Monitoring Cruise at the
Central Long Island Sound
Disposal Site
September 1995

Disposal Area Monitoring System DAMOS

DAMOS
DISPOSAL AREA MONITORING SYSTEM

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13. ABSTRACT

Science Applications International Corporation (SAIC) conducted a monitoring survey at the Central Long Island Sound Disposal Site (CLIS) from 27 August to 1 September 1995 as part of the Disposal Area Monitoring System (DAMOS) Program. The field operations were concentrated over the New Haven 1993 (NHAV 93), CLIS 1994 (CLIS 94), and Field Verification Program (FVP) mounds and consisted of precision bathymetric surveys, Remote Ecological Monitoring of the Seafloor (REMOTS®) sediment-profile photography, and geotechnical coring. These surveying techniques were employed to monitor the stability, cap thicknesses, consolidation rates, and benthic recolonization of the NHAV 93, CLIS 94, and FVP mounds.

The NHAV 93 mound was developed during the 1993/94 disposal season as part of a large scale confined aquatic disposal (CAD) project. SAIC has conducted a total of seven bathymetric, four REMOTS® sediment-profiling, and five geotechnical coring surveys over the NHAV 93 mound since September 1993. The comprehensive time-series data set documents the formation of the mound within the containment cell as well as its gradual consolidation and benthic recolonization.

The results of the September 1995 field effort indicate a moderate amount of consolidation (0.25 m) over the majority of NHAV 93 with several pockets of 0.5 m consolidation near the center of the mound. The heterogeneity of the material collected in the five-member geotechnical coring data set makes tracking a single sediment horizon throughout the project difficult. However, indicators such as shell fragments, gravel, and detritus were useful in differentiating ambient, historic, UDM, and CDM sediment strata. REMOTS® sediment profile-photography found the biota occupying the surface sediments of the NHAV 93 mound to be recovering as anticipated. A seasonal reduction in dissolved oxygen within the central Long Island Sound region appeared to be responsible for shallow redox potential discontinuity (RPD) depths over the NHAV 93 mound as well as the CLIS reference areas. As a result, lower than expected organism-sediment index (OSI) values were found near the center and extreme southern and eastern stations despite the presence of Stage III organisms at eleven of thirteen stations over the NHAV 93 mound.

In September 1994, a disposal buoy marked "CDA" was deployed at 41°09.343' N, 72°53.099' W by SAIC to the northeast of the NHAV 93 mound. Approximately 129,900 m³ of UDM was deposited at the buoy from late November through mid-December 1994 to form the foundation of the CLIS 94 mound. The UDM deposit was capped to a thickness of 0.5 to 1.0 m from January through May 1995 with an estimated volume of 161,000 m³ of CDM. The placement of the CLIS 94 mound approximately 630 m northeast of NHAV 93 began the formation of a second containment ring capable of accommodating a future CAD mound project.

Bathymetric data collected over the CLIS 94 mound exhibited a moderate sized, stable, and completely capped feature of the CLIS seafloor. The new CLIS bottom feature is approximately 470 m wide at the center with a mound height of 3.25 m at the apex. The CLIS 94 mound has completely incorporated the CS-90-1 mound, a capped mound developed during the 1989/90 disposal season. Benthic recovery of CLIS 94 was advanced with Stage III organisms present at the majority of REMOTS® stations in spite of the recent impact of disposal and added stress of seasonal hypoxia.

The FVP mound is a small mound in the northeast corner of CLIS composed of uncapped UDM dredged from Black Rock Harbor in the spring of 1983. It was formed as part of an Environmental Protection Agency (EPA) and US Army Corps of Engineers, Waterways Experiment Station (WES) joint effort to evaluate various dredged material disposal alternatives. Since 1991, FVP has displayed instability in the benthic infaunal population inhabiting the surface sediments. September 1995 REMOTS® results from FVP continue to show a lack of a stable, healthy benthic environment with the presence of depressed RPD and OSI values near the center of the mound. However, the effects of a decrease in available oxygen on the organisms inhabiting FVP might be amplified due to the preexisting stress of occupying a deposit of uncapped UDM. The FVP mound has been monitored periodically as a source of comparison for other mounds at CLIS since its formation in 1983. Now that the WES/EPA experimentation has concluded, capping of the FVP mound in order to isolate the UDM from the marine environment is recommended.

14. SUBJECT TERMS Central Long Island Sound (CLIS), Confined Aquatic Disposal (CAD), Capping Dredged Material (CDM)

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EXECUTIVE SUMMARY

Science Applications International Corporation (SAIC) conducted a monitoring survey at the Central Long Island Sound Disposal Site (CLIS) from 27 August to 1 September 1995 as part of the Disposal Area Monitoring System (DAMOS) Program. The field operations were concentrated over the New Haven 1993 (NHAV 93), CLIS 1994 (CLIS 94), and Field Verification Program (FVP) mounds and consisted of precision bathymetric surveys, Remote Ecological Monitoring of the Seafloor (REMOTS®) sediment-profile photography, and geotechnical coring. These surveying techniques were employed to monitor the stability, cap thicknesses, consolidation rates, and benthic recolonization of the NHAV 93, CLIS 94, and FVP mounds.

The NHAV 93 mound represents the culmination of ten years of thoughtful planning and controlled disposal at CLIS. This mound was developed during the 1993/94 disposal season as part of a large scale confined aquatic disposal (CAD) project. From 1984 through 1992, disposal operations at CLIS led to the construction of a ring of disposal mounds. This ring formed an artificial containment cell that was capable of accepting a large volume of unacceptably contaminated dredged material (UDM), limiting the lateral spread of the deposit and, in turn, facilitating efficient capping operations. The NHAV 93 mound was formed by the placement of approximately 590,000 m^3 of UDM within the ring of seven historic disposal mounds. The UDM deposit was then covered to a thickness of 0.5 m to 1.0 m by 569,000 m^3 of capping dredged material (CDM).

SAIC has conducted a total of seven bathymetric, four REMOTS® sediment-profiling, and five geotechnical coring surveys over the NHAV 93 mound since September 1993. The comprehensive time-series data set documents the formation of the mound within the containment cell as well as its gradual consolidation and benthic recolonization. In addition, the wealth of data has provided SAIC and the US Army Corps of Engineers, New England Division (NED), with significant insight into the short- and long-term effects of disposal and oceanographic processes on large dredged material mounds.

The results of the September 1995 field effort indicate a moderate amount of consolidation (0.25 m) over the majority of NHAV 93 with several pockets of 0.5 m consolidation near the center of the mound. The heterogeneity of the material collected in the five-member geotechnical coring data set makes tracking a single sediment horizon throughout the project difficult. However, indicators such as shell fragments, gravel, and detritus were useful in differentiating ambient, historic, UDM, and CDM sediment strata. REMOTS® sediment profile-photography found the biota occupying the surface sediments of the NHAV 93 mound to be recovering as anticipated. A seasonal reduction in dissolved oxygen within the central Long Island Sound region appeared to be responsible for shallow redox potential discontinuity (RPD) depths over the NHAV 93 mound as well as the CLIS reference areas. As a result, lower than expected organism-sediment index (OSI) values were found near the center and extreme southern and eastern stations despite the presence of Stage III organisms at eleven of thirteen stations over the NHAV 93 mound.

In September 1994, a disposal buoy marked "CDA" was deployed at 41°09.343' N, 72°53.099' W by SAIC to the northeast of the NHAV 93 mound. Approximately 129,900 m^3 of UDM was deposited at the buoy from late November through mid-December 1994 to form the foundation of the CLIS 94 mound. At the conclusion of UDM disposal operations, the CDA buoy was struck by a disposal barge and dragged off-station. The buoy was repositioned to 41°09.334' N, 72°53.084' W before the start of CDM deposition over the CLIS 94 mound. The UDM deposit was capped to a thickness of 0.5 to 1.0 m from January through May 1995 with an estimated volume of 161,000 m^3 of CDM. The placement of the CLIS 94 mound approximately 630 m northeast of NHAV 93 began the formation of a second containment ring capable of accommodating a future CAD mound project.

Bathymetric data collected over the CLIS 94 mound exhibited a moderate sized, stable, and completely capped feature of the CLIS seafloor. The new CLIS bottom feature is approximately 470 m wide at the center with a mound height of 3.25 m at the apex. The CLIS 94 mound has completely incorporated the CS-90-1 mound, a capped mound developed during the 1989/90 disposal season. Benthic recovery of CLIS 94 was advanced with Stage III organisms present at the majority of REMOTS® stations in spite of the recent impact of disposal and added stress of seasonal hypoxia.

The FVP mound is a small mound in the northeast corner of CLIS composed of uncapped UDM dredged from Black Rock Harbor in the spring of 1983. It was formed as part of an Environmental Protection Agency (EPA) and US Army Corps of Engineers, Waterways Experiment Station (WES) joint effort to evaluate various dredged material disposal alternatives. Since 1991, FVP has displayed instability in the benthic infaunal population inhabiting the surface sediments. September 1995 REMOTS® results from FVP continue to show a lack of a stable, healthy benthic environment with the presence of depressed RPD and OSI values near the center of the mound. However, the effects of a decrease in available oxygen on the organisms inhabiting FVP might be amplified due to the preexisting stress of occupying a deposit of uncapped UDM. The FVP mound has been monitored periodically as a source of comparison for other mounds at CLIS since its formation in 1983. Now that the WES/EPA experimentation has concluded, capping of the FVP mound in order to isolate the UDM from the marine environment is recommended.

1.0 INTRODUCTION

The managed disposal of dredged material was introduced to the central Long Island Sound region in October 1973 with the development of the New Haven 1974 (NHAV 74) mound in the center of the newly created New Haven Disposal Site. An estimated 1,150,000 m³ of material dredged from the New Haven Harbor was deposited at this site between October 1973 and March 1977. In 1977, the US Army Corps of Engineers, New England Division (NED), instituted the Disposal Area Monitoring System (DAMOS) Program in response to the recognized need for long-term management and monitoring of the New Haven Disposal Site as well as 10 other disposal sites in New England waters (NUSC 1979). Since 1977, advances in dredged material disposal, precision navigation, and environmental monitoring technology have continually improved the tools used in disposal site management.

In 1979, the configuration of the New Haven Disposal Site was modified, expanding the boundaries of the site and changing its name to Central Long Island Sound Disposal Site (CLIS; SAI 1979). The new disposal site boundaries encompassed a 6.86 km² (2 nmi²) area located approximately 10.39 km (5.6 nmi) south of South End Point, East Haven, Connecticut (Figure 1-1). Since its expansion in 1979, the disposal site shown in DAMOS reports has been centered at 41°08.950' N, 72°52.850' W. However, after recognizing a slight discrepancy, NED began using the set of center coordinates for CLIS as defined in the Final Programmatic Environmental Impact Statement (FPEIS; US Army Corps of Engineers 1982). CLIS is now centered at 41°08.900' N, 72°53.100' W longitude in North American Datum of 1927 (NAD 27), 362 m west-southwest of the historic DAMOS center (Figures 1-1 and 1-2). The reasons for the discrepancy between the historic and FPEIS coordinates are unknown; however, this modification corrects the locational inconsistency. Similar changes are being made for the New London Disposal Site (NLDS) and Cornfield Shoals Disposal Site (CSDS) in the eastern Long Island Sound.

Historically, CLIS has been one of the most active disposal sites in the New England region. The disposal site has received sediments dredged from New Haven, Bridgeport, Stamford, and Norwalk Harbors, as well as adjacent coastal areas. The abundance of disposal activity within the boundaries of the disposal site allowed NED to develop and refine a variety of dredged material management strategies. During the 1978/79 disposal season, subaqueous capping was introduced as a new dredged material management approach with the formation of the Stamford-New Haven mounds (STNH-N and STNH-S; SAIC 1995).

Capping is a containment method which uses sediments determined to be suitable for unconfined open water disposal, or capping dredged material (CDM), to overlay and

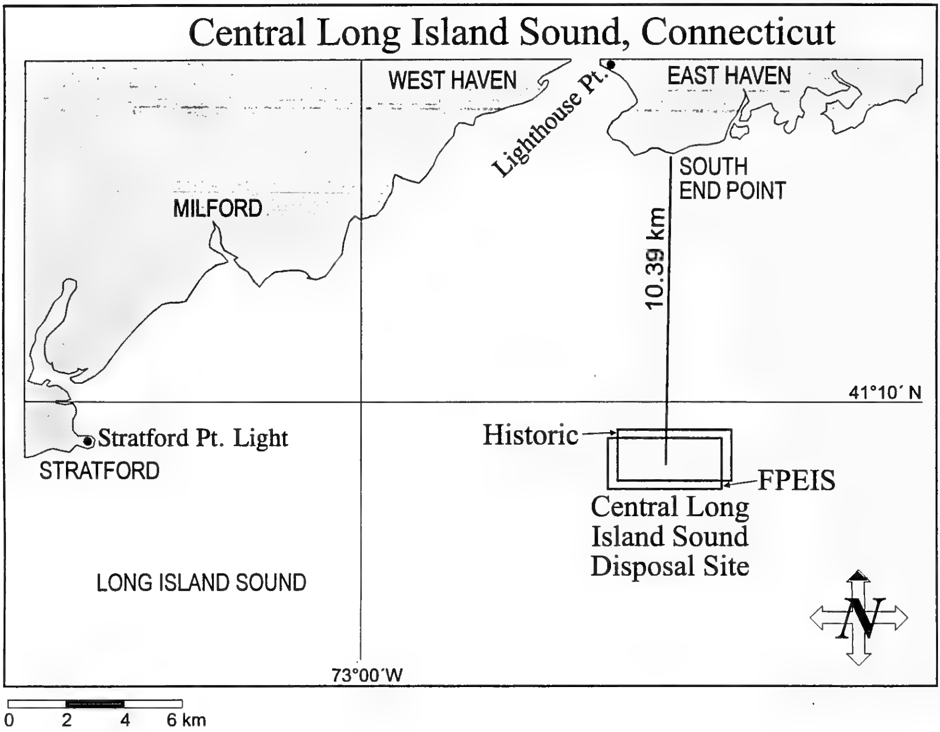


Figure 1-1. Location of the Central Long Island Sound Disposal Site and shore station benchmarks

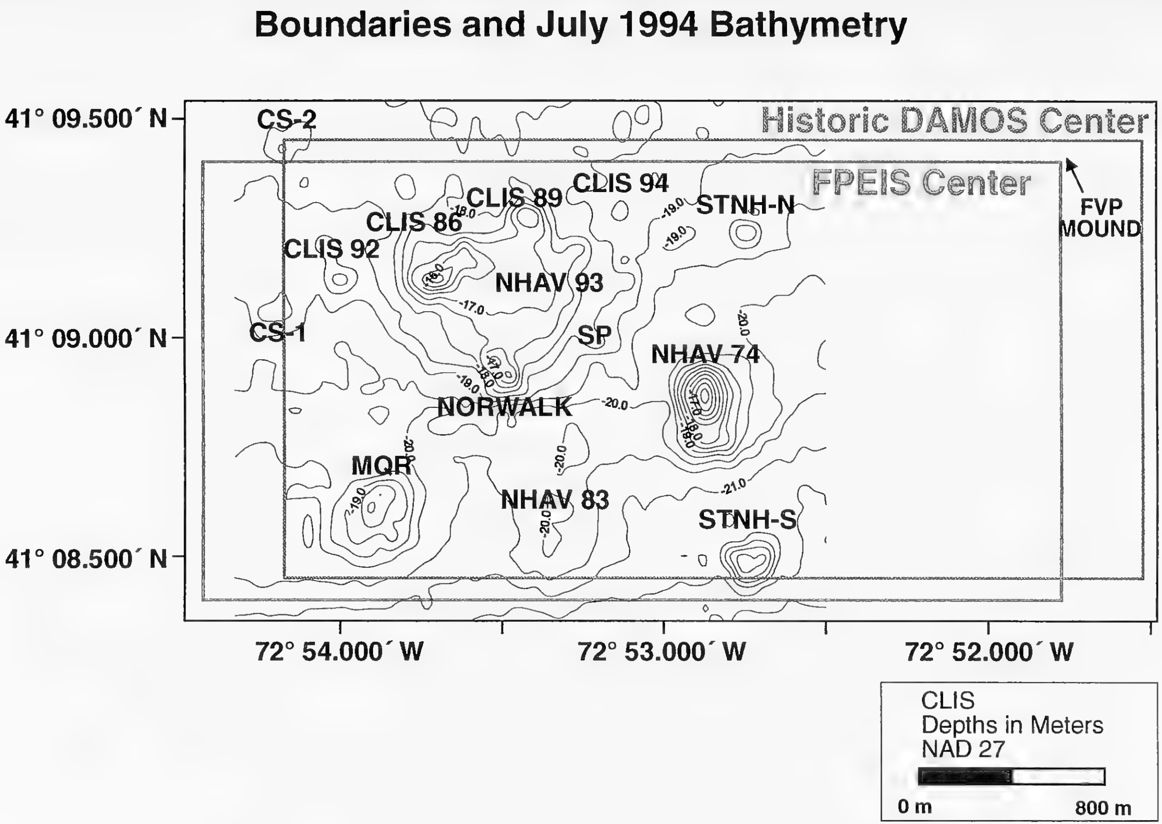


Figure 1-2. The historic DAMOS and Final Programmatic Environmental Impact Statement boundaries of the Central Long Island Sound Disposal Site over the July 1994 bathymetric survey

isolate deposits of unacceptably contaminated dredged material (UDM) from the environment (Fredette 1994). As a result of the operational success of the 1979 capping project, many additional capped mounds have been formed at CLIS (SAIC 1995).

From 1977 through 1983 the site management strategy at CLIS entailed the formation of many independent mounds over the given area of the disposal site. Each mound was monitored individually, assessing mound stability, cap thickness, benthic recolonization status, etc. Although this practice was highly successful, the overall capacity of the disposal site was compromised due to the unusable area between the discrete sediment mounds (Morris et al. 1996).

In 1983, a new management strategy was instituted at CLIS. Utilizing the ten-year dredging cycle that exists in the central Long Island Sound region, NED managed the deposition of small to moderate volumes of dredged material at CLIS to form a disposal mound ring. Upon completion in 1992, this network of disposal mounds formed an artificial containment cell that was capable of accepting a large volume of UDM, limiting the lateral spread of the deposit, and facilitating efficient capping operations.

