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September 2003

Disposal Area Monitoring System DAMOS

D A M O S

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13. ABSTRACT

The Central Long Island Sound Disposal Site (CLDS) was monitored as part of the US Army Corps of Engineers New England District Disposal Area Monitoring System (DAMOS) on 8-10, 16-17, and 22 September 2003. The 2003 field effort included bathymetric and sediment-profile imaging (SPI) surveys designed to document changes in seafloor topography, evaluate the physical distribution of dredged material and assess the benthic recolonization status associated with recent dredged material disposal activity. Disposal site data were compared with nearby reference area data and historical data from several previous CLDS surveys.

The bathymetric survey indicated that two new mounds had formed at CLDS since the previous survey in June 2001; CLIS 01 was formed by the placement of 53,000 m^3 of dredged material approximately 100 m west of CLIS 00, and CLIS 02 was formed by the placement of 312,000 m^3 of dredged material 250 m northeast of CLIS 99. The SPI survey, performed at CLIS 95/96, NHAV93, MQR, CLIS 99, and CLIS 00, indicated that benthic recovery had proceeded at least as well as expected. Stage III assemblages were present in nearly every image and the RPD depth was generally greater than 2 cm. A unique result of the 2003 SPI survey was the ubiquitous presence of a thin, rust-colored surface layer on sediments at all locations (mounds and reference areas). The color of the material suggested the presence of degrading phytoplankton, which could have resulted from a Sound-wide chlorophyll bloom that occurred in Long Island Sound 18 to 20 days prior to the September 2003 survey. Although Stage III infauna appeared unaffected by the pigmented layer, many broken and recumbent Stage I tubes were observed at the sediment surface. A SPI survey following the 2003/2004 disposal season was recommended to monitor the fate of this rust-colored layer.

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EXECUTIVE SUMMARY

A monitoring survey was conducted in September 2003 at the Central Long Island Disposal Site (CLDS) as part of the Disposal Area Monitoring System (DAMOS). The 2003 field effort consisted of bathymetric and sediment-profile imaging surveys designed to document changes in seafloor topography, evaluate the physical distribution of dredged material, and assess the recovery of the benthic community relative to ambient sediment conditions and previous monitoring surveys.

The September 2003 bathymetric survey was performed over a 1.3 km^2 area in the northeast portion of CLDS. The survey encompassed two older disposal mounds, CLIS 99 and CLIS 00, and two new mounds, CLIS 01 and CLIS 02. CLIS 99 was formed by the placement of 86,000 m^3 of dredged material during the 1999-2000 disposal season. CLIS 00 was formed by the placement of 71,000 m^3 of dredged material during the 2000-2001 disposal season. Both mounds were surveyed during the June 2001 monitoring survey. During the 2001-2002 disposal season, CLIS 01 was formed by the placement of 53,000 m^3 of dredged material on the seafloor approximately 100 m west of CLIS 00. During the 2002-2003 disposal season, CLIS 02 was formed 250 m northeast of CLIS 99 by the placement of 312,000 m^3 of dredged material. The location of these mounds was selected to further the ongoing development of confined aquatic disposal (CAD) cells within CLDS.

The results of the bathymetric survey confirmed the formation of the two new mounds, CLIS 01 and CLIS 02. The CLIS 01 Mound was generally conical in shape, with a base diameter of approximately 90 m and an apex that rose approximately 2.5 m above the surrounding seafloor. The base of the CLIS 02 Mound had an approximate diameter of 300 m and an apex that rose approximately 2 m above the surrounding seafloor. A comparison of the 2003 and the 2001 bathymetry indicated a 0.5 m decrease in the height of the CLIS 00 Mound. This scale of volume decrease is typical of the self-weight consolidation of recently disposed dredged materials in Long Island Sound (SAIC 1995).

The sediment-profile imaging (SPI) survey was performed at the two older mounds, CLIS 00 and CLIS 99, and three historic mounds, CLIS 95/96, NHAV 93 and MQR. SPI results indicated that benthic recovery of the mounds has proceeded at least as well as expected, and conditions at all mounds were indicative of a slightly disturbed or undisturbed benthic environment. Stage I surface feeders and Stage III deposit feeders were abundant, present in at least one replicate SPI image, and generally all three replicates, at every station. The RPD layer was generally deeper than 2 cm, indicative of well-oxygenated sediments and active benthic fauna.

At the CLIS 99/00 Mound Complex, the median OSI value was +8 (ranging from +6 to +10), slightly lower than the median reference OSI value of +9.5, but higher than the 2001 median of +7. The RPD ranged from 0.5 to 4 cm, with a mean of 2.2 cm. The mean RPD was somewhat shallower than both the reference (3.0 cm) and the 2001 survey results (2.7 cm), but the increased presence of Stage III assemblages resulted in higher OSI values. The advanced benthic recolonization status of the CLIS 99/00 Mound Complex observed in the September 2003 survey exceeded initial expectations for recovery.

The CLIS 95/96 Mound Complex was also was in an advanced state of recolonization, with benthic habitat conditions that were improved relative to the 2001 survey and comparable to the ambient conditions observed at the reference areas. The median OSI value was +10 (ranging from +7 to +11), slightly higher than the reference median OSI value of +9.5 (ranging from +8 to +11) and slightly improved from the 2001 median OSI value of +9 (ranging from +5 to +11). The mean RPD was 3.3 cm (ranging from 2.0 to 4.0 cm), comparable to the RPDs observed in 1999 and in the reference areas. The CLIS 95/96 Mound Complex exhibited a stable and fully recovered benthic habitat.

The NHAV 93 Mound and the MQR Mound both exhibited stable benthic conditions, with little change since the last surveys, and were comparable to ambient benthic conditions. Methane bubbles were observed at both mounds, the presence of which was likely due to the high organic content of the dredged material at depth. Despite the continued presence organic-rich surface sediments and the sub-surface production of methane at these mounds, both exhibited advanced benthic recolonization and fully recovered benthic habitat in the September 2003 survey.

A unique result from the 2003 SPI survey was the apparently ubiquitous presence of a thin, rust-colored surface layer on the sediments at all three reference areas and each of the disposal mounds. The color of this material suggested the presence of degrading phytoplankton (phaeopigments or phytodetritus). Approximately 18 to 20 days prior to the September 2003 survey, a chlorophyll bloom event in the surface waters of Long Island Sound was documented by satellite spectral imagery. It is likely that settling of phytoplankton cells following this Sound-wide, five-day event was responsible for producing the flocculant detrital layer observed in the SPI images.

In previous late summer SPI surveys, Stage I (tubiculous) polychaetes were abundant and easily recognized in the images. At all stations surveyed in 2003 evidence of Stage I activity included a highly bioturbated surface and at many stations, broken and

recumbent tubes of Stage I polychaete worms formed from the pigmented layer. It is possible that the influx of fresh organic material (phytodetritus) stimulated Stage I activity and that many of the organisms formed loose tubes of the material as it was processed. Upright tubes were also observed but did not appear to be as abundant as in some past surveys. Stage III infauna appeared to be unaffected. This may be related to the fact that the phytodetritus was confined to the sediment surface, although a few images did show the subduction of pigmented material by deposit feeders and association with active voids. It is recommended that a SPI survey be performed in 2004 to determine if this rust-colored layer continues to be subducted and/or if it remains detectable.

1.0 INTRODUCTION

A monitoring survey was conducted at the Central Long Island Sound Disposal Site in September 2003 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 ensure environmental protection of open-water disposal sites throughout the New England region. An introduction to the DAMOS Program and the Central Long Island Sound 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.

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. Thus, the data collected during DAMOS monitoring surveys serve as hypothesis tests, providing answers to strategic management questions. The results of each monitoring survey are evaluated to determine the next step in the disposal site environmental management process.

Two primary goals of DAMOS monitoring surveys have been to document the physical location of dredged material and to evaluate the environmental impact of material placed at disposal sites. Sequential bathymetric measurements are made to determine the location and buildup or consolidation of dredged material placed at disposal sites, and sediment-profile imaging (SPI) is performed after disposal to support evaluation of seafloor (benthic) habitat conditions. Each type of data collection activity is conducted periodically at disposal sites and the response of the animal-sediment system is evaluated. The conditions found after a specific set of disposal operations are compared to this long-term data set (Germano et al. 1994). DAMOS monitoring surveys may also feature additional types of data collection activities, such as side-scan sonar and sediment coring, as deemed appropriate to achieve specific survey objectives.

1.2 Introduction to the Central Long Island Sound Disposal Site

The Central Long Island Sound Disposal Site (CLDS, historically referred to as CLIS) is one of four regional dredged material disposal sites located in the waters of Long Island Sound (Figure 1-1). CLDS is situated approximately 10.4 km south of South End Point, East Haven, Connecticut. The Central Long Island Sound Disposal Site, centered at 41° 08.906' N, 72° 53.072' W (NAD 83), occupies 6.86 km^2 and is defined as a 3.70 km x 1.85 km area on the seafloor (Figure 1-2).

Initially, the management strategy at CLDS involved the controlled placement of small to moderate volumes of sediment to form individual disposal mounds. These mounds have been monitored individually to assess stability, thickness of dredged material, and benthic recolonization status relative to previous survey results and in comparison to nearby reference areas. This management strategy was later modified to promote the development of multiple rings of disposal mounds on the CLDS seafloor. The rings would be developed to form containment cells that would subsequently be used for large-scale confined aquatic disposal (CAD) operations. The containment cells aid in limiting the lateral spread of unacceptably contaminated dredged material (UDM) (Fredette, 1994). The first CAD cell developed at CLDS was the New Haven 93 (NHAV 93) Mound. Two additional containment cells are being developed for future CAD use by continuing to place annual mounds in rings (SAIC 2003).

The Central Long Island Sound Disposal Site is characterized in general by a sloping bathymetry (Figure 1-2). Water depths along the northwest edge of the study area are shallower, approximately 18 m MLLW, increasing in a southeasterly direction to approximately 22 m MLLW along the southeast boundary of the study area. The shallowest depth recorded during the multi-beam bathymetric survey in 2000 was 13.9 m, which occurred over the CLIS 97/98 Mound Complex (SAIC 2002b).

Multiple dredged material disposal mounds have been identified within CLDS (Figure 1-2). A brief description of selected mounds and their origin is provided below. The CDA disposal buoy is used to identify the current disposal location and is typically deployed for a six-month period, with initial deployment in the fall and recovery in the spring of the following year. The location of the buoy for each disposal season is driven by the effort to form a ring of disposal mounds for the development of containment cells and is therefore dependent on the amount of material disposed during the prior disposal season.

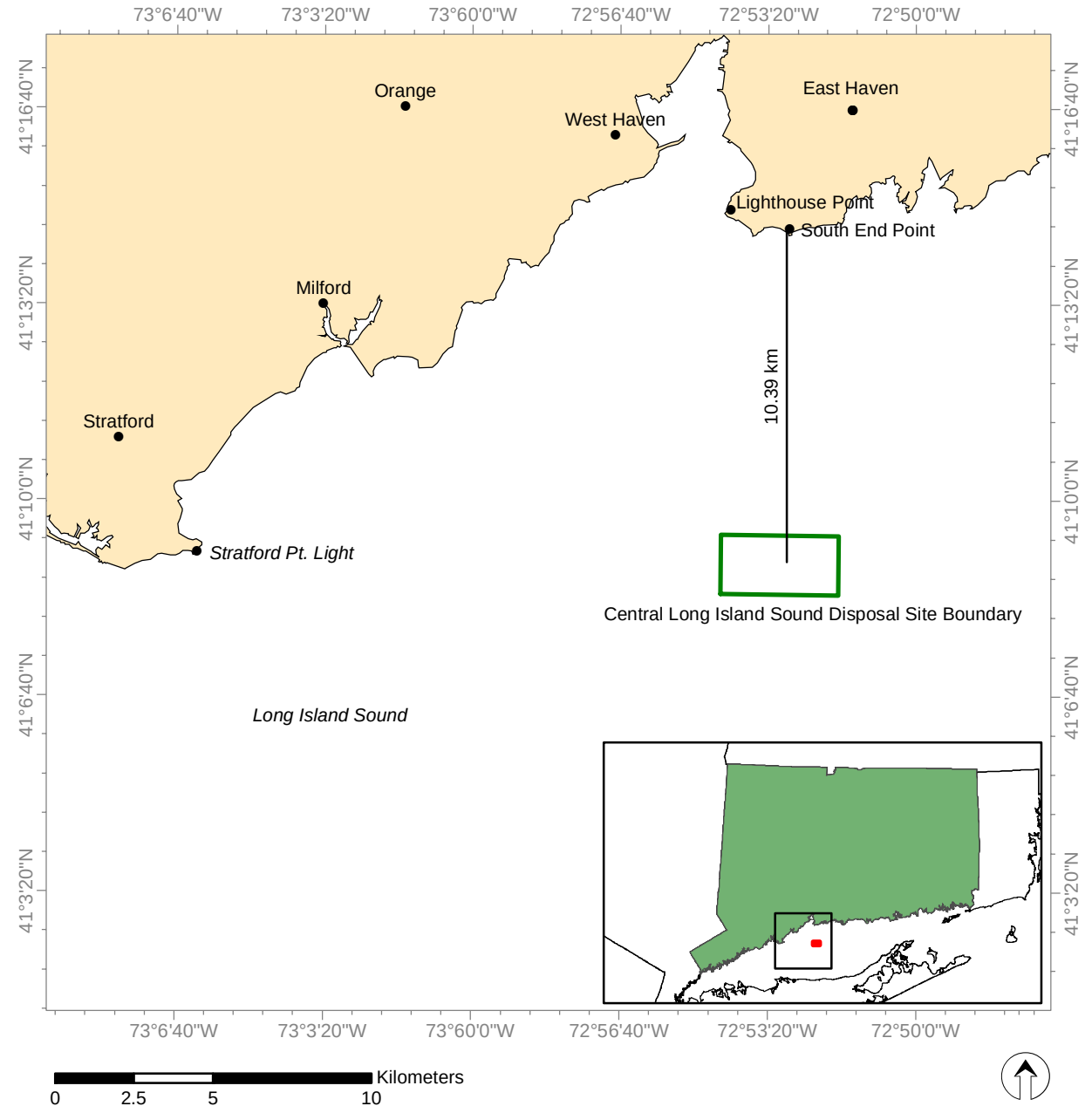

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Figure 1-1 Location of the Central Long Island Sound Disposal Site

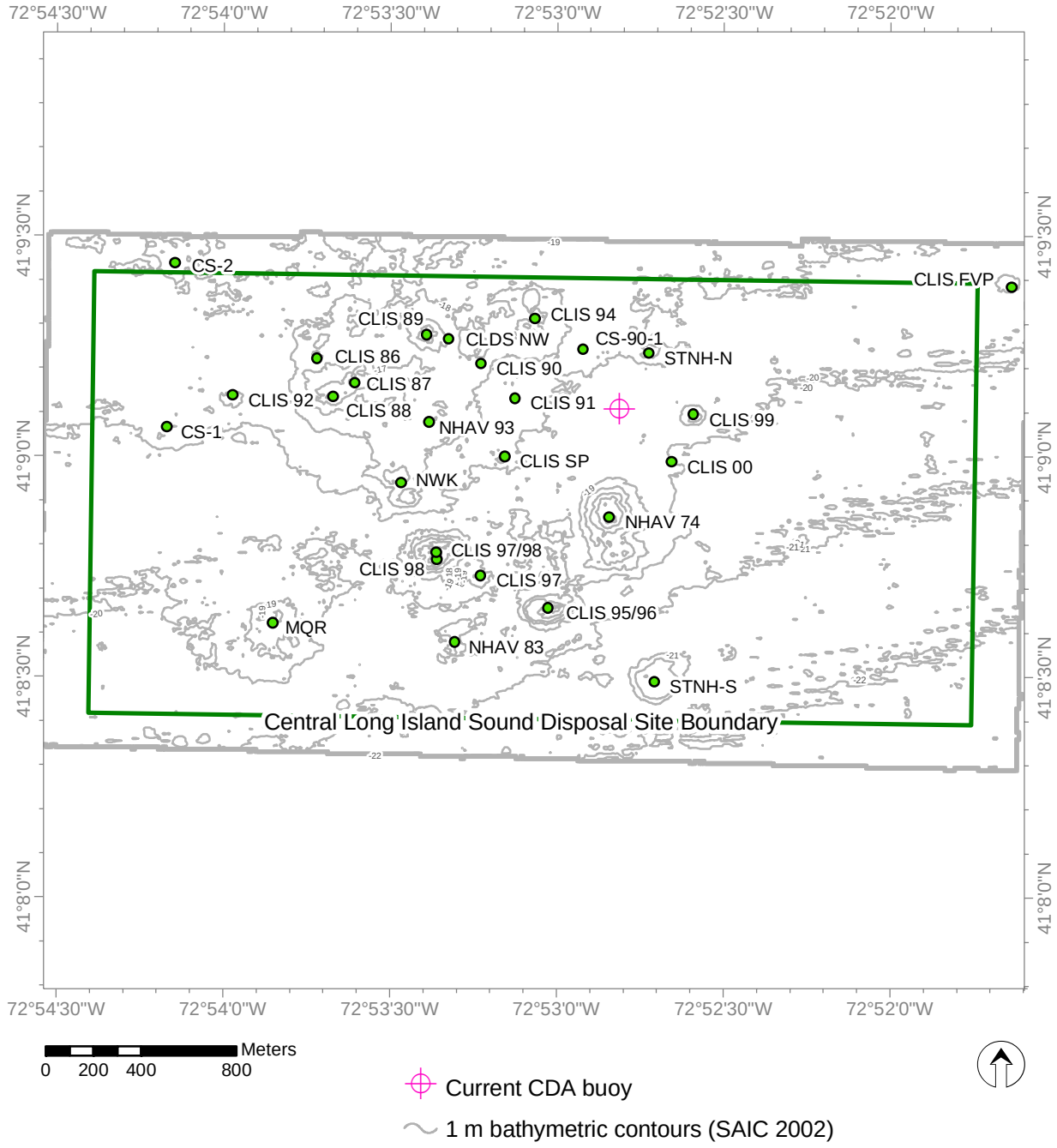

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Figure 1-2 CLDS with disposal mounds and buoy indicated

Disposal site boundaries 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 these 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 this 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 descent and placement some dredged material may extend across the boundary on the seafloor.

1.3 Historic Dredged Material Disposal Activity

Dredged material disposal has occurred at CLDS for over 60 years. CLDS has been used regularly as a regional disposal site, receiving over 4.5 million m^3 of dredged material. During the 1999–2000 disposal season, 86,000 m^3 of material from a number of small dredging projects was placed at the CDA 99 buoy, resulting in the formation of the CLIS 99 Mound, as first observed in the September 2000 multi-beam survey (SAIC 2002b). During 2000–2001, 71,000 m^3 of material was deposited at the CDA 00 buoy, approximately 175 m south of the CLIS 99 Mound, forming the CLIS 00 Mound (SAIC 2003).

Placement of dredged material from 1984 to 1993 resulted in the formation of a ring of seven disposal mounds enclosing a containment cell approximately 2.56 km^2 in area in the northwestern quadrant of CLDS. During the 1993–1994 disposal season, approximately 590,000 m^3 of unacceptably contaminated dredged material (UDM) from the inner New Haven Harbor was placed in the center of the containment cell. The UDM deposit was then covered with 569,000 m^3 of capping dredged material (CDM), forming the NHAV 93 Mound. Subsequent monitoring surveys indicated the NHAV 93 Mound to be broad, stable, and adequately capped (Morris 1997, Morris 1998a).

The CLIS 95/96 Mound Complex was developed from multiple disposal events during the 1995–1996 and 1996–1997 disposal seasons. An estimated volume of 66,400 m^3 of dredged material deposited at the CDA 95 buoy combined with the deposit of approximately 256,000 m^3 of dredged material at the nearby CDA 96 buoy resulted in the formation of a moderate-sized bottom feature on the seafloor (SAIC 2002a). Subsequent

monitoring surveys indicated that the deposit was stable and has been completely capped (Morris 1998a).

The Mill-Quinnipiac River (MQR) Mound is a historic mound formed along the southern boundary of CLDS. The mound is composed of alternating layers of UDM and CDM deposited during the 1981–1983 and 1993–1994 disposal seasons. The mound was capped with approximately 65,000 m^3 of additional CDM during the 1993–1994 disposal season in response to anomalous SPI results. Since then an improved benthic community structure has been observed.

1.4 Previous CLDS Monitoring Events

CLDS was previously surveyed in June 2001, and included a single-beam bathymetric survey and sediment-profile imaging survey (SAIC 2003). The bathymetric survey was performed over a 1 km^2 area near the center of CLDS and encompassed the CLIS 99 and CLIS 00 disposal mounds. Prior to the June 2001 survey, a multi-beam bathymetric survey was performed over the entire site in September 2000 (SAIC 2002b). The morphology of the CLIS 99 Mound was originally documented during that survey. At the time of the 2001 survey, the CLIS 00 Mound was the most recently formed disposal mound at CLDS and was originally documented in the June 2001 survey.

During the June 2001 survey, sediment-profile imaging was performed at the two most recent disposal mounds, CLIS 99 and CLIS 00, in addition to several historic mounds, NHAV 93 and CLIS 97/98 Mound Complex. The sediment-profile imaging survey indicated that the CLIS 99 and CLIS 00 Mounds were rapidly recolonized by benthic infauna, with evidence of both Stage I and Stage III species. Both historic mounds showed improved benthic habitat conditions relative to previous surveys and displayed evidence of a stable infaunal population. However, despite the improved conditions detected over the majority of NHAV 93 in June 2001, one station (200S) continued to exhibit lower than expected benthic habitat quality (SAIC 2003).

Previous surveys at CLDS were conducted in September 1997 (SAIC 2002a) and 1999 (SAIC 2002b). The 1999 survey included single-beam bathymetric and sediment-profile imaging surveys. The mounds surveyed in 1999 included the CLIS 95/96 and CLIS 97/98 Mound Complexes in addition to the NHAV 93, Field Verification Project (FVP), and Mill-Quinnipiac River (MQR) Mounds (SAIC 2002b).

The benthic conditions at the CLIS 95/96 Mound Complex in 1999 were reported to have improved relative to the 1997 survey. There were indications that the most recently placed sediments had been rapidly recolonized (SAIC 2002a). The MQR Mound

was reported to show continued improved benthic conditions since a prior survey in July 1994; however, an area of slower benthic recovery was identified in the southern area of the mound. Prior surveys of NHAV 93 Mound indicated a cyclical recovery and decline of benthic habitat conditions, roughly corresponding to the seasonal hypoxia patterns in the central Long Island Sound region. The seasonal reduction in dissolved oxygen appeared to be responsible for shallow redox potential discontinuity (RPD) depths, despite the presence of Stage III organisms, resulting in lower than expected organism-sediment (OSI) values (Morris 1997). Furthermore, the sediments comprising the surface of the NHAV 93 Mound contained high levels of organic matter, which promoted higher sediment oxygen demand (SAIC 2003).

1.5 Recent Dredged Material Disposal Activity

Since the June 2001 survey, 365,000 m^3 of dredged material has been placed in the northeast sector of CLDS (Figure 1-3, Table 1-1). During the 2001–2002 season, 53,000 m^3 of dredged material was disposed at the CDA01 buoy, located at 41° 08.868' N, 72° 52.709' W (NAD 83), approximately 80 m west of the CLIS 00 Mound, forming the CLIS 01 Mound. The dredged material deposited at CDA01 originated from a variety of marina and harbor maintenance projects. During the 2002–2003 season, 312,000 m^3 of dredged material was disposed at the CDA02 buoy, located approximately 300 m northeast of the CLIS 99 Mound at 41° 09.244' N, 72° 52.505' W (NAD 83), forming the CLIS 02 Mound. The dredged material deposited at CDA02 originated primarily from New Haven Harbor (276,000 m^3). A single disposal event indicated on Figure 1-3 appears to have occurred outside of CLDS, however it is likely that disposal coordinates were incorrectly reported, as the disposal trip narrative for this disposal event indicated disposal approximately 10 feet from the buoy. A detailed record of barge disposal activity at CLDS for the period from June 2001 to September 2003 is provided in Appendix A.

1.6 Survey Objectives

The September 2003 CLDS survey was designed to characterize potential impacts associated with recent dredged material disposal activity. Survey objectives included characterization of the seafloor topography of the area, documentation of changes in seafloor topography since the June 2001 and September 2000 surveys, and assessment of benthic recolonization status within the confines of CLDS and in comparison to the reference stations.

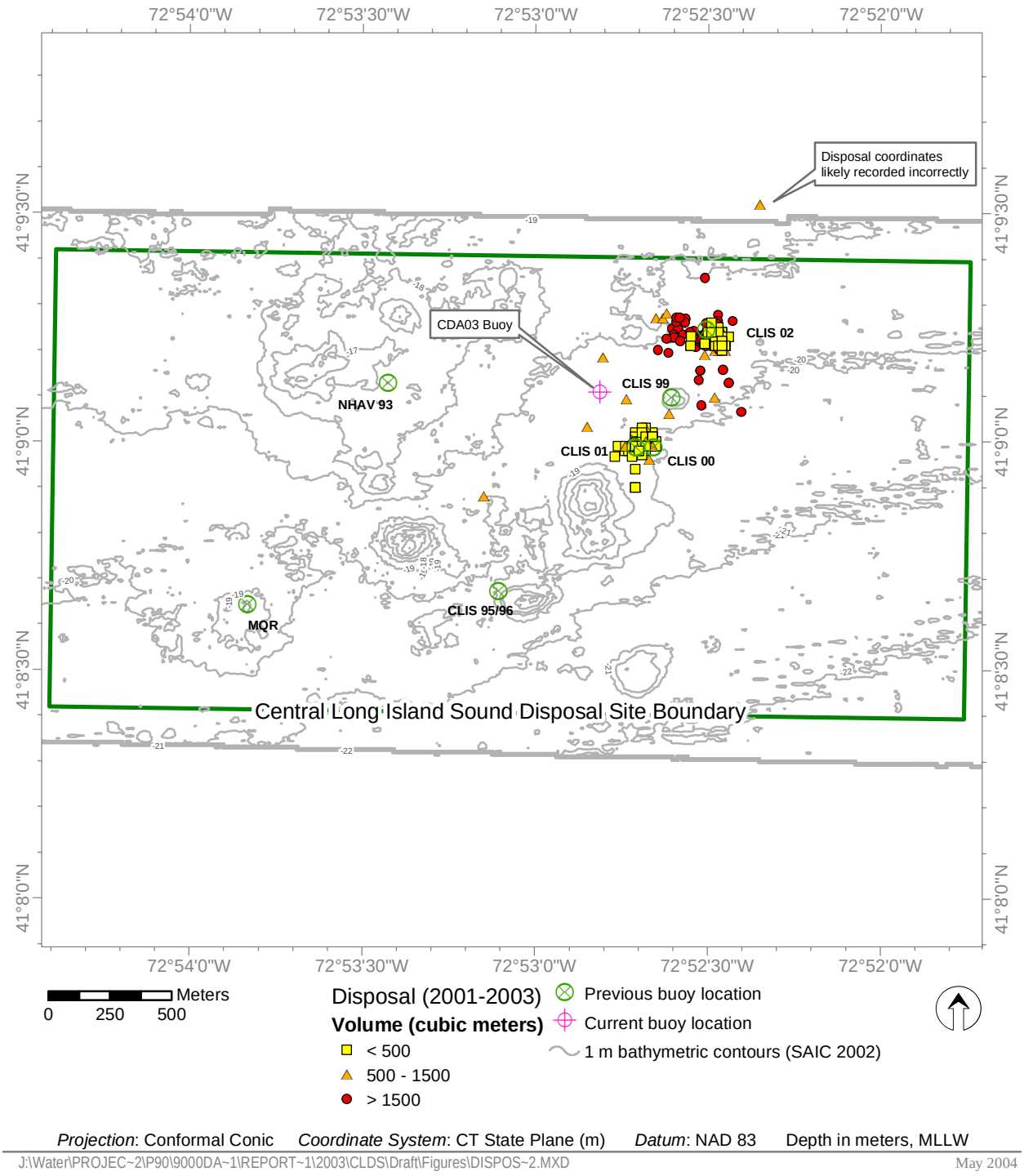

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Figure 1-3 CLDS with recent DM disposal locations indicated

Table 1-1

Overview of Recent Disposal Activity at CLDS

Source Project	Permittee	Estimated Scow Volume Disposed (m^3)	
		2001/2002 Season	2002/2003 Season
Birbarie Marina	Birbarie Marina Sales	4,014	--
Branford River	Branford Landing Marina	1,529	--
Bridgeport Harbor	Wisvest-CT	1,262	--
Cummings Park Basin	City of Stamford, CT	--	3,746
Harbor Point Marina	Harbor Point Marina	2,523	765
Marina & Access Channel	Wilson Cove Marina	6,862	--
Marina Basin	Milford Wharf	7,569	--
Marina Basin/Branford River	Indian Neck Yacht Club	--	2,141
Milford Harbor	Spencers Marina	3,593	--
Milton Harbor	City of Rye, NY	--	7,282
New Haven Harbor	COE New Haven Harbor	--	276,044
Norwalk River Basin	Saint Ann Club	--	3,326
Saugatuck River	Mark Masarenhas	3,861	--
Southport Harbor	Edward Lahey	191	--
Stamford Harbor	Avalon Bay Community	3,746	--
Veterans Park	City of Norwalk, CT	6,116	--
West River	Bayberry Creek	--	2,599
West River Channel	Guilford Yacht Club	--	12,615
Yacht Basin & West River	Guilford Yacht Club, Charles Creek & Dorlan Marina Basin	11,774	4,434
Season Total		**53,041**	**312,953**
Grand Total		**365,994**	

The design of the September 2003 survey allowed assessment of the following expectations:

- The placement of 53,000 m^3 of dredged material at the CDA01 buoy during the 2001/2002 disposal season will result in an observable disposal mound.

- The placement 312,000 m^3 of dredged material at the CDA02 buoy during the 2002/2003 disposal season will result in a discrete disposal mound.

- The CLIS 99 and 00 Mounds will support an advanced benthic community relative to the 2001 survey. The abundance of Stage II-III organisms is expected to increase, although disposal activity in the vicinity of the mounds may slow the recolonization process.

- Benthic recolonization at the 95/96 Mound Complex, NHAV 93 Mound and MQR Mound will approach that of the reference stations, after more than eight years since the last disposal. An advanced benthic community of Stage III and Stage I on III infaunal assemblages is expected (Scott et al, 1987).

2.0 METHODS

A team of investigators from ENSR International, Ocean Surveys, Inc., and Germano and Associates performed the September 2003 survey at CLDS. The bathymetric survey was conducted 16–22 September 2003 to assess dredged material distribution throughout the study area. The sediment-profile imaging (SPI) survey was conducted 8–10 September 2003 to support characterization of benthic community status, sediment conditions, and dredged material distribution. Field activities are summarized in Table 2-1 and an overview of the methods used to collect survey data as well as methods used to process and analyze the 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 4000 series Global Positional System (GPS) receiver interfaced with a Trimble Probeacon differential beacon receiver. This system received and processed satellite and land-based beacon data and provided real-time vessel position, typically to sub-meter accuracy. Coastal Oceanographics, Inc. HYPACK® hydrographic survey software 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 2003 single-beam bathymetric survey was designed to cover a 1000 x 1300 m area, representing approximately 1.3 km^2 of the northeast portion of CLDS (Figure 2-1). The survey area encompassed the region where disposal occurred from 2000-2003 and two older mounds, CLIS 99 and CLIS 00. The bathymetric survey was initiated on 16

Table 2-1

September 2003 CLDS Field Activities Summary

Survey Type	Date	Summary
Bathymetry	16–17, 22 September 2003	Area: 1300 x 1000 m Lines: 53 Spacing: 25 m
Sediment-Profile Imaging	8–10 September 2003	Stations: 82 CLIS 00 Mound: 15 CLIS 99 Mound: 10 NHAV 93 Mound: 5 MQR Mound: 13 CLIS 95/96 Mound Complex: 25 2500W Reference: 4 4500E Reference: 4 CLIS REF: 6

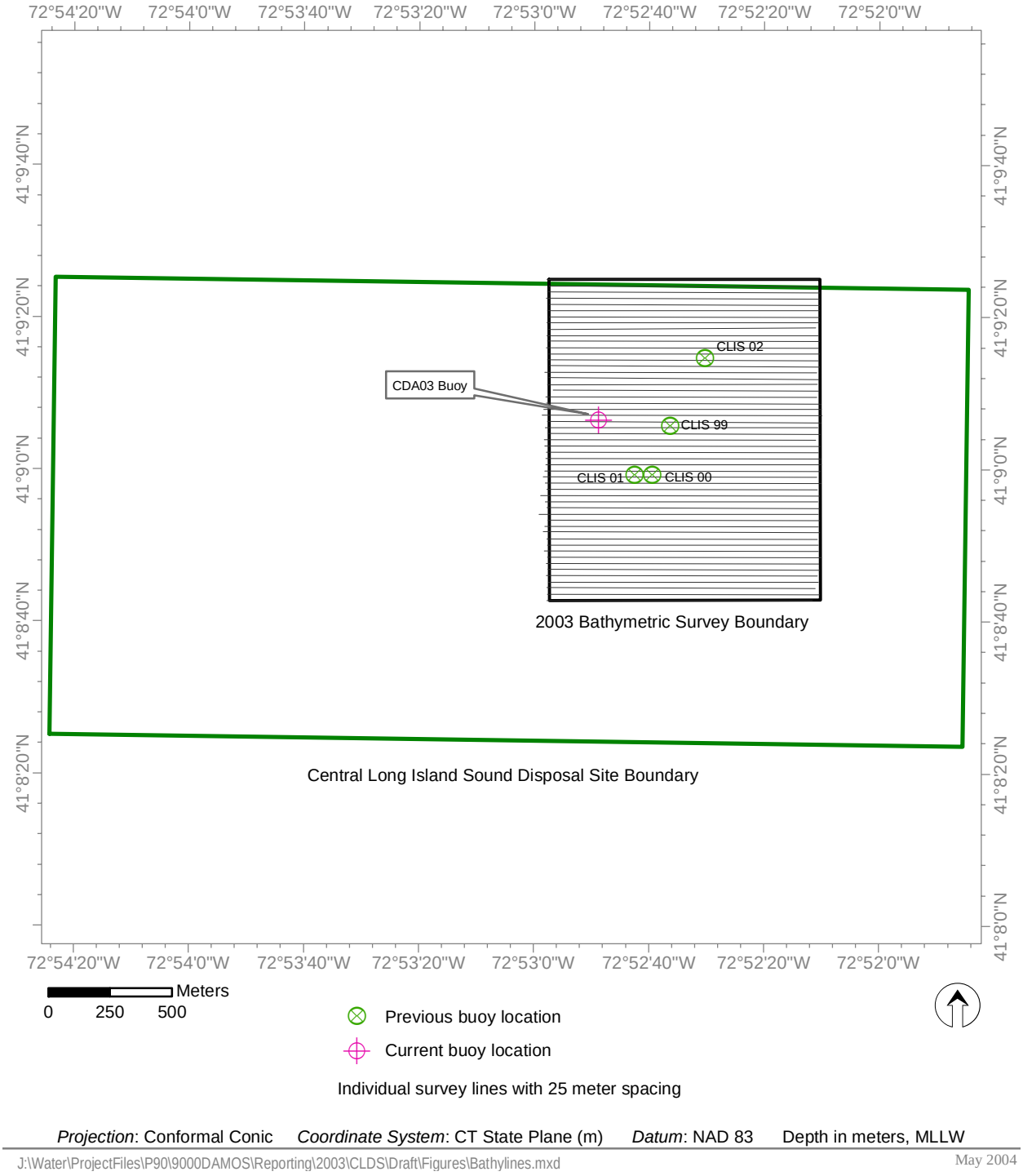


Figure 2-1 Bathymetric survey lines at CLDS, September 2003

September 2003 aboard the R/V *Willing II*, but was aborted the next day due to weather conditions; it was rescheduled and completed on 22 September 2003. A total of 53 survey lines, each 25 m apart, were occupied as part of the survey (Figure 2-1). In addition, several perpendicular cross-tie lines were occupied to assess data quality.

Bathymetric data were collected using an Innerspace Model 448 Echo Sounder outfitted with an 8° transducer, which achieved an accuracy of 5 cm in Long Island Sound. Data were collected at a rate of 17–18 soundings per second, combined with boat speeds between 4 and 4.5 knots, resulting in soundings spaced at less than 0.2-m intervals along each line. The system was calibrated at the dock prior to each survey day for local water mass speed of sound. Tidal elevations were recorded in meters and were referenced to Mean Low Water (MLW) based on water level data obtained from the National Oceanic and Atmospheric Administrating (NOAA) tide station in New Haven, CT, for use in processing the bathymetric data.

2.2.2 Bathymetric Data Processing

The bathymetric data were processed using the HYPACK® 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 MLW using the locally collected tidal elevation data. Heave data supplied by the vessels 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.

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. For this survey, 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® 8.3. Using Surfer®, the processed CLDS 2003 data were gridded to a cell size of 25 m^2, consistent with the bathymetric grid created for the previous (June 2001) survey (SAIC 2003). Once gridded, bathymetric contour lines were displayed using ArcView®.

