Matrix Spike			
EC-1	2.0 U[a]	2.0 U	2.0 U
EC-1 MS	15.0	16.0	19.0
Concentration Recovered	15.0	16.0	19.0
Amount Spiked	20.0	20.0	20.0
Percent Recovery	75%	80%	95%
EC-1	2.0 U	2.0 U	2.0 U
EC-1 MSD	15.0	16.0	18.0
Concentration Recovered	15.0	16.0	18.0
Amount Spiked	20.0	20.0	20.0
Percent Recovered	75%	80%	90%
RPD	0%	0%	5%
I-stat	0.00	0.00	0.03
Analytical Replicates			
EC-Ref Comp Replicate 1	2.0 U	ND[b]	ND
EC-Ref Comp Replicate 2	2.0 U	ND	ND
EC-Ref Comp Replicate 3	2.0 U	ND	ND
RSD	NA[c]	NA	NA

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

TABLE B.32. Total Dioxin and Furan Sediment Results, Winyah Bay Project

Sediment Treatment	Dioxins (ng/kg dry weight) Total TCDD	Total PeCDD	Total HxCDD	Total HpCDD	Total TCDF	Total PeCDF	Total HxCDF	Total HpCDF
Target DL[a]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
EC-1	0.27	0	2.95	8.48	0	0	0.43	0.21
EC-2	0	0	1.04	3.39	0	0	0.32	0.24
EC-3	0.22	0	1.37	4.7	0.13	0	0	0.32
EC-Ref Comp	0	0	0	1.96	0	0	0.32	0.26
IH-1	0.94	2.1	18.26	39.83	0.21	0	0	0.43
IH-2	0.96	1.09	17.7	72.28	0	0	1.37	2.73
IH-3	1.81	1.91	21.72	74.51	2.11	0.77	1.56	1.43
IHR1	1.27	3.92	38.77	94.48	0.86	0.45	1.04	1.87
IHR2	1.26	0.45	8.98	31.78	1.2	0.32	1.21	0.67
SR-1	4.11	2.03	40.85	170.2	13.07	2.22	1.22	3.26
SR-2	1.56	1.84	30	107.5	1.88	1.66	1.44	2.32
SR-3	0.89	1.2	17.25	53.99	2.31	0	0.75	0.92
SR-4	1.62	0	29.37	105.6	2.63	0	0.68	2.11
Quality Control Summary								
Method Blank								
Blank	0.22	0.08	0	0.61	0	0	0.49	0.33

(a) DL Detection limit.

TABLE B.33. Sediment Results for Dioxins (2378-TCDD - OCDD), Winyah Bay Project

Sediment Treatment	Dioxins (ng/kg dry weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
Target DL[a]	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL	0.3	0.1	0.2	0.1	0.4	<1.0	2.0
EC-1	0.3 U[b]	0.1 U	0.2 U	0.09	0.40 U	2.19	46.37
EC-2	0.4 U	0.1 U	0.2 U	0.10 U	0.40 U	1.03	20.63
EC-3	0.4 U	0.3 U	0.3 U	0.30 U	0.50 U	1.29	31.88
EC-Ref Comp	0.3 U	0.2 U	0.2 U	0.20 U	0.40 U	0.52	10.44
IH-1	0.4 U	0.3 U	0.2	0.27	0.96	10.73	208.90
IH-2	1.1 U	0.7 U	0.3	0.74	3.60 U	25.30	796.51
IH-3	0.6 U	0.4 U	0.3	0.56	1.36	25.47	632.11
IHR1	0.3 U	0.3	0.6	0.87	2.17	25.34	359.81
IHR2	0.3	0.4 U	0.4 U	0.36	1.70 U	9.37	252.96
SR-1	1.7	2.2 U	2.6 U	1.10	2.87	53.11	1653.64
SR-2	1.0 U	0.3	0.4	0.91	2.21	38.88	1029.00
SR-3	0.6 U	0.2	0.3	0.40	1.27	17.54	453.89
SR-4	1.1 U	0.9 U	1.2 U	1.32	4.90 U	37.74	1033.36

(a) DL Detection limit.
(b) U Analyte was not present above the level of associated value.

TABLE B.34. Sediment Results for Furans (2378-TCDF - OCDF), Winyah Bay Project

Sediment Treatment	Dioxins (ng/kg dry weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
Target DL[a]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL	0.3	0.1	0.1	0.1	0.1	0.8	0.1	0.5	0.1	0.5
EC-1	0.30 U[b]	0.2 U	0.2 U	0.2 U	0.1 U	0.32	0.1 U	0.21	0.2 U	0.25
EC-2	0.20 U	0.1 U	0.1 U	0.1 U	0.1 U	0.32	0.1 U	0.50 U	0.2 U	0.17
EC-3	0.05	0.2 U	0.2 U	0.2 U	0.2 U	0.90 U	0.2 U	0.60 U	0.4 U	0.76
EC-Ref Comp	0.30 U	0.3 U	0.3 U	0.1 U	0.1 U	0.32	0.2 U	0.60 U	0.2 U	0.50 U
IH-1	0.18	0.2 U	0.2 U	0.1 U	0.1 U	0.80 U	0.1 U	0.80 U	0.1 U	0.60
IH-2	1.70 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
IH-3	0.67	0.3 U	0.2 U	1.6 U	0.1	0.42	0.1 U	3.20 U	0.3 U	2.87
IHR1	0.26	0.2 U	0.2 U	0.3 U	0.3 U	0.37	0.1 U	0.92	1.2 U	1.18
IHR2	0.56	0.4 U	0.1	0.1	0.3 U	0.31	0.2 U	1.70 U	0.4 U	0.93
SR-1	6.98	3.0 U	2.2 U	5.4 U	1.4 U	1.30 U	0.9 U	7.50 U	1.8 U	7.45
SR-2	1.22	0.6 U	0.4 U	0.3	0.4 U	0.41	0.2 U	6.00 U	0.4 U	5.06
SR-3	0.68	0.4 U	0.3 U	0.3 U	0.3 U	0.38	0.1 U	2.20 U	0.2 U	1.86
SR-4	1.71	1.1 U	1.4 U	0.9 U	0.8 U	1.00 U	0.4 U	7.00 U	0.9 U	5.43

(a) DL Detection limit.
(b) U Analyte was not present above the level of associated value.

TABLE B.35. Quality Control Summary for Dioxins in Sediment, Winyah Bay Project

Sediment Treatment	Dioxins (ng/kg dry weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
Method Blank							
Blank	0.2 U[a]	0.08	0.3 U	0.3 U	0.3 U	0.37	1.9
Matrix Spike							
IH-2	1.1 U	0.7 U	0.31	0.74	3.6 U	25.3	796.5
IH-2 MS	98.15	454.3	453.2	439.6	474.3	459.5	966.6
Concentration Recovered	98.15	454.3	452.9	438.9	474.3	434.2	170.0
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	796.5
IH-2 MSD	101.0	447.3	472.7	467.2	510.1	502.8	1170.
Concentration Recovered	101.0	447.3	472.4	466.4	510.1	477.5	373.9
Spike Amount	100	500	500	500	500	500	1000
Percent Recovery	101%	89%	94%	93%	102%	96%	37%[b]
RPD	3%	2%	4%	6%	7%	10%	75%[c]
I-stat	0.01	0.01	0.02	0.03	0.04	0.05	0.37
Matrix Reference Material							
Certified Value	NC[d]	NC	NC	NC	NC	NC	NC
MRM	438	896	911	829	973	1410	3450

(a) U Analyte was not present above the level of the associated value.
(b) Recovery outside quality control range (40%-120%).
(c) Value exceeds relative precision range of ≤30%.
(d) NC No certified value.

TABLE B.36. Quality Control Summary for Furans in Sediment, Winyah Bay Project

Sediment Treatment	Dioxins (ng/kg dry weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
Method Blank										
Blank	0.2 U[a]	0.2 U	0.2 U	0.2 U	0.2 U	0.37	0.2 U	0.6	0.15	0.23
Matrix Spike										
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
IH-2 MS	94.61	447.5	417.4	408.8	387.2	398.9	418.8	348.9	429.26	645.5
Concentration Recovered	94.61	447.5	417.4	408.8	387.2	398.4	418.8	347.4	429.26	643.0
Spike Amount	100	500	500	500	500	500	500	500	500	1000
Percent Recovery	95%	90%	83%	82%	77%	80%	84%	69%	86%	64%
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
IH-2 MSD	94.87	446.7	432.2	426.1	429.0	436.8	441.0	414.1	472.81	741.5
Concentration Recovered	94.87	446.7	432.2	426.1	429.0	436.4	441.0	412.6	472.81	739.0
Spike Amount	100	500	500	500	500	500	500	500	500	1000
Percent Recovery	95%	89%	86%	85%	86%	87%	88%	83%	95%	74%
RPD	0%	0%	3%	4%	10%	9%	5%	17%	10%	14%
I-stat	0.00	0.00	0.02	0.02	0.05	0.05	0.03	0.09	0.05	0.07
Matrix Reference Material										
Certified Value	NC[b]	NC	NC	NC	NC	NC	NC	NC	NC	NC
MRM	416	861	824	874	865	838	863	1265	1401	2497

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

APPENDIX C

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

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

Sediment Treatment	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
EC-1	1	1	9	11	45.0	
EC-1	2	1	10	10	50.0	
EC-1	3	1	9	11	45.0	
EC-1	4	1	5	15	25.0	
EC-1	5	1	15	5	75.0	48.0
EC-2	1	1	6	14	30.0	
EC-2	2	1	10	10	50.0	
EC-2	3	1	10	10	50.0	
EC-2	4	1	12	8	60.0	
EC-2	5	1	11	9	55.0	49.0
EC-3	1	1	13	7	65.0	
EC-3	2	1	15	5	75.0	
EC-3	3	1	13	7	65.0	
EC-3	4	1	16	4	80.0	
EC-3	5	1	8	12	40.0	65.0
EC-Ref Comp	1	1	11	9	55.0	
EC-Ref Comp	2	1	6	14	30.0	
EC-Ref Comp	3	1	11	9	55.0	
EC-Ref Comp	4	1	8	12	40.0	
EC-Ref Comp	5	1	7	13	35.0	43.0
Ocean Reference	1	NA[a]	12	8	60.0	
Ocean Reference	2	NA	8	12	40.0	
Ocean Reference	3	NA	13	7	65.0	
Ocean Reference	4	NA	9	11	45.0	
Ocean Reference	5	NA	12	8	60.0	54.0
San Pablo Bay	1	NA	14	6	70.0	
San Pablo Bay	2	NA	18	2	90.0	
San Pablo Bay	3	NA	12	8	60.0	
San Pablo Bay	4	NA	12	8	60.0	
San Pablo Bay	5	NA	10	10	50.0	66.0
Sequim Bay	1	NA	17	3	85.0	
Sequim Bay	2	NA	19	1	95.0	
Sequim Bay	3	NA	14	6	70.0	
Sequim Bay	4	NA	14	6	70.0	
Sequim Bay	5	NA	16	4	80.0	80.0

(a) NA Not applicable.

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

Sediment Treatment	Segment	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max	Flow Rates (mL/min) Min	Flow Rates (mL/min) Max
Acceptable Range		18.0	22.0	7.30	8.30	5.0	NA[a]	28.0	32.0	35	45
EC-1	1	19.4	20.7	7.75	8.03	6.3	7.3	30.0	32.0	36	44
EC-2	1	19.4	20.7	7.75	8.03	6.3	7.4	30.0	32.0	36	44
EC-3	1	19.4	20.8	7.77	8.03	6.4	7.9	30.0	32.0	36	44
EC-Ref Comp	1	19.5	20.7	7.73	8.03	6.3	7.2	30.5	32.0	36	44
Ocean Reference	NA	19.3	20.7	7.77	8.03	6.4	7.2	30.0	32.0	36	44
San Pablo Bay	NA	19.3	20.6	7.75	8.02	5.8	7.2	30.0	32.0	36	44
Sequim Bay	NA	19.5	20.7	7.76	8.01	6.0	7.3	30.0	32.0	36	44

(a) NA Not applicable.

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

Cadmium Concentration mg/L	Replicate	Live	Dead	Percent Survival	Mean Percent Survival
0.00	1	4	16	20.0	
0.00	2	7	13	35.0	
0.00	3	9	11	45.0	33.3
0.25	1	8	12	40.0	
0.25	2	3	17	15.0	
0.25	3	5	15	25.0	26.7
0.50	1	5	15	25.0	
0.50	2	1	19	5.0	
0.50	3	3	17	15.0	15.0
1.00	1	0	20	0.0	
1.00	2	4	16	20.0	
1.00	3	0	20	0.0	6.7
2.00	1	0	20	0.0	
2.00	2	0	20	0.0	
2.00	3	0	20	0.0	0.0

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

Cadmium Concentration mg/L	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (ppt)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	18.0	22.0	7.30	8.30	5.0	NA[a]	28.0	32.0
0.00	20.1	20.7	7.78	8.19	6.8	7.3	30.0	32.0
0.25	20.2	20.8	8.06	8.18	6.8	7.4	30.0	32.0
0.50	20.1	20.8	8.05	8.20	6.9	7.2	30.0	32.0
1.00	20.1	20.8	8.03	8.15	7.0	7.9	30.0	32.0
2.00	20.1	20.8	7.99	8.11	6.9	7.4	30.0	32.0

(a) NA Not applicable.

APPENDIX D

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

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

Sediment Treatment	Segment	Replicate	Number Live	Dead	Percent Survival	Mean Percent Survival
EC-1	1	1	19	1	95.0	
EC-1	1	2	20	0	100.0	
EC-1	1	3	20	0	100.0	
EC-1	1	4	20	0	100.0	
EC-1	1	5	20	0	100.0	99.0
EC-2	1	1	20	0	100.0	
EC-2	1	2	20	0	100.0	
EC-2	1	3	18	2	90.0	
EC-2	1	4	20	0	100.0	
EC-2	1	5	20	0	100.0	98.0
EC-3	1	1	18	2	90.0	
EC-3	1	2	19	1	95.0	
EC-3	1	3	20	0	100.0	
EC-3	1	4	20	0	100.0	
EC-3	1	5	20	0	100.0	97.0
EC-Ref Comp	1	1	19	1	95.0	
EC-Ref Comp	1	2	18	2	90.0	
EC-Ref Comp	1	3	19	1	95.0	
EC-Ref Comp	1	4	20	0	100.0	
EC-Ref Comp	1	5	19	1	95.0	95.0
Ocean Reference	NA[a]	1	20	0	100.0	
Ocean Reference	NA	2	19	1	95.0	
Ocean Reference	NA	3	20	0	100.0	
Ocean Reference	NA	4	18	2	90.0	
Ocean Reference	NA	5	20	0	100.0	97.0
Whidbey Island	NA	1	20	0	100.0	
Whidbey Island	NA	2	19	1	95.0	
Whidbey Island	NA	3	20	0	100.0	
Whidbey Island	NA	4	20	0	100.0	
Whidbey Island	NA	5	20	0	100.0	99.0
Sequim Bay	NA	1	19	1	95.0	
Sequim Bay	NA	2	19	1	95.0	
Sequim Bay	NA	3	19	1	95.0	
Sequim Bay	NA	4	19	1	95.0	
Sequim Bay	NA	5	20	0	100.0	96.0

(a) NA Not applicable.

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

Sediment Treatment	Segment	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max
Acceptable Range		13.0	17.0	7.30	8.30	5.0	NA[a]	28.0	32.0
EC-1	1	14.4	15.8	7.91	8.14	7.5	8.2	30.0	32.0
EC-2	1	14.1	15.8	8.04	8.22	7.5	8.3	30.0	32.0
EC-3	1	14.5	15.9	8.04	8.17	7.5	8.3	30.0	32.0
EC-Ref Comp	1	14.4	15.5	8.06	8.23	7.5	8.2	30.0	32.0
Ocean Reference	NA	14.4	17.7[b]	8.02	8.18	7.4	8.2	30.0	32.0
Whidbey Island	NA	14.2	15.4	7.94	8.40[b]	7.4	8.2	30.0	32.0
Sequim Bay	NA	14.4	15.8	7.90	8.63[b]	5.7	8.1	30.0	32.0

(a) NA Not applicable.
(b) Data point out of range

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

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

APPENDIX E

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

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

Sediment Treatment	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
EC-1	1	1	8	12	40.0	
EC-1	2	1	12	8	60.0	
EC-1	3	1	12	8	60.0	
EC-1	4	1	14	6	70.0	
EC-1	5	1	9	11	45.0	55.0
EC-2	1	1	13	7	65.0	
EC-2	2	1	15	5	75.0	
EC-2	3	1	16	4	80.0	
EC-2	4	1	14	6	70.0	
EC-2	5	1	15	5	75.0	73.0
EC-3	1	1	6	14	30.0	
EC-3	2	1	17	3	85.0	
EC-3	3	1	15	5	75.0	
EC-3	4	1	17	3	85.0	
EC-3	5	1	14	6	70.0	69.0
EC-Ref Comp	1	1	15	5	75.0	
EC-Ref Comp	2	1	10	10	50.0	
EC-Ref Comp	3	1	11	9	55.0	
EC-Ref Comp	4	1	7	13	35.0	
EC-Ref Comp	5	1	1	19	5.0	44.0
Muscongus Bay	1	NA[a]	12	8	60.0	
Muscongus Bay	2	NA	14	6	70.0	
Muscongus Bay	3	NA	14	6	70.0	
Muscongus Bay	4	NA	0	20	0.0	
Muscongus Bay	5	NA	17	3	85.0	57.0

(a) NA Not applicable.

TABLE E.2. Water Quality Summary for in 10-Day *N. virens* Solid-Phase Test, Winyah Bay Project

Sediment Treatment	Segment	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max	Flow Rates (mL/min) Min	Flow Rates (mL/min) Max
Acceptable Range		13.0	17.0	7.30	8.30	6.0	NA[a]	28.0	32.0	115	135
EC-1	1	14.4	16.6	7.72	8.07	7.0	8.0	31.5	32.0	116	132
EC-2	1	14.5	16.4	7.86	8.06	7.0	8.0	31.5	32.5[b]	116	132
EC-3	1	14.5	16.2	7.86	8.04	7.0	8.0	31.5	32.5[b]	116	132
EC-Ref Comp	1	14.5	16.1	7.80	8.09	6.9	7.9	31.5	32.0	116	132
Muscongus Bay	NA	14.6	15.1	7.68	8.01	6.9	8.1	31.5	32.5[b]	116	132

(a) NA Not applicable.
(b) Data point out of range.

APPENDIX F

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

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

Sediment Treatment	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
EC-1	1	1	20	0	100.0	
EC-1	2	1	18	2	90.0	
EC-1	3	1	20	0	100.0	
EC-1	4	1	20	0	100.0	
EC-1	5	1	20	0	100.0	98.0
EC-2	1	1	17	3	85.0	
EC-2	2	1	19	1	95.0	
EC-2	3	1	19	1	95.0	
EC-2	4	1	20	0	100.0	
EC-2	5	1	14	6	70.0	89.0
EC-3	1	1	20	0	100.0	
EC-3	2	1	18	2	90.0	
EC-3	3	1	19	1	95.0	
EC-3	4	1	18	2	90.0	
EC-3	5	1	20	0	100.0	95.0
EC-Ref Comp	1	1	16	4	80.0	
EC-Ref Comp	2	1	19	1	95.0	
EC-Ref Comp	3	1	20	0	100.0	
EC-Ref Comp	4	1	19	1	95.0	
EC-Ref Comp	5	1	19	1	95.0	93.0
IH-1	1	2	19	1	95.0	
IH-1	2	2	20	0	100.0	
IH-1	3	2	20	0	100.0	
IH-1	4	2	19	1	95.0	
IH-1	5	2	18	2	90.0	96.0
IH-2, IH-3 Comp	1	2	18	2	90.0	
IH-2, IH-3 Comp	2	2	20	0	100.0	
IH-2, IH-3 Comp	3	2	18	2	90.0	
IH-2, IH-3 Comp	4	2	17	3	85.0	
IH-2, IH-3 Comp	5	2	16	4	80.0	89.0
IHR1	1	2	20	0	100.0	
IHR1	2	2	20	0	100.0	
IHR1	3	2	20	0	100.0	
IHR1	4	2	19	1	95.0	
IHR1	5	2	20	0	100.0	99.0

TABLE F.1. (contd)

Sediment Treatment	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
IHR2	1	2	18	2	90.0	
IHR2	2	2	17	3	85.0	
IHR2	3	2	20	0	100.0	
IHR2	4	2	18	2	90.0	
IHR2	5	2	20	0	100.0	93.0
Muscongus Bay	1	NA[a]	20	0	100.0	
Muscongus Bay	2	NA	19	1	95.0	
Muscongus Bay	3	NA	20	0	100.0	
Muscongus Bay	4	NA	20	0	100.0	
Muscongus Bay	5	NA	19	1	95.0	98.0

(a) NA Not applicable.