The containment ring was employed during the 1993/94 disposal season as part of the New Haven Harbor Capping Project. In September 1993, the NHAV buoy was placed in the center of seven historic disposal mounds (41°09.122' N, 72°53.453' W) designating the disposal point for approximately 590,226 m^3 of UDM dredged from the inner New Haven Harbor (Figure 1-3). The UDM deposit was then capped to a thickness of 0.5 m to 1.0 m with an estimated barge volume of 569,287 m^3 of outer New Haven Harbor CDM, forming the New Haven 1993 (NHAV 93) mound. Upon completion of disposal and capping operations in March 1994, the NHAV 93 mound displayed a height of 2.5 m and an overall diameter of 800 m (Figure 1-4; Morris et al. 1996).

Due to the utilization of an artificial containment structure, the NHAV 93 mound is considered a confined aquatic disposal (CAD) mound. The use of the disposal mound ring significantly reduced the outward migration of the UDM mound apron relative to an uncontained UDM deposit. As a result, cap material distribution was concentrated over a smaller area, decreasing the total volume of CDM required to cap the inner New Haven Harbor sediments (Morris et al. 1996). The completed CAD mound was found to be broad, stable, adequately capped, and exhibiting a CDM to UDM ratio of 0.96:1.0 (Morris and Tufts 1997). In the past, CDM to UDM ratios varied from 2:1 to 6:1 when initiating a capping operation on a flat or gently sloping area of seafloor. The NHAV 93 mound represents the first capped mound composed of a smaller volume of CDM than the initial UDM deposit.

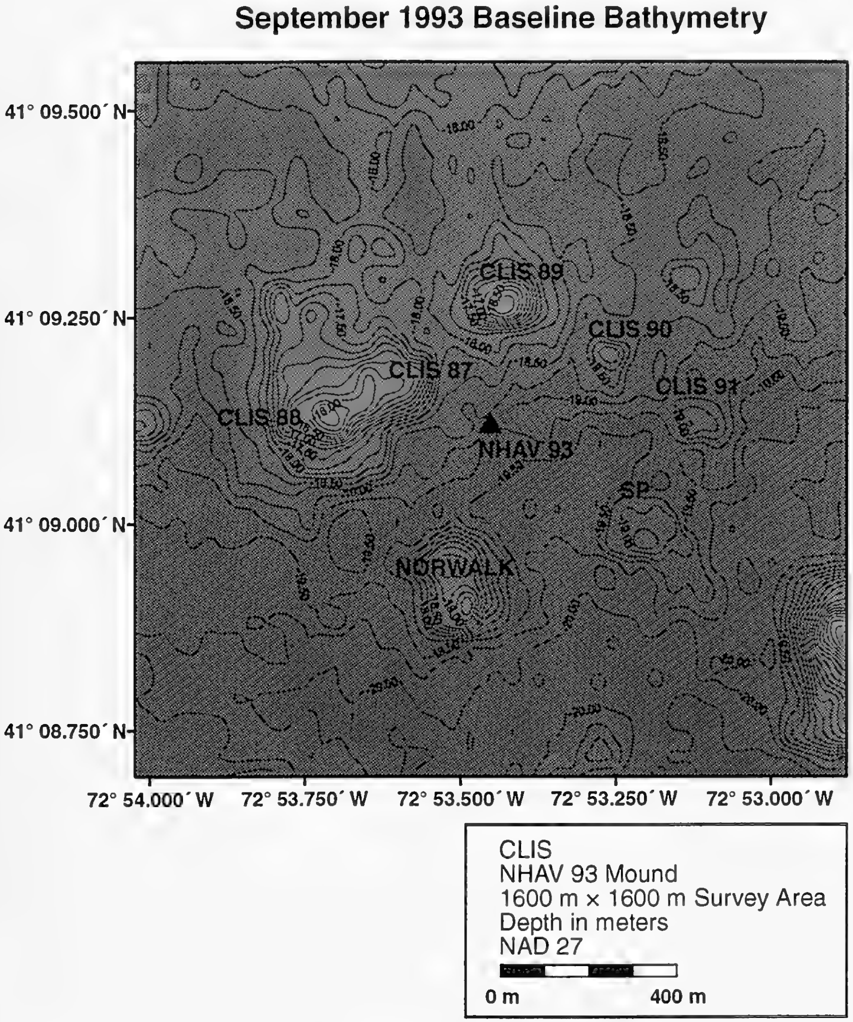


Figure 1-3. September 1993 baseline bathymetry depicting a ring of seven historic disposal mounds with plotted position of the NHAV 93 buoy, 0.25 m contour interval

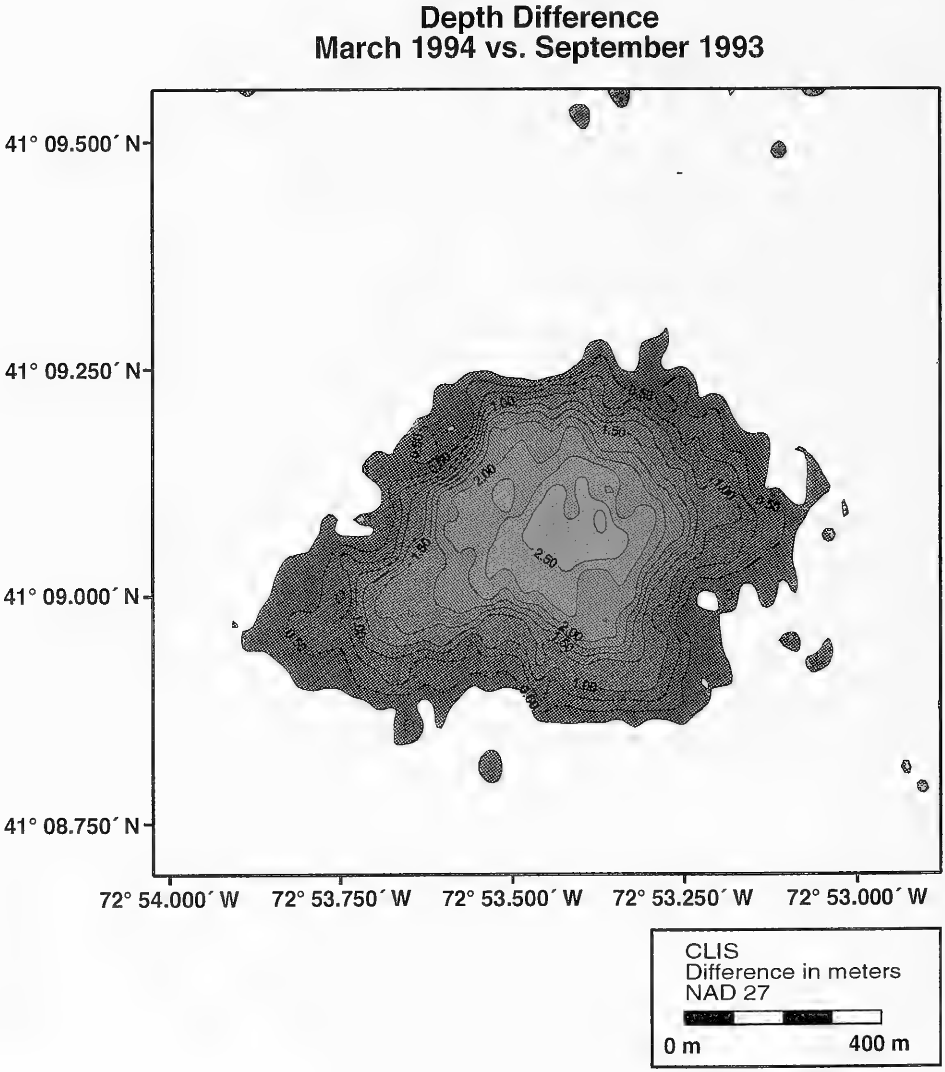


Figure 1-4. Depth difference contour chart based on the comparisons of the March 1994 postcap survey versus the September 1993 baseline survey

In September 1994, the CDA buoy was deployed over the historic CS-90-1 mound at 41°09.343' N, 72°53.099' W, approximately 630 m northeast of the NHAV 93 mound apex. The placement of a moderate-sized, capped mound in close proximity to the NHAV 93 mound complex began the formation of a second containment ring capable of accommodating a future CAD mound project. In addition, the deposition of new material over CS-90-1 was intended to cover the smaller CS-90-1 capped mound, further isolating its UDM deposit and conserving the usable surface area of the CLIS seafloor.

An estimated barge volume of 129,900 m^3 of UDM was released at the CDA buoy from late November through mid-December 1994. Toward the end of UDM disposal activity, the CDA buoy was struck by a disposal barge and dragged off-station. The buoy was repositioned at 41°09.334' N, 72°53.084' W on 27 December 1994 before the start of CDM deposition. During capping operations, the UDM deposit was covered to a thickness of 0.5 to 1.0 m from January through May 1995 with an estimated volume of 161,000 m^3 of CDM.

In 1983, the Field Verification Program (FVP) mound was formed in the northeastern corner of CLIS as the subaqueous disposal component of a joint research effort between the US Environmental Protection Agency (EPA) and US Army Corps of Engineers, Waterways Experiment Station (WES). The two agencies were evaluating upland containment, wetland creation, and subaqueous disposal alternatives for UDM (Peddicord 1988). The FVP mound is a small mound composed of 55,000 m^3 of uncapped UDM dredged from Black Rock Harbor in the spring of 1983 (Morton 1983). Since 1991, FVP has displayed instability in the benthic infaunal population inhabiting the surface sediments, suggesting an increase in environmental stress.

Science Applications International Corporation (SAIC) conducted a monitoring survey at CLIS from 27 August to 1 September 1995 as part of the DAMOS Program. The field efforts were concentrated over the NHAV 93, CLIS 94, and FVP disposal mounds, and consisted of bathymetric profiling, Remote Ecological Monitoring of the Seafloor (REMOTS®), and geotechnical coring. Precision bathymetry and REMOTS® technology are well-tested and highly regarded methods of investigating the properties and processes of dredged material disposal within the DAMOS tiered monitoring protocols. The use of geotechnical coring is not a routine monitoring approach but is used in the special study of dredged material mounds to improve our understanding of the dynamics and mass properties of these mounds.

The DAMOS tiered monitoring protocols are based on the use of a control or alternate condition to provide solid statistical testing and serve as a foundation for experimental design (Germano et al. 1994). Three reference areas surrounding CLIS are used as zones of primary control to allow comparisons between the surface sediments of the disposal mounds and ambient bottom. CLIS-REF (41°08.085' N, 72°50.109' W), 2500W (41°09.254' N, 72°55.569' W), and 4500E (41°09.254' N, 72°50.565' W) are devoid of dredged material and physically, chemically, and biologically represent the ambient bottom of CLIS. The DAMOS Program uses a multiple reference approach to strengthen the statistical models as well as provide contingencies for acute benthic disturbances (i.e., trawling) that affect smaller areas of seafloor at a reference site before or during field operations causing degradation of the data collected.

The objectives of the September 1995 field operations were to

- conduct two bathymetric surveys over CLIS to examine any topographical changes in the NHAV 93 mound and delineate the dredged material footprint of the new CLIS 94 capped mound;
- assess the benthic recolonization status of the NHAV 93, CLIS 94, and FVP mounds relative to the three surrounding CLIS reference areas; and
- sample the various layers of sediment that make up the NHAV 93 mound and quantify the amount of dredged material consolidation and de-watering within those layers.

The September 1995 field effort tested the following predictions:

- Small to moderate amounts of consolidation will be found over the majority of the NHAV 93 mound, while the CLIS 94 mound will be of moderate size, conical in shape, and fully capped.
- The sediments of NHAV 93 are expected to be supporting Stage II and Stage III individuals over the surface of the mound in accordance with the DAMOS tiered monitoring protocols.
- The benthic community over the CLIS 94 mound should consist primarily of Stage I individuals with some progression into Stage II assemblages as predicted by the DAMOS tiered monitoring protocols.
- The conditions over the FVP mound should have returned to a state similar to the three CLIS reference areas; however, seasonal changes in water quality parameters may increase the susceptibility of the benthic community to environmental stress relative to the reference areas.

- Consolidation of the NHAV 93 mound is expected to obscure the UDM/CDM interface within the geotechnical cores.

2.0 METHODS

2.1 Survey Areas

In order to fulfill the objectives of the 1995 CLIS monitoring survey, two bathymetric survey areas were defined over the CLIS 94 and NHAV 93 disposal mounds. The survey over the CLIS 94 mound was 1000 m × 1000 m, centered on the first position of the 1994 CDA buoy (41°09.343' N, 72°53.099' W). A total of 41 survey lanes at 25 m lane spacing were required to delineate the topography of the new CLIS 94 mound (Figure 2-1). The second, larger survey was conducted over a 1600 m × 1600 m area, and centered at 41°09.125' N, 72°53.413' W (Figure 2-1). The layout of this survey was identical to the surveys run over the NHAV 93 mound in the 1993 and 1994 disposal seasons, requiring 65 survey lanes to map the changes in the now historic NHAV 93 mound. Detailed bathymetric charts were generated for both areas to quantify mound height, lateral distribution of dredged material, and position relative to other disposal mounds.

2.2 Bathymetry and Navigation

The SAIC Integrated Navigation and Data Acquisition System (INDAS) provided the precision navigation and data collection required for all SAIC field operations. This system utilizes a Hewlett-Packard 9920® series computer to provide real-time navigation, as well as collect position, depth, and time data for later analysis. A Del Norte Trisponder® System provided positioning to an accuracy of ±3 m. Shore stations were established along the Connecticut coast at the known benchmarks of Stratford Point (41°09.112' N, 72°06.227' W) and Lighthouse Point (41°14.931' N, 72°54.255' W) (Figure 1-1). A detailed description of the navigation system and its operation can be found in the DAMOS Navigation and Bathymetry Reference Report (Murray and Selvitelli 1996).

An ODOM DF3200 Echotrac® Survey Fathometer with a narrow beam, 208 kHz transducer measured individual depths to a resolution of 3.0 cm (0.1 ft) as described in DAMOS Contribution No. 48 (SAIC 1985). Depth values transmitted to INDAS were adjusted for transducer depth. The acoustic returns of the fathometer can reliably detect changes in depth of 20 cm or greater due to the accumulation of errors introduced by the positioning system, tidal corrections, changes in sound velocity through the water column, the slope of the bottom, and vertical motion of the survey vessel.

The expanding resources of the Internet have allowed SAIC to access the National Oceanographic and Atmospheric Administration (NOAA), Ocean and Lake Levels

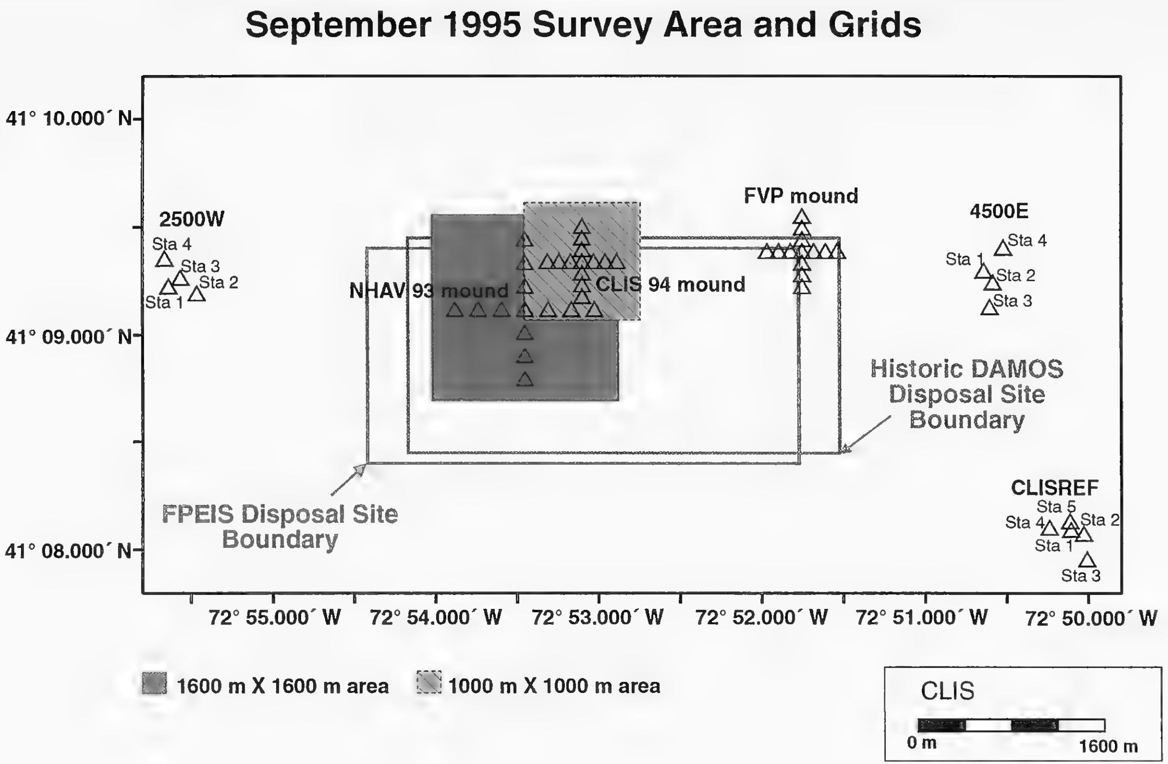


Figure 2-1. Base map displaying the bathymetric survey areas and REMOTS® stations relative to the Central Long Island Sound Disposal Site boundaries

Division's (OLLD) National Water Level Observation Network. This network is composed of 181 water level stations that are located throughout the Great Lakes and coastal regions of United States interest. These stations are equipped with the Next Generation Water Level Measurement System tide gauges and satellite transmitters that have collected and transmitted tide data to the central NOAA facility every six minutes, since 1 January 1994.

Observed tide data are available 1 to 6 hours from the time of collection in a station datum or referenced to Mean Lower Low Water (MLLW) and based on Coordinated Universal Time (UTC). For the 1995 CLIS surveys, data from NOAA tide station 8467150 in Bridgeport Harbor, Bridgeport, CT, were used for tidal calculations. The NOAA 6-minute tide data were downloaded in the MLLW datum and corrected to local time, and tidal differences based on the entrance to New Haven Harbor, New Haven, CT, were applied.

In order to make valid comparisons between present and past bathymetric surveys of the area, the July 1994 and March 1994 bathymetry models were corrected to observed MLLW. The CLIS 1993 baseline survey of the project area was previously corrected to MLLW using the predicted tides for those survey days; therefore, no re-calculation was required.

During the bathymetric survey, a Seabird Instruments, Inc. SBE 26-03 Sea Gauge wave and tide recorder was used to collect tidal data on-site. The tide gauge, deployed in the survey area, recorded pressure values every six minutes. After conversion, the pressure readings provided a constant record of tidal variations in the survey area based on a mean tidal level (MTL) datum. These observed tidal data were later used to compare and verify the corrected NOAA data generated from the Bridgeport Harbor station (Figure 2-2).