Surfer® was also used to calculate a depth-difference grid based on the June 2001 and September 2003 bathymetric data sets. This grid was calculated by subtracting interpolated depth estimates of September 2003 from the June 2001 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 an underwater frame/camera system that can photograph 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 2003 SPI survey design included 82 locations: 68 stations located within CLDS and 14 stations situated within three reference areas (Table 2-2, Figure 2-2). The 68 stations located within CLDS consisted of previously established stations at five mound locations. The 15 stations surveyed at CLIS 00 Mound and the 10 stations surveyed at CLIS 99 Mound formed a square grid and corresponded to the same stations sampled during the June 2001 survey (SAIC 2003). Thirteen stations along two transects in a cross pattern were sampled at MQR Mound and five stations in a similar cross pattern were sampled at NHAV 93 Mound. At the CLIS 95/96 Mound Complex, 25 stations were surveyed. The stations surveyed for MQR, NHAV 93, and CLIS 95/96 were the same stations sampled during the September 1999 survey (SAIC 2002b). Sampling was also conducted at three previously established references areas located west of the disposal site (REF 2500W), east of the disposal site (REF 4500E), and southeast of the disposal site (CLIS REF) to provide a basis of comparison between CLDS sediment conditions and the ambient sediment conditions in Central Long Island Sound. The actual reference stations were selected randomly within a 300-m radius of the centers of REF 2500W, REF 4500E, and CLIS REF (Table 2-2, Figure 2-2).

The sediment-profile imaging survey was conducted 8–10 September 2003 aboard the F/V *West Cove*. At each station, the vessel was positioned at the target coordinates and three replicates were collected within a defined station tolerance of 10 m. Three replicate sediment-profile images were collected at each of the 82 stations for further characterization of small-scale variability.

Table 2-2

Target Sediment-Profile Imaging Sampling Locations at CLDS

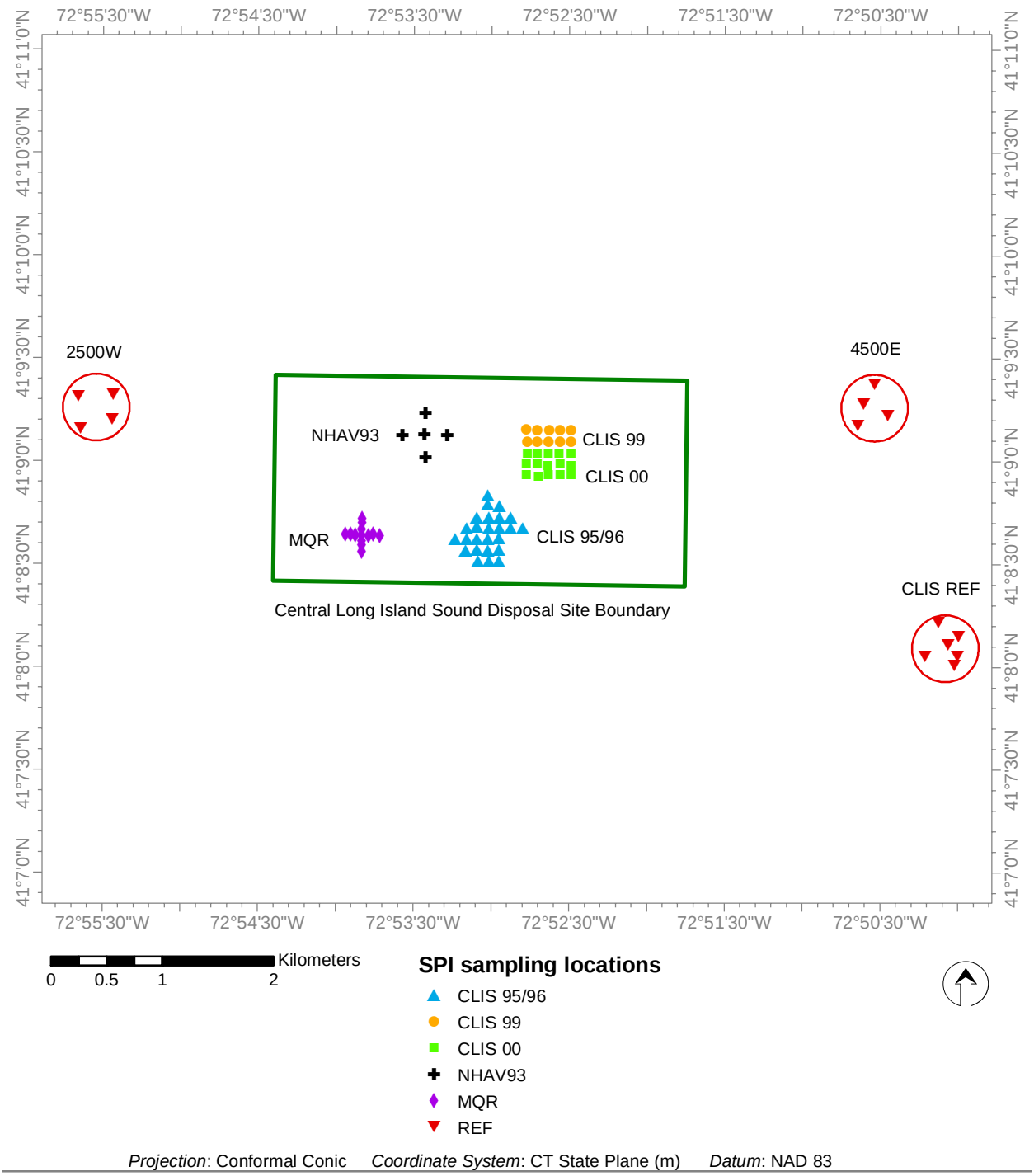
Area	Station	Latitude (N)	Longitude (W)
NHAV 93	CTR	41°09.128'	72°53.425'
	200E	41°09.127'	72°53.283'
	200N	41°09.235'	72°53.426'
	200S	41°09.019'	72°53.426'
	200W	41°09.127'	72°53.569'
CLIS 99	CLIS99-B1	41°09.148'	72°52.702'
	CLIS99-B2	41°09.094'	72°52.702'
	CLIS99-C1	41°09.148'	72°52.630'
	CLIS99-C2	41°09.094'	72°52.630'
	CLIS99-D1	41°09.148'	72°52.559'
	CLIS99-D2	41°09.094'	72°52.559'
	CLIS99-E1	41°09.148'	72°52.487'
	CLIS99-E2	41°09.094'	72°52.487'
CLIS 00	CLIS00-A3	41°09.040'	72°52.773'
	CLIS00-A4	41°08.986'	72°52.773'
	CLIS00-A5	41°08.932'	72°52.773'
	CLIS00-B3	41°09.040'	72°52.702'
	CLIS00-B4	41°08.986'	72°52.702'
	CLIS00-B5	41°08.932'	72°52.701'
	CLIS00-C3	41°09.040'	72°52.630'
	CLIS00-C4	41°08.986'	72°52.630'
	CLIS00-C5	41°08.932'	72°52.630'
	CLIS00-D3	41°09.040'	72°52.559'
	CLIS00-D4	41°08.986'	72°52.558'
	CLIS00-D5	41°08.932'	72°52.558'
	CLIS00-E3	41°09.040'	72°52.487'
	CLIS00-E4	41°08.986'	72°52.487'
	CLIS00-E5	41°08.932'	72°52.487'
	CLIS99-A1	41°09.148'	72°52.773'
	CLIS99-A2	41°09.094'	72°52.773'
CLIS 95/96	R4C9-66	41°08.784'	72°53.020'
	R4C9-75	41°08.730'	72°53.020'
	R5C10-76	41°08.730'	72°52.949'
	R5C11-77	41°08.730'	72°52.877'
	R3C9-57	41°08.838'	72°53.020'
	R4C10-67	41°08.784'	72°52.949'
	R4C11-77	41°08.730'	72°52.877'
	R5C8-74	41°08.730'	72°53.092'
	R5C9-75	41°08.730'	72°53.020'
	R6C10-85	41°08.676'	72°52.949'
	R6C11-86	41°08.676'	72°52.877'
	R6C12-87	41°08.676'	72°52.806'
	R6C7-82	41°08.676'	72°53.163'
	R6C8-83	41°08.676'	72°53.092'
	R6C9-84	41°08.676'	72°53.020'
	R7C10-92	41°08.622'	72°52.949'
	R7C6-93	41°08.622'	72°53.235'
	R7C7-89	41°08.622'	72°53.163'
	R7C8-90	41°08.622'	72°53.092'
	R7C9-91	41°08.622'	72°53.020'
	R8C10-97	41°08.568'	72°52.949'
	R8C7-94	41°08.568'	72°53.163'
	R8C8-95	41°08.568'	72°53.092'
	R8C9-96	41°08.568'	72°53.020'
	R9C10-99	41°08.514'	72°52.949'
	R9C8-101	41°08.514'	72°53.092'
	R9C9-98	41°08.514'	72°53.020'

Table 2-2 (Cont'd)

Target Sediment-Profile Imaging Sampling Locations at CLDS

Area	Station	Latitude (N)	Longitude (W)	Area	Station	Latitude (N)	Longitude (W)
MQR	CTR	41°08.642'	72°53.832'	Reference	2500W	41°09.259'	72°55.541'
	50E	41°08.642'	72°53.796'		4500E	41°09.259'	72°50.538'
	50N	41°08.669'	72°53.832'		CLIS REF	41°08.091'	72°50.082'
	50S	41°08.615'	72°53.832'				
	50W	41°08.642'	72°53.868'				
	100E	41°08.642'	72°53.761'				
	100N	41°08.696'	72°53.832'				
	100S	41°08.588'	72°53.832'				
	100W	41°08.642'	72°53.903'				
	150E	41°08.642'	72°53.72o5'				
	150N	41°08.72o3'	72°53.832'				
	150S	41°08.561'	72°53.832'				
	150W	41°08.642'	72°53.939'				

Note: All coordinates NAD83



Projection: Conformal Conic *Coordinate System*: CT State Plane (m) *Datum*: NAD 83

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Figure 2-2 SPI sampling locations at CLDS, September 2003

The SPI system consisted of a metal frame, a Benthos Model 3731 pressure housing, a prism chamber, a Nikon digital camera, and a Benthos Model 2216 Deep Sea Pinger. 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 the internal strobe twice to obtain two cross-sectional images of the upper 20 cm of the sediment column. The pinger was attached to the camera and output a constant signal of one ping per second. Upon discharge of the camera strobe, the ping rate doubled for 10 seconds. The doubling of the ping rate provided confirmation that a successful image had been obtained.

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; a conversion to other grain-size scales is provided in Appendix B. The presence and thickness of disposed dredged material was also assessed by inspection of the images.

Penetration Depth—The depth to which the camera penetrates into the seafloor was measured to provide an indication of the sediment density or bearing capacity.

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. Computer image-analysis software (Image-Pro 4.5.1.29) was used to calculate the roughness measure. Analysis also included interpretation of the source (biological or physical) of the roughness.

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 the 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 overall benthic habitat quality (Revelas et al. 1987; Table 2-3). An OSI threshold of +6 is used to evaluate the benthic habitat quality. 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 individual values.

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	

3.0 RESULTS

3.1 Bathymetry

The September 2003 bathymetric survey results for CLDS were consistent with earlier survey results, with the notable exception of the mounds (designated as CLIS 01 and CLIS 02) formed at the location of the CDA01 and CDA02 buoys during the 2001–2002 and 2002–2003 disposal seasons (Figure 3-1). The natural seafloor slopes from the northwest to the southeast across the survey area (a subset of the disposal site), with depths ranging from approximately 19 m in the northwest to 21 m in the southeast (Figure 3-1, depths reported as MLLW).

Six distinct mounds were evident: four the result of earlier disposal events and two the result of disposal events after the 2001 survey. The CLIS 99 Mound and CLIS 00 Mound were first identified during the 2001 survey and were approximately 1 to 1.5 m in height (Figure 3-2). The historic NHAV 74 Mound was approximately 4 m above the surrounding seafloor. The fourth historic feature was a small mound, approximately 1.5 m in height, which was present during the 2001 survey. This mound, which has no official designation, was located approximately 300 m west of the newly formed CLIS 02 Mound (Figures 3-1 and 3-2).

3.1.1 CLIS 01 Mound

The newly formed CLIS 01 Mound was located approximately 100 m west of the CLIS 00 Mound and was generally conical in shape. It was formed primarily from the disposal of approximately 53,000 m^3 of material during the 2001–2002 season. The base of the mound was approximately 90 m in diameter. The minimum water depth at the apex of the mound was approximately 17.5 m and the surrounding water depths averaged about 20 m, indicating that the height of the mound was approximately 2.5 m above the surrounding seafloor (Figure 3-3).

3.1.2 CLIS 02 Mound

The recently formed CLIS 02 Mound, approximately 250 m northeast of the CLIS 99 Mound, formed from the disposal of approximately 312,000 m^3 of material during the 2002–2003 disposal season. The base of the mound was approximately 300 m in diameter. The minimum water depth at the apex of the mound was approximately 17.5 m and the surrounding water depths averaged about 19.5 m, indicating that the height of the mound was approximately 2 m above the surrounding seafloor (Figure 3-3).

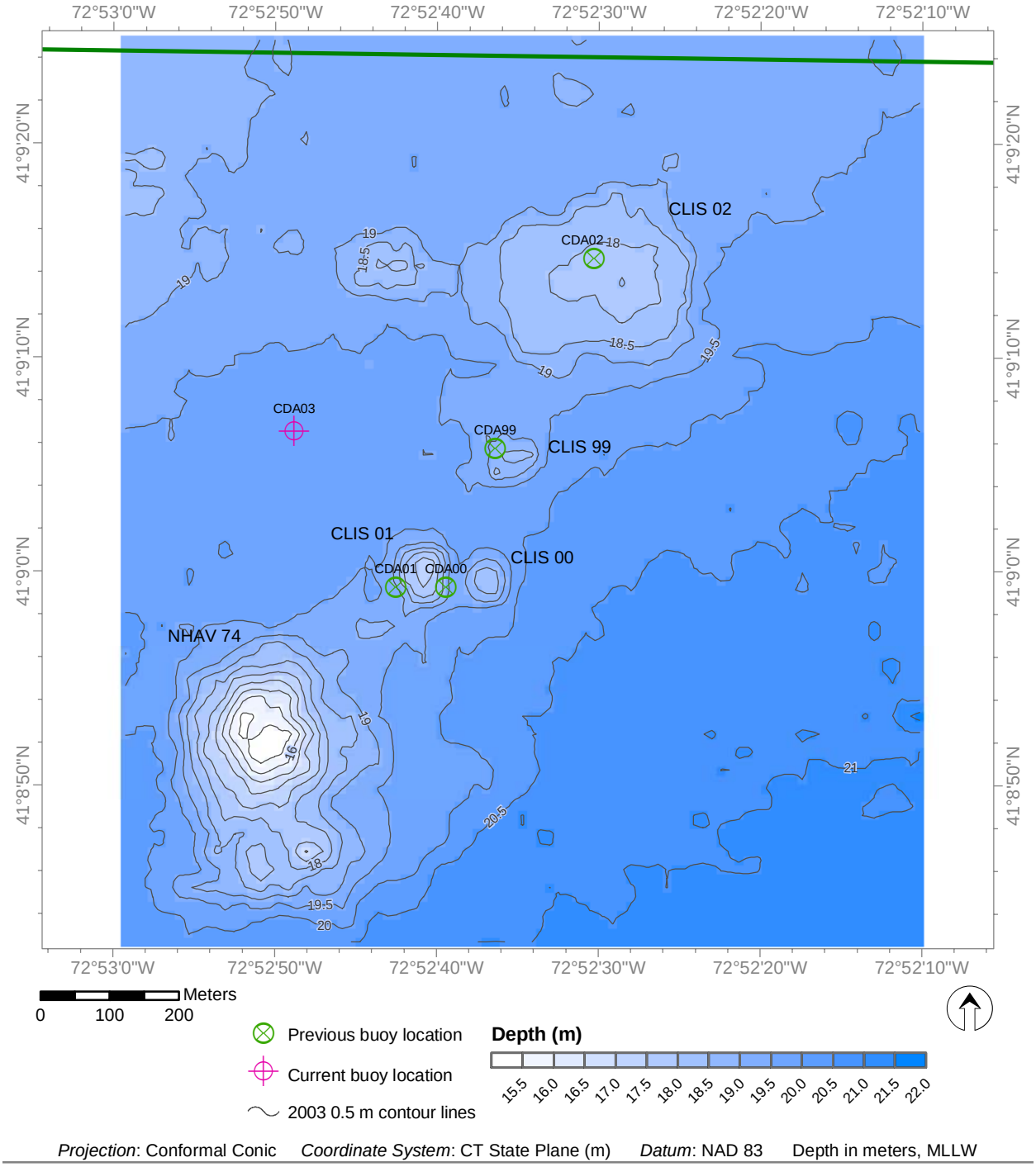


Figure 3-1 Bathymetric contour map of CLDS survey area, September 2003 (0.5-m contour interval).

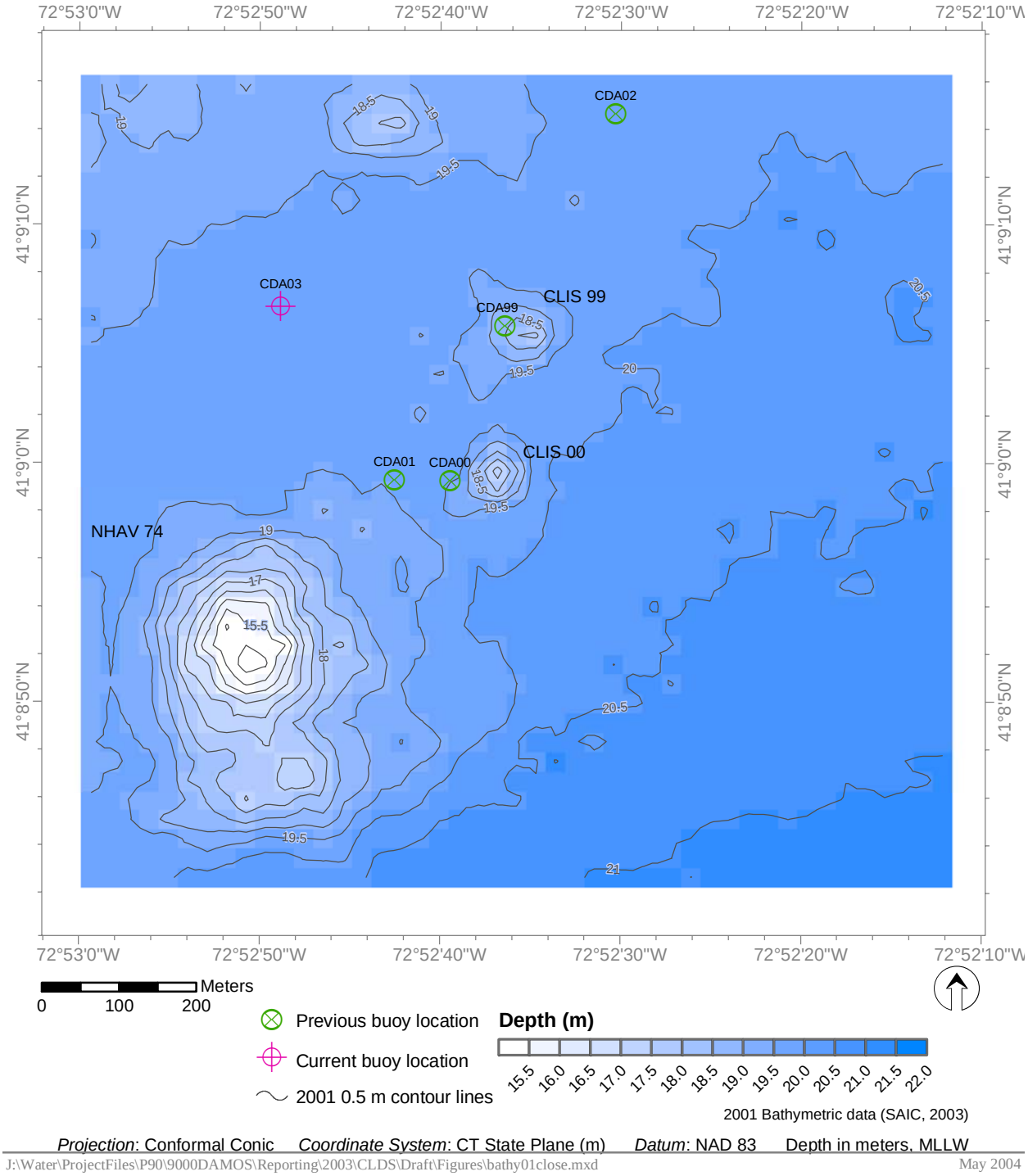
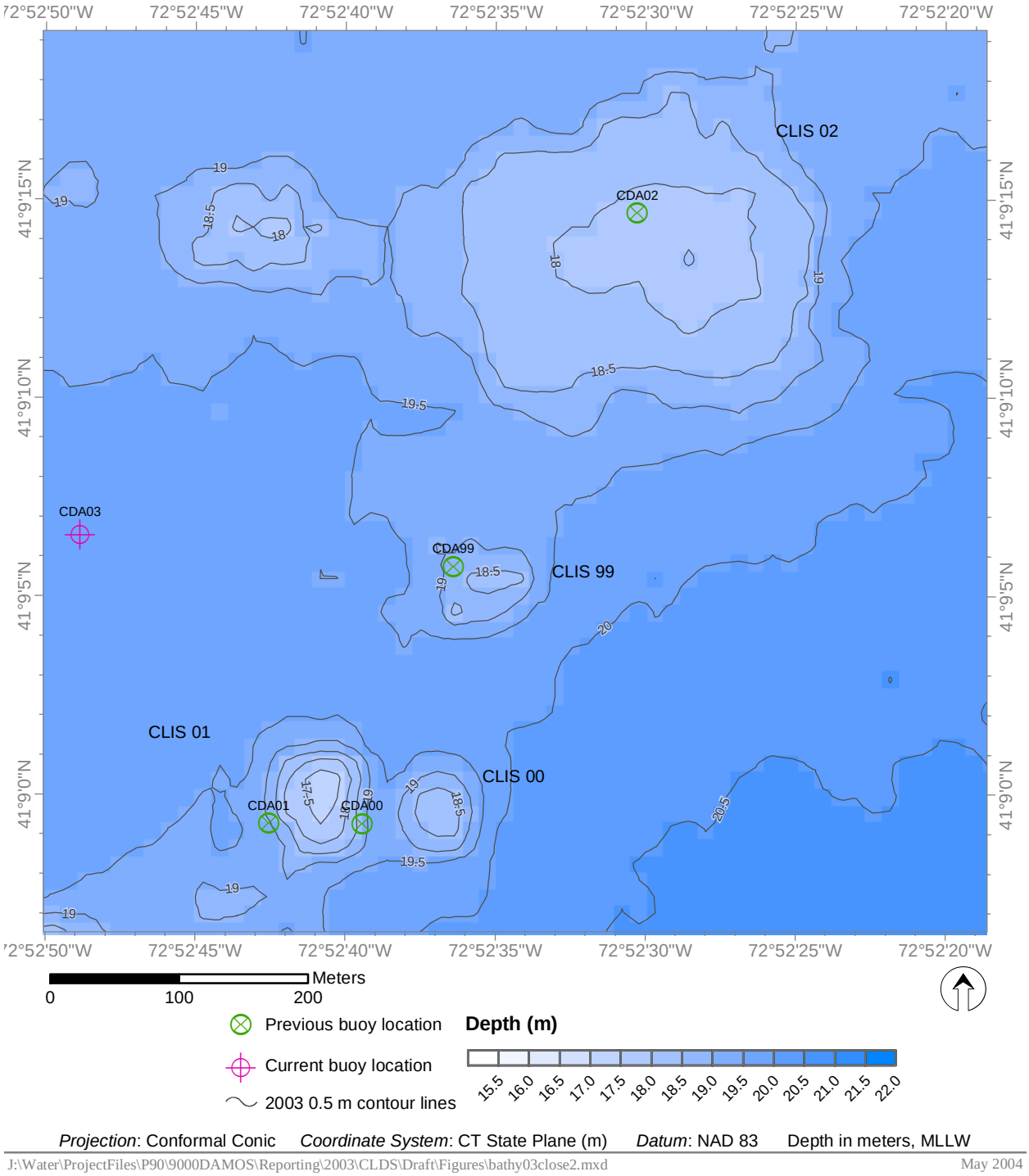


Figure 3-2 Bathymetric contour map of CLDS survey area, June 2001 (0.5-m contour interval).



Projection: Conformal Conic *Coordinate System*: CT State Plane (m) *Datum*: NAD 83 Depth in meters, MLLW

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Figure 3-3 Bathymetric contour map of CLDS survey area (close-up), September 2003 (0.5-m contour interval).

3.1.3 Comparison with Previous Bathymetry

The depth-difference map for the 2001 and 2003 bathymetric data was plotted at 0.5-m contour intervals (Figure 3-4). The most significant features are the two newly formed disposal mounds, CLIS 01 and CLIS 02. The map also indicates a 0.5-m decrease in the height of the CLIS 00 Mound. This scale of volume decrease is typical of the self-weight consolidation of recently disposed dredged materials in Long Island Sound (SAIC 1995).

3.2 Sediment-Profile Imaging

Results of the SPI survey were evaluated to assess the distribution of dredged material and to monitor the recovery and status of the benthic infaunal community. Three replicate SPI images were obtained and analyzed at each of 82 sampling stations (15 at CLIS 00, 10 at CLIS 99, 5 at NHAV 93, 13 at MQR, 25 at CLIS 95/96, 4 at REF 2500W, 4 at REF 4500E and 6 at CLIS REF). The results of the SPI analysis are presented in Appendix B.

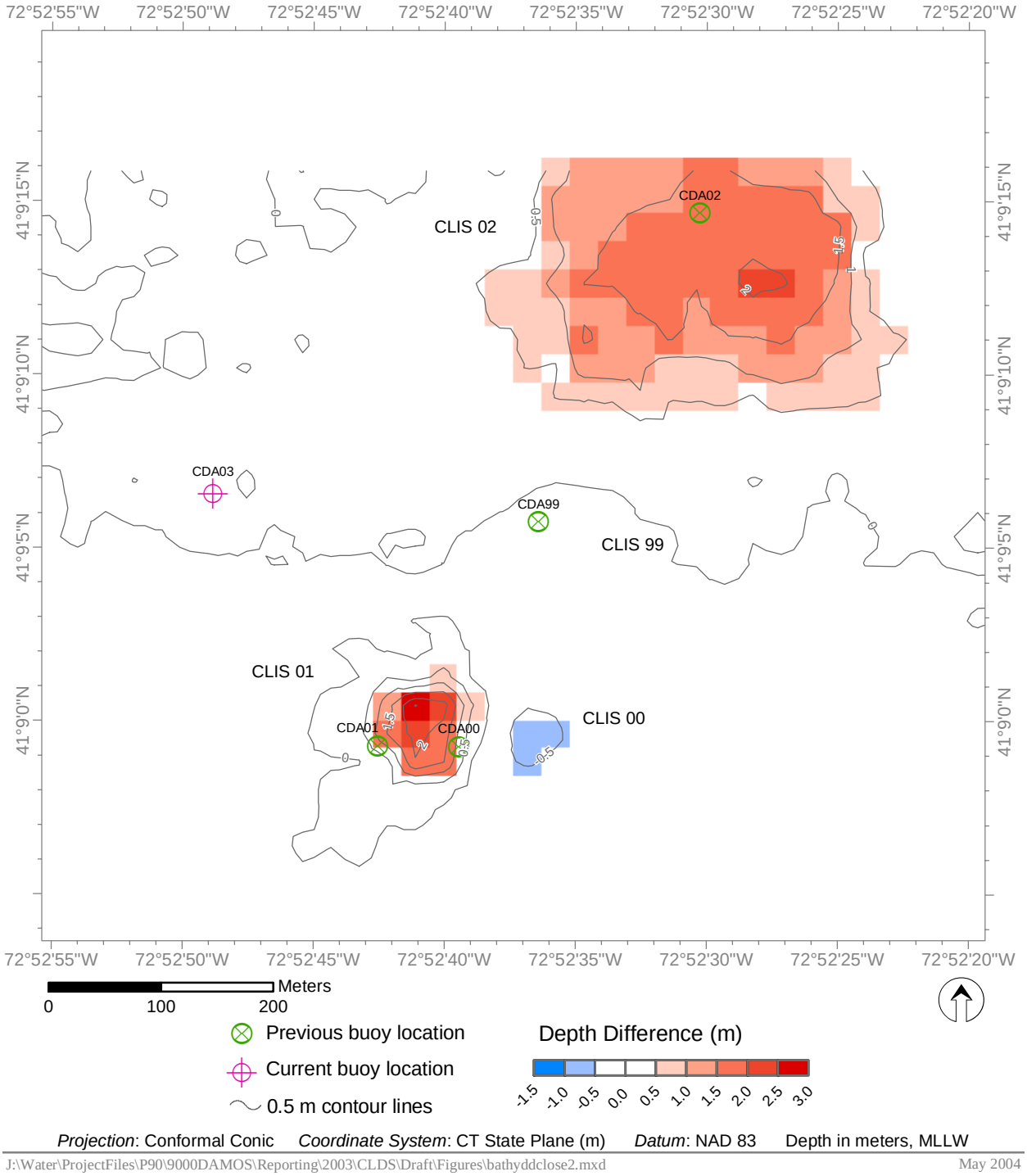
As described in greater detail below, a unique observation of the 2003 SPI survey was the ubiquitous occurrence of a thin, rust-colored surface layer that appeared to be degraded phytoplankton (phaeopigments or phytodetritus). This layer was observed in every image at all three reference areas and at each disposal mound.

3.2.1 Reference Areas

Three reference areas were established by the DAMOS program to characterize the ambient seafloor and to provide a basis for comparison with the disposal mounds. The oldest reference location is CLIS REF. Two other reference locations, 2500W and 4500E, were added later to assess ambient conditions east and west of the disposal site boundary. The results of the three reference areas were pooled to represent ambient conditions outside of CLDS. Pooling of the reference data also allowed for a more robust comparison to the mound data in evaluating the results.

Sediment Physical Characteristics

Surface sediments at all three of the reference areas consisted of silt/clay with a major modal grain size of >4 phi This is consistent with the results of past DAMOS surveys (SAIC 2003). At CLIS REF, the sediment appeared to contain a somewhat higher proportion of sand-sized particles of presumed biological origin (e.g., pellets, broken tubes of Stage I polychaetes, and tests of calcareous foraminifera). Boundary



Projection: Conformal Conic *Coordinate System*: CT State Plane (m) *Datum*: NAD 83 Depth in meters, MLLW

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Figure 3-4 Depth difference contour map of CLDS survey area, June 2001 vs. September 2003 survey results (0.5-m contour interval).

roughness values were low, ranging from 0.5 to 1.2 cm, and were attributed to both physical and biological factors. All stations exhibited a thin (< 1.0 cm) rust-colored phytodetrital layer at the sediment surface (Figure 3-5). Prism penetration depths ranged from 6.4 cm (2500W 2) to 14.9 cm (2500W 1) with a mean of 9.9 cm, indicating a relatively soft bottom. Sedimentary fabrics were dominated by homogeneous, biogenically reworked mud of relatively high reflectance at most of the stations (Table 3-1, Figure 3-5). A few images (CLIS REF 3, 6; 4500E 1, 2; 2500W 3) showed small patches of dark sulfidic sediment below the surface suggestive of older dredged material but more likely of natural origin, as all of these replicates had evidence of very extensive burrowing and reworking resulting in a mottled appearance at depth (Figures 3-6 and 3-7)

Biological Conditions and Benthic Recolonization Status

The mean apparent RPD depths at the reference areas ranged from 1.7 cm (4500E 4) to 4.6 cm (2500W 4), with an overall mean of 3.0 cm (Table 3-1, Figure 3-8). These values are typical of ambient bottom conditions in late summer in those areas of the central Sound not experiencing hypoxia. The deepest values were measured at reference area 2500W.

Infaunal succession was dominated by Stage I on III assemblages at all of the reference area stations (Table 3-1). Evidence of Stage I included upright and intact tubes that were occasionally observed at the sediment surface, but in addition, the near-surface layer of sandy phytodetritus commonly contained many broken, recumbent, and/or buried tubes. At high magnification (ca. 5×), thin, red, worm-like structures could be seen in the near-surface sediment (Figure 3-5, inset). These worms, believed to be paraonid polychaetes or possibly oligochaetes, did not occupy tubes, but rather appeared to be shallow subsurface burrowers and as such were considered to be part of the Stage I assemblage. The relative abundance of recumbent and buried tubes was consistent at all reference and disposal mound stations, suggesting that this phenomenon may have occurred throughout central Long Island Sound at the time of this survey. It may be related to the deposition of phytodetritus as most of the tubes were constructed of loose aggregations of fecal pellets composed of phytodetritus. This is typical in habitats with rapid cycling of organic material; tubes are constructed rapidly and break down rapidly when abandoned.

The presence of degraded phytodetritus at all reference stations provides a background for evaluating the fate of pulses of rich organic material that reach the seafloor in the central Sound. At most stations the organic material had been incorporated into the top few centimeters of sediment through active bioturbation, but in some cases there was a distinct horizon at the surface which had been tunneled by

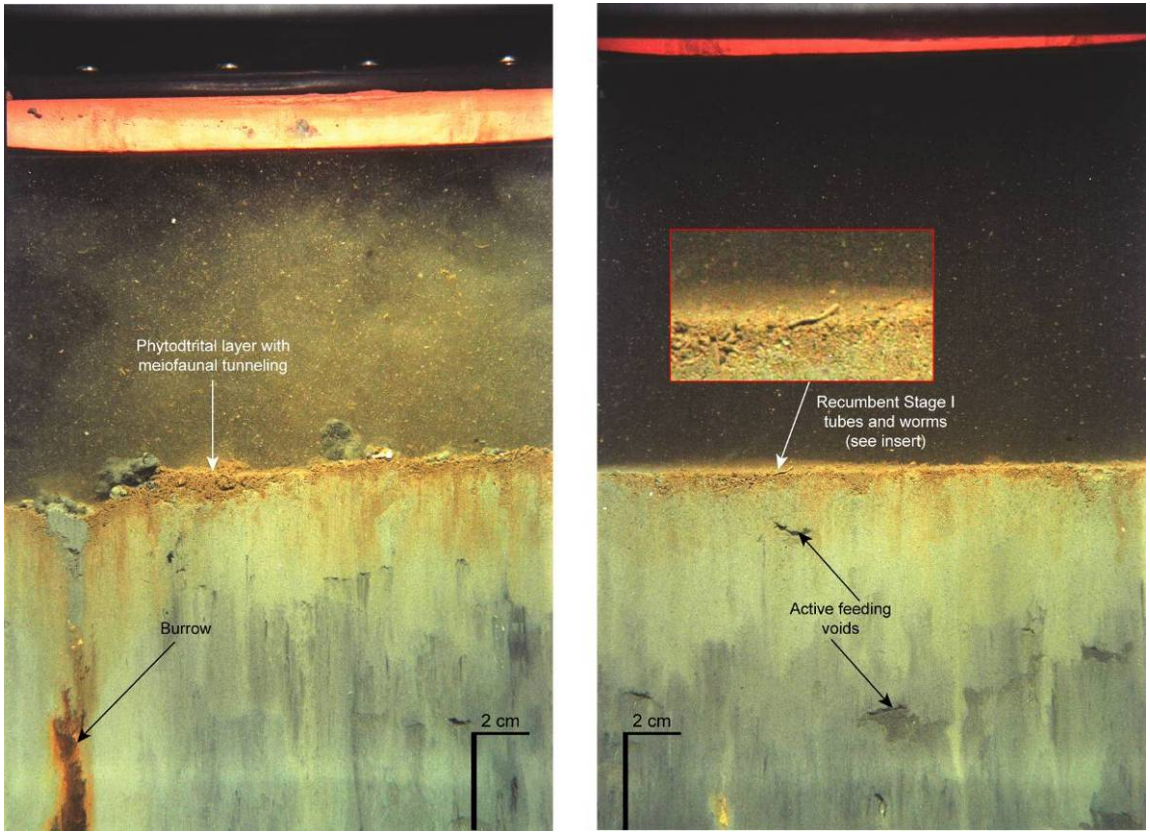

Figure 3-5 Sediment-profile images from Station REF 2500W 2B and REF 4500E 1A showing ambient bottom conditions. REF 2500W 2B (left): Note that the rust-colored phytodetritus has been brought down into the large burrow on the left. The near-surface phytodetrital layer shows extensive meiofaunal tunneling. RPD = 3.6 cm; Stage I on III; OSI = +10. REF 4500E 1A (right): Ambient bottom conditions characterized by high-reflectance sediment at depth, a well-developed apparent RPD, and several subsurface feeding voids. The inset shows broken and recumbent tubes of Stage I worms on a rust-colored phytodetrital layer. RPD = 3.8 cm; Stage I on III; OSI = +11.

