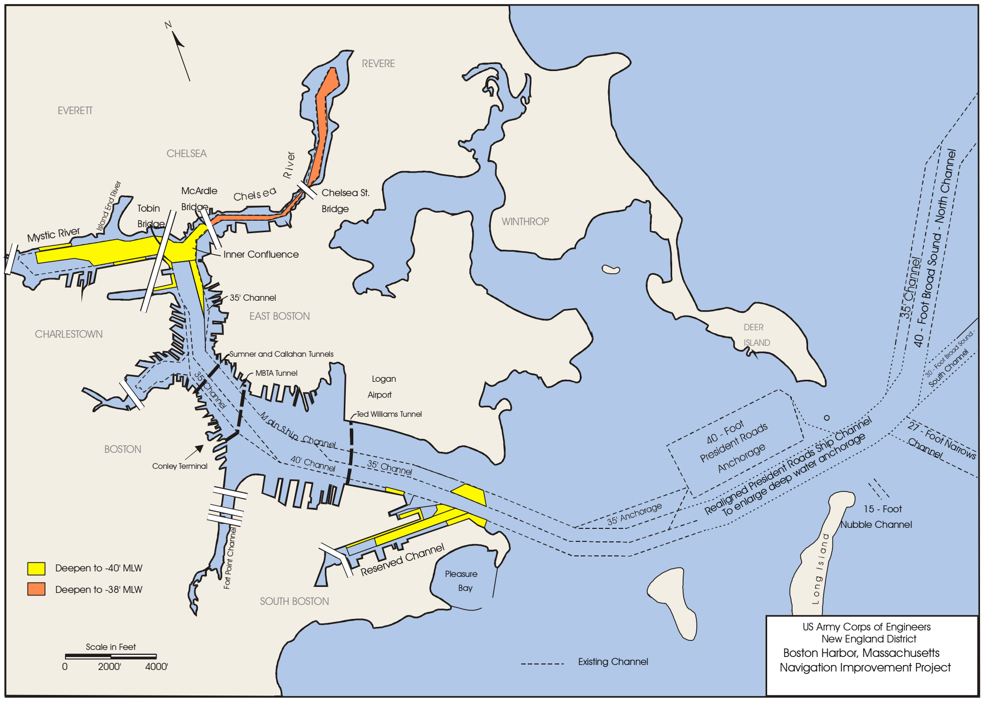
ONE-YEAR MONITORING REPORT FOR THE BOSTON HARBOR CAD CELLS–SUMMER 2001



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EXECUTIVE SUMMARY

The Boston Harbor Navigation Improvement Project (BHNIP) involved the deepening of the main shipping channels in Boston Harbor. Over 784,850 yd^3 (600,000 m^3) of dredged material deemed unsuitable for open-water disposal was dredged and contained within nine confined aquatic disposal (CAD) cells located in the navigation channel. The first CAD cell was constructed in 1997 in the Inner Confluence with an additional seven CAD cells constructed in the Mystic River and one CAD cell in the Chelsea River between 1998 and 2001. Each CAD cell was constructed in the ambient Boston Blue Clay below channel depths, filled with sediment unsuitable for open-water disposal and then capped with sand. The exception to this was Cell CR located in the Chelsea River, which received sediment in April of 1999 and currently remains uncapped.

The first cell constructed was Cell IC located in the Inner Confluence. Cell IC was filled with unsuitable sediments in June and July of 1997 and underwent the shortest period of dredged material consolidation prior to capping. Cap material was placed in Cell IC in July 1997; 10 days after the last unsuitable sediments were deposited. The next series of cells completed were M4, M5, and M12, all located in the Mystic River. Cells M4, M5, and M12 were filled with sediments from August to October 1998 and capped in November 1998. CAD Cells M2 and the Super Cell (SC) were the next two cells to be constructed. Cell M2 was filled between 23 October 1998 and 1 June 1999, while Cell SC was filled from 31 December 1998 and 7 June 1999. Both Cell M2 and SC were capped in November 1999. The most recent cells to be filled and capped were Cells M8-11 and M19. Cell M8-11 was filled over a ten-month period (August 1999 to May 2000) while M19 was filled from 28 October 1999 to 14 February 2000. Both CAD cells were capped in September 2000.

Monitoring studies performed during the early phases of the BHNIP indicated the ability to effectively cap the high water content dredged material deposit in a CAD cell was a significant challenge to this dredged material management technique. Postcap surveys of the initial CAD cells detected layers of soft sediment of various thickness at the sediment-water interface following cap placement. The presence of a dredged material layer at the sediment-water interface was attributed to the migration of the high water content silt and clay through the sand cap via diapiric action. Over the five years of CAD cell construction and filling (1997 through 2001) the various dredged material disposal and cap placement techniques were modified to improve the efficiency of capping operations and minimize the formation of diapirs, resulting in significantly thicker and cleaner sand caps over time. It was determined that allowing the dredged material to consolidate within the CAD cell for an extended period of time prior to capping resulted in the highest degree of success.

In support of the U.S. Army Corps of Engineers, New England District (NAE) Water Quality Certification monitoring requirements, Science Applications International Corporation (SAIC) completed a comprehensive geotechnical and biological assessment of the Boston Harbor CAD cells. The Summer 2001 monitoring effort consisted of the collection of vibracores, sediment-profile images, and surface sediment grab samples from

the Boston Harbor CAD cells for detailed analysis. The cores were used to examine sediment properties and stratification within eight of the CAD cells. Sediment-profile images and sediment grab samples provided additional insight into the composition of the surface material, as well as the recolonization status of the benthic infaunal community.

The CAD cells were monitored throughout their construction, and the historical data provided a basis of comparison for sediment stratification within the Summer 2001 cores. The cores collected in the 2001 survey indicated similar stratification as documented in previous surveys. The estimated cap thickness within each cell was comparable to the thickness detected after initial cap placement. The cores and sediment grab samples confirmed the presence of soft sediments on the surface of multiple cells constructed prior to 2000 (IC, M4, M5, M12, M2 and SC). However, the accumulation of any recent sediment deposited through natural processes was immeasurable due to the similarities in composition with the pre-existing dredged material. Soft sediment was not detected on the surface of the more recent cells (M8-11 and M19).

Overall, the sediment-profile imaging and the benthic community analysis indicated that a limited number of individuals and species were present in the CAD cells yielding both low species diversity and abundance. These data indicated the majority of the Boston Harbor CAD cells were supporting a Stage I benthic community composed of various types of opportunistic polychaetes, nematodes, as well as small bivalve and gastropod molluscs. The biological assessments for the CAD revealed findings that were generally consistent with those at two reference areas in the Inner Confluence and Mystic River (IC-REF and MR-REF), as well as biological assessments performed in Boston Harbor prior to the BHNIP.

1.0 INTRODUCTION

The Boston Harbor Navigation Improvement Project (BHNIP) was sponsored jointly by the U.S. Army Corps of Engineers - New England District (NAE) and the Massachusetts Port Authority (MassPort). Under the BHNIP, estuarine sediments defined as unsuitable for unconfined open-water disposal were removed from the navigation channels in Boston's Inner Harbor and placed in a series of confined aquatic disposal (CAD) cells constructed in the bottom of the Mystic and Chelsea Rivers, as well as the Inner Confluence. The dredged material unsuitable for open-water disposal was left to consolidate over a period of time, and then covered with a layer of capping dredged material comprised of clean sand to isolate the underlying sediments from the environment. The cells are located within the existing navigation channel and are therefore termed "in-channel" CAD cells.

The BHNIP involved the improvement dredging of portions of the main ship channel and three tributary channels in Boston Harbor. The main ship channel includes the Inner Confluence and the mouth of the Reserved Channel, while the tributary channels include Mystic River, Chelsea River and the Reserved Channel (Figure 1-1). All of the channels have been deepened to –40 ft MLLW, except for Chelsea River, which was dredged to –38 ft MLLW. In addition to the channels, berths at eight marine terminals were also dredged.

In July and August of 2001, an evaluation of the Boston Harbor CAD cells was conducted. The multibeam survey required under section C5(h) of the Water Quality Certification will be conducted by the U.S. Army Corps of Engineers, New England District. The objective of the study was to conduct environmental monitoring of all the cells approximately one-year following the capping of the last two cells in September 2000. The monitoring was performed in accordance with the Water Quality Certificate for the project (Conditions C5 [g] and D1 [a] through [e]). All CAD cells were constructed in association with the BNHIP between 1997 and September 2000. The first cell associated with the project was constructed in the Inner Confluence (Cell IC) in conjunction with the dredging of the Conley Terminal (Figure 1-2). This cell was completed in 1997 and resulted in the re-evaluation of cap placement methods for future cells due to mixing between the cap material and the dredged material.

Between 1998 and 2001, seven additional CAD cells (M2, M4, M5, M12, M8-11, M19 and SC) were constructed and filled in the Mystic River (Figure 1-2). All seven CAD cells in the Mystic River underwent capping, while another cell (CR) located in the Chelsea River was constructed, partially filled and left un-capped. The Chelsea River cell was not included in the vibracore survey evaluation, but was the subject of both sediment-profile imaging and benthic community assessment surveys.

The seven Mystic River CAD cells were capped after they were filled with the sediments generated by the various dredging projects within the harbor. Evaluations of the capping technique were performed over each set of capped cells as they were completed. The first three cells capped in the Mystic River displayed unique characteristics directly related to the approximate number of days of consolidation time before capping operations commenced. From the experience gained from the first few cells, modifications were made to the capping technique and settling time such that each additional series of CAD cells met with greater success in achieving the original goal of constructing a discrete 3-foot layer of cap. The duration of the pre-capping dredged material consolidation intervals was found to be the primary factor in the success of the capping operation. The last two CAD cells capped (M8-11 and M19) contained the cleanest and thickest cap of all the CAD cells.

The purpose of this report is to summarize the data collected from the one-year monitoring survey of the CAD cells associated with the BHNIP. Sediment vibracores, REMOTS® sediment-profile images and benthic grab samples were collected to address the following two objectives:

1) assess the vertical distribution of the various sediments in the cells (unsuitable dredged sediments, cap thickness and newly settled sediments)

2) assess the benthic recolonization status of the disposal cells

A summary of the project history is included below. Section 2 of this report provides a brief description of operational methods. Detailed results are provided in Section 3 and the results are discussed in Section 4.

1.1 Overview

Phase 1 of the project was conducted in the Summer of 1997, when two berths at Conley Terminal were dredged (ENSR 1997a; SAIC 1997; Figure 1-1). In the Summer of 1998, the second phase of dredging and dredged material placement was contracted to Great Lakes Dredge and Dock Company (GLDD, Oak Brook, IL). To date the following CAD cells have been filled and capped under Phase 2: M2, M4, M5, M12, M8-11, M19, the Super Cell. In addition, one partially filled cell in the Chelsea River remains uncapped (Figure 1-2).

During Phase 1 and the early part of Phase 2, important questions were raised about both the timing and method of placing the cap material (sand) relative to the goal of creating a stable, uniform capping layer at least 3 feet thick. Numerous monitoring surveys were conducted to determine whether this goal was being met. The following section provides a summary of the Phase 1 and Phase 2 monitoring results.

1.1.1 Phase 1: Conley Terminal, Inner Confluence CAD Cell

For the first phase of the BHNIP, an in-channel CAD cell was constructed for containment of unsuitable dredged material from two shipping berths at Conley Container Terminal in South Boston (ENSR 1997a; SAIC 1997). The fine-grained dredged sediments were disposed into the CAD cell and then capped with sufficient sand to cover the deposit with a 3-ft thick layer of sand.

Various postcap monitoring techniques were used to evaluate the success of the capping operation. Overall, the survey results indicated that the majority of the CAD cell had been capped with a highly variable thickness of sand, with the southern end of the cell displaying little or no detectable cap material. It was thought that the water column currents would carry the sand cap material towards the southern end of the CAD cell during placement operations. As a result, the majority of the sand cap was placed at the northern end of the CAD cell. A drag bar was later deployed within Inner Confluence cell in an attempt to re-distribute cap material to the southern end of the cell. These postcap operations designed to level the sand cap appear to have resulted in highly uneven sand coverage and potentially served to enhance mixing of the cap and underlying dredged material. Furthermore, it was found that the sediment placed in the cell (both dredged material and capping sand) continued to consolidate after capping (SAIC 1999).

Recommendations to modify the requirements for dredging and disposal operations were designed around the primary concerns raised by the Phase 1 results, including lack of spatial coverage of sand, variable thickness of sand, and potential mixing between the sand and the underlying dredged material (ENSR 1997a; SAIC 1997). The Commonwealth of Massachusetts Water Quality Certification (WQC; Babb-Brott 1997), as well as the dredging project specifications, were modified based on the Phase 1 monitoring results. The method of sand placement was viewed as the main factor resulting in both uneven spatial coverage and variable cap thickness. For Phase 2, operations were modified in an attempt to improve placement of the cap material, as well as increase the ability to diffuse the sand while capping.

As part of the requirements of the WQC during Phase 1, the maintenance materials were dredged using an environmental, or closed, clamshell bucket. The bucket is designed to limit sediment suspension in the water column, but it had the added effect of introducing large volumes of water into the dredged sediment and subsequently into the CAD cells during dredged material disposal. For Phase 2, the recommendation was made to increase the time allowed for consolidation of the fine-grained maintenance sediments prior to capping. By increasing the time allowed for the material to consolidate, the strength and bearing capacity of the material were predicted to increase. However, the Phase 1 data provided no clear guidance on the time required for sufficient consolidation prior to capping (ENSR 1997b).

1.1.2 Phase 2; Step 1: CAD Cells M4, M5 and M12

The dredging contractor for Phase 2 of the BHNIP (Great Lakes Dredge and Dock, GLDD) utilized the operational recommendations stemming from Phase 1 to construct, fill, and cap the first three cells in the Mystic River (Cells M4, M5, M12). As the first cell (M5) was dredged, it became apparent that the original CAD cell specifications (approximately 50 cells averaging 20 ft below the sediment/water interface) could be modified. The stiff Boston Blue Clay (BBC) comprising the CAD cell allowed relatively steep side slopes to be maintained, and Cells M4, M5, and M12 were dredged to a greater depth than in the project design. The steeper side slopes and increased depths resulted in increased capacity and therefore, fewer cells were required to contain the maintenance material generated under the BHNIP.

The time between the last load of maintenance material and the first load of cap material was 30 days for M12, 33 days for M4, and 52 days for M5, in compliance with the WQC and project specifications (30-60 days). The time delay between placement of the bulk of the dredged material in M5 and M12 and the completion of capping was 83 and 56 days, respectively. It was later determined that the length of time the dredged material was allowed to consolidate within the cell prior to capping was directly related to the degree of success in constructing a final cap layer (i.e., longer consolidation means greater success). All capping operations were conducted in Cells M4, M5 and M12 between 11 and 18 November 1998.

The clean sand used as cap material was dredged from the Cape Cod Canal and placed in each CAD cell using a hopper dredge. Cap verification data were collected prior to, during, and following cap placement. Several activities were conducted to support cap verification and assessment. The Phase 2 monitoring showed that each of the three CAD cells had unique characteristics, but the correlation between the timing of the last placement of dredged material and the primary cap placement indicated longer consolidation times yielded better cap integrity. A common trend noted from all three cells was the presence of a surficial, fluidized layer of mud and a laterally continuous sand zone, consisting of moderate amounts of sand down to at least the depths of the recovered cores. There were indications of a thick, mixed interval of sand and mud across the top of each cell, suggesting that the fine-grained dredged material was unable to support the entire weight of the cap material.

Although the mixed sand zone did not precisely meet the project specifications of a discrete, uniform sand layer having a thickness of 3 feet, the three cells were considered successfully capped (SAIC 1999). The 1998 survey data indicate that cap material in Cell M4 was laterally continuous (over at least 90% of the cell), as four of the six cores showed a contiguous cap of ≥2 ft sand (70%), plus an additional horizon of mixed sand (>50%) ≥1ft thick. Cell M5 indicated similar results, as cap material was laterally continuous over the cell and containing a surface layer (2.6 ft) of silt overlying a 3.8 ft layer of >50% sand. Cell M12 indicated a contiguous cap with an average of 3.2 ft of >50% sand. There was some sand present at the surface of Cell M12 indicating that the mixed sand layer extended to the surface of the cell and that the fluidized surface layer was not as distinct in Cell M12. Because the sand zone extended to the surface of Cell M12, the data indicated that Cell M12 most closely complied with the original intent of the WQC specifications (SAIC 1999). However, some requirements of the WQC and project specifications were amended.

1.1.3 Phase 2; Step 2: CAD Cells M2 and Super Cell

A geotechnical investigation was conducted on Cell M2 to evaluate the engineering behavior of capped deposits so that future cells can be designed and constructed more efficiently. Taking the recommendations from BHNIP Phase 1 and the first three cells of Phase 2 (M4, M5, M12), a plan was devised for additional studies on one of the two CAD cells being filled in the second step of Phase 2. To this end, the sediments placed in CAD Cell M2 were sampled and evaluated for engineering properties during several stages of cell development (SAIC 2000). The second round of Phase 2 allowed both CAD cells to consolidate for a longer period of time (4 to 5 months) before cap material was added. In both cases the resulting cap was cleaner, and the majority of the cap accumulated at the surface of the cell with limited mixing, indicating that the dredged material in the CAD was capable of supporting the sand.

The 1999 survey from Cell M2, estimated cap thickness in M2 to be 2.5 ft (75.6 cm) based on five cores containing cap material. The cap material was located at the surface of the five cores, with only one core displaying a surface layer of silt (M2-1; 3.9 in. or 10 cm). A sixth core collected in the 1999 survey (M2-4) did not contain any apparent cap material and was believed to have been collected on a diapir. Cores collected from the Super Cell displayed a more variable cap thickness ranging from 2 to 6 ft. The cap material was found at the surface was intermixed with silt or banded between layers of silt. In addition, a layer of contiguous cap was detected below a layer of silty clay at the surface of one core. Overall, the Super Cell contained 3.5 ft (107 cm) of cap material. Cell M2 and the Super Cell were both considered a success, and a better understanding of consolidation time needed for the CAD cells was achieved. The measured shear strength and water content of the dredged material were noted as strong indicators that the cells were ready to be capped.

1.1.4 Phase 2; Step 3: CAD Cells M8-11, M19, and Chelsea River

The final step in Phase 2 of the BHNIP CAD cells began in Fall 1999 and included the construction, filling and capping of Cells M8-11 and M19 in the Mystic River, as well as the construction and partial filling of a cell in the Chelsea River. A status survey conducted by Ocean Surveys Incorporated (OSI) of Old Saybrook, Connecticut in October 2000 indicated that a relatively thick layer of cap material was distributed over both Cell M8-11 and M19. The cap thickness varied by approximately 1.5 ft (45 cm) within each cell, as sand thickness ranged from 2.8 to 4.1 ft in Cell M8-11 and 2.2 to 4 ft in M19. The Chelsea River cell was not included in the October 2000 OSI status survey. The seismic records for Cells M8-11 and M19 indicated a relatively uniform reflective surface and a general lack of sand infiltration and silt diapirs, unlike previous cells. It appears that the increased time allowed for self-weight consolidation of the dredged material prior to capping significantly improved the ability of the dredged material to support the sand cap (OSI November 2000, status report).

As previously indicated, the environmental monitoring survey work of July/August 2001 was performed roughly one-year following the completion of capping of the last two cells (M8-11 and M19). Sediment vibracores and grab samples of surface sediment were collected in each cell to assess the vertical distribution and thickness of the sediment layers within the cell. Sediment-profile images and benthic grab samples were collected to assess the benthic recolonization status of the cells relative to nearby reference areas. The field sampling and analytical methods associated with each survey technique are described in detail in the following section.

2.0 METHODS

The field sampling for the one-year monitoring effort was conducted between 23 July and 28 August 2001. Survey operations consisted of the collection of vibracores, sediment-profile images and sediment grab samples from the Boston Harbor CAD cells. The coring survey was completed over eight cells in the Inner Confluence and Mystic River during the week of 23 July. The sediment-profile imaging survey was conducted 15-16 August aboard the M/V *Beavertail* over the same eight cells as the coring survey, as well as an additional cell in the Chelsea River. A benthic community assessment survey was conducted on 28 August aboard the vessel M/V *Monarch*, with sediment grab samples collected from REMOTS® stations that best represented benthic conditions within the cells.

2.1 Navigation and Positioning

Differentially-corrected Global Positioning System (DGPS) data in conjunction with Coastal Oceanographic's HYPACK® navigation and survey software were used to provide real-time navigation to an accuracy of ±3 m for each survey effort. A Trimble DSMPro GPS receiver was used to obtain raw satellite data and provide vessel position information in the horizontal control of North American Datum of 1983 (NAD 83). The DSMPro GPS unit also contains an integrated differential beacon receiver to improve overall accuracy of the satellite data to the necessary tolerances. The U.S. Coast Guard differential beacon broadcasting from Portsmouth, NH (288 kHz) was utilized for real-time satellite corrections due to its geographic position relative to Boston Harbor.

The DGPS data were ported to HYPACK® data acquisition software for position logging and helm display. The target stations for sediment grabs were determined before the commencement of survey operations and stored in a project database. Throughout the survey, individual stations were selected and displayed in order to position the survey vessel at the correct geographic location for sampling. All samples were collected within a 32 ft (10 m) radius of the target location. The position of each sample was logged with a time stamp in Universal Time Coordinate (UTC) and a text identifier to facilitate Quality Control (QC) and rapid input into a Geographic Information System (GIS) database for display use.

2.2 Vibracore Methods

2.2.1 Vibracore Field Survey

A series of sediment cores were collected in the CAD cells located in the Mystic River and the Inner Confluence in Boston Harbor as part of the one-year monitoring survey. The cores provided a visual cross-section of the dredged material deposited within these cells and aided in developing geotechnical profiles to verify the integrity of the individual caps. In accordance with the monitoring plan, 40 stations were selected within eight cells (M2, M4, M5, M8-11, M12, M19, IC, and the Super Cell) to assess the distribution of the various sediments within each cell (Figure 2-1). In an effort to obtain the proper number of valid sediment samples from Cell M19, three additional cores were collected, resulting in a project total of 43 cores. The geographic coordinates for each core are provided in Table 2-1.

The field collection efforts occurred between 23 and 26 July and consisted of obtaining vibracores using the OSI pontoon-coring boat M/V *CAN-DO*. An OSI Model 1500 pneumatic vibratory corer attached to a 20 ft (6 m) steel barrel (3.7 in.; 9.5 cm I.D.) vibratory coring device was used to collect the cores due to its superior ability to acquire samples through the more compact sand cap (Figure 2-2). In this type of coring, the corer is vibrated into the sediment using an air-driven hammer positioned at the top of the core barrel. All sediments were contained within a chemically inert, clear Lexane® liner (3.5 in.; 8.9 cm I.D.) that was fitted within the core barrel. A stainless steel core cutter and catcher assembly was secured to the end of the core barrel to aid in retaining the sediment sample (Figure 2-2).

The coring vessel was positioned directly over each target coring station via a multi-point mooring system. The vibracorer was lowered through the central moon pool of the vessel to the seafloor via a single, steel cable. Air supply and return lines attached to the vibratory head fed air from a deck-mounted compressor to activate the hammer and drive the coring device into the sediment. Exhaust air was then captured and ported to the surface to minimize disturbance of the surface sediments adjacent to the sampling location. Due to the shallow water, penetration was monitored via a tape measure stretching from the top of the vibracore unit to the work deck. Upon attaining an adequate penetration depth, the air supply was cut-off and the corer was extracted from the seafloor using a winch and placed on the deck of the vessel.

Upon retrieval of the vibracore, the internal plastic liner containing the sediment sample was removed from the core barrel. All cores were measured before being cut into 3.3 ft (1 m) sections, capped, taped to minimize water loss, and then labeled with station name, identification number, as well as top/bottom descriptors. The cores were transported to shore and stored vertically within a refrigerated truck at a constant temperature of 47°F until transported to the University of Rhode Island's Graduate School of Oceanography (GSO) rock and core lab for processing and sub-sample analysis.

2.2.2 Laboratory Analysis

2.2.2.1 Core Processing

Core processing procedures used for this investigation were identical to those employed in previous BHNIP CAD cell coring surveys conducted by SAIC (SAIC 2000). In the laboratory, all cores were split, visually described, and digitally photographed. Sediment sub-samples for geotechnical analyses were taken from each core by SAIC technicians and sent to GeoTesting Express in Boxborough, MA. The geotechnical analyses included bulk density, grain size, and Atterberg limits. Water content was also determined as a function of the Atterberg limit analysis. SAIC technicians conducted all shear strength analyses. Detailed descriptions of the various core-processing steps are provided in the following sections.

2.2.2.2 Core Splitting

Each core liner was scored horizontally using the GSO core splitter, consisting of two saws that cut either side of the core tube simultaneously. Care was taken to cut only the core liner and not the sediment. The scored core was then transferred to a laboratory table and the thin layer of remaining liner was cut using a utility knife. A thin piano wire was then used to split the sediment axially into two halves, by pulling the wire through the split core from top to bottom. Maintaining the integrity of the core was frequently challenging due to the relatively soft nature of the majority of the CAD cell sediment. Half of the core was used for detailed visual description and photography, while the other half was sub-sampled for the various geotechnical analyses.

2.2.2.3 Core Descriptions and Photography

After splitting, each core was carefully examined and described in detail by SAIC personnel. Significant changes in color, lithology, texture, water content, and odor were noted. Descriptive core logs were based on visual inspection and follow a standard SAIC modification of American Society for Testing and Materials (ASTM) Method D2488 for the description and identification of soils (visual procedure). The split cores were photographed with a mounted digital camera, using white light. The focal distance was kept constant so that a mosaic of the digital images could be compiled for a continuous view of the core. A centimeter scale was affixed to the core cradle to document core features and penetration depth in successive images.

2.2.2.4 Geotechnical Analysis of Cores

Sub-samples were analyzed using the following standard tests: bulk density (ASTM Method D2937), grain size (ASTM Method D422), and Atterberg limits (ASTM Method D4318 wet multi-point procedure). Technicians collected the sub-samples immediately after the cores were split to minimize the amount of water loss and disturbance to the material. Samples were sent to GeoTesting Express on ice to minimize odor and potential water loss.

Grain Size

The samples sent to GeoTesting Express for grain size were collected from 3.9 in. (10 cm) horizons of material. Samples were collected from the cores and placed in a Ziploc®

bag, sealed, labeled, and double bagged to prevent loss of material. The samples collected for grain size were primarily collected from core intervals comprised of visually-identified cap material, or areas of sand. In some cases an additional sample was collected just below the visually-identified cap and dredged material interface. No samples were collected from areas of Boston Blue Clay (BBC).

Atterberg Limits and Water Content

The samples sent to GeoTesting Express for Atterberg limits analysis were collected from 5.9 in. (15 cm) horizons of material. Samples were collected from a core half and placed in a Ziploc® bag, sealed, labeled, and double bagged to prevent loss of material. The Atterberg limit samples were collected from areas of low apparent sand content, at various depths within each core. Samples were collected from both above and below the apparent sand cap based on available sediment volume, however no samples were collected from areas containing BBC. Atterberg limit analysis results are reported as Liquid Limit (LL), Plastic Limit (PL), and the difference between the LL and PL, known as the Plasticity Index or PI of the sediment. Water content was determined for each Atterberg limit sample in the process of determining the LL and PL.

Bulk Density

Bulk density samples were extracted from the core using a small 10 cc volume cylinder. The plastic cylinder was placed in a sealed plastic bag to minimize oxidation and loss of sediment during shipment to GeoTesting Express. This was the same sample method utilized in previous CAD cell surveys and was determined to yield the most accurate bulk density results. Bulk density samples were collected from within the same 5.9 in. (15 cm) interval from which Atterberg limits samples were obtained.

Shear Strength

Vane shear sample analyses were performed by SAIC technicians using the Wykeham-Farrance International Laboratory Vane with motorized unit and a 12.7 × 24.5 mm vane. Vane selection was based on the soft nature of the sediment. Shear strength samples were collected at the same sample depth as bulk density samples and within the sample horizon for Atterberg limits. Samples were not collected in area of high sand content, due to the inability to determine valid shear strength results in sandy sediment. Samples were not collected in areas of Boston Blue Clay. The very soft nature of some surface sediment prevented accurate vane shear measurements from being obtained.

2.3 Sediment Grab Sampling

A series of sediment grab samples were collected on 28 August 2001 in the CAD cells. The purpose of the grab sampling was two-fold: 1) to ascertain the geotechnical conditions of the surface sediment and 2) to examine the benthic infauna population and diversity, supplementing the benthic community assessment information provided by the August 2001 sediment-profile imaging data.

In accordance with the monitoring plan, 12 stations were selected within six cells (M2, M5, M8-11, CR, IC and the Super Cell), as well as at two reference areas (MR-REF and IC-REF; Figure 2-3). Grab samples were distributed such that two samples were collected from the cells in the Chelsea River and Inner Confluence and four samples were distributed between the Mystic River cells (Cells M4, M12 and M19 were not sampled). Two grab samples were obtained at each of the 12 stations within Boston Harbor aboard the M/V *Monarch* operated by Normandeau Associates, Inc. A 0.04 m^2 Young-modified van Veen grab sampling device equipped with wooden doors to prevent over-penetration was used to obtain the sediment samples. The survey vessel was positioned over each target station using precision navigation (described in Section 2.1). Once on station, the grab was lowered to the harbor bottom via an electrical wench. One of the grab samples collected at each station was used for geotechnical (grain size and water content) analysis, while the second sample was used for benthic community assessment. The geographic coordinates of the sediment grab stations are provided in Table 2-2.

2.3.1 Geotechnical Analysis of Sediment Grabs

The sediment samples for grain size analysis were taken from the modified van-Veen grab sampler and placed in a Ziploc® bag, sealed, labeled, double bagged, placed on ice and delivered to GeoTesting Express for analysis. Samples were analyzed for grain size using ASTM Method D422 and for Water Content using ASTM Method D2216.

2.3.2 Benthic Community Assessment Field and Laboratory Methods

Grabs samples collected for benthic community assessment were sieved through a 0.5 mm mesh screen, and the organisms and residue retained on the screen were preserved in a Rose Bengal stained, buffered formalin solution. The samples were then transported to the laboratory facilities of Normandeau Associates Inc. Bedford, NH for species identification and enumeration. In the laboratory, the samples were inventoried against the Chain of Custody form. Each sample was washed through a 0.5 mm mesh screen and elutriated to separate heavy and light fractions of the sample for more efficient sorting. To facilitate sorting, samples that had heterogeneously sized residue and/or organisms were washed through a series of graduated sieves, with the finest sieve being 0.5 mm mesh.

Sorting of the entire sample was conducted using a dissecting microscope. Organisms removed from each sample were placed in vials and labeled by major taxonomic group. Each vial included an internal label with sample identification information. Information pertinent to further processing, as well as processor's initials, was recorded in the Sample Log Book. After completion, each sorted sample was checked to determine if the sample had been pre-selected for quality control re-sorting. Samples pre-selected for re-sorting were re-sorted by the Quality Control Supervisor, with results recorded on Quality Control Record Sheets. All completed samples were re-preserved with formalin and stored until project requirements were satisfied.

Normandeau taxonomists who specialize in various benthic infaunal groups had samples distributed to them for identification and enumeration. Organisms were identified to lowest practical taxon, usually genus or species. Specimens were placed in vials and preserved with 70% Ethanol. Data were recorded on laboratory data sheets and submitted for analysis following the identification of each sample. Samples to be re-identified for each taxonomist were randomly selected from the Sample Quality Control Log and distributed to a different taxonomist. Results were logged on Quality Control Record Sheets.

Quality control assessment of sorting and identification entailed the reprocessing of 10% of each technician's samples, with a target of at least 95% of the organisms removed or identified. Quality control of a sorter or taxonomist was performed on a batch basis of 10 samples. Taxonomists record each completed sample or portion of sample identified in the Sample QC Log and when all samples are completed, the QC Control supervisor randomly selects one sample from each batch of ten to be re-identified. Samples are re-identified by a different taxonomist and results are logged on Quality Control Record Sheets.

Results of the Quality Control Program are as follows: Sample (IC-REF-1B) was selected from the batch of 12 samples for sort QC. A total of 182 organisms were sorted and none were found during re-sorting, reflecting a 100% accuracy. Re-identification of the arthropod in sample M2-5B reflected 100% accuracy. The mollusca in sample IC5-B and the polychaeta in sample CR-2B were likewise re-identified, and the original identification found to be 100% accurate. Sorting and identification tasks met the quality control criteria for the project. Results of all QC checks were recorded on Quality Control Record Sheets and stored with the project file.

2.4 REMOTS® Sediment Profile Imaging

Sediment-profile imaging is a benthic sampling technique in which a specialized camera is used to obtain undisturbed, vertical cross-section photographs (profiles) of the upper 6 to 8 inches (15 to 20 cm) of the seafloor. This is a reconnaissance survey technique used for rapid collection, interpretation and mapping of data on physical and biological seafloor characteristics; it has been employed in estuarine, coastal and deep-sea environments worldwide for almost 20 years. Measurements obtained from sediment-profile images are used to characterize sediment types, evaluate benthic habitat quality, map disturbance gradients, and follow ecosystem recovery after disturbance abatement. This technique was first introduced under the name REMOTS® (Remote Ecological Monitoring Of The Seafloor), a registered trademark of Science Applications International Corporation (SAIC). REMOTS® is a formal and standardized technique for sediment-profile imaging and analysis, as described by Rhoads and Germano (1982; 1986). In generic terms, this sampling technique is often referred to as sediment-profile imaging (SPI) or sediment vertical profile imaging (SVPI).

2.4.1 Sampling Design

The REMOTS® survey was conducted August 15 and 16, 2001 aboard the M/V *Beavertail*. Sediment-profile images were collected at a total of 56 sampling stations located within nine CAD cells and two reference areas (Figure 2-4; Table 2-3). Six stations were occupied within each of the CAD cells and one station was occupied at each of the reference areas. The REMOTS® camera was lowered into the sediment multiple times at each sampling station to acquire three replicate sediment-profile images suitable for subsequent analysis. Color slide film was used and developed soon after the completion of each field day to verify proper equipment operation and image acquisition. Mud doors were attached to the camera's base frame to minimize over-penetration of the camera prism in the fine-grained sediments that were encountered at the majority of the CAD cells during survey operations.

2.4.2 REMOTS® Image Acquisition

A Benthos Model 3731 Sediment Profile Camera (Benthos, Inc., North Falmouth, MA) was used in this study (Figure 2-5). The camera is designed to obtain in situ profile images of the top 8 inches (20 cm) of sediment. Functioning like an inverted periscope, the camera consists of a wedge-shaped prism with a front faceplate and a back mirror mounted at a 45-degree angle to reflect the profile of the sediment-water interface facing the camera. The prism is filled with distilled water, the assembly contains an internal strobe used to illuminate the images, and a 35-mm camera is mounted horizontally on top of the prism. The REMOTS® camera is deployed from a vessel using a winch and overhead boom or A-frame. The prism assembly is moved up and down into the sediments by producing tension or slack on the winch wire. Tension on the wire keeps the prism in the up position, out of the sediments.

The camera frame is lowered to the seafloor at a rate of about 1 $m \cdot s^{-1}$ (Figure 2-5). When the frame settles onto the bottom, slack on the winch wire allows the prism to penetrate the seafloor vertically. A passive hydraulic piston ensures that the prism enters the bottom slowly (approximately 2.4 in./sec; 6 $cm \cdot s^{-1}$) and does not disturb the sediment-water interface. As the prism starts to penetrate the seafloor, a trigger activates a 13-second time delay on the shutter release to allow maximum penetration before a photo is taken. A Benthos Model 2216 Deep Sea Pinger is attached to the camera and outputs a constant

12 kHz signal of one ping per second; upon discharge of the camera strobe, the ping rate doubles for 10 seconds. Monitoring the signal output on board the survey vessel provides confirmation that a successful image was obtained. Because the sediment photographed is directly against the faceplate, turbidity of the ambient seawater does not affect image quality. When the camera is raised, a wiper blade cleans off the faceplate, the film is advanced by a motor drive, the strobe is recharged, and the camera can be lowered for another image.

2.4.3 REMOTS® Image Analysis

The REMOTS® images were analyzed with the full-color, SAIC Image Analysis System. This is a PC-based system integrated with a Javelin CCTV video camera and frame grabber. Color slides are digitally recorded as color images on computer disk. The image analysis software is a menu-driven program that incorporates user commands via keyboard and mouse. The system displays each slide on a color monitor while measurements of standard physical and biological parameters are obtained. Proprietary SAIC software allows the measurement and storage of data on up to 21 different variables for each REMOTS® image obtained. Automatic disk storage of all measured parameters allows data from any variables of interest to be compiled, sorted, displayed graphically, contoured, or compared statistically.

All measurements were printed out on individual data sheets for a quality assurance check by an SAIC Senior Scientist before being approved for final data synthesis, statistical analyses, and interpretation. The methods used for computer-based measurement of the key REMOTS® parameters discussed in this report are described in the following sections.

In general, three replicate REMOTS® images were obtained and analyzed at each sampling station. Analysis of three replicate images per station allows for characterization of any variability in benthic habitat conditions that may exist at relatively small spatial scales (i.e., on the order of a few meters between individual camera drops). For mapping purposes, the measured values for the three replicate images at each station were averaged. Mapping of the station average values is useful for characterizing the larger-scale spatial patterns in seafloor conditions existing within each surveyed area.

2.4.3.1 Sediment Type Determination

The sediment grain-size major mode and range are estimated visually from the REMOTS® images by overlaying a grain size comparator of the same scale. This comparator was prepared by photographing a series of Udden-Wentworth size classes (equal to or less than coarse silt up to granule and larger sizes) through the REMOTS® camera. Seven grain size classes are on this comparator: silt-clay (>4 phi), very fine sand (4 to 3 phi), fine sand (3 to 2 phi), medium sand (2 to 1 phi), coarse sand (1 to 0 phi), very coarse sand (0 to –1 phi), and granules or larger (<-1 phi). Table 2-4 is provided to facilitate conversions between phi units and other commonly employed grain size scales. The lower limit of optical resolution of the photographic system is about 62 microns (4 phi), allowing recognition of grain sizes equal to or greater than coarse silt. The accuracy of this method has been documented by comparing REMOTS® estimates with grain size statistics determined from laboratory sieve analyses.

The major modal grain size that is assigned to an image is the dominant grain size as estimated by area within the imaged sediment column. In images that show distinct stratigraphy (i.e., layering) of sediments having different grain size major modes (e.g., a layer of sand over a layer of mud or vice versa), the dominant major mode assigned to the image depends on how much area of the photograph is represented by one sediment type versus the others. In such cases, the textural assignment may or may not correspond to traditional sieve analyses depending on how closely the vertical sampling intervals are matched between the grab or core sample and the depth of the imaged sediment. Layering is noted as a comment within each REMOTS® image analysis data file, and the thickness of different layers is measured. The presence of different sedimentary layers in REMOTS® images typically indicates that a depositional event has occurred (e.g., a sand cap placed on top of fine-grained dredged material). Changes in the thickness of surface depositional layers over time can be used to estimate deposition rates.

2.4.3.2 Prism Penetration Depth

The optical prism of the REMOTS® sediment-profile camera penetrates the bottom under a static driving force imparted by its own weight. The penetration depth into the bottom depends on the force exerted by the optical prism and the bearing strength of the sediment. If the weight of the camera prism is held constant, the change in penetration depth over a surveyed site will reflect changes in geotechnical properties of the bottom. In this sense, the camera prism acts as a static-load penetrometer. The depth of penetration of the REMOTS® camera prism can be used to map gradients in the bearing strength (hardness) of seafloor sediments. Older, highly bioturbated and/or sediments comprised primarily of silts and clay tend to be soft and allow deeper penetration than sediments with a higher sand content, which tend to create resistance to camera penetration.

2.4.3.3 Surface Boundary Roughness

Small-scale surface boundary roughness is measured from an image with the computer image analysis system. This vertical measurement is from the highest point at the sediment-water interface to the lowest point. This measurement of vertical relief is made within a horizontal distance of 6 inches (15 cm) (the total width of the optical window). Because the optical window is 8 inches (20 cm) high, the greatest possible roughness value is 8 inches (20 cm). The source of the roughness is described if known. In most cases this is either biogenic (mounds and depressions formed by bioturbation or foraging activity) or relief formed by physical processes (ripples, scour depressions, rip-ups, mud clasts, etc.).

2.4.3.4 Infaunal Successional Stages

It is emphasized that the following discussion of REMOTS® infaunal successional stages applies only to soft-bottom habitats, where the REMOTS® camera is able to penetrate into the sediment. In hard bottom environments (i.e., rocky substrates), camera penetration is prevented and the standard suite of REMOTS® measurements cannot be made. In such instances, the infaunal successional stage is considered to be "indeterminate." It is important to note that hard bottom areas can support abundant and diverse epibenthic communities and therefore may represent habitat which is biologically productive or otherwise is of value as refuge or living space for organisms. However, it is stressed that the value of hard bottom habitats is not reflected in the REMOTS® successional stage designation.

The mapping of successional stages is based on the theory that organism-sediment interactions in fine-grained sediments follow a predictable sequence after a major seafloor perturbation (e.g., passage of a storm, disturbance by bottom trawlers, dredged material deposition, hypoxia). The theory states that primary succession results in "the predictable appearance of macrobenthic invertebrates belonging to specific functional types following a benthic disturbance. These invertebrates interact with sediment in specific ways. Because functional types are the biological units of interest, our definition does not demand a sequential appearance of particular invertebrate species or genera" (Rhoads and Boyer 1982). This theory is formally developed in Rhoads and Germano (1982) and Rhoads and Boyer (1982).

The term disturbance is used here to define natural processes, such as seafloor erosion, changes in seafloor chemistry, and foraging disturbances which cause major reorganization of the resident benthos; disturbance also includes anthropogenic impacts, such as dredged material or sewage sludge disposal, thermal effluent from power plants, bottom trawling, pollution impacts from industrial discharge, excessive organic loading, etc. An important aspect of using this successional approach to interpret benthic monitoring results is relating organism-sediment relationships to the dynamical aspects of end-member successional stages (i.e., Stage I, II, or III communities as defined in the following paragraphs). This involves deducing dynamics from structure, a technique pioneered by R. G. Johnson (1972) for marine soft-bottom habitats. The application of this approach to benthic monitoring requires in situ measurements of salient structural features of organism-sediment relationships as imaged through REMOTS® technology.

Pioneering assemblages (Stage I assemblages) usually consist of dense aggregations of near-surface living, tube-dwelling polychaetes (Figure 2-6); alternately, opportunistic bivalves may colonize in dense aggregations after a disturbance (Rhoads and Germano 1982, Santos and Simon 1980a). These functional types are usually associated with a shallow redox boundary; bioturbation depths are shallow, particularly in the earliest stages of colonization (Figure 2-6). In the absence of further disturbance, these early successional assemblages are eventually replaced by infaunal deposit feeders; the start of this "infaunalization" process is designated arbitrarily as Stage II. Typical Stage II species are shallow dwelling bivalves or, as is common in New England waters, tubicolous amphipods. In studies of hypoxia-induced benthic defaunation events in Tampa Bay, Florida, ampeliscid amphipods appeared as the second temporal dominant in two of the four recolonization cycles (Santos and Simon 1980a, 1980b).

Stage III taxa, in turn, represent high-order successional stages typically found in low-disturbance regimes. These invertebrates are infaunal, and many feed at depth in a head-down orientation (Figure 2-6). The localized feeding activity results in distinctive excavations called feeding voids. Diagnostic features of these feeding structures include a generally semicircular shape with a flat bottom and arched roof, and a distinct granulometric change in the sediment particles overlying the floor of the structure. This granulometric change is caused by the accumulation of coarse particles that are rejected by the animals feeding selectively on fine-grained material. Other subsurface structures, such as burrows or methane gas bubbles, do not exhibit these characteristics and therefore are quite distinguishable from these distinctive feeding structures. The bioturbational activities of these deposit-feeders are responsible for aerating the sediment and causing the redox horizon to be located several centimeters below the sediment-water interface. In the retrograde transition of Stage III to Stage I, it is sometimes possible to recognize the presence of relic (i.e., collapsed and inactive) feeding voids.

The end-member stages (Stages I and III) are easily recognized in REMOTS® images by the presence of dense assemblages of near-surface polychaetes (Stage I) or the presence of subsurface feeding voids (Stage III; Figure 2-6). The presence of tubicolous amphipods at the sediment surface is indicative of Stage II. It is possible for Stage I polychaetes or Stage II tubicolous amphipods to be present at the sediment surface, while at the same time, Stage III organisms are present at depth within the sediment. In such instances, where two types of assemblages are visible in a REMOTS® image, the image is designated as having either a Stage I on Stage III (I-III) or Stage II on Stage III (II-III) successional state. Additional information on REMOTS® image interpretation can be found in Rhoads and Germano (1982, 1986).

2.4.3.5 Apparent Redox Potential Discontinuity (RPD) Depth

Aerobic near-surface marine sediments typically have higher reflectance values relative to underlying anoxic sediments. Sand also has higher optical reflectance than mud. These differences in optical reflectance are readily apparent in REMOTS® images; the oxidized surface sediment contains particles coated with ferric hydroxide (an olive color when associated with particles), while reduced and muddy sediments below this oxygenated layer are darker, generally gray to black (Figure 2-6). The boundary between the colored ferric hydroxide surface sediment and underlying gray to black sediment is called the apparent redox potential discontinuity (RPD).

The depth of the apparent RPD in the sediment column is an important time-integrator of dissolved oxygen conditions within sediment pore waters. In the absence of bioturbating organisms, this high reflectance layer (in muds) will typically reach a thickness of 2 mm (Rhoads 1974). This depth is related to the supply rate of molecular oxygen by diffusion into the bottom and the consumption of that oxygen by the sediment and associated microflora. In sediments that have very high sediment-oxygen demand, the sediment may lack a high reflectance layer even when the overlying water column is aerobic.

In the presence of bioturbating macrofauna, the thickness of the high reflectance layer may be several centimeters. The relationship between the thickness of this high reflectance layer and the presence or absence of free molecular oxygen in the associated pore waters must be made with caution. The boundary (or horizon) which separates the positive Eh region (oxidized) from the underlying negative Eh region (reduced) can only be determined accurately with microelectrodes. For this reason, we describe the optical reflectance boundary, as imaged, as the "apparent" RPD, and it is mapped as a mean value.

The depression of the apparent RPD within the sediment is relatively slow in organic-rich muds (on the order of 200 to 300 micrometers per day); therefore, this parameter has a long time constant (Germano and Rhoads 1984). The rebound in the apparent RPD is also slow (Germano 1983). Measurable changes in the apparent RPD depth using the REMOTS® optical technique can be detected over periods of one or two months. This parameter is used effectively to document changes (or gradients) which develop over a seasonal or yearly cycle related to water temperature effects on bioturbation rates, seasonal hypoxia, sediment oxygen demand, and infaunal recruitment.

Another important characteristic of the apparent RPD is the contrast in reflectance values at this boundary. This contrast is related to the interactions among the degree of organic-loading, bioturbational activity in the sediment, and the levels of bottom-water dissolved oxygen in an area. High inputs of labile organic material increase sediment oxygen demand and, subsequently, sulfate reduction rates (and the abundance of sulfide end-products). This results in more highly reduced (lower reflectance) sediments at depth and higher RPD contrasts. In a region of generally low RPD contrasts, images with high RPD contrasts indicate localized sites of relatively high past inputs of organic-rich material (e.g., organic or phytoplankton detritus, dredged material, sewage sludge, etc.).

2.4.3.6 Organism-Sediment Index (OSI)

The multi-parameter REMOTS® Organism-Sediment Index (OSI) has been constructed to characterize habitat quality of soft-bottom benthic environments. Habitat quality is defined relative to two end-member standards. The lowest value is given to those bottoms which have low or no dissolved oxygen in the overlying bottom water, no apparent macrofaunal life, and methane gas present in the sediment (see Rhoads and Germano 1982, 1986, for REMOTS® criteria for these conditions). The OSI for such a condition is -10. At the other end of the scale, an aerobic bottom with a deep RPD, evidence of a mature macrofaunal assemblage, and no apparent methane gas bubbles at depth will have an OSI value of +11.

The OSI is a sum of the subset indices shown in Table 2-5. The OSI is calculated automatically by SAIC software after completion of all measurements from each REMOTS® image. The index has proven to be a useful parameter for mapping disturbance gradients in an area and documenting ecosystem recovery after disturbance (Germano and Rhoads 1984; Revelas et al. 1987; Valente et al. 1992).

The OSI may be subject to seasonal changes because the mean apparent RPD depths vary as a result of temperature-controlled changes in bioturbation rates and sediment oxygen demand. Furthermore, the successional status of a station may change over the course of a season related to recruitment and mortality patterns or the disturbance history of the bottom. The sub-annual change in successional status is generally limited to Stage I (polychaete-dominated) and Stage II (amphipod-dominated) taxa. Stage III communities tend to be maintained over periods of several years unless they are eliminated by increasing organic loading, extended periods of hypoxia, or burial by thick layers of dredged material. The recovery of Stage III communities following abatement of such events may take several years (Rhoads and Germano 1982).

Generally speaking, in the areas sampled, mid-summer (July-August) is considered to be the period of time when ecological responses to pollution exposure are likely to be most severe. During mid-summer, dissolved oxygen concentrations are most likely to approach stressful low levels, and the adverse effects of contaminant exposure are generally greatest at the low dilution flows and high temperatures that occur at this time of year.

In summary, the Organism-Sediment Index (OSI) is a metric which defines overall benthic habitat quality in soft-bottom environments by reflecting the depth of the apparent redox layer, successional stage of infauna, the presence/absence of methane gas in the sediment, and the presence/absence of reduced (i.e., anaerobic) sediment at the sediment-water interface (Table 2-5). OSI values less than +3 are considered to be indicative of degraded habitat quality, values between +3 and +6 are considered to be reflective of intermediate quality (i.e., moderately degraded or recently disturbed), and values greater than +6 are considered indicative of non-degraded or healthy benthic habitat quality.

3.0 RESULTS

3.1 Vibracore Results

Core descriptions, digital images, geotechnical analysis, and shear strength results are presented below. All grain size classifications included in the core descriptions are based on visual inspection following standard core descriptive techniques, however a level of subjectivity exists with each description. Appendix A includes the visual description logs for each core described and one representative core image from each cell. Appendix B contains core specific grain size distribution tables, while Appendix C contains the detailed geotechnical results. Foam plugs were used while cutting the cores down in an effort to maintain sample integrity and prevent surface water in the core liner from mixing with the soft surface sediments, but the descriptions have been recorded excluding these plugs.

3.1.1 Descriptive Core Results

3.1.1.1 Phase 1: Conley Terminal

The Inner Confluence CAD cell was completed in 1997 and was the first CAD cell in Boston Harbor (Figure 2-1). The 1997 survey results indicated that the majority of the CAD cell had been capped with a highly variable thickness of sand, and the southern end of the cell had little or no cap material (ENSR 1997; SAIC 1997). The Inner Confluence CAD cell that resulted from the initial construction attempt contained layers of dredged material intermixed with the both clean cap and sand mixed with the black clayey dredged material. The northern end of the cell was the focus of the Summer 2001 survey. Five vibracores were collected from the CAD cell; three of these cores (IC-1, IC-2 and IC-3) were located in positions where cores had reportedly been collected as part of the 1997 survey. However, all three of these cores consisted primarily of Boston Blue Clay (BBC) and were likely collected on the fringe or outside the CAD cell. It is presumed that the reported sampling locations for the cores collected in 1997 were in error due to inaccurate navigation information received from the DGPS positioning system utilized for that survey. Although the DGPS positioning system employed as part of the 2001 survey effort was considered more accurate, limitations in supplies and survey time prevented the field sampling crew from collecting additional samples in Cell IC. Cores IC-4 and IC-5 were selected randomly and contained sediment characteristic of the early CAD cells. Each core is described in detail below.

Cell IC

Core IC-1 was 12.25 ft (373.5 cm) long and was cut into four sections by the field team. The surface 5.2 in. (13 cm) of the core consisted of black, wet, very soft silty CLAY with a petroleum odor. The black silty CLAY was characteristic of the material placed in the CAD cells and found within Boston Harbor. Below this 5 inch (13 cm) layer of black material was solid BBC. It is believed that this core was collected outside of the IC CAD or on the very edge of the cell due to the limited volume of black sediment. No sub-samples were collected from this core.

Core IC-2 was 13 ft (396 cm) long and was cut into four sections by the field team. This entire core contained BBC. The BBC in the top 2 core sections contained a sewer like odor when removed from the core liner. This core was collected outside of the IC CAD cell and was not sub-sampled.

Core IC-3 was 11.9 ft (363 cm) long and was cut into four sections by the field team. The top 9 in. (23 cm) of the core consisted of black, wet, very soft silty CLAY with chunks of what appeared to be calcified coral or sponges. The material had a rock-like hardness, but was also porous and appeared to have a biological origin. From 9 in. (23 cm) to the end of the core (11.9 ft or 363 cm) was BBC. Due to the large quantity of BBC, this core was not utilized for analysis.

Core IC-4 was 13.9 ft (426 cm) long and was cut into four sections by the field team. This core was sampled for grain size, Atterberg limits, bulk density and shear strength. The top 28.4 in. (72 cm) of the core contained black silty CLAY varying from wet to moist and very soft to soft in texture. Below the soft material was an area of mixed silty CLAY and SAND extending from 28.4-34.3 in. (72-87 cm). This region, while black in color and accompanied by a petroleum odor, was more consolidated and contained a firm texture. A total of 23.6 in. (60 cm) of clayey SAND was located between 34.3 and 73.6 in. (87 and 187 cm), this sand band was split (46-61 in.; 117-157 cm) by a 15.8 in. (40 cm) band of black, firm silty CLAY. Below the sand band from 73.6-124.5 in. (187-316 cm) was a mixture of hard, well-consolidated silty CLAY and sandy CLAY with SILT and flecks of BBC. The remainder of the core (124.5-167.8 in.; 316-426 cm) contained BBC. This core appeared to contain a significant amount of cap material discolored from mixing with the dredged material in the CAD before reaching a depth at which the material was consolidated enough to support the sand.

Core IC-5 was 11.2 ft (344 cm) long and was cut into four sections by the field team. This core was sampled for grain size, Atterberg limits, bulk density and shear strength. The interval from 0-17.7 in. (0-45 cm) was dominated by black, silty CLAY of varying consistency and texture with softer wetter material at the surface. From 17.7-69.7 in. (45-177 cm) was a mix of material containing at least 50% SAND. From 21.7-31.1 in. (55-79 cm) was a combination of either silt and sand or clay and sand ranging from soft to firm in texture and black in color. From 31.1-39.4 in. (79-100 cm) was a band of yellowish brown SAND. This sand band was not mixed with any of the dredged material. From 39.4-69.7 in. (100-177 cm) was another region of mixed black, firm SAND and SILT followed by black silty CLAY from 69.7-106.3 in. (177-270 cm). The bottom 29.1 in. (74 cm) of the core (106.3-135.4 in.; 270-344 cm) contained BBC. This core appeared to contain a significant amount of cap material discolored by either mixing with the dredged material in the CAD or from sinking in the fluid-like dredged material until reaching a depth at which the underlying material was consolidated enough to support the sand. It also contains a clean layer of cap material that did not mix with the dredged material in the cell.

3.1.1.2 Phase 2; Step 1: CAD Cells M4, M5 and M12

CAD Cells M4, M5 and M12 were capped during the first round of Phase 2. The cap placement technique utilized over these cells was altered from the IC CAD cell approach, and the three cells capped during this step all indicated very different results. The cores collected from Cells M4 and M5 had similar results, as total lengths varied from 7.4-8.3 ft (226-253 cm) and two distinct sub-units existed in each core. A watery, unconsolidated surface layer with apparently no sand (2-4 ft thick) was detected over a second, more consolidated unit with increasing sand content down-core (SAIC 1999). The presence of a surficial aqueous layer was consistent with results of bar checks (12 lbs., 8 inch diameter) conducted in the cells, which suggested that the top few feet of the sediment consisted of low strength material (OSI 2000). Four cores collected in Cell M12 were similar in stratigraphy to the Cell M4 and M5 cores. However, two cores were collected from Cell M12 that contained a sand unit at the top of the core; core M12-4 with a thickness of 1.5 ft (46 cm) and M12-3 with 3.7 ft (113 cm). It was theorized that the cores did not offer sufficient penetration to accurately identify the degree to which the cap material penetrated into the fluid-like dredged sediment.

The 2001 vibracores were over 10 ft (3 m) in length, but many still did not penetrate into the ambient BBC. The cores for the 2001 survey were obtained from the same stations cored in the 1998 survey. The cores obtained in Cells M5 and M12 were labeled one through five. However, in Cell M4 no Core M4-4 was collected, instead M4-6 was collected (from previous survey Station 6) in order to keep the naming convention consistent with previous efforts. The five cores collected from each of the three cells all appeared to be more consolidated than the 1998 cores. A strong petroleum odor was detected in the underlying dredged material from all three of the cells. Core descriptions are listed by cell below.

Cell M4

Core M4-1 was 16.5 ft (503 cm) in length, cut into five sections, and contained 1 ft (31 cm) of dark gray and tan SAND. The sand cap was detected from 5.9-18 in. (15-46 cm), below a horizon of very dark gray to black, wet, very soft, silty CLAY 0-5.9 in. (0-15 cm). From 18-126.4 in. (46-321 cm) the core was homogeneous; very black, moist, soft silty CLAY with a sponge-like texture, characteristic of early CAD cell material. Very little difference was noted in the sediment type to the end of the core at 198 in. (503 cm), with the exception that it was more consolidated, soft to firm in texture and contained scattered BBC nodules. This core did not indicate the low level mixing many of the earlier cores indicated. This core was sub-sampled for Atterberg limits, bulk density and shear strength.

Core M4-2 was 16.3 ft (497 cm) in length and was cut into five sections. From 0-3.2 in. (0-8 cm) the core contained dark gray to black, wet, very soft silty CLAY. Under this surface layer of very soft material was a layer of clay material. From 3.2-13 in. (8-33 cm) the cap material consisted of dark gray to black SAND, however below this was an additional 3.5 in. (9 cm) of dark gray SAND. Resulting in an estimate of 1.2 ft (34 cm) of sand cap. The remainder of the core (13-176 in.; 33-447 cm) was relatively homogeneous silty CLAY with increasing consolidation (soft to firm) with depth. From 176-195.7 in. (447-497 cm) the sediment increased slightly in grain size to be considered a sandy silty CLAY, however the sand fraction was never distinct enough to estimate a percentage visually. This core was sub-sampled for Atterberg limits, bulk density and shear strength.

Core M4-3 was 17.2 ft (525.5 cm) in length, and contained 3.9 ft (119 cm) of sediment that could be considered cap material. The sand material noted in this core was more characteristic of the cores collected in previous surveys in that the SAND was highly mixed with the black silty CLAY and found at a considerable depth (125.6-172.4 in.; 319-438 cm). The core was cut into four sections with the top 2 sections (0-70 in.; 0-178 cm) containing relatively unconsolidated, black, wet, soft silty CLAY. From 70-125.6 in. (178-319 cm) there were traces of sand intermixed with black, moist, soft silty CLAY, with the majority of the sand detected below this interval (125.6-172.4 in.; 319-438 cm). From 172.4-206.9 in. (438-25.5 cm) the silty clay was more consolidated and took on a firm texture, while traces of both sand and gravel were still noted. This core was sub-sampled for Atterberg limits, bulk density and shear strength.

Core M4-5 was 15.6 ft (477 cm) long, cut into five sections and contained a 4.9 ft (151 cm) layer of mixed silty CLAY and SAND. The top 7.8 in. (20 cm) of the core contained black, wet, very soft silty CLAY on top of 36.6 in. (93 cm) of similar material increasing slightly in consistency while decreasing in water content. The silty clay was characteristic of CAD cell material capped in Phase 2 (step 1) and contained the sponge-like texture common in these cores. From 44.5-62.2 in. (113-158 cm) a trace of sand became apparent, and intermixed with the silty CLAY. From 62.2-121.7 in. (158-309 cm) the core contained mixed silty CLAY and SAND. This horizon was more consolidated (firm in texture) than the material above it. From 121.7-135.8 in. (309-345 cm) the core contained firm to hard consolidated silty CLAY. The remainder of the core (187 in.; 477 cm) contained BBC. The BBC in this core is believed to be ambient sediment. This core was sub-sampled for grain size analysis.

Core M4-6 was 17.9 ft (547 cm) in length and contained 2.9 ft (90 cm) of sand. The field team divided M4-6 into six sections for processing. The surface material extended from 0-50.4 in. (0-128 cm) and was primarily black, moist, silty CLAY with a consistency that went from very soft to soft-firm with depth. From 33.8-50.4 in. (86-128 cm) some sand was noted in the visual description, but silty CLAY remained the major mode. From 50.4-85.8 in. (128-218 cm) the core contained black sand. This horizon had apparently mixed with the silty clay during cap placement. From 85.8-113.8 in. (218-289 cm) was another region of black, firm, silty CLAY that did not appear to contain any sand. The bottom 113.8-215.4 in. (289-547 cm) of the core contained BBC and sand. The sand mixed within the BBC did not appear to originate from the cap material and was listed as ambient material. This core was sub-sampled for grain size analysis.

Cell M5

Core M5-1 was 15.5 ft (474 cm) in length and contained 2.9 ft (90 cm) of mixed clay and SAND. The core was cut into five sections for processing. Black, silty CLAY was present from 0-40.9 in. (0-104 cm), consolidating with depth. From 40.9-62.2 in. (104-158 cm), traces of sand were detected in the sediment, and it became firm. Below the sand, was silty CLAY to a depth of 86.2 in. (219 cm), this material was very well consolidated. From 115.4 in. (293 cm) to the end of the core (176 in.; 447 cm) the silty CLAY was intermixed with BBC flecks and nodules. One band of BBC was present from 144-152.8 in. (366-388 cm), however this was not considered basement material from the cell. This core was sub-sampled for Atterberg limits, bulk density and shear strength.

Core M5-2 was 16.5 ft (503 cm) in length and contained 5.8 ft (177 cm) of mixed silty clay and SAND. The core was split into five sections for processing. From 0-27.5 in. (0-70 cm) consisted of black, wet to moist, very soft to soft silty CLAY with some sand and gravel intermixed. The next 24.4 in. (62 cm) was a mix of black silty CLAY and SAND. Below 51.9 in. (132 cm) the proportion of silty clay decreased and to 97.3 in. (247 cm) the core was dominated by black SAND (115 cm). From 97.3-143.3 in. (247-364 cm) both silty CLAY and sand were noted, however BBC was also intermixed in this region. From 143.3-198 in. (364-503 cm) the core contained BBC. There was a lens of black silty clay from 155-198 in. (394-503 cm) indicating that this BBC may not be ambient material. This core was sub-sampled for Atterberg limits, bulk density and shear strength.

Core M5-3 was 16.1 ft (491 cm) long and contained 2.6 ft (80 cm) of black SAND. The core was sectioned into five pieces for processing. From 0-12.5 in. (0-32 cm) was black, soft, silty CLAY, of which the top 2.7 in. (7 cm) was extremely wet, indicating that the surface of the cell in this region remains fluid-like. From 12.5-49.6 in. (32-126 cm) the water content decreased and consistency increased yielding a black, moist, soft-firm silty CLAY with some sand followed by the 80 cm black SAND band. From 81-193.3 in. (206-491 cm) the black silty CLAY became intermixed with flecks and nodules of BBC, increasing the rigidity of the sediment. There was a band of BBC from 109.5-135 in. (278-343 cm). Ambient BBC was not obtained in this core. This core was sub-sampled for Atterberg limits, bulk density and shear strength.

Core M5-4 was 16.3 ft (497 cm) in length and contained 4.6 ft (142 cm) of black SAND. The core was divided into five sections for processing. The top 4.3 in. (11 cm) of the core contained black, wet, very soft silty CLAY, while from 4.3-70 in. (11-178 cm) included varying proportions of sand with the silty clay and was more consolidated. From 70-126 in. (178-320 cm) was black, hard silty SAND. The remainder of the core (126-196 in.; 320-497 cm) contained black silty CLAY intermixed with BBC. The amount of BBC increased with depth, but it was not considered basement material due to the mottling of black silty clay within the BBC. This core was sub-sampled for grain size and is considered a good representation of the average stratification within Cell M5.

Core M5-5 was 17.8 ft (545 cm) long and contained 8.1 ft (248 cm) of silty SAND. The core was sectioned into six pieces for processing and contained primarily consolidated or soft sediment. The top 6.2 in. (16 cm) of the core contained the highest water content and softest silty CLAY. The following 78 in. (199 cm) contained a variety of both sandy silty and silty sandy CLAY as well as a sponge-like texture. The SAND was black in color and dominated the core from 84.7-182.3 in. (215-463 cm). The last 36.2 in. (92 cm) of the core (182.3-214.6 in.; 463-545 cm) contained sandy silty CLAY with BBC flecks and nodules intermixed. There was no evidence that this core reached ambient sediment. This core was sub-sampled for grain size.

Cell M12

Core M12-1 was 14 ft (427 cm) in length and contained a mixed area of SAND and CLAY. The core was processed in four sections. This core was sub-sampled for Atterberg limits, bulk density and shear strength. The upper 46 cm of black, silty CLAY was wet and soft, indicating relatively unconsolidated material. The material from 18-39 in. (46-99 cm) was very similar with the exception that it also had traces of sand and the water content decreased allowing the consistency to be considered firm. Black, moist, soft-firm silty CLAY comprised the region from 39-82.3 in. (99-209 cm), while below to a depth of 89 in. (228 cm) sand was again present in trace amounts. Black silty CLAY dominated from 89-111.4 in. (228-283 cm), with very slight changes in color. The SAND concentration in this core was focused into the regions 89-121.3 in. (283-308 cm) and 143.7-168 in. (365-427 cm) both regions were well mixed with black silty CLAY. Between the two regions (121.3-143.7 in.; 308-365 cm) was a region with less sand that was classified as silty sandy CLAY. Ambient BBC was not obtained in this core.

Core M12-2 was 16.6 ft (508 cm) long, cut into five sections, and did not contain a clear sand cap. This core was sub-sampled for Atterberg limits, bulk density and shear strength. The top 12.1 in. (31 cm) of the core contained a very dark gray, wet, very soft silty sandy CLAY. Below this was a region of silty CLAY that extended to a depth of 81 in. (206 cm) and had a sponge-like texture. There was a pocket of silty sandy CLAY from 81-

84.6 in. (206-215 cm). The sand was not detected from 84.6-146 in. (215-371 cm) and the sponge-like texture returned. From 146 in. (371 cm) to the end of the core contained a mixed area of dark gray to black, moist, firm silty CLAY and SAND. This was the most sand detected and was located at the bottom of the core. The core did not penetrate into the ambient sediment (BBC).

Core M12-3 was15.5 ft (473 cm) in length, cut into five sections and contained 54.3 in. (138 cm) of mixed SAND and CLAY. This core was sub-sampled for Atterberg limits, bulk density and shear strength. The top 65.4 in. (166 cm) of very dark gray silty CLAY with trace sand. The silty clay decreased in water content from wet to moist with depth while increasing in consolidation from very soft to firm. From 65.4-73 in. (166-185 cm) the sand proportion increased slightly (15%). A band of firm silty CLAY was noted from 73-136 in. (185-345 cm) and contained a sponge-like texture. Three bands of mixed CLAY and SAND were noted from 96.5-101.2 in. (245-257 cm), 110-119 in. (280-303 cm) and 136.2-150.8 in. (346-383 cm). Between these bands of mixed CLAY and SAND were distinct SAND bands (101.2-110.3 in.; 257-280 cm and 119.3-136.2 in.; 303-346 cm). All of these horizons contained a minimum of 30% sand (based on visual inspection) and are included in the cap estimation of 54.3 in. (138 cm) of sand. Below the horizon containing sand was another region (150.8-181 in.; 383-460 cm) of very dark gray, firm silty CLAY. The remainder of the core (181-186 in.; 460-473 cm) contained BBC, believed to be ambient sediment.

Core M12-4 was 15.4 ft (470 cm) in length and contained mixed CLAY and SAND from 23.6-185 in. (60-470 cm) and was sub-sampled for grain size. This core was cut into five sections for processing and was described as very dark gray to black in color throughout. The top 30 in. (76 cm) of the core was described as soft while the remainder of the core was described as soft-firm. There were four horizons within the core that did not contain any sand: 0-23.6 in. (0-60 cm); 30-34.3 in. (76-87 cm); 36.6-113 in. (93-278 cm); and 113-120 in. (287-305 cm). The horizons located between the sand-free horizons contained a range of sand contents from approximately 30-80%: 23.6-30 in. (60-76 cm); 34.3-37 in. (87-93 cm); 109.5-113 in. (278-287 cm); 120-136.6 in. (305-347 cm); and 287-185 in. (347-470 cm). BBC nodules were noted from 176.4-185 in. (448-470 cm), mixed in with the silty CLAY and sand. Basement material was not reached.

Core M12-5 was 16.5 ft (503 cm) in length and contained a mix of CLAY and SAND from 5.6 ft (169 cm) to the bottom of the core (10.9 ft). The core did not contain BBC or basement sediment and was sub-sampled for grain size. The surface 0-14.5 in. (0-37 cm) of the core contained very dark gray, wet, soft silty CLAY. The only change noted with depth was a decrease in water content to a classification of moist. From 39-66.9 in. (99-170 cm) however the silty CLAY took on a sponge-like texture, characteristic of the dredged material from Phase 2 (step 1) of capping. The sponge-like texture was not present below any of the intervals containing sand. From 66.9-121.3 in. (170-308 cm) the sediment was primarily silty CLAY with 10-40% sand and a band of dark greenish gray silty CLAY from 112.6-116.5 in. (286-296 cm). Both CLAY and SAND were in equal proportions for the remainder of the core (121.3-200 in.; 308-508 cm).

3.1.1.3 Phase 2; Step 2: CAD Cells M2 and Super Cell

The capping of Cells M2 and the Super Cell was completed in November 1999. Cell M2 was part of an intensive geotechnical study conducted by SAIC for the U.S. Army Corps of Engineers Monitoring Completed Navigation Projects (MCNP) program which supplemented monitoring efforts by NAE and MassPort. The Super Cell was the largest CAD cell constructed in the Mystic River. Approximately 650 ft long and 500 ft wide, this cell occupies an estimated 325,000 ft^2 of the Mystic River bottom. Both cells were considered successfully capped with limited banding or mixing of dredged material within the final cap. The majority of the cap material placed in the cells remained at the surface of the cell. It was determined that Cell M2 contained a cap layer with an average thickness of 2 to 3 ft. The Super Cell contained a generally thicker cap with thickness ranging between 2 and 4 ft over the majority of the cell. There were some striations or banding of dredged material and sand believed to be a product of diapirs (SAIC 2000). Similar banding was noted in some of the Summer 2001 vibracores. The majority of the black dredged material below the cap contained a strong petroleum odor. However, the cap appeared to have maintained its stratigraphy and was considered to be continuous, with limited mixing.

Cell M2

Core M2-1 was 15 ft (459.5 cm) long with 2.8 ft (86 cm) of tan SAND mottled with some greenish black sand. The core was cut into five sections by the field team and sub-sampled for Atterberg limits, bulk density and shear strength. The top 6.7 in. (17 cm) of the core contained greenish black, wet-moist silty CLAY. Clean cap material was present from 6.7-40.6 in. (17-103 cm). Below the sand cap was 109.8 in. (279 cm) of black, silty CLAY with a sponge-like texture. This texture was noted in previous surveys and was presumed to be caused by methane production within the consolidating sediment. From 118.1-181 in. (300-459.5 cm), the majority of the material continued to be black, silty CLAY with varying amount of BBC flecked and lensed throughout. The silty CLAY was not consolidated beyond soft-firm until it was intermixed with significant BBC nodules. Ambient BBC was not obtained in this core.

Core M2-2 was 14.8 ft (451 cm) long and contained a total of 3.1 ft (94 cm) of SAND. The core was split into five sections for processing and sub-sampled for grain size analysis. The surface 5.9 in. (15 cm) of the core contained greenish black, wet, very soft silty CLAY. Below this surface sediment was 7.1 in. (18 cm) band of black, SAND. The coloration of the sand appeared to come from the surface material settling into the cap material. From 13-43 in. (33-109 cm) was a 30 in. (76 cm) band of yellowish brown to gray

SAND. This sand cap was considered clean and unmixed with the dredged material in the cell. Below the sand cap (43 in.; 109 cm) to the bottom of the core (177.6 in.; 451 cm) was an area of black, moist, soft-firm silty CLAY with varying levels of BBC. This sediment retained a slightly sponge-like texture in the upper strata, however, the quantity of BBC increased with depth from flecks to nodules, with three 7.9 in. (20 cm) bands at various depths. The silty clay surrounding the BBC increased in firmness, and the sponge-like texture was replaced with more consolidated, less pocked sediment. A solid band of BBC was not detected at the bottom of this core, indicating that it did not penetrate into ambient sediment.

Core M2-3 was 11.8 ft (359 cm) long, cut into four sections and contained the least amount of SAND cap collected in this cell (1.9 ft; 58.5 cm). The top 3.4 in. (8.5 cm) of the core contained black, wet, very soft silty CLAY, similar to the other cores collected in this cell. The yellowish brown, hard SAND cap was contained between 3.4 in. (8.5 cm) and 26.4 in. (67 cm). There was one band of silty CLAY in the cap from 13.4-16.5 in. (34-42 cm). From 26.4-134 in. (67-340 cm) was black, soft silty CLAY with a sponge-like texture and flecks of BBC. The quantity of BBC increased slightly with depth as flecks became small nodules. From 134-141.3 in. (340-359 cm) was ambient BBC. This core contained cap material, underlying dredged material, as well as ambient BBC.

Core M2-4 was 12.1 ft (370 cm) long with 3.1 ft (92 cm) of SAND cap. The core was cut into four sections in the field for processing. The surface 5.2 in. (13 cm) contained black, wet, very soft silty CLAY on top of 3.1 ft (92 cm) of yellowish brown and gray SAND. From 41.3-113.8 in. (105-289 cm) the core contained black, moist, soft silty CLAY with sponge-like texture and flecks of BBC. A small quantity of gravel was noted in this region. From 113.8 in. (289 cm) to the end (145.7 in.; 370 cm) of the core contained BBC. There was some banding of silty clay within the BBC from 125.2-144 in. (318-366 cm). The silty CLAY bands contained sand and some shell fragments, however, identifying this material as cap or a product of the original dredged material was not possible. It is believed that the core interval from 144-145.6 in. (366-370 cm) contained ambient BBC, but this cannot be confirmed.

Core M2-5 was 15.8 ft (481.5 cm) in length, cut into five sections and contained the greatest volume of SAND cap detected in a core from this cell (4 ft; 123 cm). The surface 7.9 in. (20 cm) contained black, wet, very soft silty CLAY on top of 48.4 in. (123 cm) of yellowish brown and gray SAND. Below 56.3 in. (143 cm) consisted of black silty CLAY with varying levels of BBC and gravel. The sediment became more consolidated with depth as the quantity of BBC increased. From 178.7-189.6 in. (454-481.5 cm), the core contained BBC. A lens of silty CLAY occurred from 181.9-185.8 in. (462-472 cm), with ambient BBC located below 185.8 in. (472 cm). Overall, this core contained cap, dredged sediment as well as ambient BBC.

Super Cell

Core SC-1 was 13.4 ft (407 cm) long and contained 3.2 ft (97 cm) of sand banded with silty clay. The core was divided into four sections by the field team. This core was sampled for grain size. The top 14 in. (35.5 cm) of the core was black, wet to moist, very soft to very soft silty CLAY. The interval from 14-19.9 in. (35.5-50.5 cm) was a band of greenish black to dark yellowish brown SAND, followed by an 3.2 in. (8 cm) band of the black silty CLAY before another band of greenish black to gray SAND (23-31.3 in.; 58.5-79.5 cm). From 31.3-47 in. (79.5-119.5 cm), as well as 58.3-96.5 in. (148.5-245.5 cm), was dominated by CLAY with various amounts of silt and sand altering the texture of the sediment, while the horizon from 47-58.3 in. (119.5-148.5 cm) contained a mix of CLAY and SAND. From 96.5-114.4 in. (245.5-290.5 cm) was dominated by greenish brown to gray SAND. The bottom of the core from 114.4-160.2 in. (290.5-407 cm) was again greenish black CLAY. This core did not appear to have penetrated into the ambient BBC layer.

Core SC-2 was 13 ft (398 cm) long and cut into four sections by the field team. This core was sampled for Atterberg limits, bulk density and shear strength at discrete locations, primarily below the cap material. One sample was collected above the sand for comparison. A total of 2.7 ft (83 cm) of SAND or SAND mixed with CLAY was noted throughout the core. There was no indication of yellow or tan sand in this core; all the sand was described as greenish black. The 0-6.3 in. (0-16 cm) horizon contained grayish black, moist, very soft silty CLAY. From 6.3-24 in. (16-61 cm) contained primarily SAND with a 5.1 in. (13 cm) band of CLAY from 11.8-17 in. (30-43 cm). From 24-40.6 in. (61-103 cm) was soft silty CLAY. A mix of SAND and CLAY dominated by SAND bands ranged from 40.6-77.6 in. (103-197 cm). From 77.6-93 in. (197-236 cm) was a region of silty CLAY without any indications of sand. From 93-100 in. (236-254 cm) was a solid band of black SAND. Below this sand band was black silty CLAY with the exception of 152.8-156.7 in. (388-398 cm) which was described as an olive brown, moist, hard CLAY, believed to be ambient BBC.