A Seabird Instruments, Inc. SEACAT SBE 19-01 Conductivity, Temperature, and Depth (CTD) probe was used to obtain sound velocity measurements at the start, midpoint, and end of each survey day. The data collected by the CTD probe were bin-averaged to 1 meter depth intervals to account for any pycnoclines, rapid changes in density that create distinct layers within the water column. A mean sound velocity was then calculated using the bin-averaged values.

The bathymetric data were analyzed using SAIC's Hydrographic Data Analysis System (HDAS), version 1.03. Raw bathymetric data were imported into HDAS, corrected for sound velocity, and standardized to MLLW using the NOAA observed tides. The bathymetric data were then used to construct depth models of the surveyed area. A

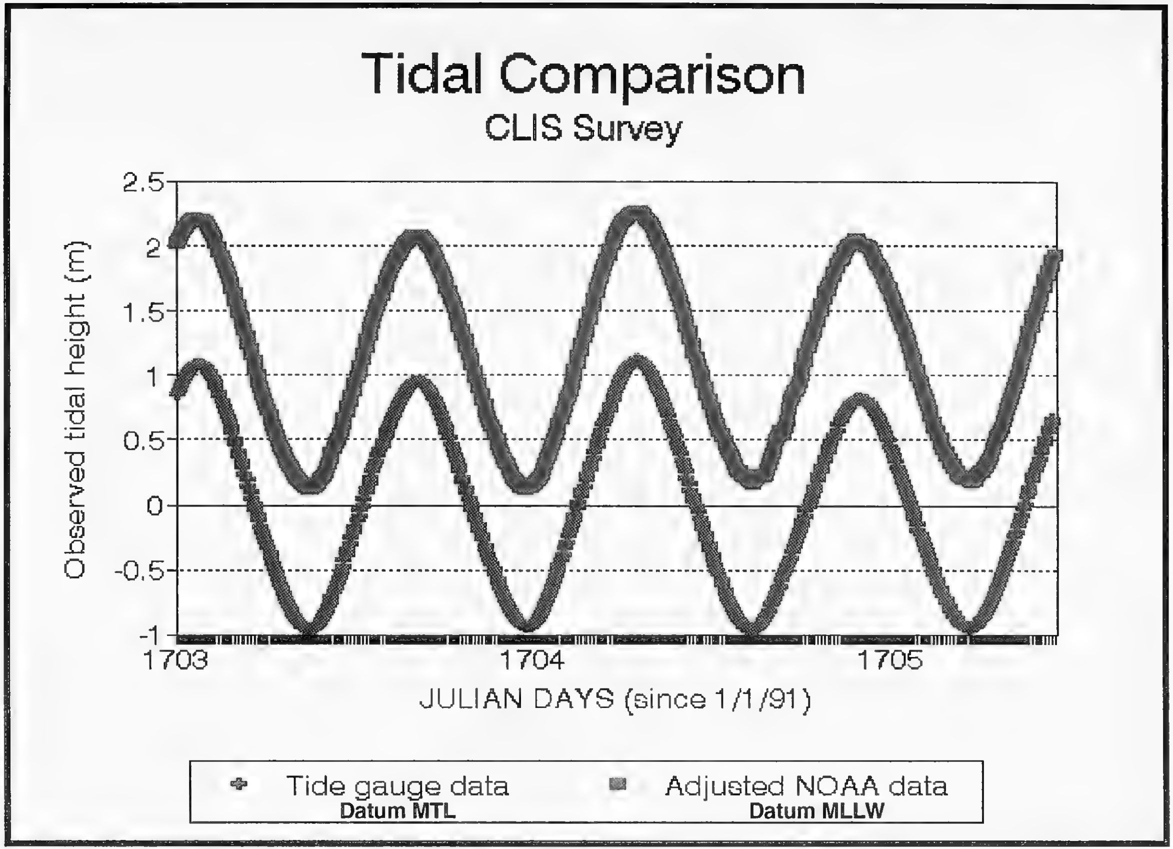


Figure 2-2. Comparisons of the two types of tidal data collected for the September 1995 bathymetric surveys. Differences in tidal height are due to datums.

detailed discussion of the bathymetric analysis technique is provided in the DAMOS Navigation and Bathymetry Reference Report (Murray and Selvitelli 1996).

2.3 REMOTS® Sediment-Profile Photography

REMOTS® photography was used to detect the distribution of dredged material layers, map benthic disturbance gradients, and monitor the benthic infaunal recolonization and/or successional status of the NHAV 93, CLIS 94, and FVP mounds relative to the CLIS reference areas. Cross-sectional photographs of the top 20 cm of sediment were taken for analysis and intercomparison with the adjacent CLIS reference areas.

Three replicate photographs were taken at thirteen stations over each of the three disposal mounds (Figure 2-1). The REMOTS® sampling grids over the disposal mounds formed a cross-shaped pattern with three stations along each of four arms and one station in the center. The REMOTS® survey over the NHAV 93 mound was centered at 41°09.122' N, 72°53.453' W with station spacing at 200 m. The CLIS 94 and FVP grids, centered at 41°09.343' N, 72°53.099' W and 41°09.390' N, 72°51.750' W, respectively, were based on the same cross-shaped pattern, but sampled every 100 m (Figure 2-1; Appendix A: Table 2-1).

Data from three reference areas (CLISREF, 2500W, and 4500E) were used for comparison of ambient central Long Island Sound sediments relative to the sediments deposited at CLIS through disposal operations. Reference areas 2500W (41°09.254' N, 72°55.569' W) and 4500E (41°09.254' N, 72 50.565' W) were sampled at four randomly selected stations. CLISREF (41°08.085' N, 72°50.109' W) was sampled at five randomly selected stations (Figure 2-1; Appendix A: Table 2-1).

2.4 Geotechnical Coring

The geotechnical coring operations completed on 28 and 29 August were the final replicates collected for the NHAV 93 project. A total of eleven sediment cores were collected from seven stations oriented to produce a cross-section of the NHAV 93 mound. The cores were obtained in an SAIC and University of Rhode Island (URI) joint effort. The sampling scheme was centered on the NHAV 93 buoy position (41°09.122' N, 72°53.453' W). Cores GC-1 through GC-5 and GC-8 through GC-11 were taken in a northeast-southwest transect across the NHAV 93 mound. Cores GC-6 and GC-7 were obtained on a northwest-southeast transect of NHAV 93 mound (Figure 2-3; Appendix A: Table 2-2).

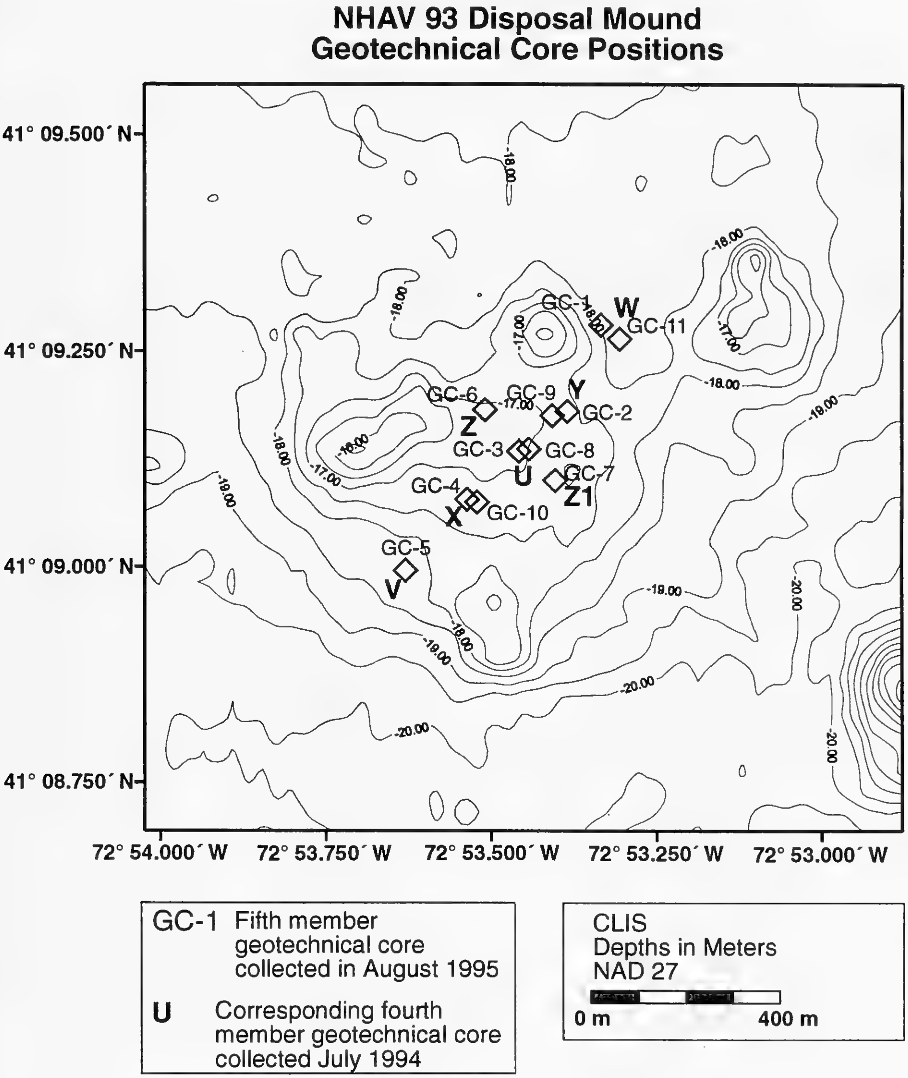


Figure 2-3. Chart of the 1600 m × 1600 m survey area with plotted geotechnical core positions and names

The sediment cores were obtained with the use of the PVC version of the University of Rhode Island/Marine Geomechanics Laboratory (URI/MGL) large-diameter gravity corer (LGC; Figure 2-4; Silva et al. 1996). The core barrel consists of a 3 m (10 ft) section of Schedule 40 PVC piping (10.2 cm or 4.0 I.D.) and includes a nose cone and core catcher on the end.

All cores were transported back to the URI laboratory facilities and refrigerated during storage. The CLIS sediment cores were processed to obtain overall sediment composition, bulk density, water content, grain size, Atterberg Limits, specific gravity, and shear strength (Silva et al. 1996). A detailed description of the methods used for the analysis of sediment cores GC-1 through GC-11 will be included in a report submitted by Armand J. Silva, P.E., of Geotechnical Consulting Engineers.

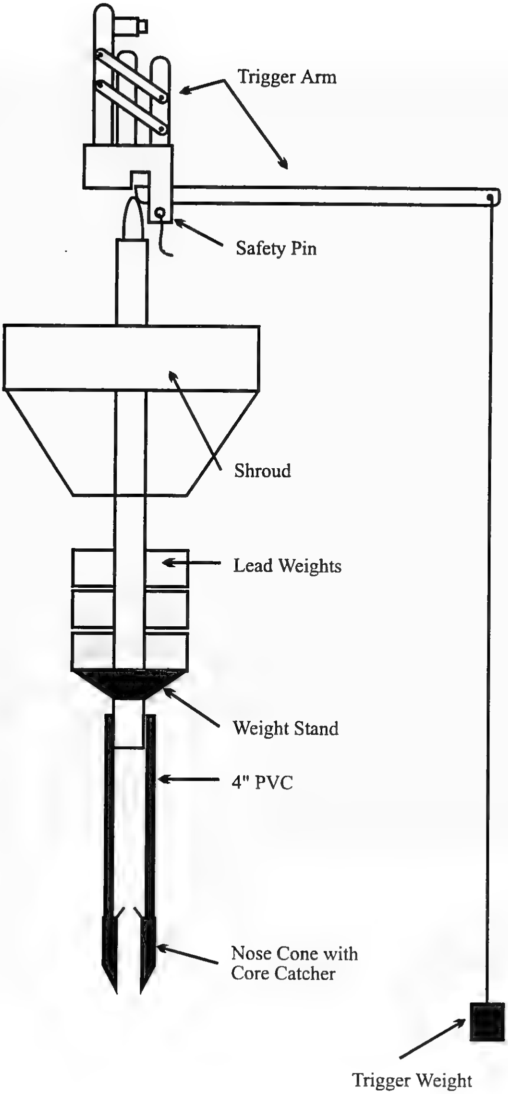


Figure 2-4. Diagram of the URI/MGL large-diameter gravity corer

3.0 RESULTS

3.1 NHAV 93 Mound

3.1.1 Bathymetry

Seven bathymetric and three REMOTS® sediment-profiling surveys were conducted over the NHAV 93 mound since September 1993 to monitor the progress of the CAD mound construction and consolidation over time. The latest bathymetric survey (1600 m × 1600 m), eighteen months after capping operations were completed, displays a mound complex approximately 820 m wide and composed of eight disposal mounds (CLIS 87, CLIS 88, CLIS 89, CLIS 90, CLIS 91, SP, NORWALK, and NHAV 93) (Figures 3-1 and 3-2). Overall, little change in size or shape was detected in the mound complex relative to previous surveys, indicating continued lateral stability.

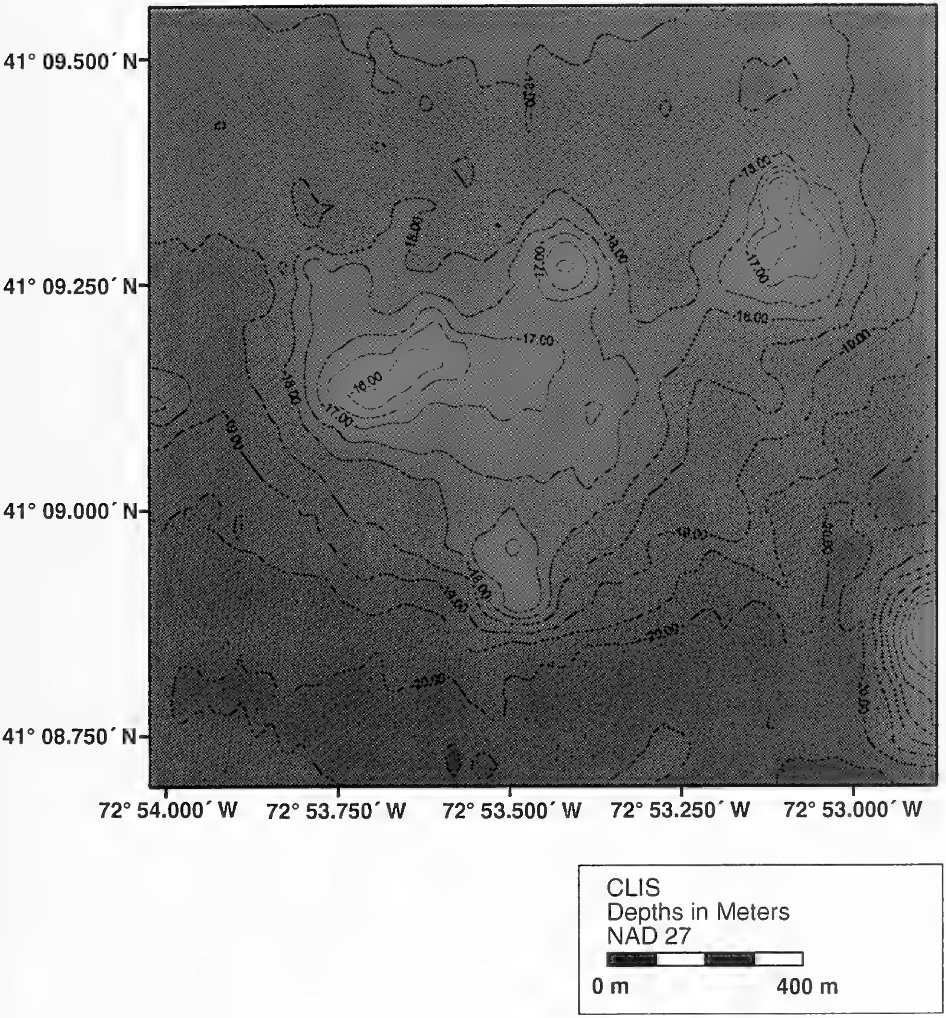
Depth difference calculations detected 0.25 m of consolidation over the majority of the NHAV 93 mound in comparison to the postcap bathymetric survey of March 1994 (Figure 3-3). Smaller pockets of 0.50 m of consolidation were detected near the center of the NHAV 93 mound. Comparisons with the September 1993 baseline survey calculated the total accumulation of material within the 2.56 km^2 area over the past two years. The depth difference contour plot displays the central NHAV 93 mound with a height of 2.25 m at the apex and a diameter of approximately 800 m (Figure 3-4). In addition the CLIS 94 mound is clearly visible to the northeast. A ridge of dredged material up to 0.5 m thick connects the two mounds, forming a berm that could be useful in containing a future UDM deposit.

3.1.2 REMOTS® Sediment-Profile Photography

The REMOTS® sediment-profile photographic survey over the NHAV 93 mound was conducted to evaluate the recolonization status of the CAD mound in comparison to the July 1994 survey, as well as to search for evidence of surface layer consolidation, bedload transport, and oxidation within the surface sediment layers. Complete REMOTS® results for the NHAV 93 disposal mound are available in Appendix B Table 1.

