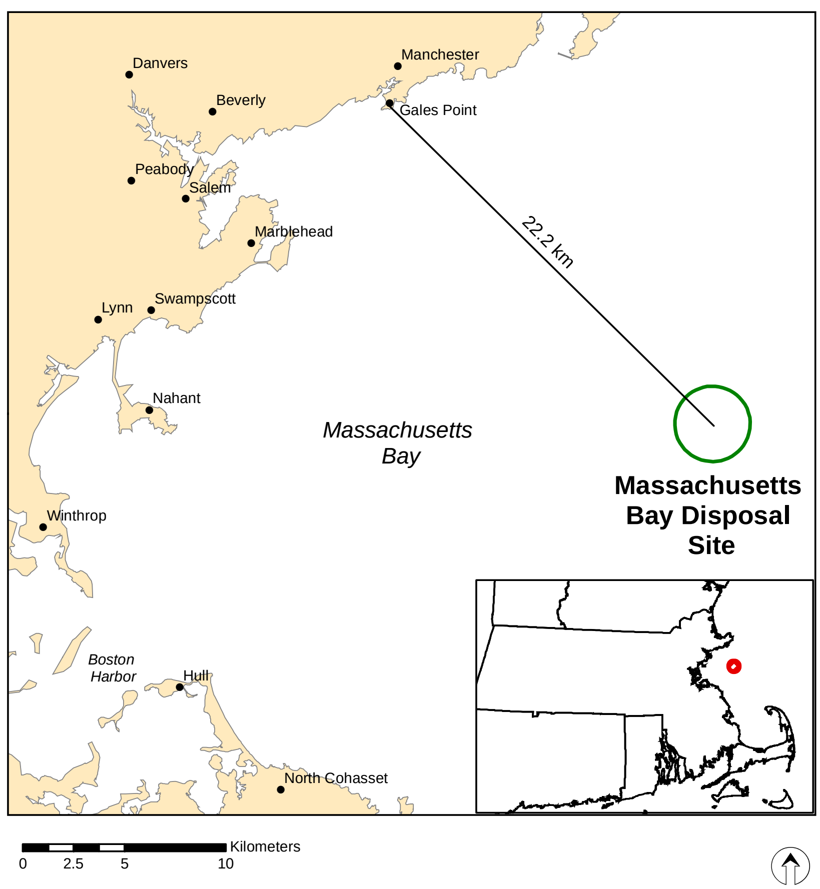
Monitoring Survey at the Massachusetts Bay Disposal Site
September 2004

Disposal Area Monitoring System DAMOS

DAMOS
DISPOSAL AREA MONITORING SYSTEM

Contribution 162
September 2005



US Army Corps of Engineers ®
New England District

This report should be cited as:

ENSR. 2005. Monitoring Survey at the Massachusetts Bay Disposal Site, September 2004. DAMOS Contribution No. 162. U.S. Army Corps of Engineers, New England District, Concord, MA, 64 pp.

REPORT DOCUMENTATION PAGE

form approved
OMB No. 0704-0188

1. AGENCY USE ONLY (LEAVE BLANK)

2. REPORT DATE
September 2005

3. REPORT TYPE AND DATES COVERED
FINAL REPORT

4. TITLE AND SUBTITLE
Monitoring Survey at the Massachusetts Bay Disposal Site September 2004

5. FUNDING NUMBERS

6. AUTHOR(S)
ENSR International, Germano and Associates, CoastalVision, and CR Environmental.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER
ENSR-9000-373-120

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US Army Corps of Engineers-New England District
696 Virginia Rd
Concord, MA 01742-2751

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
Contribution No. 162

11. SUPPLEMENTARY NOTES
Available from DAMOS Program Manager, Regulatory Division
USACE-NAE, 696 Virginia Rd, Concord, MA 01742-2751

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT

The Massachusetts Bay Disposal Site (MBDS) was monitored as part of the Disposal Area Monitoring System (DAMOS) on 14-16 September 2004. The 2004 field effort consisted of bathymetric and sediment-profile imaging (SPI) surveys designed to characterize seafloor topography, evaluate the physical distribution of dredged material around recent and historic disposal events and to assess the benthic conditions over two historic disposal mounds. Disposal site data were compared to reference area data and data from the fall 2000 MBDS monitoring survey.

Between the fall 2000 and September 2004 survey, approximately 560,000 m^3 of dredged material was placed at MBDS. The management strategy at MBDS has involved the controlled placement of small to moderate volumes of sediment to form individual disposal mounds arranged in a ring around a natural seafloor depression, with the goal of developing the boundaries of a containment cell. Previous studies conducted at MBDS verified the presence of five disposal mounds (MBDS-A through MBDS-E). The September 2004 survey identified the sixth mound, MBDS-F, with an approximate diameter of 450 m and a height of approximately 4 m above the surrounding seafloor. Results of the 2004 SPI survey showed that, in the five years since disposal activities at the MBDS-C and MBDS-D Mounds had ceased, the resident benthic community had completely recovered, and both mounds exhibited benthic conditions comparable to those found at the three reference areas.

14. SUBJECT TERMS DAMOS, Massachusetts Bay Disposal Site, Dredged Material

15. NUMBER OF TEXT PAGES: 64

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified

18. SECURITY CLASSIFICATION OF THIS PAGE

19. SECURITY CLASSIFICATION OF ABSTRACT

20. LIMITATION OF ABSTRACT

MONITORING SURVEY AT THE MASSACHUSETTS BAY DISPOSAL SITE SEPTEMBER 2004

CONTRIBUTION #162

September 2005

Report No.
ENSR-9000-373-120

Submitted to:
New England District
U.S. Army Corps of Engineers
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EXECUTIVE SUMMARY

A monitoring survey was conducted in September 2004 at the Massachusetts Bay Disposal Site (MBDS) as part of the Disposal Area Monitoring System (DAMOS). The 2004 field effort consisted of bathymetric and sediment-profile imaging surveys designed to document changes in seafloor topography, evaluate the physical distribution of dredged material around recent disposal locations, and assess the benthic recolonization status of historical disposal mounds.

The management strategy at MBDS has involved the controlled placement of small to moderate volumes of sediment to form individual disposal mounds arranged in a ring around a natural seafloor depression, with the goal of developing the boundaries of a containment cell. Previous studies conducted at MBDS verified the presence of five disposal mounds (MBDS-A through MBDS-E) surrounding the depression in the seafloor. Development of a fifth mound (MBDS-F) was initiated in September 2000, but no discernable mound was visible during the Fall 2000 survey. Since September 2000, disposal of more than 560,000 m^3 of material was targeted at the MBDS-F Mound.

The September 2004 bathymetric survey was performed over a 5.76 km^2 area in the northern portion of MBDS. The 2004 bathymetric data identified the MBDS-F Mound as a distinct feature with a base of approximately 450 m in diameter and a height of approximately 4 m above the surrounding seafloor. Small areas of depth increases and decreases were also identified over previously formed mounds MBDS-A, MBDS-B, MBDS-C, MBDS-D, and MBDS-E. Continued consolidation of dredged material at the historical mounds likely accounted for some of the depth increase, but some of the depth differences are attributed to differences in data collection and processing techniques between the 2004 and 2000 surveys.

The previous SPI survey, conducted in the fall of 2000, indicated that colonization of the surface sediments of the MBDS-B and MBDS-C Mounds had proceeded as expected with Stage III fauna observed at both mounds. However, it was noted that there were fewer occurrences of mature, deposit-feeding communities on the MBDS-C Mound than on the MBDS-B Mound, attributed to the extensive presence of consolidated Boston Blue Clay at the MBDS-C Mound. It was anticipated that as time progressed and the Boston Blue Clay was broken down by physical and biological processes, a more consistent mature infaunal community would develop. The objective of the 2004 SPI survey was to further assess the benthic recolonization status of the MBDS-C Mound and to perform an initial benthic assessment of the MBDS-D Mound. Results of the 2004 SPI survey showed that in the five years since disposal activities at the MBDS-C and MBDS-D Mounds had ceased, the resident benthic community had completely recovered, and both mounds exhibited benthic conditions comparable to those found at the three reference areas.

1.0 INTRODUCTION

A monitoring survey was conducted at the Massachusetts Bay Disposal Site in September 2004 as part of the U.S. Army Corps of Engineers (USACE) New England District (NAE) Disposal Area Monitoring System (DAMOS). DAMOS is a comprehensive monitoring and management program designed and conducted to address environmental concerns associated with use of open-water disposal sites throughout the New England region. An introduction to the DAMOS Program and the Massachusetts Bay Disposal Site, including a brief description of previous dredged material disposal activities and previous monitoring surveys, is provided below.

1.1 Overview of the DAMOS Program

The DAMOS Program features a tiered management protocol designed to ensure that any potential adverse environmental impacts associated with dredged material disposal activities are promptly identified and addressed (Germano et al. 1994). For over 25 years, the DAMOS Program has collected and evaluated disposal site data throughout New England. Based on these data, patterns of physical, chemical, and biological responses of seafloor environments to dredged material disposal activity have been documented (Fredette and French 2004).

DAMOS monitoring surveys are designed to test hypotheses related to expected physical and ecological response patterns following placement of dredged material on the seafloor at established disposal sites. The data collected and evaluated during DAMOS monitoring surveys provide answers to strategic management questions in determining the next step in the disposal site environmental management process.

Two primary goals of DAMOS monitoring surveys are to document the physical location of dredged material placed on the seafloor and to evaluate the environmental impact of placement of the dredged material. Sequential bathymetric measurements are made to characterize the height and spread of discrete dredged material deposits or mounds created at disposal sites, and sediment-profile imaging (SPI) surveys are performed to support evaluation of seafloor (benthic) habitat conditions and recovery over time. Each type of data collection activity is conducted periodically at disposal sites, and the response of the benthic community is evaluated. The conditions found after a specific set of disposal operations are compared with the long-term data set at a specific site (Germano et al. 1994). DAMOS monitoring surveys may also feature additional types of data collection activities, such as side-scan sonar or sediment coring, as deemed appropriate to achieve specific survey objectives.

1.2 Introduction to the Massachusetts Bay Disposal Site

The Massachusetts Bay Disposal Site (MBDS) is one of three regional dredged material disposal sites located off the Massachusetts coast (Figure 1-1). MBDS was officially designated an ocean dredged material disposal site by the U.S. Environmental Protection Agency (EPA) in 1993 (USEPA 1992; DeAngelo and Murray 1997). MBDS is situated approximately 22.2 km southeast of Gales Point, Manchester, Massachusetts and receives sediments from dredging projects along coastal Massachusetts. The site is circular in shape and occupies a 10.75 km^2 area on the seafloor (Figure 1-1). The site was relocated from the interim disposal site (Foul Area Disposal Site (FADS)), used for the disposal of dredged material from 1977 to 1993, to its current position centered at 42° 24.106' N, 70° 34.969' W (NAD 83) (Figure 1-2). The current location was also selected to avoid the northern part of the Industrial Waste Site (IWS), closed by EPA in 1977, where past disposal of waste barrels and other types of debris had occurred (SAIC 1997a & b).

Water depths at MBDS slope gradually from approximately 82 m along the southwestern boundary towards a shallow depression (approximately 92 m in depth) in the northeast quadrant of the site. North of the depression and outside of the MBDS boundary is a distinct topographic high (approximately 67 m in depth), thought to be a remnant glacial deposit (SAIC 1997a; Figure 1-3).

Since January 1994, the management strategy at MBDS has involved the controlled placement of small to moderate volumes of sediment to form individual disposal mounds arranged around the natural seafloor depression in the northeast quadrant of the site. The goal of this approach is to construct the boundary of a containment cell over time. Once complete, the containment cell may be used to limit the lateral spread of future dredged material or be employed as part of confined aquatic disposal. To date, five dredged material disposal mounds have been constructed within MBDS (MBDS-A through MBDS-E; Figure 1-3). A brief description of the mounds and their origin is provided below in Section 1.3.

MBDS is open year-round; however, most dredging activities occur from September through February. In general, a disposal marker buoy is used to identify the current disposal location within the disposal site. The placement of the buoy for each disposal season is based on the amount of material deposited during the previous season and the morphology of the mounds identified during periodic surveys.

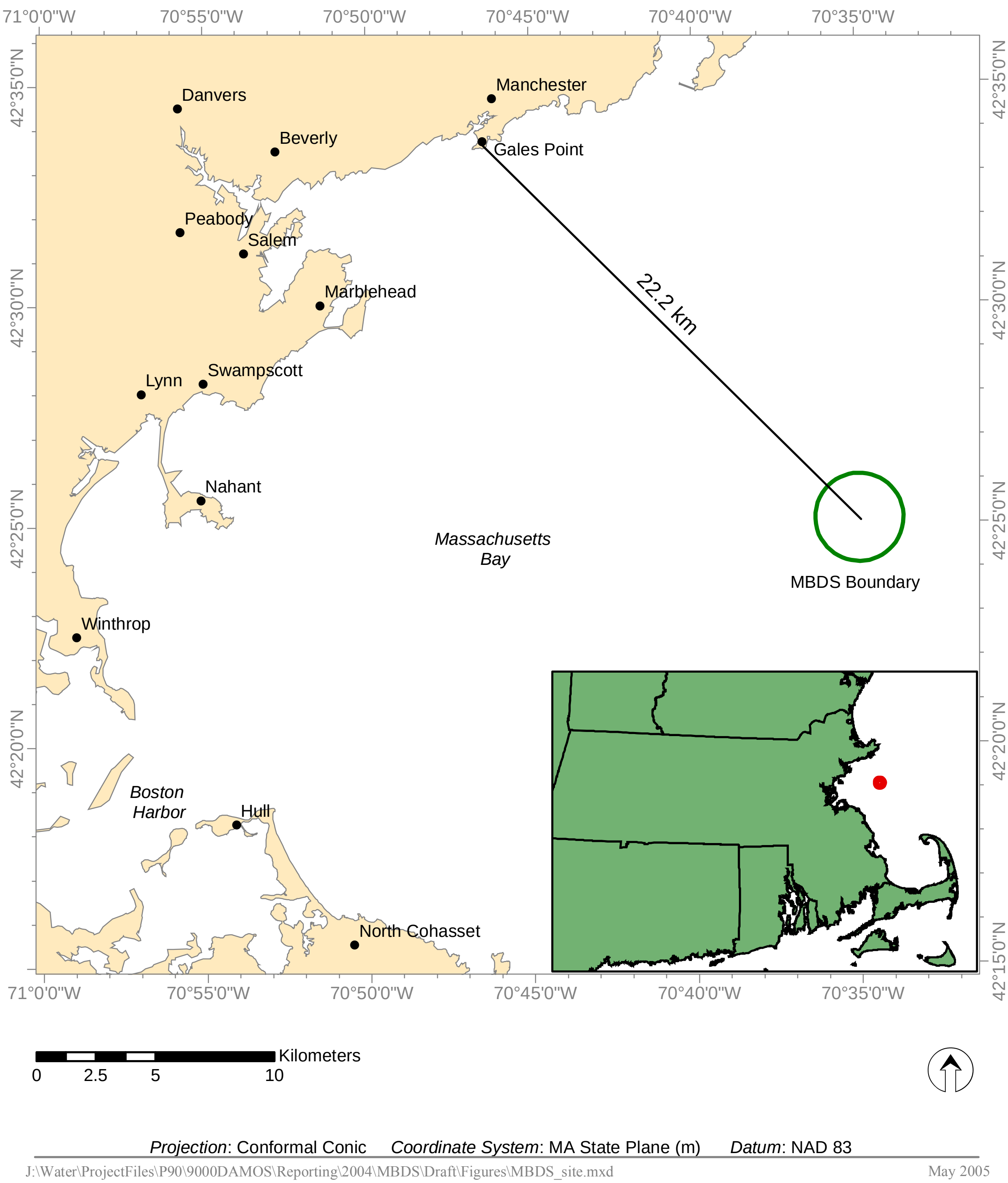


Figure 1-1. Location of the Massachusetts Bay Disposal Site

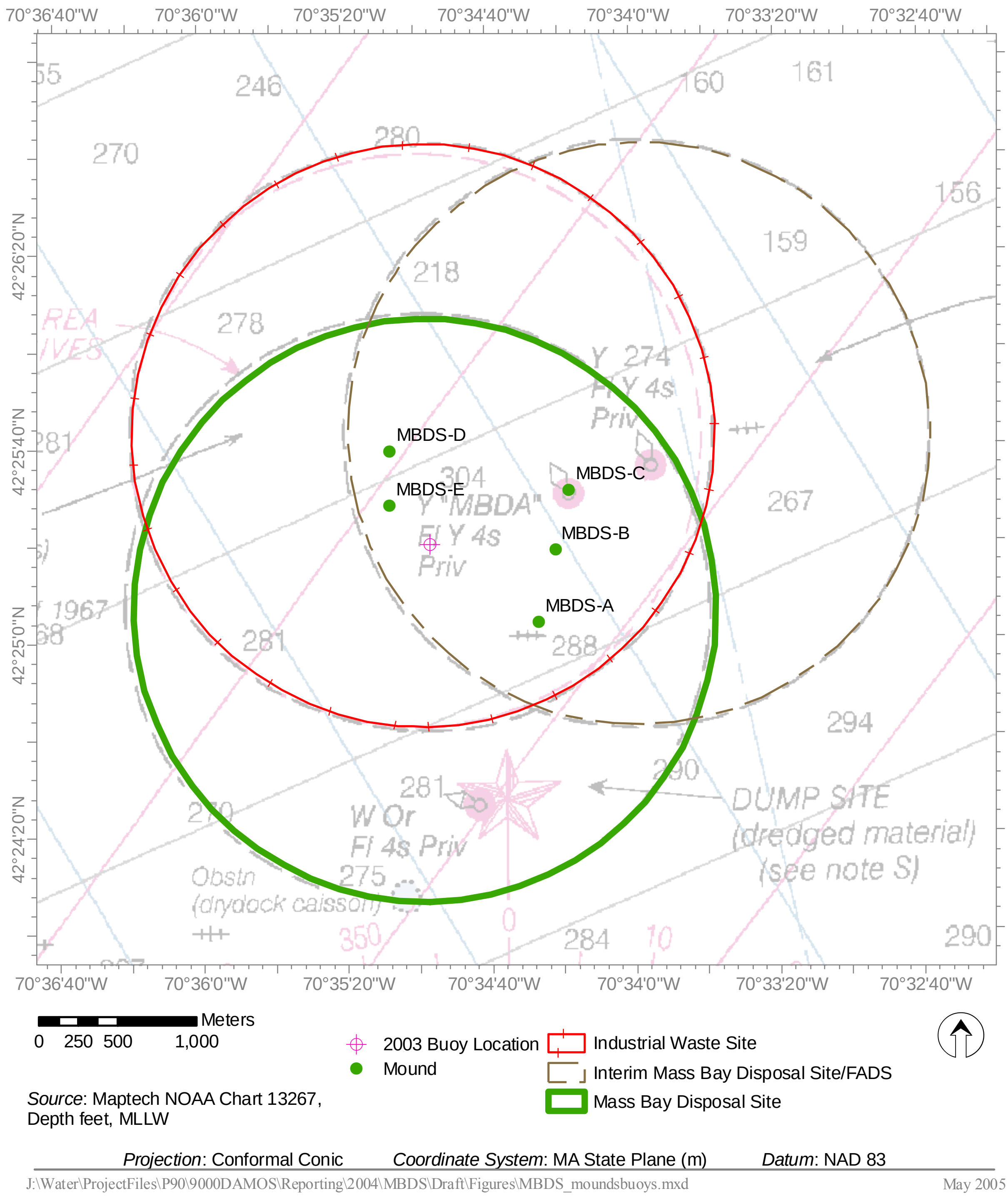


Figure 1-2. MBDS with historical site boundaries, disposal mounds, and 2003 buoy location indicated

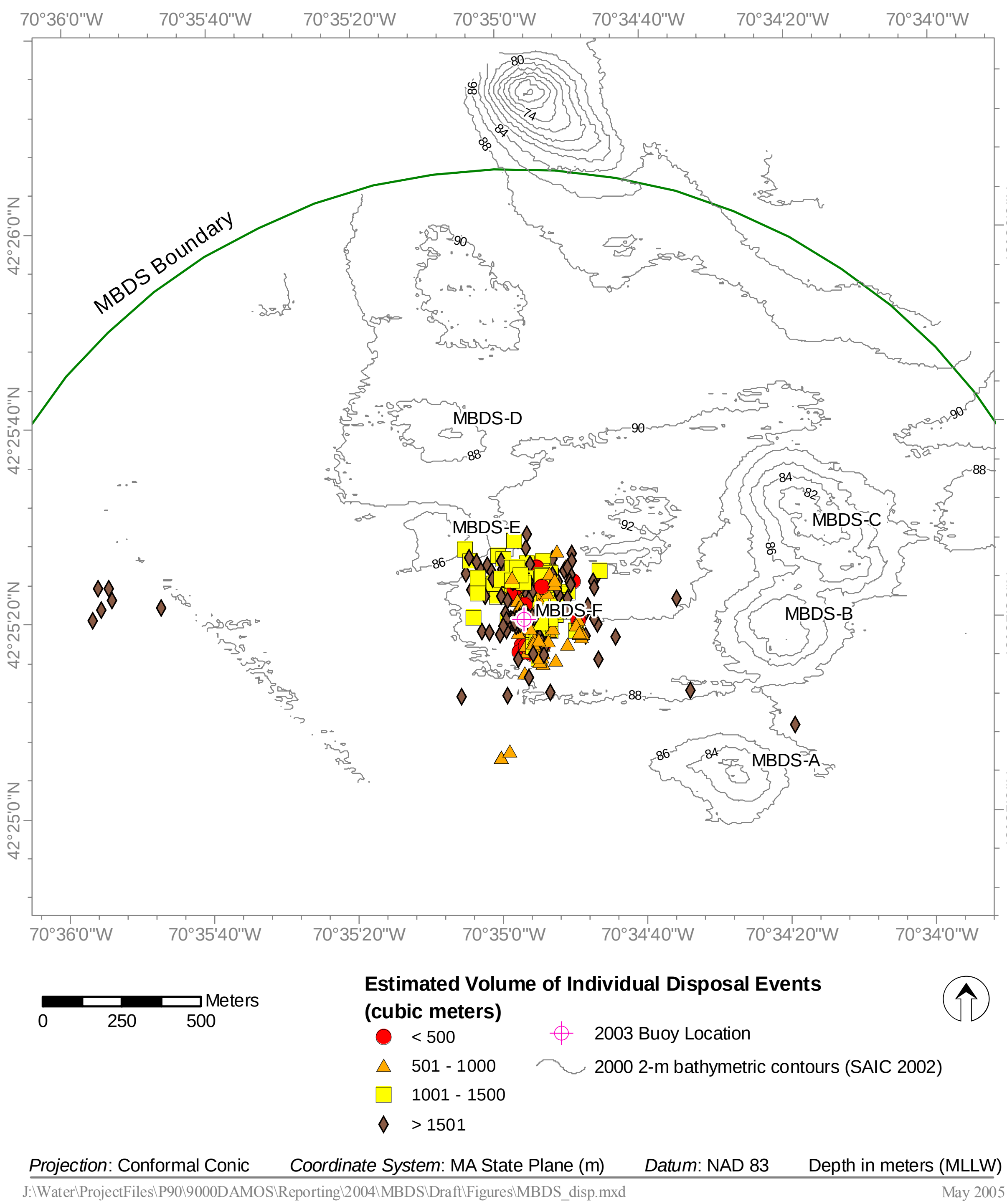


Figure 1-3. MBDS with reported 2000-2004 dredged material disposal locations indicated

The disposal site boundaries of MBDS and other New England disposal sites have been established to provide a management objective for placement of dredged material on the seafloor. Barge operators are given specific coordinates (and often visible lighted buoys) within the disposal boundaries to navigate to and release their cargo of dredged material. In practice, it is expected that barge disposal will occur in a cluster around the buoy location and that some dredged material will be lost in the water column during release. The Clean Water Act Section 404(b)(1) provides guidelines for the discharge of dredged material and defines the "discharge point" as the point within the disposal site (the bottom surface area and any overlying volume of water) at which the dredged material is released. The Marine Protection, Research and Sanctuaries Act Section 102 defines the release zone as a locus of points 100 m around the barge from beginning to end of the discharge. Monitoring objectives recognize that the site boundary is a target area for release at the water's surface, and that during placement and descent some dredged material may extend across the boundary on the seafloor.

1.3 Historical Dredged Material Disposal Activity

MBDS has been used regularly as a regional disposal site for 12 years, receiving over 6.5 million m^3 of dredged material. Five distinct disposal mounds have been developed on the seafloor in the northern half of MBDS (MBDS-A through MBDS-E; Figure 1-2). Development of a sixth mound, MBDS-F, was initiated just prior to the last survey in Fall 2000.

The MBDS-A Mound was formed from the disposal of fine grained material, including consolidated clay, originating from the Third Harbor Tunnel Project between 1992 and 1994. The MBDS-B Mound was formed from the disposal of sediment dredged from channels and harbors in the region from December 1994 through November 1998. The three subsequent disposal mounds (MBDS-C, MBDS-D and MBDS-E) were constructed over a short period of time (1998-2000), consisting primarily of Boston Blue Clay (BBC) dredged as part of the Boston Harbor Navigation Improvement Project. The MBDS-C Mound is the largest of the disposal mounds, formed by the placement of nearly 1.4 million m^3 of dredged material between November 1998 and August 1999. The MBDS-D Mound is the smallest mound, formed by the disposal of approximately 386,000 m^3 of dredged material from Boston Harbor placed at the site over a 2.5-month period (August – October 1999). The fifth mound, MBDS-E, resulted from the disposal of over 750,000 m^3 of dredged material from October 1999 through June 2000. A sixth mound, MBDS-F, was initiated in September 2000, but no obvious mound had formed at the time of the Fall 2000 survey.

1.4 Previous MBDS Monitoring Events

Monitoring surveys have been conducted at or near the site that is currently known as MBDS since 1987. A list of monitoring events that have occurred since MBDS was designated by EPA in 1992 is presented in Table 1-1. Mounds at MBDS have been monitored individually to assess stability, thickness of dredged material, and benthic recolonization status relative to previous survey results and in comparison with nearby reference areas.

The most recent monitoring survey conducted at MBDS was in the fall of 2000 and included a single-beam bathymetric survey and sediment-profile imaging survey (SAIC 2002). The 2000 survey was focused in the northeastern portion of the disposal site and was conducted to document changes in seafloor topography and benthic community recovery following the placement of large volumes of dredged material.

The 2000 bathymetric survey covered a 2400 x 2400 m area centered at 42° 25.551' N, 70° 34.792' W (NAD 83) and confirmed the formation of four new mounds (MBDS-B, MBDS-C, MBDS-D, and MBDS-E) from the disposal of dredged material between 1993 and 2000. The 2000 SPI survey evaluated benthic habitat conditions over two disposal mounds (MBDS-B and MBDS-C) and two reference areas (FG-23 and SE-REF). The Fall 2000 SPI survey results indicated that the surface sediment of the two disposal mounds had been moderately colonized and were supporting a stable Stage I community with Stage III organisms present at depth. The benthic community at the MBDS-B Mound was slightly more advanced than that found at the more recently formed MBDS-C Mound. This suggested that benthic conditions over the surface of the MBDS-B Mound were more conducive for burrowing infauna given the increased time following disturbance. Colonization was proceeding as expected given the substantial percentage of BBC in the surface layers at both disposal mounds. Establishment of Stage III deposit-feeding communities took somewhat longer than expected for benthic community recovery in response to disturbance due to the cohesive nature and lower organic carbon content of these clays (Rhoads et al. 1978). It was anticipated that as time progressed, benthic conditions at the MBDS-C Mound would show continued improvement. Future monitoring at MBDS-C Mound was recommended in order to track the continued recovery of benthic habitat conditions.

Table 1-1

Overview of Survey Activities at MBDS since 1993

Date	Purpose of Survey	Bathymetry Area (mxm)	# SPI Stations	Sediment Grabs (#)	Additional Studies	Contribution No.
9/1993	Baseline of reconfigured site	4000x4075		Grain-size, metals, PAHs, pesticides, PCBs, TOC (26)	Side-scan, sediment acoustic characterization	115
8/1994	Monitoring		76		Benthic recolonization, ground-truthing acoustic data	116
Fall 1998	Capping Demonstration-Baseline	800x800	91	Grain size, color, consistency, other (13)	Side-scan	147
12/1998	Capping Demonstration-Single-barge	800x800	82		Side-scan	147
3/1999	Capping Demonstration-Pre-cap	800x800	30	Grain size, color, consistency, other (13)	Side-scan	147
9/2000	Capping Demonstration-Post-cap	800x800	33	grain size, tracers	Side-scan, sediment cores (12)	147
9/2000	Monitoring	2400x2400	39		Benthic recolonization, distribution of dredged material	134

Earlier DAMOS monitoring surveys at MBDS were conducted in 1998/1999 (SAIC 2003), 1994 (SAIC 1997a) and 1993 (SAIC 1997b). The 1993 survey was the baseline survey for the reconfigured MBDS, conducted to delineate the topography and sediment composition of the site for DAMOS management. Bathymetry, side-scan sonar, and sediment acoustic characterization surveys were performed in addition to sediment collection for grain size and chemical analyses. Results of the 1993 baseline survey indicated that the new MBDS could be separated into two distinct areas: the southwestern area where no documented disposal had occurred and the northeastern portion where dredged material had been disposed and one dredged material disposal mound was already evident (MBDS-A). A high topographic peak was also observed just to the north of the site, assumed to be the remnant of a glacial deposit (SAIC 1997b).

Previous chemistry data collected during a survey of the interim MBDS in 1989 indicated that elevated levels of PAHs were present in the sediments near the center of the current MBDS (Murray 1994). Results from the 1993 survey confirmed the presence of high levels of both metal and organic contaminants at the center of the site and that concentrations decreased with radial distance away from the center (SAIC 1997b).

The 1994 survey at MBDS included sediment-profile and plan view image collection to assess the recolonization status of recently disposed material, determine the areal extent of historical dredged material, and investigate the successional status and benthic conditions around the area where elevated levels of PAHs and other contaminants were found in 1989 and 1993. Results of the 1994 survey at MBDS indicated that the area of recent disposal (MBDS-A) was supporting a relatively advanced benthic community with Stage I organisms at the surface and burrowing Stage III organisms at depth. Furthermore, although some sediments did show signs of organic eutrophication (high sediment oxygen demand (SOD) and thin RPD intervals), overall results indicated a highly developed Stage III community (SAIC 1997a).

The 1998/1999 MBDS survey was focused over the southern portion of MBDS, away from areas of active disposal, as part of the Massachusetts Bay Disposal Capping Demonstration Project. The objective was to evaluate the feasibility of effectively capping a discrete mound of sediment at a deep water site (90 m). Dredging needs analyses at the time indicated that large volumes of sediment would need to be dredged in the near future, a percentage of which was expected to be considered unsuitable for unconfined open water disposal due to elevated levels of contaminants. Subaqueous capping had proven to be an environmentally and economically sound method of managing large volumes of unacceptably-contaminated dredged material (UDM) in the shallow waters of Long Island Sound (20 m) and the moderate water depths of Portland Disposal Site (65 m) (Fredette 1994). However, capping at deeper water disposal sites

(>65 m) remained unexplored. Sediments from Cohasset Harbor and Chelsea River, both considered suitable for unconfined open water disposal, were deposited at MBDS as part of the Capping Demonstration Project. Dredged material from Cohasset Harbor was deposited to form the base and was capped with dredged material from the Chelsea River. The dredged material from these two different sources (Cohasset and Chelsea) displayed sufficient visual distinction to identify the source of the material after disposal and capping were complete. Single-beam bathymetry, side-scan sonar, SPI, sediment grabs, and core surveys were conducted to document the development of a layered deposit consisting of distinct sediment strata on the MBDS seafloor. Overall, the project showed that dredged material could be effectively placed, capped, and monitored in the deep waters of MBDS (SAIC 2003).

1.5 Recent Dredged Material Disposal Activity

Since the Fall 2000 survey, approximately 560,000 m^3 of dredged material has been placed at the disposal buoy, which was positioned to build the MBDS-F Mound (Figure 1-3, Table 1-2). The dredged material deposited during this period originated primarily from maintenance dredging in Scituate Harbor (approximately 203,000 m^3), Boston Harbor (approximately 110,000 m^3), and Hull Harbor (approximately 90,000 m^3). A detailed record of barge disposal activity at MBDS for the period from September 2000 to September 2004, including the origin of dredged material, the volume deposited, the disposal location, and the associated physical and chemical analysis data is provided in Appendix A.

1.6 Survey Objectives

The September 2004 MBDS survey was designed to document the distribution of dredged material across a 2400 x 2400 m area of MBDS using single-beam bathymetry and to assess the benthic recolonization status of historical disposal mounds MBDS-C and MBDS-D using sediment-profile imaging.

The design of the September 2004 survey allowed assessment of the following expectations:

- The placement of more than 560,000 m^3 of dredged material at the disposal buoy since September 2000 will result in the continued development of the MBDS-F Mound;
- The MBDS-F Mound is expected to be approximately 800 m in diameter and 4 m high based on the amount of material deposited;

Table 1-2.

Overview of Recent Disposal Activity at MBDS (9/1/2000 – 9/15/2004)

Source Project	Estimated Scow Volume Disposed (m^3)				
	9/1/2000 – 12/31/2000	2001	2002	2003	1/1/2004 – 9/15/2004
Fort Point Channel	2,829	8,678	--	1,070	--
Heron Way Marina	--	--	--	--	--
Hull Harbor	63,974	25,097	3,823	--	--
Manchester Harbor	--	9,289	--	--	--
Neponset River	--	--	--	11,736	--
Pemberton Pier	--	2,141	--	--	--
Quincy Bay	--	10,704	--	--	--
Salem Harbor Station	--	--	32,264	--	--
Saugus River	31,366	--	--	--	--
Scituate Harbor – Satuit Waterfront Club	--	--	--	3,135	--
Scituate Harbor Marina	--	--	--	4,205	--
Scituate Harbor – Satuit Boat Club	--	--	--	3,670	--
Scituate Harbor Maintenance Dredging	--	--	192,591	--	--
Scituate Harbor Yacht Club	--	--	--	2,982	--
Winthrop Harbor	40,158	--	--	--	--
Point of Pines Yacht Club	--	--	--	--	3,708
Boston Harbor Federal Navigation	--	--	--	--	109,904
Total	138,237	55,908	228,678	26,798	113,613
Grand Total			563,324		

- Mounds created in past years will show limited change in elevation except for the most recently created mounds that should show some evidence of continued consolidation; and

- As the MBDS-C and MBDS-D Mounds have not received dredged material in approximately five years (since November 1999), it is expected that the benthic community will have at least Stage II if not Stage III taxa present and have conditions comparable to those found at the reference areas.

2.0 METHODS

A team of investigators from ENSR International, CR Environmental, and Germano and Associates performed the September 2004 survey at MBDS. The bathymetry survey was conducted 15-16 September 2004 to assess dredged material distribution at MBDS. The sediment-profile imaging (SPI) survey was conducted 14-15 September 2004 to assess benthic conditions at the MBDS-C and MBDS-D Mounds. Field activities are summarized in Table 2-1, and an overview of the methods used to collect, process, and analyze the survey data is provided below. A more detailed description of methodology and the related terminology can be found in ENSR (2004).

2.1 Navigation and On-Board Data Acquisition

Positional data, comprised of horizontal positioning (x- and y-dimensional data) and time (t-dimensional data), were collected using a Trimble AG-132 Differential Global Position System (DGPS) unit. This system received and processed satellite and land-based beacon data and provided real-time vessel position, typically to sub-meter accuracy. HYPACK® hydrographic survey software, developed by HYPACK, Inc. (formerly Coastal Oceanographics, Inc.), was used to acquire, integrate, and store all positional data from the DGPS as well as bathymetric and station data. The HYPACK® software also displayed real-time vessel position, bathymetric data, and SPI stations over a background electronic chart of the study area, thus enabling survey scientists to review and evaluate survey data on a real-time basis.