Core SC-3 was 13 ft (397.5 cm) long and contained 3.1 ft (94.5 cm) of dark gray to grayish brown SAND. This core was cut into four sections by the field team and sampled for grain size at four locations within the cap material and one just below the cap and dredged material interface. The surface (0-2 in.; 0-5 cm) of this core contained wet, very soft, silty CLAY. From 2-3.2 in. (5-8 cm) contained black, very soft silty CLAY with pockets of greenish gray CLAY. From 3.2-41.5 in. (8-105.5 cm) contained SAND, with only one 1.2 in. (3 cm) band of silty CLAY from 32.7-33.9 in. (83-86 cm). Below the sand was an area that contained black silty CLAY and both nodules and bands of BBC (41.5-148.4 in.; 105.5-377 cm). From 148.4 in. (377 cm) to the end of the core (156.5 in.; 397.5 cm) was solid BBC. This core was a good example of cap material over dredged material over ambient BBC.

Core SC-4 was 12.7 ft (388 cm) long and contained 1.3 ft (38 cm) of dark gray SAND. The field team cut the core into four sections prior to processing. This core was sampled for Atterberg limits, bulk density and shear strength. The top 2.8 in. (7 cm) of the core contained greenish gray silty CLAY while from 2.8-19.7 in. (7-50 cm) was SAND with a SILT band from 10.2-12.2 in. (26-31 cm). Below the sand cap (19.7-152.8 in.; 50-388 cm) was a mix of black, soft silty CLAY and BBC nodules. The black silty CLAY appeared more consolidated with depth. This core did not penetrate into the ambient BBC and only contained on band of BBC from 103.2-106 in. (262-269 cm).

Core SC-5 was 15.4 ft (467.5 cm) long, was cut into five sections, and contained 2.8 ft (84 cm) of SAND cap. This core was sampled for Atterberg limits, bulk density and shear strength. The surface 3.9 in. (10 cm) of the core contained a black, wet, very soft silty CLAY with a sulfur odor. From 3.9-15 in. (10-38 cm) the core contained a mix of SAND and CLAY as well as SAND and clayey SILT. A small band of black, silty CLAY extended from 15-24 in. (38-61 cm). While from 24-37 in. (61-94 cm) was greenish gray to tan SAND. The remainder of the core (37-184 in.; 94-467.5 cm) was well consolidated black, silty CLAY with scattered mussel shells and BBC. A solid band of BBC was not found at the bottom of the core indicating that the core did not penetrate ambient material.

3.1.1.4 Phase 2; Step 3: CAD Cells M8-11, M19 and Chelsea River (CR)

Cell M8-11 and M19 were capped in the final step of Phase 2 of the BHNIP. These cells were constructed over an area that had been originally designated for the construction of many smaller cells. However, due to the properties of the ambient Boston Blue Clay, the cells walls were capable of maintaining their structural integrity at a greater depth then predicted and fewer cells were needed. The changing of the boundaries for Cell M19 became a planning issue for the coring survey, in that SAIC was not in possession of the final cell boundaries during survey planning. Three of the original five target coring locations fell on the fringe of the final cell boundaries for M19. The anomalous results detected during core collection prompted a re-evaluation of sampling locations and the collection of three additional cores from the center portion of M19.

All the cores were split, photographed and described; however, due to the large proportions of BBC in three of the cores, sub-samples were not collected from the cores believed to be outside the cell boundary. The black dredged material in the cores contained a strong odor that was organic with petroleum undertones, the odor was not noticed in the sand at the surface of the core. The cores collected from within both M8-11 and M19 contained a distinct layer of clean sand over top of the dredged material. Neither cell contained the soft surface material on the surface of the core that was seen in cores collected from all the other cells. The cap in M8-11 ranged from 2.8 to 4.1 ft, while M19 cap thickness ranged from 2.2 to 4 ft.

Cell M8-11

Core M8-11-1 was 13.9 ft (424 cm) in length, cut into four sections and contained 1.9 ft (89 cm) of SAND at the surface of the core. This core was sub-sampled for Atterberg limits, bulk density and shear strength. The top 18.9 in. (48 cm) of sand was gray in color while from 18.9-35 in. (48-89 cm) was a yellowish brown to tan. There was no indication of the very wet soft surface material noted in many of the other cells. Below the cap, to a depth of 59.5 in. (151 cm) the black, firm sediment was described as a silty sandy CLAY with some scattered shell fragments. From 59.5-145.7 in. (151-370 cm) the core contained black, moist, soft-firm silty CLAY. This material was well consolidated. The remainder of the core (145.7-167 in.; 370-424 cm) contained BBC that was considered ambient.

Core M8-11-2 was 19.8 ft (602 cm) long, was cut into six sections and contained 3 ft (94 cm) of SAND mixed with shell fragments at the surface of the core. This core was sub-sampled for grain size. The top 20.9 in. (53 cm) of the core contained gray, moist hard SAND. Below the gray sand was 16.14 in. (41 cm) of yellowish brown to tan SAND. The remainder of the core was dominated by black firm silty CLAY with various proportions of sand (37-237 in.; 94-602 cm). The sand appeared to be of a slightly finer texture than that used in the cap and may be part of the original dredged material placed in this cell. There was a band of BBC extending from 54-102 in. (137-258 cm), but it was not considered basement material.

Core M8-11-3 was 16.2 ft (495 cm) in length, cut into five sections and contained 3.8 ft (115 cm) of SAND. The top 33 in. (84 cm) of the core contained gray SAND, while from 33-45.3 in. (84-115 cm) was a yellowish brown to tan SAND. The remainder of the core contained black, soft-firm silty sandy CLAY. The sediment was intermixed with some shell fragments, gravel as well as BBC flecks and nodules. Based on the degree of mixing and the distinction of the cap interface it was unlikely that the sand, gravel and shell fragments mixed in the lower regions of this core originated as cap. This core did not penetrate into ambient BBC and was sub-sampled for Atterberg limits, bulk density and shear strength. This core is considered a good representation of the stratification of sediments within Cell M8-11.

Core M8-11-4 was 10.4 ft (315 cm) in length was cut into three sections. This core contained 3.6 ft (110 cm) of SAND and was sub-sampled for grain size. The top 24.8 in. (63 cm) of the core contained gray SAND, while from 624.8-41.4 in. (3-105 cm) contained yellowish brown to tan SAND. This color layering was noted in other cores from this cell. From 41.4-43.3 in. (105-110 cm) was a region of black SAND that appears to have mixed with the surface of the dredged material. Below the SAND was a 13.4 in. (34 cm) band of black, soft silty CLAY on top of 67.3 in. (171 cm) of firm silty sandy CLAY intermixed with shell fragments and gravel. This core did not contain the BBC at the end to indicate basement sediment.

Core M8-11-5 was 16.2 ft (493 cm) in length was cut into five sections and contained the least amount of SAND detected in the M8-11 cores (2.3 ft; 69 cm). The top 27 in. (69 cm) of the core contained gray SAND there was no indication of mixing in this surface material. Immediately below the cap was a region of black, soft-firm silty CLAY with sand. It was unable to be determined if this sand originated from cap material. From 36.6-117 in. (93-297 cm) the black silty CLAY appeared to increase in water content while decreasing to a very soft consistency from soft-firm. The remainder of the core (117-194 in.; 297-493 cm) also contained sand, but it was slightly more consolidated then the material above it. This core did not penetrate ambient sediment and may have been collected in an area where a diapir formed during the initial cap placement. All other cores collected from this cell contained a layering of gray over yellowish brown sand this core however did not contain the layer of yellowish brown sand. It appears that the diapir occurred prior to the placement of the gray sand. This core was sub-sampled for Atterberg limits, bulk density and shear strength.

Cell M19

Core M19-1 was collected from the southeast corner of the cell wall. It was 15.6 ft (477 cm) in length was cut into five sections and aside from the top 9 in. (23 cm) contained all ambient BBC. The top 9 in. (23 cm) of the core contained gray, soft silty CLAY intermixed with both BBC and sand. This core was not sub-sampled.

Core M19-2 was collected from the southern cell boundary. The core was 14.1 ft (430 cm) in length was cut into four sections and contained 8.9 ft (270 cm) of ambient BBC as well as 1.4 ft (43 cm) of SAND. The surface sediment of the core extended from 0-16.9 in. (0-43 cm) and consisted of yellowish brown and gray SAND. Below the cap was a 3 cm region of firm sandy SILT. A 13.8 in. (35 cm) band of BBC was present to a depth of 30.1 in. (78 cm). Black, soft-firm silty CLAY was present from 30.1-63 in. (78-160 cm) and contained a sponge-like texture. This core was not sub-sampled, as it was believed to have been collected along of the cell boundary.

Core M19-3 was collected along the southern boundary of the cell; however, it contained ample material for sub-sampling and was thus sampled for Atterberg limits, bulk density and shear strength. The core was 12 ft (363 cm) in length, cut into four sections with the surface 9.8 in. (25 cm) of the core consisting of yellowish brown SAND. Below the sand cap was 6.3 in. (16 cm) of black, sandy silty CLAY. The material that extended from 16.2-39.4 in. (41-100 cm) was most unusual in that is was primarily black silty CLAY, however intermixed throughout the region were large quantities of rock-like material. The material is calcareous in nature and likely biological in origin. There was no indication that the corer had disturbed this coralline material in that it appeared to have been previously broken into many small parts. Below this region of rock the silty CLAY continued for 13.4 in. (34 cm) before BBC dominated the remainder of the core (52.8-143 in.; 134-363 cm).

Core M19-4 was also collected along the southern boundary of the cell, but contained 3.2 ft (97 cm) of yellowish brown SAND and was sub-sampled for grain size. From 38-67.3 in. (97-171 cm) the core contained black, silty SAND with coralline rock intermixed. From 67.3-97.6 in. (171-248 cm) the core contained slight color variations of BBC including a yellowish brown BBC. Silty SAND was present from 97.6-126.4 in. (248-321 cm) before the sediment returned to BBC (126.4-136.2 in.; 321-346 cm).

Core M19-5 was 9.7 ft (297 cm) and collected along the southern boundary of the cell. The core was not sub-sampled because it was believed to be collected outside the cell. From 0-1.6 in. (0-4 cm) consisted of black, wet, very soft silty CLAY. Below the thin layer of silty clay was a 8.3 in. (21 cm) horizon of black and gray hard SAND on top of 107 in. (272 cm) of BBC.

Core M19-16 was core was collected from the center portion of southeastern end of the cell and was 9.5 ft (291 cm) in length, was cut into three sections and sampled for Atterberg limits, bulk density and shear strength. The top 3.8 ft (116 cm) of the core contained yellowish brown and gray SAND. Black, soft-firm silty CLAY was present from 45.7-81 in. (116-206 cm). From 81.1-100.4 in. (206- 255 cm) was a mix of black silty CLAY with sand. The remainder of the core (100.4-114.6 in.; 255-291 cm) BBC and considered ambient sediment.

Core M19-17 was 14.7 ft (448 cm) in length, was cut into five sections and sampled for Atterberg limits, bulk density and shear strength. The core was collected from the center of the cell and contained 2.7 ft (82 cm) of yellowish brown and gray SAND at the surface, followed by 18.1 in. (46 cm) of black SAND and clay. From a depth of 50.4-107.9 in. (128-274 cm) the core contained black, silty CLAY with various sand and gravel proportions. The black silty CLAY intermixed with the coralline rock noted in core M19-3 and M19-4 was also present from 107.9-126 in. (274-320 cm). Dark gray soft-firm CLAY with silt was present for 15.7 in. (40 cm) before the sediment changed to BBC for the remainder of the core (141.7-176.4 in.; 360-448 cm). This core was considered a good representation of the stratification of sediments within Cell M19.

Core M19-18 was 12.8 ft (390 cm) in length, was cut into four sections and sub-sampled for grain size. This core was collected from the eastern side of the cell and contained 3 ft (94 cm) of yellowish brown to tan/gray SAND. Below the sand the sediment consisted of soft-firm silty CLAY with about 10% sand. A region of hard yellowish brown CLAY was noted from 63-69.3 in. (160-176 cm). Black silty CLAY with 20% sand was present until the corer penetrated BBC (77.6-153.5 in.; 197-390 cm). This BBC was considered ambient sediment. This core was considered a good representation of the stratification of sediments within Cell M19.

3.1.2 Laboratory Results

With the exception of shear strength analysis all samples were processed by GeoTesting Express, Boxbourgh, MA. SAIC technicians conducted shear strength analysis while processing the cores at the URI GSO Rock and Core Laboratory. Summary tables of the sediment grain size results are located in Appendix B. Detailed information pertaining to the remainder of the geotechnical analyses are presented in Appendix C.

3.1.2.1 Grain Size Results Conley Terminal

Cell IC

Core IC-4 was sampled at five intervals for grain size analysis (Figure 3-1A). Samples were collected between the penetration depths of 6.7 and 69.7 in. (17 and 177 cm) with variable amounts of sand present. Sample A was collected from 6.7-10.6 in. (17-27 cm) in an area described as silty clay. The grain size results indicate that this sample was dominated by silt (67%) with 23% clay and only 10% sand. The apparent sand cap was noted visually at 28.4 in. (72 cm) and was confirmed by grain size data indicating sample B (26.4-30.3 in.; 67-77 cm) contained 54% sand, 32% silt and 14% clay. The remaining three samples all indicated increases in sand content with depth (Figure 3-1A). Sample C (38.2-42.1 in.; 97-107 cm) contained 67% sand, 26% silt and 14% clay. Sample D (50-54 in.; 127-137 cm) contained 93% sand and 7% silt, while sample E (65.8-69.7 in.; 167-177 cm) contained 87% sand, 5% silt and 8% clay. The visual descriptions indicate that the majority of the sand ended at 73.6 in. (187 cm). Grain size data was not collected below 69.7 in. (177 cm) to confirm the bottom most depth in which sand was detected.

Core IC-5 was sampled at five intervals for grain size analysis (Figure 3-1B). Samples were collected between 19.3 and 66.5 in. (49-69 cm) and all contained greater then 60% sand. Core IC-5 was described as having sand from 25.2-69.7 in. (64-177 cm) or a total cap thickness of 1.4 ft (43 cm). This is confirmed by the grain size analysis. Sample C (33-37 in.; 84-94 cm) contained 100% sand, while samples A (19.3-23.2 in.; 49-59 cm), B (27.2-31.1 in.; 69-79 cm), D (44.9-48.8 in.; 114-124 cm) and E (62.6-66.5 in.; 159-169 cm) contained approximately 66% sand, 24% silt and 10% clay. These results indicate cap material was present at 66% or greater concentration over 17 in. (43 cm) of the sediment stratigraphy.

3.1.2.2 Grain Size Results CAD Cells M4, M5 and M12

Cell M4

Core M4-5 was sampled for grain size analysis at five intervals between 62.9 and 118.1 in. (160 and 300 cm; Figure 3-2A). Four of the five samples indicated sand concentrations over 50%, silt concentrations of 15-35% and clay concentrations less than

13%. Sample A was collected from 62.9-67 in. (160-170 cm) and contained a mix of clay (13%) silt (35%), and sand (52%). Sample B (78.7-82.7 in.; 200-210 cm) contained 60% sand, 31% silt and 9% clay. Interestingly, Sample C collected from 90.6-94.5 in. (230-240 cm) contained the least amount of sand (36%), 48% silt and 16% clay. The highest levels of sand were detected in Samples D and E, 102.4-106.3 in. (260-270 cm) and 114.2-118.1 in. (290-300 cm) respectively, with both samples containing over 70% sand and approximately 17% silt and both 9% clay (Figure 3-2A).

Core M4-6 was sampled at five intervals between 50.4 and 85.8 in. (128 and 218 cm) for grain size analysis (Figure 3-2B). All five samples contained greater then 60% sand while only Samples A, B and C contained clay (8-19%). The greatest sand concentrations were seen in Samples D (76-80 in.; 193-203 cm) and E (81.9-85.8 in.; 208-218 cm), 97% and 96% respectively. Sample C (68.1-72 in.; 173-183 cm) contained 86% sand, 6% silt and 8% clay, indicating that the greatest sand concentration was between 68 and 85.8 in. (173 and 218 cm).

Cell M5

Core M5-4 was sampled at five intervals for grain size analysis (Figure 3-3A). Sample A was collected from 34.5-37.4 in. (85-95 cm) and contained almost equal portions of silt and sand. Samples B (57-61 in.; 145-155 cm), C (72.8-76.8 in.; 185-195 cm), D (104-108.3 in.; 265-275 cm) and E (122-126 in.; 310-320 cm) contained greater then 60% sand, less then 30% silt and less then 11% clay. The grain size data indicates that sand cap was present over a greater depth range then that described in the visual descriptions. Based on grain size results core M5-4 contained sand at greater then 50% concentration from at least 57-126 in. (145-320 cm), indicating at least 69 in. (175 cm) of cap material.

Core M5-5 was sampled at five intervals between 43.3 and 177.2 in. (110 and 450 cm) for grain size analysis (Figure 3-3B). Sample A was collected from 43.3-47.3 in. (110-120 cm) and was dominated by 66% silt with 25% sand and 9% clay. The results for Samples B (70.9-74.8 in.; 180-190 cm) and D (104.3-108.3 in.; 265-275 cm) were similar, with approximately 65% sand, 30% silt, and 6% clay. Sample C (86.6-90.6 in.; 220-230 cm) contained significantly more sand (84%) and less silt (11%), however clay content remained low at 5%. Surprisingly, the deepest sample analyzed (E; 173.2-177.2 in.; 440-450 cm) contained the greatest amount of sand detected in this core (97%). The visual description of this core indicated sand from 51.2-182.3 in. (130-463 cm), with the majority of the sand between 84.6 and 182.3 in. (215 and 463 cm). Samples C, D and E confirm greater than 65% sand in this region of the core.

Cell M12

Core M12-4 was sampled a five intervals between 22.8 and 172.4 in. (58 and 438 cm) for grain size analysis (Figure 3-4A). Sample A (22.8-26.8 in.; 58-68 cm) contained the greatest sand concentration of all the samples, 68%. Sample A also contained 20% silt and 12% clay. The remaining four samples (B-E) contained a relatively even mix of silt and sand with percentages between the two modes only varying by 4-6%. The grain size results agree with the 'mixed' classification given in the visual description with an average of 46% sand and 48% silt for the majority of the core (23.6-185 in.; 60-470 cm).

Core M12-5 was sampled at five 3.9 in. (10 cm) intervals for grain size analysis (Figure 3-4B). Samples were collected between 52.8-182.7 in. (134 and 464 cm). Samples A (52.8-56.7 in.; 134-144 cm), B (76.4-80.3 in.; 194-204 cm) and C (137.4-141.3 in.; 349-359 cm) were dominated by silt (greater then 50%), followed by 16-21% clay and 0.5-27% sand. The grain size samples analyzed indicated sediment dominated by sand present from 151.2-182.7 in.; 384-464 cm. Sample D contained 50% sand, 38% silt and 12% clay, while sample E contained 71% sand, 21% silt and 8% clay.

3.1.2.3 Grain Size Results CAD Cells M2 and Super Cell

Cell M2

Core M2-2 was sampled at six 3.9 in. (10 cm) intervals for grain size analysis (Figure 3-5A). The deepest sample (F; 43.3-47.3 in.; 110-120 cm) was collected below the apparent cap interface. Figure 3-5A clearly indicates the difference between samples collected from within the cap and below the cap. Sample F was the only sample that contained clay at 21%. Sample F also contained 69% silt while the other five samples (A-E) contained between 3 and 6% silt. The sand content of sample F was only 10% while that of the other five samples ranged from 94-97%. The visual description log indicates that the upper 5.9 in. (15 cm) of this core contained silty clay, however, this material was not analyzed for grain size. Sample A was collected just below the softer surface material and based on grain size was clearly cap material. The grain size data confirms that the cap material ended at approximately 42.9 in. (109 cm), with a total cap thickness of 3 ft. (94 cm).

Core M2-5 was sampled at five intervals for grain size analysis. The visual descriptions included a surface layer of silty clay extending to a depth of 7.9 in. (20 cm) before the sediment type transitioned to cap material (96% sand, 7.9-11.8 in.; 20-30 cm). All five samples contained less then 5% silt and greater then 95% sand. Clay was not detected in any of the samples (Figure 3-5B). The grain size data supports the visual description indicating cap material from 7.9-56.3 in. (20-143 cm) or approximately 4 ft (123 cm) thick.

Super Cell

Core SC-1 was sampled at five intervals between 14 and 112.4 in. (35.5 and 285.5 cm; Figure 3-6A). All five samples (A-E) indicated sand concentrations of 90% or greater, with 10% or less silt and no clay detected. This core was described as banded and contained sand bands interlaced with bands of silty clay. The grain size samples were collected from these bands of sand. The banding extended to a depth of 114.4 in. (290.5 cm). Over the 100.4 in. (255 cm) of the core that were banded, a total of 3.1 ft (97 cm) contained sand while 5.2 ft (158 cm) contained silty clay. The grain size data do not illustrate this banding because the focus of the sampling effort was within the cap area or the bands of sand.

Core SC-3 was sampled at five 3.9 in. (10 cm) intervals between 2.8 and 42.1 in. (7 and 107 cm; Figure 3-6B). The upper 41.5 in. (105.5 cm) of this core consisted primarily of sand (3.1 ft; 94.5 cm) with some slight banding of silty clay. The five samples analyzed for grain size all indicated greater than 90% sand at all sample intervals. No clay was detected in any of the samples. Sample A (2.8-6.7 in.; 7-17 cm) contained the greatest amount of silt (10%). Sample C (26.4-30.3 in.; 67-77 cm) contained 99% sand. Overall the grain size data supports the visual descriptions indicating that the majority of the sand cap was located from 2.8-42.1 in. (7-107 cm).

3.1.2.4 Grain Size Results CAD Cells M8-11 and M19

Cell M8-11

Core M8-11-2 was sampled for grain size at four intervals above the apparent cap interface and one below (sample E, Figure 3-7A). The visual description of this core indicated sand from the surface (0 cm) of the core to a depth of 3 ft (94 cm). The grain size results confirm these descriptions. Samples A-D were collected from 2.8-36 in. (7-92 cm) and sample E was collected just below the apparent interface from 38.2-42.1 in. (97-107 cm). The sand content of samples A-D ranged from 94-97%, with clay absent and silt comprising less than 6% of the total sample. Sample E contained 34% sand, indicating some mixing below the apparent interface, while sample E was dominated by 49% silt and also contained 17% clay.

Core M8-11-4 was sampled at five intervals for grain size. Four samples (A-D) were collected above the cap interface and sample E was collected below the apparent interface. None of the samples contained any clay (Figure 3-7B). Samples A-D contained 0-4% silt and 94-100% sand. All of these samples were collected in the upper 3.6 ft (110 cm) of the core. Sample A was the surface-most sample and was collected from 3.9-7.9 in. (10-20 cm) and indicated similar characteristics to the deeper samples. A softer silty clay layer was not noted above the 3.9 in. (10 cm) sample interval. Sample E was collected just below the interface from 43.3-47.3 in. (110-120 cm) and only contained 12% sand indicating little mixing below the apparent interface. Sample E was dominated by silt (88%). Both visual descriptions and grain size results indicated the majority of the cap was located from the surface to a depth of 3 ft (94 cm).

Cell M19

Core M19-4 was analyzed at five 3.9 in. (10 cm) intervals for grain size (Figure 3-8A). Samples A-D were collected in what appeared to be continuous cap between 3.9 in. (10 cm) and 37.4 in. (95 cm). Sample E was collected just below the apparent interface in horizon described at silty sand that extended from 38.2-67.3 in. (97-171 cm). Samples A-D contained on average 98% sand and 2% silt. Sample E was also dominated by sand (82%) but also contained 13% silt and 5% clay. The grain size results indicate that the apparent cap interface extended to a greater depth then noted in the visual descriptions and analyzed for grain size. Additional sand was noted between 97.6-136.2 in. (248-346 cm); however, this sand was believed to have originated in the dredged material and not a portion of the cap. Grain size data indicates that the cap was homogenous in the upper 3.2 ft (97 cm) and then is intermixed to a depth of 67.3 in. (171 cm) with unknown sand concentrations below 42.9 in. (109 cm).

Core M19-18 was analyzed at five intervals for grain size (Figure 3-8B). Sample E (39.4-43.3 in.; 100-110 cm) was collected below the apparent cap interface and consequently contained 64% silt, 23% sand and 13% clay. The other four samples (A-D) were composites of 3.9 in. (10 cm) intervals of the core distributed between 3.9 and 35.4 in. (10-90 cm) of penetration. All four sample horizons contained between 99 and 100% sand. The sand cap was visually described as extensive from the surface to a depth of 3.1 ft (94 cm), which is supported by the grain size data.

3.1.3 Atterberg Limits, Bulk Density and Shear Strength

Select cores from each cell were sampled for Atterberg limits, bulk density and shear strength. Water content was derived in conjunction with the Atterberg limit analysis. The sampling plan focused on regions within each core below and occasionally above the apparent sand cap. Sand degrades the accuracy of Atterberg limit analysis and for this reason the region of the cap was avoided. Detailed results are included in Appendix C while summary results are listed below.

3.1.3.1 Conley Terminal

Cell IC

Core IC-4 was analyzed at five sampling intervals for Atterberg limits, water content, bulk density and shear strength. Sample A was collected above the apparent cap from 18.5-24.4 in. (47-62 cm). The liquid limit (LL) for this sample was 104, the plastic limit was 33 with a resulting PI of 70. The water content of this sample was 131%. The bulk density and shear strength were analyzed at 20.5 in. (52 cm), with a resulting wet density of 1.3 g·cc^{-1}

and a dry density of 0.6 g·cc^{-1}. The shear strength for Sample A was 1.08 kPa. Sample A contained the greatest proportion of water, highest LL, the lowest shear strength and least dense sediment out of the five samples analyzed from this core. Samples B (55.9-61.8 in.; 142-157 cm), C (73.6-77.6 in.; 187-197 cm), D (95.3-101.2 in.; 242-257 cm) and E (113-119 in.; 287-302 cm) had similar sediment characteristics. Wet density ranged from 1.5 to 1.6 g·cc^{-1}, while dry density ranged from 0.6 g·cc^{-1} (D) to 1.0 g·cc^{-1} (E). Water content was more variable, ranging from 57% (E) to 79% (B). LL was similar, ranging from 54 (E) to 73 (D) with PL ranging from 24 (E) to 31 (C and D). The resulting PI ranged from 31 (E) to 53 (C). Shear strength increased with depth from Sample A at 1.08 kPa to 7.02 kPa for both Samples C and D. Sample E was softer with a shear strength value of 4.32 kPa. Overall, this core indicated that the sediment was relatively consolidated with depth and consequently decreased in water content.

Core IC-5 was sampled at five intervals with Sample A collected above the cap interface. Sample A was a composite from 3.5-9.5 in. (9-24 cm), however, the majority of the sand in this core was present from 25.2-69.7 in. (64-177 cm). The most significant characteristic of Sample A was that it contained the highest water content (129%) and the lowest shear strength (0.54 kPa) of this core. Even so, the density and Atterberg limits of sample A were consistent with the remainder of the core. The average wet density was 1.6 g·cc^{-1} with a dry density of 0.8 g·cc^{-1} (A-E). LL ranged from 69 (B, 49-54.7 in.; 124-139 cm) to 79 (A). The PL ranged from 25 (E, 98-143.3 in.; 249-364 cm) to 29 (B), resulting in an average PI of 46 for this core. Shear strength was consistently between 2.16 and 3.78 kPa for Samples B through E. Overall, this core displayed a consistent stratigraphy, with only a slight elevation in water content at the surface of the core.

3.1.3.2 CAD Cells M4, M5 and M12

Cell M4

Core M4-1 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from below the apparent cap interface. Shear strength increased with depth from Sample A (1.08 kPa) to F (3.24 kPa). Samples A (23.6-29.5 in.; 60-75 cm) and B (39.4-45.3 in.; 100-115 cm) exhibited similar sediment characteristics, with higher water contents 103% (A) and 125% (B) and an average wet density of 1.35 g·cc^{-1} and dry density of 0.65 g·cc^{-1}. PI for Sample A was 58 and 64 for Sample B, the highest PI for this core. Samples C (67-72.8 in.; 170-185 cm), D (98.4-104.3 in.; 250-265 cm), E (137.8-143.7 in.; 350-365 cm) and F (177-183 in.; 450-465 cm) were similar with an average water content of 55%. Wet density ranged from 1.4 g·cc^{-1} (D) to 1.8 g·cc^{-1} (F) and dry density ranged from 0.8 g·cc^{-1} (D) to 1.5 g·cc^{-1} (E). The liquid limit for sample F was only 32 with a PL of 19 and a PI of 13. Conversely the average values for Samples C, D and E yield a LL of 64, PL of 29 resulting in a PI of 35. Overall, this core indicated sediment consolidating with depth.

Core M4-2 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All samples were collected from below the apparent sand cap. Shear strength was consistently 1.08 kPa for Samples A through D and 1.62 kPa for Samples E and F. Water content, LL, PL and PI decreased with depth. Sample A had the highest water content with 108% while Sample F was 35%. The LL decreased with depth from 83 to 40 while the PL decreased from 32 to 21 resulting in a decreasing PI of 51 to 19. Density was also consistent within this core with an average wet density of 1.7 $g{\cdot}cc^{-1}$ and an average dry density of 1.1 $g{\cdot}cc^{-1}$. Overall, this core indicated slightly more consolidated sediment at depth, with a similar sediment type.

Core M4-3 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All samples were collected from above the apparent sand cap due to the location of the majority of sand between 10.5 ft (319 cm) and the end of the core (17.3 ft; 525.5 cm). Shear strength increased with depth from 0.54 kPa (Samples A, B, C) to 2.70 kPa (Sample F). Samples A, B and C came from the upper 5.8 ft (178 cm) of the core and the sediment was described as wet. Overall, these samples are similar in density with an average wet density of 1.15 $g{\cdot}cc^{-1}$and a dry density of 0.55 $g{\cdot}cc^{-1}$. The major difference in these samples was the high water content and LL of Sample B, 135% and 102 respectively. Sample A had a water content of 77% while Sample C had 82%, and the liquid limits were 97 and 72 respectively. Samples D, E and F were more similar in water content (31-40%), LL (35-59), PL (17-27) and PI (18-33). However, the density steadily increased with depth from 1.8 $g{\cdot}cc^{-1}$ to 3.1 $g{\cdot}cc^{-1}$ (D to F) for wet and 1.3 $g{\cdot}cc^{-1}$ to 2.2 $g{\cdot}cc^{-1}$ for dry density. This material did not appear to have the same consistent consolidated characteristics of other sediment in Cell M4.

Cell M5

Core M5-1 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. Samples A and B were collected from above the apparent sand cap while Sample C was collected in a sandy cap region. Samples D through F were collected below the apparent cap (129-219 cm). Shear strength increased with depth from 0.54 kPa (Sample A) to 4.86 kPa (Sample F). There was no significant difference between samples collected above and below the apparent cap. The average water content was 76% with an average wet density of 1.6 $g{\cdot}cc^{-1}$ and a dry density of 1.0 $g{\cdot}cc^{-1}$. The average LL was 75, PL was 30 and a resulting average PI of 46. Sample C was collected from a sandier region of the core and contained significantly less water (35%) and thus also had a lower PI of 25. The wet and dry densities were almost identical, 0.6 $g{\cdot}cc^{-1}$ and 0.5 $g{\cdot}cc^{-1}$, respectively.

Core M5-2 was sampled at four intervals for Atterberg limits, water content, bulk density and shear strength. Samples A and B were collected from above the apparent sand cap while Sample C was collected from within the cap region and Sample D was collected below the cap. No significant difference was noted between Sample C and D. Shear strength for Sample A failed due to the high viscosity of the sample; however, the other 3 samples indicated increasing strength with depth from 0.27 kPa to 9.17 kPa. Sample A had the highest water content and LL at 158% and 104 respectively. Sample B had a water content of 99% and LL of 84. The density of Samples A and B were similar with an average wet density of 1.6 $g\cdot cc^{-1}$ and dry density of 0.6 $g\cdot cc^{-1}$. The average PI for Samples A and B was 55 and 45 for Samples C and D. Samples C and D had an average water content of 58% and a corresponding LL of 75. The average wet density of Samples C and D was 1.5 $g\cdot cc^{-1}$ and the dry density was 1.0 $g\cdot cc^{-1}$.

Core M5-3 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. Samples A, B and C were collected from above the apparent sand cap while Samples C, D and E were collected below the cap. The shear strength indicated a consistent increase in strength with depth from 0.54 kPa at the 7.5 in. (19 cm) to 2.97 kPa at 163 in. (414 cm). Though Sample C was collected above the cap the sediment characteristics were most similar to the samples collected below the cap. Samples A and B had significantly higher water content 172% and 136% and liquid limit, 109 and 112 respectively. Higher PI was also detected in Samples A and B, 70 and 76 respectively. With the exception of Sample C the density was consistent down core with an average wet density of 1.4 $g\cdot cc^{-1}$ and a dry density of 0.7 $g\cdot cc^{-1}$. Sample C had a higher dry density of 1.0 $g\cdot cc^{-1}$ and a wet density of 1.5 $g\cdot cc^{-1}$. The lower water content (56%) of Sample C added to the higher dry density indicated that the sample most likely contained a significant quantity of sand. However the LL, PL and PI indicated that there are still significant fine-grained sediments in Sample C due to the similarities in Atterberg limits with Samples D, E and F. Samples D through F had an average PI of 48 while Sample C had a PI of 50.

Cell M12

Core M12-1 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All the samples were collected from regions above the cap due to the location of the cap towards the lower portion of the core (114-168.1 in.; 289-427 cm). The shear strength indicated a consistent increase in strength with depth from 0.54 kPa at the 11.4 in. (29 cm; Sample A) to 3.24 kPa at 133.5 in. (339 cm; Sample F). The density of the sediment was consistently between 1.4-1.6 $g\cdot cc^{-1}$ wet and 0.7-1.0 $g\cdot cc^{-1}$ dry weight with no distinct relationship between depth, density or water content observed. Samples A (9.5-15.4 in.; 24-39 cm), D (92.1-98 in.; 234-249 cm) and E (106-111.8 in.; 269-284 cm) displayed water contents greater then 100%. Sample A had a water content of 113%, Sample D 102% and Sample E was 103%. Likewise, these samples had higher liquid limits (Sample A [91], D [99] and E [81]) resulting in a plasticity index that ranged from 54-61. The other samples collected from this core displayed a plastic index ranging from 41-50 and LL of 65-79 and lower water contents ranging from 64-89%. The lowest water content and highest dry density were detected in Sample F (133.5 in.; 339 cm) and are attributed to the higher sand concentration detected in the visual description of the sediment in the sample region.

Core M12-2 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. Samples A-E were collected from regions above the cap due to the location of the cap towards the bottom of the core (146-200 in.; 371-508 cm) however Sample F was collected from 165.4-171.3 in. (420-435 cm). The shear strength indicates a consistent increase in strength with depth from 1.08 kPa at the 23.6 in. (60 cm; Sample A) to 2.16 kPa at 167.3 in. (425 cm; Sample F). All but Sample F contained water contents greater then 100% (F was 76%). The highest water contents were detected in Samples C (90.5-96.5 in.; 230-245 cm) and E (137.9-143.7 in.; 350-365 cm) at 124%. On average the water content of the sediment in this core was 108%. The LL ranged from 67-95 with an average of 87. The PL ranged from 26 to 30 with a resulting PI ranging from 41-64. Liquid limit, plastic limit and the plasticity index did not indicate any trends associated with depth. The average wet 1.3 $g \cdot cc^{-1}$ and dry 0.7 $g \cdot cc^{-1}$ densities were consistent within the sediment sampled and did not display characteristics associated with depth, water content or Atterberg limits. Sample F was collected from the sandiest area of the core and contained a slightly higher dry density (0.8 $g \cdot cc^{-1}$) and lower water content (76%) associated with sandier sediments.

Core M12-3 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. Samples A-D were collected from regions above the cap due to the location of the cap towards the bottom of the core (96.5-150.8 in.; 245-383 cm). Samples E and F were collected from below the apparent cap at 156.7-162.6 in. (398-413 cm) and 174.4-180.3 in. (443-458 cm) respectively. A consistent increase in shear strength with depth was noted as values ranged from 0.54 kPa at the 20.8 in. (53 cm; Sample A) to 4.86 kPa at 176.4 in. (448 cm; Sample F). The overall sediment in the core was classified as highly mixed. Samples A and D came from regions described as containing 10% sand and may be attributed to the lower water content observed in these samples relative to the other samples collected above the sand cap. Sample A had a water content of 95 %, a LL of 78, PL of 28 resulting in a PI of 50. Overall the core had an average wet density of 1.4 $g \cdot cc^{-1}$ and a dry density of 0.7 $g \cdot cc^{-1}$ (including Sample A). Both Samples B and C came from a relatively sand free area of the core above the cap and displayed higher water contents, 116% and 106% respectively. Likewise the liquid and plastic limits were proportional, yielding an average PI of 52. Sample D was similar to Sample A in that it had 92% water content, a LL of 84, PL of 29 and PI of 56. Samples E and F indicated a decrease in water content, 84% and 79% respectively. These samples had identical PL of 31, a LL of 80 (E) and 88 (F) resulting in a PI of 49 (E) and 57 (F).

3.1.3.3 CAD Cells M2 and Super Cell

Cell M2

Core M2-1 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (6.7-40.5 in.; 17-103 cm). The shear strength of this core was variable with Sample A (51.2 in.; 130 cm) and F (131.9 in.; 335 cm) at 2.16 kPa, Sample C was 108 kPa while the remainder of the sediment was consistently 1.62 kPa. The density of the sediment was consistent and averaged 1.5 $g \cdot cc^{-1}$ for wet and 0.8 $g \cdot cc^{-1}$ for dry density. The water content, LL, PL, and PI all decreased with depth. The water content in Sample A was 114% while it steadily decreased to 62% in Sample F with an average of 84%. The LL decreased from 97 to 66, the PL from 37 to 28 while the PI decreased from 60 to 38.

Core M2-3 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (3.4-26.4 in.; 8.5-67 cm). The shear strength was consistent down core at 1.62 kPa. Density was also consistent down core and averaged 1.4 $g \cdot cc^{-1}$ wet and 0.7 $g \cdot cc^{-1}$ dry. The water content of the sediment indicated slight consolidation with depth as values decreased from 121% in Sample A (31.5 in.; 80 cm) to 74% in Sample F (124 in.; 315 cm). Both liquid limit and plastic limit also decreased with depth, yielding a decreasing PI from 59 in Sample A to 42 in Sample F. This core appeared to contain relatively homogenous material with little variation in sediment characteristics associated with depth or relationship to cap material.

Core M2-4 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (5.2-41.4 in.; 13-105 cm). The shear strength of this core was variable with Sample A (43.4 in.; 110 cm) displaying a value of 2.7 kPa and Sample E (102.4 in.; 260 cm) 2.16 kPa while the remainder of the sediment consistently yielded a value of 1.62 kPa. Water content, Atterberg limits and density do not illustrate the same randomness of the shear strength results. Density was consistent down core and averaged 1.4 $g \cdot cc^{-1}$ wet and 0.8 $g \cdot cc^{-1}$ dry. Water content steadily decreased with depth from 88% (Sample A) to 59% (Sample F). Likewise the LL, PL and PI all decreased with depth. The PI was 56 in Sample A and 39 in Sample F.

Cell SC

Core SC-2 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (6.3-100 in.; 16-254 cm) from areas of limited sand. The shear strength of this core was variable with Sample A (32.3 in.; 82 cm) 4.32 kPa and Sample E (140.5 in.; 357 cm) 3.78 kPa. Density was consistent with depth with an average wet density of 1.5 $g \cdot cc^{-1}$ and a dry density of 0.8 $g \cdot cc^{-1}$. The water content of the sediment decreased slightly with depth from 70% in

Sample A to 66% in Sample F. The LL, PL and PI are variable and reflective of the banding of the sediment noted in the visual description. Overall, LL ranged from 65-85, PL from 29-32 and a resulting PI ranging from 35-55. The banding noted in the core description indicated that the Atterberg limit analysis could have been affected by varying sand concentrations within each sample thus affecting the liquid limit.

Core SC-4 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (2-19.7 in.; 5-50 cm). The shear strength of this core was variable with the weakest Sample A 4.32 kPa collected at 25.3 in. (65 cm). Samples B through F ranged from 5.40 kPa (C) to 9.17 kPa (E) with no distinct patterns in strength. The water content of these samples was also variable with Samples A, B and F having the greatest percentage, 79%, 87% and 83% respectively. The other 3 samples were 68% (C), 55% (D), and 59% (E). The average LL was 64, the PL was 26 and the average PI was 38. The density of the sediment was consistent and ranged from 1.5 $g{\cdot}cc^{-1}$-2 $g{\cdot}cc^{-1}$ wet density and 0.8-1.2 $g{\cdot}cc^{-1}$ dry density.

Core SC-5 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (3.9-37 in.; 10-94 cm). The shear strength of this core was variable with the weakest Sample F at 1.35 kPa. Sample D had the highest shear strength at 5.4 kPa. The water content of these samples was also variable with Samples A at 99% and Sample F at 60%, the average for the core was 79%. Liquid limit, plastic limit and plasticity index were relatively consistent with average values of 68, 27 and 40.

3.1.3.4 CAD Cells M8-11 and M19

Cell M8-11

Core M8-11-1 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (0-35 in.; 0-89 cm). The shear strength of this core increased with depth from 1.62 kPa (Sample A, 36.2 in.; 92 cm) to 3.24 kPa (Sample F; 135.8 in.; 345 cm). The water content of this core decreased from 104% (Sample A) to 68% (Sample F). The overall density of the core was consistent with an average wet density of 1.4 $g{\cdot}cc^{-1}$ and a dry density of 0.8 $g{\cdot}cc^{-1}$. The LL, PL and PI were slightly variable. The PI ranged from 33 in Sample B (53.2-59 in.; 135-150 cm) to 59 in Sample E (118.1-124 in.; 300-315 cm). The average LL of this core was 72, PL was 28 and PI was 45.

Core M8-11-3 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (0-45.3 in.; 0-115 cm). The shear strength of this core was variable with the strongest sediments at Sample A, 2.16 kPa, and the weakest 1.08 kPa at Samples B, C, and E.

Samples D and F were 1.62 kPa. The water content of this core decreased from 104% (Sample A) to 48% (Sample F) with an average water content of 55%. The overall density of the core was consistent with an average wet density of 1.7 g·cc^{-1} and a dry density of 1.1 g·cc^{-1}. The LL, PL and PI were slightly variable. The PI ranged from 18 in Sample D (126-131.2 in.; 320-335 cm) to 58 in Sample A. The average LL of this core was 56, PL was 24 and PI was 32.

Core M8-11-5 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (0-27.2 in.; 0-69 cm). The shear strength of this core was variable with the highest value at 175.2 in. (445 cm) with a value of 7.55 kPa. The other samples collected from the core varied between 3.78-6.48 kPa. The water content of this core decreased from 100% (Sample A) to 82% (Sample F) with an average water content of 98%. Samples B and D were higher at 131% and 107%, respectively. This was a higher water content then noted in other cores from this cell. The overall density of the core was consistent with an average wet density of 1.4 g·cc^{-1} and a dry density of 0.7 g·cc^{-1}. The LL, PL and PI were slightly variable. The PI ranged from 40 in Samples E and F (133.9-139.8 in.; 340-355 cm and 173.2-179.1 in.; 440-455 cm respectively) to 56 in Sample B. The average LL of this core was 76, PL was 30 and PI was 47.

Cell M19

Core M19-3 was sampled at four intervals for Atterberg limits, water content, bulk density and shear strength. All four samples were collected from regions below the cap (0-9.8 in.; 0-25 cm). The shear strength of this core was highest just below the cap at 11.8 in. (30 cm) with a value of 4.32 kPa. The other samples collected from the core were all 1.62 kPa. The water content of this core increased with depth from 51% (Sample A) to 61% (Sample F) with an average water content of 55%. The overall density of the core was consistent with an average wet density of 1.6 g·cc^{-1} and a dry density of 1.0 g·cc^{-1}. The LL, PL and PI were slightly variable. The PI ranged from 24 in Samples B (19.7-25.6 in.; 50-65 cm) to 41 in Sample D (43.3-49.2 in.; 110-125 cm). The average LL of this core was 55, PL was 21 and PI was 35.

Core M19-16 was sampled at five intervals for Atterberg limits, water content, bulk density and shear strength. All five samples were collected from regions below the cap (0-45.3 in.; 0-115 cm). The shear strength result from this core displayed the same variability with the highest strength below the cap at 47.3 in. (120 cm) with a value of 3.24 kPa. The other samples collected from the core ranged from 2.16-2.70 kPa. The water content of this core was highest in the middle of the core, Samples B, C and D 108%, 114%, and 100%, respectively. Samples A and E both had a water content of 78%. The average water content of the core was 86% with Samples B through D having greater then 100%. The overall density of the core was consistent with an average wet density of 1.3 g·cc^{-1} and a dry density of 0.7 g·cc^{-1}. The highest LL analyzed was at Sample C (68.9-74.8 in.; 175-190 cm) with a LL of 110, a PL of 32 and a resulting PI of 79. Atterberg limits for this core were variable with LL ranging from 54-110, PL ranging from 22-32, and resulting PL of 32-79. The average LL of this core was 77, PL was 25 and PI was 53.

Core M19-17 was sampled at six intervals for Atterberg limits, water content, bulk density and shear strength. All six samples were collected from regions below the cap (0-50.4 in.; 0-128 cm). The shear strength of this core was slightly variable decreasing from 2.16 kPa just below the cap to 1.62 kPa in Sample F (128 in.; 325 cm). However, Sample E had the lowest shear strength with 0.54 kPa. The water content of this core increased with depth from 38% in Sample A (51.2-57 in.; 130-145 cm) to Sample E with 67%. The average water content of the core was 57%. The overall density of the core was consistent with an average wet density of 1.6 g·cc^{-1} and a dry density of 1.0 g·cc^{-1}. Sample A had a very low LL of 31 and a PL of 19, resulting in a PI of 12. This suggests that this sample may contain sand. The other samples collected from this core had LL between 49-72, PL ranged from 20-26 and the resulting PI ranged from 28-46. The average LL of this core was 55, PL was 22 and PI was 33.

3.2 Sediment Grab Results

3.2.1 Geotechnical Results

Surface sediment grab samples were visually described on the survey vessel prior to sub-sampling. Sediment grain size results are illustrated in comparison with neighboring cell grabs as well as the reference stations within the region (Figure 3-9). The grab sampling device utilized samples to a depth of 5.9 in. (15 cm). Detailed grain size and water content results are in Appendix B.

3.2.1.1 Conley Terminal Cell IC

Grab samples IC-2 and IC-5 were described as a dark brown, wet, soft, silty CLAY sediment surface layer (0.8-1.6 in.; 2-4 cm deep) over a black, wet, soft, clayey SILT. Grab IC-2 and IC-5 were analyzed for grain size and water content. The surface sediment (0-5.9 in.; 0-15 cm) of Cell IC consists primarily of clayey (25-34%) silt (59-69%) with a minor sand component (6-7%). Station IC-2 had a water content of 208% while IC-5 was 225%. These high water contents indicate a very soft, fluid like surface layer consisting of significant quantities of fine-grained sediments in Cell IC. The sediment in Cell IC appears to be slightly less sandy than the reference area in the Inner Confluence.

3.2.1.2 CAD Cell M5

The grab samples collected from M5-1 consisted of grayish-black, wet-moist, sandy SILT. Grab M5-1 indicated that the surface (0-5.9 in.; 0-15 cm) at the sample location consisted proportionately of silt (46%) and sand (43%) with 11% clay. M5-1 had a water content of 123%, slightly less than reference station water contents presumably due to the greater concentration of sand in the surface material of Cell M5.

3.2.1.3 CAD Cell M2

Grab samples collected from Cell M2 were described as a dark brown, wet, soft, silty CLAY sediment surface layer (0.8-1.6 in.; 2-4 cm) over a of black, wet, soft, clayey SILT. Grab M2-5 was collected from the western side of the cell in an area known to display silt diapirs. This sample indicated a surface dominated by silt (75%), clay (18%) and sand (7%). The water content of M2-5 was 217%, significantly higher than ambient values (173%). The higher water content can be attributed to the high concentration of fine-grained sediments. This sample may represent either new sediment accumulation on the cell surface or dredged material that rose to the surface of the cell during capping.

3.2.1.4 Cell SC

Grab samples collected from the Super Cell contained a dark brown, wet, soft, silty CLAY sediment surface layer (0.8-1.6 in.; 2-4 cm). Beneath the surface layer was a black, wet, soft, silty CLAY. Grab SC-4 was dominated by sand (74%). The silt and clay component at the surface of the cell was relatively minor at 16% and 10% respectively. The water content of the SC-4 sample (62%) was reflective of a sediment unable to retain water.

3.2.1.5 CAD Cell M8-11

Grab samples collected from Cell M8-11 consisted of shell fragments, blackish-gray, wet-moist sand, and contained a few amphipods. Grab M8-11 contained 75% sand, 16% silt and 9% clay and had a water content (65%) reflective of the high portion of sand at the surface of the cell.

3.2.1.6 Chelsea River Cell (CR)

A number of attempts were made to obtain grab samples from Cell CR however the majority were rejected due to twigs and clay catching in the jaws of the grab sampler. Grab samples successfully collected from the Chelsea River cell consisted of surface sediment described as dark brown, wet, sandy silt, with no visible organisms. The two grabs analyzed for grain size from the Chelsea River CR-2 and CR-4 both indicated very similar grain size characteristics. On average the surface of Cell CR contained 55% silt, 32% sand and 13%

clay. The water contents of these two samples were very different. CR-2 was 116% while CR-4 was 86%. CR-2 contained slightly (2%) less clay than CR-4 and 3% more silt, however this should not cause the 30% difference in water contents.

3.2.1.7 Mystic River Reference Stations

MR-REF1 and MR-REF2 were described as a dark brown, wet, soft, silty clay sediment surface layer from 0.8-1.6 in. (2-4 cm) on top of a layer of black, wet, soft, silty clay sediment. The two reference stations sampled were located in the Mystic River between M8-11 and M5 (Figure 2-1). MR-REF1 and MR-REF2 were very similar in geotechnical parameters. The Mystic River reference stations indicated an ambient surface dominated by 68% silt, and on average 14% sand and 18% clay. The average water content of the reference station sediment was 173%.

3.2.1.8 Inner Confluence Reference Stations

Grab samples were obtained at Stations IC-REF1 and IC-REF2. The samples consisted of shell fragments, blackish-gray, wet-moist sand and silt, and contained amphipods. The Inner Confluence reference stations were highly variable with one sample (IC-REF2) being dominated by 50% sand. Grab IC-REF2 also contained 37% silt and 13% clay. IC-REF1 was dominated by silt (69%) and also contained 10% clay and only 11% sand. The spatial variation in grain size within the Chelsea River appears to be significant.

3.2.2 Benthic Community Assessment Results

Following field washing, samples contained soft detrital material and variable amounts of sand. Representatives of the phyla Nematoda, Annelida and Arthropoda were each present at all stations except one (Table 3-1). Mollusca were present at seven stations, Bryozoa at three, Insecta and Urochordata at two and Entoprocta at one station. None of the stations had representatives from all nine phyla.

Species richness across the 12 stations totaled 41 discrete taxa. In some cases, damaged or small individuals could not be identified to species. These incompletely identified taxa were excluded from species richness when related individuals were present that could be identified more precisely. Of the unique taxa found, 14 were annelids, eight were arthropods, eight were molluscs and two were insects. Colonial cnidarians contributed two taxa, solitary cnidarians one taxa, and bryozoans contributed three. Other phyla, including nematodes, entoprocts, and urochordates were either represented by one species or were not further identified. The Inner Confluence Reference stations had the greatest taxa richness with 21 taxa at Station IC-REF-2B and 18 taxa at Station IC-REF-1B (Table 3-1). The Mystic River Reference stations had the lowest taxa richness with four taxa at MR-REF-2B and three taxa at MR-REF-1B. With the exception of M5-1B, where species richness was 4, and CR-2B, where species richness was 6, all of the CAD cell stations supported 10 or more species. The ten most abundant taxa at each station are listed in Table 3-2.

3.2.2.1 Cell IC

Grab sample IC-2B contained fourteen unique taxa including the phyla Nematoda (1), Annelida (6), Mollusca (4), and Arthropoda (3) (Table 3-1). The annelid Nephtyidae (20.8%), Nematoda (19.5%), and annelids *Streblospio benedicti* (14.3%) and *T. acutus*/Cirratulidae (14.3%) represented the dominant species at IC2-B, representing approximately 69% of the samples total abundance (77 organisms per 0.04 m ^{2}; Table 3-2). Of note is the presence of the bivalves *Yoldia limatula* (7.8%) and *Mytilidae* (3.9%), as well as the gastropod *Ilyanassa trivittata* (6.5%). IC2-B had the highest diversity (2.220) and evenness (0.841) of all CAD cells (Table 3-1).

Grab sample IC-5B contained fourteen unique taxa were present; including the phyla Nematoda (1), Annelida (8), Mollusca (3), and Arthropoda (2). The annelid *Streblospio benedicti* (22.7%), Nematoda (22.7%), and annelids *T. acutus*/Cirratulidae (19.3) and Nephthyidae (10.0%) represented the dominant species at IC5-B, accounting for 75% of the samples total abundance (150; Table 3-2). Of note is the highest annelid abundance (97) at all of the CAD cells. Diversity (2.080) and evenness (0.788) were high at IC5-B.

3.2.2.2 Cell M5

Grab M5-1B had four unique taxa; including the phyla Cnidaria (1), Nematoda (1), Arthropoda (1) and Insecta (1). Nematoda (72.7%) and the arthropod *Crangon septemspinosa* (18.2%) represented the dominant species at M5-1B, representing approximately 91% of the stations total abundance (11; Table 3-2). Of note was the absence of both annelids and molluscs and the presence of the dipteran *Chaoborus sp*. and the hydrozoan Campanularidae. Diversity was 0.760 with an evenness of 0.691 (Table 3-1).

3.2.2.3 Cell M2

Twelve unique taxa were present in grab sample M2-5B; including the phyla Anthozoa (1), Nematoda (1), Annelida (4), Mollusca (2), Arthropoda (3), and Insecta (1). M2-5B had the highest abundance (153) of all the disposal cells, with Nematoda representing 81.1% of the stations total abundance (Table 3-2). Of note is the presence of *Metridium senile*, an Anthozoan and *Anurida maritima*, a marine Collembola. The highest abundance of Nematodes (124) present among all CAD cells was at M2-5B and was likely responsible for the lowest evenness (0.334) among all CAD cells. Diversity was 0.830.

3.2.2.4 Cell SC

Fifteen unique taxa were present in grab sample SC-4B; including the phyla Nematoda (1), Annelida (9), Mollusca (3), and Arthropoda (2; Table 3-1). Nematoda (54.2%) and the annelids *T. acutus*/Cirratulidae (21.2%) represented the dominant species at SC-4B, accounting for approximately 75% of the stations total abundance (118; Table 3-2). Diversity was 1.570 and evenness 0.580.

3.2.2.5 Cell M8-11

Twelve unique taxa were present in grab sample M8-11-3B; including the phyla Nematoda (1), Annelida (6), Mollusca (4), and Arthropda (1). The annelids Polycirrus eximius/Polycirrus sp. (37.0%), Nematoda (30.1%) and the annelid *T. acutus* (12.3%) were the dominant species at M8-11-3B, representing approximately 79% of the stations total abundance (73; Table 3-2). M8-11-3B had the highest diversity (1.851) and evenness (0.745) of the Mystic River cells (Table 3-1).

3.2.2.6 Cell CR

Six unique taxa were present in grab sample CR-2B; including the phyla Nematoda (1), Annelida (3), Bryozoa (1) and Urochordata (1). Nematoda (50.0%) and the annelids *T. acutus*/Cirratulidae (31.6%) were the dominant species, representing approximately 82% of the cells total abundance (38; Table 3-2). Of note is the absence of molluscs and arthropods at the station and the presence of the bryozoan *Bugula sp*. and the urochordate Ascidiacea. Diversity was 1.221 and evenness 0.759 (Table 3-1).

Ten unique taxa were present in grab CR-4B; including the phyla Nematoda (1), Annelida (5), Arthropoda (1), Bryozoa (2) and Urochordata (1). Nematoda (50.0%) and the urochordate Ascidiacea (26.9%) were the dominant species at CR-4B, representing approximately 77% of the cells total abundance (78; Table 3-2). Of note was the absence of molluscs at the cell and the presence of the bryozoans *Bowerbankia gracilis* and *Bugula sp*. as well as the urochordate Ascidiacea. Diversity at CR-4B was a bit higher (1.392) than at the other Chelsea River stations, and evenness was a bit lower (0.669), likely in response to the higher abundance of Nematodes and the high abundance (21) of Ascidiacea.

3.2.2.7 Inner Confluence Reference Site

Eighteen unique taxa were present at IC REF-1B; representing the phyla Nematoda (1) Annelida (8), Mollusca (2), Arthropoda (4), Bryozoa (2) and Entoprocta (1). Nematoda (29.7%), and the annelids *Polydora cornuta* (26.9%) and *P. eximius*/*Polycirrus sp*. (13.2%) were the dominant species, representing approximately 70% of the cells total abundance (182; Table 3-2). Of note was the presence of the bryozoans *B. gracilis* and Ascophora (otherwise present only at the Chelsea River CAD cell) and the entoproct *Barentsia sp*. (absent at all other reference sites and all CAD cells). At the Inner Confluence Reference sites, diversity (1.827) and evenness (0.675) were highest at IC REF-1B (Table 3-1).

Nineteen unique taxa were present at IC REF-2B; representing the phyla Nematoda (1), Annelida (11), Mollusca (3) and Arthropda (3). Nematoda (43.8%) and the annelids *Polydora cornuta* (18.3%) and *T. acutus*/Cirratulidae (11.2%) were the dominant species, representing approximately 73% of the cells total abundance (224; Table 3-2). Abundance and species richness were higher at the Inner Confluence reference site IC REF-2B than at any of the CAD cells or other reference sites. Of note is the presence of the cnidarian Hydrozoa. Diversity (1.694) and evenness (0.586) were lower than the other Inner Confluence reference site (Table 3-1).

3.2.2.8 Mystic River Reference Site

Diversity at MR REF-1B (1.099) with a high evenness (1.000) was in response to the presence of only three unique taxa at this reference site. Annelida (66.6%) and Arthropoda (33.3%) were the only phyla present. Abundance at the site (3), the lowest among all disposal cells and reference sites, was equally distributed among the annelids *T. acutus* (1), *Eteone longa* (1) and the arthropod *Jassa marmorata* (1; Table 3-1 and Table 3-2). The reference site MR REF-1B was the only location where Nematodes were absent.

Four unique taxa were present at MR REF-2B; representing the phyla Nematoda (1), Annelida (2), and Arthropoda (1). Nematoda (72.1%) and the annelid *Tharyx acutus* (20.9%) were the dominant species, representing 93% of the stations total abundance (43; Table 3-2). Of note is the absence of molluscs. MR REF-2B represented the lower diversity (0.793) and lower evenness (0.572) of the two Mystic River reference sites (Table 3-1).

3.2.2.9 Benthic Summary

Averaging over all stations, mean abundance (no./0.04 m^2) was highest for Nematodes (42.3) (Table 3-1). Next most abundant were the polychaetes *T. acutus*/Cirratulidae (12.5). Ranking third through tenth were the annelids *Polydora cornuta* (8.8), *Streblospio benedicti* (5.7), *Nephthys incisa*/Nephthyidae (5.6), *Polycirrus eximius*/*Polycirrus sp*. (5.5), Oligochaeta (3.3); the urochordate Ascideacea (2.0); the gastropod *Ilyannassa trivitttus* (1.7); and the arthropod *Crangon septemspinosa* (1.2) and polychaete *Capitella capitata* (1.2).

Total abundance (Table 3-1) ranged from 3 (MR-REF-1B) to 224 (IC-REF-2B). Nematoda were present at 11 of the 12 stations representing approximately 20% or more of the abundance at each station (Table 3-2): M2-5B (81.1%), M5-1B (72.7%), MR-REF-2B (72.1%), SC-4B (54.2%), M8-11-3B (30.1%), CR-2B and CR-4B (50.0%), IC-2B (19.5%), IC-REF-1B (29.7%), and IC-REF-2B (43.8%). Because of the dominance of Nematodes, total abundance excluding Nematodes is also shown in Table 3-1. *T. acutus*/Cirratulidae was one of the dominant species at all stations except M5-1B and *N. incisa*/Nephthyidae was one of the six dominant species at seven of the 12 stations. The Annelid *S. benedicti*, Oligochaeta, *P. cornuta* and *P. eximius*/*Polycirrus sp*. each ranked among the ten dominant species at five to nine of the 12 stations (Table 3-2).

Diversities (H') ranged from a low of 0.76 at the Mystic River Station M5-1B (evenness 0.69) to a high of 2.22 at the Inner Confluence Station IC2-B (evenness 0.84) (Table 3-1). The Inner Confluence Stations IC2-B and IC5-B exhibited relatively high diversities with high evenness (Table 3-1). These stations in the CAD cell have greater species diversity than the Inner Confluence reference stations, although they have fewer taxa. The higher abundance of Nematodes at the IC reference stations may account for the lower diversity and evenness values.

The Mystic River CAD cell stations generally had more taxa, greater species diversity and higher abundance than the Mystic River reference stations. The high prevalence of Nematodes at Station M2-5B, resulted in low evenness at that station. Species diversity and evenness in the Super Cell (SC-4B) fell within the range displayed by other Mystic River stations.

The Chelsea River samples CR-2B and CR-4B had few taxa. Species diversity was higher than the Mystic River reference stations but lower than the Inner Confluence reference stations.

Species composition of the benthic assemblage was compared among stations using the Bray-Curtis numerical classification (clustering). The similarity value linking ten of the stations was approximately 47%, with two distinct station groups linking at great than 50% similarity (Figure 3-10). The Inner Confluence group included the two IC samples within the cell and the two IC reference stations, exhibited higher diversity, evenness and species richness than the stations at the Mystic River/Chelsea River group. Abundances were generally higher at all stations in the Inner Confluence. The Inner Confluence stations, IC-2B and IC-5B shared four dominant species: Nephthyidae, Nematodes, *S. benedicti* and *T. acutus*/Cirratulidae, accounting for approximately 70% of each stations total abundance. Nematodes and *P. cornuta*, the two dominant species at the IC reference Stations, IC-REF-1B and IC-REF-2B, represented approximately 60% of their stations total abundance. Mystic River Station M8-11-3B and the Super Cell Station SC-4B had the lowest abundances of the stations in the IC group. Nematodes and *T. acutus*/Cirratulidae were the common dominant species at Stations M8-11-3B and SC-4B, with *P. eximius*/*Polycirrus sp*. also dominant at M8-11-3B.

The Mystic River/Chelsea River group included both Chelsea River Stations CR-2B and CR-4B, and the Mystic River Station M2-5B and reference Station MR-REF-2B. All stations exhibited generally low abundance, low species richness, low diversity and evenness. Nematodes and *T. acutus*/Cirratulidae were the dominant species, averaging about 85% of the total abundance at both CR-2B and MR-REF-2B. These stations had very low species richness (four to five taxa). Station CR-4B had eight taxa with the urochordate Ascidiacea being dominant. Station M2-5B had five taxa with the dominant species, Nematodes and *T. acutus*/Cirratulidae representing 90% of the total abundance. Abundance at this station was higher than that at the other stations in this group.

The Stations M8-11-3B and SC-4B exhibited higher diversity, evenness and species richness than other stations in the Mystic River/Chelsea River group.

Stations M5-1B and MR-REF-1B exhibited little in common with other stations, with overall similarity values of 28% and 8% to the other stations (Figure 3-10). Both of these stations had very low abundance and few taxa.

The majority of the polychaetes at disposal sites and reference stations are early colonizers, as indicated by the relatively high numbers of surface deposit feeding species (Fauchald and Jumars 1979). The subsurface deposit feeding *Nephtys incisa*/Nephtyidae were abundant at each of the Inner Confluence stations suggesting a somewhat more established benthic community in this area than in the Mystic River or Chelsea River.

3.3 REMOTS® Sediment Profile Imaging

A total of 56 stations were occupied during the Boston Harbor REMOTS® survey conducted on August 15 and 16, 2001 (Table 2-3; Figure 2-4). Six stations were established within each of the nine CAD cells along with one station within each of two reference areas. With the exception of Stations M5-6, M19-1, CR-1 and CR-2, three replicate images were obtained and analyzed at each station for the purpose of preparing the tables and graphs presented below. Therefore, a total of 164 replicate images were analyzed as part of this survey. The complete results of this analysis are presented in Appendix D. The results presented below are a summary of the replicate-averaged results for the physical and biological parameters measured at each station.

3.3.1 Phase 1: Conley Terminal

3.3.1.1 Cell IC

Dredged Material Distribution and Physical Sediment Characteristics

All the sediment observed in the REMOTS® images was considered to be dredged material and exceeded camera penetration in all replicate images. In general, the dredged material throughout the cell consisted of fine-grained, white-to-gray material overlying fine-grained reduced sediment, resulting in a grain size major mode of >4 phi (fine-grained silts and clay) at all of the stations (Table 3-3). A small number of images showed evidence of a very thin (<0.4 in.; <1.0 cm) depositional layer at the sediment-water interface (Figure 3-11). A number of images also showed reduced (anoxic) sediments and mud clasts at the sediment-water interface.

The mean camera penetration for stations within Cell IC ranged from 2.5 in. (6.35 cm) at Station IC-3 to 5 in. (12.84 cm) at Station IC-5, with an overall average of 4 in. (10.16 cm) (Table 3-3). Boundary roughness values ranged from 0.15 in. (0.38 cm) at Station IC-4 to 1.5 in. (3.72 cm) at Station IC-3, resulting in an overall cell average of 0.5 in. (1.37 cm; Table 3-3). Surface roughness was predominantly classified as physical in nature.

Biological Conditions and Benthic Recolonization

Overall, the benthic recolonization of Cell IC was relatively advanced, with at least one replicate image from each station indicating the presence of Stage III organisms below the sediment-water interface (Figure 3-11 and Figure 3-12; Table 3-3). The primary evidence of Stage III activity in the sediment-profile images consisted of feeding voids observed at depth within the sediment (Figure 3-11). Opportunistic, tube-dwelling polychaetes (Stage I) were also identified at the surface-water interface in a number of images throughout the cell.

The mean apparent redox potential discontinuity (RPD) depth provides an indication of the level of oxygen penetration into surface sediment due to both physical (e.g., intra-sediment and inter-sediment/water chemical reactions) and biological (e.g., active bioturbation of sediments via biological organisms) processes. In general, an RPD depth greater than 0.78-1.2 in. (2-3 cm) in marine sediments reflects moderate to deep oxygen penetration and is indicative of good or “healthy” sediment aeration. The replicate-averaged RPD values in Cell IC ranged from 0.3 in. (0.81 cm) at Station IC-4 to 0.6 in. (1.58 cm) at the nearby Station IC-6. The average RPD value for this CAD cell was 0.5 in. (1.27 cm), nearly identical to the value calculated for the IC-REF area (0.504 in.; 1.28 cm; Figure 3-13; Table 3-3).

Although the cell appears to have an active benthic community capable of extensive bioturbation (i.e., Stage III organisms) and hence aeration of the surface sediments, these relatively shallow RPD depths are most likely attributable to a high sediment oxygen demand within the dredged material. Chemical oxidation of the organic matter entrained within the Boston Harbor sediments continually depletes the majority of the oxygen incorporated into the benthos via bioturbation. As a result, the RPD depths within Cell IC and most of the other cells are expected to be fairly shallow. No redox rebound intervals (areas showing evidence of intermittent or seasonal oxidation below the oxidized surface layer), low dissolved oxygen conditions, or methane gas bubbles were observed at any of the six stations within Cell IC.

The Organism-Sediment Index (OSI) is a summary parameter reflecting overall benthic habitat quality. The primary variables of this index are successional stage, apparent RPD depth, oxygen conditions at the sediment-water interface, and the presence or absence of methane gas in the subsurface sediments (Section 2.4.3.6). In general, OSI values greater than +6 are considered indicative of non-degraded or healthy benthic habitat quality. Values between +3 and +6 are considered to be reflective of moderately degraded or recently disturbed benthic habitats.

Median OSI values over Cell IC ranged between +3 at Station IC-4 to +8 at Station IC-1 (Table 3-2). The average OSI value for this cell was +6, slightly lower than the value calculated for IC-REF (+7). Three of the six stations (IC-1, IC-2 and IC-5) had median OSI values of greater than +6, the three remaining stations were slightly lower, ranging from +3 to +5 (Figure 3-13). Although an advanced successional stage was present at every station sampled, the OSI values at Stations IC-3, IC-4, and IC-6 were impacted somewhat by relatively shallow RPD depths.

3.3.2 Phase 2; Step 1: CAD Cells M4, M5 and M12

3.3.2.1 Cell M4

Dredged Material Distribution and Physical Sediment Characteristics

All the sediment observed in the REMOTS® images was considered to be dredged material and exceeded camera penetration in all replicate images. The dredged material throughout the cell consisted primarily of fine-grained, reduced sediment. However, a number of images showed variability in sediment types including the presence of consolidated gray clay at the sediment-water interface (Figure 3-14). The grain size major mode at all of the stations within Cell M4 was >4 phi due to the predominance of fine-grained silts and clay (Table 3-4A).

The mean camera penetration within Cell M4 ranged from 5.02-6.7 in. (12.76-17.09 cm), with an overall average for the cell of 5.9 in. (14.97 cm; Table 3-4A). Boundary roughness values ranged from 0.2 in. (0.45 cm) at Station M4-3 to 0.48 in. (1.22 cm) at Station M4-2, resulting in an overall cell average of 0.31 in. (0.80 cm; Table 3-4A). Values in this range reflect only a small amount of fine-scale surface relief and suggest that neither physical nor biological processes are significantly affecting the sediment surface throughout the site. Small, reduced mud clasts were detected at the sediment-water interface in some of the replicate images.

Biological Conditions and Benthic Recolonization

Only two stations (M4-2 and M4-4) showed the presence of an advanced successional stage, as Stage III feeding voids were identified below the sediment-water interface (Figure 3-15; Table 3-3A). The remaining four stations showed only Stage I organisms present, suggesting that overall, the benthic community in Cell M4 is comprised mainly of pioneering, opportunistic, surface-dwelling organisms.

Replicate-averaged RPD depths over Cell M4 ranged from 0.2-0.73 in. (0.53-1.85 cm. The mean value of 0.4 in. (1.04 cm) calculated for the cell was slightly lower than the RPD value for the reference area selected in Mystic River (0.7 in.; 1.7 cm; Table 3-3A). RPD depths in excess of 0.39 in. (1 cm) were detected at the stations located in the center and eastern portion of the cell, while the shallow RPDs appeared concentrated along the western margin (Figure 3-16). These relatively lower RPD depths can mainly be attributed to both the lack of deep bioturbation over most of the cell and the high sediment oxygen demand of the organically enriched material near the surface of the cell. However, none of the replicate images from Cell M4 showed evidence of low dissolved oxygen conditions at the sediment-water interface.

Methane bubbles were observed within the sediment column in the images obtained at Stations M4-3 and M4-5 (Table 3-4A; Figure 3-17). A product of the anaerobic decomposition of organic matter, the presence of methane is used as an indicator of enriched sediments and an oxygen-poor environment.

Median OSI values over Cell M4 ranged from +2 to +4 (Figure 3-16; Table 3-3A). The shallow RPD depths, predominance of Stage I organisms within the site, and presence of methane at Stations M4-3 and M4-5 yielded an overall average OSI value of +2.7. This RPD value is generally lower than the Mystic River reference station, which displayed an OSI value of +4. These results are indicative of relatively degraded benthic habitat quality, and suggest this CAD cell remains in an early stage of recovery.

3.3.2.2 Cell M5

Dredged Material Distribution and Physical Sediment Characteristics

Overall, the sediments of Cell M5 were comprised of mottled gray and black fine-grained sediments with a major mode of >4 phi (fine-grained silts and clay; Table 3-4B). All of the sediment observed in the REMOTS® images was considered to be dredged material, which exceeded camera penetration at all stations sampled.

Replicate-averaged camera penetration ranged between 1.2 in. (3.07 cm) at Station M5-6 to and 7.2 in. (18.11 cm) at Station M5-1. The overall average camera penetration in Cell M5 was 3.6 in. (9.04 cm; Table 3-4B). Boundary roughness values ranged from 0.18-0.77 in. (0.46-1.96 cm, resulting in an overall cell average of 0.36 in. (0.92 cm). Values in this range reflect only a small amount of fine-scale surface relief and suggest that neither physical nor biological processes are significantly affecting the sediment surface throughout the site.

Biological Conditions and Benthic Recolonization

Stage I organisms were the predominant successional stage present in the M5 sediments (Figure 3-15; Table 3-4B). Stage I individuals were identified in the majority of the analyzable images collected over Cell M5. Two of the six stations (M5-4 and M5-6) had at least one replicate image that was deemed indeterminate (INDET) due to over penetration of the camera prism or a disturbed sediment surface-water interface that made the identification of the successional status difficult. One replicate image from Station M5-2 was classified as azoic due to the fact that it did not show evidence of any benthic organisms within the sediments.

Four of the six stations had replicate-averaged RPD depths of less than 0.78 in. (2 cm), which suggests that the sediments at these stations are not subject to extensive bioturbation by benthic organisms (Figure 3-16; Table 3-3B). These results are most likely due to the predominance of only surface dwelling Stage I organisms coupled with the lack of deep dwelling Stage III organisms and a high sediment-oxygen demand within the sediment. However, Station M5-1 located in the southwest corner of the cell, displayed a deeper RPD of 1.9 in. (4.72 cm), but failed to provide any evidence of Stage III activity. The average RPD value for Cell M5 was 0.8 in. (2.11 cm), deeper than the 0.67 in. (1.7 cm) value for the reference area.

Methane was observed within the sediment column in one of the replicate images from Station M5-1, indicating that the dredged material at this station may contain a relatively high inventory of organic matter that is being decomposed under anaerobic conditions at depth. However, none of the replicate images from Cell M5 showed evidence of redox rebound or low dissolved oxygen conditions at the sediment-water interface.

The overall lower RPD depths coupled with the presence of only Stage I organisms resulted in OSI values that averaged +3.9, equivalent to the value calculated for the Mystic River reference area (Table 3-4B). OSI values within the cell ranged from +3 to +6, with the highest OSI value assigned to Station M5-1 in response to the deep RPD depth (Figure 3-16).

3.3.2.3 Cell M12

Dredged Material Distribution and Physical Sediment Characteristics

Similar to the other Mystic River CAD cells, the surface sediments within Cell M12 were comprised of fine-grained silts and clay overlying fine-grained reduced (black) dredged material. The grain size major mode at all of the stations within M12 was >4 phi (fine-grained silts and clay; Table 3-4C). All the sediment observed in the REMOTS® images was considered to be dredged material and exceeded camera penetration in all replicate images.

Replicate-averaged camera penetration within the cell ranged from 3.6 in. (9.07 cm) at Station M12-3 to 7.22 in. (18.34 cm) at Station M12-2, with an overall average of 4.72 in. (11.99 cm; Table 3-4C). Boundary roughness values ranged from 0.15-0.95 in. (0.38-2.41 cm), resulting in an overall cell average of 0.38 in. (0.96 cm; Table 3-4C). Values in this range reflect only a small amount of fine-scale surface relief and suggest that neither physical nor biological processes are significantly affecting the sediment surface throughout the cell.

Biological Conditions and Benthic Recolonization

Benthic recolonization status of Cell M12 was relatively advanced, as evidence of Stage III activity was detected at three of the six stations (Figure 3-15; Table 3-4C). Two stations (M12-1 and M12-5) were classified as Stage I going to Stage II, which indicates the presence of both small, opportunistic polychaetes at the sediment surface with evidence of burrowing just below the sediment surface (Figure 3-18). This near-surface burrowing is attributed to amphipods and other shallow-dwelling Stage II organisms that become abundant as benthic succession beyond Stage I results in a community living increasingly deeper within the sediment. Station M12-6 showed only the presence of Stage I organisms.

The mean apparent RPD for the Cell M12 was 0.59 in. (1.51 cm), comparable to the Mystic River reference area (0.67 in.; 1.7 cm). Replicate-averaged RPD values ranged from a shallow 0.26 in. (0.67 cm) to a reasonably well-established depth of 0.76 in. (1.94 cm; Figure 3-16; Table 3-4C). Once again, high sediment oxygen demand appears to be the cause for relatively shallow RPD depths, despite the presence of Stage III organisms. No redox rebound intervals, low dissolved oxygen conditions, or methane gas production was noted in the replicate images.

The average OSI value of Cell M12 was a +3.7, as individual stations displayed median OSI values ranging between +2 at Station M12-6 to +5 at Station M12-4 (Figure 3-16; Table 3-4C). Although comparable to the MR-REF data, these OSI values are still considered indicative of degraded benthic habitat quality, and are primarily due to the shallow RPD depths.

3.3.3 Phase 2; Step 2: CAD Cells M2 and Super Cell

3.3.3.1 Cell M2

Dredged Material Distribution and Physical Sediment Characteristics

Similar to the Phase 2; Step 1 CAD Cells, the sediments in Cell M2 were generally comprised of fine-grained silts and clay overlying fine-grained reduced (black) dredged material. The grain size major mode at all of the stations within this CAD cell was >4 phi (fine-grained silts and clay; Table 3-5A). All the sediment observed in the REMOTS® images was considered to be dredged material and exceeded camera penetration in all replicate images.