3.1.2.1 Sediment Grain Size and Stratigraphy

Grain size and surface roughness data indicated no distinct pattern at the NHAV 93 disposal mound. The major modal grain size at every station was >4 phi, indicating no significant coarsening of surface CDM due to bedload transport of fine-grained material. Boundary roughness values ranged from 0.42 cm to 1.82 cm with the lowest surface



NHAV 93 Disposal Mound
1600 m × 1600 m Survey Area

Figure 3-1. Bathymetric chart of the 1600 m × 1600 m survey area over the NHAV 93 mound, 0.5 m contour interval

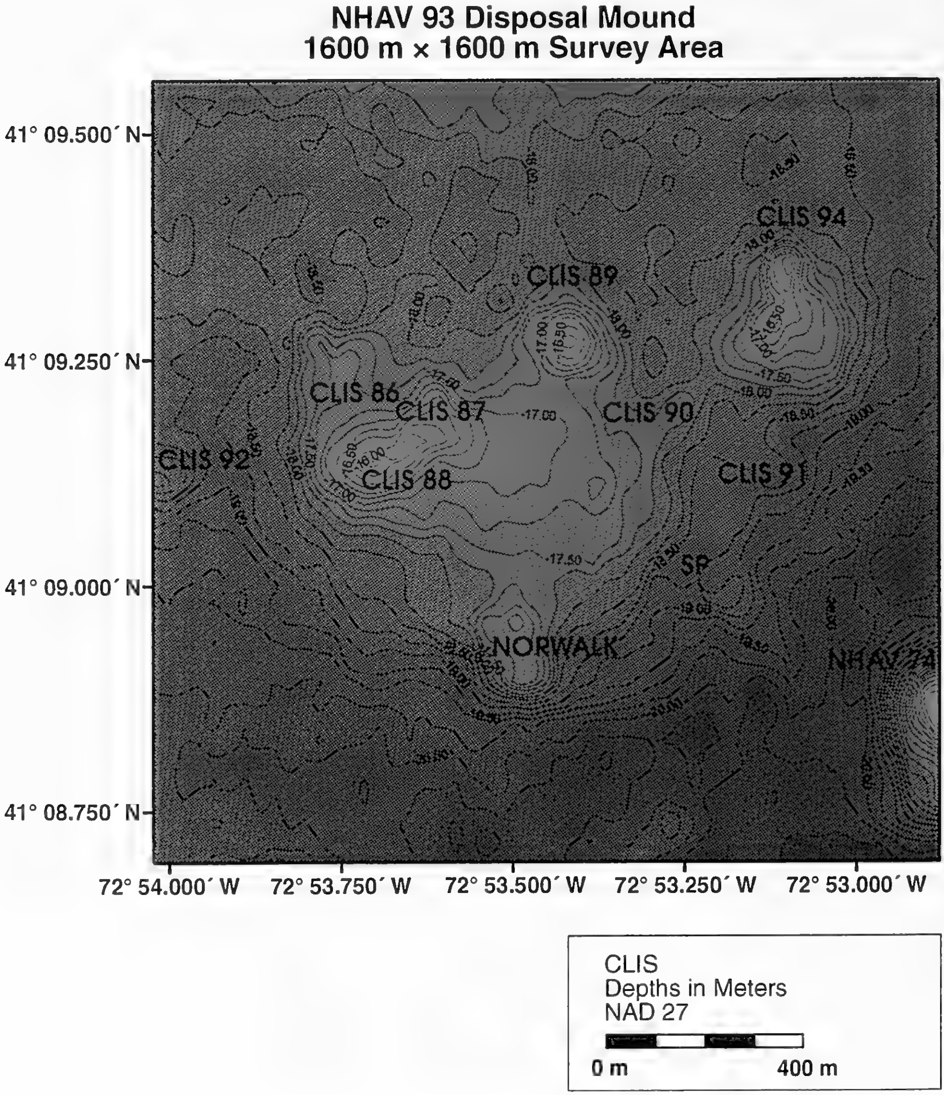


Figure 3-2. Bathymetric chart of the 1600 m × 1600 m survey area over the NHAV 93 mound, with mound names, 0.25 m contour interval

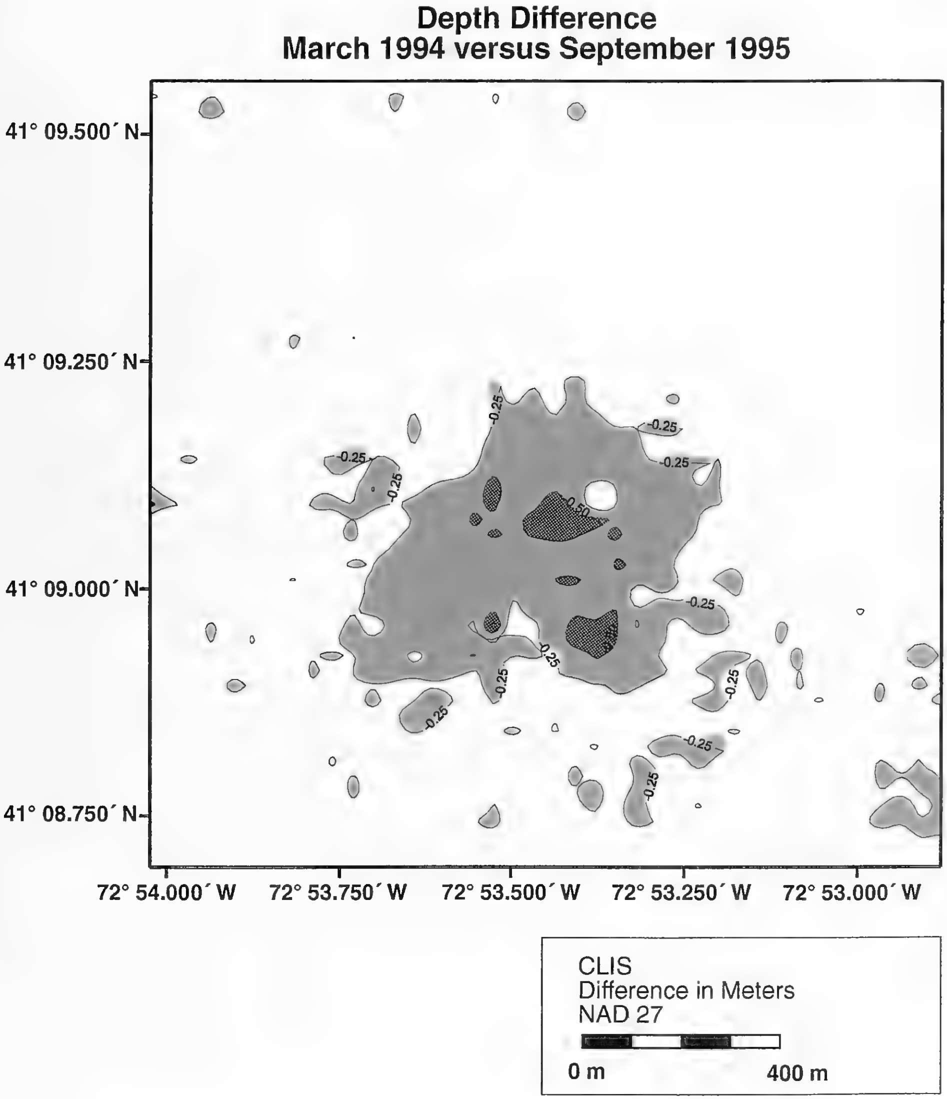


Figure 3-3. Depth difference plot of the postcap survey of March 1994 versus the September 1995 survey over the NHAV 93 mound, 0.25 m contour interval

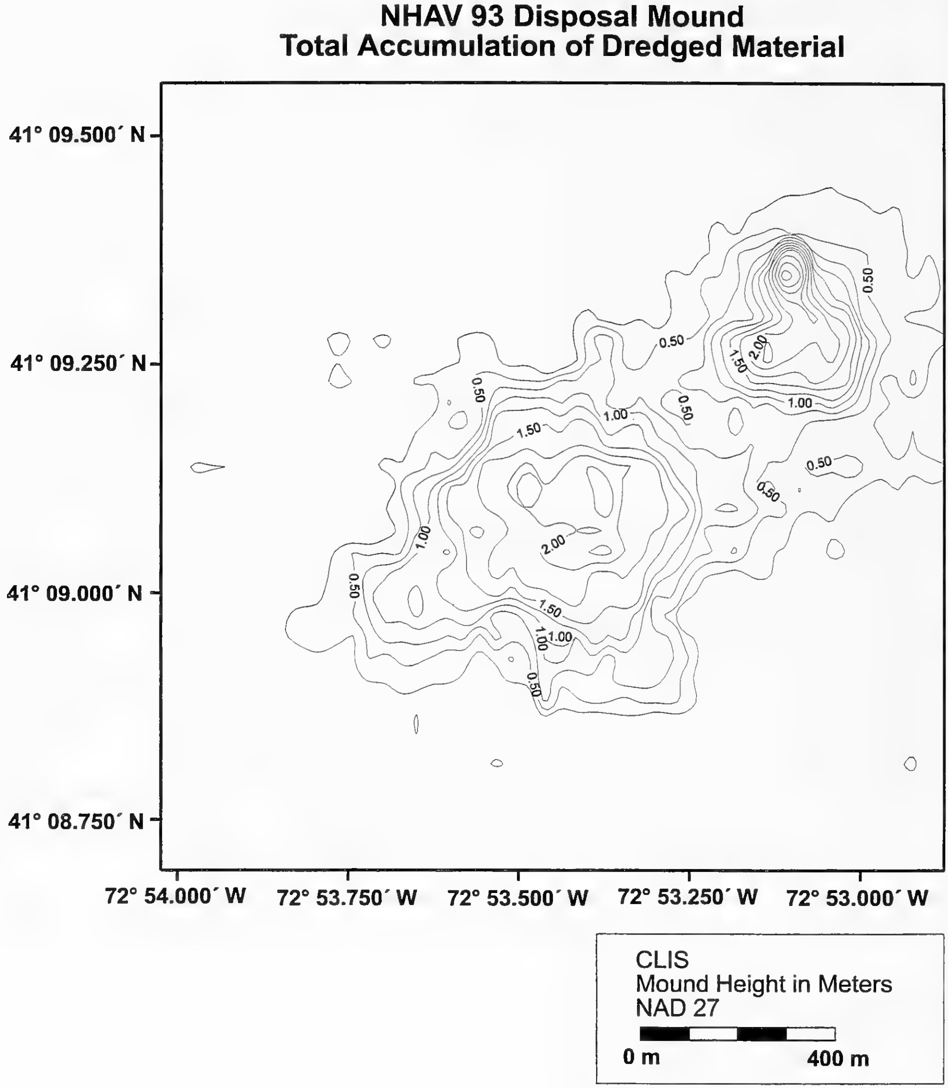


Figure 3-4. Depth difference plot of the baseline survey of September 1993 versus the September 1995 survey, 0.25 m contour interval. Chart represents the total apparent accumulation of dredged material since September 1993.

disturbance values (<0.5 cm) concentrated at the center of the mound (CTR, 200E, 200S; Appendix A: Table 3-1a). The primary cause of boundary roughness was biogenic activity within surface sediments.

The replicate-averaged mean camera penetration ranged from 12.86 cm to 18.91 cm (Appendix A: Table 3-1a). Dredged material was absent at three stations (400N, 600N, 600W), and measured replicate-averaged dredged material thicknesses ranged from 3 cm at 600S to full penetration (20 cm) at many stations (Appendix A: Table 3-1a). The apparent absence of dredged material at stations 400N, 600N, and 600W may be attributed to complete reworking of historical dredged material, to the extent that there are no recognizable indicators. Redox rebound intervals, areas of intermittent or seasonal oxidation below the oxidized surface layer, were noted at several stations, including two of the three stations which had no measurable dredged material (400N, 600N).

3.1.2.2 Benthic Community Assessment

Three parameters were used to assess the benthic recolonization rate and overall health of the project mounds relative to the CLIS reference areas. The apparent Redox Potential Discontinuity (RPD) depth, infaunal successional status, and the Organism-Sediment Index (OSI) were mapped on station location plots to outline the biological conditions at each station.

The apparent RPD depth is the depth of oxygenation in the upper sediment layers. This value indicates dissolved oxygen conditions within sediment pore water as well as the availability and consumption of molecular oxygen (O_2) in the surface sediments. Since actual oxygen status in the sediment is not measured, the apparent RPD is estimated by measuring the thickness of the layer of high reflectance in contrast to the usually gray to black reduced sediments at depth (Rhoads and Germano 1982).

Replicate-averaged RPD values over the NHAV 93 mound ranged from 0.91 cm at 600E to 4.23 cm at 400E, indicating improvement relative to the 1994 survey, especially at the stations previously exhibiting slow benthic recovery (Figure 3-5; Appendix A: Tables 3-1a and 3-1b). RPDs of <2 cm were measured at the central, south, and east sections of the sampling grid (CTR; 200E, W, and S; 400S; and 600S and E). Station 600E, displaying a relatively shallow RPD depth, has probably been affected by the recent deposition of CDM over the CLIS 94 mound reducing the level of oxidation in the surface sediment layers. However, the mean RPD value for the entire project area was 2.14 cm, indicating improving conditions relative to the 0.78 cm RPD value for July 1994. Neither methane nor low dissolved oxygen was noted in any photograph.

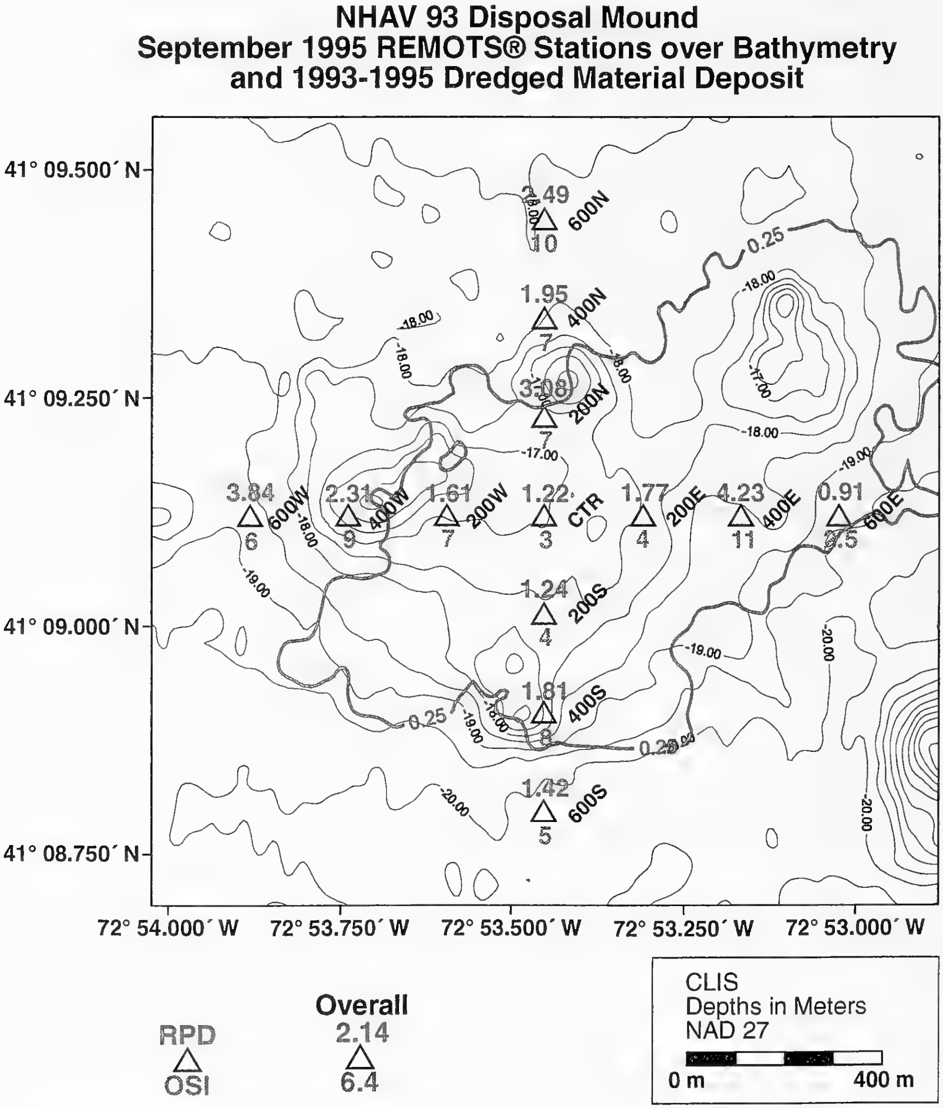


Figure 3-5. Distribution of RPD (cm) and OSI values over the NHAV 93 mound, overlaid on September 1995 bathymetry and detectable margins of the mound

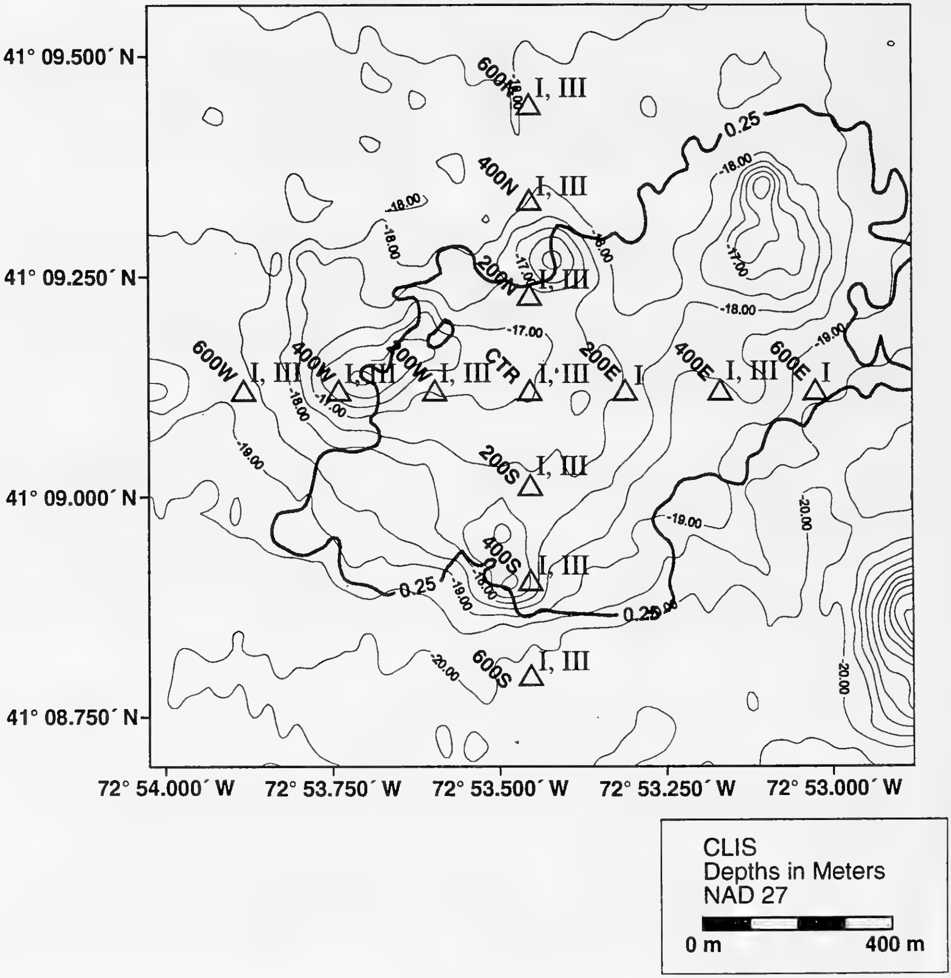
The mapping of successional stages is based on the theory that organism-sediment interactions follow a predictable sequence after a major seafloor disturbance (Rhoads and Germano 1982). This sequence is defined by end-member assemblages of benthic organisms. Stage I is made up of pioneering assemblages usually consisting of dense aggregations of near-surface, tube-dwelling polychaetes. If left undisturbed, Stage II infaunal deposit feeders such as shallow-dwelling bivalves or tubicolous amphipods then colonize the recovering seafloor. Stage III organisms are generally head-down deposit-feeding invertebrates whose presence results in distinctive subsurface feeding voids. Stage III taxa are associated with relatively low-disturbance regimes (Rhoads and Germano 1986).