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

Sediment Treatment	Segment	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max	Flow Rates (mL/min) Min	Flow Rates (mL/min) Max
Acceptable Range		13.0	17.0	7.30	8.30	5.0	NA[a]	28.0	32.0	115	135
EC-1	1	14.5	16.5	7.74	8.22	7.0	8.9	30.0	31.5	100[b]	132
EC-2	1	14.5	15.6	7.78	8.21	6.8	8.4	30.0	31.5	116	132
EC-3	1	14.5	15.5	7.82	8.21	7.1	8.4	30.0	31.5	116	132
EC-Ref Comp	1	14.5	16.2	7.77	8.22	6.8	8.7	30.0	31.5	116	132
IH-1	2	14.3	15.5	7.70	8.20	6.4	8.3	30.0	32.0	116	132
IH-2,IH-3 Comp	2	14.7	15.9	7.70	8.18	6.7	8.2	30.0	31.5	108[b]	132
IHR1	2	14.5	15.7	7.73	8.21	6.4	8.4	30.0	31.5	116	132
IHR2	2	14.4	15.5	7.71	8.19	6.6	8.4	30.0	31.5	116	132
Muscongus Bay	NA	14.2	15.6	7.75	8.23	6.9	8.5	30.0	31.5	116	132

(a) NA Not applicable.
(b) 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, Winyah Bay Project

Sediment Treatment	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
EC-1	1	1	18	7	72.0	
EC-1	2	1	23	2	92.0	
EC-1	3	1	25	0	100.0	
EC-1	4	1	21	4	84.0	
EC-1	5	1	17	8	68.0	83.2
EC-2	1	1	22	3	88.0	
EC-2	2	1	22	3	88.0	
EC-2	3	1	18	7	72.0	
EC-2	4	1	20	5	80.0	
EC-2	5	1	21	4	84.0	82.4
EC-3	1	1	20	5	80.0	
EC-3	2	1	16	9	64.0	
EC-3	3	1	14	11	56.0	
EC-3	4	1	20	5	80.0	
EC-3	5	1	23	2	92.0	74.4
EC-Ref Comp	1	1	20	5	80.0	
EC-Ref Comp	2	1	22	3	88.0	
EC-Ref Comp	3	1	13	12	52.0	
EC-Ref Comp	4	1	15	10	60.0	
EC-Ref Comp	5	1	23	2	92.0	74.4
IH-1	1	2	23	2	92.0	
IH-1	2	2	15	10	60.0	
IH-1	3	2	14	11	56.0	
IH-1	4	2	24	1	96.0	
IH-1	5	2	23	2	92.0	79.2
IH-2, IH-3 Comp	1	2	24	1	96.0	
IH-2, IH-3 Comp	2	2	22	3	88.0	
IH-2, IH-3 Comp	3	2	24	1	96.0	
IH-2, IH-3 Comp	4	2	22	3	88.0	
IH-2, IH-3 Comp	5	2	23	2	92.0	92.0
IHR1	1	2	24	1	96.0	
IHR1	2	2	21	4	84.0	
IHR1	3	2	24	1	96.0	
IHR1	4	2	24	1	96.0	
IHR1	5	2	24	1	96.0	93.6

TABLE G.1. (contd)

Sediment Treatment	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
IHR2	1	2	14	11	56.0	
IHR2	2	2	24	1	96.0	
IHR2	3	2	24	1	96.0	
IHR2	4	2	25	0	100.0	
IHR2	5	2	25	0	100.0	89.6
Sequim Bay	1	NA[a]	23	2	92.0	
Sequim Bay	2	NA	25	0	100.0	
Sequim Bay	3	NA	24	1	96.0	
Sequim Bay	4	NA	23	2	92.0	
Sequim Bay	5	NA	25	0	100.0	96.0

(a) NA Not applicable.

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

Sediment Treatment	Segment	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max	Flow Rates (mL/min) Min	Flow Rates (mL/min) Max
Acceptable Range		13.0	17.0	7.30	8.30	6.0	NA[a]	28.0	32.0	115	135
EC-1	1	14.2	15.9	7.82	8.12	7.2	8.2	29.5	32.0	116	132
EC-2	1	14.2	15.9	7.87	8.15	7.2	8.3	29.5	32.0	116	132
EC-3	1	14.2	16.0	7.87	8.17	7.3	8.3	30.0	32.0	116	132
EC-Ref Comp	1	14.3	16.0	7.85	8.16	7.4	8.3	30.0	32.0	116	132
IH-1	2	14.0	15.9	7.84	8.12	6.8	8.2	30.0	32.0	116	132
IH-2,IH-3 COMP	2	14.2	16.0	7.81	8.10	6.8	8.2	30.0	32.0	116	132
IHR1	2	14.4	15.8	7.89	8.11	7.0	8.1	30.0	32.0	116	132
IHR2	2	14.1	15.7	7.84	8.13	7.2	8.2	30.0	32.0	116	132
Sequim Bay	NA	14.1	15.8	7.87	8.12	6.9	8.1	30.0	32.0	116	132

(a) NA Not applicable.

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, Winyah Bay Project

Sediment Treatment	Concentration (Percent SPP)	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
EC-1	0	1	1	10	0	100.0	
EC-1	0	2	1	10	0	100.0	
EC-1	0	3	1	10	0	100.0	
EC-1	0	4	1	10	0	100.0	
EC-1	0	5	1	9	1	90.0	98.0
EC-1	10	1	1	10	0	100.0	
EC-1	10	2	1	10	0	100.0	
EC-1	10	3	1	10	0	100.0	
EC-1	10	4	1	10	0	100.0	
EC-1	10	5	1	10	0	100.0	100.0
EC-1	50	1	1	9	1	90.0	
EC-1	50	2	1	10	0	100.0	
EC-1	50	3	1	10	0	100.0	
EC-1	50	4	1	9	1	90.0	
EC-1	50	5	1	10	0	100.0	96.0
EC-1	100	1	1	10	0	100.0	
EC-1	100	2	1	10	0	100.0	
EC-1	100	3	1	10	0	100.0	
EC-1	100	4	1	10	0	100.0	
EC-1	100	5	1	10	0	100.0	100.0
EC-2	0	1	1	10	0	100.0	
EC-2	0	2	1	10	0	100.0	
EC-2	0	3	1	10	0	100.0	
EC-2	0	4	1	10	0	100.0	
EC-2	0	5	1	10	0	100.0	100.0
EC-2	10	1	1	8	2	80.0	
EC-2	10	2	1	10	0	100.0	
EC-2	10	3	1	10	0	100.0	
EC-2	10	4	1	10	0	100.0	
EC-2	10	5	1	10	0	100.0	96.0
EC-2	50	1	1	10	0	100.0	
EC-2	50	2	1	9	1	90.0	
EC-2	50	3	1	10	0	100.0	
EC-2	50	4	1	9	1	90.0	
EC-2	50	5	1	10	0	100.0	96.0
EC-2	100	1	1	9	1	90.0	
EC-2	100	2	1	9	1	90.0	
EC-2	100	3	1	9	1	90.0	
EC-2	100	4	1	9	1	90.0	
EC-2	100	5	1	9	1	90.0	90.0

TABLE H.1. (contd)

Sediment Treatment	Concentration (Percent SPP)	Replicate	Seament	Live	Dead	Percent Survival	Mean Percent Survival
EC-3	0	1	1	10	0	100.0	
EC-3	0	2	1	10	0	100.0	
EC-3	0	3	1	10	0	100.0	
EC-3	0	4	1	10	0	100.0	
EC-3	0	5	1	10	0	100.0	100.0
EC-3	10	1	1	10	0	100.0	
EC-3	10	2	1	9	1	90.0	
EC-3	10	3	1	8	2	80.0	
EC-3	10	4	1	10	0	100.0	
EC-3	10	5	1	10	0	100.0	94.0
EC-3	50	1	1	10	0	100.0	
EC-3	50	2	1	10	0	100.0	
EC-3	50	3	1	8	2	80.0	
EC-3	50	4	1	10	0	100.0	
EC-3	50	5	1	10	0	100.0	96.0
EC-3	100	1	1	10	0	100.0	
EC-3	100	2	1	10	0	100.0	
EC-3	100	3	1	10	0	100.0	
EC-3	100	4	1	10	0	100.0	
EC-3	100	5	1	10	0	100.0	100.0

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

Sediment Treatment	Concentration (Percent SPP)	Segment	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max
Acceptable Range			18.0	22.0	7.30	8.30	4.0	NA[a]	28.0	32.0
EC-1	0	1	19.0	20.2	7.84	8.07	5.5	8.2	31.0	32.0
EC-1	10	1	19.0	20.2	7.71	8.10	6.2	7.9	31.0	32.0
EC-1	50	1	19.0	20.2	7.79	8.04	6.2	8.4	31.0	32.0
EC-1	100	1	19.0	20.2	7.86	8.10	6.4	8.8	31.5	32.0
EC-2	0	1	19.0	20.2	7.85	8.12	5.8	8.4	30.0	32.5[b]
EC-2	10	1	19.0	19.9	7.71	8.05	6.2	8.5	31.0	32.0
EC-2	50	1	19.0	20.2	7.87	8.07	6.5	8.5	30.5	32.0
EC-2	100	1	19.0	20.1	7.97	8.11	6.3	8.1	31.0	32.0
EC-3	0	1	19.1	20.1	7.70	8.06	6.1	8.4	31.0	32.0
EC-3	10	1	19.1	20.3	7.72	8.09	6.1	8.4	31.0	32.0
EC-3	50	1	19.0	20.2	7.82	8.09	6.4	8.3	31.5	32.5[b]
EC-3	100	1	19.1	20.2	7.91	8.08	6.4	8.5	31.0	32.0

(a) NA Not applicable.
(b) Data point out of range.

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

Copper Concentration µg/L	Replicate	Live	Dead	Percent Survival	Mean Percent Survival
0	1	10	0	100.0	
0	2	10	0	100.0	
0	3	10	0	100.0	100.0
16	1	10	0	100.0	
16	2	10	0	100.0	
16	3	10	0	100.0	100.0
64	1	10	0	100.0	
64	2	10	0	100.0	
64	3	10	0	100.0	100.0
160	1	9	1	90.0	
160	2	8	2	80.0	
160	3	6	4	60.0	76.7
400	1	0	10	0.0	
400	2	0	10	0.0	
400	3	1	9	10.0	3.3

TABLE H.4. Water Quality Summary for 96-h *M. beryllina* Reference Toxicant Test, Winyah Bay Project

Copper Concentration (µg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (ppt)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	18.0	22.0	7.30	8.30	4.0	NA[a]	28.0	32.0
0	19.9	20.5	8.00	8.15	6.3	8.2	31.5	32.0
16	19.9	20.4	7.98	8.09	6.4	8.4	31.5	32.0
64	19.9	20.5	7.90	8.10	6.4	8.3	31.5	32.0
160	19.9	20.4	7.91	8.10	6.3	8.1	31.5	32.0
400	20.0	20.5	7.87	8.09	6.6	8.3	31.5	32.0

(a) NA Not applicable.

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, Winyah Bay Project

Sediment Treatment	Concentration (Percent SPP)	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
EC-1	0	1	1	10	0	100.0	
EC-1	0	2	1	9	1	90.0	
EC-1	0	3	1	9	1	90.0	
EC-1	0	4	1	9	1	90.0	
EC-1	0	5	1	10	0	100.0	94.0
EC-1	10	1	1	9	1	90.0	
EC-1	10	2	1	8	2	80.0	
EC-1	10	3	1	9	1	90.0	
EC-1	10	4	1	10	0	100.0	
EC-1	10	5	1	9	1	90.0	90.0
EC-1	50	1	1	9	1	90.0	
EC-1	50	2	1	10	0	100.0	
EC-1	50	3	1	9	1	90.0	
EC-1	50	4	1	9	1	90.0	
EC-1	50	5	1	9	1	90.0	92.0
EC-1	100	1	1	10	0	100.0	
EC-1	100	2	1	9	1	90.0	
EC-1	100	3	1	9	1	90.0	
EC-1	100	4	1	9	1	90.0	
EC-1	100	5	1	8	2	80.0	90.0
EC-2	0	1	1	10	0	100.0	
EC-2	0	2	1	9	1	90.0	
EC-2	0	3	1	10	0	100.0	
EC-2	0	4	1	10	0	100.0	
EC-2	0	5	1	9	1	90.0	96.0
EC-2	10	1	1	10	0	100.0	
EC-2	10	2	1	9	1	90.0	
EC-2	10	3	1	9	1	90.0	
EC-2	10	4	1	8	2	80.0	
EC-2	10	5	1	9	1	90.0	90.0
EC-2	50	1	1	9	1	90.0	
EC-2	50	2	1	9	1	90.0	
EC-2	50	3	1	10	0	100.0	
EC-2	50	4	1	9	1	90.0	
EC-2	50	5	1	8	2	80.0	90.0
EC-2	100	1	1	9	1	90.0	
EC-2	100	2	1	8	2	80.0	
EC-2	100	3	1	8	2	80.0	
EC-2	100	4	1	9	1	90.0	
EC-2	100	5	1	10	0	100.0	88.0

TABLE I.1 (contd)

Sediment Treatment	Concentration (Percent SPP)	Replicate	Segment	Live	Dead	Percent Survival	Mean Percent Survival
EC-3	0	1	1	9	1	90.0	
EC-3	0	2	1	9	1	90.0	
EC-3	0	3	1	10	0	100.0	
EC-3	0	4	1	10	0	100.0	
EC-3	0	5	1	9	1	90.0	94.0
EC-3	10	1	1	9	1	90.0	
EC-3	10	2	1	9	1	90.0	
EC-3	10	3	1	10	0	100.0	
EC-3	10	4	1	10	0	100.0	
EC-3	10	5	1	8	2	80.0	92.0
EC-3	50	1	1	9	1	90.0	
EC-3	50	2	1	8	2	80.0	
EC-3	50	3	1	10	0	100.0	
EC-3	50	4	1	9	1	90.0	
EC-3	50	5	1	8	2	80.0	88.0
EC-3	100	1	1	9	1	90.0	
EC-3	100	2	1	10	0	100.0	
EC-3	100	3	1	8	2	80.0	
EC-3	100	4	1	9	1	90.0	
EC-3	100	5	1	10	0	100.0	92.0

TABLE I.2. Water Quality Summary for 96-h *M. bahia* Suspended-Particulate-Phase Test, Winyah Bay Project

Sediment Treatment	Concentration (Percent SPP)	Segment	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max
Acceptable Range			18.0	22.0	7.30	8.30	4.0	NA[a]	28.0	32.0
EC-1	0	1	20.0	20.7	7.74	8.07	6.2	8.3	31.0	32.0
EC-1	10	1	19.9	20.6	7.77	8.12	6.0	8.5	31.5	32.0
EC-1	50	1	19.8	20.5	7.90	8.16	6.4	8.6	31.0	32.0
EC-1	100	1	19.9	20.5	7.83	8.18	6.0	8.4	31.0	32.5[b]
EC-2	0	1	20.0	20.7	7.63	8.14	6.1	8.5	31.0	32.0
EC-2	10	1	20.0	20.6	7.88	8.10	6.2	8.6	30.5	32.0
EC-2	50	1	20.0	20.5	7.93	8.17	6.4	8.6	31.0	32.0
EC-2	100	1	19.9	20.5	7.93	8.14	6.6	8.4	30.5	32.5[b]
EC-3	0	1	20.0	20.7	7.81	8.14	6.4	8.5	31.0	32.0
EC-3	10	1	20.0	20.6	7.57	8.13	5.3	8.6	31.5	32.5[b]
EC-3	50	1	19.9	20.6	7.94	8.12	6.2	8.3	31.0	32.5[b]
EC-3	100	1	19.9	20.5	7.76	8.14	4.9	8.6	30.0	32.0

(a) NA Not applicable.
(b) Data point out of range.

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

Copper Concentration µg/L	Replicate	Live	Dead	Percent Survival	Mean Percent Survival
0	1	10	0	100.0	
0	2	9	1	90.0	
0	3	10	0	100.0	96.7
50	1	9	1	90.0	
50	2	10	0	100.0	
50	3	9	1	90.0	93.3
100	1	9	1	90.0	
100	2	9	1	90.0	
100	3	10	0	100.0	93.3
150	1	9	1	90.0	
150	2	8	2	80.0	
150	3	8	2	80.0	83.3
300	1	4	6	40.0	
300	2	3	7	30.0	
300	3	2	8	20.0	30.0

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

Copper Concentration µg/L	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max
Acceptable Range	18.0	22.0	7.30	8.30	4.0	NA[a]	28.0	32.0
0	19.8	20.6	8.00	8.15	6.4	8.5	31.0	32.5[b]
50	19.8	20.4	7.99	8.09	6.6	8.6	31.0	32.5[b]
100	19.9	20.4	7.98	8.12	6.3	8.4	31.5	32.0
150	19.9	20.4	8.00	8.16	6.5	8.4	31.5	32.5[b]
300	19.8	20.3	8.02	8.15	6.5	8.6	31.0	32.5[b]

(a) NA Not applicable.
(b) Data point out of range.

APPENDIX J

3-DAY *L. pictus* SUSPENDED PARTICULATPHASE TEST

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

Sediment Treatment	Concentration (Percent SPP)	Replicate	Segment	Stocking Density	Pluteus	Gastrula	Blastula	Abnormal	Percent Normal	Mean Percent Survival
EC-1	0	1	1	242	253	0	0	0	104.5	
EC-1	0	2	1	257	243	1	0	5	94.6	
EC-1	0	3	1	286	248	0	0	7	86.7	
EC-1	0	4	1	309	268	1	0	1	86.7	
EC-1	0	5	1	ND[a]	ND	ND	ND	ND	ND	93.9
EC-1	10	1	1	280	218	0	0	25	77.9	
EC-1	10	2	1	258	178	0	0	5	69.0	
EC-1	10	3	1	292	230	0	0	4	78.8	
EC-1	10	4	1	256	208	0	0	11	81.3	
EC-1	10	5	1	276	224	0	0	11	81.2	81.8
EC-1	50	1	1	253	239	0	0	7	94.5	
EC-1	50	2	1	257	242	0	0	1	94.2	
EC-1	50	3	1	301	281	0	0	13	93.4	
EC-1	50	4	1	267	165	0	0	40	61.8	
EC-1	50	5	1	233	187	0	0	8	80.3	90.2
EC-1	100	1	1	289	218	0	0	3	75.4	
EC-1	100	2	1	259	206	0	0	11	79.5	
EC-1	100	3	1	265	248	0	0	11	93.6	
EC-1	100	4	1	303	218	1	0	4	71.9	
EC-1	100	5	1	288	235	0	0	11	81.6	83.0
EC-2	0	1	1	290	280	0	0	3	96.6	
EC-2	0	2	1	264	248	0	0	11	93.9	
EC-2	0	3	1	318	223	0	0	9	70.1	
EC-2	0	4	1	267	224	0	0	2	83.9	
EC-2	0	5	1	242	248	0	0	2	102.5	90.5
EC-2	10	1	1	275	212	0	0	2	77.1	
EC-2	10	2	1	257	244	2	0	20	94.9	
EC-2	10	3	1	269	227	2	0	5	84.4	
EC-2	10	4	1	286	225	0	0	5	78.7	
EC-2	10	5	1	263	232	0	0	5	88.2	87.5
EC-2	50	1	1	280	235	0	0	8	83.9	
EC-2	50	2	1	277	239	0	0	10	86.3	
EC-2	50	3	1	261	228	0	0	10	87.4	
EC-2	50	4	1	248	199	0	0	16	80.2	
EC-2	50	5	1	258	235	0	0	5	91.1	89.5

TABLE J.1. (contd)

Sediment Treatment	Concentration (Percent SPP)	Replicate	Segment	Stocking Density	Pluteus	Gastrula	Blastula	Abnormal	Percent Normal	Mean Percent Survival
EC-2	100	1	1	249	210	0	0	16	84.3	
EC-2	100	2	1	245	239	0	0	2	97.6	
EC-2	100	3	1	272	212	0	0	22	77.9	
EC-2	100	4	1	244	214	0	0	11	87.7	
EC-2	100	5	1	253	160	8	0	42	76.2	86.1
EC-3	0	1	1	308	231	0	0	1	75.0	
EC-3	0	2	1	288	214	0	0	0	74.3	
EC-3	0	3	1	304	214	1	0	4	70.4	
EC-3	0	4	1	287	247	1	0	6	86.1	
EC-3	0	5	1	271	237	0	0	1	87.5	79.4
EC-3	10	1	1	239	220	0	0	3	92.1	
EC-3	10	2	1	263	201	0	0	1	76.4	
EC-3	10	3	1	274	194	2	0	1	70.8	
EC-3	10	4	1	269	216	0	0	10	80.3	
EC-3	10	5	1	271	236	0	0	7	87.1	82.9
EC-3	50	1	1	228	254	1	0	7	111.4	
EC-3	50	2	1	245	188	0	0	12	76.7	
EC-3	50	3	1	231	211	0	0	1	91.3	
EC-3	50	4	1	304	274	0	0	12	90.1	
EC-3	50	5	1	258	202	0	0	7	78.3	92.3
EC-3	100	1	1	290	246	0	0	3		
EC-3	100	2	1	262	206	0	0	21	78.6	
EC-3	100	3	1	272	254	0	0	7	93.4	
EC-3	100	4	1	249	190	0	0	23	76.3	
EC-3	100	5	1	275	264	0	0	12	96.0	90.9

(a) ND No data.