The replicate-averaged camera penetration depths ranged from 4.3-6.78 in. (10.99-17.23 cm), with an overall average of 5.4 in. (13.81 cm). Boundary roughness values over the surface of M2 ranged from 0.2-33 in. (0.51-0.84 cm), resulting in an overall cell average of 0.26 in. (0.66 cm; Table 3-5A). Values in this range reflect only a small amount of fine-scale surface relief.

Biological Conditions and Benthic Recolonization

Three of the six stations in Cell M2 showed evidence of Stage III organisms present in the subsurface sediments (Stations M2-1, M2-4 and M2-6; Figure 3-19; Table 3-5A). Two of the stations (M2-3 and M2-5) showed only Stage I organisms present, and one station (M2-2) was considered azoic with no benthic organisms detected in any of the replicate images acquired.

Despite the presence of Stage III deposit feeders at three stations within the CAD cell, replicate-averaged RPD depths over the surface of M2 were quite shallow. A maximum value of 0.36 in. (0.91 cm) was calculated for Station M2-1 and a minimum RPD depth of 0.16 in. (0.40 cm) was observed at Stations M2-2 and M2-6 (Figure 3-20; Table 3-5A). The overall average for the cell was 0.26 in. (0.67 cm), significantly lower than the reference area measurements. No redox rebound intervals, low dissolved oxygen conditions, or methane gas production was noted in the replicate images.

In response to the shallow RPD depths, low median OSI values were calculated for all the stations within M2, suggesting stressed or degraded benthic habitat quality. The overall average OSI value for the cell was +2, indicating a lower overall habitat quality in comparison to the reference area (OSI of +4). Station M2-2, which was determined to be azoic and displaying a thin, diffusional RPD (0.16 in.; 0.4 cm), had an OSI value of –2. The presence of Stage III organisms at Station M2-1 and RPD depths approaching 0.39 in. (1 cm) deep yielded a median OSI value of +4 for this station and a maximum value for the CAD cell.

3.3.3.2 Cell SC

Dredged Material Distribution and Physical Sediment Characteristics

The sediments observed in the images obtained from SC-1 and SC-2 were oxidized silt overlying gray clay. A distinct coarser-grained sand cap layer overlying fine-grained gray and black silt and clay inter-mixed with shell fragments was observed at Stations SC-3 through SC-6 (Figure 3-21). Despite the presence of sand at the sediment-water interface, the major modal grain size of CAD Cell SC was >4 phi (fine-grained silts and clay; Table 3-5B). All the sediment observed in the REMOTS® images was considered to be dredged material and exceeded camera penetration in all replicate images.

The replicate-averaged camera penetration depths over Cell SC ranged from 3.9 in. (9.94 cm) at Station SC-2 to 5.6 in. (14.25 cm) at Station SC-3. The overall average camera penetration for the cell was 4.8 in. (12.27 cm; Table 3-5B). Boundary roughness values ranged from 0.17-0.48 in. (0.43-1.21 cm), with the primary cause of surface roughness determined to be small-scale physical disturbance.

Biological Conditions and Benthic Recolonization

Stage I organisms were the predominate component of the infaunal community within Cell SC (Figure 3-19; Table 3-5B). One of the six SC stations (SC-3) displayed evidence of Stage III organisms in the subsurface sediments. Station SC-2 had one replicate image that was classified as indeterminate (INDET) due to the fact that the sediment surface was disturbed and therefore could not be adequately analyzed.

In contrast to the findings in the other Phase 2 CAD cells, a number of the stations within Cell SC had mean apparent RPD depths of greater than 0.78 in. (2.0 cm; Figure 3-20; Table 3-5B). The replicate-averaged RPD depths ranged from 0.46 in. (1.18 cm) at Station SC-2 to 1.15 in. (2.93 cm) at Station SC-3. The overall average apparent RPD depth for Cell SC was 0.79 in. (2.02 cm), slightly deeper than the reference area RPD. These RPD depths are indicative of relatively well-aerated marine sediments. No redox rebound intervals, low dissolved oxygen conditions, or methane gas production was noted in the replicate images.

Based on the deeper RPD depths, the station median OSI value for the cells were generally higher than the other Phase 2 CAD cells, ranging from +3 to +7. The overall average value of +4.3 for Cell SC was slightly above the value calculated for the Mystic River reference area (+4). As expected, the highest OSI value was calculated for Station SC-3, which displayed evidence of Stage III activity at depth. This indicates that the benthic habitat conditions within Cell SC are of intermediate quality and may be recovering from the deposition of dredged sediment and capping material (Figure 3-20; Table 3-5B).

3.3.4 Phase 2; Step 3: CAD Cells M8-11, M19, Chelsea River and MR Reference Area

3.3.4.1 Cell M8-11

Dredged Material Distribution and Physical Sediment Characteristics

The surficial sediment layer appeared somewhat coarser over Cell M8-11 in comparison to the other Phase 2 CAD cells, as sand was detected in most of the REMOTS® images. These sediments were comprised of coarse brown and black sand mixed with shell material that extended beyond camera prism penetration (Figure 3-22). The predominant grain size major mode within Cell M8-11 was 4 to 3 phi (very fine to fine-grained sand; Table 3-6A). Two of the stations (Stations M8-11-2 and M8-11-4) had grain size major modes that were classified as medium sand (3 to 2 phi). One station (Station M8-11-3) had a grain size major mode of >4 phi (silt and clay). All the sediment observed in the REMOTS® images was considered to be dredged material and exceeded camera penetration in all replicate images.

The mean camera penetration depths were relatively shallow due to the higher sand content in the surface sediments, ranging from 1.7-2.6 in. (4.31-6.59 cm). The overall average of the camera penetration for the cell was 2.19 in. (5.56 cm). Boundary roughness values ranged from 0.13-0.45 in. (0.33-1.15 cm), resulting in an overall cell average of 0.22 in. (0.57 cm; Table 3-6A). Surface roughness was classified as physical in nature for all replicate images obtained over M8-11.

Biological Conditions and Benthic Recolonization

All six of the stations established within Cell M8-11 displayed a successional stage assemblage composed of Stage I organisms (Figure 3-23; Table 3-6A). Replicate-averaged RPD values for the cell ranged from 0.39 in. (1.0 cm) at Station M8-11-5 to 0.76 in. (1.92 cm) at Station M8-11-3 (Figure 3-24; Table 3-6A). The overall average RPD value for the cell was 0.54 in. (1.37 cm), slightly shallower than the RPD at the Mystic River reference station. These rather shallow apparent RPD depths can most likely be attributed to the absence of deeper dwelling organisms (i.e., Stage III), high levels of sediment oxygen demand associated with the degradation of organic compounds in the dredged material sediments, and/or periodic near-bottom hypoxia in the overlying water.

The median OSI values for the M8-11 stations ranged from +3 to +5, with an overall average of +3.7 for the cell (Figure 3-24; Table 3-6A). This somewhat low OSI value is due to both the absence of an advanced successional stage (i.e., Stage III) and the somewhat shallow apparent RPD depths. These results are comparable to the OSI value for the Mystic River reference area, but indicate that benthic conditions within Cell M8-11 are still recovering from the disturbance associated with cap material placement. No redox rebound intervals, low dissolved oxygen conditions, or methane gas production was noted in the replicate images.

3.3.4.2 Cell M19

Dredged Material Distribution and Physical Sediment Characteristics

The sediments observed in the majority of the REMOTS® images acquired over Cell M19 were composed of a distinct sand cap mixed with shell fragments (Figure 3-25). The remaining images showed layered sediments consisting of fine-grained sediment mixed with gray sand, over a band of sand mixed with small shell fragments. The major modal grain size classifications for the M19 stations were variable, ranging from >4 phi (silt and clay) at Stations M19-1, M19-2 and M19-6 to 2 to 1 phi (very coarse sand) at Station M19-5 (Table 3-6B). The predominant grain size at two stations (M19-3 and M19-4) was classified as medium sand (3 to 2 phi). All the sediment observed in the REMOTS® images was considered to be dredged material and exceeded camera penetration in all replicate images.

The mean camera penetration was again relatively shallow due to the presence of sand, ranging from 1.63-2.92 in. (4.15-7.42 cm) with an overall average penetration depth of 2.26 in. (5.75 cm) for the cell. Boundary roughness values ranged from 0.2-0.74 in. (0.51-1.87 cm), resulting in an overall cell average of 0.45 in. (1.13 cm ; Table 3-6B). Surface roughness was generally classified as physical in nature due to the presence of coarse sediments and shell at the sediment-water interface.

Biological Conditions and Benthic Recolonization

Two of the six stations (M19-2 and M19-4) in Cell M19 displayed a relatively advanced successional stage assemblage, as evidence of Stage III activity was present in at least one of the replicate image obtained at each station (Figure 3-23; Table 3-6B). Three of the stations showed only the presence of Stage I organisms. Stations M19-4 and M19-5 had at least one replicate image where the successional stage was indeterminate (INDET) due to a large amount of shell material at the sediment water interface, making it difficult to accurately identify any surface dwelling Stage I organisms.

Replicate-averaged RPD depths over Cell M19 ranged from 0.26 in. (0.66 cm) at Station M19-6 to 0.47 in. (1.20 cm) at Station M19-3. The mean apparent RPD for Cell M19 was 0.39 in. (0.98 cm), which is somewhat shallower than the reference area in Mystic River (Figure 3-24; Table 3-6B). Station M19-5 displayed coarse sand and shell at the sediment-water interface resulting in an indeterminate RPD depth. Silica sand and calcium carbonate shell materials in the sediments lack the ferric oxide coating that is common on fine-grained sediments. As a result, these sediments are not subject to a distinct color change when oxidized, which subsequently makes identification of the RPD difficult. No redox rebound intervals, low dissolved oxygen conditions, or methane gas production was noted in the replicate images.

Median OSI values over Cell M19 ranged from +2 at Station M19-6 (shallow RPD and Stage I) to +5 at M19-4 (moderate RPD and Stage III; Figure 3-24; Table 3-6B). The overall average for the CAD cell was +3.6, slightly lower than the reference area and suggesting that overall benthic habitat quality within Cell M19 was stressed or degraded at the time of the survey.

3.3.4.3 Cell CR

Dredged Material Distribution and Physical Sediment Characteristics

The majority of the sediments observed in the images from Cell CR were mottled white and brown clay intermixed with reduced sediments (Figure 3-26). A number of replicate images also showed reduced sediments at or near the sediment-water interface. A small number of the images appeared to have “pockets” of depositional material collecting in depressions in the surface sediments (Figure 3-26 and Figure 3-27). Relic RPDs (distinct horizons below the sediment–water interface that were previously oxidized) were also seen in a number of images acquired in the Chelsea River CAD cell (Figure 3-28). The presence of relic RPDs is often used as an indicator of the deposition and development of a new layer of material over a pre-existing layer of sediment with an established RPD.

As anticipated for this CAD cell, the grain size major mode at all of the stations was >4 phi, indicating the predominance of fine-grained silts and clay (Table 3-6C). All the sediment observed in the REMOTS® images was considered to be dredged material, with thicknesses classified as greater than camera penetration in all replicate images (Table 3-6C).

The replicate-averaged camera penetration depths ranged from 2.66 in. (6.75 cm) at Station CR-2 to 7.29 in. (18.54 cm) at Station CR-5. The overall average of the camera penetration value for the cell was 5.07 in. (12.87 cm). Boundary roughness values ranged from 0.23-1.39 in. (0.60-3.52 cm), resulting in an overall cell average of 0.69 in. (1.76 cm; Table 3-6C). Surface roughness was classified as physical in all replicate images. The higher roughness values were the result of large clumps of Boston Blue Clay present at the sediment-water interface.

Biological Conditions and Benthic Recolonization

Three of the six stations (CR-2, CR-3, and CR-4) in Chelsea River cell showed evidence of relatively advanced Stage III organisms in at least one of the replicate images acquired at each station (Figure 3-23; Table 3-6C). The remaining three Stations CR-1, CR-5, and CR-6 showed only Stage I organisms present.

The replicate-averaged RPD depths within the cell ranged from 0.28-1.06 in. (0.71-2.69 cm), yielding an overall value of 0.64 in. (1.62 cm; Figure 3-24). This average value was comparable to the MR-REF results, and slightly deeper than the RPD depth measured at the IC-Ref station (0.51 in.; 1.3 cm). No redox rebound intervals, low dissolved oxygen conditions, or methane gas production was noted in the replicate images.

OSI values for the stations established within Cell CR ranged from +2 at Station CR-6 to +5 at Station CR-1 and CR-4 (Figure 3-24). The overall average OSI value for the cell was +4.1, equivalent to the Mystic River reference area and slightly lower than the results from the Inner Confluence reference station. This OSI value suggests that the Chelsea River CAD cell had moderately degraded benthic habitat quality in the process of recovering from the deposition of dredged material.

3.3.5 Reference Areas

One station was occupied in both the Inner Confluence and the Mystic River to serve as a basis of comparison to the data collected within the confines of the CAD cells (Figure 2-4; Table 2-3). The reference areas utilized as part of this study were located outside the BHNIP dredging areas and were not subjected to the benthic disturbance associated with removal of sediment. However, Boston Harbor is an industrialized body of water that is subject to significant input of organic material and physical disturbances associated with shipping activity. As a result, benthic conditions at the reference areas are probably influenced by similar types of environmental stress (organic loading, reduced dissolved oxygen concentrations, propeller wash, etc.) that affect the benthic recovery at the nearby CAD cells.

3.3.5.1 IC Reference Station

Physical Sediment Characteristics

The REMOTS® images for IC-REF displayed sediment composed of tan, oxidized silt over a reduced silt and clay, resulting in a major modal grain size classification of >4 phi (Table 3-3). The camera penetration was 3.8 in. (9.66 cm) and the boundary roughness of the IC reference area was 0.16 in. (0.42 cm), with surface roughness classified as physical.

Biological Conditions and Benthic Recolonization

The successional stage at the IC reference area was relatively advanced with Stage III organisms present in at least one of the three replicate images (Figure 3-12 and Figure 3-29A; Table 3-3). One replicate displayed a successional status of Stage I organisms going to Stage II (Figure 3-29B). This stage indicates the presence of both small, opportunistic polychaetes at the sediment surface together with evidence of burrowing just below the sediment surface. This near-surface burrowing is attributed to amphipods and other shallow-dwelling, Stage II organisms.

The mean apparent RPD depth was 0.5 in. (1.28 cm), which is considered slightly shallow for marine sediments (Figure 3-13; Table 3-3). The median OSI for the station was +7 due to the presence of advanced successional stages and indicative of healthy benthic habitat quality (Figure 3-13; Table 3-3). No redox rebound intervals, low dissolved oxygen conditions, or methane gas production was noted in the replicate images.

3.3.5.2 MR Reference

Dredged Material Distribution and Physical Sediment Characteristics

One station (MR-REF) was occupied near the western edge of CAD Cell M8-11 as a reference area to provide a basis of comparison for the seven Mystic River CAD cells and the Chelsea River CAD cell to conditions at an undisturbed area of seafloor in Boston Harbor. The REMOTS® images displayed surficial sediment composed of tan, oxidized silt over dark, reduced silt and clay, yielding a major modal grain size for MR-REF was >4 phi (Table 3-6D).

The mean camera penetration was 4.64 in. (11.79 cm) and the boundary roughness of the Mystic River reference area was 2.9 in. (7.29 cm). Two of the three stations displayed very high boundary roughness values of 3.15 and 4.72 in. (8 and 12 cm), likely attributable to the dredging activity in Mystic River as part of the BHNIP.

Biological Conditions and Benthic Recolonization

The successional stage at the Mystic River reference area was dominated by opportunistic Stage I organisms (Table 3-6D; Figure 3-23). The mean apparent RPD depth was 0.67 in. (1.70 cm), which is considered slightly shallow for marine sediments (Table 3-6D; Figure 3-24). The median OSI for the station was +4, indicative of a moderately degraded or recently disturbed benthic environment (Table 3-6D; Figure 3-23).

4.0 DISCUSSION

4.1 Geotechnical Evaluation

4.1.1 Phase 1; Cell IC

The Inner Confluence CAD was the first cell constructed in Boston Harbor (Figure 2-1). The 1997 survey of Cell IC indicated that the cell contained layers of dredged material intermixed with the clean cap, as well as layers of sand mixed with black clayey dredged material. The 1997 survey results also indicated that the northern portion of the Cell IC had been capped with a highly variable thickness of sand, while the southern end of the cell had little or no cap material (ENSR 1997; SAIC 1997). For this reason the Summer 2001 surveys focused on the northern half of the cell.

The vibracore survey required the collection of five cores, three of which were collected from stations utilized in the 1997 coring survey of this cell. Unfortunately, these three cores did not contain stratified sediment as expected from cores within the cell and it was theorized that these cores were collected outside the cell boundary. All three of these cores consisted primarily of BBC and were not sampled for additional analysis beyond visual descriptions and digital imagery. Additional sediment sub-samples were collected from cores IC-4 and IC-5 to provide the desired amount of geotechnical data for Cell IC. However, these data were restricted to the two valid cores located near the center portion of Cell IC rather than the five cores that should have been collected within the cell to provide the desired spatial coverage.

As described in Section 3.1.1, Cores IC-1, IC-2, and IC-3 displayed a 5-9 in. (13-23 cm) surface interval of black, silty CLAY overlying solid BBC. This core stratification is believed to be characteristic of the fringe or an area of seafloor just outside of the CAD cell. Although these cores were collected at the specified targeted station locations, which were identical to those reported in 1997, the results suggest the target sampling locations were actually several yards east of the cell boundary. The error in position is likely linked to the coordinates reported as part of the 1997 effort over Cell IC and the inaccuracies of the DGPS system used in 1997 to position the sampling vessel in this inland waterway. Unfortunately, survey time and resources did not allow for new target areas within Cell IC to be selected and sampled once the error was discovered.

Cores IC-4 and IC-5 from the 2001 sampling effort were selected randomly within the known cell boundaries and contained sediment characteristic of cores previously collected from Cell IC. These core locations were located to the west of the IC-1, IC-2, and IC-3, and provided a cross-section of the sediments within Cell IC. Cores IC-4 and IC-5 were analyzed for all geotechnical parameters. Both cores contained unmixed yellowish brown sand as well as black, silty, clayey sand detected on top of slightly consolidated dredged material. In addition, both cores displayed softer sediment in the upper 19.7 in. (50 cm). This “surface” (6.7-10.6 in. (17-27 cm), IC-4 and 19.3-23.2 in. (49-59 cm), IC-5) sediment had approximately 60% more water (130% on average) than deeper sediments in the cell and exhibited weaker shear strength within this surface region. Due to the known disturbance to surface sediment caused by vibracoring methods, grab samples were also analyzed for grain size and water content. The grab samples had significantly higher water content then the cores, with an average of 216%. Both grab samples indicated a surface dominated by silt (65%) with 30% clay and 5% sand. The core sample collected from the upper 9.8 in. (25 cm) of core IC-4 indicated similar grain sizes. Core IC-5 was not sampled above 19.3 in. (49 cm) and was dominated by sand. Overall, sediment bulk density was very consistent, even in the surficial sediment layer that displayed a high water content.

The cores from Cell IC indicated that sediments were banded with layers of sand intermixed with layers of sandy clay and silty clay. There were distinct layers where unmixed sand was present (IC-5, Sample C). Overall, the underlying dredged sediments within the cell appears to have consolidated somewhat. The banding of cap material and the underlying sediments unsuitable for open-water disposal occurred over a 3.8 ft (115 cm) interval in IC-4 and 43 cm interval in IC-5 or an average of 2.6 ft (79 cm). The stratigraphy of sand and underlying sediment within Cell IC appeared to be maintaining the same structure as noted in the post capping surveys in 1997 (SAIC 1997).

Surface conditions of the cell were determined based on cores IC-4 and IC-5 as well as the grab samples. Based on the results from surface grab samples, the upper 9.8 in. (25 cm) of the cell consisted primarily of silt (Figure 3-9). The cores indicated that the sand cap was not present until a depth of 26.7 in. (68 cm; average of both cores). Once sand was noted in the stratification of sediment, it composed a total layer of approximately 2 ft (59 cm) thick. Due to similarities in composition, geotechnical data alone cannot differentiate between the original dredged sediment placed in the cell and newly deposited sediments. The surface of Cell IC remains similar to the surface reported after capping in 1997.

4.1.2 Phase 2; CAD Cells M4, M5 and M12

CAD Cells M4, M5 and M12 were capped during the first round of Phase 2 in October-November 1998 (Figure 2-1). The cap placement technique utilized over these cells was altered from the Cell IC approach, and the three cells capped during this phase of the projects indicated different results. The results of each cell were determined to be linked to the amount of time the cells were allowed to consolidate prior to capping. The surface of the 1998 cores contained an aqueous layer, which suggested that the top few feet of the sediment consisted of low strength material with no apparent sand, and a more consolidated unit with increasing sand deeper in the core. The one-year monitoring survey collected five vibracores from each of the three cells as well as a surface grab from Cell M5. The cores appeared to be more consolidated than the 1998 cores; however, the grab sample indicated that surface sediments maintained an elevated water content. A strong petroleum odor continued to be present in the underlying dredged material from all cells.

4.1.2.1 Cell M4 Summary

The cores in Cell M4 facilitated cap material identification while indicating that the majority of the soft dredged material had consolidated slightly since capping was completed in November 1998. The sponge-like texture noted in many of the cores indicated that there were still significant amounts of gas (likely methane) entrained within the sediments of this cell. All of the cores contained an accumulation of silty clay on top of the cap material. Surface grabs were not collected from this cell to confirm the water content in the surface sediment. However, the core sub-samples collected from the upper 3.3 ft (100 cm) all indicated the presence of soft sediments with water content values over 100%.

The results for the five cores collected for geotechnical analysis indicated high variability in the thickness of cap accumulated, and the depth at which cap was detected. Core M4-1 contained 1ft (31 cm) of cap starting at a depth of 5.9 in. (15 cm); M4-3 contained 3.9 ft (119 cm) of cap starting at 10.5 ft (319 cm); and M4-5 contained 5 ft (151 cm) of cap starting at a depth of 5.2 ft (158 cm). The overall average for cap accumulation for Cell M4 was 2.8 ft (85 cm), with the majority of cap present below 4.2 ft (127 cm). The cores indicated that the material below the cap steadily increased in strength and consistency while decreasing in water content with depth. However, Core M4-3 illustrated some of the variability identified within the cell. Sand cap was detected below the majority of the sampled sediment resulting in softer sediments in the top portion of the core. These softer sediments did not display the same consolidated characteristics found in other regions of the cell. Overall, the sub-samples collected in the upper portion of the core (nearer to the surface of the cell) had higher water contents and liquid limits as well as lower shear strengths.

The underlying sediments in the majority of the 2001 cores appeared to be more consolidated with an average water content of 69%. Water content was not analyzed in the 1998 survey. However, the 1998 cores were described as very wet and most likely contained a higher water content. The cores collected in 2001 did not indicate any change in the cell stratigraphy in comparison to the 1998 results. The 1998 survey indicated that the majority of the sand was detected below 4.2 ft (127 cm), consistent with the results noted in the 2001 survey.

4.1.2.2 Cell M5 Summary

The five cores collected from this cell varied in the amount of cap present, as well as the depth at which cap material was observed. The core penetration depths ranged from 16-17.9 ft (490-545 cm) with mixed sand cap visible within the cores from 3-8.1 ft (90-248 cm). The cap material horizon was located at a variety of depths within the cores, ranging from

2.3-15.2 ft (70-463 cm) down core. A grab sample was collected from the surface of the cell and indicated that the surface (0-5.9 in.; 0-15 cm) sediment had a water content of 123% and consisted of 46% silt, 43% sand and 11% clay. This indicated that cap material was present at the surface of the cell at the location of the grab sample.

Grain size analysis was performed on two cores from Cell M5 at depths of 2.79 and 3.6 ft (85 and 110 cm) resulting in 41% and 25% sand at the respective depths. The upper most samples collected in this cell contained the highest water contents and consequently the highest liquid limits. The sediment displayed more consolidation with depth, which was indicated by increasing shear strengths and decreasing water contents. The sand cap was noted at various depths throughout the cell and the samples collected for Atterberg limit analysis came from a variety of depths within the cell (from both above and below the apparent cap). In general, sediments sampled from below the apparent cap contained lower water contents and higher shear strengths. The cores indicated that the sand cap was not continuous on the surface of the cell. On average the cell contained 4.8 ft (147 cm) thick cap starting at an average depth of 4.7ft (144 cm). The cores indicated that the stratigraphy of the cell has not changed dramatically over the past three years.

4.1.2.3 Cell M12 Summary

The 2001 cores collected from Cell M12 displayed sand intermixed with silty clay from a depth of 2-16.6 ft (60-508 cm) in the cell. The average thickness of the cap was 4.9 ft (148 cm), with the cap starting at approximately 7.5 ft (227 cm) on average. The majority of the sand was located below 6.6 ft (200 cm) and extended to the bottom of the cores. The plasticity index indicates variability in the proportions of fine-grained sediments intermixed with sand at various depths. Overall, there was little variability in wet and dry density within the cell with averages of 1.4 $g \cdot cc^{-1}$ and 0.7 $g \cdot cc^{-1}$ respectively. The high variability in Atterberg limits within the 2001 cores from M12 was also reflected in the 1998 cores. In the 1998 survey four of the six cores collected contained at least 47% sand at the surface of the core, while only one of the 2001 survey cores indicated a significant percentage (60%) of sand above 5.6 ft (170 cm). The basis for the decreasing sand content in the upper portion of the core could be due to either additional diapir activity or natural deposition of fine-grained sediments on the surface of the cell. However, because a soft surface sediment layer was present in both the 1998 and 2001 cores, accurate assessment of any recent changes in surface sediment composition cannot be determined geotechnically.

The cores collected as part of the Summer 2001 survey were similar to those obtained during the 1998 survey in that the sand was intermixed throughout the cores. Though the majority of the Cell M12 cores contained very soft, wet surface material, the majority of the sediment appeared to have consolidated slightly since the 1998 survey. As per the sampling design described in Section 2.3, no surface grab samples were collected from Cell M12. The majority of the sediment had enough strength to maintain shape within the core liner, opposed to the 1998 cores, which had a tendency to 'run' or 'bleed' when the liner was scored. The shear strength data indicated that the sediment strength increases with depth and that overall water content decreases. The underlying dredged material continued to contain a strong petroleum based odor, as well as intermittent sponge-like textures associated with sediments rich in methane gas.

4.1.3 Phase 2; Step 2: CAD Cells M2 and Super Cell

The capping of Cells M2 and the Super Cell was completed in November of 1999. The majority of the cap material placed in the cells remained at the surface of the cells. There were some striations or bands of dredged material layered with sand, believed to be a product of diapirs (SAIC 2000). Similar banding was noted in some of the Summer 2001 vibracores.

4.1.3.1 Cell M2 Summary

Overall, all but one core (M2-3) collected from Cell M2 contained 3 feet (93 cm) of sand cap. The sand cap noted in Cell M2 was relatively unmixed and had retained its tan to yellow coloration, but existed under a surface layer of silt and clay. The grab sample collected at station M2-5 confirmed the surface stratigraphy noted in the cores as surface material consisted of 75% silt, 18% clay and only 7% sand. However, the surface sediment in the grab sample contained higher water content (217%) then the surface interval sampled from the cores (84% average). This fluid-like, soft surface layer was not present in the surface interval of the M2 cores and may have been displaced by the process of vibracoring.

Core M2-3 was the only core to contain less than 3 feet of cap material, it contained 1.5 ft (58.5 cm). Cores M2-3 and M2-5 contained distinct layering of silty clay (5.1 in.; 13 cm average) over sand, over dredged material, over ambient BBC and are considered excellent examples of the stratification of sediments within the M2 CAD cell. On average the cell contained a 3 ft (90.6 cm) thick cap with an average of 0.59 in. (18 cm) of silty clay on top of the cap. This silty clay on the surface may be sediment that has accumulated in the cell post capping via natural deposition, adding to the minimal thickness of the sediment noted at the surface in the 1999 survey.

Atterberg limit analysis was conducted on sediment below the cap interface. The samples all indicated that the water content of the sediment below the cap decreases with depth. The overall density of sediment below the cap was consistent with an average wet density of 1.5 $g{\cdot}cc^{-1}$ and a dry density of 0.8 $g{\cdot}cc^{-1}$. The shear strength of the sediment below the cap fell within the range of 1.08 kPa and 2.7 kPa. The majority of the sediment was 1.62 kPa. There was an indication in two of the cores that the sediment immediately below the cap was slightly higher in shear strength decreased slightly before increasing again at the bottom of the core. The majority of the black dredged material below the cap contained a strong petroleum odor. The cap appears to maintain its stratigraphy and is considered to have a continuous cap with limited mixing.

4.1.3.2 Super Cell Summary

The five cores collected from this cell contained a layer of silty clay on top of the sand cap. Similar to Cell M2, Cell SC contained a 5.9 in. (15 cm) layer of silty clay on top of the cap. The grab sample collected from this cell contradicts this finding, as surface sediments contained 74% sand, 16% silt and only 10% clay. The high percentage of sand in the surface grab was the basis for a low (62%) water content, similar to the average water content of the cores (70%). There were areas of the cell noted in the 1999 survey where sediments apparently migrated to the surface of the cap via diapirs, those 2001 cores (SC-1 and SC-2) that contained the thickest layer of sediment on top of the cap may have come from areas where diapirs were present.

In general the stratification of sand and silty clay found within the 2001 cores was very similar to that of the 1999 vibracore survey. The majority of cores contained a significant amount of sand over consolidated dredged material. Unlike past surveys the bottom material of the 2001 cores was described as firm, whereas it was considered very soft to soft in 1999.

The 2001 cores analyzed illustrated the variability within Cell SC. On average the cap was 2.5 ft (75 cm) thick, was detectable at a depth of 5.9 in.(15 cm), and extended to 8 ft (254 cm) in various cores. The water content of the sediment had a tendency to decrease with depth, indicating sediment consolidation. The shear strength was higher in this cell than any of the other cells tested. The density of the sediment was consistent throughout the cell and averaged 1.5 $g \cdot cc^{-1}$ wet and 0.9 $g \cdot cc^{-1}$ dry. Similar to Cell M2, the cap in the Super Cell appears to be maintaining its stratigraphy.

4.1.4 Phase 2; Step 3: CAD Cells M8-11, M19 and Chelsea River

Cells M8-11 and M19 were capped in September 2000 as part of the final step of BHNIP Phase 2 (Figure 2-1). Additional cores were collected from Cell M19 due to high volumes of BBC in three of the initial cores. All the cores were split, photographed and described. However, due to the large proportions of BBC in three of the cores, sub-samples were not collected from the cores believed to be outside the cell boundary. The black dredged material in the cores contained a strong odor that was organic in nature with petroleum undertones, the odor was not noticed in the sand at the surface of the core. The cores collected from within both Cells M8-11 and M19 contained a distinct layer of clean sand over the top of the dredged material. Neither cell contained the soft sediment on the surface that was seen in cores collected from all the other cells.

4.1.4.1 Cell M8-11 Summary

Based on the vibracores collected, Cell M8-11 contains a thick layer (3.1 ft; 95 cm) of unmixed cap. Unlike the earlier CAD cells, M8-11 does not contain a layer of black silty clay over the surface (0 cm) of the sand. The sand cap and dredged material interface was distinct and it is believed that very little mixing occurred during cap placement. All of the cores collected from Cell M8-11 indicated a distinct sand cap over softer dredged material in the cell. The cap thickness varied between cores, but an average thickness of 3 ft (95 cm) of sand was present on the surface of Cell M8-11. Core M8-11-5 was collected from the southeast corner of the cell, and contained the least amount of cap (2.3 ft; 69 cm). All of the cores contained a layer of gray sand over yellowish brown sand with the exception of Core M8-11-5 (see description for details). It is believed that core M8-11-5 indicated the presence of a diapir type formation during cell construction. The underlying yellowish-brown sand was absent from Core M8-11-5 and potentially displaced by a diapir. Unlike earlier cells, the cells containing the diapir apparently stabilized over time to a level capable of supporting subsequent sand placement.

The overall density of the sediment was consistent with an average wet density of 1.5 $g \cdot cc^{-1}$ and an average dry density of 0.9 $g \cdot cc^{-1}$. The overall cell conditions indicated a softer horizon with a higher water content just below the cap and yielding a more consolidated sediment with depth. There were pockets of sediment that were softer or contained higher liquid limits then the material in the intervals above and below. However, the pockets were not continuous and the general trend of more solid stable sediment underlying the cap was consistent throughout the cores analyzed. The overall cell appears to contain a stable, thick sand cap over consolidated dredged sediments unsuitable for unconfined open-water disposal.

4.1.4.2 Cell M19 Summary

A total of eight cores were collected from Cell M19, three of which contained BBC and were not analyzed. The three cores collected from the east, center and west along the central axis (M19-16, M19-17, and M19-18) of the cell were considered an excellent representation of the sediment, exhibiting volumes of cap over dredged material, as well as ambient BBC at depth. On average, the cell contains 2.3 ft (71 cm) of sand cap on top of relatively consolidated dredged material. Two (M19-4 and M19-5) of the seven cores containing sand cap displayed softer dredged material at the surface of the core. Core M19-4 contained 3.2 ft (97 cm) of silty clay over a continuous layer of sand, while M19-5 contained only 1.6 in. (4 cm) of soft sediment over the cap. The three cores (M19-16, M19-17 and M19-18) collected from the center of the cell contained an average cap thickness of 3.7 ft (113 cm), with no indication of a surface layer of silty clay. This variability indicates that diapirs may have been occurring along the margins of this cell as it was capped.

The cores analyzed for geotechnical properties from this cell contained significant quantities (average of 2.3 ft;71 cm) of sand cap over consolidated material. Surprisingly, the majority of the cores from this cell demonstrated increasing water content with depth and had the highest shear strength values just below the cap material. This indicates that the dredged material has not yet fully consolidated and the weight of the cap is forcing the consolidation of sediment immediately below the cap. The overall density of the sediment in the cell was fairly consistent at 1.5 $g \cdot cc^{-1}$ wet and 0.9 $g \cdot cc^{-1}$ dry density. The liquid limit, plastic limit and resulting plasticity index were highly variable and attributable to the presence of significant amounts of clay in the underlying material. The shear strength of the sediment in this cell was the most variable of all the cells analyzed, as softer sediments appeared to be intermixed with more consolidated, stronger sediments. The addition of the sand cap to the CAD cells has been known to increase the shear strength and decrease the water content of underlying sediments (SAIC 2000). It can be predicted that with additional time the sediments in the deeper regions of the cell will further consolidate as pore water is gradually extruded upwards through the cap.

4.2 REMOTS® Sediment-Profile Imaging

The primary objectives of the Boston Harbor Summer 2001 REMOTS® sediment profile survey was to examine the distribution of sediments (cap thickness and newly settled sediments) within each cell and assess benthic recolonization status of the disposal cells. REMOTS® images were collected from 56 stations located within the nine CAD cells and two reference areas. Overall summaries of the results of this survey are provided below.

4.2.1 Physical Conditions

All of the sediments that were analyzed in the sediment profile images from the nine CAD cells were considered to be dredged material. In all replicates, this dredged material extended beyond the penetration depth of the camera. Overall, the predominate grain size major mode of the material on the surface of the CAD cells was >4 phi (silt and clay). These results are similar to the conditions observed within the two reference areas. In addition, a small number of the replicate images showed evidence of a distinct cap material layer at the sediment-water interface (Figure 3-25). In general, this distinguishable cap material layer correlated with the stations that also showed evidence of coarser-grained (fine and medium sand) sediments (Cells M8-11, M19 and SC). A significant amount of shell hash was also seen in a number of replicate images acquired at these stations.

A depositional layer of fine-grained flocculent material was observed in many of the replicate images from each of the cells. The depth of this depositional layer varied between images and was generally difficult to differentiate from the fine-grained oxygenated sediments that comprised the RPD (Figure 3-11 and Figure 3-27). In a number of images obtained from the Mystic River CAD cells that displayed a significant amount of sand or shell material fragments at the sediment-water interface, this depositional layer was not prevalent. This finding suggests that natural depositional processes are not contributing significant amounts of material to the CAD cells in Mystic River.

Perhaps the most discernable evidence of naturally occurring depositional sediments is from the images that were acquired in the Chelsea River CAD cell. A small number of the images appear to have “pockets” of depositional material in what appears to be minor depressions in the surface sediments (Figure 3-26 and Figure 3-27). However, the presence of the depositional material in the images was relatively rare, as many of the images did not appear to have any obvious depositional material present.

4.2.2 Biological Conditions

The predominant successional stage in the majority of the sediment-profile images from the nine CAD cells was Stage I. A number of the images also suggested that a sparse population of Stage II and Stage III organisms was also present. Immature amphipod tubes and small feeding voids at depth within some of the images provided the evidence that the surface of the CAD cells are supporting an infaunal population. In general, these results indicate that the CAD cells are still in the initial stages of benthic recolonization, but also display strong similarities to the benthic conditions observed at the two reference areas. As a result, this finding suggests the ambient sediments throughout the Mystic and Chelsea River environments are continually experiencing similar levels of environmental stress. Subsequently, the development of a stable benthic community over the surface of the CAD cells may require a significantly longer period of time in comparison to an open water environment.

Apparent RPD depths throughout the nine CAD cells were somewhat variable and generally shallow. These results can most likely be attributed to the predominance of shallow dwelling opportunistic Stage I organisms that do not aggressively aerate sediments at depth, coupled with the high organic loading rates of estuarine environments like Boston Harbor. The presence of primarily Stage I organisms, shallow apparent RPD depths, and the occasional methane gas bubble resulted in OSI values that are considered relatively low in marine environments. However, the OSI values and overall benthic conditions within the CAD cells are similar to the values and benthic conditions of the reference areas.

The physical configurations of the completed CAD cells indicate a 10-17 ft (3 to 5 m) differences in depth between the CAD cell and the surrounding seafloor. One concern regarding the differences in seafloor topography was related to the isolation of the CAD cell sediments from water exchange and the resulting impacts to water quality within the cells. The similarity in benthic habitat conditions noted within the CAD cell and reference area stations, suggest this differences in depth are having no distinct impact on benthic community recovery due to variation in water exchange or water quality.

However, of the three areas of Boston Harbor surveyed with REMOTS® sediment-profile imaging (Inner Confluence, Mystic River, and Chelsea River), the Inner Confluence (both Cell IC and IC-REF) displayed healthier benthic conditions with relatively deep RPD depths and the presence of advanced successional stages. The Summer 2001 survey was completed in mid-August at what would be the height of a seasonal hypoxia event within the entire system, due to the presence of a stratified water column and warm water temperatures. Although subject to the effects of tides, Boston Harbor is a relatively closed system with minimal exchange or flushing with water from Massachusetts Bay. Based on the configuration of the harbor, the Inner Confluence likely receives the highest amount of tidal flushing, relative to the Mystic and Chelsea Rivers. As a result, water quality over Cell IC and IC-REF may actually be better (higher dissolved oxygen concentrations), reducing environmental stress on the benthos, and promoting the development of an advanced benthic infaunal community.

4.3 Benthic Community Assessment

In general, the benthic community assessment survey performed over the CAD cells and reference area confirmed the findings of the REMOTS® sediment profile imaging results. The benthic infaunal population within Boston Harbor was composed primarily of species classified as opportunistic, early colonizers or Stage I individuals, but the total abundance of organisms was rather low throughout the study area. The benthic community structure of the CAD cells and reference areas were quite similar, as Stage I polychaetes were found in relative abundance.

Some representatives from advanced successional seres were also present in the Boston Harbor sediment samples. Stage II amphipods (Ampelisca) were detected in the Cell IC, while Stage III polychaetes (Nephtyidae, likely *Nephtys incisa*) were found foraging in Cells IC, M2, CR, and the reference areas. In addition to the various marine worms, bivalves (*Yolida*, *Pandora*, *Tellina*, *Hiatella*, and *Mytilidae*), gastropod (*Ilyanassa*), shrimp (*Crangon*), and tunicates (Ascidiacea) were also present, but often in low numbers.

Of all the stations sampled within the CAD cells, the two Cell IC stations (IC-2 and IC-5) showed the highest diversity and evenness values with 14 unique taxa detected and a reduced number of nematodes. This cell was constructed and capped in Summer 1997, allowing approximately four years for benthic community recovery before the 2001 sampling event. As a result, it appears the surface sediments within Cell IC are beginning to reflect a more stable benthic infaunal community in comparison to the remaining CAD cells.

Cell M5 appeared to exhibit the poorest benthic habitat quality with low numbers of total organisms (11), as well as low diversity (0.76) due to the relative dominance of nematodes in the surface sediments. This CAD cell was completed in November 1998, allowing nearly three years for benthic recovery to occur. The grab sample was collected over Station M5-1 and the results generally conflict with the REMOTS® data for this station. Sediment-profile images displayed the presence of Stage I, tube-dwelling polychaetes and relatively deep RPD depths in all three replicates, which yielded a median OSI of +6. The degraded conditions suggested by the grab sample results may simply be the product of spatial variability within close proximity to the target station location.

Dredged material disposal operations over the Chelsea River CAD cell (Cell CR) were concluded in Fall 2000, permitting approximately 9 months of recovery time before the benthic community assessment survey. Within that time period an apparently stable pioneering benthic community (Stage I) had become established in the CAD cell sediments, with limited advancement into higher successional seres (Stage III). Opportunistic worms composed a significant percentage of the infaunal community within CR; however, species diversity and evenness values are comparable to the Mystic River and Inner Confluence reference areas.

Overall, the results of this sampling effort are generally consistent with conditions observed in the inner Boston Harbor prior to the BHNIP. In the Fall 1994, the Inner Confluence exhibited the highest species richness (1-24 taxa) and abundance (1-163/0.04 m^2) of these three areas (Inner Confluence, Mystic River, and Chelsea River; Normandeau Associates and Diaz 1995). Chelsea River supported 1-17 taxa and 0-79 individuals/0.04 m^2. The Mystic River channel supported a depauperate benthic community of 0-4 taxa and 0-6 individuals/0.04 m^2. In all cases, the benthic community was considered to be a pioneering stage (Stage I) in which opportunistic species known for great reproductive capacity and rapid growth tend to dominate.

Characteristics of the benthic infaunal assemblage observed in the CAD cells in August 2001 compare favorably with both the appropriate reference stations sampled concurrently and the historical data. The CAD cells support benthic communities of a similar successional stage, species composition, species richness, and abundance to both reference stations and historical observations.

5.0 CONCLUSIONS

- The sediment vibracores collected from the eight Boston Harbor CAD cells studied under the one-year monitoring effort indicate that the various layers of sediment within each cell have maintained their original stratigraphy. Comparison between the 2001 cores to those collected at each cell after the respective postcap surveys displayed no distinct change in sediment composition or layering since the initial cap placement.

- The most recently capped CAD Cells SC, M8-11, and M19 continue to display the thickest accumulation of cap material and indicate very little mixing of the sand with underlying dredged material at depth.

- Changes in the various geotechnical parameters (water content, Atterberg limits, and shear strength) over time indicate the dredged material residing within the CAD cells has continued to consolidate as pore water is gradually extruded up through the cap layer. Due to variable thickness of silty clays on the surface of Cells IC, M4, M5 and M12 immediately after capping, no clear calculation of depositional accumulation in the 2001 cores can be determined.

- The cores, grab samples, and REMOTS® images indicate that a layer of soft sediment exists over the surface of most of the Boston Harbor CAD cells. This layer is of a variable thickness, and a portion of which may be the direct result of natural sediment deposition occurring within cells. However, the origin of this sediment accumulation could not be determined based on the available data due to similarities in the composition of the disposed dredged material and ambient Boston Harbor sediments.

- The accumulation of a new layer of sediment on the surface of Cells M2 and SC indicate that natural deposition may be occurring. However, small patches of silty clay were also noted on the surface of the cells during postcap surveys, and believed to be the product of diapirs. Unfortunately, the ability to discriminate between layers of silty clay on the surface of the cells resulting from natural deposition from those produced by diapiric processes does not exist within the parameters of this survey. Although the lack of change in sediment stratigraphy within the 2001 (M8-11 and M19) cores suggests no major diapiric activity has occurred within the CAD cells relative to previous monitoring efforts, the information obtained from this survey is insufficient to determine if the pre-existing diapirs continue to transfer small quantities of dredged material to the surface along with the pore water during consolidation.

- The benthic community found to be recolonizing the surface of the CAD cells appears to be comprised mainly of Stage I pioneering species of polychaetes, as well as various small bivalve and gastropod molluscs. Limited advancement to Stage II and Stage III assemblages were noted at several stations within Cells M4, M12, M2, SC, M19 and CR. At four years post-completion, Cell IC displays the most stable benthic community relative to the other CAD cells and nearby reference areas with relatively deep RPDs approaching 0.78 in. (2 cm) and a higher abundance of Stage II and Stage III organisms.

- The benthic community assessment data collected over the CAD cells and the reference areas as part of the Summer 2001 survey is comparable to the results obtained from similar efforts performed in Boston Harbor prior to the BHNIP. The seafloor within this industrialized harbor is subject to a significant amount of organic loading and benthic disturbance associated with vessel activity. As a result, the surface of the Boston Harbor CAD cells will likely require a long period of time to establish a stable benthic community and be considered fully recovered from the impacts associated with dredged material deposition and cap placement.

6.0 REFERENCES

Babb-Brott, D. 1997. "BHNIP: State permitting considerations for CAD disposal." Conference Proceedings of Coastal Zone '97, Vol. I., pp. 196-198,

ENSR. 1997a. "Summary report of independent observations Phase 1 - Boston Harbor Navigation Improvement Project." Prepared for Massachusetts Coastal Zone Management Agency, Executive Office of Environmental Affairs, Boston, MA. ENSR Document Number 4479-001-150, ENSR, Acton, MA.

ENSR. 1997b. "Summary of capping investigations." BHNIP Independent Observer Report I/O-9703. Prepared for Massachusetts Coastal Zone Management Agency, Executive Office of Environmental Affairs, Boston, MA. ENSR Document Number 4479-001-120, ENSR, Acton, MA.

Fauchald, K. and Peter A. Jumars. 1979. The diet of worms: A Study of Polychaete Feeding Guilds, Oceanography Mar. Biol. Ann. Rev., 17, 193-284.

Germano, J. D. (1983). Infaunal succession in Long Island Sound: Animal-sediment interactions and the effects of predation. Ph. D. dissertation, Yale University, New Haven, CT.

Germano, J. D., and Rhoads D. C. (1984). REMOTS® sediment profiling at the Field Verification Program (FVP) disposal site. pp. 536-544. R. L. Montgomery and J. W. Leach eds. Dredging and Dredged Material Disposal. Volume 1. Am. Soc. Civil Engineers. New York.

Johnson, R. G. (1972). Conceptual models of benthic marine communities. Models of Paleobiology T. J. M. Schopf, ed., Freeman, Cooper, and Co., San Francisco, pp. 145-159.

Normandeau Associates, Inc. (NAI) and R.J. Diaz. 1995. Environmental Studies for the Boston Harbor Navigation Improvement and Berth Dredging Environmental Impact Report/Statement: Task 1: Benthic Studies. Prepared for U.S. Army Corps of Engineers.

OSI. 2000. "Final Report-Hydrographical and Subbottom Profiling Status Survey, Confined Disposal Facilities (CDF), Mystic River, Boston, Massachusetts." Submitted to: Great Lakes Dock and Dredge, Oakbrook, IL.

Revelas, E. C., Germano, J. D., and Rhoads, D. C. (1987). REMOTS$^{®}$ Reconnaissance of benthic environments. Coastal Zone '87: Proceedings of the Conference, WW Div/ASCE/May 26-29, Seattle, WA, pp. 2069-2083.

Rhoads, D. C. (1974). Organism-sediment relations on the muddy sea floor. Oceanogr. Mar. Biol. Ann. Rev. 12: 263-300.

Rhoads, D. C., and Boyer, L. F. (1982). The effects of marine benthos on physical properties of sediments. Animal-Sediment Relations P. L. McCall and M. J. S. Tevesz, eds., Plenum Press, New York, pp. 3-52.

Rhoads, D. C., and Germano, J. D. (1982). Characterization of organism-sediment relations using sediment profile imaging: An efficient method of Remote Ecological Monitoring of the Seafloor (REMOTS$^{®}$ System). Mar. Ecol. Prog. Ser. 8:115-128.

Rhoads, D. C., and Germano, J. D. (1986). Interpreting long-term changes in benthic community structure: a new protocol. Hydrobiologia 142: 291-308.

SAIC. 1997. “Postcap Monitoring of Boston Harbor Navigation Improvement Project (BHNIP) Phase 1: Assessment of Inner Confluence CAD Cell.” SAIC Report No. 413. Submitted to: U.S. Army Corps of Engineers, New England District, Waltham, MA.

SAIC. 1999. “Monitoring Results Summary from the First Three Mystic River CAD Cells.” SAIC Report No. 466. Submitted to Great Lakes Dredge and Dock, East Boston, MA.

SAIC. 2000. Geotechnical Investigation of CAD Cells; Boston Harbor Navigation Improvement Project. SAIC Report No. 503. Submitted to U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Santos, S. L., and Simon, J. L. (1980a). Marine soft-bottom community establishment following annual defaunation: Larval or adult recruitment? Mar. Ecol. Prog. Ser. 2:235-241.

Santos, S. L., and Simon, J. L. (1980b). Response of soft-bottom benthos to annual catastrophic disturbance in a south Florida estuary. Mar. Ecol. Prog. Ser. 3:347-355.

Valente, R. M., D. C. Rhoads, J. D. Germano and V. J. Cabelli. (1992). Mapping of benthic enrichment patterns in Narragansett Bay, RI. Estuaries 15:1-17.

Tables

Table 2-1. **Summer 2001 Vibracore Sampling Locations within the Boston Harbor CAD Cells**

Cell	Core Name	Latitude	Longitude
		NAD 83	
Cell IC	IC-1	42° 22.7611' N	71° 02.6098' W
	IC-2	42° 22.7801' N	71° 02.6087' W
	IC-3	42° 22.7845' N	71° 02.6052' W
	IC-4	42° 22.7691' N	71° 02.6220' W
	IC-5	42° 22.7820' N	71° 02.6289' W
Cell M4	M4-1	42° 23.2736' N	71° 03.8886' W
	M4-2	42° 23.2625' N	71° 03.8856' W
	M4-3	42° 23.2637' N	71° 03.8383' W
	M4-5	42° 23.2502' N	71° 03.8157' W
	M4-6	42° 23.2618' N	71° 03.7994' W
Cell M5	M5-1	42° 23.2765' N	71° 03.7678' W
	M5-2	42° 23.2783' N	71° 03.7559' W
	M5-3	42° 23.2785' N	71° 03.7382' W
	M5-4	42° 23.2723' N	71° 03.7304' W
	M5-5	42° 23.2744' N	71° 03.7235' W
Cell M12	M12-1	42° 23.1338' N	71° 03.4789' W
	M12-2	42° 23.1239' N	71° 03.4929' W
	M12-3	42° 23.1297' N	71° 03.4550' W
	M12-4	42° 23.1181' N	71° 03.4130' W
	M12-5	42° 23.1210' N	71° 03.4413' W
Cell M2	M2-1	42° 23.2784' N	71° 03.9781' W
	M2-2	42° 23.2766' N	71° 03.9550' W
	M2-3	42° 23.2725' N	71° 03.9328' W
	M2-4	42° 23.2674' N	71° 03.9563' W
	M2-5	42° 23.2697' N	71° 03.9782' W
Cell SC	SC-1	42° 23.1215' N	71° 03.3725' W
	SC-2	42° 23.1404' N	71° 03.3241' W
	SC-3	42° 23.1684' N	71° 03.3609' W
	SC-4	42° 23.1756' N	71° 03.3177' W
	SC-5	42° 23.1925' N	71° 03.2890' W
Cell M8-11	M811-1	42° 23.1829' N	71° 03.5250' W
	M811-2	42° 23.1796' N	71° 03.4997' W
	M811-3	42° 23.1643' N	71° 03.4748' W
	M811-4	42° 23.1723' N	71° 03.4440' W
	M811-5	42° 23.1562' N	71° 03.4198' W
Cell M19	M19-1	42° 23.1049' N	71° 03.2467' W
	M19-2	42° 23.0963' N	71° 03.2259' W
	M19-3	42° 23.0934' N	71° 03.2068' W
	M19-4	42° 23.0978' N	71° 03.1872' W
	M19-5	42° 23.0907' N	71° 03.1666' W
	M19-16	42° 23.1024' N	71° 03.0988' W
	M19-17	42° 23.1261' N	71° 03.1575' W
	M19-18	42° 23.1333' N	71° 03.2209' W

Table 2-2. Sediment Grab Sampling Locations within the Boston Harbor CAD Cells and Reference Areas

Station	Latitude	Longitude
	NAD 83	
IC-2	42° 22.780´ N	71° 02.629´ W
IC-5	42° 22.780´ N	71° 02.619´ W
M5-1	42° 23.281´ N	71° 03.769´ W
M2-5	42° 23.272´ N	71° 03.983´ W
SC-4	42° 23.176´ N	71° 03.319´ W
M8-11	42° 23.162´ N	71° 03.475´ W
CR-2	42° 23.283´ N	71° 01.171´ W
CR-4	42° 23.247´ N	71° 01.221´ W
IC-REF1	42° 22.846´ N	71° 02.736´ W
IC-REF2	42° 22.840´ N	71° 02.726´ W
MR-REF1	42° 23.190´ N	71° 03.700´ W
MR-REF2	42° 23.190´ N	71° 03.707´ W

Table 2-3. REMOTS® Sediment-Profile Imaging Locations within the Boston Harbor CAD Cells and Reference Areas

CAD Cell	Station	Latitude	Longitude
		NAD 83	
Inner Confluence (IC)	IC-1	42° 22.762' N	71° 02.619' W
	IC-2	42° 22.781' N	71° 02.618' W
	IC-3	42° 22.786' N	71° 02.616' W
	IC-4	42° 22.769' N	71° 02.622' W
	IC-5	42° 22.782' N	71° 02.629' W
	IC-6	42° 22.765' N	71° 02.627' W
M4	M4-1	42° 23.272' N	71° 03.890' W
	M4-2	42° 23.262' N	71° 03.886' W
	M4-3	42° 23.263' N	71° 03.839' W
	M4-4	42° 23.255' N	71° 03.848' W
	M4-5	42° 23.250' N	71° 03.815' W
	M4-6	42° 23.261' N	71° 03.799' W
M5	M5-1	42° 23.276' N	71° 03.768' W
	M5-2	42° 23.278' N	71° 03.756' W
	M5-3	42° 23.279' N	71° 03.737' W
	M5-4	42° 23.272' N	71° 03.730' W
	M5-5	42° 23.274' N	71° 03.723' W
	M5-6	42° 23.274' N	71° 03.746' W
M12	M12-1	42° 23.133' N	71° 03.478' W
	M12-2	42° 23.124' N	71° 03.494' W
	M12-3	42° 23.130' N	71° 03.456' W
	M12-4	42° 23.118' N	71° 03.413' W
	M12-5	42° 23.121' N	71° 03.440' W
	M12-6	42° 23.120' N	71° 03.463' W
M2	M2-1	42° 23.280' N	71° 03.976' W
	M2-2	42° 23.276' N	71° 03.955' W
	M2-3	42° 23.273' N	71° 03.933' W
	M2-4	42° 23.267' N	71° 03.957' W
	M2-5	42° 23.270' N	71° 03.978' W
	M2-6	42° 23.265' N	71° 03.926' W
Super Cell (SC)	SC-1	42° 23.123' N	71° 03.373' W
	SC-2	42° 23.139' N	71° 03.323' W
	SC-3	42° 23.167' N	71° 03.362' W
	SC-4	42° 23.174' N	71° 03.317' W
	SC-5	42° 23.193' N	71° 03.290' W
	SC-6	42° 23.197' N	71° 03.346' W
M8-11	M8-11-1	42° 23.183' N	71° 03.527' W
	M8-11-2	42° 23.179' N	71° 03.499' W
	M8-11-3	42° 23.163' N	71° 03.475' W
	M8-11-4	42° 23.172' N	71° 03.444' W
	M8-11-5	42° 23.156' N	71° 03.419' W
	M8-11-6	42° 23.165' N	71° 03.524' W
M19	M19-1	42° 23.102' N	71° 03.099' W
	M19-2	42° 23.126' N	71° 03.157' W
	M19-3	42° 23.134' N	71° 03.218' W
	M19-4	42° 23.120' N	71° 03.241' W
	M19-5	42° 23.112' N	71° 03.182' W
	M19-6	42° 23.107' N	71° 03.138' W
Chelsea River (CR)	C12-1	42° 23.294' N	71° 01.195' W
	C12-2	42° 23.282' N	71° 01.170' W
	C12-3	42° 23.274' N	71° 01.217' W
	C12-4	42° 23.249' N	71° 01.221' W
	C12-5	42° 23.241' N	71° 01.251' W
	C12-6	42° 23.220' N	71° 01.259' W
Mystic River (MR) and Inner Confluence (IC) Reference Areas	MR-REF	42° 23.193' N	71° 03.699' W
	IC-REF	42° 22.845' N	71° 02.736' W

Table 2-4. Grain Size Scales for Sediments

ASTM (Unified) Classification[1]	U.S. Std. Sieve[2]	Size in mm	Phi (Φ) Size	Wentworth Classification[3]
Boulder		4096.	-12.0	Boulder
		1024.	-10.0	
	12 in (300 mm)	256.	-8.0	
Cobble		128.	-7.0	Large Cobble
		107.64	-6.75	Small Cobble
		90.51	-6.5	
	3 in (75mm)	76.11	-6.25	
Coarse Gravel		64.00	-6.0	
		53.82	-5.75	Very Large Pebble
		45.26	-5.5	
		38.05	-5.25	
		32.00	-5.0	
		26.91	-4.75	
		22.63	-4.5	Large Pebble
	3/4 in (19 mm)	19.03	-4.25	
Fine Gravel		16.00	-4.0	
		13.45	-3.75	
		11.31	-3.5	Medium Pebble
		9.51	-3.25	
	2.5	8.00	-3.0	
	3	6.73	-2.75	
	3.5	5.66	-2.5	Small Pebble
	4 (4.75 mm)	4.76	-2.25	
Coarse Sand	5	4.00	-2.0	
	6	3.36	-1.75	
	7	2.83	-1.5	Granule
	8	2.38	-1.25	
	10 (2.0 mm)	2.00	-1.0	
Medium Sand	12	1.68	-0.75	
	14	1.41	-0.5	
	16	1.19	-0.25	Very Coarse Sand
	18	1.00	0.0	
	20	0.84	0.25	
	25	0.71	0.5	
	30	0.59	0.75	Coarse Sand
	35	0.50	1.0	
	40 (0.425 mm)	0.420	1.25	
Fine Sand	45	0.354	1.5	
	50	0.297	1.75	Medium Sand
	60	0.250	2.0	
	70	0.210	2.25	
	80	0.177	2.5	
	100	0.149	2.75	Fine Sand
	120	0.125	3.0	
	140	0.105	3.25	
	170	0.088	3.5	
	200 (0.075 mm)	0.074	3.75	
Fine-grained Soil: Clay if PI ³ 4 and plot of PI vs. LL is on or above "A" line* Silt if PI < 4 and plot of PI vs. LL is below "A" line* * and the presence of organic matter does not influence LL.	230	0.0625	4.0	Very Fine Sand
	270	0.0526	4.25	
	325	0.0442	4.5	
	400	0.0372	4.75	
		0.0312	5.0	Coarse Silt
		0.0156	6.0	
		0.0078	7.0	
		0.0039	8.0	
		0.00195	9.0	Medium Silt
		0.00098	10.0	Fine Silt
		0.00049	11.0	Very Fine Silt
		0.00024	12.0	Coarse Clay
		0.00012	13.0	Medium Clay
		0.000061	14.0	Fine Clay

1. ASTM Standard D 2487-92. This is the ASTM version of the Unified Soil Classification System. Both systems are similar (from ASTM (1993)).
2. Note that British Standard, French, and German DIN mesh sizes and classifications are different.
3. Wentworth sizes (in inches) cited in Krumbein and Sloss (1963).

Table 2-5. Calculation of REMOTS® Organism Sediment Index Value

A. CHOOSE ONE VALUE:

Mean RPD Depth	Index Value
0.00 cm	0
> 0 - 0.75 cm	1
0.75 - 1.50 cm	2
1.51 - 2.25 cm	3
2.26 - 3.00 cm	4
3.01 - 3.75 cm	5
> 3.75 cm	6

B. CHOOSE ONE VALUE:

Successional Stage	Index Value
Azoic	-4
Stage I	1
Stage I ® II	2
Stage II	3
Stage II ® III	4
Stage III	5
Stage I on III	5
Stage II on III	5

C. CHOOSE ONE OR BOTH IF APPROPRIATE:

Chemical Parameters	Index Value
Methane Present	-2
No/Low Dissolved Oxygen**	-4

REMOTS® ORGANISM-SEDIMENT INDEX = Total of above subset indices (A+B+C)

RANGE: -10 - +11

** **Note**: This is not based on a Winkler or polarigraphic electrode measurement. It is based on the imaged evidence of reduced, low reflectance (i.e., high oxygen demand) sediment at the sediment-water interface.

Table 3-1. Abundance (Number of Organisms Per 0.04 m^2) of Benthic Macrofauna. Boston Harbor Confined Aquatic Disposal Cells, August 28, 2001

Taxon	Disposal Sites								Reference Sites				95% Confidence Limits		
	IC-2B	IC-5B	M5-1B	M2-5B	SC-4B	M8-11-3B	CR-2B	CR-4B	MR REF-1B	MR REF-2B	IC REF -1B	IC REF- 2B	Mean	Lower	Upper
Cnidaria															
Hydrozoa												P*			
Campanularidae			P*												
Anthozoa															
Metridium senile				1									0.1	-0.1	0.3
Nematoda															
Nematoda	15	34	8	124	64	22	19	39		31	54	98	42.3	18.7	66.0
Annelida															
Polychaeta															
Eteone longa									1				0.1	-0.1	0.3
Microphthalmus aberrans		5			5							1	0.9	-0.3	2.1
Nephtyidae	16	15		3			2	2			15	10	5.3	1.0	9.5
Nephtys incisa					1						1	1	0.3	0.0	0.5
Ninoe nigripes					1							3	0.3	-0.2	0.9
Polydora cornuta	1	3			5	5		1			49	41	8.8	-2.1	19.6
Prionospio steenstrupi	2												0.2	-0.2	0.5
Streblospio benedicti	11	34			2	2	2	7		2	3	5	5.7	-0.4	11.7
Dipolydora socialis												2	0.2	-0.2	0.5
Cirratulidae	3	6			2		2				1	9	1.9	0.1	3.7
Tharyx acutus	8	23		14	23	9	10	5	1	9	9	16	10.6	5.9	15.3
Capitella capitata				1							1	12	1.2	-1.0	3.3
Mediomastus californiensis		1			1	1					1		0.3	0.0	0.6
Mediomastus sp.												1	0.1	-0.1	0.3
Polycirrus eximius		2			4	11					14	1	2.7	-0.4	5.7
Polycirrus sp.		1				16					10	6	2.8	-0.6	6.1
Oligochaeta															
Oligochaeta	2	7		2	5	1		2			9	11	3.3	0.8	5.7

P*=partial specimen

(continued)

Table 3-1. (Continued)

Taxon	Disposal Sites								Reference Sites				95% Confidence Limits		
	IC-2B	IC-5B	M5-1B	M2-5B	SC-4B	M8-11-3B	CR-2B	CR-4B	MR REF-1B	MR REF-2B	IC REF- 1B	IC REF- 2B	Mean	Lower	Upper
Mollusca															
Gastropoda															
Crepidula fornicata												1	0.1	-0.1	0.3
Ilyanassa trivittata	5	11									3	1	1.7	-0.5	3.8
Bivalvia															
Yoldia limatula	6	1				1					2	1	0.9	-0.2	2.0
Mytilidae	3			3	1								0.6	-0.2	1.3
Ensis directus					1								0.1	-0.1	0.3
Tellina agilis	1	4		1	1	1							0.7	-0.1	1.4
Hiatella sp.						1							0.1	-0.1	0.3
Pandora glacialis						1							0.1	-0.1	0.3
Arthropoda															
Cirripedia															
Semibalanus balanoides											6	1	0.6	-0.5	1.7
Mysidacea															
Neomysis americana				1							1	1	0.3	0	0.5
Isopoda															
Edotia triloba				1									0.1	-0.1	0.3
Jaera marina					1								0.1	-0.1	0.3
Amphipoda															
Ampelisca abdita	1												0.1	-0.1	0.3
Monocorophium acherusicum		1									2		0.3	-0.1	0.6
Jassa marmorata	1			1					1				0.3	0.0	0.5
Decapoda															
Crangon septemspinosa	2	2	2		1	2		1		1	1	2	1.2	0.6	1.7
Insecta															
Collembolla															
Anurida maritima				1									0.1	-0.1	0.3
Diptera															
Chaoborus sp.			1										0.1	-0.1	0.3

P*=partial specimen

(continued)

Table 3-1. (Continued)

Taxon	Disposal Sites								Reference Sites				95% Confidence Limits		
	IC-2B	IC-5B	M5-1B	M2-5B	SC-4B	M8-11-3B	CR-2B	CR-4B	MR REF-1B	MR REF-2B	IC REF 1B	IC REF 2B	Mean	Lower	Upper
Bryozoa															
Bowerbankia gracilis								P*			P*				
Bugula sp.							P*	P*							
Ascophora											P*				
Entoprocta															
Pedicellinida															
Barentsia sp.											P*				
Urochordata															
Ascidiacea							3	21					2.0	-1.8	5.8
Total Abundance	**77**	**150**	**11**	**153**	**118**	**73**	**38**	**78**	**3**	**43**	**182**	**224**			
Number of Unique Taxa	**14**	**14**	**4**	**12**	**15**	**12**	**6**	**10**	**3**	**4**	**18**	**21**			
Abundance without Nematoda	**62**	**116**	**3**	**29**	**54**	**51**	**19**	**39**	**3**	**12**	**128**	**126**			
Shannon-Weiner Diversity (H')	**2.220**	**2.080**	**0.760**	**0.830**	**1.570**	**1.851**	**1.221**	**1.392**	**1.099**	**0.793**	**1.827**	**1.694**			
Shannon-Weiner Evenness (J')	**0.841**	**0.788**	**0.691**	**0.334**	**0.580**	**0.745**	**0.759**	**0.669**	**1.000**	**0.572**	**0.675**	**0.586**			

P*=partial specimen

Table 3-2. **Dominant Taxa Representing Greater than 1.0% of the Total for each Boston Harbor Grab Sampling Station**

7.0 TAXON	Mean Count	Percent of Total	Successional Stage
Station IC2-B (77 Total)			
Nephtyidae	16	20.80%	III
Nematoda	15	19.50%	I
Streblospio benedicti	11	14.30%	I
Tharyx acutus/Cirratulidae[a]	11	14.30%	I
Yoldia limatula	6	7.80%	
Ilyanassa trivittata	5	6.50%	
Mytilidae	3	3.90%	
Crangon septemspinosa	2	2.60%	
Prionospio steenstrupi	2	2.60%	I
Oligochaeta	2	2.60%	I
Ampelisca abdita	1	1.30%	II
Polydora cornuta	1	1.30%	I
Tellina agilis	1	1.30%	
Jassa marmorata	1	1.30%	
Station IC5-B (150 Total)			
Streblospio benedicti	34	22.70%	I
Nematoda	34	22.70%	I
Tharyx acutus/Cirratulidae	29	19.30%	I
Nephtyidae	15	10.00%	III
Ilyanassa trivittata	11	7.30%	
Oligochaeta	7	4.70%	I
Microphthalmus aberrans	5	3.30%	I
Tellina agilis	4	2.70%	
Polydora cornuta	3	2.00%	I
Polycirrus eximius/Polycirrus sp.[b]	3	2.00%	I
Crangon septemspinosa	2	1.30%	
Station M5-1B (11 Total)			
Nematoda	8	72.70%	I
Crangon septemspinosa	2	18.20%	
Chaoborus sp.	1	9.10%	
Station M2-5B (153 Total)			
Nematoda	124	81.10%	I
Tharyx acutus	14	9.20%	I
Mytilidae	3	2.00%	
Nephtyidae	3	2.00%	III
Oligochaeta	2	1.30%	I

(continued)

Table 3-2. (Continued)

Station SC-4B (118 Total)			
Nematoda	64	54.20%	I
Tharyx acutus/Cirratulidae	25	21.20%	I
Polydora cornuta	5	4.20%	I
Microphthalmus aberrans	5	4.20%	I
Oligochaeta	5	4.20%	I
Polycirrus eximius	4	3.40%	I
Streblospio benedicti	2	1.70%	I
Station M8-11-3B (73 Total)			
Polycirrus eximius/Polycirrus sp.	27	37.00%	I
Nematoda	22	30.10%	I
Tharyx acutus	9	12.30%	I
Polydora cornuta	5	6.90%	I
Crangon septemspinosa	2	2.70%	
Streblospio benedicti	2	2.70%	I
Yoldia limatula	1	1.40%	
Mediomastus californiensis	1	1.40%	I
Pandora glacialis	1	1.40%	
Oligochaeta	1	1.40%	I
Tellina agilis	1	1.40%	
Hiatella sp.	1	1.40%	
Station CR-2B (38 Total)			
Nematoda	19	50.00%	I
Tharyx acutus/Cirratulidae	12	31.60%	I
Ascidiacea	3	7.90%	
Nephtyidae	2	5.30%	III
Streblospio benedicti	2	5.30%	I
Station CR-4B (78 Total)			
Nematoda	39	50.00%	I
Ascidiacea	21	26.90%	
Streblospio benedicti	7	9.00%	I
Tharyx acutus	5	6.40%	I
Oligochaeta	2	2.60%	I
Nephtyidae	2	2.60%	III
Polydora cornuta	1	1.30%	I
Crangon septemspinosa	1	1.30%	

(continued)

Table 3-2. (Continued)

Station MR-REF-1B (3 Total)			
Tharyx acutus	1	33.30%	I
Jassa marmorata	1	33.30%	
Eteone longa	1	33.30%	II/III
Station MR-REF-2B (43 Total)			
Nematoda	31	72.10%	I
Tharyx acutus	9	20.90%	I
Streblospio benedicti	2	4.70%	I
Crangon septemspinosa	1	2.30%	
Station IC-REF-1B (182 Total)			
Nematoda	54	29.70%	I
Polydora cornuta	49	26.90%	I
Polycirrus eximius/Polycirrus sp.	24	13.20%	I
Nephtys incisa/Nephtyidae[c]	16	8.80%	III
Tharyx acutus/Cirratulidae	10	5.50%	I
Oligochaeta	9	5.00%	I
Semibalanus balanoides	6	3.30%	
Ilyanassa trivittata	3	1.70%	
Streblospio benedicti	3	1.70%	I
Yoldia limatula	2	1.10%	
Monocorophium acherusicum	2	1.10%	
Station IC-REF-2B (224 Total)			
Nematoda	98	43.80%	I
Polydora cornuta	41	18.30%	I
Tharyx acutus/Cirratulidae	25	11.20%	I
Capitella capitata	12	5.40%	I
Oligochaeta	11	4.90%	I
Nephtys incisa/Nephtyidae	11	4.90%	III
Polycirrus eximius/Polycirrus sp.	7	3.10%	I
Streblospio benedicti	5	2.20%	I
Ninoe nigripes	3	1.30%	III

[a] Cirratulidae comprises damaged species that are probably *Tharyx acutus*.
[b] *Polycirrus* sp. comprises damaged species that are probably *Polycirrus eximius*.
[c] Nephtyidae comprises juveniles that are probably *Nephtys incisa*.