Organism-sediment index values are calculated by summarizing the apparent RPD depth, successional status, and indicators of methane or low oxygen. OSIs can range from -10 (azoic with methane gas present in sediment) to 11 (aerobic bottom with deep apparent RPD, evidence of mature macrofaunal assemblage, and no apparent methane). OSI values are useful in mapping disturbances and quantifying ecosystem recovery (Rhoads and Germano 1982).

Eleven stations within the thirteen-station survey grid showed evidence of Stage III organisms (Figure 3-6). The most common stages noted in the replicate photographs were Stage I and Stage I on III. Replicate median OSIs range from 2.5 at 600E (low RPD, no Stage III due to recent CDM deposition) to 11 at 400E (Figure 3-6; Appendix A: Table 3-1a). Low OSIs (<6) are concentrated at the center (CTR, 200E, 200S), and at the extremes of the southern and eastern legs of the grid (600S, 600E). Overall, the mean OSI value for the NHAV 93 mound was 6.4, a substantial improvement over the July 1994 value of 3.5.

The results of the July 1994 REMOTS® survey indicated the presence of three areas of concern (CTR, 200N, and 400S; Morris and Tufts 1997). All three stations exhibited shallow to diffusional RPD depths, limited recolonization, and lower OSI values than anticipated. As part of the DAMOS tiered monitoring protocols, sediment from stations CTR, 200N, and 400S was collected and subjected to *Ampelisca* bioassay testing for toxicity. No significant differences in mortality were found between the sediment samples originating from NHAV 93 stations CTR, 200N, and 400S and the sediments collected from CLIS-REF (Mueller 1994). As a result, no action was taken at NHAV 93 (i.e., cap supplementation) and the stations were closely monitored for changes in benthic conditions (Morris and Tufts 1997).

The September 1995 REMOTS® results indicate that, in general, the NHAV 93 mound is recovering from the impact of dredged material disposal as predicted (Germano et al. 1994). The three stations that exhibited poor benthic conditions with low RPDs in



NHAV 93 Disposal Mound
September 1995 REMOTS® Stations over Bathymetry
and 1993-1995 Dredged Material Deposit

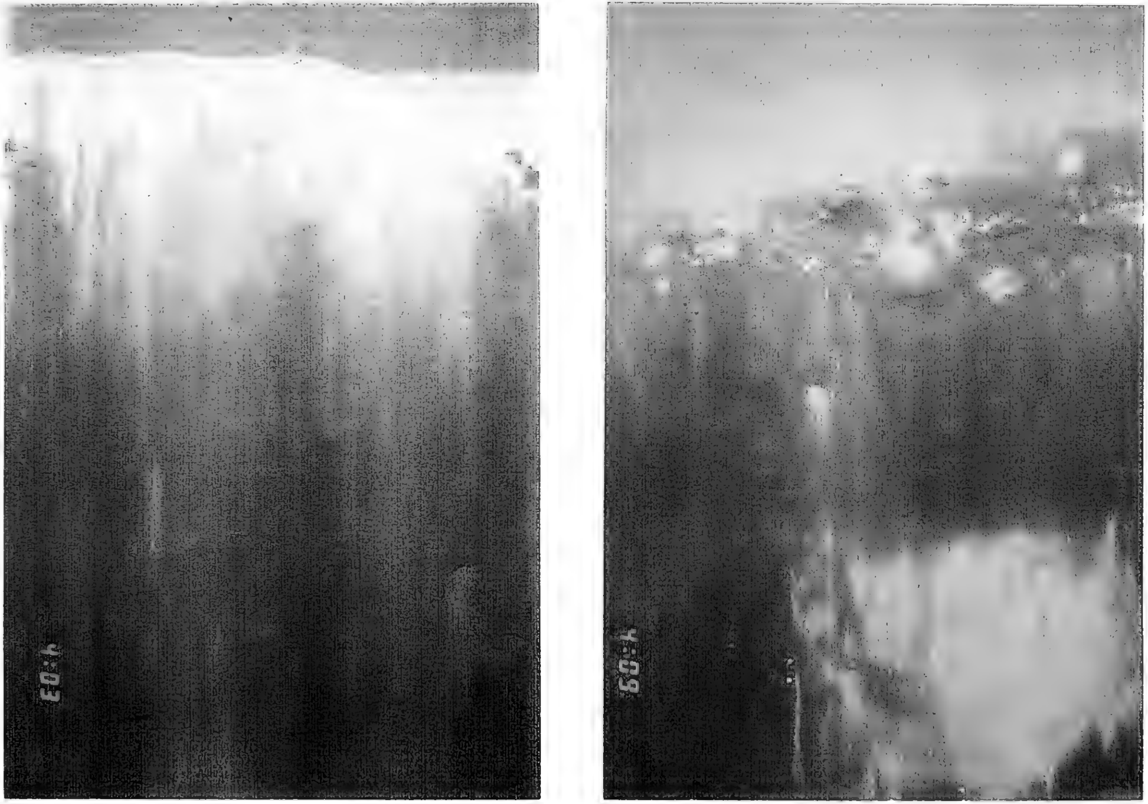
Figure 3-6. Distribution of successional stage assemblages over the NHAV 93 mound, overlaid on September 1995 bathymetry and detectable margins of the mound the 1994 survey (CTR, 200N, 400S) showed improvement, although two replicates at CTR had thin and patchy RPD and low OSI values of 2 and 3 (Figures 3-7 and 3-8). Comparisons of the 1995 NHAV 93 REMOTS® results to the reference areas indicate the oxygenation status at the sediment/water interface over the region may have been affected by seasonal hypoxia. As a result, RPD and OSI values on the mound and in the reference areas may have decreased in response to the reduction in available oxygen.

3.1.3 Geotechnical Coring

A total of eleven geotechnical cores were collected to provide a deep, cross-sectional view of the multiple sediment layers that make up the NHAV 93 mound (Figure 3-9; Appendix A: Table 2-2). Seven cores with penetration depths varying from 131 cm (GC-9) to 272 cm (GC-6) were split, visually described, and analyzed for the properties listed in Section 2.4 of this document. These seven cores represent the end-member of a five-core data set collected over the NHAV 93 mound at different stages of development (baseline, precap, postcap, four months postcap, and eighteen months postcap; Appendix C: Table 1). Graphics depicting the entire time-series data set are provided in Appendix C. A report pertaining to the geotechnical analysis of cores GC-1 through GC-11 will be included in a final report submitted by Armand J. Silva, P.E., of Geotechnical Consulting Engineers.

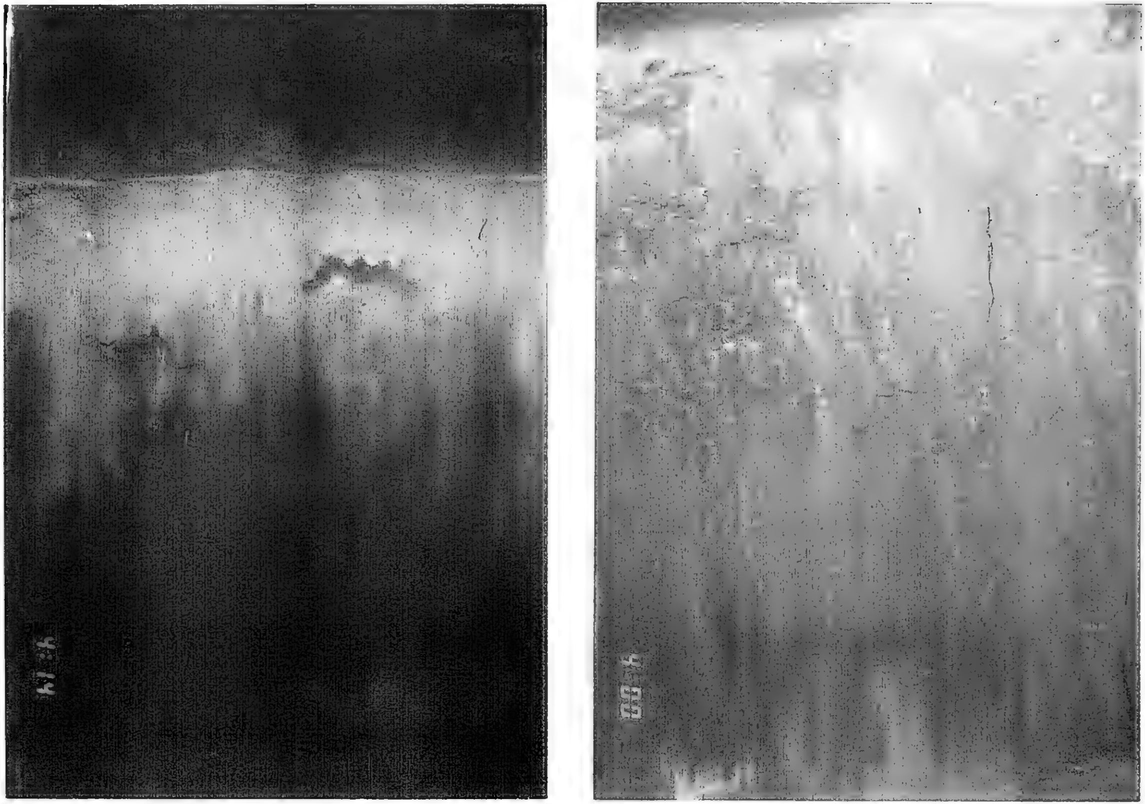
Core GC-5 was obtained over the southwest flank of the NHAV 93 mound (41°08.996' N, 72°53.629' W) and penetrated 269 cm into the sediments (Figure 3-9). The visual core description indicates the first 180 cm of material constitutes the New Haven project CDM (Figure 3-10). The CDM layer is composed of several sediment strata of soft, black and olive-gray sands, silts, and clays. A thin layer of New Haven UDM, olive-grey clayey silt, was visible from 180 cm to 200 cm of penetration. A 10 cm to 15 cm layer of dark silt is representative of the historic dredged material that makes up the CLIS 88 and Norwalk mound aprons. The remaining 55 cm of sediment collected in Core GC-5, olive-gray, clayey silt with shell fragments, is typical of ambient, basement material at CLIS.

Core GC-10 was taken approximately 75 m southwest of the NHAV 93 mound center (41°09.075' N, 72°53.521' W; Figure 3-9). A total of 248 cm of CDM, UDM, and historic dredged material was recovered in GC-10. The top 134 cm of sediment was composed of soft, black, clayey silt with organics and shell fragments (Figure 3-10). No distinct horizon was visually detected between New Haven cap and dredged material layers; however, the UDM/CDM interface is estimated at approximately 100 cm of penetration. From 100 cm to 218 cm of penetration this core is made up of the various layers of silt, sand, and gravel. The division between New Haven dredged material and



(A) (B)

Figure 3-7. REMOTS® photographs showing the improving conditions at Station 400S over the NHAV 93 mound during the September 1995 (A) survey relative to the July 1994 (B) survey



(A) (B)

Figure 3-8. REMOTS® photographs showing the improving conditions at Station CTR over the NHAV 93 mound during the September 1995 (A) survey relative to the July 1994 (B) survey

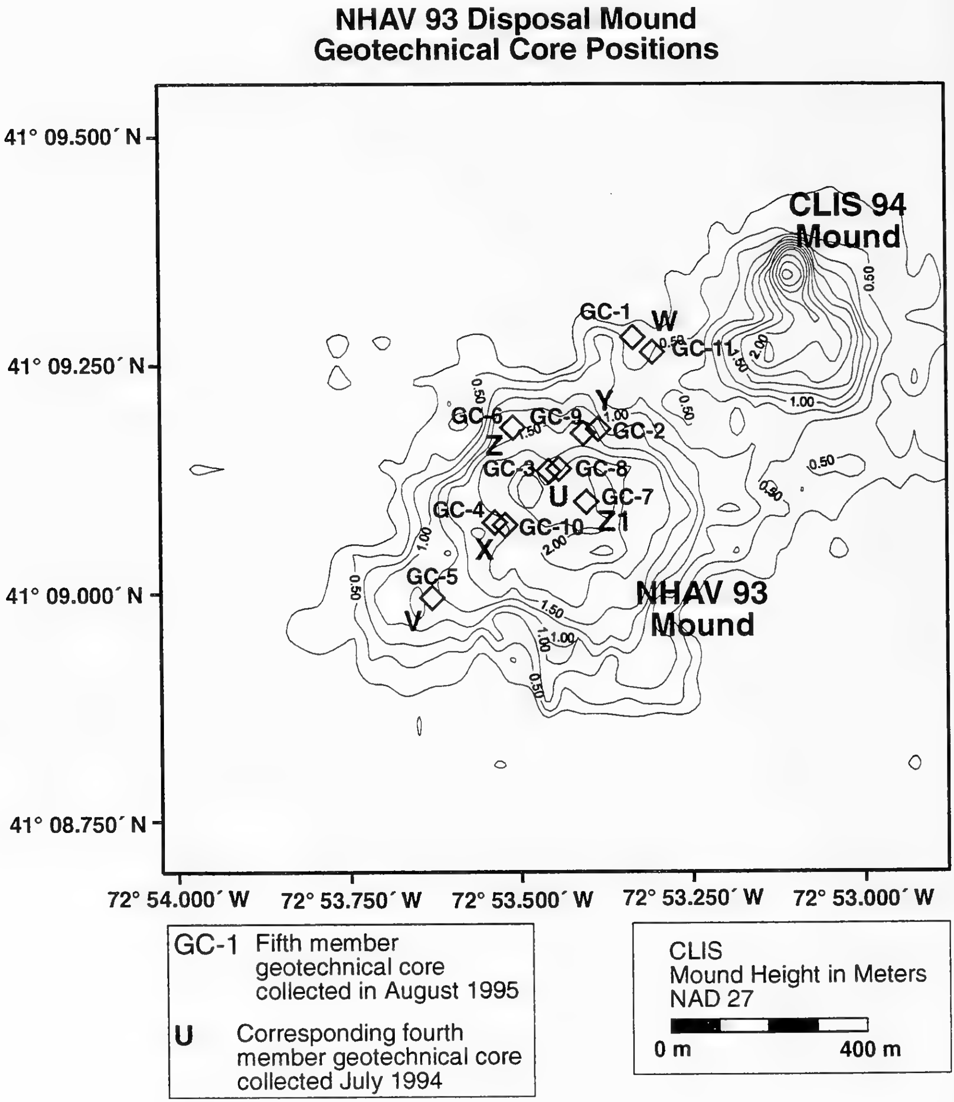


Figure 3-9. Location of geotechnical cores GC-1 through GC-11 over the apparent total accumulation of dredged material since September 1993

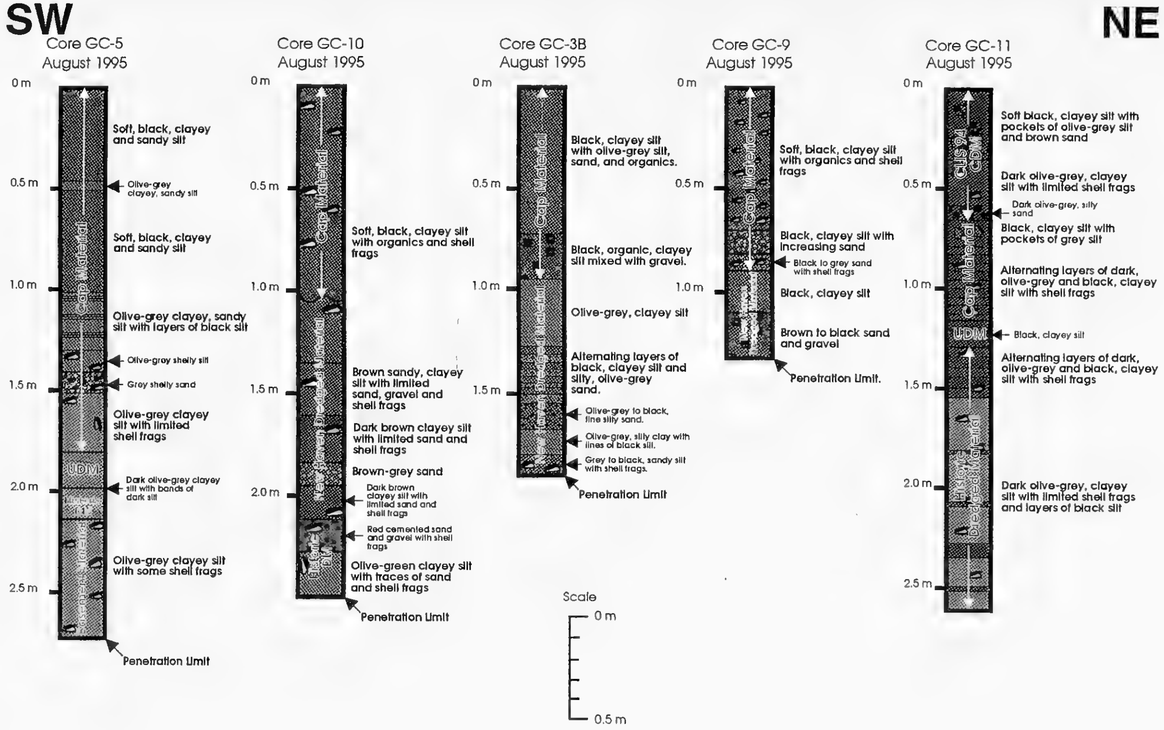


Figure 3-10. Color geotechnical core descriptions oriented to display the results of the SW-NE transect over the NHAV 93 mound

historic dredged material exists at 215 cm. No ambient material was sampled in Core GC-10.

Core GC-3B, collected over the center of the NHAV 93 mound (41°09.134' N, 72°53.458' W), penetrated 185 cm into the New Haven sediments (Figure 3-9). The core description indicates that the top 93 cm is composed of two layers of black, clayey silt, representative of the CDM layer (Figures 3-10 and 3-11). The remaining 92 cm of sediment displayed the various strata of the UDM deposit with alternating layers of silt and sands. The multiple sediment horizons within the UDM component depict the heterogeneity of material disposed over the center of the NHAV 93 mound.