Table 3-1

Summary of SPI Results for CLDS Reference Stations, September 2003

Area	Station	Mean Prism Penetration Depth (cm)	Grain Size Major Mode (phi)	Boundary Roughness (cm)	Mean RPD Depth (cm)	Successional Stages present (no. of replicates)	Median OSI	Mean Total Phytodetritus (cm)	Methane Present?
2500 W	1	14.9	>4	1.2	3.6	I on III (3)	10	0.8	No
	2	6.4	>4	1.1	3.1	I on III (3)	10	0.5	No
	3	10.1	>4	0.6	4.3	I on III (3)	11	0.6	No
	4	9.9	>4	0.7	4.6	I on III (3)	11	0.7	No
4500 E	1	10.8	>4	0.5	3.3	I on III (3)	10	0.5	No
	2	10.7	>4	1.1	2.4	I on III (3)	9	0.4	No
	3	9.4	>4	0.6	1.8	I on III (3)	8	0.3	No
	4	9.4	>4	0.5	1.7	I on III (3)	8	0.4	No
CLIS REF	1	8.3	>4	0.6	3.4	I on III (3)	10	0.3	No
	2	9.5	>4	0.5	3.6	I on III (3)	10	0.3	No
	3	8.4	>4	0.6	3.2	I on III (3)	9	0.2	No
	4	8.6	>4	0.8	2.2	I on III (3)	9	0.3	No
	5	9.2	>4	0.7	2.7	I on III (3)	9	0.5	No
	6	12.5	>4	0.6	2.8	I on III (3)	9	0.4	No
Average		9.9		0.7	3.0		NA	0.5	
Median		NA		NA	NA		9.5	NA	
Minimum		6.4		0.5	1.7		8	0.2	
Maximum		14.9		1.2	4.6		11	0.8	

NA = Not applicable

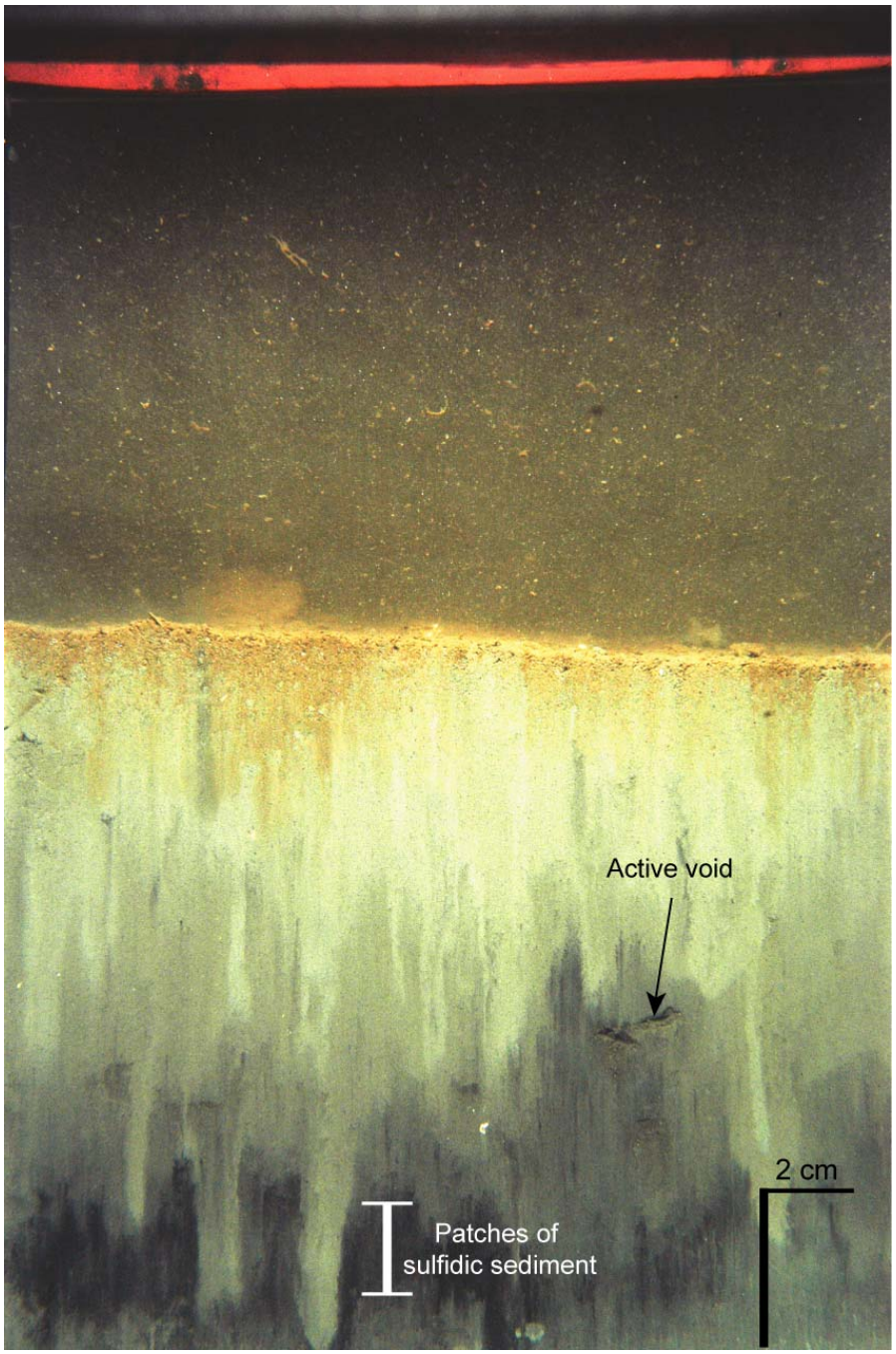

Figure 3-6 Sediment-profile image from Station REF 4500E 1C showing discontinuous patches of dark sulfidic sediment at depth that has the characteristic appearance of an old dredged layer. It is considered more likely that this is a naturally occurring, localized zone of organic enrichment in the sediment column. RPD = 3.5 cm; Stage I on III; OSI = +10.

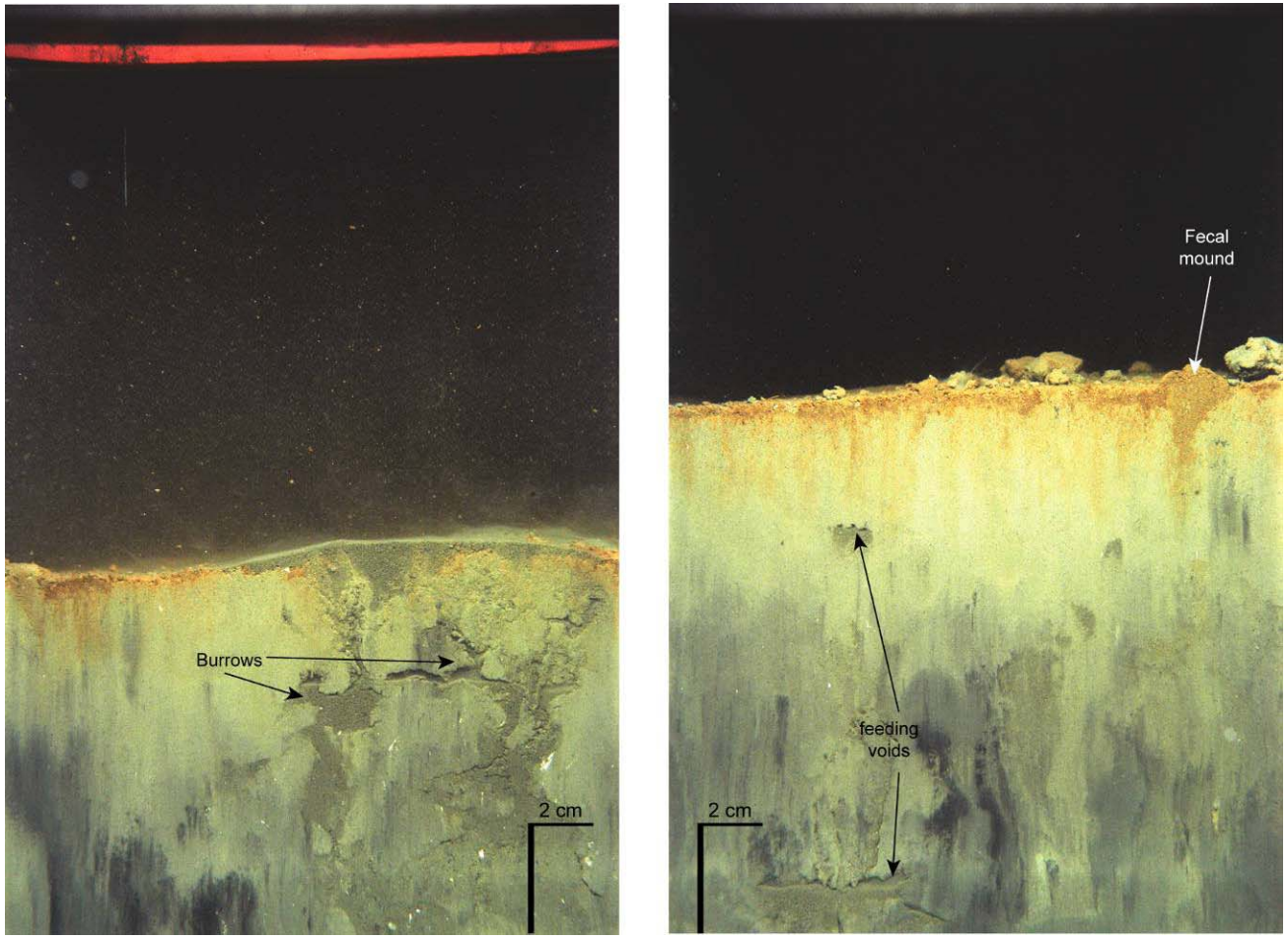

Figure 3-7 Sediment-profile images from Station CLIS REF 3C and CLIS REF 6A showing mottled coloring of the sediment due to extensive burrowing and biological reworking (e.g. burrows, feeding voids, fecal mound).

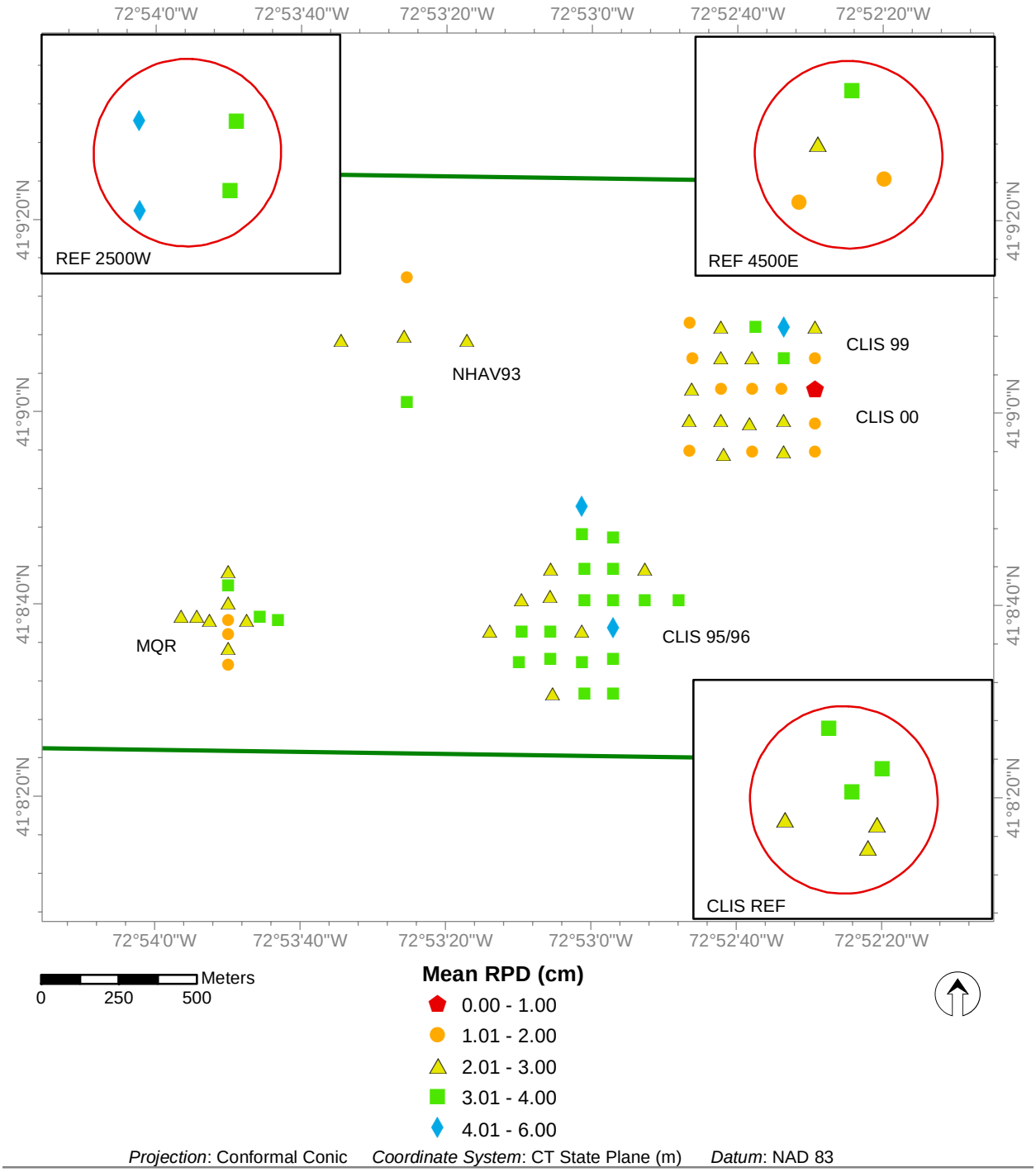

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Figure 3-8. Mean apparent RPD depths at CLDS Reference Areas, September 2003

meiofauna and incorporated into loose tubes and fecal pellets. Active feeding on the surface was evident in images where deep burrowing organisms had brought the distinctive colored organic material into their burrows (Figure 3-5).

Median OSI values ranged from +8 to +11, a range commonly encountered on the ambient bottom in DAMOS SPI surveys (Table 3-1, Figure 3-9).

3.2.2 CLIS 99 and CLIS 00 Mounds

Sediment Physical Characteristics

Because the CLIS 99 and CLIS 00 Mounds were located within the same sampling grid, they are described and mapped together. At all of the stations, the surface sediment consisted of dredged material having a grain size major mode of >4 phi (Table 3-2). At most stations, the thickness of the surface dredged material layer exceeded the imaging depth of the SPI camera, but discrete layers of dredged material also were evident and could be measured at some stations (Figures 3-10 and 3-11). Camera prism penetration depths at CLIS 00 and CLIS 99 ranged from 5.4 to 18.4 cm, with the softest sediment found at the CLIS 99 Mound. The sediment-profile camera prism over-penetrated the seafloor at CLIS 99-A1, CLIS 99-B1, and CLIS 99-E1, making it necessary to fit the camera with mud doors to obtain useful images. Boundary roughness was attributed to both physical and biological factors and was relatively low (0.3 to 1.2 cm) over both mounds (Table 3-2).

The phytodetrital layer was observed at all CLIS 99 and CLIS 00 stations, ranging in thickness from 0.3 to 1.0 cm (Table 3-2). This layer had broken Stage I polychaete tubes, the same feature described for the reference areas (Section 3.2.1). Sedimentary fabrics within the sampled area consisted of bedded, laminated, or mottled sediments typical of incompletely reworked dredged material, but subsurface sediments also have extensive burrows, feeding voids and biogenic textures indicating active reworking.

Biological Conditions and Benthic Recolonization Status

Mean apparent RPD depths ranged from 0.5 to 4.0 cm (Table 3-2, Figure 3-12). The shallowest mean RPD (0.5 cm) was observed at Station 00-E3 located on the central eastern boundary, and the deepest (4.0 cm) was observed at Station 99-D1 in the northeastern corner of the sampling grid, suggesting that the areas of deep and shallow RPD horizons were patchy. Infaunal succession across the surface of the CLIS 99 and CLIS 00 mounds was advanced; Stage I on III was present in at least one replicate image

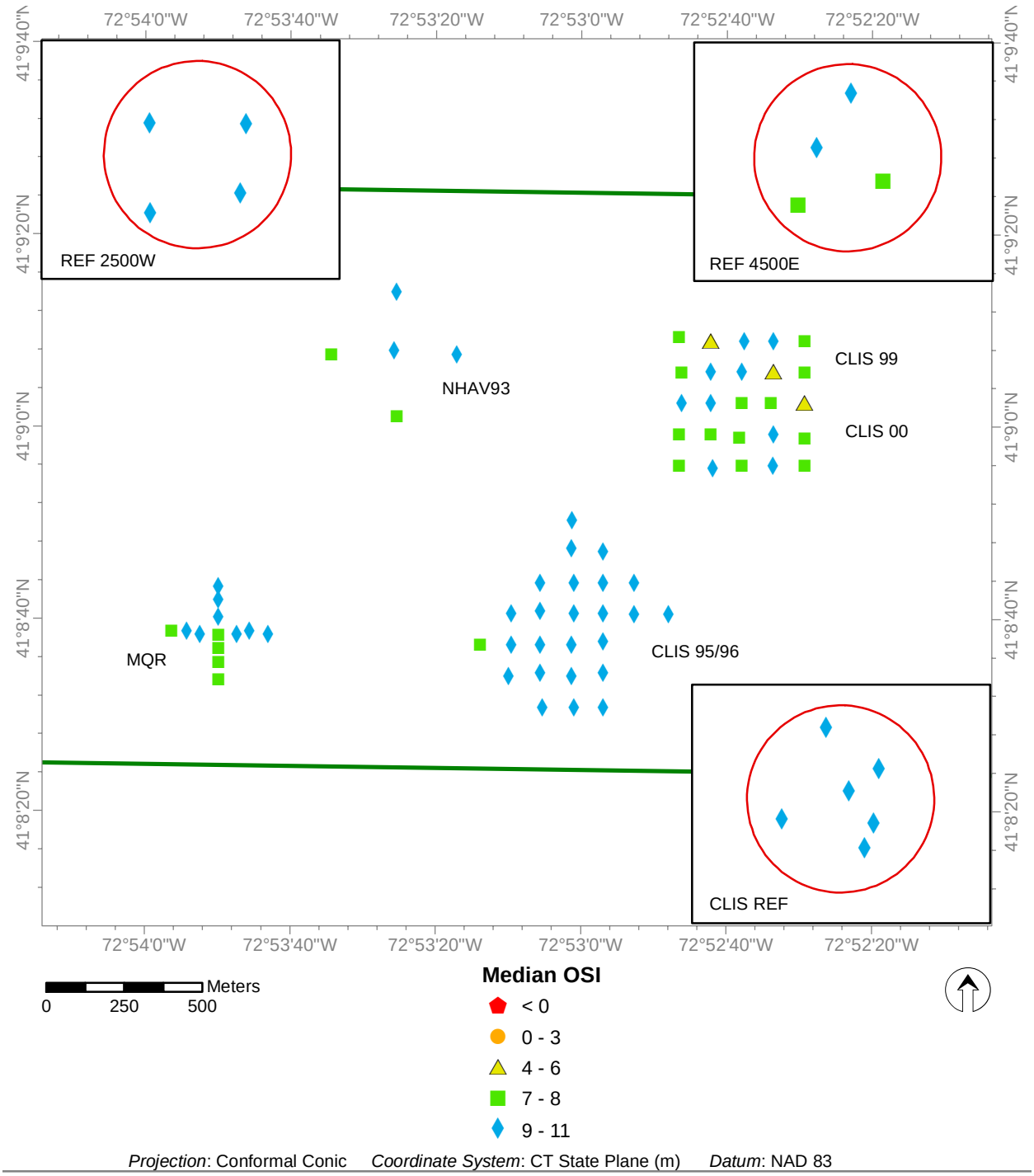

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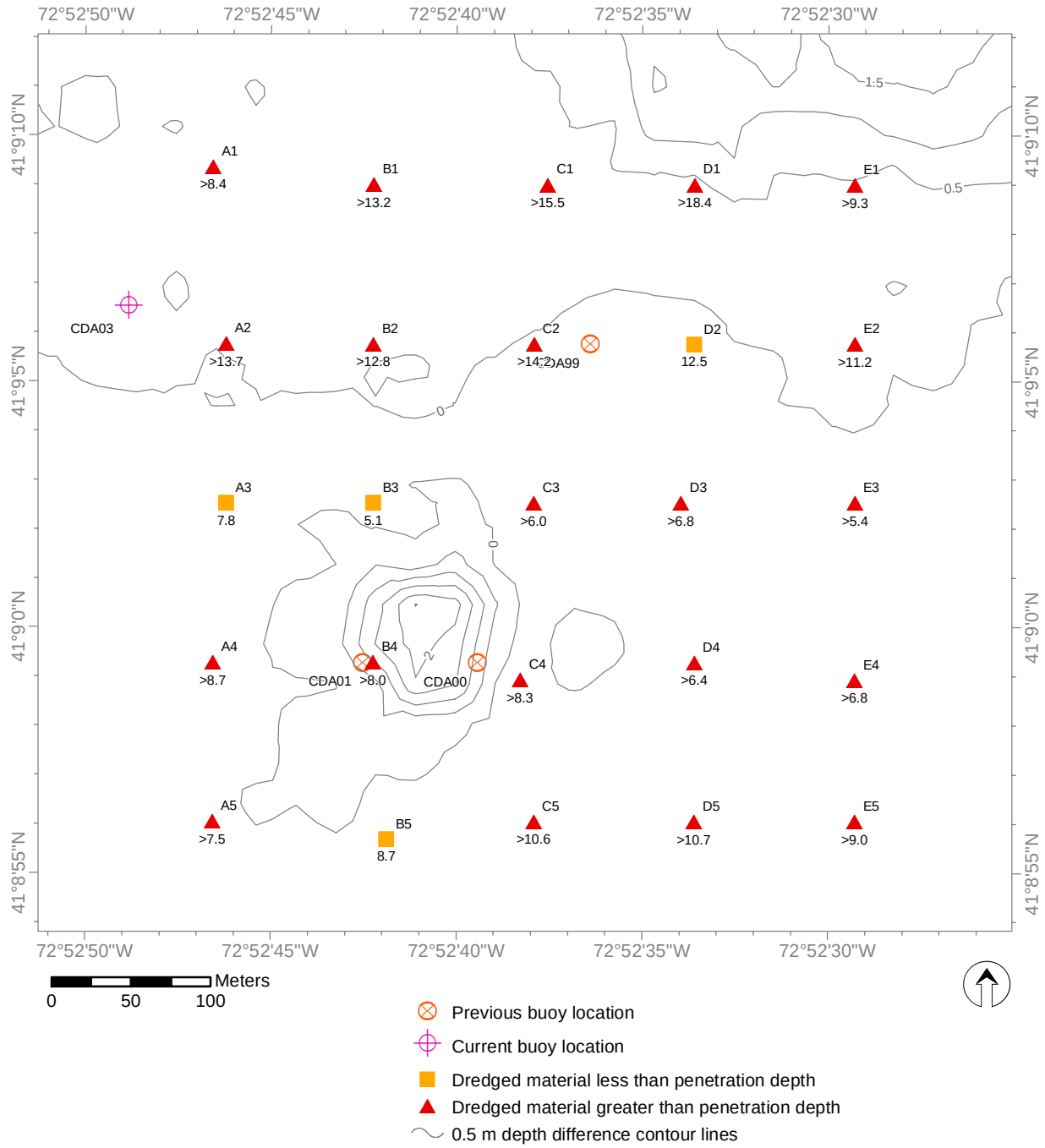
Figure 3-9 Median OSI values at CLDS Reference Areas, September 2003

Table 3-2

Summary of SPI Results for CLDS CLIS 99 and CLIS 00 Mound Stations, September 2003

Area	Station	Mean Prism Penetration Depth (cm)	Grain Size Major Mode (phi)	Boundary Roughness (cm)	Mean RPD Depth (cm)	Successional Stages present (no. of replicates)	Median OSI	Mean Total Phytodetritus (cm)	Methane Present?
CLIS 99	A1	8.4	> 4	0.5	1.8	I on III (3)	8	0.3	No
	A2	15.0	> 4	0.7	1.9	I on III (3)	8	0.6	No
	B1	13.2	> 4	1.2	2.4	I-II (2), I on III (1)	6	0.6	No
	B2	13.7	> 4	0.7	2.5	I on III (3)	9	0.5	No
	C1	15.5	> 4	0.7	3.2	II (1), I on III (2)	9	0.5	No
	C2	14.2	> 4	0.9	2.9	II (1), I on III (2)	10	0.4	No
	D1	18.4	> 4	0.6	4.0	II (1), I on III (2)	10	0.6	No
	D2	13.1	> 4	0.6	3.1	I (2), I on III (1)	6	1.0	No
	E1	9.3	> 4	0.7	2.3	I on III (3)	8	0.4	No
	E2	11.2	> 4	0.6	1.9	I on III (3)	8	0.3	No
CLIS 00	A3	9.6	> 4	0.7	2.6	I on III (3)	9	0.7	No
	A4	8.7	> 4	1.0	2.1	I on III (3)	8	0.6	No
	A5	7.5	> 4	0.9	2.0	II-III (2), I on III (1)	7	0.6	No
	B3	7.9	> 4	0.6	1.9	I on III (3)	9	0.9	No
	B4	10.2	> 4	0.5	2.9	II (I), I on III (2)	8	0.5	No
	B5	11.2	> 4	0.6	2.4	I on III (3)	9	0.5	No
	C3	7.6	> 4	0.6	1.5	I on III (3)	8	0.9	No
	C4	8.3	> 4	0.7	2.2	II-III (2), I on III (1)	8	0.6	No
	C5	10.6	> 4	0.7	1.8	I on III (3)	8	0.7	No
	D3	6.8	> 4	0.7	2.0	I on III (3)	8	0.9	No
	D4	6.4	> 4	0.5	2.3	I on III (3)	9	0.5	No
	D5	11.0	> 4	0.7	2.1	I on III (3)	9	0.6	No
	E3	5.4	> 4	0.6	0.5	I on III (3)	6	0.9	No
	E4	6.8	> 4	0.3	2.0	III (2), 1 missing	8	0.5	No
	E5	9.6	> 4	0.9	1.6	I on III (3)	8	0.5	No
Average		10.4		0.7	2.2		NA	0.6	
Median		NA		NA	NA		8	NA	
Minimum		5.4		0.3	0.5		6	0.3	
Maximum		18.4		1.2	4.0		10	1.0	

NA = Not applicable



Projection: Conformal Conic *Coordinate System*: CT State Plane (m) *Datum*: NAD 83

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Figure 3-10 Dredged material presence at CLIS 99 and CLIS 00 Mounds, CLDS, September, 2003

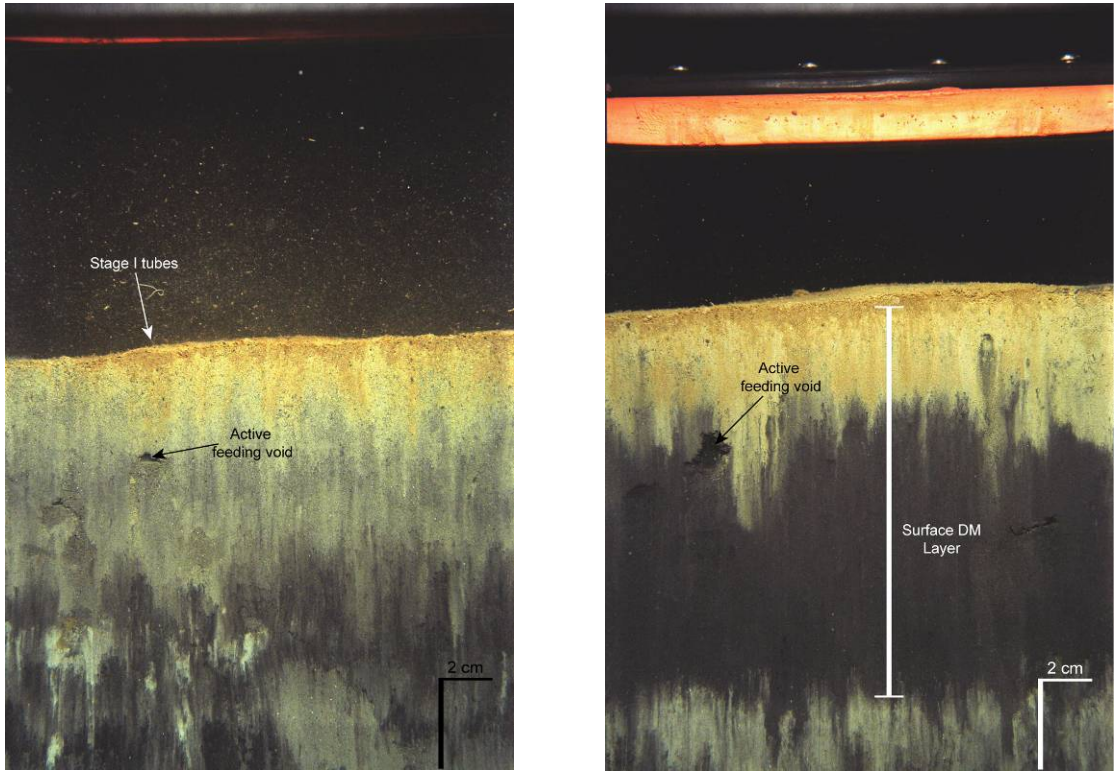
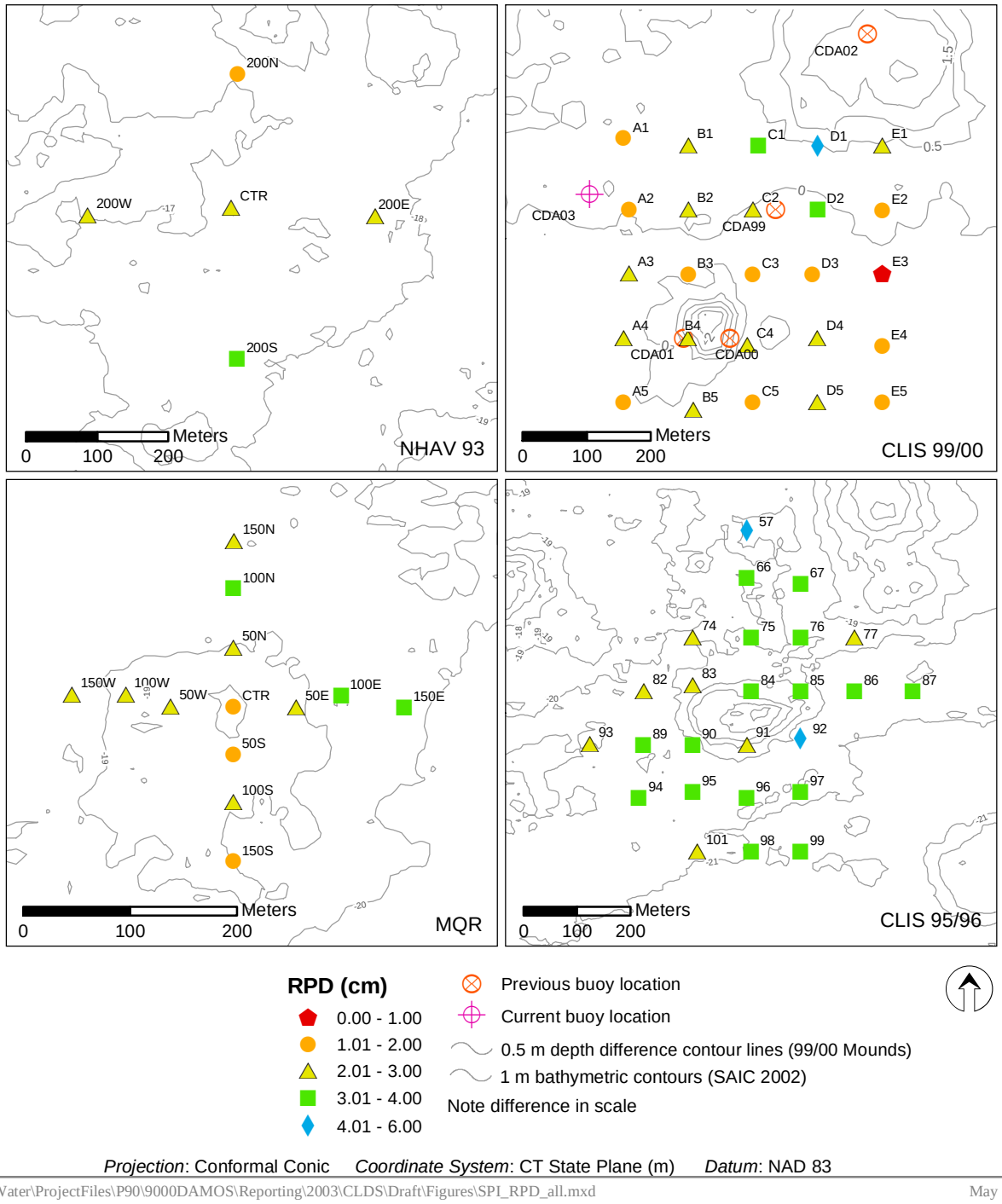


Figure 3-11 Representative SPI images illustrating surface layers of fine-grained dredged material observed at stations over the CLIS 99 and CLIS 00 Mounds. CLIS 00 C5A (left): Dredged material layer extending from the surface to below the camera's imaging depth, with active Stage III feeding voids and Stage I surface tubes (Stage I on III). RPD = 1.7 cm; OSI = +8. CLIS 99 B2A (right): A discrete surface layer of fine-grained, organic-rich dredged material having a thickness of 11.3 cm; the lighter-colored sediment at depth marks the former RPD (i.e. "relic RPD") prior to deposition of the newer dredged material. RPD = 2.5 cm; Stage I on III; OSI = +9.



Projection: Conformal Conic *Coordinate System*: CT State Plane (m) *Datum*: NAD 83

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Figure 3-12 Mean apparent RPD depths at CLIS 99, CLIS 00, CLIS 95/96, NHAV 93 and MQR Mounds, CLDS, September 2003

at all of the stations and was observed in all three replicate images at 16 of the 25 stations (Table 3-2, Figure 3-13).

With the exception Stations B1 and D2 within the CLIS 99 grid and Station E3 within the CLIS 00 grid, median OSI values were greater than +6 (range of +7 to +10) at all of the stations (Table 3-2, Figure 3-14). Values of +6 at Stations B1, D2 and E3 indicate only a minor degree of disturbance relative to the reference conditions.

3.2.3 CLIS 95/96 Mound Complex

Sediment Physical Characteristics

Dredged material was present at most of the stations over the CLIS 95/96 Mound Complex to a depth greater than the prism penetration depth (8.4 to 13.2 cm) (Table 3-3, Figure 3-15). Some of the sediment at Station R3C9-57 on the northern edge of the sampling grid and at two stations near the southern edge (R9C9-98 and R9C10-99) was similar in appearance to the ambient sediment at the reference areas. It is likely that the sediment at these stations is older dredged material that has weathered and been reworked to the point of becoming indistinguishable from ambient sediment. The major modal grain size at all of the stations over the mound complex was silt-clay (>4 phi). Individual particles within the uppermost layer consisted of pellets and broken tubes of Stage I organisms. Camera prism penetration depths were greater than 10 cm near the margins of the sampling grid and less than 10 cm toward the center. Relatively hard bottom was encountered at Station R6C9-84, making it necessary to fit the camera frame with weights to obtain useful images. Boundary roughness was low, ranging from 0.5 to 1.6 cm, and was attributed to both physical and biological factors.

Biological Conditions and Benthic Recolonization Status

Mean apparent RPD depths were all deeper than 2.0 cm, with 18 of the 25 stations having RPD depths greater than 3.0 cm (Table 3-3, Figure 3-12). Of the five mounds investigated during this survey, the 95/96 Mound Complex had the deepest overall apparent RPD depths. All stations had Stage III infauna. Overall, the stations were dominated by Stage I on III infauna (Table 3-3, Figures 3-13 and 3-16).

Median OSI values were uniformly high at this mound, with an overall station median of +10. OSI values ranged from +7 to +11 (Table 3-3). Based on the OSI values, the mound complex was in an advanced state of recolonization, comparable to CLDS reference area conditions.