Table 3-3. Summary of REMOTS® Sediment-Profile Imaging Results for Cell IC, Summer 2001

Cell-Station	Camera Penetration (cm)	Dredged Material Thickness (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
IC-1	6.74	>6.74	1.57	I,III	ST_I_ON_III	>4	NO	7.50	7.5	1.51
IC-2	10.71	>10.71	1.54	I,III	ST_I_ON_III	>4	NO	6.00	7	0.56
IC-3	6.35	>6.35	1.01	I,III,INDET	ST_I_ON_III	>4	NO	5.00	5	3.72
IC-4	11.67	>11.67	0.81	I,III	ST_I_ON_III	>4	NO	2.50	2.5	0.38
IC-5	12.84	>12.84	1.09	I,III,INDET	ST_I_ON_III	>4	NO	7.00	7	0.98
IC-6	12.63	>12.63	1.58	I,III	ST_I_ON_III	>4	NO	5.00	4	1.07

MIN	6.35	6.35	0.81					2.50	2.5	0.38
MAX	12.84	>12.84	1.58					7.50	7.5	3.72
AVG	10.16	>10.16	1.27					5.50	5.5	1.37

Cell-Station	Camera Penetration (cm)	Dredged Material Thickness (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
IC-REF	9.66		1.28	I,II,III	ST_I_ON_III	>4	NO	6	7	0.42

Table 3-4. Summary of REMOTS® Sediment-Profile Imaging Results for Cells M4, M5, and M12, Summer 2001

A Cell-Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
M4-1	15.21	>15.21	0.68	I	ST_I	>4	NO	2	2	0.80
M4-2	15.85	>15.85	0.53	I,III	ST_I_ON_III	>4	NO	4	2	1.22
M4-3	13.31	>13.31	0.92	I	ST_I	>4	YES	2	2	0.45
M4-4	17.09	>17.09	1.11	I,III	ST_I_ON_III	>4	NO	5	4	0.85
M4-5	15.62	>15.62	1.16	I	ST_I	>4	YES	2	2	0.82
M4-6	12.76	>12.76	1.85	I	ST_I	>4	NO	4	4	0.66

MIN	12.76	12.76	0.53					2.00	2.00	0.45
MAX	17.09	>17.09	1.85					4.67	4.00	1.22
AVG	14.97	>14.97	1.04					3.17	2.67	0.80

B Cell-Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
M5-1	18.11	>18.11	4.72	I	ST_I	>4	YES	6	6	0.49
M5-2	9.24	>9.24	0.88	I,AZOIC	ST_I	>4	NO	3	3	0.92
M5-3	7.29	>7.29	1.31	I	ST_I	>4	NO	3	3	0.46
M5-4	7.81	>7.81	1.69	I,INDET	ST_I	>4	NO	4	3.5	0.50
M5-5	8.74	>8.74	1.95	I	ST_I	>4	NO	4	4	1.19
M5-6	3.07	>3.07	NA	I,INDET	ST_I	>4	NO	NA	NA	1.96

MIN	3.07	3.07	0.88					3.00	3.00	0.46
MAX	18.11	>18.11	4.72					6.00	6.00	1.96
AVG	9.04	>9.04	2.11					4.03	3.90	0.92

C Cell-Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
M12-1	11.42	>11.42	1.74	I,II	ST_I_TO_II	>4	NO	4	4	2.41
M12-2	18.34	>18.34	1.80	I,III	ST_I_ON_III	>4	NO	5	4	0.67
M12-3	9.07	>9.07	1.94	I,III	ST_I_ON_III	>4	NO	5	4	1.30
M12-4	10.32	>10.32	1.34	I,III	ST_I_ON_III	>4	NO	6	5	0.38
M12-5	11.41	>11.41	1.59	I,II	ST_I_TO_II	>4	NO	3	3	0.39
M12-6	11.37	>11.37	0.67	I	ST_I	>4	NO	2	2	0.63

MIN	9.07	9.07	0.67					2.00	2.00	0.38
MAX	18.34	>18.34	1.94					6.00	5.00	2.41
AVG	11.99	>11.99	1.51					4.39	3.67	0.96

Cell-Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
MR-REF	11.79		1.70	I,INDET	ST_I	>4	NO	4	4	7.29

Table 3-5. Summary of REMOTS® Sediment-Profile Imaging Results for Cells M2 and SC, Summer 2001

A Cell-Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
M2-1	14.50	>14.50	0.91	I,III	ST_I_ON_III	>4	NO	4.00	4	0.84
M2-2	17.23	>17.23	0.40	INDET,AZOIC	AZOIC	>4	NO	-2.00	-2	0.51
M2-3	13.72	>13.72	0.77	I	ST_I	>4	NO	2.67	3	0.60
M2-4	10.99	>10.99	0.80	I,III	ST_I_ON_III	>4	NO	3.67	2	0.73
M2-5	12.16	>12.16	0.74	I	ST_I	>4	NO	3.00	3	0.61
M2-6	14.28	>14.28	0.40	I,III	ST_I_ON_III	>4	NO	3.33	2	0.66
MIN	10.99	10.99	0.40					-2.00	-2.00	0.51
MAX	17.23	>17.23	0.91					4.00	4.00	0.84
AVG	13.81	>13.81	0.67					2.44	2.00	0.66

B Cell-Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
SC-1	13.09	>13.09	2.13	I	ST_I	>4	NO	4.33	4	1.00
SC-2	9.94	>9.94	1.18	I,INDET	ST_I	>4	NO	3.00	3	1.21
SC-3	14.25	>14.25	2.93	I,III	ST_I_ON_III	>4	NO	7.00	7	0.56
SC-4	10.28	>10.28	2.47	I	ST_I	3 to 2	NO	4.67	5	0.43
SC-5	13.38	>13.38	1.70	I	ST_I	>4	NO	4.00	4	0.68
SC-6	12.69	>12.69	1.70	I	ST_I	>4	NO	3.33	3	0.88
MIN	9.94	9.94	1.18					3.00	3.00	0.43
MAX	14.25	>14.25	2.93					7.00	7.00	1.21
AVG	12.27	>12.27	2.02					4.39	4.33	0.79

Cell-Station	Camera Penetration Mean (cm)	Dredged Material Thickness Mean (cm)	Apparent RPD Mean (cm)	Successional Stages Present	Highest Stage Present	Grain Size Major Mode (phi)	Methane Present	OSI Mean	OSI Median	Boundary Roughness Mean (cm)
MR-REF	11.79		1.70	I,INDET	ST_I	>4	NO	4	4	7.29

Table 3-6. Summary of REMOTS® Sediment-Profile Imaging Results for Cells M8-11, M19, and CR, Summer 2001

A **Cell-Station**	**Camera Penetration Mean (cm)**	**Dredged Material Thickness Mean (cm)**	**Apparent RPD Mean (cm)**	**Successional Stages Present**	**Highest Stage Present**	**Grain Size Major Mode (phi)**	**Methane Present**	**OSI Mean**	**OSI Median**	**Boundary Roughness Mean (cm)**
M8-11-1	5.16	>5.16	1.42	I	ST_I	4 to 3	NO	3.67	3	1.15
M8-11-2	5.94	>5.94	1.27	I	ST_I	3 to 2	NO	3.00	3	0.57
M8-11-3	5.97	>5.97	1.92	I	ST_I	>4	NO	4.33	4	0.33
M8-11-4	5.39	>5.39	1.50	I	ST_I	3 to 2	NO	3.67	4	0.56
M8-11-5	4.31	>4.31	1.00	I	ST_I	4 to 3	NO	3.00	3	0.48
M8-11-6	6.59	>6.59	1.10	I	ST_I	4 to 3	NO	3.00	5	0.33

MIN	4.31	>4.31	1.00					3.00	3.00	0.33
MAX	6.59	>6.59	1.92					4.33	5.00	1.15
AVG	5.56	>5.56	1.37					3.44	3.67	0.57

B **Cell-Station**	**Camera Penetration Mean (cm)**	**Dredged Material Thickness Mean (cm)**	**Apparent RPD Mean (cm)**	**Successional Stages Present**	**Highest Stage Present**	**Grain Size Major Mode (phi)**	**Methane Present**	**OSI Mean**	**OSI Median**	**Boundary Roughness Mean (cm)**
M19-1	6.03	>6.03	0.94	I	ST_I	>4	NO	3.00	3	0.51
M19-2	5.66	>5.66	0.93	I,III	ST_I_ON_III	>4	NO	4.50	4.5	0.73
M19-3	5.07	>5.07	1.20	I	ST_I	3 to 2	NO	3.33	3	1.75
M19-4	6.16	>6.16	1.19	I,III,INDET	ST_I_ON_III	3 to 2	NO	5.00	5	0.95
M19-5	4.15	>4.15	NA	INDET	INDET	2 to 1	NO	NA	NA	1.87
M19-6	7.42	>7.42	0.66	I	ST_I	>4	NO	2.33	2	0.93

MIN	4.15	>4.15	0.66					2.33	2.00	0.51
MAX	7.42	>7.42	1.20					5.00	5.00	1.87
AVG	5.75	>5.75	0.98					3.63	3.50	1.13

C **Cell-Station**	**Camera Penetration Mean (cm)**	**Dredged Material Thickness Mean (cm)**	**Apparent RPD Mean (cm)**	**Successional Stages Present**	**Highest Stage Present**	**Grain Size Major Mode (phi)**	**Methane Present**	**OSI Mean**	**OSI Median**	**Boundary Roughness Mean (cm)**
CR-1	16.17	>16.17	2.69	I	ST_I	>4	NO	5.00	5	2.74
CR-2	18.54	>18.54	0.78	I,III	ST_I_ON_III	>4	NO	4.50	4.5	0.65
CR-3	12.04	>12.04	1.26	I,III	ST_I_ON_III	>4	NO	4.67	4	0.60
CR-4	9.09	>9.09	2.34	I,III	ST_I_ON_III	>4	NO	5.67	5	1.66
CR-5	6.75	>6.75	1.95	I	ST_I	>4	NO	4.33	4	3.52
CR-6	14.61	>14.61	0.71	I	ST_I	>4	NO	2.33	2	1.41

MIN	6.75	>6.75	0.71					2.33	2.00	0.60
MAX	18.54	>18.54	2.69					5.67	5.00	3.52
AVG	12.87	>12.87	1.62					4.42	4.08	1.76

Cell-Station	**Camera Penetration Mean (cm)**	**Dredged Material Thickness Mean (cm)**	**Apparent RPD Mean (cm)**	**Successional Stages Present**	**Highest Stage Present**	**Grain Size Major Mode (phi)**	**Methane Present**	**OSI Mean**	**OSI Median**	**Boundary Roughness Mean (cm)**
MR-REF	11.79	----	1.70	I	ST_I	>4	NO	4.00	4	7.29
IC-REF	9.66		1.28	I,II,III	ST_I_ON_III	>4	NO	6.33	7	0.42

Figures

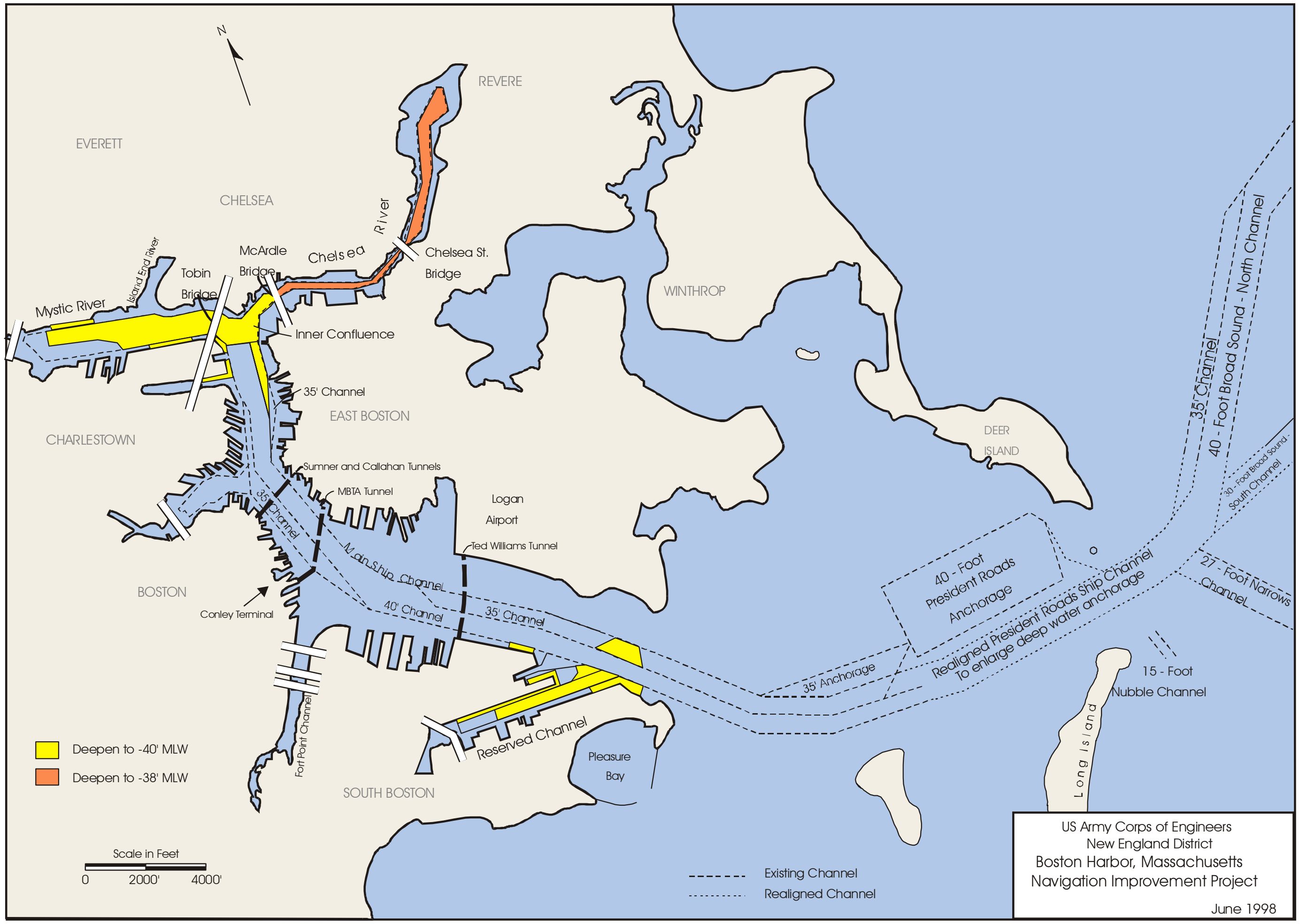
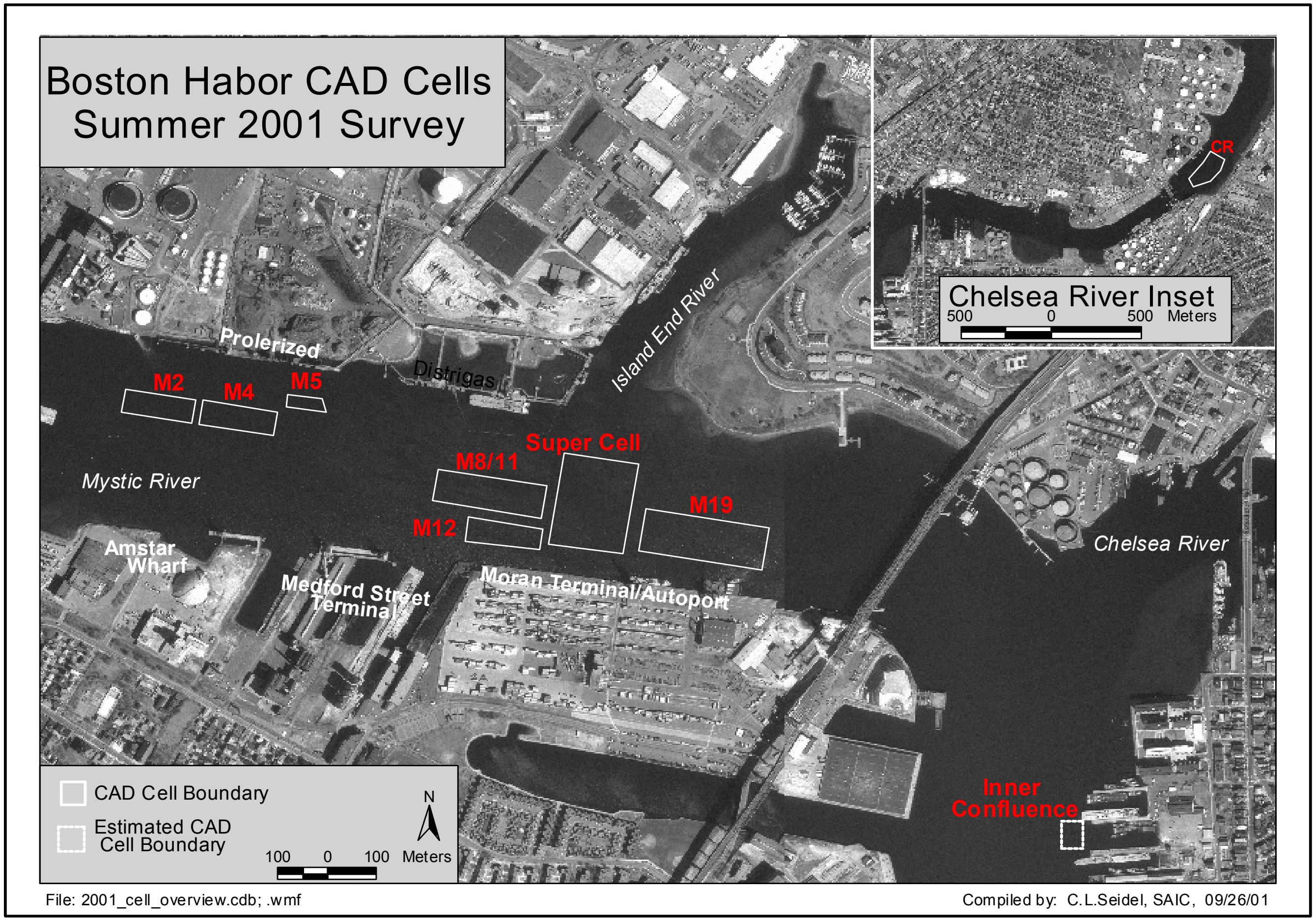


Figure 1-1. Boston Harbor Navigation Improvement Project location of main channels and berths to be dredged (from NAE and Massport 1995).



File: 2001_cell_overview.cdb; .wmf

Compiled by: C.L.Seidel, SAIC, 09/26/01

Figure 1-2. Boston Harbor CAD Cells surveyed Summer 2001.

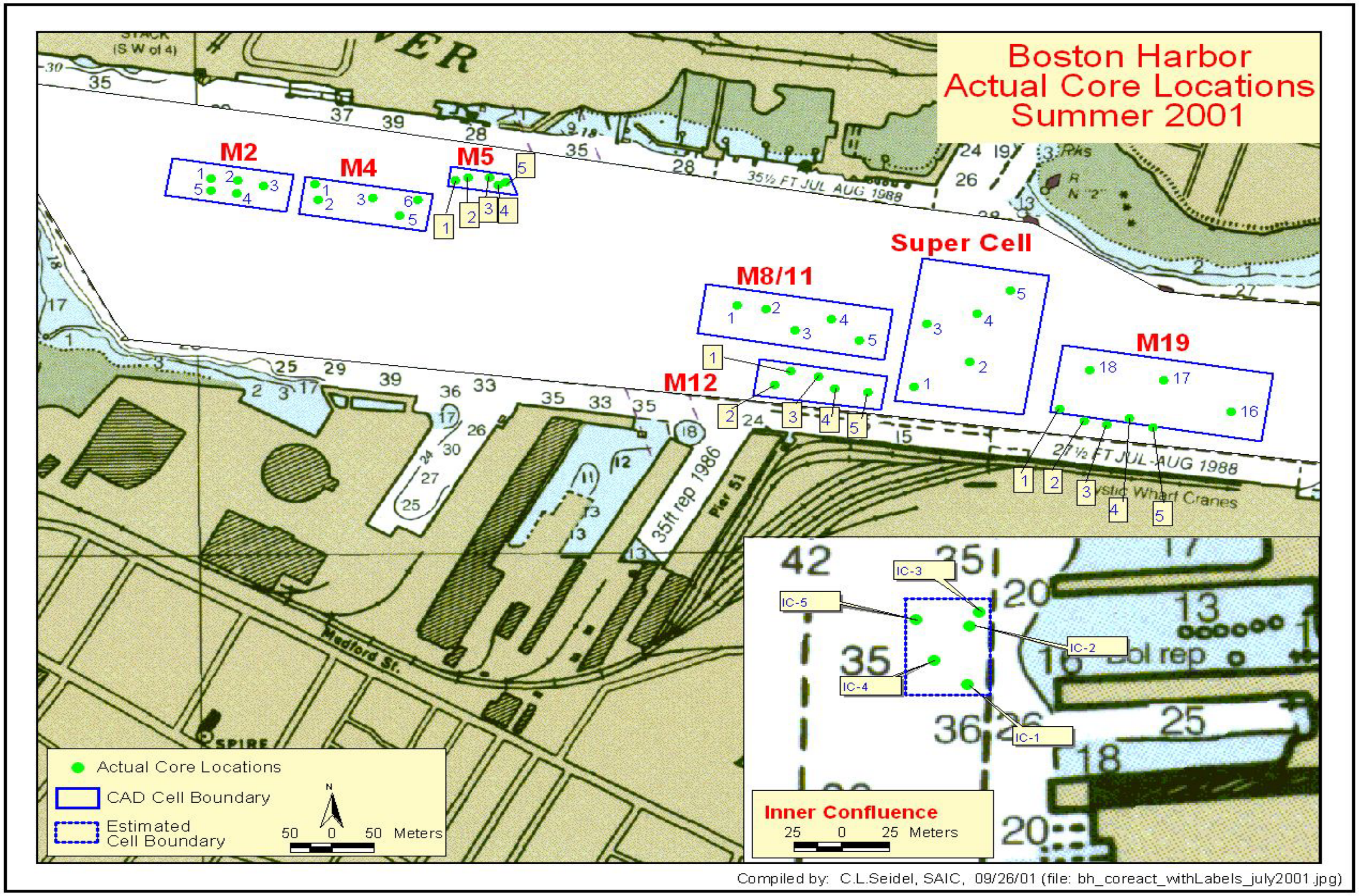


Figure 2-1. Core locations for Summer 2001 survey.

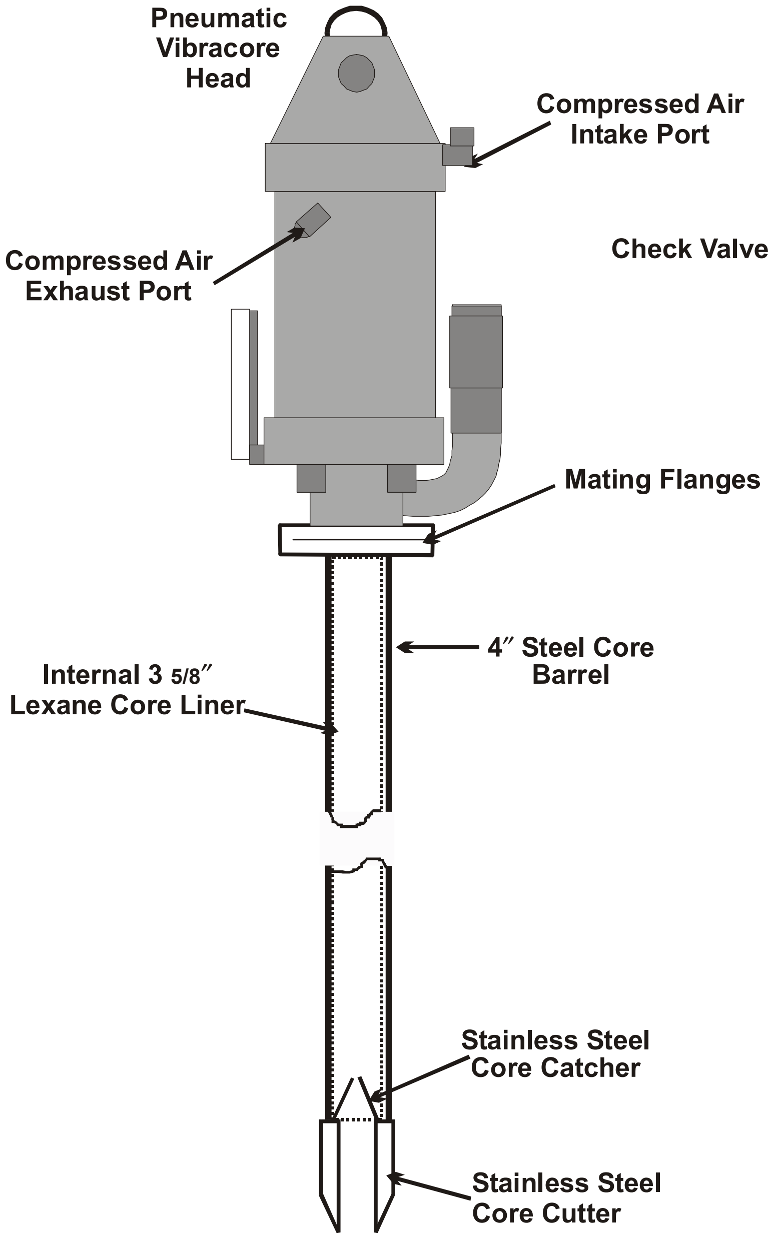


Figure 2-2. Diagram of the vibracore device

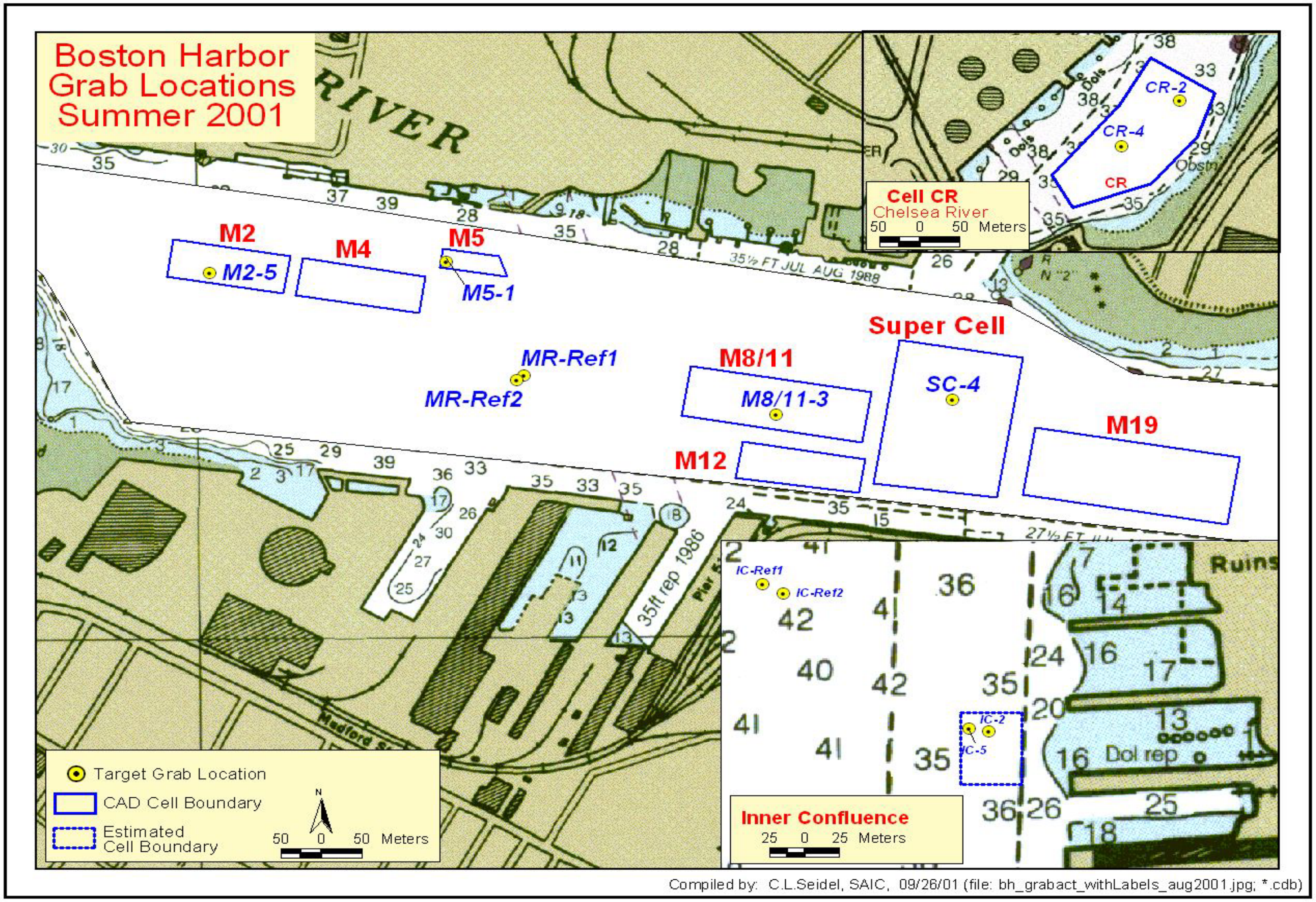


Figure 2-3. Sediment grab locations for Summer 2001 survey.

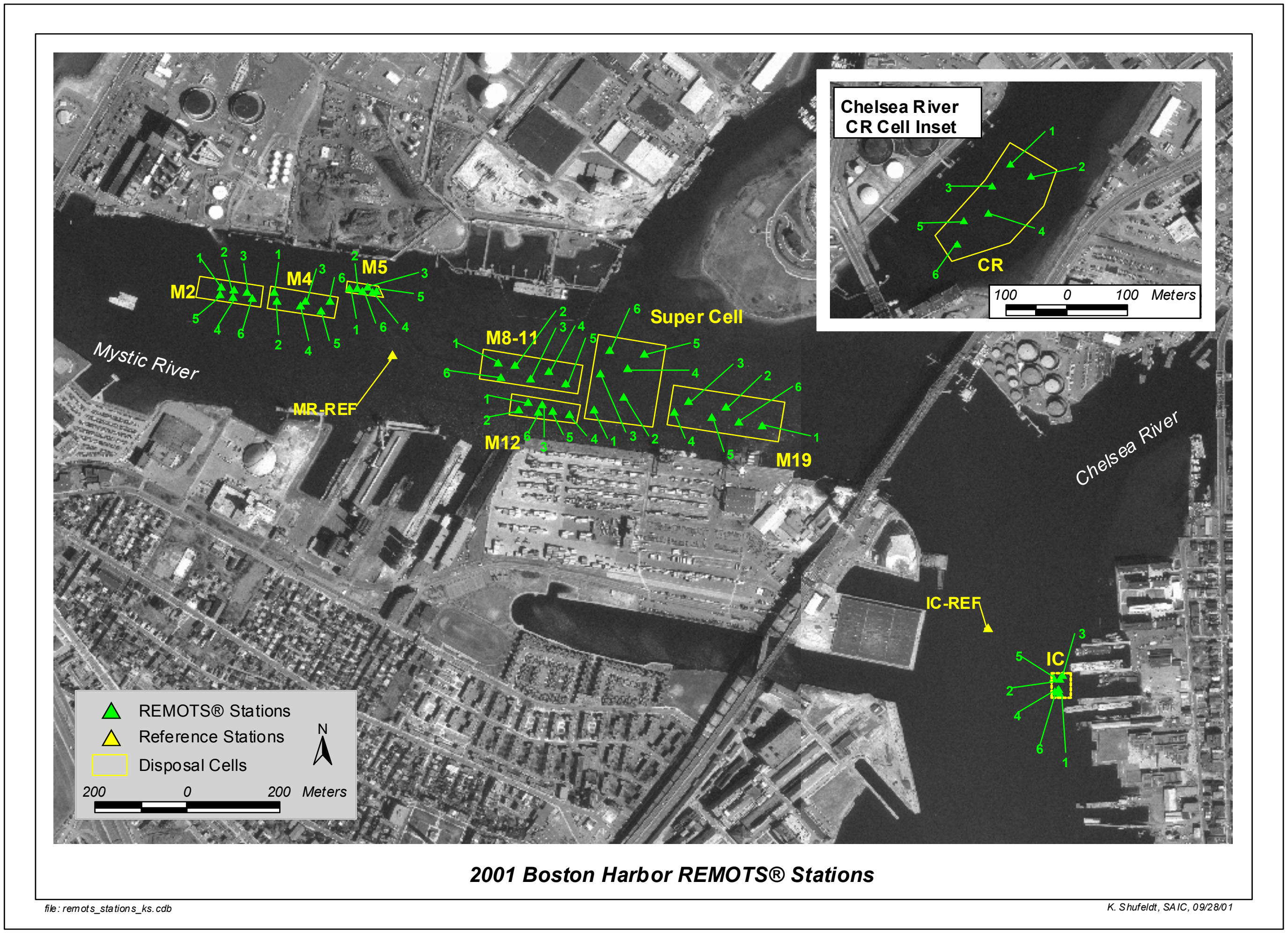


Figure 2-4. REMOTS® sediment profile locations for Summer 2001 survey.

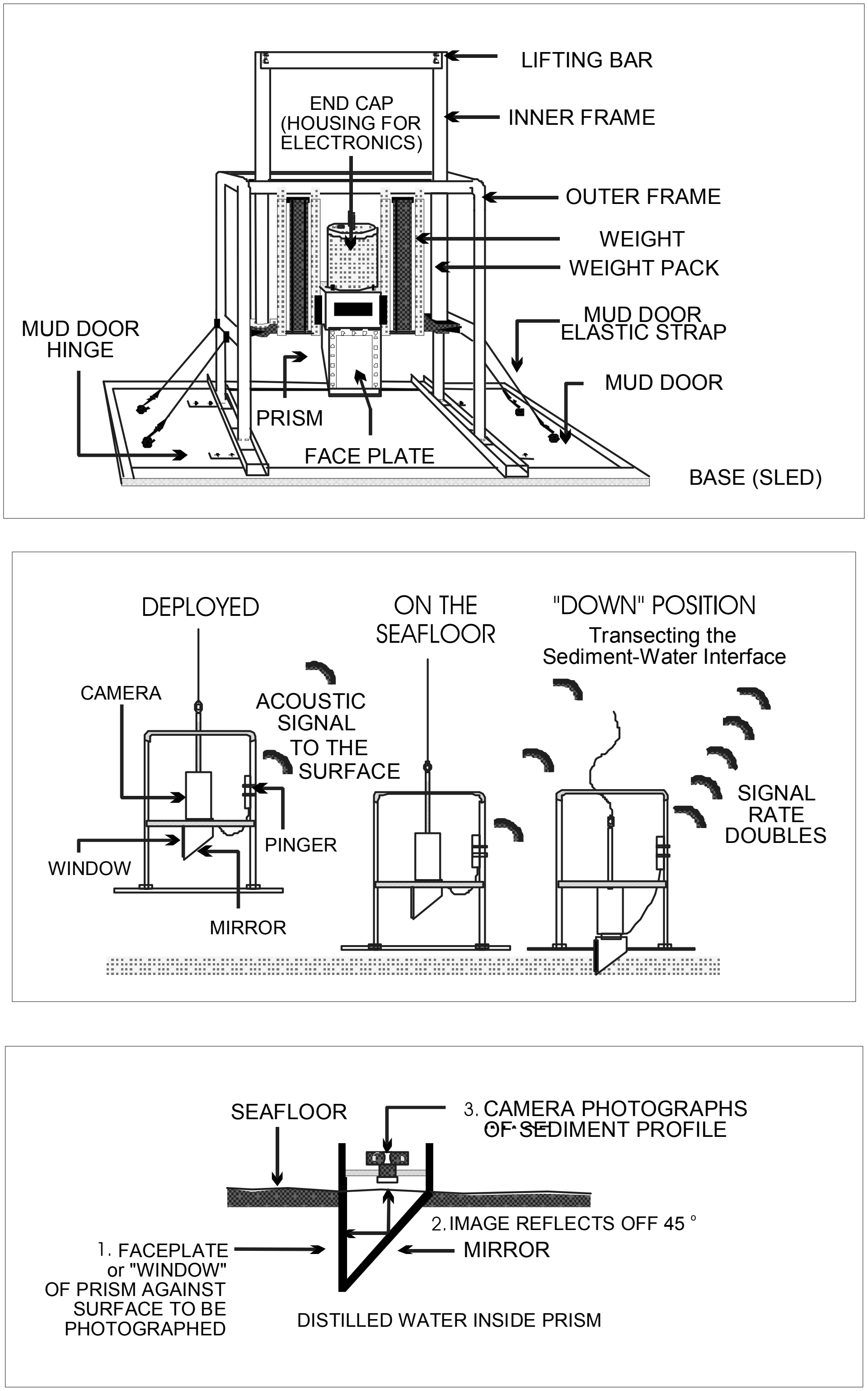


Figure 2-5. Schematic diagram of Benthos, Inc. Model 3731 REMOTS® sediment-profile camera and sequence of operation on deployment

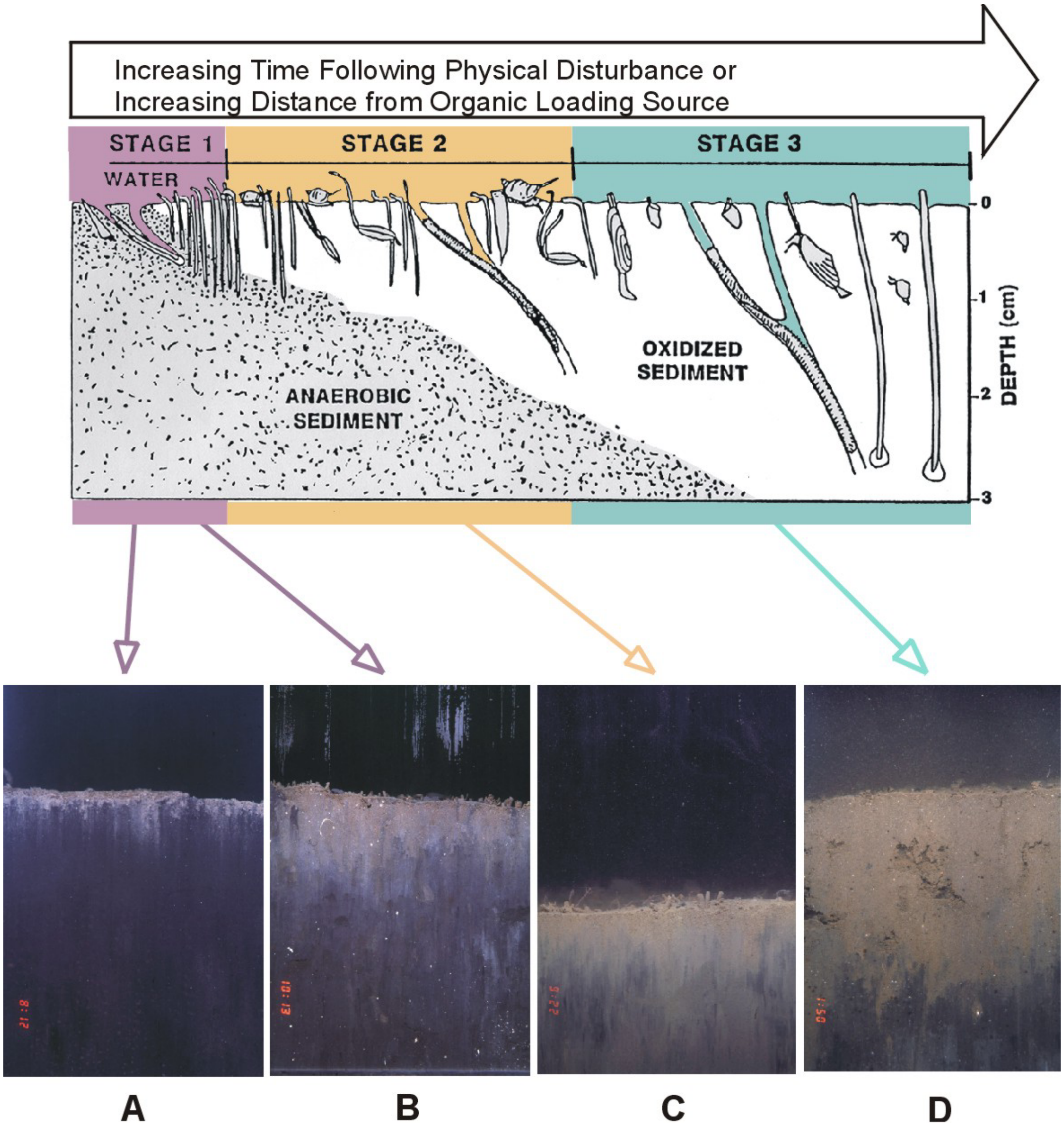
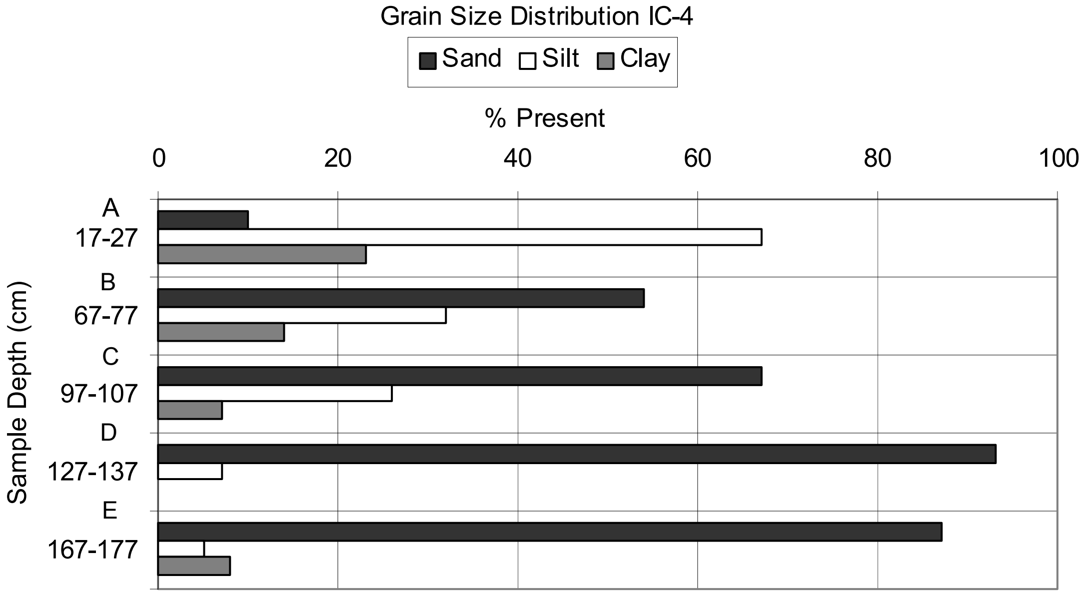
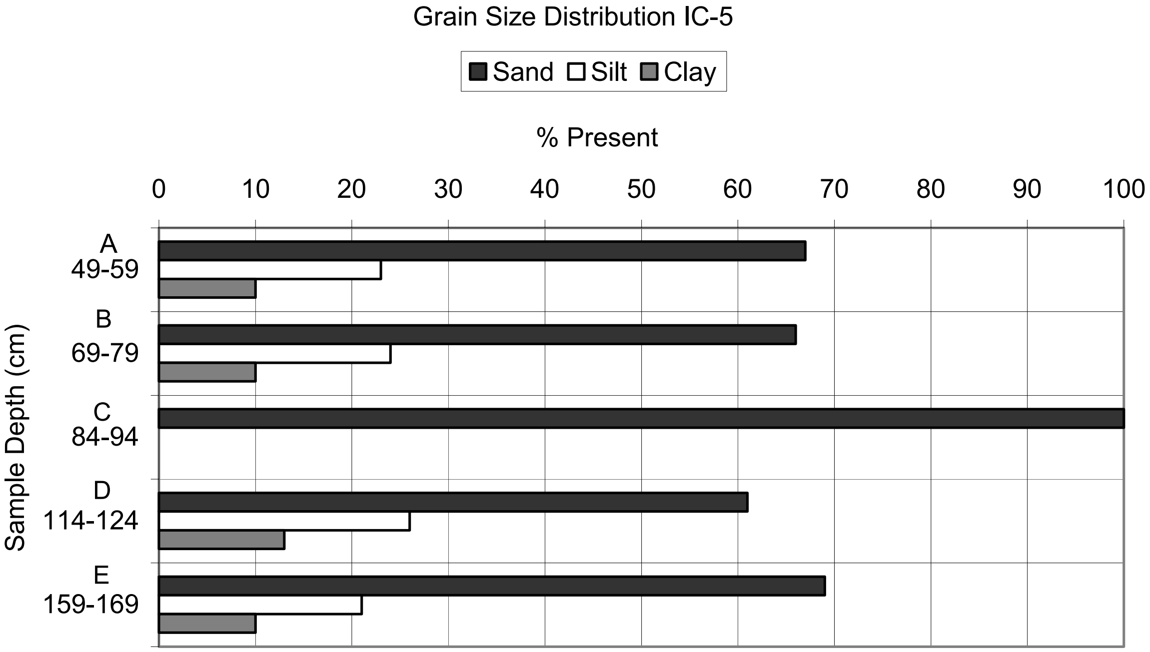


Figure 2-6. The drawing at the top illustrates the development of infaunal successional stages over time following a physical disturbance or with distance from an organic loading source (from Rhoads and Germano 1986). The REMOTS® images below the drawing provide examples of the different successional stages. Image A shows highly reduced sediment with a very shallow redox layer (contrast between light colored surface sediments and dark underlying sediments) and little evidence of infauna. Numerous small polychaete tubes are visible at the sediment surface in image B (Stage I), and the redox depth is deeper than in image A. A mixture of polychaete and amphipod tubes occurs at the sediment surface in image C (Stage II). Image D shows numerous burrow openings and feeding pockets (voids) at depth within the sediment; these are evidence of deposit-feeding, Stage III infauna. Note the RPD is relatively deep in this image, as bioturbation by the Stage III organisms has resulted in increased sediment aeration.

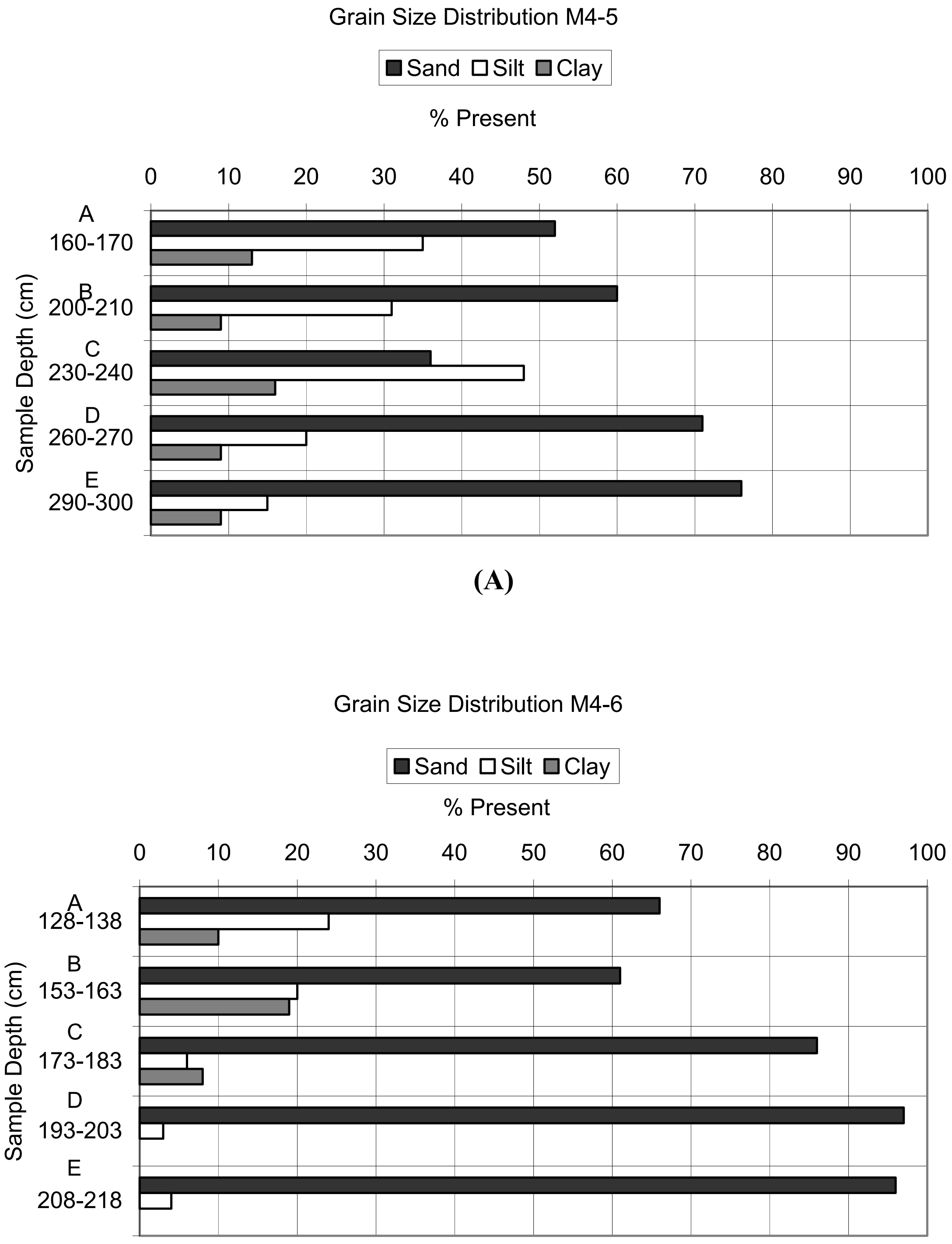


(A)



(B)

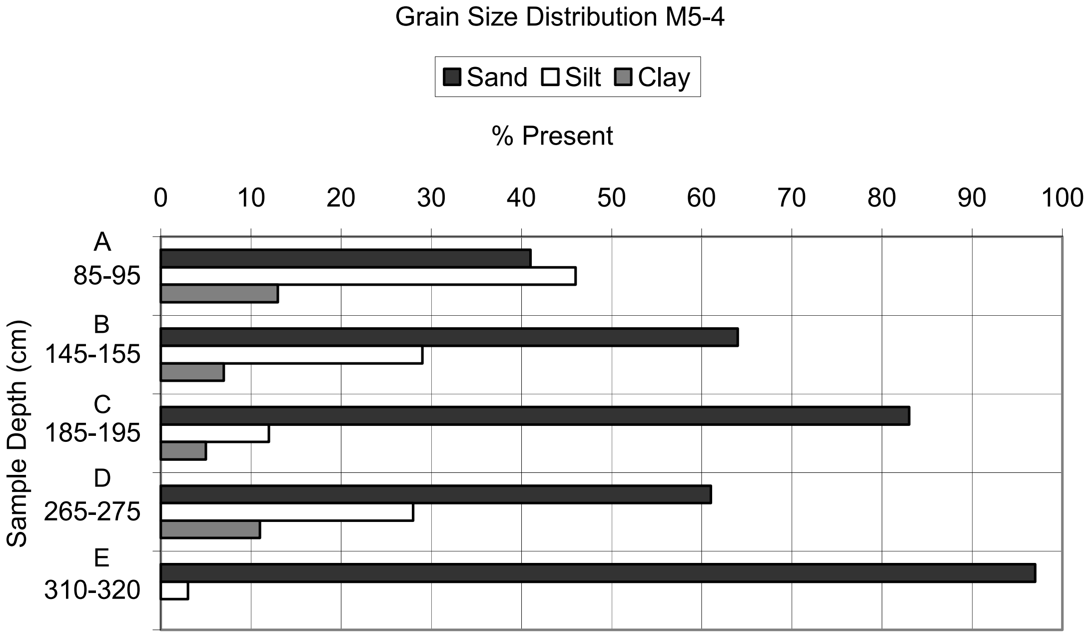
Figure 3-1. Grain size distribution in Cell IC, core IC-4 (A) and core IC-5 (B)



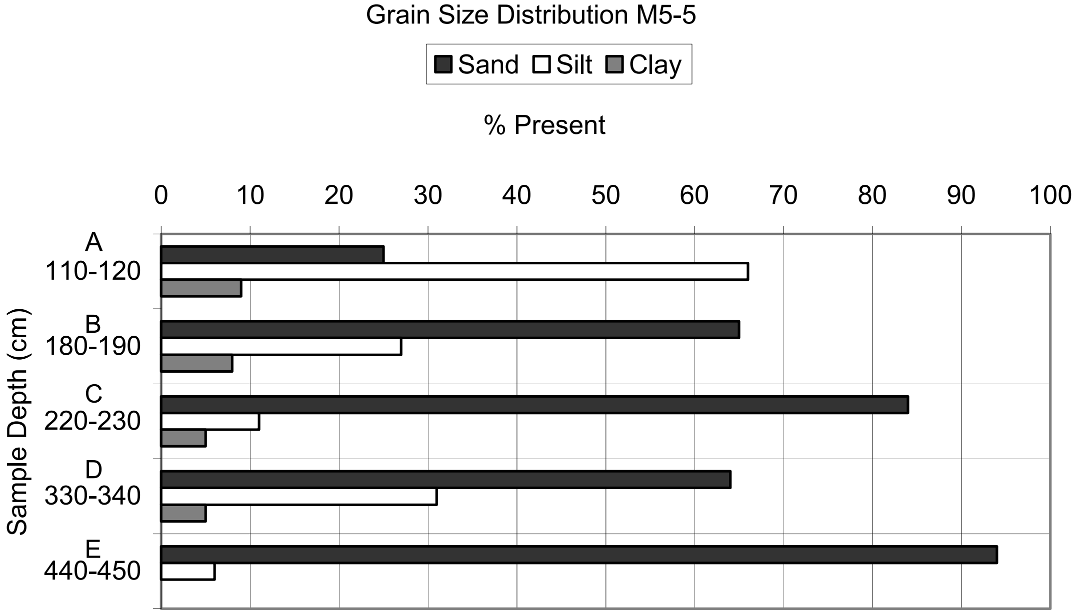
(A)

(B)

Figure 3-2. Grain size distribution in cell M4, core M4-5 (A) and core M4-6 (B)

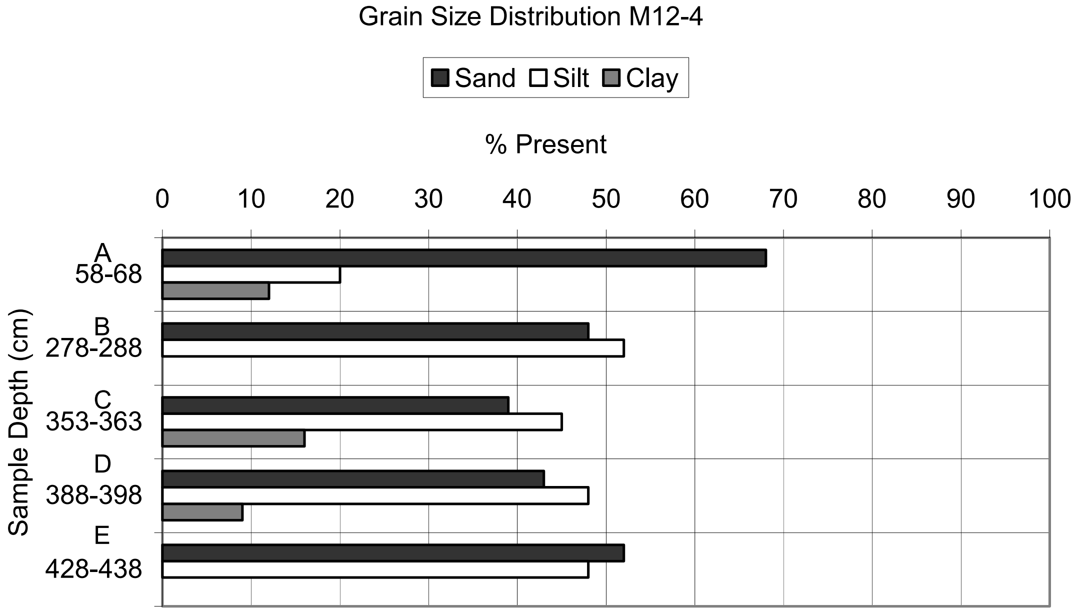


(A)

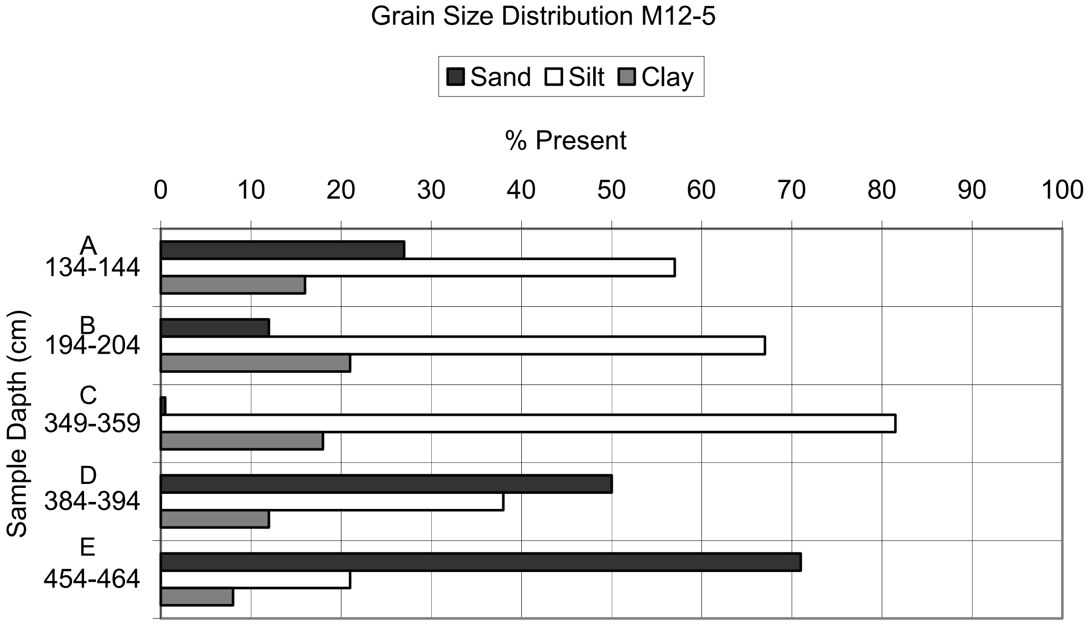


(B)

Figure 3-3. Grain size distribution cell M5, core M5-4 (A) and core M5-5 (B)

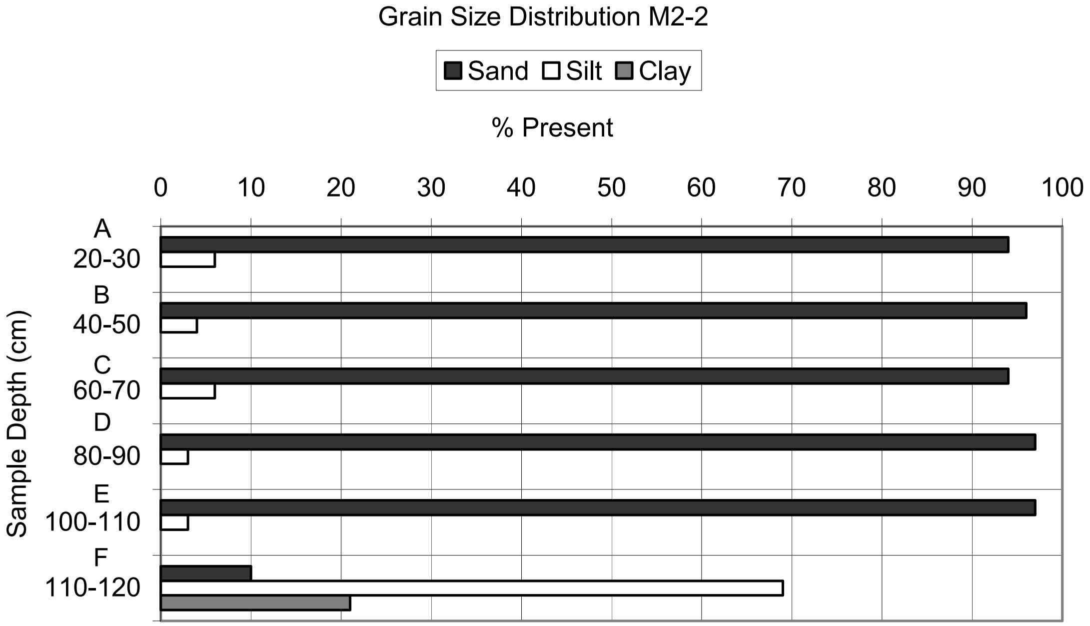


(A)

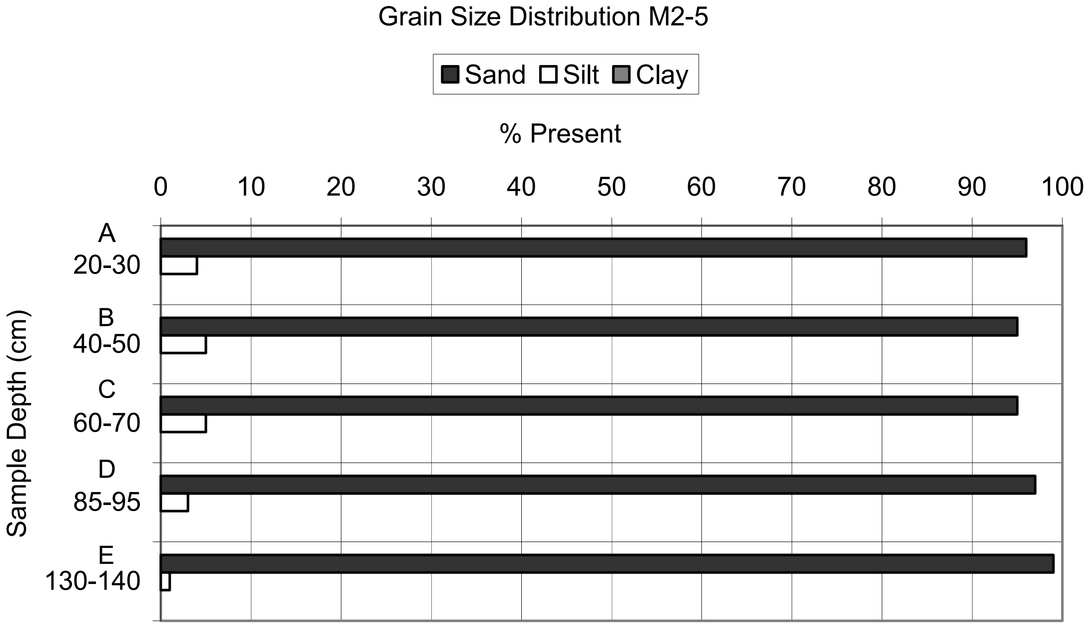


(B)

Figure 3-4. Grain size distribution cell M12, core M12-4 (A) and M12-5 (B)



(A)



(B)

Figure 3-5. Grain size distribution in cell M2, core M2-2 (A) and core M2-5 (B)

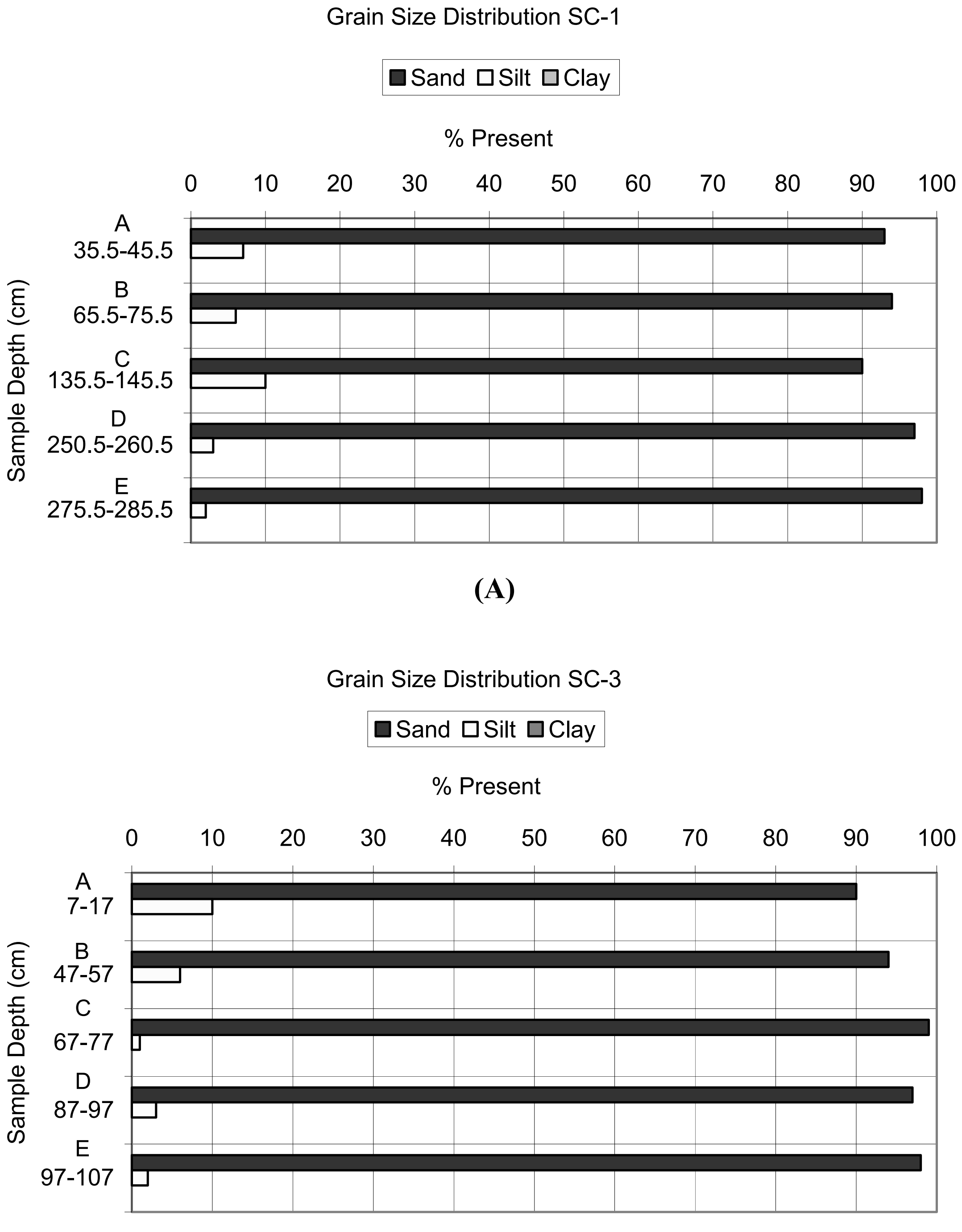
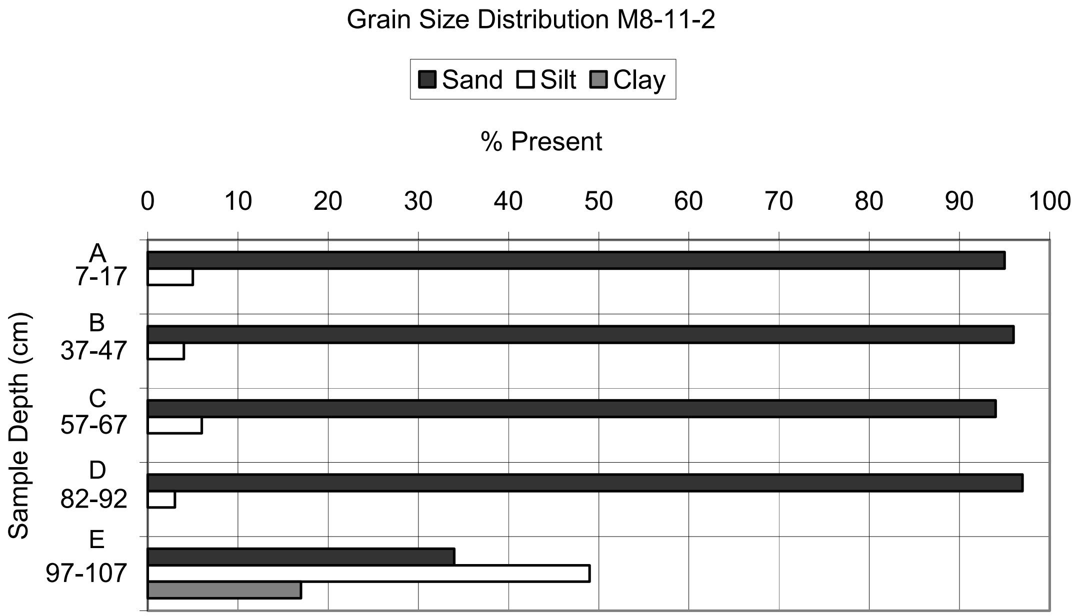
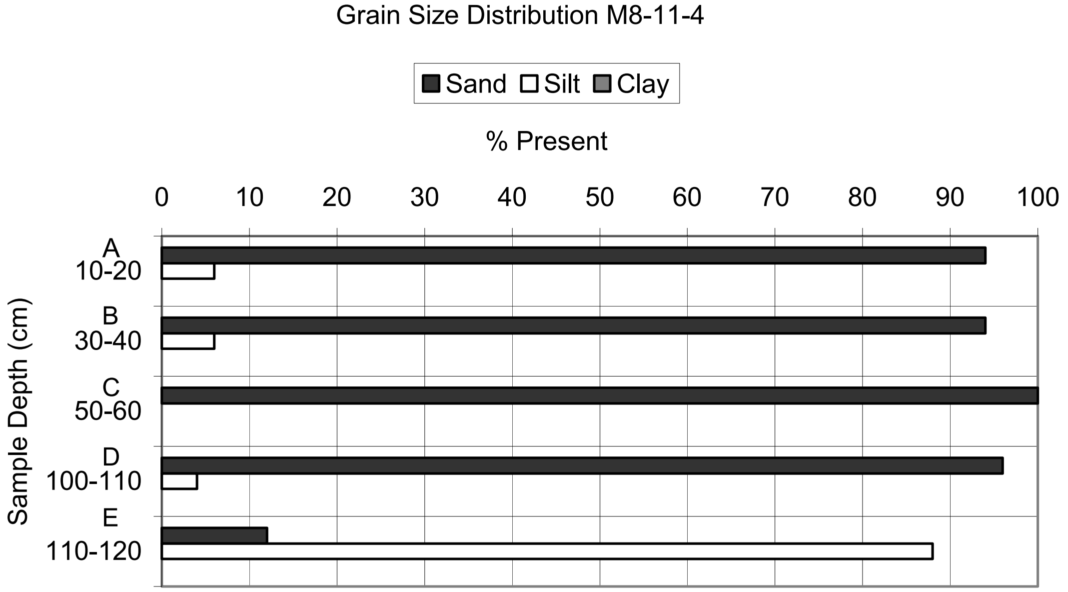


Figure 3-6. Grain size distribution in the Super Cell, core SC-1 (A) and core SC-3 (B)

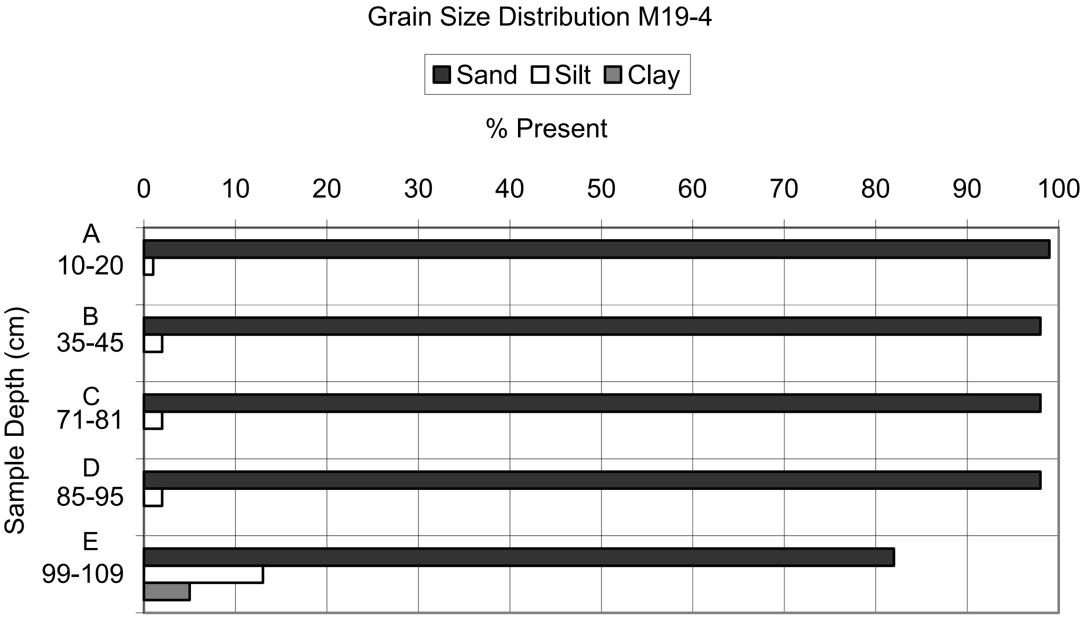


(A)

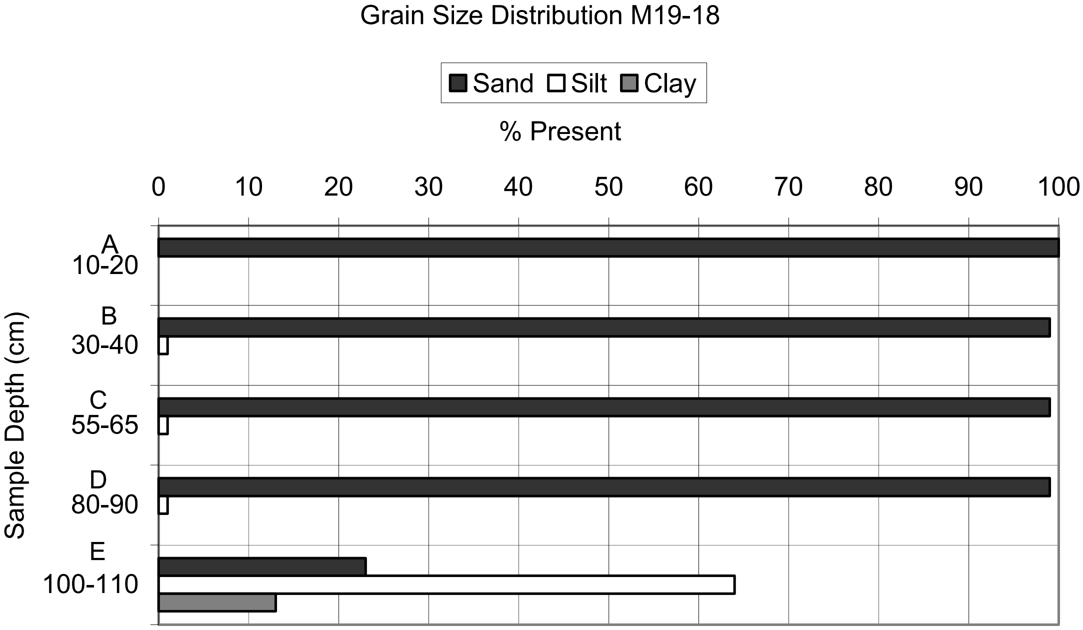


(B)

Figure 3-7. Grain size distribution cell M8-11, core M8-11-2 (A) and core M8-11-4 (B)

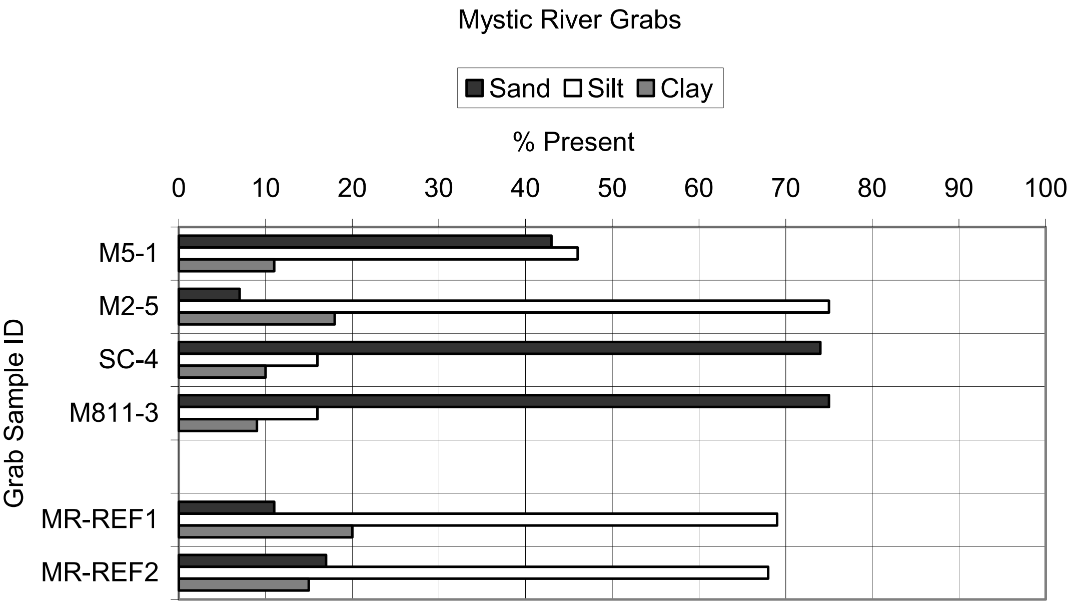


(A)

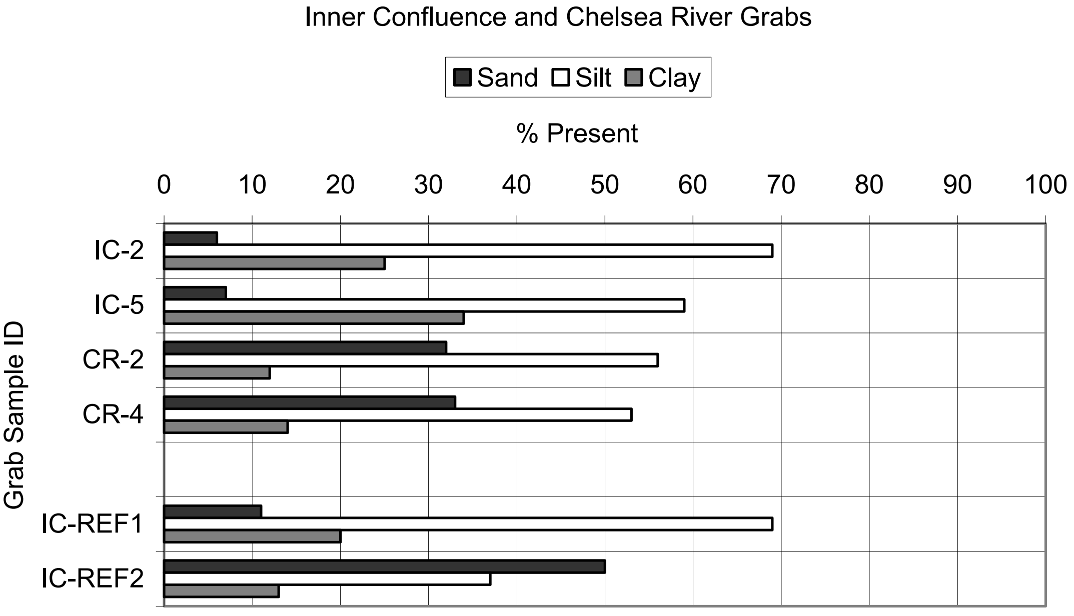


(B)

Figure 3-8. Grain size distribution for cell M19, core M19-4 (A) and M19-18 (B)



(A)



(B)

Figure 3-9. Grain size distribution for grab samples in the Mystic River (A) and the Inner Confluence/Chelsea River (B)

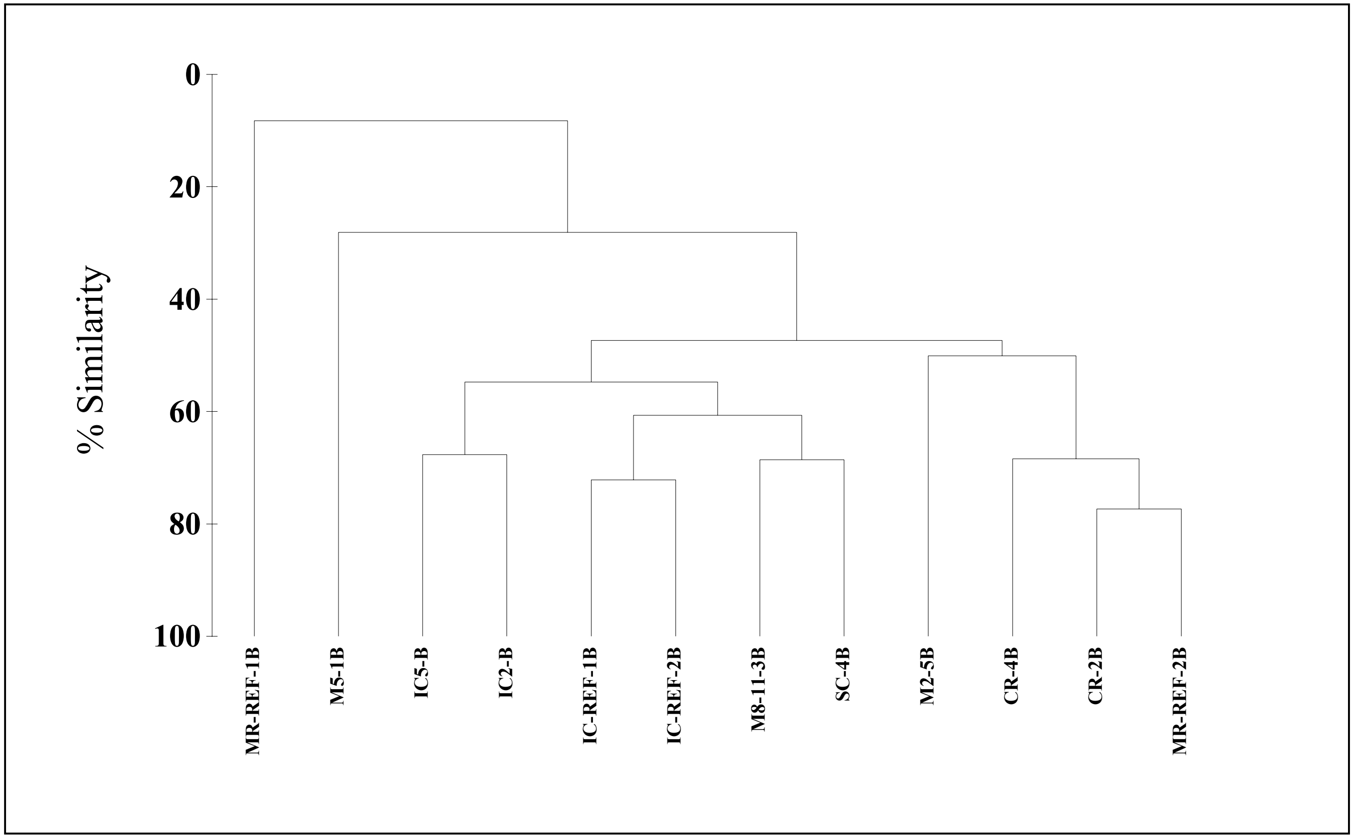


Figure 3-10. Bray-Curtis Numerical Classification of Benthic Communities at Stations in the Boston Harbor Confined Aquatic Disposal Cells, 28 August 2001