Core GC-9, obtained approximately 100 m northeast of the NHAV 93 mound apex (41°09.175' N, 72°53.407' W), penetrated 131 cm into the New Haven Harbor sediments (Figure 3-9). A visual description of Core GC-9 shows three layers of silt, sand, and shell fragments making up the 89 cm thick cap (Figure 3-10). The sediment sampled from 90 cm to 110 cm was a uniform black, clayey silt and considered to be UDM. The second UDM stratum, a layer of brown to black sand and gravel, was visible from 111 cm to the penetration limit.

Core GC-11 was collected on the northeast flank of the NHAV 93 mound (41°09.264' N, 72°53.306' W) and is composed of both NHAV 93 and CLIS 94 dredged material (Figure 3-9). The top 60 cm of sediment in Core GC-11 is consistent with the clayey silt material used as CDM over the CLIS 94 mound (Figure 3-10). The alternating layers of dark olive-gray and black clayey silt that extends from 60 cm to 120 cm correspond to the NHAV 93 cap material, as collected in previous cores. New Haven UDM was sampled at 120 cm of penetration and meets the dark, olive-gray, basement material at 155 cm. The basement material is visible from 155 cm to the penetration limit of 262 cm.

Core GC-7, collected 50 m from the center of the mound, represents the southeast quadrant of NHAV 93 (Figure 3-9). The core penetrated 223 cm into the sediments, providing a cross-section of the CDM and UDM making up the NHAV 93 mound as well as the ambient basement material (Figure 3-11). The top 67 cm of penetration represents the clayey silt cap over the UDM deposit. Layers of soft black, and an olive-gray, clayey silt overlay 147 cm of New Haven dredged material composed of a heterogenous mixture of clay, silt, sand, and gravel. The bottom 9 cm of Core GC-7 is composed of olive-gray silt, the ambient sediment at CLIS.

Core GC-6 was obtained 60 m northwest of the mound center (41°09.182' N, 72°53.509' W) and penetrated 272 cm through NHAV 93 sediments and historic dredged

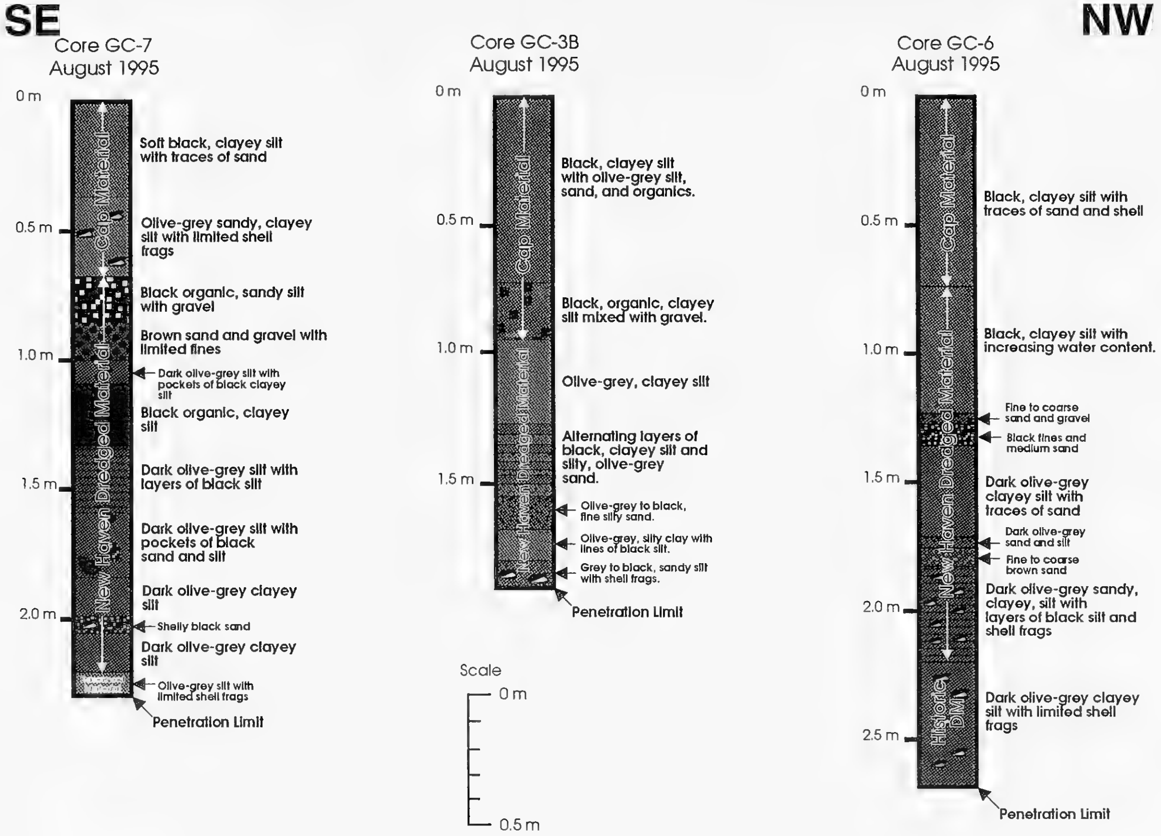


Figure 3-11. Color geotechnical core descriptions oriented to display the results of the NW-SE transect over the NHAV 93 mound

material into ambient bottom (Figure 3-9). The top 70 cm of sediment in GC-6 is composed of black, clayey silt with traces of sand and shell and is representative of New Haven CDM (Figure 3-11). The second layer of sediment extends from 70 cm down to 122 cm and is similar to the cap material but displays a noticeable increase in water content. As a result, the second stratum is likely to be a constituent of the New Haven UDM. Two thin layers of sands and gravel also appear to be part of the heterogenous UDM deposit. From 123 cm to 210 cm of penetration, several strata of clays, silts, and sands make up a deposit of historic dredged material originating from disposal activity at the CLIS 89 mound.

3.2 CLIS 94 Mound

3.2.1 Bathymetry

The new CLIS 94 mound is evident in both the large 2.56 km^2 (1600 m × 1600 m) and the smaller 1.0 km^2 (1000 m × 1000 m) survey areas. The mound is approximately 490 m wide at the center with a minimum depth of 15.75 m (Figure 3-12). The CLIS 94 mound is irregularly shaped with the apex of the mound 20 m northwest of the first position of the 1994 "CDA" disposal buoy (CDA #1). The mound becomes broader and less pronounced as it extends to the south. The new mound has completely incorporated the historic CS 90-1 mound and encroaches on the northeast flank of the historic CLIS 90 mound. Depth difference plots indicate a mound height of 3.0 m at the apex (Figure 3-13).

Barge logs indicated that approximately 290,900 m^3 of dredged material was released at the CDA 94 buoy positions. Volume calculations based on depth differences between the July 1994 and September 1995 surveys indicate that 169,600 m^3 of sediment accumulated in the vicinity of the disposal buoy (Appendix A: Table 3-2). A large percentage of the 121,300 m^3 mass balance shortfall can be accounted for by restricting the size of the analysis models and closely monitoring the development of the CLIS 94 mound. The refocused analysis of the CLIS 94 bathymetric data has revealed a significant amount of consolidation, mainly due to compression and de-watering of the UDM deposit at the center of the mound during capping operations.

Bathymetric survey data collected by Ocean Surveys, Inc. (OSI) of Old Saybrook, Connecticut, at the precap (18 December 1994) and interim cap (23 April 1995) stages of development, in conjunction with SAIC's baseline (July 1994) and postcap (September 1995) surveys, were used to document the development of the CLIS 94 mound as well as detect significant amounts of central mound consolidation. By performing several depth

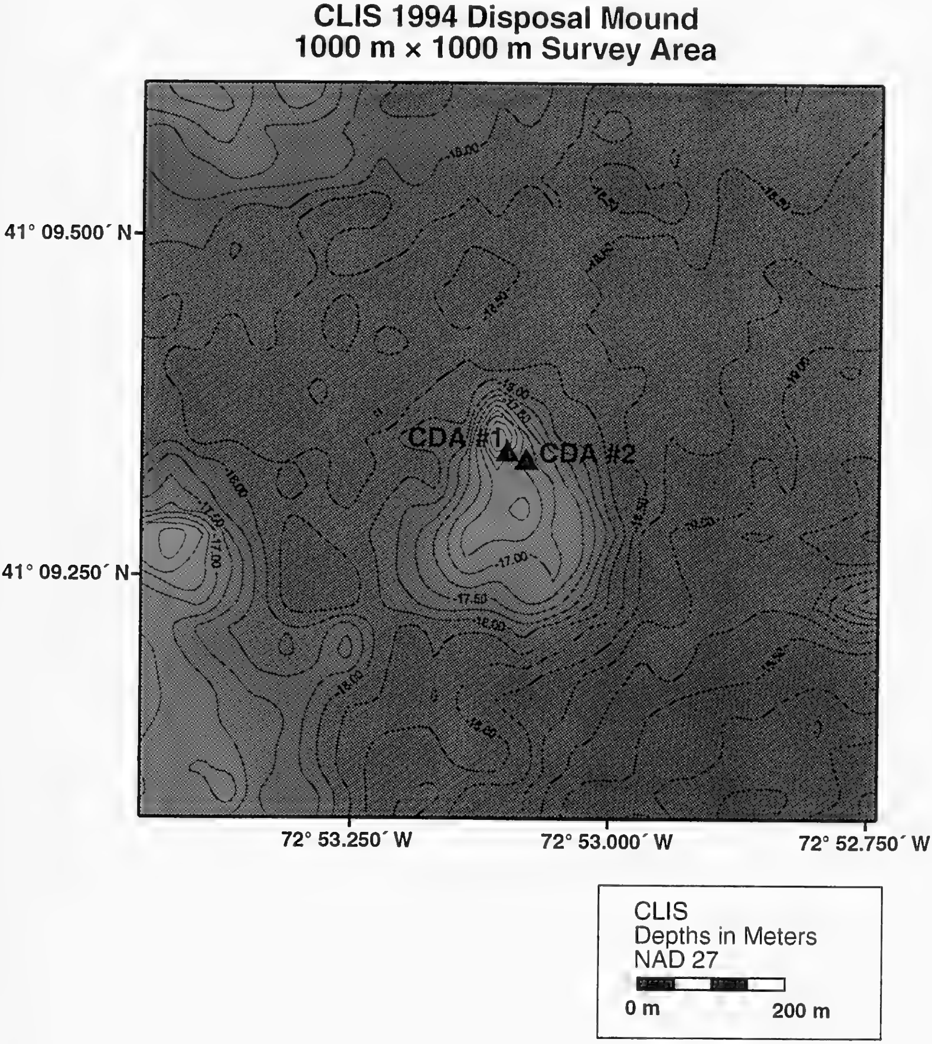


Figure 3-12. Bathymetric chart of the 1000 m × 1000 m survey area over the CLIS 94 mound with plotted CDA 94 buoy positions, 0.25 m contour interval

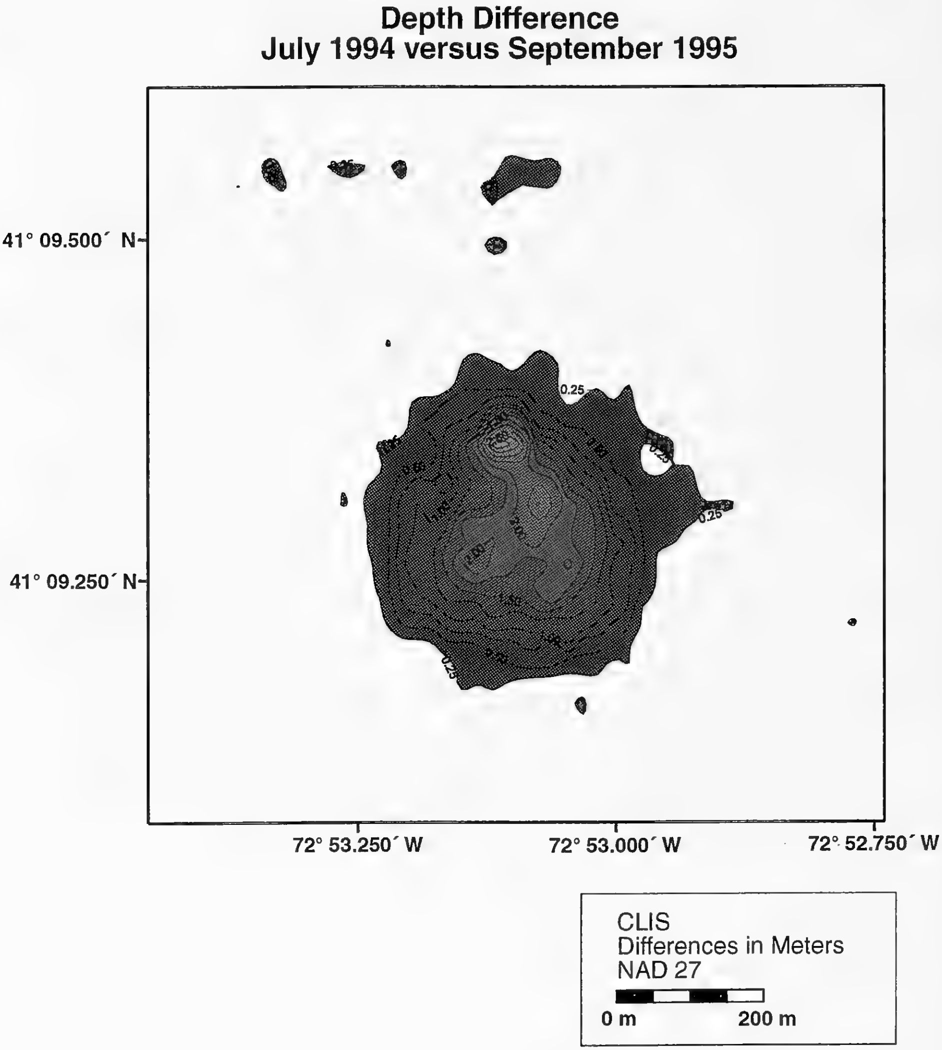


Figure 3-13. Depth difference plot of SAIC's July 1994 baseline survey versus SAIC's September 1995 postcap survey, 0.25 m contour interval

differencing routines with the four bathymetric data sets, both total accumulations and apparent losses of material can be identified.

By comparing a scaled down version of SAIC's baseline survey in July 1994 to the OSI precap bathymetry, a UDM deposit with a height of 2.75 m and a width of 380 m was detected south of the CDA buoy positions (Figures 3-14, 3-15, and 3-16). The apex of the UDM mound was located approximately 145 m south of the CDA #1 buoy position. DAMOS disposal logs reported the deposition of approximately 129,900 m^3 of UDM at CLIS between the dates of 30 November and 13 December 1994 (Appendix D: Table 1). Volume difference calculations detected a total accumulation of 114,700 m^3 of new material in the vicinity of the CDA buoy (Appendix A: Table 3-2). By utilizing the bathymetric profile of the disposal mound at the precap stage of development, calculations based on successive bathymetric surveys accounted for 88% of the barge log estimates submitted by on-site inspectors. These findings represent extremely good agreement between the two methods of volume estimates (barge volume vs. sequential bathymetric survey).

The first phase of capping over the CLIS 94 mound was performed from 16 January 1995 through 22 April 1995 (Appendix D: Table 2). During that time period an estimated barge volume of 41,700 m^3 of CDM was released over the initial UDM deposit, isolating the majority of the contaminated material from the sediment/water interface. An interim cap bathymetric survey was performed on 23 April 1995 to document the progress of capping operations. The depth difference calculations based on comparisons of the April 1995 interim cap and July 1994 baseline surveys show the total accumulation of material over the CLIS 94 mound (Figures 3-17 and 3-18). A maximum height of 2.75 m was detected over the CLIS 94 mound, and the deposition of CDM has caused the dredged material apron to expand to the north, east, and south, increasing its diameter to approximately 490 m.

Further bathymetric analysis between the December 1994 and April 1995 bathymetric surveys revealed a large pocket of consolidation over the center of the disposal mound. Depth difference plots indicate a net loss in mound height, up to 1.0 m relative to the precap stage of development (Figure 3-19). The deposition of 41,700 m^3 of capping material over the UDM deposit caused the formation of three peaks of CDM approximately 1.25 m thick over the north, southeast, and southwest regions of the mound. The majority of the CDM was reportedly released over the fringes of the consolidation pocket during the initial stages of capping operations (Figure 3-19). Volume calculations detected 38,664 m^3 of new material over the restricted analysis area, which is considered to make up the ring of accumulation around the CLIS 94 mound. In addition, a negative volume of 26,500 m^3

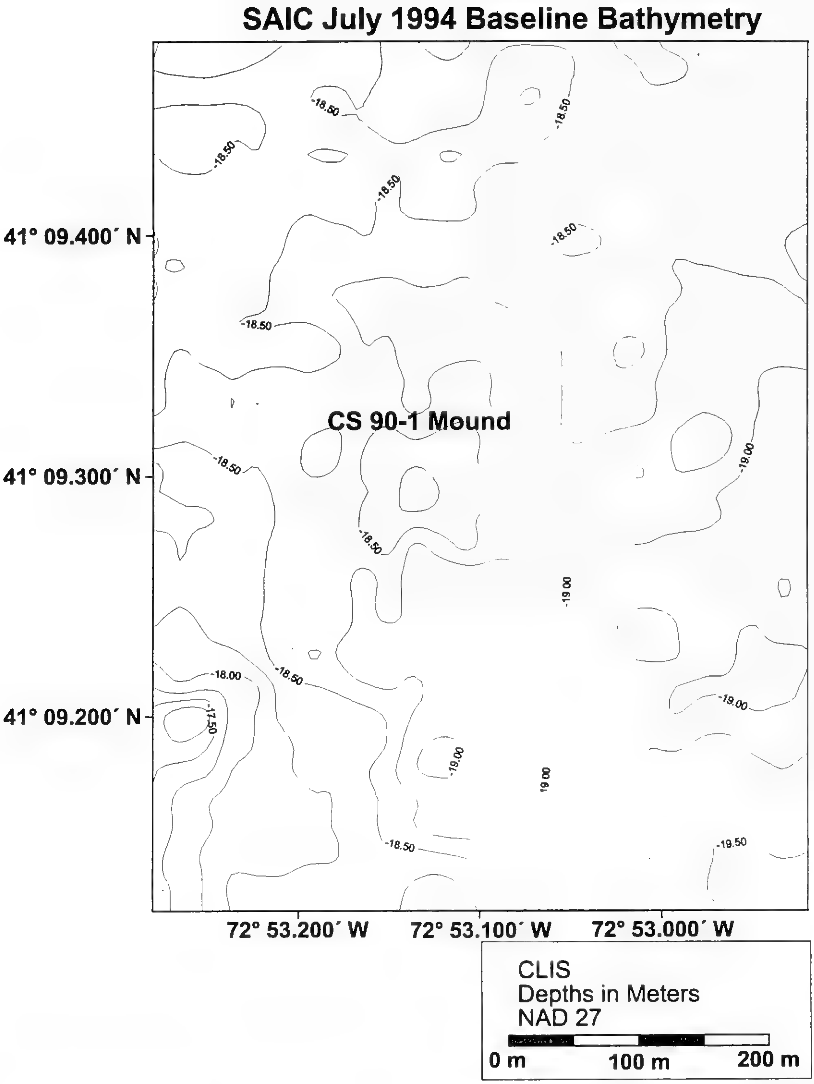


Figure 3-14. Bathymetric chart of the 675 m × 500 m area of concentrated analysis over the CS 90-1 mound, SAIC's July 1994 baseline survey, 0.25 m contour interval