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

Sediment Treatment	Concentration (Percent SPP)	Segment	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (ppt) Min	Salinity (ppt) Max
Acceptable Range			18.0	22.0	7.50	8.50	5.0	NA[a]	28.0	32.0
EC-1	0	1	20.0	20.6	8.07	8.18	6.4	7.3	30.0	31.5
EC-1	10	1	20.0	20.7	8.07	8.19	6.4	7.3	30.0	31.5
EC-1	50	1	20.1	20.7	8.04	8.20	6.6	7.2	30.0	31.5
EC-1	100	1	20.1	20.7	7.95	8.20	6.5	7.4	30.0	31.5
EC-2	0	1	20.0	20.7	8.07	8.19	6.4	7.3	30.0	32.0
EC-2	10	1	20.1	20.7	8.06	8.20	6.5	7.2	30.0	31.5
EC-2	50	1	20.1	20.7	8.05	8.21	6.6	7.4	30.0	31.5
EC-2	100	1	20.1	20.6	8.09	8.22	6.7	7.3	30.0	31.5
EC-3	0	1	20.0	20.6	8.07	8.19	6.4	7.3	30.0	31.5
EC-3	10	1	20.0	20.7	8.08	8.20	6.5	7.3	30.0	31.5
EC-3	50	1	20.0	20.6	8.07	8.19	6.6	7.3	30.0	31.5
EC-3	100	1	20.1	20.6	8.08	8.20	6.7	7.4	30.0	31.5

(a) NA Not applicable.

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

Copper Concentration µg/L	Replicate	Stocking Density	Pluteus	Gastrula	Blastula	Abnormal	Percent Normal	Mean Percent Survival
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, Winyah Bay Project

Copper Concentration (µg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (ppt)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	18.0	22.0	7.50	8.50	5.0	NA[a]	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

(a) NA Not applicable.

APPENDIX K

M. nasuta TISSUE CHEMISTRY AND QUALITY CONTROL DATA

QA/QC SUMMARY

Project:	Winyah Bay
Parameter:	PAHs
Laboratory:	Battelle Ocean Sciences (BOS)
Matrix:	*M. nasuta* Tissues
Holding Times	Tissues samples were to sent BOS on October 15,1992, extracted on October 28, 1992, and analyzed on November 5 and 6, 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 criteria of 1 blank per 20 samples was met. 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 criteria of one surrogate standard per sample was met. Three surrogate standards were evaluated: d8 naphthalene, d10 acenapthalene, and d12 benzo(a)pyrene. Surrogate recoveries were within the QA goals of 40% to 120%.
Matrix Spike/Matrix Spike Duplicate	The criteria of one matrix spike/matrix spike duplicate (MS/MSD) per 20 samples was met. The 40% to 120% criteria for spike recovery was met for the LPAH and the HPAHs with the exception of acenaphthene, fluorene, phenanthrene, fluoranthene, and pyrene. These five percent recoveries ranged from 121% to 123%. The relative percent difference (RPD) between MS and MSD were all less than 7%: well within the QA limit of ≤30%.
Replication	The criteria of one duplicate analysis per 10 samples was met. The QA limit for RPDs is ≤30%. All of the calculated RPDs were within this limit and ranged from 0% to 27%.
SRMs	QA limits specify that the observed value for an SRM must be within 30% of the certified value. All of the SRM values for LPAHs were within 30% of the certified value. HPAH SRM data showed all compounds except benzo(a)pyrene (35%) and benzo(ghi) perylene (60%) were within 30% of the certified value.

QA/QC SUMMARY

Project:	Winyah Bay
Parameter:	Butyltins
Laboratory:	Battelle Ocean Sciences (BOS)
Matrix:	*M. nasuta* Tissues
Holding Times	Tissues samples were to sent BOS on October 15,1992, extracted on October 30, 1992, and analyzed on November 5 and 6, 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 criteria of 1 blank per 20 samples was met. The butyltin compounds were not detected above the target detection limit of 10 µg/kg.
Detection Limits	The detection limit goal of 10 µg/kg was met for all Butyltin compounds.
Surrogate Internal Standards	The criteria of one surrogate standard per sample was met. Two surrogate standards were evaluated: tripropyltin and tripentlytin. Surrogate recoveries were within the QA goals of 40% to 120% with the exception of *M. nasuta* background replicate 3, which had a surrogate recovery of 125% .
Matrix Spike/Matrix Spike Duplicate	The criteria of one matrix spike/matrix spike duplicate (MS/MSD) per 20 samples was met. The 40% to 120% criteria for spike recovery was met for the tri- and dibutyltin compounds. Monobutyltin compounds were outside the QA range of 40% to 120% with recoveries of 4% for the MS and 18% for the MSD. The relative percent difference (RPD) calculations for tributyltin (34%) and monobutyltin (133%) exceeded the limit of ≤30%.
Replication	The criteria of one duplicate analysis per 10 samples was met. The RPD for monobutyltin (81%) was outside the QA limit of ≤30%.
SRMs	SRMs were not analyzed for the butyltin compounds.

TABLE K.1. Total Polynuclear Aromatic Hydrocarbons (HPAHs), Wet Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Percent Dry Weight	*M. nasuta* PAHs (µg/kg wet weight) Total LPAH	Total HPAH	Total PAH
IH-2,IH-3 Comp	1	12.73	15	11	26
IH-2,IH-3 Comp	2	10.49	9	4	13
IH-2,IH-3 Comp Replicate 1	3	10.71	14	5	19
IH-2,IH-3 Comp Replicate 2	3	10.71	14	5	19
IH-2,IH-3 Comp	4	11.21	10	5	15
IH-2,IH-3 Comp	5	11.40	11	5	16
IHR2	1	10.76	11	4	15
IHR2	2	10.16	8	5	13
IHR2	3	8.96	13	6	19
IHR2	4	10.19	13	3	16
IHR2	5	11.59	10	3	16
M. nasuta Background	1	12.14	10	6	16
M. nasuta Background	2	13.79	11	6	17
M. nasuta Background	3	17.24	11	13	24
M. nasuta Background	4	17.58	11	11	22
M. nasuta Background	5	18.59	14	14	28

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

Sediment Treatment	Replicate	Percent Dry Weight	*M. nasuta* LPAHs (µg/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
IH-2,IH-3 Comp	1	12.73	3.55 J[b]	4.05	2.43	3.96 U[c]	2.14 U	1.57 J	3.10	0.33 J
IH-2,IH-3 Comp	2	10.49	1.96	1.91	1.63	1.73 U	0.49 J	0.88 J	2.15	0.36 J
IH-2,IH-3 Comp Replicate 1	3	10.71	3.70	3.49	2.24	3.64 U	1.97 U	1.22 J	2.63	0.29 J
IH-2,IH-3 Comp Replicate 2	3	10.71	3.55	3.13	2.02	3.46 U	0.80 J	1.36 J	2.94	0.22 J
IH-2,IH-3 Comp	4	11.21	1.85 J	1.97	1.34	1.85 U	0.60 J	1.10	2.81	0.24 J
IH-2,IH-3 Comp	5	11.40	2.58	2.33	1.62	1.99 U	1.08 U	1.11 J	2.54	0.94
IHR2	1	10.76	2.27 J	2.48	1.55	2.53 U	0.66 J	1.13 J	2.35	0.24 J
IHR2	2	10.16	1.62 J	1.58	1.00	1.77 U	0.56 J	0.86 J	2.15	0.23 J
IHR2	3	8.96	2.92 J	3.17	2.16	3.36 U	0.79 J	1.25 J	2.82	0.25 J
IHR2	4	10.19	3.00 J	3.25	2.04	3.05 U	0.51 J	1.27 J	2.17	0.62 J
IHR2	5	11.59	2.00	2.18	1.42	1.77 U	0.65 J	0.91 J	2.50	0.70 J
M. nasuta Background	1	12.14	2.31 J	2.30	1.37 J	2.78 U	1.51 U	0.90 J	2.46	0.24 J
M. nasuta Background	2	13.79	2.64 J	2.73	1.94	3.15 U	1.70 U	1.07 J	2.05	0.24 J
M. nasuta Background	3	17.24	2.31 J	2.52	1.60	0.37 J	0.46 J	1.09 J	2.73	0.32 J
M. nasuta Background	4	17.58	2.59 J	2.73	1.63	[illegible] J	1.45 U	0.97 J	2.16	0.34 J
M. nasuta Background	5	18.59	3.44 J	3.81	2.31	[illegible] U	2.15 U	1.27 J	2.67	0.43 J

(a) DL Detection limit.
(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).
(c) Analyte was not present above the level of associated value.

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

Sediment Treatment	Replicate	Percent Dry Weight	*M. nasuta* HPAHs (µg/kg wet weight) Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	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
IH-2,IH-3 Comp	1	12.73	3.89	2.48	0.91 J[b]	2.11	1.06 J	0.60 J	2.59 [c]	3.12 U	2.12 U	4.23 U
IH-2,IH-3 Comp	2	10.49	1.59	1.29	0.13 J	0.48 J	0.41 J	0.16 J	1.13 U	1.36 U	0.92 U	1.84 U
IH-2,IH-3 Comp Replicate 1	3	10.71	1.76	1.28 J	0.40 J	0.55 J	0.46 J	0.22 J	2.38 U	2.86 U	1.95 U	3.88 U
IH-2,IH-3 Comp Replicate 2	3	10.71	1.82	1.28 J	0.37 J	0.57 J	0.47 J	0.22 J	2.27 U	2.73 U	1.86 U	3.70 U
IH-2,IH-3 Comp	4	11.21	1.92	1.45	0.43 J	0.71 J	0.51 J	0.39 J	1.21 U	1.45 U	0.99 U	1.97 U
IH-2,IH-3 Comp	5	11.40	1.95	1.54	0.30 J	0.67 J	0.58 J	0.24 J	1.31 U	1.57 U	1.07 U	2.13 U
IHR2	1	10.76	1.71	1.18 J	0.42 J	0.43 J	1.91 U	1.59 U	1.66 U	2.00 U	1.36 U	2.71 U
IHR2	2	10.16	1.70	1.02	0.46 J	0.64 J	0.44 J	0.26 J	1.16 U	1.39 U	0.95 U	1.89 U
IHR2	3	8.96	2.96	1.77	0.27 J	0.58 J	0.31 J	0.18 J	2.20 U	2.64 U	1.80 U	3.59 U
IHR2	4	10.19	1.41	0.92 J	0.18 J	0.42 J	0.32 J	0.16 J	2.00 U	2.40 U	1.63 U	3.26 U
IHR2	5	11.59	2.82	1.94	0.17 J	0.58 J	0.38 J	0.19 J	1.16 U	1.39 U	0.95 U	1.89 U
M. nasuta Background	1	12.14	2.77	1.40 J	0.23 J	0.84 J	0.40 J	0.17 J	1.82 U	2.19 U	1.49 U	2.97 U
M. nasuta Background	2	13.79	3.00	1.56 J	0.29 J	0.91 J	0.37 J	0.24 J	2.06 U	2.48 U	1.69 U	3.36 U
M. nasuta Background	3	17.24	6.90	2.97	0.59 J	1.72	0.61 J	0.38 J	0.11 J	2.06 U	1.40 U	2.79 U
M. nasuta Background	4	17.58	5.04	2.71	0.64 J	1.60	0.82 J	0.42 J	1.76 U	2.11 U	1.44 U	2.86 U
M. nasuta Background	5	18.59	5.90	3.30	0.87 J	1.88 J	0.99 J	0.55 J	0.27 J	3.14 U	2.13 U	4.26 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.4. Total Polynuclear Aromatic Hydrocarbons (PAHs), Dry Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Percent Dry Weight	*M. nasuta* PAHs (µg/kg dry weight) Total LPAH	Total HPAH	Total PAH
IH-2,IH-3 Comp	1	12.73	118	87	205
IH-2,IH-3 Comp	2	10.49	89	39	128
IH-2,IH-3 Comp Replicate 1	3	10.71	127	44	171
IH-2,IH-3 Comp Replicate 2	3	10.71	131	44	175
IH-2,IH-3 Comp	4	11.21	88	48	136
IH-2,IH-3 Comp	5	11.40	98	46	144
IHR2	1	10.76	99	35	134
IHR2	2	10.16	79	44	123
IHR2	3	8.96	149	68	217
IHR2	4	10.19	126	33	159
IHR2	5	11.59	89	52	141
M. nasuta Background	1	12.14	79	48	127
M. nasuta Background	2	13.79	77	46	123
M. nasuta Background	3	17.24	66	77	143
M. nasuta Background	4	17.58	61	64	125
M. nasuta Background	5	18.59	75	74	149

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

Sediment Treatment	Replicate	Percent Dry Weight	*M. nasuta* LPAHs (µg/kg dry weight) Naphthalene	2-methyl-naphthalene	1-methyl naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
IH-2,IH-3 Comp	1	12.73	27.88 J[a]	31.81	19.08	31.10 U[b]	16.81 U	12.33 J	24.35	2.59 J
IH-2,IH-3 Comp	2	10.49	18.69	18.21	15.54	16.50 U	4.67 J	8.39 J	20.50	3.43 J
IH-2,IH-3 Comp Replicate 1	3	10.71	34.56	32.60	20.92	34.00 U	18.40 U	11.40 J	24.57	2.71 J
IH-2,IH-3 Comp Replicate 2	3	10.71	33.16	29.24	18.87	32.32 U	7.47 J	12.70 J	27.46	2.06 J
IH-2,IH-3 Comp	4	11.21	16.50 J	17.57	11.95	16.50 U	5.35 J	9.81	25.06	2.14 J
IH-2,IH-3 Comp	5	11.40	22.63	20.44	14.21	17.45 U	9.47 U	9.74 J	22.28	8.24
IHR2	1	10.76	21.09 J	23.04	14.40	23.51 U	6.13 J	10.50 J	21.84	2.23 J
IHR2	2	10.16	15.95 J	15.55	9.84	17.42 U	5.51 J	8.47 J	21.16	2.26 J
IHR2	3	8.96	32.59 J	35.38	24.11	37.50 U	8.82 J	13.95 J	31.47	2.79 J
IHR2	4	10.19	29.44 J	31.89	20.02	29.93 U	5.00 J	12.46 J	21.30	6.08 J
IHR2	5	11.59	17.25	18.80	12.25	15.27 U	5.61 J	7.85 J	21.56	6.04 J
M. nasuta Background	1	12.14	19.03 J	18.95	11.29 J	22.90 U	12.44 U	7.41 J	20.26	1.98 J
M. nasuta Background	2	13.79	19.15 J	19.80	14.07	22.84 U	12.33 U	7.76 J	14.87	1.74 J
M. nasuta Background	3	17.24	13.40 J	14.61	9.28	2.15 J	2.67 J	6.32 J	15.83	1.86 J
M. nasuta Background	4	17.58	14.73 J	15.53	9.27	2.05 J	8.25 U	5.52 J	12.28	1.93 J
M. nasuta Background	5	18.59	18.50 J	20.49	12.43	21.41 U	11.57 U	6.83 J	14.36	2.31 J

(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.6. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs), Dry Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Percent Dry Weight	*M. nasuta* HPAHs (µg/kg dry weight)									
			Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
IH-2,IH-3 Comp	1	12.73	30.55	19.48	7.15 J[a]	16.57	8.32 J	4.71 J	20.34 U[b]	24.50 U	16.65 U	33.22 U
IH-2,IH-3 Comp	2	10.49	15.16	12.30	1.24 J	4.58 J	3.91 J	1.53 J	10.78 U	12.97 U	8.77 U	17.55 U
IH-2,IH-3 Comp Replicate 1	3	10.71	16.44	11.96 J	3.74 J	5.14 J	4.30 J	2.06 J	22.23 U	26.72 U	18.22 U	36.24 U
IH-2,IH-3 Comp Replicate 2	3	10.71	17.00	11.96 J	3.46 J	5.32 J	4.39 J	2.06 J	21.21 U	25.50 U	17.38 U	34.56 U
IH-2,IH-3 Comp	4	11.21	17.12	12.93	3.83 J	6.33 J	4.55 J	3.48 J	10.79 U	12.93 U	8.83 U	17.57 U
IH-2,IH-3 Comp	5	11.40	17.10	13.51	2.63 J	5.88 J	5.09 J	2.10 J	11.49 U	13.77 U	9.38 U	18.68 U
IHR2	1	10.76	15.89	10.96 J	3.90 J	4.00 J	17.75 U	14.77 U	15.42 U	18.58 U	12.64 U	25.18 U
IHR2	2	10.16	16.73	10.04	4.53 J	6.30 J	4.33 J	2.56 J	11.42 U	13.68 U	9.35 U	18.60 U
IHR2	3	8.96	33.04	19.75	3.01 J	6.47 J	3.46 J	2.01 J	24.55 U	29.46 U	20.09 U	40.07 U
IHR2	4	10.19	13.84	9.03 J	1.77 J	4.12 J	3.14 J	1.57 J	19.63 U	23.55 U	16.00 U	31.99 U
IHR2	5	11.59	24.33	16.73	1.47 J	5.00 J	3.28 J	1.64 J	10.01 U	11.99 U	8.19 U	16.30 U
M. nasuta Background	1	12.14	22.82	11.53 J	1.89 J	6.92 J	3.29 J	1.40 J	14.99 U	18.04 U	12.27 U	24.46 U
M. nasuta Background	2	13.79	21.76	11.31 J	2.10 J	6.60 J	2.68 J	1.74 J	14.94 U	17.99 U	12.26 U	24.37 U
M. nasuta Background	3	17.24	40.01	17.22	3.42 J	9.97	3.54 J	2.20 J	0.64 J	11.95 U	8.12 U	16.18 U
M. nasuta Background	4	17.58	28.66	15.41	3.64 J	9.10	4.66 J	2.39 J	10.01 U	12.00 U	8.19 U	16.26 U
M. nasuta Background	5	18.59	31.74	17.75	4.68 J	10.11 J	5.33 J	2.96 J	1.45 J	16.89 U	11.46 U	22.92 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*, Winyah Bay Project

Sediment Treatment	Replicate	*M. nasuta* LPAHs (µg/kg wet weight) Naphthalene	2-methyl-naphthalene	1-methyl naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Method Blank									
Blank	1	1.01 J[a]	0.62 J	0.37 J	2.55 U[b]	1.38 U	0.15 J	0.43 J	1.13 U
Matrix Spike									
IH-2,IH-3 Comp	1	3.55 J	4.05 [c]	2.43	3.96 U	2.14 U	1.57 J	3.10	0.33 J
IH-2,IH-3 Comp MS	1	176.69	ND [d]	ND	191.28	193.19	197.06	197.57	185.44
Concentration Recovered		173.14	NA [e]	NA	191.28	193.19	195.49	194.47	185.11
Amount Spiked		160.19	NS	NS	160.19	160.19	160.19	160.19	160.19
Percent Recovery		108%	NA	NA	119%	121%[f]	122%[f]	121%[f]	116%
IH-2,IH-3 Comp	1	3.55 J	4.05	2.43	3.96 U	2.14 U	1.57 J	3.10	0.33 J
IH-2,IH-3 Comp MSD	1	167.27	ND	ND	182.82	182.25	183.14	179.20	168.58
Concentration Recovered		163.72	NA	NA	182.82	182.25	181.57	176.10	168.25
Amount Spiked		155.31	NS	NS	155.31	155.31	155.31	155.31	155.31
Percent Recovery		105%	NA	NA	118%	117%	117%	113%	108%
RPD		3%	NA	NA	1%	3%	4%	7%	6%
I-Stat		0.01	NA	NA	0.01	0.01	0.02	0.03	0.03
Standard Reference Material									
Certified Value		NC [g]	NC	NC	NC	NC	NC	5.6 ±1.4	0.75 ±0.21
NIST 1974		NA	NA	NA	NA	NA	NA	5.36	0.89 J

TABLE K.7. (contd)

Sediment Treatment	Replicate	*M. nasuta* LPNHs (µg/kg wet weight) Naphthalene	2-methyl-naphthalene	1-methyl naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Analytical Duplicates									
IH-2,IH-3 Comp Replicate 1	3	3.70	3.49	2.24	3.64 U	1.97 U	1.22 J	2.63	0.29 J
IH-2,IH-3 Comp Replicate 2	3	3.55	3.13	2.02	3.46 U	0.80 J	1.36 J	2.94	0.22 J
RPD		4%	11%	10%	NA	NA	11%	11%	27%
I-Stat		0.02	0.05	0.05	NA	NA	0.05	0.06	0.14

(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) NS Not spiked.
(f) Recovery outside quality control range (40%-120%).
(g) NC Not certified.