2.2 Bathymetry

Bathymetric surveys provide measurements of water depth that, when processed, can be used to map the seafloor topography. The processed data can also be compared with previous surveys to track changes in the size and location of seafloor features. This technique is the primary tool in the DAMOS Program for mapping the distribution of dredged material at disposal sites.

2.2.1 Bathymetric Data Collection

The 2004 single-beam bathymetric survey was designed to cover a 2400 x 2400 m area representing approximately 5.76 km^2 of the northern portion of MBDS (Figure 2-1). The survey was initiated on 17 August using a 200-kHz single beam echosounder. The water column was strongly stratified, with extreme near-surface thermocline and halocline gradients. These strong gradients resulted in substantial reflection and refraction of the

Table 2-1.

September 2004 MBDS Field Activities Summary

Survey Type	Date	Summary
Swath Bathymetry	15-16 September 2004	Area: 2400 x 2400 m Lines: 17 Spacing: 150 m
Sediment-Profile Imaging	14-15 September 2004	Stations: 45 MBDS C: 15 MBDS D: 15 FG23 Reference: 5 MBDREF Reference: 5 SEREF Reference: 5

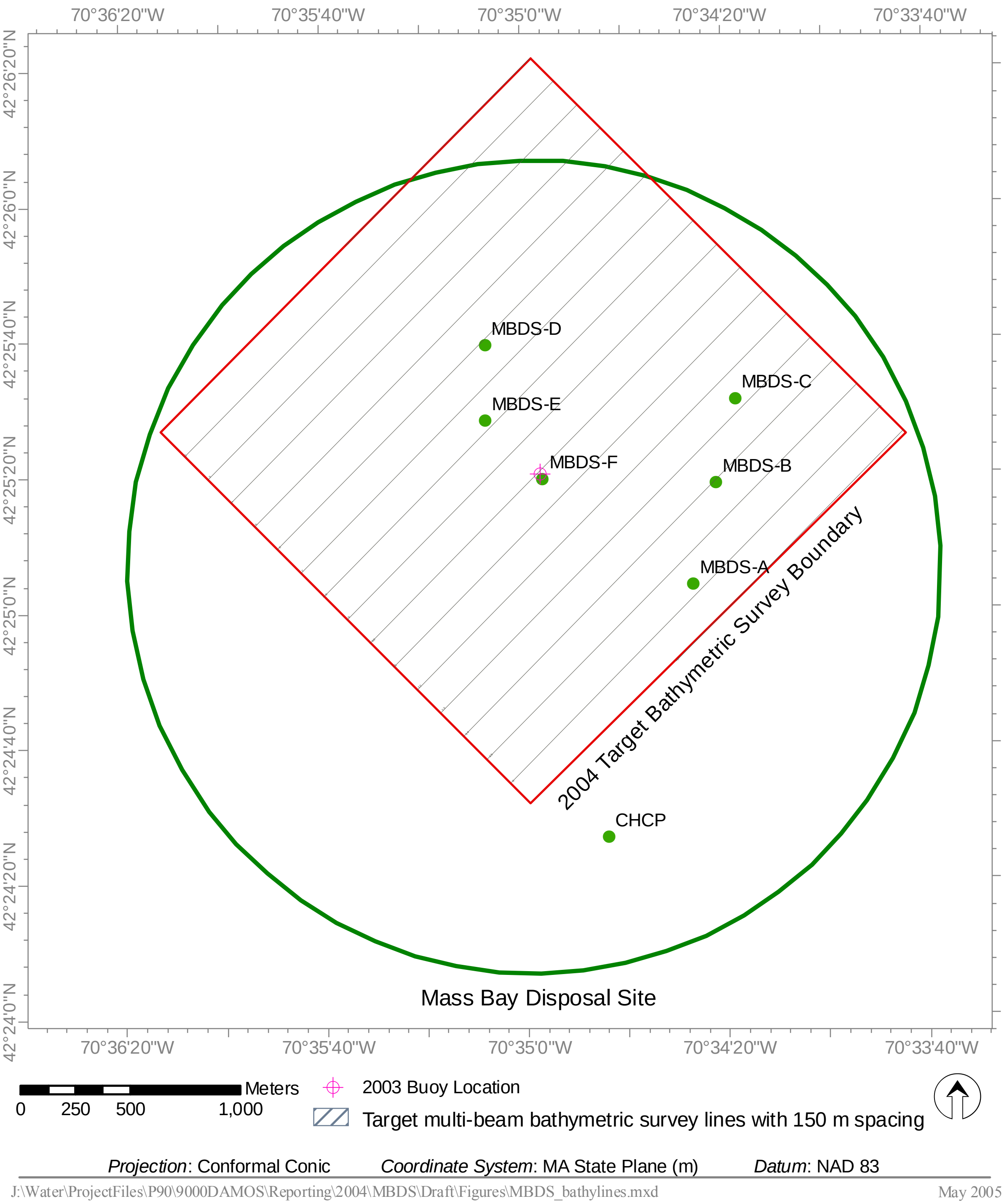


Figure 2-1. Target bathymetric survey lines at MBDS, September 2004

signal, thereby resulting in poor data quality. A switch was made to a lower frequency transducer (40-kHz) in order to better penetrate the clines. The lower frequency transducer was able to penetrate the clines but the survey was hampered by rough sea conditions and preliminary processing of the data revealed that it did not compare well with the 200-kHz data of the previous survey in 2000. As a result the single-beam bathymetry survey was discontinued and the decision was made to switch to a swath bathymetry system and the survey was performed the following month.

The 2004 swath bathymetric survey was conducted 15-16 September 2004 aboard the F/V *Christopher Andrew*. The swath survey targeted the same 2400 x 2400 m area and overlapped much of the area covered in the 2000 survey. A total of 17 survey lines, each 150 m apart, were occupied as part of the survey (Figure 2-1).

Bathymetric data from the swath survey were collected using a 125-kHz GeoAcoustics, Inc., GeoSwath® interferometric swath bathymetric system. The Geoswath® system produces a dense dataset across wide swaths of the seafloor, similar to conventional beam-forming multi-beam survey systems. The GeoSwath® system was equipped with a TSS DMS2-05 Motion Reference Unit (MRU) for measuring heave, pitch and roll; a Tritech® Precision Altimeter; and a Valeport® Mini Sound Velocity Sensor for measuring real-time sound velocity at the face of the transducer. Accurate vessel heading guidance was provided by a S.G Brown Meridian® Gyro Compass and Trimble® DGPS.

The swath data acquisition system consisted of a GeoSwath® PC equipped with specialized signal processing hardware and software. The GeoSwath® PC received and recorded data streams from the swath transducers, motion sensors, gyrocompass and Differential Global Position System (DGPS). The swath survey used HYPACK® software for navigation along preset survey transects. Data recorded on the GeoSwath® PC was archived to DVDs daily.

Calibration procedures were conducted on-site prior to data collection as well as at the conclusion of each survey day. The average speed of sound through the water column was obtained from a full depth cast of a Seabird SBE-19 SeaCat profiler. Calibration lines were run with the swath set-up prior to the actual collection of survey data to facilitate the correction of field data for latency errors and any misalignment between the axis of the gyro compass and that of the transducers. Pitch and roll calibrations between the port and starboard channels of the transducer were also performed prior to the start of the survey. Tidal elevations were recorded in meters and were referenced to Mean Lower Low Water (MLLW) based on water level data obtained from the National

Oceanic and Atmospheric Administration (NOAA) tide station in Boston Harbor (Station 8443970).

2.2.2 Bathymetric Data Processing

The bathymetric data were processed using the GeoAcoustics, Inc. GS32® software program and included corrections for tidal conditions, local speed of sound, and spurious data points. Tidal correction consisted of transforming the raw measurements of depth below the transducer to seafloor elevation measurements relative to MLLW using the locally collected tidal elevation data. Heave data supplied by the vessel's motion reference unit (MRU) was incorporated into the raw data to minimize the effects of vessel motion. The bathymetric data were also reviewed for spurious data points (clearly unrealistic measurements resulting from signal interference), and these points were removed.

Processed swath bathymetric data were binned to a 1.0 m density using GS32® software. Binned data were converted to the Massachusetts Mainland, NAD 83 metric grid using ACOE TEC Corpscon software. The GeoSwath® system also generated preliminary side-scan sonar imagery, facilitating bottom classification and target identification. A side-scan mosaic was created from the data using GeoAcoustics, Inc. Gridder 32® software. The mosaic was exported from Gridder 32® as a georeferenced TIF image and imported to ArcView® 9.0 for display.

2.2.3 Bathymetric Data Analysis

Bathymetric data were analyzed to gain a better understanding of the existing conditions at the site and to document changes in seafloor topography in comparison with previous surveys. The corrected bathymetric data were analyzed using a combination of the contouring and surface plotting software program, Surfer® 8.0 and the GIS-based software package ArcView® 9.0. Using Surfer®, the processed MBDS 2004 data were gridded to a cell size of 10 m x 10 m, consistent with the bathymetric grid created for the previous (Fall 2000) survey (SAIC 2002). Once gridded, bathymetric contour lines were generated and displayed using ArcView®.

Surfer® was also used to calculate a depth-difference grid based on the Fall 2000 and September 2004 bathymetric data sets. This grid was calculated by subtracting the Fall 2000 interpolated depth estimates from the September 2004 depth estimates at each point throughout the grid. The resulting depth differences were contoured and displayed using ArcView®.

2.3 Sediment-Profile Imaging

Sediment-profile imaging (SPI) is a monitoring technique used to provide data on the physical characteristics of the seafloor as well as the status of the benthic biological community. The technique involves deploying an underwater camera system that photographs a cross section of the sediment-water interface. Computer-aided analysis of the resulting images provides a set of standard measurements that can be compared between different locations and different surveys. The DAMOS Program has successfully used this technique for over 20 years to map the distribution of disposed dredged material and to monitor benthic recolonization at disposal sites. For a detailed discussion of SPI methodology, see ENSR (2004).

2.3.1 SPI Data Acquisition

The 2004 SPI survey design included 45 stations: 30 stations located within MBDS and 15 stations distributed within three reference areas (Table 2-2, Figure 2-2). The 30 stations located within MBDS were distributed as follows: 15 stations randomly located within a 0.15 km^2 area centered around the MBDS-C Mound and 15 stations randomly located within a 0.26 km^2 area centered around the MBDS-D Mound. Dredged material has not been disposed at either the MBDS-C or MBDS-D Mound since 1999. Three previously established reference areas (FG23, MBDREF, and SEREF; Figure 2-2), located south and southeast of the disposal site, were also surveyed to provide a basis of comparison between MBDS sediment conditions and the ambient sediment conditions in Massachusetts Bay. Five reference stations were selected randomly within a 300-m radius of the centers of each of the three references areas (Table 2-2, Figure 2-2).

The sediment-profile imaging survey was conducted 14-15 September 2004 aboard the F/V *Shanna Rose*. At each station, the vessel was positioned at the target coordinates and the camera was deployed within a defined station tolerance of 10 m. Three replicate sediment-profile images were collected at each of the 45 stations for characterization of small-scale (i.e. within-station) spatial variability.

Acquisition of high-resolution SPI images was accomplished using an Ocean Imaging Model 3731 pressure housing system with a Nikon D100 digital single-lens reflex camera. The camera was mounted inside the pressure housing and sat atop a wedge-shaped prism with a front faceplate and a back mirror. The mirror was mounted at a 45° angle to reflect the profile of the sediment-water interface. As the prism penetrated the seafloor, a trigger activated a time-delay circuit that fired an internal strobe to obtain a cross-sectional image of the upper 15 to 20 cm of the sediment column. The

Table 2-2.

MBDS Sediment-Profile Image Target Sampling Locations

Area	Station	Latitude (N)	Longitude (W)
MBDS-C	C-01	42° 25.538'	70° 34.103'
	C-02	42° 25.511'	70° 34.403'
	C-03	42° 25.352'	70° 34.197'
	C-04	42° 25.599'	70° 34.260'
	C-05	42° 25.600'	70° 34.232'
	C-06	42° 25.507'	70° 34.441'
	C-07	42° 25.598'	70° 34.190'
	C-08	42° 25.538'	70° 34.208'
	C-09	42° 25.498'	70° 34.188'
	C-10	42° 25.594'	70° 34.400'
	C-11	42° 25.503'	70° 34.299'
	C-12	42° 25.656'	70° 34.281'
	C-13	42° 25.504'	70° 34.363'
	C-14	42° 25.595'	70° 34.332'
	C-15	42° 25.416'	70° 34.324'
MBDS-D	D-01	42° 25.664'	70° 35.295'
	D-02	42° 25.614'	70° 35.140'
	D-03	42° 25.668'	70° 34.974'
	D-04	42° 25.634'	70° 35.240'
	D-05	42° 25.743'	70° 35.277'
	D-06	42° 25.632'	70° 35.212'
	D-07	42° 25.679'	70° 35.177'
	D-08	42° 25.727'	70° 34.971'
	D-09	42° 25.695'	70° 35.007'
	D-10	42° 25.636'	70° 35.270'
	D-11	42° 25.750'	70° 35.055'
	D-12	42° 25.744'	70° 35.295'
	D-13	42° 25.754'	70° 35.174'
MBDS-D	D-14	42° 25.678'	70° 35.298'
(cont.)	D-15	42° 25.713'	70° 35.067'
Reference	FG23-01	42 22.668'	70° 34.667'
	FG23-02	42° 22.572'	70° 34.556'
	FG23-03	42° 22.804'	70° 34.714'
	FG23-04	42° 22.727'	70° 34.777'
	FG23-05	42° 22.563'	70° 34.637'
	MBDREF-01	42° 22.748'	70° 30.179'
	MBDREF-02	42° 22.572'	70° 30.244'
	MBDREF-03	42° 22.738'	70° 30.068'
	MBDREF-04	42° 22.643'	70° 30.264'
	MBDREF-05	42° 22.579'	70° 30.336'
	SEREF-01	42° 20.123'	70° 27.922'
	SEREF-02	42° 19.943'	70° 28.021'
	SEREF-03	42° 19.895'	70° 27.944'
	SEREF-04	42° 20.002'	70° 27.919'
	SEREF-05	42° 19.990'	70° 27.974'

Note: Coordinate System NAD 83

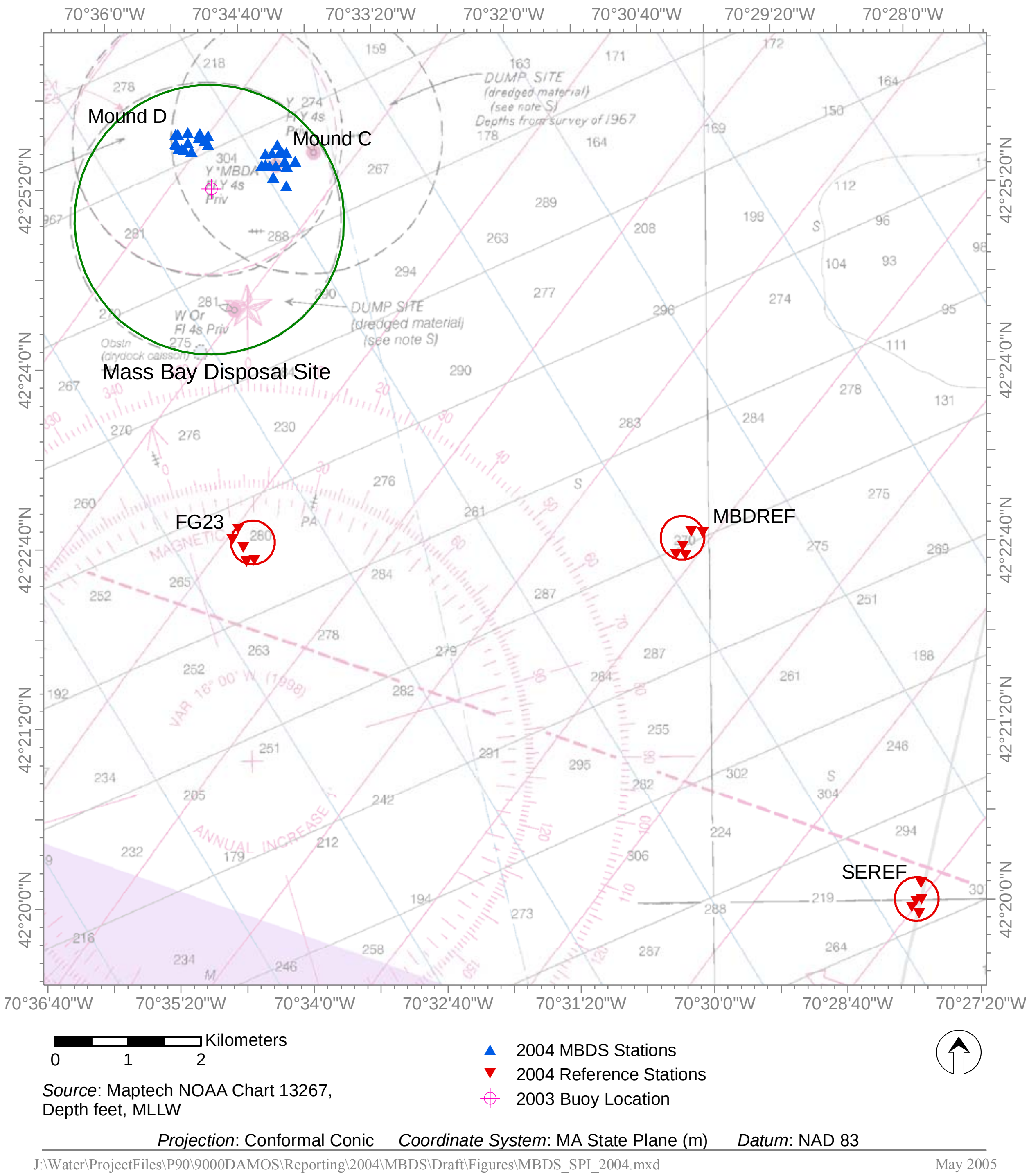


Figure 2-2. MBDS with target SPI stations indicated, September 2004

camera remained on the seafloor for approximately 20 seconds to ensure that a successful image had been obtained.

Two types of adjustments to the SPI system were typically made in the field: 1) physical adjustments to the frame stop collars and/or adding/subtracting lead weights to the frame to control penetration in harder or softer sediments, and 2) electronic software adjustments to the Nikon D100 to control camera settings. Each image was assigned a unique time stamp in the digital file attributes by the camera's data logger and cross-checked with the time stamp in the navigational system's computer data file. In addition, the field crew kept redundant written sample logs. Images were downloaded periodically to verify successful sample acquisition or to assess what type of sediment/depositional layer was present at a particular station. Digital image files were re-named with the appropriate station name immediately after downloading on deck as a further quality assurance step.

Test exposures of the Kodak® Color Separation Guide (Publication No. Q-13) were made on deck at the beginning and end of each survey to verify that all internal electronic systems were working to design specifications and to provide a color standard against which final images could be checked for proper color balance. After deployment of the camera at each station, the frame counter was checked to ensure that the requisite number of replicates had been obtained. In addition, a prism penetration depth indicator on the camera frame was checked to verify that the optical prism had actually penetrated the bottom to a sufficient depth. If images were missed or the penetration depth was insufficient, the camera frame stop collars were adjusted and/or weights were added or removed, and additional replicate images were taken. Changes in prism weight amounts, the presence or absence of mud doors, and frame stop collar positions were recorded for each replicate image.

2.3.2 SPI Data Analysis

Computer-aided analysis of each image was performed to provide measurement of the following standard set of parameters:

- *Sediment Type*—The sediment grain size major mode and range were estimated visually from the images using a grain-size comparator at a similar scale. Results were reported using the phi scale. Conversion to other grain-size scales is provided in Appendix B. The presence and thickness of disposed dredged material were also assessed by inspection of the images.

- *Penetration Depth*—The depth to which the camera penetrated into the seafloor was measured to provide an indication of the sediment density or bearing capacity. The penetration depth can range from a minimum of 0 cm (i.e., no penetration on hard substrates) to a maximum of 20 cm (full penetration on very soft substrates).

- *Surface Boundary Roughness*—Surface boundary roughness is a measure of the vertical relief of features at the sediment-water interface in the sediment-profile image. Surface boundary roughness was determined by measuring the vertical distance between the highest and lowest points of the sediment-water interface. The surface boundary roughness (sediment surface relief) measured over the width of sediment-profile images typically ranges from 0 to 4 cm, and may be related to physical structures (e.g., ripples, rip-up structures, mud clasts) or biogenic features (e.g., burrow openings, fecal mounds, foraging depressions). Biogenic roughness typically changes seasonally and is related to the interaction of bottom turbulence and bioturbational activities.

- *Apparent Redox Potential Discontinuity (RPD) Depth*— RPD provides a measure of the integrated time history of the balance between near surface oxygen conditions and biological reworking of sediments. Sediment particles exposed to oxygenated waters oxidize and lighten in color to brown or light grey. As the particles are moved downwards by biological activity or buried, they are exposed to reduced oxygen concentrations in subsurface pore waters and their oxic coating slowly reduces, changing color to dark grey or black. When biological activity is high, the RPD depth increases; when it is low or absent, the RPD depth decreases. The RPD depth was measured by assessing color and reflectance boundaries within the images.

- *Infaunal Successional Stage*—Infaunal successional stage is a measure of the biological community inhabiting the seafloor. Current theory holds that organism-sediment interactions in fine-grained sediments follow a predictable sequence of development after a major disturbance (such as dredged material disposal), and this sequence has been divided subjectively into three stages (Rhoads and Germano 1982, 1986). Successional stage was assigned by assessing which types of species or organism-related activities were apparent in the images.

- *Organism-Sediment Index (OSI)*—OSI is a summary parameter incorporating the apparent mean RPD depth, successional stage, and presence of methane or low oxygen and reflects the seafloor's response to natural or anthropogenic disturbance (Revelas et al. 1987; Table 2-3). An OSI threshold of +6 is used to evaluate the degree of benthic habitat disturbance along the continuum from highly disturbed

Table 2-3.

Organism-Sediment Index (OSI) Terms and Formulation

Parameter	Index Value
A. Mean RPD Depth (choose one)	
0.00 cm	0
0.01 – 0.75 cm	1
0.76 – 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. Successional Stage (choose one)	
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. Chemical Parameters (choose all that apply)	
Methane Present	-2
No/Low Dissolved Oxygen	-4
Calculation of Organism-Sediment Index (OSI)	
OSI = Total of above indices (A+B+C)	
Range of possible OSI values is -10 to +11	

(OSI value of -10) to undisturbed (OSI value of +11). In general, OSI values of +6 and below are indicative of a moderately to highly disturbed habitat.

Additional components of the SPI analysis included calculation of means and ranges for the parameters listed above and mapping of individual values.

2.3.3 SPI Statistical Analysis

The objective of the SPI survey at MBDS was to assess the benthic recolonization status of the MBDS-C and MBDS-D Mounds relative to reference conditions. The typical statistical approach to evaluate this type of objective is point-null hypothesis testing. This approach postulates the null hypothesis that there is no difference in benthic conditions between the mean values of the reference area and the mean values of the disposal mound; if the p-value is less than the accepted Type I error risk ($\alpha = 0.05$), it is concluded that the sites are different (e.g., Underwood 1990, 1997; Fairweather 1991). As such, p-values are treated as evidence for or against rejecting the null hypotheses.

As limitations have been identified with this approach (e.g., Carver 1978; Tukey 1991; McBride et al. 1993; Germano 1999; McBride 1999; Nelder 1999; Cole et al. 2001), equivalence tests (also known as interval hypothesis tests) have been employed to analyze SPI data. Statistical analysis of the 2004 MBDS SPI data included equivalence tests to compare biological conditions at the MBDS-C and MBDS-D Mounds with those at the reference stations.

Equivalence tests can examine either 1) the equivalence hypothesis, where the true difference between means is postulated to lie within a prescribed equivalence interval, or, 2) the inequivalence hypothesis, in which the true difference between means is postulated to lie beyond that interval. These two approaches provide a framework for demonstrating proof of hazard (equivalence tests), or proof of safety (inequivalence tests). It is the latter approach that is particularly appropriate for the evaluation of disposal mounds relative to nearby reference areas for the DAMOS program. In this application of bioequivalence (interval) testing, the null hypothesis was chosen as one that presumes the difference between parameter values measured within a disposal site relative to reference areas is great, i.e., an inequivalence hypothesis (e.g., McBride 1999). This is recognized as a 'proof of safety' approach because rejection of this inequivalence null hypothesis requires sufficient proof that the difference is actually small. The null and alternative hypotheses to be tested were:

H0: $d \leq -\delta$ or $d \geq \delta$ (presumes the difference is great)
HA: $-\delta < d < \delta$ (requires proof that the difference is small)

Where:

d = the actual difference between the reference mean and the site mean for a particular parameter
δ = the maximum difference expected for that parameter considering background variability/noise.

If the null hypothesis is rejected, then it can be concluded that the two means are not different from one another within $\pm\delta$ units. The size of δ should be determined from historical data and/or best professional judgment to identify a maximum difference that is within background variability/noise and is therefore not ecologically meaningful.

The two key SPI parameters most affected by animal-sediment interactions during the recovery process are RPD and successional stage. Because the successional stage is a categorical classification, the OSI value was used as a surrogate for this parameter (furthermore, it incorporates additional information on sources of habitat disturbance). To determine the expected difference (δ) between an undisturbed seafloor (i.e., reference area) and a recently-disturbed disposal site (i.e., disposal mound) for RPD and OSI, both the mean and range of values in historical DAMOS SPI monitoring data were considered. Based on these historical data, it was determined that realistic δ for RPD and OSI values would be 3 and 4, respectively. These difference values were based on the typical spread of RPD and OSI values observed at the reference areas and were representative of a background range.

In the sampling design employed at MBDS, there were actually five distinct areas, three of which were categorized as reference locations; therefore, the difference equation of interest was defined as the average of the three reference means minus the mound mean:

$$[\tfrac{1}{3} (Mean_{FG23} + Mean_{SE} + Mean_{MB}) - Mean_{Mound}]$$

The three reference areas collectively represent ambient conditions, and if appropriate, were pooled into a single reference group. However, if there were mean differences among these three areas, then pooling them into a single reference group would increase the variance beyond true background variability. The effect of keeping the three reference areas separate has no effect on the grand reference mean (when n was equal among these areas), but it maintains the variance as a true background variance for each individual population with a constant mean. Differences among the three reference areas were evaluated prior to comparison with the mound data to determine if pooling the reference areas was appropriate.

The difference equations, $\hat{d}_i$, for the two comparisons of interest were:

$$\hat{d}_1 = ⅓ (\text{Mean}_{FG23} + \text{Mean}_{SE} + \text{Mean}_{MB}) - \text{Mean}_{C} \text{ or } \text{Mean}_{\text{pooled refs}} - \text{Mean}_{C};$$
$$\hat{d}_2 = ⅓ (\text{Mean}_{FG23} + \text{Mean}_{SE} + \text{Mean}_{MB}) - \text{Mean}_{D} \text{ or } \text{Mean}_{\text{pooled refs}} - \text{Mean}_{D};$$

The standard error of each difference was calculated identical to the standard error of Scheffe's linear contrasts which derives from the fact that the variance of a sum is the sum of the variances for independent variables, or:

$$SE(\hat{d}_i) = \sqrt{\sum_j \left(S_j^2 c_j^2 / n_j\right)} \qquad \text{(Zar 1996)}$$

Where:

c_j = coefficients for the j area means in the difference equation, $\hat{d}_i$ (i.e., for the first difference equation shown above, the coefficients were 1/3, 1/3, 1/3, -1, and 0 for FG23, SEREF, MBREF, MBDS-C and MBDS-D, respectively, or 1, -1, 0 for Reference, MBDS-C, and MBDS-D, if the three reference areas were pooled).

S_j^2 = variance for the j^{th} area. If equal variances were assumed, a single pooled variance estimate was substituted for each group, equal to the mean square error from the ANOVA.

n_j = number of replicates for the j^{th} area (5, 5, 5, 15, 15 for areas FG23, SEREF, MBREF, MBDS-C, MBDS-D, respectively, or 15 for all areas if reference areas were pooled).

The test of this interval hypothesis was broken down into two one-sided tests (TOST) (McBride 1999 after Schuirmann 1987) which were based on the Student's t-distribution. The statistics used to test the interval hypotheses shown here were based on the Central Limit Theorem (CLT) such that the mean of any random variable is normally distributed and linear combinations of normal random variables are also normal. Hence, a linear function of means is normally distributed. As a result, the t-distribution can be used to construct a confidence interval around any linear function of means. If this confidence interval contained the specified δ then the true difference was greater than δ (H0 above); if the specified δ was not contained in this interval then the true difference was less than δ (HA above) and was concluded that equivalence was within δ units.

Specifically, the inequivalence null hypothesis was rejected if the confidence interval on the difference of means, $\hat{d}_i$, contained neither +δ nor –δ, i.e., if :

$$T_a = \frac{\hat{d}_i - (-\delta)}{SE(\hat{d}_i)} \geq t_{\alpha,\upsilon} \quad \text{and} \quad T_b = \frac{\hat{d}_i - (+\delta)}{SE(\hat{d}_i)} \leq -t_{\alpha,\upsilon}$$ (McBride 1999)

Where:

$\hat{d}_i$ = observed difference in means between the Reference and Mound

$t_{\alpha,\upsilon}$ = upper 100α percentile of a Student's t-distribution with υ degrees of freedom

$SE(\hat{d}_i)$ = standard error of the difference.

υ = degrees of freedom for the standard error. If a pooled variance estimate was used, the degrees of freedom term was equal to the sum of the sample sizes for all groups included in the $\hat{d}_i$ minus the number of groups; if separate variance estimates were used, the degrees of freedom term was calculated based on the Brown and Forsythe estimation (Zar 1996).

Equality of the references areas were graphically evaluated using boxplots and summary statistics. The assumptions of normality and equal variance were tested using Shapiro-Wilk's test for normality (α=0.05) and Levene's test for equality of variances among the five areas (α =0.05). If normality was not rejected but equality of variances was, then the variance for the difference equation was based on separate variances for each area. If systematic deviations from normality were identified, then the data were transformed to approximate normality, if possible.

3.0 RESULTS

3.1 Bathymetry

The general bathymetry of MBDS is characterized by a gradual slope from approximately 85 m depth in the western and central portion of the site to a natural depression in the northern and northeastern portion of the site with depths up to 92 m. Bathymetric features identified at MBDS by the September 2004 survey (Figure 3-1) were similar to those of the previous (Fall 2000) survey (Figure 3-2), with five disposal mounds (MBDS-A through MBDS-E) apparent along with a shallower feature just north of the MBDS boundary. A sixth mound, MBDS-F, was also identified in the September 2004 survey (Figure 3-1).

The five existing mounds (MBDS-A through MBDS-E) have changed little in shape from the previous survey. The MBDS-C Mound was the largest, with an elongated shape oriented along a northwest-southeast axis that was approximately 600 m in length and rising to a peak height of approximately 8 m above the surrounding seafloor. The MBDS-C Mound was partially conjoined with the MBDS-B Mound to the south. The MBDS-B Mound had a diameter of approximately 350 m and a height of approximately 6 m. The MBDS-A Mound was located farthest south and was elongated in an east-west orientation, approximately 500 m in length and 5 m in height. To the west, the MBDS-D and MBDS-E Mounds were much smaller, both with a diameter of approximately 250 m and height of approximately 3 m (Figure 3-3).

The new MBDS-F Mound, formed from the disposal of approximately 560,000 m^3 of material between 2000 and 2004, was located partway between the MBDS-E and MBDS-A Mounds. Two peaks were apparent, a primary peak in the center and a small, secondary peak to the northeast (Figure 3-3).

The 2004 bathymetry survey overlapped with much of the previous 2000 survey area (Figure 3-2) allowing for generation of a depth-difference map, plotted at a 1-m contour interval (Figure 3-4). The depth difference map clearly shows the formation of the MBDS-F Mound. The MBDS-F Mound was approximately 450 m in diameter and 4 m in height. Limited areas of both depth increases and decreases were identified over the older mounds, and a more pronounced area of difference was noted to the north, outside of the MBDS boundary. The depth increase over the older mounds may be the result of continued consolidation; however, more pronounced areas of difference are likely artifacts due to difficulties in resolving steep bathymetric gradients and differences in data

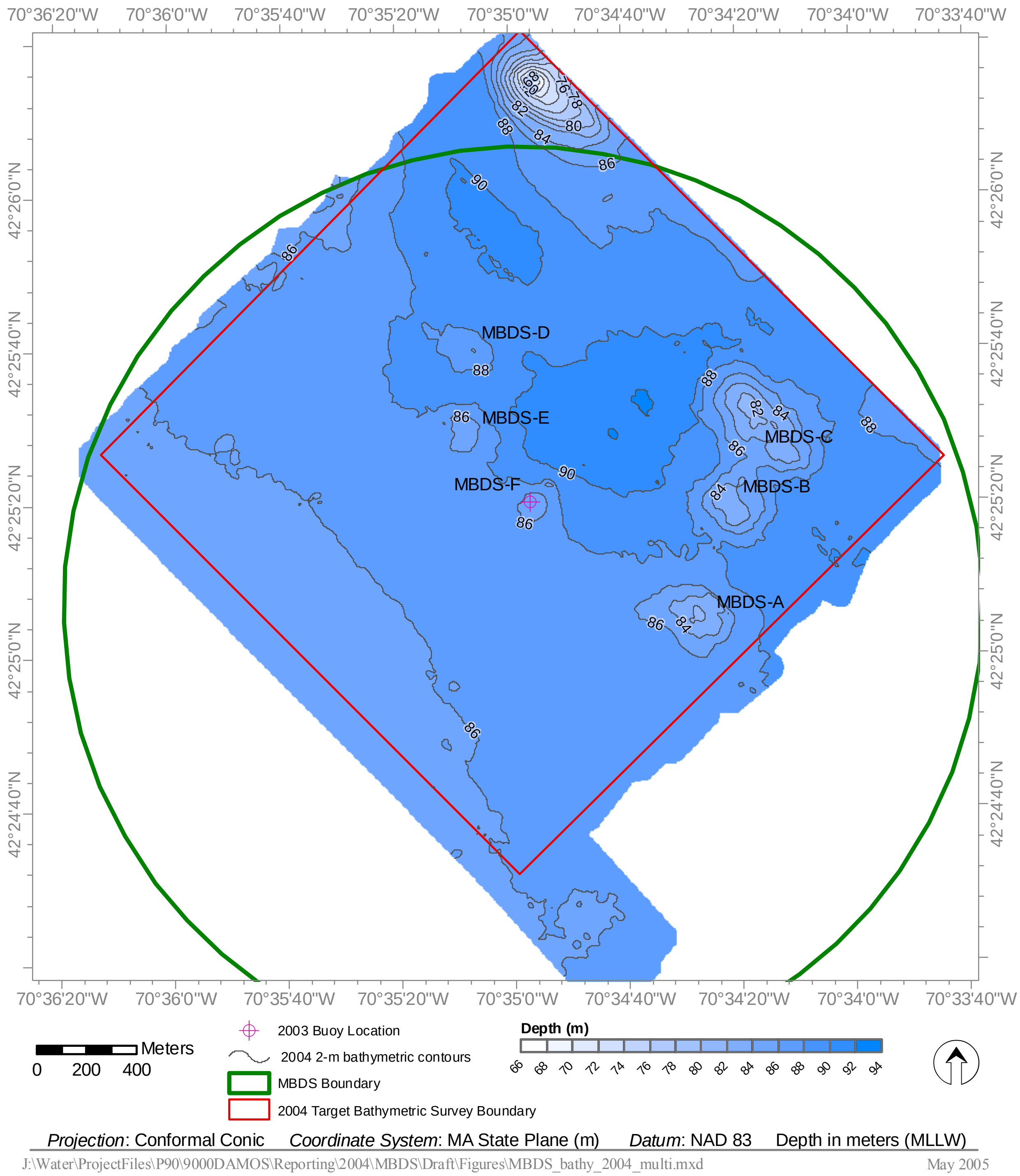


Figure 3-1. Bathymetric contour map of MBDS survey area, September 2004 (2-m contour interval).

