

2. FIELD SAMPLING PROGRAM

The field sampling program for this project was established according to the SSAP provided by URS Greiner (1998) and the approved *Work Plan to Conduct Sediment Sampling and Analysis for the Daniel Island Marine Terminal* (EA 1998). Sampling procedures followed protocols established in the *U.S. EPA Region IV RIM* and U.S. EPA, 1991 (where appropriate).

2.1 SAMPLING OBJECTIVES

The objectives of the Daniel Island sampling program were to:

- Collect sediments representative of the sampling locations (to a depth of -47 ft. MLLW or to the Cooper marl, whichever is shallower).
- Collect the required volume of sediment for the analytical and ecotoxicological testing.
- Collect and maintain sediments in appropriate containers, and hold samples for shipment according to protocols that ensure sample integrity.
- Transport samples to the laboratory according to the requirements of chain-of-custody protocols.
- Composite sediments at the laboratory according to protocols that ensure sample integrity.

2.2 SAMPLING LOCATIONS

Mapped locations for sampling stations in the Cooper and Wando Rivers were provided to EA by URS Greiner (Figure 2-1). EA used National Oceanic and Atmospheric Administration (NOAA) charts to determine latitude/longitude coordinates for the locations, and these coordinates were used to determine approximate coring locations in the field. Coring locations were determined in the field using a Trimble ProXR Differential Global Positioning System (DGPS) with an accuracy of +/-1 m. The precise location of each core was recorded from the DGPS after the core barrel was vibrated into the sediment to either the Cooper Marl layer or to a depth of -47 ft MLLW, whichever was shallower. Coordinates for the coring locations are provided in Table 2-1. The reference site sampling locations were provided to EA in latitude/longitude coordinates by URS Greiner and were used for the reference site sampling (Figure 2-2).

2.3 VIBRACORING PROCEDURES

Wando River and Cooper River samples were collected during the period 08 July through 13 July 1998 using a vibracoring system supplied by Coastal Carolina University. Sampling commenced in the Wando River and proceeded to the Cooper River and Charleston Naval Base reaches. Coring operations were conducted from a 100-ft spud barge positioned with a tug boat.

The barge was outfitted with a crane to lift the core barrel during coring operations. Barge, tugboat, and crane equipment were provided and operated by Salmons Dredging Corporation in Charleston, South Carolina. Salmons Dredging Corporation's dockyard, located on the west shore of Shipyard Creek, a western tributary to the Cooper River, served as the staging area for the field event.

The vibracoring rig, supplied by Coastal Carolina University, was identical to gear used by the Dutch Geological Survey in the North Sea and was designed for coring into hard sand. The vibracoring system used a core barrel capable of holding a core liner with an outside diameter of 3.5 in. The motor of the vibracoring system had a 1-in. stroke and a maximum driving force of 14,000 lb—sufficient to drive the cores well into the Marl prior to refusal. Cellulose Acetate Butylrate (CAB) core liners with an inner diameter of 3.125 in. were used; 20-ft lengths of core liner were sealed together with Teflon tape and were placed inside the core barrel to allow for continuous sediment cores. CAB liners were approved by U.S. EPA Region IV and USACE—Charleston District as an acceptable substitution for polycarbonate (Lexan) core liners. The core liners were fitted with a one-way valve at the top and a stainless steel catcher at the bottom to retain sediment during retrieval; the catcher was riveted into place with stainless steel rivets. The core barrel was fitted with a stainless steel cutter head to facilitate sediment penetration.

During barrel/liner preparation, water depth was measured using a weighted line. Station depth was determined by subtracting tide height (calculated from NOAA tide tables for Charleston Harbor) from water depth. Station depths were referenced to feet MLLW. After the station depth was determined, the core barrel was marked with duct tape to reflect water depth and target penetration depth to reach -47 ft MLLW. The barrel was then lifted from the deck by crane and lowered until it reached the sediment surface. The vibrating unit was started, and the core was deployed until it reached target penetration or refusal, whichever came first. After the core reached refusal or penetration, core location was determined using the Differential Global Positioning System (DGPS). The DGPS antenna was placed within 5 ft of the vibrating head, and the coring position was recorded into a field logbook in latitude and longitude coordinates. Positions were converted to South Carolina State Plane Coordinates, NAD 1983, following sampling at EA's office in Sparks, Maryland.