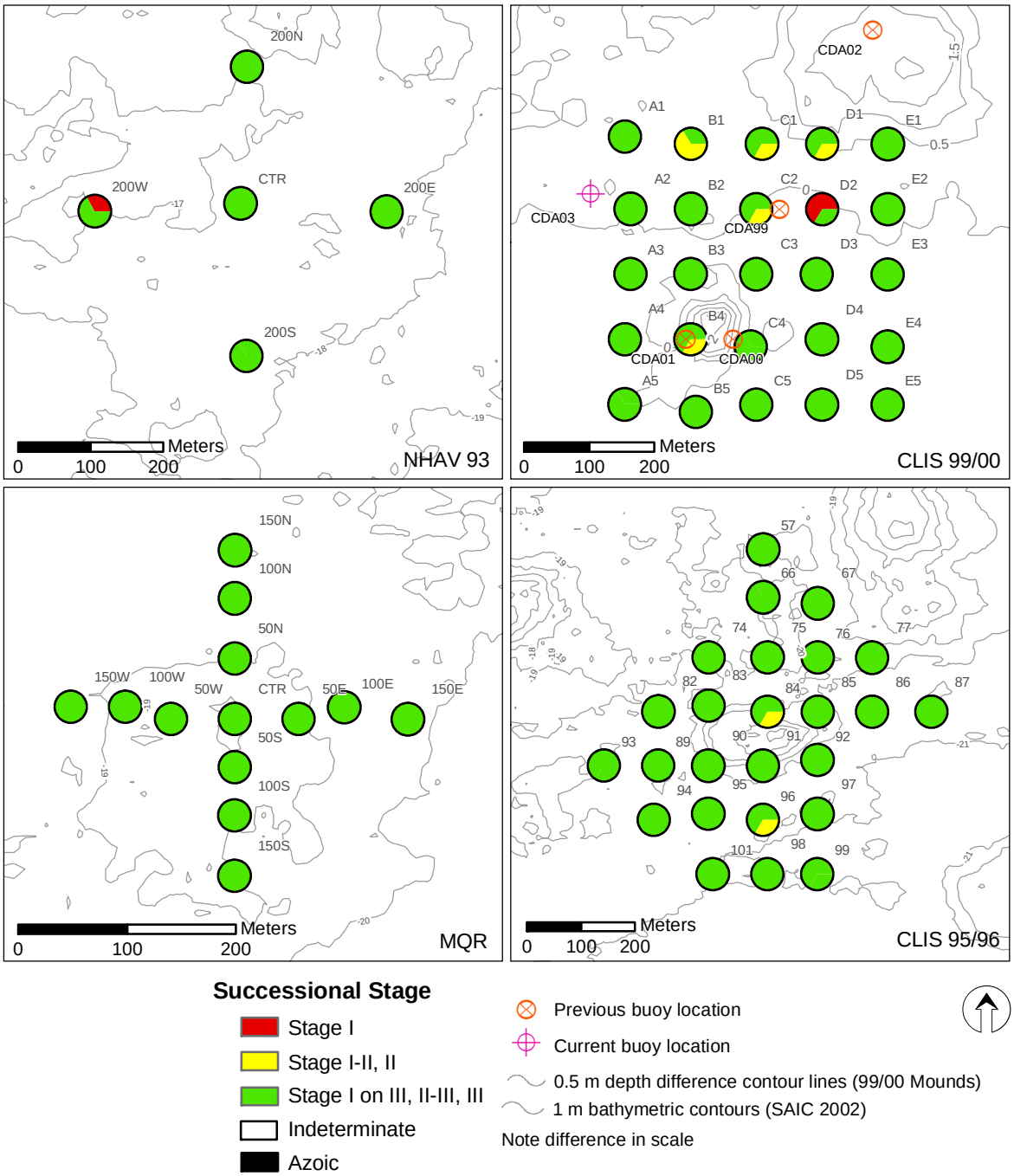
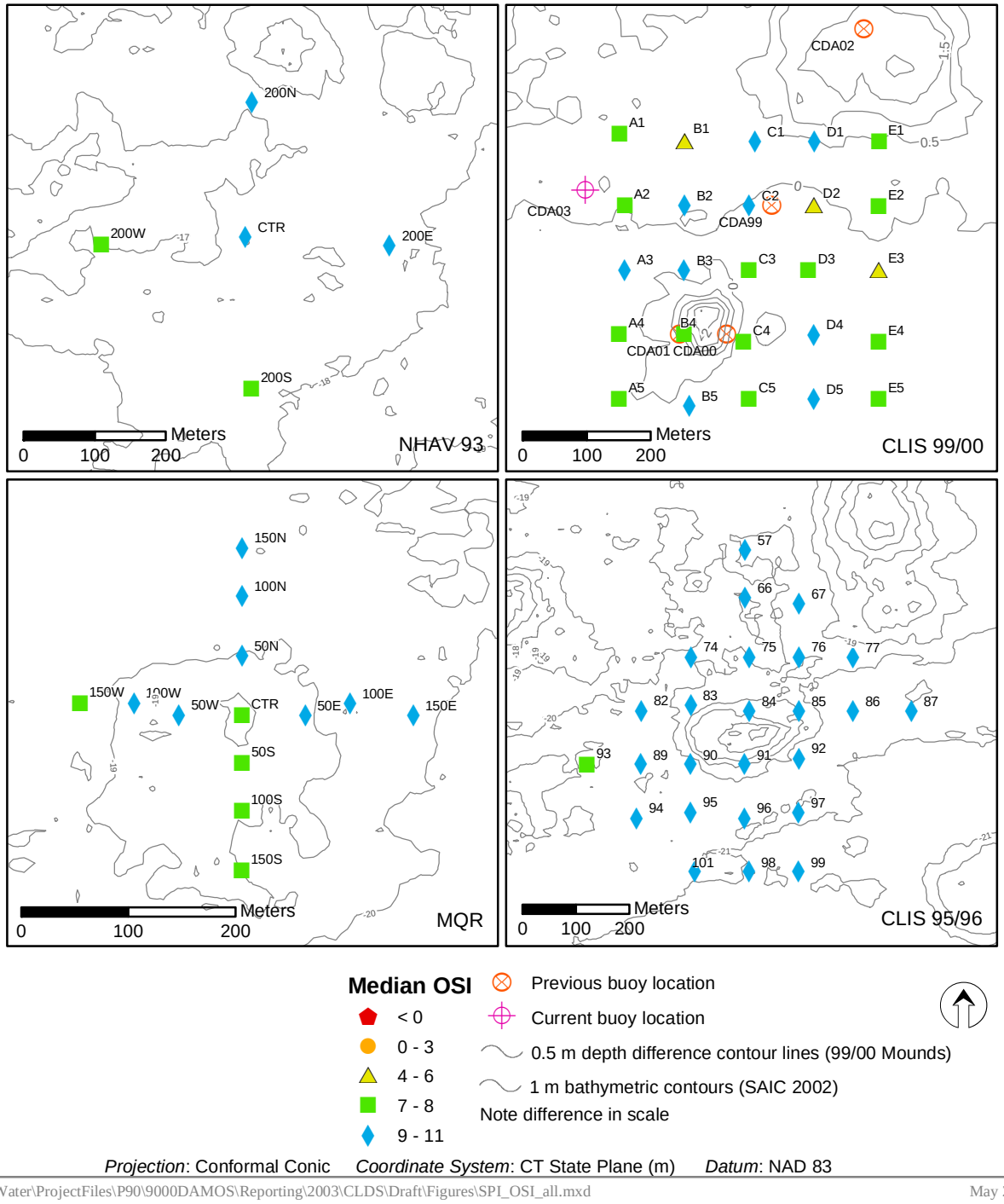


Figure 3-13 Infaunal successional stages at CLIS 99, CLIS 00, CLIS 95/96, NHAV 93 and MQR Mounds, CLDS, September 2003.



Projection: Conformal Conic *Coordinate System*: CT State Plane (m) *Datum*: NAD 83

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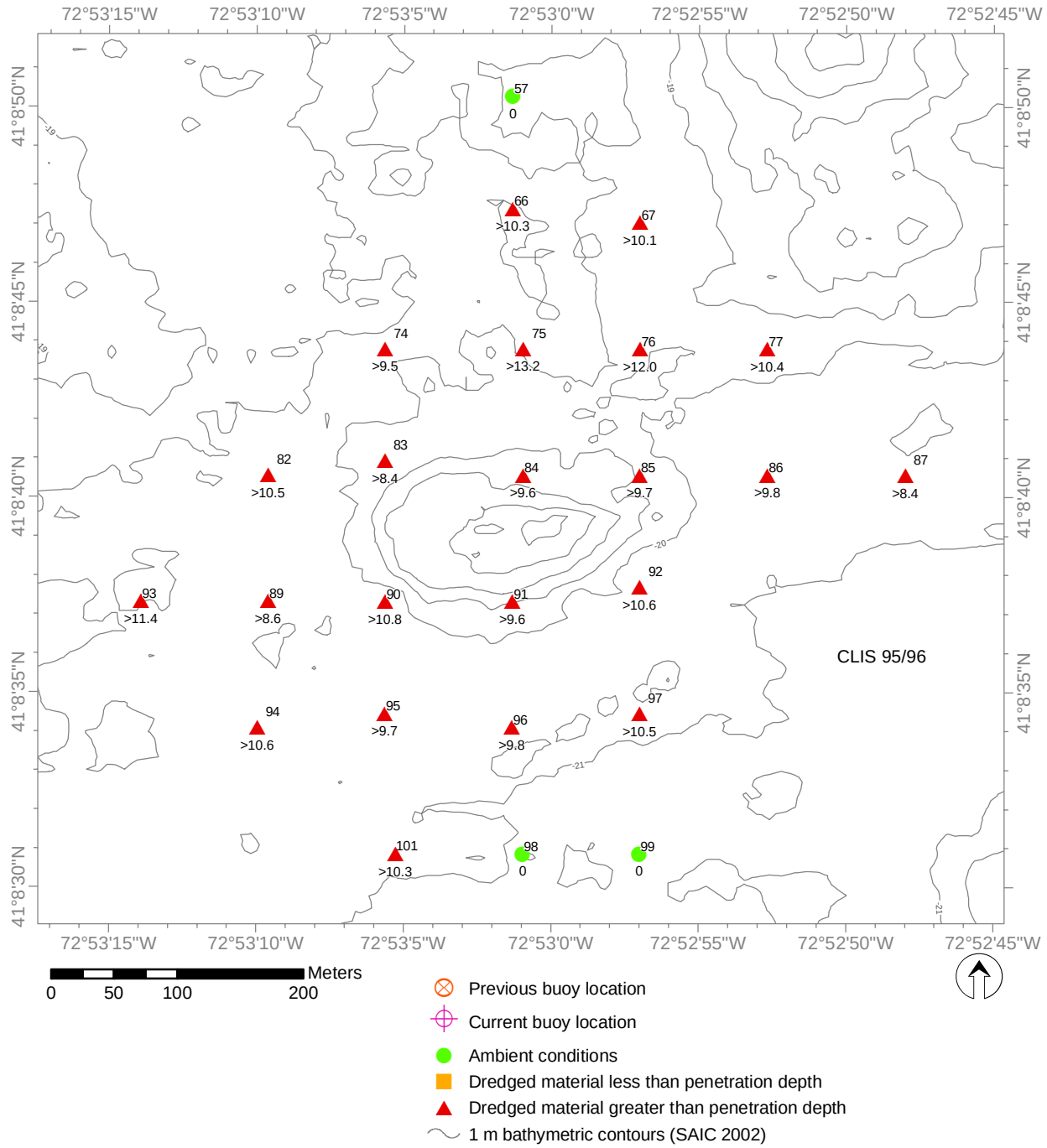
Figure 3-14 Median OSI values at CLIS 99, CLIS 00, CLIS 95/96, NHAV 93 and MQR Mounds, CLDS, September 2003

Table 3-3

Summary of SPI Results for CLDS CLIS 95/96 Mound Complex Stations, September 2003

Area	Station	Mean Prism Penetration Depth (cm)	Grain Size Major Mode (phi)	Boundary Roughness (cm)	Mean RPD Depth (cm)	Successional Stages present (no. of replicates)	Median OSI	Mean Total Phytodetritus (cm)	Methane Present?
CLIS	R3C9-57	12.9	> 4	1.1	4.0	I on III (3)	11	0.7	No
95/96	R4C9-66	10.3	> 4	0.9	3.5	II-III (2), I on III (1)	9	0.5	No
	R4C10-67	10.1	> 4	1.1	3.3	I on III (3)	10	0.8	No
	R5C8-74	9.5	> 4	0.7	2.9	I on III (3)	10	0.8	No
	R4C9-75	13.2	> 4	1.6	3.4	I on III (3)	10	0.8	No
	R5C10-76	12.0	> 4	0.8	3.9	I on III (3)	11	1.2	No
	R5C11-77	10.4	> 4	0.8	2.7	I on III (3)	9	0.8	No
	R6C7-82	10.5	> 4	1.4	2.9	I on III (3)	10	0.7	No
	R6C8-83	8.4	> 4	0.8	2.9	I on III (3)	9	1.0	No
	R6C9-84	9.6	> 4	1.4	3.1	II (1), I on III (2)	10	1.2	No
	R6C10-85	9.7	> 4	1.1	3.9	I on III (3)	11	0.7	No
	R6C11-86	9.8	> 4	0.8	3.6	I on III (3)	10	0.6	No
	R6C12-87	8.4	> 4	0.9	3.3	I on III (3)	10	0.5	No
	R7C7-89	8.6	> 4	0.5	3.0	I on III (3)	10	0.6	No
	R7C8-90	10.8	> 4	0.6	3.1	I on III (3)	10	0.7	No
	R7C9-91	9.6	> 4	1.2	2.7	I on III (3)	9	0.9	No
	R7C10-92	10.6	> 4	0.7	4.0	I on III (3)	11	0.7	No
	R7C6-93	11.4	> 4	1.5	2.0	II-III (1), I on III (2)	7	0.8	No
	R8C7-94	10.6	> 4	0.7	3.3	I on III (3)	11	0.6	No
	R8C8-95	9.7	> 4	1.0	3.4	I on III (3)	10	1.1	No
	R8C9-96	9.8	> 4	1.2	3.5	II (1), I on III (2)	9	0.4	No
	R8C10-97	10.5	> 4	0.7	3.5	I on III (3)	10	0.7	No
	R9C9-98	10.2	> 4	0.7	3.5	I on III (3)	10	0.6	No
	R9C10-99	10.6	> 4	1.0	3.4	II-III (1), I on III (2)	10	0.6	No
	R9C8-101	10.3	> 4	0.7	2.9	I on III (3)	9	0.7	No
Average		10.3		1.0	3.3		NA	0.7	
Median		NA		NA	NA		10	NA	
Minimum		8.4		0.5	2.0		7	0.4	
Maximum		13.2		1.6	4.0		11	1.2	

NA = Not applicable



Projection: Conformal Conic *Coordinate System*: CT State Plane (m) *Datum*: NAD 83

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Figure 3-15 Dredged material presence at CLIS 95/96 Mound Complex, CLDS, September, 2003

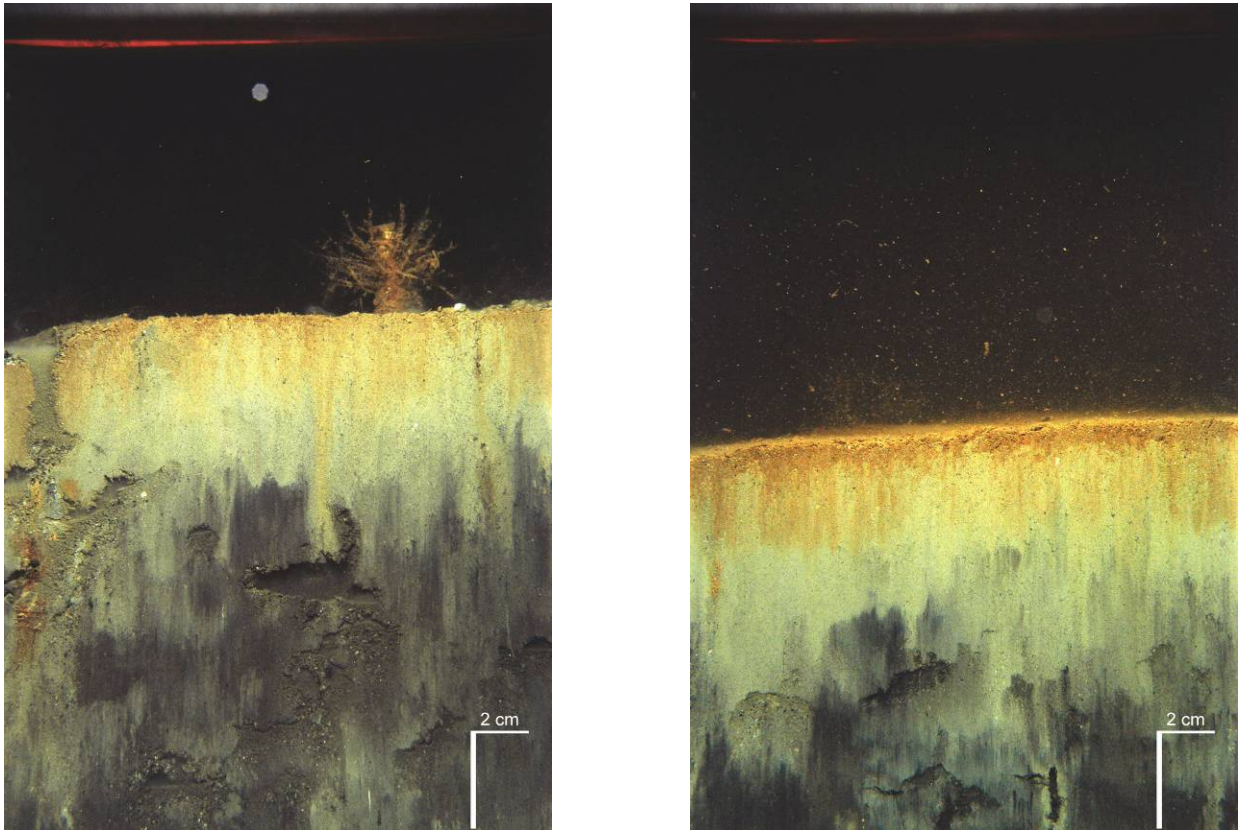


Figure 3-16 SPI images illustrating advanced successional status over the CLIS 95/96 Mound Complex. Station R5C10 76A (left): Dredged material with multiple Stage III feeding voids, Stage I surface tubes, a single *Chaetopterus* tube encrusted with hydrozoans, and a vertical burrow complex. RPD = 3.1 cm; Stage I on III; OSI = +10. Station R8C7 94B (right): Dredged material with a well-developed RPD of 3.3 cm, Stage I activity at the sediment surface, multiple Stage III feeding voids and an OSI of +11.

3.2.4 NHAV 93 Mound

Sediment Physical Characteristics

All stations at NHAV 93 had dredged material exceeding the penetration depth of the camera optical prism, which ranged from 9.2 to 11.4 cm (Table 3-4). These mean camera prism penetration depths were comparable to those measured at the reference area stations. Sediment texture was uniform over the five stations (>4 phi silt/clay) and all replicates showed the presence of the same rust-colored phytodetrital layer described for the reference areas (Figure 3-17). A small methane gas bubble was observed inside an active feeding void in one of the replicate images from Station 200E. This methane was likely produced at depth (as a result of anaerobic decomposition of organic-rich sediment located deeper within the mound) and became entrapped in the feeding void while migrating toward the sediment surface.

Biological Conditions and Benthic Recolonization Status

Mean apparent RPD depths ranged from 2.0 cm at Station NHAV 93 200N to 3.4 cm at Station NHAV93-200S; this is within the range of values observed at the reference area stations (Table 3-4, Figure 3-12). The NHAV 93 disposal mound had a uniform distribution of successional assemblages: Stage I on III infauna were present at all five of the stations (Table 3-4, Figure 3-13). Average OSI values ranged from +7 to +9 (Table 3-4, Figure 3-14), indicating that conditions over the NHAV 93 mound were comparable to those observed at the CLDS reference areas.

3.2.5 MQR Mound

Sediment Physical Characteristics

All station replicates at the MQR mound exhibited a surface layer of dredged material that extended deeper than the camera prism could penetrate (6.9 to 12.2 cm; Table 3-5). Sediment texture was primarily either silt-clay (>4 phi) or very fine sand (4–3 phi; Table 3-5). The presence of fine sand is related to the use of sandy sediment as capping dredged material (CDM) added to the mound during the 1993-94 disposal season. A few images showed a surface layer of sandy CDM overlying sulfidic, fine-grained dredged material at depth (Figure 3-18). The sediment surface also exhibited the rust-colored layer of phytodetritus that was associated with significant Stage I activity (e.g., small polychaete tubes, meiofauna tunnels, fecal pellets). More compact sediment was encountered at Stations MQR-50N and MQR-100E, making it necessary to add weights to the camera frame to obtain useful images for analysis.

Table 3-4

Summary of SPI Results for CLDS NHAV 93 Mound Stations, September 2003

Area	Station	Mean Prism Penetration Depth (cm)	Grain Size Major Mode (phi)	Boundary Roughness (cm)	Mean RPD Depth (cm)	Successional Stages present (no. of replicates)	Median OSI	Mean Total Phytodetritus (cm)	Methane Present?
NHAV 93	200E	11.4	> 4	0.7	2.8	I on III (3)	9	0.7	Yes
	200N	10.9	> 4	0.9	2.0	I on III (3)	9	0.6	No
	200S	9.2	> 4	1.6	3.4	II-III (2), I on III (1)	8	0.8	No
	200W	10.9	> 4	1.0	2.3	I (1), I on III (2)	7	0.5	No
	CTR	9.5	> 4	0.7	2.1	I on III (3)	9	0.7	No
Average		10.4		1.0	2.5		NA	0.7	
Median		NA		NA	NA		9	NA	
Minimum		9.2		0.7	2.0		7	0.5	
Maximum		11.4		1.6	3.4		9	0.8	

NA = Not applicable

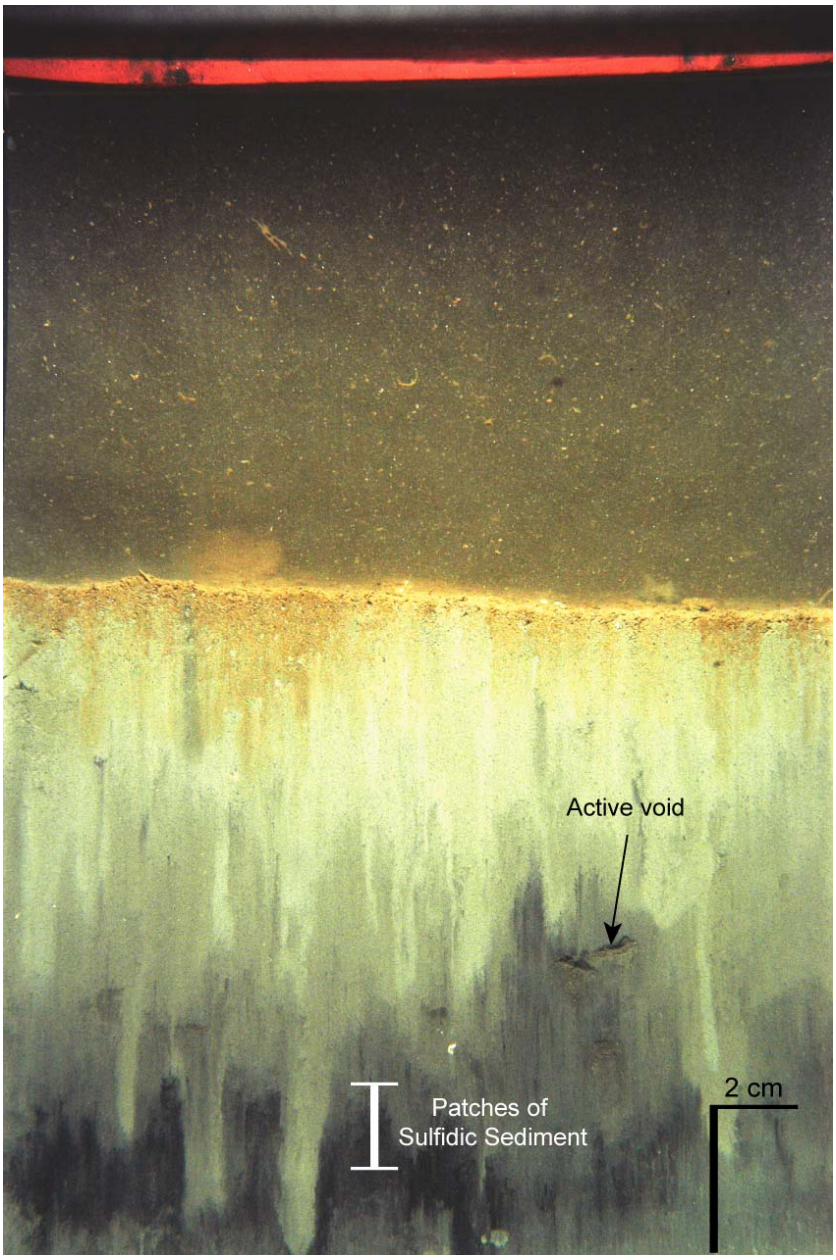


Figure 3-17 Representative SPI image from the NHAV 93 mound (Station NHAV 93 200E) showing dark, sulfidic, fine-grained dredged material extending from the sediment surface to below the camera's imaging depth. This image also shows the rust-colored phytodetritus layer with Stage I organisms, an RPD depth of 2.8 cm, and several sub-surface feeding voids. Successional stage I-III; OSI = +9.

Table 3-5

Summary of SPI Results for CLDS MQR Mound Stations, September 2003

Area	Station	Mean Prism Penetration Depth (cm)	Grain Size Major Mode (phi)	Boundary Roughness (cm)	Mean RPD Depth (cm)	Successional Stages present (no. of replicates)	Median OSI	Mean Total Phytodetritus (cm)	Methane Present
MQR	100E	11.7	4 to 3	1.6	3.8	I on III (3)	10	1.3	No
	100N	8.6	> 4	1.2	3.3	I on III (3)	10	1.0	No
	100S	7.5	> 4	0.6	2.3	I on III (3)	8	0.6	No
	100W	6.9	> 4	1.0	2.5	I on III (3)	9	0.7	No
	150E	10.3	> 4	1.3	3.3	I on III (3)	10	0.5	No
	150N	9.6	> 4	0.7	2.9	I on III (3)	10	0.5	No
	150S	7.2	4 to 3	1.2	1.3	I on III (3)	8	1.0	No
	150W	8.3	> 4	0.6	2.0	I on III (3)	8	0.5	No
	50E	6.9	> 4	1.2	2.7	I on III (3)	9	0.5	Yes
	50N	12.2	4 to 3	1.3	2.9	I on III (3)	9	0.6	No
	50S	9.8	> 4	0.9	1.1	I on III (3)	7	0.4	Yes
	50W	8.1	> 4	0.8	2.4	I on III (3)	9	0.5	No
	CTR	7.5	4 to 3	1.5	1.4	I on III (3)	7	0.3	No
Average		8.8		1.1	2.5		NA	0.6	
Median		NA		NA	NA		9	NA	
Minimum		6.9		0.6	1.1		7	0.3	
Maximum		12.2		1.6	3.8		10	1.3	

NA = Not applicable

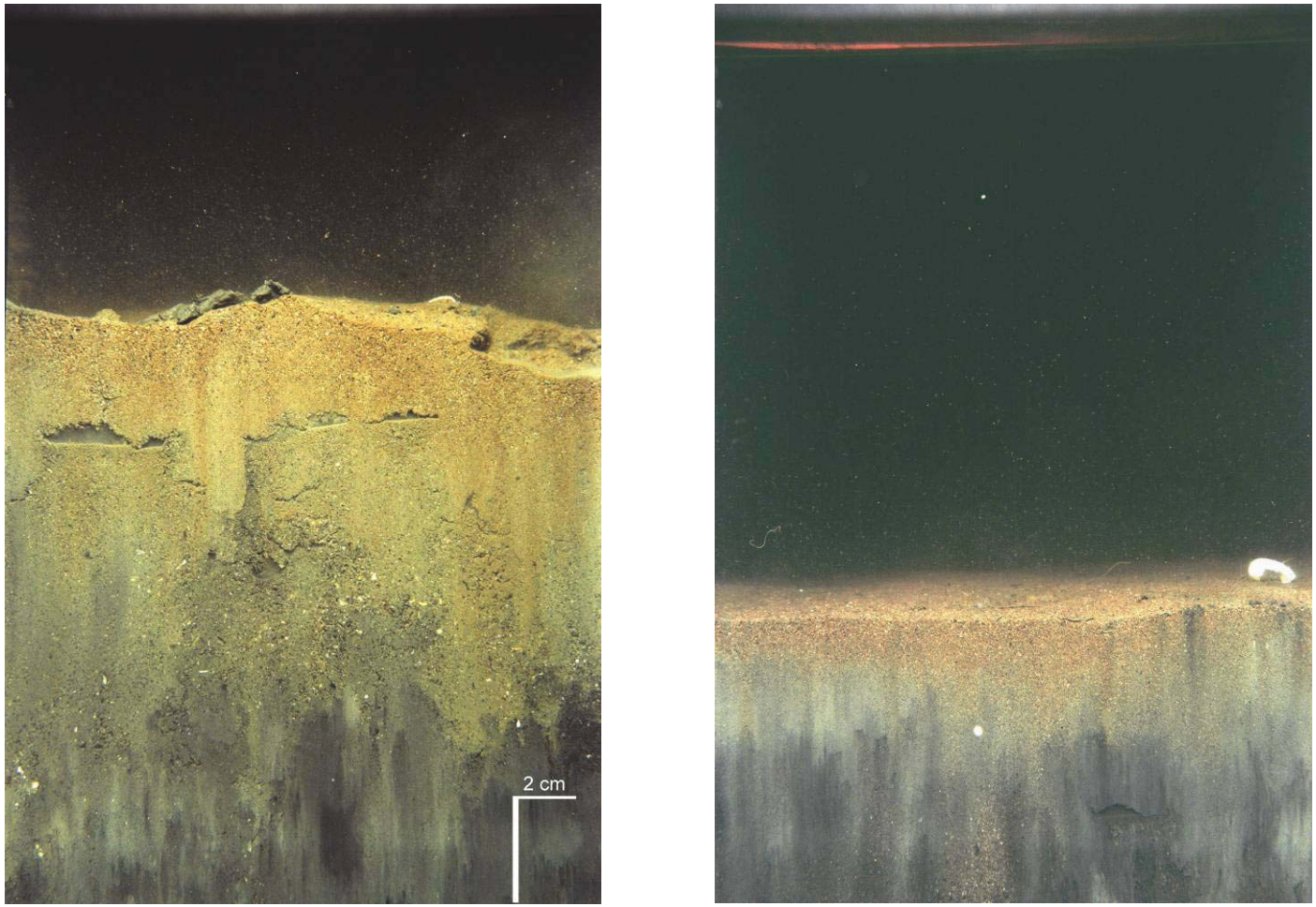


Figure 3-18 SPI images from Stations MQR 50N D2 (left) and 150S A2 (right) showing surface layers of muddy fine sand (4-3 phi) overlying reduced, silt-clay (>4 phi) dredged material.

As in previous SPI surveys at the MQR mound (SAIC 2002b), methane gas was observed in images at Stations MQR-50E and MQR-50S (Figure 3-19). The methane may have migrated through the sediment toward the surface from a source deeper within the mound (Table 3-5, Figure 3-20). Boundary roughness was attributed to both physical and biological factors, with values ranging from 0.6 to 1.6 cm and an average of 1.1 cm.

Biological Conditions and Benthic Recolonization Status

Mean apparent RPD depths were 2.0 cm or deeper at all stations except MQR-50S, MQR-150S, and MQR-CTR, where values ranged from 1.1 to 1.4 cm (Table 3-5, Figure 3-12). All stations at MQR had Stage III organisms and were dominated by Stage I on III infaunal assemblages (Table 3-5, Figure 3-13).

All MQR stations had median OSI values of +6 or greater (Table 3-5, Figure 3-14), and the median value for the mound was +9. This, as well as the presence of large *Chaetopterus* sp. tubes in three images, suggests that the MQR mound was in an advanced state of recolonization at the time of the 2003 survey.

3.2.6 Summary of CLDS Conditions

High median OSI values of +8 to +11 suggest that the CLDS reference stations represented an undisturbed benthic habitat. Most stations at the CLIS 99 and CLIS 00 Mounds had OSI values of +6 or higher, with ample evidence of the presence of higher-order Stage I on III infauna at all stations. This suggests that benthic infaunal communities were active and that nearly all stations were in an advanced state of recolonization.

The CLIS 95/96 Mound Complex median OSI values were uniformly high (all greater than +7). Based on this information, the 95/96 Mound Complex was in an advanced state of recolonization and was comparable in habitat to the CLDS reference stations.

All stations at the NHAV 93 Mound had OSI values of +6 or higher and Stage III organisms. Although methane gas was observed in one image, it was likely due to the high organic content in the original disposal material. These results suggest that benthic infaunal communities were active and all stations were in an advanced state of recolonization.

Methane gas bubbles likewise were observed in two images from the MQR Mound; methane has been observed at various times and locations over this mound in

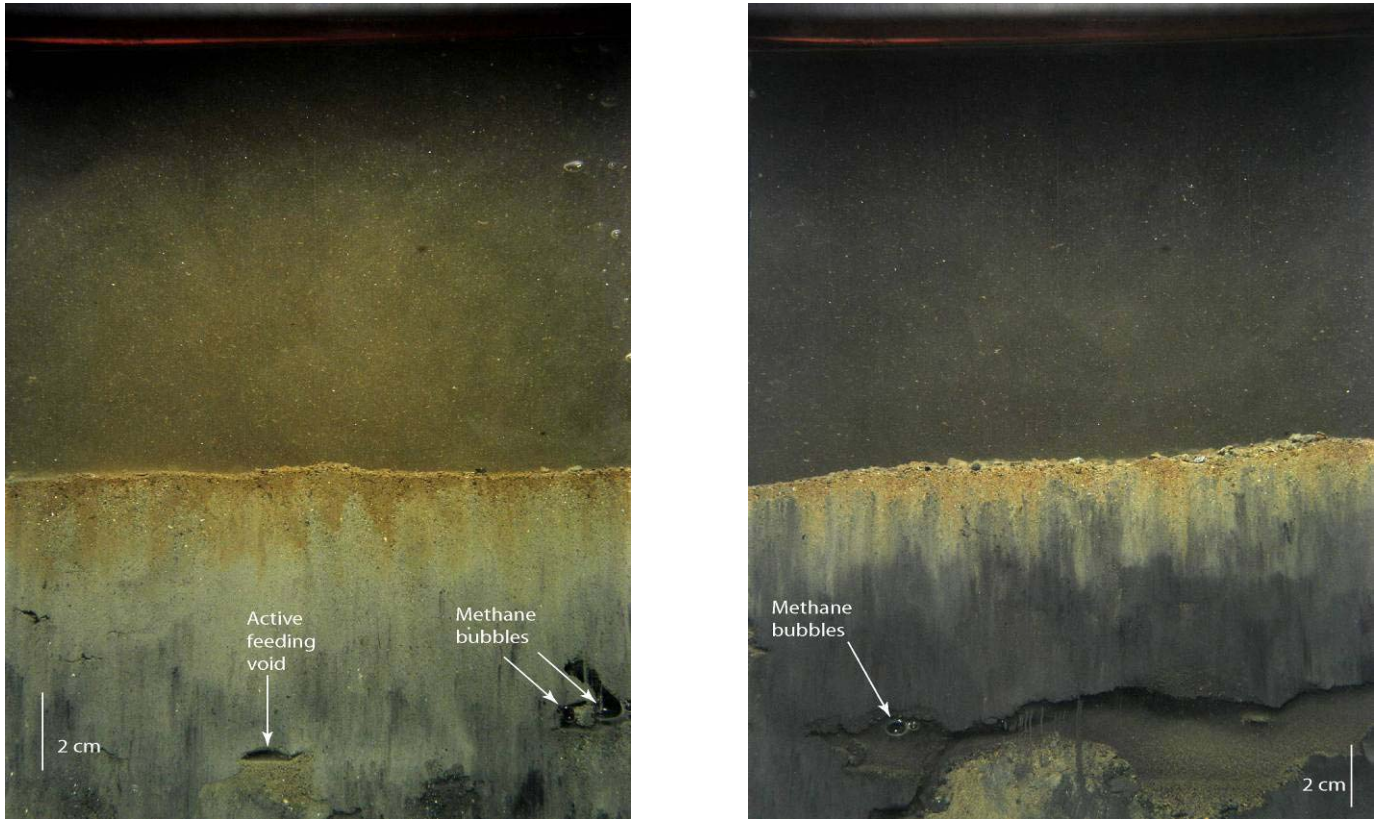


Figure 3-19 Sediment-profile images from Stations MQR 50E B and MQR 50S D. MQR 50E B (left): Well-bioturbated muddy sand with methane gas bubbles. Gas rising through the sediment column commonly accumulates in biogenic voids such as the subsurface feeding voids seen here. RPD = 2.7 cm; Stage I on III; OSI = 7. MQR 50S D (right): Methane gas bubbles are trapped in a subsurface water-filled void as they rise towards the surface. The origin of this particular void is uncertain. RPD = 0.6 cm; Stage I on III; OSI = 4.