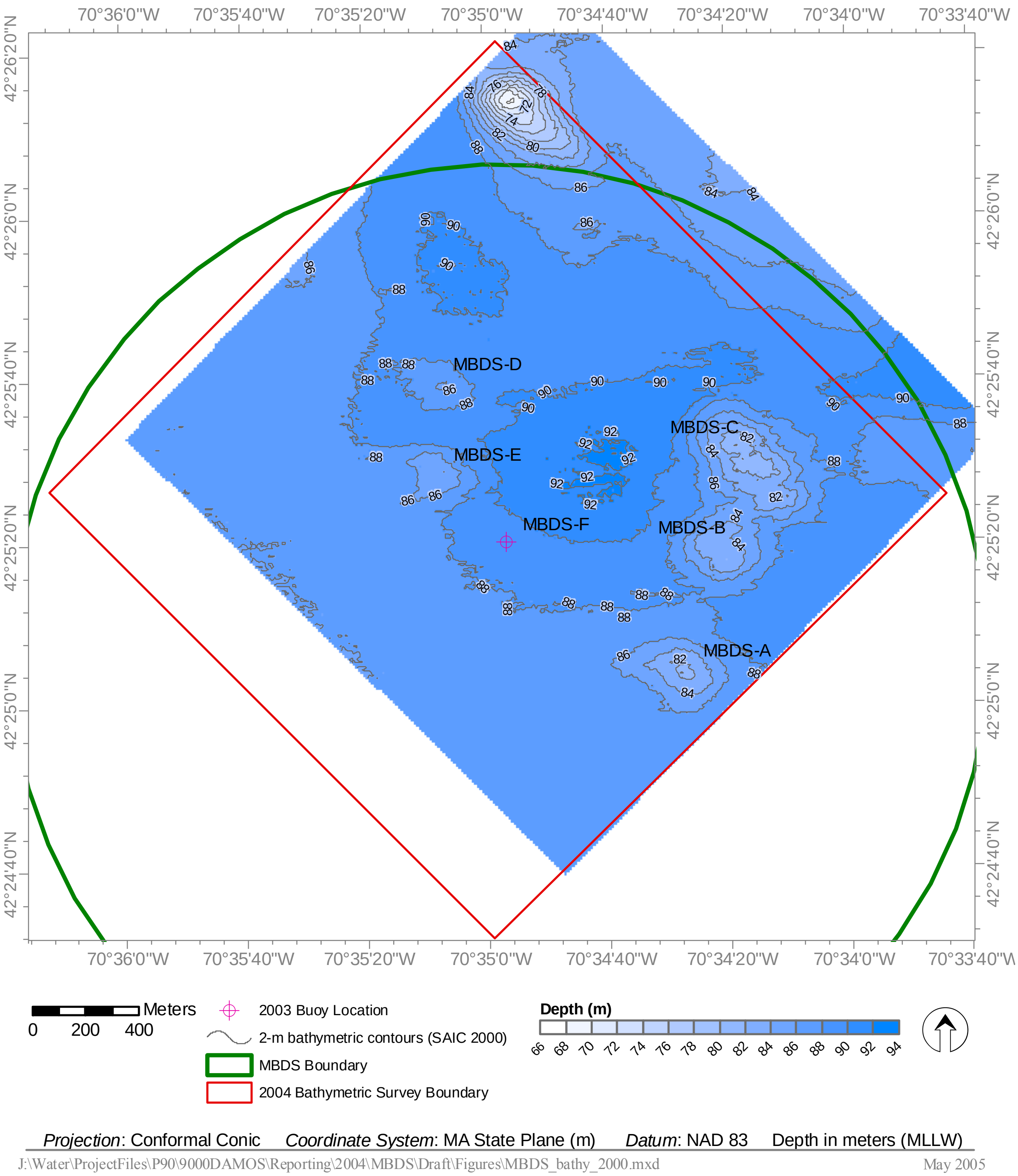


Figure 3-2. Bathymetric contour map of MBDS survey area, Fall 2000 (2-m contour interval).

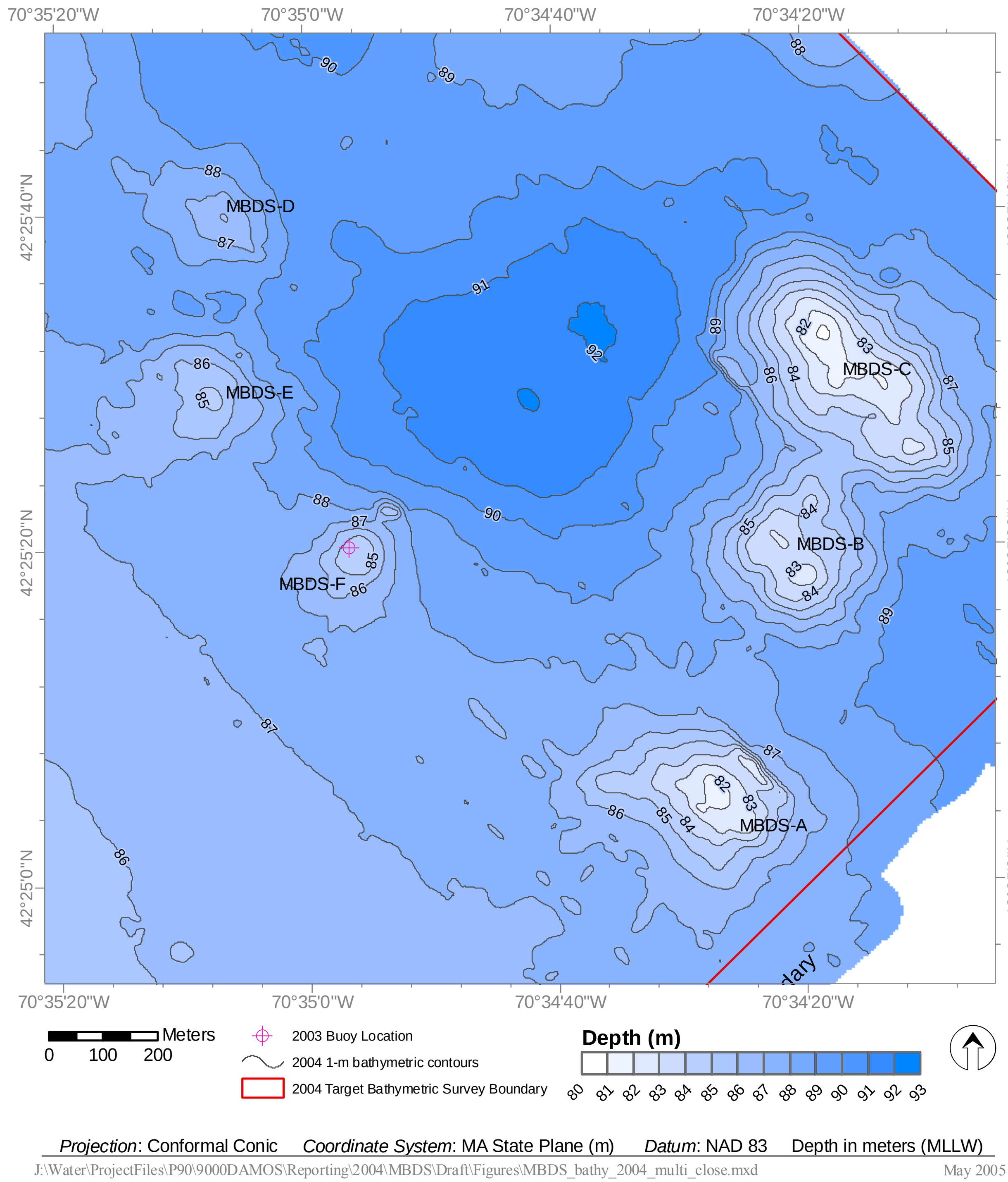


Figure 3-3. Bathymetric contour map of MBDS survey area, September 2004 (1-m contour interval).

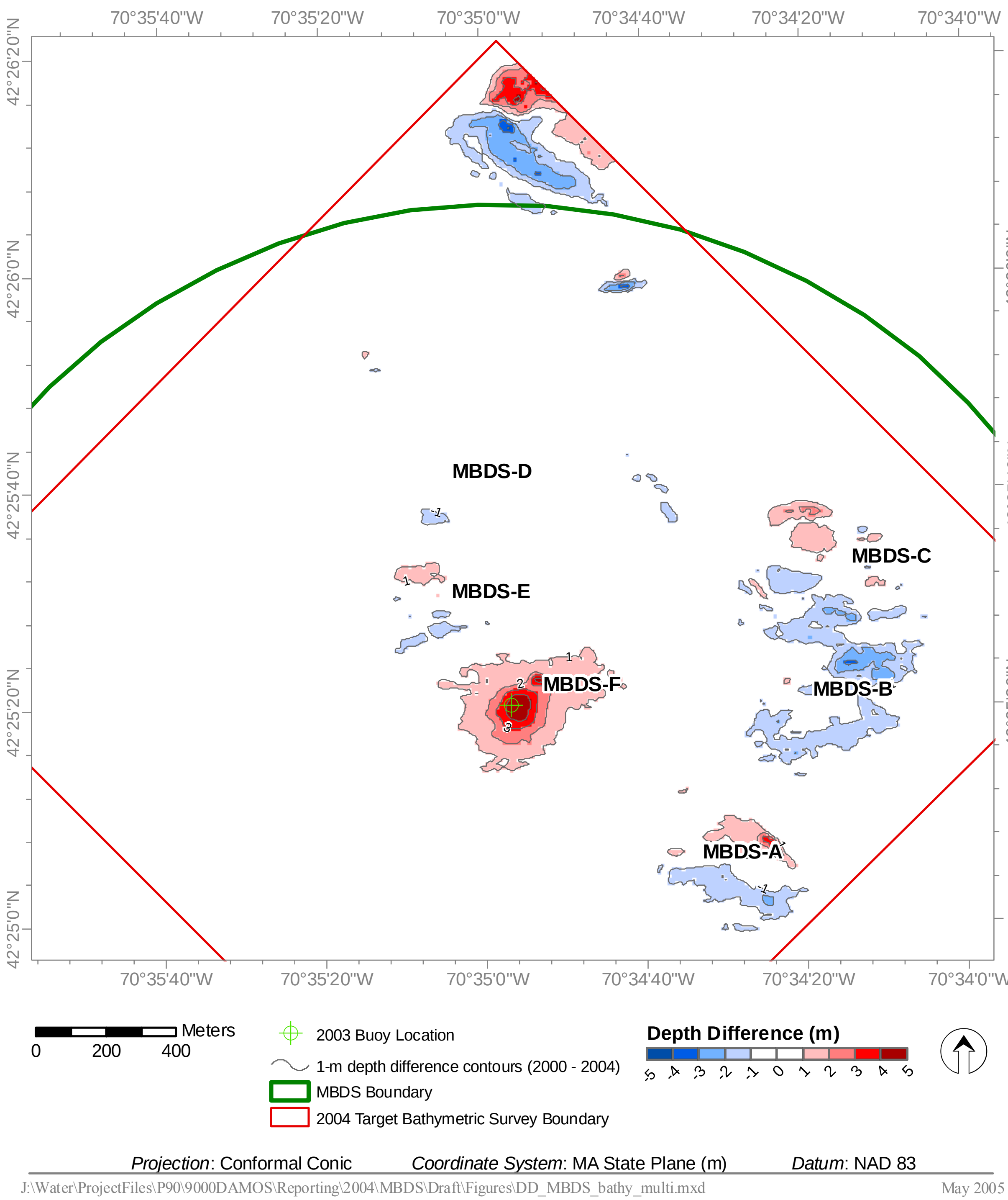


Figure 3-4. Depth difference contour map of MBDS survey area, Fall 2000 vs. September 2004 survey results (1-m contour interval).

collection and processing techniques (125-kHz swath system in 2004 vs. a 208-kHz single beam system in 2000).

3.2 Sediment-Profile Imaging

The objective of the September 2004 SPI survey was to compare the benthic recolonization status and benthic conditions of the MBDS-C and MBDS-D Mounds with those at the reference areas. A complete set of results for the SPI images analysis is presented in Appendix B; the summary of results is presented below.

3.2.1 Reference Areas

Sediment Physical Characteristics

No evidence of errant dredged material or unusual physical disturbance was found at any of the stations in the three reference areas. Fine-grained muds were found at all the reference stations sampled, with the sediment grain-size major mode at all stations >4 phi (Table 3-1). The mean station camera prism penetration values ranged from 5.3 to 18.3 cm, with an overall site mean penetration of 15.2 cm (Table 3-1). Small-scale surface boundary roughness values ranged from 0.8 to 2.6 cm, with an overall site mean boundary roughness of 1.4 cm (Table 3-1). The origin of the small-scale surface roughness elements was mainly from the burrowing and feeding activities of the resident infauna (Figure 3-5). No evidence of low oxygen conditions in the overlying water or methanogenesis in the sediments was observed at any of the reference stations.

Biological Conditions and Benthic Recolonization Status

The mean apparent RPD values from the three reference areas ranged from 2.4 to 4.4 cm, with an overall reference area mean value of 3.5 cm (Table 3-1). Mature infaunal assemblages (Stage III taxa) were found in all 46 images analyzed from the reference stations (Table 3-1), and evidence of their sediment reworking activities were prominent in many of the images (Figure 3-6).

OSI values were also uniformly high across the three reference areas, with station median values ranging from +9 to +11, and an overall median reference area value of +10 (Table 3-1). None of the reference areas showed any sign of unusual physical stress or anthropogenic disturbance.

Table 3-1

Summary of SPI Results for MBDS Reference Stations, September 2004

Station	Grain Size Major Mode (phi)	Mean Prism Penetration Depth (cm)	Mean RPD Depth (cm)	Boundary Roughness (cm)	Mean DM Thickness (cm)	Mean Void Depth (cm)	Successional Stages present (no. of replicates)	Median OSI	Mean OSI	Methane present?	Low DO?
FG23-01	>4	14.9	3.1	1.4	0.0	9.5	I on III (3)	10.0	9.7	No	No
FG23-02	>4	15.7	3.8	1.0	0.0	6.2	I on III (2), III (1)	11.0	10.7	No	No
FG23-03	>4	18.1	3.3	0.9	0.0	6.7	I on III (3)	10.0	9.7	No	No
FG23-04	>4	17.9	3.5	1.6	0.0	8.1	I on III (3)	9.0	9.7	No	No
FG23-05	>4	16.2	2.4	1.4	0.0	7.8	I on III (3)	9.0	8.7	No	No
MBDREF-1	>4	7.9	3.7	1.7	0.0	5.1	I on III (2), III (1)	10.0	10.3	No	No
MBDREF-2	>4	14.6	3.3	1.2	0.0	9.9	I on III (3)	10.0	10.0	No	No
MBDREF-3	>4	5.3	3.6	2.61	0.0	3.6	I on III (2), III (1)	10.0	10.0	No	No
MBDREF-4	>4	16.4	4.0	1.4	0.0	10.3	I on III (3), III (1)	11.0	10.8	No	No
MBDREF-5	>4	14.9	3.1	0.8	0.0	8.1	I on III (3)	10.0	9.7	No	No
SEREF-1	>4	18.3	3.7	1.0	0.0	12.9	I on III (3)	10.0	10.3	No	No
SEREF-2	>4	16.7	3.7	2.0	0.0	9.9	I on III (3)	10.0	10.3	No	No
SEREF-3	>4	16.9	4.4	1.1	0.0	11.9	I on III (3)	11.0	10.7	No	No
SEREF-4	>4	16.7	3.5	1.8	0.0	12.3	I on III (3)	10.0	10.0	No	No
SEREF-5	>4	17.7	3. 8	0.8	0.0	9.5	I on III (3)	10.0	10.3	No	No
Average		15.2	3.5	1.4	NA	8.8		NA	10.1		
Median		NA	NA	NA	NA	NA		10.0	NA		
Minimum		5.3	2.4	0.8	NA	3.6		9.0	8.7		
Maximum		18.3	4.4	2.6	NA	12.9		11.0	10.8		

NA = Not Applicable

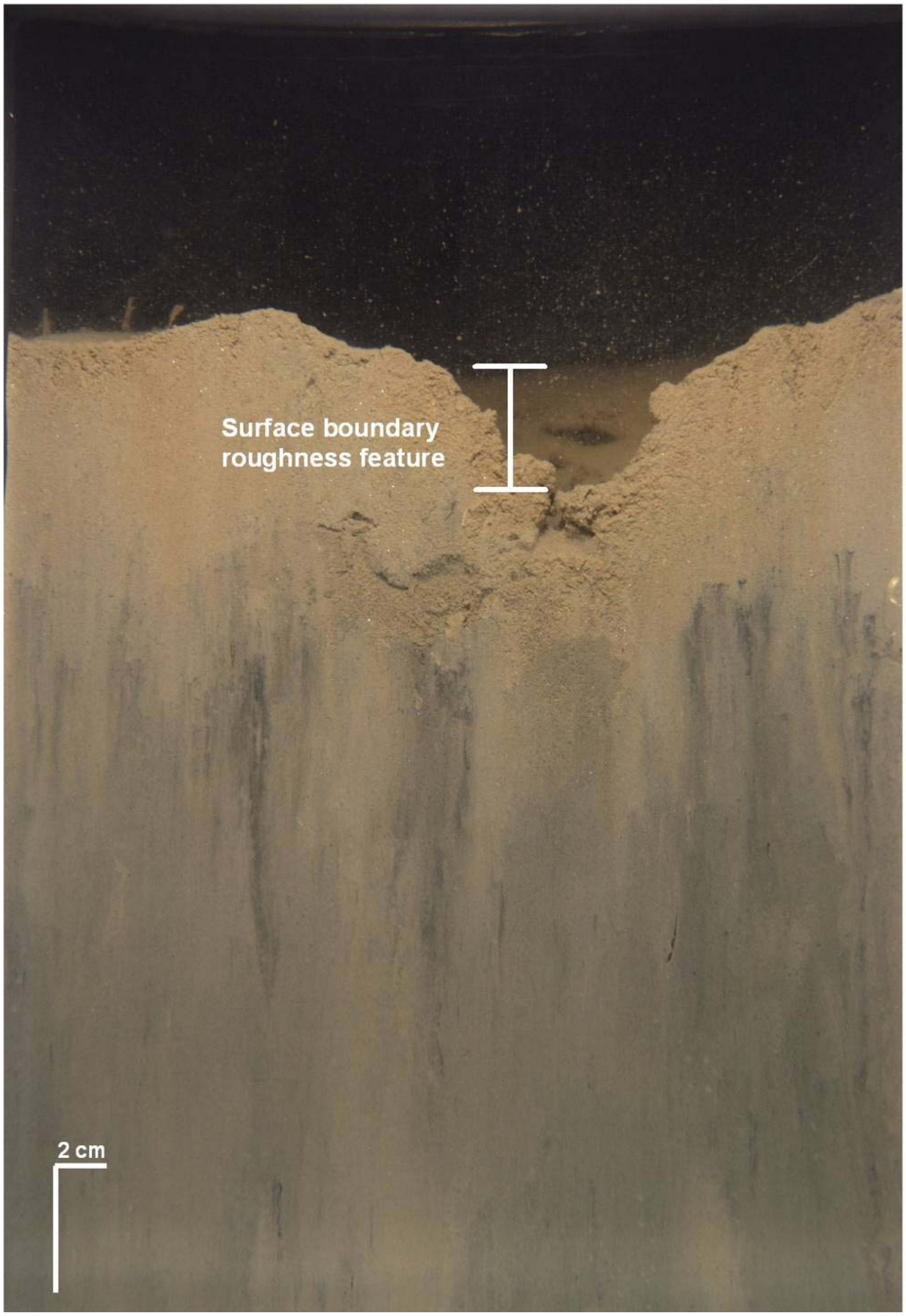


Figure 3-5. SPI image from reference area FG23, Station 4 showing a prominent surface boundary roughness feature due to macrofaunal bioturbation.

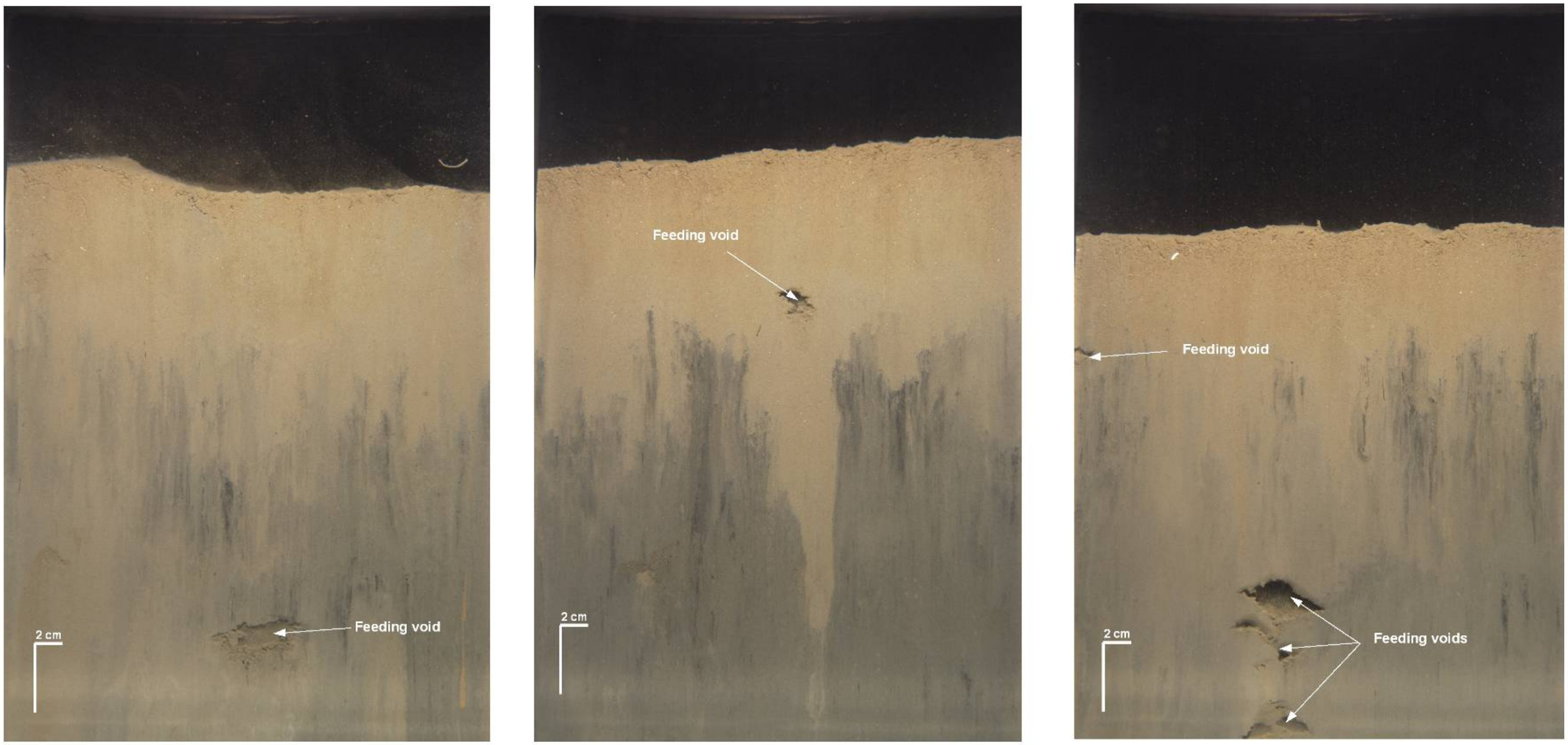


Figure 3-6. Deposit-feeding infauna were present in all three reference areas, as evidenced by the prominent feeding voids seen in these SPI images from SE REF (left), FG23 (center), and MB REF (right).

3.2.2 MBDS-C Mound

The MBDS-C Mound received approximately 1.4 million m^3 of dredged material between 1998 and 1999, approximately three times more than the volume placed at the MBDS-D Mound (SAIC 2002). Historical dredged material was still evident in every single image and extended beyond the depth of prism penetration (Table 3-2). Even though there had been no disposal at this location for over five years, the evidence of multiple disposal events was still preserved in many of the sediment cross-sectional images (Figure 3-7).

Sediment Physical Characteristics

The sediments found at each of the 15 stations surveyed at the MBDS-C Mound were primarily fine-grained with a grain size major mode of >4 phi. One distinguishing characteristic of the sediments on this particular mound was the presence of Boston Blue Clay at all of the stations sampled. The prism penetration values on this mound ranged from 7.9 to 18.1 cm (Table 3-2), reflecting the variation in sediment bearing strength from the differing amounts of cohesive BBC found from station to station (Figure 3-8). The overall average penetration value at the MBDS-C Mound was 12.9 cm, reflecting the predominantly fine-grained sediments found at all the stations (Table 3-2).

Small-scale surface boundary roughness ranged from 0.6 to 2.1 cm; most of the small-scale relief was biogenic in origin, caused by feeding pits or mounds. However, there were still a few remnants of physically-derived roughness elements associated with the dredged material disposal, mainly from large clay clumps (Figure 3-8) still evident on the sediment surface. Mud clasts were evident in approximately one-third of the images (Appendix B), but were likely caused by sampling artifacts from the camera frame or wiper blade and not due to any transport processes occurring in the vicinity of the disposal site. No stations exhibited any evidence of low dissolved oxygen in the overlying water or signs of methane in the subsurface sediments.

Biological Conditions and Benthic Recolonization Status

The mean apparent RPD values at the MBDS-C Mound stations ranged from 1.6 to 3.4 cm, with an overall average depth of 2.6 cm (Table 3-2; Figure 3-9). The variation in mean apparent RPD depth was largely a function of distance of the BBC layers from the sediment surface; the closer the clay layer, the more resistance the sediment offered to burrowing infauna and the shallower the apparent RPD depth at a particular station (Figure 3-10).

Table 3-2.

Summary of SPI Results for MBDS-C Mound Stations, September 2004

Station	Grain Size Major Mode (phi)	Mean Prism Penetration Depth (cm)	Mean RPD Depth (cm)	Boundary Roughness (cm)	Mean DM Thickness (cm)	Mean Void Depth (cm)	Successional Stages present (no. of replicates)	Median OSI	Mean OSI	Methane present?	Low DO?
MBDS C-1	>4	12.6	2.2	0.9	> 12.6	9.3	II -> III (1), I on III (2)	8.0	8.3	No	No
MBDS C-2	>4	13.4	2.6	0.6	> 13.4	8.5	I on III (3)	9.0	9.0	No	No
MBDS C-3	>4	17.7	2.9	1.0	> 17.7	9.4	I on III (3)	10.0	9.3	No	No
MBDS C-4	>4	7.9	2.3	2.1	> 7.9	6.0	I -> II (1), I on III (2)	8.0	7.3	No	No
MBDS C-5	>4	11.3	2.3	1.6	> 11.3	7.4	I on III (3)	9.0	8.3	No	No
MBDS C-6	>4	18.1	3.4	0.7	> 18.1	10.7	I on III (3)	10.0	10.0	No	No
MBDS C-7	>4	11.7	2.9	1.9	> 11.7	7.3	I on III (2), III (1)	9.0	9.3	No	No
MBDS C-8	>4	9.8	2.5	1.1	> 9.8	6.7	I on III (3)	9.0	9.0	No	No
MBDS C-9	>4	9.0	2.2	0.6	> 9.0	6.2	I on III (3)	8.0	8.3	No	No
MBDS C-10	>4	14.9	2.7	0.6	> 14.9	11.5	I on III (3)	9.0	9.3	No	No
MBDS C-11	>4	11.0	2.8	1.3	> 11.0	7.3	I on III (3)	9.0	9.0	No	No
MBDS C-12	>4	12.9	3.2	0.6	> 12.9	7.3	I on III (3)	10.0	9.7	No	No
MBDS C-13	>4	15.7	3.0	1.3	> 15.7	7.2	I on III (3)	9.0	9.3	No	No
MBDS C-14	>4	10.4	1.6	1.6	> 10.4	6.9	I on III (3)	8.0	7.7	No	No
MBDS C-15	>4	17.1	3.0	1.5	> 17.1	8.2	I on III (3)	9.0	9.3	No	No
Average		12.9	2.6	1.2	NA	8.0		NA	8.9		
Median		NA	NA	NA	NA	NA		9.0	NA		
Minimum		7.9	1.6	0.6	NA	6.0		8.0	7.3		
Maximum		18.1	3.4	2.1	NA	11.5		10.0	10.0		

NA = Not Applicable

Figure 3-7. SPI image from Station C3 showing multiple depositional horizons from past disposal activity.

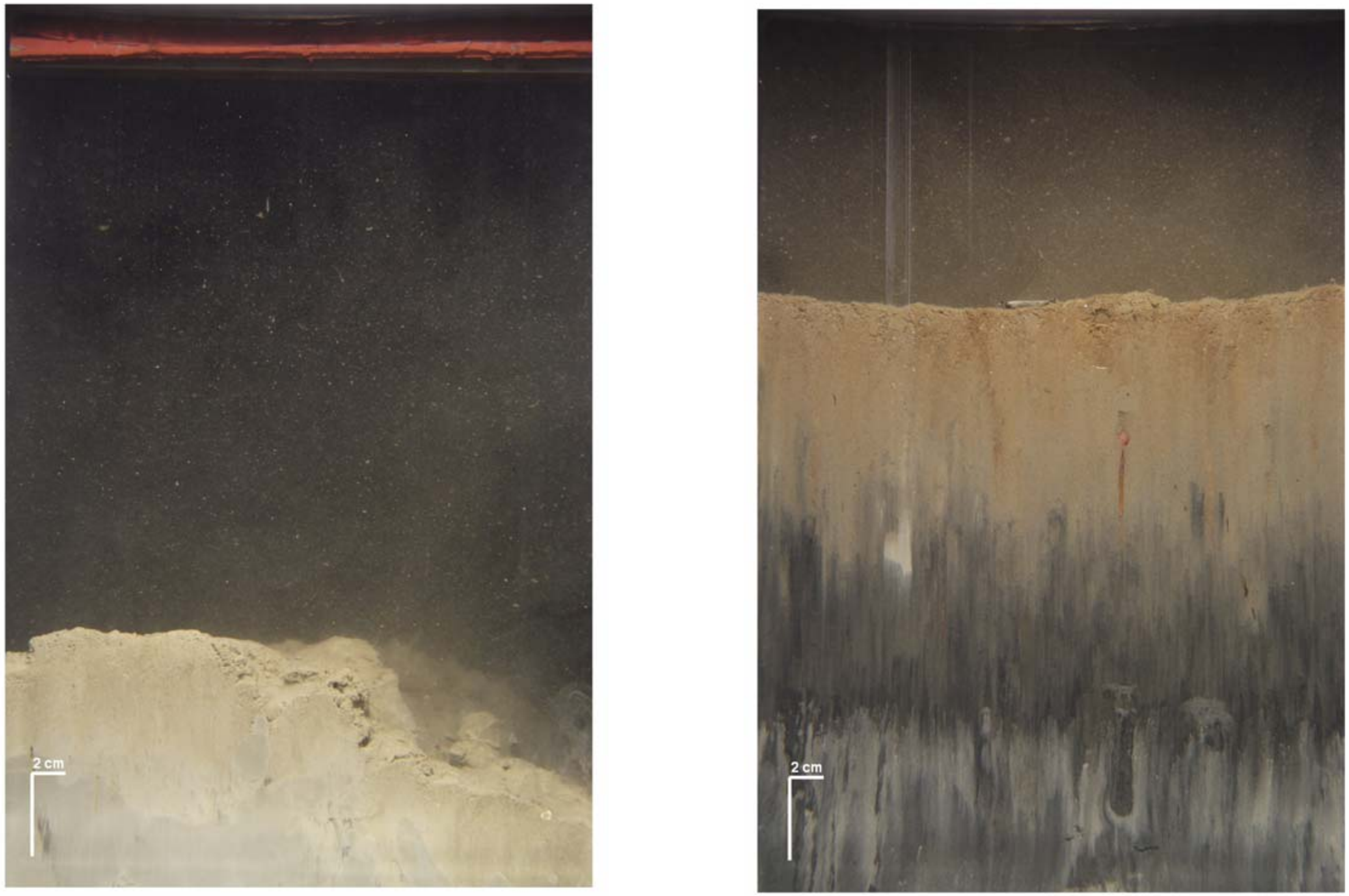


Figure 3-8. SPI images showing the difference in camera prism penetration due to the increased amount of Boston Blue Clay at Station C4 (left) versus Station C1 (right); the stop collar settings and amount of lead weights in the camera frame were identical at each station.

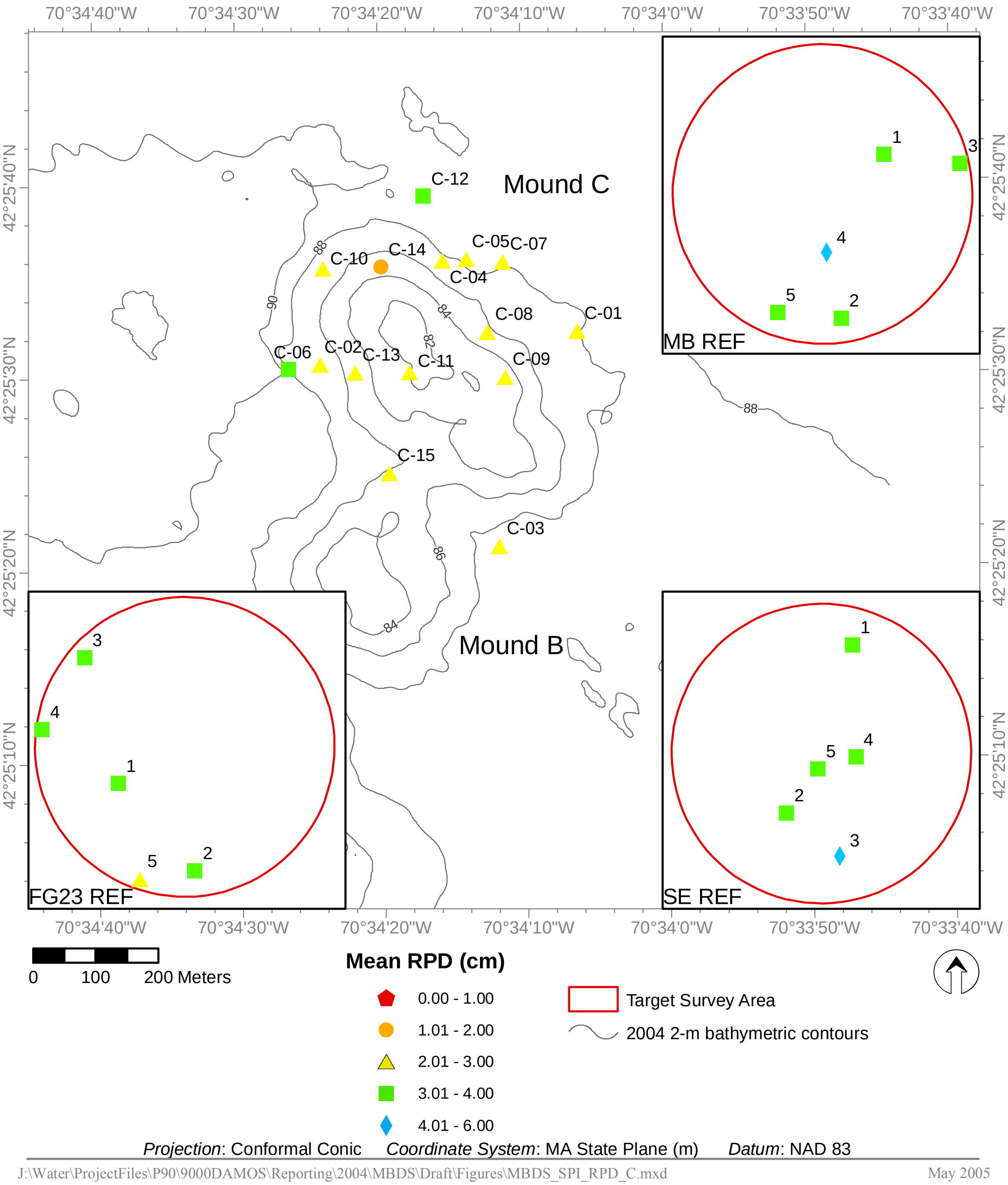


Figure 3-9. Distribution of station-averaged mean apparent RPD depths (cm) at the MBDS-C Mound, September 2004.