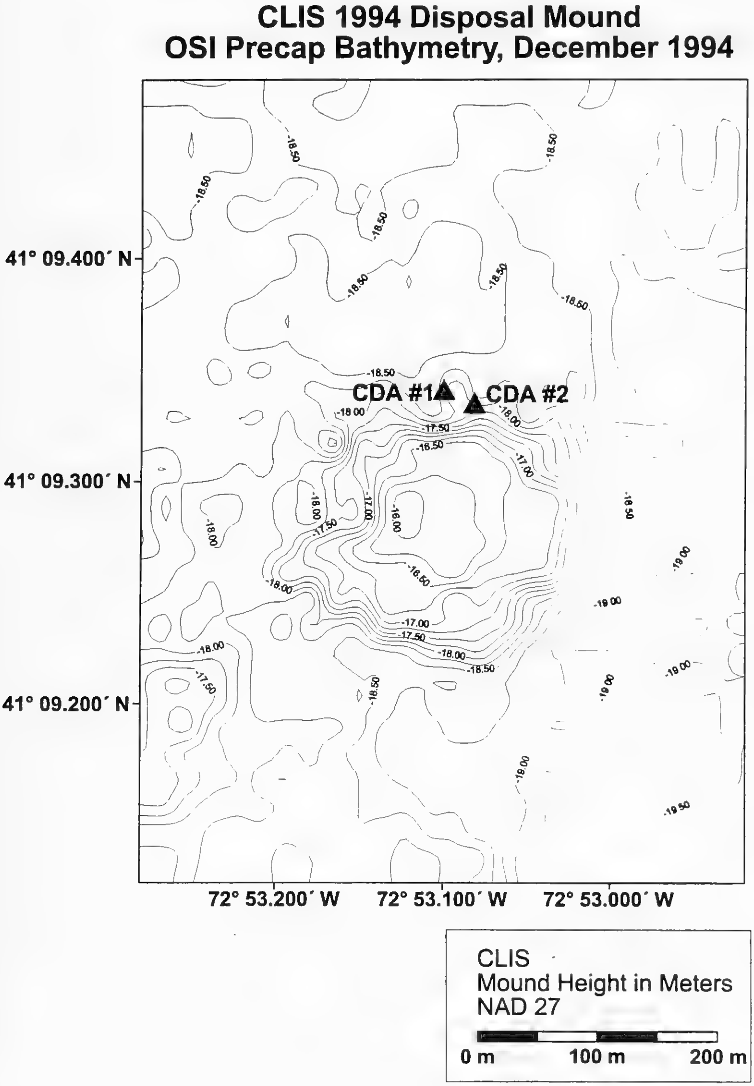
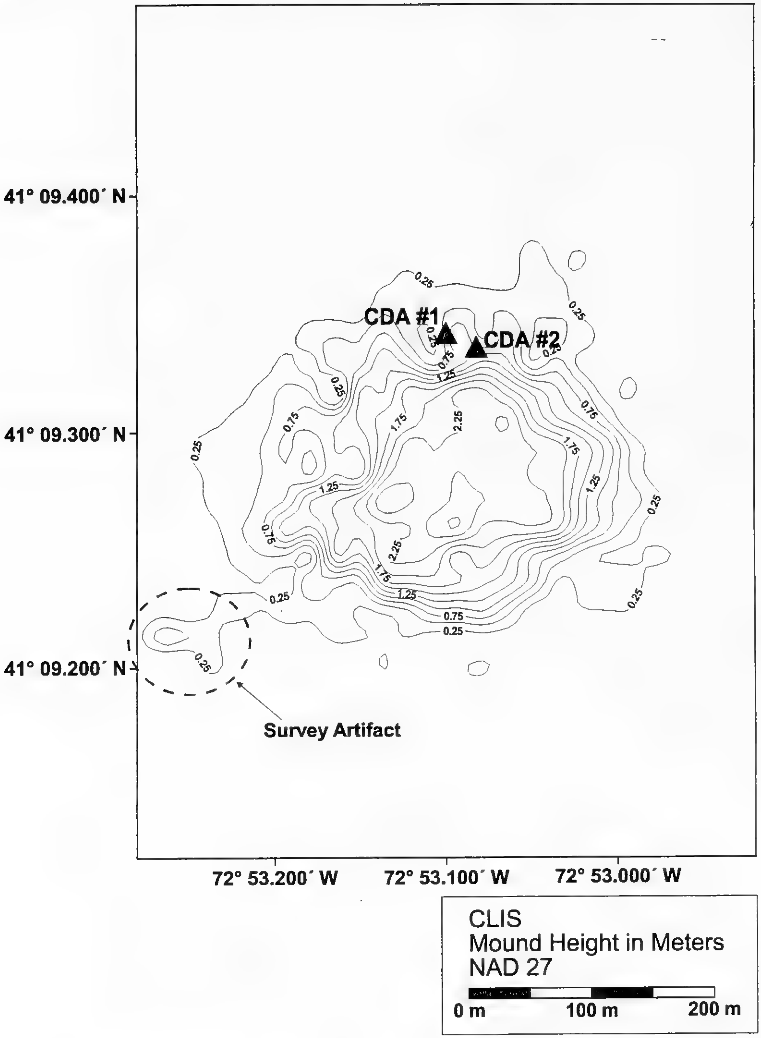


Figure 3-15. Bathymetric chart of the 675 m × 500 m area of concentrated analysis over the CLIS 94 mound UDM deposit, OSI's December 1994 precap survey, 0.25 m contour interval



CLIS 1994 UDM Deposit Depth Difference
SAIC July 1994 Baseline versus OSI December 1994 Precap

Figure 3-16. Depth difference plot of SAIC's July 1994 baseline survey versus OSI's December 1994 precap survey with plotted CDA 94 buoy positions, 0.25 m contour interval

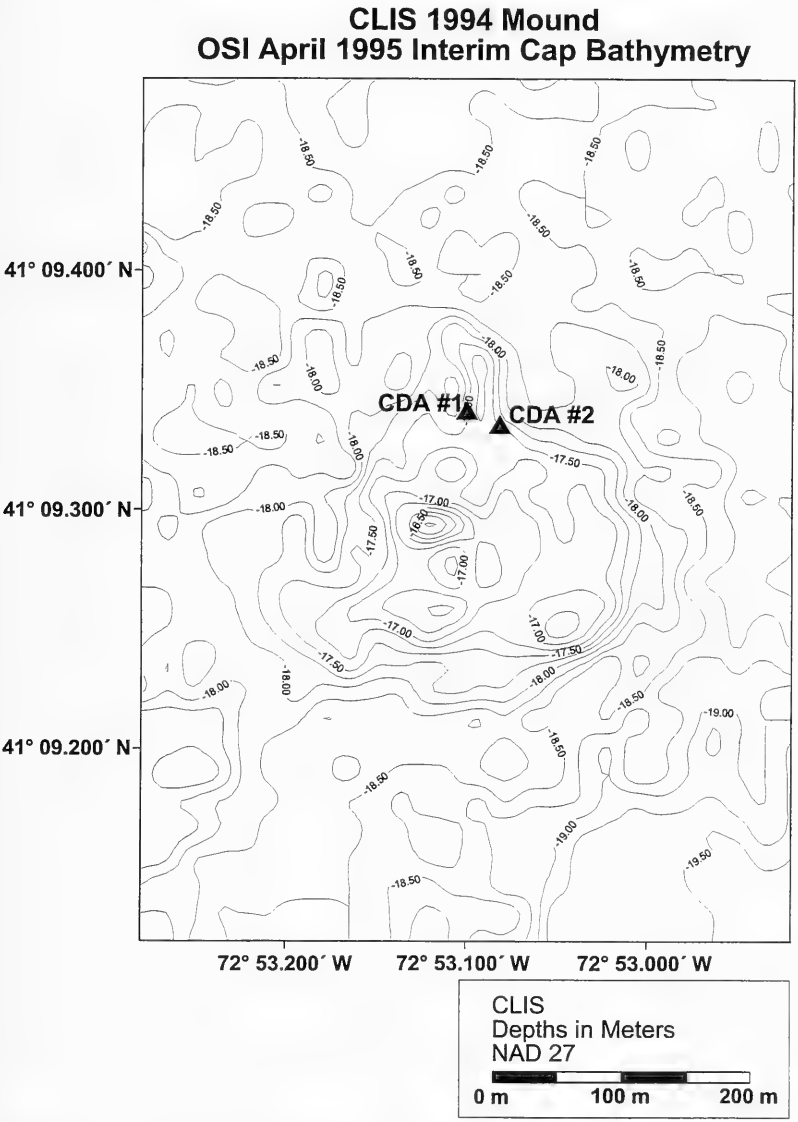
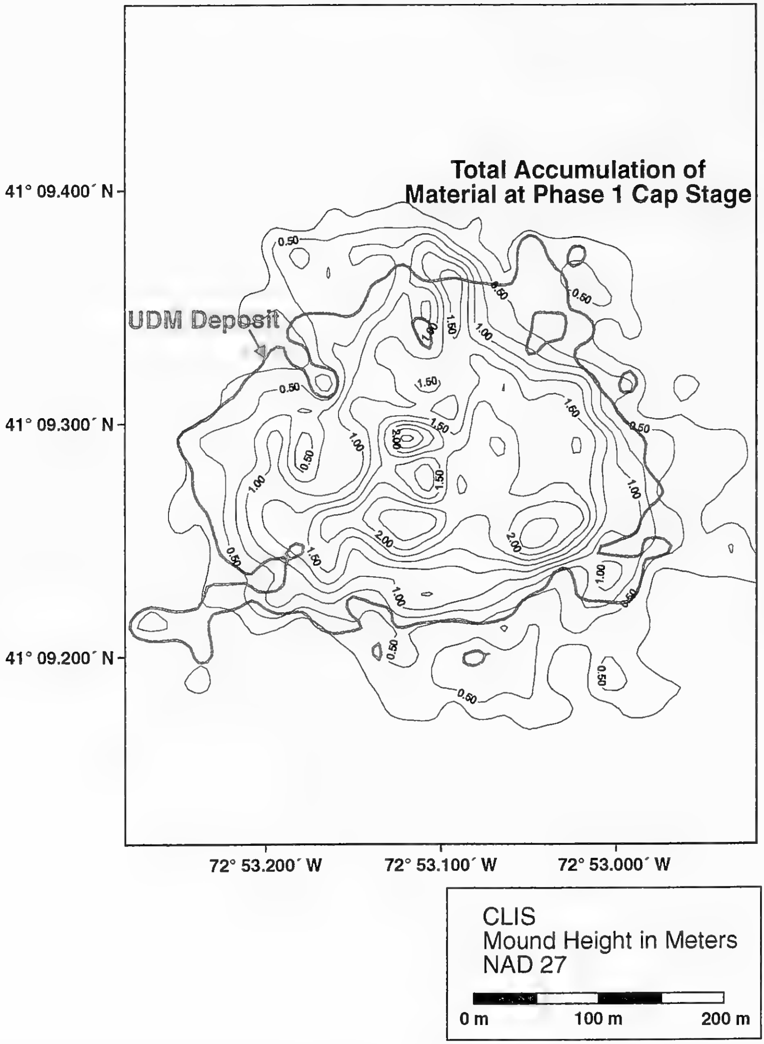


Figure 3-17. Bathymetric chart of the 675 m × 500 m area of concentrated analysis over the CLIS 94 mound at interim cap status, OSI's April 1995 interim cap survey, 0.25 m contour interval



CLIS 1994 Mound Depth Difference
SAIC July 1994 versus OSI April 1995

Figure 3-18. Depth difference plot of SAIC's July 1994 baseline survey versus OSI's April 1995 interim cap survey, overlaid with the detectable margin of the UDM deposit, 0.25 m contour interval

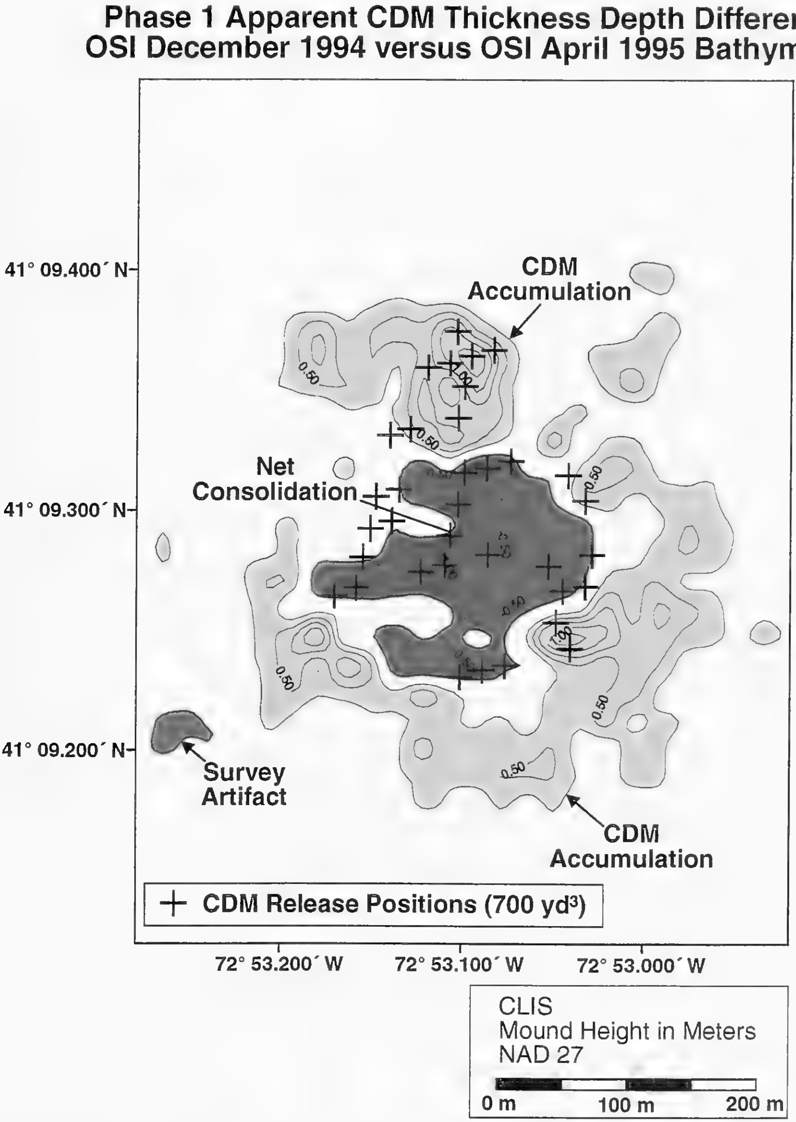

Phase 1 Apparent CDM Thickness Depth Difference
OSI December 1994 versus OSI April 1995 Bathymetry

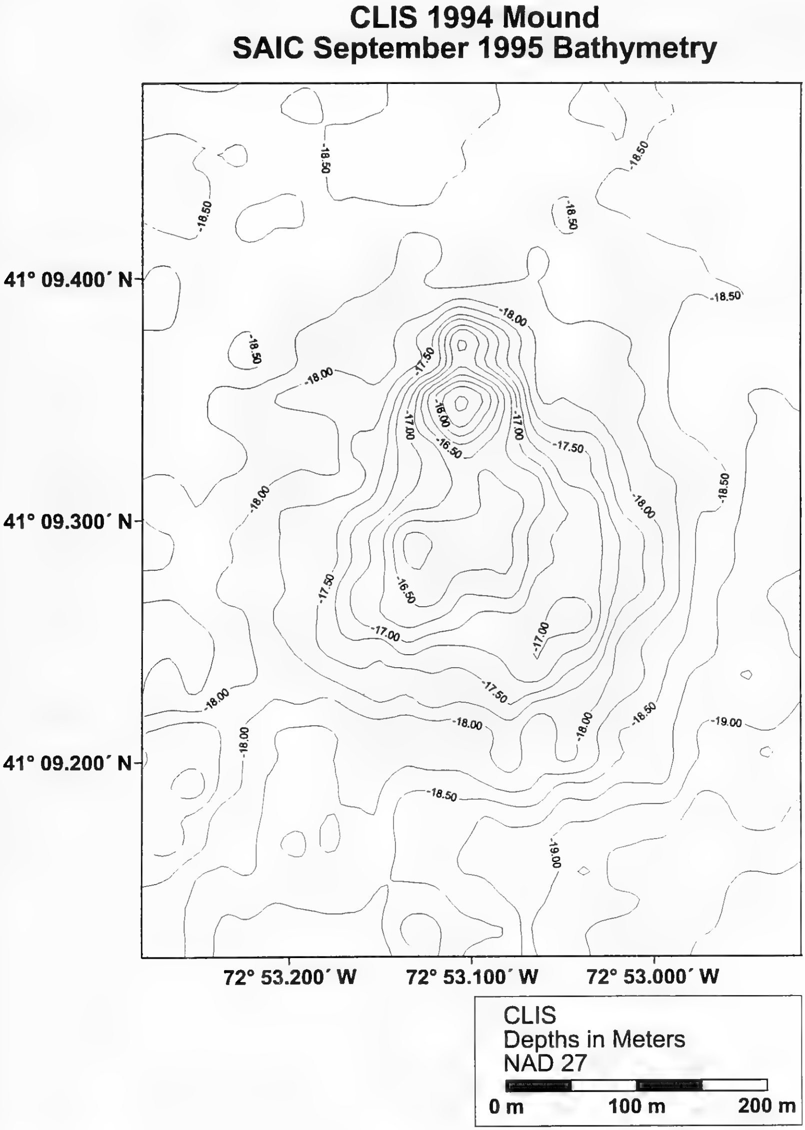
Figure 3-19. Depth difference plot of OSI's December 1994 baseline survey versus OSI's April 1995 interim cap survey, overlaid with the reported 700 yd³ barge release positions, 0.25 m contour interval of material was found and is considered to be the product of the central mound consolidation (Appendix A: Table 3-2).