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

Sediment Treatment	Replicate	*M. nasuta* HPAHs (µg/kg wet weight) Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
Method Blank											
Blank	1	0.25 J[a]	0.57 J	1.88 U[b]	0.08 J	1.92 U	1.60 U	1.67 U	2.01 U	1.37 U	2.72 U
Matrix Spike											
IH-2,IH-3 Comp	1	3.89	2.48	0.91 J	2.11	1.06 J	0.60 J	2.59 U	3.12 U	2.12 U	4.23 U
IH-2,IH-3 Comp MS	1	201.11	197.80	179.34	177.99	171.21	171.70	159.04	176.87	168.83	161.41
Concentration Recovered		197.22	195.32	178.43	175.88	170.15	171.10	159.04	176.87	168.83	161.41
Amount Spiked		160.19	160.19	160.19	160.19	160.19	160.19	160.19	160.19	160.19	160.19
Percent Recovery		123%[c]	122%[c]	111%	110%	106%	107%	99%	110%	105%	101%
IH-2,IH-3 Comp	1	3.89	2.48	0.91 J	2.11	1.06 J	0.60 J	2.59 U	3.12 U	2.12 U	4.23 U
IH-2,IH-3 Comp MSD	1	188.24	180.88	165.92	163.78	161.69	158.03	150.57	170.07	160.63	153.30
Concentration Recovered		184.35	178.4	165.01	161.67	160.63	157.43	150.57	170.07	160.63	153.30
Amount Spiked		155.31	155.31	155.31	155.31	155.31	155.31	155.31	155.31	155.31	155.31
Percent Recovery		119%	115%	106%	104%	103%	101%	97%	110%	103%	99%
RPD		4%	6%	5%	5%	3%	5%	2%	1%	2%	2%
I-Stat		0.02	0.03	0.02	0.03	0.01	0.03	0.01	0.00	0.01	0.01
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		33.72	33.12	NA[e]	NA	6.24	NA	1.49 J[f]	1.72 J	NA	3.95 J[f]

TABLE K.8. (contd)

Sediment Treatment	Replicate	Fluor-anthene	Pyrene	Benzo(a)-anthra-cene	Chrysene	Benzo(b)-fluor-anthene	Benzo(k)-fluor-anthene	Benzo(a)-pyrene	Indeno-(1,2,3-cd) pyrene	Dibenzo-(a,h) anthra-cene	Benzo-(g,h,i)-perylene
		Aromatic HPAHs (µg/kg wet weight)									
Analytical Duplicates											
IH-2,IH-3 Comp Replicate 1	3	1.76	1.28 J	0.40 J	0.55 J	0.46 J	0.22 J	2.38 U	2.86 U	1.95 U	3.88 U
IH-2,IH-3 Comp Replicate 2	3	1.82	1.28 J	0.37 J	0.57 J	0.47 J	0.22 J	2.27 U	2.73 U	1.86 U	3.70 U
RPD		3%	0%	8%	4%	2%	0%	NA	NA	NA	NA
I-Stat		0.02	0.00	0.04	0.02	0.01	0.00	NA	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) NA Not applicable.
(f) Value exceeds SRM range ≤30%.

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

Sediment Treatment	Replicate	Surrogate Percent Recovery: Naphthalene-d8	Acenaphthene-d10	Benzo(a)pyrene-d12
IH-2,IH-3 Comp	1	80	63	66
IH-2,IH-3 Comp	2	93	74	70
IH-2,IH-3 Comp Replicate 1	3	81	64	66
IH-2,IH-3 Comp Replicate 2	3	76	62	65
IH-2,IH-3 Comp	4	75	67	65
IH-2,IH-3 Comp	5	105	74	75
IHR2	1	83	68	68
IHR2	2	74	67	67
IHR2	3	86	70	70
IHR2	4	91	70	71
IHR2	5	95	67	72
M. nasuta Background	1	83	67	67
M. nasuta Background	2	83	66	68
M. nasuta Background	3	86	67	67
M. nasuta Background	4	73	61	58
M. nasuta Background	5	82	66	67
Quality Control Data				
Method Blank				
Blank	1	92	73	70
Matrix Spike				
IH-2,IH-3 Comp	1	80	63	66
IH-2,IH-3 Comp MS	1	84	69	71
IH-2,IH-3 Comp	1	80	63	66
IH-2,IH-3 Comp MSD	1	92	75	75
Analytical Duplicates				
IH-2,IH-3 Comp Replicate 1	3	81	64	66
IH-2,IH-3 Comp Replicate 2	3	76	62	65

TABLE K.10. Butyltins, Wet and Dry Weight, in Tissue of *M. nasuta* Winyah Bay Project

Sediment Treatment	Replicate	Surrogate Percent Recoveries: Tri-propyltin	Surrogate Percent Recoveries: Tri-pentyltin	*M. nasuta* Butyltins (µg/kg wet weight): Tri-butyltin	Di-butyltin	Mono-butyltin	Percent Dry Weight	*M. nasuta* Butyltins (µg/kg dry weight): Tri-butyltin	Di-butyltin	Mono-butyltin
Target DL[a]				10.0	10.0	10.0				
Achieved DL				≤10.0	≤10.0	≤10.0				
IH-2,IH-3 Comp	1	42	63	10.50 J[b]	4.30 U[c]	7.55	12.73	82.46 J	33.77 U	59.29
IH-2,IH-3 Comp	2	54	53	1.62 J	1.68 U	2.11 U	10.49	15.45 J	16.02 U	20.12 U
IH-2,IH-3 Comp Replicate 1	3	50	76	8.28	2.60 U	5.87	10.7*	77.35	24.29 U	54.83
IH-2,IH-3 Comp Replicate 2	3	81	65	6.21	1.72 U	2.49	10.71	58.01	16.07 U	23.26
IH-2,IH-3 Comp	4	77	60	7.48	2.05 U	3.65	11.21	66.71	18.28 U	32.55
IH-2,IH-3 Comp	5	68	52	6.16 J	2.46 U	4.04	11.40	54.03 J	21.58 U	35.43
IHR2	1	91	55	5.90	2.00 U	2.50 U	10.76	54.82	18.58 U	23.23 U
IHR2	2	78	68	8.37	2.16 U	4.04	10.16	82.39	21.26 U	39.77
IHR2	3	67	77	5.73 J	2.35 U	3.02	8.96	63.95 J	26.23 U	33.71
IHR2	4	87	44	5.77 J	2.35 U	2.95 U	10.19	56.62 J	23.06 U	28.95 U
IHR2	5	84	52	7.72	2.55 U	6.81	11.59	66.59	22.00 U	58.74
M. nasuta Background	1	82	60	7.49	2.55 U	0.15 J	12.14	61.70	21.00 U	1.24 J
M. nasuta Background	2	94	46	5.34 J	2.53 U	3.17 U	13.79	38.73 J	18.35 U	22.99 U
M. nasuta Background	3	125[d]	55	8.74	2.61 U	3.27 U	17.24	50.68	15.14 U	18.96 U
M. nasuta Background	4	97	45	10.61	3.00 U	3.76 U	17.58	60.34	17.06 U	21.38 U
M. nasuta Background	5	65	43	7.65 J	4.61 U	5.78 U	18.59	41.15 J	24.80 U	31.09 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.
(d) Recovery outside quality control range (40%-120%).

TABLE K.11. Quality Control Summary for Butyltins, Wet and Dry Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Surrogate Percent Recoveries: Tri-propyltin	Surrogate Percent Recoveries: Tri-pentyltin	*M. nasuta* Butyltins (µg/kg wet weight): Tri-butyltin	Di-butyltin	Mono-butyltin
Method Blank						
Blank	1	55	63	3.75 J[a]	2.42 U[b]	3.03 U
Matrix Spike						
IH-2,IH-3 Comp	1	42	63	10.50 J	4.30 U	7.55
IH-2,IH-3 Comp MS	1			62.78	33.20	8.92
Concentration Recovered				52.28	33.20	1.37
Amount Spiked				46.13	46.61	38.39
Percent Recovery		96	44	113%	71%	4%[c]
IH-2,IH-3 Comp	1	42	63	10.50 J	4.30 U	7.55
IH-2,IH-3 Comp MSD	1			27.28	13.66	4.48
Concentration Recovered				16.78	13.66	3.07
Amount Spiked				20.94	21.16	17.42
Percent Recovery		77	44	80%	65%	18%[c]
RPD				34%[d]	10%	133%[d]
I-Stat				0.17	0.05	0.66
Analytical Duplicates						
IH-2,IH-3 Comp Replicate 1	3	50	76	8.28	2.60 U	5.87
IH-2,IH-3 Comp Replicate 2	3	81	65	6.21	1.72 U	2.49
RPD				29%	NA	81%[d]
I-Stat				0.14	NA	0.40

(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) Value exceeds relative precision range ≤30%.

TABLE K.12. Total Dioxins and Furans, Wet Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*M. nasuta* (ng/kg wet weight) Total TCDD	Total PeCDD	Total HxCDD	Total HpCDD	Total TCDF	Total PeCDF	Total HxCDF	Total HpCDF
Target DL[a]				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL				<1.0	NA[b]	1.0	1.0	<1.0	<1.0	<1.0	<1.0
IH-2,IH-3 Comp	1	2	12.733 [c]	ND[d]	ND	2.19[e]	6.31	0.39	0.69	0.19	ND
IH-2,IH-3 Comp	2	2	10.486 [c]	0.55	ND	2.58	7.94	1.69	ND	ND	ND
IH-2,IH-3 Comp	3	1	10.705 [c]	ND	ND	2.18	5.59	1.76	ND	ND	0.22
IH-2,IH-3 Comp	4	1	11.213 [c]	ND	ND	1.35	5.05	0.78	ND	ND	ND
IH-2,IH-3 Comp	5	1	11.402 [c]	0.20	ND	2.82	7.84	1.54	0.28	0.22	0.26
IHR1 Replicate 1	1	2	11.707 [f]	ND	ND	ND	4.26	ND	ND	ND	ND
IHR1 Replicate 2	1	2	11.707 [f]	ND	ND	0.57	2.96	ND	0.54	ND	ND
IHR1	2	1	11.707 [f]	ND	ND	1.77	5.52	ND	ND	ND	ND
IHR1	3	1	11.707 [f]	ND	ND	2.70	5.38	0.13	ND	ND	ND
IHR1	4	1	11.707 [f]	ND	ND	2.55	7.93	ND	ND	0.77	ND
IHR1	5	2	11.707 [f]	ND	ND	2.00	4.14	ND	ND	ND	ND
IHR2	1	2	10.762 [c]	ND	ND	ND	4.23	ND	ND	ND	ND
IHR2	2	1	10.159 [c]	0.24	ND	1.94	5.48	1.38	ND	0.32	ND
IHR2	3	1	8.960 [c]	0.47	ND	2.04	6.10	1.71	ND	0.24	0.25
IHR2	4	2	10.190 [c]	ND	ND	1.30	3.66	0.39	ND	ND	ND
IHR2	5	1	11.593 [c]	ND	ND	1.89	4.76	0.91	ND	0.21	0.24
M. nasuta Background	1	1	12.140 [c]	ND	ND	ND	1.09	ND	ND	ND	ND
M. nasuta Background	2	1	13.789 [c]	ND	ND	ND	1.22	ND	ND	ND	0.26
M. nasuta Background	3	1	17.244 [c]	ND	ND	ND	1.63	ND	ND	ND	ND
M. nasuta Background	4	2	17.584 [c]	ND	ND	ND	ND	ND	ND	ND	ND
M. nasuta Background	5	2	18.590 [c]	ND	ND	ND	1.49	0.28	ND	ND	ND
Quality Control Data											
Method Blank											
Blank		1		0.24	ND	ND	0.15	ND	ND	ND	0.15
Blank		2		ND	ND	ND	ND	ND	ND	ND	ND

TABLE K.12. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*M. nasuta* (ng/kg wet weight) Total TCDD	Total PeCDD	Total HxCDD	Total HpCDD	Total TCDF	Total PeCDF	Total HxCDF	Total HpCDF
Analytical Duplicates											
IHR1 Replicate 1	1	2	11.707 (f)	ND	ND	ND	4.26	ND	ND	ND	ND
IHR1 Replicate 2	1	2	11.707 (f)	ND	ND	0.57	2.96	ND	0.54	ND	ND
RPD				ND	ND	NA	36% (g)	ND	ND	ND	ND
I-Stat				ND	ND	NA	0.31	ND	ND	ND	ND

(a) DL Detection limit.
(b) NA Not applicable.
(c) PAH percent dry weights
(d) ND No data.
(e) Mass ratio out of limits.
(f) Average weight of PAH percent dry weights.
(g) Value exceeds relative precision range ≤30%.

TABLE K.13. Dioxins, Wet Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*M. nasuta* (ng/kg wet weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
Target DL[a]				1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL				<1.0	<1.0	<1.0	<1.0	<1.0	1.0	5.0
IH-2,IH-3 Comp	1	2	12.733 [b]	0.6 U[c]	0.2 U	0.3 U	0.50 U	0.40 U	2.04	37.82
IH-2,IH-3 Comp	2	2	10.486 [b]	0.7 U	0.4 U	0.2 U	0.50 U	0.50 U	2.57	57.74
IH-2,IH-3 Comp	3	1	10.705 [b]	0.4 U	0.3 U	0.2 U	0.30 U	0.21 [d]	1.92	40.19
IH-2,IH-3 Comp	4	1	11.213 [b]	0.9 U	0.5 U	0.2 U	1.20 U	0.60 U	1.99	37.04
IH-2,IH-3 Comp	5	1	11.402 [b]	0.4 U	0.3 U	0.2 U	0.18	0.50 U	2.68	54.94
IHR1 Replicate 1	1	2	11.707 [e]	0.4 U	0.5 U	0.7 U	0.80 U	0.90 U	1.39	22.77
IHR1 Replicate 2	1	2	11.707 [e]	0.4 U	0.2 U	0.2 U	0.30 U	0.40 U	3.00 U	15.41
IHR1	2	1	11.707 [e]	0.5 U	0.4 U	0.3 U	0.30 U	0.50 U	1.60	19.79
IHR1	3	1	11.707 [e]	0.6 U	0.3 U	0.2 U	0.40 U	0.50 U	1.62	16.52
IHR1	4	1	11.707 [e]	0.6 U	1.1 U	1.4 U	1.20 U	1.80 U	2.41	22.37
IHR1	5	2	11.707 [e]	0.5 U	0.5 U	0.4 U	0.40 U	0.40 U	1.33	21.44
IHR2	1	2	10.762 [b]	1.7 U	1.0 U	1.1 U	0.60 U	1.50 U	1.62	39.24
IHR2	2	1	10.159 [b]	0.5 U	0.5 U	0.6 U	0.50 U	0.37	1.75	31.94
IHR2	3	1	8.960 [b]	0.6 U	0.3 U	0.1	0.40 U	0.40 U	1.96	34.45
IHR2	4	2	10.190 [b]	0.4 U	0.3 U	0.2 U	0.30 U	0.30 U	1.33	25.30
IHR2	5	1	11.593 [b]	0.3 U	0.2 U	0.2 U	0.17	0.27	1.51	24.88
M. nasuta Background	1	1	12.140 [b]	0.3 U	0.2 U	0.2 U	0.10 U	0.20 U	0.53	5.50
M. nasuta Background	2	1	13.789 [b]	0.3 U	0.3 U	0.3 U	0.10 U	0.20 U	0.49	5.40
M. nasuta Background	3	1	17.244 [b]	0.5 U	0.2 U	0.1 U	0.30 U	0.20 U	0.68	6.94
M. nasuta Background	4	2	17.584 [b]	0.5 U	0.3 U	0.3 U	0.20 U	0.50 U	1.70 U	9.09
M. nasuta Background	5	2	18.590 [b]	0.5 U	0.4 U	0.1 U	0.20 U	0.20 U	0.64	8.09

(a) DL Detection limit.
(b) PAH percent dry weights
(c) U Analyte was not present above the level of associated value.
(d) Mass ratio out of limits.
(e) Average weight of PAH percent dry weights.