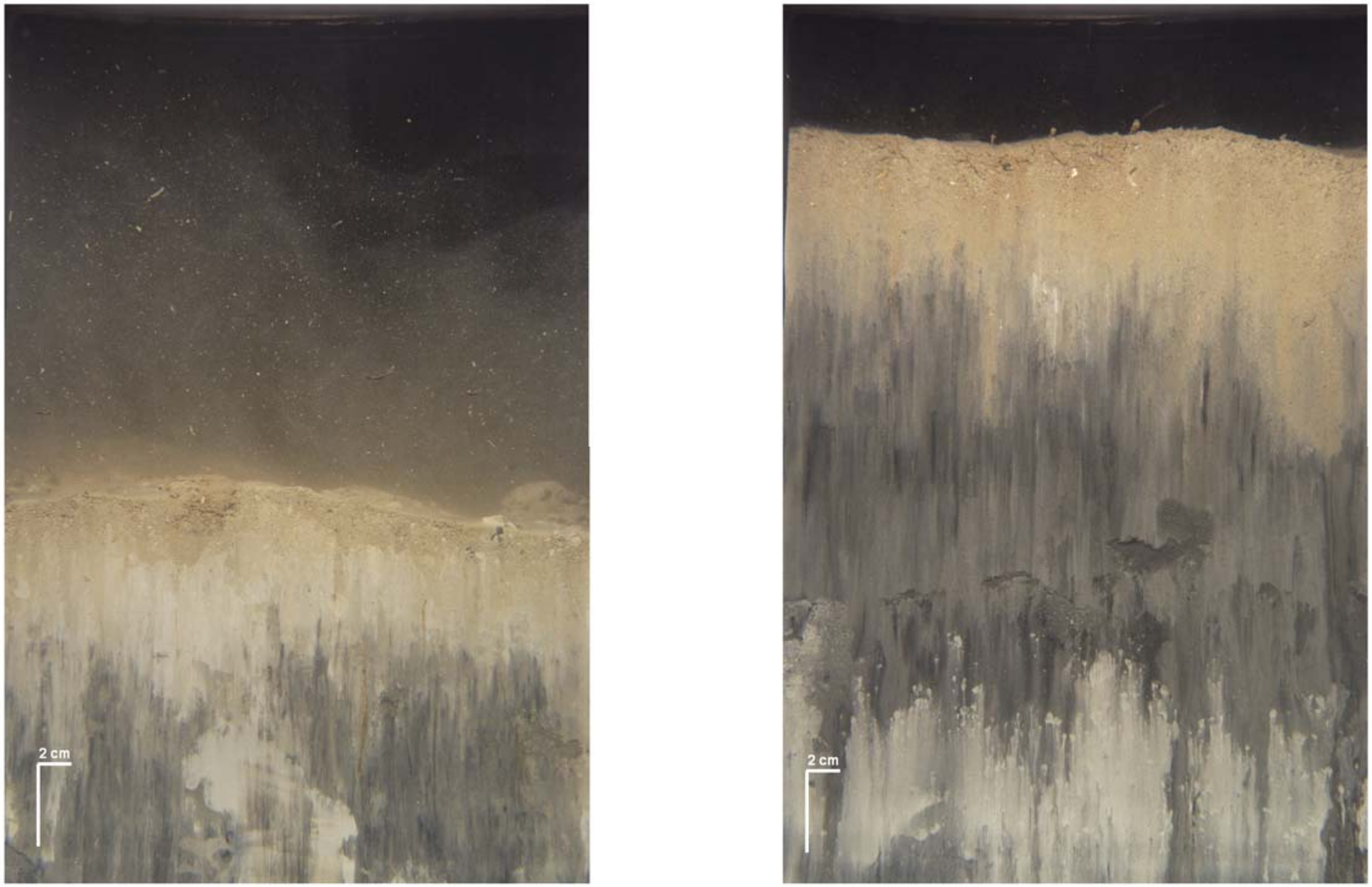


Figure 3-10. SPI images showing the effect of the Boston Blue Clay layer on RPD. Note the shallower apparent RPD depth (1.3 cm) at Station C5 (left) as compared with that measured at Station C6 (2.9 cm) because of the cohesive clay layer at the sediment surface.

Evidence of mature, deposit-feeding assemblages (Stage III taxa) were found at all stations (Figure 3-11) and in all replicate images except one from Station C4 (Table 3-2; Figure 3-8). Given the mature successional status and relatively deep apparent RPD values, the OSI values across the mound were uniformly high (Figure 3-12). Median OSI values calculated for each station ranged from +8 to +10, with an overall mound median value of +9 (Table 3-2).

3.2.3 MBDS-D Mound

The MBDS-D Mound received approximately 386,000 m^3 of dredged material in the fall of 1999 (SAIC 2002). While historical dredged material was still evident in every single image and extended beyond the depth of prism penetration, the striking difference between the dredged material signature at this mound versus the MBDS-C Mound was that there was a much lower frequency of BBC at MBDS-D (Figure 3-13).

Sediment Physical Characteristics

Similar to all the stations sampled at the MBDS-C Mound, every station sampled at the MBDS-D Mound also had a sediment grain-size major mode of >4 phi (Table 3-3). The camera prism penetration depths ranged from 12.5 to 18.0 cm, with an overall average mean value of 15.0 cm, reflecting the relatively soft nature of these fine-grained muds (Table 3-3). Small-scale boundary roughness values ranged from 0.4 to 1.6 cm, with an overall station-averaged mean value of 1.0 cm (Table 3-3). With the exception of one of the three replicate images from Station 14 (Appendix B), all the small-scale surface roughness elements were of biogenic origin, either from feeding pits or mounds on the sediment surface caused by infaunal activity.

Mud clasts were present in only four of the images (Appendix B), and as before, they were likely caused by artifacts from the camera frame or wiper blade. No stations exhibited any evidence of low dissolved oxygen in the overlying water or signs of methane in the subsurface sediments (Table 3-3).

Biological Conditions and Benthic Recolonization Status

The mean apparent RPD values at the MBDS-D Mound stations ranged from 3.4 to 4.8 cm, with an overall average depth of 3.8 cm (Table 3-3; Figure 3-14). The average apparent RPD depths were much greater at the MBDS-D Mound compared with the MBDS-C Mound because of the lower frequency of BBC clasts/layers.

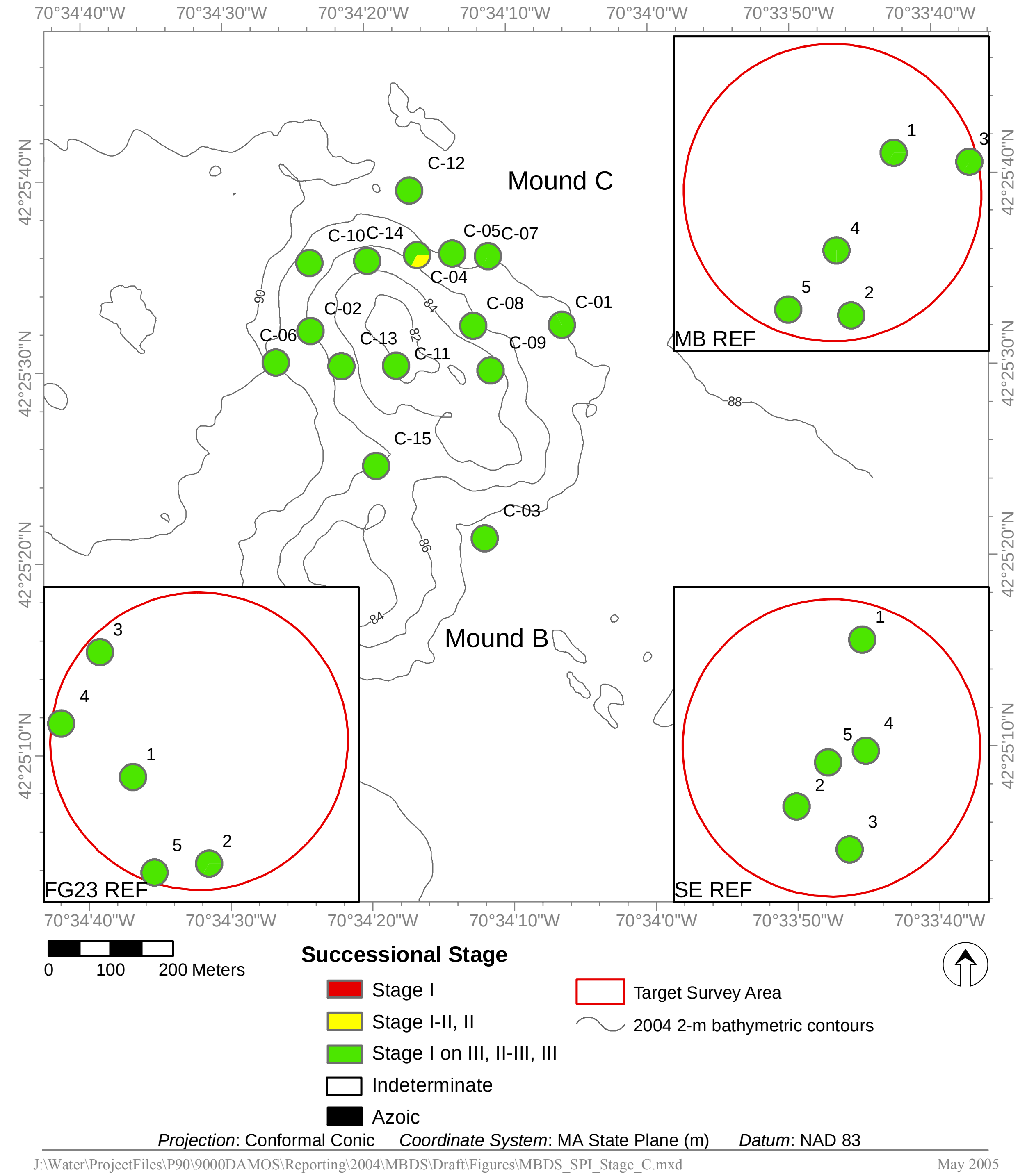


Figure 3-11. Distribution of infaunal successional stages at the MBDS-C Mound, September 2004

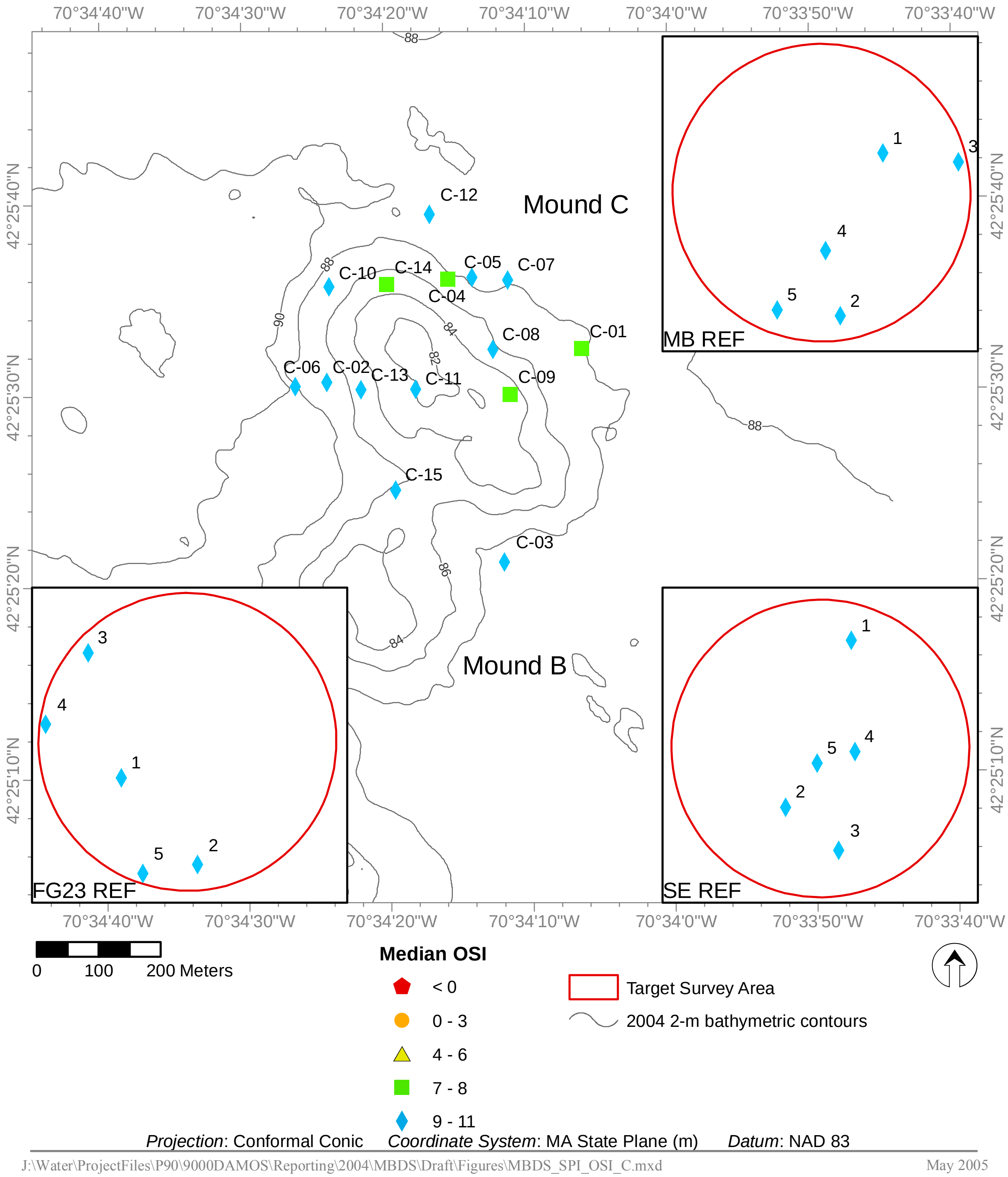


Figure 3-12. Distribution of median OSI values at the MBDS-C Mound, September 2004.

Figure 3-13. Evidence of historical dredged material disposal activity at the MBDS-D Mound is still visible after five years as seen by the buried horizon of the former sediment-water interface at Station D1 (left). There was much lower incidence of embedded clasts of Boston Blue Clay (as seen in this profile image from Station D3, right) on this mound as compared with the MBDS-C Mound.

Table 3-3.

Summary of SPI Results for MBDS-D Mound Stations, September 2004

Station	Grain Size Major Mode (phi)	Mean Prism Penetration Depth (cm)	Mean RPD Depth (cm)	Boundary Roughness (cm)	Mean DM Thickness (cm)	Mean Void Depth (cm)	Successional Stages present (no. of replicates)	Median OSI	Mean OSI	Methane present?	Low DO?
MBDS D-1	>4	17.1	4.8	0.7	> 17.1	8.8	I on III (3)	11.0	11.0	No	No
MBDS D-2	>4	18.0	3.5	0.4	> 18.0	10.3	I on III (3)	11.0	10.3	No	No
MBDS D-3	>4	16.3	3.7	0.9	> 16.3	11.3	I on III (3)	10.0	10.3	No	No
MBDS D-4	>4	16.1	4.1	1.2	> 16.1	8.9	I on III (3)	11.0	10.7	No	No
MBDS D-5	>4	13.2	3.5	0.5	> 13.2	9.0	I on III (3)	10.0	10.3	No	No
MBDS D-6	>4	14.3	4.1	1.2	> 14.3	7.4	I on III (3)	11.0	10.7	No	No
MBDS D-7	>4	13.5	3.8	1.0	> 13.5	10.4	I on III (3)	11.0	10.7	No	No
MBDS D-8	>4	12.5	4.0	1.6	> 12.5	5.6	I on III (3)	11.0	10.7	No	No
MBDS D-9	>4	16.4	3.6	1.2	> 16.4	8.6	I on III (3)	10.0	10.0	No	No
MBDS D-10	>4	14.8	4.1	1.0	> 14.8	7.7	I on III (3)	11.0	10.7	No	No
MBDS D-11	>4	13.1	3.5	1.4	> 13.1	7.4	I on III (3)	10.0	10.0	No	No
MBDS D-12	>4	15.3	3.9	1.2	> 15.3	7.3	I on III (3)	10.0	10.3	No	No
MBDS D-13	>4	15.9	3.4	0.6	> 15.9	6.9	I on III (3)	10.0	10.0	No	No
MBDS D-14	>4	16.3	3.9	1.1	> 16.3	8.3	I on III (3)	11.0	10.7	No	No
MBDS D-15	>4	12.6	3.5	1.0	> 12.6	11.6	I on III (3)	11.0	10.3	No	No
Average		15.0	3.8	1.0	NA	8.6		NA	10.4		
Median		NA	NA	NA	NA	NA		11.0	NA		
Minimum		12.5	3.4	0.4	NA	5.6		10.0	10.0		
Maximum		18.0	4.8	1.6	NA	11.6		11.0	11.0		

NA = Not Applicable

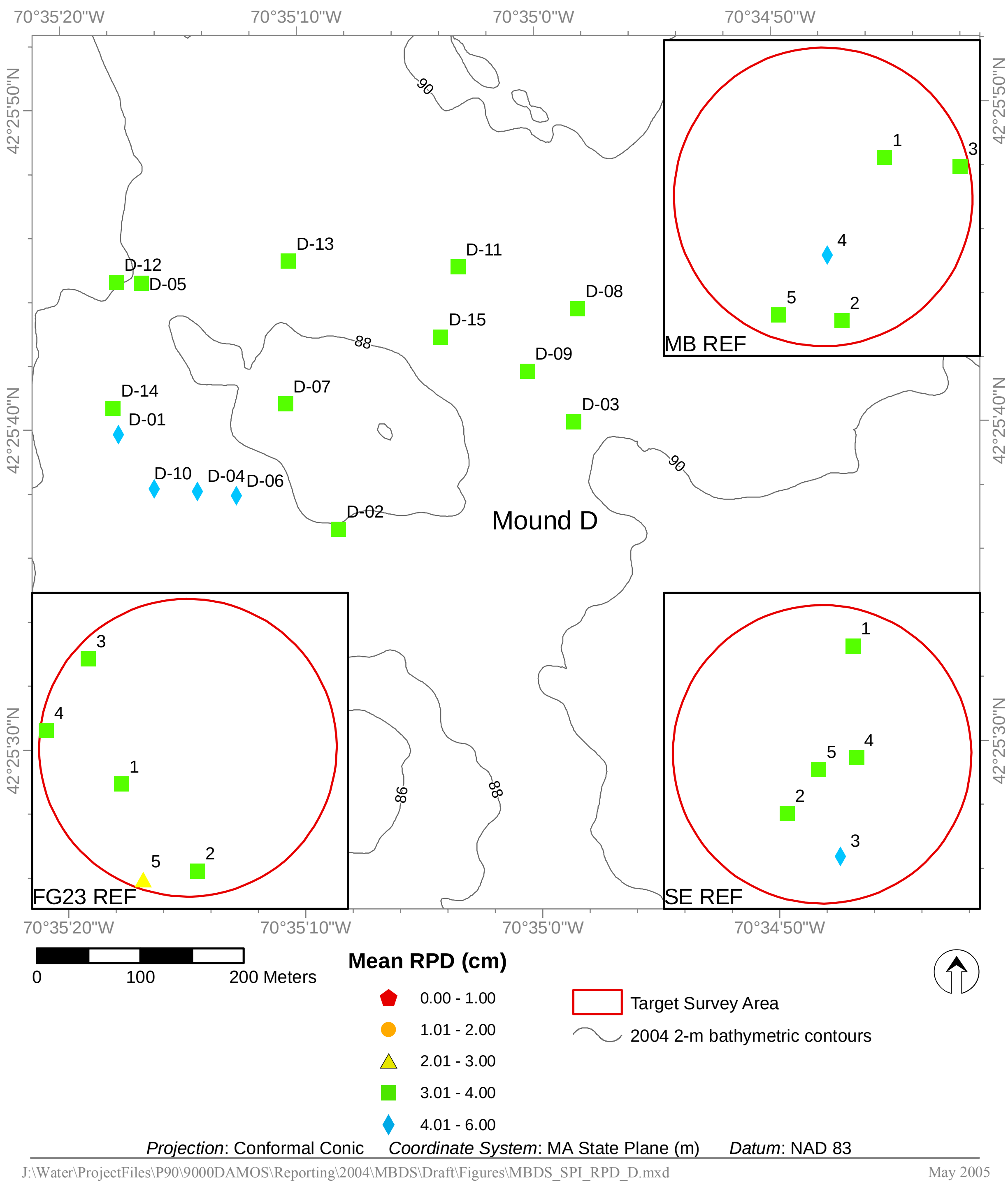


Figure 3-14. Distribution of station-averaged mean apparent RPD depths (cm) at the MBDS-D Mound, September 2004.

All images collected at the MBDS-D Mound showed evidence of mature, deposit-feeding assemblages (Figure 3-15) with secondary succession of Stage I opportunists (Stage I on III communities; Table 3-3). The biological mixing activities of the infauna were quite evident at many of the stations in which reduced, subsurface particles were transported to the sediment-water interface (Rhoads and Young, 1971) (Figure 3-16).

The median OSI values across all stations sampled were uniformly very high, ranging from +10 to +11, with an overall site median value of +11 (Table 3-3; Figure 3-17).

3.2.4 Comparison of MBDS Mounds to Reference Area Conditions

Three distinct reference areas were sampled during the 2004 MBDS SPI survey (FG23, MBREF, and SEREF). Five randomly located stations were sampled within each of the reference areas, and at least three replicate images were analyzed at each station. The SPI sampling at MBDS targeted two separate areas, the MBDS-C Mound and the MBDS-D Mound. At each mound, stations were randomly located, and at least three replicate images were analyzed at each station. The replicate observations were averaged to get one value per station at each reference area station and mound station. A summary of the mean RPD and OSI values are presented in Table 3-4.

Mean RPD Variable

The means and variances of RPD measurements at the three reference areas were similar (Table 3-4, Figure 3-18). The maximum difference in average RPD values among reference locations was 0.6 cm, which was less than two times the pooled standard deviation for the reference areas (2 x 0.41) (Table 3-4). Consequently, the three reference areas were pooled in the following analysis.

The assumption of normality was not rejected by the Shapiro-Wilk's test on area residuals (i.e., each observation minus the area mean) ($p=0.20$), and the assumption of equal variances was also not rejected by Levene's test ($p=0.60$). Hence, a pooled variance estimate was used to compute the variance for the difference equations.

The specified δ of ±3 for RPD values was outside of the 95% lower and upper confidence bounds for all observed differences (Table 3-5). This indicated that the true difference between the mean RPD values from the reference areas and mean RPD values from each of the disposal mounds was within 3 RPD units, and therefore, the group means were equivalent.

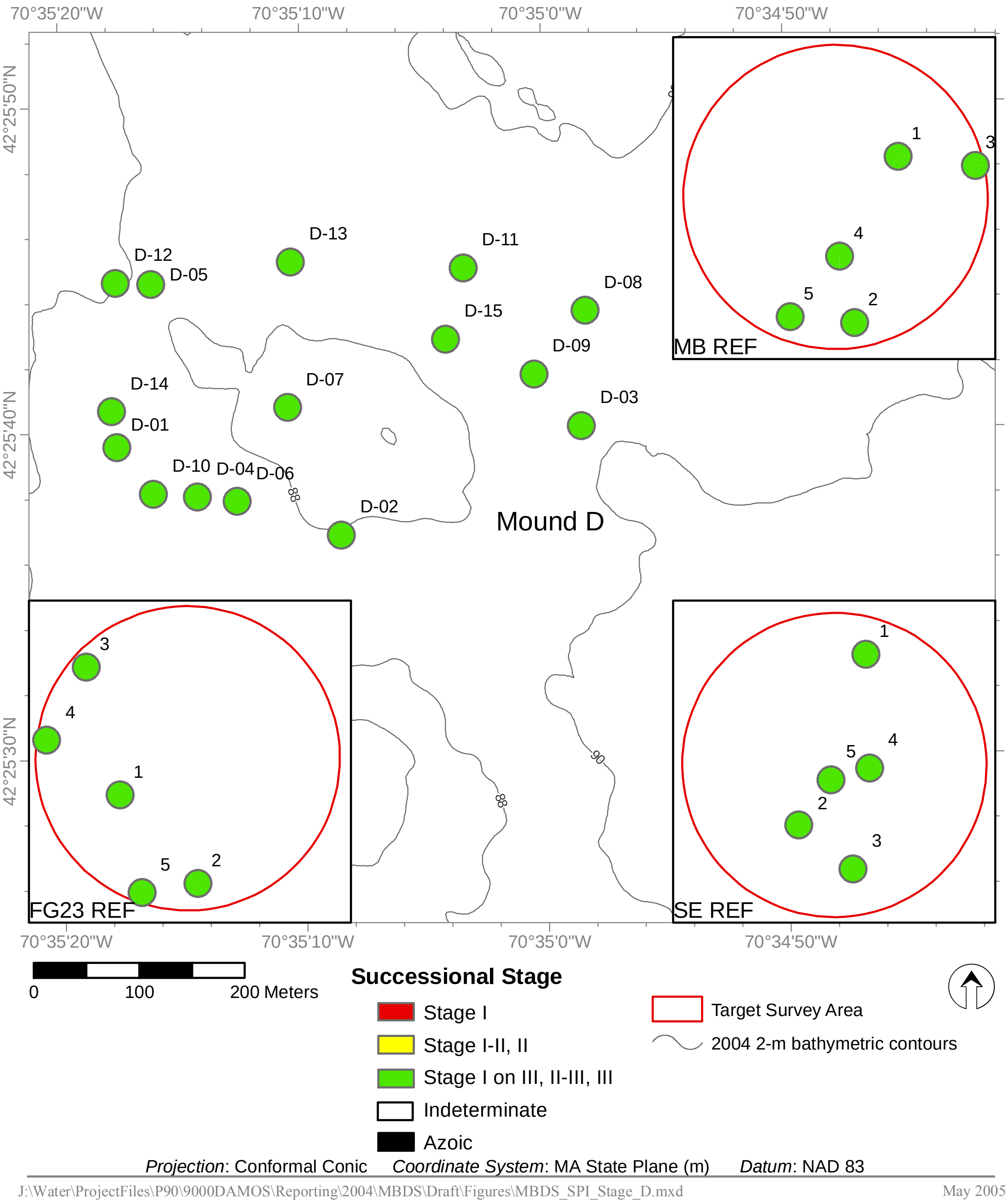


Figure 3-15. Distribution of infaunal successional stages at the MBDS-D Mound, September 2004.

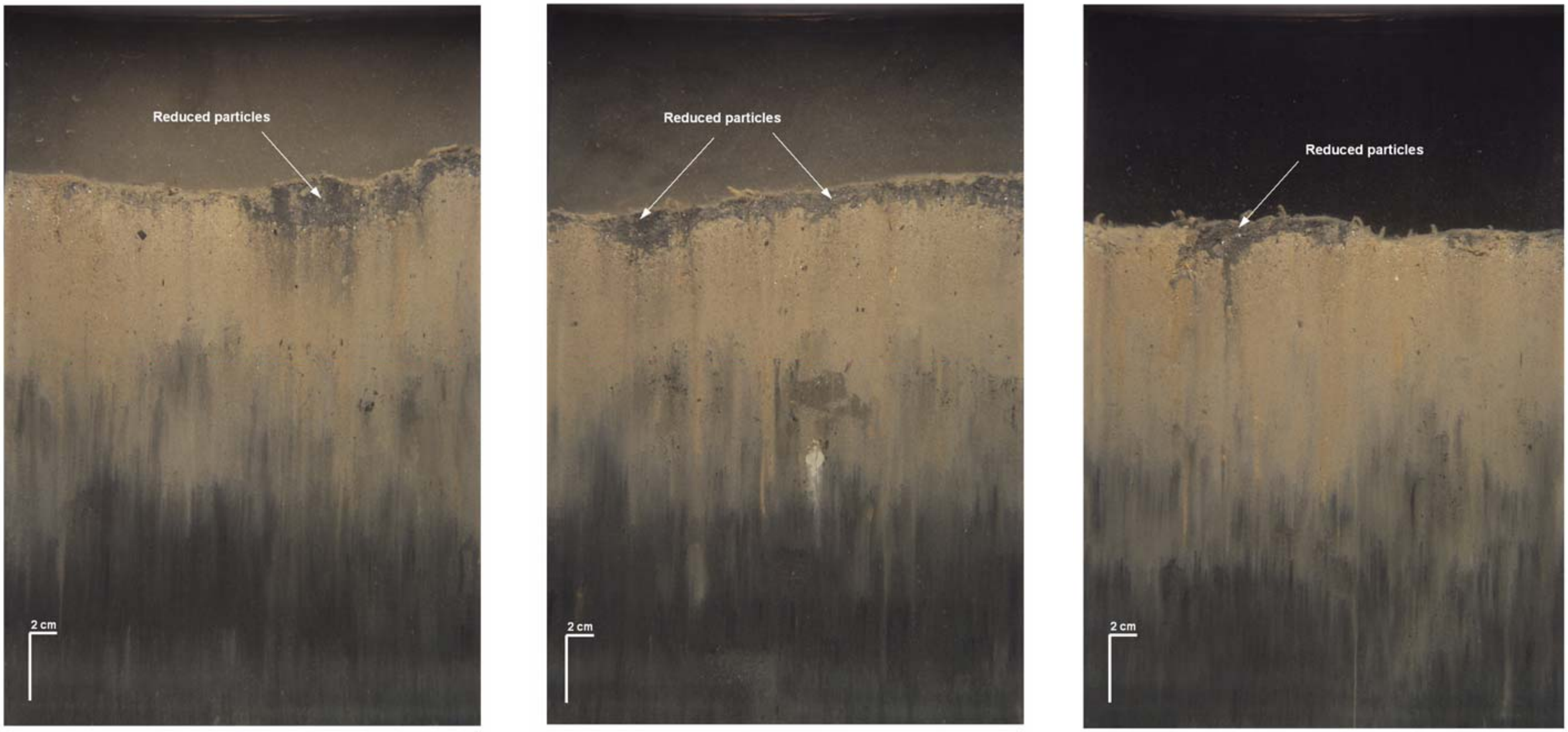


Figure 3-16. The bioturbational activities of deposit-feeding infauna are illustrated in these three replicate images from Station D4. The reduced particles from below the oxidized surface layer are being brought to the sediment surface through the feeding activities of larger polychaetes.

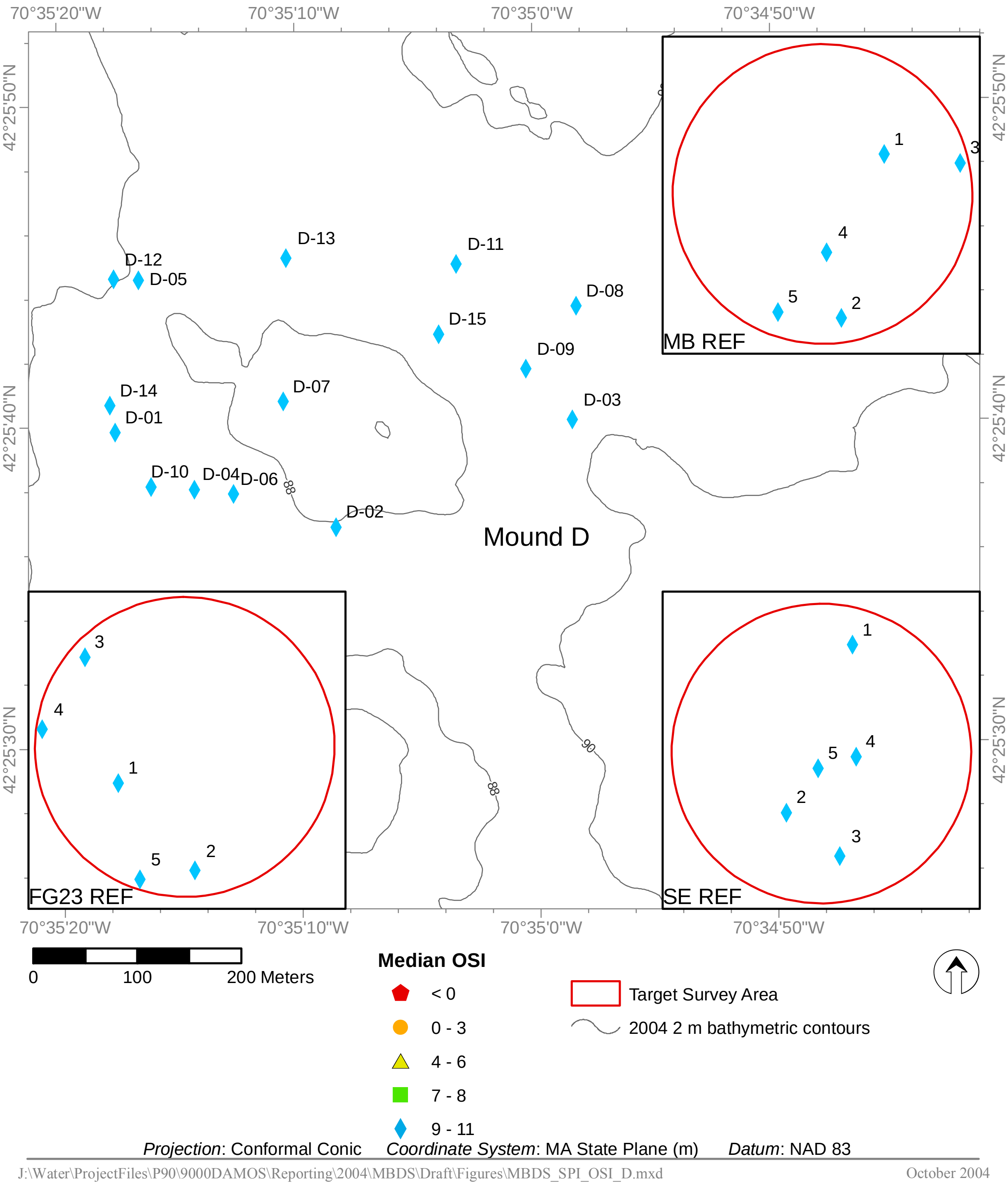
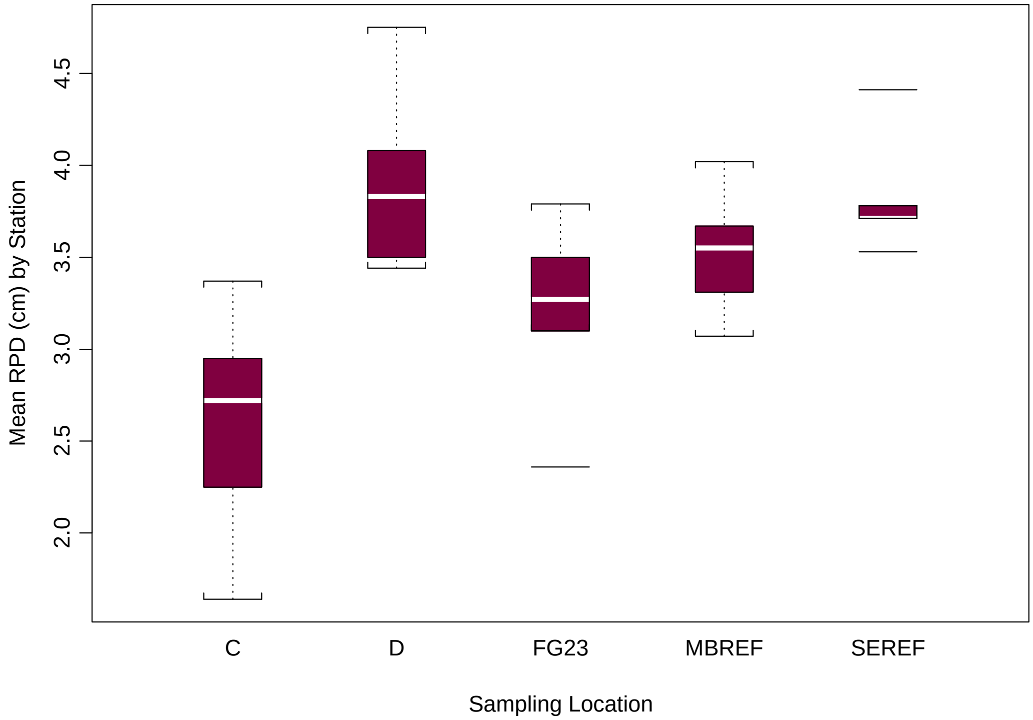


Figure 3-17. Distribution of median OSI values at the MBDS-D Mound, September 2004.