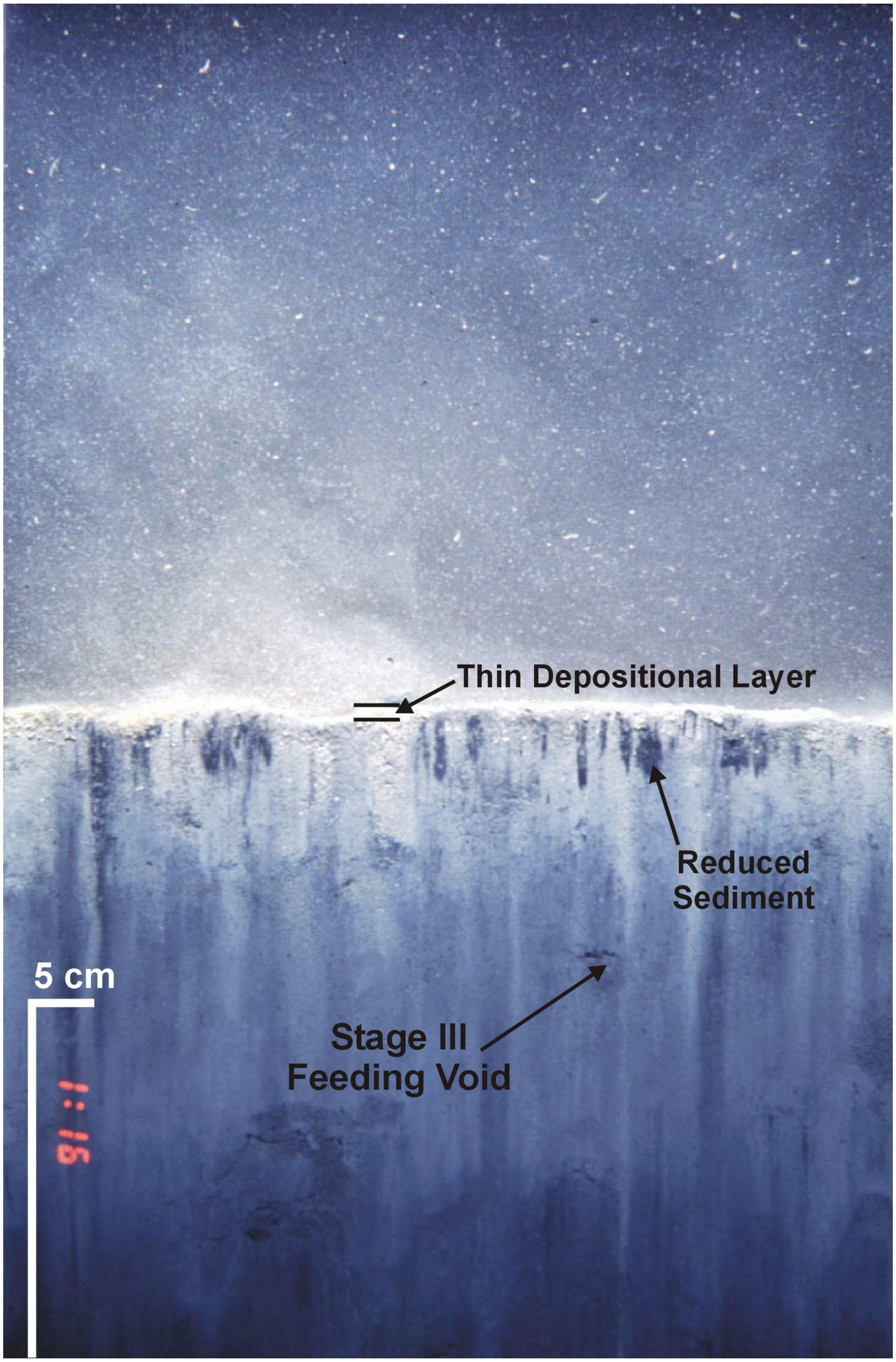


Figure 3-11. REMOTS® image collected from Station IC-2 illustrating a relatively thin, fine-grained depositional layer overlying dark, fine grained dredged material. Evidence of this type of depositional layer can be seen in a number of images acquired within the cell. This image also shows reduced sediments near the sediment-water interface and a small Stage III feeding void at depth

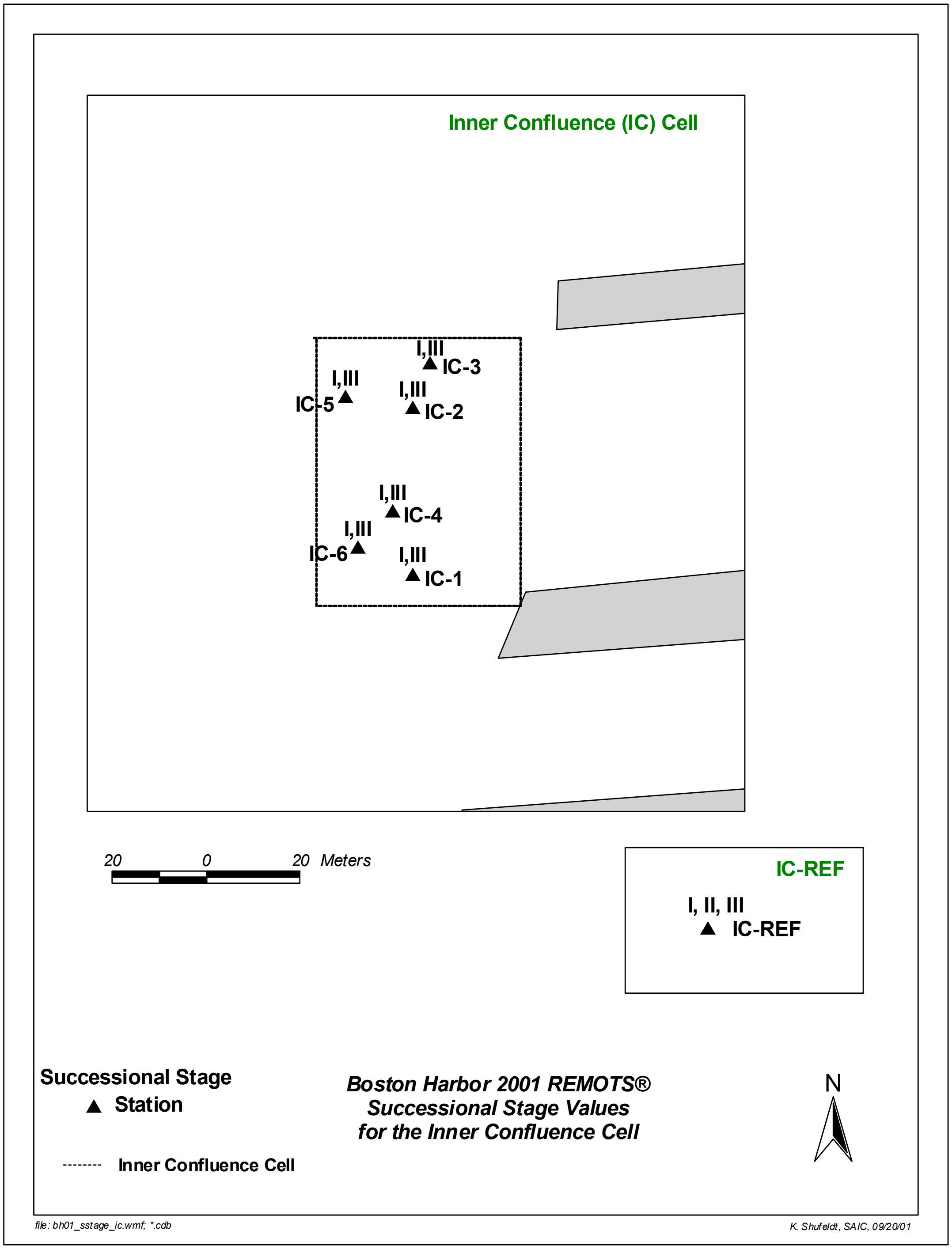


Figure 3-12. Map of successional stages found at each REMOTS® station within the Inner Confluence CAD cell (Cell IC) and IC-REF for the Summer 2001 survey

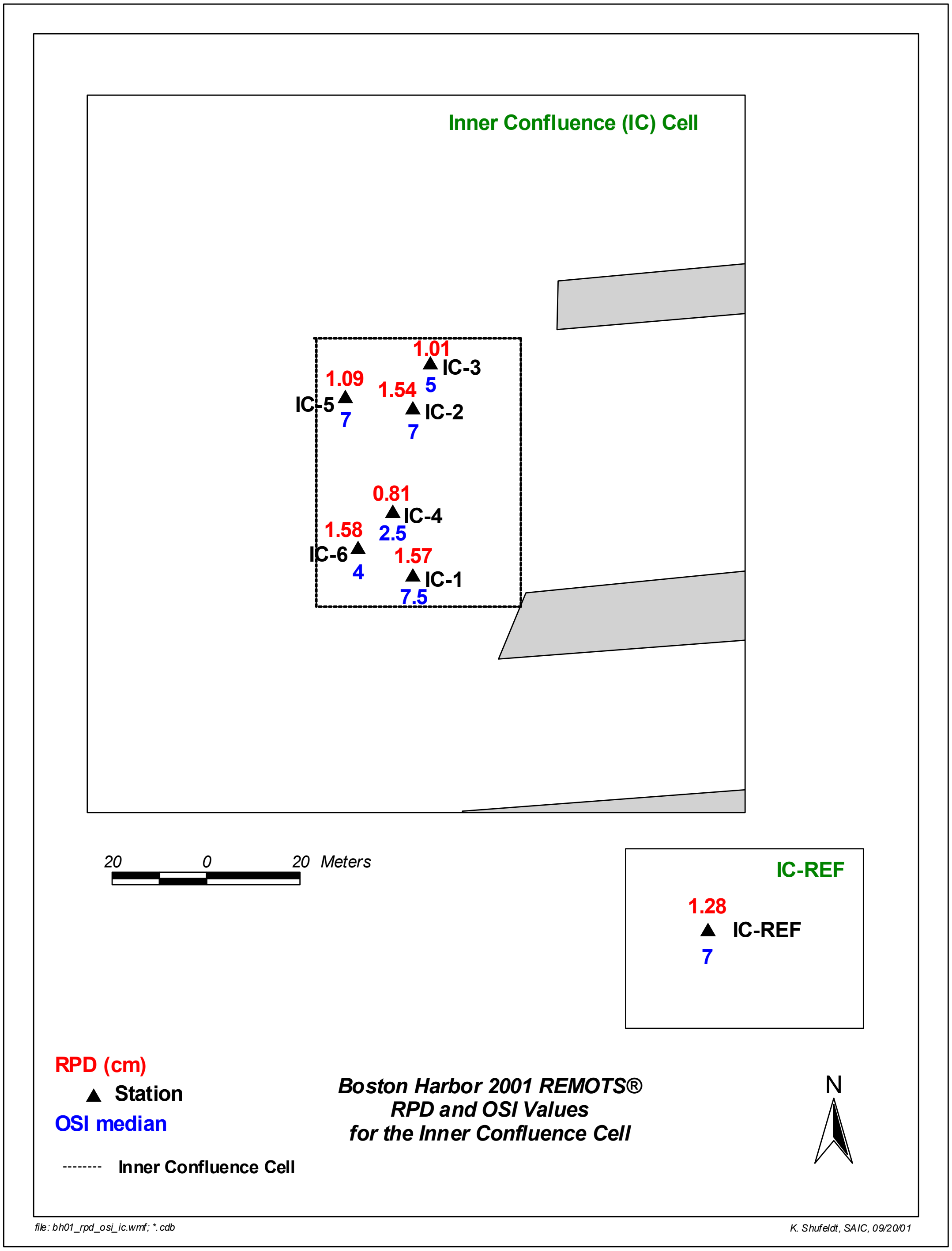


Figure 3-13. Map of replicate-averaged RPD depths (red) and median OSI values (blue) for the Inner Confluence CAD cell (Cell IC) and IC-REF for the Summer 2001 survey

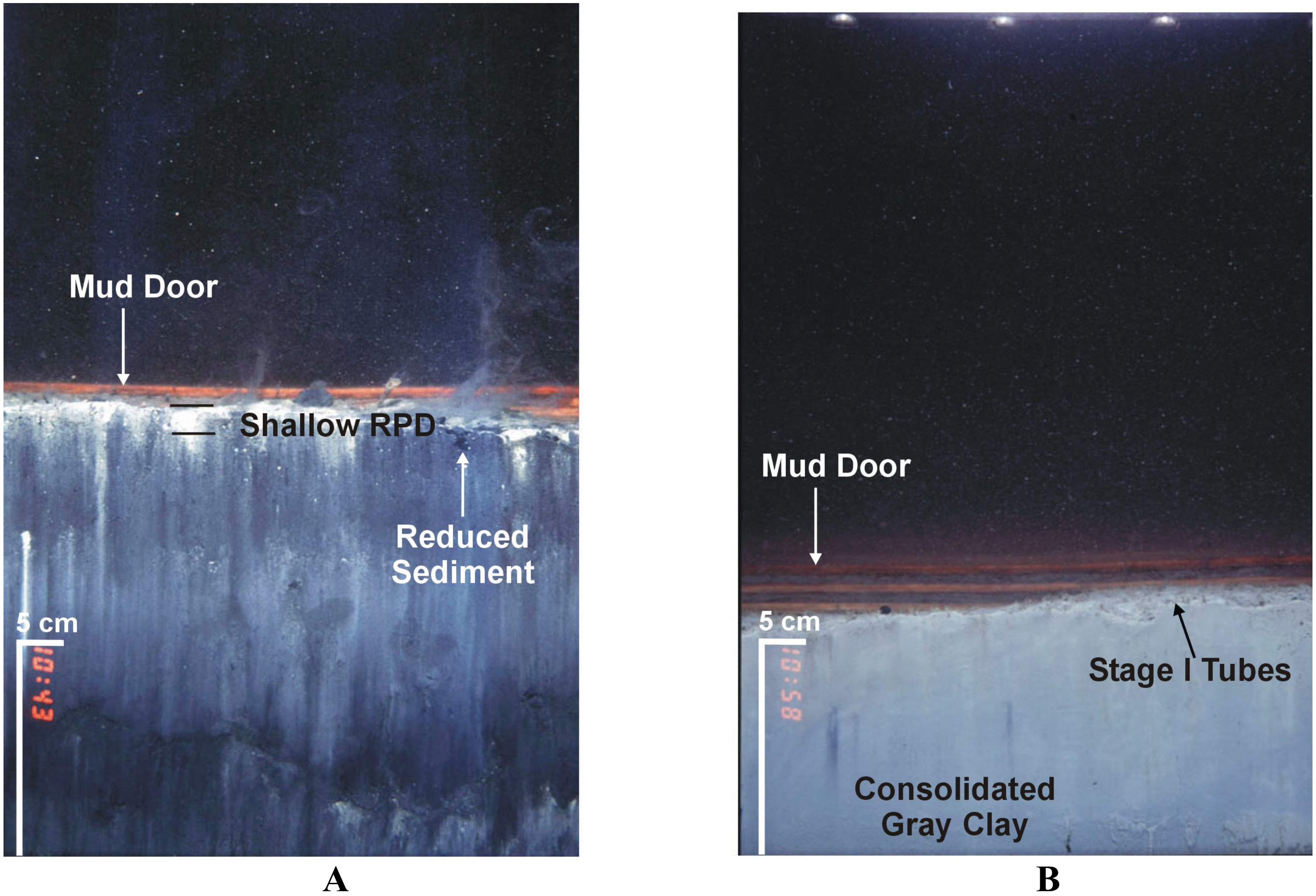


Figure 3-14. Two REMOTS® images collected at Stations M4-2 (A) and M4-6 (B) displaying variability in sediment types within Cell M4. Station M4-2 is composed of fine-grained silts and clays with an thin oxidized surface layer, while M4-6 sediments are comprised of consolidated gray clay with an indeterminate redox layer

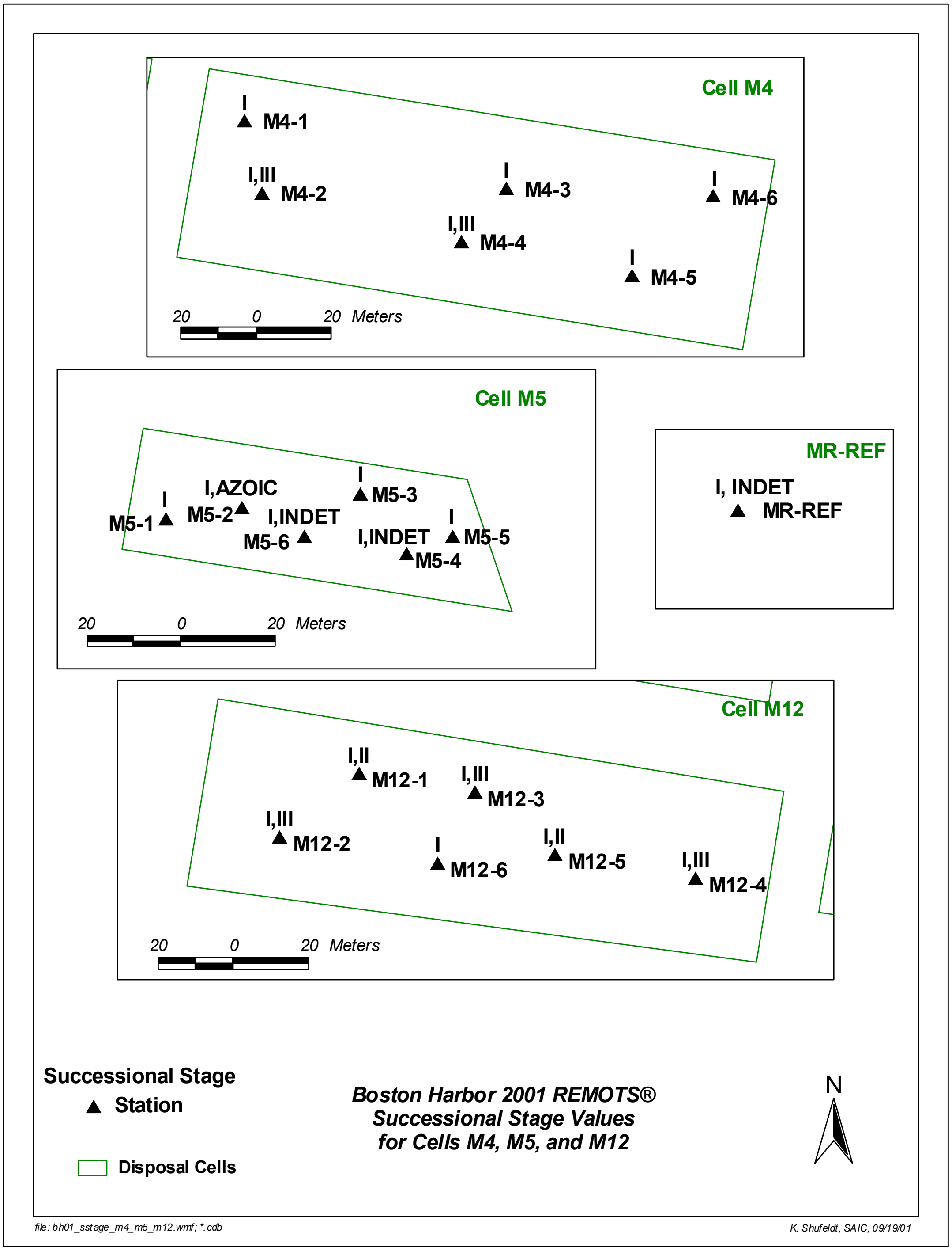


Figure 3-15. Map of successional stages found at each REMOTS® station within Cells M4, M5, and M12, as well as the Mystic River reference area (MR-REF) for the Summer 2001 survey

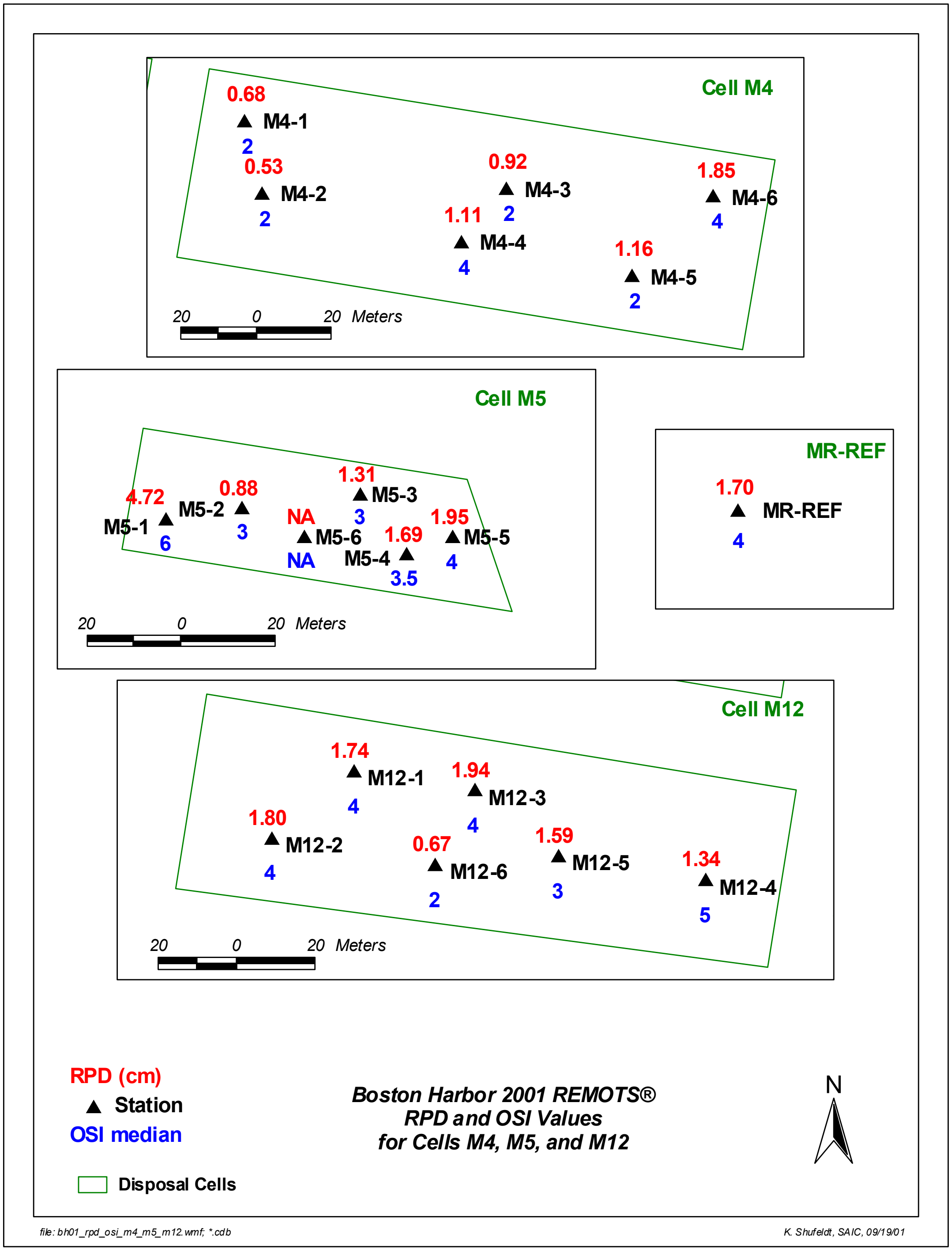


Figure 3-16. Map of replicate-averaged RPD depths (red) and median OSI values (blue) for Cells M4, M5, and M12, as well as the Mystic River reference area (MR-REF) for the Summer 2001 survey

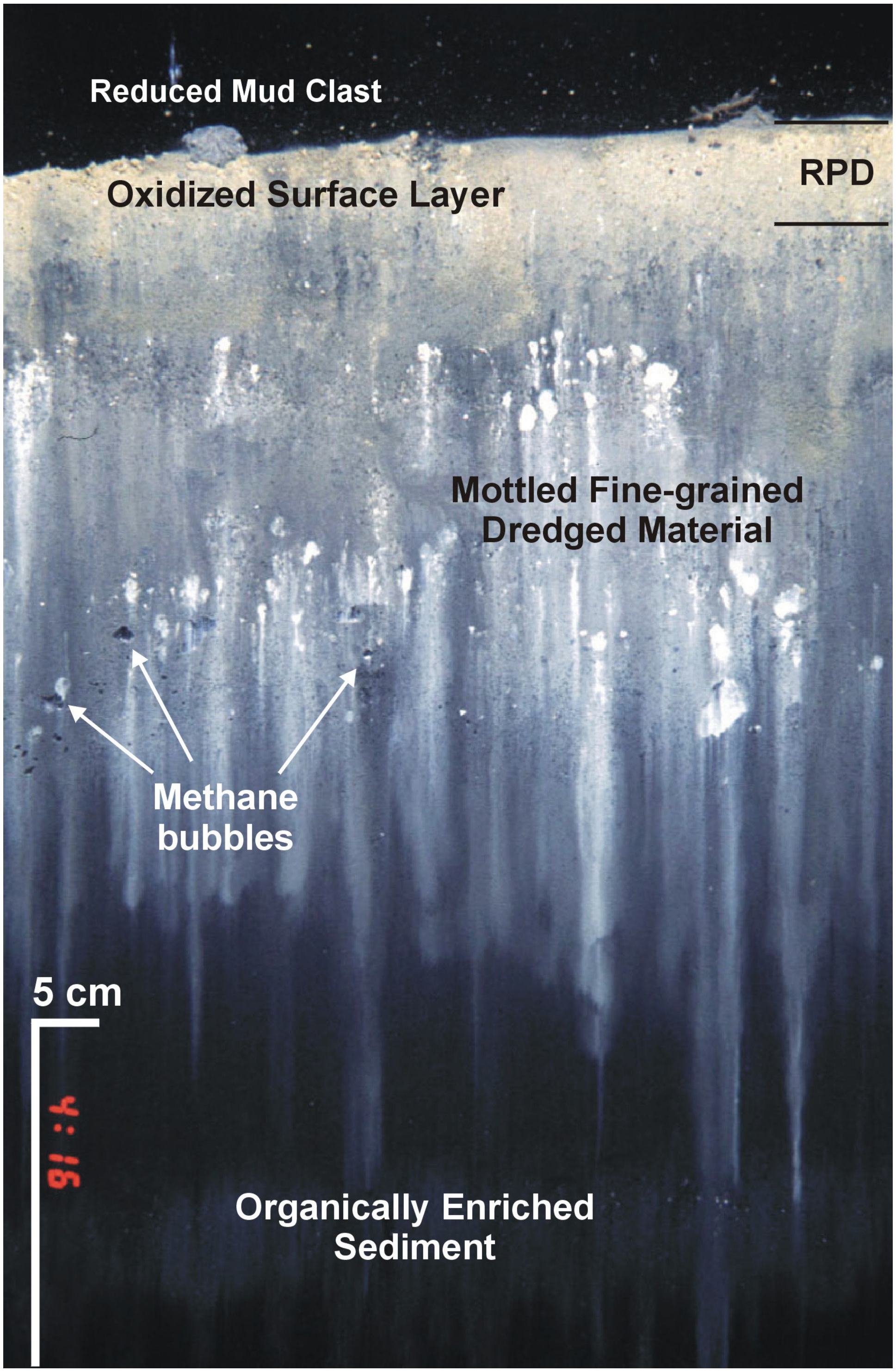


Figure 3-17. REMOTS® image from Station M4-3 showing a relatively well developed RPD overlying fine-gained mottled dredged material (silt and Boston Blue Clay). Numerous methane bubbles can also be seen in the image and serves as an indicator of organically enriched sediment at depth

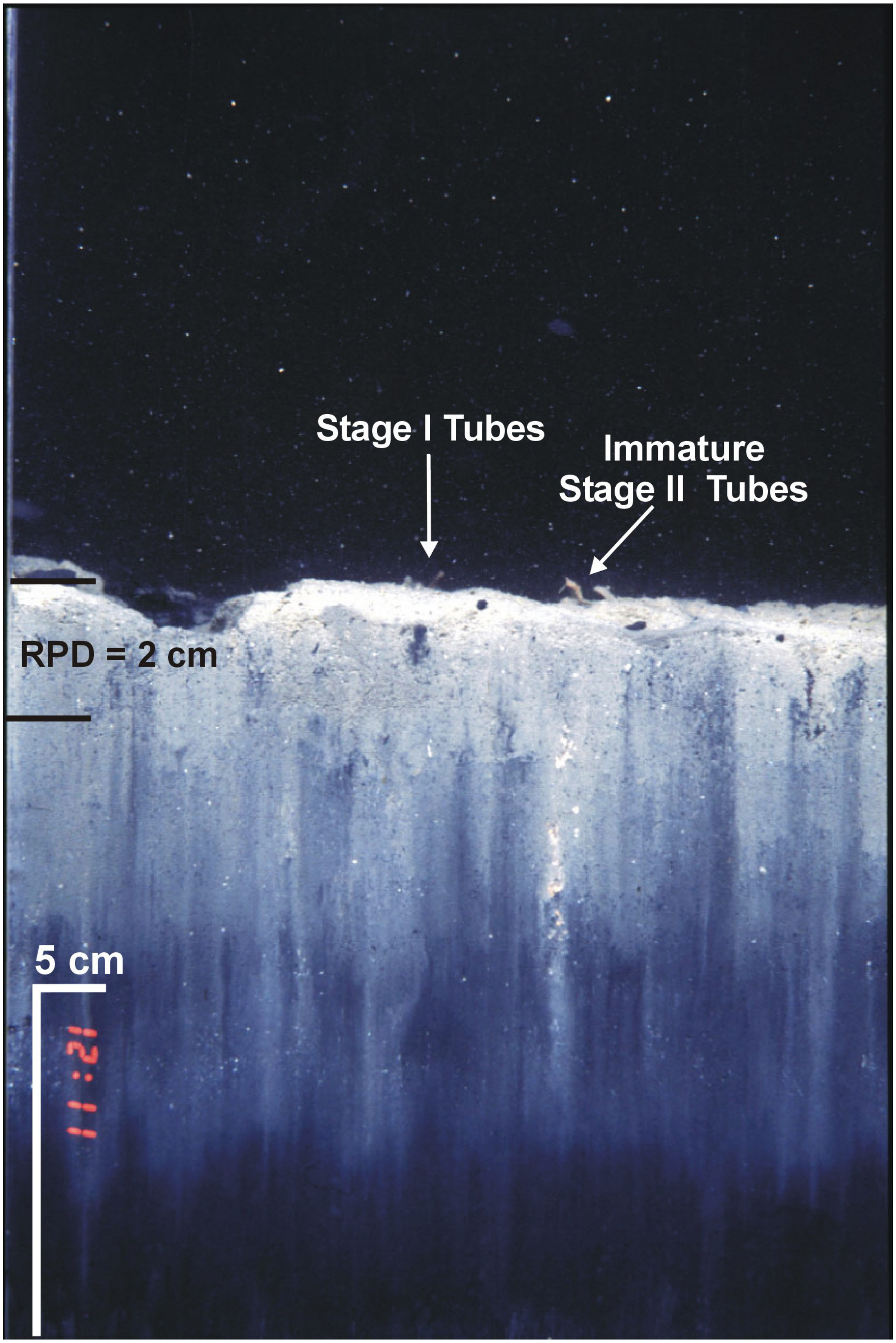


Figure 3-18. REMOTS® image from Station M12-5 displaying a relatively well established RPD, as well as Stage I and Stage II benthic organisms at the sediment-water interface

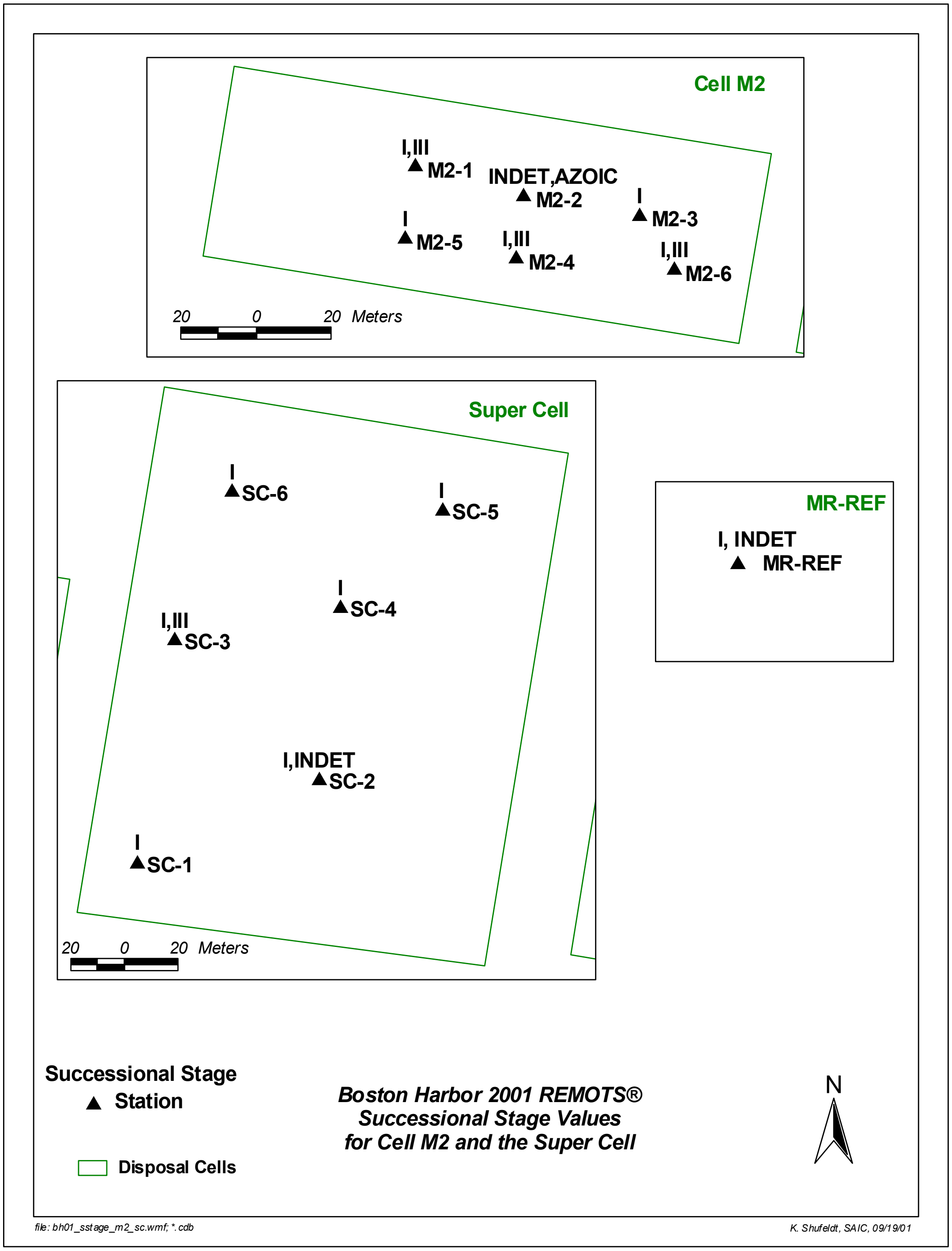


Figure 3-19. Map of successional stages found at each REMOTS® station within Cell M2, Super Cell (SC) and the Mystic River reference area (MR-REF) for the Summer 2001 survey

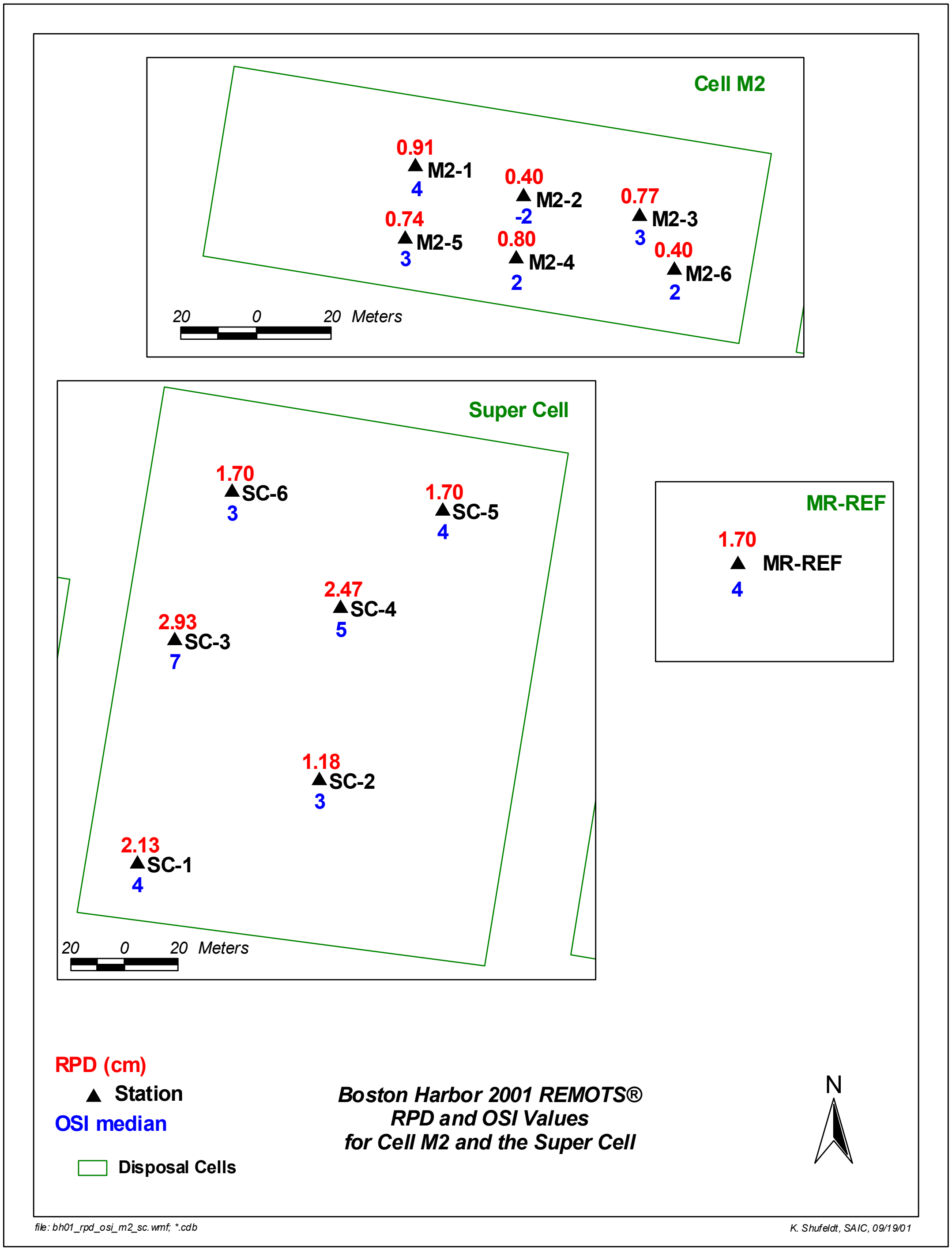


Figure 3-20. Map of replicate-averaged RPD depths (red) and median OSI values (blue) for Cell M2, Super Cell (SC) and the Mystic River reference area (MR-REF) for the Summer 2001 survey

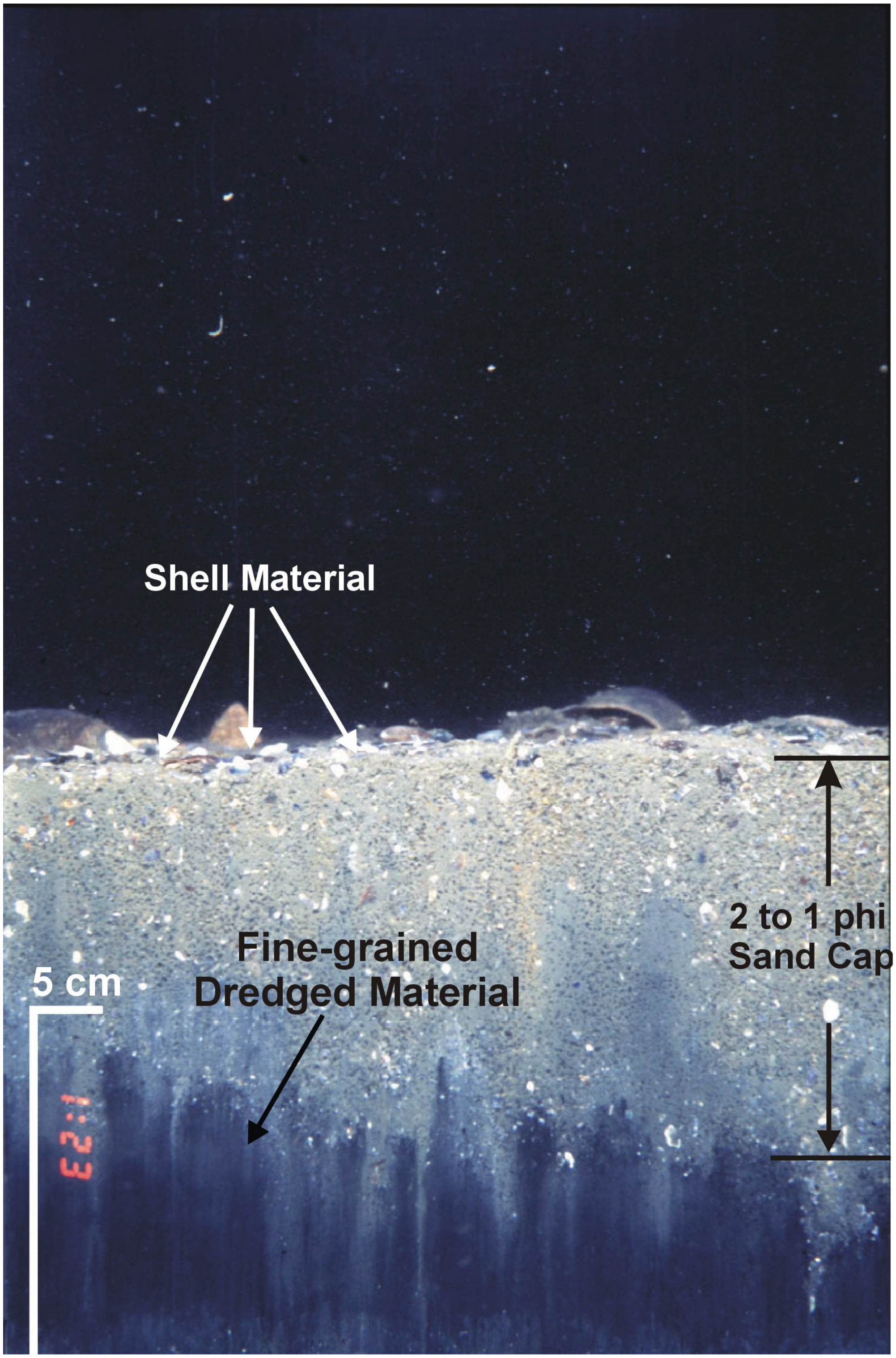


Figure 3-21. REMOTS® image from Station SC-4 showing a distinct layer of 2 to 1 phi sand overlying fine-grained (>4 phi) dredged material. The cap material also contains a significant amount of shell, which was noted in many replicate images throughout the cell

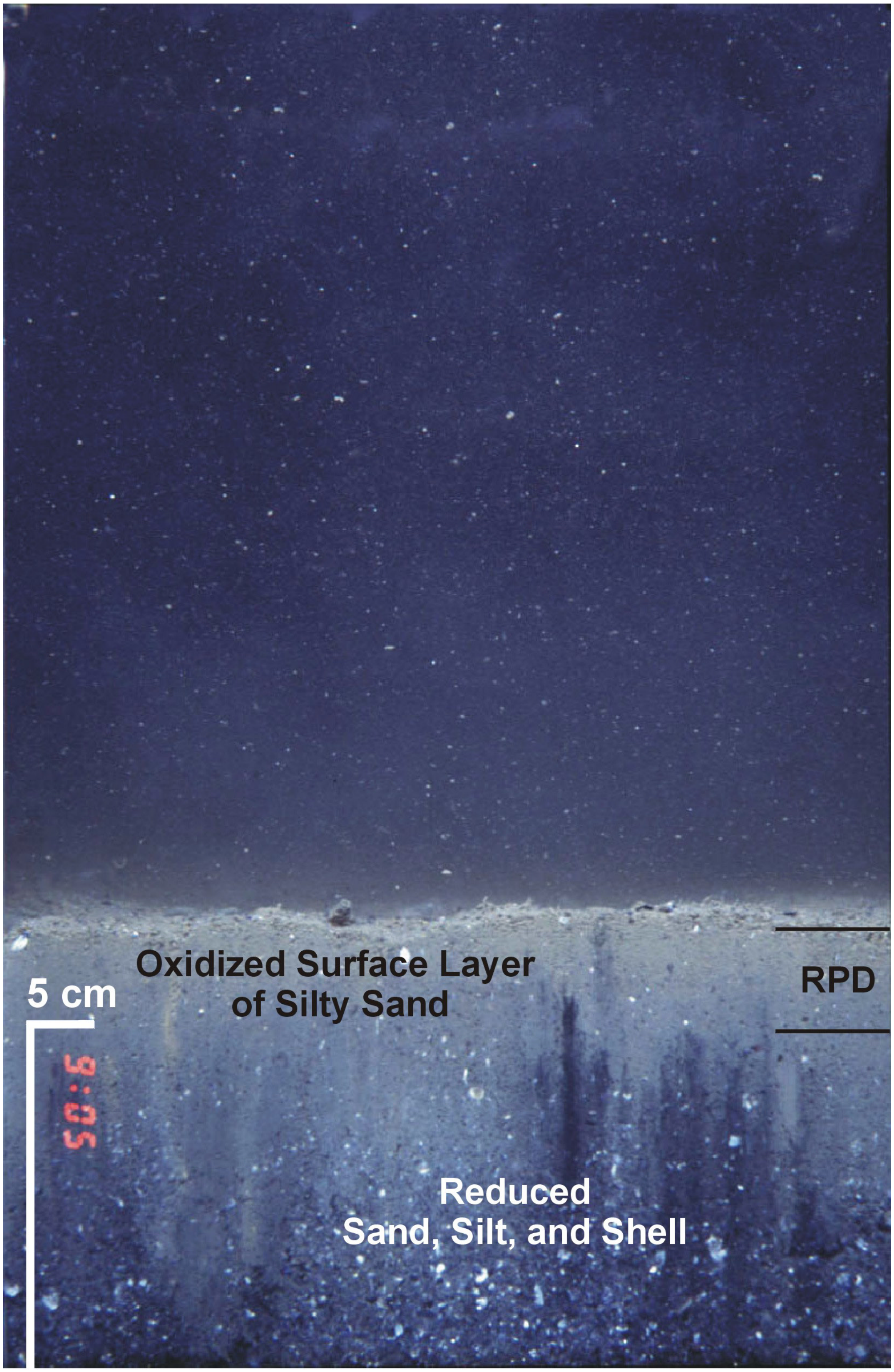


Figure 3-22. REMOTS® image from Station M8-11-3 showing a layer of oxidized silty sand overlying reduced 2 to 1 phi sand, silt and shell hash. This cap material was seen in a number of replicates throughout the cell

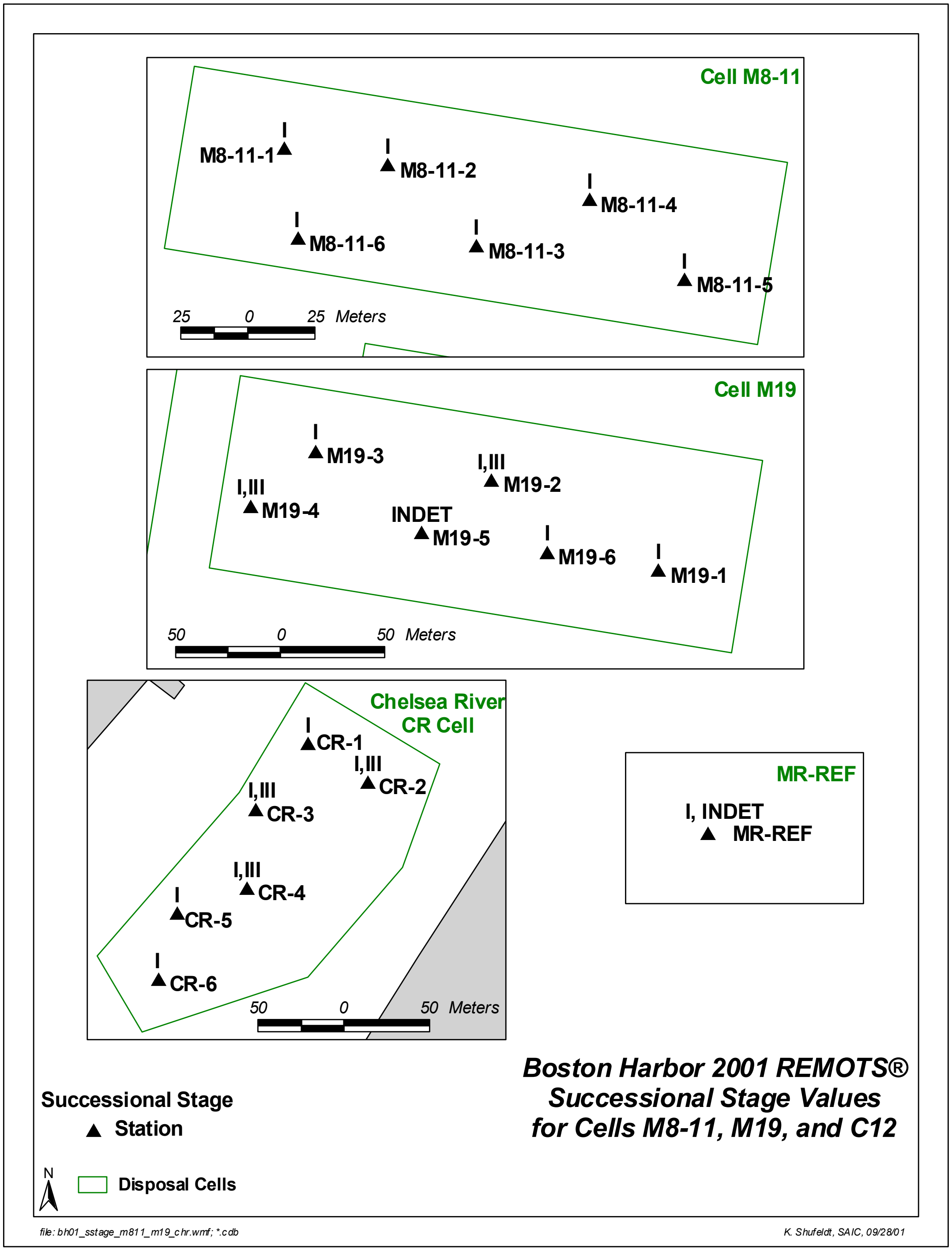


Figure 3-23. Map of successional stages found at each REMOTS® station within Cells M8-11, M19, and Chelsea River (CR), as well as the Mystic River reference area (MR-REF) for the Summer 2001 survey

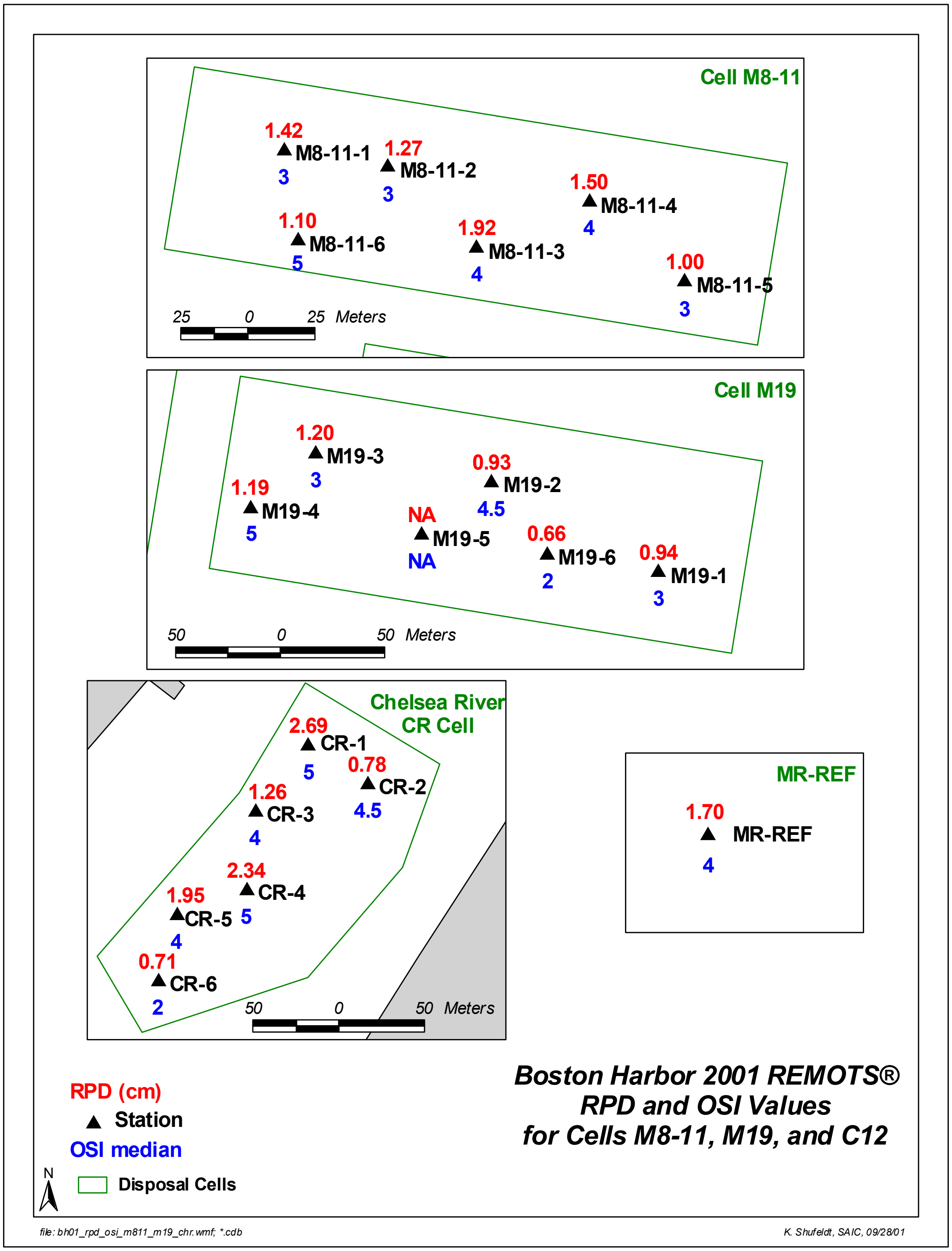
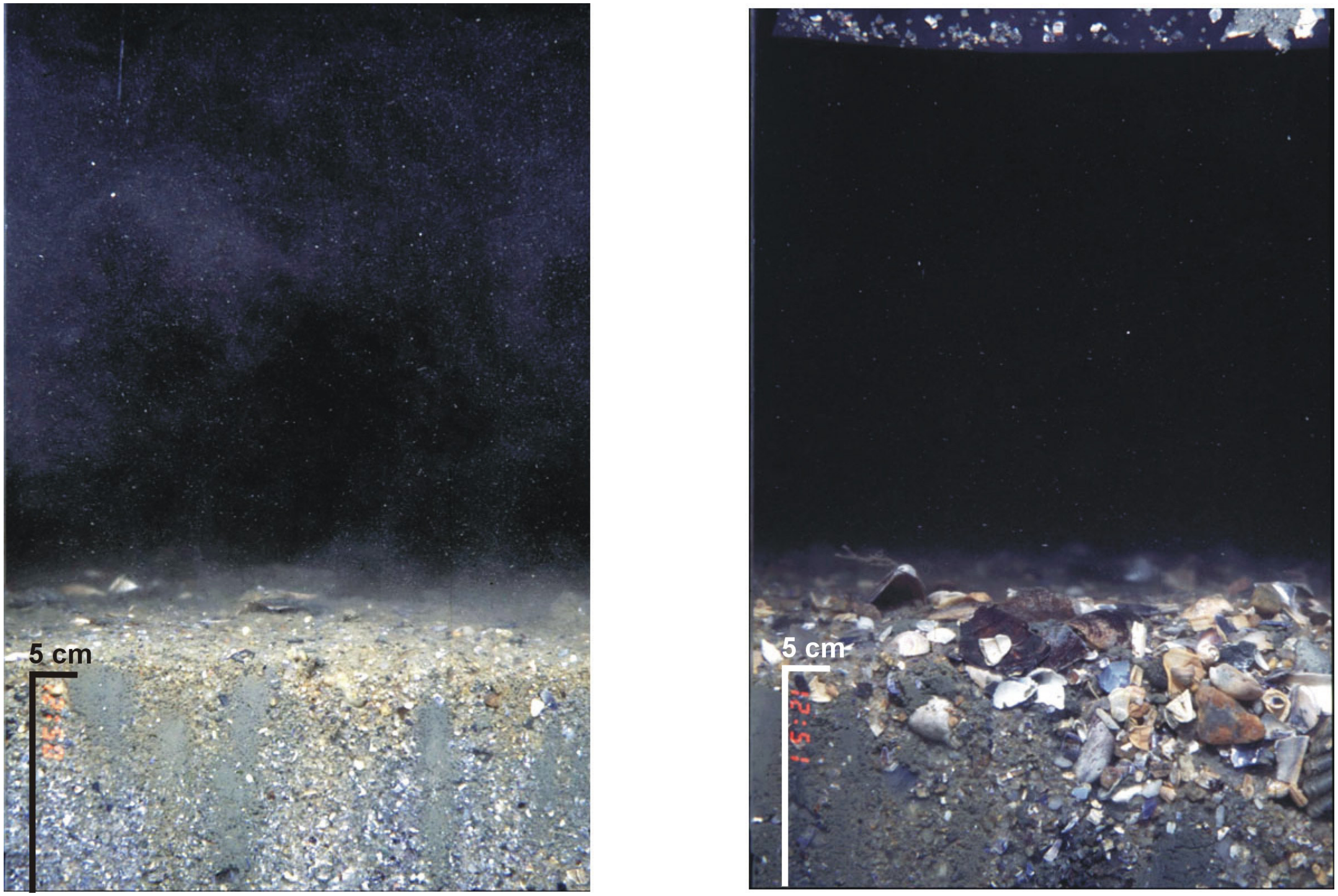


Figure 3-24. Map of replicate-averaged RPD depths (red) and median OSI values (blue) for Cells M8-11, M19, and Chelsea River (CR), as well as the Mystic River reference area (MR-REF) for the Summer 2001 survey



A

B

Figure 3-25. Two REMOTS® images collected from Station M19-5 illustrating a grain size major mode of 2 to 1 phi sand, mixed with larger (1 phi) sand and shell. The relatively shallow penetration of the REMOTS® camera prism suggests that the sand is relatively compact

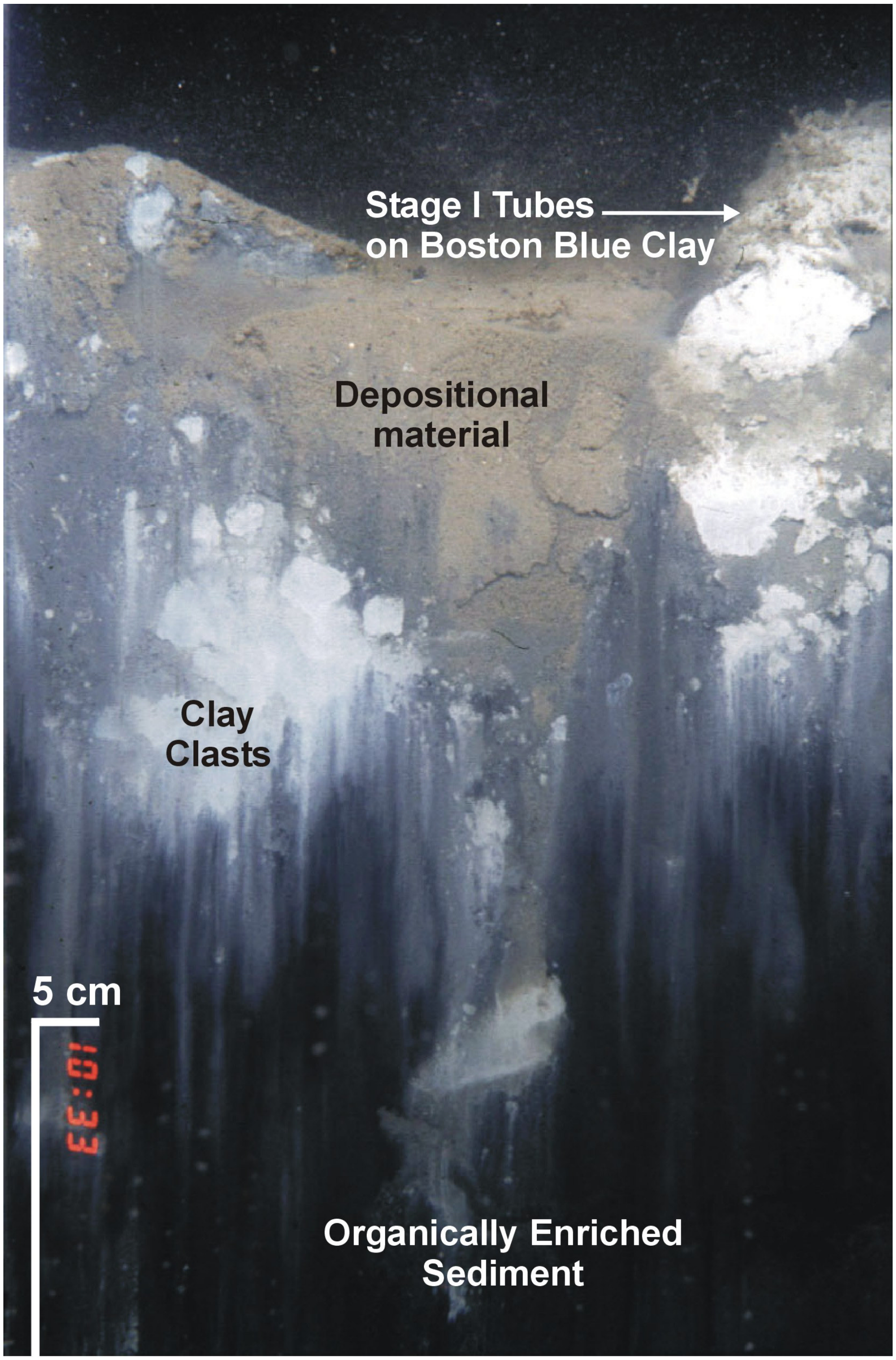


Figure 3-26. REMOTS® image from Station CR-1 showing mottled sediments composed of clay and darker fine-grained dredged material. A small amount of naturally deposited material can also be seen in the depression with evidence of biological activity. Stage I tubes can also be seen at the surface. These types of conditions were common across the surface of Cell CR

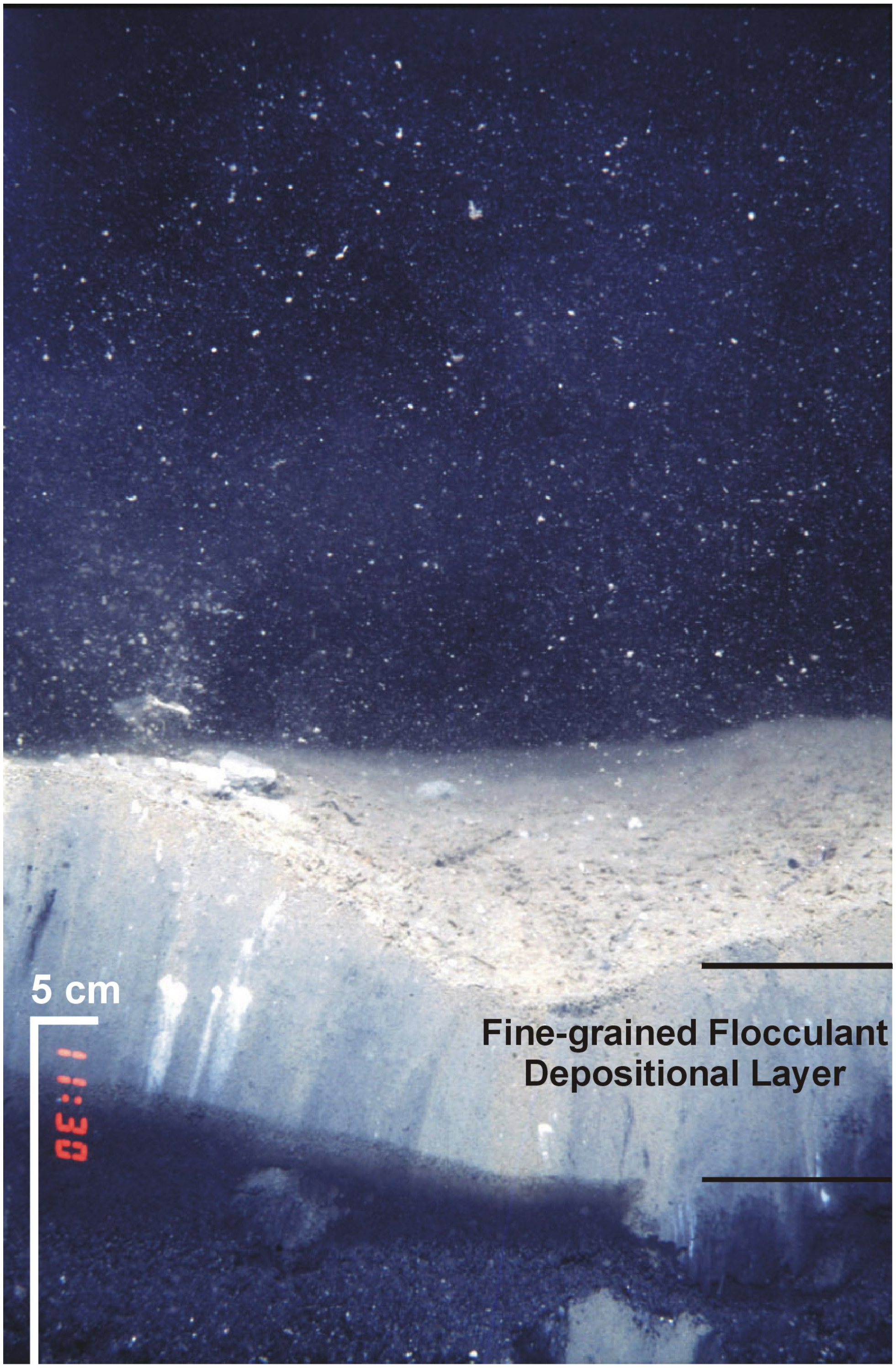


Figure 3-27. REMOTS® image from Chelsea River Station CR-4 showing a relatively thick, fine-grained depositional layer overlying darker fine-grained dredged material. Evidence of this type of depositional layer can be seen in a number of replicate images acquired within the cell

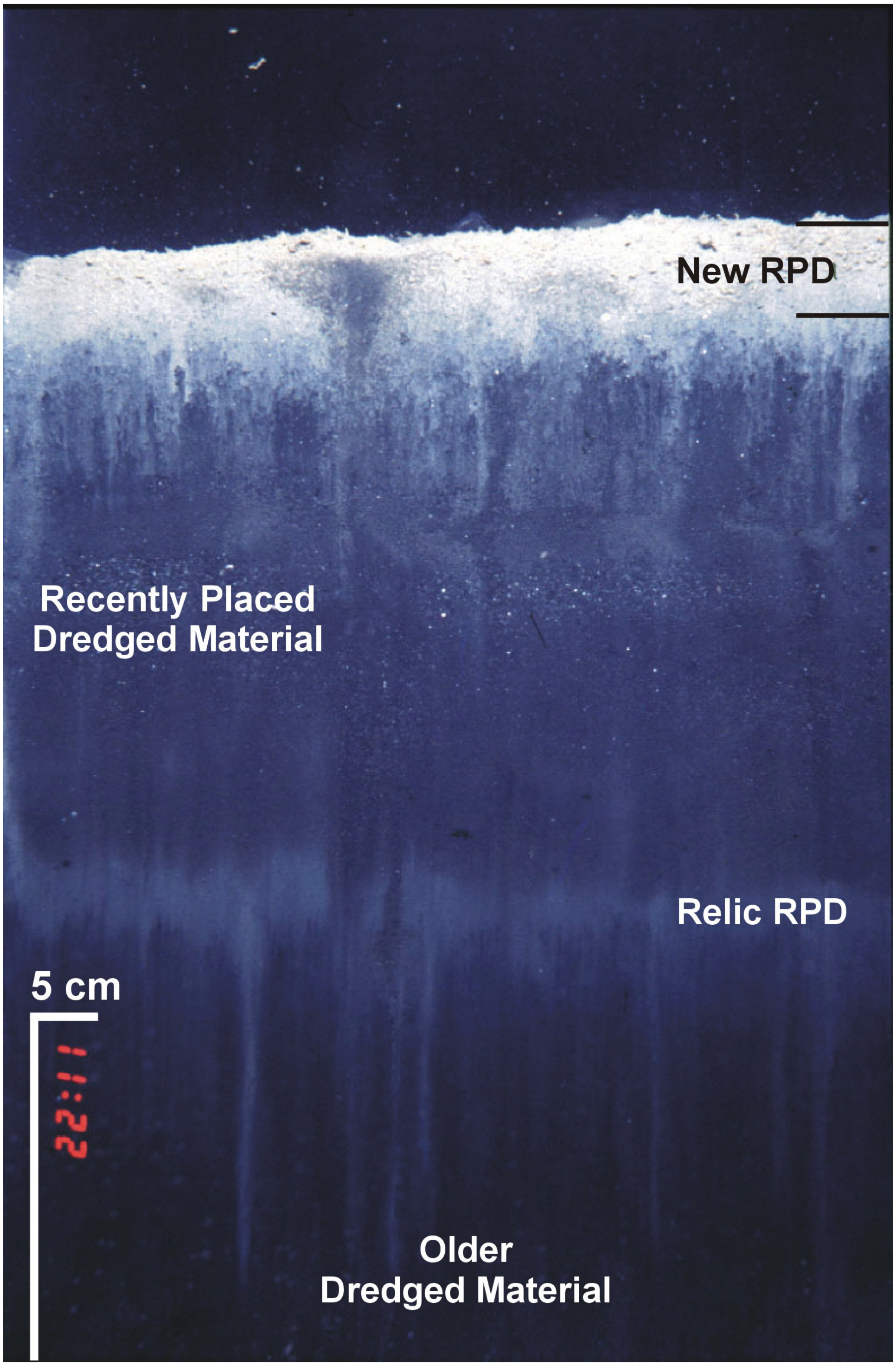


Figure 3-28. REMOTS® image from Chelsea River Station CR-3 showing evidence of a relic RPD at depth. A relic RPD is a historic RPD that once represented the sediment-water interface and has since been subject to had additional dredged material placement. The light colored band (relic RPD) is temporary as the sediment becomes reduced over time

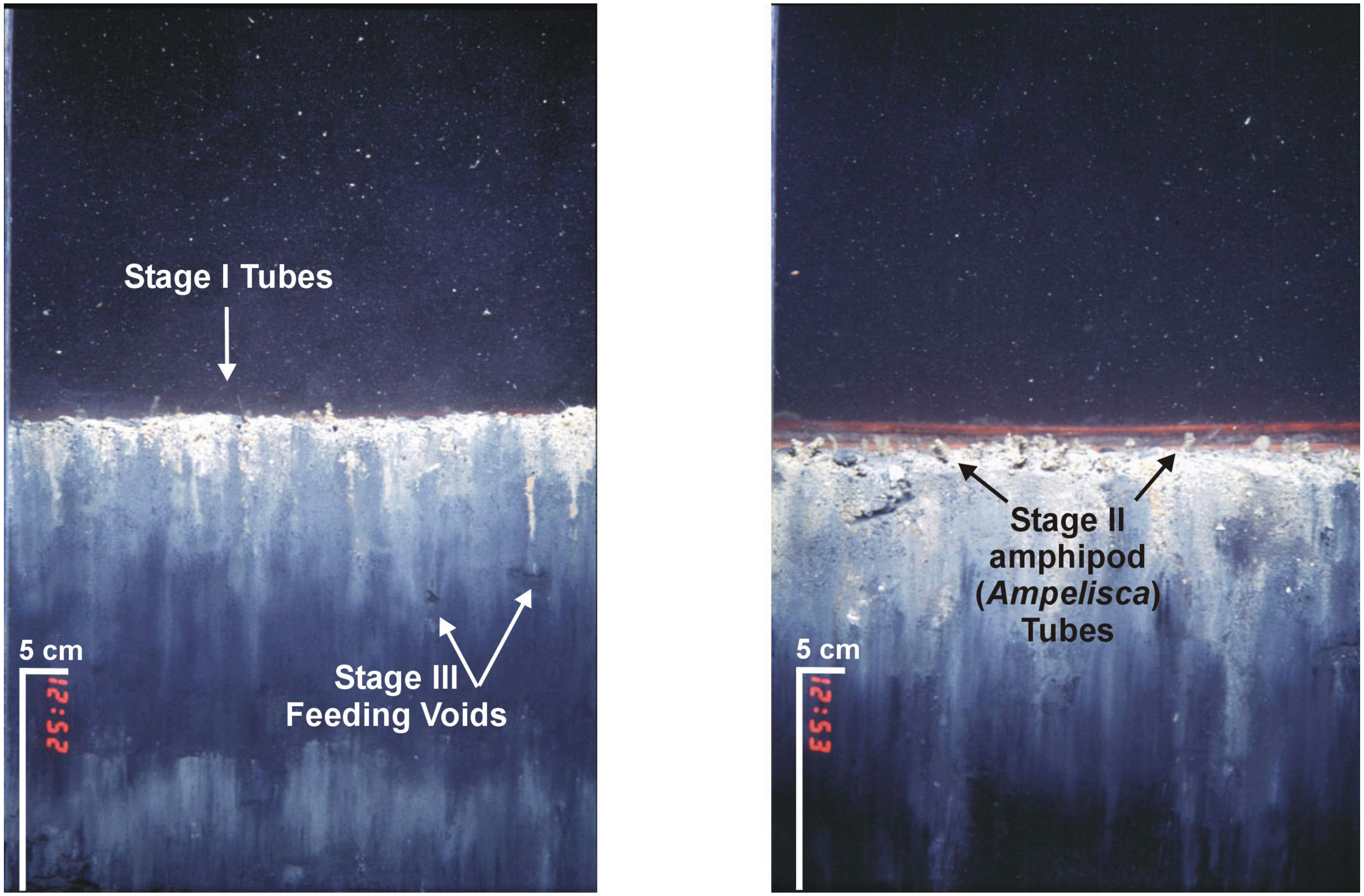


Figure 3-29. Two REMOTS® images from the Inner Confluence reference area (IC-REF) illustrating advanced successional stages within the unconsolidated silt and clay sediments. The image on the left displays evidence of Stage III activity consisting of small feeding voids at depth. The image on the right provides an example of Stage I organisms with advancement to Stage II status as amphipod tubes become established at the sediment-water interface

Appendices

Appendix A

Lab Sheet - Core Descriptions
Lab Analysis Date(s): 8/7/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id IC-1
Data_Type core description
Total_core_length_cm 373.5
Cap Material NA

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	373.5					
		0	73		core section 4	
0	13				black, petroleum odor, wet, very soft silty CLAY	
13	373.5				BBC	
		73	173.5		core section 3	
		173.5	273.5		core section 2	
		273.5	373.5		core section 1	

No sub samples collected due to BBC

NA= none apparent

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/7/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	IC-2
Data_Type	core description
Total_core_length_cm	396
Cap Material	NA

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	396				total core length, sewer odor between BBC and core liner	
		0	94		core section 4	
		94	196		core section 3	
		196	296		core section 2	
		296	396		core section 1	
0	396				BBC	

No sub samples collected due to BBC

NA= none apparent

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/7/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	IC-3
Data_Type	core description
Total_core_length_cm	363
Cap Material	NA

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	363					
		0	77		core section 4	
0	23				black, petroleum odor, wet, very soft silty CLAY w/ chunks of rock	
23	363				BBC	
		77	162		core section 3	
		162	263		core section 2	
		263	363		core section 1	