After the core position was recorded, the core barrel was retrieved from the sediment and placed on the deck of the barge. The nose cone was removed and a core cap was placed on the bottom of the first section. The core liner was then removed from the barrel. Upon reaching the junction of the two liners, the Teflon tape was removed and core caps were placed on the top of the first section and the bottom of the second section (if sediment was present in the second section). Each liner was measured to determine sediment recovery, divided into sections, labeled, and sealed with external plastic bagging. Recovery lengths and number of sections for each core were recorded in the field logbook. Cores were labeled to denote station number and sequence of collection. For example, cores WDR-01A and WDR-01B were the first and second cores collected, respectively, at station WDR-01. Each core's target penetration, actual penetration, start time, and end time were also recorded in a field logbook. Copies of information from the field logbook are provided in Attachment 2-1. In addition, information for each individual core was recorded on individual datasheets. Copies of datasheets are provided in Attachment 2-2.

Approximately 20 gallons of sediment were required from each station to conduct the analytical and ecotoxicological testing. The number of cores collected at each station varied depending upon water depth and sample recovery. A summary of vibracoring station information, including station coordinates, sampling dates, water depth, core lengths, and number of cores collected at each location, is provided in Table 2-1.

Capped and labeled core sections were kept on-board the barge in an ice-filled storage box until the end of each work day. Cores were transferred to a secured, refrigeration trailer (cooled to 4°C) at the on-shore staging area at the end of each work day. After completion of all coring activities, the sediment cores were transported in the 4°C refrigeration trailer to EA's laboratory campus in Sparks, Maryland, where they were logged, composited, and homogenized for testing. Methods for sediment compositing and homogenization are explained more explicitly in Section 3.2.1. Sample holding times were initiated when the cores were opened and homogenized at the laboratory.

2.4 REFERENCE SEDIMENT COLLECTION

Reference sediment was collected from three predetermined locations in the vicinity of the CODMDS (Figure 2-2). Work was attempted on 11 July 1998 using a 26-ft aluminum work boat outfitted with a gantry and hydraulic winch. Sampling operations were aborted, however, due to sea conditions that were incompatible (swells of 3-4 ft) with sampling operations from the 26-ft vessel. Due to rough sea conditions (4-6 ft seas) predicted by the National Weather Service for the following few days, a larger vessel was chartered to conduct the offshore sampling on 14 July 1998. A 67-ft shrimp boat ("Winds of Fortune"), piloted by Captain Wayne Magwood of Charleston, South Carolina, was used for transit to the reference site and to collect sediment samples. Sea conditions at the reference site were rough with easterly winds of 15-20 knots and waves of 4-6 ft, with occasional 8-ft swells.

Sediment samples were collected using a large stainless steel Van Veen grab sampler with a 10.5-gal capacity (1.4-ft³). The sampler was decontaminated prior to use following protocols described in Section 2.6. Sediment obtained from the three reference locations was placed into individual pre-cleaned, 3.5-gallon polypropylene buckets, which were sealed, labeled, and chilled on ice. The buckets were transported to the refrigeration trailer (cooled to 4°C) located at the project staging area and were transported to EA's laboratory facilities in Sparks, Maryland with the sediment cores. A summary of station information for the reference site sampling is provided in Table 2-2.

The reference sediment was composited and homogenized in the laboratory prior to bulk chemistry and ecotoxicological analysis. Methods for sediment compositing and homogenization are explained more explicitly in Section 3.2.1. Because the reference sediment was not collected in a core liner, the holding time was initiated at the sample collection time.