Table 3-4.

Summary of Stations Means by Sampling Location

Area	N	RPD (cm)		OSI	
		Mean	Standard deviation	Mean	Standard deviation
Reference					
FG23	5	3.20	0.54	9.7	0.71
MBDREF	5	3.52	0.36	10.2	0.42
SEREF	5	3.83	0.34	10.3	0.25
Mean		3.52	0.41	10.1	0.46
MBDS Mounds					
MBDS-C	15	2.64	0.46	8.9	0.74
MBDS-D	15	3.82	0.36	10.4	0.32



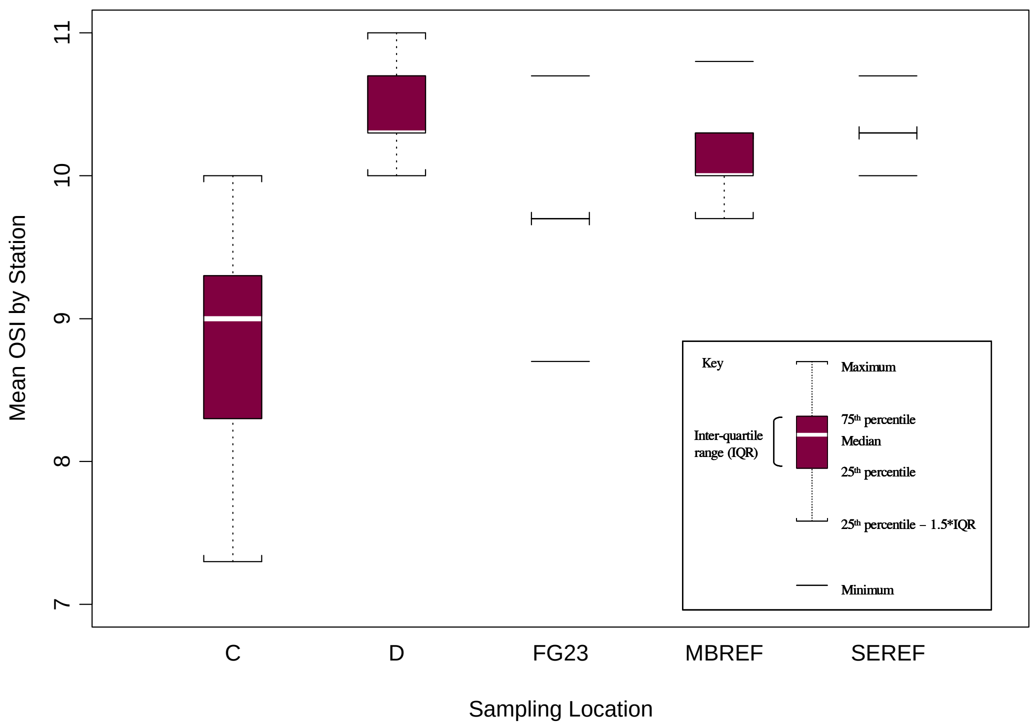


Figure 3-18. Boxplots showing distribution of RPD and OSI station values for MBDS.

Table 3-5.

Summary Statistics and Results of Bioequivalence Testing for RPD and OSI Values

Difference Equation	Observed Difference ($\hat{d}_i$)	SE ($\hat{d}_i$)	Degrees of Freedom for SE ($\hat{d}_i$)	95% Lower Confidence Bound	95% Upper Confidence Bound
RPD					
1. Ref – C	0.88	0.158	28	0.61	1.15
2. Ref – D	-0.30	0.158	28	-0.57	-0.03
OSI					
1. Ref – C	1.19	0.24	25	0.78	1.59
2. Ref – D	-0.39	0.16	22	-0.11	-0.66

Mean OSI Variable

The means and variances of OSI values at the three reference areas were also fairly similar (Table 3-4, Figure 3-18). The maximum difference in OSI values among reference locations was 0.6, which was less than two times the pooled standard deviation for the reference areas (2 x 0.46) (Table 3-4). Consequently, the three reference areas were pooled in the following analysis.

The assumption of normality was rejected by the Shapiro-Wilk's test on area residuals ($p=0.04$). Evaluation of the normal probability plot (Figure 3-19) revealed that deviation from normality was not systematic, but was due to three influential data points at the lower end of the distribution (two from MBDS-C, and one from reference area FG23). Removal of these three data points resulted in a normal distribution (Shapiro-Wilk's $p= 0.15$). The assumption of equal variances appeared questionable and was rejected by Levene's test ($p=0.03$), so separate group variances were used to compute the variance for each difference equation (Figure 3-18).

Typically, the effect of such influential data points as these three outliers is to increase the variance, but if there is general symmetry in the data, then the basis for the t-distribution confidence interval is not completely invalidated. A higher variance has the effect of increasing the width of the confidence interval, thereby making it more likely to contain δ and thus decreasing the probability that equivalence would be concluded (i.e., lowering the risk to the environment) (McBride 1999). If α is maintained at 0.05 then there will be greater certainty in the conclusions made about equivalence.

The specified δ of 4 for OSI values was outside of the 95% lower and upper confidence bounds for all observed differences (Table 3-5). This indicated that the true difference between the mean OSI values from the reference areas and mean OSI values from each of the disposal mounds was within 4 OSI units, and therefore the group means were equivalent.

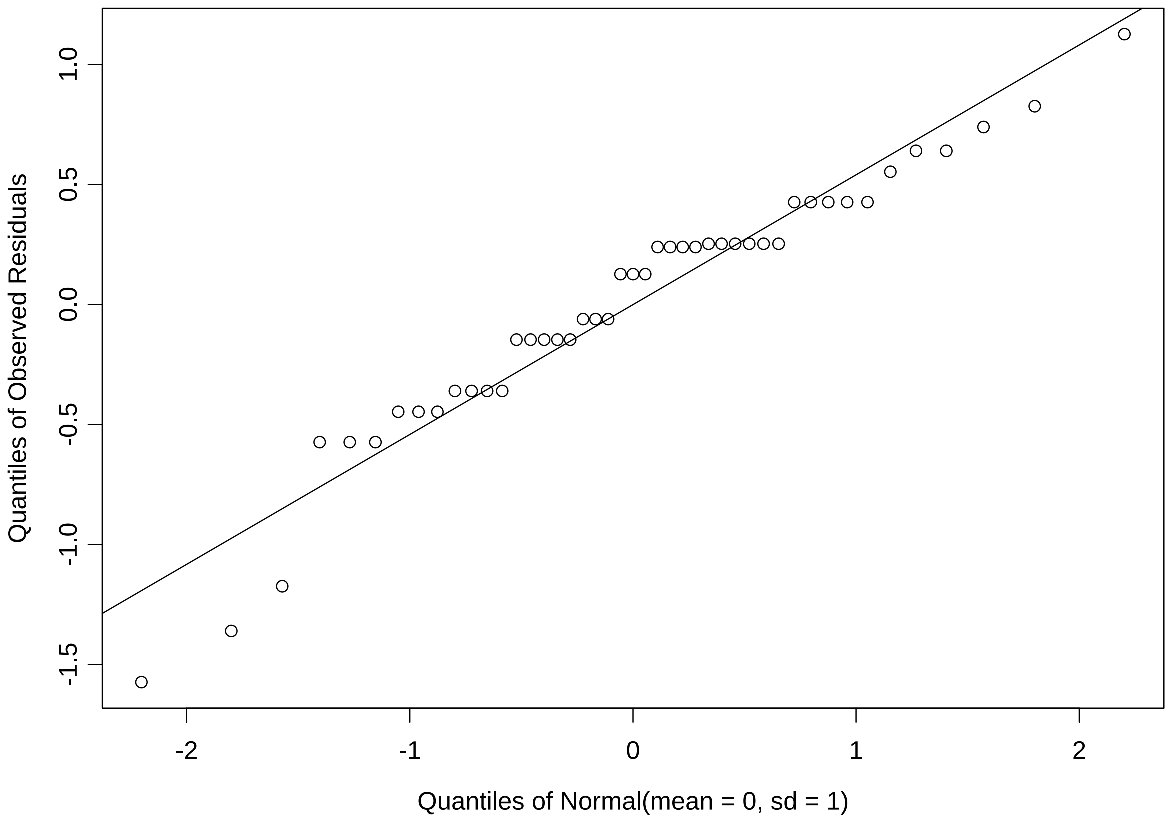


Figure 3-19. Normal probability plot of area residuals (observations minus area mean) for OSI values.

4.0 DISCUSSION

The objectives of the September 2004 survey at MBDS were the characterization of dredged material distribution around recent and historical disposal points and assessment of the benthic recolonization status of historical disposal mounds, MBDS-C and MBDS-D. These objectives were accomplished using bathymetric and SPI survey techniques.

4.1 Dredged Material Distribution

The management strategy at MBDS involves the creation of small to moderate sized mounds oriented in a ring to form a containment cell around a natural depression in the seafloor. The September 2004 bathymetric survey was intended to assess the distribution of dredged material around the location of recent disposal activity (MBDS-F Mound) as well as to assess changes at historical mounds. Dredged material disposal had been initiated at the MBDS-F Mound just prior to the Fall 2000 survey but had not formed a discernable mound. The area continued to receive dredged material from 2000 through 2004, receiving over 560,000 m^3 of material, originating primarily from the Scituate Harbor Maintenance Dredging Project and the Boston Harbor Federal Navigation Project. This disposal resulted in the formation of a distinct MBDS-F Mound, approximately 450 m in diameter and 4 m in height based on comparison of the 2004 and 2000 bathymetric data. The measured mound height matched the predicted height of 4 m. Given the limitations in the bathymetric depth difference technique to resolve the outer extent of the mound apron, where dredged material thicknesses are less than 0.25 m, the measured diameter (450 m) was consistent with the predicted diameter of the full extent of the mound (800 m). The MBDS-F Mound was expected to continue to increase in size as the disposal marker buoy remained at the same position during the winter of 2004-05.

Overall, there were no major differences in bathymetry over the historical mounds. Some areas of depth increases were observed over the older mounds between 2000 and 2004, indicative of potential consolidation. However, there were also limited areas where depth reductions were observed. It should be noted that the 2004 and 2000 bathymetry data were collected/processed using different techniques (125-kHz swath system in 2004 vs. a 208-kHz single beam system in 2000), which likely resulted in some of the observed depth differences.

4.2 Biological Conditions and Benthic Recolonization

During the last monitoring survey at MBDS in 2000, it was observed that benthic recolonization within MBDS had proceeded as expected, but there were notably fewer occurrences of mature, deposit-feeding communities present on the MBDS-C Mound compared with the MBDS-B Mound. This was attributed to the presence of consolidated BBC at the MBDS-C Mound (SAIC 2002). The closer the clay was to the sediment surface the greater the resistance of the sediment to burrowing infauna and, as a result, the shallower the RPD depths. The 2000 survey was conducted about one year after completion of disposal operations at the MBDS-C Mound, and it was anticipated that as time progressed, a more mature infaunal community would develop. Numerous monitoring studies performed within the DAMOS program in the past (Germano et al. 1994) as well as at other dredged material disposal sites (e.g., Rhoads et al. 1978; Rhoads and Germano 1986; Hall 1994; Newell et al, 1998, Smith and Rule 2001) have shown that even in dredged material deposits exceeding a meter or more, or consisting of highly cohesive, consolidated material, benthic recolonization and community succession will occur with full ecosystem recovery over time. The time for these recoveries has taken from as little as 18 months to as long as 3 to 5 years.

The latest survey conducted in September 2004 on both the MBDS-C and MBDS-D Mounds showed that, in the five years since disposal activities at these two mounds had ceased, the resident benthic community had completely recovered, and both mounds exhibited benthic conditions comparable to those found on the three reference areas. Equivalence tests supported these observations, demonstrating that differences in RPD and OSI values between the MBDS mounds and the reference areas were not significant.

5.0 CONCLUSIONS

The September 2004 bathymetric survey at MBDS provided a means to observe the continued formation of the MBDS-F Mound and evaluate the stability of older mounds in the survey area. The 2004 SPI survey allowed for assessment of the recolonization status of the benthic community. The 2004 survey was designed to assess the following expectations:

- The placement of more than 560,000 m^3 of dredged material at the disposal buoy since September 2000 would result in the continued development of the MBDS-F Mound;

- The MBDS-F Mound was expected to be approximately 800 m in diameter and 4 m high based on the amount of material deposited;

- Mounds created in past years would show limited change in elevation except for the most recently created mounds that should show some evidence of continued consolidation; and

- As the MBDS-C and MBDS-D Mounds have not received dredged material in approximately five years (since November 1999), it was expected that the benthic community would have at least Stage II if not Stage III taxa present and have conditions comparable to those found at the reference areas.

Following the disposal of approximately 560,000 m^3 of dredged material since the Fall 2000 survey, the MBDS-F Mound was identified as a distinct feature on the seafloor. The measured height matched that predicted (4 m), and the measured diameter (450 m) was consistent with the predicted diameter (800 m) given that the bathymetric depth differencing technique is unable to resolve the full mound apron.

Benthic conditions over the surface of the MBDS-C and MBDS-D Mounds were comparable to those observed in the reference areas and an infaunal community comprised of both surface-dwelling opportunists (Stage I) and sub-surface deposit-feeders (Stage III) was observed consistently at both the reference and disposal mound stations. The 2004 survey on the MBDS-C and MBDS-D Mounds established that the resident benthic community had completely recovered in the five years since the cessation of disposal activities at these two mounds.

Based on the findings of the 2004 MBDS survey, the following recommendations are proposed:

- R1) Periodic bathymetric surveys should be continued to check the accuracy of predictions of individual mound morphology and as part of tracking the long-term formation of a containment cell at MBDS;

- R2) Following completion of disposal, a SPI survey should be performed over the newly created MBDS-F Mound and the previously created MBDS-E Mound to confirm that a normal pattern of benthic recolonization is occurring.

6.0 REFERENCES

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Appendix A

Disposal Barge Log Summary and Chemical Analysis Results for MBDS
September 2000 to September 2004

Project Name: BOSTON HARBOR
Permittee: COE - BOSTON HARBOR FED. PROJECT
Permit Number: 2004C0006

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
8/24/2004	4,800	3,670	42.422458	-70.582406	3325	
8/24/2004	3,800	2,905	42.422330	-70.582560	100 ft	
8/25/2004	4,800	3,670	42.422300	-70.581978	No buoy	
8/25/2004	4,000	3,058	42.422083	-70.582591	No buoy	
8/26/2004	4,800	3,670	42.422143	-70.582788	No buoy	
8/26/2004	4,000	3,058	42.422154	-70.583022	No buoy	
8/27/2004	4,000	3,058	42.422335	-70.582063	No buoy	
8/28/2004	3,800	2,905	42.422146	-70.582769	No buoy	
8/29/2004	3,300	2,523	42.422163	-70.583102	No buoy	
8/30/2004	3,600	2,752	42.422349	-70.582349	No buoy	
8/30/2004	3,200	2,447	42.422263	-70.582693	No buoy	
8/31/2004	3,850	2,944	42.422780	-70.583011	No buoy	
9/1/2004	5,000	3,823	42.422333	-70.582317	No buoy	
9/1/2004	3,800	2,905	42.422020	-70.583058	No buoy	
9/2/2004	5,600	4,282	42.422194	-70.582284	No buoy	
9/2/2004	3,600	2,752	42.422215	-70.582928	No buoy	
9/3/2004	5,400	4,129	42.422275	-70.583011	No buoy	
9/4/2004	3,700	2,829	42.422068	-70.582667	No buoy	
9/4/2004	6,000	4,587	42.422254	-70.582798	No buoy	
9/5/2004	3,800	2,905	42.422439	-70.583088	No buoy	
9/6/2004	5,200	3,976	42.422156	-70.582996	No buoy	
9/6/2004	3,000	2,294	42.422209	-70.582937	No buoy	
9/7/2004	4,500	3,440	42.422189	-70.582668	No buoy	
9/8/2004	3,500	2,676	42.420072	-70.583027	No buoy	
9/8/2004	5,200	3,976	42.422165	-70.582963	No buoy	
9/9/2004	3,600	2,752	42.422250	-70.583043	No buoy	
9/10/2004	5,600	4,282	42.422237	-70.582228	No buoy	
9/10/2004	3,500	2,676	42.421950	-70.583035	No buoy	
9/10/2004	5,500	4,205	42.422123	-70.582539	No buoy	
9/11/2004	3,100	2,370	42.422057	-70.583199	No buoy	
9/11/2004	5,000	3,823	42.422155	-70.582735	No buoy	
9/12/2004	3,800	2,905	42.422350	-70.582283	No buoy	
9/12/2004	5,400	4,129	42.422800	-70.576517	No buoy	
9/13/2004	2,000	1,529	42.422306	-70.582507	No buoy	
Total Dredged Material Volume:	143,750	109,905				

Project Name: FORT POINT CHANNEL
Permittee: MASS BAY TRANSIT AUTHORITY
Permit Number: 199802805

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
8/12/2003	600	459	42.422117	-70.582250	Buoy Gone	
8/27/2003	800	612	42.422467	-70.582500	Buoy Gone	0.000000
Total Dredged Material Volume:	1,400	1,070				

Project Name: FORT POINT CHANNEL BOSTON, MA
Permittee: MA HIGHWAY DEPT.
Permit Number: 199101378

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
9/7/2000	1,000	765	42.421830	-70.581830	3325	E
10/24/2000	1,000	765	42.422330	-70.582200	50ft	NE
11/21/2000	800	612	42.421900	-70.581410	30ft	S
12/10/2000	900	688	42.422160	-70.581830	50ft	N
1/24/2001	800	612	42.422150	-70.581830	25ft	N
2/9/2001	700	535	42.421450	-70.581850	50ft	S
2/15/2001	1,000	765	42.422267	-70.581933	75ft	N
2/20/2001	1,000	765	42.422833	-70.580833	300ft	N
3/1/2001	750	573	42.422183	-70.582066	50ft	N
3/26/2001	1,000	765	42.422533	-70.582066	75ft	NE
4/3/2001	700	535	42.422250	-70.581990	50	N
4/11/2001	700	535	42.422620	-70.581820	50	N
4/16/2001	800	612	42.422620	-70.582180	50	N
4/19/2001	700	535	42.422520	-70.582050	50	N
5/1/2001	800	612	42.422530	-70.582050	50	N
5/3/2001	800	612	42.421680	-70.581990	50	S
5/4/2001	800	612	42.422470	-70.581950	50	N
5/24/2001	800	612	42.421570	-70.582020	50 FT	S
Total Dredged Material Volume:	15,050	11,507				

Project Name: HERON WAY MARINA
Permittee: HERON WAY MARINA
Permit Number: 200000295

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
11/5/2002	750	573	42.422160	-70.582170	100ft	SSW
11/13/2002	750	573	42.422330	-70.582170	90	SSW
11/15/2002	750	573	42.423000	-70.581500	100	E
11/21/2002	750	573	42.422670	-70.581830	100	E
11/26/2002	750	573	42.422330	-70.582170	60ft	N
12/4/2002	750	573	42.421670	-70.581830	100	E
12/9/2002	500	382	42.422670	-70.582340	80	E
Total Dredged Material Volume:	5,000	3,823				

Project Name: HULL HARBOR
Permittee: TOWN OF HULL
Permit Number: 199902220

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
10/25/2000	2,400	1,835	42.421730	-70.582280	30	S
10/26/2000	2,450	1,873	42.421970	-70.582170	30	SE
10/27/2000	2,250	1,720	42.421900	-70.582520	50	SW
11/3/2000	2,000	1,529	42.421730	-70.582270	50	SE
11/4/2000	1,850	1,414	42.422350	-70.582080	50	NW
11/7/2000	1,650	1,262	42.421800	-70.582340	50ft	SW
11/8/2000	2,350	1,797	42.421680	-70.582340	50	SW
11/9/2000	2,400	1,835	42.421550	-70.582280	60ft	SW
11/10/2000	2,400	1,835	42.421680	-70.582030	50	SW
11/13/2000	2,450	1,873	42.421620	-70.582120	50	SW
11/14/2000	2,450	1,873	42.422250	-70.581850	30ft	N
11/15/2000	2,400	1,835	42.421630	-70.582020	50ft	SW
11/16/2000	2,100	1,606	42.422600	-70.581800	50ft	N
11/17/2000	2,000	1,529	42.422480	-70.581970	50	N
11/18/2000	2,400	1,835	42.421230	-70.581800	75	S
11/28/2000	2,350	1,797	42.421480	-70.581850	50	S
11/29/2000	2,350	1,797	42.422480	-70.582020	50	NW
11/30/2000	2,350	1,797	42.421320	-70.581830	50	S
12/1/2000	2,350	1,797	42.421220	-70.581820	50	S
12/2/2000	2,350	1,797	42.421350	-70.582050	50	S
12/2/2000	1,375	1,051	42.421620	-70.582020	50	S
12/3/2000	2,050	1,567	42.421350	-70.582120	75	SW
12/5/2000	2,450	1,873	42.422800	-70.582050	75	N
12/7/2000	1,250	956	42.422180	-70.581860	30	N
12/7/2000	2,250	1,720	42.422380	-70.581750	50	N
12/8/2000	1,250	956	42.421730	-70.581680	30ft	S
12/9/2000	2,450	1,873	42.421620	-70.581730	50	S
12/10/2000	2,450	1,873	42.421750	-70.581970	50	S
12/12/2000	1,650	1,262	42.421500	-70.581930	50	S
12/12/2000	1,750	1,338	42.421620	-70.581820	50ft	S
12/13/2000	1,650	1,262	42.421480	-70.581830	70	S
12/14/2000	2,300	1,758	42.422680	-70.581730	75	N
12/15/2000	1,500	1,147	42.421730	-70.581800	30ft	S
12/15/2000	2,250	1,720	42.421620	-70.581680	50	S
12/18/2000	2,350	1,797	42.422580	-70.581800	50	N
12/19/2000	1,500	1,147	42.422350	-70.581850	30	N
12/21/2000	1,850	1,414	42.422370	-70.581730	30	N
12/23/2000	1,500	1,147	42.421800	-70.581730	30ft	S
12/23/2000	1,500	1,147	42.421970	-70.582020	30ft	S
12/29/2000	1,500	1,147	42.422220	-70.581520	50ft	E
12/29/2000	1,550	1,185	42.421630	-70.581820	50ft	S
1/2/2001	1,600	1,223	42.421220	-70.581850	75dr	A
1/3/2001	1,500	1,147	42.421420	-70.581820	50ft	S
1/3/2001	1,675	1,281	42.421750	-70.581900	30ft	S
1/4/2001	1,500	1,147	42.421130	-70.581833	75ft	S
1/4/2001	1,500	1,147	42.421750	-70.581680	30ft	S
1/5/2001	1,500	1,147	42.422680	-70.581850	50ft	N
1/7/2001	1,350	1,032	42.421480	-70.582020	50frt	S
1/8/2001	1,350	1,032	42.422520	-70.581800	30ft	N
1/9/2001	1,350	1,032	42.421550	-70.581930	50ft	S
1/10/2001	1,350	1,032	42.421450	-70.581820	50ft	S
1/12/2001	2,400	1,835	42.422050	-70.582180	50ft	W
1/12/2001	1,500	1,147	42.422130	-70.581620	30ft	E

1/13/2001	1,500	1,147	42.421750	-70.581850	30ft	S
1/14/2001	2,400	1,835	42.421400	-70.581730	50ft	S
1/16/2001	2,400	1,835	42.421730	-70.581850	30ft	S
1/17/2001	1,500	1,147	42.421590	-70.581730	30ft	S
1/17/2001	2,100	1,606	42.421370	-70.581830	50ft	S
1/18/2001	2,100	1,606	42.421750	-70.581790	25ft	S
1/23/2001	1,500	1,147	42.422620	-70.581730	30ft	N
1/25/2001	750	573	42.421380	-70.581830	50ft	S
Total Dredged Material Volume:	116,500	89,071				

Project Name: MANCHESTER HARBOR
Permittee: TOWN OF MANCHESTER BY THE SEA
Permit Number: 199702969

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
12/7/2001	700	535	42.422730	-70.582400	100	W
12/11/2001	1,000	765	42.422500	-70.582470	50	W
12/14/2001	1,000	765	42.422420	-70.582520	50	W
12/15/2001	1,000	765	42.422300	-70.582920	100	W
12/18/2001	1,200	917	42.422270	-70.581680	100 ft	E
12/20/2001	2,200	1,682	42.422280	-70.582890	100 ft	W
12/22/2001	1,000	765	42.422200	-70.582970	100 ft	W
12/26/2001	800	612	42.422160	-70.582900	100 ft	W
12/28/2001	800	612	42.422300	-70.582850	100 ft	W
Total Dredged Material Volume:	9,700	7,416				

Project Name: MANCHESTER HARBOR
Permittee: DAVIS MCCUE
Permit Number: 199702992

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
1/4/2001	950	726	42.421870	-70.582620	75ft	W
1/6/2001	1,500	1,147	42.422250	-70.582580	100ft	W
Total Dredged Material Volume:	2,450	1,873				

Project Name: NEPONSET RIVER
Permittee: PORT NORFOLK YACHT CLUB
Permit Number: 200100531

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
2/6/2003	950	726	42.422800	-70.582620	85	NNW
2/8/2003	950	726	42.422570	-70.582600	100	NW
2/10/2003	950	726	42.422650	-70.582520	100	NW
2/12/2003	950	726	42.422530	-70.582310	10	NNW
2/15/2003	800	612	42.421530	-70.580730	100	NW
2/17/2003	800	612	42.421820	-70.580250	100	S
2/20/2003	850	650	42.423350	-70.581170	100	SE
2/21/2003	1,000	765	42.421830	-70.580120	100	S
2/26/2003	800	612	42.422070	-70.580370	50	S
2/28/2003	850	650	42.421870	-70.580280	100	S
11/26/2003	1,400	1,070	42.422150	-70.581750	55 ft	0.000000
12/20/2003	1,200	917	42.418333	-70.583333	75 - 100 '	0.000000
12/21/2003	1,250	956	42.418333	-70.583333	50/75 ft	E
12/22/2003	1,300	994	42.418333	-70.583333	75 - 100 '	W
12/23/2003	1,300	994	42.418333	-70.583333	75/100 ft	E
Total Dredged Material Volume:	15,350	11,736				

Project Name: PEMBERTON PIER
Permittee: TOWN OF HULL
Permit Number: 199902633

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
10/13/2001	1,400	1,070	42.422250	-70.581383	100 ft	E
10/17/2001	1,400	1,070	42.422220	-70.583030	100 ft	N
Total Dredged Material Volume:	2,800	2,141				

Project Name: QUINCY BAY
Permittee: CITY OF QUINCY
Permit Number: 199701243

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
2/8/2001	1,200	917	42.421350	-70.581800	50ft	S
2/12/2001	1,000	765	42.421620	-70.581730	30ft	S
2/13/2001	1,200	917	42.421300	-70.581850	50ft	S
2/14/2001	1,200	917	42.421170	-70.581730	50ft	S
2/15/2001	1,200	917	42.421050	-70.581800	75ft	S
2/16/2001	1,200	917	42.421630	-70.581730	30ft	S
2/18/2001	1,000	765	42.422630	-70.581820	30ft	M
2/19/2001	1,200	917	42.423020	-70.581850	75ft	N
2/20/2001	1,200	917	42.422880	-70.581860	50ft	N
2/21/2001	1,200	917	42.421280	-70.581680	50ft	S
2/22/2001	1,200	917	42.421180	-70.581820	50ft	S
2/24/2001	1,200	917	42.421980	-70.581310	50ft	W
Total Dredged Material Volume:	14,000	10,704				

Project Name: SALEM HARBOR STATION
Permittee: US GEN NEW ENGLAND
Permit Number: 200000860

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
11/5/2002	3,500	2,676	42.419170	-70.572000	50yrd	N
11/5/2002	3,200	2,447	42.420170	-70.576000	25yrds	N
11/8/2002	2,500	1,911	42.423250	-70.598750	100	0
11/8/2002	3,000	2,294	42.423250	-70.598360	125ft	0
11/9/2002	2,600	1,988	42.422680	-70.596340	75ft	0
11/9/2002	3,000	2,294	42.422650	-70.598630	60ft	0
11/9/2002	3,000	2,294	42.422330	-70.598970	25ft	0
11/9/2002	3,200	2,447	42.422920	-70.598240	25ft	0
11/9/2002	1,800	1,376	42.422730	-70.582180	50	0
11/10/2002	2,500	1,911	42.422090	-70.579570	75ft	0
11/10/2002	2,500	1,911	42.422970	-70.582280	75ft	0
11/10/2002	3,000	2,294	42.421090	-70.579540	50ft	0
11/10/2002	2,800	2,141	42.423020	-70.582060	100ft	0
11/11/2002	3,100	2,370	42.422800	-70.582170	75ft	0
11/12/2002	2,500	1,911	42.422810	-70.582180	25ft	0
Total Dredged Material Volume:	42,200	32,264				

Project Name: SAUGUS RIVER
Permittee: COE-SAUGUS RIVER
Permit Number: 2000C0021

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
9/9/2000	2,000	1,529	42.422330	-70.582150	30ft	W
9/10/2000	2,100	1,606	42.421430	-70.581670	50	S
9/11/2000	2,100	1,606	42.422550	-70.581090	50ft	N
9/12/2000	1,825	1,395	42.421670	-70.582340	75ft	SW
9/13/2000	2,025	1,548	42.421750	-70.582300	75ft	SW
9/14/2000	1,625	1,242	42.422000	-70.581860	30ft	SW
9/15/2000	1,625	1,242	42.422470	-70.582180	50ft	NW
9/16/2000	1,600	1,223	42.422370	-70.581150	50ft	NE
9/17/2000	1,600	1,223	42.422570	-70.582080	50ft	NW
9/18/2000	1,475	1,128	42.422830	-70.581920	80ft	N
9/19/2000	1,425	1,089	42.422920	-70.582340	80ft	NW
9/20/2000	1,700	1,300	42.421590	-70.581800	40ft	S
9/21/2000	1,625	1,242	42.421820	-70.582100	30ft	SW
9/22/2000	1,575	1,204	42.422780	-70.582030	60	NW
9/24/2000	1,650	1,262	42.421800	-70.582300	50ft	SW
9/25/2000	1,600	1,223	42.421930	-70.581370	60ft	SE
9/28/2000	1,550	1,185	42.422630	-70.581990	50	NW
9/30/2000	1,625	1,242	42.422270	-70.581920	30	NW
10/2/2000	1,550	1,185	42.422266	-70.581816	0	0
10/4/2000	1,650	1,262	42.421830	-70.581830	0	0
10/6/2000	1,550	1,185	42.421630	-70.581800	0	0
10/8/2000	1,550	1,185	42.422160	-70.581830	0	0
10/22/2000	1,200	917	42.421530	-70.581800	30ft	S
11/25/2000	1,400	1,070	42.422000	-70.581820	25ft	S
11/25/2000	1,400	1,070	42.422000	-70.581820	25ft	S
Total Dredged Material Volume:	41,025	31,366				

Project Name: SCITUATE HARBOR
Permittee: SATUIT WATERFRONT CLUB
Permit Number: 199902530

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
2/4/2003	1,500	1,147	42.423370	-70.582850	100	E
2/6/2003	1,800	1,376	42.423520	-70.582500	100	S
2/7/2003	800	612	42.423433	-70.582817	100 ft	S
Total Dredged Material Volume:	4,100	3,135				

Project Name: SCITUATE HARBOR
Permittee: SCITUATE HARBOR MARINA
Permit Number: 200001850

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
1/30/2003	1,200	917	42.423450	-70.582800	100	S
1/31/2003	2,800	2,141	42.423367	-70.582550	100 ft	S
2/3/2003	1,500	1,147	42.423300	-70.582367	100 ft	S
Total Dredged Material Volume:	5,500	4,205				

Project Name: SCITUATE HARBOR
Permittee: SATUIT BOAT CLUB
Permit Number: 200101432

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
1/20/2003	400	306	42.422220	-70.580310	100	S
1/23/2003	2,400	1,835	42.422470	-70.581540	50	E
1/28/2003	2,000	1,529	42.422500	-70.580760	100	S
Total Dredged Material Volume:	4,800	3,670				

Project Name: SCITUATE HARBOR MAINT. DREDGING
Permittee: COE-SCITUATE HARBOR
Permit Number: 2002C0014