No sub samples collected due to BBC

NA= none apparent

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Boston Harbor CAD Cells

Core: **IC-4**

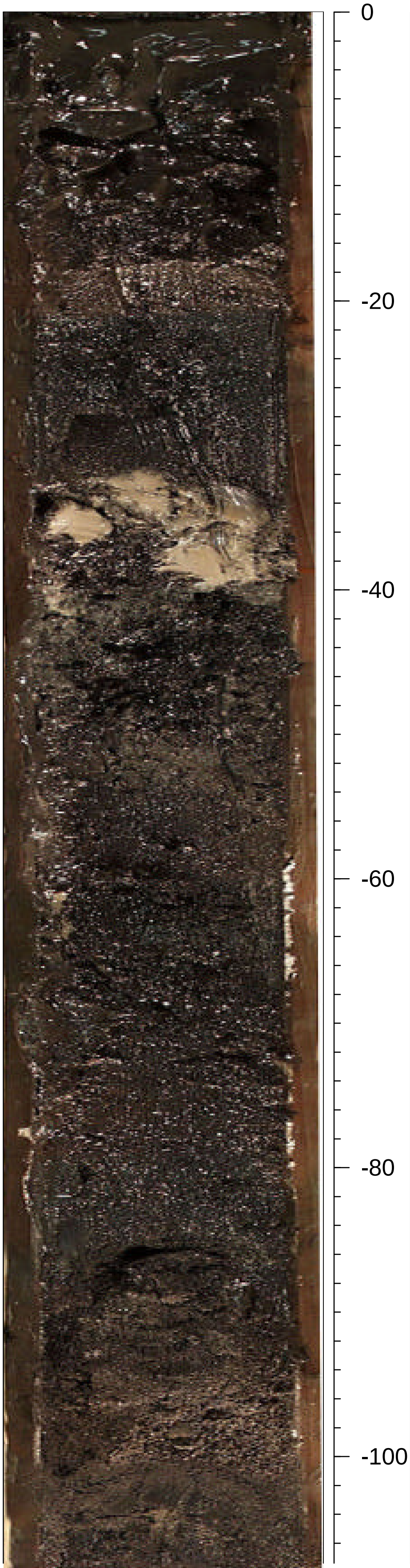
Survey: One-Year Monitoring

Total Core Length: 426 cm

Latitude: 42.379

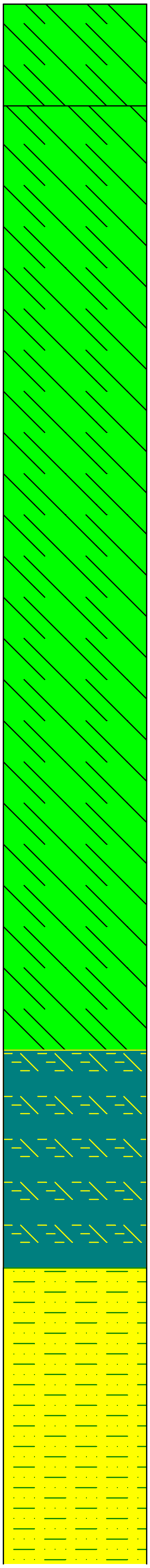
Longitude: -71.044

Core Photo **Depth** (cm) **Major Sample** **Sub Sample** **Lithology**



0-7	black, organic odor, wet-moist, very soft silty CLAY
7-72	black, petroleum odor, moist, soft silty CLAY
72-87	black, petroleum odor, moist, firm silty CLAY and SAND
87-117	black, petroleum odor, moist, hard clayey SAND

0-126	core section 4
17-27	grain size
31-38	BBC nodule
47-62	Atterberg limits
52-52	bulk density, shear strength
67-77	grain size
97-107	grain size



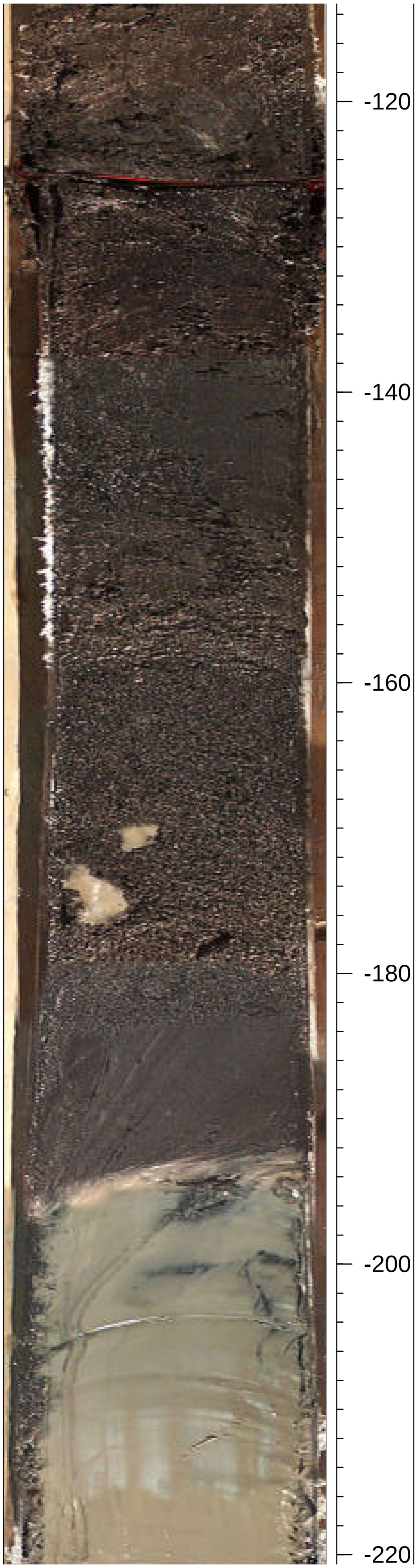
Boston Harbor CAD Cells

Core: IC-4
Survey: One-Year Monitoring

Total Core Length: 426 cm

Latitude:	42.379
Longitude:	-71.044

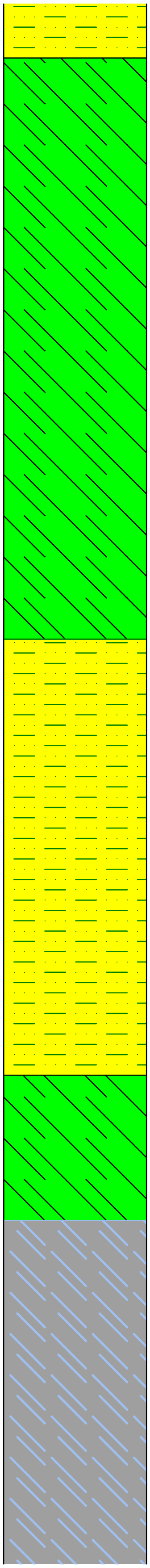
Core Photo | **Depth** (cm)



Major Sample	
117-157	black, petroleum odor, moist, firm sandy silty CLAY
157-187	black, petroleum odor, moist, hard clayey SAND
187-197	black, petroleum odor, moist, hard silty CLAY
197-236	BBC

Sub Sample	
126-226	core section 3
127-137	grain size
142-157	Atterberg limits
147-147	bulk density, shear strength
167-177	grain size
187-197	Atterberg limits
189-189	bulk density, shear strength

Lithology



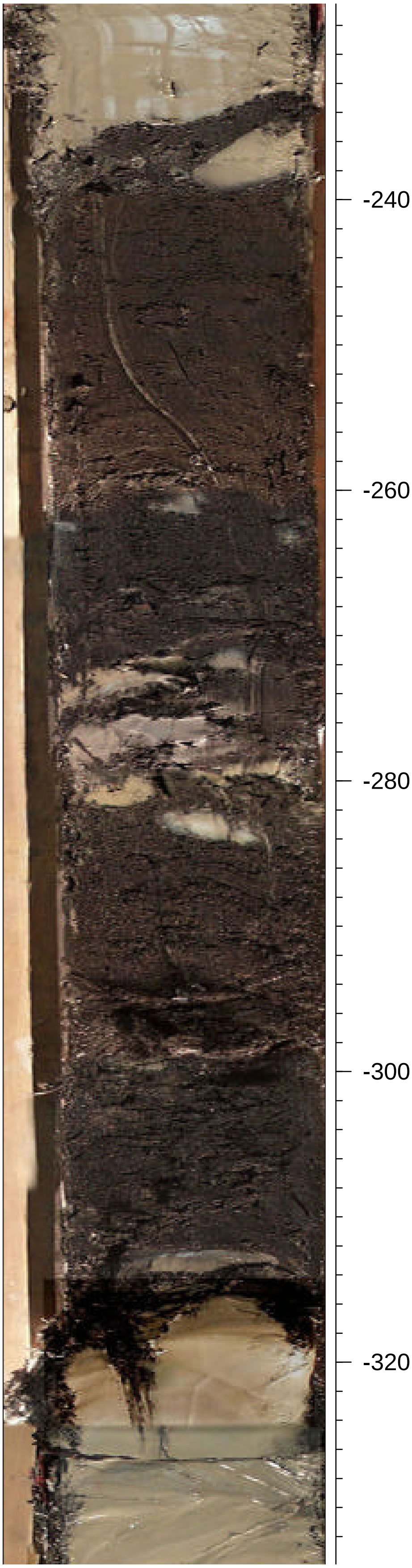
Boston Harbor CAD Cells

Core: **IC-4**
Survey: One-Year Monitoring

Total Core Length: 426 cm

Latitude: 42.379
Longitude: -71.044

Core Photo | **Depth** (cm) | **Major Sample** | **Sub Sample** | **Lithology**

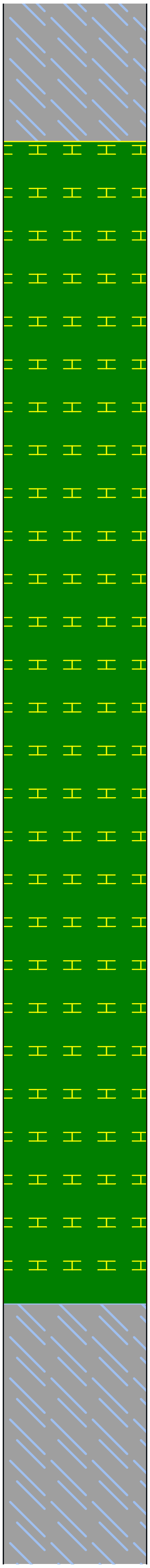


Major Sample

236-316	black, petroleum odor, moist, firm sandy CLAY and SILT w/ flecks of BBC
316-426	BBC

Sub Sample

226-326	core section 2
242-257	Atterberg limits
247-247	bulk density, shear strength
287-302	Atterberg limits
292-292	bulk density, shear strength
326-426	core section 1



Boston Harbor CAD Cells

Core: **IC-4**

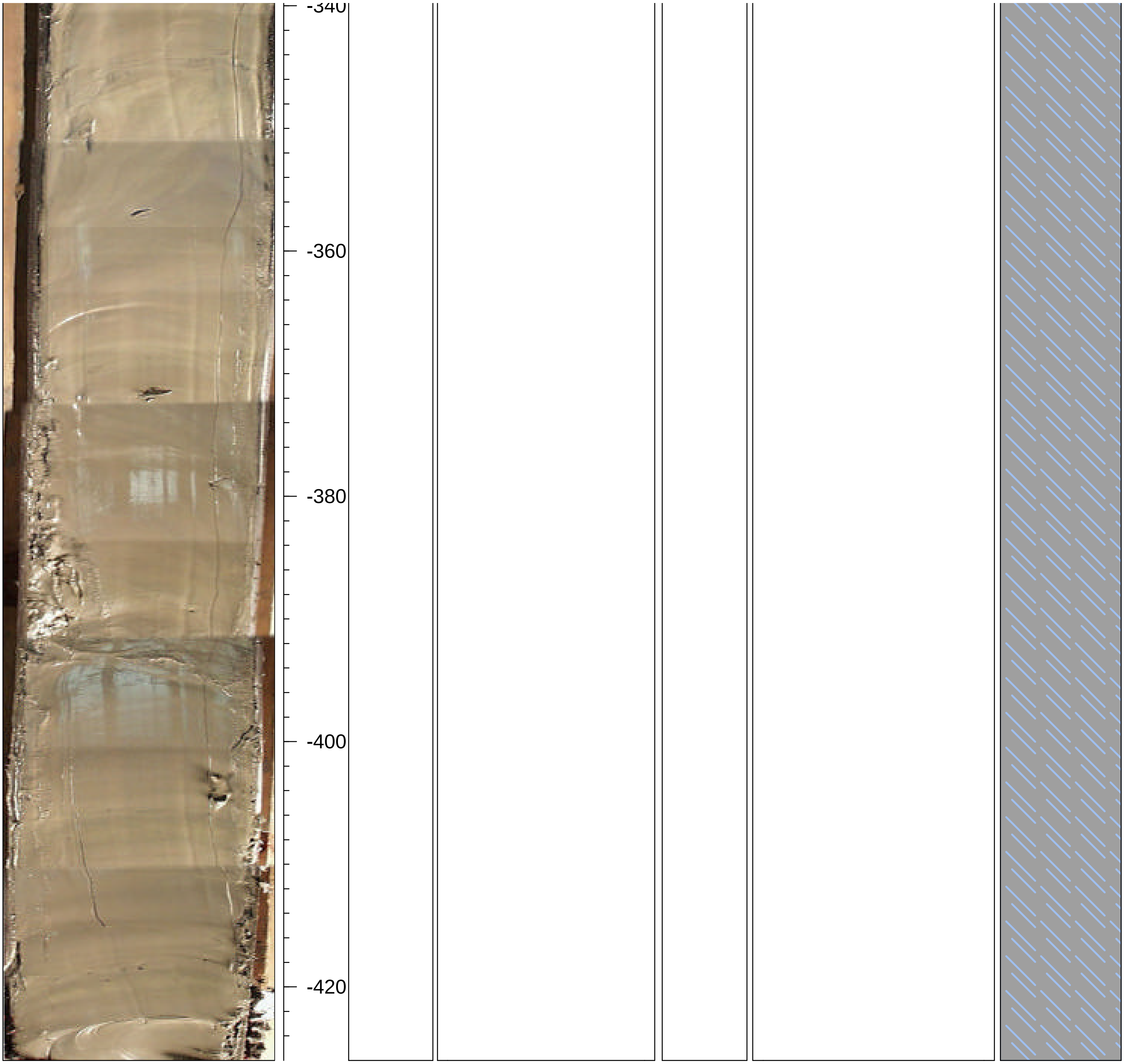
Survey: One-Year Monitoring

Total Core Length: **426 cm**

Latitude: 42.379

Longitude: -71.044

Core Photo **Depth** (cm) **Major Sample** **Sub Sample** **Lithology**



Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/7/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	IC-4
Data_Type	core description
Total_core_length_cm	426
Cap Material	72-117cn and 157-187cm (75cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	426					
		0	126		core section 4	
0	7				black, organic, wet-moist, very soft silty CLAY	
7	72				black, petroleum, moist, soft silty, sandy CLAY	
		17	27	IC-4-AG		grain size
		47	62	IC-4-A		Atterberg limits
		52	52	IC-4-A		bulk density, shear strength
		67	77	IC-4-BG		grain size
		31	38		BBC nodule	
72	87				black, petroleum, moist, firm silty CLAY and SAND	
		126	226		core section 3	
87	117				black, petroleum, moist, hard clayey SAND	
		97	107	IC-4-CG		grain size
		127	137	IC-4-DG		grain size
		142	157	IC-4-B		Atterberg limits
		147	147	IC-4-B		bulk density, shear strength
117	157				black, petroleum, moist, firm sandy silty CLAY	
157	187				black, petroleum, moist, hard clayey SAND	
		167	177	IC-4-EG		grain size
		187	197	IC-4-C		Atterberg limits
		189	189	IC-4-C		bulk density, shear strength
187	197				black, petroleum, moist, hard silty CLAY	
197	236				BBC	
236	316				black, petroleum, moist, firm sandy CLAY and SILT w/ flecks of BBC	
		242	257	IC-4-D		Atterberg limits
		247	247	IC-4-D		bulk density, shear strength
		287	302	IC-4-E		Atterberg limits
		292	292	IC-4-E		bulk density, shear strength
316	426				BBC	
		226	326		core section 2	
		326	426		core section 1	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/7/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	IC-5
Data_Type	core description
Total_core_length_cm	344
Cap Material	64-177cm mixed (43cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	344					
		0	64		core section 4	
0	15				black, petroleum and organic odor, wet, very soft silty CLAY w/ gravel	
15	45				black, petroleum and slight organic odor, moist, soft silty CLAY	
45	55				black, petroleum odor, moist, firm SAND and SILT	
		9	24	IC-5-A		Atterberg limits
		14	14	IC-5-A		bulk density, shear strength
		49	59	IC-5-AG		grain size
		69	79	IC-5-BG		grain size
		84	94	IC-5-CG		grain size
55	64				black, petroleum odor, moist soft-firm silty CLAY w/ sand	
		64	142		core section 3	
64	79				black, petroleum odor, moist, firm SAND and SILT	
79	100				yellowish brown to tan, moist, hard SAND	
100	177				black, petroleum odor, moist, firm SAND and SILT	
		114	124	IC-5-DG		grain size
		124	139	IC-5-B		Atterberg limits
		129	129	IC-5-B		bulk density, shear strength
		159	169	IC-5-EG		grain size
		169	184	IC-5-C		Atterberg limits
		179	179	IC-5-C		bulk density, shear strength
		142	243		core section 2	
177	270				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge like texture	
		214	229	IC-5-D		Atterberg limits
		219	219	IC-5-D		bulk density, shear strength
		249	264	IC-5-E		Atterberg limits
		254	254	IC-5-E		bulk density, shear strength
		243	344		core section 1	
270	344				BBC	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions
Lab Analysis Date(s): 7/30/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M4-1
Data_Type core description
Total_core_length_cm 503
Cap Material 15-46cm (31cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	503				total core length, petroleum odor	
		0	97.5		core section 5	
0	15				very dark gray to black, wet, very soft silty CLAY	
15	46				dark gray and tan, moist, firm SAND w/ shell fragments and coarse sand	
46	321				very black, moist, soft silty CLAY w/ sponge-like texture	
		60	75	M4-1-A		Atterberg limits
		65	65	M4-1-A		bulk density, shear strength
		100	115	M4-1-B		Atterberg limits
		105	105	M4-1-B		bulk density, shear strength
		170	185	M4-1-C		Atterberg limits
		175	175	M4-1-C		bulk density, shear strength
		250	265	M4-1-D		Atterberg limits
		255	255	M4-1-D		bulk density, shear strength
		90	94		BBC nodule	
		97.5	198		core section 4	
		198	300		core section 3	
		200	206		shell fragments	
		262	276		gravel	
		300	401		core section 2	
321	404				very black, moist, soft-firm silty CLAY w/ sponge-like texture	
		350	365	M4-1-E		Atterberg limits
		355	355	M4-1-E		bulk density, shear strength
		450	465	M4-1-F		Atterberg limits
		455	455	M4-1-F		bulk density, shear strength
		401	503		core section 1	
404	503				very black, moist, soft-firm sandy silty CLAY w/ BBC nodules	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions
Lab Analysis Date(s): 7/30/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M4-2
Data_Type core description
Total_core_length_cm 497
Cap material 16-50cm (34cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	497				total core length, petroleum odor	
		0	96		core section 5	
0	8				very dark gray to black, wet, very soft silty CLAY	
8	33				very dark gray to black, moist, firm SAND w/ shell fragments	
33	42				very dark gray, moist, firm clayey fine SAND	
42	283				very dark gray to black, moist, soft silty CLAY w/ sponge-like texture	
		42	57	M4-2-A		Atterberg limits
		47	47	M4-2-A		bulk density, shear strength
		112	127	M4-2-B		Atterberg limits
		117	117	M4-2-B		bulk density, shear strength
		96	197		core section 4	
		197	297		core section 3	
283	357				very dark gray to black, moist, soft-firm silty CLAY	
		162	177	M4-2-C		Atterberg limits
		167	167	M4-2-C		bulk density, shear strength
		297	397		core section 2	
357	447				very dark gray to black, moist, firm silty CLAY	
		397	497		core section 1	
		242	257	M4-2-D		Atterberg limits
		247	247	M4-2-D		bulk density, shear strength
		342	357	M4-2-E		Atterberg limits
		347	347	M4-2-E		bulk density, shear strength
447	497				very dark gray to black, moist, firm sandy silty CLAY	
		422	437	M4-2-F		Atterberg limits
		427	427	M4-2-F		bulk density, shear strength

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 7/30/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells

Survey_name one-year monitoring

Replicate_id M4-3

Data_Type core description

Total_core_length_cm 525.5

Cap material 319-438cm mixed (119cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	525.5				total core length, petroleum odor	
		0	125.5		core section 5	
		30	45	M4-3-A		Atterberg limits
		35	35	M4-3-A		bulk density, shear strength
		95	110	M4-3-B		Atterberg limits
		100	100	M4-3-B		bulk density, shear strength
		160	175	M4-3-C		Atterberg limits
		165	165	M4-3-C		bulk density, shear strength
0	178				black, wet-moist, very soft sitly CLAY	
		125.5	225.5		core section 4	
178	319				black, moist, soft sandy sitly CLAY	
		225.5	325.5		core section 3	
		270	285	M4-3-D		Atterberg limits
		275	275	M4-3-D		bulk density, shear strength
		370	385	M4-3-E		Atterberg limits
		375	375	M4-3-E		bulk density, shear strength
		490	505	M4-3-F		Atterberg limits
		500	500	M4-3-F		bulk density, shear strength
319	438				black, moist, firm sitly CLAY and SAND	
		325.5	425.5		core section 2	
		425.5	525.5		core section 1	
438	525.5				black, moist, firm sitly CLAY w/ sandy gravel	
		459	472		BBC lens	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

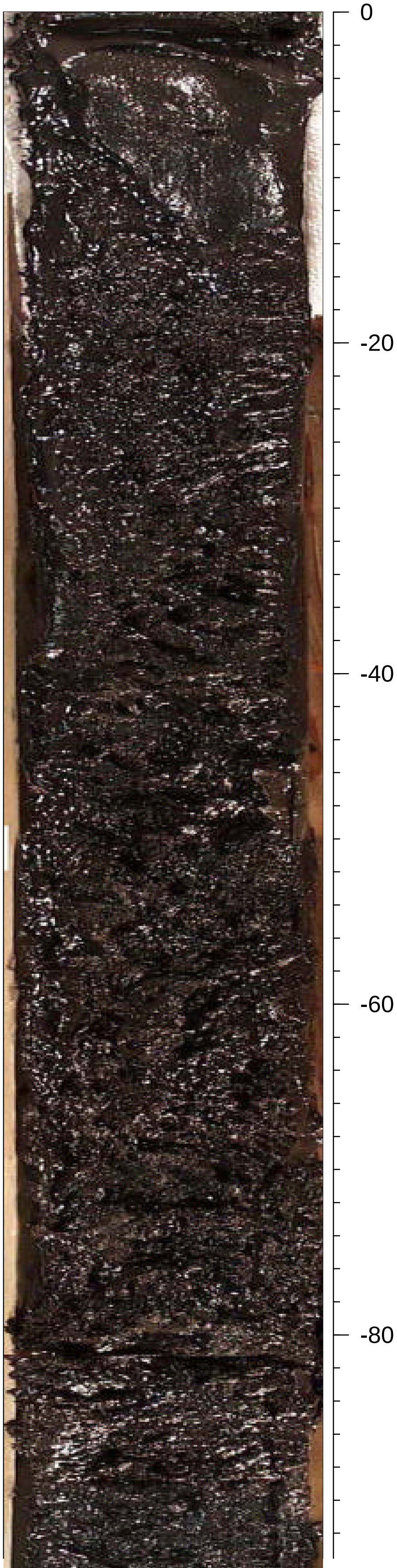
Boston Harbor CAD Cells

Core: M4-5
Survey: One-Year Monitoring

Total Core Length: 477 cm

Latitude: 42.388
Longitude: -71.064

Core Photo | **Depth** (cm) | **Major Sample** | **Sub Sample** | **Lithology**



Major Sample

0-20	black, wet, very soft, silty CLAY	▨
20-45	black, wet, very soft-soft, silty CLAY, w/ sponge-like texture	▨
45-113	black, wet to moist, soft, silty CLAY w/ sponge-like texture	▨

Sub Sample

0-83.5	core section 5
83.5-176	core section 4

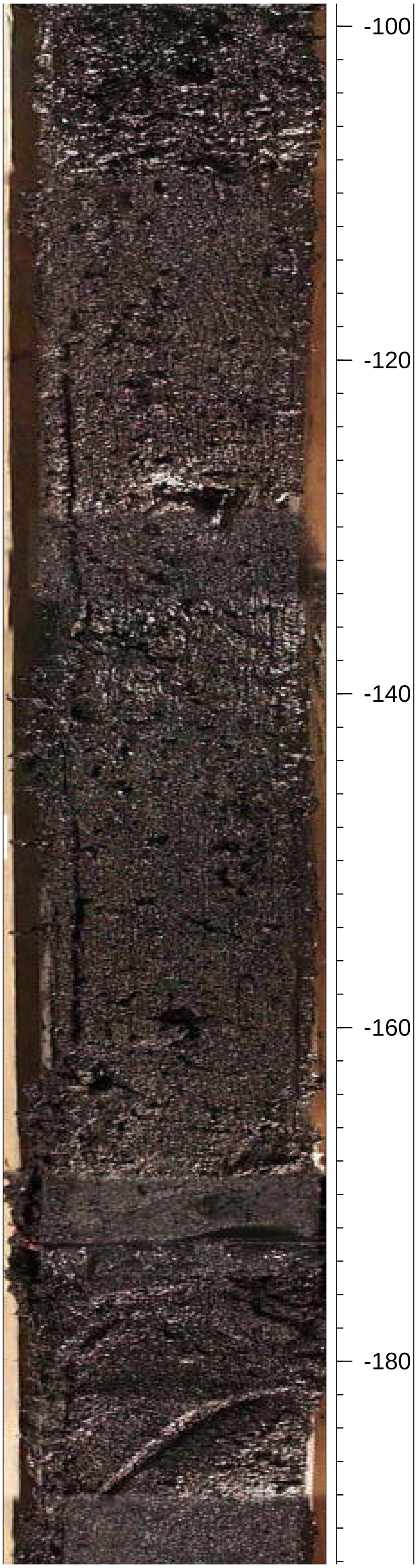
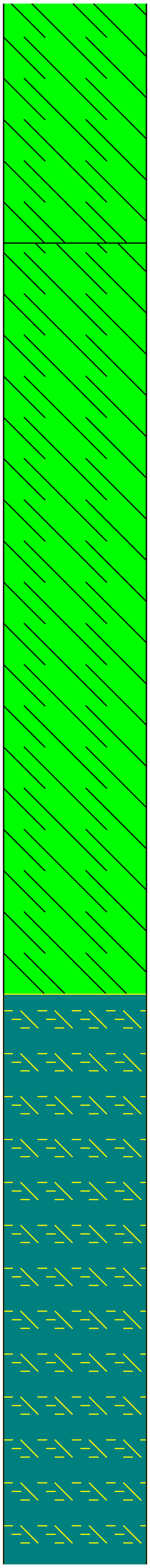
Core: **M4-5**

Survey: One-Year Monitoring

Total Core Length: **477 cm**

Latitude: 42.388

Longitude: -71.064

Core Photo	Depth (cm)	Major Sample		Sub Sample		Lithology
		113-158	black, moist, soft, silty CLAY w/ fine sand and sponge-like texture			
		158-213	black, ,moist, soft-firm, silty CLAY and SAND	160-170	grain size	
				176-276	core section 3	

Core: **M4-5**

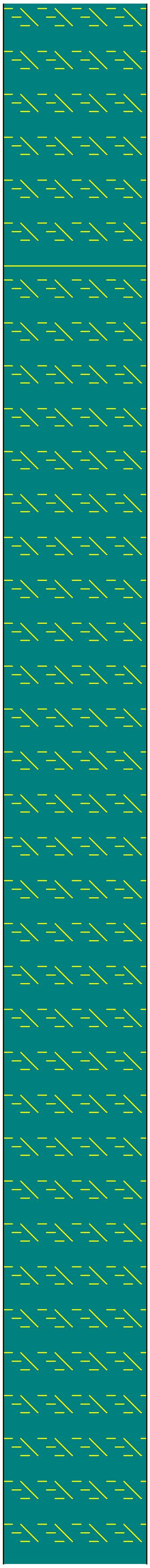
Survey: One-Year Monitoring

Total Core Length: 477 cm

Latitude: 42.388

Longitude: -71.064

Core Photo	Depth (cm)	Major Sample		Sub Sample		Lithology
	-200			200-210	grain size	
		213-309	black, moist, firm, silty CLAY and SAND			
	-220					
				230-240	grain size	
	-240					
	-260			260-270	grain size	
				276-376	core section 2	
	-280					
				290-300	grain size	



Boston Harbor CAD Cells

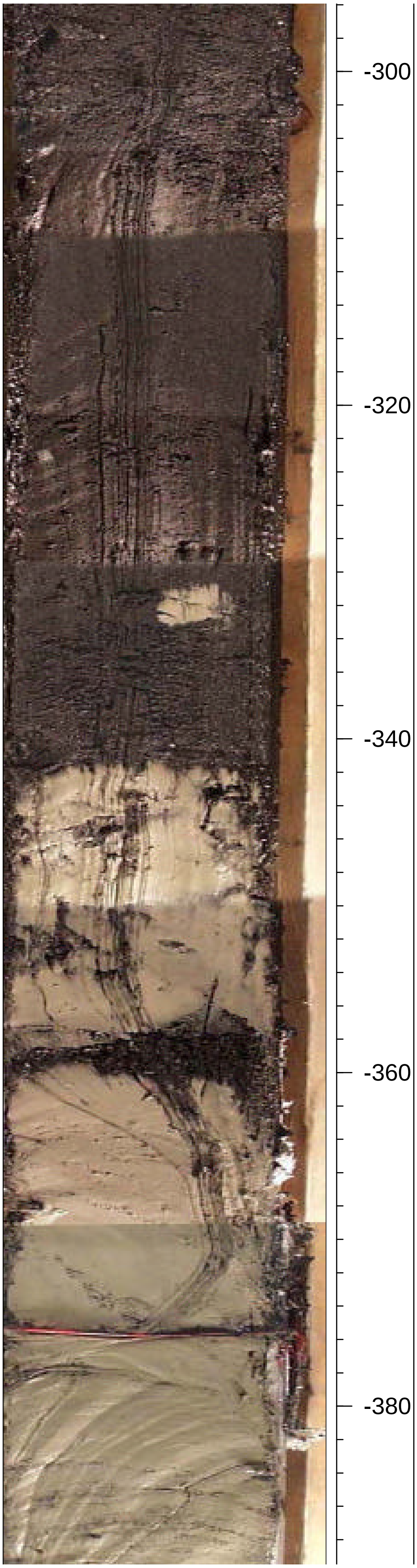
Core: M4-5

Survey: One-Year Monitoring

Total Core Length: 477 cm

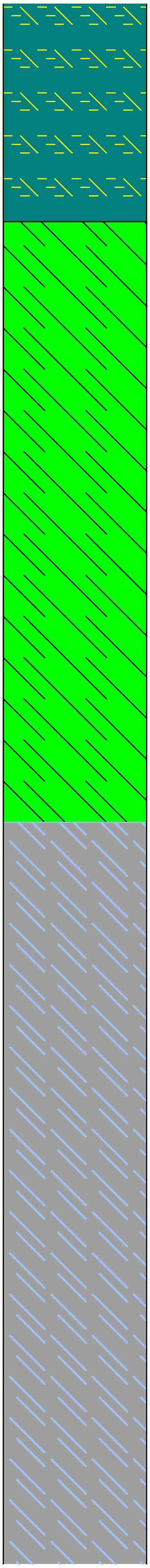
Latitude: 42.388
Longitude: -71.064

Core Photo **Depth** (cm)



Major Sample		Sub Sample	
309-345	black, moist, firm-hard, silty CLAY	331-332	BBC nodule
345-477	BBC	360-362	lens; black, moist, firm-hard, silty CLAY
		376-477	core section 1

Lithology



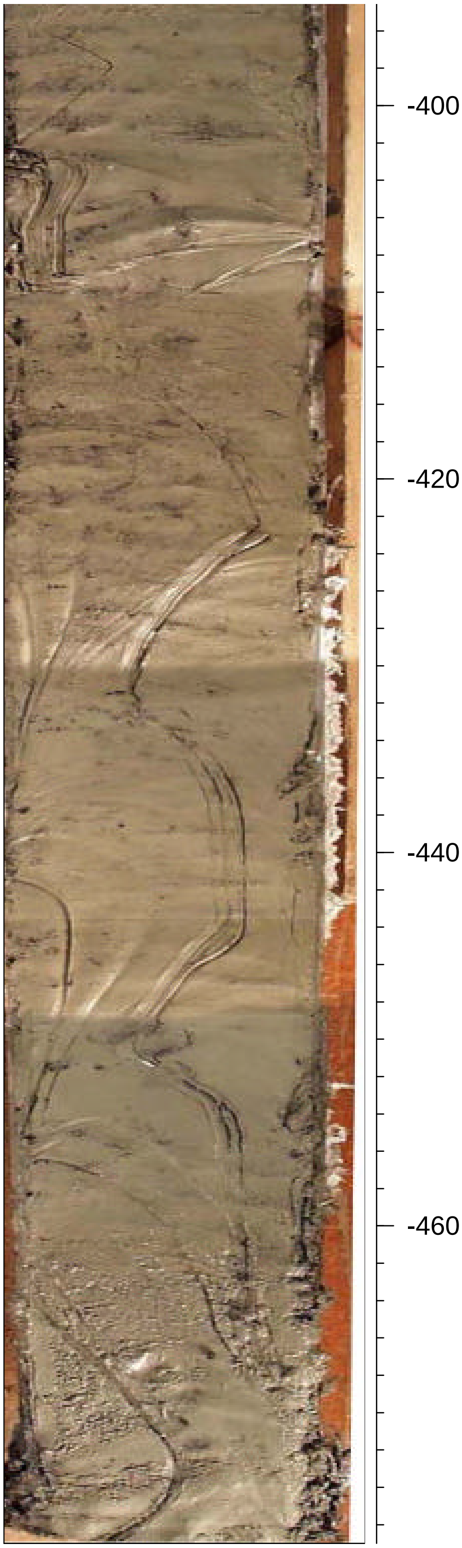
Core: M4-5

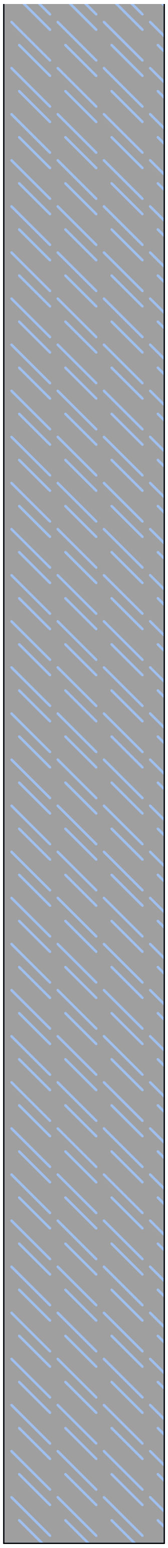
Survey: One-Year Monitoring

Total Core Length: 477 cm

Latitude: 42.388
Longitude: -71.064

Core Photo	Depth (cm)	Major Sample	Sub Sample	Lithology





Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/1/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M4-5
Data_Type core description
Total_core_length_cm 477
Cap material 158-309cm mixed (151cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	477				total core length, petroleum odor	
		0	83.5		core section 5	
0	20				black, wet, very soft, silty CLAY	
20	45				black, wet, very soft-soft, silty CLAY, w/ sponge-like texture	
45	113				black, wet to moist, soft, silty CLAY w/ sponge-like texture	
		83.5	176		core section 4	
113	158				black, moist, soft, silty CLAY w/ fine sand and sponge-like texture	
158	213				black, ,moist, soft-firm, silty CLAY and SAND	
		160	170	M4-5-A		grain size
		176	276		core section 3	
		200	210	M4-5-B		grain size
213	309				black, moist, firm, silty CLAY and SAND	
		230	240	M4-5-C		grain size
		260	270	M4-5-D		grain size
		276	376		core section 2	
		290	300	M4-5-E		grain size
309	345				black, moist, firm-hard, silty CLAY	
		331	332		BBC Nodule	
345	477				BBC	
		360	362		lens of black, moist, firm-hard, silty CLAY	
		376	477		core section 1	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/1/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M4-6
Data_Type	core description
Total_core_length_cm	547
Cap material	128-218cm slighly mixed (90cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	547				total core length, petroleum odor	
		0	69		core section 6	
0	40				black, wet-moist, very soft silty CLAY	
40	86				black, moist, soft, silty CLAY w/ sponge-like texture	
		69	150		core section 5	
86	128				black, moist, soft-firm silty CLAY w/ sand	
128	165				black, moist, firm-hard silty clayey SAND	
		128	138	M4-6-A		grain size
		153	163	M4-6-B		grain size
		150	250		core section 4	
165	218				black, moist, firm-hard SAND w/ minor silt component	
		173	183	M4-6-C		grain size
		193	203	M4-6-D		grain size
		208	218	M4-6-E		grain size
218	289				black, moist, firm silty CLAY	
		250	349		core section 3	
289	547				BBC	
		349	448		core section 2	
		448	547		core section 1	
		537	547		BBC and SAND (ambient)	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/2/2001
Lab Technician(s):	Walter, Montgomergy, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M5-1
Data_Type	core description
Total_core_length_cm	474
Cap Material	129-219cm (90cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	474				total core length, petroleum odor	
		0	80		core section 5	
0	11				black, wet-moist, very soft silty CLAY w/ gravel	
11	104				black, moist, soft silty CLAY w/ sponge-like texture and sand	
		12	13		BBC nodule	
		80	174		core section 4	
104	129				black, moist, firm sandy silty CLAY	
		64	79	M5-1-A		Atterberg limits
		69	69	M5-1-A		bulk density, shear strength
		94	109	M5-1-B		Atterberg limits
		99	99	M5-1-B		bulk density, shear strength
129	158				black, moist, firm silty CLAY and SAND	
158	219				black, moist, firm silty clayey SAND	
		174	274		core section 3	
		129	144	M5-1-C		Atterberg limits
		134	134	M5-1-C		bulk density, shear strength
219	293				black, moist, firm-hard silty CLAY	
		274	374		core section 2	
		229	244	M5-1-D		Atterberg limits
		234	234	M5-1-D		bulk density, shear strength
		284	299	M5-1-E		Atterberg limits
		289	289	M5-1-E		bulk density, shear strength
293	366				black, moist, firm-hard silty CLAY w/ flecks of BBC	
		374	474		core section 1	
366	388				BBC	
		404	419	M5-1-F		Atterberg limits
		409	409	M5-1-F		bulk density, shear strength
		374	377.5		foam plug	
388	474				black, moist, firm-hard silty CLAY w/ flecks of BBC	
		447	449		stainless steel *Gillette* razor blade	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/2/2001
Lab Technician(s):	Walter, Montgomergy, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M5-2
Data_Type	core description
Total_core_length_cm	503
Cap material	70-247cm (177cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	503				total core length, petroleum odor	
		0	101		core section 5	
					foam plug	
0	25				black, wet-moist, very soft silty CLAY w/gravel/sand	
		26	41	M5-2A		Atterberg Limits
		34	34	M5-2A		Bulk Density, Shear Strength
25	70				black, moist, soft silty CLAY w/gravel/sand and sponge-like texture	
		71	86	M5-2B		Atterberg Limits
		76	76	M5-2B		Bulk Density, Shear Strength
70	132				black, moist, soft-firm silty CLAY and SAND	
		99	101		foam plug	
		101	203		core section 4	
		106	121	M5-2C		Atterberg Limits
		111	111	M5-2C		Bulk Density, Shear Strength
132	247				black, moist, firm-hard silty SAND	
		203	303		core section 3	
		251	266	M5-2D		Atterberg Limits
		256	256	M5-2D		Bulk Density, Shear Strength
247	275				black, moist, firm silty CLAY w/sand	
275	289				BBC	
289	364				mottled:black, moist, firm silty CLAY w/sand and BBC	
		303	403		core section 2	
364	503				BBC	
		394	503		lens black, moist, firm silty CLAY	
		403	503		core section 1	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions
Lab Analysis Date(s): 8/2/2001
Lab Technician(s): Walter, Montgomergy, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M5-3
Data_Type core description
Total_core_length_cm 491
Cap Material 126-206cm (80cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	491				total core length, petroleum odor	
		0	96		core section 5	
0	7				black, wet, very soft silty CLAY	
7	32				black, wet-moist, very soft-soft silty CLAY	
		14	29	M5-3-A		Atterberg limits
		19	19	M5-3-A		bulk density, shear strength
32	126				black, moist, soft-firm silty CLAY w/sand and sponge-like texture	
		49	64	M5-3-B		Atterberg limits
		54	54	M5-3-B		bulk density, shear strength
		96	191		core section 4	
		104	119	M5-3-C		Atterberg limits
		109	109	M5-3-C		bulk density, shear strength
126	206				black, moist, firm-hard silty SAND	
		191	291		core section 3	
206	278				black, moist, firm silty CLAY w/ BBC flecks and nodules	
		234	249	M5-3-D		Atterberg limits
		239	239	M5-3-D		bulk density, shear strength
		291	391		core section 2	
278	343				BBC	
343	491				black, moist, firm silty CLAY w/ BBC flecks and nodules	
		354	369	M5-3-E		Atterberg limits
		359	359	M5-3-E		bulk density, shear strength
		391	491		core section 1	
		409	424	M5-3-F		Atterberg limits
		414	414	M5-3-F		bulk density, shear strength

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Boston Harbor CAD Cells

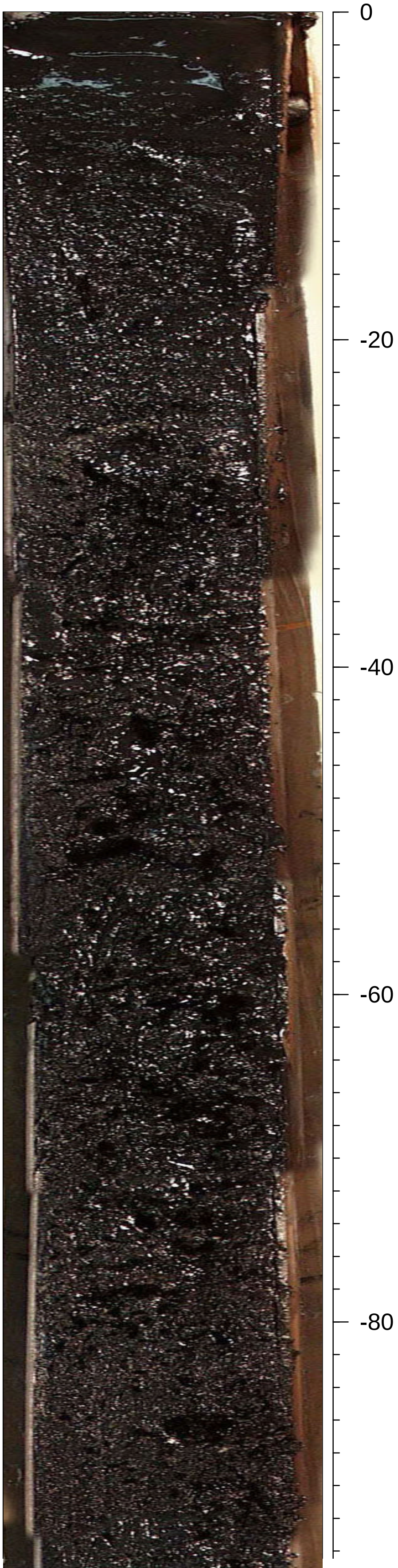
Core: M5-4

Survey: One-Year Monitoring

Total Core Length: 497 cm

Latitude: 42.388
Longitude: -71.062

Core Photo | **Depth** (cm) | **Major Sample** | **Sub Sample** | **Lithology**



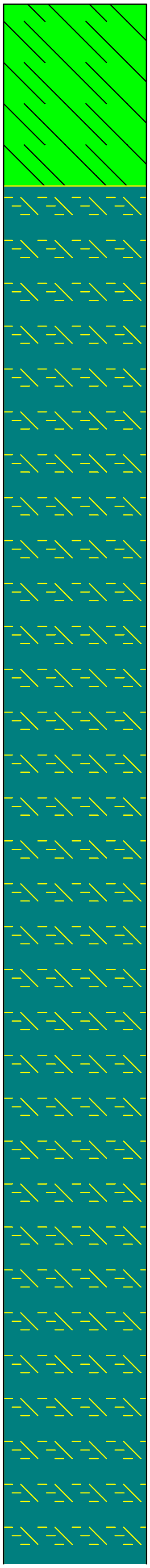
Major Sample

0-11	black, wet, very soft silty CLAY
11-100	black, wet-moist, soft silty CLAY and SAND and sponge-like texture

Sub Sample

0-106	core section 5
85-95	grain size

Lithology



Boston Harbor CAD Cells

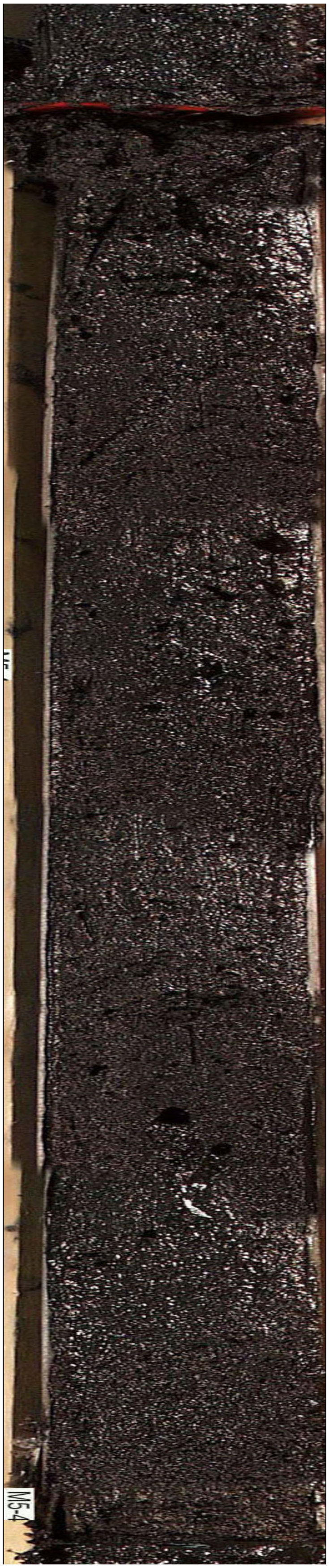
Core: M5-4

Survey: One-Year Monitoring

Total Core Length: 497 cm

Latitude: 42.388
Longitude: -71.062

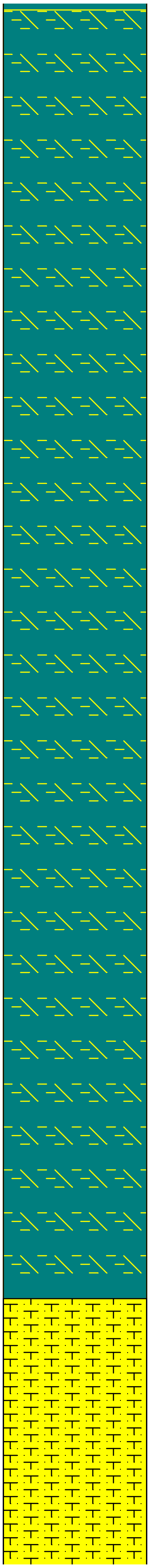
Core Photo	Depth (cm)	Major Sample		Sub Sample		Lithology



-100
-120
-140
-160
-180

Major Sample	
100-178	black, moist, soft-firm silty CLAYand SAND and sponge-like texture
178-276	black, moist, firm-hard silty SAND

Sub Sample	
106-195	core section 4
145-155	grain size
185-195	grain size



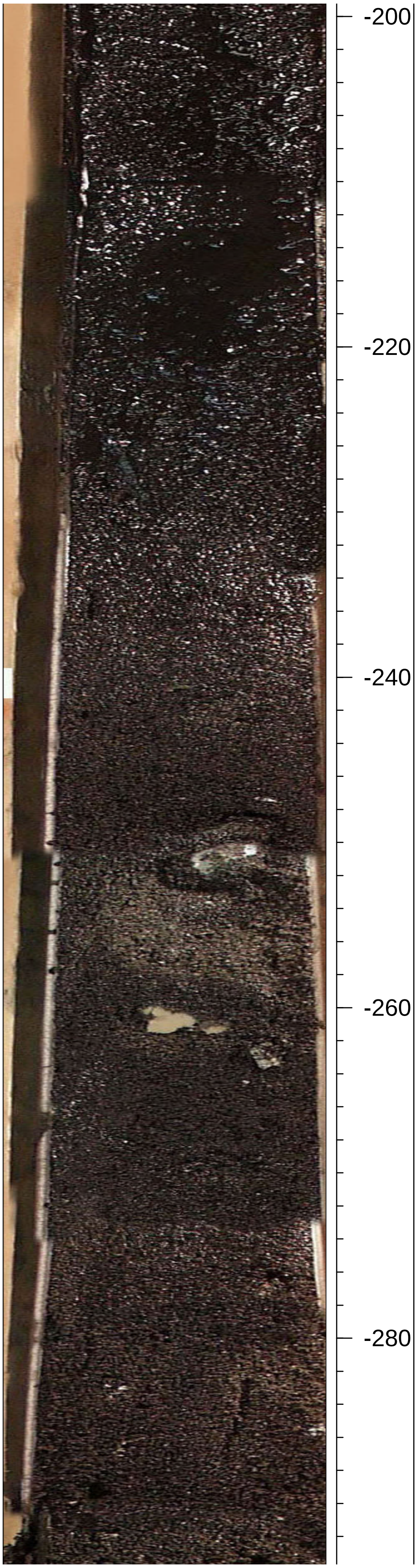
Core: **M5-4**

Survey: One-Year Monitoring

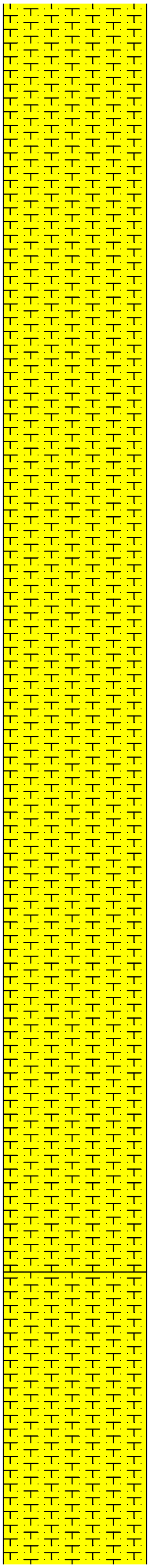
Total Core Length: **497 cm**

Latitude: 42.388

Longitude: -71.062



Core Photo	Depth (cm)	Major Sample		Sub Sample		Lithology
				265-275	grain size	
		276-320	black and tan, moist, hard silty SAND			
				282-295	shell fragments	



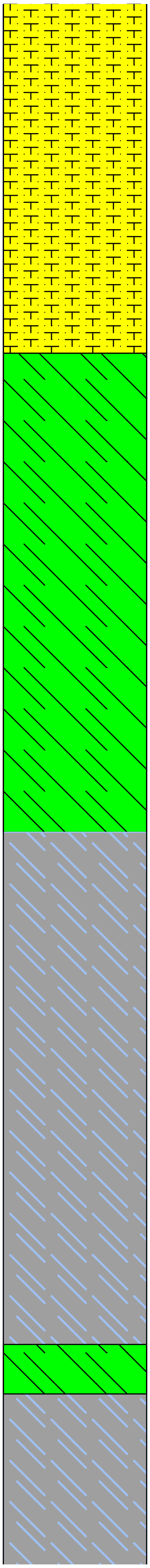
Boston Harbor CAD Cells

Core: M5-4

Survey: One-Year Monitoring

Total Core Length: 497 cm

Latitude: 42.388
Longitude: -71.062



Depth (cm)	Major Sample		Sub Sample	
-300				
			310-320	grain size
-320	320-349	black, moist, firm-hard silty CLAY w/ flecks of BBC		
-340				
	349-407	BBC		
-360				
-380		black, moist, firm-hard silty CLAY	380-383	

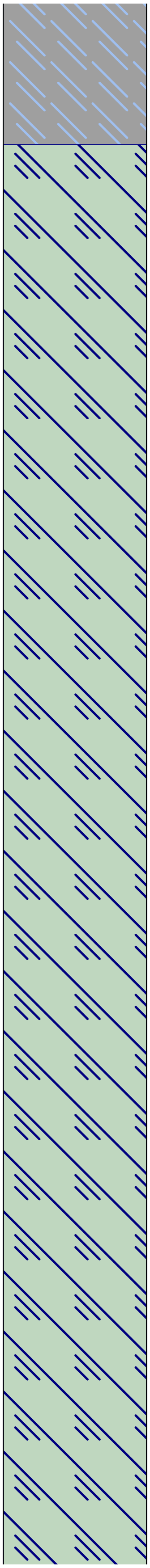
Core: M5-4

Survey: One-Year Monitoring

Total Core Length: 497 cm

Latitude: 42.388
Longitude: -71.062

Core Photo	Depth (cm)	Major Sample	Sub Sample	Lithology
	407-497	mottled: black, moist, firm-hard silty CLAY and BBC		



Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/2/2001
Lab Technician(s):	Walter, Montgomergy, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M5-4
Data_Type	core description
Total_core_length_cm	497
Cap Material	178-320cm slightly mixed (142cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	497				total core length, petroleum odor	
		0	106		core section 5	
0	11				black, wet, very soft silty CLAY	
11	100				black, wet-moist, soft silty CLAY and SAND and sponge-like texture	
		85	95	M5-4-A		grain size
100	178				black, moist, soft-firm silty CLAY and SAND and sponge-like texture	
		106	195		core section 4	
		145	155	M5-4-B		grain size
		185	195	M5-4-C		grain size
178	276				black, moist, firm-hard silty SAND	
		195	295		core section 3	
		282	295		shell fragments	
		265	275	M5-4-D		grain size
		295	395		core section 2	
276	320				black and tan, moist, hard silty SAND	
		310	320	M5-4-E		grain size
320	349				black, moist, firm-hard silty CLAY w/ flecks of BBC	
349	407				BBC	
		380	383		black, moist, firm-hard silty CLAY	
		395	497		core section 1	
407	497				mottled: black, moist, firm-hard silty CLAY and BBC	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/2/2001

Lab Technician(s): Walter, Montgomergy, Shufeldt

Site_Name Boston Harbor CAD Cells

Survey_name one-year monitoring

Replicate_id M5-5

Data_Type core description

Total_core_length_cm 545

Ccap Material 215-463cm (248cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	545				total core length, petroleum odor	
		0	68		core section 6	
0	16				black, wet-moist, very soft silty CLAY	
16	130				black, moist, soft sandy silty CLAY w/ sponge-like texture	
		110	120	M5-5-A		grain size
		68	155		core section 5	
130	215				black, moist, soft-firm, silty CLAY w/ SAND and sponge-like texture	
		180	190	M5-5-B		grain size
		220	230	M5-5-C		grain size
		155	255		core section 4	
215	317				black, moist, firm-hard, silty SAND	
		255	355		core section 3	
317	463				black, moist, hard silty SAND	
		330	340	M5-5-D		grain size
		440	450	M5-5-E		grain size
		355	445		core section 2	
		445	545		core section 1	
463	545				black, moist, firm sandy silty CLAY w/ BBC flecks and nodules	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions
Lab Analysis Date(s): 8/3/2001
Lab Technician(s): Montgomery, Shufeldt, Seidel

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M12-1
Data_Type	core description
Total_core_length_cm	427
Cap material	289-427cm mixed (138cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	427				total core length, petroleum/organic odor	
		0	124		core section 4	
		24	39	M12-1A		Atterberg limits
		29	29	M12-1A		bulk density, shear strength
0	46				very dark greenish gray to black, wet-moist, soft, sitly CLAY	
		74	89	M12-1B		Atterberg limits
		79	79	M12-1B		bulk density, shear strength
46	99				dark gray to black, moist, soft-firm, silty sandy CLAY	
		164	179	M12-1C		Atterberg limits
		169	169	M12-1C		bulk density, shear strength
99	209				very dark gray to black, moist, soft-firm, silty CLAY	
		124	224		core section 3	
209	228				very dark gray to black, moist, soft-firm, silty sandy CLAY	
		224	327		core section 2	
		234	249	M12-1D		Atterberg limits
		239	239	M12-1D		bulk density, shear strength
228	283				very dark gray to black, moist, soft-firm, silty CLAY	
		269	284	M12-1E		Atterberg limits
		274	274	M12-1E		bulk density, shear strength
283	289				very dark greenish gray to black, moist, soft-firm, silty CLAY	
289	308				very dark gray to black, moist, soft-firm, silty CLAY & SAND	
		327	427		core section 1	
		334	349	M12-1F		Atterberg limits
		339	339	M12-1F		bulk density, shear strength
308	365				very dark gray to black, moist, soft-firm, silty sandy CLAY	
365	427				very dark gray to black, moist, firm, silty CLAY & SAND	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/3/2001
Lab Technician(s):	Montgomery, Shufeldt, Seidel
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M12-2
Data_Type	core description
Total_core_length_cm	508
Cap material	371-508cm mixed (137cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	508				total core length, petroleum/organic odor	
		0	107		core section 5	
0	31				very dark gray to black, wet, very soft, silty sandy CLAY	
		55	70	M12-2-A		Atterberg limits
		60	60	M12-2-A		bulk density, shear strength
31	77				very dark gray to black, moist, soft, silty CLAY, sponge-like texture	
77	206				very dark gray to black, moist, soft-firm, silty CLAY, sponge-like texture	
		107	208		core section 4	
		170	185	M12-2-B		Atterberg limits
		175	175	M12-2-B		bulk density, shear strength
206	215				very dark gray to black, moist, soft-firm, silty sandy CLAY, sponge-like texture	
		208	309		core section 3	
215	371				very dark gray to black, moist, soft-firm, silty CLAY, sponge-like texture	
		230	245	M12-2-C		Atterberg limits
		235	235	M12-2-C		bulk density, shear strength
		309	408		core section 2	
		320	335	M12-2-D		Atterberg limits
		325	325	M12-2-D		bulk density, shear strength
		350	365	M12-2-E		Atterberg limits
		355	355	M12-2-E		bulk density, shear strength
371	508				very dark gray to black, moist, firm, silty CLAY and SAND	
		408	508		core section 1	
		420	435	M12-2-F		Atterberg limits
		425	425	M12-2-F		bulk density, shear strength

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

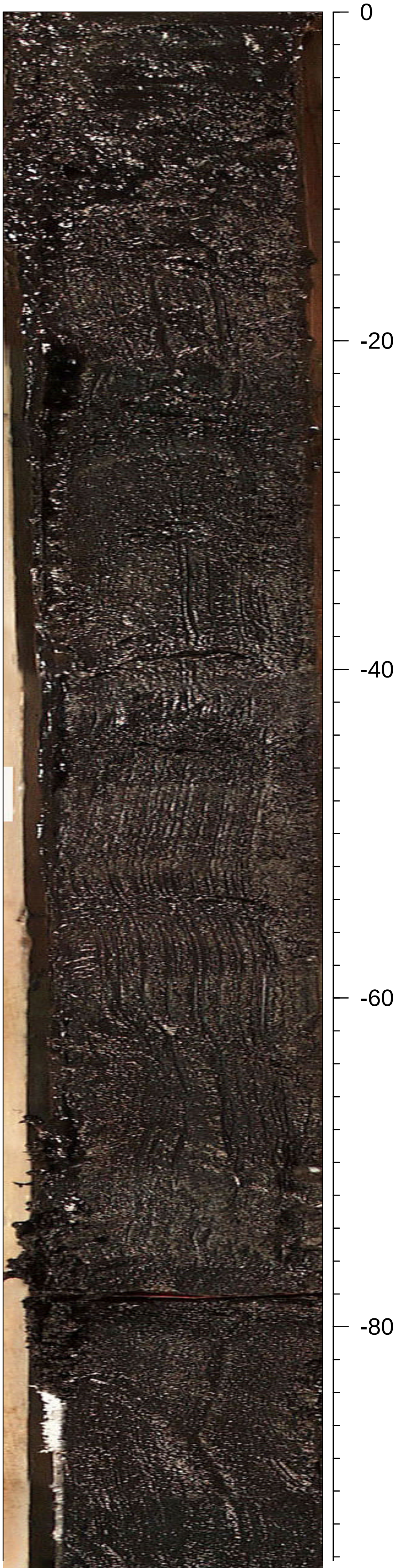
Boston Harbor CAD Cells

Core: **M12-3**
Survey: One-Year Monitoring

Total Core Length: 473 cm

Latitude: 42.385
Longitude: -71.058

Core Photo



Major Sample		**Lithology**
0-21	very dark gray to black, wet, very soft-soft, silty CLAY w/ sand	▨
21-60	very dark gray to black, wet-moist, soft, silty CLAY w/ sand	▨
60-124	very dark gray to black, moist, soft, silty CLAY	▨

Sub Sample	
0-82	core section 5
48-63	Atterberg limits
53-53	bulk density, shear strength
82-169	core section 4

Core: M12-3
Survey: One-Year Monitoring

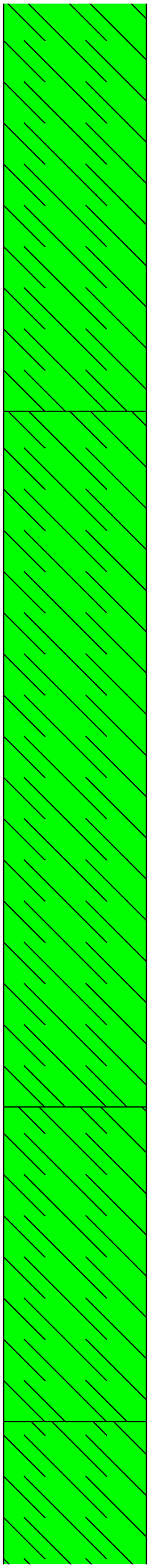
Total Core Length: 473 cm

Latitude: 42.385
Longitude: -71.058

Core Photo	Depth (cm)	Major Sample		Sub Sample		Lithology

Major Sample	
124-166	very dark gray to black, moist, soft-firm, silty CLAY
166-185	very dark gray to black, moist, soft-firm, silty sandy CLAY
185-345	very dark gray to black, moist, soft-firm, silty CLAY, sponge-like texture

Sub Sample	
	Atterberg limits
103-103	bulk density, shear strength
112-118	wood chips
128-143	Atterberg limits
133-133	bulk density, shear strength
169-270	core section 3
183-198	Atterberg limits
188-188	bulk density, shear strength



Core: M12-3

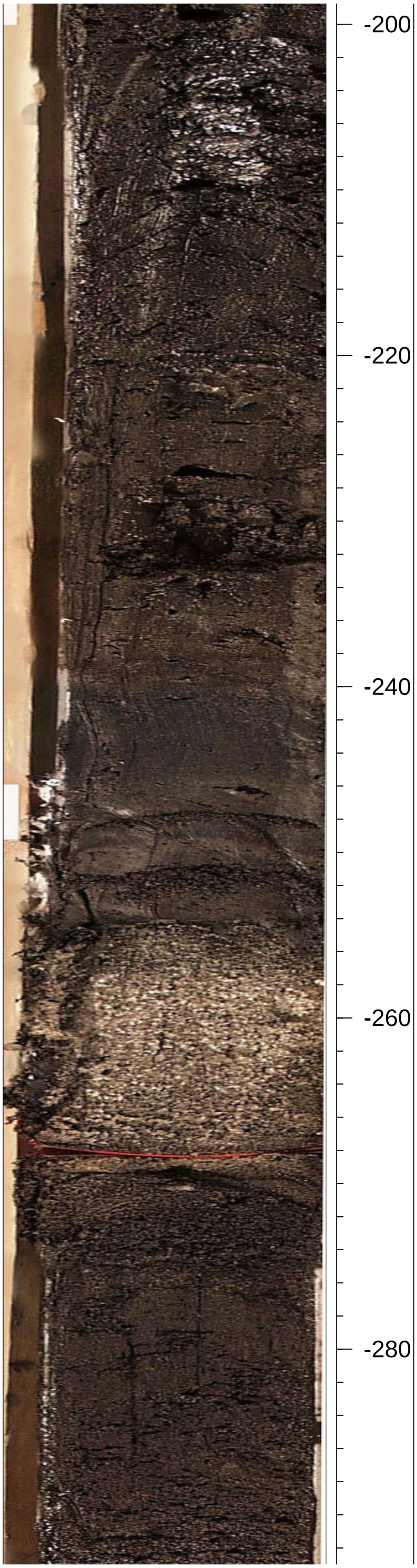
Survey: One-Year Monitoring

Total Core Length: 473 cm

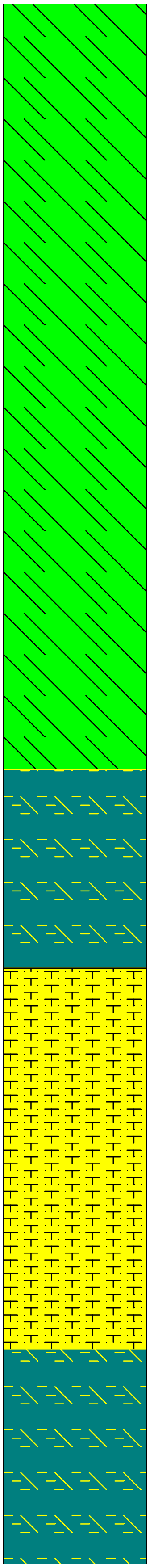
Latitude: 42.385

Longitude: -71.058

Core Photo	Depth (cm)	Major Sample		Sub Sample	Lithology



Depth (cm)	Major Sample	Sub Sample	
245-257	very dark greenish gray to black, moist, soft-firm, silty CLAY and SAND		
257-280	dark gray to very dark gray, moist, firm-hard, silty SAND	270-371	core section 2
280-303	very dark gray to black, moist, soft-firm, silty CLAY and SAND		



Boston Harbor CAD Cells

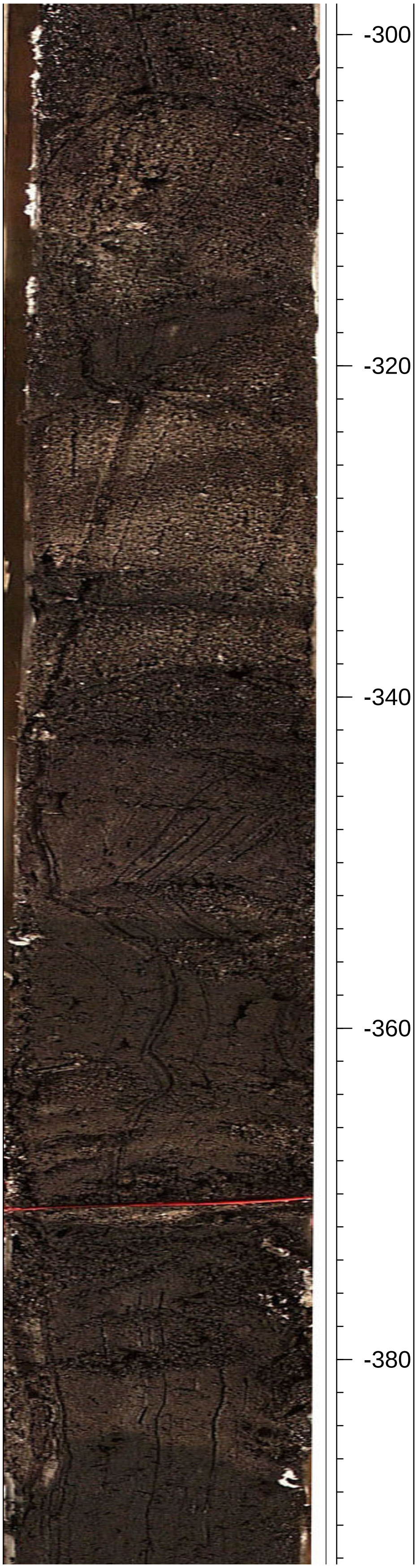
Core: M12-3

Survey: One-Year Monitoring

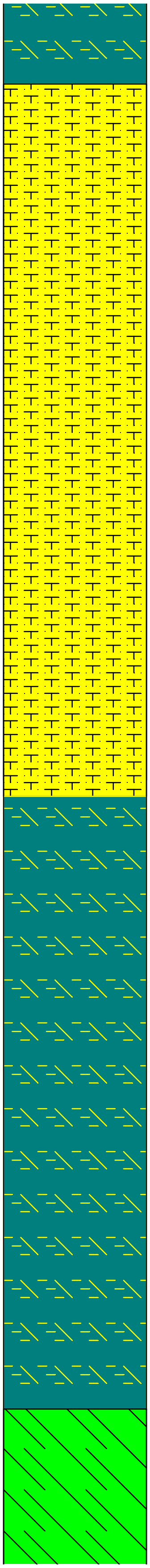
Total Core Length: 473 cm

Latitude: 42.385
Longitude: -71.058

Core Photo | **Depth** (cm) | **Major Sample** | **Sub Sample** | **Lithology**



Major Sample		Sub Sample	
303-346	dark gray to very dark gray, moist, firm-hard, silty SAND w/ shell fragments		
346-383	dark gray to black, moist, firm, silty CLAY and SAND	371-473	core section 1
383-460	very dark gray to black, moist, firm, silty CLAY		



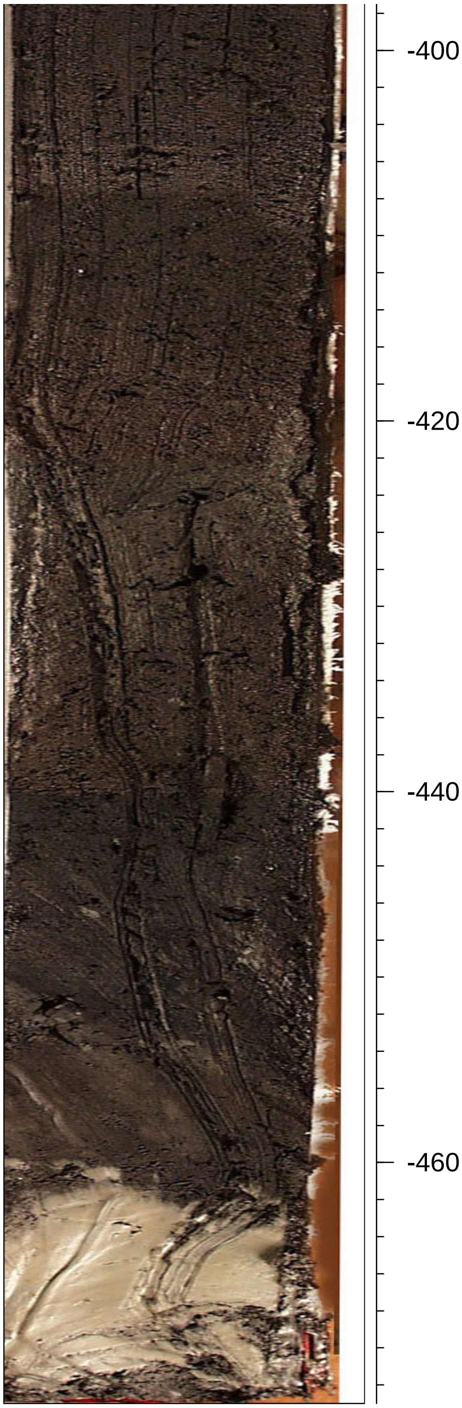
Boston Harbor CAD Cells

Core: **M12-3**
Survey: One-Year Monitoring

Total Core Length: 473 cm

Latitude: 42.385
Longitude: -71.058

Core Photo



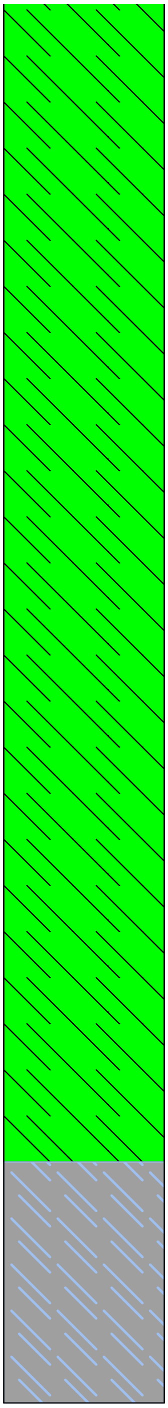
Major Sample

460-473	BBC

Sub Sample

398-413	Atterberg limits
403-403	bulk density, shear strength
443-458	Atterberg limits
448-448	bulk density, shear strength

Lithology



Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/3/2001
Lab Technician(s): Montgomery, Shufeldt, Seidel

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M12-3
Data_Type core description
Total_core_length_cm 473
Cap material 245-383cm mixed (138cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	473				total core length, petroleum/organic odor	
		0	82		core section 5	
0	21				very dark gray to black, wet, very soft-soft, silty sandy CLAY, w/ sand	
21	60				very dark gray to black, wet-moist, soft, silty sandy CLAY, w/ sand	
		48	63	M12-3-A		Atterberg limits
		53	53	M12-3-A		bulk density, shear strength
60	124				very dark gray to black, moist, soft, silty CLAY	
		82	169		core section 4	
		98	113	M12-3-B		Atterberg limits
		103	103	M12-3-B		bulk density, shear strength
		112	118		wood chips	
124	166				very dark gray to black, moist, soft-firm, silty CLAY	
		128	143	M12-3-C		Atterberg limits
		133	133	M12-3-C		bulk density, shear strength
166	185				very dark gray to black, moist, soft-firm, silty sandy CLAY	
		169	270		core section 3	
		183	198	M12-3-D		Atterberg limits
		188	188	M12-3-D		bulk density, shear strength
185	345				very dark gray to black, moist, soft-firm, silty CLAY, sponge-like texture	
245	257				very dark greenish gray to black, moist, soft-firm, silty CLAY and SAND	
257	280				dark gray to very dark gray, moist, firm-hard, silty SAND	
		270	371		core section 2	
280	303				very dark gray to black, moist, soft-firm, silty CLAY and SAND	
303	346				dark gray to very dark gray, moist, firm-hard, silty SAND (w/ shell fragments)	
346	383				dark gray to black, moist, firm, silty CLAY and SAND	
		398	413	M12-3E		Atterberg limits
		403	403	M12-3E		bulk density, shear strength
383	460				very dark gray to black, moist, firm, silty CLAY	
460	473				BBC	
		443	458	M12-3F		Atterberg limits
		448	448	M12-3F		bulk density, shear strength
		371	473		core section 1	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/3/2001

Lab Technician(s): Montgomery, Shufeldt, Seidel

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M12-4
Data_Type	core description
Total_core_length_cm	470
Cap material	60-470 heavily mixed (106 cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	470				total core length, petroleum/organic odor	
		0	86		core section 5	
0	60				very dark gray to black, wet, very soft-soft, silty CLAY and SAND	
		58	68	M12-4-A		grain size
60	76				very dark gray to black, moist, soft, silty CLAY and SAND	
76	87				very dark gray to black, moist, soft, silty CLAY	
		84	165		core section 4	
87	93				very dark gray to black, moist, soft-firm, silty CLAY and SAND	
93	216				very dark gray to black, moist, soft-firm, silty CLAY	
		165	267		core section 3	
216	278				very dark gray to black, moist, soft-firm, silty CLAY, sponge-like texture	
278	287				very dark gray to black, moist, soft-firm, silty CLAY and SAND	
		267	369		core section 2	
		278	288	M12-4-B		grain size
287	305				very dark gray to black, moist, soft-firm, silty CLAY	
305	311				very dark gray to black, moist, soft-firm, silty CLAY and SAND	
311	347				very dark gray to black, moist, soft-firm, silty CLAY and SAND	
		353	363	M12-4-C		grain size
		369	470		core section 1	
		388	398	M12-4-D		grain size
347	470				very dark gray to black, moist, firm, silty CLAY and SAND	
		428	438	M12-4-E		grain size
		448	470		BBC nodules	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/3/2001

Lab Technician(s): Montgomery, Shufeldt, Seidel

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M12-5
Data_Type core description
Total_core_length_cm 503
Cap material 170-503cm mixed (223cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	503				total core length	
		0	107		core section 5	
					foam plug	
0	37				very dark gray to black, wet, soft, silty CLAY	
37	99				very dark gray to black, moist, soft, silty CLAY	
99	170				very dark gray to black, moist, soft-firm, silty CLAY, sponge-like texture	
		107	207		core section 4	
		134	144	M12-5-A		grain size
		194	204	M12-5-B		grain size
170	286				very dark gray to black, moist, soft-firm, silty sandy CLAY	
		207	308		core section 3	
286	296				dark greenish gray to black, moist, soft-firm, silty CLAY	
296	308				very dark gray to black, moist, soft-firm, silty CLAY w/ Sand	
		308	403		core section 2	
308	503				very dark greenish gray to black, moist, firm, silty CLAY and SAND	
		349	359	M12-5-C		grain size
		384	394	M12-5-D		grain size
		403	503		core section 1	
		454	464	M12-5-E		grain size

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 7/31/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells

Survey_name one-year monitoring

Replicate_id M2-1

Data_Type core description

Total_core_length_cm 459.5

Cap material 17-103cm (86cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	459.5				total core length, organic/petroleum odor	
		0	59		core section 5	
0	10				black to greenish black, petroleum odor, wet, very soft silty CLAY	
10	17				black to greenish black, petroleum odor, wet-moist, soft silty CLAY	
17	103				tan w/ some greenish black, moist, firm-hard SAND	
		59	159.5		core section 4	
		105	120	M2-1-A		Atterberg limits
		130	130	M2-1-A		bulk density, shear strength
		140	155	M2-1-B		Atterberg limits
		150	150	M2-1-B		bulk density, shear strength
		159.5	259.5		core section 3	
103	300				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture (gas pockets?) w/ gravel	
		170	185	M2-1-C		Atterberg limits
		180	180	M2-1-C		bulk density, shear strength
		235	250	M2-1-D		Atterberg limits
		240	240	M2-1-D		bulk density, shear strength
		275	290	M2-1-E		Atterberg limits
		280	280	M2-1-E		bulk density, shear strength
		280	282		pocket of oil sheen (2cm wide)	
		259.5	359.5		core section 2	
300	382				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture (gas pockets?) and flecks of BBC and gravel	
		330	345	M2-1-F		Atterberg limits
		335	335	M2-1-F		bulk density, shear strength
382	393				BBC	
393	459.5				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture (gas pockets?), gravel and BBC lenses	
		411	414		BBC lens	
		443	449		air pocket w/ brown, moist, firm, CLAY and sand/ gravel	
		449	459.5		BBC lens	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	7/31/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M2-2
Data_Type	core description
Total_core_length_cm	451
Cap material	15-109cm (94cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	451				total core length, petroleum odor	
		0	66		core section 5	
0	15				greenish black, wet, very soft silty CLAY	
15	33				greenish black, moist, firm-hard SAND w/ shells	
		20	30	M2-2-A		grain size
		40	50	M2-2-B		grain size
		60	70	M2-2-C		grain size
		80	90	M2-2-D		grain size
		100	110	M2-2-E		grain size
33	109				light yellowish brown w/ gray, moist, firm-hard SAND	
		79	80		dark gray, moist, firm-hard SAND	
		66	151		core section 4	
109	165				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture (gas?)	
		110	120	M2-2-F		grain size (flex sample below CAP)
		151	251		core section 3	
165	251				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture (gas?) and flecks of BBC w/ gravel	
		221	244		BBC	
		251	351		core section 2	
251	298				black, petroleum odor, moist, firm silty CLAY w/ gravel and BBC nodules	
298	332				BBC	
		320	322		lens of black, moist, firm silty CLAY	
332	369				black, petroleum odor, moist, firm silty CLAY w/ shells/gravel and BBC nodules	
		351	451		core section 1	
369	393				BBC	
393	430				black, petroleum odor, moist, firm silty CLAY w/ shells/gravel and BBC nodules	
430	443				BBC	
443	451				black, petroleum odor, moist, firm silty CLAY w/ shells/gravel and BBC nodules	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions
Lab Analysis Date(s): 7/31/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M2-3
Data_Type core description
Total_core_length_cm 359
Cap material 8.5-67cm (58cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	359				total core length, petroleum odor	
		0	63		core section 4	
0	8.5				black, petroleum odor, wet, very soft silty CLAY	
8.5	67				light yellowish brown, moist, firm-hard SAND w/ shell fragments	
		34	42		banding, black, petroleum odor, moist, firm silty CLAY	
		63	165		core section 3	
67	340				black, petroleum odor, moist, soft silty CLAY w/ sponge-like texture and flecks of BBC	
		70	85	M2-3-A		Atterberg limits
		80	80	M2-3-A		bulk density, shear strength
		110	120	M2-3-B		Atterberg limits
		115	115	M2-3-B		bulk density, shear strength
		140	155	M2-3-C		Atterberg limits
		145	145	M2-3-C		bulk density, shear strength
		165	265		core section 2	
		175	190	M2-3-D		Atterberg limits
		185	185	M2-3-D		bulk density, shear strength
		202	205		BBC nodule	
		230	245	M2-3-E		Atterberg limits
		235	235	M2-3-E		bulk density, shear strength
		265	359		core section 1	
		277	282		BBC nodule	
		310	325	M2-3-F		Atterberg limits
		315	315	M2-3-F		bulk density, shear strength
340	359				BBC	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 7/31/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells

Survey_name one-year monitoring

Replicate_id M2-4

Data_Type core description

Total_core_length_cm 370

Cap material 13-105cm (92cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	370				total core length, petroleum odor	
		0	69		core section 4	
0	13				black, organic odor, wet, very soft silty CLAY	
13	105				light yellowish brown and gray, moist, firm-hard SAND w/shell fragments	
		69	170		core section 3	
		110	125	M2-4-A		Atterberg limits
		115	115	M2-4-A		bulk density, shear strength
		145	160	M2-4-B		Atterberg limits
		150	150	M2-4-B		bulk density, shear strength
105	289				black, petroleum odor, moist, soft silty CLAY w/ sponge-like texture and gravel and flecks of BBC	
		170	270		core section 2	
		185	200	M2-4-C		Atterberg limits
		190	190	M2-4-C		bulk density, shear strength
		230	245	M2-4-D		Atterberg limits
		235	235	M2-4-D		bulk density, shear strength
		270	370		core section 1	
289	370				BBC	
		255	270	M2-4-E		Atterberg limits
		260	260	M2-4-E		bulk density, shear strength
		275	290	M2-4-F		Atterberg limits
		280	280	M2-4-F		bulk density, shear strength
		318	324		black, petroleum odor, moist, soft-firm silty CLAY w/ shell fragments/sand	
		342	347		black, petroleum odor, moist, soft-firm silty CLAY w/ shell fragments/sand	
		360	366		black, petroleum odor, moist, soft-firm silty CLAY w/ shell fragments/sand	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Boston Harbor CAD Cells

Core: **M2-5**
Survey: One-Year Monitoring

Total Core Length: 481.5 cm

Latitude: 42.388
Longitude: -71.066

Core Photo

Depth (cm)	Major Sample		Sub Sample		Lithology
0	0-20	black, petroleum odor, wet, very soft silty CLAY	0-81	core section 5	🟩
-20	20-143	light yellowish brown and gray, moist, firm-hard SAND w/shell fragments	20-30	grain size	⁘
-40			40-50	grain size	
-60			60-70	grain size	
-80			81-182	core section 4	
			85-95	grain size	

Boston Harbor CAD Cells

Core: **M2-5**

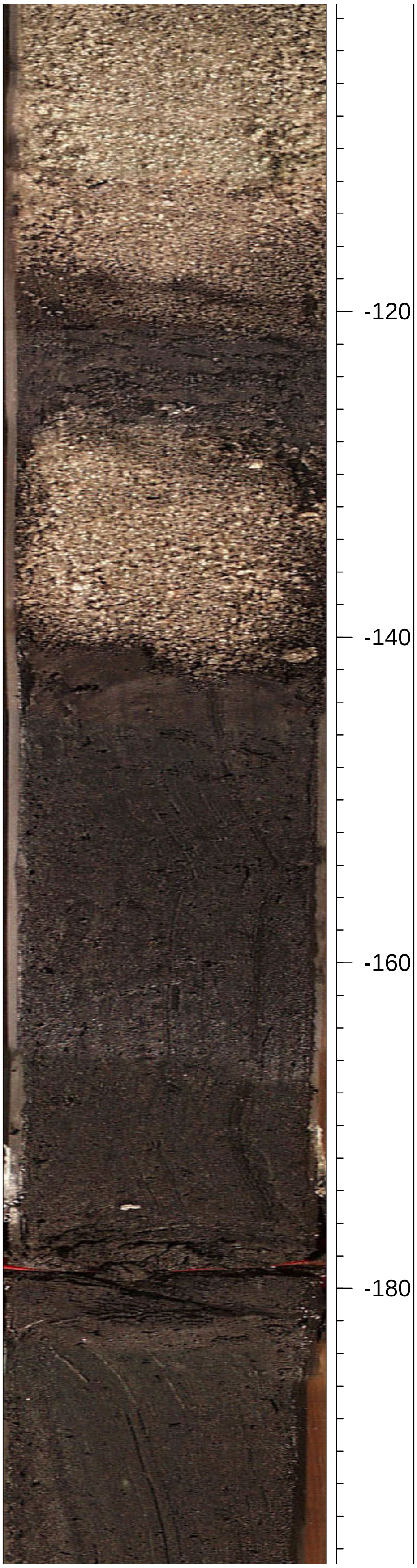
Survey: One-Year Monitoring

Total Core Length: 481.5 cm

Latitude: 42.388

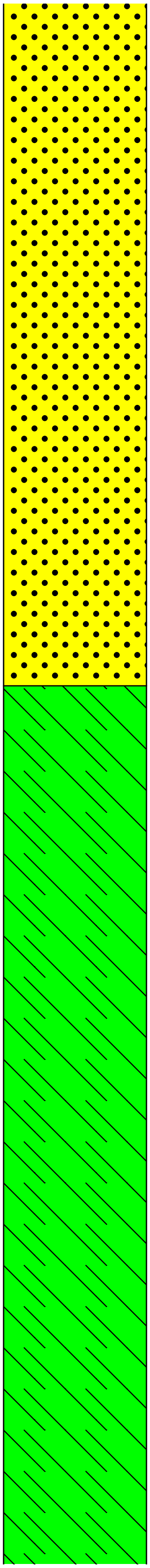
Longitude: -71.066

Core Photo **Depth** (cm)



Major Sample		Sub Sample	
		124-128	lensed; black, moist, soft-firm silty CLAY
		130-140	grain size
143-214	black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture		
		182-282	core section 3

Lithology



Core: **M2-5**

Survey: One-Year Monitoring

Total Core Length: 481.5 cm

Latitude: 42.388

Longitude: -71.066

Core Photo	Depth (cm)	Major Sample		Sub Sample		Lithology
	-220 -240 -260 -280	214-349	black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture and BBC flecks and gravel	282-382	core section 2	

Core: M2-5

Survey: One-Year Monitoring

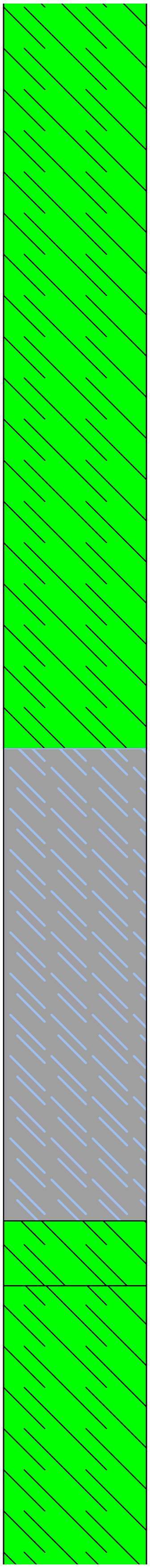
Total Core Length: 481.5 cm

Latitude: 42.388

Longitude: -71.066

Core Photo | **Depth** (cm) | **Major Sample** | **Sub Sample** | **Lithology**

Major Sample		Sub Sample	
349-378	BBC		
378-382	black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture, BBC flecks and gravel		
382-454	black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture and shell fragments	382-481.5	core section 1



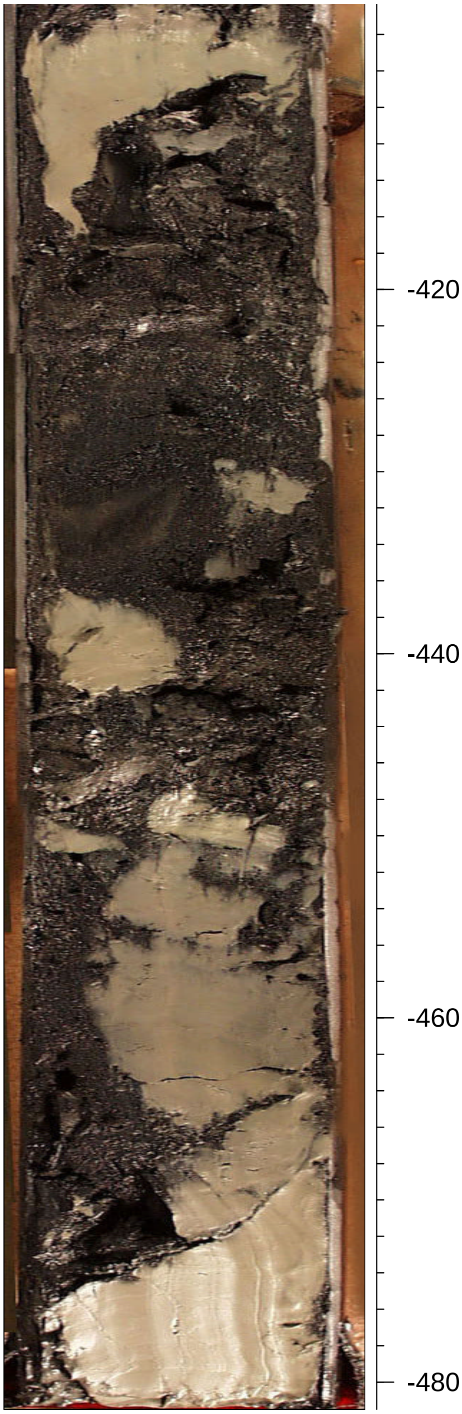
Core: **M2-5**

Survey: One-Year Monitoring

Total Core Length: 481.5 cm

Latitude: 42.388

Longitude: -71.066



Major Sample		Sub Sample		Lithology
		406-411	lensed BBC	🟩
		437-439	lensed BBC	🟩
454-481.5	BBC			▨
		462-472	lensed; black, petroleum odor, moist, soft-firm silty CLAY w/ sand and gravel	▨

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	7/31/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M2-5
Data_Type	core description
Total_core_length_cm	481.5
Cap material	20-143cm (123cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	481.5				total core length, petroleum odor	
		0	81		core section 5	
0	20				black, petroleum odor, wet, very soft silty CLAY	
20	143				light yellowish brown and gray, moist, firm-hard SAND w/ shell fragments	
		20	30	M2-5-A		grain size
		40	50	M2-5-B		grain size
		60	70	M2-5-C		grain size
		85	95	M2-5-D		grain size
		130	140	M2-5-E		grain size
		124	128		lensed, black, moist, soft-firm silty CLAY	
		81	182		core section 4	
143	214				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture	
		182	282		core section 3	
214	349				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture and BBC flecks and gravel	
		282	382		core section 2	
349	378				BBC	
378	382				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture and BBC flecks and gravel	
		382	481.5		core section 1	
382	454				black, petroleum odor, moist, soft-firm silty CLAY w/ sponge-like texture and shell fragments	
		406	411		lensed BBC	
		437	439		lensed BBC	
454	481.5				BBC	
		462	472		lensed, black, petroleum odor, moist, soft-firm silty CLAY w/ sand and gravel	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 7/30/2001
Lab Technician(s): Walter,Pinckard, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	SC-1
Data_Type	core description
Total_core_length_cm	407
Cap material	35.5-290.5cm banded (97 cm Sand, 158 cm silt/clay)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	407				organic, petroleum odor	
		0	107		core section 4	
	0				foam plug	
0	11.5				greenish black, wet-moist, very soft, silty CLAY	
11.5	35.5				greenish black, moist, soft, silty CLAY	
35.5	50.5				greenish black and dark yellowish brown, moist, firm silty SAND and coarse SAND	
		35.5	45.5	SC-1-A		grain size
50.5	58.5				greenish black, moist, soft, silty CLAY	
58.5	79.5				greenish black w/ dark greenish gray, moist, firm shelly coarse SAND	
		65.5	75.5	SC-1-B		grain size
79.5	90.5				banded greenish gray and black; moist, firm sandy SILT w/ silty CLAY (bands)	
90.5	107				greenish black, moist, firm silty CLAY	
		107	207.5		core section 3	
107	119.5				greeenish black, moist, firm silty CLAY	
119.5	135.5				greenish black, moist, soft shelly, silty CLAY and SAND	
135.5	148.5				greenish black, moist, firm SAND w/ coarse sand and silty CLAY	
		135.5	145.5	SC-1-C		grain size
		134.5	134.5		shell	
148.5	207.5				greenish black, moist, soft silty CLAY	
		207.5	307		core section 2	
207.5	245.5				greenish black, moist, soft, silty CLAY	
		250.5	260.5	SC-1-D		grain size
245.5	265.5				banded, dark greenish gray and greenish gray, moist, firm silty clayey SAND	
265.5	290.5				greenish gray and brown, moist, firm, coarse SAND and shells and pebble	
		275.5	285.5	SC-1-E		grain size
290.5	307				greenish black, moist, soft silty CLAY	
		307	407		core section 1	
307	407				greenish black, moist, soft, silty CLAY	
		373.5	380.5		stick, plant fragments	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	7/30/2001
Lab Technician(s):	Walter,Pinckard, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	SC-2
Data_Type	core description
Total_core_length_cm	398
Cap Material	16-254cm intermixed/banded (83cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	398					
		0	96		core section 4	
0	16				grayish black w/ olive streaking, moist, very soft silty CLAY	
16	30				greenish black, moist, firm coarse SAND w/ shells	
30	43				greenish black, moist, soft sandy silty CLAY	
43	61				greenish black, moist, firm silty clayey SAND	
		82	82	SC-2-A		bulk density, shear strength
		77	92	SC-2-A		Atterberg limits
61	96				greenish black, moist, soft silty CLAY	
		96	197		core section 3	
96	99				air void	
99	103				greenish black, moist, very soft silty CLAY	
103	133				greenish black, moist, soft silty CLAY w/ SAND (coarse)	
		120	123		rock	
133	169				greenish black, moist, firm silty CLAY w/ pockets of greenish black, moist, firm silty coarse SAND	
169	173				greenish black, moist, firm coarse SAND and silty CLAY	
173	188				greenish black to black, moist, firm, silty CLAY w/ pocket of sandy silty CLAY	
188	197				greenish black and dark greenish gray, moist, firm silty CLAY and SAND	
		197	298		core section 2	
197	204				black, moist, firm sandy clayey SILT w/ shells	
204	236				black, moist, firm silty CLAY	
		217	217	SC-2-B		bulk density, shear strength
		212	227	SC-2-B		Atterberg limits
236	254				black and olive, moist, firm SAND w/ shells	
		272	272	SC-2-C		bulk density, shear strength
		262	277	SC-2-C		Atterberg limits
254	298				black, moist, soft silty CLAY lensed w/ CLAY	
		298	398		core section 1	
		317	317	SC-2-D		bulk density, shear strength
		307	322	SC-2-D		Atterberg limits
298	334				black, moist, firm silty CLAY	
		313	316		mussel shell	
334	343				greenish black, moist, firm sandy silty CLAY w/ shell fragments	
		357	357	SC-2-E		bulk density, shear strength
		350	365	SC-2-E		Atterberg limits
343	372				greenish black, moist, firm, silty CLAY	
		343	344		plastic	
		350	354		plant fragments	
		371	374		mussel shell	
372	388				greenish black and dark greenish gray, moist, firm sandy SILT	
		392	392	SC-2-F		bulk density, shear strength
		387	398	SC-2-F		Atterberg limits
388	395				greenish black to black, moist, firm, silty CLAY	
395	398				olive brown moist, firm silty CLAY	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Boston Harbor CAD Cells

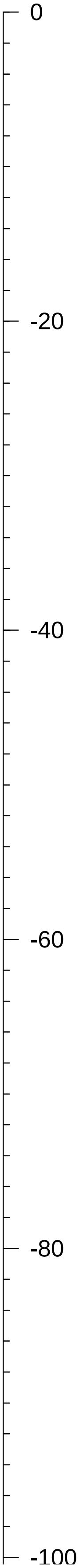
Core: **SC-3**

Survey: One-Year Monitoring

Total Core Length: 397.5 cm

Latitude: 42.386
Longitude: -71.056

Core Photo | **Depth** (cm) | **Major Sample** | **Sub Sample** | **Lithology**

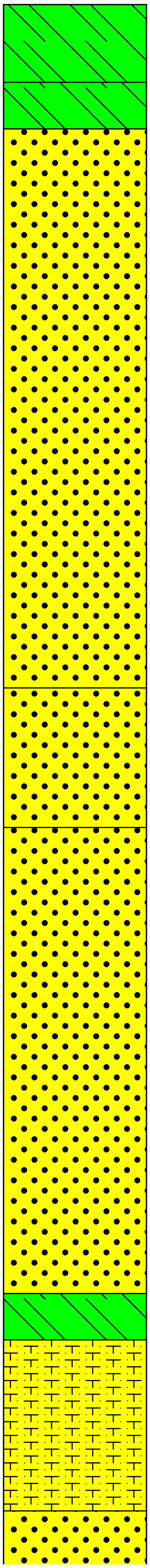


Major Sample

0-5	greenish black, wet, very soft silty CLAY
5-8	black, moist, very soft, sandy silty CLAY w/ pockets of greenish gray CLAY
8-44	gray, moist, firm coarse SAND w/ shells and pebbles
44-53	dark gray, moist, firm SAND w/ shells
53-83	dark grayish brown, moist, hard SAND
83-86	black, moist, firm silty CLAY
86-97	dark gray, moist, firm silty SAND
97-105.5	very dark gray, moist, firm SAND

Sub Sample

0-97	core section 4
7-17	grain size
47-57	grain size
67-77	grain size
87-97	grain size
97-197.5	core section 3
97-107	grain size



Core: **SC-3**
Survey: One-Year Monitoring

Total Core Length: 397.5 cm

Latitude:	42.386
Longitude:	-71.056

Core Photo

Major Sample		Sub Sample		Lithology
105.5- 197.5	black, moist, soft silty CLAY			▨
197.5- 298.5	black, moist, soft silty CLAY w/ BBC nodules	197.5- 298.5	core section 2	▨

Boston Harbor CAD Cells

Core: **SC-3**
Survey: One-Year Monitoring

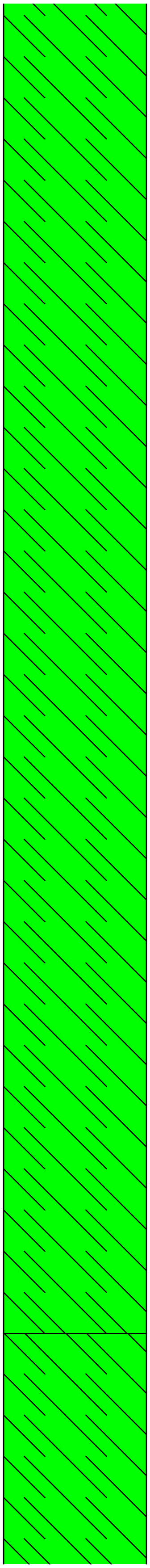
Total Core Length: 397.5 cm

Latitude: 42.386
Longitude: -71.056

Core Photo

Depth (cm)	Major Sample		Sub Sample	
			232-236	plant material
			272-274	shell
	297.5-377	black, moist, soft silty CLAY w/ BBC nodules	297.5-397.5	core section 1

Lithology



Core: **SC-3**

Survey: One-Year Monitoring

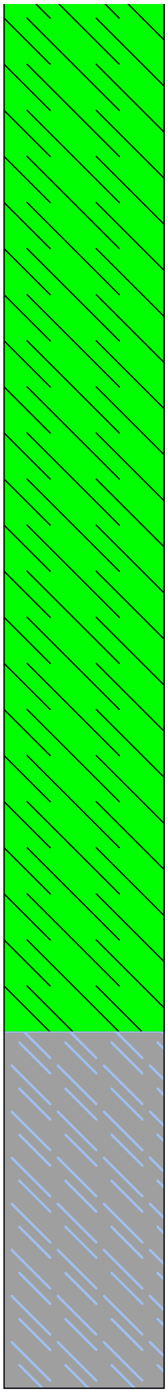
Total Core Length: 397.5 cm

Latitude: 42.386

Longitude: -71.056

Core Photo | **Depth** (cm) | **Major Sample** | **Sub Sample** | **Lithology**

Major Sample		Sub Sample	
		319-323	BBC pocket
		321-332	BBC pocket
		347-354	BBC pocket
		354-363	BBC pocket
		363-366	air pocket w/ very dark grayish brown, moist, soft silty CLAY
377-397.5	moist, firm-hard BBC		



Lab Sheet - Core Descriptions

Lab Analysis Date(s): 7/30/2001

Lab Technician(s): Walter,Pinckard, Shufeldt

Site_Name Boston Harbor CAD Cells

Survey_name one-year monitoring

Replicate_id SC-3

Data_Type core description

Total_core_length_cm 397.5cm

Cap Material 5-105.5cm w/ clay bands (94.5cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	397.5				organic and petroleum odor below sand	
		0	97		core section 4	
0	5				greenish black, wet, very soft silty CLAY	
5	8				black, moist, very soft, sandy silty CLAY w/ pockets of greenish gray CLAY	
		7	17	SC-3-A		grain size
8	44				gray to gray, moist, firm coarse SAND w/ shells and pebbles	
44	53				dark gray, moist, firm SAND w/ shells	
		47	57	SC-3-B		grain size
53	83				dark grayish brown, moist, hard SAND	
		67	77	SC-3-C		grain size
83	86				black, moist, firm silty CLAY	
86	97				dark gray, moist, firm silty SAND	
		87	97	SC-3-D		grain size
		97	197.5		core section 3	
97	105.5				very dark gray, moist, firm SAND	
		97	107	SC-3-E		grain size
105.5	197.5				black, moist, soft silty CLAY	
		197.5	298.5		core section 2	
197.5	298.5				black, moist, soft silty CLAY w/ BBC nodules	
		232	236		plant material	
		272	274		shell	
		297.5	397.5		core section 1	
297.5	377				black, moist, soft silty CLAY w/ BBC nodules	
		315	317		plant material	
		319	323		BBC pocket	
		321	332		BBC pocket	
		347	354		BBC pocket	
		354	363		BBC pocket	
		363	366		air pocket w/ very dark grayish brown, moist, soft silty CLAY	
377	397.5				moist, firm-hard BBC	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 7/30/2001

Lab Technician(s): Walter,Pinckard, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	SC-4
Data_Type	core description
Total_core_length_cm	388
Cap Material	7-50cm mixed/banded (38cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	390				petroleum odor, organic	
		0	98.5		core section 4	
0	7				dark greenish gray, moist, soft silty CLAY	
7	23				very dark gray, moist, firm coarse SAND w/ shells and pebbles	
23	26				dark greenish gray, moist, firm-hard SAND	
26	28				black, moist, firm sandy SILT	
28	31				dark greenish gray, moist, firm sandy SILT	
31	50				very dark gray, moist, firm SAND w/ shells	
50	57				very dark gray, moist, firm sandy SILT	
		65	65	SC-4-A		bulk density, shear strength
		60	75	SC-4-A		Atterberg limits
57	98.5				black, moist, very soft silty CLAY w/ BBC nodules	
		98.5	200		core section 3	
98.5	200				black, moist, very soft silty CLAY and mussels	
		119	121		glass	
		124	126		chunks of black, dry, hard silty CLAY	
		155	155	SC-4-B		bulk density, shear strength
		150	165	SC-4-B		Atterberg limits
		162	166		greenish gray, moist, soft silty CLAY and shell	
		167	200		BBC nodules (>1cm big)	
		200	300		core section 2	
200	300				black, moist, very soft silty CLAY lensed w/ black CLAY and BBC nodules	
		215	215	SC-4-C		bulk density, shear strength
		210	225	SC-4-C		Atterberg limits
		230	237		mussel shell	
		262	269		pocket of BBC	
		260	270		shells and glass bottle top	
		280	280	SC-4-D		bulk density, shear strength
		275	290	SC-4-D		Atterberg limits
		300	388		core section 1	
300	338				black, moist, soft silty CLAY	
		313	313	SC-4-E		bulk density, shear strength
		308	323	SC-4-E		Atterberg limits
		313	320		pocket of BBC w/ small nodules	
338	388				black, moist, very soft silty CLAY	
		340	341		plant material	
		363	363	SC-4-F		bulk density, shear strength
		358	373	SC-4-F		Atterberg limits

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 7/31/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	SC-5
Data_Type	core description
Total_core_length_cm	467.5
Cap Material	10-94cm mixed/banded

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	467.5				organic, petroleum odor throughout	
		0	84		core section 5	
0	10				greenish black, sulfur odor, wet, very soft silty CLAY	
10	27				dark greenish black, petroleum odor, moist, soft silty CLAY and SAND	
27	38				dark greenishgray, moist, soft to firm SAND w/ clayey SILT	
38	61				greenish black, petroleum odor, moist, soft silty CLAY	
61	94				greenish-gray to tan, moist, hard SAND w/ shell fragments	
		84	167.5		core section 4	
94	167.5				greenish black, moist, soft-firm silty CLAY	
		100	115	SC-5-A		Atterberg limits
		110	110	SC-5-A		bulk density, shear strength
		153	163		lensed; greenish black, moist, firm-hard SAND	
		167.5	267.5		core section 3	
		175	190	SC-5-B		Atterberg limits
		185	185	SC-5-B		bulk density, shear strength
		235	250	SC-5-C		Atterberg limits
		140	140	SC-5-C		bulk density, shear strength
167.5	267.5				greenish black, petroleum odor, moist, soft silty CLAY	
		267.5	367.5		core section 2	
		290	305	SC-5-D		Atterberg limits
		295	295	SC-5-D		bulk density, shear strength
		350	365	SC-5-E		Atterberg limits
		355	355	SC-5-E		bulk density, shear strength
267.5	367.5				greenish black, petroleum odor, moist, firm silty CLAY w/ scattered mussel shells	
		367.5	467.5		core section 1	
		450	465	SC-5-F		Atterberg limits
		460	460	SC-5-F		bulk density, shear strength
367.5	467.5				greenish black to black, petroleum odor, moist, firm silty CLAY w/ scattered mussel shells and flecks of BBC	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/6/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells

Survey_name one-year monitoring

Replicate_id M811-1

Data_Type core description

Total_core_length_cm 424

Cap Material 89cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	424				total core length, organic/petroleum odor	
		0	124		core section 4	
0	48				gray, moist, hard SAND w/ shells and gravel	
48	89				yellowish brown to tan, moist, hard SAND w/ shells and gravel	
89	151				black, moist, soft-firm silty sandy CLAY w/ shells	
		89	104	M811-1-A		Atterberg limits
		92	92	M811-1-A		bulk density, shear strength
		124	223		core section 3	
		135	150	M811-1-B		Atterberg limits
		140	140	M811-1-B		bulk density, shear strength
		200	215	M811-1-C		Atterberg limits
		205	205	M811-1-C		bulk density, shear strength
151	370				black, moist, soft-firm silty CLAY	
		240	255	M811-1-D		Atterberg limits
		245	245	M811-1-D		bulk density, shear strength
		223	323		core section 2	
		300	315	M811-1-E		Atterberg limits
		305	305	M811-1-E		bulk density, shear strength
		289	289		rock	
		323	424		core section 1	
		340	355	M811-1-F		Atterberg limits
		345	345	M811-1-F		bulk density, shear strength
370	424				BBC	
		394	424		lens of black, firm-hard, silty CLAY	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/6/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M811-2
Data_Type	core description
Total_core_length_cm	602
Cap Material	94cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	602				total core length, organic/petroleum odor	
		0	101		core section 6	
					foam plug	
0	53				gray, moist, hard SAND w/ shell fragments	
		7	17	M811-2-A		grain size
		37	47	M811-2-B		grain size
		57	67	M811-2-C		grain size
		82	92	M811-2-D		grain size
53	94				yellowish-brown to tan, moist hard SAND w/ shell fragments	
		97	107	M811-2-E		grain size
94	137				black, petroleum odor, moist, soft-firm, silty sandy CLAY w/ BBC nodules	
		101	202		core section 5	
137	258				BBC	
		161	240		lens:black, moist, soft-firm silty CLAY	
		202	302		core section 4	
		302	402		core section 3	
258	341				black, petroleum odor, moist, soft-firm silty CLAY w/ gravel and shells	
341	360				black, petroleum odor, moist, soft-firm silty sandy CLAY	
360	376				black, petroleum odor, moist, soft-firm silty CLAY	
376	384				black, petroleum odor, moist, firm silty sandy CLAY	
		402	502		core section 2	
384	407				black, petroleum odor, moist, soft-firm silty CLAY w/ gravel	
407	602				black, petroleum odor, moist, firm silty sandy CLAY	
		502	602		core section 2	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

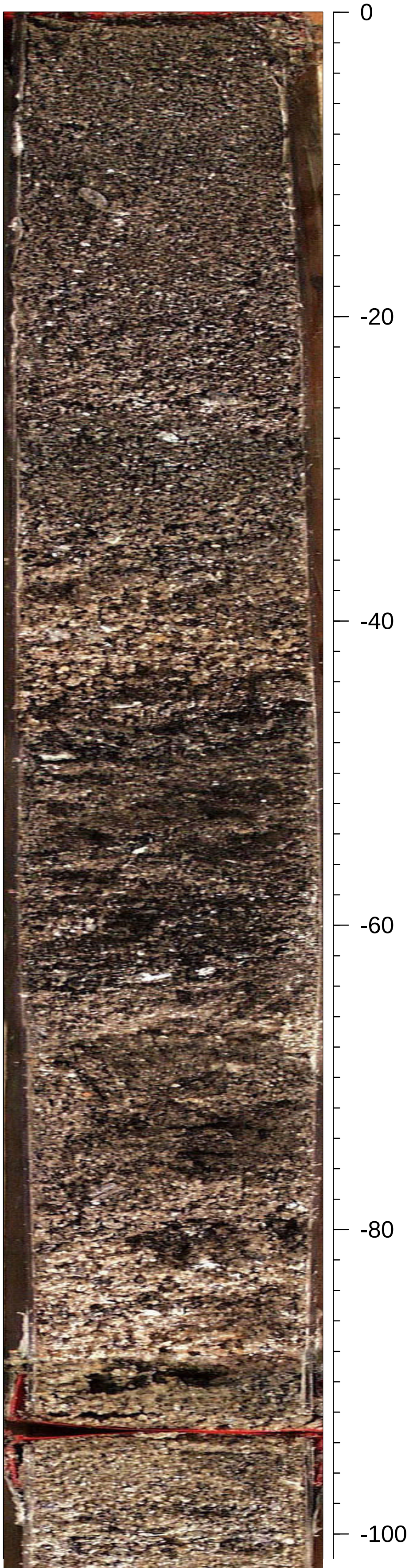
Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Core: M811-3
Survey: One-Year Monitoring

Total Core Length: 495 cm

Latitude: 42.386
Longitude: -71.058

Core Photo | **Depth** (cm)



Major Sample

0-84	gray, moist, hard SAND w/ shell fragments
84-115	yellowish brown to tan, moist, hard SAND w/ shell fragments

Sub Sample

0-95	core section 5
95-195	core section 4

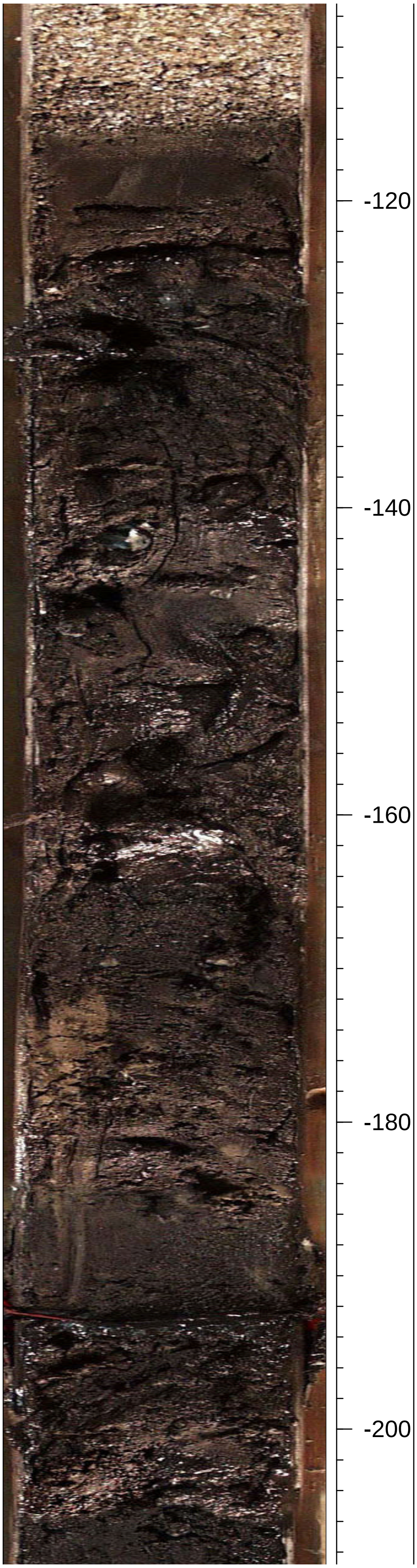
Lithology

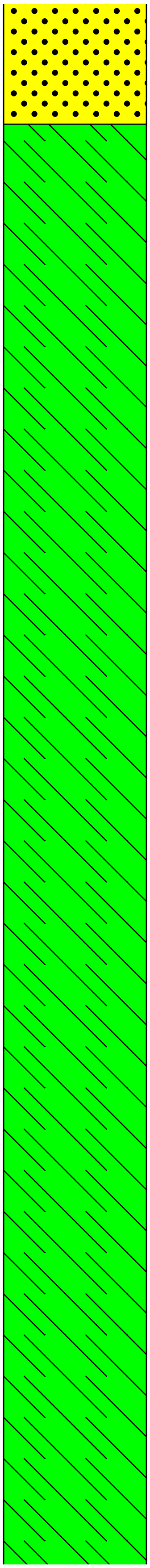
Core: M811-3
Survey: One-Year Monitoring

Total Core Length: 495 cm

Latitude: 42.386
Longitude: -71.058

Core Photo	Depth (cm)	Major Sample		Sub Sample		Lithology
		115-218	black, petroleum odor, moist, soft-firm silty sandy CLAY w/ shell fragments			
				118-135	Atterberg limits	
				120-120	bulk density, shear strength	
				170-185	Atterberg limits	
				175-175	bulk density, shear strength	
				195-295	core section 3	
				200-220	Atterberg limits	
				205-205	bulk density, shear strength	





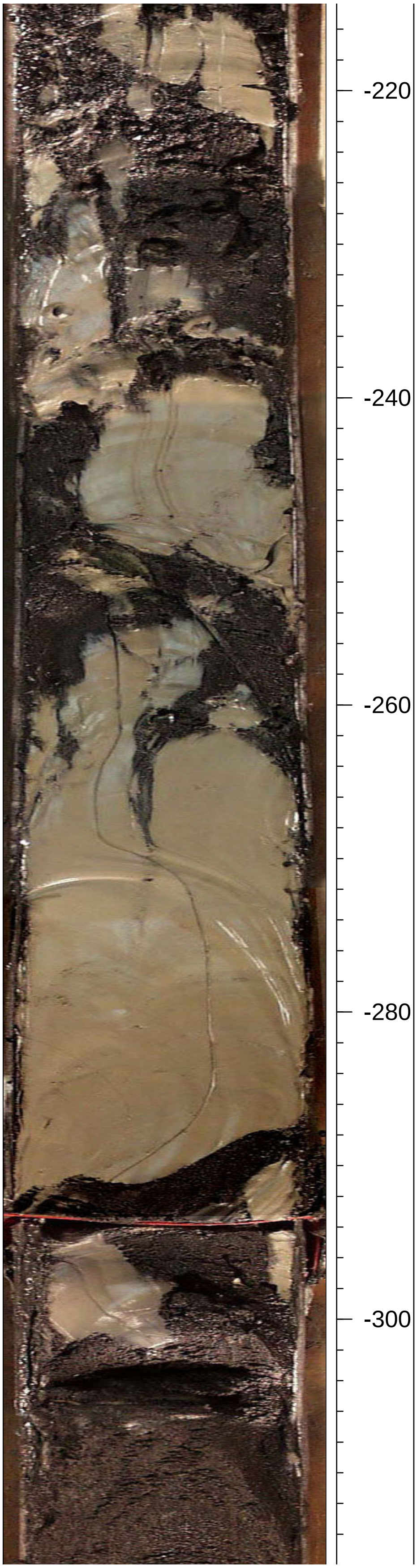
Boston Harbor CAD Cells

Core: **M811-3**
Survey: One-Year Monitoring

Total Core Length: 495 cm

Latitude: 42.386
Longitude: -71.058

Core Photo | **Depth** (cm)



Major Sample		Sub Sample		Lithology
				🟩
218-265	black, organic/petroleum odor, moist, firm silty sandy CLAY w/ BBC nodules and gravel			🟩
265-295	BBC			▨
295-495	black, organic/petroleum odor, moist, firm silty sandy CLAY w/ BBC flecks	295-395	core section 2	🟩

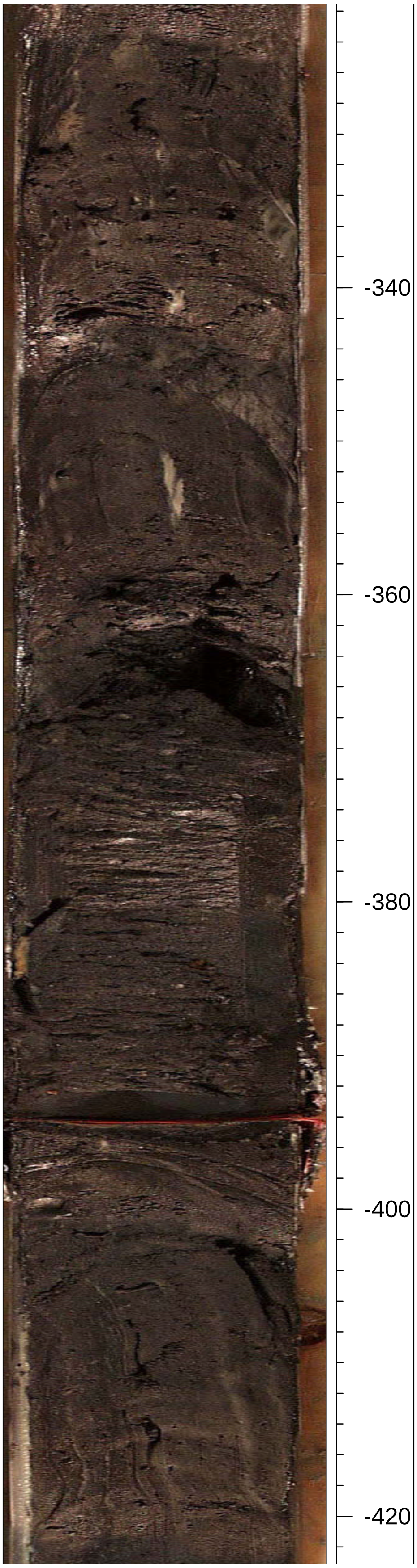
Boston Harbor CAD Cells

Core: **M811-3**
Survey: One-Year Monitoring

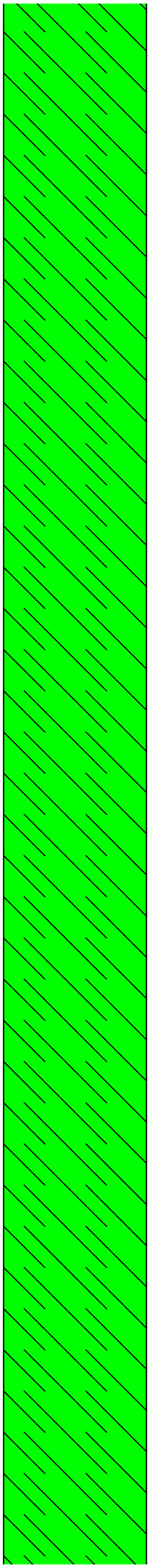
Total Core Length: 495 cm

Latitude: 42.386
Longitude: -71.058

Core Photo	Depth (cm)	Major Sample	Sub Sample	Lithology



	Atterberg limits
325-325	bulk density, shear strength
355-375	Atterberg limits
360-360	bulk density, shear strength
395-495	core section 1



Core: M811-3

Survey: One-Year Monitoring

Total Core Length: 495 cm

Latitude: 42.386
Longitude: -71.058

Core Photo	Depth (cm)	Major Sample	Sub Sample		Lithology
	-440		440-455	Atterberg limits	🟩
			445-445	bulk density, shear strength	
	-460				
	-480				

Lab Sheet - Core Descriptions
Lab Analysis Date(s): 8/6/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M811-3
Data_Type core description
Total_core_length_cm 495
Cap Material 115cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	495				total core length, organic/petroleum odor	
		0	95		core section 5	
0	84				gray, moist, hard SAND w/ shell fragments	
84	115				yellowish brown to tan, moist, hard SAND w/ shell fragments	
		95	195		core section 4	
		118	135	M811-3-A		Atterberg limits
		120	120	M811-3-A		bulk density, shear strength
115	218				black, petroleum odor, moist, soft-firm silty sandy CLAY w/ shell fragments	
		170	185	M811-3-B		Atterberg limits
		175	175	M811-3-B		bulk density, shear strength
		195	295		core section 3	
		200	220	M811-3-C		Atterberg limits
		205	205	M811-3-C		bulk density, shear strength
218	265				black, organic/petroleum odor, moist, firm silty sandy CLAY w/ BBC nodules and gravel	
		295	395		core section 2	
265	295				BBC	
295	495				black, organic/petroleum odor, moist, firm silty sandy CLAY w/ BBC flecks	
		320	335	M811-3-D		Atterberg limits
		325	325	M811-3-D		bulk density, shear strength
		355	375	M811-3-E		Atterberg limits
		360	360	M811-3-E		bulk density, shear strength
		395	495		core section 1	
		440	455	M811-3-F		Atterberg limits
		445	445	M811-3-F		bulk density, shear strength

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/6/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M811-4
Data_Type	core description
Total_core_length_cm	315
Cap Material	110cm

Core_Interval Lith_Top_Depth_cm	**Core_Interval Lith_Bottom_Depth_cm**	**Core_Unit Top_Depth_cm**	**Core_Unit Bottom_Depth_cm**	**Subsample_ID**	**SAIC_lab_description**	**Lab_analysis**
0	315				total core length, organic/petroleum odor	
		0	115		core section 3	
0	63				gray, moist, hard SAND w/ shell fragments	
		10	20	M811-4-A		grain size
		30	40	M811-4-B		grain size
		50	60	M811-4-C		grain size
		100	110	M811-4-D		grain size
		110	120	M811-4-E		grain size
63	105				yellowish brown to tan, moist, hard SAND w/ shell fragments	
105	110				black, moist, hard SAND	
110	144				black, petroleum odor, moist, soft clayey SILT	
		115	215		core section 2	
		215	315		core section 1	
144	315				black, petroleum odor, moist, firm silty sandy CLAY w/ shell fragments and gravel	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/6/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M811-5
Data_Type	core description
Total_core_length_cm	493
Cap Material	69cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	493				total core length, organic/petroleum odor	
		0	93		core section 5	
0	69				gray, moist, hard SAND w/shell fragments	
69	93				black, organic/petroleum odor, moist, soft-firm silty CLAY w/ sand	
93	297				black, organic-slight petroleum odor, moist, very soft to soft silty CLAY w/ shell fragments and sand	
		70	85	M811-5-A		Atterberg limits
		75	75	M811-5-A		bulk density, shear strength
		100	115	M811-5-B		Atterberg limits
		105	105	M811-5-B		bulk density, shear strength
		93	193		core section 4	
		150	165	M811-5-C		Atterberg limits
		170	170	M811-5-C		bulk density, shear strength
		240	255	M811-5-D		Atterberg limits
		245	245	M811-5-D		bulk density, shear strength
		193	293		core section 3	
		340	355	M811-5-E		Atterberg limits
		345	345	M811-5-E		bulk density, shear strength
		440	455	M811-5-F		Atterberg limits
		445	445	M811-5-F		bulk density, shear strength
		293	393		core section 2	
297	493				black, organic, moist, soft silty CLAY w/ sand	
		393	493		core section 1	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/7/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M19-1
Data_Type	core description
Total_core_length_cm	477
Cap Material	NA

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	477				total core length	
		0	76		core section 5	
0	23				gray, moist, soft silty CLAY w/ BBC and sand	
23	477				BBC	
		76	176		core section 4	
		176	276		core section 3	
		276	377		core section 2	
		377	477		core section 1	

NA= none apparent

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s):	8/7/2001
Lab Technician(s):	Walter, Montgomery, Shufeldt
Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M19-2
Data_Type	core description
Total_core_length_cm	430
Cap Material	40cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	430				total core length	
		0	129		core section 4	
0	40				yellowish brown and gray, moist, hard SAND w/ shell fragments	
40	43				black, petroleum odor, moist, firm sandy SILT	
43	78				BBC	
78	160				black, petroleum odor, moist, soft-firm silty CLAY w/ spongelike texture and gravel	
		129	229		core section 3	
160	430				BBC	
		229	330		core section 2	
		330	430		core section 1	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/7/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells

Survey_name one-year monitoring

Replicate_id M19-3

Data_Type core description

Total_core_length_cm 363

Cap Material 25cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	363				total core length	
		0	63		core section 4	
0	25				yellowish brown, moist, hard SAND w/ shell fragments	
		25	40	M19-3A		Atterberg limits
		30	30	M19-3A		bulk density, shear strength
25	41				black, petroleum odor, moist, firm sandy silty CLAY	
		50	65	M19-3B		Atterberg limits
		55	55	M19-3B		bulk density, shear strength
		70	85	M19-3C		Atterberg limits
		75	75	M19-3C		bulk density, shear strength
41	100				black, petroleum odor, moist, soft-firm silty CLAY w/ sand, gravel and flecks of BBC, rock-like material	
		91	97		rock	
		63	163		core section 3	
		110	125	M19-3D		Atterberg limits
		115	115	M19-3D		bulk density, shear strength
100	134				black, petroleum odor, moist, firm silty CLAY w/ sponge-like texture	
134	363				BBC	
		163	263		core section 2	
		263	363		core section 1	

Limited samples collected due to volume

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/7/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M19-4
Data_Type core description
Total_core_length_cm 346
Cap Material 97cm, 97-171cm mixed

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	346				total core length	
		0	71		core section 4	
0	97				yellowish brown and gray, moist, hard SAND w/ shell fragments	
		10	20	M19-4-A		grain size
		35	45	M19-4-B		grain size
		71	81	M19-4-C		grain size
		85	95	M19-4-D		grain size
		54	57		scallop shell	
97	171				black, petroleum odor, moist, firm silty SAND w/ rocks	
		99	109	M19-4-E		grain size
		71	146		core section 3	
171	186				lens, BBC	
		146	246		core section 2	
186	242				yellowish brown, moist, hard BBC	
242	248				BBC	
		246	346		core section 1	
248	321				black, petroleum odor, moist, firm-hard silty SAND w/ rocks and shell fragments	
321	346				BBC	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/7/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells

Survey_name one-year monitoring

Replicate_id M19-5

Data_Type core description

Total_core_length_cm 297

Cap Material 4-25cm (21cm)

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	297	▨	▨		total core length	
		0	97		core section 3	
0	4				black, wet, very-soft silty CLAY	
4	25				black w/ gray, slight petroleum odor, moist, hard SAND w/ silt	
		97	197		core section 2	
		197	297		core section 1	
25	297				BBC	
		76	80		rock	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions
Lab Analysis Date(s): 8/7/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M19-16
Data_Type	core description
Total_core_length_cm	291
Cap Material	116cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	291				total core length	
		0	91		core section 3	
0	116				yellowish brown and gray, moist, hard SAND w/ shell fragments	
		91	191		core section 2	
116	206				black, petroleum/organic odor, moist, soft-firm silty CLAY	
		117	137	M19-16-A		Atterberg limits
		120	120	M19-16-A		bulk density, shear strength
		150	165	M19-16-B		Atterberg limits
		155	155	M19-16-B		bulk density, shear strength
		175	190	M19-16-C		Atterberg limits
		180	180	M19-16-C		bulk density, shear strength
		191	291		core section 1	
206	255				sand	
		200	215	M19-16-D		Atterberg limits
		205	205	M19-16-D		bulk density, shear strength
		235	250	M19-16-E		Atterberg limits
		240	240	M19-16-E		bulk density, shear strength
255	291				BBC	
		274	291		rocks	

Limited samples collected due to volume

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/7/2001

Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name	Boston Harbor CAD Cells
Survey_name	one-year monitoring
Replicate_id	M19-17
Data_Type	core description
Total_core_length_cm	448
Cap Material	128cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	448				total core length	
		0	67		core section 5	
0	82				yellowish brown and gray, moist, hard SAND w/ shell fragments	
		67	147		core section 4	
82	128				black, petroleum odor, moist, hard silty SAND and CLAY w/ rocks/gravel	
		130	145	M19-17-A		Atterberg limits
		135	135	M19-17-A		bulk density, shear strength
128	156				black, petroleum odor, moist, soft-firm silty CLAY w/ Sand	
		147	247		core section 3	
156	274				black, petroleum odor, moist, soft-firm silty CLAY w/ sand/gravel	
		160	175	M19-17-B		Atterberg limits
		165	165	M19-17-B		bulk density, shear strength
		200	215	M19-17-C		Atterberg limits
		205	205	M19-17-C		bulk density, shear strength
		260	275	M19-17-D		Atterberg Limits
		265	265	M19-17-D		bulk density, shear strength
		247	348		core section 2	
274	320				black, petroleum odor, wet-moist, soft-firm silty CLAY w/ rock-like material and BBC nodules	
		290	305	M19-17-E		Atterberg limits
		295	295	M19-17-E		bulk density, shear strength
320	360				dark gray, wet-moist, soft-firm CLAY w/ silt	
		320	335	M19-17-F		Atterberg limits
		325	325	M19-17-F		bulk density, shear strength
360	448				BBC	
		366	375		rock	
		348	448		core section 1	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

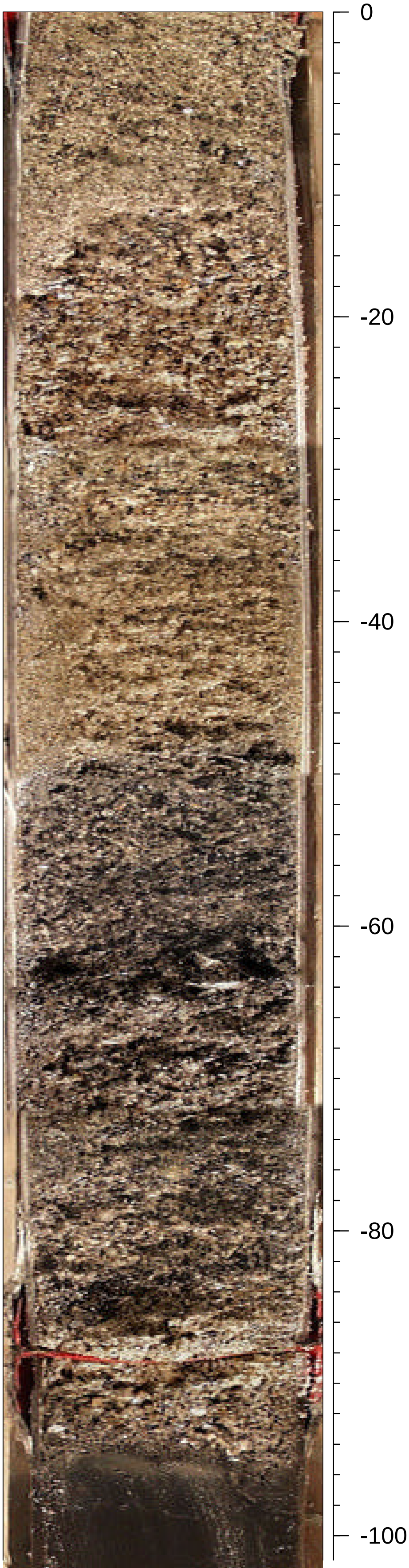
Boston Harbor CAD Cells

Core: **M19-18**
Survey: One-Year Monitoring

Total Core Length: 390 cm

Latitude: 42.386
Longitude: -71.054

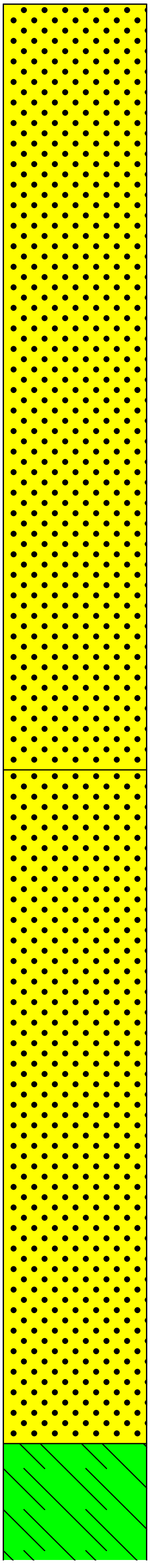
Core Photo



Major Sample	
0-50	yellowish brown to tan, moist, hard SAND w/ shell fragments
50-94	yellowish brown and gray, moist, hard SAND w/ shell fragments
94-160	black, organic odor, moist, soft-firm silty CLAY w/ sand

Sub Sample	
0-88	core section 4
10-20	grain size
30-40	grain size
55-65	grain size
80-90	grain size
88-189	core section 3
100-110	grain size

Lithology

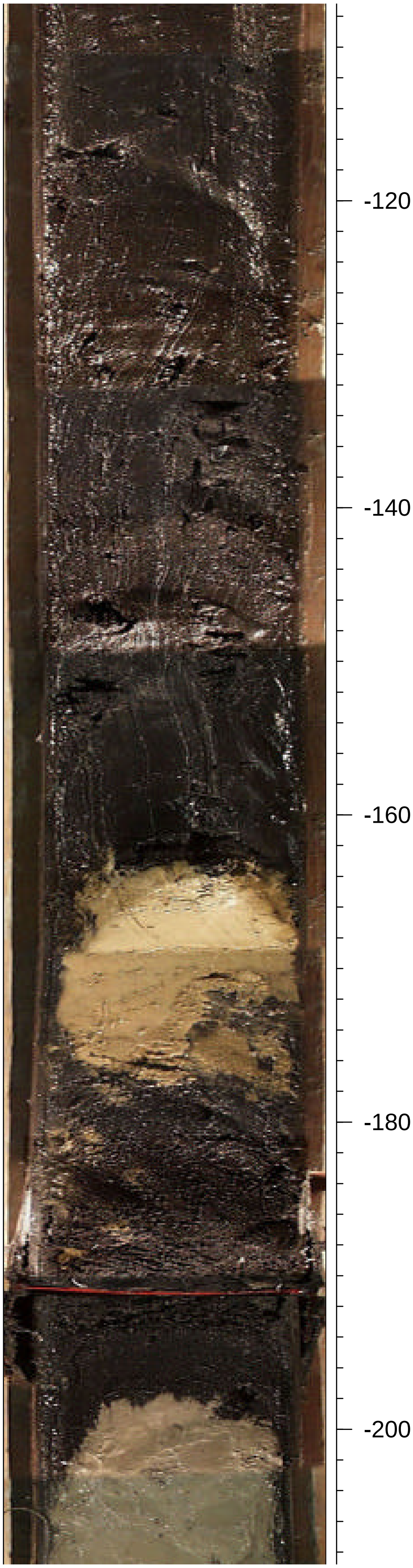
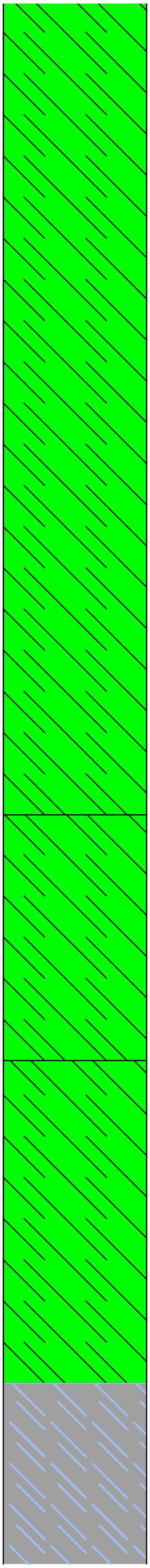


Boston Harbor CAD Cells

Core: **M19-18**
Survey: One-Year Monitoring

Total Core Length: 390 cm

Latitude: 42.386
Longitude: -71.054

Core Photo	Depth (cm)	Major Sample		Sub Sample		Lithology
	-120 -140 -160 -180 -200	160-176	yellowish brown, moist, firm-hard silty CLAY			
		176-197	black, organic odor, moist, soft-firm silty CLAY w/ sand	189-289	core section 2	
		197-390	BBC			

Core: M19-18

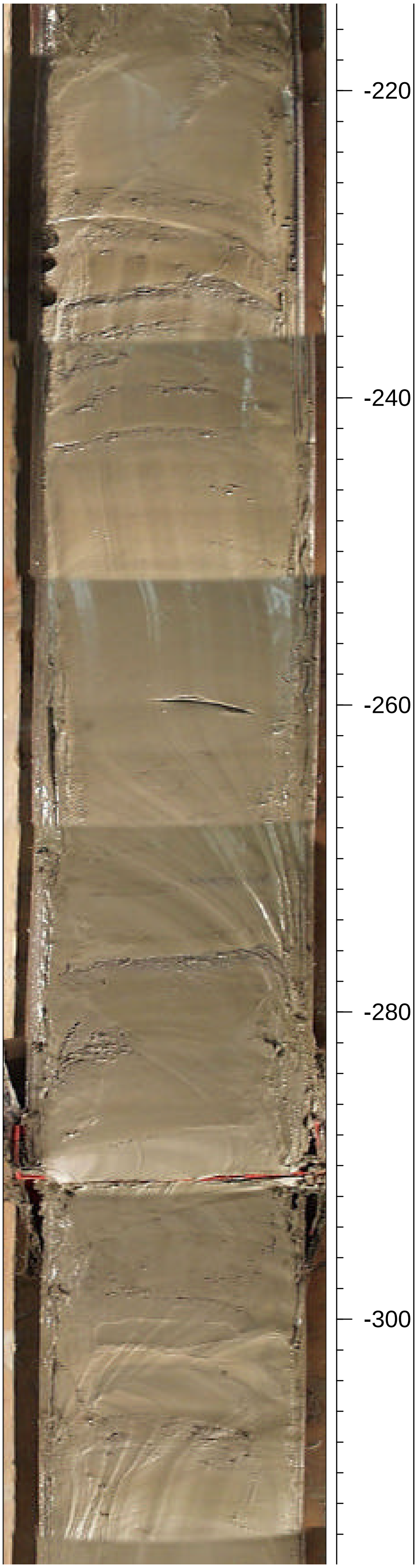
Survey: One-Year Monitoring

Total Core Length: 390 cm

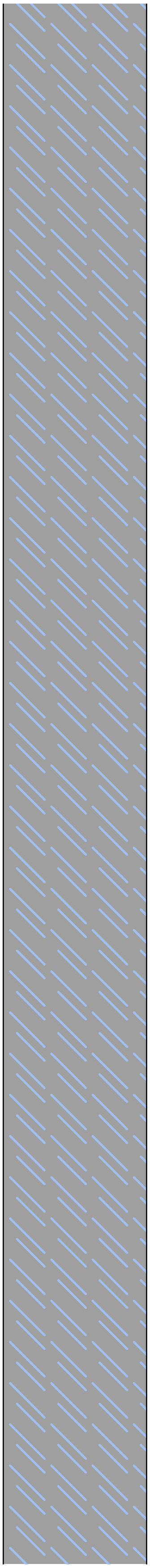
Latitude: 42.386

Longitude: -71.054

Core Photo	Depth (cm)	Major Sample	Sub Sample	Lithology



289-390	core section 1



Core: M19-18

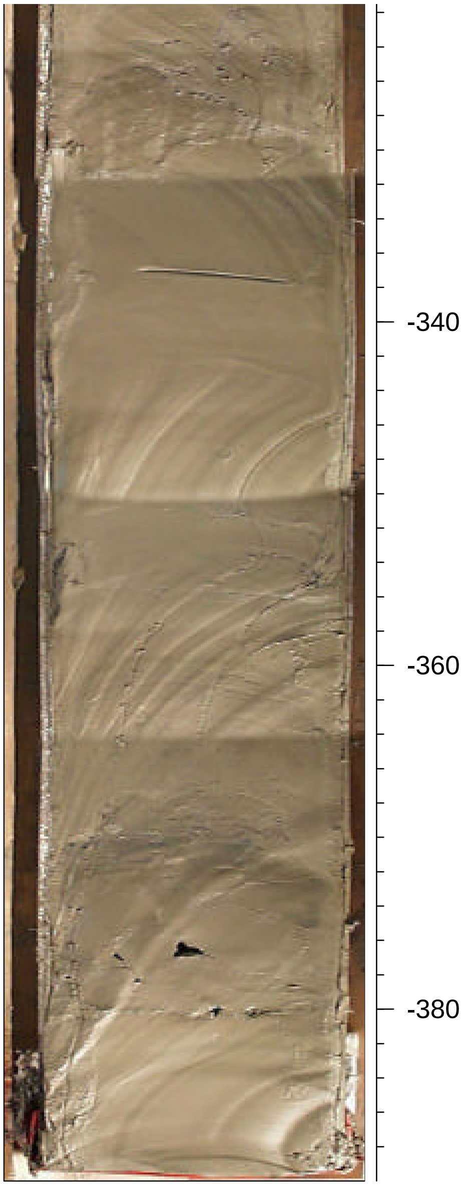
Survey: One-Year Monitoring

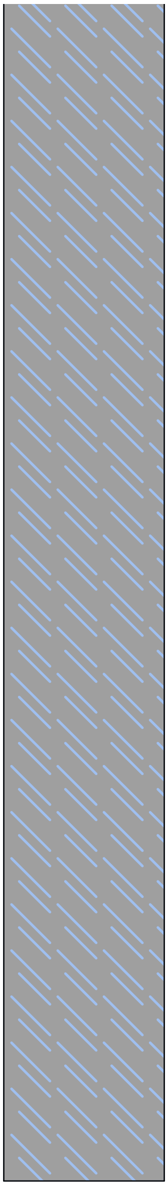
Total Core Length: 390 cm

Latitude: 42.386

Longitude: -71.054

Core Photo	Depth (cm)	Major Sample	Sub Sample	Lithology





Lab Sheet - Core Descriptions

Lab Analysis Date(s): 8/7/2001
Lab Technician(s): Walter, Montgomery, Shufeldt

Site_Name Boston Harbor CAD Cells
Survey_name one-year monitoring
Replicate_id M19-18
Data_Type core description
Total_core_length_cm 390
Cap Material 94cm

Core_Interval Lith_Top_Depth_cm	Core_Interval Lith_Bottom_Depth_cm	Core_Unit Top_Depth_cm	Core_Unit Bottom_Depth_cm	Subsample_ID	SAIC_lab_description	Lab_analysis
0	390				total core length	
		0	88		core section 4	
0	50				yellowish brown to tan, moist, hard SAND w/ shell fragments	
		10	20	M19-18-A		grain size
		30	40	M19-18-B		grain size
		55	65	M19-18-C		grain size
50	94				yellowish brown and gray, moist, hard SAND w/ shell fragments	
		80	90	M19-18-D		grain size
		100	110	M19-18-E		grain size
		88	189		core section 3	
94	160				black, organic odor, moist, soft-firm silty CLAY w/ Sand	
160	176				yellowish brown, moist, firm-hard silty CLAY	
176	197				black, organic odor, moist, soft-firm silty CLAY w/ Sand	
		189	289		core section 2	
197	390				BBC	
		289	390		core section 1	

Core Interval = major asspects of the core

Core Unit= descreate samples or subsets of the Core Interval, IF a sub sample is collected it goes under unit, IF the subsample is collect at 3cm both top and bottom unit are 3

Lab Description= follow SOP for visual description of sediment: Color, odor (if present), moisture, consistency, cementation, structure grain size

Appendix B

Cell IC

Classification	**Sample ID**	**IC-4-AG**	**IC-4-BG**	**IC-4-CG**	**IC-4-DG**	**IC-4-EG**
	Sample Depth (cm)	**17-27**	**67-77**	**97-107**	**127-137**	**167-177**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	0	13	0
	#10	0	0	2	1	0
Medium Sand	#20	0	5	6	17	9
	#40	1	15	17	43	37
Fine Sand	#60	2	15	23	8	24
	#100	4	11	18	8	12
	#200	3	8	1	3	5
Total Sand	**> #200**	**10**	**54**	**67**	**93**	**87**
Silt	0.002 mm	67	32	26	7	5
Clay	<0.002mm	23	14	7	0	8

Classification	**Sample ID**	**IC-5-AG**	**IC-5-BG**	**IC-5-CG**	**IC-5-DG**	**IC-5-EG**
	Sample Depth (cm)	**49-59**	**69-79**	**84-94**	**114-124**	**159-169**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	10	0	0
	#10	2	5	18	4	11
Medium Sand	#20	8	13	33	13	22
	#40	19	21	27	19	21
Fine Sand	#60	16	13	11	14	8
	#100	13	9	1	7	4
	#200	9	5	0	4	3
Total Sand	**> #200**	**67**	**66**	**100**	**61**	**69**
Silt	0.002 mm	23	24	0	26	21
Clay	<0.002mm	10	10	0	13	10

Cell M4

Classification	Sample ID	M4-5-A	M4-5-B	M4-5-C	M4-5-D	M4-5-E
	Sample Depth (cm)	160-170	200-210	230-240	260-270	290-300
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	1	0	0	0
	#10	0	0	5	0	1
Medium Sand	#20	3	5	1	4	4
	#40	12	18	3	19	21
Fine Sand	#60	27	29	10	39	41
	#100	6	5	11	7	7
	#200	4	2	6	2	2
Total Sand	**> #200**	**52**	**60**	**36**	**71**	**76**
Silt	0.002 mm	35	31	48	20	15
Clay	<0.002mm	13	9	16	9	9

Classification	Sample ID	M4-6-A	M4-6-B	M4-6-C	M4-6-D	M4-6-E
	Sample Depth (cm)	128-138	153-163	173-183	193-203	208-218
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	0	0	2
	#10	1	0	3	4	10
Medium Sand	#20	3	8	17	26	32
	#40	16	22	41	53	40
Fine Sand	#60	38	27	23	13	10
	#100	7	3	2	1	1
	#200	1	1	0	0	1
Total Sand	**> #200**	**66**	**61**	**86**	**97**	**96**
Silt	0.002 mm	24	20	6	3	4
Clay	<0.002mm	10	19	8	0	0

Cell M5

Classification	**Sample ID**	**M5-4-A**	**M5-4-B**	**M5-4-C**	**M5-4-D**	**M5-4-E**
	Sample Depth (cm)	**85-95**	**145-155**	**185-195**	**265-275**	**310-320**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	0	0	0
	#10	0	1	0	3	5
Medium Sand	#20	1	6	15	8	18
	#40	15	29	43	27	50
Fine Sand	#60	20	24	23	21	23
	#100	3	2	1	2	1
	#200	2	2	1	0	0
Total Sand	**> #200**	**41**	**64**	**83**	**61**	**97**
Silt	0.002 mm	46	29	12	28	3
Clay	<0.002mm	13	7	5	11	0

Classification	**Sample ID**	**M5-5-A**	**M5-5-B**	**M5-5-C**	**M5-5-D**	**M5-5-E**
	Sample Depth (cm)	**110-120**	**180-190**	**220-230**	**330-340**	**440-450**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	0	0	0
	#10	0	1	1	2	6
Medium Sand	#20	2	5	12	9	19
	#40	8	28	39	31	45
Fine Sand	#60	9	27	29	19	23
	#100	2	3	2	2	1
	#200	4	1	1	1	0
Total Sand	**> #200**	**25**	**65**	**84**	**64**	**94**
Silt	0.002 mm	66	27	11	31	6
Clay	<0.002mm	9	8	5	5	0

Cell M12

Classification	**Sample ID**	**M12-4A**	**M12-4B**	**M12-4C**	**M12-4D**	**M12-4E**
	Sample Depth (cm)	**58-68**	**278-288**	**353-363**	**388-398**	**428-438**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	0	0	0
	#10	2	0	0	0	1
Medium Sand	#20	8	3	1	3	4
	#40	25	12	5	9	15
Fine Sand	#60	28	17	19	19	25
	#100	3	9	6	3	4
	#200	2	7	8	9	3
Total Sand	**> #200**	**68**	**48**	**39**	**43**	**52**
Silt	0.002 mm	20	52	45	48	48
Clay	<0.002mm	12	0	16	9	0

Classification	**Sample ID**	**M12-5A**	**M12-5B**	**M12-5C**	**M12-5D**	**M12-5E**
	Sample Depth (cm)	**134-144**	**194-204**	**349-359**	**384-394**	**454-464**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	0	0	0
	#10	1	1	0	0	0
Medium Sand	#20	1	0	0	4	4
	#40	1	0	0	13	13
Fine Sand	#60	2	1	0	25	41
	#100	6	3	0	4	10
	#200	16	7	0.5	4	3
Total Sand	**> #200**	**27**	**12**	**0.5**	**50**	**71**
Silt	0.002 mm	57	67	81.5	38	21
Clay	<0.002mm	16	21	18	12	8

Cell M2

Classification	**Sample ID**	**M2-2-A**	**M2-2-B**	**M2-2-C**	**M2-2-D**	**M2-2-E**	**M2-2-F**
	Sample Depth (cm)	**20-30**	**40-50**	**60-70**	**80-90**	**100-110**	**110-120**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0	0
	0.75"	0	0	0	0	0	0
	0.5"	0	0	0	0	0	0
	0.375"	0	0	0	0	0	0
	#4	0	0	0	0	0	0
	#10	5	1	1	1	0	0
Medium Sand	#20	11	4	2	6	4	0
	#40	51	24	19	33	31	1
Fine Sand	#60	21	47	44	52	46	2
	#100	5	18	25	5	14	1
	#200	1	2	3	0	2	6
Total Sand	**> #200**	**94**	**96**	**94**	**97**	**97**	**10**
Silt	0.002 mm	6	4	6	3	3	69
Clay	<0.002mm	0	0	0	0	0	21

Classification	**Sample ID**	**M2-5-A**	**M2-5-B**	**M2-5-C**	**M2-5-D**	**M2-5-E**
	Sample Depth (cm)	**20-30**	**40-50**	**60-70**	**85-95**	**130-140**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	0	0	0
	#10	0	0	0	1	2
Medium Sand	#20	1	0	2	8	14
	#40	16	8	19	40	41
Fine Sand	#60	53	54	46	45	34
	#100	24	30	26	3	7
	#200	2	3	2	0	1
Total Sand	**> #200**	**96**	**95**	**95**	**97**	**99**
Silt	0.002 mm	4	5	5	3	1
Clay	<0.002mm	0	0	0	0	0

Cell SC

Classification	**Sample ID**	**SC-1-A**	**SC-1-B**	**SC-1-C**	**SC-1-D**	**SC-1-E**
	Sample Depth (cm)	**35.5-45.5**	**65.5-75.5**	**135.5-145.5**	**250.5-260.5**	**275.5-285.5**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
	1.0"	0	0	0	0	0
Coarse	0.75"	0	0	0	0	0
Sand	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	1	1	3	12
	#10	6	13	16	6	14
Medium	#20	18	23	29	10	33
Sand	#40	41	49	37	31	35
Fine	#60	25	6	6	34	3
Sand	#100	3	2	1	11	1
	#200	0	0	0	2	0
Total Sand	**> #200**	**93**	**94**	**90**	**97**	**98**
Silt	0.002 mm	7	6	10	3	2
Clay	<0.002mm	0	0	0	0	0

Classification	**Sample ID**	**SC-3-A**	**SC-3-B**	**SC-3-C**	**SC-3-D**	**SC-3-E**
	Sample Depth (cm)	**7-17**	**47-57**	**67-77**	**87-97**	**97-107**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
	1.0"	0	0	0	0	0
Coarse	0.75"	0	0	0	0	0
Sand	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	1	0	0	0	0
	#10	12	3	0	0	0
Medium	#20	26	7	6	2	4
Sand	#40	42	50	23	14	20
Fine	#60	8	29	59	50	58
Sand	#100	1	4	10	29	15
	#200	0	1	1	2	1
Total Sand	**> #200**	**90**	**94**	**99**	**97**	**98**
Silt	0.002 mm	10	6	1	3	2
Clay	<0.002mm	0	0	0	0	0

Cell M8-11

Classification	**Sample ID**	**M8-11-2-A**	**M8-11-2-B**	**M8-11-2-C**	**M8-11-2-D**	**M8-11-2-E**
	Sample Depth (cm)	**7-17**	**37-47**	**57-67**	**82-92**	**97-107**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	0	0	0	3	2
	#10	2	6	10	6	2
Medium Sand	#20	12	21	22	27	4
	#40	59	50	50	51	6
Fine Sand	#60	20	17	10	8	3
	#100	2	2	1	1	12
	#200	0	0	1	1	5
Total Sand	**> #200**	**95**	**96**	**94**	**97**	**34**
Silt	0.002 mm	5	4	6	3	49
Clay	<0.002mm	0	0	0	0	17

Classification	**Sample ID**	**M8-11-4-A**	**M8-11-4-B**	**M8-11-4-C**	**M8-11-4-D**	**M8-11-4-E**
	Sample Depth (cm)	**10-20**	**30-40**	**50-60**	**100-110**	**110-120**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	0	0	0	0
	0.375"	0	0	0	0	0
	#4	5	1	5	0	0
	#10	12	6	12	32	1
Medium Sand	#20	29	23	27	33	3
	#40	37	43	42	27	4
Fine Sand	#60	10	18	12	3	0
	#100	1	3	2	1	1
	#200	0	0	0	0	3
Total Sand	**> #200**	**94**	**94**	**100**	**96**	**12**
Silt	0.002 mm	6	6	0	4	88
Clay	<0.002mm	0	0	0	0	0

Cell M19

Classification	**Sample ID**	**M19-4-A**	**M19-4-B**	**M19-4-C**	**M19-4-D**	**M19-4-E**
	Sample Depth (cm)	**10-20**	**35-45**	**71-81**	**85-95**	**99-109**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	14
	0.5"	0	0	0	0	2
	0.375"	1	0	3	0	0
	#4	2	11	7	0	2
	#10	7	12	9	17	6
Medium Sand	#20	29	23	24	23	12
	#40	47	34	45	39	16
Fine Sand	#60	10	16	9	17	13
	#100	2	2	1	2	9
	#200	1	0	0	0	8
Total Sand	**> #200**	**99**	**98**	**98**	**98**	**82**
Silt	0.002 mm	1	2	2	2	13
Clay	<0.002mm	0	0	0	0	5

Classification	**Sample ID**	**M19-18-A**	**M19-18-B**	**M19-18-C**	**M19-18-D**	**M19-18-E**
	Sample Depth (cm)	**10-20**	**30-40**	**55-65**	**80-90**	**100-110**
	Seive Size	% frequency	% frequency	% frequency	% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0	0
	0.75"	0	0	0	0	0
	0.5"	0	3	2	0	0
	0.375"	0	0	2	1	0
	#4	8	6	3	5	0
	#10	11	9	4	8	0
Medium Sand	#20	25	22	19	19	2
	#40	46	38	55	41	4
Fine Sand	#60	8	19	13	23	3
	#100	2	2	0	1	4
	#200	0	0	1	1	10
Total Sand	**> #200**	**100**	**99**	**99**	**99**	**23**
Silt	0.002 mm	0	1	1	1	64
Clay	<0.002mm	0	0	0	0	13