TABLE K.14. Furans, Wet Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*M. nasuta* (ng/kg wet weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
Target DL[a]				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
IH-2,IH-3 Comp	1	2	12.733 [b]	0.39	0.69	0.2 U[c]	0.1 U	0.2 U	0.19	0.1 U	1.8 U	0.3 U	0.90 U
IH-2,IH-3 Comp	2	2	10.486 [b]	0.50	0.20 U	0.2 U	0.2 U	0.1 U	0.40 U	0.2 U	2.3 U	0.1 U	0.57
IH-2,IH-3 Comp	3	1	10.705 [b]	0.45	0.10 U	0.1 U	0.2 U	0.1 U	0.40 U	0.1 U	1.2 U	0.2 U	0.75
IH-2,IH-3 Comp	4	1	11.213 [b]	0.48	0.30 U	0.1 U	0.2 U	0.3 U	0.80 U	0.3 U	1.3 U	0.4 U	1.30 U
IH-2,IH-3 Comp	5	1	11.402 [b]	0.44	0.10 U	0.1 U	0.1 U	0.1 U	0.22	0.1 U	1.3 U	0.1 U	0.50
IHR1 Replicate 1	1	2	11.707 [d]	0.40 U	0.60 U	0.6 U	0.6 U	0.3 U	0.80 U	0.3 U	1.3 U	1.0 U	2.50 U
IHR1 Replicate 2	1	2	11.707 [d]	0.20 U	0.10 U	0.2 U	0.2 U	0.2 U	0.40 U	0.2 U	0.9 U	0.3 U	0.30
IHR1	2	1	11.707 [d]	0.50 U	0.40 U	0.3 U	0.3 U	0.2 U	0.80 U	0.4 U	0.6 U	0.5 U	2.10 U[e]
IHR1	3	1	11.707 [d]	0.13	0.10 U	0.2 U	0.2 U	0.2 U	0.50 U	0.1 U	1.0 U	0.3 U	0.66
IHR1	4	1	11.707 [d]	0.40 U	2.10 U	1.0 U	1.3 U	0.9 U	0.77	1.4 U	2.6 U	1.7 U	1.59
IHR1	5	2	11.707 [d]	0.50 U	0.30 U	0.5 U	0.3 U	0.2 U	0.60 U	0.2 U	1.3 U	0.5 U	1.90 U
IHR2	1	2	10.762 [b]	1.10 U	1.00 U	0.8 U	0.9 U	0.9 U	1.60 U	0.8 U	2.8 U	1.6 U	2.60 U
IHR2	2	1	10.159 [b]	0.47	0.40 U	0.4 U	0.5 U	0.4 U	0.32	0.5 U	1.2 U	0.6 U	0.97
IHR2	3	1	8.960 [b]	0.59	0.20 U	0.2 U	0.2 U	0.2 U	0.24	0.1 U	1.1 U	0.2 U	0.39
IHR2	4	2	10.190 [b]	0.39	0.20 U	0.3 U	0.2 U	0.2 U	0.40 U	0.2 U	1.9 U	0.1 U	0.42
IHR2	5	1	11.593 [b]	0.39	0.20 U	0.2 U	0.3 U	0.1 U	0.21	0.2 U	1.4 U	0.4 U	0.58
M. nasuta Background	1	1	12.140 [b]	0.30 U	0.20 U	0.2 U	0.1 U	0.2 U	0.50 U	0.2 U	0.8 U	0.2 U	0.23
M. nasuta Background	2	1	13.789 [b]	0.20 U	0.20 U	0.1 U	0.3 U	0.1 U	0.50 U	0.2 U	1.3 U	0.3 U	0.37
M. nasuta Background	3	1	17.244 [b]	0.30 U	0.30 U	0.3 U	0.2 U	0.2 U	0.60 U	0.2 U	1.8 U	0.5 U	0.58
M. nasuta Background	4	2	17.584 [b]	0.50 U	0.30 U	0.5 U	0.5 U	0.4 U	0.70 U	0.3 U	1.5 U	0.6 U	1.30 U
M. nasuta Background	5	2	18.590 [b]	0.28	0.40 U	0.1 U	0.2 U	0.2 U	0.60 U	0.2 U	1.4 U	0.4 U	1.12

(a) DL Detection limit.
(b) PAH percent dry weights
(c) U Analyte was not prsent above the level of associated value.
(d) Average weight of PAH percent dry weights.
(e) Mass ratio out of limits.

TABLE K.15. Total Dioxins and Furans, Dry Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*M. nasuta* (ng/kg dry weight) Total TCDD	Total PeCDD	Total HxCDD	Total HpCDD	Total TCDF	Total PeCDF	Total HxCDF	Total HpCDF
IH-2,IH-3 Comp	1	2	12.733 (a)	ND (b)	ND	17.2 (c)	49.6	3.1	5.4	1.5	ND
IH-2,IH-3 Comp	2	2	10.486 (a)	5.2	ND	24.6	75.7	16.1	ND	ND	ND
IH-2,IH-3 Comp	3	1	10.705 (a)	ND	ND	20.4	52.2	16.4	ND	ND	2.1
IH-2,IH-3 Comp	4	1	11.213 (a)	ND	ND	12.0	45.0	7.0	ND	ND	ND
IH-2,IH-3 Comp	5	1	11.402 (a)	1.8	ND	24.7	68.8	13.5	2.5	1.9	2.3
IHR1 Replicate 1	1	2	11.707 (d)	ND	ND	ND	36.4	ND	ND	ND	ND
IHR1 Replicate 2	1	2	11.707 (d)	ND	ND	4.9	25.3	ND	4.6	ND	ND
IHR1	2	1	11.707 (d)	ND	ND	15.1	47.2	ND	ND	ND	ND
IHR1	3	1	11.707 (d)	ND	ND	23.1	46.0	1.1	ND	ND	ND
IHR1	4	1	11.707 (d)	ND	ND	21.8	67.7	ND	ND	6.6	ND
IHR1	5	2	11.707 (d)	ND	ND	17.1	35.4	ND	ND	ND	ND
IHR2	1	2	10.762 (a)	ND	ND	ND	39.3	ND	ND	ND	ND
IHR2	2	1	10.159 (a)	2.4	ND	19.1	53.9	13.6	ND	3.1	ND
IHR2	3	1	8.960 (a)	5.2	ND	22.8	68.1	19.1	ND	2.7	2.8
IHR2	4	2	10.190 (a)	ND	ND	12.8	35.9	3.8	ND	ND	ND
IHR2	5	1	11.593 (a)	ND	ND	16.3	41.1	7.8	ND	1.8	2.1
M. nasuta Background	1	1	12.140 (a)	ND	ND	ND	9.0	ND	ND	ND	ND
M. nasuta Background	2	1	13.789 (a)	ND	ND	ND	8.8	ND	ND	ND	1.9
M. nasuta Background	3	1	17.244 (a)	ND	ND	ND	9.5	ND	ND	ND	ND
M. nasuta Background	4	2	17.584 (a)	ND	ND	ND	ND	ND	ND	ND	ND
M. nasuta Background	5	2	18.590 (a)	ND	ND	ND	8.0	1.5	ND	ND	ND

(a) PAH percent dry weights.
(b) ND No data.
(c) Mass ratio out of limits.
(d) Average weight of PAH percent dry weights.

TABLE K.16. Dioxins, Dry Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*M. nasuta* (ng/kg dry weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
IH-2,IH-3 Comp	1	2	12.733 (a)	4.7 U (b)	1.6 U	2.4 U	3.9 U	3.1 U	16.0	297.0
IH-2,IH-3 Comp	2	2	10.486 (a)	6.7 U	3.8 U	1.9 U	4.8 U	4.8 U (c)	24.5	550.6
IH-2,IH-3 Comp	3	1	10.705 (a)	3.7 U	2.8 U	1.9 U	2.8 U	2.0	17.9	375.4
IH-2,IH-3 Comp	4	1	11.213 (a)	8.0 U	4.5 U	1.8 U	10.7 U	5.4 U	17.7	330.3
IH-2,IH-3 Comp	5	1	11.402 (a)	3.5 U	2.6 U	1.8 U	1.6	4.4 U	23.5	481.8
IHR1 Replicate 1	1	2	11.707 (d)	3.4 U	4.3 U	6.0 U	6.8 U	7.7 U	11.9	194.5
IHR1 Replicate 2	1	2	11.707 (d)	3.4 U	1.7 U	1.7 U	2.6 U	3.4 U	25.6 U	131.6
IHR1	2	1	11.707 (d)	4.3 U	3.4 U	2.6 U	2.6 U	4.3 U	13.7	169.0
IHR1	3	1	11.707 (d)	5.1 U	2.6 U	1.7 U	3.4 U	4.3 U	13.8	141.1
IHR1	4	1	11.707 (d)	5.1 U	9.4 U	12.0 U	10.3 U	15.4 U	20.6	191.1
IHR1	5	2	11.707 (d)	4.3 U	4.3 U	3.4 U	3.4 U	3.4 U	11.4	183.1
IHR2	1	2	10.762 (a)	15.8 U	9.3 U	10.2 U	5.6 U	13.9 U	15.1	364.6
IHR2	2	1	10.159 (a)	4.9 U	4.9 U	5.9 U	4.9 U	3.6	17.2	314.4
IHR2	3	1	8.960 (a)	6.7 U	3.3 U	1.1	4.5 U	4.5 U	21.9	384.5
IHR2	4	2	10.190 (a)	3.9 U	2.9 U	2.0 U	2.9 U	2.9 U	13.1	248.3
IHR2	5	1	11.593 (a)	2.6 U	1.7 U	1.7 U	1.5	2.3	13.0	214.6
M. nasuta Background	1	1	12.140 (a)	2.5 U	1.6 U	1.6 U	0.8 U	1.6 U	4.4	45.3
M. nasuta Background	2	1	13.789 (a)	2.2 U	2.2 U	2.2 U	0.7 U	1.5 U	3.6	39.2
M. nasuta Background	3	1	17.244 (a)	2.9 U	1.2 U	0.6 U	1.7 U	1.2 U	3.9	40.2
M. nasuta Background	4	2	17.584 (a)	2.8 U	1.7 U	1.7 U	1.1 U	2.8 U	9.7 U	51.7
M. nasuta Background	5	2	18.590 (a)	2.7 U	2.2 U	0.5 U	1.1 U	1.1 U	3.4	43.5

(a) PAH percent dry weights
(b) U Analyte was not present above the level of associated value.
(c) Mass ratio out of limits.
(d) Average weight of PAH percent dry weights.

TABLE K.17. Furans, Dry Weight, in Tissue of *M. nasuta*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	*M. nasuta* (ng/kg dry weight) Percent Dry Weight	2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
IH-2,IH-3 Comp	1	2	12.733 (a)	3.1	5.4	1.6 U (b)	0.8 U	1.6 U	1.5	0.8 U	14.1 U	2.4 U	7.1 U
IH-2,IH-3 Comp	2	2	10.486 (a)	4.8	1.9 U	1.9 U	1.9 U	1.0 U	3.8 U	1.9 U	21.9 U	1.0 U	5.4
IH-2,IH-3 Comp	3	1	10.705 (a)	4.2	0.9 U	0.9 U	1.9 U	0.9 U	3.7 U	0.9 U	11.2 U	1.9 U	7.0
IH-2,IH-3 Comp	4	1	11.213 (a)	4.3	2.7 U	0.9 U	1.8 U	2.7 U	7.1 U	2.7 U	11.6 U	3.6 U	11.6 U
IH-2,IH-3 Comp	5	1	11.402 (a)	3.9	0.9 U	0.9 U	0.9 U	0.9 U	1.9	0.9 U	11.4 U	0.9 U	4.4
IHR1 Replicate 1	1	2	11.707 (c)	3.4 U	5.1 U	5.1 U	5.1 U	2.6 U	6.8 U	2.6 U	11.1 U	8.5 U	21.4 U
IHR1 Replicate 2	1	2	11.707 (c)	1.7 U	0.9 U	1.7 U	1.7 U	1.7 U	3.4 U	1.7 U	7.7 U	2.6 U	2.6
IHR1	2	1	11.707 (c)	4.3 U	3.4 U	2.6 U	2.6 U	1.7 U	6.8 U	3.4 U	5.1 U	4.3 U	17.9 U (d)
IHR1	3	1	11.707 (c)	1.1	0.9 U	1.7 U	1.7 U	1.7 U	4.3 U	0.9 U	8.5 U	2.6 U	5.6
IHR1	4	1	11.707 (c)	3.4 U	17.9 U	8.5 U	11.1 U	7.7 U	6.6	12.0 U	22.2 U	14.5 U	13.6
IHR1	5	2	11.707	4.3 U	2.6 U	4.3 U	2.6 U	1.7 U	5.1 U	1.7 U	11.1 U	4.3 U	16.2 U
IHR2	1	2	10.762 (a)	10.2 U	9.3 U	7.4 U	8.4 U	8.4 U	14.9 U	7.4 U	26.0 U	14.9 U	24.2 U
IHR2	2	1	10.159 (a)	4.6	3.9 U	3.9 U	4.9 U	3.9 U	3.1	4.9 U	11.8 U	5.9 U	9.5
IHR2	3	1	8.960 (a)	6.6	2.2 U	2.2 U	2.2 U	2.2 U	2.7	1.1 U	12.3 U	2.2 U	4.4
IHR2	4	2	10.190 (a)	3.8	2.0 U	2.9 U	2.0 U	2.0 U	3.9 U	2.0 U	18.6 U	1.0 U	4.1
IHR2	5	1	11.593 (a)	3.4	1.7 U	1.7 U	2.6 U	0.9 U	1.8	1.7 U	12.1 U	3.5 U	5.0
M. nasuta Background	1	1	12.140 (a)	2.5 U	1.6 U	1.6 U	0.8 U	1.6 U	4.1 U	1.6 U	6.6 U	1.6 U	1.9
M. nasuta Background	2	1	13.789 (a)	1.5 U	1.5 U	0.7 U	2.2 U	0.7 U	3.6 U	1.5 U	9.4 U	2.2 U	2.7
M. nasuta Background	3	1	17.244 (a)	1.7 U	1.7 U	1.7 U	1.2 U	1.2 U	3.5 U	1.2 U	10.4 U	2.9 U	3.4
M. nasuta Background	4	2	17.584 (a)	2.8 U	1.7 U	2.8 U	2.8 U	2.3 U	4.0 U	1.7 U	8.5 U	3.4 U	7.4 U
M. nasuta Background	5	2	18.590 (a)	1.5	2.2 U	0.5 U	1.1 U	1.1 U	3.2 U	1.1 U	7.5 U	2.2 U	6.0

(a) PAH percent dry weights.
(b) U Analyte was not present above the level of associated value.
(c) Average weight of PAH percent dry weights.
(d) Mass ratio out of limits.

TABLE K.18. Quality Control Summary for Dioxins, Wet Weight, in Tissue of *M. nasuta* Winyah Bay Project

Sediment Treatment	Replicate	Batch	*M. nasuta* (ng/kg wet weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
Method Blank									
Blank		1	0.1 U[a]	0 U	0.1 U	0.1 U	0.1 U	0.40 U	2.40
Blank		2	0.9 U	0.7 U	0.4 U	0.4 U	0.4 U	1.50 U	9.07
Matrix Spike									
IH-2,IH-3 Comp	1	2	0.6 U	0.2 U	0.3 U	0.5 U	0.4 U	2.04	37.82
IH-2,IH-3 Comp MS	1	2	27.0	118.0	116.0	100.0	108.0	107.00	276.00
Concentration Recovered			27.0	118.0	116.0	100.0	108.0	104.96	238.18
Amount Spiked			22.0	110.0	110.0	110.0	110.0	110.00	220.00
Percent Recovery			123%[b]	107%	105%	91%	98%	95%	108%
IH-2,IH-3 Comp	1	2	0.6 U	0.2 U	0.3 U	0.5 U	0.4 U	2.04	37.82
IH-2,IH-3 Comp MSD	1	2	27.0	111.0	121.0	90.0	103.0	102.00	270.00
Concentration Recovered			27.0	111.0	121.0	90.0	103.0	99.96	232.18
Amount Spiked			22.0	110.0	110.0	110.0	110.0	110.00	221.00
Percent Recovery			123%[b]	101%	110%	82%	94%	91%	105%
RPD			0%	6%	4%	11%	5%	5%	3%
I-Stat			0.00	0.05	0.03	0.06	0.03	0.02	0.00
Matrix Spike Reference Material									
Concensus Value			460	960	900	870	900	1390	3510
MRM			487	978	885	798	904	1315	3170
Analytical Duplicates									
IHR1 Replicate 1	1	2	0.4 U	0.5 U	0.7 U	0.8 U	0.9 U	1.39	22.77
IHR1 Replicate 2	1	2	0.4 U	0.2 U	0.2 U	0.3 U	0.4 U	3.00 U	15.41
RPD			NA[c]	NA	NA	NA	NA	NA	39%[d]
I-Stat			NA	NA	NA	NA	NA	NA	0.19

(a) U Analyte was not present above the level of associated value.
(b) Recovery outside quality control range (40%-120%).
(c) NA Not applicable.
(d) Value exceeds relative precision range ≤30%.

TABLE K.19. Quality Control Summary for Furans, Wet Weight, in Tissue of *M. nasuta* Winyah Bay Project

Sediment Treatment	Replicate	Batch	*M. nasuta* (ng/kg wet weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
Method Blank												
Blank		1	0.10 U[a]	0.00 U	0.0 U	0.0 U	0.0 U	0.80 U	0.1 U	0.3 U	0.1 U	0.25 [b]
Blank		2	0.20 U	0.40 U	0.6 U	0.4 U	0.4 U	1.00 U	0.9 U	0.9 U	1.1 U	2.20 U
Matrix Spike												
IH-2,IH-3 Comp	1	2	0.39	0.69	0.2 U	0.1 U	0.2 U	0.19	0.1 U	1.8 U	0.3 U	0.90 U
IH-2,IH-3 Comp MS	1	2	22.00	113.00	106.0	116.0	108.0	112.00	116.0	97.0	111.0	279.00
Concentration Recovered			21.61	112.31	106.0	116.0	108.0	111.81	116.0	97.0	111.0	279.00
Amount Spiked			22.00	110.00	110.0	110.0	110.0	110.00	110.0	110.0	110.0	220.00
Percent Recovery			98%	102%	96%	105%	98%	102%	105%	88%	101%	127%[c]
IH-2,IH-3 Comp	1	2	0.39	0.69	0.2 U	0.1 U	0.2 U	0.19	0.1 U	1.8 U	0.3 U	0.90 U
IH-2,IH-3 Comp MSD	1	2	22.00	104.00	96.0	115.0	110.0	112.00	115.0	98.0	110.0	279.00
Concentration Recovered			21.61	103.31	96.0	115.0	110.0	111.81	115.0	98.0	110.0	279.00
Amount Spiked			22.00	110.00	110.0	110.0	110.0	110.00	110.0	110.0	110.0	221.00
Percent Recovery			98%	94%	87%	105%	100%	102%	105%	89%	100%	126%[c]
RPD			0%	8%	10%	1%	2%	0%	1%	1%	1%	0%
I-Stat			0.00	0.05	0.08	0.01	0.02	0.00	0.01	0.00	0.01	0.00
Matrix Spike Reference Material												
Concensus Value			450	870	860	880	950	820	910	1270	1120	2250
MRM			437	905	832	971	926	938	955	1214	1393	2361
Analytical Duplicates												
IHR1 Replicate 1	1	2	0.40 U	0.60 U	0.6 U	0.6 U	0.3 U	0.80 U	0.3 U	1.3 U	1.0 U	2.50 U
IHR1 Replicate 2	1	2	0.20 U	0.10 U	0.2 U	0.2 U	0.2 U	0.40 U	0.2 U	0.9 U	0.3 U	0.30
RPD			NA (d)	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

(a) U Analyte was not present above the level of associated value.
(b) Calibration response factor at beginning and end of day out of limits.
(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:	Winyah Bay
Parameter:	Butyltins
Laboratory:	Battelle Ocean Sciences (BOS)
Matrix:	*N. virens* Tissues
Holding Times	Tissues samples were to sent BOS on October 15,1992, extracted on October 30, 1992, and analyzed on November 5 and 6, 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 criteria of 1 blank per 20 samples was met. The butyltin compounds were not detected above the target detection limit of 10 µg/kg.
Detection Limits	The detection limit goal of 10 µg/kg was met for all butyltin compounds.
Surrogate Internal Standards	The criteria of one surrogate standard per sample was met. Two surrogate standards were evaluated: tripropyltin and tripentlytin. Surrogate recoveries were within the QA goals of 40% to 120% with the exception of *N. virens* background replicate 5, which had a surrogate recovery of 127.4% .
Matrix Spike/Matrix Spike Duplicate	The criteria of one matrix spike/matrix spike duplicate (MS/MSD) per 20 samples was met. The 40% to 120% criteria for spike recovery was met for the tri- and dibutyltin compounds. Monobutyltin compounds were outside the QA range of 40% to 120% with recoveries of 26% for the MS and 28% for the MSD. The relative percent difference (RPD) calculations for the MS/MSD were all within the QA limit of .≤30%, ranging from 9% to 18%.
Replication	The criteria of one duplicate analysis per 10 samples was met. The RPD for tributyltin (65%) was outside the QA limit of≤30%.
SRMs	SRMs were not analyzed for the butyltin compounds.

QA/QC SUMMARY

Project:	Winyah Bay
Parameter:	Dioxins and Furans
Laboratory:	Battelle Columbus
Matrix:	*N. virens* Tissues

Holding Times

Sediment samples were collected from June 23 to 25, 1992. Samples arrived on October 14, 1992, were extracted on October 21 through November 6, 1992, and analyzed on November 11 through November 18, 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 criteria of 1 blank per 20 samples was met. Dioxins and furans were not detected above the target detection limit of 1.0 ng/kg, with the exception of blanks 1 and 2, which had OCDD levels detected at 2.4 ng/kg and 9.1 ng/kg, respectively

Detection Limits

The detection limit goal of 1.0 ng/kg was met for all of the dioxin congeners. Some of the furans were found slightly higher than the target goal of 1.0 ng/kg.

Surrogate Internal Standards

The criteria of one internal surrogate standard per sample was met. Most surrogate recoveries were within the 40% to 120% range required in the QA Plan.