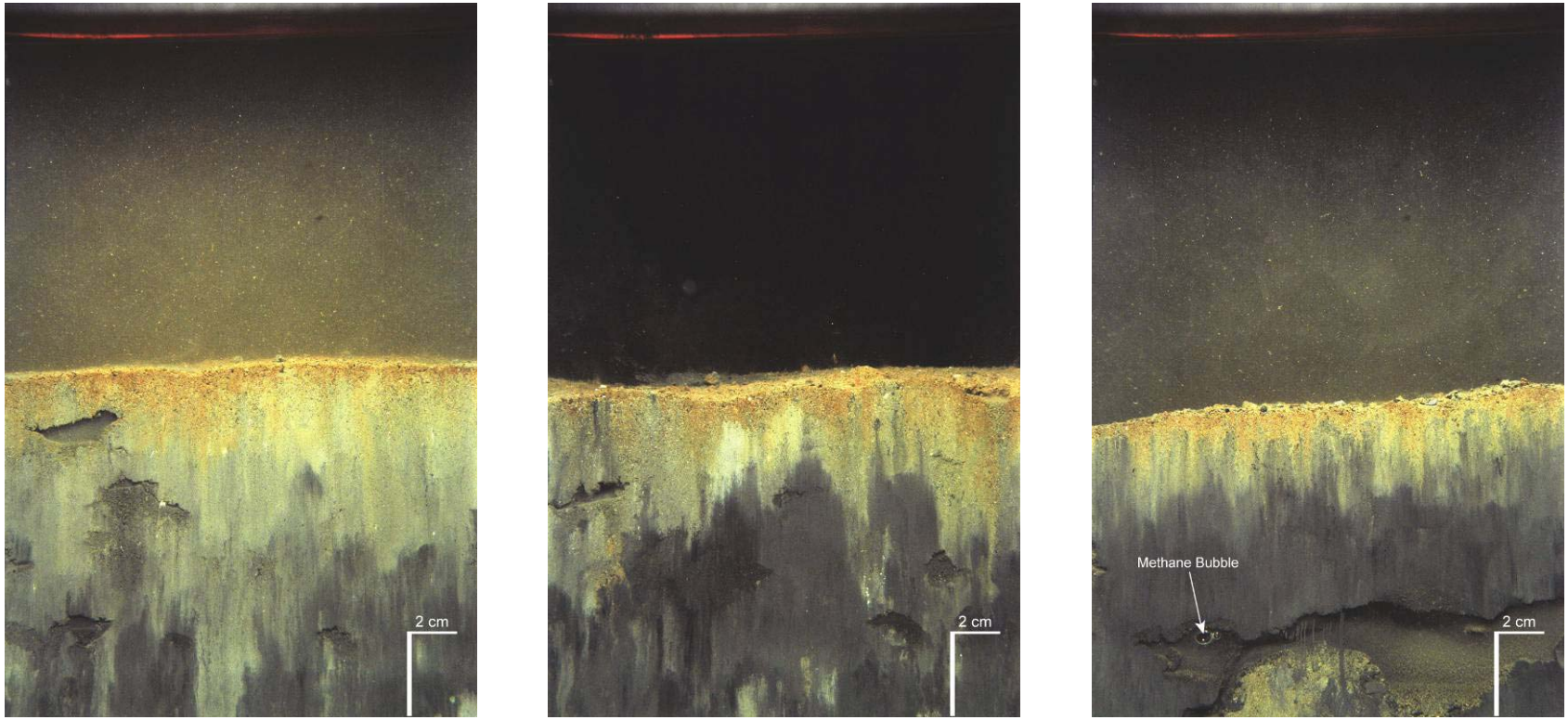


Figure 3-20 SPI images from Station MQR 50S. The methane gas bubble in the image at right was probably produced as a result of anaerobic decomposition of organic-rich dredged material located deeper within the MQR mound. Despite the presence of such organic-rich sediment at depth, all three images show evidence of extensive biological activity by Stage III organisms, in the form of multiple active feeding voids (left and center images) and the relatively large oxidized burrow (right image).

previous SPI surveys. Despite the presence of highly organic-rich dredged material at depth within this mound, the SPI images of the mound's surface revealed the presence of Stage III organisms at all stations, and all stations had OSI values greater than the +6 threshold value. This suggests that MQR Mound was in an advanced state of recolonization.

3.2.7 Comparison with Reference Area Conditions

The rust-colored phytodetrital layer was present at the three CLDS reference areas and at the CLDS mounds. There appeared to be significant biological activity by tube-building Stage I polychaetes and shallow-burrowing meiofauna associated with this layer. The majority of stations over the surveyed mounds were characterized by dredged material having a grain size major mode of > 4 phi (silt-clay), as did all stations in the reference areas. Some stations on MQR Mound were characterized by very fine sand (4 to 3 phi).

The ecological status of the CLDS disposal mounds, as reflected in the median OSI values, was compared to that at the reference areas (Table 3-6). The highest OSI values were found most consistently at the CLIS 95/96 Mound Complex, where the median OSI value of +10 was comparable to that of the combined reference stations (+9.5). Stage I on III infauna were present in at least one replicate image, and typically in all three images, at all 25 stations surveyed (Figure 3-13).

The overall median OSI values at the other surveyed mounds (MQR, NHAV 93, CLIS 99 and 00) ranged from +8 to +9, slightly lower than the overall median of +9.5 at the reference stations. This reflects the somewhat shallower average RPD depths at these mounds, due to the presence of organic-rich dredged material that was still undergoing biological reworking at the time of the survey. From an ecological perspective, however, the median OSI values over these were indicative of slightly disturbed or undisturbed benthic conditions. Both the disposal mounds and reference areas exhibited reasonably well-developed RPD depths and an advanced recolonization status attributed to the widespread presence of surface-dwelling Stage I and larger-bodied, subsurface Stage III infauna.

3.2.8 Comparison with Previous Monitoring Surveys

Various mounds located at the Central Long Island Sound Disposal Site have been incorporated into the DAMOS monitoring program over the past 26 years. In any given survey year, selected mounds are investigated to determine the location of disposed dredged material (historic and newly placed) as well as to determine the ecological status

Table 3-6

Comparison of 1997, 1999, 2001, and 2003 Sediment Biological Conditions for CLDS and Reference Stations

Area	Year*	Average RPD, in cm (range)	Median OSI (range)
CLIS99/00	2001	2.7 (1.3 to 5.7)	+7 (+2 to +11)
	2003	2.2 (0.5 to 4.0)	+8 (+6 to +10)
CLIS95/96	1999	2.9 (2.2 to 4.1)	+9 (+5 to +11)
	2003	3.3 (2.0 to 4.0)	+10 (+7 to +11)
NHAV 93	1997	2.2 (1.6 to 3.0)	+5 (2.5 to +8)
	1999	2.2 (1.8 to 2.5)	+8 (+4 to +9)
	2001	2.6 (1.8 to 3.3)	+8 (+5 to +9)
	2003	2.5 (2.0 to 3.4)	+9 (+7 to +9)
MQR	1999	2.5 (1.7 to 3.3)	+9 (+4 to +10)
	2003	2.5 (1.1 to 3.8)	+9 (+7 to +10)
Reference	1997	2.4 (1.6 to 3.4)	+7.25 (+3.5 to+10)
	1999	3.3 (1.5 to 4.7)	+9 (+6 to +11)
	2001	3.1 (2.3 to 3.9)	+9 (+ 4 to +10)
	2003	3.0 (1.7 to 4.6)	+9.5 (+8 to +11)

*June 2001, September 1999 and September 1997 CLDS data from SAIC (2002a, 2002b, 2003)

of the benthic infauna. Where appropriate data exist, the 2003 SPI results were compared with earlier DAMOS SPI surveys conducted at CLDS (Table 3-6, Figure 3-21). Prior data are drawn from DAMOS Contributions 135 (SAIC 2002a), 139 (SAIC 2002b), and 142 (SAIC 2003).

CLDS Reference Areas

As part of the DAMOS monitoring protocol, reference station data are collected to provide a baseline for comparison with the results from the dredged material mounds (SAIC 2002a). The CLDS reference areas are used to characterize the ambient conditions within the central Long Island Sound region during the period that monitoring operations are being conducted at the disposal site (SAIC 2002a). In the past, natural (e.g., hypoxia) and/or anthropogenic (e.g., unintentional dredged material disposal, trawling activities) disturbances within the reference areas have been an important consideration in the interpretation of the monitoring data within CLDS (SAIC 2002a).

Historic OSI data from the reference areas show that in 1997, 1999, 2001, and 2003 (this survey), most values were above +8 (Figure 3-21). In 1997, however, 6 of 15 stations had OSI values less than +6 (SAIC 2002a). The prevalence of low OSI values at the reference stations in 1997 was attributed to relatively thin apparent RPD intervals caused by low dissolved oxygen conditions and the absence of Stage III infauna (SAIC 2002a). Other than the 1997 anomaly, the reference areas have had consistently high OSI values.

CLIS 99 and CLIS 00 Mounds

The CLIS 99 and CLIS 00 Mounds were previously surveyed in 2001, providing the only data for comparison with the results of the 2003 SPI survey (SAIC 2003). In the 2001 survey dredged material greater than the penetration depth was observed at all stations. Recent dredged material was observed at the majority of stations with the exception of Stations 99-E1, 99-B2, 99-C2, 00-D3, 00-A4, 00-D5, and 00-E5, and only small amounts (<3.0 cm) were found at Stations 99-D2 and 00-C3. The 2003 survey documented dredged material present at the majority of CLIS 99 and CLIS 00 stations, and all stations with dredged material had dredged material greater than the camera penetration depth with the exception of 99-D2, 00-A3, 00-B3, and 00-B5 (Figure 3-10).

Mean apparent RPD depths at the CLIS 99/00 stations ranged from 0.5 to 4.0 cm in 2003, which were shallower than those found in 2001 (Table 3-6). The shallowest mean RPD was observed at Station 00-E3 (0.5 cm). This station, located on the central eastern boundary of the sampling grid, also had the shallowest RPD during the 2001

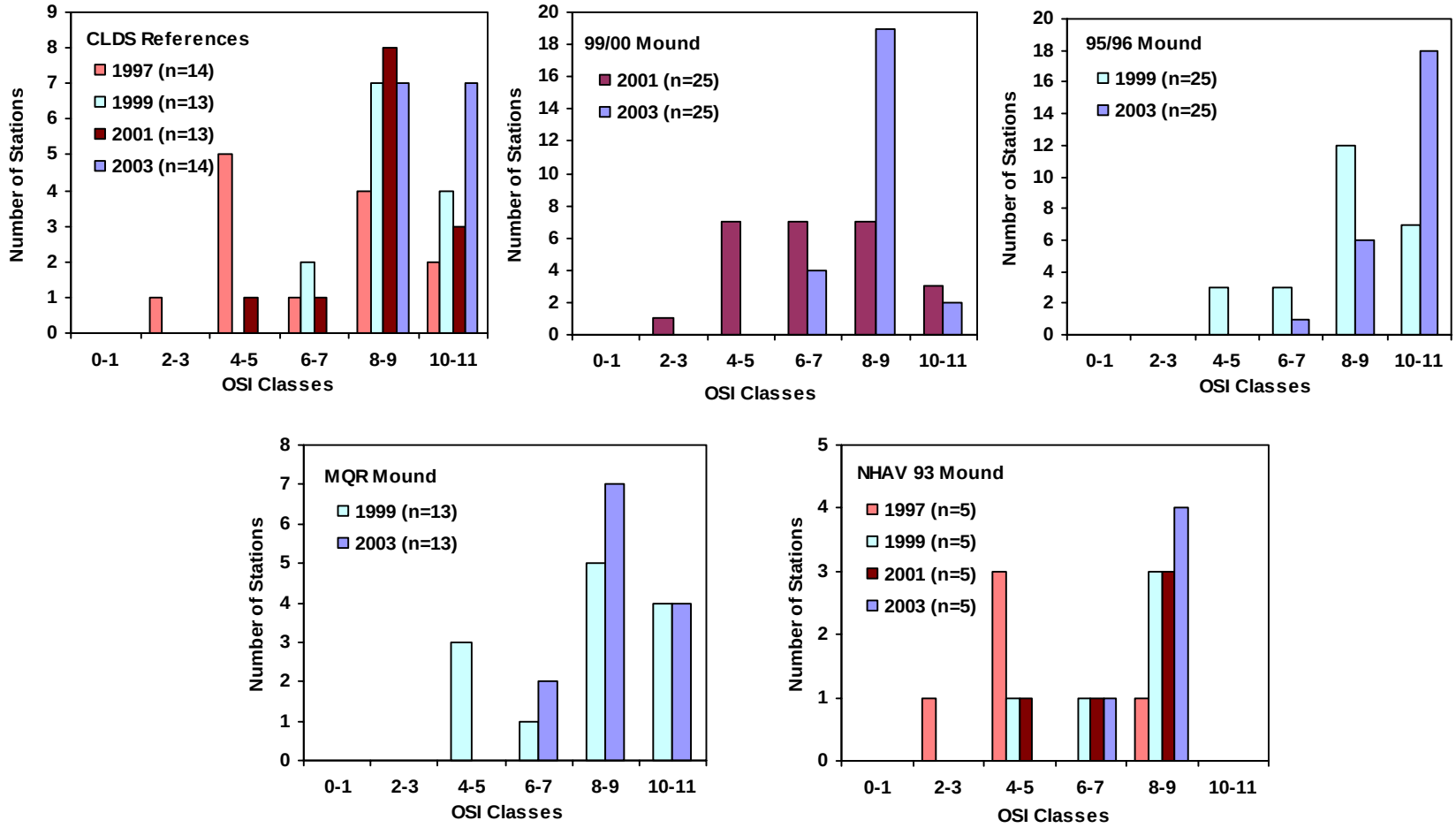


Figure 3-21 Frequency distribution of median OSI values for CLDS reference areas, CLIS 99 and CLIS 00 Mounds, CLIS 95/96 Mound Complex, NHAV 93 Mound and MQR Mound in 1997, 1999, 2001 and 2003.

survey. The deepest mean apparent RPD was observed at Station 99-D1 (4.0 cm), whereas in 2001, Station 99-E2 had the deepest RPD; both stations are located in the northeastern corner of the sampling grid. These results suggest that the specific locations of shallow and deep RPD may differ, but that the general areas where they are found within the site have remained consistent over the past four years.

A positive change in OSI values was evident in 2003 compared with 2001 results. The majority of OSI values in 2001 were distributed equitably over the ranges of +4 to +5, +6 to +7, and +8 to +9 (Table 3-6, Figure 3-21). In the 2003 survey, most OSI values ranged from +8 to +9, indicating a general improvement in site conditions.

CLIS 95/96 Mound Complex

The CLIS 95/96 Mound Complex was developed during the 1995 and 1996 disposal seasons. A survey in 1997 determined that the UDM, from Milford and Bridgeport Harbors, was completely capped with CDM and isolated from the surrounding environment (SAIC 2002a). The results of the September 1997 survey were comparable to those of the 1999 survey. Stage III organisms were present at all stations over the mound complex, and relatively deep RPD depths were observed (SAIC 2002b). The sediments at this mound have been left undisturbed for six years, allowing further recruitment of Stage III fauna. The mean apparent RPD depth increased from 2.9 cm in 1999 to 3.3 cm in 2003. The median OSI in 1999 was +9, which increased to +10 in the 2003 survey (Table 3-6, Figure 3-21) suggesting improved benthic habitat quality. The CLIS 95/96 Mound Complex continues to be in an advanced state of succession and was comparable to CLDS reference conditions at the time of the September 2003 survey.

NHAV 93 Mound

Disposal activities at this mound were completed in the spring of 1994. Subsequent monitoring in 1997, 1999, and 2001 demonstrated a cyclical pattern of recovery and decline (SAIC 2002b). Some stations such as 200S have consistently had relatively low OSI values, whereas other stations typically have exhibited higher OSI values and were considered to be in a more advanced stage of benthic recovery.

OSI values at the NHAV 93 mound were compared over most survey years (Table 3-6; Figure 3-21). The lowest median OSI was in 1997 (+5). In 1999, the median OSI increased to +8, remained at +8 in 2001, and increased slightly to +9 in 2003 survey (Figure 3-21). The sediment at NHAV 93 in 2003 was rich in organic matter as evidenced by the reduced black color of the underlying sediment and the presence of methane in a single replicate image from Station 200E. Despite the presence of this

organic-rich sediment, RPD depths were moderately well-developed and there was evidence of advanced Stage III recolonization at all of the 2003 stations.

MQR Mound

The MQR mound was first developed during the 1981–1982 disposal season and consists of UDM capped with CDM, which was placed during the 1982–1983 season (SAIC 2002b). Following placement of additional CDM during the 1993–1994 season, a survey in 1994 detected Stage II and Stage III organisms in the benthic community (SAIC 2002b). The 1999 survey provided evidence of improved benthic conditions relative to 1994 with the exception of the presence of low OSI values in the southern portion of the mound. Results from the 2003 survey at MQR Mound indicate little change in mean apparent RPD and overall distribution of OSI values over the four-year interval between SPI surveys, suggesting that the site is relatively stable (Table 3-6, Figure 3-21). The majority of stations sampled in 2003 had OSI values in the +8 to +9 category, with a few stations falling in the higher +10 to +11 category. This historic mound appears to be well colonized by Stage I and Stage III infauna. Large polychaete tubes, believed to be *Chaetopterus,* were identified from sediment-profile images taken in 1999 and 2003. The southern Stations 100S and 150S, which had median OSI values of +4 in 1999, had OSI values of +8 and +6, respectively, in 2003, indicating improved benthic conditions compared with 1999.

4.0 DISCUSSION

The objectives of the September 2003 survey at CLDS included characterization of the seafloor topography of the study area, documentation of dredged material distribution, and assessment of benthic recolonization status at CLIS 99, CLIS 00, CLIS 95/96, NHAV 93, and MQR relative to reference areas and previous surveys. Seafloor topography, dredged material distribution, and benthic recolonization at these mounds and the three CLDS reference areas were characterized with bathymetric and SPI surveys.

4.1 Dredged Material Distribution

The September 2003 single-beam bathymetric survey at CLDS was intended to assess the seafloor topography of a portion of CLDS where dredged material had been deposited since the last survey in 2001. Two newly developed mounds, CLIS 01 and CLIS 02, were observed. CLIS 01 was a small mound located to the west of the original CLIS 00 Mound; CLIS 02 was a larger mound located to the northeast of the CLIS 99 Mound.

The management strategy at CLDS involves the disposal of small to moderate volumes of dredged material in rings, which can serve as containment cells on the seafloor. In September 2003, the CDA buoy was relocated to the west of the CLIS 99 Mound. Dredged material deposited during the 2003–2004 disposal season will likely form another discrete mound in this area.

Surface layers of dredged material having a thickness that exceeded the penetration depth of the camera prism were found in the majority of SPI images at all of the surveyed mounds. Ambient conditions were only detected at few stations over the CLIS 95/96 Mound Complex. Due to the extensive disposal of dredged material that has taken place at CLDS over time it was somewhat difficult to distinguish between recent and historical layers of dredged material observed in some of the SPI images. Small, subsurface patches of black, sulfidic sediment observed in a few images at some of the reference area stations (2500W 3, 4500 E 1 and 2, CLIS REF 3, 4 and 6) are most likely of natural origin. Such patches could develop, for example, as a result of pulses of organic matter at the sediment surface being mixed downward by organisms, creating localized zones of organic enrichment at depth. Past investigations into the possible origin of an observed disturbed surface layer and chaotic sediment fabric within CLIS REF did not reveal any large-scale sediment deposits but rather naturally occurring sedimentary furrows and trawl door scars (SAIC 2002a).

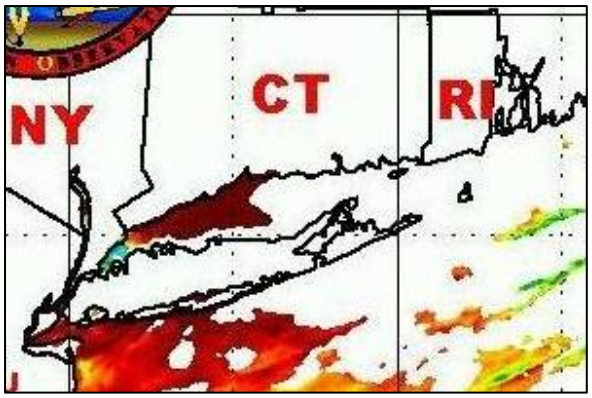
4.2 Biological Conditions and Benthic Recolonization

Benthic recolonization at the CLIS 99, CLIS 00, CLIS 95/96, NHAV 93, MQR Mounds and Reference areas was evaluated by the SPI survey conducted in September 2003. The 2003 SPI survey results indicated that the biological condition of the historic MQR Mound has improved since the previous survey of 1999. Between the 1999 and 2003 surveys at this mound, average RPD values have not changed significantly but OSI values have increased, reflecting a higher incidence of advanced Stage III taxa. This improvement suggests that the placement of dredged material at MQR in 1993-1994 has resulted in normal biological recovery over the mound. The deepest average RPD depths (3.3 cm) and highest median OSI values (+10) were observed at the CLIS 95/96 Mound Complex, which appeared to have completely recovered to ambient conditions and attained RPD and OSI values comparable to the reference areas. Likewise, average RPD and median OSI values over the CLIS 99 and CLIS 00 Mounds indicated relatively advanced recolonization status comparable to the reference areas. The conditions at NHAV 93 appeared to have improved from the 2001 survey, particularly at Station 200S where clear evidence of Stage III organisms was present. In 2001, the sediments at 200S were characterized by black sulfidic sediments below a moderate RPD; in 2003 the subsurface sediments were also sulfidic (high organic load) but were clearly being reworked by Stage III organisms.

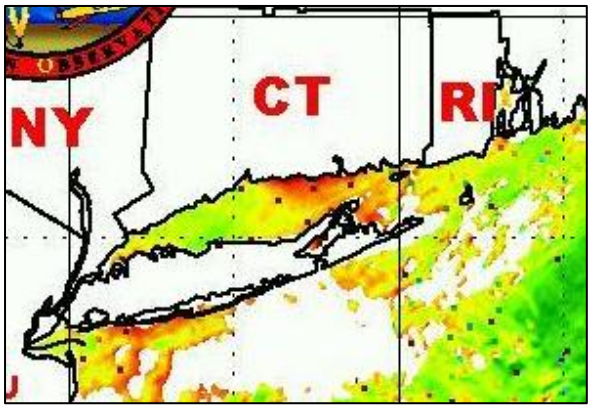
A unique result from the 2003 SPI survey was the apparently ubiquitous presence of a thin, rust-colored surface layer on the sediments at all three reference areas and each of the disposal mounds. The color of this material suggested the presence of degrading phytoplankton (phaeopigments or phytodetritus). The 2003 SPI survey took place from 8–10 September 2003. Approximately 18 to 20 days prior to the survey, a chlorophyll bloom event was documented by satellite spectral imagery (Figure 4-1). This apparent bloom was not present on 19 August, but on 20 August the highest concentration of chlorophyll was imaged. Chlorophyll concentrations decreased to moderate to high levels on 22 August, and returned to below threshold detection levels on 25 August (Figure 4-1). It is likely that this Sound-wide, five-day event was responsible for producing the phytodetrital layer observed in the SPI images.

Under usual circumstances, a phytoplankton settlement event would be expected to enhance growth or activities of Stage I infauna. In previous late summer SPI surveys, Stage I (tubiculous) polychaetes were abundant and easily recognized in the images. At all reference and disposal mound stations that were surveyed with SPI in 2003, broken and recumbent tubes of Stage I polychaete worms formed from this pigmented layer were scattered throughout a highly bioturbated surface layer (meiofaunal tunneling and

August 20, 2003



August 22, 2003



Chlorophyll Concentrations

August 25, 2003

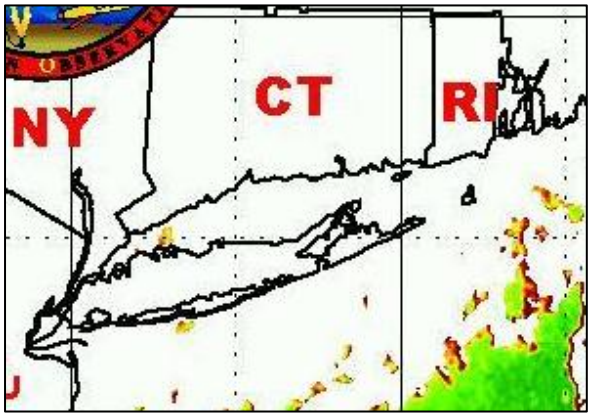


Figure 4-1 Chlorophyll concentrations along Atlantic Coast from Rutgers University Coastal Ocean Observation Lab, August 20, 22, and 25, 2003

abundant foraminifera were also common in this layer). Upright tubes were also observed but did not appear to be as abundant as in some past surveys. It appears that the input of extra organic material caused an increase in biological activity and that Stage I organisms may have rapidly formed loose tubes from fecal pellets that easily disaggregated. At magnifications of 4× to 5×, the bodies of thin, red-colored worms, tentatively identified as paraonid polychaetes and/or oligochaetes, within and in close proximity to the phytodetrital layer were observed. Stage III infauna appeared to be unaffected. This may be related to the fact that the phytodetritus was confined to the sediment surface, although a few images did show the subduction of pigmented material by deposit feeders and association with active voids (e.g., Figure 3-5).

Another event that may factor into the origin of the phytodetrital layer is the presence of *Prorocentrum triestinum*, a non-toxic dinoflagellate, in the coastal waters of Milford, CT, from 20-25 August, (Gary Wikfors, NOAA Milford Laboratory, personal communication). The presence of these dinoflagellates in coastal waters, however, does not prove that this species dominated in the open water area of CLDS. The actual phytoplanktonic species present in the open waters of Long Island Sound have yet to be confirmed.

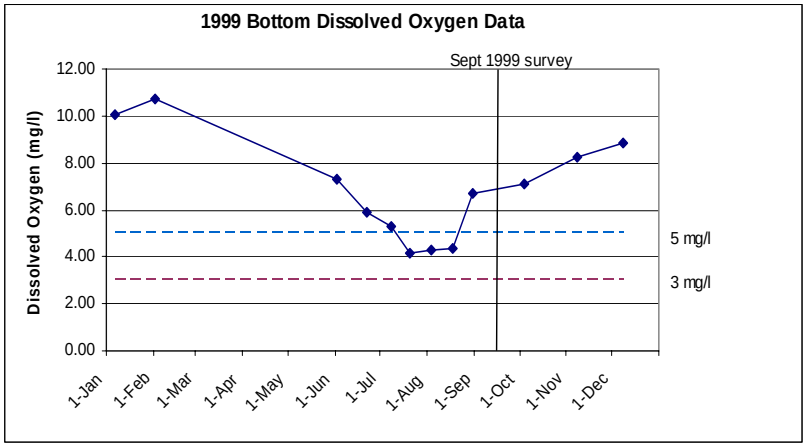
4.2.1 Seasonal Hypoxia in Long Island Sound

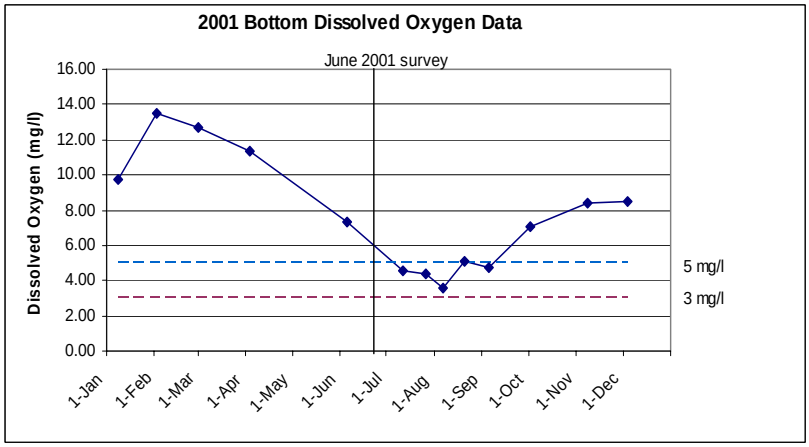
The bottom waters of central and western Long Island Sound are known to experience hypoxia (i.e., low oxygen concentrations in bottom water) during the summer. Hence, dissolved oxygen concentrations in Long Island Sound are monitored by the Connecticut Department of Environmental Protection (DEP). Dissolved oxygen (DO) concentrations of 5.0 mg/l and above are considered healthy for marine life. Concentrations below 3.0 mg/l are considered hypoxic and can cause stress or mortality to benthic organisms (LISS, 1990). Bottom water dissolved oxygen concentrations are an important factor that must be considered while interpreting sediment-profile images.

DAMOS monitoring surveys in Long Island Sound are typically conducted at the end of summer following the disposal season to allow benthic infaunal recolonization of the new sediments. A seasonal reduction of dissolved oxygen concentrations in the late summer can be reflected in the dredged material deposits and ambient sediments as a reduction in RPD depths, fewer Stage I organisms, and, possibly, decreased levels of Stage III activity in the subsurface sediment.

The results of the CTDEP 1999, 2001 and 2003 DO surveys at Station H2 are presented in Figure 4-2. Station H2 is the closest station to CLDS that has sufficient data allowing for multiyear comparisons (Figure 4-3). The lowest bottom water concentrations

were above the 3.0 mg/l threshold value but were below 5.0 mg/l suggesting the habitat was stressed but not hypoxic throughout July and August of 1999 and 2001. The 2003 data shows that the lowest oxygen concentrations at Station H2 were during July and August and did reach the hypoxic threshold of 3.0 mg/l during the last two weeks of August. The minimum DO value was observed at the same time as the previously discussed phytoplankton bloom. At the time of the September 2003 survey, however, the oxygen concentration in the bottom waters had rebounded to levels at or above 5.0 mg/l.





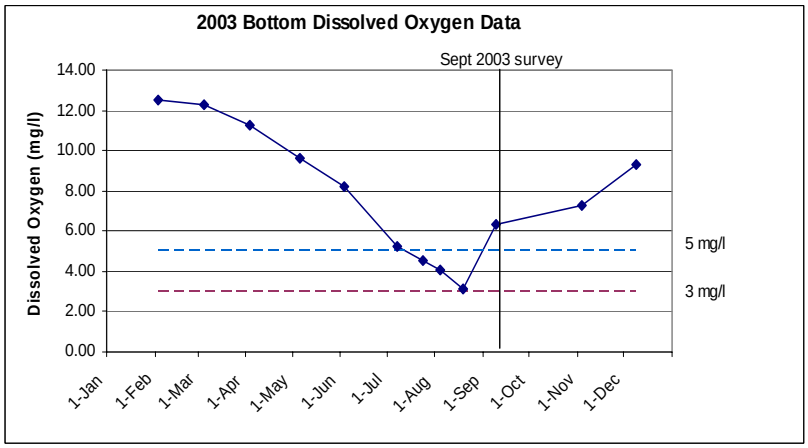
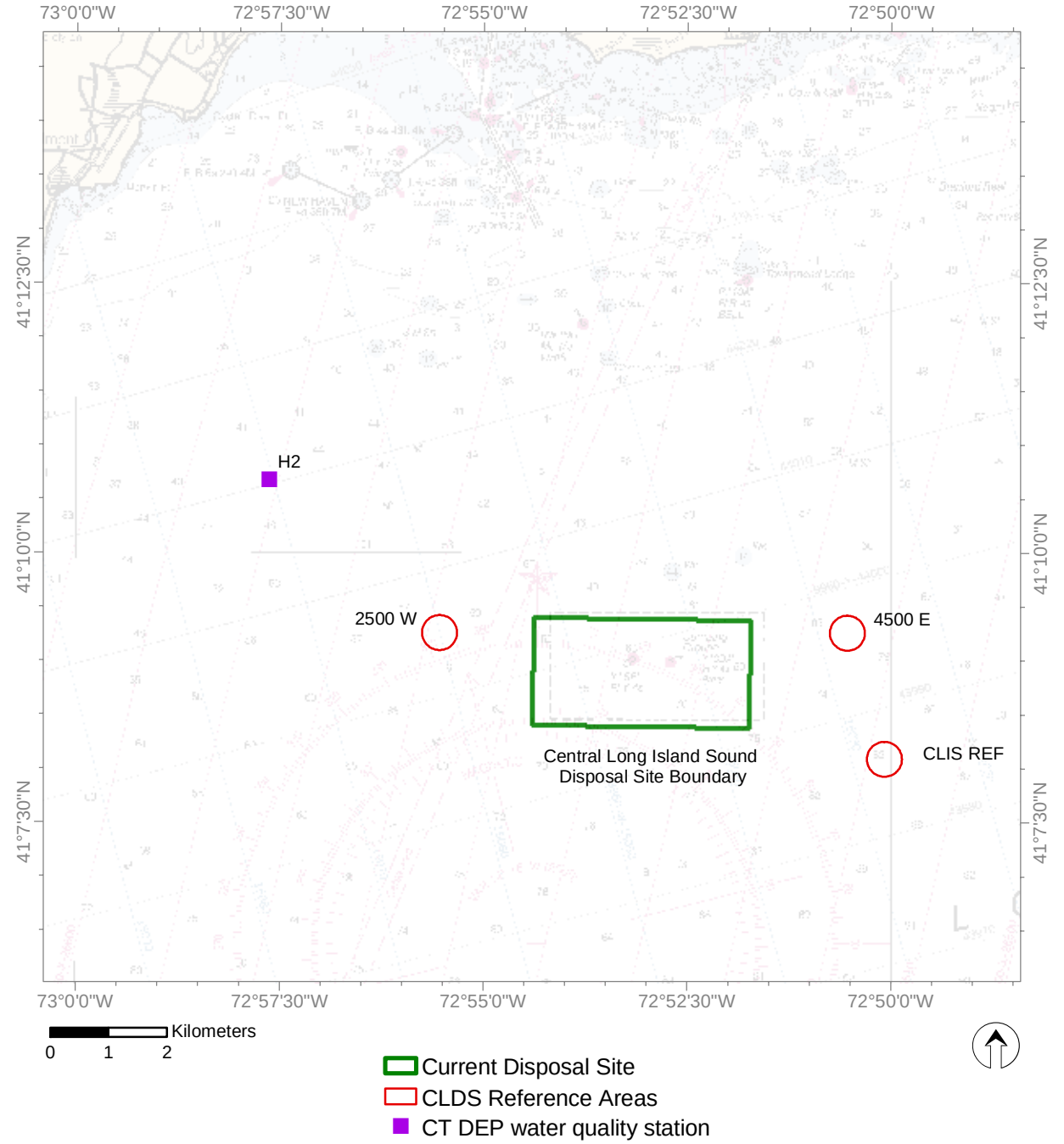


Figure 4-2 Dissolved oxygen concentrations in central Long Island Sound, Station H2, from CTDEP for 1999, 2001 and 2003



Projection: Conformal Conic *Coordinate System*: CT State Plane (m) *Datum*: NAD 83 Depth in meters, MLLW

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Figure 4-3 Location of Station H2, CTDEP water quality station in central Long Island Sound.

5.0 CONCLUSIONS

The September 2003 survey was performed at CLDS to provide post-disposal bathymetry at two recently formed mounds, CLIS 01 and CLIS 02, and two older mounds, CLIS 00 and CLIS 99. Benthic conditions were evaluated at the two older mounds, CLIS 00 and CLIS 99, and three historic mounds, CLIS 95/96, NHAV 93 and MQR. The 2003 survey results showed that recolonization at the CLIS 99 and CLIS 00 Mounds has proceeded along the expected sequence of recovery. The CLIS 95/96 Mound Complex and the NHAV 93 and MQR Mounds were completely recovered to ambient conditions despite the presence of sulfidic material at depth at NHAV 93 and MQR.

The 2003 survey was designed to assess the following expectations:

- The placement of 53,000 m^3 of dredged material at the CDA01 buoy during the 2001/2002 disposal season will result in an observable disposal mound.

- The placement 312,000 m^3 of dredged material at the CDA02 buoy during the 2002/2003 disposal season will result in a discrete disposal mound.

- The CLIS 99 and 00 Mounds will support an advanced benthic community relative to the 2001 survey. The abundance of Stage II-III organisms is expected to increase, although disposal activity in the vicinity of the mounds may slow the recolonization process.

- Benthic recolonization at the 95/96 Mound Complex, NHAV 93 Mound and MQR Mound will approach that of the reference stations, after more than eight years since the last disposal. An advanced benthic community of Stage III and Stage I on III infaunal assemblages is expected (Scott et al, 1987).

Following the disposal of 53,000 m^3 of dredged material during the 2001/2002 disposal season and 312,000 m^3 of dredged material during the 2002/2003 disposal season, two new disposal mounds were formed as expected within the site boundary.

The three DAMOS reference areas continue to exhibit well-established benthic communities as defined by high OSI values. Over time, the status of the mounds has generally improved. Benthic recolonization was more advanced than initially expected at CLIS 99 and CLIS 00, with Stage III assemblages present at the majority of stations

sampled even though the average RPD depth decreased compared with the 2001 survey (Table 3-6). Recolonization at CLIS 95/96 has continued to improve, as expected, and has reached a successional stage comparable to the reference areas. The average RPD depth at MQR is consistent with other mounds although slightly lower than the average reference RPD depth. The high median OSI value and presence of Stage I on III assemblages indicate that the status of this mound is improving. Conditions at NHAV 93 have apparently improved from the 2001 survey, despite the continued presence of high organic content sediments near the surface of the mound. The 2001 and 2003 average RPD values are comparable and median OSI values at NHAV 93 have increased slightly since 2001, with Stage I on III assemblages present at all stations.

In 1999, SAIC (2002b) recommended that a small volume of additional sediment be directed to NHAV 93 Station 200S to expedite full recovery, and to continue environmental monitoring and management measures at the NHAV 93 Mound to determine the time required to dissipate the organic load within the CDM. The results of the 2003 survey indicated that, while there was still evidence of a high organic load in the surface sediments of this mound, benthic recolonization has advanced and bioturbation activities were reducing the organic content of the sediments. Cap augmentation may not be necessary, but this mound should continue to be monitored for potential impacts from the organic-rich sediments.