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
9/5/2002	2,800	2,141	42.420170	-70.581400	50ft	S
9/6/2002	2,800	2,141	42.420070	-70.584830	200ft	SW
9/7/2002	2,900	2,217	42.423800	-70.582170	50ft	E
9/8/2002	2,200	1,682	42.423450	-70.582920	50ft	W
9/9/2002	2,200	1,682	42.423300	-70.582790	50ft	W
9/9/2002	2,500	1,911	42.421590	-70.581720	50ft	S
9/10/2002	2,800	2,141	42.421520	-70.581550	50ft	W
9/10/2002	2,200	1,682	42.421820	-70.583300	50ft	E
9/11/2002	1,500	1,147	42.423220	-70.583310	50ft	SE
9/12/2002	2,950	2,255	42.423380	-70.582850	25ft	W
9/13/2002	2,300	1,758	42.423330	-70.583280	150ft	W
9/13/2002	2,400	1,835	42.423220	-70.583580	50ft	W
9/14/2002	2,100	1,606	42.423630	-70.581170	100ft	W
9/14/2002	2,500	1,911	42.423350	-70.582470	50ft	W
9/15/2002	2,200	1,682	42.423350	-70.582170	100ft	N
9/16/2002	2,200	1,682	42.423560	-70.584620	50ft	W
9/16/2002	2,200	1,682	42.423520	-70.584100	50ft	W
9/17/2002	2,000	1,529	42.423440	-70.579600	200ft	N
9/18/2002	2,200	1,682	42.423730	-70.584070	50ft	W
9/18/2002	2,000	1,529	42.423520	-70.581930	100ft	E
9/19/2002	2,200	1,682	42.423630	-70.582000	100ft	E
9/19/2002	1,600	1,223	42.423220	-70.583650	100ft	W
9/20/2002	2,900	2,217	42.423350	-70.583630	100ft	W
9/20/2002	1,800	1,376	42.423620	-70.579470	100ft	E
9/21/2002	2,000	1,529	42.423800	-70.583790	100ft	W
9/21/2002	1,600	1,223	42.423350	-70.583450	100ft	W
9/22/2002	2,650	2,026	42.423110	-70.584420	100ft	W
9/22/2002	2,400	1,835	42.423200	-70.583500	100ft	W
9/24/2002	2,500	1,911	42.423980	-70.581270	150ft	E
9/24/2002	700	535	42.423750	-70.580760	100ft	E
9/25/2002	2,300	1,758	42.422920	-70.581000	150ft	E
9/25/2002	1,600	1,223	42.423830	-70.581830	150ft	E
9/26/2002	1,300	994	42.423230	-70.581310	100ft	E
9/26/2002	1,300	994	42.423100	-70.583270	100ft	W
9/27/2002	2,000	1,529	42.423680	-70.583180	100ft	W
9/29/2002	1,500	1,147	42.423900	-70.581620	100ft	E
9/29/2002	2,000	1,529	42.423670	-70.583000	100ft	W
9/30/2002	2,000	1,529	42.423330	-70.583130	100ft	W
9/30/2002	1,700	1,300	42.423630	-70.581670	100ft	E
10/1/2002	2,400	1,835	42.423320	-70.581050	150	E
10/1/2002	1,600	1,223	42.423020	-70.580700	150	E
10/2/2002	2,100	1,606	42.423550	-70.582480	50	W
10/2/2002	2,100	1,606	42.423630	-70.580800	200	E
10/3/2002	2,100	1,606	42.421230	-70.581630	50	W
10/4/2002	1,500	1,147	42.424280	-70.584630	150	W
10/4/2002	2,000	1,529	42.423620	-70.583620	50	W
10/5/2002	1,500	1,147	42.423920	-70.584450	100	W
10/5/2002	2,000	1,529	42.423100	-70.583400	100	SW
10/6/2002	1,600	1,223	42.422920	-70.583420	100	S
10/6/2002	2,000	1,529	42.424680	-70.582230	50	W
10/7/2002	1,800	1,376	42.423280	-70.583550	50	W
10/8/2002	1,700	1,300	42.423280	-70.583550	150	W
10/8/2002	1,900	1,453	42.423870	-70.582250	50	W
10/9/2002	1,400	1,070	42.424080	-70.583350	100	W
10/9/2002	1,900	1,453	42.423980	-70.583170	50	W
10/10/2002	300	229	42.423720	-70.581870	100	W
10/15/2002	2,200	1,682	42.422930	-70.583850	100	W
10/15/2002	2,200	1,682	42.424130	-70.580510	100	N
10/17/2002	2,100	1,606	42.423620	-70.583130	50	W
10/18/2002	2,000	1,529	42.422500	-70.580920	50	S
10/19/2002	2,200	1,682	42.421100	-70.582620	100	NE
10/19/2002	2,100	1,606	42.423530	-70.582420	50	W

10/20/2002	2,100	1,606	42.423330	-70.579700	100	E
10/20/2002	2,000	1,529	42.423530	-70.582680	100	W
10/21/2002	2,100	1,606	42.423320	-70.581200	100	E
10/21/2002	1,700	1,300	42.421920	-70.580380	50	S
10/22/2002	2,200	1,682	42.423500	-70.580570	100	W
10/23/2002	2,400	1,835	42.423420	-70.583580	100	W
10/23/2002	2,200	1,682	42.422430	-70.580020	100	NW
10/24/2002	2,200	1,682	42.424270	-70.582300	100	W
10/24/2002	1,800	1,376	42.422970	-70.580960	100	W
10/25/2002	2,100	1,606	42.423920	-70.583250	100	W
10/25/2002	2,200	1,682	42.423330	-70.581200	100	W
10/26/2002	2,300	1,758	42.423900	-70.580540	100	W
10/27/2002	1,800	1,376	42.423350	-70.582480	100	W
10/28/2002	2,500	1,911	42.423250	-70.580570	50	W
10/28/2002	1,600	1,223	42.423620	-70.582820	100	S
10/29/2002	2,200	1,682	42.423830	-70.582120	100	W
10/30/2002	2,400	1,835	42.423350	-70.581250	100	E
10/31/2002	2,100	1,606	42.423350	-70.582440	50	W
11/1/2002	2,200	1,682	42.423500	-70.581920	50	W
11/1/2002	1,000	765	42.424180	-70.581100	150	E
11/2/2002	2,200	1,682	42.423130	-70.579650	100	SE
11/3/2002	1,800	1,376	42.423420	-70.582300	100	S
11/3/2002	1,800	1,376	42.423100	-70.581250	100	S
11/4/2002	1,500	1,147	42.422800	-70.581070	50	S
11/4/2002	2,000	1,529	42.422930	-70.581020	50	S
11/5/2002	1,600	1,223	42.423580	-70.581350	100	S
11/5/2002	1,600	1,223	42.423530	-70.581680	50	W
11/8/2002	1,200	917	42.420730	-70.582370	150	E
11/9/2002	2,200	1,682	42.420600	-70.582230	100	NE
11/10/2002	1,200	917	42.421620	-70.581450	100	E
11/11/2002	2,300	1,758	42.423900	-70.584180	50	W
11/12/2002	2,300	1,758	42.422830	-70.580720	100	S
11/14/2002	2,100	1,606	42.423330	-70.580620	100	S
11/14/2002	2,200	1,682	42.421710	-70.578850	100	N
11/15/2002	2,200	1,682	42.423440	-70.581520	50	SE
11/15/2002	2,200	1,682	42.421920	-70.584010	50	NE
11/19/2002	2,300	1,758	42.423730	-70.580670	50	S
11/19/2002	1,800	1,376	42.423480	-70.581680	100	S
11/20/2002	2,000	1,529	42.422920	-70.583270	100	S
11/20/2002	1,900	1,453	42.422320	-70.584350	100	W
11/21/2002	2,000	1,529	42.422920	-70.583850	50	SW
11/21/2002	1,500	1,147	42.423020	-70.584170	50	SW
11/22/2002	1,800	1,376	42.423730	-70.582830	100	SW
11/22/2002	1,600	1,223	42.423440	-70.584150	100	SW
11/23/2002	1,600	1,223	42.423350	-70.582580	50	S
11/24/2002	2,300	1,758	42.422250	-70.579700	50	SW
11/24/2002	2,300	1,758	42.422580	-70.579920	50	S
11/25/2002	2,400	1,835	42.423440	-70.582820	100	S
11/25/2002	2,300	1,758	42.423420	-70.582660	50	SW
11/26/2002	600	459	42.423170	-70.581700	100	S
11/30/2002	2,100	1,606	42.423110	-70.581120	100	S
12/1/2002	2,200	1,682	42.422620	-70.579920	100	S
12/2/2002	2,300	1,758	42.423330	-70.582170	100	SW
12/4/2002	1,400	1,070	42.423420	-70.583250	100	S

12/5/2002	2,000	1,529	42.421900	-70.583700	100	E
12/7/2002	1,900	1,453	42.423750	-70.582620	100	S
12/9/2002	2,000	1,529	42.423520	-70.581250	100	SE
12/10/2002	2,000	1,529	42.421250	-70.582050	100	NE
12/11/2002	1,900	1,453	42.422470	-70.580780	100	S
12/15/2002	2,200	1,682	42.422370	-70.580440	100	E
12/19/2002	1,600	1,223	42.424510	-70.582720	100	W
12/21/2002	2,100	1,606	42.421750	-70.580020	50	S
12/29/2002	2,400	1,835	42.423220	-70.580570	50	S
12/31/2002	2,200	1,682	42.424030	-70.584480	100	W
Total Dredged Material Volume:	251,900	192,591				

Project Name: SCITUATE HARBOR YACHT CLUB
Permittee: SCITUATE HARBOR YACHT CLUB
Permit Number: 199900643

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
1/9/2003	900	688	42.423250	-70.581170	100	SE
1/10/2003	1,200	917	42.423530	-70.581380	100	E
1/13/2003	1,000	765	42.421730	-70.580200	100	S
1/20/2003	800	612	42.422220	-70.580310	100	S
Total Dredged Material Volume:	3,900	2,982				

Project Name: YACHT CLUB
Permittee: POINT OF PINES YACHT CLUB
Permit Number: 200002894

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
7/30/2004	1,100	841	42.418500	-70.583000	No buoy	0
8/8/2004	1,250	956	42.422317	-70.582300	No buoy	0
8/18/2004	1,300	994	42.422467	-70.581167	No buoy	0
9/1/2004	1,200	917	42.422000	-70.582167	No buoy	0
Total Dredged Material Volume:	4,850	3,708				

Project Name: WINTHROP HARBOR, MA
Permittee: DEP MGMT & TOWN OF WINTHROP
Permit Number: 199901259

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy (ft)	Direction from Buoy
10/4/2000	1,500	1,147	42.421980	-70.582350	0	0
10/5/2000	450	344	42.421980	-70.582350	0	0
10/7/2000	600	459	42.421980	-70.582350	0	0
10/8/2000	1,500	1,147	42.421980	-70.582350	0	0
10/8/2000	600	459	42.421980	-70.582350	0	0
10/9/2000	1,500	1,147	42.421980	-70.582350	0	0
10/11/2000	1,500	1,147	42.421980	-70.582350	0	0
10/12/2000	600	459	42.421980	-70.582350	0	0
10/12/2000	1,500	1,147	42.421980	-70.582350	0	0
10/13/2000	600	459	42.421980	-70.582350	0	0
10/13/2000	1,500	1,147	42.421980	-70.582350	0	0
10/14/2000	600	459	42.421980	-70.582350	0	0
10/14/2000	1,500	1,147	42.421980	-70.582350	0	0
10/15/2000	600	459	42.421980	-70.582350	0	0
10/15/2000	600	459	42.421980	-70.582350	0	0
10/19/2000	1,500	1,147	42.422050	-70.582350	20ft	SE
10/19/2000	600	459	42.422000	-70.582350	20ft	SE
10/20/2000	1,300	994	42.421330	-70.582350	100ft	ESE
10/20/2000	600	459	42.421500	-70.582350	100ft	E
10/22/2000	1,100	841	42.422160	-70.582660	50ft	N
10/23/2000	500	382	42.423330	-70.580500	75	N
10/24/2000	1,200	917	42.421080	-70.581170	100	S
10/24/2000	500	382	42.423330	-70.582170	100	N
10/25/2000	500	382	42.421500	-70.581670	100	S
10/26/2000	1,200	917	42.421000	-70.581670	100	S
10/27/2000	500	382	42.421270	-70.582080	75	S
10/28/2000	1,200	917	42.421330	-70.582500	75	S
11/3/2000	500	382	42.423500	-70.581670	100	N
11/3/2000	1,100	841	42.423070	-70.582080	100	N
11/4/2000	500	382	42.423420	-70.581670	100	N
11/4/2000	1,100	841	42.421500	-70.581670	100	S
11/5/2000	500	382	42.422880	-70.582660	75	N
11/7/2000	600	459	42.423420	-70.581830	100	N
11/8/2000	1,100	841	42.422830	-70.582500	75	N
11/8/2000	600	459	42.421500	-70.582500	75	S
11/9/2000	600	459	42.422920	-70.582870	100	N
11/9/2000	1,150	879	42.423330	-70.581670	100	N
11/11/2000	600	459	42.421330	-70.582580	75	S
11/13/2000	1,100	841	42.421500	-70.582250	50	S
11/13/2000	500	382	42.423000	-70.582920	100	N
11/14/2000	500	382	42.422670	-70.582340	75	N
11/15/2000	1,100	841	42.422830	-70.582340	75	N
11/16/2000	600	459	42.421330	-70.582340	50	S
11/16/2000	1,200	917	42.422720	-70.582250	50	N
11/19/2000	500	382	42.422430	-70.582340	50	N
11/20/2000	1,100	841	42.421420	-70.581830	50	S
11/20/2000	600	459	42.422670	-70.582340	100	N
11/21/2000	1,150	879	42.421330	-70.582300	50	N
11/24/2000	1,150	879	42.422670	-70.582300	75	N
11/25/2000	600	459	42.421500	-70.582340	75	S
11/25/2000	625	478	42.422160	-70.582340	50	N
11/26/2000	1,200	917	42.421500	-70.582340	75	S
11/28/2000	1,100	841	42.422670	-70.582340	100	N
11/28/2000	600	459	42.422330	-70.582300	75	N
11/29/2000	1,100	841	42.422750	-70.582340	100	N
11/29/2000	600	459	42.422720	-70.582310	100	N
12/2/2000	1,150	879	42.423020	-70.582300	100	N
12/2/2000	650	497	42.422350	-70.582300	100	N
12/3/2000	1,200	917	42.422920	-70.582340	75	N
Total Dredged Material Volume:	52,525	2,752				

Appendix B

Sediment-Profile Image Results for MBDS
September 2004 Survey

Table B-1

Grain Size Scale for Sediments

Phi (Φ) size	Size range (mm)	Size class (Wentworth class)
< -1	> 2	Gravel
0 to –1	1 to 2	Very coarse sand
1 to 0	0.5 to 1	Coarse sand
2 to 1	0.25 to 0.5	Medium sand
3 to 2	0.125 to 0.25	Fine sand
4 to 3	0.0625 to 0.125	Very fine sand
> 4	< 0.0625	Silt/clay

Table B-2
Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBREF	1 A	9/15/2004	1:08:00 PM	288	2	13.0	14.59	>4	0.00	>4	>4 - 0	89.01	6.10	5.51	6.94	1.43	Bio	47.50	3.26	0.00	-	N	0.00	0.00	-	-	No	-		2.00	4.48	5.85	5.17	Stage III	10	Tan to gray, coarse sandy silt/clay. Voids at center bottom of frame. Abundant detritus at SWI. Large pink polychaete at right. Unusual distribution of grain sizes in surface sediments. Firm. Native/ambient.
MBREF	1 B	9/15/2004	1:09:31 PM	289	2	13.0	14.59	>4	0.00	>4	>4 - 0	105.54	7.23	5.43	8.45	3.03	Phys	64.02	4.39	1.00	O	N	0.00	0.00	-	-	No	-		2.00	4.11	6.63	5.37	Stage I on III	11	Tan to gray, coarse sandy silt/clay. Voids at center and bottom left of frame. Abundant detritus at SWI. Appears to have been recently disturbed/foraged. Tubes at right SWI. Unusual distribution of grain sizes in surface sediments. Firm. Native/ambient.
MBREF	1 C	9/15/2004	1:10:20 PM	289	2	13.0	14.59	>4	0.00	>4	>4 - 0	151.47	10.38	9.94	10.71	0.77	Bio	48.96	3.35	0.00	-	N	0.00	0.00	-	-	No	-		1.00	4.54	5.14	4.84	Stage I on III	10	Tan to light gray, coarse sandy silt/clay. Void with oxidized sediment upper right. Burrow at right with oxidized sediment. Two polychaetes at left. Numerous Stage I tubes at SWI. Abundant detritus at SWI. Large pink polychaete at right. Unusual distribution of grain sizes in surface sediments. Firm. Native/ambient.
MBREF	2 A	9/15/2004	12:51:55 PM	293	2	13.0	14.59	>4	2.00	>4	>4 - 2	217.21	14.88	14.54	15.17	0.63	Bio	46.55	3.19	0.00	-	N	0.00	0.00	-	-	No	-		3.00	5.06	8.74	6.90	Stage I on III	10	Tan to light gray, soft, silt/clay. Multi-chambered void complex at left with oxidized sediment. Four polychaetes in sediment column. Subsurface sediment well-processed of organics. Tube in left SWI background and abundant infaunal fecal matter at SWI. Native/ambient.
MBREF	2 B	9/15/2004	12:53:40 PM	291	2	13.0	14.59	>4	2.00	>4	>4 - 2	222.95	15.28	15.14	15.37	0.23	Bio	51.96	3.56	0.00	-	N	0.00	0.00	-	-	No	-		3.00	10.60	15.28	12.94	Stage I on III	10	Tan to light gray, soft, silt/clay. Multi-chambered void complex at center with oxidized sediment and oxidized halo Void in upper left. Subsurface sediment well-processed of organics. Three thin red polychaetes in upper right-center. A few Stage I tubes at SWI and abundant infaunal fecal matter at SWI. Native/ambient.
MBREF	2 C	9/15/2004	12:54:43 PM	292	2	13.0	14.59	>4	2.00	>4	>4 - 2	199.48	13.67	11.97	14.62	2.66	Bio	46.57	3.19	0.00	-	N	0.00	0.00	-	-	No	-		2.00	5.80	14.14	9.97	Stage I on III	10	Tan to light gray, soft, silt/clay. Surface topography at left possibly due to epifaunal/fish foraging. Small void in upper left and very small void with oxidized sediment at bottom center. Intact mud tube at center SWI and broken tubes and fecal strings in background at right SWI. Native/ambient.

Table B-2
Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBREF	3 A	9/15/2004	1:17:07 PM	281	2	13.0	14.59	>4	0.00	>4	>4 - 0	74.95	5.14	3.48	6.20	2.71	Phys	51.47	3.53	0.00	-	N	0.00	0.00	-	-	No	-		1.00	3.60	5.97	4.78	Stage I on III	10	Tan to light gray coarse sandy silt. Unusual mix of particle sizes in sediment column. Low penetration, hard bottom. Cobble? In background. Burrow/void in left-center. Tubes at SWI and sac-like organism at right SWI (tunicate?). Native ambient - similar to Ref 1A.
MBREF	3 B	9/15/2004	1:18:01 PM	280	2	13.0	14.59	>4	0.00	>4	>4 - 0	104.93	7.19	5.97	7.80	1.83	Bio	53.03	3.63	0.00	-	N	0.00	0.00	-	-	No	-		2.00	0.54	4.46	2.50	Stage I on III	10	Tan to light gray coarse sandy silt. Unusual mix of particle sizes in sediment column. Low penetration, hard bottom. Void/burrow complexes at left and right. Tubes at SWI and fecal strands. Native ambient - similar to Ref 1A and Rep A of this station.
MBREF	3 C	9/15/2004	1:19:19 PM	281	2	13.0	14.59	>4	0.00	>4	>4 - 0	50.90	3.49	2.00	5.28	3.28	Phys	50.90	3.49	0.00	-	N	0.00	0.00	-	-	No	-		0.00	-	-	-	Stage III	10	Tan to light gray coarse sandy silt. Unusual mix of particle sizes in sediment column. Low penetration, hard bottom. Seafloor in front of prism is disturbed, presumably from the previous rep. RPD>pen. Tubes at SWI and fecal strands. Native ambient - similar to Ref 1A and Rep A of this station.
MBREF	4 A	9/15/2004	12:59:13 PM	293	2	13.0	14.59	>4	2.00	>4	>4 - 2	238.96	16.37	15.85	16.68	0.83	Bio	64.22	4.40	0.00	-	N	0.00	0.00	-	-	No	-		4.00	8.43	12.03	10.23	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay. Several voids, some filled with oxidized sediment, in center of frame. Two long, red polychaetes among the void complex. Deep RPD with thick accumulation of reworked fecal material at SWI. A few Stage I tubes at SWI. Sediment column is well processed of organics. Native/ambient. Nice Pic.
MBREF	4 B	9/15/2004	12:59:51 PM	293	2	13.0	14.59	>4	2.00	>4	>4 - 2	239.40	16.40	16.02	16.51	0.49	Bio	58.28	3.99	2.00	R	N	0.00	0.00	-	-	No	-		2.00	5.94	10.62	8.28	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay. Some streaking of organics in subsurface sediment but otherwise, sediment column well-processed of organics by infauna. Twp large, obvious voids in upper center and lower right. Oxidized burrow and polychaete at depth at far right. A few Stage I tubes at SWI and classic shallow burrow (L-shaped) in upper right. Native/ambient. Nice Pic.

Table B-2
Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBREF	4 C	9/15/2004	1:01:20 PM	293	2	13.0	14.59	>4	3.00	>4	>4 - 3	233.62	16.01	15.57	16.19	0.63	Bio	47.47	3.25	0.00	-	N	0.00	0.00	-	-	No	-		0.00	-	-	-	Stage III	10	Tan to light gray, well-bioturbated, silt/clay. Some streaking of organics in subsurface sediment but otherwise, sediment column well-processed of organics by infauna. Polychaetes in lower left-center. Abundant shallow burrows in RPD. Native/ambient. Similar to Reps A and B.
MBREF	4 D	9/15/2004	1:02:08 PM	296	2	13.0	14.59	>4	2.00	>4	>4 - 2	246.13	16.87	15.14	18.68	3.54	Bio	64.84	4.44	1.00	R	N	0.00	0.00	-	-	No	-		4.00	9.37	15.40	12.38	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active, oxidized voids in center running to lower left corner. Several polychaetes in sediment column at left. Deep RPD. Mudclast at SWI is an artifact. A few small Stage I tubes at SWI. Native/ambient. Most similar to Reps A and B rather than C.
MBREF	5 A	9/15/2004	12:45:48 PM	291	2	13.0	14.59	>4	2.00	>4	>4 - 2	200.09	13.71	13.45	14.28	0.83	Bio	55.09	3.77	0.00	-	N	0.00	0.00	-	-	No	-		1.00	11.45	12.20	11.82	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active, oxidized void in bottom-center. Deep RPD with very little RPD contrast. Polychaete at left and oxidized burrow in lower right. Biogenic depression in center SWI background A few small Stage I tubes at SWI. Native/ambient. Similar to Stations 2 and 4.
MBREF	5 B	9/15/2004	12:46:42 PM	296	2	13.0	14.59	>4	2.00	>4	>4 - 2	215.85	14.79	14.68	14.97	0.29	Bio	51.30	3.51	0.00	-	N	0.00	0.00	-	-	No	-		2.00	3.86	5.80	4.83	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active, oxidized voids in upper left and upper right. Polychaete in upper right. Abundant fecal pellets at SWI. A few small Stage I tubes at SWI. Native/ambient.
MBREF	5 C	9/15/2004	12:47:49 PM	292	2	13.0	14.59	>4	2.00	>4	>4 - 2	236.42	16.20	15.51	16.71	1.20	Bio	28.18	1.93	0.00	-	N	0.00	0.00	-	-	No	-		2.00	6.26	9.03	7.64	Stage I on III	8	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active, oxidized void complex in center of sediment column. Thin, long, polychaete at right of void complex. Patches of oxidized sediment in the lower portion of the sediment column. Abundant fecal pellets at SWI. A few small Stage I tubes at SWI. Native/ambient. Generally similar to Reps A and B.

Table B-2
Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
SEREF	1 A	9/15/2004	11:36:49 AM	300	2	13.5	14.59	>4	2.00	>4	>4 - 2	263.82	18.08	17.85	18.31	0.46	Bio	52.72	3.61	0.00	-	N	0.00	0.00	-	-	No	-		2.00	3.23	16.51	9.87	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay with small blebs of cohesive, light blue-gray clay interspersed throughout the sediment column. Sediment column well-processed of organics by infauna. Active void/burrow in upper right and large, oxidized sediment filled voids or void halos in bottom center. Two thin red polychaetes in upper portion of the sediment column. A few Stage I tubes at SWI along with abundant infaunal fecal matter. Native/ambient.
SEREF	1 B	9/15/2004	11:38:02 AM	299	2	13.5	14.59	>4	2.00	>4	>4 - 2	266.23	18.24	17.22	18.94	1.71	Bio	59.00	4.04	0.00	-	N	0.00	0.00	-	-	No	-		3.00	3.48	17.54	10.51	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay with small blebs of cohesive, light blue-gray clay interspersed throughout the sediment column. Sediment column well-processed of organics by infauna. Active void/burrow in upper left, left and bottom right. Large red polychaete in lower left corner of the sediment column and a few small polychaetes in the upper sediment column. RPD contrast is slight. Several oxidized burrows in upper sediment column.. A few Stage I tubes at SWI along with abundant infaunal fecal matter. Native/ambient.
SEREF	1 C	9/15/2004	11:38:41 AM	299	2	13.5	14.59	>4	2.00	>4	>4 - 2	271.57	18.61	18.08	18.94	0.86	Bio	50.73	3.48	0.00	-	N	0.00	0.00	-	-	No	-		1.00	17.76	18.59	18.18	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active void with oxidized sediment at bottom right corner. Several oxidized burrows in upper sediment column. Large patch of subsurface oxidized sediment at lower right. Nice shallow burrow in upper right SWI. A few Stage I tubes at SWI along with abundant infaunal fecal matter. Native/ambient.
SEREF	2 A	9/15/2004	11:52:40 AM	296	2	13.5	14.59	>4	2.00	>4	>4 - 2	248.85	17.05	16.54	17.96	1.43	Bio	55.46	3.80	0.00	-	N	0.00	0.00	-	-	No	-		1.00	4.17	4.77	4.47	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active void with oxidized sediment in upper center and is part of RPD. Several oxidized burrows in upper sediment column and at depth. Polychaete in lower center. A few Stage I tubes at SWI along with abundant infaunal fecal matter. Native/ambient.

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Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
SEREF	2 B	9/15/2004	11:54:14 AM	292	2	13.5	14.59	>4	2.00	>4	>4 - 2	253.91	17.40	16.94	17.74	0.80	Bio	54.06	3.70	0.00	-	N	0.00	0.00	-	-	No	-		2.00	5.80	13.62	9.71	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active void with oxidized sediment in lower left. Several oxidized burrows in upper sediment column and at depth. Polychaete at far left. Buried asteroid in center of sediment column. Abundant infaunal fecal matter at SWI. Native/ambient.
SEREF	2 C	9/15/2004	11:55:40 AM	293	2	13.5	14.59	>4	2.00	>4	>4 - 2	228.87	15.68	13.65	17.42	3.77	Bio	53.09	3.64	1.00	R	N	0.00	0.00	-	-	No	-		2.00	13.82	17.08	15.45	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active void complex with oxidized sediment in lower right. Several oxidized burrows in upper sediment column and at depth. Biogenic mound at right SWI. Abundant infaunal fecal matter at SWI. Native/ambient. Three reps at this station are similar.
SEREF	3 A	9/15/2004	12:00:16 PM	293	2	13.5	14.59	>4	2.00	>4	>4 - 2	245.16	16.80	16.34	17.51	1.17	Bio	71.93	4.93	0.00	-	N	0.00	0.00	-	-	No	-		3.00	2.83	14.02	8.43	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active voids with oxidized sediment or halo in upper left, lower left, and bottom center. Polychaete/burrow with oxidized sediment at far right. Biogenic mound at left SWI. Abundant infaunal fecal matter at SWI. Native/ambient.
SEREF	3 B	9/15/2004	12:01:29 PM	293	2	13.5	14.59	>4	2.00	>4	>4 - 2	253.75	17.39	16.71	18.02	1.31	Bio	53.59	3.67	0.00	-	N	0.00	0.00	-	-	No	-		2.00	7.05	16.65	11.85	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Active void/burrow with oxidized sediment or halo in upper right and bottom right corner. Biogenic depression at right SWI. A few Stage I tubes at SWI. Thin polychaete(s)) in upper left. Abundant infaunal fecal matter at SWI. Native/ambient.
SEREF	3 C	9/15/2004	12:03:23 PM	295	2	13.5	14.59	>4	2.00	>4	>4 - 2	242.37	16.61	16.08	16.85	0.77	Bio	67.52	4.63	0.00	-	N	0.00	0.00	-	-	No	-		1.00	14.65	15.97	15.31	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Oxidized sediment and sand-filled void in bottom center. Three thin polychaetes in upper right and numerous shallow, oxidized burrows. A few Stage I tubes at SWI. Abundant infaunal fecal matter at SWI. Native/ambient. Three reps at this station are similar.

Table B-2
Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
SEREF	4 A	9/15/2004	11:42:09 AM	299	2	13.5	14.59	>4	2.00	>4	>4 - 2	220.41	15.10	14.51	16.28	1.77	Bio	38.61	2.65	0.00	-	N	0.00	0.00	-	-	No	-		2.00	9.40	14.48	11.94	Stage I on III	9	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Large void in lower left and small void/burrow in right, both with oxidized sediment. Three polychaetes in upper sediment column. A few Stage I tubes at SWI. Native/ambient.
SEREF	4 B	9/15/2004	11:42:49 AM	296	2	13.5	14.59	>4	2.00	>4	>4 - 2	260.66	17.86	17.22	18.56	1.34	Bio	67.80	4.65	0.00	-	N	0.00	0.00	-	-	No	-		3.00	5.54	18.11	11.83	Stage I on III	11	Tan RPD and light gray to dark gray, well-bioturbated, silt/clay. Patches of organics in subsurface sediment. Water rich sediment. Burrow/void in upper left, void at left and void complex in lower right. All voids have oxidized sediment. Several oxidized burrows and polychaete in upper left. A few Stage I tubes at SWI. Native/ambient.
SEREF	4 C	9/15/2004	11:43:40 AM	299	2	13.5	14.59	>4	2.00	>4	>4 - 2	250.58	17.17	15.85	18.22	2.37	Bio	48.31	3.31	0.00	-	N	0.00	0.00	-	-	No	-		2.00	10.88	15.60	13.24	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna with only a few small patches of dark, reduced, subsurface sediment. Two voids at left and lower left that appear to be related. Both voids have oxidized sediment and are located in line under biogenic depression at left SWI. A few Stage I tubes at SWI. Native/ambient. Three reps at this station are generally similar.
SEREF	5 A	9/15/2004	11:47:45 AM	291	2	13.0	14.59	>4	2.00	>4	>4 - 2	253.51	17.37	16.79	17.51	0.71	Bio	50.70	3.47	0.00	-	N	0.00	0.00	-	-	No	-		2.00	3.71	15.02	9.37	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna. Void complex with oxidized sediment in upper right and distinct, singular feeding void in lower right corner. Biogenic depression at right SWI. Native/ambient.
SEREF	5 B	9/15/2004	11:49:03 AM	296	2	13.0	14.59	>4	2.00	>4	>4 - 2	259.69	17.79	17.56	18.16	0.60	Bio	54.80	3.75	0.00	-	N	0.00	0.00	-	-	No	-		4.00	4.14	13.99	9.07	Stage I on III	10	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna and only a few patches of organics in upper right. Several shallow voids in upper center of the sediment column with all having oxidized sediment. Deeper void with oxidized halo in lower right. Several oxidized burrow traces and a Stage I tube at center SWI. Native/ambient.

Table B-2
Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
SEREF	5 C	9/15/2004	11:49:38 AM	292	2	13.0	14.59	>4	2.00	>4	>4 - 2	262.40	17.98	17.56	18.56	1.00	Bio	60.05	4.11	0.00	-	N	0.00	0.00	-	-	No	-		3.00	5.06	15.31	10.18	Stage I on III	11	Tan to light gray, well-bioturbated, silt/clay. Sediment column well-processed of organics by infauna and only a few patches of organics in upper right. Shallow void in upper right of the sediment column at the patch or organic sediment and oxidized sediment-filled small void in bottom center. Stage I tube at center SWI. Polychaete in upper center of sediment column. Native/ambient. Three reps are similar.
FG23	01 A	9/15/2004	2:26:22 PM	287	2	13.0	14.59	>4	2.00	>4	>4 - 2	213.74	14.65	13.14	15.28	2.14	Bio	53.37	3.66	0.00	-	N	0.00	0.00	-	-	No	-		3.00	4.63	13.34	8.98	Stage I on III	10	Gray silt/clay with biological depression at far right and deep burrow void complex at left. RPD depressed around burrow and feeding depression. Patches of organics in subsurface sediment. Highly bioturbated. Tubes and shallow burrows at SWI - secondary colonization on flanks of larger Stage 3 structures. Two polychaetes at depth in center of frame. Native.
FG23	01 B	9/15/2004	2:27:27 PM	285	2	13.0	14.59	>4	2.00	>4	>4 - 2	225.32	15.44	15.19	15.62	0.43	Bio	36.65	2.51	0.00	-	N	0.00	0.00	-	-	No	-		4.00	7.25	15.37	11.31	Stage I on III	9	Gray silt clay with well-developed tan RPD. Three void at right and one at left. All voids contain oxidized sediment. Large nephtid in lower left-center and three types of thin red polychaetes (left, upper center and upper right). Two tube types at SWI and abundant fecal matter at SWI. Native. Highly reworked.
FG23	01 C	9/15/2004	2:28:16 PM	285	2	13.0	14.59	>4	2.00	>4	>4 - 2	213.42	14.62	13.48	15.11	1.63	Bio	45.62	3.13	2.00	O&R	N	0.00	0.00	-	-	No	-		4.00	3.89	12.35	8.12	Stage I on III	10	Gray silt/clay with tan RPD and several oxidized burrows. Voids in upper right and lower left-center. Thin red polychaetes in lower left center and at right. Tubes at SWI. Well--bioturbated. Ambient sediment.
FG23	02 A	9/15/2004	2:13:29 PM	286	2	13.0	14.59	>4	2.00	>4	>4 - 2	208.60	14.29	13.82	14.82	1.00	Bio	49.88	3.42	0.00	-	N	0.00	0.00	-	-	No	-		2.00	4.51	8.88	6.70	Stage I on III	10	Gray silt/clay with tan RPD. Void in upper center and at left. Dense tubes at SWI. Polychaete mid-left. Two tube types at SWI, bivalve in RPD in left-center. Well-bioturbated. Ambient sediment.

Table B-2
Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
FG23	02 B	9/15/2004	2:14:52 PM	286	2	13.0	14.59	>4	2.00	>4	>4 - 2	230.97	15.83	15.34	16.25	0.91	Bio	57.69	3.95	0.00	-	N	0.00	0.00	-	-	No	-		3.00	3.14	8.28	5.71	Stage I on III	11	Gray silt/clay with tan RPD. Voids in upper right and upper left-center, voids at right are in burrow/void complex. Polychaetes and bivalve in upper right. Several tubes and abundant infaunal fecal matter at SWI. Patches of oxidized sediment in subsurface sediment column. Well-bioturbated. Native (ambient) sediment.
FG23	02 C	9/15/2004	2:15:48 PM	285	2	13.0	14.59	>4	2.00	>4	>4 - 2	245.65	16.83	16.14	17.22	1.09	Bio	58.35	4.00	0.00	-	N	0.00	0.00	-	-	No	-		0.00	-	-	-	Stage III	11	Gray silt/clay with highly invaginated tan RPD. RPD very deep at right. Large polychaete in center of frame, and different large polychaete in upper right. Tube at right SWI. Numerous shallow burrows at right SWI and abundant infaunal fecal matter at SWI. Oxidized sediment at depth. Well-bioturbated. Ambient/native sediment.
FG23	03 A	9/15/2004	2:39:36 PM	286	2	13.0	14.59	>4	2.00	>4	>4 - 2	240.66	16.49	15.82	16.99	1.17	Bio	62.67	4.29	0.00	-	N	0.00	0.00	-	-	No	-		2.00	6.03	9.17	7.60	Stage I on III	11	Gray silt clay with deep, tan RPD. Oxidized sediment filled void at right and void in center of frame. Three tubes at SWI and red-brown polychaete in upper left. Burrow extending to the bottom of frame in center. Well--bioturbated and patches of oxidized sediment at depth. Ambient/native sediment.
FG23	03 B	9/15/2004	2:40:41 PM	284	2	13.0	14.59	>4	1.00	>4	>4 - 1	243.53	16.69	16.36	16.99	0.63	Bio	31.58	2.16	0.00	-	N	0.00	0.00	-	-	No	-		2.00	2.28	5.48	3.88	Stage I on III	8	Gray silt clay with tan RPD. Relict RPD 10.7 cm below SWI. Appears to be recent deposition that is native in origin. No change in sediment petrology between upper and lower sediment units. Small voids in upper right and far left. Top package of sediment is being recolonized. Relict RPD is thick. Interesting pic.
FG23	03 C	9/15/2004	2:41:28 PM	285	2	13.0	14.59	>4	2.00	>4	>4 - 2	306.39	20.99	20.39	21.25	0.86	Bio	48.72	3.34	0.00	-	N	0.00	0.00	-	-	No	-		2.00	4.94	12.40	8.67	Stage I on III	10	Soft, gray silt/clay with tan RPD and prominent burrow in right-center of frame. Two oxidized sediment filled voids at left. Highly bioturbated native sediment.