2.5 SITE WATER COLLECTION

Approximately 25 gallons of site water were collected from the Cooper River in the vicinity of station CPB-01 on 12 July 1998 for the bioassay testing. Water was collected from the tugboat by submerging 5-gallon, pre-cleaned high density polyethylene carboys below the surface of the water. The carboys were filled, labeled, and chilled on ice in the field. The containers were stored in the onshore refrigeration trailer and transported to EA with the core samples.

Due to excessive mortality in the controls of the water column toxicity tests with *Menidia beryllina* (see Section 3.3.2), additional site water was required to re-run tests in the ecotoxicology laboratory. An additional 20 gallons of site water were collected from the Wando River near Remley's Point (closest to station WDR-03) on 03 July 1998 by Salmons Dredging Corporation personnel. EA's ecotoxicology laboratory provided 5-gallon, pre-cleaned high density polyethylene carboys to Salmons Dredging Corporation prior to the collection date. The water was collected in the same manner as the initial site water sample, was chilled on ice, and was sent via overnight delivery to EA in Sparks, Maryland.

2.6 EQUIPMENT DECONTAMINATION

CAB core liners, core catchers, core caps, nose cones, bowls, spoons, and the Van Veen sampler were decontaminated following protocols in the SSAP (1998) and EA Work Plan (1998) prior to deployment in the field to minimize cross-contamination. Also to avoid cross-contamination, disposable nitrile gloves were worn by the sampling personnel and changed between sampling points. While performing the decontamination procedure, "phthalate-free gloves," such as nitrile, were used in order to prevent phthalate contamination of the sampling equipment or the samples. The equipment was decontaminated in a designated area on the work barge. Decontamination procedures took place concurrently with vibracoring operations.

The SSAP decontamination protocols are summarized below:

- Rinse equipment using clean tap water, distilled water, or de-ionized water
- Wash and scrub with non-phosphate detergent (Liquinox or other laboratory-grade detergent)
- Rinse with tap water
- Rinse with 10 percent nitric acid (HNO₃)
- Rinse with distilled or de-ionized water
- Rinse with methanol followed by hexane
- Rinse with distilled or de-ionized water
- Air dry (in area not adjacent to the decontamination area)

- Wrap equipment in aluminum foil, shiny side out, until next use

Waste water and decontamination chemicals were collected and contained in a 55-gallon drum and transported back to EA in Sparks, Maryland for proper disposal.

2.7 EQUIPMENT BLANKS

Three rinsate blanks were collected during the sampling event. One rinsate was collected from each section of river sampled (Charleston Naval Base, Cooper River, and Wando River). In addition, one rinsate blank was collected from the polypropylene buckets used to store the reference site sediments. The equipment blanks consisted of reagent water (de-ionized water) collected from a final rinse of the sampling equipment after the decontamination procedure had been performed. The rinsate was transferred into pre-cleaned laboratory bottles. The rinsate bottles were labeled, packed on ice, and shipped overnight to EA's analytical laboratory in Sparks, Maryland for chemical analysis. Custody forms were sealed in a water-tight plastic envelope and transported with the samples to the laboratory. The rinsate blanks were tested for the same analytical parameters as the bulk sediments.

2.8 SAMPLE LABELING AND CHAIN-OF-CUSTODY

Cores were labeled with the following information and each core cap was sealed with a custody seal prior to transport to EA:

- Client
- Project number
- Sampler's name/initials
- Type of analysis
- Station location/site
- Date and time collected
- Unique sample ID
- Core number of total number of cores for station

Reference sediments and site water were also labeled with the above information with the exception of the core-specific information.

After completion of sampling activities, the sediment cores, reference sediments, and site water were transported in a refrigerated trailer to EA's laboratory in Sparks, Maryland. Chain-Of-Custody (COC) forms were sealed in a water-tight plastic envelope and transported with the samples to the laboratory. Upon receipt at the laboratory, the cores were inspected for integrity and checked against the COC form. A copy of the COC form for the sediment cores is provided in Attachment 2-3.