A reddish-brown-colored phytodetrital layer covered all reference and disposal sites imaged with SPI during the September 2003 survey. Satellite spectral imagery showed a large chlorophyll bloom in the central Sound 18 to 20 days prior to the SPI survey that may have been responsible for the observed phytodetrital layer.

Based on the findings of the 2003 CLDS survey, the following recommendations are proposed:

R1) A SPI survey should be conducted at selected randomized reference and randomized mound locations after the 2003/2004 disposal season to determine if this rust-colored layer continues to be subducted and/or if it remains detectable.

R2) Continued monitoring of CLIS 01 and CLIS 02 Mounds in addition to the CLIS 99 and CLIS 00 Mounds, to determine if Stage III populations continue to develop and to monitor progress of containment cell development.

R3) Periodic monitoring is recommended for the CLIS 95/96 Mound Complex. This mound has developed Stage III infauna and has reached a successional stage comparable to the reference areas.

R4) Periodic surveying is recommended for MQR and NHAV to monitor the stability of the Stage III populations.

R5) The aggregate number of reference stations should be comparable to the number of stations on each disposal mound (or mound complex) for all subsequent SPI surveys to allow for robust statistical comparisons of reference area conditions with disposal site conditions. For example, ANOVA or Kruskal-Wallis tests could be performed as appropriate to determine if significant differences in SPI parameters exist between the disposal mound and reference areas.

R6) The Rutgers Coastal Ocean Observation Lab satellite imagery should be accessed and examined for evidence of plankton blooms in central Long Island Sound prior to the next survey.

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Appendix A

Disposal Barge Log Summary for CLDS
June 2001 to September 2003

Project Name: MARINA & ACCESS CHANNEL
Permittee: WILSON COVE MARINA
Permit Number: 199702342

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
12/29/2001	800	612	41.14980	-72.87849	50 FT	S
12/30/2001	800	612	41.14980	-72.87845	75 FT	S
1/3/2002	825	631	41.14996	-72.87849	50 ft	N
1/4/2002	1,000	765	41.14997	-72.87849	2 FT	N
1/5/2002	1,000	765	41.14997	-72.87843	75 FT	NW
1/8/2002	700	535	41.14993	-72.87849	50 FT	S
1/9/2002	700	535	41.14997	-72.87850	100 FT	W
1/10/2002	650	497	41.14997	-72.87849	25 FT	N
1/11/2002	800	612	41.14997	-72.87849	100 FT	W
4/11/2002	450	344	41.14945	-72.87950	50ft	
4/12/2002	400	306	41.14967	-72.87833	25ft	
4/11/2002	450	344	41.14945	-72.87867	50ft	
4/12/2002	400	306	41.14967	-72.87833	25ft	
Total Dredged Material Volume	8,975	6,862				

Project Name: NORWALK RIVER BASIN
Permittee: SAINT ANN CLUB
Permit Number: 199800234

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
12/6/2002	350	268	41.15383	-72.87521	30	SW
1/6/2003	400	306	41.15373	-72.87508	10	NW
1/7/2003	400	306	41.15373	-72.87508	15	NW
1/11/2003	400	306	41.15373	-72.87508	25	NW
1/12/2003	400	306	41.15373	-72.87508	30	NW
12/9/2002	400	306	41.15373	-72.87508		
12/10/2002	400	306	41.15373	-72.87508	50	SE
12/13/2002	400	306	41.15373	-72.87508	50	NW
12/16/2002	400	306	41.15373	-72.87508	50	NW
12/18/2002	400	306	41.15373	-72.87508	40	NW
12/19/2002	400	306	41.15373	-72.87508	25	NW
Total Dredged Material Volume	4,350	3,326				

Project Name: STAMFORD HARBOR
Permittee: AVALON BAY COMMUNITIES
Permit Number: 199900082

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
12/17/2001	750	573	41.14983	-72.87900	30	W
12/18/2001	800	612	41.15000	-72.87800	20	NNE
12/19/2001	700	535	41.14983	-72.87900	30	SW
12/22/2001	800	612	41.14983	-72.87816	30	S
12/27/2001	750	573	41.14983	-72.87800	40 FT	NE
12/29/2001	700	535	41.15000	-72.87767	50 FT	
12/30/2001	400	306	41.14983	-72.87767	50 FT	
Total Dredged Material Volume	4,900	3,746				

Project Name: VETERANS PARK
Permittee: CITY OF NORWALK
Permit Number: 199901251

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
10/27/2001	250	191	41.14983	-72.87767	30 FT	NE
10/26/2001	550	421	41.14983	-72.87750	50 FT	E
10/25/2001	600	459	41.15000	-72.87817	20 FT	N
10/23/2001	600	459	41.15000	-72.87817	30	NE
10/22/2001	550	421	41.15000	-72.87850	20 FT	N
10/19/2001	600	459	41.15033	-72.87850	20 FT	NNE
10/18/2001	600	459	41.14983	-72.87783	20 FT	NNE
10/16/2001	650	497	41.14967	-72.87900	30 FT	SE
10/15/2001	550	421	41.14983	-72.87817	20 FT	NNE
10/13/2001	600	459	41.15000	-72.87783	30 FT	NNE
10/12/2001	700	535	41.15050	-72.87800	20 FT	NNE
10/10/2001	600	459	41.15033	-72.87767	30 FT	E
10/9/2001	650	497	41.15000	-72.87850	40 FT	NNW
10/8/2001	500	382	41.14983	-72.87783	30 FT	ENE
Total Dredged Material Volume	8,000	6,116				

Project Name: YACHT BASIN & WEST RIVER
Permittee: CHARLES CREEK & DORLON MARINA BASIN
Permit Number: 199902819

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
1/18/2002	950	726	41.15000	-72.87783	30 FT	NNE
1/22/2002	850	650	41.15050	-72.87800	30 FT	N
Total Dredged Material Volume	1,800	1,376				

Project Name: SOUTHPORT HARBOR
Permittee: EDWARD LAHEY
Permit Number: 199903166

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
2/20/2002	250	191	41.14833	-72.87850	15ft	
Total Dredged Material Volume	250	191				

Project Name: SAUGATUCK RIVER
Permittee: MARK MASARENHAS
Permit Number: 200000769

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
12/16/2001	800	612	41.14980	-72.87849	25	SW
12/17/2001	750	573	41.15008	-72.87868	50	NW
12/15/2001	750	573	41.14980	-72.87849	20	S
12/12/2001	1,000	765	41.14833	-72.87849	75	W
12/11/2001	1,000	765	41.14978	-72.87843	100	E
12/14/2001	750	573	41.14980	-72.87849	25	S
Total Dredged Material Volume	5,050	3,861				

Project Name: BRANFORD RIVER
Permittee: BRANFORD LANDING MARINA
Permit Number: 200001120

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
10/29/2001	500	382	41.14983	-72.87767	30	E
10/30/2001	550	421	41.14983	-72.87817	20	SE
10/31/2001	500	382	41.14967	-72.87800	30	E
10/31/2001	450	344	41.15000	-72.87783	20	NE
Total Dredged Material Volume	2,000	1,529				

Project Name: CUMMINGS PARK BASIN
Permittee: CITY OF STAMFORD
Permit Number: 200001522

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
1/6/2003	800	612	41.15102	-72.87687	50 yds	SW
1/13/2003	850	650	41.15055	-72.88083	60 yds	W
1/15/2003	850	650	41.15160	-72.87468	30 yds	S
1/21/2003	800	612	41.15308	-72.88007		
12/26/2002	800	612	41.15155	-72.87895	80 yds	S
12/31/2002	800	612	41.14800	-72.88583	30 yds	SW
Total Dredged Material Volume	4,900	3,746				

Project Name: BRIDGEPORT HARBOR
Permittee: WISVEST-CT
Permit Number: 200002085

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
10/4/2001	800	612	41.14983	-72.87800	60 FT	
10/4/2001	350	268	41.14983	-72.87817	60	
10/2/2001	500	382	41.14983	-72.87783	50 FT	E
Total Dredged Material Volume	1,650	1,262				

Project Name: MARINA BASIN
Permittee: MILFORD WARF CO
Permit Number: 200002086

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
11/28/2001	550	421	41.14983	-72.87933	40	W
11/29/2001	600	459	41.14983	-72.87900	20	W
12/3/2001	700	535	41.14983	-72.87783	40	NE
12/3/2001	650	497	41.14900	-72.87850	60	SE
12/5/2001	800	612	41.15000	-72.87800	20	NE
12/5/2001	700	535	41.15000	-72.87833	20	N
12/6/2001	500	382	41.15000	-72.87817	10	NNE
12/7/2001	600	459	41.15000	-72.87850	20	NNW
12/10/2001	550	421	41.14983	-72.87800	30	NE
12/11/2001	650	497	41.14983	-72.87783	20	SE
12/11/2001	700	535	41.14933	-72.87783	30	ESE
12/12/2001	600	459	41.14967	-72.87883	15	SSW
12/12/2001	800	612	41.15000	-72.87867	30	N
12/13/2001	800	612	41.14983	-72.87783	30	NE
12/14/2001	700	535	41.14983	-72.87783	20	ENE
Total Dredged Material Volume	9,900	7,569				

Project Name: BIRBARIE MARINA
Permittee: BIRBARIE MARINA SALES
Permit Number: 200003033

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
11/2/2001	400	306	41.14983	-72.87767	40 ft	
11/2/2001	400	306	41.15017	-72.87850	40 ft	
11/3/2001	400	306	41.15050	-72.87800	45	
11/5/2001	450	344	41.14983	-72.87850	40	E
11/6/2001	400	306	41.14983	-72.87783	40	E
11/6/2001	350	268	41.14983	-72.87800	30	E
11/7/2001	400	306	41.14983	-72.87783	30	E
11/8/2001	450	344	41.15000	-72.87783	30	ENE
11/9/2001	400	306	41.14983	-72.87800	50	NE
11/9/2001	350	268	41.14983	-72.87767	40	NE
11/12/2001	400	306	41.14983	-72.87783	30	E
11/13/2001	500	382	41.14983	-72.87767	40	E
11/13/2001	350	268	41.15000	-72.87750	40	ENE
Total Dredged Material Volume	5,250	4,014				

Project Name: YACHT BASIN & WEST RIVER
Permittee: GUILFORD YACHT CLUB
Permit Number: 200100511

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
1/3/2002	500	382	41.14983	-72.87767	50 FT	
1/4/2002	500	382	41.14983	-72.87767	50 FT	
1/5/2002	700	535	41.15000	-72.87817	50 FT	
1/6/2002	700	535	41.15000	-72.87817	50 FT	
1/8/2002	700	535	41.15033	-72.87817	50 FT	
2/14/2002	300	229	41.14983	-72.87783	30ft	NE
2/16/2002	400	306	41.14983	-72.87817	20ft	E
2/19/2002	300	229	41.15000	-72.87817	30ft	NE
2/20/2002	500	382	41.15050	-72.87817	20ft	NNE
2/21/2002	400	306	41.15017	-72.87783	30ft	NNE
2/22/2002	300	229	41.15017	-72.87800	30ft	NNE
2/23/2002	400	306	41.15017	-72.87783	30ft	ENE
2/26/2002	300	229	41.15017	-72.87783	20ft	N
3/1/2002	500	382	41.14983	-72.87783	40ft	N
2/25/2002	500	382	41.14983	-72.87800	30ft	
3/4/2002	300	229	41.14983	-72.87783	90ft	
3/5/2002	400	306	41.14983	-72.87783	30ft	NE
3/6/2002	400	306	41.15000	-72.87783	40	NNE
3/7/2002	300	229	41.15033	-72.87817	30ft	N
3/8/2002	400	306	41.15017	-72.87800	40ft	N
3/12/2002	500	382	41.14950	-72.87817	20ft	SE
3/13/2002	300	229	41.15017	-72.87767	50ft	NE
3/14/2002	400	306	41.15017	-72.87767	40ft	N
3/15/2002	300	229	41.14983	-72.87783	30ft	N
3/16/2002	500	382	41.14983	-72.87783	40ft	E
3/19/2002	400	306	41.14983	-72.87783	20ft	E
3/25/2002	500	382	41.14983	-72.87783	30ft	E
3/25/2002	300	229	41.15017	-72.87767	40ft	NE
3/27/2002	400	306	41.14983	-72.87767	40ft	E
3/28/2002	300	229	41.14983	-72.87783	30ft	NE
3/29/2002	500	382	41.15017	-72.87767	30ft	NE
3/30/2002	400	306	41.14983	-72.87750	40ft	E
10/1/2002	600	459	41.14833	-72.87850		
10/2/2002	400	306	41.14983	-72.87867		
10/9/2002	600	459	41.14983	-72.87800		
10/10/2002	800	612	41.14983	-72.87767		
10/13/2002	600	459	41.14983	-72.87850		
10/14/2002	500	382	41.14983	-72.87850		
10/15/2002	600	459	41.14983	-72.87817		
10/17/2002	500	382	41.14983	-72.87850		
10/21/2002	600	459	41.14983	-72.87817		
10/24/2002	600	459	41.14983	-72.87800		
Total Dredged Material Volume	19,400	14,832				

Project Name: MILTON HBR
Permittee: CITY OF RYE, NY
Permit Number: 200101105

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
12/31/2002	1,000	765	41.15450	-72.87750	5	W
1/1/2003	925	707	41.15450	-72.87717	1	NW
1/5/2003	1,000	765	41.15467	-72.87700	10	N
1/7/2003	900	688	41.15434	-72.87634	10	E
1/9/2003	1,000	765	41.15430	-72.87502	14	N
1/10/2003	1,000	765	41.15867	-72.87250	10	S
1/12/2003	1,000	765	41.15428	-72.87502	50	N
1/16/2003	900	688	41.15375	-72.87503	100	N
1/17/2003	900	688	41.15332	-72.87417	100	SW
1/19/2003	900	688	41.15365	-72.87582	25	N
Total Dredged Material Volume	9,525	7,282				

Project Name: MILFORD HARBOR
Permittee: SPENCERS MARINA
Permit Number: 200101437

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
11/15/2001	500	382	41.15000	-72.87783	20	NE
11/15/2001	550	421	41.14983	-72.87783	30	NE
11/16/2001	450	344	41.14983	-72.87783	45	
11/17/2001	450	344	41.14983	-72.87767	35	
11/19/2001	550	421	41.15000	-72.87783	0	NE
11/20/2001	550	421	41.14983	-72.87783	20	E
11/21/2001	600	459	41.15000	-72.87783	30	NE
11/27/2001	550	421	41.14983	-72.87783	20	E
11/28/2001	500	382	41.14983	-72.87783	20	E
Total Dredged Material Volume	4,700	3,593				

Project Name: HARBOR POINT MARINA
Permittee: HARBOR POINT MARINA
Permit Number: 200102331

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
5/16/2002	850	650	41.15000	-72.87800	30ft	NE
5/17/2002	800	612	41.14983	-72.87817	20ft	N
5/20/2002	850	650	41.14983	-72.87783	20ft	NE
5/21/2002	800	612	41.14983	-72.87767	30ft	
5/19/2003	600	459	41.15400	-72.87483	30 ft	N
5/20/2003	400	306	41.15433	-72.87483	30 ft	N
Total Dredged Material Volume	4,300	3,288				

Project Name: MARINA BASIN/BRANFORD RIVER
Permittee: INDIAN NECK YACHT CLUB
Permit Number: 200102859

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
12/21/2002	700	535	41.15434	-72.87466	30	NNE
12/21/2002	800	612	41.15383	-72.87434	60	NE
12/22/2002	600	459	41.15383	-72.87434	50	NNE
12/23/2002	700	535	41.15350	-72.87417	60	E
Total Dredged Material Volume	2,800	2,141				

Project Name: WEST RIVER
Permittee: BAYBERRY CREEK
Permit Number: 200201083

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
3/14/2003	400	306	41.15350	-72.87466	30	E
3/15/2003	200	153	41.15358	-72.87517	35	E
3/16/2003	500	382	41.15350	-72.87417	30	E
3/17/2003	400	306	41.15350	-72.87417	50	NE
3/20/2003	400	306	41.15383	-72.87400	60	NE
3/22/2003	600	459	41.15350	-72.87417	30	N
3/23/2003	500	382	41.15383	-72.87434	20	N
3/24/2003	400	306	41.15383	-72.87466	20	N
Total Dredged Material Volume	3,400	2,599				

Project Name: WEST RIVER CHANNEL
Permittee: GUILFORD YACHT CLUB
Permit Number: 200201571

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
11/25/2002	500	382	41.15417	-72.87466	30ft	N
12/4/2002	700	535	41.15367	-72.87434	60	NE
12/6/2002	500	382	41.15350	-72.87417	60	E
12/16/2002	800	612	41.15350	-72.87434	60	NNE
12/17/2002	600	459	41.15350	-72.87583	70	SE
10/28/2002	700	535	41.15350	-72.87466	40	NE
10/29/2002	500	382	41.15333	-72.87450	60	ENE
11/9/2002	600	459	41.15367	-72.87500	20	ENE
11/12/2002	700	535	41.15350	-72.87466	60	E
11/13/2002	700	535	41.15333	-72.87466	60	E
11/14/2002	500	382	41.15400	-72.87434	50	NE
11/15/2002	700	535	41.15367	-72.87434	60	NE
11/19/2002	600	459	41.15400	-72.87434	30	NNE
11/20/2002	700	535	41.15367	-72.87417	50	E
11/22/2002	500	382	41.15367	-72.87417	60	E
11/22/2002	700	535	41.15317	-72.87517	20	SE
3/25/2003	400	306	41.15417	-72.87450	30	N
3/26/2003	500	382	41.15333	-72.87434	50	E
3/27/2003	350	268	41.15400	-72.87500	55	E
3/28/2003	550	421	41.15400	-72.87483	45	
4/3/2003	400	306	41.15400	-72.87450	30	N
4/4/2003	500	382	41.15383	-72.87583	40	W
4/8/2003	400	306	41.15367	-72.87433	30 ft	E
4/9/2003	400	306	41.15350	-72.87583	20 ft	W
4/10/2003	500	382	41.15400	-72.87500	20 ft	SW
4/12/2003	500	382	41.15350	-72.87433	40 ft	E
4/13/2003	300	229	41.15350	-72.87450	20 ft	E
4/15/2003	400	306	41.15367	-72.87433	30 ft	E
11/26/2002	700	535	41.15350	-72.87433	30 ft	ESE
11/26/2002	600	459	41.15350	-72.87433	30 ft	E
Total Dredged Material Volume	16,500	12,615				

Project Name: NEW HAVEN HARBOR
Permittee: COE NEW HAVEN HARBOR
Permit Number: 2003C0001

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
1/7/2003	3,500	2,676	41.15412	-72.87672	100	W
1/7/2003	3,500	2,676	41.15337	-72.87448	25	E
1/7/2003	2,700	2,064	41.15345	-72.87560	10	W
1/8/2003	3,000	2,294	41.15430	-72.87502	10	E
1/8/2003	3,500	2,676	41.15448	-72.87608	75	W
1/8/2003	2,500	1,911	41.15462	-72.87450	50	E
1/8/2003	3,000	2,294	41.15258	-72.87537	25	W
1/8/2003	3,000	2,294	41.15258	-72.87535	50	E
1/9/2003	2,500	1,911	41.15373	-72.87508	50	E
1/9/2003	3,000	2,294	41.15357	-72.87517	10	E
1/9/2003	3,800	2,905	41.15215	-72.87400	25	W
1/9/2003	3,500	2,676	41.15440	-72.87452	25	E
1/9/2003	3,500	2,676	41.15350	-72.87477	25	E
1/9/2003	3,500	2,676	41.15390	-72.87565	25	E
1/10/2003	3,500	2,676	41.15387	-72.87527	25	W
1/10/2003	3,600	2,752	41.15410	-72.87470	25	E
1/10/2003	3,600	2,752	41.15378	-72.87673	50	W
1/10/2003	3,600	2,752	41.15108	-72.87340	50	E
1/10/2003	3,700	2,829	41.15410	-72.87645	25	E
1/11/2003	3,700	2,829	41.15335	-72.87740	100	W
1/11/2003	3,236	2,474	41.15428	-72.87487	25	E
1/11/2003	3,756	2,872	41.15402	-72.87442	50	E
1/12/2003	3,650	2,791	41.15390	-72.87665	50	W
1/12/2003	3,750	2,867	41.15323	-72.87690	125	W
1/12/2003	3,750	2,867	41.15437	-72.87653	25	E
1/12/2003	3,750	2,867	41.15223	-72.87543	25	E
1/12/2003	4,077	3,117	41.15380	-72.87663	50	W
1/12/2003	3,700	2,829	41.15453	-72.87652	25	E
1/13/2003	3,650	2,791	41.15435	-72.87610	25	W
1/13/2003	3,576	2,734	41.15375	-72.87701	75	W
1/13/2003	3,756	2,872	41.15417	-72.87479	25	E
1/14/2003	3,436	2,627	41.15390	-72.87620	25	W
1/14/2003	3,756	2,872	41.15598	-72.87513	20	E
1/14/2003	3,596	2,749	41.15430	-72.87455	50	E
1/14/2003	3,917	2,995	41.15402	-72.87569	20	W
1/14/2003	3,756	2,872	41.15453	-72.87637	25	E
1/15/2003	3,758	2,873	41.15400	-72.87587	20	W
1/15/2003	3,759	2,874	41.15262	-72.87427	20	W
1/15/2003	3,917	2,995	41.15440	-72.87379	100	N
1/15/2003	3,917	2,995	41.15373	-72.87508	60	W
1/16/2003	3,436	2,627	41.15418	-72.87472	0	E
1/16/2003	3,596	2,749	41.15133	-72.87532	15	W
1/16/2003	3,000	2,294	41.15432	-72.87510	10	E
1/16/2003	3,000	2,294	41.15367	-72.87495	90	E
1/16/2003	3,506	2,681	41.15373	-72.87520	35	W

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
1/17/2003	3,756	2,872	41.15373	-72.87510	10	W
1/17/2003	3,500	2,676	41.15375	-72.87510	5	NW
1/17/2003	3,000	2,294	41.15373	-72.87518	35	W
1/17/2003	4,077	3,117	41.15378	-72.87520	40	NW
1/17/2003	3,756	2,872	41.15367	-72.87634	45	SW
1/18/2003	3,917	2,995	41.15373	-72.87517	20	W
1/18/2003	3,917	2,995	41.15387	-72.87515	60	NNW
1/18/2003	3,766	2,879	41.15365	-72.87508	30	S
1/18/2003	3,596	2,749	41.15363	-72.87537	75	SW
1/18/2003	3,756	2,872	41.15373	-72.87513	10	W
1/19/2003	3,917	2,995	41.15373	-72.87521	30	W
1/19/2003	3,756	2,872	41.15373	-72.87524	40	W
1/19/2003	3,816	2,918	41.15375	-72.87510	10	NW
1/19/2003	3,756	2,872	41.15373	-72.87510	10	W
1/19/2003	3,756	2,872	41.15373	-72.87534	50	W
1/20/2003	3,917	2,995	41.15387	-72.87492	90	NE
1/21/2003	3,917	2,995	41.15373	-72.87493	30	E
1/21/2003	3,115	2,382	41.15373	-72.87524	30	W
1/21/2003	3,917	2,995	41.15373	-72.87497	50	E
1/22/2003	3,756	2,872	41.15373	-72.87507	5	E
1/22/2003	3,756	2,872	41.15375	-72.87510	10	NW
1/22/2003	3,756	2,872	41.15373	-72.87525	60	W
1/22/2003	3,596	2,749	41.15373	-72.87508	5	W
1/22/2003	3,756	2,872	41.15373	-72.87493	45	E
1/23/2003	3,756	2,872	41.15373	-72.87505	15	E
1/23/2003	3,705	2,833	41.15373	-72.87521	40	W
1/23/2003	3,705	2,833	41.15353	-72.87483	90	SE
1/24/2003	3,596	2,749	41.15373	-72.87510	5	W
1/24/2003	3,436	2,627	41.15373	-72.87475	95	E
1/24/2003	3,756	2,872	41.15373	-72.87510	5	W
1/24/2003	3,917	2,995	41.15373	-72.87483	65	E
1/25/2003	4,578	3,500	41.15353	-72.87521	95	SSW
1/25/2003	3,917	2,995	41.15373	-72.87513	10	W
1/25/2003	3,756	2,872	41.15360	-72.87508	50	S
1/25/2003	3,456	2,642	41.15373	-72.87532	65	W
1/25/2003	3,278	2,506	41.15373	-72.87480	90	S
1/25/2003	4,077	3,117	41.15373	-72.87480	40	E
1/26/2003	3,754	2,870	41.15373	-72.87524	40	W
1/26/2003	3,569	2,729	41.15373	-72.87492	50	E
1/26/2003	3,436	2,627	41.15373	-72.87495	30	E
1/26/2003	3,556	2,719	41.15370	-72.87510	20	SW
1/26/2003	4,578	3,500	41.15373	-72.87511	10	W
1/27/2003	4,077	3,117	41.15373	-72.87521	40	W
1/27/2003	4,877	3,729	41.15373	-72.87543	475	E
1/27/2003	3,436	2,627	41.15350	-72.87508	65	S
1/28/2003	3,765	2,879	41.15360	-72.87508	25	S

Disposal Date	Volume Disposed (yd^3)	Volume Disposed (m^3)	Disposal Latitude	Disposal Longitude	Distance from Buoy	Direction from Buoy
1/28/2003	4,077	3,117	41.15373	-72.87503	10	E
1/28/2003	3,796	2,902	41.15373	-72.87508		
1/28/2003	3,917	2,995	41.15373	-72.87508		
1/29/2003	3,438	2,629	41.15382	-72.87500	35	NE
1/30/2003	4,502	3,442	41.15378	-72.87508	20	N
1/31/2003	4,612	3,526	41.15373	-72.87528	45	W
1/31/2003	6,000	4,587	41.15373	-72.87493	40	E
Total Dredged Material Volume	361,052	276,044				

Appendix B

Sediment-Profile Image Results for CLDS September 2003 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 CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
2500W1	A2	9/10/2003 7:47	16.08	16.70	16.45	0.62	Biological	0.08	2.30	0.86	>4	3 to 2	>4	1.62	4.25	3.79	No		No	No	Stage I-III	11	few stage I's;hydroids present;voids at 3.21,14.31cm
2500W1	B2	9/10/2003 7:49	12.30	13.60	12.83	1.30	Biological	0.06	1.60	0.69	>4	3 to 2	>4	1.95	4.7	3.44	No		No	No	Stage I-III	10	few stage I's;hydroids present;voids at 0.58, 3.26, 9.27,10.44,11.33
2500W1	C2	9/10/2003 7:49	14.20	15.88	15.38	1.68	Physical	0.68	1.77	0.86	>4	3 to 2	>4	0.38	4.55	3.51	No		No	No	Stage I-III	10	few stage I's;voids at 2.6, 8.48, 17.74
2500W2	A2	9/10/2003 7:54	7.28	7.66	7.46	0.38	Biological	0.20	1.50	0.40	>4	3 to 2	>4	0.89	2.43	1.72	No		No	No	Stage I-III	8	stage I's;meiofaunal tunneling;active void at 2.74
2500W2	B2	9/10/2003 7:56	2.81	4.91	3.61	2.10	Physical	0.44	1.27	0.65	>4	3 to 2	>4	2.81	4.91	3.61	10	1.7, 1.45, 1.15, 1.14	No	No	Stage I-III	10	stage I's;worm at surface, tiny, not abundant, broken tubes in suspension;voids at 6.91, 2.22
2500W2	C2	9/10/2003 7:58	7.84	8.60	8.17	0.76	Biological	0.20	1.42	0.57	>4	3 to 2	>4	2.51	5.77	3.85	No		No	No	Stage I-III	11	stage I's;voids at 6.65, 7.92
2500W3	A2	9/10/2003 8:12	9.58	10.01	9.80	0.43	Physical	0.24	0.89	0.64	>4	3 to 2	>4	0.59	4.5	2.68	10	1.2, 0.59, 0.62, 1.05, 0.4, 0.7	No	No	Stage I-III	9	stage I's;void at 7.82
2500W3	B2	9/10/2003 8:13	10.53	11.30	10.99	0.77	Biological	0.29	1.45	0.68	>4	3 to 2	>4	4.61	8.4	6.19	No		No	No	Stage I-III	11	slight sulfidic horizon@depth=suggests DM but unlikely;stage I's;voids at 8.27, 8.28, 10.56
2500W3	C2	9/10/2003 8:14	9.35	10.02	9.62	0.67	Biological	0.15	4.12	0.61	>4	3 to 2	>4	1.59	6.12	4.11	No		No	No	Stage I-III	11	few stage I's anemone;void at 9.02
2500W4	A2	9/10/2003 8:20	9.55	10.29	10.00	0.74	Biological	0.38	2.89	0.96	>4	3 to 2	>4	2.84	7.48	4.45	No		No	No	Stage I-III	11	oligochaetes-stage I's;oligochaetes;void at 4.95, 5.40
2500W4	B2	9/10/2003 8:21	9.52	10.67	10.06	1.15	Biological	0.20	0.77	0.36	>4	3 to 2	>4	1.24	4.64	3.58	No		No	No	Stage I-III	10	rare stage I's;voids at 4.43, 7.55
2500W4	C2	9/10/2003 8:21	9.55	9.82	9.75	0.27	Physical	0.41	2.90	0.67	>4	3 to 2	>4	3.46	8.19	5.64	5	1.84, 0.93, 1.11, 0.75, 1.92	No	No	Stage I-III	11	worm at 9.25cm, rare stage I's;void at 9.18
4500E1	A2	9/10/2003 8:57	9.11	9.49	9.24	0.38	Biological	0.09	0.74	0.33	>4	3 to 2	>4	2.07	4.91	3.76	No		No	No	Stage I-III	11	few stage I's;voids at 1.43, 5.64, 4.95
4500E1	B2	9/10/2003 8:58	11.83	12.16	11.99	0.33	Biological	0.06	1.54	0.51	>4	3 to 2	>4	0.24	3.37	2.63	3	tiny clasts	No	No	Stage I-III	9	stage I's;voids at 3.45, 7.69
4500E1	C2	9/10/2003 8:59	10.85	11.62	11.15	0.77	Biological	0.06	1.54	0.51	>4	3 to 2	>4	1.42	5	3.46	few	tiny	No	No	Stage I-III	10	sulfidic patches/discontinuous horizon@depth=suggests DM but unlikely;stage I's;void at 5.81
4500E2	A2	9/10/2003 9:04	11.53	12.01	11.76	0.48	Biological	0.03	0.71	0.40	>4	3 to 2	>4	0.18	3.61	2.77	No		No	No	Stage I-III	9	v. faint sulfidic patches/horizon@depth suggests DM but unlikely;few stage I's;sulfidic layer below RPD;void at 7.33
4500E2	B2	9/10/2003 9:05	8.78	10.14	9.35	1.36	Biological	0.06	0.98	0.39	>4	3 to 2	>4	0.15	3.55	2.37	No		No	No	Stage I-III	9	sulfidic patches/discontinuous horizon@depth=suggests DM but unlikely;few stage I's;void at 10cm

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

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
4500E2	C2	9/10/2003 9:06	9.97	11.39	10.99	1.42	Biological	0.24	0.71	0.45	>4	3 to 2	>4	0.27	3.64	2.16	No		No	No	Stage I-III	8	small sulfidic patch@right;few stage I's;voids at 1.42, 2.4
4500E3	A2	9/10/2003 9:12	9.49	9.84	9.67	0.35	Physical	0.06	0.83	0.34	>4	3 to 2	>4	1.45	3.76	2.56	2	1.50, 1.50	No	No	Stage I-III	9	organism at 4.52cm, stage I's;voids at 2.67, 5.9
4500E3	B2	9/10/2003 9:13	9.95	10.91	9.98	0.96	Biological	0.15	0.65	0.34	>4	3 to 2	>4	0.7	1.74	1.16	2	1.50, 3.00	No	No	Stage I-III	7	stage I's;voids at 6.59, 7.24
4500E3	C2	9/10/2003 9:14	8.31	8.72	8.48	0.41	Biological	0.09	0.41	0.27	>4	3 to 2	>4	0.15	2.37	1.57	No		No	No	Stage I-III	8	stage I's;voids at 2.65, 2.7
4500E4	A2	9/10/2003 9:19	10.05	10.38	10.15	0.33	Biological	0	0.53	0.34	>4	3 to 2	>4	0	2.4	1.45	several	< 0.5 cm	No	No	Stage I-III	7	nephtys at 5.54 mollusc at 5.5;void at 6.75
4500E4	B2	9/10/2003 9:21	8.93	9.49	9.18	0.56	Biological	0	0.92	0.43	>4	3 to 2	>4	0.77	2.9	1.92	Yes	camera artifact	No	No	Stage I-III	8	few stage I's;voids at 3.78, 7.52
4500E4	C2	9/10/2003 9:22	8.46	9.08	8.74	0.62	Biological	0	0.71	0.41	>4	3 to 2	>4	0.09	2.34	1.62	No		No	No	Stage I-III	8	few stage I's;void at 4.41
CLISREF1	A2	9/10/2003 9:37	8.19	8.70	8.41	0.51	Biological	0.03	0.74	0.30	>4	2 to 1	>4	1.04	4.2	3.11	No		No	No	Stage I-III	10	stage I's, bivalve on surface;Pitar morrhuana;void at 8.11
CLISREF1	B2	9/10/2003 9:38	7.19	8.19	7.77	1.00	Biological	0.18	0.53	0.40	>4	2 to 1	>4	2.04	4.82	3.49	No		No	No	Stage I-III	10	stage I's;void at 5.49
CLISREF1	C2	9/10/2003 9:39	8.46	8.78	8.60	0.32	Biological	0.21	0.41	0.27	>4	2 to 1	>4	3.02	4.55	3.52	2	0.45, 0.27	No	No	Stage I-III	10	Nephtys at 5 cm on right edge;fecal mound present, abundant forams;no voids;fecal mound, small clastsphytodetritus lightly reworkednumerous visible filled burrows connected to surface fecal mounds, one with Nephtysclear Stage IIIRPD > 2 cm
CLISREF2	A2	9/10/2003 9:44	9.49	9.79	9.62	0.30	Biological	0	0.56	0.26	>4	2 to 1	>4	2.9	4.97	4.32	2	0.27, 0.35	No	No	Stage I-III	11	stage I's;erosional boundary roughness;void at 6.07
CLISREF2	B2	9/10/2003 9:46	8.96	9.73	9.40	0.77	Physical	0.03	0.53	0.30	>4	2 to 1	>4	0.09	4.2	2.82	Yes	tiny clasts	No	No	Stage I-III	9	few stage I's;voids at 1.81, 3.19
CLISREF2	C2	9/10/2003 9:47	IND	IND	IND		IND	IND	IND	IND	>4	2 to 1	>4	IND	IND	IND	No		No	No	Stage I-III	IND	no rpd=camera frame disturbance;stage I's;RPD causing Indet.;void at 5.0
CLISREF3	A2	9/10/2003 9:51	7.30	7.99	7.62	0.69	Physical	0	0.68	0.25	>4	2 to 1	>4	0.89	3.34	2.46	2	1.27, 0.38	No	No	Stage I-III	9	stage I's;voids at 4.28, 3.06
CLISREF3	B2	9/10/2003 9:53	9.05	9.43	9.24	0.38	Physical	0	0.41	0.21	>4	2 to 1	>4	0.18	3.55	2.58	No		No	No	Stage I-III	9	stage I's

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

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLISREF3	C2	9/10/2003 9:56	8.07	8.81	8.40	0.74	Biological	0	0.80	0.19	>4	2 to 1	>4	2.3	8.81	4.42	No		No	No	Stage I-III	11	sulfidic patch@lower left=suggests DM but unlikely;intense bioturbation by large macrofauna (most likely arthropod);spread of reduced fecal pellets at SWI;small clasts, reduced fecal pellets pushed out of active burrow networkphytodetritus reworkedlarge active burrow network RPD >2 cm not DM
CLISREF4	A2	9/10/2003 10:01	8.70	9.61	9.29	0.91	Biological	0.12	0.74	0.53	>4	2 to 1	>4	1.98	3.52	2.53	No		No	No	Stage I-III	9	stage I's;void at 7.33
CLISREF4	B2	9/10/2003 10:03	8.31	9.20	8.58	0.89	Physical	0.09	0.59	0.30	>4	2 to 1	>4	0.53	3.55	2.4	No		No	No	Stage I-III	9	discontinuous sulfidic patches@depth=suggests DM but unlikely;stage I's at surf;body of worm against faceplate at depth
CLISREF4	C2	9/10/2003 10:04	7.60	8.16	7.85	0.56	Physical	0	0.44	0.19	>4	2 to 1	>4	0.47	2.96	1.64	No		No	No	Stage I-III	8	stage I's;erosional boundary roughness, small molluscs in sediment;voids at 5.77, 6.02, 7.42
CLISREF5	A2	9/10/2003 10:09	7.93	8.34	8.11	0.41	Biological	0.09	0.62	0.42	>4	2 to 1	>4	1.98	4.23	2.76	2	0.65, 0.74	No	No	Stage I-III	9	stage I's, abundant forams;voids at 7.33, 6.27
CLISREF5	B2	9/10/2003 10:11	8.37	8.81	8.50	0.44	Physical	0	1.15	0.56	>4	2 to 1	>4	1.6	3.55	2.63	No		No	No	Stage I-III	9	stage I's;void at 4.5
CLISREF5	F2	9/10/2003 10:42	10.26	11.45	10.86	1.19	Biological	0.12	0.83	0.45	>4	2 to 1	>4	0.71	3.64	2.69	No		No	No	Stage I-III	9	one small sulfidic patch@right;stage I's;worm in suspension;void at 2.5
CLISREF6	A2	9/10/2003 10:48	12.07	13.10	12.48	1.03	Biological	0	2.04	0.47	>4	2 to 1	>4	1.6	4.67	3.77	2	1.59, 1.43	No	No	Stage I-III	11	faint sulfidic patch@depth;abundant forams;anemone tentacles? at surface;voids at 11.09, 2.94
CLISREF6	B2	9/10/2003 10:48	12.10	12.45	12.24	0.35	Physical	0.09	0.68	0.38	>4	2 to 1	>4	0	3.87	2.18	No		No	No	Stage I-III	8	slightly sulfidic sed @ depth;stage I's;3 voids
CLISREF6	C2	9/10/2003 10:49	12.51	12.84	12.64	0.33	Physical	0	1.63	0.34	>4	2 to 1	>4	0.06	4.26	2.46	Yes	camera artifact	No	No	Stage I-III	9	small sulfidic patch@depth;stage I's;void at 2.28