Matrix Spike/Matrix Spike Duplicate

The criteria of one matrix spike/matrix spike duplicate (MS/MSD) per 10 samples was met. The 40% to 120% criteria for spike recovery was met for all the dioxin and furan congeners with the exception of 2378-TCDD and OCDF, which had percent recoveries ranging from 123% to 127%. The calculated relative percent differences (RPDs) between MS/MSD were within the QA limit of ≤30%, indicating excellent precision of the measurement.

Replication

The criteria of one duplicate analysis per 10 samples was met. One calculated RPD for OCDD was outside of the QA limit of ≤30%.

SRMs

QA limits specify that the observed value for an SRM must be within 30% of the certified value. Since there is not a certified reference material for dioxins in tissues, a matrix reference material with consensus values was used. All of the dioxin and furan congener values were within the QA limit of 30% of the concensus value and indicate excellent analytical accuracy.

QA/QC SUMMARY

Project:	Winyah Bay
Parameter:	PAHs
Laboratory:	Battelle Ocean Sciences (BOS)
Matrix:	*N. virens* Tissues
Holding Times	Tissues samples were to sent BOS on October 15,1992, extracted on October 21, 1992, and analyzed on October 28 and 29, 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 criteria of 1 blank per 20 samples was met. 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 criteria of one surrogate standard per sample was met. Three surrogate standards were evaluated: d8 naphthalene, d10 acenapthalene, and d12 benzo(a)pyrene. Surrogate recoveries were within the QA goals of 40% to 120%.
Matrix Spike/Matrix Spike Duplicate	The criteria of one matrix spike/matrix spike duplicate (MS/MSD) per 20 samples was met. The 40% to 120% criteria for spike recovery was met for the LPAH and the HPAHs. The relative percent difference (RPD) between MS and MSD were all less than 11%: well within the QA limit of ≤30%.
Replication	The criteria of one duplicate analysis per 10 samples was met. The QA limit for RPDs is ≤30%. Fourteen out of a possible 17 RPDs exceeded the RPD limit of ≤30%.
SRMs	QA limits specify that the observed value for an SRM must be within 30% of the certified value. All of the SRM values for LPAHs and HPAHs were within 30% of the certified value.

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

Sediment Treatment	Replicate	Percent Dry Weight	*N. virens* PAHs (µg/kg wet weight) Total LPAH	Total HPAH	Total PAH
IH-2,IH-3 Comp	1	13.80	4	1	5
IH-2,IH-3 Comp	2	14.62	5	1	6
IH-2,IH-3 Comp	3	12.57	4	3	7
IH-2,IH-3 Comp Replicate 1	4	12.51	8	2	10
IH-2,IH-3 Comp Replicate 2	4	12.74	5	1	6
IH-2,IH-3 Comp	5	14.95	8	1	9
IH-Ref 2	1	13.66	8	1	9
IH-Ref 2	2	13.80	6	1	7
IH-Ref 2 Replicate 1	3	15.13	7	1	8
IH-Ref 2 Replicate 2	3	14.08	10	1	11
IH-Ref 2	4	14.24	6	1	7
IH-Ref 2	5	12.85	3	1	4
N. virens Background	1	17.70	9	26	35
N. virens Background	2	18.13	7	15	22
N. virens Background	3	13.53	5	19	24
N. virens Background	4	16.80	7	18	25
N. virens Background	5	17.14	5	13	18

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

Sediment Treatment	Replicate	Percent Dry Weight	*N. virens* LPAHs (µg/kg wet weight) Naphthalene	2-methylnaphthalene	1-methylnaphthalene	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
IH-2,IH-3 Comp	1	13.60	1.32 J[b]	0.63 J	0.73	1.33 U[c]	0.59 J	0.22 J	0.53 J	0.59 U
IH-2,IH-3 Comp	2	14.62	1.40	0.67	0.91	0.11 J	0.83	0.35 J	0.86	0.58 U
IH-2,IH-3 Comp	3	12.57	1.29 J	0.54 J	0.83	0.08 J	0.70 J	0.21 J	0.68	0.06 J
IH-2,IH-3 Comp Replicate 1	4	12.51	2.46 J	1.33 J	1.47 J	3.93 U	1.11 J	0.52 J	1.33 J	1.74 U
IH-2,IH-3 Comp Replicate 2	4	12.74	1.89 J	0.87 J	0.90 J	3.95 U	0.66 J	0.23 J	0.62 J	1.74 U
IH-2,IH-3 Comp	5	14.95	2.45 J	1.24 J	1.16 J	3.96 U	1.12 J	0.53 J	1.46 J	1.75 U
IH-Ref 2	1	13.66	2.82	1.31	1.68	0.21 J	0.98	0.45 J	0.88	0.75 U
IH-Ref 2	2	13.80	1.76	0.84	1.11	0.13 J	1.01	0.41 J	0.84	0.59 U
IH-Ref 2 Replicate 1	3	15.13	2.50 J	1.14 J	1.15 J	3.90 U	0.85 J	0.31 J	0.82 J	1.72 U
IH-Ref 2 Replicate 2	3	14.08	2.78 J	1.65 J	1.58 J	0.15 J	1.40 J	0.58 J	1.48 J	1.73 U
IH-Ref 2	4	14.24	1.60	0.78	1.06	0.09 J	0.95	0.38 J	0.94	0.58 U
IH-Ref 2	5	12.85	0.94 J	0.40 J	0.51 J	0.07 J	0.44 J	0.13 J	0.36 J	0.04 J
N. virens Background	1	17.70	1.44 J	1.06 J	1.04 J	0.86 J	1.52 J	0.51 J	1.97	0.55 J
N. virens Background	2	18.13	1.64 J	1.05 J	0.94 J	0.65 J	1.03 J	0.31 J	1.12 J	0.36 J
N. virens Background	3	13.53	1.09 J	0.63 J	0.63 J	0.40 J	0.66 J	0.19 J	0.81 J	0.20 J
N. virens Background	4	16.80	1.39 J	0.89 J	0.87 J	0.60 J	0.98 J	0.33 J	1.23 J	0.33 J
N. virens Background	5	17.14	1.07 J	0.67 J	0.66 J	0.52 J	0.77 J	0.28 J	0.84	0.33 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.3. High Molecular Weight Polynuclear Aromatic Hydrocarbons in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Percent Dry Weight	*N. virens* HPAHs (µg/kg wet weight)									
			Fluoranthene	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
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
IH-2,IH-3 Comp	1	13.60	0.43 J[b]	0.29 J	0.07 J	0.11 J	1.00 U[c]	0.84 U	0.87 U	1.05 U	0.71 U	1.42 U
IH-2,IH-3 Comp	2	14.62	0.55 J	0.32 J	0.98 U	0.11 J	1.00 U	0.83 U	0.87 U	1.04 U	0.71 U	1.41 U
IH-2,IH-3 Comp	3	12.57	1.46	0.90	0.30 J	0.31 J	0.12 J	0.10 J	0.03 J	1.05 U	0.71 U	1.42 U
IH-2,IH-3 Comp Replicate 1	4	12.51	0.86 J	0.50 J	2.91 U	0.15 J	2.97 U	2.48 U	2.58 U	3.10 U	2.11 U	4.20 U
IH-2,IH-3 Comp Replicate 2	4	12.74	0.47 J	0.33 J	2.92 U	0.10 J	2.98 U	2.48 U	2.59 U	3.11 U	2.12 U	4.22 U
IH-2,IH-3 Comp	5	14.95	0.71 J	0.44 J	2.93 U	0.12 J	2.99 U	2.49 U	2.60 U	3.12 U	2.12 U	4.23 U
IH-Ref 2	1	13.66	0.46 J	0.49 J	1.25 U	0.10 J	1.28 U	1.07 U	1.11 U	1.34 U	0.91 U	1.81 U
IH-Ref 2	2	13.80	0.46 J	0.22 J	0.03 J	0.06 J	1.00 U	0.83 U	0.87 U	1.04 U	0.71 U	1.42 U
IH-Ref 2 Replicate 1	3	15.13	0.49 J	0.28 J	2.88 U	0.08 J	2.94 U	2.45 U	2.56 U	3.07 U	2.09 U	4.16 U
IH-Ref 2 Replicate 2	3	14.08	0.75 J	0.38 J	2.89 U	2.02 U	2.95 U	2.46 U	2.56 U	3.08 U	2.10 U	4.18 U
IH-Ref 2	4	14.24	0.62	0.30 J	0.02 J	0.10 J	0.99 U	0.83 U	0.86 U	1.03 U	0.70 U	1.40 U
IH-Ref 2	5	12.85	0.34 J	0.17 J	0.96 U	0.05 J	0.98 U	0.82 U	0.85 U	1.02 U	0.70 U	1.39 U
N. virens Background	1	17.70	11.61	9.16	0.66 J	3.58	0.34 J	0.36 J	0.21 J	2.46 U	1.67 U	3.34 U
N. virens Background	2	18.13	6.14	5.48	0.40 J	2.51	0.20 J	0.24 J	0.12 J	2.60 U	1.77 U	3.53 U
N. virens Background	3	13.53	7.73	6.51	0.34 J	2.62	0.51 J	0.60 J	0.27 J	1.56 U	1.06 U	0.35 J
N. virens Background	4	16.80	7.23	5.85	0.60 J	2.92	0.60 J	0.49 J	0.23 J	2.33 U	1.59 U	3.16 U
N. virens Background	5	17.14	5.10	4.75	0.27 J	1.95	0.36 J	0.40 J	0.16 J	1.19 U	0.81 U	1.61 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 assoicated value.

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

Sediment Treatment	Replicate	Percent Dry Weight	*N. virens* PAHs (µg/kg dry weight) Total LPAH	Total HPAH	Total PAH
IH-2,IH-3 Comp	1	13.60	30	7	37
IH-2,IH-3 Comp	2	14.62	35	7	42
IH-2,IH-3 Comp	3	12.57	35	26	61
IH-2,IH-3 Comp Replicate 1	4	12.51	66	12	78
IH-2,IH-3 Comp Replicate 2	4	12.74	41	7	48
IH-2,IH-3 Comp	5	14.95	53	8	61
IH-Ref 2	1	13.66	61	8	69
IH-Ref 2	2	13.80	44	6	50
IH-Ref 2 Replicate 1	3	15.13	45	6	51
IH-Ref 2 Replicate 2	3	14.08	68	8	76
IH-Ref 2	4	14.24	41	7	48
IH-Ref 2	5	12.85	22	4	26
N. virens Background	1	17.70	51	146	197
N. virens Background	2	18.13	39	83	122
N. virens Background	3	13.53	34	140	174
N. virens Background	4	16.80	39	107	146
N. virens Background	5	17.14	30	76	106

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

Sediment Treatment	Replicate	Percent Dry Weight	*N. virens* LPAHs (µg/kg dry weight)							
			Naphthalene	2-methyl-naphthalene	1-methyl-naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
IH-2,IH-3 Comp	1	13.60	9.71 J[a]	4.63 J	5.37	9.78 U[b]	4.34 J	1.62 J	3.90 J	4.34 U
IH-2,IH-3 Comp	2	14.62	9.58	4.58	6.22	0.75 J	5.68	2.39 J	5.88	3.97 U
IH-2,IH-3 Comp	3	12.57	10.26 J	4.30 J	6.60	0.64 J	5.57 J	1.67 J	5.41	0.48 J
IH-2,IH-3 Comp Replicate 1	4	12.51	19.66 J	10.63 J	11.75 J	31.41 U	8.87 J	4.16 J	10.63 J	13.91 U
IH-2,IH-3 Comp Replicate 2	4	12.74	14.84 J	6.83 J	7.07 J	31.01 U	5.18 J	1.81 J	4.87 J	13.66 U
IH-2,IH-3 Comp	5	14.95	16.39 J	8.29 J	7.76 J	26.49 U	7.49 J	3.54 J	9.77 J	11.70 U
IH-Ref 2	1	13.66	20.65	9.59	12.30	1.54 J	7.18	3.30 J	6.44	5.49 U
IH-Ref 2	2	13.80	12.76	6.09	8.05	0.94 J	7.32	2.97 J	6.09	4.28 U
IH-Ref 2 Replicate 1	3	15.13	16.52 J	7.53 J	7.60 J	25.78 U	5.62 J	2.05 J	5.42 J	11.37 U
IH-Ref 2 Replicate 2	3	14.08	19.74 J	11.72 J	11.22 J	1.07 J	9.94 J	4.12 J	10.51 J	12.29 U
IH-Ref 2	4	14.24	11.23	5.48	7.44	0.63 J	6.67	2.67 J	6.60	4.07 U
IH-Ref 2	5	12.85	7.32 J	3.11 J	3.97 J	0.54 J	3.43 J	1.01 J	2.80 J	0.31 J
N. virens Background	1	17.70	8.13 J	5.99 J	5.87 J	4.86 J	8.59 J	2.88 J	11.13	3.11 J
N. virens Background	2	18.13	9.04 J	5.79 J	5.18 J	3.58 J	5.68 J	1.71 J	6.18 J	1.99 J
N. virens Background	3	13.53	8.06 J	4.66 J	4.66 J	2.96 J	4.88 J	1.40 J	5.99 J	1.48 J
N. virens Background	4	16.80	8.27 J	5.30 J	5.18 J	3.57 J	5.83 J	1.96 J	7.32 J	1.96 J
N. virens Background	5	17.14	6.24 J	3.91 J	3.85 J	3.03 J	4.49 J	1.63 J	4.90	1.92 J

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

Sediment Treatment	Replicate	Percent Dry Weight	*N. virens* (HPAHs (µg/kg dry weight) Fluoranthene	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
IH-2,IH-3 Comp	1	13.60	3.16 J[a]	2.13 J	0.51 J	0.81 J	7.36 U[b]	6.18 U	6.40 U	7.72 U	5.22 U	10.45 U
IH-2,IH-3 Comp	2	14.62	3.76 J	2.19 J	6.70 U	0.75 J	6.84 U	5.68 U	5.95 U	7.11 U	4.86 U	9.64 U
IH-2,IH-3 Comp	3	12.57	11.61	7.16	2.39 J	2.47 J	0.95 J	0.80 J	0.24 J	8.35 U	5.65 U	11.30 U
IH-2,IH-3 Comp Replicate 1	4	12.51	6.87 J	4.00 J	23.26 U	1.20 J	23.74 U	19.82 U	20.62 U	24.78 U	16.87 U	33.57 U
IH-2,IH-3 Comp Replicate 2	4	12.74	3.69 J	2.59 J	22.92 U	0.79 J	23.39 U	19.47 U	20.33 U	24.42 U	16.64 U	33.13 U
IH-2,IH-3 Comp	5	14.95	4.75 J	2.94 J	19.60 U	0.80 J	20.00 U	16.65 U	17.39 U	20.87 U	14.18 U	28.29 U
IH-Ref 2	1	13.66	3.37 J	3.59 J	9.15 U	0.73 J	9.37 U	7.83 U	8.13 U	9.81 U	6.66 U	13.25 U
IH-Ref 2	2	13.80	3.33 J	1.59 J	0.22 J	0.43 J	7.25 U	6.02 U	6.31 U	7.54 U	5.15 U	10.29 U
IH-Ref 2 Replicate 1	3	15.13	3.24 J	1.85 J	19.04 U	0.53 J	19.43 U	16.19 U	16.92 U	20.29 U	13.81 U	27.50 U
IH-Ref 2 Replicate 2	3	14.08	5.33 J	2.70 J	20.53 U	14.35 U	20.95 U	17.47 U	18.18 U	21.88 U	14.91 U	29.69 U
IH-Ref 2	4	14.24	4.35	2.11 J	0.14 J	0.70 J	6.95 U	5.83 U	6.04 U	7.23 U	4.91 U	9.83 U
IH-Ref 2	5	12.85	2.65 J	1.32 J	7.47 U	0.39 J	7.63 U	6.38 U	6.62 U	7.94 U	5.45 U	10.82 U
N. virens Background	1	17.70	65.58	51.74	3.73 J	20.22	1.92 J	2.03 J	1.19 J	13.90 U	9.43 U	18.87 U
N. virens Background	2	18.13	33.86	30.22	2.21 J	13.84	1.10 J	1.32 J	0.66 J	14.34 U	9.76 U	19.47 U
N. virens Background	3	13.53	57.13	48.11	2.51 J	19.36	3.77 J	4.43 J	2.00 J	11.53 U	7.83 U	2.59 J
N. virens Background	4	16.80	43.03	34.81	3.57 J	17.38	3.57 J	2.92 J	1.37 J	13.87 U	9.46 U	18.81 U
N. virens Background	5	17.14	29.75	27.71	1.57 J	11.37	2.10 J	2.33 J	0.93 J	6.94 U	4.72 U	9.39 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 L.7. Quality Control Summary for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs), Wet Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	*N. virens* LPAHs (µg/kg wet weight) Naphthalene	2-methylnaphthalene	1-methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Method Blank									
Blank 1		0.77 J[a]	0.33 J	0.19 J	1.99 U[b]	1.08 U	1.16 U	0.23 J	0.88 U
Matrix Spike									
IH-2,IH-3 Comp	5	2.45 J	1.24 J	1.16 J	3.96 U	1.12 J	0.53 J	1.46 J	1.75 U
IH-2,IH-3 Comp MS	5	147.45	ND[c]	ND	161.04	150.31	151.87	156.52	151.04
Concentration Recovered		145.00	NA[d]	NA	161.04	149.19	151.34	155.06	151.04
Amount Spiked		146.18	NS[e]	NS	146.18	146.18	146.18	146.18	146.18
Percent Recovery		99%	NA	NA	110%	102%	104%	106%	103%
IH-2,IH-3 Comp	5	2.45 J	1.24 J	1.16 J	3.96 U	1.12 J	0.53 J	1.46 J	1.75 U
IH-2,IH-3 Comp MSD	5	142.09	ND	ND	156.38	145.73	146.82	147.94	147.87
Concentration Recovered		139.64	NA	NA	156.38	144.61	146.29	146.48	147.87
Amount Spiked		143.23	NS	NS	143.23	143.23	143.23	143.23	143.23
Percent Recovery		97%	NA	NA	109%	101%	102%	102%	103%
RPD		2%	NA	NA	1%	1%	1%	4%	0%
I-Stat		0.01	NA	NA	0.00	0.01	0.01	0.02	0.00
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	4.84	0.91 J
Analytical Duplicates									
IH-Ref 2 Replicate 1	3	2.50 J	1.14 J	1.15 J	3.90 U	0.85 J	0.31 J	0.82 J	1.72 U
IH-Ref 2 Replicate 2	3	2.78 J	1.65 J	1.58 J	0.15 J	1.40 J	0.58 J	1.48 J	1.73 U
RPD		11%	37%[g]	32%[g]	NA	49%[g]	61%[g]	57%[g]	NA
I-Stat		0.05	0.18	0.16	NA	0.24	0.30	0.29	NA

TABLE L.7. (contd)

Sediment Treatment	Replicate	*N. virens* LPAHs (µg/kg wet weight) Naptha-lene	2-methyl-naptha-lene	1-methyl-naphtha-lene	Acenaph-thylene	Acenaph-thene	Fluorene	Phenan-threne	Anthra-cene
IH-2,IH-3 Comp Replicate 1	4	2.46 J	1.33 J	1.47 J	3.93 U	1.11 J	0.52 J	1.33 J	1.74 U
IH-2,IH-3 Comp Replicate 2	4	1.89 J	0.87 J	0.90 J	3.95 U	0.66 J	0.23 J	0.62 J	1.74 U
RPD		26%	42%(g)	48%(g)	NA	51%(g)	77%(g)	73%(g)	NA
I-Stat		0.13	0.21	0.24	NA	0.25	0.39	0.36	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) ND No data.
(d) NA Not applicable.
(e) NS Not spiked.
(f) NC Not certified.
(g) Value exceeds relative precision range ≤30%.