Table B-2
Sediment-Profile Image Results for Reference Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
FG23	04 A	9/15/2004	2:32:48 PM	284	2	13.0	14.59	>4	2.00	>4	>4 - 2	258.08	17.68	17.11	18.11	1.00	Bio	80.41	5.51	0.00	-	N	0.00	0.00	-	-	No	-		2.00	4.06	12.57	8.31	Stage I on III	11	Light to medium gray silt/clay with deep, well-defined tan RPD. Distinct zone of sulphate reduction under RPD. Void/burrow in upper center and oxidized active void in lower left. Several small mud tubes at SWI and abundant infaunal fecal material at SWI. Two small polychaetes - one orange-yellow and the other red in the RPD. Native/ambient sediment.
FG23	04 B	9/15/2004	2:34:15 PM	286	2	13.0	14.59	>4	2.00	>4	>4 - 2	237.12	16.25	14.34	16.99	2.66	Bio	37.39	2.56	0.00	-	N	0.00	0.00	-	-	No	-		2.00	2.63	6.05	4.34	Stage I on III	9	Gray silt clay with tan RPD and highly irregular SWI. Appears to be on flank of biogenic mound and burrow in center-right. Small void in upper center-left and void at far right edge of frame. Three polychaetes of different species in subsurface sediment. Native/ambient sediment.
FG23	04 C	9/15/2004	2:35:12 PM	283	2	13.0	14.59	>4	2.00	>4	>4 - 2	288.56	19.77	19.02	20.13	1.11	Bio	35.48	2.43	0.00	-	N	0.00	0.00	-	-	No	-		2.00	7.14	16.05	11.60	Stage I on III	9	Gray silt clay with tan RPD. Void in upper left and active, sediment filled void in lower center. Two oxidized sediment-filled voids that appear inactive at right. Tubes and shallow burrows at SWI. Several polychaetes of at least three different species in subsurface sediment. Native/ambient sediment.
FG23	05 A	9/15/2004	2:18:53 PM	286	2	13.0	14.59	>4	2.00	>4	>4 - 2	199.89	13.70	12.22	14.99	2.77	Phys	36.50	2.50	0.00	-	N	0.00	0.00	-	-	No	-		1.00	10.88	11.37	11.12	Stage I on III	9	Light gray silt/clay with tan RPD. Penetration at an angle. Nice view of biogenic structures at SWI background. Small oxidized sediment filled void in lower left. Two polychaetes at lower right and numerous tunes and shallow burrows at SWI. Ambient/native sediment.
FG23	05 B	9/15/2004	2:19:51 PM	285	2	13.0	14.59	>4	2.00	>4	>4 - 2	241.43	16.54	16.08	16.85	0.77	Bio	34.11	2.34	0.00	-	N	0.00	0.00	-	-	No	-		1.00	3.68	4.77	4.23	Stage I on III	9	Light gray silt/clay with tan RPD. Void/burrow complex in upper center of sediment column. Numerous polychaetes in sediment column. Several tubes of at least two types at SWI. Numerous patches of oxidized sediment at depth. Well-bioturbated sediment. Ambient/native sediment.
FG23	05 C	9/15/2004	2:22:20 PM	284	2	13.0	14.59	>4	2.00	>4	>4 - 2	269.85	18.49	18.08	18.76	0.69	Bio	32.62	2.23	0.00	-	N	0.00	0.00	-	-	No	-		1.00	7.57	8.23	7.90	Stage I on III	8	Light gray silt/clay with tan RPD. Oxidized sediment filled void in upper left. Several mud tubes - of two types- at SWI. Oxidized sediment patches in lower sediment column. Burrow at left. Well-bioturbated native/ambient sediment.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	1 A	9/14/2004	4:02:02 PM	291	2	13.5	14.59	>4	2.00	>4	>4 - 2	214.48	14.70	14.11	15.14	1.03	Bio	29.48	2.02	0.00	-	N	214.48	> 14.70	> 14.11	> 15.14	No	9.30	Recent DM	4.00	4.57	8.80	6.68	Stage I on III	8	DM > P. Layered medium to dark gray silt/clay over mixed blue-gray to gray clay. Voids at left, small void in lower center and two voids in upper right which contain oxidized sediment. More recent DM layer (top) is 9.3 cm thick. Tubes at SWI. Appears to be top-down recolonization based on integrity of blue clay layer at bottom.
MBDS C	1 B	9/14/2004	4:03:06 PM	288	2	13.5	14.59	>4	2.00	>4	>4 - 2	215.33	14.75	14.42	15.05	0.63	Bio	44.05	3.02	1.00	R	N	215.33	> 14.75	> 14.42	> 15.05	No	10.20	Recent DM	4.00	9.65	13.97	11.81	Stage I on III	10	DM > P. Layered medium to dark gray silt/clay over mixed blue-gray to gray clay. Voids at lower right center in cluster. More recent DM layer (top) is 10.2 cm thick. Tubes at SWI. Bioturbation beneath blue-gray clay horizon suggests vertical migration. Large polychaete in upper right center and second large polychaete in lower left center. Deep RPD and several shallow burrows in RPD. Nice pic. Mudclast at SWI and white clay clasts in upper DM layer are artifacts based on smearing of window above the SWI.
MBDS C	1 C	9/14/2004	4:03:51 PM	291	2	13.5	14.59	>4	1.00	>4	>4 - 1	122.29	8.38	7.85	9.02	1.17	Phys	23.52	1.61	0.00	-	N	122.29	> 8.38	> 7.85	> 9.02	No	-		0.00	-	-	-	Stage II -> III	7	DM > P. Chaotic fabric with large cohesive clast of light hued clay in slightly sandy silt/clay matrix; top chunk of clast appears to be transported artifact from last replicate. RPD is partially depositional. Polychaetes in upper 4 cm of sediment column. Going to Stage III with preferential burrowing in non-clay clast areas. Numerous tubes of two types at SWI and abundant fecal matter. Very different from other two reps.
MBDS C	2A	9/15/2004	10:02:02 AM	291	3	14.5	14.59	>4	1.00	>4	>4 - 1	240.43	16.47	16.02	16.74	0.71	Bio	36.66	2.51	0.00	-	N	240.43	> 16.47	> 16.02	> 16.74	No	11.60	Recent DM	2.00	8.68	12.59	10.64	Stage I on III	9	DM > P and DM in two distinct layer. Top layer is dominantly silt clay with some sand near the base of the unit. This layer also has heterogeneous jumble of small clots of syntactically unrelated clays. Bottom layer is dominated by the presence of light hued cohesive clay. Large void complex in center and san lag in voids. At least four species of polychaetes present in upper DM layer. Stage I and Stage III tubes at SWI. Very nice pic.

Table B-3 Sediment Profile Image Results for MBDS-C at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	2 B	9/15/2004	10:02:42 AM	292	3	14.5	14.59	>4	2.00	>4	>4 - 2	106.70	7.31	6.91	7.60	0.69	Bio	36.24	2.48	0.00	-	N	106.70	> 7.31	> 6.91	> 7.60	No	-		2.00	4.48	6.54	5.51	Stage I on III	9	DM>P. Gray to dark gray silt/clay with heterogeneous fabric due to small clay clasts in matrix. Void at far left and active void/burrow in lower center. This unit is similar to the upper DM unit in previous rep. Penetration far less in this rep. Scattered tubes at SWI background and several shallow burrows in RPD. Smeared polychaetes above void at far left.
MBDS C	2 C	9/15/2004	10:03:48 AM	291	3	14.5	14.59	>4	1.00	>4	>4 - 1	237.79	16.29	15.97	16.45	0.49	Bio	41.06	2.81	0.00	-	N	237.79	> 16.29	> 15.97	> 16.45	No	11.00	Recent DM	7.00	5.63	13.25	9.44	Stage I on III	9	DM>P. Layer of gray to dark gray heterogeneous silt/clay over light gray clay dominated secondary DM layer. Upper DM layer is 11 cm thick and is riddled with feeding voids. Numerous tubes at SWI and several polychaetes smeared in upper sediment column. Nice pic of both vertical migration and top-down colonization. Similar to Rep A.
MBDS C	3 B	9/15/2004	10:47:35 AM	296	3	14.5	14.59	>4	2.00	>4	>4 - 2	270.78	18.55	18.14	19.22	1.09	Bio	61.74	4.23	0.00	-	N	270.78	> 18.55	> 18.14	> 19.22	No	7.30	Recent DM	3.00	4.06	8.17	6.11	Stage I on III	11	DM>P. Three layers of DM. Top layer is 7.3 cm thick and is composed of dark gray to gray silt/clay with deep, tan RPD, Middle layer is cohesive light-hued clay 1.8 cm thick. Bottom layer is medium to dark gray silt/clay with some smear-down of overlying cohesive silt/clay. Two large voids in right, just above light-hued clay and smaller void with oxidized sediment in upper left. Polychaete at left. Possible relict RPD at bottom of frame.
MBDS C	3 C	9/15/2004	10:48:28 AM	295	3	14.5	14.59	>4	2.00	>4	>4 - 2	233.29	15.99	15.34	16.48	1.14	Bio	21.46	1.47	0.00	-	N	233.29	> 15.99	> 15.34	> 16.48	No	3.20	Recent DM	6.00	7.14	13.88	10.51	Stage I on III	7	DM>P. Six distinct layers 2.6,0.6,6.3, 0.3, 2.4 and 2.1+ cm thick. Layers are gray to dark gray silt/clay with alternating cohesive light-hued clay. Multi-chambered void complex in center of frame and extending to lower left. Numerous small polychaetes in upper sediment column. Similar to Rep B. Interesting picture.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	3 D	9/15/2004	10:49:33 AM	295	3	14.5	14.59	>4	2.00	>4	>4 - 2	269.90	18.49	17.85	18.65	0.80	Bio	45.61	3.13	2.00	1 O, 1 R	N	269.90	> 18.49	> 17.85	> 18.65	No	7.20	Recent DM	2.00	5.74	17.68	11.71	Stage I on III	10	DM>P. Five layers of DM. Top is dark gray silt clay (7.2 cm) followed by light-hued cohesive clay (0.9 cm), gray silt/clay (4.9 cm), dark gray silt (1.8 cm) and cohesive light-hued clay at bottom (2.3+ cm). Oxidized void at bottom right and oxidized sediment in active void in upper left. Long polychaete with oxidized burrow trace in upper right. At least three species of polychaete visible in upper sediment column. Abundant fecal pellets at SWI. Similar to rep A and B.
MBDS C	4 C	9/15/2004	8:54:39 AM	288	2	13.5	14.59	>4	3.00	>4	>4 - 3	68.12	4.67	1.86	6.51	4.66	Phys	28.01	1.92	1.00	O	N	68.12	> 4.67	> 1.86	> 6.51	No	-		0.00	-	-	-	Stage I -> II	5	DM>P. Cohesive, light-hued clay clast with mantle of silt/clay. Thin RPD partially depositional. Polychaetes at left. Top-down colonization but infaunalization occurring on clay clast. Reps A and B had very little penetration to no penetration. Recent deposition of DM.
MBDS C	4 E	9/15/2004	9:34:26 AM	288	3	14.5	14.59	>4	0.00	>4	>4 - 0	141.57	9.70	9.14	10.17	1.03	Bio	30.63	2.10	0.00	-	N	141.57	> 9.70	> 9.14	> 10.17	No	-		1.00	4.66	5.03	4.84	Stage I on III	8	DM>P. Mottle gray DM over large tear in sediment, coarse sand at bottom of tear - it is possible that the tear is some type of megafaunal burrow, but not enough evidence. Numerous polychaetes in sediment column. Large fecal string at SWI at left and several biogenic hummocks in background. Void at far left. Very different from Rep C.
MBDS C	4 F	9/15/2004	9:35:13 AM	287	3	14.5	14.59	>4	1.00	>4	>4 - 1	137.47	9.42	9.11	9.82	0.71	Bio	42.48	2.91	0.00	-	N	137.47	> 9.42	> 9.11	> 9.82	No	-		2.00	5.48	8.63	7.06	Stage I on III	9	DM>P. Mottled gray to dark gray DM with patch of blue gray clay and sand in lower left corner. Active void with oxidized sediment in lower left-center and sediment filled void at far left. Dense stage I tubes in background at SWI and several larger broken Stage III mud tunes at SWI. Numerous polychaetes of at least three species smeared in upper and mid-sediment column. Nice pic.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	5 C	9/15/2004	8:58:52 AM	291	2	13.5	14.59	>4	0.00	>4	>4 - 0	166.97	11.44	10.28	12.08	1.80	Phys	38.32	2.63	0.00	-	N	166.97	> 11.44	> 10.28	> 12.08	No	-		3.00	4.11	9.43	6.77	Stage I on III	9	DM>P. Gray to dark gray silt clay with interspersed clots of cohesive, light-hued, blue-gray clay. Dense assemblage of Stage I tubes at SWI and active void/burrow with oxidized halo at far right. Large, multi-chambered void complex at bottom of frame with fluidized mud. Several polychaetes of at least for different species smeared throughout sediment column.
MBDS C	5 D	9/15/2004	9:38:41 AM	293	3	14.5	14.59	>4	2.00	>4	>4 - 2	139.23	9.54	8.80	10.02	1.23	Phys	18.30	1.25	1.00	O	N	139.23	> 9.54	> 8.80	> 10.02	No	-		3.00	4.46	9.28	6.87	Stage I on III	7	DM>P. Band of cohesive, light-hued clay at SWI with some top-down colonization of clay. Subsurface sediment has chaotic fabric and is dominantly gray to dark gray mottled silt/clay with clots of cohesive, light-hued clay interspersed. Void lower left corner, upper center, and far right. Several polychaetes of at least three different species smeared in sediment column. Different from Rep C.
MBDS C	5 E	9/15/2004	9:39:26 AM	292	3	14.5	14.59	>4	1.00	>4	>4 - 1	188.65	12.93	11.80	13.51	1.71	Phys	42.08	2.88	2.00	R	N	188.65	> 12.93	> 11.80	> 13.51	No	-		1.00	6.23	10.80	8.51	Stage I on III	9	DM>P. Gray to dark gray silt/clay with interspersed clots of cohesive, light-hued clay. Large burrow in center of frame with oxidized sediment at left wall of burrow and sand lag lining on floor of burrow. Numerous polychaetes of at least five species smeared against faceplate. Patches of oxidized sediment at depth at left due to infaunal feeding in head-down orientation. A few tubes at SWI. Mudclasts are artifacts.
MBDS C	6 A	9/15/2004	9:52:34 AM	296	3	14.5	14.59	>4	2.00	>4	>4 - 2	271.15	18.58	18.02	18.99	0.97	Bio	60.41	4.14	0.00	-	N	271.15	> 18.58	> 18.02	> 18.99	No	16.30	Recent DM	1.00	11.08	15.62	13.35	Stage I on III	11	DM>P. Top layer of Dm is 16.3 cm thick and consists of gray to dark gray mottled silt/clay with scattered clasts of light-hued cohesive clay interspersed throughout the sediment column. Bottom part of sediment column is dominated by gray clay. Large active, multi-chambered void in lower right-center of sediment column. Long, oxidized burrow to left of void. Numerous oxidized, shallow burrows in upper portion of the sediment column. Abundant fecal matter at SWI. Nice pic of intense reworking.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	6 B	9/15/2004	9:53:18 AM	298	3	14.5	14.59	>4	2.00	>4	>4 - 2	272.98	18.70	18.31	18.97	0.66	Bio	42.31	2.90	0.00	-	N	272.98	> 18.70	> 18.31	> 18.97	No	7.90	Recent DM	5.00	9.08	12.74	10.91	Stage I on III	9	DM>P. Layered Dm with three layers visible (7.9, 5.9 and 4.3+ cm thick moving downward from the sediment water interface). Top two layers are composed of gray to dark gray silt/clay with interspersed clasts of light gray, cohesive clay. Bottom layer in dominated by the light-hued, blue-gray clay. String of voids in center of sediment column. Bioturbation of the sediment in rep is not as extensive as that in Rep A. Biogenic mound at right SWI and three very nicely preserved stage I tubes (spionids?).
MBDS C	6 D	9/15/2004	9:56:07 AM	298	3	14.5	14.59	>4	2.00	>4	>4 - 2	247.10	16.93	16.68	17.22	0.54	Bio	44.85	3.07	1.00	O	N	247.10	> 16.93	> 16.68	> 17.22	No	11.20	Recent DM	2.00	6.28	9.31	7.80	Stage I on III	10	DM>P. Layered DM with the layering being obscured by bioturbation. Sediment column is dominantly gray to dark silt/clay with scattered interspersed clots of light-hued, blue-gray clay. Active void with polychaete in upper center and active void with some suspended oxidized sediment at right. Several polychaetes of at least four species smeared against faceplate, Abundant fecal matter at SWI and both Stage I and Stage III tubes present. Similar to reps A and B and intermediate between those two in terms of the amount of bioturbation.
MBDS C	7 A	9/14/2004	4:17:47 PM	290	2	13.5	14.59	>4	-4.00	>4	>4 - -4	184.95	12.67	11.85	13.74	1.88	Phys	61.58	4.22	0.00	-	N	184.95	> 12.67	> 11.85	> 13.74	No	-		1.00	4.23	5.34	4.79	Stage III	11	DM>P. Mottled light gray silt/clay over cohesive, light-hued, blue-gray clay. Spectacular effusion of mucous from burrowing fish/epibenthos which is disrupting the vast portion of the upper sediment column. Organism in void in center of sediment column and polychaete in lower right. Angular, epizoan encrusted cobble in center and shell debris at right.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	7 B	9/14/2004	4:18:35 PM	289	2	13.5	14.59	>4	1.00	>4	>4 - 1	179.92	12.33	11.68	12.94	1.26	Bio	31.23	2.14	1.00	R	N	179.92	> 12.33	> 11.68	> 12.94	No	11.30	Recent DM	3.00	6.48	11.51	9.00	Stage I on III	8	DM>P. Two layers of DM, top layer is gray to dark silt/clay with interspersed clasts of cohesive, light gray-blue clay and the bottom layer is light-blue cohesive clay. Void at left, above clay layer and oxidized sediment filled void in center of frame. Numerous stage I tubes at SWI. Several shallow burrows at SWI and mudclast at SWI is an artifact.
MBDS C	7 C	9/14/2004	4:19:21 PM	293	2	13.5	14.59	>4	2.00	>4	>4 - 2	148.16	10.15	9.45	11.91	2.46	Phys	33.95	2.33	>5	R	N	148.16	> 10.15	> 9.45	> 11.91	No	-		1.00	7.25	8.83	8.04	Stage I on III	9	DM>P. DM is a mix of very cohesive, light-hued blue-gray clay and mixed gray to dark gray silt/clay. Active void complex in lower left. Polychaete in upper left. Numerous artifactual mudclasts of cohesive clay at SWI. A few stage I tubes at SWI and a Stage III tube at right SWI. Similar to rep B.
MBDS C	8 B	9/14/2004	4:13:09 PM	283	2	13.5	14.59	>4	1.00	>4	>4 - 1	177.23	12.14	11.60	12.48	0.89	Bio	37.75	2.59	0.00	-	N	177.23	> 12.14	> 11.60	> 12.48	No	-		2.00	8.11	12.48	10.30	Stage I on III	9	DM>P. Gray to dark gray silt/clay with large clast of light-hued, cohesive clay. Some subsurface voids are due to infauna, some are clearly tears in the sedimentary fabric. Numerous polychaetes in the sediment column of at least two different species. Shallow burrows and several stage I tubes at SWI.
MBDS C	8 C	9/14/2004	4:13:56 PM	282	2	13.5	14.59	>4	1.00	>4	>4 - 1	112.36	7.70	7.34	8.51	1.17	Bio	34.20	2.34	0.00	-	N	112.36	> 7.70	> 7.34	> 8.51	No	-		2.00	3.80	7.14	5.47	Stage I on III	9	DM>P. Chaotic fabric, gray to dark gray silt/clay with scattered clasts of cohesive, blue gray clay. Void/burrow in lower center and active void complex with oxidized sediment at left. Tear in sediment in lower right. Venting of burrow with dark, reduced sediment being expelled into the water column at right SWI. Very pleasing aesthetically with psuedo-smoke wafting over towards the benthic bad moon rising - Lon Chaney structure. Numerous Stage I tubes at SWI. Firm sediment, not extensively well-bioturbated. Similar to B.

Table B-3 Sediment Profile Image Results for MBDS-C at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	8 E	9/15/2004	9:43:46 AM	281	2	13.5	14.59	>4	2.00	>4	>4 - 2	138.85	9.51	9.17	10.25	1.08	Bio	38.95	2.67	0.00	-	N	138.85	> 9.51	> 9.17	> 10.25	No	-		1.00	4.03	4.40	4.21	Stage I on III	9	DM>P. Gray to dark gray silt/clay with cohesive clast of light blue-gray clay in bottom right. Burrow with loose oxidized sediment in upper right. Large polychaete in lower right (Stage III). Numerous Stage I tubes at SWI. Polychaete in lower center. Similar to other reps.
MBDS C	9 A	9/14/2004	4:06:30 PM	275	2	13.5	14.59	>4	2.00	>4	>4 - 2	169.36	11.60	11.31	11.77	0.46	Bio	25.83	1.77	0.00	-	N	169.36	> 11.60	> 11.31	> 11.77	No	8.60	Recent DM	2.00	5.68	7.97	6.83	Stage I on III	8	DM>P. Two distinct layers, top layer is gray to dark gray silt/clay with interspersed clots of cohesive light gray-blue clay. Bottom layer is cohesive clay. Void in center and right center. Polychaetes at left. Numerous Stage I tubes at SWI. Firm sediment, not well bioturbated.
MBDS C	9 B	9/14/2004	4:07:25 PM	273	2	13.5	14.59	>4	2.00	>4	>4 - 2	108.03	7.40	7.11	7.77	0.66	Bio	42.68	2.92	0.00	-	N	108.03	> 7.40	> 7.11	> 7.77	No	-		1.00	5.26	6.14	5.70	Stage I on III	9	DM>P. Light to dark gray silt/clay with clay clots over large cohesive clasts of light hued gray-blue clay at bottom right. Void in lower left with polychaete. Stage I tubes at SWI. Abundant fecal pellets at SWI. Similar to Rep A.
MBDS C	9 C	9/14/2004	4:08:24 PM	273	2	13.5	14.59	>4	2.00	>4	>4 - 2	117.37	8.04	7.63	8.37	0.74	Bio	26.28	1.80	0.00	-	N	117.37	> 8.04	> 7.63	> 8.37	No	-		2.00	4.83	7.31	6.07	Stage I on III	8	DM>P. Mottled gray to dark gray silt/clay over cohesive, light-hued blue-gray clay. Active void in lower left and large lateral void complex just above blue-gray clay in bottom center of the frame. Ophiuroid at center SWI and large broken Stage II tube at left SWI. Sediment column stiff. Similar to other reps.
MBDS C	10 A	9/15/2004	8:43:27 AM	287	2	13.5	14.59	>4	2.00	>4	>4 - 2	209.33	14.34	13.85	14.68	0.83	Bio	37.67	2.58	0.00	-	N	209.33	> 14.34	> 13.85	> 14.68	No	-		5.00	7.63	13.85	10.74	Stage I on III	9	DM>P. Dm is faintly layered gray to dark gray silt clays with scattered smearing of lighter clay. Appears to older DM than C1-9 with bioturbation nearly obscuring all layering. Numerous active voids at bottom of frame and middle of frame with oxidized sediment in many of the voids. Polychaetes against faceplate in upper sediment column - at least four species present. Stage I tube at SWI. Nice pic.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	10 B	9/15/2004	8:44:07 AM	289	2	13.5	14.59	>4	2.00	>4	>4 - 2	219.44	15.04	14.82	15.11	0.29	Bio	44.78	3.07	0.00	-	N	219.44	> 15.04	> 14.82	> 15.11	No	-		1.00	13.65	14.02	13.84	Stage I on III	10	DM>P. DM is faintly layered gray to dark gray silt clays with scattered smearing of lighter clay. Appears to older DM than C1-9 with bioturbation nearly obscuring all layering. Small void in lower left corner. Patches of oxidized sediment at bottom of frame frame infaunal feeding activity. Fleshy organism in left center. Numerous shallow, remarkably well-preserved burrows in RPD (polydorids?). Several small polychaetes in upper sediment column. Similar to Rep A.
MBDS C	10 C	9/15/2004	8:44:44 AM	287	2	13.5	14.59	>4	2.00	>4	>4 - 2	223.65	15.33	15.02	15.59	0.57	Bio	36.83	2.52	0.00	-	N	223.65	> 15.33	> 15.02	> 15.59	No	-		1.00	6.05	14.02	10.04	Stage I on III	9	DM>P. Layered Dm which is dominantly gray to dark gray silt/clay and band of light-hued, cohesive silt/clay near bottom of frame. Appears to be older DM or more reworked than C1-9. Large oxidize burrow at right with pellets directly above burrow. Numerous polychaetes of at least three species in upper sediment column and a few tubes at SWI. Abundant fecal pellets at SWI. Similar to other reps from this station.
MBDS C	11 A	9/15/2004	10:33:20 AM	274	3	14.5	14.59	>4	1.00	>4	>4 - 1	198.73	13.62	13.02	14.08	1.06	Bio	42.97	2.94	0.00	-	N	198.73	> 13.62	> 13.02	> 14.08	No	-		2.00	6.26	9.51	7.89	Stage I on III	9	DM>P. Gray to dark gray, mottle silt/clay with some small light-hued blue-gray clay particles over a melange of silts and large, light gray blue clay clasts. Great example of chaotic fabric at depth. Large void complex that runs across width of frame immediately above melange layer. Flank of biogenic mound at right SWI. Numerous Stage I tubes at SWI and in SWI background. Thin polychaete in upper right sediment column.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	11 B	9/15/2004	10:34:05 AM	275	3	14.5	14.59	>4	1.00	>4	>4 - 1	128.91	8.83	8.28	9.71	1.43	Bio	36.31	2.49	2.00	R	N	128.91	> 8.83	> 8.28	> 9.71	No	-		3.00	4.00	8.48	6.24	Stage I on III	9	DM>P. Gray to dark gray, mottle silt/clay with some small light-hued blue-gray clay particles over a melange of silts and large, light gray blue clay clasts. Great example of chaotic fabric at depth. Large void complex that runs across width of frame immediately above melange layer with small, active, sediment-filled void at right. Several polychaetes of at least two species in sediment column. Two distinct feeding depressions at SWI. Similar to Rep A.
MBDS C	11 C	9/15/2004	10:34:40 AM	275	3	14.5	14.59	>4	1.00	>4	>4 - 1	152.88	10.48	9.91	11.31	1.40	Bio	42.15	2.89	1.00	R	N	152.88	> 10.48	> 9.91	> 11.31	No	-		1.00	6.20	9.40	7.80	Stage I on III	9	DM>P. Gray to dark gray, mottle silt/clay with some small light-hued blue-gray clay particles over a melange of silts and large, light gray blue clay clasts. Great example of chaotic fabric at depth. Large void at bottom left with oxidized sediment in void. Polychaete above void in sediment column. A few Stage I tubes at SWI and abundant fecal matter at SWI. Stratigraphy nearly identical to Reps A and B.
MBDS C	12 A	9/14/2004	3:54:16 PM	299	2	13.5	14.59	>4	2.00	>4	>4 - 2	202.60	13.88	13.45	14.22	0.77	Bio	40.64	2.78	0.00	-	N	202.60	> 13.88	> 13.45	> 14.22	No	9.80	Recent DM	2.00	4.57	8.80	6.69	Stage I on III	9	DM>P. Layered DM with top layer consisting of gray to dark gray silt/clay (9.8 cm) over a layer of cohesive, light-hued, blue-gray clay (3.7 cm). Two voids at lower right and Nereid polychaete at far lower right. Biogenic mound above voids and Nereid, at right SWI. Numerous Stage I tubes at SWI.
MBDS C	12 B	9/14/2004	3:55:07 PM	298	2	13.5	14.59	>4	2.00	>4	>4 - 2	165.00	11.31	11.00	11.60	0.60	Bio	49.21	3.37	0.00	-	N	165.00	> 11.31	> 11.00	> 11.60	No	-		2.00	5.17	7.20	6.19	Stage I on III	10	DM>P. Gray to dark gray silt/clay with two large clots of light-hued cohesive blue-gray clay at bottom of frame. Two voids, one in right center and one in left center. Large polychaete in lower left corner. Elongate oxidized burrows in upper right. Abundant fecal pellets at SWI.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	12 C	9/14/2004	3:56:06 PM	296	2	13.5	14.59	>4	2.00	>4	>4 - 2	199.05	13.64	13.34	13.79	0.46	Bio	51.87	3.55	0.00	-	N	199.05	> 13.64	> 13.34	> 13.79	No	10.40	Recent DM	2.00	6.68	11.51	9.10	Stage I on III	10	DM>P. Layered DM with top layer consisting of gray to dark gray silt/clay (10.4 cm) over a layer of cohesive, light-hued, blue-gray clay (2.6+ cm). Active void in mid-right and void with oxidized sediment in lower left-center. Several small polychaetes of three different species in upper sediment column and polychaete in bottom right corner. A few Stage I tubes at SWI and abundant fecal pellets. Similar to Rep A - Rep B may also be similar but penetration was less - which precluded seeing the bottom clay as a distinct layer.
MBDS C	13 A	9/15/2004	10:27:40 AM	284	3	14.5	14.59	>4	2.00	>4	>4 - 2	238.40	16.34	15.77	16.85	1.09	Bio	40.37	2.77	0.00	-	N	238.40	> 16.34	> 15.77	> 16.85	No	10.70	Recent DM	4.00	2.68	10.31	6.50	Stage I on III	9	DM>P. Gray to dark gray silt clay DM (10.7 cm) over highly chaotic, cohesive, light-hued, blue-gray clay 6.1 cm). Void in upper left, lower left, and at far right. Appears to tears in sediment fabric at bottom of frame. Clays at bottom deposited in a jumbled mass and several large clast appear top be dissociated. Polychaetes in center of frame. Several Stage I tubes at SWI.
MBDS C	13 B	9/15/2004	10:28:59 AM	283	3	14.5	14.59	>4	1.00	>4	>4 - 1	232.87	15.96	15.39	16.42	1.03	Bio	51.46	3.53	0.00	-	N	232.87	> 15.96	> 15.39	> 16.42	No	7.20	Recent DM	3.00	5.54	10.91	8.23	Stage I on III	10	DM>P. Gray to dark gray silt clay DM (7.2 - 13.4 cm) over highly chaotic, cohesive, light-hued, blue-gray clay (0.8-8.5 cm). Clays at bottom deposited in a jumbled mass and several large clasts appear to be dissociated. Void in upper left center, lower left and lower right. Similar to Rep A but Bottom clays have a much more irregular paleo-surface. Stage I tubes and abundant fecal pellets at SWI.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	13 C	9/15/2004	10:30:14 AM	284	3	14.5	14.59	>4	1.00	>4	>4 - 1	217.88	14.93	14.14	15.85	1.71	Bio	37.42	2.56	0.00	-	N	217.88	> 14.93	> 14.14	> 15.85	No	-		1.00	6.74	6.94	6.84	Stage I on III	9	DM>P. Gray to dark gray silt clay with interspersed small clots of cohesive, light hued, blue-gray clay in upper sediment column. Larger Clasts of blue gray in lower right in a chaotic distribution. Layering not apparent at depth. Large tear in sediment fabric running across width of frame. Small void with oxidized sediment and polychaete at very far left. Numerous Stage I tubes at SWI, abundant fecal matter and biogenic hummocks. Similar to Reps A and B but without the distinct layering of clays at the bottom of the frame.
MBDS C	14 A	9/15/2004	8:47:48 AM	282	2	13.5	14.59	>4	2.00	>4	>4 - 2	127.28	8.72	7.57	9.28	1.71	Bio	30.36	2.08	0.00	-	N	127.28	> 8.72	> 7.57	> 9.28	No	7.80	Recent DM	1.00	5.77	6.09	5.93	Stage I on III	8	DM>P. Gray to dark gray silt/clay (7.8 cm) over very cohesive, light hued, blue-gray clay (1.8+ cm). Small proto-void with oxidized sediment and polychaete at mid right. Polychaetes and oxidized burrow at far right under Feeding depression at SWI. Numerous tubes around feeding depression (secondary succession). Numerous Stage I tubes at SWI.
MBDS C	14 C	9/15/2004	8:49:04 AM	280	2	13.5	14.59	>4	2.00	>4	>4 - 2	180.34	12.36	11.20	13.48	2.29	Phys	11.82	0.81	2.00	R	N	180.34	> 12.36	> 11.20	> 13.48	No	-		3.00	6.68	9.48	8.08	Stage I on III	7	DM>P. Chaotic fabric. Cohesive, light-hued, blue-gray clay at SWI. Thinly developed RPD partially due to the presence of the clay at the SWI. Subsurface sediment is a mix of cohesive clay and gray to dark Gray silt/clay. Nice oxidized burrow/void in lower left. Two large polychaetes, one in upper center and one in far right above void. Great example of the properties of the sediment at SWI influence RPD development, even in the presence of deep dwelling fauna. Different from Rep A.
MBDS C	14 D	9/15/2004	8:49:50 AM	280	2	13.5	14.59	>4	2.00	>4	>4 - 2	147.03	10.07	9.74	10.48	0.74	Bio	29.83	2.04	3.00	R	N	147.03	> 10.07	> 9.74	> 10.48	No	-		4.00	4.94	8.48	6.71	Stage I on III	8	DM>P. Gray to dark gray silt/clay with light-hued, cohesive, blue-gray clay clast in lower left. Artifactual mudclasts at SWI. Two voids in center of frame, one at far right and one in clay clast. Several polychaetes of at lest three species in sediment column. Numerous Stage I tubes at SWI. Similar to rep A,