Table B-3
Sediment-Profile Image Results for CLIS 99/00 Stations at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 99 A1	G2	9/10/2003 12:02	9.32	10.14	9.69	0.82	Biological	0.06	1.18	0.42	>4	3 to 2	>4	0.77	4.61	2.06	No		No	No	Stage I-III	8	DM>PD;oligochaetes;broken tubes at surface;voids at 2.60, 1.11
CLIS 99 A1	H2	9/10/2003 12:07	7.13	7.39	7.27	0.26	Physical	0	0.50	0.14	>4	3 to 2	>4	0.53	2.81	1.85	No		No	No	Stage I-III	8	DM>PD;oligochaetes; void at 3.72
CLIS 99 A1	I2	9/10/2003 12:08	8.01	8.43	8.19	0.42	Physical	0	0.35	0.21	>4	3 to 2	>4	0.35	2.75	1.45	No		No	No	Stage I-III	7	DM>PD;oligochaetes;void at 2.50
CLIS 99 A2	A2	9/8/2003 15:54	14.37	15.08	14.70	0.71	Biological	0.12	1.27	0.43	>4	2 to 1	>4	1.69	1.80	1.78	1	0.39	No	No	Stage I-III	8	DM>PD;stage I's abundant forams;relict void at 3.63
CLIS 99 A2	B2	9/8/2003 15:56	14.82	15.20	15.04	0.38	Biological	0.66	1.92	0.66	>4	2 to 1	>4	1.09	5.03	2.49	1	0.53	No	No	Stage I-III	9	DM ca. 14 cm;surface DM layer over older DM or ambient;stage I's present; abundant forams;relict RPD at 13.5-14.7cm;void at 2.0
CLIS 99 A2	C2	9/8/2003 15:57	14.70	15.62	15.15	0.92	Physical	IND	IND	IND	>4	2 to 1	>4	0.97	2.48	1.34	No		No	No	Stage I-III	7	DM=12.3 cm;surface DM layer over older DM or ambient;oligochaetes;relict voids at 4.33, 13.14, active 2.5;numerous voids, some active, RPD obscured over > 50% by reduced mud clasts (camera artifact?)
CLIS 99 B1	A1	9/8/2003 15:29	15.35	17.30	16.21	1.95	Physical	0.09	2.00	0.50	>4	2 to 1	>4	0.83	3.08	2.00	No		No	No	Stage I-III	8	DM>PD;stage I's;voids at 10.61, 4.53, 3.06
CLIS 99 B1	B1	9/8/2003 15:34	15.91	17.21	16.60	1.30	Physical	0.09	0.86	0.32	>4	2 to 1	>4	0.86	4.61	2.35	No		No	No	Stage I-II	6	DM>PD;stage I's, shallow deposit feeders, possible nephtys at 9.0cm;void at 5.0
CLIS 99 B1	E1	9/10/2003 12:13	6.60	6.83	6.70	0.23	Physical	0.44	1.72	0.85	>4	3 to 2	>4	1.80	5.18	2.75	Yes	many tiny clasts	No	No	Stage I-II	6	DM>PD;oligochaetes;no voids
CLIS 99 B2	A2	9/8/2003 16:01	12.42	13.31	12.92	0.89	Physical	0.33	1.72	0.66	>4	2 to 1	>4	1.24	3.76	2.48	1	0.5	No	No	Stage I-III	9	DM=11.3cm;surface DM layer over older DM or ambient;stage I's;relict RPD at 9.94-13.04cm;voids at 1.29, 3.90, 6.64, 4.81
CLIS 99 B2	B2	9/8/2003 16:03	13.57	14.14	13.95	0.57	Biological	0.30	2.00	0.50	>4	3 to 2	>4	0.59	3.61	2.13	2	0.30, 0.27	No	No	Stage I-III	8	DM=12.9cm;surface DM layer over older DM or ambient;stage I's;relict RPD at 12.24-14.11cm;relict voids at 2.71, 0.63, active at 2.50
CLIS 99 B2	C2	9/8/2003 16:04	13.75	14.43	14.10	0.68	Biological	0.09	1.39	0.46	>4	3 to 2	>4	1.69	3.69	2.80	No		No	No	Stage I-III	9	DM>PD;stage I's abundant forams;one burrow present, relict RPD at 13.5cm;void at 2.78
CLIS 99 C1	A2	9/8/2003 15:20	13.69	14.70	14.09	1.01	Biological	0.24	2.13	0.70	>4	3 to 2	>4	2.69	4.50	3.29	No		No	No	Stage II	8	DM>PD;stage I's;burrows present, shallow deposit feeders;relict void at 1.52cm

Table B-3
Sediment-Profile Image Results for CLIS 99/00 Stations at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 99 C1	B2	9/8/2003 15:21	15.73	16.41	16.04	0.68	Biological	0.30	2.63	0.61	>4	3 to 2	>4	2.45	4.52	3.35	No		No	No	Stage I-III	10	DM>PD;stage I's present abundant forams;two burrows present, Nephtys against faceplate
CLIS 99 C1	C2	9/8/2003 15:24	16.09	16.41	16.22	0.32	Biological	0.00	0.77	0.30	>4	3 to 2	>4	1.98	3.90	2.96	No		No	No	Stage I-III	9	DM>PD;stage I's at surface;multiple burrows that are oxygenated at depth;void edge transected
CLIS 99 C2	A2	9/8/2003 16:08	15.08	15.82	15.39	0.74	Biological	0.33	1.80	0.40	>4	3 to 2	>4	1.39	4.14	3.19	No		No	No	Stage I-III	10	DM>PD;few stage I's;one burrow present at 1.0cm;voids at 3.22, 4.22, 3.08
CLIS 99 C2	B2	9/8/2003 16:09	14.31	14.99	14.59	0.68	Biological	0.12	1.72	0.40	>4	3 to 2	>4	1.09	5.94	3.05	No		No	No	Stage I-III	10	DM>PD;stage I's;void at 3.57cm
CLIS 99 C2	C1	9/8/2003 16:10	11.71	12.92	12.60	1.21	Physical	ind	ind	ind	>4	3 to 2	>4	0.25	4.80	2.53	No		No	No	Stage II	7	DM>PD;stage I's;evidence of burrows & shallow deposit feeders in oxidized surface layer;surface covered with layer of small mud clasts; phytodetritus reworked by active burrowers; RPD > 2 cm; small plant or wood detritus in sediment; no voids visible
CLIS 99 D1	A2	9/8/2003 15:01	17.01	17.57	17.26	0.56	Biological	0.35	0.86	0.59	>4	3 to 2	>4	2.72	5.20	4.07	No		No	No	Stage II	9	DM>PD;stage I's at surface;shallow voids, possible Stage 3 present;active void at 1.48
CLIS 99 D1	B1	9/8/2003 15:08	18.84	19.43	19.07	0.59	Biological	0.38	1.20	0.69	>4	3 to 2	>4	2.72	5.38	4.31	No		No	No	Stage I-III	11	DM>PD;stage I's at surface;voids at 4.45 8.12
CLIS 99 D1	C1	9/8/2003 15:09	18.75	19.25	18.88	0.50	Biological	0.30	1.36	0.61	>4	3 to 2	>4	2.66	4.25	3.71	No		No	No	Stage I-III	10	DM>PD;stage I's;one burrow present;void at 4.0cm
CLIS 99 D2	A2	9/8/2003 16:14	14.67	15.20	15.00	0.53	Biological	0.56	1.89	1.06	>4	3 to 2	>4	1.48	5.18	3.37	No		No	No	Stage I	6	DM =13.63cm;surface DM layer over older DM or ambient;stage I's;relict RPD at 13.5cm;no voids
CLIS 99 D2	B2	9/8/2003 16:16	12.81	13.52	13.05	0.71	Biological	0.27	2.45	1.11	>4	3 to 2	>4	1.50	6.51	2.89	No		No	No	Stage I-III	9	DM = 12.5cm;surface DM layer over older DM or ambient;stage I's;relict RPD at 12cm;void at 2.81cm
CLIS 99 D2	C2	9/8/2003 16:17	10.94	11.42	11.20	0.48	Biological	0.41	1.04	0.93	>4	3 to 2	>4	0.59	3.84	3.06	No		No	No	Stage I	6	DM=11.36cm;surface DM layer over older DM or ambient;stage I's;one burrow present near surface relict RPD at 11.0cm;void at 1.92
CLIS 99 E1	G2	9/10/2003 12:31	9.55	10.14	9.88	0.59	Biological	0.06	1.25	0.30	>4	3 to 2	>4	1.86	2.72	2.23	Yes	tiny clasts present	No	No	Stage I-III	8	DM>PD;stage I's;void at 1.97cm
CLIS 99 E1	H2	9/10/2003 12:34	8.07	9.26	8.72	1.19	Biological	0.15	1.42	0.55	>4	3 to 2	>4	1.36	3.31	2.66	1	1.07	No	No	Stage I-III	9	DM>PD;few stage I's;void at 3.0cm?

Table B-3
Sediment-Profile Image Results for CLIS 99/00 Stations at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 99 E1	I2	9/10/2003 12:35	8.99	9.43	9.17	0.44	IND	0.00	0.50	0.30	>4	3 to 2	>4	2.50	8.00	2.00	many	1.17	No	No	Stage I-III	8	DM>PD;oligochaetes;disturbed in farfield;voids at 3.39 4.27;surface covered with layer of large mud clasts; phytodetritus partially reworked by active burrowers; RPD > 2 cm; small plant or wood detritus in sediment; active voids visible
CLIS 99 E2	A2	9/8/2003 16:21	10.91	11.86	11.39	0.95	Biological	0.18	0.65	0.41	>4	3 to 2	>4	1.09	3.31	1.84	No		No	No	Stage I-III	8	DM>PD;stage I's at surface;voids at depth
CLIS 99 E2	B2	9/8/2003 16:22	11.21	11.59	11.45	0.38	Biological	0.15	0.30	0.21	>4	3 to 2	>4	0.53	1.69	1.18	Yes	camera artifact	No	No	Stage I-III	7	DM>PD;stage I's;voids at 11.07, 11.22, 10.69, 11.30, active at 2.00
CLIS 99 E2	C2	9/8/2003 16:23	10.62	11.21	10.74	0.59	Physical	0.21	0.90	0.30	>4	3 to 2	>4	0.75	5.23	2.61	5	1.59, 1.63, 1.34, 1.65, 2.87	No	No	Stage I-III	9	DM>PD;oligochaetes @ surface;relict voids at 11.13 10.74 2.73 , active voids at 3.84 & 11 cm in lower left ;surface covered with large mud clasts in background; phytodetritus partially reworked; RPD > 2 cm; two active voids visible; detritus visible
CLIS 00 A3	A2	9/8/2003 17:18	9.05	9.94	9.65	0.89	Physical	0.30	1.86	0.66	>4	3 to 2	>4	0.77	3.90	2.69	No		No	No	Stage I-III	9	DM=7.99cm;surface DM layer over older DM or ambient;stage I's;relict RPD at 6.33-8.81cm;voids at 2.00 and 5.00
CLIS 00 A3	B2	9/8/2003 17:20	9.32	9.95	9.44	0.63	Physical	0.00	1.09	0.54	>4	3 to 2	>4	1.80	3.93	2.81	Yes	camera artifact	No	No	Stage I-III	9	DM=7.98cm;surface DM layer over older DM or ambient;oligochaetes;relict RPD at 7.33-8.99cm;void at 6.00
CLIS 00 A3	C2	9/8/2003 17:23	9.29	10.0	9.63	0.71	Biological	0.09	1.95	0.76	>4	3 to 2	>4	1.04	4.70	2.41	No		No	No	Stage I-III	9	DM=7.5cm;surface DM layer over older DM or ambient;few stage I's;relict RPD at 6.21-8.70cm;voids at 4.77, 2.37, 7.85
CLIS 00 A4	A2	9/9/2003 7:24	8.46	10.20	8.86	1.74	Physical	0.00	0.74	0.48	>4	3 to 2	>4	0.00	2.04	1.19	No		No	No	Stage I-III	7	DM>PD;stage I's;void at 2.69
CLIS 00 A4	B2	9/9/2003 7:25	8.87	9.11	9.02	0.24	Physical	0.47	0.68	0.58	>4	2 to 1	>4	3.05	3.37	3.26	No		No	No	Stage I-III	10	DM>PD;stage I's;voids 6.0 and 7.0
CLIS 00 A4	C2	9/9/2003 7:26	7.63	8.61	8.25	0.98	Physical	0.38	1.21	0.79	>4	2 to 1	>4	0.56	2.66	1.89	No		No	No	Stage I-III	8	DM>PD;possible DM layering;oligochaetes;abundant forams present;active void at depth
CLIS 00 A5	A2	9/9/2003 7:31	6.06	6.65	6.35	0.59	Biological	0.18	1.33	0.62	>4	2 to 1	>4	1.15	2.51	1.65	No		No	No	Stage II-III	7	DM>PD;DM not distinct - lacks sulfidic patches;possible Stage 3 fully developed but low densities;small fecal mounds;burrows at depth, shallow voids

Table B-3
Sediment-Profile Image Results for CLIS 99/00 Stations at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 00 A5	B2	9/9/2003 7:32	8.34	9.76	9.07	1.42	Biological	0.47	1.72	0.95	>4	2 to 1	>4	1.39	2.99	2.03	No		No	No	Stage I-III	8	DM>PD;occassional stage I's;fecal mound @ high point of SWI on right;voids at 2.80, 4, & 8 cm;no clasts; phytodetritus lightly reworked; active voids visible; Stage III worm visible below fecal mound;RPD ca. 2
CLIS 00 A5	C2	9/9/2003 7:34	6.92	7.66	7.19	0.74	Biological	0.09	0.71	0.34	>4	2 to 1	>4	1.30	2.99	2.24	No		No	No	Stage II-III	7	DM>PD;possible Stage 3 fully developed but low densities;no voids
CLIS 00 B3	A2	9/8/2003 17:26	6.80	7.30	6.95	0.50	Biological	0.09	3.13	0.93	>4	2 to 1	>4	0.15	2.01	0.96	No		No	No	Stage I-III	7	DM=4.43cm;surface DM layer over older DM or ambient;stage I's;relict RPD at 3.43-6.27cm;voids at 4.79, 5.81
CLIS 00 B3	B2	9/8/2003 17:27	8.67	9.26	8.94	0.59	Biological	0.21	2.13	0.74	>4	2 to 1	>4	0.80	4.08	2.27	2	0.43, 0.42	No	No	Stage I-III	9	DM=6.26cm;surface DM layer over older DM or ambient;oligochaetes, forams present;clast are reduced, relict RPD at 5.47-8.62cm;void at 4.0
CLIS 00 B3	C2	9/8/2003 17:29	7.60	8.22	7.81	0.62	Biological	0.21	1.83	0.91	>4	2 to 1	>4	1.30	3.73	2.43	No		No	No	Stage I-III	9	DM=4.71cm;surface DM layer over older DM or ambient;oligochaetes, forams present;small fecal mounds, relict RPD at 5.02-6.21cm;void at 5.0
CLIS 00 B4	A2	9/9/2003 7:17	13.46	14.17	13.75	0.71	Biological	0.35	0.89	0.70	>4	3 to 2	>4	1.74	5.35	4.17	No		No	No	Stage I-III	11	DM=7.19cm;surface DM layer over older DM - faint relic RPD;stage I's;relict RPD at 7.35cm;void at 8.20
CLIS 00 B4	B2	9/9/2003 7:19	8.93	9.40	9.19	0.47	Biological	0.21	0.98	0.45	>4	2 to 1	>4	1.57	3.55	2.40	No		No	No	Stage II	7	DM>PD;shallow voids at depth - Stage 2
CLIS 00 B4	C2	9/9/2003 7:20	7.57	7.93	7.73	0.36	Physical	0.15	0.59	0.33	>4	2 to 1	>4	1.51	2.81	2.13	No		No	No	Stage I-III	8	DM>PD;stage I's;small void at 2.72
CLIS 00 B5	A2	9/9/2003 7:40	10.85	11.45	11.09	0.60	Physical	0.09	0.80	0.48	>4	2 to 1	>4	2.01	2.96	2.44	No		No	No	Stage I-III	9	DM=8.02cm;surface DM layer over older DM or ambient;stage I's;void at 2.50
CLIS 00 B5	B2	9/9/2003 7:41	9.88	10.56	10.19	0.68	Biological	0.15	1.15	0.35	>4	2 to 1	>4	1.51	2.54	2.08	No		No	No	Stage I-III	8	DM=7.78cm;surface DM layer over older DM or ambient;stage I's;relict RPD at depth;void at 8.00
CLIS 00 B5	C2	9/9/2003 7:43	12.21	12.72	12.34	0.51	Biological	0.27	0.92	0.62	>4	2 to 1	>4	2.04	3.40	2.74	No		No	No	Stage I-III	9	DM=10.44cm;surface DM layer over older DM or ambient;stage I's;feeding mound present, relict RPD at depth;void at 5.00
CLIS 00 C3	A2	9/8/2003 17:32	7.28	7.90	7.69	0.62	Biological	0.15	2.01	0.85	>4	2 to 1	>4	0.65	2.81	1.56	No		No	No	Stage I-III	8	DM=4.15cm;sulfidic horizon = faint layering of DM;oligochaetes;voids at 5.75, 6.00
CLIS 00 C3	B2	9/8/2003 17:36	7.45	8.01	7.79	0.56	Biological	0.47	2.37	1.20	>4	2 to 1	>4	0.92	2.66	1.72	No		No	No	Stage I-III	8	DM>PD;oligochaetes, many forams with burrows;voids at 2.43, 2.21

Table B-3
Sediment-Profile Image Results for CLIS 99/00 Stations at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 00 C3	C2	9/8/2003 17:37	6.98	7.72	7.43	0.74	Biological		patchy	<0.50	>4	2 to 1	>4	0.18	2.66	1.14	2	tiny clasts present	No	No	Stage I-III	7	DM=5.95cm;faint layering of DM - surface layer over older DM;oligochaetes, many forams present, portion of large polychaete against faceplate @ 4 cm depth;relict RPD at 4.91-7.54cm;voids at 4.00, 4.80;small clasts on surface; phytodetritus reworked; wood detrititus visible; large active polychaete; active voids; RPD < 2; relict RPD crossed by burrow
CLIS 00 C4	A2	9/9/2003 7:01	7.99	8.96	8.42	0.97	Physical	0.33	1.77	0.72	>4	2 to 1	>4	1.54	3.52	2.26	No		No	No	Stage II-III	8	DM>PD;oligochaetes;tiny burrow present;shallow voids, edge of large void just below RPD at left
CLIS 00 C4	B2	9/9/2003 7:05	8.31	9.02	8.63	0.71	Biological	0.50	0.83	0.69	>4	2 to 1	>4	1.45	3.46	2.47	No		No	No	Stage II-III	8	DM>PD;stage I's at surface;shallow voids, edge of large void just below RPD in right half of image
CLIS 00 C4	C2	9/9/2003 7:08	7.57	7.93	7.74	0.36	Biological	0.12	0.83	0.33	>4	2 to 1	>4	1.54	2.19	1.88	No		No	No	Stage I-III	8	DM>PD;oligochaetes;void at 2.84
CLIS 00 C5	A2	9/9/2003 7:50	11.36	12.21	11.83	0.85	Biological	0.12	0.71	0.43	>4	3 to 2	4 to 3 / >4	0.86	2.45	1.69	No		No	No	Stage I-III	8	DM>PD; very fine sand @ surf over mud;faint layering;stage I's forams present;voids at 3.08, 4.91
CLIS 00 C5	B2	9/9/2003 7:51	8.25	9.05	8.70	0.80	Biological	0.86	1.72	1.31	>4	1 to 0	>4	0.50	3.16	1.79	No		No	No	Stage I-III	8	DM?;sandy DM;stage I's forams present;voids at 3.84, 4.88
CLIS 00 C5	C2	9/9/2003 7:54	11.00	11.48	11.31	0.48	Biological	0.09	0.53	0.35	>4	2 to 1	>4	0.68	3.46	1.85	No		No	No	Stage I-III	8	DM>PD;faint layering;stage I's;
CLIS 00 D3	A2	9/8/2003 17:40	7.51	8.19	7.79	0.68	Biological	0.38	2.31	0.89	>4	2 to 1	>4	0.68	2.78	1.64	No		No	No	Stage I-III	8	DM>PD;stage I's many forams present;void at 3.60cm
CLIS 00 D3	B2	9/8/2003 17:42	5.71	6.71	6.15	1.00	Biological	0.03	1.83	0.88	>4	2 to 1	>4	0.38	2.16	1.72	No		No	No	Stage I-III	8	DM>PD;older DM = loss of sulfidic signature;worm at 5.65cm no tubes many forams;relict RPD at 4.35-6.42;void at 4.79
CLIS 00 D3	C2	9/8/2003 17:43	6.30	6.74	6.48	0.44	Biological	0.24	2.01	0.91	>4	2 to 1	>4	1.77	3.55	2.51	1	tiny clast present	No	No	Stage I-III	9	DM>PD;older DM = loss of sulfidic signature;mollusc at 0.66cm no tubes;no voids
CLIS 00 D4	A2	9/8/2003 18:00	5.65	6.09	5.87	0.44	Biological	0.27	1.01	0.52	>4	2 to 1	>4	2.07	2.63	2.33	1	0.68	No	No	Stage I-III	9	DM>PD;oligochaetes, forams present;voids at 2.79, 5.46, 10.00;small clast ; phytodetritus lightly reworked; visible active voids; RPD > 2
CLIS 00 D4	B2	9/8/2003 18:01	6.42	7.04	6.82	0.62	Biological	0.00	0.68	0.28	>4	2 to 1	>4	0.53	3.87	2.29	No		No	No	Stage I-III	9	DM>PD;oligochaetes;one burrow present;voids at 4.82, 0.64, 1.60

Table B-3
Sediment-Profile Image Results for CLIS 99/00 Stations at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 00 D4	C2	9/8/2003 18:02	6.51	6.80	6.63	0.29	Biological	0.12	1.15	0.54	>4	2 to 1	>4	1.04	3.93	2.19	No		No	No	Stage I-III	8	DM>PD;oligochaetes;voids at 2.71, 3.25, 1.41
CLIS 00 D5	A2	9/9/2003 8:00	10.94	11.71	11.50	0.77	Biological	0.00	0.56	0.31	>4	2 to 1	>4	0.65	2.72	1.48	No		No	No	Stage I-III	7	DM=10.61cm;surface DM layer over older DM or ambient;oligochaetes, forams less abundant;relict RPD at 8.72-9.34cm;void at 1.66cm
CLIS 00 D5	B2	9/9/2003 8:03	10.82	11.36	11.11	0.54	Biological	0.89	2.01	0.83	>4	2 to 1	>4	1.18	3.13	2.28	No		No	No	Stage I-III	9	DM>PD;stage I's present forams less abundant;voids at 2.69, 5.47
CLIS 00 D5	C2	9/9/2003 8:04	10.06	10.82	10.31	0.76	Biological	0.15	1.66	0.53	>4	2 to 1	>4	0.45	4.32	2.48	No		No	No	Stage I-III	9	DM>PD;stage I's small chaetopterus tube;occassional forams present;voids at 2.95, 0.47, 1.98
CLIS 00 E3	A2	9/8/2003 17:47	5.00	5.41	5.21	0.41	Physical	0.24	1.89	0.86	>4	2 to 1	>4	0.00	2.00	0.50	2	in farfield likely from camera	No	No	Stage I-III	6	DM>PD;DM not distinct - lacks sulfidic patches;ampharetid tentacles in background ; voids at 4.47, 4.27
CLIS 00 E3	B2	9/8/2003 17:48	5.50	6.03	5.69	0.53	Biological	0.41	2.01	1.09	>4	2 to 1	>4	0.20	2.00	0.50	No		No	No	Stage I-III	6	DM>PD;DM not distinct - lacks sulfidic patches;oligochaetes;one small burrow present at 0.71cm;void at 4.50, 3.50, 5.00
CLIS 00 E3	C2	9/8/2003 17:49	4.76	5.62	5.37	0.86	Physical	1.77	1.98	0.76	>4	2 to 1	>4	0.00	1.00	0.50	No		No	No	Stage I-III	6	DM>PD;DM not distinct - lacks sulfidic patches;oligochaetes;void at 4.00;possible clast in background; phytodetritus reworked; visible active voids, numerous filled voids and burrow structures; RPD < 2; biological surface roughness (fecal mounds)
CLIS 00 E4	NO IMAGE	9/8/2003 17:54																					NO IMAGE
CLIS 00 E4	B2	9/8/2003 17:56	7.22	7.66	7.45	0.44	Biological	0.03	0.94	0.49	>4	2 to 1	>4	1.01	2.57	1.98	No		No	No	Stage III	8	DM>PD;oligochaetes, forams less abundant;voids at 3.91, 6.47
CLIS 00 E4	C2	9/8/2003 17:57	6.00	6.24	6.12	0.24	Biological	0.18	1.74	0.55	>4	2 to 1	>4	1.09	2.78	1.97	No		No	No	Stage III	8	DM>PD;DM not distinct - lacks sulfidic patches;oligochaetes;one burrow present;voids at 5.47, 4.62, 0.44, 0.47, 5.18, 5.86
CLIS 00 E5	A2	9/9/2003 8:10	7.96	9.14	8.56	1.18	Biological	0.18	1.06	0.45	>4	2 to 1	>4	0.05	3.31	1.16	few	in farfield	No	No	Stage I-III	7	DM>PD;faint layering - mutiple DM layers;stage I's forams more abundant;patchy RPD;voids at 3.82, 7.11, 5.25, 3.75, 3.03, 6.30

Table B-3
Sediment-Profile Image Results for CLIS 99/00 Stations at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 00 E5	B2	9/9/2003 8:11	9.73	10.71	10.10	0.98	Biological	0.06	1.48	0.56	>4	2 to 1	>4	1.33	4.94	2.07	Yes	too tiny to measure	No	No	Stage I-III	8	DM>PD;faint layering - older DM;few stage I's forams more abundant;voids at 0.71, 3.93, 5.12, 5.65, 3.48
CLIS 00 E5	C2	9/9/2003 8:13	9.67	10.20	9.98	0.53	Biological	0.03	0.89	0.39	>4	2 to 1	>4	1.04	2.69	1.63	2	1.67, 0.44	No	No	Stage I-III	8	8.27;faint layering - older DM;few stage I's forams more abundant;voids at 8.77, 5.13, 6.39, 6.80, 1.58

Table B-4
Sediment-Profile Image Results for CLIS 95/96 at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 95/96 57	A1	9/9/2003 8:23	14.40	16.41	15.32	2.01	Physical	0.47	2.78	1.08	>4	2 to 1	>4	2.40	5.53	4.09	2	0.35, 1.45	No	No	Stage I-III	11	similar appearance to ambient, but could be older DM lacking sulfidic signature;few stage I's;small voids at 7.64, 12.36
CLIS 95/96 57	B1	9/9/2003 8:24	11.74	12.16	11.87	0.42	Physical	0.30	2.13	0.57	>4	2 to 1	>4	1.45	5.50	3.31	5	1.54, 0.59, 0.63, 0.65, 0.20	No	No	Stage I-III	10	similar appearance to ambient, but could be older DM lacking sulfidic signature;few stage I's, small cluster;relict voids at 6.46, 8.07
CLIS 95/96 57	C1	9/9/2003 8:28	11.00	11.98	11.36	0.98	Biological	0.24	1.42	0.49	>4	2 to 1	>4	2.54	6.21	4.64	No		No	No	Stage I-III	11	similar appearance to ambient, but could be older DM;stage I's;active void at 11.0 cm
CLIS 95/96 66	A1	9/9/2003 8:37	7.66	9.20	8.72	1.54	Physical	0	0.53	0.25	>4	2 to 1	>4	1.27	4.94	3.08	1	0.95	No	No	Stage II-III	9	DM>PD;some sulfidic patches=most likely older DM but could be ambient;chaetopterus tube, oligochaete stage I's;shallow voids & burrows, low densities of Stage 3 probably present
CLIS 95/96 66	B1	9/9/2003 8:38	10.77	11.03	10.89	0.26	Physical	0	2.40	0.46	>4	2 to 1	>4	0.15	5.71	3.70	4	1.58, 0.98, 0.77, 0.30	No	No	Stage II-III	9	DM>PD;some sulfidic patches=most likely older DM but could be ambient;stage I's present;erosional ;shallow voids & burrows, low densities of Stage 3 probably present
CLIS 95/96 66	C1	9/9/2003 8:41	10.70	11.71	11.18	1.01	Biological	0.18	2.28	0.72	>4	2 to 1	>4	2.07	5.47	3.64	Yes	very tiny	No	No	Stage I-III	10	DM>PD;some sulfidic patches=most likely older DM but could be ambient;Stage I tubes @ SWI;burrow at right edge of image ca. 5 cm depth;v.small clasts; phytodetritus very lightly reworked (fluffy with Stage I and foram activity); visible active voids and burrows; RPD > 2 cm
CLIS 95/96 67	A2	9/9/2003 8:48	10.94	12.10	11.51	1.16	Physical	0.59	2.25	1.09	>4	2 to 1	>4	2.51	4.79	3.67	No		No	No	Stage I-III	10	DM>PD;few stage I's;voids at 3.05, 4.77, 6.29, 10.43, 11.04
CLIS 95/96 67	B1	9/9/2003 8:50	7.72	8.90	8.40	1.18	Biological	0	1.04	0.38	>4	2 to 1	>4	1.45	3.84	2.65	No		No	No	Stage I-III	9	DM>PD;stage I's in farfield;active void at 6.5 cm;relict voids at 5.91 6.42
CLIS 95/96 67	C2	9/9/2003 8:51	9.97	10.91	10.47	0.94	Biological	0.33	2.04	0.94	>4	2 to 1	>4	1.95	5.38	3.62	No		No	No	Stage I-III	10	DM>PD;stage I's present;small voids at 3.61, 2.63
CLIS 95/96 74	A2	9/9/2003 9:30	8.93	9.40	9.10	0.47	Biological	0.18	2.25	0.82	>4	2 to 1	>4	1.25	4.26	2.55	No		No	No	Stage I-III	9	DM>PD;stage I's;meiofaunal tunnelings present;voids at 1.72
CLIS 95/96 74	B2	9/9/2003 9:33	9.17	10.14	9.91	0.97	Biological	0.24	1.54	0.59	>4	2 to 1	>4	0.98	5.23	3.01	No		No	No	Stage I-III	10	DM>PD;stage I's;voids at 5.89, 4.86, 6.65
CLIS 95/96 74	C1	9/9/2003 9:37	9.32	9.91	9.58	0.59	Biological	0.21	5.50	0.95	>4	2 to 1	>4	1.72	4.76	3.11	3	0.44, 0.56, 0.92	No	No	Stage I-III	10	DM>PD;few stage I's worm in water column;void at 9.58

Table B-4
Sediment-Profile Image Results for CLIS 95/96 at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 95/96 75	A2	9/9/2003 9:21	13.63	15.41	14.39	1.78	Physical	0.09	2.01	1.22	>4	3 to 2	>4	1.83	7.13	4.08	1	0.86	No	No	Stage I-III	11	DM>PD;possible worm few stage I's;1 present meiofaunal tunneling present;voids at 7.24, 9.11
CLIS 95/96 75	B2	9/9/2003 9:22	11.80	12.98	12.31	1.18	Physical	0.15	2.04	0.61	>4	2 to 1	>4	0.50	4.97	3.06	7	0.58, 0.51, 1.01, 0.68, 0.37, 0.91, 2.22	No	No	Stage I-III	10	DM>PD;older DM with faint layering; sulfidic horizon=bottom of DM surf layer?;few stage I's;void at 8.34
CLIS 95/96 75	C2	9/9/2003 9:23	12.07	13.99	12.95	1.92	Biological	0.15	2.31	0.70	>4	2 to 1	>4	0.08	4.94	3.16	No		No	No	Stage I-III	10	DM>PD;few I's;one large burrow present to depth;voids at 6.45, 9.20, 12.00, 4.46, 12.89
CLIS 95/96 76	A2	9/9/2003 9:09	12.63	13.49	13.27	0.86	Biological	0.59	3.55	1.27	>4	3 to 2	>4	2.34	4.97	3.12	6 to 7	tiny	No	No	Stage I-III	10	DM>PD;stage I's;one present hydroids on chaetopterus tube present;voids at 5.7, 4.92
CLIS 95/96 76	B2	9/9/2003 9:13	11.56	12.42	11.81	0.86	Biological	0.35	3.43	1.36	>4	3 to 2	>4	2.43	6.83	4.47	2	0.29, 0.59	No	No	Stage I-III	11	DM>PD;stage I's;voids at 8.14 10.55;small clasts; phytodetritus reworked; visible active voids and burrows; RPD > 2 cm
CLIS 95/96 76	C2	9/9/2003 9:15	10.41	11.12	10.84	0.71	Biological	0	2.51	0.87	>4	3 to 2	>4	0.00	5.56	3.99	2	tiny	No	No	Stage I-III	11	DM>PD;occassional stage I's;voids at 5.55, 9.87, 6.58, 5.29
CLIS 95/96 77	A2	9/9/2003 9:00	9.96	10.59	10.31	0.63	Biological	0.12	2.04	1.07	>4	2 to 1	>4	1.36	5.12	2.79	No		No	No	Stage I-III	9	DM>PD;worm at 7.73, oligochaetes;relict RPD at 9.5cm;voids 3.19, 2.66, 7.75, 2.08, 1.02, 9.69, 5.66, 2.30, 3.62
CLIS 95/96 77	B2	9/9/2003 9:02	10.92	11.45	11.28	0.53	Biological	0.30	1.83	0.59	>4	2 to 1	>4	2.16	3.64	2.88	No		No	No	Stage I-III	9	DM>PD;oligochaetes-few I's;relict RPD at 11cm;voids at 5.65, 1.34, 1.32
CLIS 95/96 77	C2	9/9/2003 9:04	8.93	10.09	9.68	1.16	Biological	0.18	1.66	0.62	>4	2 to 1	>4	0.83	3.87	2.53	No		No	No	Stage I-III	9	DM>PD;oligochaetes-few stage I's;void at 1.94
CLIS 95/96 82	A2	9/9/2003 9:43	8.84	10.17	9.57	1.33	Biological	0	1.89	0.71	>4	2 to 1	>4	1.01	3.90	2.15	No		No	No	Stage I-III	8	DM>PD;few I's and oligochaetes;one present;voids at 0.95, 1.33, 1.41, 3.43, 4.77, 8.61
CLIS 95/96 82	B1	9/9/2003 9:44	13.72	15.41	14.19	1.69	Biological	0	0.86	0.22	>4	2 to 1	>4	0.53	5.65	3.45	1	1.66	No	No	Stage I-III	10	DM>PD;stage I's;one present hydroids present;void at 3.53
CLIS 95/96 82	C1	9/9/2003 9:45	7.04	8.31	7.60	1.27	Physical	0	3.49	1.05	>4	2 to 1	>4	0.56	6.48	3.13	1	0.97	No	No	Stage I-III	10	DM>PD;stage I's;void at 4.56
CLIS 95/96 83	A2	9/9/2003 10:02	6.80	7.89	7.12	1.09	Physical	0	1.69	0.80	>4	2 to 1	>4	1.98	5.00	3.13	2	0.72, 0.92	No	No	Stage I-III	10	DM>PD;oligochaetes-stage I's;erosional;voids at 5.48, 5.43
CLIS 95/96 83	B2	9/9/2003 10:05	9.46	10.03	9.80	0.57	Physical	0.21	1.86	0.79	>4	2 to 1	>4	0.62	4.52	2.75	1	0.5	No	No	Stage I-III	9	DM>PD;some layering evident @ depth ;few stage I's;scoured, relict RPD at 7-10cm;voids at 6.06, 6.65, 3.60, 6.56
CLIS 95/96 83	C2	9/9/2003 10:06	8.13	8.75	8.36	0.62	Biological	0.33	3.52	1.28	>4	2 to 1	>4	1.83	4.85	2.76	No		No	No	Stage I-III	9	DM>PD;stage I's nephtys at 6.86;hyroids present;void at 2.54
CLIS 95/96 84	A2	9/9/2003 10:12	7.90	8.43	8.08	0.53	Biological	0.18	2.69	1.42	>4	2 to 1	>4	1.80	5.00	2.50	No		No	No	Stage II	7	DM>PD;oligochaetes-stage I's;relict RPD from 4 to 6cm;no voids