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

Sediment Treatment	Replicate	*N. virens* HPAHs (µg/kg wet weight) Fluoranthene	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
Method Blank											
Blank 1		0.22 J[a]	0.7 J	1.47 U[b]	0.05 J	1.5 U	1.25 U	1.31 U	1.57 U	1.07 U	2.13 U
Matrix Spike											
IH-2,IH-3 Comp	5	0.71 J	0.44 J	2.93 U	0.12 J	2.99 U	2.49 U	2.60 U	3.12 U	2.12 U	4.23 U
IH-2,IH-3 Comp MS	5	158.65	155.79	155.26	151.81	141.24	157.20	142.48	153.83	152.76	128.91
Concentration Recovered		157.94	155.35	155.26	151.69	141.24	157.20	142.48	153.83	152.76	128.91
Amount Spiked		146.18	146.18	146.18	146.18	146.18	146.18	146.18	146.18	146.18	146.18
Percent Recovery		108%	106%	106%	104%	97%	108%	97%	105%	104%	88%
IH-2,IH-3 Comp	5	0.71 J	0.44 J	2.93 U	0.12 J	2.99 U	2.49 U	2.60 U	3.12 U	2.12 U	4.23 U
IH-2,IH-3 Comp MSD	5	153.47	149.77	146.26	143.94	136.09	147.76	133.16	137.34	134.54	117.24
Concentration Recovered		152.76	149.33	146.26	143.82	136.09	147.76	133.16	137.34	134.54	117.24
Amount Spiked		143.23	143.23	143.23	143.23	143.23	143.23	143.23	143.23	143.23	143.23
Percent Recovery		107%	104%	102%	100%	95%	103%	93%	96%	94%	82%
RPD		1%	2%	4%	3%	2%	4%	5%	9%	11%	7%
I-Stat		0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.05	0.05	0.04
Standard Reference Material											
Certified Value		33.6 ±5.8	34.1 ±3.7	NC[c]	NC	6.5 ±1.2	NC	2.29 ±0.47	1.8 ±0.33	NC	1.8 ±0.28
NIST 1974		33.78	33.36	NA[d]	NA	6.48	NA	1.98	2.04 J	NA	2.46 J
Analytical Duplicates											
IH-Ref 2 Replicate 1	3	0.49 J	0.28 J	2.88 U	0.08 J	2.94 U	2.45 U	2.56 U	3.07 U	2.09 U	4.16 U
IH-Ref 2 Replicate 2	3	0.75 J	0.38 J	2.89 U	2.02 U	2.95 U	2.46 U	2.56 U	3.08 U	2.10 U	4.18 U
RPD		42%[e]	30%	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat		0.21	0.15	NA	NA	NA	NA	NA	NA	NA	NA

TABLE L.8. (contd)

Sediment Treatment	Replicate	*N. virens* HPAHs (µg/kg wet weight) Fluoranthene	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
IH-2,IH-3 Comp Replicate 1	4	0.86 J	0.50 J	2.91 U	0.15 J	2.97 U	2.48 U	2.58 U	3.10 U	2.11 U	4.20 U
IH-2,IH-3 Comp Replicate 2	4	0.47 J	0.33 J	2.92 U	0.10 J	2.98 U	2.48 U	2.59 U	3.11 U	2.12 U	4.22 U
RPD		59%(e)	41%(e)	NA	40%(e)	NA	NA	NA	NA	NA	NA
I-Stat		0.29	0.20	NA	0.20	NA	NA	NA	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) NC Not certified.
(d) NA Not applicable.
(e) Value exceeds relative precision range ≤30%.

TABLE L.9. Surrogate Recoveries for Polynuclear Aromatic Hydrocarbons, Wet Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Percent Dry Weight	Surrogate Percent Recoveries: Naptha-lene d8	Acenaph-thene d10	Benzo(a) Pyrene d12
IH-2,IH-3 Comp	1	13.60	53	46	49
IH-2,IH-3 Comp	2	14.62	66	59	62
IH-2,IH-3 Comp	3	12.57	71	65	69
IH-2,IH-3 Comp Replicate 1	4	12.51	65	59	62
IH-2,IH-3 Comp Replicate 2	4	12.74	70	64	68
IH-2,IH-3 Comp	5	14.95	69	62	64
IH-Ref 2	1	13.66	62	61	66
IH-Ref 2	2	13.80	71	64	68
IH-Ref 2 Replicate 1	3	15.13	68	61	65
IH-Ref 2 Replicate 2	3	14.08	72	66	71
IH-Ref 2	4	14.24	60	54	60
IH-Ref 2	5	12.85	58	53	57
N. virens Background	1	17.70	68	64	68
N. virens Background	2	18.13	68	64	68
N. virens Background	3	13.53	82	72	71
N. virens Background	4	16.80	75	65	66
N. virens Background	5	17.14	72	61	63
QC Data					
Method Blank					
Blank 1			74	60	65
Matrix Spike					
IH-2,IH-3 Comp	5	14.95	69	62	64
IH-2,IH-3 Comp MS	5	14.95	76	64	69
IH-2,IH-3 Comp	5	14.95	69	62	64
IH-2,IH-3 Comp MSD	5	14.95	79	69	72
Analytical Duplicates					
IH-Ref 2 Replicate 1	3	15.13	68	61	65
IH-Ref 2 Replicate 2	3	14.08	72	66	71
IH-2,IH-3 Comp Replicate 1	4	12.51	65	59	62
IH-2,IH-3 Comp Replicate 2	4	12.74	70	64	68

TABLE L.10. Butyltins, Wet and Dry Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Surrogate Percent Recoveries: Tri-proplytin	Surrogate Percent Recoveries: Tri-pentyltin	*N. virens* Butyltins (µg/kg wet weight): Tri-butyltin	Di-butyltin	Mono-butyltin	Percent Dry Weight	*N. virens* Butyltins (µg/kg dry weight): Tri-butyltin	Di-butyltin	Mono-butyltin
Target DL[a]				10.0	10.0	10.0				
Achieved DL				≤10.0	≤10.0	≤10.0				
IH-2,IH-3 Comp	1	69	59	1.08 J[b]	1.93 U[c]	2.41 U	13.60	7.94 J	14.20 U	17.73 U
IH-2,IH-3 Comp	2	69	42	1.28 J	2.07 U	2.59 U	14.62	8.76 J	14.16 U	17.72 U
IH-2,IH-3 Comp	3	90	50	2.04 J	1.88 U	2.35 U	12.57	16.23 J	14.96 U	18.70 U
IH-2,IH-3 Comp Replicate 2	4	88	45	1.73 J	2.40 U	3.00 U	12.74	13.58 J	18.84 U	23.55 U
IH-2,IH-3 Comp Replicate 1	4	74	50	3.41 J	4.39 U	5.50 U	12.51	27.26 J	35.09 U	43.96 U
IH-2,IH-3 Comp	5	57	49	12.05 U	4.22 U	5.29 U	14.95	80.60 U	28.23 U	35.38 U
IH-Ref 2	1	73	52	1.88 J	1.79 U	2.25 U	13.66	13.77 J	13.11 U	16.48 U
IH-Ref 2	2	106	62	1.42 J	1.92 U	2.41 U	13.80	10.29 J	13.92 U	17.47 U
IH-Ref 2 Replicate 1	3	65	53	10.59 U	3.71 U	4.65 U	15.13	69.99 U	24.52 U	30.73 U
IH-Ref 2 Replicate 2	3	63	42	6.98 U	2.45 U	3.06 U	14.08	49.57 U	17.40 U	21.73 U
IH-Ref 2	4	91	55	2.15 J	2.15 U	2.70 U	14.24	15.09 J	15.09 U	18.96 U
IH-Ref 2	5	62	50	0.77 J	1.59 U	1.99 U	12.85	5.99 J	12.38 U	15.49 U
N. virens Background	1	82	55	1.35 J	1.43 U	1.79 U	17.70	7.63 J	8.08 U	10.11 U
N. virens Background	2	84	49	0.92 J	1.53 U	1.92 U	18.13	5.07 J	8.44 U	10.59 U
N. virens Background	3	70	48	1.08 J	2.47 U	3.09 U	13.53	7.98 J	18.25 U	22.84 U
N. virens Background	4	87	58	2.55 J	2.61 U	3.27 U	16.80	15.17 J	15.53 U	19.46 U
N. virens Background	5	127[d]	48	3.18 J	1.90 U	2.38 U	17.14	18.55 J	11.08 U	13.88 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.
(d) Recovery outside quality control range (40%-120%).

TABLE L.11. Quality Control Summary for Butyltins, Wet Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Percent Surrogate Recoveries: Tri-proplytin	Tri-pentyltin	*N. virens* Butyltins (µg/kg wet weight): Tri-butyltin	Di-butyltin	Mono-butyltin
Method Blank						
Blank		46	62	0.65 J[a]	2.14 U[b]	2.68 U
Matrix Spike						
IH-2,IH-3 Comp	5	57	49	12.05 U	4.22 U	5.29 U
IH-2,IH-3 Comp MS	5			67.37	50.81	14.87
Concentration Recovered				67.37	50.81	14.87
Amount Spiked				69.705	70.43	58.00
Percent Recovery		61	57	97%	72%	26%[c]
IH-2,IH-3 Comp	5	57	49	12.05 U	4.22 U	5.29 U
IH-2,IH-3 Comp MSD	5			75.76	52.26	15.30
Concentration Recovered				75.76	52.26	15.30
Amount Spiked				65.596	66.28	54.58
Percent Recovery		66	64	115%	79%	28%[c]
RPD				18%	9%	9%
I-Stat				0.09	0.04	0.04
Analytical Duplicates						
IH-Ref 2 Replicate 1	3	65	53	10.59 U	3.71 U	4.65 U
IH-Ref 2 Replicate 2	3	63	42	6.98 U	2.45 U	3.06 U
RPD				NA[d]	NA	NA
I-Stat				NA	NA	NA
IH-2,IH-3 Comp Replicate 1	4	74	50	3.41 J	4.39 U	5.50 U
IH-2,IH-3 Comp Replicate 2	4	88	45	1.73 J	2.40 U	3.00 U
RPD				65%[e]	NA	NA
I-Stat				0.33	NA	NA

(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) Recovery outside quality control range (40%-120%).
(d) NA Not applicable.
(e) Value exceeds relative precision range ≤30%.

TABLE L.12. Total Dioxins and Furans, Wet Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg wet weight) Total TCDD	Total PeCDD	Total HxCDD	Total HpCDD	Total TCDF	Total PeCDF	Total HxCDF	Total HpCDF
Target DL[a]				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL				≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0
IH-2,IH-3 Comp	1	1	13.595[b]	ND[c]	ND	0.48	2.05	0.26	ND	ND	ND
IH-2,IH-3 Comp	2	1	14.620[b]	ND	ND	ND	ND	ND	ND	ND	ND
IH-2,IH-3 Comp	3	1	12.570[b]	0.20	ND	0.38	1.77	0.98	0.10	ND	0.22
IH-2,IH-3 Comp	4	2	12.510[b]	ND	ND	0.46	1.69	0.26	ND	ND	ND
IH-2,IH-3 Comp	5	2	14.951[b]	ND	ND	ND	ND	3.24	ND	ND	ND
IH-Ref 1	1	1	13.728[d]	ND	ND	ND	1.43	ND	ND	ND	0.55
IH-Ref 1 Replicate 1	2	2	13.728[d]	ND	ND	1.06	2.21	0.41	ND	0.29	0.22
IH-Ref 1 Replicate 2	2	2	13.728[d]	ND	ND	ND	ND	0.17	ND	ND	ND
IH-Ref 1	3	1	13.728[d]	ND	ND	0.85	2.80	ND	ND	ND	0.48
IH-Ref 1	4	1	13.728[d]	ND	ND	ND	1.17	0.13	ND	ND	0.39
IH-Ref 1	5	1	13.728[d]	ND	ND	0.51	1.80	ND	ND	ND	0.5
IH-Ref 2	1	1	13.657[b]	ND	ND	0.78	2.02	0.21	ND	ND	0.55
IH-Ref 2	2	1	13.797[b]	ND	ND	ND	1.67	0.33	ND	ND	0.67
IH-Ref 2 Replicate 1	3	1	15.130[b]	ND	ND	ND	2.14[e]	ND	ND	ND	0.36
IH-Ref 2 Replicate 2	3	1	14.080[b]	ND	ND	0.41	2.72	0.24	ND	ND	0.78
IH-Ref 2	4	2	14.244[b]	ND	ND	0.79	1.75	0.42	0.18	ND	0.13
IH-Ref 2	5	1	12.845[b]	ND	ND	0.47	0.94	0.27	ND	ND	ND
N. virens Background	1	1	17.703[b]	0.74	ND	4.34	10.77	4.49	4.31	ND	ND
N. virens Background	2	1	18.134[b]	ND	ND	ND	6.72	5.03	1.05	ND	ND
N. virens Background	3	1	13.531[b]	0.83	ND	3.18	10.12	9.94	4.35	2.48	0.65
N. virens Background	4	2	16.804[b]	ND	ND	14.0	17.30	6.66	3.18	ND	ND
N. virens Background	5	2	17.144[b]	ND	0.32[e]	5.42	6.01	3.38	2.04	0.49	ND
QC Data											
Method Blank											
Blank		1		ND	ND	ND	ND	ND	ND	ND	ND

TABLE L.12. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg wet weight) Total TCDD	Total PeCDD	Total HxCDD	Total HpCDD	Total TCDF	Total PeCDF	Total HxCDF	Total HpCDF
Analytical Duplicates											
IH-Ref 2 Replicate 1	3	1	15.130[b]	ND	ND	ND	2.14	ND	ND	ND	0.36
IH-Ref 2 Replicate 2	3	1	14.080[b]	ND	ND	0.41	2.72	0.24	ND	ND	0.78
RPD				NA[f]	NA	NA	24%	NA	NA	NA	74%[g]
I-Stat				NA	NA	NA	0.12	NA	NA	NA	0.37
IH-Ref 1 Replicate 1	2	2	13.728[d]	ND	ND	1.06	2.21	0.41	ND	0.29	0.22
IH-Ref 1 Replicate 2	2	2	13.728[d]	ND	ND	ND	ND	0.17	ND	ND	ND
RPD				NA	NA	NA	NA	83%[g]	NA	NA	NA
I-Stat				NA	NA	NA	NA	0.41	NA	NA	NA

(a) DL Detection limit.
(b) PAH percent dry weight.
(c) ND No data.
(d) Average percent dry weight based on PAH percent dry weight.
(e) Mass ratio out of limits.
(f) NA Not applicable.
(g) Value exceeds relative precision range ≤30%.

TABLE L.13. Dioxins, Wet Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg wet weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
Target DL[a]				1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL				≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0
IH-2,IH-3 Comp	1	1	13.595[b]	0.30 U[c]	0.2 U	0.2 U	0.3 U	0.2 U	0.82	12.96
IH-2,IH-3 Comp	2	1	14.620[b]	0.50 U	0.6 U	0.5 U	0.6 U	0.5 U	2.10 U	12.66
IH-2,IH-3 Comp	3	1	12.570[b]	0.40 U	0.2 U	0.1 U	0.2 U	0.1 U	0.75[d]	13.43
IH-2,IH-3 Comp	4	2	12.510[b]	0.30 U	0.1 U	0.1 U	0.2 U	0.2 U	0.62[d]	11.18
IH-2,IH-3 Comp	5	2	14.951[b]	2.10 U	3.8 U	3.4 U	1.1 U	2.5 U	6.90 U	91.42
IH-Ref 1	1	1	13.728[e]	0.40 U	0.4 U	0.9 U	1.0 U	1.5 U	2.50 U	8.40[d]
IH-Ref 1 Replicate 1	2	2	13.728[e]	0.30 U	0.2 U	0.1 U	0.2 U	0.2 U	0.78	8.82
IH-Ref 1 Replicate 2	2	2	13.728[e]	0.20 U	0.2 U	0.2 U	0.2 U	0.2 U	2.40 U	14.74
IH-Ref 1	3	1	13.728[e]	0.20 U	0.2 U	0.3 U	0.3 U	0.3 U	1.01	12.40
IH-Ref 1	4	1	13.728[e]	0.40 U	0.2 U	0.1 U	0.2 U	0.2 U	1.60 U	9.41
IH-Ref 1	5	1	13.728[e]	0.30 U	0.2 U	0.3 U	0.1 U	0.3 U	0.57	9.48
IH-Ref 2	1	1	13.657[b]	0.50 U	0.3 U	0.2 U	0.2 U	0.3 U	0.78	17.77
IH-Ref 2	2	1	13.797[b]	0.30 U	0.3 U	0.2 U	0.2 U	0.2 U	0.47	10.35
IH-Ref 2 Replicate 1	3	1	15.130[b]	0.30 U	0.2 U	0.2 U	0.2 U	0.3 U	0.89	11.19
IH-Ref 2 Replicate 2	3	1	14.080[b]	0.30 U	0.2 U	0.2 U	0.2 U	0.4 U	1.14	12.03
IH-Ref 2	4	2	14.244[b]	0.20 U	0.1 U	0.1 U	0.1 U	0.1 U	0.58	7.82
IH-Ref 2	5	1	12.845[b]	0.40 U	0.2 U	0.2 U	0.1 U	0.2 U	1.40 U	7.59
N. virens Background	1	1	17.703[b]	0.22	0.5 U	0.4 U	0.8 U	0.4 U	0.89	4.71
N. virens Background	2	1	18.134[b]	0.60 U	0.4 U	0.3 U	0.4 U	0.3 U	0.73	4.50
N. virens Background	3	1	13.531[b]	0.80 U	0.8 U	0.4 U	1.7 U	0.5 U	1.06	5.52
N. virens Background	4	2	16.804[b]	0.40 U	0.5 U	0.2 U	0.7 U	0.2 U	3.20 U	8.53
N. virens Background	5	2	17.144[b]	0.30 U	0.3 U	0.2 U	0.4 U	0.2 U	0.53	4.86

(a) DL Detection limit.
(b) PAH percent dry weight.
(c) U Analyte was not present above the level of associated value.
(d) Mass ratio out of limits.
(e) Average percent dry weight based on PAH percent dry weight.

TABLE L.14. Furans, Wet Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg wet weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
Target DL[a]				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Achieved DL				≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0
IH-2,IH-3 Comp	1	1	13.595[b]	0.26	0.1 U[c]	0.2 U[d]	0.1 U	0.2 U	0.50 U	0.1 U	0.70 U	0.3 U	0.90 U[d]
IH-2,IH-3 Comp	2	1	14.620[b]	0.50 U	1.0 U	0.5 U	0.3 U	0.6 U	3.00 U	0.7 U	1.10 U	1.1 U	3.60 U
IH-2,IH-3 Comp	3	1	12.570[b]	0.25	0.1 U	0.1 U[d]	0.2 U	0.2 U	0.40 U	0.2 U	0.60 U	0.2 U	1.10 U[d]
IH-2,IH-3 Comp	4	2	12.510[b]	0.26	0.2 U	0.1 U	0.1 U	0.0 U	0.50 U	0.1 U	0.80 U	0.1 U	0.60 U[d]
IH-2,IH-3 Comp	5	2	14.951[b]	2.10 U	1.5 U	2.1 U	3.8 U	3.5 U	2.70 U	5.9 U	9.60 U	4.4 U	20.10 U
IH-Ref 1	1	1	13.728[e]	0.50 U	0.3 U	0.4 U	1.0 U	0.7 U	1.20 U	0.8 U	0.55	1.1 U	1.05
IH-Ref 1 Replicate 1	2	2	13.728[e]	0.50 U	0.1 U	0.2 U	0.2 U	0.2 U	0.29	0.1 U	0.90 U	0.1 U	0.60 U[d]
IH-Ref 1 Replicate 2	2	2	13.728[e]	0.17	0.2 U	0.2 U	0.3 U	0.3 U	0.60 U	0.4 U	1.10 U	0.4 U	2.00 U[d]
IH-Ref 1	3	1	13.728[e]	0.50 U	0.2 U	0.2 U	0.2 U	0.2 U	0.60 U	0.3 U	3.20 U	0.3 U	0.83
IH-Ref 1	4	1	13.728[e]	0.13	0.1 U	0.1 U[d]	0.1 U	0.1 U	0.40 U	0.3 U	0.70 U	0.1 U	1.52[d]
IH-Ref 1	5	1	13.728[e]	0.40 U	0.2 U	0.1 U	0.1 U	0.1 U	0.60 U	1.1 U	0.90 U	0.3 U	1.61
IH-Ref 2	1	1	13.657[b]	0.21	0.2 U	0.2 U[d]	0.2 U	0.2 U	0.40 U	0.1 U	0.80 U	0.1 U	2.61[d]
IH-Ref 2	2	1	13.797[b]	0.33	0.2 U	0.3 U	0.2 U	0.2 U	0.40 U	0.3 U	1.20 U	0.4 U	1.45[f]
IH-Ref 2 Replicate 1	3	1	15.130[b]	0.60 U	0.2 U	0.3 U	0.4 U	0.2 U	0.60 U	0.2 U	1.30 U	0.4 U	0.54
IH-Ref 2 Replicate 2	3	1	14.080[b]	0.24	0.3 U	0.3 U	0.4 U	0.3 U	0.80 U	0.3 U	1.70 U	0.3 U	0.69
IH-Ref 2	4	2	14.244[b]	0.70 U	0.1 U	0.1 U	0.1 U	0.1 U	0.50 U	0.1 U	0.50 U	0.1 U	0.17[d]
IH-Ref 2	5	1	12.845[b]	0.27	0.1 U	0.2 U[d]	0.1 U	0.2 U	0.50 U	0.2 U	1.10 U	0.1 U	0.80 U[d]
N. virens Background	1	1	17.703[b]	1.58[f]	0.6 U	0.7 U[d]	0.4 U	0.4 U	0.50 U	0.3 U	1.30 U	0.3 U	1.00 U[d]
N. virens Background	2	1	18.134[b]	1.17	0.5 U	0.5 U[d]	0.4 U	0.5 U	0.50 U	0.1 U	1.80 U	0.2 U	0.70 U[d]
N. virens Background	3	1	13.531[b]	2.28	0.4 U	0.4[d][f]	0.5 U	0.6 U	0.50 U	0.1 U	1.80 U	0.1 U	0.38 U[d]
N. virens Background	4	2	16.804[b]	1.54	0.4 U	0.7 U	0.4 U	0.2 U	0.60 U	0.5 U	1.70 U	0.4 U	12.10 U[d]
N. virens Background	5	2	17.144[b]	0.91	0.3 U	0.4 U	0.3 U	0.2 U	0.28	0.2 U	1.20 U	0.1 U	1.00 U[d]

(a) DL Detection limit.
(b) PAH percent dry weight.
(c) U Analyte was not present above the level of associated value.
(d) Calibration response factor at end of day out of limits.
(e) Average percent dry weight based on PAH percent dry weight.
(f) Mass ratio out of limits.