Grab Sample Grain Size and Water Content

Classification	**Sample ID**	**IC-2**	**IC-5**	**CR-2**	**CR-4**		**IC-REF1**	**IC-REF2**
	Sample Depth (cm)	**0-25**	**0-25**	**0-25**	**0-25**		**0-25**	**0-25**
	Seive Size	% frequency	% frequency	% frequency	% frequency		% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0		0	0
	0.75"	0	0	0	0		0	0
	0.5"	0	0	0	0		0	0
	0.375"	0	0	0	0		0	0
	#4	0	0	0	2		0	1
	#10	0	0	0	2		1	2
Medium Sand	#20	0	0	0	3		1	4
	#40	0	1	1	5		3	9
Fine Sand	#60	1	0	2	3		1	10
	#100	0	2	6	4		1	8
	#200	5	4	23	14		4	16
Total Sand	**> #200**	**6**	**7**	**32**	**33**		**11**	**50**
Silt	0.002 mm	69	59	56	53		69	37
Clay	<0.002mm	25	34	12	14		20	13
Water Content %		**208**	**225**	**116**	**86**		**120**	**80**

Classification	**Sample ID**	**M5-1**	**M2-5**	**SC-4**	**M811-3**		**MR-REF1**	**MR-REF2**
	Sample Depth (cm)	**0-25**	**0-25**	**0-25**	**0-25**		**0-25**	**0-25**
	Seive Size	% frequency	% frequency	% frequency	% frequency		% frequency	% frequency
Coarse Sand	1.0"	0	0	0	0		0	0
	0.75"	0	0	0	0		0	0
	0.5"	0	0	0	0		0	0
	0.375"	0	0	0	0		0	0
	#4	0	0	0	0		0	0
	#10	4	0	1	0		0	0
Medium Sand	#20	9	0	6	3		0	1
	#40	17	1	26	38		1	1
Fine Sand	#60	9	1	23	25		2	3
	#100	1	1	9	5		1	6
	#200	3	4	9	4		7	6
Total Sand	**> #200**	**43**	**7**	**74**	**75**		**11**	**17**
Silt	0.002 mm	46	75	16	16		69	68
Clay	<0.002mm	11	18	10	9		20	15
Water Content %		**123**	**217**	**62**	**65**		**185**	**161**

Appendix C

Cell IC; Density, Atterberg Limits, Water Content and Shear Strength

Sample ID	Depth (cm)	Wet Density g/cc	Dry Density g/cc	Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	Water Content %	Shear Strength (kPa)
IC-4-A	52	1.3	0.6	104	33	70	131	1.08
IC-4-B	147	1.5	0.8	64	25	39	79	1.62
IC-4-C	189	1.5	0.9	84	31	53	70	7.02
IC-4-D	247	1.5	0.6	73	31	42	65	7.02
IC-4-E	292	1.6	1.0	54	24	31	57	4.32
IC-5-A	14	1.5	0.6	79	28	51	129	0.54
IC-5-B	129	1.5	0.8	69	29	40	80	3.24
IC-5-C	179	1.4	0.8	72	27	45	79	2.16
IC-5-D	219	1.5	0.9	71	26	45	67	2.16
IC-5-E	254	1.6	1.1	71	25	45	52	3.78
Cell Min.		**1.3**	**0.6**	**54**	**24**	**31**	**52**	**1**
Cell Max.		**1.6**	**1.1**	**104**	**33**	**70**	**131**	**7**
Cell Average		**1.5**	**0.8**	**74**	**28**	**46**	**81**	**3**

Cells M4, M5 and M12; Density, Atterberg Limits, Water Content and Shear Strength

Sample ID	Depth (cm)	Wet Density g/cc	Dry Density g/cc	Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	Water Content %	Shear Strength (kPa)
M4-1-A	65	1.4	0.7	94	36	58	103	1.08
M4-1-B	105	1.3	0.6	99	34	64	125	1.35
M4-1-C	175	1.5	0.9	60	32	29	66	1.62
M4-1-D	255	1.4	0.8	74	28	46	80	2.16
M4-1-E	355	1.7	1.1	57	26	31	50	2.16
M4-1-F	455	1.8	1.5	32	19	13	23	3.24
M4-2-A	47	1.7	0.8	83	32	51	108	1.08
M4-2-B	117	1.6	0.9	84	32	53	87	1.08
M4-2-C	167	1.6	0.9	70	27	43	68	1.08
M4-2-D	247	1.5	0.9	55	23	32	61	1.08
M4-2-E	347	2.2	1.6	46	24	22	37	1.62
M4-2-F	427	1.8	1.3	40	21	19	35	1.62
M4-3-A	35	1.1	0.6	97	34	62	77	0.54
M4-3-B	100	1.1	0.5	102	36	66	135	0.54
M4-3-C	165	1.2	0.6	72	28	44	82	0.54
M4-3-D	275	1.8	1.3	49	21	29	40	1.62
M4-3-E	375	2.1	1.6	35	17	18	31	1.62
M4-3-F	500	3.1	2.2	59	27	33	38	2.70
Cell Min.		**1.1**	**0.5**	**32**	**17**	**13**	**23**	**1**
Cell Max.		**3.1**	**2.2**	**102**	**36**	**66**	**135**	**3**
Cell Average		**1.6**	**1.0**	**67**	**28**	**40**	**69**	**1**
M5-1-A	69	1.9	1.0	78	28	50	83	0.54
M5-1-B	99	1.8	1.1	82	29	53	61	0.54
M5-1-C	134	0.6	0.5	45	20	25	35	1.08
M5-1-D	234	2.0	1.2	71	29	42	75	3.24
M5-1-E	289	1.9	1.1	65	31	34	70	3.24
M5-1-F	409	1.8	1.0	83	32	51	89	4.86
M5-2-A	34	1.3	0.5	104	40	64	158	failed
M5-2-B	76	1.4	0.7	84	37	47	99	0.27
M5-2-C	111	1.5	1.0	77	30	47	54	1.08
M5-2-D	256	1.5	0.9	73	30	44	62	9.17
M5-3-A	19	1.3	0.5	109	38	70	172	0.54
M5-3-B	54	1.3	0.6	112	36	76	136	0.81
M5-3-C	109	1.5	1.0	79	30	50	56	1.62
M5-3-D	239	1.4	0.8	71	30	40	83	2.70
M5-3-E	359	1.4	0.8	85	32	52	83	2.70
M5-3-F	414	1.5	0.8	83	32	51	81	2.97
Cell Min.		**0.6**	**0.5**	**45.1**	**19.8**	**25.3**	**34.9**	**0.3**
Cell Max.		**2.0**	**1.2**	**112**	**40**	**76**	**172**	**9**
Cell Average		**1.5**	**0.8**	**81**	**32**	**50**	**87**	**2**

Cells M4, M5 and M12; Density, Atterberg Limits, Water Content and Shear Strength (Continued)

Sample ID	Depth (cm)	Wet Density g/cc	Dry Density g/cc	Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	Water Content %	Shear Strength (kPa)
M12-1A	29	1.5	0.7	91	30	61	113	0.54
M12-1B	79	1.5	0.9	65	24	41	76	1.08
M12-1-C	169	1.4	0.7	79	29	50	89	1.62
M12-1D	239	1.6	0.8	99	33	66	102	1.62
M12-1E	274	1.4	0.7	81	28	54	103	1.62
M12-1F	339	1.6	1.0	74	30	44	64	3.24
M12-2A	60	1.4	0.7	67	26	41	101	1.08
M12-2B	175	1.3	0.6	86	30	56	106	1.08
M12-2C	235	1.2	0.5	95	31	64	124	1.08
M12-2D	325	1.5	0.7	93	32	62	114	1.62
M12-2-E	355	1.3	0.6	91	31	60	124	1.62
M12-2F	425	1.4	0.8	90	31	58	76	2.16
M12-3A	53	1.4	0.7	78	28	50	95	0.54
M12-3B	103	1.3	0.6	89	34	55	116	1.08
M12-3C	133	1.4	0.7	82	30	51	106	1.08
M12-3D	188	1.4	0.7	84	29	56	92	1.08
M12-3E	403	1.4	0.7	80	31	49	84	4.32
M12-3F	448	1.5	0.7	88	31	57	79	4.86
Cell Min.		**1.2**	**0.5**	**65**	**24**	**41**	**64**	**1**
Cell Max.		**1.6**	**1.0**	**99**	**34**	**66**	**124**	**5**
Cell Average		**1.4**	**0.7**	**84**	**30**	**54**	**98**	**2**

Cells M2 and SC; Density, Atterberg Limits, Water Content and Shear Strength

Sample ID	Depth (cm)	Wet Density g/cc	Dry Density g/cc	Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	Water Content %	Shear Strength (kPa)
M2-1-A	130	1.4	0.6	97	37	60	114	2.16
M2-1-B	150	1.3	0.6	85	34	51	106	1.62
M2-1-C	180	1.4	0.7	77	32	45	93	1.08
M2-1-D	240	1.6	1.0	60	27	33	61	1.62
M2-1-E	280	1.7	1.0	63	27	36	73	1.62
M2-1-F	335	1.6	1.0	66	28	38	62	2.16
M2-3-A	80	1.3	0.6	94	35	59	121	1.62
M2-3-B	115	1.4	0.7	79	30	49	89	1.62
M2-3-C	145	1.4	0.7	84	30	54	94	1.62
M2-3-D	185	1.4	0.8	66	27	40	79	1.62
M2-3-E	235	1.5	0.8	73	28	44	82	1.62
M2-3-F	315	1.5	0.9	69	27	42	74	1.62
M2-4-A	115	1.4	0.7	89	33	56	88	2.70
M2-4-B	150	1.4	0.7	76	30	46	87	1.62
M2-4-C	190	1.5	0.8	72	28	44	83	1.62
M2-4-D	235	1.4	0.8	71	28	43	80	1.62
M2-4-E	260	1.5	0.8	70	31	39	75	2.16
M2-4-F	280	1.5	1.0	64	25	39	59	1.62
Cell Min.		**1.3**	**0.6**	**64**	**25**	**39**	**59**	**1**
Cell Max.		**1.5**	**1.0**	**94**	**35**	**59**	**121**	**3**
Cell Average		**1.4**	**0.8**	**75**	**29**	**46**	**84**	**2**
SC-2-A	82	1.5	0.9	73	30	43	70	4.32
SC-2-B	217	1.5	0.8	65	30	35	77	2.16
SC-2-C	272	1.6	0.9	79	29	51	71	2.70
SC-2-D	317	1.4	0.8	85	30	55	69	2.16
SC-2-E	357	1.4	0.8	79	31	48	69	3.78
SC-2-F	392	1.4	0.9	81	32	49	66	3.78
SC-4-A	65	1.6	0.9	77	29	48	79	4.32
SC-4-B	155	1.5	0.8	75	28	47	87	8.09
SC-4-C	215	2.0	1.2	68	28	41	68	5.40
SC-4-D	280	1.8	1.2	47	22	25	55	7.02
SC-4-E	313	1.5	0.9	53	24	30	59	9.17
SC-4-F	363	1.5	0.8	63	27	35	83	8.09
SC-5-A	110	1.5	0.7	74	27	48	99	2.16
SC-5-B	185	1.5	0.8	68	27	41	77	2.16
SC-5-C	140	1.5	0.8	65	26	39	80	2.16
SC-5-D	295	1.5	0.9	64	27	38	72	5.40
SC-5-E	355	1.5	0.8	74	30	43	84	2.70
SC-5-F	460	1.6	1.0	60	25	35	60	1.35
Cell Min.		**1.4**	**0.7**	**47**	**22**	**25**	**55**	**1**
Cell Max.		**2.0**	**1.2**	**85**	**32**	**55**	**99**	**9**
Cell Average		**1.5**	**0.9**	**69**	**28**	**42**	**74**	**4**

Cells M8-11 and M19; Density, Atterberg Limits, Water Content and Shear Strength

Sample ID	Depth (cm)	Wet Density g/cc	Dry Density g/cc	Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	Water Content %	Shear Strength (kPa)
M811-1-A	92	1.4	0.7	72	28	44	104	1.62
M811-1-B	140	1.3	0.7	58	25	33	92	1.08
M811-1-C	205	1.6	0.8	62	27	35	95	1.62
M811-1-D	245	1.3	0.7	80	28	52	92	2.16
M811-1-E	305	1.5	0.8	93	34	59	87	2.70
M811-1-F	345	1.5	0.9	69	25	44	68	3.24
M811-3-A		1.4	0.7	87	29	58	104	2.16
M811-3-B	120	1.9	1.3	49	23	26	48	1.08
M811-3-C	175	2.1	1.5	44	20	24	40	1.08
M811-3-D	205	1.8	1.4	38	19	18	33	1.62
M811-3-E	325	1.5	1.0	63	25	37	59	1.08
M811-3-F	360	1.6	1.1	58	24	33	48	1.62
M811-5-A	75	1.4	0.7	78	28	50	100	3.78
M811-5-B	105	1.3	0.6	86	30	56	131	6.48
M811-5-C	170	1.5	0.8	74	31	43	89	4.32
M811-5-D	245	1.4	0.7	82	31	52	107	4.86
M811-5-E	345	1.5	0.8	68	28	40	82	5.94
M811-5-F	445	1.2	0.7	67	27	40	82	7.55
Cell Min.		**1.2**	**0.6**	**38**	**19**	**18**	**33**	**1**
Cell Max.		**2.1**	**1.5**	**93**	**34**	**59**	**131**	**8**
Cell Average		**1.5**	**0.9**	**68**	**27**	**41**	**81**	**3**
M19-3A	30	1.6	1.0	56	20	36	51	4.32
M19-3B	55	1.5	1.0	42	18	24	52	1.62
M19-3C	75	1.5	1.0	60	23	38	54	1.62
M19-3D	115	1.8	1.1	63	23	41	61	1.62
M19-16-A	120	1.4	0.8	72	25	48	78	3.24
M19-16-B	155	1.3	0.6	81	22	59	108	2.16
M19-16-C	180	1.1	0.5	110	32	79	114	3.24
M19-16-D	205	1.3	0.7	69	23	45	100	2.16
M19-16-E	240	1.4	0.8	54	23	32	78	2.70
M19-17-A	135	1.7	1.3	31	19	12	38	2.16
M19-17-B	165	1.5	0.9	66	25	41	62	2.70
M19-17-C	205	1.5	0.9	72	26	46	69	2.16
M19-17-D	265	1.6	1.1	49	20	28	56	1.62
M19-17-E	295	1.6	1.0	57	21	36	52	0.54
M19-17-F	325	1.5	0.9	53	21	32	67	1.62
Cell Min.		**1.1**	**0.5**	**31**	**18**	**12**	**38**	**1**
Cell Max.		**1.8**	**1.3**	**110**	**32**	**79**	**114**	**4**
Cell Average		**1.5**	**0.9**	**62**	**23**	**40**	**69**	**2**

Appendix D

Appendix D-1
REMOTS Image Analysis Results for the Boston Harbor Summer 2001 Survey

Station	Replicate	Date	Time	Grain Size			Camera Penetration (cm)				Surface Roughness	Apparent RPD Thickness(cm)				Successional Stage	Low DO	OSI	Mud Clasts		Dredged Material Thickness (cm)			Redox Rebound Thickness (cm)			Methane				Comments
				Min	Max	Maj Mode	Min	Max	Range	Mean		Area	Min	Max	Mean				Count	Diameter	Min	Max	Mean	Min	Max	Mean	Diameter	Min	Max	Mean	
IC																															
IC-1	A	8/16/2001	13:26	>4	4	>4	10.8	11.06	0.25	10.93	PHYSICAL	18.689	0.45	2.71	1.4	ST_I_ON_III	NO	7	0	0.35	10.8	11.06	>10.93	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD/BLKMUD,SMALLVOID,SMTUBES FF
IC-1	B	8/16/2001	13:27	>4	4	>4	6.03	6.28	0.25	6.16	PHYSICAL	20.237	0.1	3.07	1.73	ST_I_ON_III	NO	8	0	0.55	6.03	6.28	>6.16	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD(REBOUND?),RED CLASTS&DRAGDOWN,VOID LWR LEFT,TUBES
IC-1	C	8/16/2001	13:28	>4	4	>4	1.11	5.13	4.02	3.12	PHYSICAL	NA	NA	NA	NA	ST_I	NO	99	0	0	1.11	5.13	>3.12	0	0	0	0	0	0	0	DM>P,RPD>P,RED SED@SURF&DRGDOWN,TUBES@SURF
IC-2	A	8/16/2001	13:15	>4	4	>4	8.98	9.8	0.82	9.39	PHYSICAL	14.914	0.36	2.86	1.13	ST_I_ON_III	NO	7	0	0	8.98	9.8	>9.39	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD/BLKMUD,DISSECTBURROW,VOID,TUBE@SURF,POSS REBOUND
IC-2	B	8/16/2001	13:16	>4	4	>4	10.05	10.05	0	10.05	PHYSICAL	13.188	0.05	2.46	1.5	ST_I_ON_III	NO	7	1	0.31	10.05	10.05	>10.05	0	0	0	0	0	0	0	DM>P,BRN SLTYMUD/GRAYMUD/BLKMUD,REDSED PATECHES@SURF,VOIDS,SM TUBES@SURF
IC-2	C	8/16/2001	13:17	>4	3	>4	12.26	13.12	0.85	12.69	PHYSICAL	45.348	1.46	3	2	ST_I	NO	4	6	0.68	12.26	13.12	>12.69	0	0	0	0	0	0	0	DM>P,BRN MUD/GRAYBLK MUD,CLASTS&TUBES@SURF,FECAL MOUND
IC-3	A	8/16/2001	13:19	>4	4	>4	3.47	13.07	9.6	8.27	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	6	0.68	3.47	13.07	>8.27	0	0	0	0	0	0	0	DM>P,SOLID DK&LTGRAY CLAY,VERY ROUGHSURF,SM TUBES@SURF,PULL AWAY
IC-3	B	8/16/2001	13:20	>4	3	>4	4.97	5.88	0.9	5.43	PHYSICAL	20.486	0.1	2.71	1.61	ST_I_ON_III	NO	8	0	0	4.97	5.88	>5.43	0	0	0	0	0	0	0	DM>P,BRN MUD/GRAY MUD&CLAY,VOIDS,TUBES@SURF
IC-3	C	8/16/2001	13:20	>4	4	>4	5.03	5.68	0.65	5.35	PHYSICAL	35.647	0.1	0.5	0.4	ST_I	NO	2	6	0.42	5.03	5.68	>5.35	0	0	0	0	0	0	0	DM>P,BRN MUD/GRAYBLK,MUD&CLAY
IC-4	A	8/16/2001	13:11	>4	2	>4	11.76	12.16	0.4	11.96	PHYSICAL	NA	0.2	1	0.5	ST_I	NO	2	0	0.05	11.76	12.16	>11.96	0	0	0	0	0	0	0	DM>P,VERYTHIN RPD/GRAY MUD/BLACKMUD,TUBES IN FF,REDSED@SURF
IC-4	B	8/16/2001	13:12	>4	4	>4	12.01	12.41	0.4	12.21	PHYSICAL	NA	NA	NA	NA	ST_I_ON_III	NO	99	1	0.51	12.01	12.41	>12.21	0	0	0	0	0	0	0	DM>P,VOIDS,TUBES@SURF,VERYTHIN RPD DUE TO REBOUND,REDSED@SURF
IC-4	C	8/16/2001	13:12	>4	4	>4	10.65	11.01	0.35	10.83	PHYSICAL	15.861	0.1	1.66	1.12	ST_I	NO	3	0	0.98	10.65	11.01	>10.83	0	0	0	0	0	0	0	DM>P,BRNSLTYMUD/GREYMUD/BLKMUD,TUBES
IC-5	A	8/16/2001	12:57	>4	4	>4	14.59	16.34	1.75	15.46	INDETERMINATE	0	NA	NA	NA	INDET	NO	99	5	0.58	14.59	16.34	>15.46	0	0	0	0	0	0	0	DM>P,REDUCED MUD>P,PULL AWAY=DISTURBED SURF
IC-5	B	8/16/2001	12:58	>4	1	>4	12.78	13.4	0.62	13.09	INDETERMINATE	NA	NA	NA	NA	ST_III	NO	99	0	0	12.78	13.4	>13.09	0	0	0	0	0	0	0	DM>P,OBSCURED SURF,COARSE&FLUID MUD/GRAY&BLK MUD,WORM,SM VOID
IC-5	C	8/16/2001	12:59	>4	4	>4	9.69	10.26	0.57	9.97	PHYSICAL	15.41	0.65	1.76	1.09	ST_I_ON_III	NO	7	3	0.47	9.69	10.26	>9.97	0	0	0	0	0	0	0	DM>P,BRNSLTYMUD/GRAYMUD/BLKMUD,VOID,TUBES@SURF,THIN RPD
IC-6	A	8/16/2001	13:32	>4	3	>4	13.17	14.12	0.95	13.64	PHYSICAL	15.41	0.65	1.76	1.09	ST_I_ON_III	NO	7	0	1.02	13.17	14.12	>13.64	0	0	0	0	0	0	0	DM>P,RPD VERYTHIN DUE TO REBOUND,FILLEDBURROW,VOID,TUBE@SURF
IC-6	B	8/16/2001	13:33	>4	4	>4	12.31	13.72	1.41	13.02	PHYSICAL	15.107	0.82	4.59	2.15	ST_I	NO	4	0	0.46	12.31	13.72	>13.02	0	0	0	0	0	0	0	DM>P,BRNSILTY MUD/GRAY MUD/BLK MUD,WORM@Z,
IC-6	C	8/16/2001	13:33	>4	4	>4	10.8	11.66	0.85	11.23	PHYSICAL	20.442	0.7	2.51	1.51	ST_I	NO	4	0	0.61	10.8	11.66	>11.23	0	0	0	0	0	0	0	DM>P,BRNSLTYMUD/GRAYMUD/BLKMUD,CLASTS@SURF
REF																															
IC-REF	A	8/16/2001	12:51	>4	3	>4	7.74	8.59	0.85	8.17	PHYSICAL	12.86	0.25	1.91	0.95	ST_I_ON_III	NO	7	0	0.61	7.74	8.59	>8.17	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD,VOID,TUBES@SURF,HIGH SOD,THIN RPD
IC-REF	B	8/16/2001	12:52	>4	3	>4	10.85	11.01	0.15	10.93	PHYSICAL	11.375	0.25	2.16	1.1	ST_I_ON_III	NO	7	0	0	10.85	11.01	>10.93	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD/GRAYMUD/BLKMUD,DBL REBOUND,VOIDS,TUBES
IC-REF	C	8/16/2001	12:53	>4	2	>4	9.75	10	0.25	9.87	PHYSICAL	23.204	0.35	3.47	1.78	ST_I_to_II	NO	5	0	0	9.75	10	>9.87	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD,MANYTUBES@SURF,HIGH SOD

Appendix D-2
REMOTS Image Analysis Results for the Boston Harbor Summer 2001 Survey

Station	Replicate	Date	Time	Grain Size			Camera Penetration (cm)				Surface Roughness	Apparent RPD Thickness(cm)				Successional Stage	Low DO	OSI	Mud Clasts		Dredged Material Thickness (cm)			Redox Rebound Thickness (cm)			Methane				Comments
				Min	Max	Maj Mode	Min	Max	Range	Mean		Area	Min	Max	Mean				Count	Diameter	Min	Max	Mean	Min	Max	Mean	Diameter	Min	Max	Mean	
M4																															
M4-1	A	8/15/2001	15:54	>4	3	>4	12.45	13.28	0.83	12.86	PHYSICAL	11.864	0.05	1.93	0.5	ST_I	NO	2	0	0	12.45	13.28	>12.86	0	0	0	0	0	0	0	DM>P,BRNMUD/BANDED GRAY AND BLK MUD,RELIC RPD,HIGH SOD
M4-1	B	8/15/2001	15:54	>4	4	>4	15.26	16.2	0.94	15.73	PHYSICAL	8.396	0.1	2.08	1.12	ST_I	NO	3	0	0	15.26	16.2	>15.73	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAY&BLKMUD,HIGH SOD,RELIC RPD
M4-1	C	8/15/2001	15:56	>4	2	>4	16.72	17.34	0.63	17.03	PHYSICAL	6.668	0.05	1.35	0.43	ST_I	NO	2	1	0.83	16.72	17.34	>17.03	0	0	0	0	0	0	0	DM>P,BRNRPD/BANDED GRAY&BLKMUD,POSS REBOUND,HIGH SOD
M4-2	A	8/15/2001	16:02	>4	3	>4	19.38	20.83	1.46	20.1	PHYSICAL	14.041	0.26	2.29	0.99	ST_I_ON_III	NO	7	0	0	19.38	20.83	>20.1	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD/BLKMUD,VOID,SMTUBES@SURF,HIGH SOD,LAYERING
M4-2	B	8/15/2001	16:02	>4	3	>4	16.2	17.76	1.56	16.98	PHYSICAL	14.346	0.1	1	0.5	ST_I	NO	2	2	0.68	16.2	17.76	>16.98	0	0	0	0	0	0	0	DM>P,THIN BRNMUD/MOTTLED GRAY&BLKMUD,HIGH SOD,RELIC RPD,REDSED@SURF
M4-2	D	8/16/2001	10:43	>4	3	>4	10.16	10.78	0.63	10.47	PHYSICAL	NA	0.01	0.3	0.1	ST_I	NO	2	1	0.58	10.16	10.78	>10.47	0	0	0	0	0	0	0	DM>P,THIN BRNMUD/GRAYCLAY/MOTTLEDBLKMUD,REDSED@SURF,TUBE@SURF,FRACTURES
M4-3	A	8/15/2001	16:16	>4	4	>4	18.54	19.48	0.94	19.01	PHYSICAL	9.854	0.21	2.55	1.42	ST_I	NO	1	2	0.68	18.54	19.48	>19.01	0	0	0	0.561	0.22	0.22	0.22	DM>P,BRNMUD/CLAY/BLKMUD/GRAYMUD/BLKMUD,RELIC RPD,METH,TUBES@SURF
M4-3	C	8/15/2001	16:18	>4	3	>4	9.9	10.31	0.42	10.1	PHYSICAL	7.275	0.16	1.61	0.84	ST_I	NO	3	1	0.42	9.9	10.31	>10.1	0	0	0	0	0	0	0	DM>P,BRNMUD/MOTLLED MUD&CLAY,DEWATERING CHANNELS,HIGH SOD
M4-3	D	8/16/2001	10:49	>4	2	>4	10.83	10.83	0	10.83	PHYSICAL	13.178	0.31	1	0.5	ST_I	NO	2	0	0	10.83	10.83	>10.83	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD/BLKMUD,FRACTURES,TUBES,HIGH SOD
M4-4	A	8/15/2001	16:07	>4	3	>4	18.02	18.65	0.63	18.33	PHYSICAL	21.719	0.73	2.24	1.55	ST_I_ON_III	NO	8	1	0.42	18.02	18.65	>18.33	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD/BLKMUD,POSS REBOUND,VOIDS,TUBES,HIGH SOD
M4-4	B	8/15/2001	16:08	>4	2	>4	15.57	17.14	1.56	16.35	PHYSICAL	NA	0	0.5	0.1	ST_I	NO	2	1	1.31	15.57	17.14	>16.35	0	0	0	0	0	0	0	DM>P,PATCHYBRNMUD/GRAY&BLKMUD,REDSED@SURF,SANDBAND,HIGH SOD
M4-4	C	8/15/2001	16:09	>4	1	>4	16.41	16.77	0.36	16.59	PHYSICAL	24.083	0.36	2.08	1.68	ST_I	NO	4	4	0.78	16.41	16.77	>16.59	0	0	0	0	0	0	0	DM>P,BRNSANDYMUD/GRAY&BLKMUD,COARSE BLK SEDS@Z,DRAGDOWN OVER RPD,HIGH SOD
M4-5	B	8/15/2001	16:21	>4	2	>4	18.02	19.11	1.09	18.57	PHYSICAL	40.048	0.05	3.23	2	ST_I	NO	4	5	0.54	18.02	19.11	>18.57	0	0	0	0	15	19.11	17.06	DM>P,BRNSANDYMUD/GRAY&BLKMUD,METHANE@Z,SMEARED RPD
M4-5	C	8/15/2001	16:22	>4	2	>4	18.8	19.01	0.21	18.91	PHYSICAL	24.52	0.57	1.5	1	ST_I	NO	1	0	0.42	18.8	19.01	>18.91	0	0	0	0.316	8.44	18.23	13.33	DM>P,BRNSANDYMUD/GRAY&BLKMUD,METHANE,OBSCURED RPD
M4-5	D	8/16/2001	10:53	>4	2	>4	8.8	9.95	1.15	9.38	PHYSICAL	7.173	0.05	1.25	0.47	ST_I	NO	2	0	0	8.8	9.95	>9.38	0	0	0	0	0	0	0	DM>P,BRNSANDYMUD/GRAY&BLKMUD,TUBES
M4-6	A	8/15/2001	16:27	>4	2	>4	18.39	19.22	0.83	18.8	PHYSICAL	22.664	0.73	2.66	1.57	ST_I	NO	4	0	0	18.39	19.22	>18.8	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,RELIC RPD,HIGH SOD
M4-6	C	8/15/2001	16:28	>4	2	>4	13.18	14.07	0.89	13.62	PHYSICAL	30.271	1.04	2.76	2.13	ST_I	NO	4	0	0	13.18	14.07	>13.62	0	0	0	0	0	0	0	DM>P,MOTTLED CLAY,REDSED@SURF,FRACTURES
M4-6	E	8/16/2001	10:58	>4	>4	>4	5.73	5.99	0.26	5.86	PHYSICAL	0	NA	NA	NA	ST_I	NO	99	0	0	5.73	5.99	>5.86	0	0	0	0	0	0	0	DM>P,WHITE CLAY>P,DENSE TUBES@SURF
M5																															
M5-1	B	8/15/2001	16:35	>4	1	>4	19.01	19.43	0.42	19.22	PHYSICAL	68.429	0.52	6.72	5.27	ST_I	NO	7	0	0	19.01	19.43	>19.22	0	0	0	0	0	0	0	DM>P,BRNMUD W/MOTTLED CLAY&REDSED/BLKMUD,HIGH SOD@Z
M5-1	C	8/15/2001	16:37	>4	2	>4	18.02	18.54	0.52	18.28	PHYSICAL	75.605	2.81	7.24	5.69	ST_I	NO	5	0	0	18.02	18.54	>18.28	0	0	0	0.75	5	5.75	5.38	DM>P,BRNMUD/BLKMUD W/MOTTLED CLAY,HIGH SOD,METH BUBBLE RIGHT
M5-1	E	8/15/2001	16:38	>4	2	>4	16.56	17.08	0.52	16.82	PHYSICAL	42.636	1.61	4.43	3.19	ST_I	NO	6	0	0	16.56	17.08	>16.82	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD W/CLAY,HIGH SOD,LAYERING
M5-2	A	8/16/2001	11:03	>4	2	>4	9.43	10.78	1.35	10.1	PHYSICAL	NA	NA	NA	NA	AZOIC	NO	99	0	0	9.43	10.78	>10.1	0	0	0	0	0	0	0	DM>P,BLKMUD W/THIN RPD,WHITE CLAY CLAST,OX BRNSED@SURF,HIGH SOD
M5-2	B	8/16/2001	11:04	>4	4	>4	7.92	9.01	1.09	8.46	PHYSICAL	12.914	0.05	1.72	0.83	ST_I	NO	3	0	0	7.92	9.01	>8.46	0	0	0	0	0	0	0	DM>P,BRNMUD/MOTTLEDCLAY/BLKMUD,REDSED@SURF,LAYERING
M5-2	C	8/16/2001	11:05	>4	4	>4	9.01	9.32	0.31	9.17	PHYSICAL	12.883	0.31	1.67	0.93	ST_I	NO	3	0	0	9.01	9.32	>9.17	0	0	0	0	0	0	0	DM>P,BRNMUD/BLK MUD,MOTTLEDCLAY,CLAY,HIGH SOD
M5-3	A	8/16/2001	11:13	>4	3	>4	1.86	2.06	0.21	1.96	PHYSICAL	11.67	0.05	1.49	0.84	ST_I	NO	3	2	0.37	1.86	2.06	>1.96	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD,UNDERPEN
M5-3	B	8/16/2001	11:13	>4	4	>4	9.79	10.57	0.77	10.18	PHYSICAL	23.35	1.03	1.96	1.63	ST_I	NO	4	4	0.52	9.79	10.57	>10.18	0	0	0	0	0	0	0	DM>P,BRNFLOCCULANT MUD/CLAY/BLKMUD,DRAGDOWN,HIGH SOD@Z
M5-3	C	8/16/2001	11:14	>4	4	>4	9.54	9.95	0.41	9.74	PHYSICAL	20.866	0.98	1.91	1.45	ST_I	NO	3	0	0	9.54	9.95	>9.74	0	0	0	0	0	0	0	DM>P,BRNMUD/CLAY/BLKMUD/GRAYMUD,POSS RELIC RPD OR REBOUND,HIGH SOD
M5-4	A	8/16/2001	11:18	>4	4	>4	9.33	9.43	0.1	9.38	PHYSICAL	11.587	0.21	1.86	1.12	ST_I	NO	3	0	0	9.33	9.43	>9.38	0	0	0	0	0	0	0	DM>P,BRN VYFINESAND/CLAY/BLKMUD,DRAGDOWN,FRACTURES,HIGH SOD
M5-4	B	8/16/2001	11:19	>4	4	>4	3.3	4.07	0.77	3.69	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	0	0	3.3	4.07	>3.69	0	0	0	0	0	0	0	DM>P,DIST.SURF,BRNMUD/BLKMUD,CLAY
M5-4	C	8/16/2001	11:20	>4	2	>4	10.05	10.67	0.62	10.36	PHYSICAL	38.626	0.26	3	2.25	ST_I	NO	4	2	0.49	10.05	10.67	>10.36	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD&CLAY,DRAGDOWN,LAYERING,HIGH SOD
M5-5	A	8/16/2001	11:22	>4	2	>4	8.82	10.1	1.29	9.46	PHYSICAL	44.01	2.27	3.97	3.09	ST_I	NO	6	1	0.67	8.82	10.1	>9.46	0	0	0	0	0	0	0	DM>P,BRNMUD/CLAY/BLKMUD
M5-5	B	8/16/2001	11:23	>4	2	>4	8.25	8.97	0.72	8.61	PHYSICAL	16.696	0.1	1.55	1.15	ST_I	NO	3	1	0.67	8.25	8.97	>8.61	0	0	0	0	0	0	0	DM>P,BRNMUD/CLAY/BLKMUD,MOTTLED
M5-5	C	8/16/2001	11:24	>4	2	>4	7.37	8.92	1.55	8.14	PHYSICAL	21.967	0.15	2.37	1.61	ST_I	NO	4	1	0.67	7.37	8.92	>8.14	0	0	0	0	0	0	0	DM>P,BRNMUD/CLAY/BLKMUD,CLASTS FF
M5-6	A	8/16/2001	11:09	>4	>4	>4	0.21	2.16	1.96	1.19	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	0	0	0.21	2.16	>1.19	0	0	0	0	0	0	0	DM>P,STIFF WHITE CLAY,UNDERPEN
M5-6	C	8/16/2001	11:10	>4	>4	>4	3.97	5.93	1.96	4.95	PHYSICAL	NA	NA	NA	NA	ST_I	NO	99	0	0	3.97	5.93	>4.95	0	0	0	0	0	0	0	DM>P,WHITE CLAY,DIST SURF,TUBES,UNDERPEN=STIFF CLAY
M12																															
M12-1	A	8/15/2001	14:32	>4	2	>4	10.25	15.07	4.82	12.66	PHYSICAL	29.651	0.36	3.64	2.2	ST_I	NO	4	5	1.62	10.25	15.07	>12.66	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,SMTUBES@SURF,LARGE CLASTS,HIGH SOD
M12-1	E	8/16/2001	11:50	>4	2	>4	10.05	10.61	0.56	10.33	PHYSICAL	16.521	0.21	2.05	1.26	ST_I	NO	3	0	0	10.05	10.61	>10.33	0	0	0	0	0	0	0	DM>P,BRNMUD/SAND W/SHELL/BLKMUD,SHELL HASH LAYER@Z
M12-1	G	8/16/2001	11:52	>4	2	>4	10.35	12.2	1.85	11.28	PHYSICAL	35.807	0.46	2.4	1.75	ST_I_TO_II	NO	6	0	0	10.35	12.2	>11.28	0	0	0	0	0	0	0	DM>P,BRNMUD/SAND/BLKMUD,AMP@SURF?,HIGH SOD,SHELLFRAG LAYER@Z
M12-2	A	8/16/2001	14:29	>4	4	>4	17.89	18.25	0.36	18.07	PHYSICAL	24.403	0.51	3.02	1.84	ST_I	NO	4	1	0.64	17.89	18.25	>18.07	0	0	0	0	0	0	0	DM>P,BRNMUD,BLKMUD,HIGH SOD
M12-2	B	8/16/2001	14:29	>4	3	>4	19.53	20.09	0.56	19.81	PHYSICAL	48.461	0.82	2.5	2	ST_I_ON_III	NO	8	0	0.47	19.53	20.09	>19.81	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,OBSCURED RPD,SMEARED CLASTS,SM VOIDS,HIGH SOD
M12-2	C	8/16/2001	14:30	>4	2	>4	16.61	17.68	1.08	17.15	PHYSICAL	22.084	0.21	2.51	1.56	ST_I	NO	4	4	0.36	16.61	17.68	>17.15	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD
M12-3	D	8/16/2001	11:58	>4	2	>4	10.61	10.97	0.36	10.79	PHYSICAL	34.473	0.26	4.12	2.61	ST_I_ON_III	NO	9	4	0.36	10.61	10.97	>10.79	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,VOID,SM TUBES@SURF,HIGH SOD
M12-3	E	8/16/2001	11:59	>4	4	>4	4.97	7.84	2.87	6.41	PHYSICAL	13.264	0.1	1.74	1.03	ST_I	NO	3	0	0	4.97	7.84	>6.41	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,REDSED NEARSURF,TUBES,HIGH SOD
M12-3	F	8/16/2001	12:00	>4	2	>4	9.69	10.35	0.67	10.02	PHYSICAL	18.269	0.1	3.13	2.17	ST_I	NO	4	0	0	9.69	10.35	>10.02	0	0	0	0	0	0	0	DM>P,BRNSANDYMUD/BLKMUD,POSS REBOUND,WORM@Z,PATCHY REDSED@SURF
M12-4	D	8/16/2001	12:15	>4	3	>4	10.2	10.87	0.67	10.53	PHYSICAL	10.358	0.05	1.9	0.81	ST_I_ON_III	NO	7	0	0	10.2	10.87	>10.53	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,VOID,AMP,HIGH SOD
M12-4	E	8/16/2001	12:16	>4	3	>4	10.2	10.3	0.1	10.25	PHYSICAL	7.426	0.05	1.44	0.7	ST_I_ON_III	NO	6	0	0	10.2	10.3	>10.25	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,POSS RELIC RPD OR REBOUND,REDSED@SURF,SHALLOW VOID,SMTUBE
M12-4	F	8/16/2001	12:17	>4	3	>4	10	10.35	0.36	10.17	PHYSICAL	16.731	0.1	3	2.5	ST_I	NO	5	0	0	10	10.35	>10.17	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,SM PATCHES RESED@SURF(SMEARED),SM TUBES,HIGH SOD@Z
M12-5	D	8/16/2001	12:11	>4	3	>4	11.64	12.2	0.56	11.92	PHYSICAL	17.725	0.36	2.31	1.35	ST_I	NO	3	0	0	11.64	12.2	>11.92	0	0	0	0	0	0	0	DM>P,BRNMUD/SANDLAYER/BLKMUD,TUBES@SURF
M12-5	E	8/16/2001	12:11	>4	2	>4	10.97	11.43	0.46	11.2	PHYSICAL	13.136	0.1	2.05	2	ST_I_TO_II	NO	4	2	0.69	10.97	11.43	>11.2	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD/BLKMUD,POSS RELIC RPD OR REBOUND,AMP TUBES@SURF
M12-5	F	8/16/2001	12:12	>4	3	>4	11.02	11.17	0.15	11.1	PHYSICAL	7.844	0.05	3.43	1.42	ST_I	NO	3	2	0.69	11.02	11.17	>11.1	0	0	0	0	0	0	0	DM>P,BRNMUD/SAND/GRAYMUD/BLKMUD,REDSED@SURF,TUBE@SURF,HIGH SOD
M12-6	D	8/16/2001	12:05	>4	3	>4	13.22	13.38	0.15	13.3	PHYSICAL	9.302	0.15	1.28	0.64	ST_I	NO	2	0	1.03	13.22	13.38	>13.3	0	0	0	0	0	0	0	DM>P,BRNMUD/SAND/BLKMUD,HIGH SOD
M12-6	E	8/16/2001	12:06	>4	2	>4	10.71	11.28	0.56	10.99	PHYSICAL	6.793	0.1	1.44	0.67	ST_I	NO	2	0	0	10.71	11.28	>10.99	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD/SHALLOWSAND,RESED@SURF,SMTUBES@SURF,REBOUND,HIGH SOD
M12-6	F	8/16/2001	12:07	>4	2	>4	9.23	10.4	1.18	9.82	PHYSICAL	6.75	0.05	2.46	0.7	ST_I	NO	2	0	0	9.23	10.4	>9.82	0	0	0	0	0	0	0	DM>P,THINBRNMUD/BLKMUD,BLK DEBRIS@SURF,REDSED IN FF,BURROW IN FF?,HIGH SOD
REF																															
MR-REF	B	8/16/2001	11:31	>4	4	>4	5.83	14.47	8.64	10.15	PHYSICAL	0	NA	NA	NA	INDET	NO	99	0	0	5.83	14.47	>10.15	0	0	0	0	0	0	0	DISSECTED BRN&BLK CLAY CLUMP
MR-REF	C	8/16/2001	11:31	>4	2	>4	10.45	11.16	0.7	10.8	PHYSICAL	22.289	0.6	3.42	1.7	ST_I	NO	4	3	1.04	10.45	11.16	>10.8	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD,TRACE 2PHI@SURF?
MR-REF	D	8/16/2001	11:32	>4	2	>4	8.14	20.67	12.53	14.41	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	3	1.04	8.14	20.67	>14.41	0	0	0	0	0	0	0	OVERPEN,BRNMUD/BLKMUD,REDSED@SURF,DISTURBED SURF,BURROWS,HIGH SOD

Appendix D-3
REMOTS Image Analysis Results for the Boston Harbor Summer 2001 Survey

Station	Replicate	Date	Time	Grain Size			Camera Penetration (cm)				Surface Roughness	Apparent RPD Thickness(cm)				Successional Stage	Low DO	OSI	Mud Clasts		Dredged Material Thickness (cm)			Redox Rebound Thickness (cm)			Methane				Comments
				Min	Max	Maj Mode	Min	Max	Range	Mean		Area	Min	Max	Mean				Count	Diameter	Min	Max	Mean	Min	Max	Mean	Diameter	Min	Max	Mean	
M2																															
M2-1	D	8/16/2001	9:52	>4	2	>4	14.61	16.28	1.68	15.44	PHYSICAL	21.939	0.42	1.88	1.53	ST_I	NO	4	0	0	14.61	16.28	>15.44	0	0	0	0	0	0	0	DM>P,BRNRPD/LAYERED GRAY&BLKMUD,OBSCURED RPD,FRACTURES,HIGH SOD
M2-1	F	8/16/2001	9:53	>4	2	>4	16.23	16.65	0.42	16.44	PHYSICAL	NA	0.2	0.7	0.5	ST_I	NO	2	0	0	16.23	16.65	>16.44	0	0	0	0	0	0	0	DM>P,RPD~.5-1.0CM/GRAYMUD/BLKMUD/GRAYMUD,RELIC RPD,HIGH SOD
M2-1	I	8/16/2001	10:09	>4	3	>4	11.41	11.83	0.42	11.62	PHYSICAL	5.694	0.05	1.26	0.7	ST_I_ON_III	NO	6	0	0	11.41	11.83	>11.62	0	0	0	0	0	0	0	DM>P,BRNRPD/BANDEDGRAY&BLKMUD,RELIC RPD,SMTUBES&VOIDS,HIGH SOD
M2-2	A	8/15/2001	15:38	>4	3	>4	16.91	16.91	0	16.91	INDETERMINATE	NA	NA	NA	NA	INDET	NO	99	0	0	16.91	16.91	>16.91	0	0	0	0	0	0	0	DM>P,OBSCUREDINTERFACE,RPD/BANDED GRAY&BLKMUD,RELIC RPD,HIGH SOD
M2-2	B	8/15/2001	15:39	>4	2	>4	16.65	16.81	0.16	16.73	PHYSICAL	16.084	0.1	0.5	0.4	AZOIC	NO	-2	0	0	16.65	16.81	>16.73	0	0	0	0	0	0	0	DM>P,OBSCURED RPD/GRAY&BLKMUD,HIGH SOD,RELIC RPD,REDSED@SURF
M2-2	C	8/15/2001	15:39	>4	3	>4	17.38	18.74	1.36	18.06	PHYSICAL	17.159	0.1	0.5	0.4	AZOIC	NO	-2	0	0	17.38	18.74	>18.06	0	0	0	0	0	0	0	DM>P,OBSCURED RPD/GRAY&BLKMUD,HIGH SOD
M2-3	C	8/15/2001	15:44	>4	2	>4	19.84	20.47	0.63	20.16	PHYSICAL	18.904	0.1	0.75	0.5	ST_I	NO	2	5	0.42	19.84	20.47	>20.16	0	0	0	0	0	0	0	DM>P,PART OBSUCURED RPD,TUBES@SURF,HIGH SOD
M2-3	D	8/16/2001	10:30	>4	2	>4	10.05	10.63	0.58	10.34	PHYSICAL	12.867	0.05	1.57	0.91	ST_I	NO	3	6	0.73	10.05	10.63	>10.34	0	0	0	0	0	0	0	DM>P,BRNRPD/GRAY&BLKMUD,HIGH SOD,RED. MUDCLASTS
M2-3	E	8/16/2001	10:30	>4	3	>4	10.37	10.94	0.58	10.65	PHYSICAL	12.768	0.16	1.83	0.89	ST_I	NO	3	6	0.73	10.37	10.94	>10.65	0	0	0	0	0	0	0	DM>P,BRNRPD/GRAY&BLKMUD,TUBES,VOID
M2-4	D	8/16/2001	10:25	>4	1	>4	10.94	11.2	0.26	11.07	PHYSICAL	7.039	0.31	1.2	0.68	ST_I	NO	2	0	0	10.94	11.2	>11.07	0	0	0	0	0	0	0	DM>P,BRNSANDYMUD/GRAY&BLKMUD,SM TUBES@SURF,HIGH SOD
M2-4	E	8/16/2001	10:26	>4	2	>4	10.73	11.73	0.99	11.23	PHYSICAL	5.416	0.26	1.57	1	ST_I_ON_III	NO	7	4	0.69	10.73	11.73	>11.23	0	0	0	0	0	0	0	DM>P,BRNMUDSANDYMUD/GRAY&BLKMUD,VOID?,TUBES@SURF,HIGH SOD
M2-4	F	8/16/2001	10:27	>4	3	>4	10.21	11.15	0.94	10.68	PHYSICAL	6.273	0.16	1.47	0.73	ST_I	NO	2	2	0.46	10.21	11.15	>10.68	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAY/BLK/GRAYMUD,RELIC RPD,TUBES@SURF,HIGH SOD
M2-5	D	8/16/2001	10:02	>4	3	>4	11.15	12.72	1.57	11.94	PHYSICAL	7.998	0.26	1.31	0.87	ST_I	NO	3	1	0	11.15	12.72	>11.94	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAY&BLKMUD,TUBES@SURF,HIGH SOD,MUDCLAST ARTIFACT
M2-5	E	8/16/2001	10:02	>4	3	>4	12.3	12.41	0.1	12.36	PHYSICAL	13.271	0.37	1.41	0.5	ST_I	NO	3	8970	0.53	12.3	12.41	>12.36	0	0	0	0	0	0	0	DM>P,BRNRPD,GRAY&BLKMUD,SM TUBES@SURF,HIGH SOD
M2-5	F	8/16/2001	10:03	>4	3	>4	12.09	12.25	0.16	12.17	PHYSICAL	12.655	0.36	1.13	0.86	ST_I	NO	3	2	0.52	12.09	12.25	>12.17	0	0	0	0	0	0	0	DM>P,BRNRPD/GRAY&BLKMUD,SM TUBES@SURF,HIGH SOD
M2-6	B	8/15/2001	15:48	>4	3	>4	19.58	20.21	0.63	19.89	PHYSICAL	6.03	0.05	1	0.5	ST_I_ON_III	NO	6	2	0.52	19.58	20.21	>19.89	0	0	0	0	0	0	0	DM>P,THINBRNRPD/BANDEDGRAY&BLKMUD,SM TUBES@SURF,VOID DEEP,HIGH SOD
M2-6	D	8/16/2001	10:35	>4	3	>4	11.83	12.2	0.37	12.02	PHYSICAL	22.88	0.16	2	0.5	ST_I	NO	2	1	0.48	11.83	12.2	>12.02	0	0	0	0	0	0	0	DM>P,BRNRPD/GRAYMUD/BLKMUD,REDSED@SURF,SM TUBES@SURF,HIGH SOD
M2-6	E	8/16/2001	10:35	>4	2	>4	10.42	11.41	0.99	10.92	PHYSICAL	16.423	0.01	0.5	0.2	ST_I	NO	2	0	0	10.42	11.41	>10.92	0	0	0	0	0	0	0	DM>P,SHALLOWRPD/GRAY&BLKMUD,HIGH SOD
SC																															
SC-1	D	8/16/2001	12:40	>4	2	>4	12.76	13.32	0.56	13.04	PHYSICAL	20.715	0.26	3.88	1.64	ST_I	NO	4	2	0.77	12.76	13.32	>13.04	0	0	0	0	0	0	0	DM>P,BRN SANDYMUD/BLKMUD,HIGH SOD
SC-1	E	8/16/2001	12:41	>4	2	>4	10.15	10.82	0.66	10.48	PHYSICAL	45.609	1.19	4.9	2.5	ST_I	NO	5	1	1.04	10.15	10.82	>10.48	0	0	0	0	0	0	0	DM>P,BRNSANDYMUD/BLKMUD,TUBES@SURF,SHELLFRAGS,S/M
SC-1	F	8/16/2001	12:42	>4	3	>4	14.85	16.63	1.79	15.74	PHYSICAL	35.677	0.1	3	2.25	ST_I	NO	4	2	0.99	14.85	16.63	>15.74	0	0	0	0	0	0	0	DM>P,BRN SANDYMUD/BLKMUD,SHELL
SC-2	D	8/16/2001	12:21	>4	>4	>4	6.43	7.96	1.53	7.19	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	2	0.99	6.43	7.96	>7.19	0	0	0	0	0	0	0	DM>P,LARGE CLAY CLUMP,REDSED@SURF,FLUID LAYER,POSS REBOUND,SM RPD?
SC-2	E	8/16/2001	12:22	>4	3	>4	11.28	12.91	1.63	12.09	PHYSICAL	18.368	0.26	1.99	1.35	ST_I	NO	3	0	0	11.28	12.91	>12.09	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,SMSHELLFRAGS,TUBES@SURF
SC-2	F	8/16/2001	12:23	>4	2	>4	10.31	10.77	0.46	10.54	PHYSICAL	44.894	0.36	1.5	1	ST_I	NO	3	0	0	10.31	10.77	>10.54	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,TUBES@SURF,CLASTS FF
SC-3	A	8/15/1986	13:38	>4	2	>4	18.37	18.78	0.41	18.57	PHYSICAL	45.122	1.33	3.88	3.26	ST_I_ON_III	NO	10	2	0.51	18.37	18.78	>18.57	0	0	0	0	0	0	0	DM>P,BRNSANDYMUD/BLKMUD/GRAYMUD,VOIDS,TUBES@SURF,POSS REBND,HIGH SOD
SC-3	B	8/15/1986	13:39	>4	2	>4	9.34	9.9	0.56	9.62	PHYSICAL	15.756	0	3.72	3.03	ST_I	NO	6	0	0	9.34	9.9	>9.62	0	0	0	0	0	0	0	DM>P,BRNSANDYMUD/BLKMUD,REDSED@SURF,TUBES
SC-3	C	8/15/1986	13:39	>4	2	>4	14.2	14.92	0.72	14.56	PHYSICAL	40.517	1.18	3	2.5	ST_I	NO	5	0	0	14.2	14.92	>14.56	0	0	0	0	0	0	0	DM>P,SANDCAP,BRNSANDYMUD/GRAYMUD/BLKMUD,PATCHY REDSED@SURF,HIGH SOD
SC-4	A	8/15/1986	13:23	>4	2	3 to 2	9.38	9.79	0.41	9.58	PHYSICAL	40.324	1.28	4.72	2.84	ST_I	NO	5	0	0	9.38	9.79	>9.58	0	0	0	0	0	0	0	DM>P,SANDCAP,BRNSAND/BLKMUD,SHELLFRAGS@Z,SHELLANDROCKS@SURF
SC-4	B	8/15/1986	13:24	>4	2	3 to 2	9.38	9.53	0.15	9.46	PHYSICAL	34.066	1.03	3.84	2.57	ST_I	NO	5	0	0	9.38	9.53	>9.46	0	0	0	0	0	0	0	DM>P,BRNSAND/GRAYMUD/BLKMUD,SANDCAP,POSSREBOUND,SMSHELLFRAGS@Z,S/M
SC-4	C	8/15/1986	13:24	>4	2	3 to 2	11.43	12.15	0.72	11.79	PHYSICAL	NA	0.5	3	2	ST_I	NO	4	0	0	11.43	12.15	>11.79	0	0	0	0	0	0	0	DM>P,SAND CAP/BLKMUD,GRAY MUD@Z,SHELLFRAGS&SHELLS,SM PATCHY REDSED@SURF
SC-5	A	8/15/1986	13:28	>4	2	>4	18.96	19.78	0.82	19.37	PHYSICAL	21.418	0.15	3.54	1.66	ST_I	NO	4	0	0	18.96	19.78	>19.37	0	0	0	0	0	0	0	DM>P,SANDCAP/BLKMUD W/GRAYBAND,POSS RELICRPD/REBOUND,SHELLFRAGS IN CAP,TUBES
SC-5	D	8/16/2001	12:33	>4	2	>4	9.34	10.1	0.77	9.72	PHYSICAL	25.538	1.02	3.47	1.92	ST_I	NO	4	0	0	9.34	10.1	>9.72	0	0	0	0	0	0	0	DM>P,SANDY BRNMUD/BLKMUD,SHELL FRAGS,TUBES,HIGH SOD
SC-5	E	8/16/2001	12:34	>4	3	>4	10.82	11.28	0.46	11.05	PHYSICAL	20.169	0.71	2.55	1.51	ST_I	NO	4	0	0	10.82	11.28	>11.05	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD/BLKMUD,TUBES@SURF,POSS REBOUND
SC-6	C	8/15/2001	13:35	>4	2	>4	18.42	19.54	1.12	18.98	PHYSICAL	12.057	0.66	2.5	1.5	ST_I	NO	3	5	0.62	18.42	19.54	>18.98	0	0	0	0	0	0	0	DM>P,BRN SANDYMUD W/SHELL FRAGS/BLK MUD,TUBE@SURF,SAND/MUD
SC-6	E	8/16/2001	12:28	>4	3	>4	8.83	9.54	0.71	9.18	PHYSICAL	31.235	1.79	2.65	2.22	ST_I	NO	4	0	0	8.83	9.54	>9.18	0	0	0	0	0	0	0	DM>P,SANDY BRNMUD/BLKMUD,SMSHELLS,TUBES@SURF,HIGH SOD
SC-6	F	8/16/2001	12:29	>4	2	>4	9.49	10.31	0.82	9.9	PHYSICAL	19.711	0.46	2.14	1.38	ST_I	NO	3	0	0	9.49	10.31	>9.9	0	0	0	0	0	0	0	DM>P,BRN SANDYMUD/BLKMUD,SHELLS,TUBE@SURF,HIGH SOD
REF																															
MR-REF	B	8/16/2001	11:31	>4	4	>4	5.83	14.47	8.64	10.15	PHYSICAL	0	NA	NA	NA	INDET	NO	99	0	0	5.83	14.47	>10.15	0	0	0	0	0	0	0	DISSECTED BRN&BLK CLAY CLUMP
MR-REF	C	8/16/2001	11:31	>4	2	>4	10.45	11.16	0.7	10.8	PHYSICAL	22.289	0.6	3.42	1.7	ST_I	NO	4	3	1.04	10.45	11.16	>10.8	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD,TRACE 2PHI@SURF?
MR-REF	D	8/16/2001	11:32	>4	2	>4	8.14	20.67	12.53	14.41	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	3	1.04	8.14	20.67	>14.41	0	0	0	0	0	0	0	OVERPEN,BRNMUD/BLKMUD,REDSED@SURF,DISTURBED SURF,BURROWS,HIGH SOD

Appendix D-4
REMOTS Image Analysis Results for the Boston Harbor Summer 2001 Survey

Station	Replicate	Date	Time	Grain Size			Camera Penetration (cm)				Surface Roughness	Apparent RPD Thickness(cm)				Successional Stage	Low DO	OSI	Mud Clasts		Dredged Material Thickness (cm)			Redox Rebound Thickness (cm)			Methane				Comments
				Min	Max	Maj Mode	Min	Max	Range	Mean		Area	Min	Max	Mean				Count	Diameter	Min	Max	Mean	Min	Max	Mean	Diameter	Min	Max	Mean	
M8-11																															
M811-1	A	8/15/2001	15:01	>4	1	>4	3.81	5.98	2.16	4.9	PHYSICAL	25.573	0.46	3.87	1	ST_I	NO	3	0	0	3.81	5.98	>4.9	0	0	0	0	0	0	0	DM>P,SANDY BRNMUD/GRAYMUD,ROCKS,SHELL@SURF
M811-1	B	8/15/2001	15:02	>4	2	4 to 3	3.97	4.69	0.72	4.33	PHYSICAL	9.517	0.05	2.11	0.98	ST_I	NO	3	1	0.88	3.97	4.69	>4.33	0	0	0	0	0	0	0	DM>P,MUDDY FINE SAND W/SHELLBITS
M811-1	C	8/15/2001	15:02	>4	1	4 to 3	5.98	6.55	0.57	6.26	PHYSICAL	30.506	1.13	3.97	2.27	ST_I	NO	5	1	0.88	5.98	6.55	>6.26	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYSANDYMUD,SHELL HASH
M811-2	D	8/16/2001	9:10	>4	1	3 to 2	4.59	5.31	0.72	4.95	PHYSICAL	14.022	0.05	2.16	1.36	ST_I	NO	3	0	0	4.59	5.31	>4.95	0	0	0	0	0	0	0	DM>P,MUDDY SAND W/SHELLHASH>P,TUBE IN FF
M811-2	E	8/16/2001	9:10	>4	1	>4	6.44	6.7	0.26	6.57	PHYSICAL	18.179	0.52	2.16	1.33	ST_I	NO	3	2	0.52	6.44	6.7	>6.57	0	0	0	0	0	0	0	DM>P,SANDY BRNMUD/BLKMUD,SHELL@SURF,SHELL HASH
M811-2	F	8/16/2001	9:21	>4	1	3 to 2	5.93	6.65	0.72	6.29	PHYSICAL	15.273	0.1	2.11	1.11	ST_I	NO	3	0	0	5.93	6.65	>6.29	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAY SAND,TUBES IN FF
M811-3	A	8/15/2001	14:46	>4	1	>4	4.79	5.05	0.26	4.92	PHYSICAL	19.36	0.1	2.32	1.51	ST_I	NO	4	2	0.27	4.79	5.05	>4.92	0	0	0	0	0	0	0	DM>P,BRNMUD/SANDYMUD
M811-3	B	8/15/2001	14:47	>4	1	>4	6.19	6.55	0.36	6.37	PHYSICAL	30.486	1.44	3.3	2.26	ST_I	NO	5	0	0	6.19	6.55	>6.37	0	0	0	0	0	0	0	DM>P,BRNMUD/SAND,DEPOSITIONAL LAYER OVER CAP?
M811-3	F	8/16/2001	9:05	>4	0	3 to 2	6.44	6.8	0.36	6.62	PHYSICAL	33.425	0.5	2.5	2	ST_I	NO	4	1	0.43	6.44	6.8	>6.62	0	0	0	0	0	0	0	DM>P,BRNMUD/SAND&SHELLS,SMTUBES
M811-4	D	8/16/2001	9:00	>4	1	3 to 2	4.56	5.02	0.46	4.79	PHYSICAL	22.569	0.05	3.18	1.75	ST_I	NO	4	0	0	4.56	5.02	>4.79	0	0	0	0	0	0	0	DM>P,SAND CAP>P,THINMUD/CAP SAND
M811-4	E	8/16/2001	9:00	>4	1	3 to 2	5.54	6.05	0.51	5.79	PHYSICAL	32.19	1.38	2.5	1.75	ST_I	NO	4	1	0.8	5.54	6.05	>5.79	0	0	0	0	0	0	0	DM>P,SAND&MUD CAP>P,SHELLFRAGS
M811-4	F	8/16/2001	9:01	>4	1	3 to 2	5.23	5.95	0.72	5.59	PHYSICAL	19.352	0.21	2	1	ST_I	NO	3	1	0.8	5.23	5.95	>5.59	0	0	0	0	0	0	0	DM>P,BRNSANDYMUD CAP>P
M811-5	A	8/15/2001	14:38	>4	3	4 to 3	3.18	3.33	0.15	3.25	PHYSICAL	8.046	0.05	2.36	0.76	ST_I	NO	3	0	0	3.18	3.33	>3.25	0	0	0	0	0	0	0	DM>P,BRNMUD>P,OLD WORM?
M811-5	B	8/15/2001	14:38	>4	3	4 to 3	2.82	3.33	0.51	3.08	PHYSICAL	13.169	0.21	1.79	0.97	ST_I	NO	3	0	0	2.82	3.33	>3.08	0	0	0	0	0	0	0	DM>P,BRN&GRAY MUDDYSAND>P
M811-5	F	8/16/2001	8:50	>4	2	4 to 3	6.2	6.97	0.77	6.59	PHYSICAL	10.332	0.1	2	1.26	ST_I	NO	3	0	0	6.2	6.97	>6.59	0	0	0	0	0	0	0	DM>P,BRNMUD/SANDYMUD,REDSED CLAST@SURF W/DRAGDOWN,TUBES
M811-6	A	8/15/2001	14:56	>4	1	4 to 3	5.74	5.74	0	5.74	PHYSICAL	NA	0.1	0.5	0.2	ST_I	NO	2	0	0	5.74	5.74	>5.74	0	0	0	0	0	0	0	DM>P,OLIVEBRNMUD/COARSERGRAINED SED,SM SHELLFRAGS@Z&SURF,RPD<0.5CM,REDSED@SURF
M811-6	B	8/15/2001	14:57	>4	3	4 to 3	6.92	7.59	0.67	7.25	PHYSICAL	20.165	0.62	2.26	1.5	ST_I	NO	3	0	0	6.92	7.59	>7.25	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYMUD W/SMSHELLFRAGS,SHELLLAYER@SURF,SMTUBE
M811-6	D	8/16/2001	9:26	>4	2	3 to 2	6.61	6.92	0.31	6.77	PHYSICAL	21.697	0.97	2.51	1.59	ST_I	NO	4	0	0.65	6.61	6.92	>6.77	0	0	0	0	0	0	0	DM>P,BRNMUD/GRAYSAND W/SMSHELLFRAGS,SMTUBE,CLASTS IN FF
M19																															
M19-1	B	8/15/2001	12:34	>4	2	>4	5.31	5.77	0.46	5.54	PHYSICAL	13.432	0.41	1.53	0.93	ST_I	NO	3	1	0.79	5.31	5.77	>5.54	0	0	0	0	0	0	0	DM>P,OLIVEBRN SANDYMUD/LTBRN&GRAY MUD,SMTUBES@SURF,FRACTURED SED
M19-1	C	8/15/2001	12:34	>4	1	>4	6.22	6.79	0.56	6.51	PHYSICAL	11.758	0.1	1.58	0.94	ST_I	NO	3	1	0.51	6.22	6.79	>6.51	0	0	0	0	0	0	0	DM>P,OLIVEBRN SANDYMUD/BRNGRAY MUD,SMTUBES@SURF,CRACKEDSEDS,SM SHELL FRAGS@Z
M19-2	A	8/15/2001	12:44	>4	2	>4	5.51	5.77	0.26	5.64	PHYSICAL	8.102	0.15	0.97	0.54	ST_I	NO	2	0	0	5.51	5.77	>5.64	0	0	0	0	0	0	0	DM>P,OLIVEBRN SANDYMUD/BRN&GRAY MUD,TUBES@SURF,FRACTURED SED
M19-2	C	8/15/2001	12:45	>4	0	3 to 2	4.8	5.31	0.51	5.05	PHYSICAL	0	NA	NA	NA	ST_I	NO	99	0	0	4.8	5.31	>5.05	0	0	0	0	0	0	0	DM(CAP)>P,FRACTURES,BRNSAND W/BLKSAND MIX,VOIDS,SHELLS&ROCKS@SURF,TUBES IN WATER?
M19-2	E	8/16/2001	8:32	>4	1	>4	5.56	6.99	1.43	6.28	BIOGENIC	17.933	0.51	1.89	1.31	ST_I_ON_III	NO	7	0	0	5.56	6.99	>6.28	0	0	0	0	0	0	0	DM>P,BRN/GRAY/BLKMUD,BURROWS,VOIDS,TRACE VCOARSE/GRAN SAND,SHELLFRAG,TUBES
M19-3	A	8/15/2001	12:54	>4	1	4 to 3	4.39	6.02	1.63	5.2	PHYSICAL	26.568	1.17	3.01	1.87	ST_I	NO	4	1	0.58	4.39	6.02	>5.2	0	0	0	0	0	0	0	DM>P,SANDCAP,BRNSAND FINE/COARSER,PATCHES FINE GRAY SAND,SHELLS
M19-3	B	8/15/2001	12:55	>4	2	3 to 2	3.06	5.87	2.81	4.46	BIOGENIC	13.24	0.36	1.63	0.94	ST_I	NO	3	0	0	3.06	5.87	>4.46	0	0	0	0	0	0	0	DM>P,SANDCAP,BRN W/BLKSANDW/FINE GRAYSEDW/SHELLFRAGS,DIS BURROW,TUBES IN WATER
M19-3	C	8/15/2001	12:55	>4	2	3 to 2	5.15	5.97	0.82	5.56	PHYSICAL	11.134	0.1	1.84	0.78	ST_I	NO	3	0	0	5.15	5.97	>5.56	0	0	0	0	0	0	0	DM>P,SANDCAP,BRNSANDYMUD W/REDSED,SHELLFRAGS@Z&SURF
M19-4	A	8/15/2001	13:13	>4	1	>4	6.12	6.58	0.46	6.35	PHYSICAL	22.987	0.31	2.6	1.72	ST_I_ON_III	NO	8	0	0	6.12	6.58	>6.35	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,VOIDS,SHELL@SURF
M19-4	E	8/16/2001	8:38	>4	1	3 to 2	5.61	6.33	0.72	5.97	PHYSICAL	9.509	0.05	1.79	0.65	ST_I	NO	2	0	0	5.61	6.33	>5.97	0	0	0	0	0	0	0	DM>P,SANDCAP,SAND W/SHELLFRAG,LG ROCK FF
M19-4	G	8/16/2001	8:42	>4	-1	1 to 0	5.31	6.99	1.68	6.15	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	0	0	5.31	6.99	>6.15	0	0	0	0	0	0	0	DM>P,SANDCAP,VY COARSESAND&GRAVEL W/FINE GRAYMUD,FRACTURE
M19-5	A	8/15/2001	12:49	>4	1	1 to 0	4.08	5.41	1.33	4.75	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	0	0	4.08	5.41	>4.75	0	0	0	0	0	0	0	DM>P,SANDCAP,COARSE SAND W/FINE BRN&GRAY CLAY,SHELL FRAGS@Z&SURF
M19-5	B	8/15/2001	12:50	>4	0	2 to 1	4.69	5.15	0.46	4.92	PHYSICAL	15.184	NA	NA	NA	INDET	NO	99	0	0	4.69	5.15	>4.92	0	0	0	0	0	0	0	DM>P,SANDCAP,COARSE SAND W/PATCHES CLAY&DRAGDOWN,SHELLS@SURF
M19-5	C	8/15/2001	12:51	>4	-1	0 to -1	0.87	4.69	3.83	2.78	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	0	0	0.87	4.69	>2.78	0	0	0	0	0	0	0	DM>P,SANDCAP,MAJOR SHELL DEPOSIT@SURF,FRAGS@Z
M19-6	A	8/15/2001	12:38	>4	1	>4	7.86	9.23	1.38	8.55	PHYSICAL	9.155	0.05	1.53	0.64	ST_I	NO	2	0	0	7.86	9.23	>8.55	0	0	0	0	0	0	0	DM>P,BRNMUD&SAND W/GRAYMUD&SAND,SHELLFRAGS,TUBES@SURF
M19-6	C	8/15/2001	12:39	>4	3	>4	6.33	6.94	0.61	6.63	PHYSICAL	12.06	0.1	2.35	0.83	ST_I	NO	3	0	0.96	6.33	6.94	>6.63	0	0	0	0	0	0	0	DM>P,BRNMUD/BLKMUD,REDESED@SURF,FRACTURE,TUBES IN WATER?
M19-6	E	8/16/2001	8:24	>4	2	>4	6.68	7.49	0.8	7.09	PHYSICAL	18.229	0.2	1	0.5	ST_I	NO	2	0	0	6.68	7.49	>7.09	0	0	0	0	0	0	0	DM>P,BRNMUD/FINE&COARSE GRAYMUD,FRACTURES,TUBES,REBOUND>P?
CR																															
CR-1	C	8/15/2001	10:26	>4	2	>4	14.17	16.23	2.06	15.2	PHYSICAL	32.712	0.7	3.42	2.4	ST_I	NO	5	0	0	14.17	16.23	>15.2	0	0	0	0	0	0	0	DM>P,BRN SLTYSND/FINE BLK M/FINE GRAYSAND, BURROW,CLAY@Z
CR-1	D	8/15/2001	10:33	>4	3	>4	15.43	18.85	3.43	17.14	PHYSICAL	22.261	0.35	4.77	2.99	ST_I	NO	5	0	2.04	15.43	18.85	>17.14	0	0	0	0	0	0	0	DM>P,BRNSLTY&PATCHY RPD,CLAY@SURF&Z
CR-2	A	8/15/2001	11:17	>4	3	>4	19.45	20.3	0.85	19.87	PHYSICAL	14.483	0.2	2.36	1.36	ST_I_ON_III	NO	7	0	0	19.45	20.3	>19.87	0	0	0	0	0	0	0	DM>P,BLKMATERIAL@SURF,GRAYCLAY BAND@Z,VOID,LAYERED
CR-2	C	8/15/2001	11:18	>4	3	>4	16.98	17.44	0.45	17.21	PHYSICAL	6.069	0.1	0.5	0.2	ST_I	NO	2	6	0.68	16.98	17.44	>17.21	0	0	0	0	0	0	0	DM>P,THIN PATCHYRPD,TUBES@SURF,MULT DM LAYERS,WIPER CLASTS@SURF,RED SED@SURF
CR-3	A	8/15/2001	11:22	>4	2	>4	16.58	17.39	0.8	16.98	PHYSICAL	17.822	0.15	1.81	1.35	ST_I	NO	3	2	0.52	16.58	17.39	>16.98	0	0	0	0	0	0	0	DM>P,FINEBRN SILT/BLK SAND/GRAY BAND/BLACKSED,TUBES@SURF,HIGH SOD,LAYERS
CR-3	B	8/15/2001	11:23	>4	3	>4	6.93	7.79	0.85	7.36	PHYSICAL	10.776	0.05	1.96	0.8	ST_I_ON_III	NO	7	0	0	6.93	7.79	>7.36	0	0	0	0	0	0	0	DM>P,BRNSILTYSAND/BLKMUD/GRAY CLAYBAND,VOIDS,TUBES@SURF,RED SED NEARSURF
CR-3	C	8/15/2001	11:23	>4	2	>4	11.71	11.86	0.15	11.78	PHYSICAL	8.779	0.05	2.71	1.62	ST_I	NO	4	0	0	11.71	11.86	>11.78	0	0	0	0	0	0	0	DM>P,PATCHY BRNRPD/GRAYCLAY/COARSE BLK MUD,MULTIPLE DM LAYERS, REDSED&TUBES@SURF
CR-4	A	8/15/2001	11:30	>4	2	>4	5.48	9.2	3.72	7.34	PHYSICAL	39.664	1.76	4.57	2.98	ST_I	NO	5	3	0.45	5.48	9.2	>7.34	0	0	0	0	0	0	0	DM>P,BRNSILTY MUD/FLUID LAYER/COARSE BLKSAND,CLASTSIN FF
CR-4	B	8/15/2001	11:30	>4	3	>4	12.56	13.02	0.45	12.79	PHYSICAL	33.349	0.45	3.97	2.59	ST_I	NO	5	10	0.81	12.56	13.02	>12.79	0	0	0	0	0	0	0	DM>P,BRNSILTY MUD/FINE@COARSE BLKMUD/BURROWS,TUBES@SURF,CLASTS FF,VOIDS?
CR-4	C	8/15/2001	11:31	>4	3	>4	6.73	7.54	0.8	7.14	PHYSICAL	19.452	0.15	2.21	1.46	ST_I_ON_III	NO	7	3	0.52	6.73	7.54	>7.14	0	0	0	0	0	0	0	DM>P,BRN SILTYMUD/BLK MUD,BURROWS&VOIDS,TUBES@SURF,CLASTS FF
CR-5	A	8/15/2001	11:34	>4	2	>4	7.14	10.45	3.32	8.79	PHYSICAL	14.534	0.75	2.26	1.58	ST_I	NO	4	2	9.03	7.14	10.45	>8.79	0	0	0	0	0	0	0	DM>P,BRN SILTY MUD&VERYLG GRAYCLASTS/BLACK MUD,LIQUIFIED BURROW
CR-5	B	8/15/2001	11:34	>4	2	>4	4.72	8.74	4.02	6.73	BIOGENIC	9.949	0.05	4.27	2.42	ST_I	NO	5	0	0	4.72	8.74	>6.73	0	0	0	0	0	0	0	DM>P,BRNSILTY MUD/FINE&COARSEMUD&SAND,SM CLAYCLASTS@Z,BURROW,REDSED DUSTING@SURFBIOGENIC
CR-5	C	8/15/2001	11:35	>4	4	>4	3.12	6.33	3.22	4.72	PHYSICAL	22.034	0.05	4.12	1.85	ST_I	NO	4	0	0	3.12	6.33	>4.72	0	0	0	0	0	0	0	DM>P,ERRADIC RPD,REDSED@SURF,CONCAVE SURF
CR-6	A	8/15/2001	11:39	>4	2	>4	17.04	18.34	1.31	17.69	PHYSICAL	6.914	0.15	1.21	0.72	ST_I	NO	2	0	0	17.04	18.34	>17.69	0	0	0	0	0	0	0	DM>P,BRN VFSAND/MOTTLED GRAYSANDYMUD/COARSER BLKMUD,TUBES@SURF,HIGH SOD
CR-6	B	8/15/2001	11:40	>4	3	>4	14.72	16.08	1.36	15.4	PHYSICAL	NA	0.1	1	0.4	ST_I	YES	2	0	0	14.72	16.08	>15.4	0	0	0	0	0	0	0	DM>P,PATCHY RPD,REDSED@SURF,HIGH SOD
CR-6	C	8/15/2001	11:41	>4	2	>4	9.95	11.51	1.56	10.73	PHYSICAL	25.067	0.1	1.5	1	ST_I	NO	3	0	0	9.95	11.51	>10.73	0	0	0	0	0	0	0	DM>P,MOTTLED,STREAKED,BRNSAND,GRAYCLAY,BLKMUD,TUBES@SURF
REF																															
IC-REF	A	8/16/2001	12:51	>4	3	>4	7.74	8.59	0.85	8.17	PHYSICAL	12.86	0.25	1.91	0.95	ST_I_ON_III	NO	7	0	0.61	7.74	8.59	>8.17	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD,VOID,TUBES@SURF,HIGH SOD,THIN RPD
IC-REF	B	8/16/2001	12:52	>4	3	>4	10.85	11.01	0.15	10.93	PHYSICAL	11.375	0.25	2.16	1.1	ST_I_ON_III	NO	7	0	0	10.85	11.01	>10.93	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD/GRAYMUD/BLKMUD,DBL REBOUND,VOIDS,TUBES
IC-REF	C	8/16/2001	12:53	>4	2	>4	9.75	10	0.25	9.87	PHYSICAL	23.204	0.35	3.47	1.78	ST_I_to_II	NO	5	0	0	9.75	10	>9.87	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD,MANYTUBES@SURF,HIGH SOD
MR-REF	B	8/16/2001	11:31	>4	4	>4	5.83	14.47	8.64	10.15	PHYSICAL	0	NA	NA	NA	INDET	NO	99	0	0	5.83	14.47	>10.15	0	0	0	0	0	0	0	DISSECTED BRN&BLK CLAY CLUMP
MR-REF	C	8/16/2001	11:31	>4	2	>4	10.45	11.16	0.7	10.8	PHYSICAL	22.289	0.6	3.42	1.7	ST_I	NO	4	3	1.04	10.45	11.16	>10.8	0	0	0	0	0	0	0	BRNMUD/GRAYMUD/BLKMUD,TRACE 2PHI@SURF?
MR-REF	D	8/16/2001	11:32	>4	2	>4	8.14	20.67	12.53	14.41	PHYSICAL	NA	NA	NA	NA	INDET	NO	99	3	1.04	8.14	20.67	>14.41	0	0	0	0	0	0	0	OVERPEN,BRNMUD/BLKMUD,REDSED@SURF,DISTURBED SURF,BURROWS,HIGH SOD