Table B-4
Sediment-Profile Image Results for CLIS 95/96 at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 95/96 84	B2	9/9/2003 10:15	8.22	9.88	8.81	1.66	Biological	0	4.47	1.35	>4	2 to 1	>4	1.80	5.62	3.28	No		No	No	Stage I-III	10	DM>PD;few stage I's;one present;voids at 5.09, 3.19
CLIS 95/96 84	D2	9/10/2003 11:45	10.62	12.60	12.02	1.98	Biological	0	3.70	0.94	>4	1 to 0	>4	1.74	5.83	3.64	1	1.36	No	No	Stage I-III	10	DM>PD;few stage I's; voids at 2.49, 3.91, 5.23
CLIS 95/96 85	A1	9/9/2003 10:25	8.90	10.17	9.52	1.27	Biological	0	2.13	0.58	>4	2 to 1	>4	0.15	5.15	3.12	No		No	No	Stage I-III	10	DM>PD;stage I's;one oxidized clast present erosional surface;relict voids at 5.98 4.94 5.02, active at 7.0;erosion pit exposing tubes; phytodetritus reworked; visible active voids and burrows, one with phytodetritus at depth, some possible relict voids; RPD > 2cm
CLIS 95/96 85	B2	9/9/2003 10:26	9.20	10.20	9.66	1.00	Biological	0.18	1.98	0.58	>4	2 to 1	>4	1.33	5.74	3.76	1	0.68	No	No	Stage I-III	11	DM>PD;stage I's;one present;voids at 8, 2.97, 4.87, 2.7, 4.64, 2.77, 6.64, 4.33
CLIS 95/96 85	C2	9/9/2003 10:27	9.49	10.41	9.86	0.92	Biological	0.24	2.07	0.79	>4	2 to 1	>4	2.63	8.60	4.67	1	0.54	No	No	Stage I-III	11	DM>PD;probably older DM lacking strong sulfidic signature; similar in appearance to ambient;stage I's;hydroids present;active at 3.5, 4.0
CLIS 95/96 86	A2	9/9/2003 10:33	9.23	9.76	9.58	0.53	Biological	0.89	1.77	0.53	>4	2 to 1	>4	1.80	4.76	3.31	1	0.74	No	No	Stage I-III	10	DM>PD;oligochaetes only, worm in water column;voids at 6.56, 4.41, 4.63, 3.71, 3.49, 4.52, 4.79
CLIS 95/96 86	B2	9/9/2003 10:36	8.34	9.08	8.69	0.74	Biological	0	1.15	0.44	>4	2 to 1	>4	0.95	5.91	2.96	No		No	No	Stage I-III	9	DM>PD;DM lacking strong sulfidic signature;stage I's only at edge of viewing field;one present;voids at 2.84, 6.46, 7.36, 7.5, 5.94, 4, 3.69
CLIS 95/96 86	C2	9/9/2003 10:37	10.68	11.80	11.18	1.12	Physical	0.24	2.40	0.76	>4	2 to 1	>4	2.04	6.06	4.38	2	0.93, 1.01	No	No	Stage I-III	11	DM>PD;few stage I's;relict RPD at 10cm;voids at 1.92, 2.63, 1.58, 3.30
CLIS 95/96 87	A2	9/9/2003 10:44	7.45	8.46	7.90	1.01	Physical	0.59	1.33	0.54	>4	2 to 1	>4	1.06	3.37	2.17	No		No	No	Stage I-III	8	DM>PD;DM lacking strong sulfidic signature but has sand horizon@depth ;stage I's in farfield tube worm at 5.60;one present;2 voids at depth (bottom left quadrant)
CLIS 95/96 87	B2	9/9/2003 10:48	8.52	9.14	8.81	0.62	Physical	0.89	1.48	0.49	>4	2 to 1	>4	2.72	5.94	4.08	1	0.53	No	No	Stage I-III	11	DM>PD;DM lacking strong sulfidic signature;stage I's;active void at 4.0 cm
CLIS 95/96 87	C2	9/9/2003 10:49	8.19	9.20	8.52	1.01	Biological	0	1.39	0.46	>4	2 to 1	>4	1.68	4.76	3.51	1	0.68	No	No	Stage I-III	10	DM>PD;DM lacking strong sulfidic signature;stage I's;voids at 1.86, 5.63
CLIS 95/96 89	A1	9/9/2003 11:41	8.34	8.84	8.64	0.50	Biological	0	2.87	0.60	>4	2 to 1	>4	2.13	5.80	3.50	No		No	No	Stage I-III	10	DM>PD;oligochaetes only;one present ;voids at 1.7 and 2cm
CLIS 95/96 89	B2	9/9/2003 11:43	9.40	9.94	9.64	0.54	Biological	0	2.22	0.68	>4	2 to 1	>4	2.51	5.12	3.33	No	old clast burried at depth	No	No	Stage I-III	10	DM>PD;few stage I's worm at 3.98;active void at 7.0;relict voids at 9.34, 7.15, 6.11

Table B-4
Sediment-Profile Image Results for CLIS 95/96 at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 95/96 89	C2	9/9/2003 11:46	7.30	7.78	7.54	0.48	Physical	0.24	1.74	0.56	>4	2 to 1	>4	0.65	3.64	2.28	No		No	No	Stage I-III	9	DM>PD;chaetopterus tube, few I's and oligochaetes;shell lag, hydroids present;void at 2.73
CLIS 95/96 90	A2	9/9/2003 11:27	8.61	9.38	9.05	0.77	Physical	0	2.40	0.67	>4	2 to 1	>4	2.10	7.01	3.23	No		No	No	Stage I-III	10	DM>PD;stage I's;one present;voids at 3.64, 8.40, 8.45
CLIS 95/96 90	B2	9/9/2003 11:30	12.63	13.10	12.93	0.47	Physical	0.35	2.31	0.78	>4	2 to 1	>4	0.95	4.67	2.64	No		No	No	Stage I-III	9	DM>PD;stage I's;relict RPD at 5-8cm;voids at 1.18, 7.31
CLIS 95/96 90	C2	9/9/2003 11:34	10.20	10.88	10.51	0.68	Biological	0.24	1.86	0.55	>4	2 to 1	>4	2.16	5.00	3.55	Yes	too small to measure	No	No	Stage I-III	10	DM>PD;few stage I's;voids at 6.33, 5.12
CLIS 95/96 91	A2	9/9/2003 11:20	9.64	10.35	10.01	0.71	Biological	0.35	1.89	1.05	>4	2 to 1	>4	2.81	5.68	3.61	Yes	too tiny to measure	No	No	Stage I-III	10	DM>PD;oligochaetes only;voids at 8.84, 5.57, 4.29
CLIS 95/96 91	B2	9/9/2003 11:21	10.17	10.53	10.35	0.36	Physical	0.24	1.83	1.10	>4	2 to 1	>4	2.10	3.46	2.75	No		No	No	Stage I-III	9	DM>PD;oligochaetes only;disturbed near surface from camera, looks like fresh sand at surf.;voids at 3.11, 6.98, 3.33, 7.83
CLIS 95/96 91	C2	9/9/2003 11:22	8.01	10.52	9.63	2.48	Physical	0	2.10	0.67	>4	2 to 1	4 to 3	0.00	4.08	1.81	No		No	No	Stage I-III	8	DM>PD;oligochaetes, chaetopterus tube;complex burrow network with active particle reworking;.;many small clasts and physical disturbance of surface (large clump of substrate fractured along burrow walls); chaetopterus tube; phytodetritus reworked; visible active burrow complex containing fresh sediment; RPD variable > 2 cm in undisturbed section
CLIS 95/96 92	A1	9/9/2003 10:56	10.11	11.09	10.76	0.98	Biological	0.35	3.13	1.15	>4	2 to 1	>4	1.36	5.71	3.52	2	0.35, 1.01	No	No	Stage I-III	10	DM>PD;few stage I's;void at 6.33
CLIS 95/96 92	B2	9/9/2003 11:06	10.26	10.94	10.53	0.68	Biological	0.21	2.63	0.66	>4	2 to 1	>4	3.02	4.94	3.89	No		No	No	Stage I-III	11	DM>PD;stage I's;voids at 7.17, 4.14
CLIS 95/96 92	C2	9/9/2003 11:08	10.26	10.62	10.38	0.36	Biological	0.15	0.71	0.34	>4	3 to 2	>4	2.13	6.27	4.66	No		No	No	Stage I-III	11	DM>PD;few stage I's;sulfidic patches at depth;voids at 6.69, 9.19
CLIS 95/96 93	A1	9/9/2003 11:52	9.29	10.03	9.58	0.74	Biological	0	1.98	0.79	>4	3 to 2	>4	2.25	5.29	3.95	No		No	No	Stage I-III	11	DM>PD;few stage I's;hydroidson chaetopterus tube;void at 1.50cm
CLIS 95/96 93	B1	9/9/2003 11:53	11.86	14.14	13.12	2.28	Physical	ind	ind	ind	>4	2 to 1	>4	0.50	2.13	0.94	2	0.49, 1.23	No	No	Stage II-III	6	DM>PD;few stage I's;single large burrow present, disturbed surface from wiper clasts;no voids
CLIS 95/96 93	C2	9/9/2003 11:56	10.82	12.30	11.41	1.48	Physical	ind	ind	ind	>4	2 to 1	>4	0.84	9.22	1.13	1	3.82	No	No	Stage I-III	7	DM>PD;stage ``s;large burrow presen; fresh DM? Uncompacted, dewatering pipe present;void at 1.96cm
CLIS 95/96 94	A2	9/9/2003 12:40	11.74	12.21	12.03	0.47	Biological	0.18	1.83	0.68	>4	2 to 1	>4	0.00	5.26	2.09	No		No	No	Stage I-III	8	DM>PD;stage I's;fecal mound present;voids at 3.60, 5.66, 5.10, 6.07, 5.29
CLIS 95/96 94	B2	9/9/2003 12:41	9.67	10.62	10.20	0.95	Biological	0.24	1.69	0.57	>4	2 to 1	>4	2.13	5.59	3.98	No		No	No	Stage I-III	11	DM>PD;oligochaetes only;voids? at 7.09, 6.31, 9.10, 9.21

Table B-4
Sediment-Profile Image Results for CLIS 95/96 at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 95/96 94	C2	9/9/2003 12:43	9.32	10.00	9.49	0.68	Biological	0.33	2.87	0.50	>4	2 to 1	>4	2.19	6.33	3.96	1	0.45	No	No	Stage I-III	11	DM>PD;few stage I's;fecal mound present hydroids on chateropterus tube present;voids at 8.69 9.42;small clasts; chaetopterus tube, Stage I tubes, fecal mound; phytodetritus lightly reworked, incorporated into small tubes; visible voids and burrows extending from depth to surface mounds; RPD > 2cm
CLIS 95/96 95	A2	9/9/2003 12:51	8.96	9.61	9.36	0.65	Biological	0.09	1.21	0.55	>4	2 to 1	>4	0.41	3.70	2.46	No		No	No	Stage I-III	9	DM>PD;few stage I's;fecal mounds present, relict RPD at 7-8.5cm;void at 3.40
CLIS 95/96 95	B1	9/9/2003 12:52	9.46	10.71	10.2	1.25	Physical	0.27	2.66	1.45	>4	2 to 1	>4	0.53	4.41	3.59	No		No	No	Stage I-III	10	DM>PD;few I's, oligochaetes, worm at 4.48cm;chaetopterus tube, relict RPD at 9.5cm to depth;voids at 7.5, 6.38
CLIS 95/96 95	C2	9/9/2003 12:54	9.14	10.35	9.56	1.21	Biological	0.09	3.31	1.26	>4	2 to 1	>4	2.31	5.89	4.01	No		No	No	Stage I-III	11	DM>PD;stage I's;fecal mound present;void at depth
CLIS 95/96 96	A2	9/9/2003 13:01	9.79	11.33	10.29	1.54	Physical	0.03	0.95	0.42	>4	2 to 1	>4	2.78	4.08	3.41	No		No	No	Stage I-III	10	DM>PD;stage I's worm present;burrow with worm at depth
CLIS 95/96 96	B2	9/9/2003 13:03	8.31	9.35	8.83	1.04	Biological	0	1.30	0.42	>4	2 to 1	>4	0.00	4.29	2.94	No		No	No	Stage I-III	9	DM>PD;close to ambient in appearance but most likely DM based on other 2 reps;oligochaetes only;voids at 3.11, 8.46
CLIS 95/96 96	C2	9/9/2003 13:04	9.82	10.82	10.25	1.00	Biological	0	0.77	0.32	>4	2 to 1	>4	0.47	5.50	4.20	Yes	wiper blade artifact	No	No	Stage II	9	DM>PD;few stage I's;shallow voids & burrows, low densities of Stage 3 probably present
CLIS 95/96 97	A2	9/9/2003 13:15	10.74	11.21	10.96	0.47	Biological	0.18	1.18	0.52	>4	2 to 1	>4	2.43	5.38	3.61	No		No	No	Stage I-III	10	DM>PD;few stage I's;relict RPD at 8-10cm;voids at 4.46 1.31 1.71;fecal mound and biological roughness; phytodetritus reworked especially around fecal mound; visible burrow and void near surface; RPD > 2cm; relict RPD
CLIS 95/96 97	B2	9/9/2003 13:18	9.91	11.00	10.51	1.09	IND	0	2.63	1.14	>4	2 to 1	>4	0.00	5.12	3.48	Yes	too tiny to measure	No	No	Stage I-III	10	DM>PD;oligochaetes only;voids at 6.00, 4.48
CLIS 95/96 97	C1	9/9/2003 13:20	9.73	10.31	10.04	0.58	Biological	0.30	2.16	0.50	>4	2 to 1	>4	1.15	4.47	3.27	1	0.74	No	No	Stage I-III	10	DM>PD;stage I's;small fecal mound present;voids at 5.52, 2.55, 3.19, 6.89
CLIS 95/96 98	A1	9/9/2003 13:37	10.00	10.53	10.30	0.53	Biological	0.21	2.34	0.53	>4	2 to 1	>4	1.66	5.38	3.29	1	0.39	No	No	Stage I-III	10	ambient;few tubes;voids at 4.36, 9.31
CLIS 95/96 98	B2	9/9/2003 13:43	9.58	10.59	10.25	1.01	Biological	0	1.39	0.58	>4	2 to 1	>4	2.60	6.15	3.74	No		No	No	Stage I-III	10	ambient;stage I's;relict RPD at 6.95-8.58cm;void at 4.9
CLIS 95/96 98	C2	9/9/2003 13:47	9.79	10.29	10.06	0.50	Physical	0.03	2.10	0.56	>4	2 to 1	>4	1.77	4.85	3.40	No		No	No	Stage I-III	10	ambient;nepthys at 8.11, few tubes and oligochaetes;voids at 8.74, 5.54

Table B-4
Sediment-Profile Image Results for CLIS 95/96 at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
CLIS 95/96 99	A2	9/9/2003 13:26	9.70	10.44	9.91	0.74	Biological	0.27	1.74	0.63	>4	2 to 1	>4	2.40	4.20	3.06	No		No	No	Stage I-III	10	ambient;oligochaetes only;fecal mound present;transect thru oxygenated burrow at left
CLIS 95/96 99	B1	9/9/2003 13:28	11.65	12.60	12.04	0.95	Physical	0.12	1.15	0.47	>4	2 to 1	>4	1.69	4.20	3.19	5	1.65, 0.24, 0.041, 0.45, 0.63	No	No	Stage II-III	9	DM>PD;few stage 1s;shallow voids & burrows, low densities of Stage 3 probably present
CLIS 95/96 99	C2	9/9/2003 13:31	9.17	10.44	9.89	1.27	Physical	0.09	2.13	0.57	>4	2 to 1	>4	2.19	5.47	3.80	No		No	No	Stage I-III	11	ambient;few stage I's;voids at 2.78, 8.68, 3.87
CLIS 95/96 101	A2	9/9/2003 13:54	10.26	10.88	10.56	0.62	Biological	0.12	1.15	0.57	>4	2 to 1	>4	1.80	3.64	2.81	No		No	No	Stage I-III	9	DM>PD;worm at 3.1cm stageI's;one burrow present;nephtys against faceplate at right @ depth
CLIS 95/96 101	B2	9/9/2003 13:57	8.84	9.20	9.11	0.36	Biological	0.18	2.90	1.07	>4	2 to 1	>4	1.60	4.08	3.43	No		No	No	Stage I-III	10	ambient;oligochaetes only;void at 5.50;a few tiny clasts; fecal mound; phytodetritus lightly reworked; visible voids and burrows; RPD > 2cm; apparent relict RPD looks like lighting artifact at bottom of image
CLIS 95/96 101	C2	9/9/2003 14:00	10.65	11.65	11.21	1.00	Biological	0	1.21	0.35	>4	2 to 1	>4	0.06	3.87	2.35	1	2.35	No	No	Stage I-III	9	DM>PD;few stage I's;void at 3.96, 5.77, 5.39

Table B-5
Sediment-Profile Image Results for NHAV 93 at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
NHAV93 200E	A2	9/10/2003 7:12	11.89	12.45	12.22	0.56	Biological	0	1.18	0.69	>4	2 to 1	>4	1.74	3.43	2.76	No		No	No	Stage I-III	9	DM>PD;few stage I's
NHAV93 200E	B2	9/10/2003 7:13	11.03	11.92	11.57	0.89	Biological	0.12	1.04	0.56	>4	2 to 1	>4	0.09	2.81	2.13	No		Yes	No	Stage I-III	6	DM>PD;few stage I's;methane bubble at 7.8cm;voids at 5.72, 7.28
NHAV93 200E	C1	9/10/2003 7:14	9.93	10.44	10.26	0.51	Biological	0.24	3.90	0.70	>4	2 to 1	>4	0.95	6.51	3.39	No		No	No	Stage I-III	10	DM>PD;oligochaetes-stage I's;burrow with reduced feces ejected;no voids but evidence of burrows at depth
NHAV93 200N	A2	9/10/2003 7:20	10.94	11.45	11.23	0.51	Biological	0.52	1.51	0.52	>4	2 to 1	>4	1.54	4.88	2.7	Yes	clasts in farfield	No	No	Stage I-III	9	DM>PD;few stage I's and oligochaetes;feeding pit present;void at 2.60cm?
NHAV93 200N	B2	9/10/2003 7:21	11.06	11.42	11.24	0.36	Biological	0.24	2.69	0.70	>4	2 to 1	>4	0.89	4.41	2.44	No		No	No	Stage I-III	9	DM>PD;few stage I's;void at 8.5cm
NHAV93 200N	C2	9/10/2003 7:22	8.90	10.74	10.12	1.84	Biological	IND	IND	IND	>4	2 to 1	>4	0	3.67	0.87	2	1.60, 1.40	No	No	Stage I-III	7	DM>PD;stage I's;one large burrow present, surface disturbed;voids at 3.36 5.37;surface disturbed (camera frame); phytodetritus reworked; visible voids and burrow; RPD < 2 cm
NHAV93 200S	A2	9/9/2003 17:07	7.75	10.65	9.39	2.90	Biological	0	2.54	0.95	>4	2 to 1	>4	1.24	7.93	4.5	3	1.17, 1.19, 0.92	No	No	Stage I-III	11	DM>PD;large burrow present;no voids
NHAV93 200S	B2	9/9/2003 17:10	8.66	9.32	9.01	0.66	Physical	0.17	1.62	0.54	>4	2 to 1	>4	1.36	4.99	2.86	No		No	No	Stage II-III	8	DM>PD;oligochaetes-stage I's;meiofaunal tunneling;shallow voids, possible Stage 3 present
NHAV93 200S	C2	9/9/2003 17:13	8.60	9.91	9.29	1.31	Physical	0.00	2.50	0.94	>4	2 to 1	>4	0.12	5.14	2.74	No		No	No	Stage II-III	8	DM>PD;stage I's worm at surface;shallow voids, Stage 3 present in low densities
NHAV93 200W	A1	9/10/2003 7:30	10.56	11.42	11.03	0.86	Physical	0.15	1.98	0.52	>4	2 to 1	>4	0.38	4.73	2.82	2	1.72, 1.05	No	No	Stage I	5	DM>PD;no tubes;no tubes, two relict RPDs at 5.5 and 10.9cm;relict void 4.0
NHAV93 200W	B2	9/10/2003 7:31	11.06	11.41	11.24	0.35	Biological	0.24	2.69	0.70	>4	2 to 1	>4	0.89	4.41	2.44	No		No	No	Stage I-III	9	DM>PD;stage I's;relict RPDs at 6.5-7.5 and 8-9.5;relict voids at 5.14 7.80;shell with hydroid on surface; phytodetritus reworked; visible voids and burrows, most with highly reduced fecal pellets; clay at depth; RPD > 2cm
NHAV93 200W	C2	9/10/2003 7:32	8.90	10.79	10.32	1.89	Physical	0	1.83	0.35	>4	2 to 1	>4	0	2.69	1.48	No		No	No	Stage I-III	7	DM>PD;stage I's, decapod on surface;fragmented relict RPD 6.5-8.2 and 9-12.5cm;relic void at 3.26, active at 8.0, 9.0
NHAV93 CTR	A2	9/9/2003 17:19	8.72	9.35	9.15	0.63	Biological	0.24	2.51	0.69	>4	2 to 1	>4	1.24	4.32	2.97	No		No	No	Stage I-III	9	DM>PD;stage I's in farfield;relict voids at 8.50 5.32, active void at 3.0
NHAV93 CTR	B2	9/9/2003 17:22	8.22	9.52	9.05	1.30	Physical	0.35	2.13	0.79	>4	2 to 1	>4	0.98	3.61	2.4	No		No	No	Stage I-III	9	DM>PD;stage I's;erosional surface roughness;relict voids at 5.59, 5.89, 5.43, 4.18, 6.94, 7.59

Table B-5
Sediment-Profile Image Results for NHAV 93 at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
NHAV93 CTR	C2	9/9/2003 17:23	10.09	10.38	10.29	0.29	Biological	0.33	1.01	0.55	>4	2 to 1	>4	0	1.86	0.87	No		No	No	Stage I-III	7	DM>PD;stage I's worm at 10.05;void at 1.34

Table B-6
Sediment-Profile Image Results for MQR at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
MQR 100E	D2	9/10/2003 11:33	12.33	13.01	12.68	0.68	Biological	0.27	2.25	1.19	>4	2 to 1	4 to 3	1.44	7.96	3.72	No		No	No	Stage I-III	10	DM>PD;non-sulfidic sandy capping DM;big tubes in far field hydroids, oligochaetes;voids at 0.65 0.89 5.51;
MQR 100E	E2	9/10/2003 11:33	7.33	10.44	8.81	3.11	Biological	0.20	3.61	1.82	>4	2 to 1	4 to 3	2.45	8.28	5.77	No		No	No	Stage I-III	11	DM>PD;non-sulfidic sandy capping DM;chaetopetus tube in farfield, oligochaetes;disc shaped burrow,hydroids present but no tubes, poorly sorted sand;void at 1.23
MQR 100E	F2	9/10/2003 11:35	13.22	14.11	13.74	0.89	Biological	0.41	2.25	0.91	>4	3 to 2	>4	1.74	3.05	2.05	No		No	No	Stage I-III	8	DM>PD;sandy capping DM; sulfidic patches @ depth;oligochaetes;voids at 6.04, 2.05, 7.90, 11.7
MQR 100N	A2	9/9/2003 16:40	6.55	8.25	7.63	1.70	Physical	0.26	1.39	0.88	>4	3 to 2	>4	0.35	2.99	2.11	2	0.97, 0.72	No	No	Stage I-III	8	DM>PD;non-sulfidic sandy capping DM;oligochaetes;voids at 5.85, 7.23
MQR 100N	B2	9/9/2003 16:41	8.39	9.40	8.88	1.01	Biological	0.70	3.25	1.61	>4	3 to 2	4 to 3	2.39	5.50	4.11	No		No	No	Stage I-III	11	DM>PD;non-sulfidic sandy capping DM;oligochaete;5 voids - active deposit feeders;fecal mounds; phytodetritus reworked; large visible active voids and burrows connected to surface mounds; RPD > 2 cm
MQR 100N	C2	9/9/2003 16:47	9.02	10.00	9.42	0.98	Physical	0.08	1.18	0.42	>4	3 to 2	>4	2.78	5.14	3.67	No		No	No	Stage I-III	10	DM>PD;non-sulfidic sandy capping DM;oligochaetes;voids at 4.41, 6.69
MQR 100S	A2	9/9/2003 15:45	7.89	8.01	7.95	0.12	Physical	0.53	0.86	0.69	>4	3 to 2	>4	1.92	3.58	2.68	Yes	only in far field	No	No	Stage I-III	9	DM>PD;moderately sulfidic DM - cap material?;oligochaetes;void at 7.13
MQR 100S	B2	9/9/2003 15:48	6.80	7.75	7.23	0.95	Physical	0.21	0.83	0.47	>4	3 to 2	>4	1.09	2.78	2.16			No	No	Stage I-III	8	DM>PD;oligochaetes;no tubes;tiny void at 3.98
MQR 100S	C2	9/9/2003 15:52	7.00	7.57	7.30	0.57	Biological	0.12	1.83	0.76	>4	3 to 2	>4	0.74	2.93	2.05	No		No	No	Stage I-III	8	DM>PD;oligochaetes;voids at 3.76, 6.53
MQR 100W	A2	9/9/2003 15:10	5.77	6.39	6.16	0.62	Biological	0.44	0.92	0.66	>4	3 to 2	>4	1.24	2.99	2.77	No		No	No	Stage I-III	9	DM>PD;oligochaetes;hydroids present? Reduced sediment at surface camera artifact defacto capping;voids at 2.72, 2.93, 3.2
MQR 100W	B2	9/9/2003 15:13	6.30	8.04	7.39	1.74	Physical	0.06	0.77	0.44	>4	3 to 2	>4	0.62	2.87	2.08	1	2	No	No	Stage I-III	8	DM>PD;Nephtys at 3.65;voids;large clasts in background, small clasts in foreground, coarse layer on mound in center; phytodetritus reworked; visible active voids and burrows, large Nephtys; RPD > 2
MQR 100W	C2	9/9/2003 15:16	6.74	7.45	7.13	0.71	Physical	0.27	1.51	0.86	>4	3 to 2	>4	1.33	4.55	2.75	No		No	No	Stage I-III	9	DM>PD;oligochaetes;erosional surface roughness retrograde stage I's and III's present defacto capping;void at 6.1

Table B-6
Sediment-Profile Image Results for MQR at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
MQR 150E	A2	9/9/2003 14:14	10.50	11.68	11.09	1.18	Physical	0.27	0.86	0.55	>4	3 to 2	>4	1.86	3.52	2.98	No		No	No	Stage I-III	9	DM>PD;possible DM layering;oligochaetes;no tubes;relic RPD 9.5 to>PD
MQR 150E	B2	9/9/2003 14:17	9.61	10.91	10.12	1.30	Physical	0.12	0.71	0.37	>4	3 to 2	>4	0.89	6.12	3.58	No		No	No	Stage I-III	10	DM>PD;oligochaetes;no tubes ;void at 4.44
MQR 150E	C2	9/9/2003 14:18	8.70	10.20	9.56	1.50	Physical	0.21	1.04	0.53	>4	3 to 2	>4	1.15	5.12	3.25	No		No	No	Stage I-III	10	DM>PD;oligochaetes;void at 6
MQR 150N	A2	9/9/2003 16:52	9.23	9.55	9.37	0.32	Biological	0.27	0.83	0.53	>4	3 to 2	>4	0.47	3.22	2.73	1	0.5	No	No	Stage I-III	9	DM>PD;DM lacking a strong sulfidic signature;few I's and oligochaetes;void at 7.8
MQR 150N	B2	9/9/2003 16:53	9.67	9.82	9.72	0.15	Biological	0.27	0.62	0.38	>4	3 to 2	>4	0.94	4.88	3.01	No		No	No	Stage I-III	10	DM>PD;sulfidic patches/horizon @ depth;oligochaetes;void at 4.8
MQR 150N	C2	9/9/2003 16:56	8.64	10.11	9.56	1.47	Biological	0.21	0.92	0.52	>4	3 to 2	>4	1.83	3.64	3.06	No		No	No	Stage I-III	10	DM>PD;DM lacking a strong sulfidic signature;stage I's;void at 4.0 and 5.0
MQR 150S	A2	9/9/2003 15:33	6.60	7.07	6.73	0.47	Physical	0	1.04	0.72	>4	2 to 1	4 to 3 / >4	0.00	2.22	1.64	No		No	No	Stage I-III	8	DM>PD;sandy DM = CDM?;oligochaetes;thin sand layer over mud;relict void at 4.47
MQR 150S	B2	9/9/2003 15:36	6.71	7.96	7.49	1.25	Biological	0.03	0.92	0.52	>4	3 to 2	4 to 3 / >4	0.03	0.92	0.52	No		No	No	Stage I-III	6	DM>PD;sandy DM = CDM?;oligochaetes;thin sand layer over mud, RPD same as detritus depth;void at 1.88
MQR 150S	C2	9/9/2003 15:39	6.51	8.25	7.22	1.74	Physical	0.03	3.28	1.85	>4	1 to 0	3 to 2 / >4	0.03	3.28	1.85	No		No	No	Stage I-III	8	DM>PD;sandy DM - sulfidic @ depth;oligochaetes;thin sand layer over mud;7 hermit crabs on surface, burrow at depth
MQR 150W	A1	9/9/2003 15:22	7.42	8.01	7.73	0.59	Biological	0.15	0.92	0.48	>4	3 to 2	>4	1.77	5.26	2.75	No		No	No	Stage I-III	9	DM>PD;oligochaetes;void at 3.31
MQR 150W	B2	9/9/2003 15:23	7.66	8.13	7.90	0.47	Biological	0.5	0.5	0.5	>4	3 to 2	>4	0.09	2.45	1.62	No		No	No	Stage I-III	8	DM>PD;Stage I tubes @ SWI;edge of active void to left of relict void; errant burrow at depth;small clasts in background, one at foreground, small Stage I tubes at surface, fecal mounds;phytodetritus reworked; large burrow on lower left; elements of active burrow (round oxidized features) below central relict void;margin of active burrow extends to surface on left of relict burrow;another likely tube on left extends to surface; RPD > 2 cm
MQR 150W	C2	9/9/2003 15:27	8.99	9.82	9.38	0.83	Physical	0	0.86	0.41	>4	3 to 2	>4	0.38	3.52	1.71	2	camera artifact 2.5, 0.5	No	No	Stage I-III	8	DM>PD;oligochaetes;hydroids present defacto capping;void at 3.82

Table B-6
Sediment-Profile Image Results for MQR at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
MQR 50E	A2	9/9/2003 14:35	6.27	3.99	5.50	2.28	Physical	0.00	0.77	0.43	>4	2 to 1	4 to 3	1.15	4.20	2.92	No		No	No	Stage I-III	9	DM>PD;sandy capping DM lacking a strong sulfidic signature;oligochaetes;cohesive sediment fractures camera artifact;voids at depth
MQR 50E	B2	9/9/2003 14:39	8.87	9.67	9.03	0.80	Biological	0.03	1.06	0.49	>4	2 to 1	>4	2.01	3.70	2.66	No		Yes	No	Stage I-III	7	DM>PD;oligochaetes;3 methanebubbles at 5.15cm;voids at 7.42, 7.53
MQR 50E	C2	9/9/2003 14:42	6.06	6.60	6.29	0.54	Biological	0.15	0.74	0.42	>4	2 to 1	>4	1.77	3.64	2.61	No		No	No	Stage I-III	9	DM>PD;sandy capping DM lacking a strong sulfidic signature;oligochaetes;void at 5.55
MQR 50N	A2	9/9/2003 16:28	6.54	7.54	7.18	1.00	Physical	0.18	1.09	0.58	>4	0 to 1	4 to 3	1.80	3.02	2.37	No		No	No	Stage I-III	9	DM>PD;sandy capping DM lacking a strong sulfidic signature;oligochaetes;erosional surface roughness;void at 3.5
MQR 50N	D2	9/10/2003 11:18	12.42	14.46	13.68	2.04	Physical	0.62	1.36	0.93	>4	1 to 0	4 to 3 / >4	1.39	4.61	3.46	Yes	reduced camera artifact	No	No	Stage I-III	10	DM>PD;possible layering = sandy capping DM over sulfidic DM;oligochaetes;possible pull away;void at 2.0, 2.5
MQR 50N	F2	9/10/2003 11:19	15.32	16.21	15.63	0.89	Biological	0	0.8	0.3	>4	1 to 0	>4	2.84	3.31	2.96	No		No	No	Stage I-III	9	DM>PD;scattered stage I's at surface;reduced fecal pellets at right being ejected to surface via large burrow
MQR 50S	A2	9/9/2003 16:01	10.03	10.68	10.42	0.65	Biological	0.09	0.77	0.39	>4	2 to 1	>4	0.27	2.48	1.41	No		No	No	Stage I-III	7	DM>PD;stage I's and oligochaetes;voids at 8.39, 2.8, 1.55, 7.39
MQR 50S	B1	9/9/2003 16:03	9.38	10.09	9.71	0.71	Biological	0	0.98	0.37	>4	2 to 1	>4	0.00	2.51	1.15	No		No	No	Stage I-III	7	DM>PD;reduced/sulfidic @ depth;scattered stage I's;thin sand layer over mud;voids at 3.18, 2.86, 5.32, 7.3
MQR 50S	D2	9/9/2003 16:23	8.64	9.97	9.21	1.33	Physical	0.03	0.8	0.43	>4	2 to 1	>4	0.00	1.69	0.64	No		Yes	No	Stage I-III	4	DM>PD;reduced/sulfidic @ depth; methane bubble;oligochaetes and broken tubes;erosional surface roughness methane bubble at 6.38cm;void at 4.5
MQR 50W	A2	9/9/2003 15:00	8.61	9.26	8.92	0.65	Biological	0.12	0.89	0.41	>4	2 to 1	>4	0.47	3.22	2.60	No		No	No	Stage I-III	9	DM>PD;sandy capping DM lacking a strong sulfidic signature;oligochaetes;very fine sand over mud;void at 6.14 relict voids at depth
MQR 50W	B2	9/9/2003 15:01	6.95	8.25	7.42	1.30	Physical	0.06	1.04	0.59	>4	2 to 1	>4	0.00	3.25	1.93	2	0.78, 0.62	No	No	Stage I-III	8	DM>PD;sandy capping DM lacking a strong sulfidic signature;oligochaetes;hydroids on chaetopterus tube scour lag;void at 5.79
MQR 50W	C2	9/9/2003 15:04	7.72	8.13	7.93	0.41	Biological	0.03	1.54	0.42	>4	2 to 1	>4	0.09	4.11	2.59	No		No	No	Stage I-III	9	DM>PD;sandy capping DM; sulfidic patches @ depth;oligochaetes;voids at 3.04, 3.02

Table B-6
Sediment-Profile Image Results for MQR at CLDS

Station	Replicate	Date/Time	Min Penetration (cm)	Max Penetration (cm)	Mean Penetration (cm)	Boundary Roughness (cm)	BR Process (Bio/Phys)	Min Phytodetritus (cm)	Max Phytodetritus (cm)	Mean Phytodetritus (cm)	Min Grainsize (phi)	Max Grainsize (phi)	Major Mode Grainsize (phi)	Min RPD (cm)	Max RPD (cm)	Mean RPD (cm)	No. Clasts	Mean Clast diameter (cm)	Methane Presence	Anoxia	Successional State	OSI	Comments
MQR CTR	A2	9/9/2003 14:48	5.89	8.25	6.93	2.36	Physical	0.86	0.18	0.32	>4	2 to 1	>4	0.09	2.25	0.99	No		No	No	Stage I-III	7	DM>PD;sandy capping DM lacking a strong sulfidic signature;oligochaetes and broken tubes;hydroid;mound with burrow opening at right corner; burrowing worm against faceplate at depth
MQR CTR	B2	9/9/2003 14:52	6.33	7.99	7.07	1.66	Biological	IND	IND	IND	>4	2 to 1	3 to 2	0.00	3.11	1.35	No		No	No	Stage I-III	7	DM>PD;sandy capping DM lacking a strong sulfidic signature;worm? at 3.4cm, oligochaetes;hydroid;void at depth
MQR CTR	C2	9/9/2003 14:55	8.22	8.55	8.43	0.33	Biological	0	0.98	0.28	>4	2 to 1	4 to 3	0.18	2.45	1.87	No		No	No	Stage I-III	8	DM reworked to point of where it resembles ambient;sandy capping DM lacking a strong sulfidic signature;stage I's and oligochaetes;one burrow present hydroids on chaetopterus tube present;void at 2.0;very large burrow open to surface and chaetopterus tube; phytodetritus reworked; coarser sediment at surface adjacent to burrow (reworking); visible active voids and burrows; RPD < 2 cm

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