TABLE L.15. Total Dioxins and Furans, Dry Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg dry weight) Total TCDD	Total PeCDD	Total HxCDD	Total HpCDD	Total TCDF	Total PeCDF	Total HxCDF	Total HpCDF
IH-2,IH-3 Comp	1	1	13.595[a]	ND[b]	ND	3.5	15.1	1.9	ND	ND	ND
IH-2,IH-3 Comp	2	1	14.620[a]	ND	ND	ND	ND	ND	ND	ND	ND
IH-2,IH-3 Comp	3	1	12.570[a]	1.6	ND	3.0	14.1	7.8	0.8	ND	1.8
IH-2,IH-3 Comp	4	2	12.510[a]	ND	ND	3.7	13.5	2.1	ND	ND	ND
IH-2,IH-3 Comp	5	2	14.951[a]	ND	ND	ND	ND	21.7	ND	ND	ND
IH-Ref 1	1	1	13.728[c]	ND	ND	ND	10.4	ND	ND	ND	4.0
IH-Ref 1 Replicate 1	2	2	13.728[c]	ND	ND	7.7	16.1	3.0	ND	2.1	1.6
IH-Ref 1 Replicate 2	2	2	13.728[c]	ND	ND	ND	ND	1.2	ND	ND	ND
IH-Ref 1	3	1	13.728[c]	ND	ND	6.3	20.4	ND	ND	ND	3.5
IH-Ref 1	4	1	13.728[c]	ND	ND	ND	ND	0.9	ND	ND	2.8
IH-Ref 1	5	1	13.728[c]	ND	ND	3.7	13.1	ND	ND	ND	3.6
IH-Ref 2	1	1	13.657[a]	ND	ND	5.7	14.8	1.5	ND	ND	4.0
IH-Ref 2	2	1	13.797[a]	ND	ND	ND	12.1	2.4	ND	ND	4.9
IH-Ref 2 Replicate 1	3	1	15.130[a]	ND	ND	ND	14.1[d]	ND	ND	ND	2.4
IH-Ref 2 Replicate 2	3	1	14.080[a]	ND	ND	2.9	19.3	1.7	ND	ND	5.5
IH-Ref 2	4	2	14.244[a]	ND	ND	5.5	12.3	2.9	1.3	ND	0.9
IH-Ref 2	5	1	12.845[a]	ND	ND	3.7	7.3	2.1	ND	ND	ND
N. virens Background	1	1	17.703[a]	4.2	ND	24.5	60.8	25.4	24.3	ND	ND
N. virens Background	2	1	18.134[a]	ND	ND	ND	37.1	27.7	5.8	ND	ND
N. virens Background	3	1	13.531[a]	6.1	ND	23.5	74.8	73.5	32.1	18.3	4.8
N. virens Background	4	2	16.804[a]	ND	ND	83.8	103.0	39.6	18.9	ND	ND
N. virens Background	5	2	17.144[a]	ND	1.9[d]	31.6	35.1	19.7	11.9	2.9	ND

(a) PAH percent dry weight.
(b) U Analyte was not present above the level of associated value.
(c) Average percent dry weight based on PAH percent dry weight.
(d) Mass ratio out of limits.

TABLE L.16. Dioxins, Dry Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg dry weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
IH-2,IH-3 Comp	1	1	13.595[a]	2.2 U[b]	1.5 U	1.5 U	2.2 U	1.5 U	6.0	95.3
IH-2,IH-3 Comp	2	1	14.620[a]	3.4 U	4.1 U	3.4 U	4.1 U	3.4 U	14.4 U	86.6
IH-2,IH-3 Comp	3	1	12.570[a]	3.2 U	1.6 U	0.8 U	1.6 U	0.8 U	6.0	106.8
IH-2,IH-3 Comp	4	2	12.510[a]	2.4 U	0.8 U	0.8 U	1.6 U	1.6 U	5.0[c]	89.4
IH-2,IH-3 Comp	5	2	14.951[a]	14.0 U	25.4 U	22.7 U	7.4 U	16.7 U	46.2 U	611.5
IH-Ref 1	1	1	13.728[d]	2.9 U	2.9 U	6.6 U	7.3 U	10.9 U	18.2 U	61.2[c]
IH-Ref 1 Replicate 1	2	2	13.728[d]	2.2 U	1.5 U	0.7 U	1.5 U	1.5 U	5.7	64.2
IH-Ref 1 Replicate 2	2	2	13.728[d]	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	17.5 U	107.4
IH-Ref 1	3	1	13.728[d]	1.5 U	1.5 U	2.2 U	2.2 U	2.2 U	7.4	90.3
IH-Ref 1	4	1	13.728[d]	2.9 U	1.5 U	0.7 U	1.5 U	1.5 U	11.7 U	68.5
IH-Ref 1	5	1	13.728[d]	2.2 U	1.5 U	2.2 U	0.7 U	2.2 U	4.2	69.1
IH-Ref 2	1	1	13.657[a]	3.7 U	2.2 U	1.5 U	1.5 U	2.2 U	5.7	130.1
IH-Ref 2	2	1	13.797[a]	2.2 U	2.2 U	1.4 U	1.4 U	1.4 U	3.4	75.0
IH-Ref 2 Replicate 1	3	1	15.130[a]	2.0 U	1.3 U	1.3 U	1.3 U	2.0 U	5.9	74.0
IH-Ref 2 Replicate 2	3	1	14.080[a]	2.1 U	1.4 U	1.4 U	1.4 U	2.8 U	8.1	85.4
IH-Ref 2	4	2	14.244[a]	1.4 U	0.7 U	0.7 U	0.7 U	0.7 U	4.1	54.9
IH-Ref 2	5	1	12.8[illegible][a]	3.1 U	1.6 U	1.6 U	0.8 U	1.6 U	10.9 U	59.1
N. virens Background	1	1	17.703[a]	1.2	2.8 U	2.3 U	4.5 U	2.3 U	5.0	26.6
N. virens Background	2	1	18.134[a]	3.3 U	2.2 U	1.7 U	2.2 U	1.7 U	4.0	24.8
N. virens Background	3	1	13.531[a]	5.9 U	5.9 U	3.0 U	12.6 U	3.7 U	7.8	40.8
N. virens Background	4	2	16.804[a]	2.4 U	3.0 U	1.2 U	4.2 U	1.2 U	19.0 U	50.8
N. virens Background	5	2	17.144[a]	1.7 U	1.7 U	1.2 U	2.3 U	1.2 U	3.1	28.3

(a) PAH percent dry weight.
(b) U Analyte was not present above the level of associated value.
(c) Mass ratio out of limits.
(d) Average percent dry weight based on PAH percent dry weight.

TABLE L.17. Furans, Dry Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg dry weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
IH-2,IH-3 Comp	1	1	13.595[a]	1.9	0.7 U[b]	1.5 U[d]	0.7 U	1.5 U	3.7 U	0.7 U	5.1 U	2.2 U	6.6 U[d]
IH-2,IH-3 Comp	2	1	14.620[a]	3.4 U	6.8 U	3.4 U	2.1 U	4.1 U	20.5 U	4.8 U	7.5 U	7.5 U	24.6 U
IH-2,IH-3 Comp	3	1	12.570[a]	2.0	0.8 U	0.8 U[c]	1.6 U	1.6 U	3.2 U	1.6 U	4.8 U	1.6 U	8.8 U[c]
IH-2,IH-3 Comp	4	2	12.510[a]	2.1	1.6 U	0.8 U	0.8 U	0.0 U	4.0 U	0.8 U	6.4 U	0.8 U	4.8 U[c]
IH-2,IH-3 Comp	5	2	14.951[a]	14.0 U	10.0 U	14.0 U	25.4 U	23.4 U	18.1 U	39.5 U	64.2 U	29.4 U	134.4 U
IH-Ref 1	1	1	13.728[c]	3.6 U	2.2 U	2.9 U	7.3 U	5.1 U	8.7 U	5.8 U	4.0	8.0 U	7.6
IH-Ref 1 Replicate 1	2	2	13.728[c]	3.6 U	0.7 U	1.5 U	1.5 U	1.5 U	2.1	0.7 U	6.6 U	0.7 U	4.4 U[c]
IH-Ref 1 Replicate 2	2	2	13.728[c]	1.2	1.5 U	1.5 U	2.2 U	2.2 U	4.4 U	2.9 U	8.0 U	2.9 U	14.6 U[c]
IH-Ref 1	3	1	13.728[c]	3.6 U	1.5 U	1.5 U	1.5 U	1.5 U	4.4 U	2.2 U	23.3 U	2.2 U	6.0
IH-Ref 1	4	1	13.728[c]	0.9	0.7 U	0.7 U[c]	0.7 U	0.7 U	2.9 U	2.2 U	5.1 U	0.7 U	11.1[c]
IH-Ref 1	5	1	13.728[c]	2.9 U	1.5 U	0.7 U	0.7 U	0.7 U	4.4 U	8.0 U	6.6 U	2.2 U	11.7
IH-Ref 2	1	1	13.657[a]	1.5	1.5 U	1.5 U[c]	1.5 U	1.5 U	2.9 U	0.7 U	5.9 U	0.7 U	19.1[c]
IH-Ref 2	2	1	13.797[a]	2.4	1.4 U	2.2 U	1.4 U	1.4 U	2.9 U	2.2 U	8.7 U	2.9 U	10.5[e]
IH-Ref 2 Replicate 1	3	1	15.130[a]	4.0 U	1.3 U	2.0 U	2.6 U	1.3 U	4.0 U	1.3 U	8.6 U	2.6 U	3.6
IH-Ref 2 Replicate 2	3	1	14.080[a]	1.7	2.1 U	2.1 U	2.8 U	2.1 U	5.7 U	2.1 U	12.1 U	2.1 U	4.9
IH-Ref 2	4	2	14.244[a]	4.9 U	0.7 U	0.7 U	0.7 U	0.7 U	3.5 U	0.7 U	3.5 U	0.7 U	1.2[c]
IH-Ref 2	5	1	12.845[a]	2.1	0.8 U	1.6 U[c]	0.8 U	1.6 U	3.9 U	1.6 U	8.6 U	0.8 U	6.2 U[c]
N. virens Background	1	1	17.703[a]	8.9[e]	3.4 U	4.0 U[c]	2.3 U	2.3 U	2.8 U	1.7 U	7.3 U	1.7 U	5.6 U[c]
N. virens Background	2	1	18.134[a]	6.5	2.8 U	2.8 U[c]	2.2 U	2.8 U	2.8 U	0.6 U	9.9 U	1.1 U	3.9 U[c]
N. virens Background	3	1	13.531[a]	16.9	3.0 U	2.7[c][e]	3.7 U	4.4 U	3.7 U	0.7 U	13.3 U	0.7 U	2.8[c]
N. virens Background	4	2	16.804[a]	9.2	2.4 U	4.2 U	2.4 U	1.2 U	3.6 U	3.0 U	10.1 U	2.4 U	72.0 U[c]
N. virens Background	5	2	17.144[a]	5.3	1.7 U	2.3 U	1.7 U	1.2 U	1.6	1.2 U	7.0 U	0.6 U	5.8 U[c]

(a) PAH percent dry weight.
(b) U Analyte was not present above the level of associated value.
(c) Calibration response factor at end of day out of limits.
(d) Average percent dry weight based on PAH percent dry weight.
(e) Mass ratio out of limits.

TABLE L.18. Quality Control Summary for Dioxins, Wet Weight, in Tissue of *N. virens*, Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg wet weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDD
Method Blank										
Blank		1		0.3 U[a]	0.3 U	0.9 U	0.5 U	0.8 U	0.7 U	2.45[b]
Matrix Spike										
IH-2,IH-3 Comp	5	2	14.951[c]	2.1 U	3.8 U	3.4 U	1.1 U	2.5 U	6.9 U	91.42
IH-2,IH-3 Comp MS	5	2	14.951[c]	31.0	137.0	144.0	109.0	131.0	125.0	302.00
Concentration Recovered				31.0	137.0	144.0	109.0	131.0	125.0	210.58
Amount Spiked				31.0	153.0	153.0	153.0	153.0	153.0	305.00
Percent Recovery				100%	90%	94%	71%	86%	82%	69%
IH-2,IH-3 Comp	5	2	14.951[c]	2.1 U	3.8 U	3.4 U	1.1 U	2.5 U	6.9 U	91.42
IH-2,IH-3 Comp MSD	5	2	14.951[c]	31.0	135.0	140.0	100.0	79.0	105.0	378.00
Concentration Recovered				31.0	135.0	140.0	100.0	79.0	105.0	286.58
Amount Spiked				30	152	152	152	152	152	305
Percent Recovery				103%	89%	92%	66%	52%	69%	94%
RPD				3%	1%	2%	8%	49%[d]	17%	31%[d]
I-Stat				0.02	0.00	0.01	0.04	0.24	0.08	0.15
Matrix Reference Material										
Concensus Value*				460.0	960.0	900.0	870.0	900.0	1390.00	3510.00
MRM				437.0	883.0	813.0	764.0	800.0	1261.00	2395.00[e]
Analytical Duplicates										
IH-Ref 2 Replicate 1	3	1	15.130[c]	0.3 U	0.2 U	0.2 U	0.2 U	0.3 U	0.89	11.19
IH-Ref 2 Replicate 2	3	1	14.080[c]	0.3 U	0.2 U	0.2 U	0.2 U	0.4 U	1.14	12.03
RPD				NA[f]	NA	NA	NA	NA	25%	7%
I-Stat				NA	NA	NA	NA	NA	0.12	0.04

TABLE 1.18. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg wet weight) 2378-TCDD	12378-PeCDD	123478-HxCDD	123678-HxCDD	123789-HxCDD	1234678-HpCDD	OCDC
IH-Ref 1 Replicate 1	2	2	13.728[g]	0.3 U	0.2 U	0.1 U	0.2 U	0.2 U	0.78	8.82
IH-Ref 1 Replicate 2	2	2	13.728[g]	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	2.4 U	14.74
RPD				NA	NA	NA	NA	NA	NA	50%[c]
I-Stat				NA	NA	NA	NA	NA	NA	0.25

(a) U Analyte was not present above the level of associated value.
(b) Mass ratio out of limits.
(c) PAH percent dry weight.
(d) Value exceeds relative precision range ≤30%.
(e) Value exceeds SRM range ≤30% certified value.
(f) NA Not applicable.
(g) Average percent dry weight based on PAH percent dry weight.

TABLE L.19. Quality Control Data for Furans, Wet Weight, in Tissue of *N. virens* Winyah Bay Project

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg wet weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
Method Blank													
Blank		1		0.1 U[a]	0.3 U	0.6 U[b]	0.7 U	0.6 U	1.0 U	0.5 U	0.9 U	0.5 U	1.3 U
Matrix Spike													
IH-2,IH-3 Comp	5	2	14.951[c]	2.1 U	1.5 U	2.1 U	3.8 U	3.5 U	2.7 U	5.9 U	9.6 U	4.4 U	20.1 U
IH-2,IH-3 Comp MS	5	2	14.951[c]	27.0	135.0	138.0	137.0	140.0	138.0	142.0	116.0	130.0	280.0
Concentration Recovered				27.0	135.0	138.0	137.0	140.0	138.0	142.0	116.0	130.0	280.0
Amount Spiked				31.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	305.0
Percent Recovery				87%	88%	90%	90%	92%	90%	93%	76%	85%	92%
IH-2,IH-3 Comp	5	2	14.951[c]	2.1 U	1 5 U	2.1 U	3.8 U	3.5 U	2.7 U	5.9 U	9.6 U	4.4 U	20.1 U
IH-2,IH-3 Comp MSD	5	2	14.951[c]	27.0	134.0	134.0	145.0	141.0	143.0	139.0	120.0	136.0	433.0
Concentration Recovered				27.0	134.0	134.0	145.0	141.0	143.0	139.0	120.0	136.0	433.0
Amount Spiked				30	152	152	152	152	152	152	152	152	305
Percent Recovery				90%	88%	88%	95%	93%	94%	91%	79%	89%	142%[d]
RPD				3%	0%	2%	6%	1%	4%	1%	4%	5%	43%[e]
I-Stat				0.02	0.00	0.01	0.03	0.01	0.02	0.01	0.02	0.03	0.21
Matrix Reference Material													
Concensus Value*				450.0	870.0	860.0	880.0	950.0	820.0	910.0	1270.0	1120.0	2250.0
MRM				398.0	861.0	826.0	886.0	872.0	889.0	881.0	1019.0	1185.0	1908.0
Analytical Duplicates													
IH-Ref 2 Replicate	3	1	15.130[c]	0.6 U	0.2 U	0.3 U	0.4 U	0.2 U	0.6 U	0.2 U	1.3 U	0.4 U	0.54
IH-Ref 2 Replicate	3	1	14.080[c]	0.24	0.3 U	0.3 U	0.4 U	0.3 U	0.8 U	0.3 U	1.7 U	0.3 U	0.69
RPD				NA[f]	NA	NA	NA	NA	NA	NA	NA	NA	24%
I-Stat				NA	NA	NA	NA	NA	NA	NA	NA	NA	0.12

TABLE L.19. (contd)

Sediment Treatment	Replicate	Batch	Percent Dry Weight	*N. virens* (ng/kg wet weight) 2378-TCDF	12378-PeCDF	23478-PeCDF	123478-HxCDF	123678-HxCDF	123789-HxCDF	234678-HxCDF	1234678-HpCDF	1234789-HpCDF	OCDF
IH-Ref 1 Replicate	2	2	13.728[g]	0.5 U	0.1 U	0.2 U	0.2 U	0.2 U	0.29	0.1 U	0.9 U	0.1 U	0.6 U
IH-Ref 1 Replicate	2	2	13.728[g]	0.17	0.2 U	0.2 U	0.3 U	0.3 U	0.6 U	0.4 U	1.1 U	0.4 U	2 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) U Analyte was not present above the level of associated value.
(b) Calibration response factor at end of day out of limits.
(c) PAH percent dry weight.
(d) Recovery outside quality control range (40%-120%).
(e) Value exceeds relative precision range ≤30%.
(f) NA Not applicable.
(g) Average percent dry weight based on PAH percent dry weight.

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