Table B-3 Sediment Profile Image Results for MBDS-C at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS C	15 A	9/15/2004	10:39:18 AM	286	3	14.5	14.59	>4	1.00	>4	>4 - 1	246.00	16.86	15.54	17.59	2.06	Bio	44.22	3.03	0.00	-	N	246.00	> 16.86	> 15.54	> 17.59	No	8.20	Recent DM	3.00	6.57	12.20	9.38	Stage I on III	10	DM>P. Mottled gray to dark gray silt(8.2 cm) over gray silt and abundant intermixed clast of cohesive blue-gray clay. Subsurface sediment is archetypal chaotic fabric. Voids in center of frame and small oxidized void in lower center of frame. Biogenic hummock at SWI. Several Stage I tubes at SWI.
MBDS C	15 B	9/15/2004	10:40:40 AM	283	3	14.5	14.59	>4	1.00	>4	>4 - 1	242.58	16.62	16.34	16.71	0.37	Bio	43.73	3.00	0.00	-	N	242.58	> 16.62	> 16.34	> 16.71	No	7.50	Recent DM	5.00	4.11	8.31	6.21	Stage I on III	9	DM>P. Mottled gray to dark gray silt (7.5 cm) over gray silt and abundant intermixed clasts of cohesive blue-gray clay (9.3+ cm). Subsurface sediment is archetypal chaotic fabric. Numerous active voids in upper layer and possible cerianthid burrow in lower right. Abundant well formed stage I tubes at SWI and a few intact Stage III tubes. Similar to Rep A.
MBDS C	15 C	9/15/2004	10:41:29 AM	283	3	14.5	14.59	>4	1.00	>4	>4 - 1	261.05	17.89	16.94	18.96	2.03	Bio	42.79	2.93	3.00	R	N	261.05	> 17.89	> 16.94	> 18.96	No	11.00	Recent DM	4.00	4.86	12.85	8.85	Stage I on III	9	DM>P. Mottled gray to dark gray silt (11 cm) over gray silt and abundant intermixed clasts of cohesive blue-gray clay (6.6+ cm). Subsurface sediment is archetypal chaotic fabric. Numerous active voids in upper layer and extending into clay dominated subsurface sediment. Mudclasts at SWI are artifacts. Several polychaetes in upper sediment column and several Stage I tubes at SWI. Similar to Reps A and B.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	1 A	9/14/2004	12:05:04 PM	300	2	13.5	14.59	>4	1.00	>4	>4 - 1	230.45	15.79	15.45	16.02	0.57	Bio	70.22	4.81	0.00	-	N	230.45	> 15.79	> 15.45	> 16.02	No	0.70	pseudofeces	3.00	7.48	13.68	10.58	Stage I on III	11	DM > P. Dark gray silt/clay with large active void that contains oxidized sediment in lower right. Small void in lower left-center and active burrow/void above large void. Thin layer of reduced material at SWI that is starting to become reworked. This layer is 0.7 cm thick and overlies a very thick RPD, most likely reduced material from depth being transported to the surface by conveyor belt feeders. Fecal pellets at SWI and numerous shallow burrows. DM very different from that seen on Mound C.
MBDS D	1 B	9/14/2004	12:06:33 PM	300	2	13.5	14.59	>4	1.00	>4	>4 - 1	260.74	17.87	17.54	17.99	0.46	Bio	68.36	4.68	0.00	-	N	260.74	> 17.87	> 17.54	> 17.99	No	-		3.00	6.20	8.91	7.56	Stage I on III	11	DM > P. Dark gray homogeneous silt/clay with relict RPD at bottom of frame. Very deep RPD. Voids at left, center and upper right of frame. Leftmost void filled with oxidized sediment. Numerous large mud tubes at SWI. Upper portion of the RPD has abundant organic debris (small < 1 cm). Abundant fecal pellets at SWI. Does not have thin band of reduced sediment at SWI like Rep A.
MBDS D	1 C	9/14/2004	12:36:11 PM	300	2	13.5	14.59	>4	1.00	>4	>4 - 1	257.15	17.62	16.85	17.96	1.11	Bio	69.27	4.75	0.00	-	N	257.15	> 17.62	> 16.85	> 17.96	No	0.60	pseudofeces	3.00	5.00	11.77	8.38	Stage I on III	11	DM > P. Dark gray, slightly sandy silt/clay with relict RPD at bottom of frame. Large void in lower left and small voids in upper far left and far right. A thin (0.6 cm) band of reduced sediment with a diffusional RPD at SWI. Origin of this material is most likely the exhumation of reduced subsurface sediment and conveyoring to the SWI by resident infauna. Several polychaetes of at least three species at right. Reduced sediment at SWI is deflected downward above large void. Numerous tubes at SWI. Deep relict RPD dierectly below the thin band of reduced sediment at the SWI. Similar to Rep A.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	2 A	9/14/2004	1:10:23 PM	300	2	13.5	14.59	>4	1.00	>4	>4 - 1	233.25	15.98	15.68	16.14	0.46	Bio	56.78	3.89	0.00	-	N	233.25	> 15.98	> 15.68	> 16.14	No	0.90	pseudofeces	4.00	5.60	12.05	8.83	Stage I on III	11	DM>P. Dark gray, slightly sandy silt/clay with minor light bluish-gray clay. Thin band (0.9 cm) of reduced, slightly sandy silt at SWI and this band has a diffusional RPD. Deep RPD immediately underlying this layer. Several active feeding voids with oxidized sediment in the right and center of the sediment column. Tube at far right SWI and abundant fecal strings at SWI.
MBDS D	2 B	9/14/2004	1:11:25 PM	298	2	13.5	14.59	>4	1.00	>4	>4 - 1	299.81	20.54	20.33	20.68	0.34	Bio	40.63	2.78	0.00	-	N	299.81	> 20.54	> 20.33	> 20.68	No	0.70	pseudofeces	1.00	8.72	9.53	9.13	Stage I on III	9	DM>P. DM is dominantly layered, light to dark gray silt/clay with a minor amount of fine sand and a few clots of cohesive, blue-gray clay. Five distinct layers visible. A band of reduced sandy silt 0.7 cm thick at SWI. Diffusional RPD incipient at SWI. It appears that this material is recently deposited rather than anoxia-induced as all of the infaunal tubes projecting above the SWI retain their oxidized sediment coatings. Polychaete at upper left.
MBDS D	2 C	9/14/2004	1:12:07 PM	297	2	13.5	14.59	>4	1.00	>4	>4 - 1	252.78	17.32	17.14	17.59	0.46	Bio	55.79	3.82	0.00	-	N	252.78	> 17.32	> 17.14	> 17.59	No	0.80	pseudofeces	4.00	10.80	14.99	12.90	Stage I on III	11	DM>P. DM is gray to dark gray silt/clay with minor amount of cohesive light blue-gray clay. Thin band of reduced sediment (0.8 cm thick) at SWI that is being reworked into oxidized layer by bioturbation. Numerous subsurface feeding voids in lower center portion of the frame, many with some oxidized sediment. Abundant fecal material at SWI and deep RPD under the reduced sediment. Similar to Reps A and B.
MBDS D	3 A	9/14/2004	2:08:53 PM	298	2	13.5	14.59	>4	1.00	>4	>4 - 1	245.09	16.79	16.57	17.22	0.66	Bio	51.92	3.56	0.00	-	N	245.09	> 16.79	> 16.57	> 17.22	No	-		4.00	9.03	14.45	11.74	Stage I on III	10	DM>P. DM is light to dark gray silt/clay with large clast of cohesive, light blue-gray clay at right subsurface. Deep RPD with numerous small organic particles (terrestrial plant). Acive voids in lower right (with oxidized sediment), lower center (with oxidized burrow trace), mid center and far left. Large polychaete in upper right and diagonal burrow trace in upper center. A few small Stage I tubes at right SWI and abundant fecal pellets at SWI.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	3 B	9/14/2004	2:09:58 PM	297	2	13.5	14.59	>4	1.00	>4	>4 - 1	234.15	16.04	15.77	16.25	0.49	Bio	56.74	3.89	1.00	R	N	234.15	> 16.04	> 15.77	> 16.25	No	-		1.00	12.37	12.68	12.52	Stage I on III	11	DM>P. DM is light to dark gray silt/clay with small amounts of light blue-gray clay near bottom of frame. Clay mudclasts at SWI artifactual. Small void in lower right. Large polychaete in lower left, and a few smaller polychaetes of different species in upper sediment column. Two prominent oxidized burrows in upper left-center. Several Stage I mud tubes at SWI.
MBDS D	3 C	9/14/2004	2:11:08 PM	296	2	13.5	14.59	>4	1.00	>4	>4 - 1	236.16	16.18	14.97	16.65	1.68	Bio	53.59	3.67	0.00	-	N	236.16	> 16.18	> 14.97	> 16.65	No	-		4.00	6.45	13.02	9.74	Stage I on III	10	DM>P. DM is light to dark gray silt/clay with small amounts of light blue-gray clay. Prominent large void in left center of sediment column and voids contain some oxidized sediment. Large biogenic depression at left SWI and secondary colonization - numerous Stage I tubes - surrounding depression. Large polychaetes in upper center and upper right. Faint layering of DM which is becoming obscured with bioturbation. Similar to rep B.
MBDS D	4 A	9/14/2004	12:56:51 PM	298	2	13.5	14.59	>4	1.00	>4	>4 - 1	243.33	16.67	16.19	17.59	1.40	Bio	70.13	4.81	0.00	-	N	243.33	> 16.67	> 16.19	> 17.59	No	0.30	pseudofeces	1.00	9.20	10.05	9.63	Stage I on III	11	DM>P. DM is faintly layered dark gray silt/clay with a few minor streaks of blue-gray clay. Reduced sediment-filled void at left. Thin band of reduced sediment with diffusional RPD at SWI (0.3 - 1.6 cm thick) that appears to be recent deposition. Organic fragments (terrestrial) in upper sediment column. Nice fecal mound with string of pellets leading to surface at far left - and this mound is above void. Similar to D1 and D2.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	4 B	9/14/2004	12:58:08 PM	296	2	13.5	14.59	>4	1.00	>4	>4 - 1	237.24	16.26	15.54	16.85	1.31	Bio	53.32	3.65	0.00	-	N	237.24	> 16.26	> 15.54	> 16.85	No	0.20	pseudofeces	3.00	4.97	11.51	8.24	Stage I on III	10	DM > P. DM is faintly layered dark gray silt/clay with a few minor streaks of blue-gray clay and a clot of the clay in center of sediment column. Thin band of reduced sediment with diffusional RPD at SWI (0.2 - 1.2 cm thick) that appears to be recent deposition. Organic fragments (terrestrial) in upper sediment column. Sediment filled voids in center of frame with distinct sand filled relict void at bottom of frame. Numerous mud tubes at SWI and the mud tubes have oxidized coatings. Deep relict RPD under recent layer of reduced sediment. Similar to Rep A.
MBDS D	4 C	9/14/2004	12:59:37 PM	297	2	13.5	14.59	>4	1.00	>4	>4 - 1	223.52	15.32	14.88	15.62	0.74	Bio	55.73	3.82	0.00	-	N	223.52	> 15.32	> 14.88	> 15.62	No	-		0.00	-	-	-	Stage I on III	11	DM > P. DM is layered gray to dark gray silt/clay. Burrows in center of sediment column. Discontinuous thin band of reduced sediment at SWI presumably from subsurface conveyor belt feeders. Numerous shallow burrows and several polychaetes in the upper sediment column. Abundant mud tubes at SWI . Deep RPD under reduced sediment layer at SWI. Similar to Reps A and B.
MBDS D	5 A	9/14/2004	3:14:07 PM	295	2	13.5	14.59	>4	1.00	>4	>4 - 1	153.15	10.49	10.34	10.65	0.31	Bio	44.11	3.02	0.00	-	N	153.15	> 10.49	> 10.34	> 10.65	No	-		3.00	5.57	9.45	7.51	Stage I on III	10	DM > P. DM is light to medium gray silt/clay over jumbled mass of cohesive, light-hued, blue gray clay. Fain evidence of surficial reduced layer that has been reworked into the sediment column. Sediment-filled - some oxidized -void complex in center of frame running to lower left corner. Two types of tubes present at the SWI and two types of polychaetes smeared in upper sediment column. Abundant fecal matter at SWI. Different from previous stations.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	5 B	9/14/2004	3:15:43 PM	289	2	13.5	14.59	>4	1.00	>4	>4 - 1	209.30	14.34	14.14	14.74	0.60	Bio	46.62	3.19	0.00	-	N	209.30	> 14.34	> 14.14	> 14.74	No	-		4.00	5.37	12.54	8.95	Stage I on III	10	DM>P. Layered gray to dark gray silt and cohesive, light-hued, blue-gray clay. Layer of reduced sediment at SWI that is being incorporated into the RPD and is no longer measurable as a distinct layer. Large, active void complex running from left edge to bottom right. Terrestrial organic detritus in upper sediment column. Two large polychaetes at lower left, under void and a few small polychaetes smeared in upper sediment column. Several tubes at SWI and abundant fecal material at SWI. Similar to Rep A with more penetration.
MBDS D	5 C	9/14/2004	3:16:27 PM	294	2	13.5	14.59	>4	1.00	>4	>4 - 1	214.36	14.69	14.42	15.08	0.66	Bio	64.05	4.39	0.00	-	N	214.36	> 14.69	> 14.42	> 15.08	No	-		3.00	6.57	14.34	10.46	Stage I on III	11	DM>P. Layered gray and dark gray silt/clay with isolated 1-2 cm clasts of cohesive blue-gray clay. Thin band of reduced sediment at the SWI that is being incorporated into the upper sediment column and no longer measurable as a discrete layer and is incorporated into the RPD measurement. Void complex at mid0left and void complex with oxidized burrow and sediment in center. Two types of tubes at SWI and three polychaetes of differing species in upper sediment column. Generally similar to Reps A and B, but does not have distinct layer of cohesive clay in the subsurface.
MBDS D	6 A	9/14/2004	1:02:13 PM	300	2	13.5	14.59	>4	1.00	>4	>4 - 1	224.96	15.41	14.68	16.34	1.66	Bio	61.37	4.21	0.00	-	N	224.96	> 15.41	> 14.68	> 16.34	No	0.70	pseudofeces	3.00	6.60	11.45	9.03	Stage I on III	11	DM>P. DM is layered gray to dark gray silt/clay and cohesive, light-hued, blue-gray clay. The cohesive clay is present both admixed in a subsurface band along with a 2-3 clast of intact clay. Thin, discrete band of reduced sediment at SWI, 0.7 to 3.3 cm thick, that is most likely subsurface biogenically processed mud with a diffusional RPD that is being thickened by infaunal activity. Thick active RPD under this layer. Active feeding voids in left center. Several small stage I tubes at SWI. Four polychaetes in upper sediment column. Terrestrial organic fragments in RPD.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	6 B	9/14/2004	1:03:52 PM	301	2	13.5	14.59	>4	1.00	>4	>4 - 1	164.55	11.28	10.60	11.77	1.17	Bio	53.78	3.69	0.00	-	N	164.55	> 11.28	> 10.60	> 11.77	No	9.40	Recent DM	3.00	6.23	8.17	7.20	Stage I on III	10	DM > P. DM is medium to dark gray silt/clay with band of light-hued , cohesive, blue-gray clay 9.4 cm below the SWI. Band of reduced sediment 0.1 to 1.2 cm thick at SWI right above subsurface voids support the possibility of biogenic exhumation rather than deposition. Three voids in middle of sediment column. Left and right voids are large and active. The reduced sediment at the SWI is thickest above the two largest voids. Two polychaetes at left. Similar to Rep A.
MBDS D	6 C	9/14/2004	1:04:42 PM	296	2	13.5	14.59	>4	1.00	>4	>4 - 1	238.47	16.34	15.97	16.59	0.63	Bio	64.52	4.42	0.00	-	N	238.47	> 16.34	> 15.97	> 16.59	No	1 - 1.2	pseudofeces	1.00	5.80	6.00	5.90	Stage I on III	11	DM > P. DM is medium to dark gray silt/clay with band of light-hued , cohesive, blue-gray clay 12.3 cm below the SWI. Band of reduced sediment 1 to 1.2 cm thick at SWI. This reduced band has diffusional RPD. Small void in upper left and large, elongate oxidized burrow at right. A few small polychaetes in upper sediment column. Tubes projecting upward through reduced band and tubes are oxidized. While it appears to be recent deposition, given limited spatial extent & thickness it is most likely subsurface reduced muds as a result of biogenic transport. Scattered terrestrial organic matter in upper sediment column. Similar to Reps A and B.
MBDS D	7 A	9/14/2004	2:00:43 PM	291	2	13.5	14.59	>4	1.00	>4	>4 - 1	158.71	10.88	10.22	11.48	1.26	Bio	49.92	3.42	0.00	-	N	158.71	> 10.88	> 10.22	> 11.48	No	0.30	pseudofeces	2.00	6.97	10.74	8.85	Stage I on III	10	DM > P. Layered, gray to dark gray silt/clay. Thin band of reduced sediment 0.3 to 1.1 cm thick which has a dominantly diffusional RPD. Active void in lower left center and numerous oxidized Stage I tubes at SWI. Reduced layer at SWI not continuous and lends support for subsurface conveyor belt transport. Several large polychaetes in upper sediment column and terrestrial organic fragments in upper sediment column.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	7 B	9/14/2004	2:02:11 PM	294	2	13.5	14.59	>4	1.00	>4	>4 - 1	212.93	14.59	14.02	15.08	1.06	Bio	62.21	4.26	0.00	-	N	212.93	> 14.59	> 14.02	> 15.08	No	-		1.00	8.25	8.97	8.61	Stage I on III	11	DM > P. Layer gray to dark silt/clay with layering becoming obscured by bioturbation. Active void at left and patch of reduced sediment at SWI above void - likely from biogenic exhumation. Two deep oxidized burrows and polychaetes, one in lower right center and one at right. Numerous tubes at SWI and in background with at least three tube types present. Abundant terrestrial organic fragments in upper sediment column. Similar to Rep A but without the continuous reduced band of sediment at the SWI.
MBDS D	7 C	9/14/2004	2:03:06 PM	296	2	13.5	14.59	>4	1.00	>4	>4 - 1	218.95	15.00	14.68	15.22	0.54	Bio	55.64	3.81	0.00	-	N	218.95	> 15.00	> 14.68	> 15.22	No	-		1.00	13.62	13.79	13.71	Stage I on III	11	DM > P. Layered gray to dark gray silt/clay with banding on 2-3 cm scale. Thin band of reduced sediment at SWI from biogenic activity. Small void in lower left and Three large polychaetes in upper left. A few oxidized Stage I tubes at SWI and abundant fecal pellets at SWI. Similar to Rep A with the band of reduced sediment at the SWI continuous across the frame.
MBDS D	8 B	9/14/2004	2:24:00 PM	297	2	13.5	14.59	>4	2.00	>4	>4 - 2	169.12	11.59	11.20	12.37	1.17	Bio	62.30	4.27	0.00	-	N	169.12	> 11.59	> 11.20	> 12.37	No	-		2.00	3.63	7.63	5.63	Stage I on III	11	DM > P. Gray to dark gray faintly layered silt/clay with large clast of cohesive, light-hued, blue-gray clay at left. Two void/burrows in center-right, each containing oxidized sediment. Polychaete above clay clast at left. Abundant Stage I tubes at SWI. Deep RPD.
MBDS D	8 C	9/14/2004	2:25:05 PM	302	2	13.5	14.59	>4	1.00	>4	>4 - 1	179.07	12.27	10.85	12.97	2.11	Bio	60.21	4.13	0.00	-	N	179.07	> 12.27	> 10.85	> 12.97	No	-		0.00	-	-	-	Stage I on III	11	DM > P. Gray to dark gray, layered (1-2 cm) silt/clay with a few streaks of cohesive, light-hued, blue-gray clay at left. Abundant terrestrial organic fragments in the upper sediment column. Two deep oxidized burrows and center-left and left. A few thin red polychaetes at upper right. Deep RPD and abundant infaunal fecal pellets at SWI. Several small Stage I tubes at SWI and biogenic depression at far right. Similar to Rep A.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	8 D	9/14/2004	2:27:00 PM	300	2	13.5	14.59	>4	2.00	>4	>4 - 2	198.75	13.62	12.88	14.25	1.37	Bio	51.75	3.55	0.00	-	N	198.75	> 13.62	> 12.88	> 14.25	No	-		0.00	-	-	-	Stage I on III	10	DM>P. Gray to dark gray, faintly layered, water-rich, silt/clay. Abundant terrestrial organic fragments in upper sediment column. Oxidized burrow at bottom of frame. Stage I and Stage III tubes at SWI along with abundant infaunal fecal pellets. Two small polychaetes just below RPD in center and upper right.
MBDS D	9 A	9/14/2004	2:15:50 PM	302	2	13.5	14.59	>4	1.00	>4	>4 - 1	226.15	15.50	15.14	15.99	0.86	Bio	51.09	3.50	0.00	-	N	226.15	> 15.50	> 15.14	> 15.99	No	-		3.00	8.57	14.88	11.72	Stage I on III	10	DM>P. Gray to dark gray silt/clay with minor amounts of light-hued, cohesive, blue-gray clast at bottom right of frame. Oxidized sediment filled void in center, reduced void lower left, and sand lag-filled void in lower right. A few Stage I tubes at SWI, abundant infaunal fecal pellets at SWI and two oxidized burrows in upper left. Terrestrial organic fragments in upper sediment column.
MBDS D	9 B	9/14/2004	2:17:07 PM	296	2	13.5	14.59	>4	1.00	>4	>4 - 1	254.17	17.42	16.45	18.22	1.77	Bio	52.00	3.56	0.00	-	N	254.17	> 17.42	> 16.45	> 18.22	No	-		3.00	4.97	8.85	6.91	Stage I on III	10	DM>P. Layered gray to dark gray silt/clay with band of light-hued blue-gray clay at 7.7 and 16.5 cm below SWI. Thin bands of clay are <1 cm thick. Active void/burrow in upper right and sediment filled voids at first clay horizon. Several Small Stage I tubes at left and larger, presumably Stage III tubes at right. Three thin red polychaetes in upper left and center.
MBDS D	9 C	9/14/2004	2:17:56 PM	300	2	13.5	14.59	>4	2.00	>4	>4 - 2	239.18	16.39	15.82	16.65	0.83	Bio	53.51	3.67	0.00	-	N	239.18	> 16.39	> 15.82	> 16.65	No	-		1.00	7.00	7.57	7.28	Stage I on III	10	DM>P. Gray to dark gray, layered silt/clay. Thin band of sand 11.3 cm below SWI. Small oxidized sediment-filled void in upper right below biogenic depression at right SWI. Numerous small Stage I tubes at SWI along with abundant infaunal fecal matter. Terrestrial organic fragments in upper sediment column. Similar to other two reps but without blue-gray clay.

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	10 A	9/14/2004	12:49:51 PM	301	2	13.5	14.59	>4	1.00	>4	>4 - 1	220.40	15.10	14.25	15.62	1.37	Bio	68.44	4.69	0.00	-	N	220.40	> 15.10	> 14.25	> 15.62	No	-		2.00	5.20	8.71	6.95	Stage I on III	11	DM>P. Gray to dark silt/clay with layering. Band of light-hues, partial mixed, blue-gray cohesive clay 9.1 cm below the SWI. Active void complex from upper left to center of frame with oxidized sediment in both chambers. Large polychaete above void. Thin band (0.7-1.2 cm thick) of reduced sediment at the SWI and this layer is continuous across the frame. Diffusional RPD but layer is being rototilled into sediment column at left. Polychaete in lower right corner.
MBDS D	10 B	9/14/2004	12:51:23 PM	298	2	13.5	14.59	>4	1.00	>4	>4 - 1	185.93	12.74	12.40	13.34	0.94	Bio	57.69	3.95	0.00	-	N	185.93	> 12.74	> 12.40	> 13.34	No	-		4.00	4.71	10.77	7.74	Stage I on III	11	DM>P. Dark gray silt/clay with scattered terrestrial organic fragments in sediment column. Thin band (0.7 to 1.9 cm) of reduced sediment with a diffusional RPD that is continuous across the width of the frame. Layer is being admixed into sediment column at center-right. Deeper active RPD under this band. Large void complex in mid-sediment column with oxidized sediment-filled voids in upper left and upper center and reduced voids in lower left-center and lower right. Burrow in upper right and a few small polychaetes in upper sediment column Oxidized tubes at SWI. Similar to Rep A without clay.
MBDS D	10 C	9/14/2004	12:53:48 PM	299	2	13.5	14.59	>4	1.00	>4	>4 - 1	243.05	16.65	16.25	16.79	0.54	Bio	52.47	3.60	0.00	-	N	243.05	> 16.65	> 16.25	> 16.79	No	-		1.00	8.23	8.54	8.38	Stage I on III	10	DM>P. Light to dark gray silt/clay with band of light-hued, cohesive, blue-gray clay 9.1 cm below the SWI. Thin band of reduced sediment at SWI with a diffusional RPD. Similar to Reps A and B. Small void burrow with oxidized trace and halo in mid-left. Infaunal fecal pellets at SWI. Thin band of reduced sediment is in the process of being incorporated into the sediment column via bioturbation.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	11 A	9/14/2004	2:32:16 PM	298	2	13.5	14.59	>4	2.00	>4	>4 - 2	225.48	15.45	15.08	15.77	0.69	Bio	69.82	4.78	1.00	R	N	225.48	> 15.45	> 15.08	> 15.77	No	-		2.00	6.83	7.43	7.13	Stage I on III	11	DM>P. Faintly layered, mottled, light to dark gray silt/clay, with very minor scattered smears of cohesive clay in lower sediment column. Small, oxidized sediment-filled void in center. Elongate oxidized burrow at right and two burrows/organisms in lower left. Polychaete in upper right and biogenic depression at right SWI. A few Stage I tubes at SWI and several shallow burrows in RPD.
MBDS D	11 B	9/14/2004	2:33:34 PM	296	2	13.5	14.59	>4	2.00	>4	>4 - 2	125.34	8.59	7.80	9.51	1.71	Bio	33.33	2.28	0.00	-	N	125.34	> 8.59	> 7.80	> 9.51	No	-		5.00	3.60	6.74	5.17	Stage I on III	9	DM>P. Faintly layered, mottled, light to dark gray silt/clay. Band of cohesive gray-blue clay near bottom of frame. Stiff sediment and little penetration. Large void complex at left and active void at right. Numerous well-formed oxidized Stage I tubes at SWI. Polychaete in center (large) and several small thin, red polychaetes in upper right. Appears to much more cohesive and firm than Rep A.
MBDS D	11 C	9/14/2004	2:35:07 PM	296	2	13.5	14.59	>4	2.00	>4	>4 - 2	222.73	15.26	13.85	15.71	1.86	Bio	48.04	3.29	0.00	-	N	222.73	> 15.26	> 13.85	> 15.71	No	-		3.00	5.97	13.68	9.82	Stage I on III	10	DM>P. Layered gray to dark gray silt/clay with large clot of cohesive, light-hued, blue-gray clay in lower right corner. Layering is on the 1-2 cm scale in lower sediment column and layering in the upper 7 cm of the sediment column has been obscured by bioturbation. Three active, oxidized voids: two in center of frame and one in lower right corner, within the clay clot. Biogenic depression at right SWI. Large polychaete in upper center and several small, thin polychaetes in or just below RPD. Several Stage I tubes at SWI. Nice pic.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	12 A	9/14/2004	3:18:59 PM	292	2	13.5	14.59	>4	2.00	>4	>4 - 2	210.44	14.42	13.91	15.02	1.11	Bio	63.14	4.33	0.00	-	N	210.44	> 14.42	> 13.91	> 15.02	No	-		2.00	4.34	10.54	7.44	Stage I on III	11	DM>P. Partially layered light to dark gray silt/clay with large clasts of light-hued, cohesive blue-gray clay, randomly (chaotically) distributed in the sediment column. Active, oxidized void in upper left and larger void complex at right which is adjacent to large clay clast. A few Stage I tubes at SWI and small patch of reduced sediment at right SWI, above large void complex, which appears to be due to biogenic exhumation.
MBDS D	12 B	9/14/2004	3:19:54 PM	291	2	13.5	14.59	>4	2.00	>4	>4 - 2	226.66	15.53	14.85	15.85	1.00	Bio	53.66	3.68	0.00	-	N	226.66	> 15.53	> 14.85	> 15.85	No	-		3.00	6.20	10.94	8.57	Stage I on III	10	DM>P. Layered, light gray to black silt/clay with a several cohesive, blue gray clay colts distributed in a linear band immediately above layer of black, reduced sediment. Layer of black, reduced sediment 8.2 cm below the SWI and 2.4 cm thick. Small voids in upper right (oxidized sediment-filled), center (reduced, but with some oxidized particles) and lower left (minor oxidized particles). Appears that a reduced sediment layer at SWI has been nearly obscured by bioturbation. Nice pic.
MBDS D	12 C	9/14/2004	3:21:02 PM	291	2	13.5	14.59	>4	2.00	>4	>4 - 2	233.22	15.98	15.59	16.94	1.34	Bio	51.95	3.56	1.00	O	N	233.22	> 15.98	> 15.59	> 16.94	No	-		3.00	3.06	8.74	5.90	Stage I on III	10	DM>P. Layered, light gray to black silt/clay with band of black sediment 3.2 cm thick that is 8.7 cm below the SWI. Small, sediment filled voids/burrows in upper right, center and mid-left. Patch of oxidized sediment at depth at far right and it appears to be the sidewall of a void. Oxidized mudclast in water column. Abundant fecal matter at SWI. Similar to Rep B.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	13 A	9/14/2004	3:09:13 PM	294	2	13.5	14.59	>4	2.00	>4	>4 - 2	230.44	15.79	15.65	16.11	0.46	Bio	54.78	3.75	0.00	-	N	230.44	> 15.79	> 15.65	> 16.11	No	-		0.00	-	-	-	Stage I on III	10	DM>P. Layered light gray to dark gray/black silt clay. Relict RPD at bottom of frame. Layering well-preserved at depth. Two polychaetes at upper right, and extending 6 cm into sediment column. A few Stage I tubes at SWI and abundant fecal matter and edge of worm burrow transected with animal at bottom of frame. Oxidized burrows at the bottom of the RPD along with polychaetes suggest moving also support evidence of a Stage III community.
MBDS D	13 B	9/14/2004	3:10:01 PM	297	2	13.5	14.59	>4	1.00	>4	>4 - 1	235.53	16.14	15.57	16.45	0.89	Bio	48.84	3.35	0.00	-	N	235.53	> 16.14	> 15.57	> 16.45	No	-		1.00	7.97	9.91	8.94	Stage I on III	10	DM>P. Layered light gray to dark gray/black silt clay. Layering well-preserved at depth. Distinct layer of reduced dark to black sediment 9.5 cm below the SWI and 2.4 cm thick. Sand lag from infaunal feeding in center of frame and polychaete to right of the lag. Long, thin red polychaete in upper center. A few stage I tubes at SWI and a dense accumulation of fecal pellets at SWI. Similar to Rep A and Station 12.
MBDS D	13 C	9/14/2004	3:10:55 PM	291	2	13.5	14.59	>4	2.00	>4	>4 - 2	231.93	15.89	15.54	16.08	0.54	Bio	47.07	3.23	0.00	-	N	231.93	> 15.89	> 15.54	> 16.08	No	-		1.00	4.88	5.00	4.94	Stage I on III	10	DM>P. Layered light to dark gray/black silt/clay. Distinct band of dark gray/black sediment 7.6 cm below the SWI and is 3.1 cm thick. Several clast of cohesive, light hued, blue-gray clays in the subsurface sediment. Small void in upper right and oxidized burrow - possibly a cerianthid - at left. Two polychaetes with oxidized burrow traces at right. Several Stage I tubes at SWI. Similar to Reps A and B along with Station 12.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	14 A	9/14/2004	12:42:39 PM	298	2	13.5	14.59	>4	2.00	>4	>4 - 2	248.59	17.03	16.59	17.31	0.71	Bio	59.94	4.11	0.00	-	N	248.59	> 17.03	> 16.59	> 17.31	No	-		1.00	6.45	9.85	8.15	Stage I on III	11	DM > P. Layered light gray to dark gray silt clay with distinct band of reduced sediment 3.2 cm thick that is 9.7 cm below the SWI. Thin band of reduced sediment at SWI that is not continuous across the frame. Sand lag from infaunal feeding in center and large polychaete left of sand lag. Reduced layer at SWI included in RPD measure as it is discontinuous. The reduced sediment at SWI thickest above areas of infaunal activity. Oxidized tubes at SWI. Similar to Stations 12 and 13 in terms of strata.
MBDS D	14 B	9/14/2004	12:44:15 PM	296	2	13.5	14.59	>4	2.00	>4	>4 - 2	238.32	16.33	15.85	16.68	0.83	Bio	54.97	3.77	0.00	-	N	238.32	> 16.33	> 15.85	> 16.68	No	-		3.00	5.51	10.88	8.20	Stage I on III	11	DM > P. Layered light to dark gray/black silt/clay. Thin layer of reduced sediment 0.3 to 1.3 cm thick at SWI from bioturbation. Layer will be incorporated into RPD with time. Subsurface sediment retains distinct layering. Oxidized sediment filled voids in upper left and upper right with two active voids and long, large polychaete in lower mid-left. At least four species of large polychaetes present in the sediment column. Oxidized burrow at right. Nice pic.
MBDS D	14 C	9/14/2004	12:45:56 PM	295	2	13.5	14.59	>4	2.00	>4	>4 - 2	226.97	15.55	14.77	16.48	1.71	Phys	54.46	3.73	4.00	O&R	N	226.97	> 15.55	> 14.77	> 16.48	No	-		1.00	8.40	8.94	8.67	Stage I on III	10	DM > P. Light to dark gray/black silt/clay. Subsurface sediment is dominantly thick (> 6 cm) band of dark gray to black silt/clay that is homogeneous. Small void in upper left. SWI shows evidence of a thin band of reduced sediment that has been admixed into the upper sediment column by both biological and physical processes. Similar to Reps A and B, but the layer is much less distinct. Abundant mudclasts at SWI and are being incorporated into the sediment column.
MBDS D	15 A	9/14/2004	3:01:23 PM	293	2	13.5	14.59	>4	2.00	>4	>4 - 2	185.07	12.68	12.11	13.11	1.00	Bio	57.02	3.91	0.00	-	N	185.07	> 12.68	> 12.11	> 13.11	No	-		1.00	5.91	12.51	9.21	Stage I on III	11	DM > P. Mottled light to dark gray silt/clay with some streaks of cohesive, blue-gray clay and clot of clay in lower left. Large active void complex in center of frame. Large polychaete lower left. Several small polychaetes in RPD. Stage I tubes at SWI background.

Table B-4
Sediment-Profile Image Results for MBDS D Stations at MBDS

Station	Replicate	Date	Time	Depth (ft)	No. of Weights	Stop Collar settings (in.)	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Average Penetration (cm)	Minimum Penetration (cm)	Maximum Penetration (cm)	Boundary Roughness (cm)	Boundary Roughness Process (Bio/Phys)	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State: Oxidized(O), Reduced (R)	Methane (Y/N)	TOTAL DM AREA	TOTAL DM MEAN	TOTAL DM MIN	TOTAL DM MAX	Anoxia	Depth of Top Layer	Top Layer Process	No. Feeding Voids	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Successional Stage	OSI	COMMENT
MBDS D	15 B	9/14/2004	3:02:22 PM	296	2	13.5	14.59	>4	2.00	>4	>4 - 2	210.00	14.39	13.94	14.57	0.63	Bio	36.64	2.51	0.00	-	N	210.00	> 14.39	> 13.94	> 14.57	No	-		2.00	13.62	14.31	13.97	Stage I on III	9	DM > P. Mottled gray to black silt/clay with cohesive, blue-gray clay clast at bottom left. Two voids with suspended sediment to right of clay clast and burrow/bioturbation traces in center and upper right. Polychaete at left and several small, thin polychaetes in upper sediment column at RPD reduced sediment boundary. Stage I tubes at SWI. Oxidized burrows at left.
MBDS D	15 C	9/14/2004	3:03:21 PM	294	2	13.5	14.59	>4	2.00	>4	>4 - 2	155.99	10.69	9.85	11.17	1.31	Bio	58.23	3.99	0.00	-	N	155.99	> 10.69	> 9.85	> 11.17	No	-		0.00	-	-	-	Stage I on III	11	DM > P. Mottled light to dark gray silt/clay with abundant terrestrial organic fragments interspersed throughout sediment column. Patch of oxidized sediment at depth in center and large polychaete-elongate - at left. Numerous shallow, oxidized burrow traces extending from RPD into subsurface reduced sediment. Very unusual texture and is attributable to the organic fragments. Different from Reps A and B. Biogenic depression and flanking mound at right. Stage I tubes at SWI.