These results suggest that the amount of consolidation was significant, concentrated in the UDM deposit, and expedited by the placement of capping material. The area of dredged material subsidence showed an overall reduction in height up to 1.0 m beyond the thickness of the new cap material. This major dredged material consolidation within the center of the mound is responsible for 22% of the 121,300 m^3 mass balance shortfall experienced in the standard baseline to postcap volume difference calculations.

From 24 April to 27 May 1995 the final 119,300 m^3 of capping was released over the CLIS 94 mound (Appendix D: Table 2). The bottom feature was resurveyed in September 1995, three months after capping operations were completed (Figure 3-20). Comparisons between the September postcap and April interim cap surveys show the additional capping material placed over the CLIS 94 mound (Figure 3-21). Major accumulations of CDM were detected in the vicinity of the CDA buoy, as well as over the northwest and southeast flanks of the mound. Volume calculations have determined an additional of 51,000 m^3 (43%) of CDM detectable through the use of successive bathymetric surveys had accumulated over the CLIS bottom (Appendix A: Table 3-2). Larger disposal barges (4000 yd^3) were employed during the last phase of capping and were fundamental in the placement of a large volume of capping material in a short period of time (35 days).

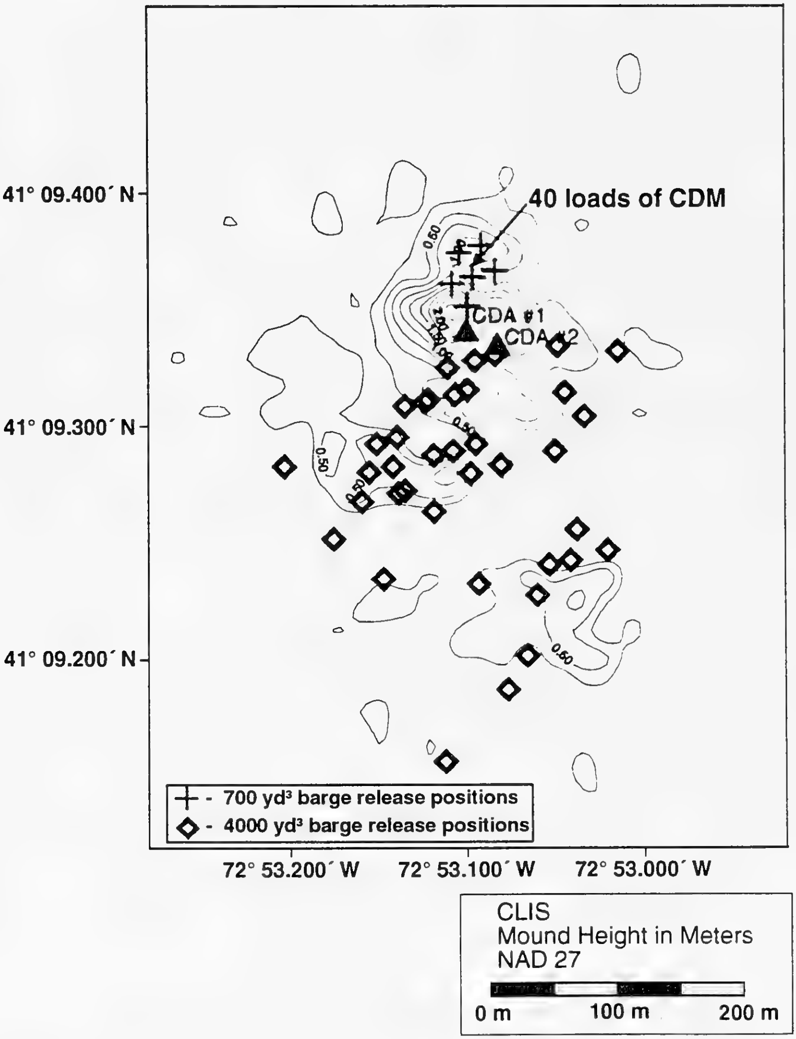
Further analysis of the postcap survey shows an apparent ring of CDM approximately 375 m in diameter clearly visible as “Total Net CDM Accumulation” as well as a central “Total Net Consolidation” feature (Figure 3-22). The majority of smaller barge (700 yd^3) release points appear to be north-northwest of the CDA #2 buoy position, adding to the small mound of capping material visible at the interim cap stage of development. The northern CDM feature is 3.0 m high at the apex and 110 m wide and is responsible for the irregular shape of the CLIS 94 mound. The remainder of the CDM layer exhibits several other high spots south and southeast along the ring. The 4000 yd^3 capacity barges concentrated their efforts over the central area of the mound. As a result, the pocket of consolidation discovered in the analysis of earlier surveys seems to have been filled to a certain degree, as a total negative volume of 10,800 m^3 is the end result (Appendix A: Table 3-2).

By tracking the three stages of development for the CLIS 94 mound, the UDM deposit appears to be successfully capped and laterally stable (Figure 3-23). The survey artifact that is visible as an irregular projection of UDM in most of the depth difference plots corresponds to the northeast apron of the CLIS 90 mound. Differences in lane



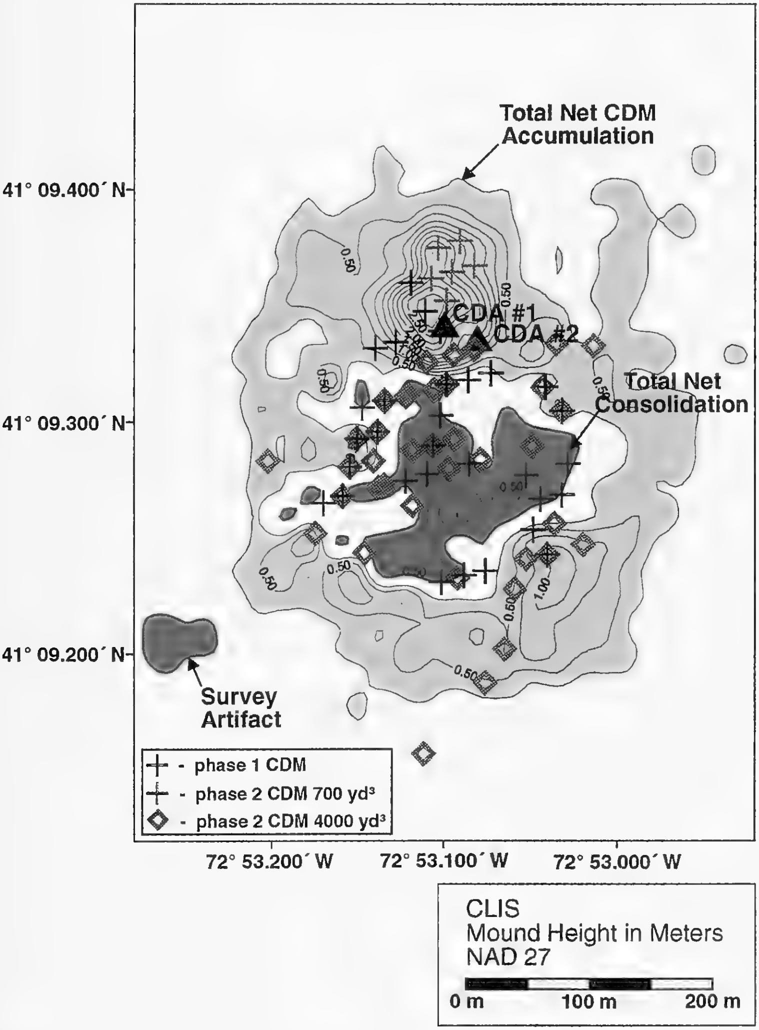
CLIS 1994 Mound
SAIC September 1995 Bathymetry

Figure 3-20. Bathymetric chart of the 675 m × 500 m area of concentrated analysis over the CLIS 94 mound at postcap status, SAIC's September 1995 postcap survey, 0.25 m contour interval



Phase 2 Cap Material Placement Depth Difference
SAIC September 1995 versus OSI April 1995

Figure 3-21. Depth difference plot of SAIC's September 1995 postcap survey versus OSI's April 1995 interim cap survey with plotted CDA 94 buoy and reported barge release positions, 0.25 m contour interval



Final Apparent CDM Thickness Depth Difference
SAIC September 1995 versus OSI December 1994

Figure 3-22. Depth difference plot of SAIC's September 1995 postcap survey versus OSI's December 1994 precap survey, overlaid with the CDA 94 buoy and reported barge release positions, 0.25 m contour interval

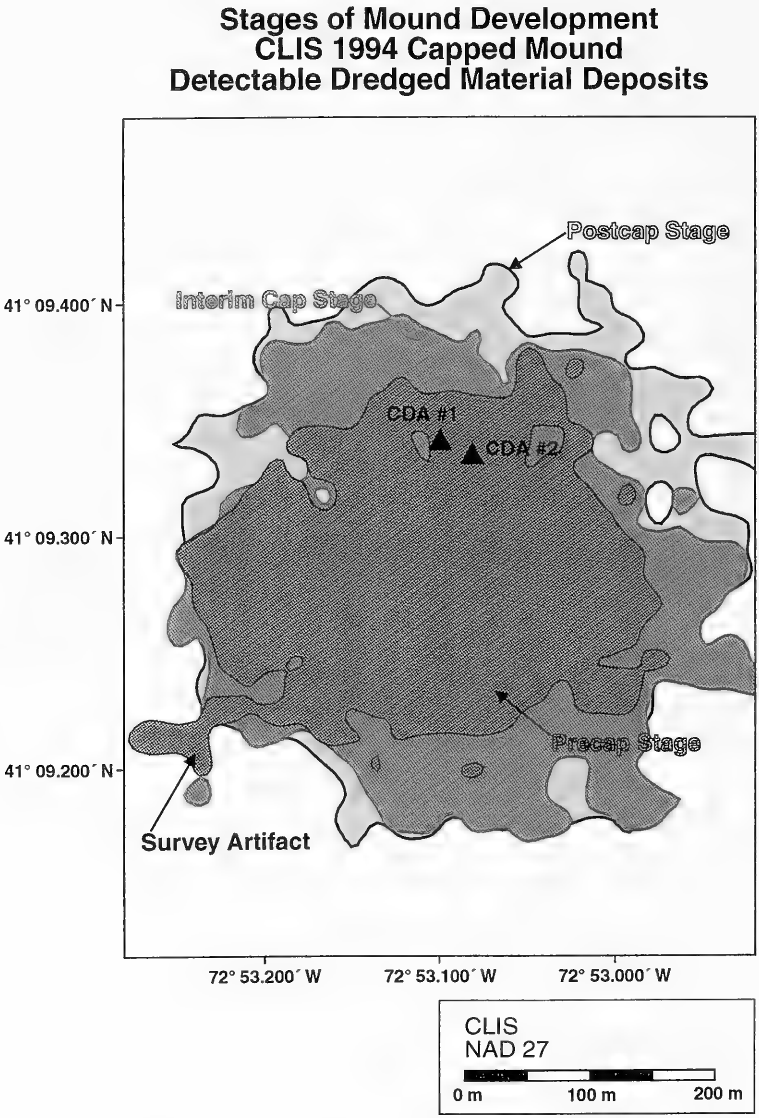


Figure 3-23. Plot of the three stages of CLIS 94 mound development, overlaid with the CDA 94 buoy positions

orientation and gridding routines between SAIC and OSI are responsible for its appearance.

Due to the effects of consolidation, tracking volumes of material throughout the different phases of mound development accounted for more of the reported volumes than comparisons over long expanses of time. The cumulative volume detected by the use of multiple surveys is 204,362 m^3 or 70% of the total reported volume (Appendix A: Table 3-2). Without the use of interim survey data, volume calculations detected 70,643 m^3 of CDM, 44% of the reported cap material volume, and 169,624 m^3 or 58% of the total material volume.

These latter calculations are typically utilized as part of most disposal and/or capping projects where depositional volumes are quantified using differences in depth between a predisposal and a postcap survey only. Results of in-depth research studies of the operations surrounding clamshell dredging and subaqueous disposal of dredged material have demonstrated an apparent 41% reduction in volume between consecutive bathymetric surveys (Tavolaro 1984). Differences of this magnitude are expected and are attributed to barge volume over-estimation, the volume of material undetectable through acoustic bathymetric data processing techniques, and dredged material consolidation over time; they do not represent actual material loss.

3.2.2 REMOTS® Sediment-Profile Photography

REMOTS® sediment-profile photography was used to document benthic recolonization, as well as map thin layers of material and assess the overall impact of dredged material deposition at the CLIS 94 disposal mound. Complete REMOTS® results for the disposal mound are available in Appendix B: Table 2.

3.2.2.1 Sediment Grain Size and Stratigraphy

Fresh dredged material was detected and measured at every station except for one replicate at 200N. Replicate-averaged mean dredged material thickness ranged from 8.8 cm to full camera penetration (20 cm) (Appendix A: Table 3-3). Redox rebound intervals, areas showing evidence of intermittent or seasonal oxidation below the oxidized surface layer, were noted at stations 200 m and 300 m from the center.

Physical REMOTS® parameters showed that the major modal grain size was consistently reported as >4 phi (silt and clay), indicating the deposition of predominantly fine-grained dredged material. However, the sediments detected at Station 100E were slightly coarser (4 to 3 phi) silts and fine sands. The replicate-averaged mean camera penetration ranged from 12.86 cm to full penetration (20 cm), generally increasing towards the center of the mound, except at the center station (14.47 cm; Appendix A: Table 3-3). In general, the lower camera penetration values correlated with the highest surface disturbance values; values >1 cm occurred at 200S, 300E, 300N, 300W, and CTR. The primary cause of surface disturbance over the CLIS 1994 mound was biogenic activity.

3.2.2.2 Benthic Community Assessment

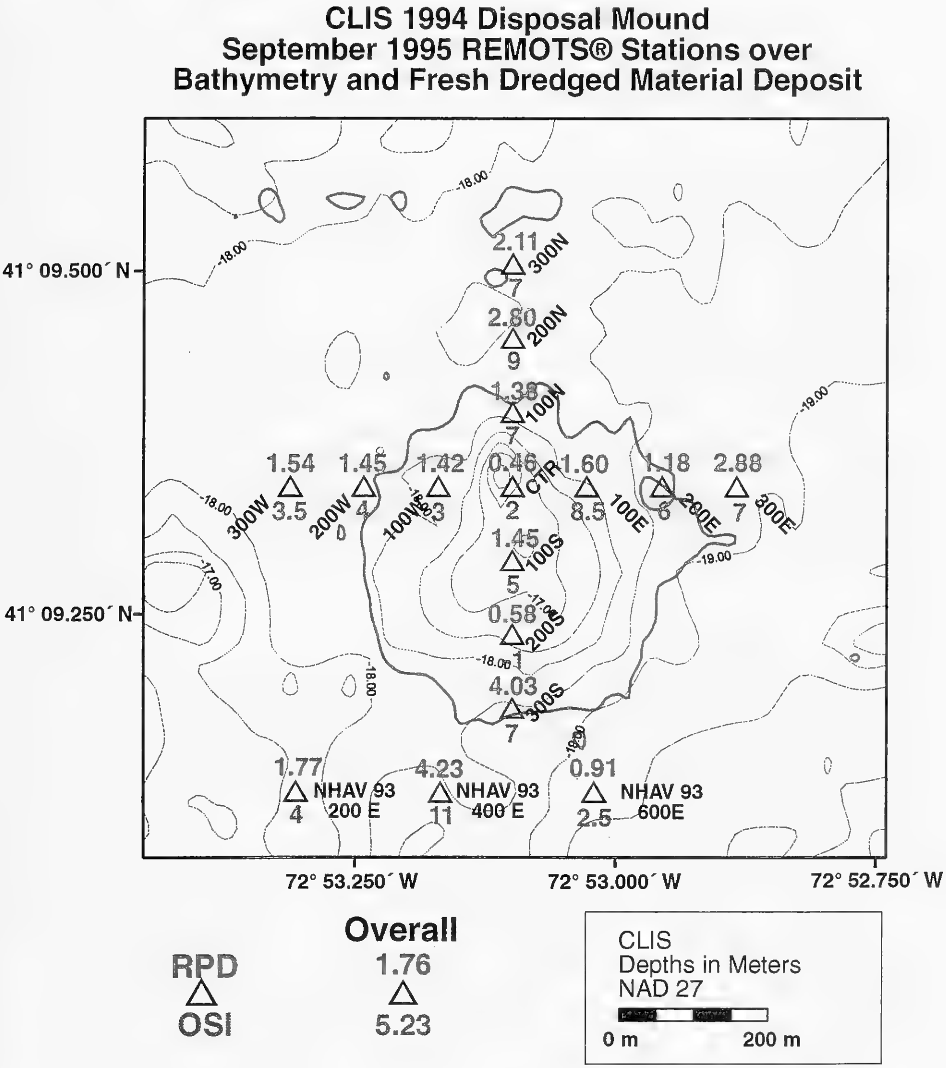
The replicate-averaged mean Redox Potential Discontinuity (RPD) values ranged from 0.46 cm at CTR to 4.03 cm at 300S (Figure 3-24). A gradient of RPDs increased from the center out towards the edges of the mound, ranging from approximately 0.5 cm at CTR, to 1.5 cm at 100 m, to 2-4 cm at 300 m. The overall average RPD value for the mound was 1.76 cm, despite indications of low dissolved oxygen resulting from hypoxic conditions within the bottom waters over many REMOTS® sediment-profile photography stations (100W, 200S, 200W, 300E, 300N, 300S, 300W).

No methane was noted in any photograph obtained on the surface of the CLIS 94 mound. However, the RPD depths varied among replicates of the same station, indicating a patchy benthic environment. Replicate A at Station 300S exhibits a mean RPD depth of 5.87 cm indicative of a healthy benthic environment (Figure 3-25A). Conversely, replicate B of Station 300S displays a shallow RPD and indications of low dissolved oxygen (Figure 3-25B).

The successional stage status was relatively advanced for Station 300S and the remainder of the CLIS 94 mound as an area recently impacted by dredged material (Germano et al. 1994). Station 100W was the only station without evidence of Stage III organisms in any of the replicates (Figure 3-26). The most common stages noted in the replicate photographs were Stage I and Stage I on III. Median Organism-Sediment Index (OSI) values of the replicates ranged from -1 at 200S (low RPD, low DO) to 9 at 200N. Low OSIs (<6) are concentrated along the western and southern arms of the grid primarily due to the indication of a low dissolved oxygen event (Figure 3-24).

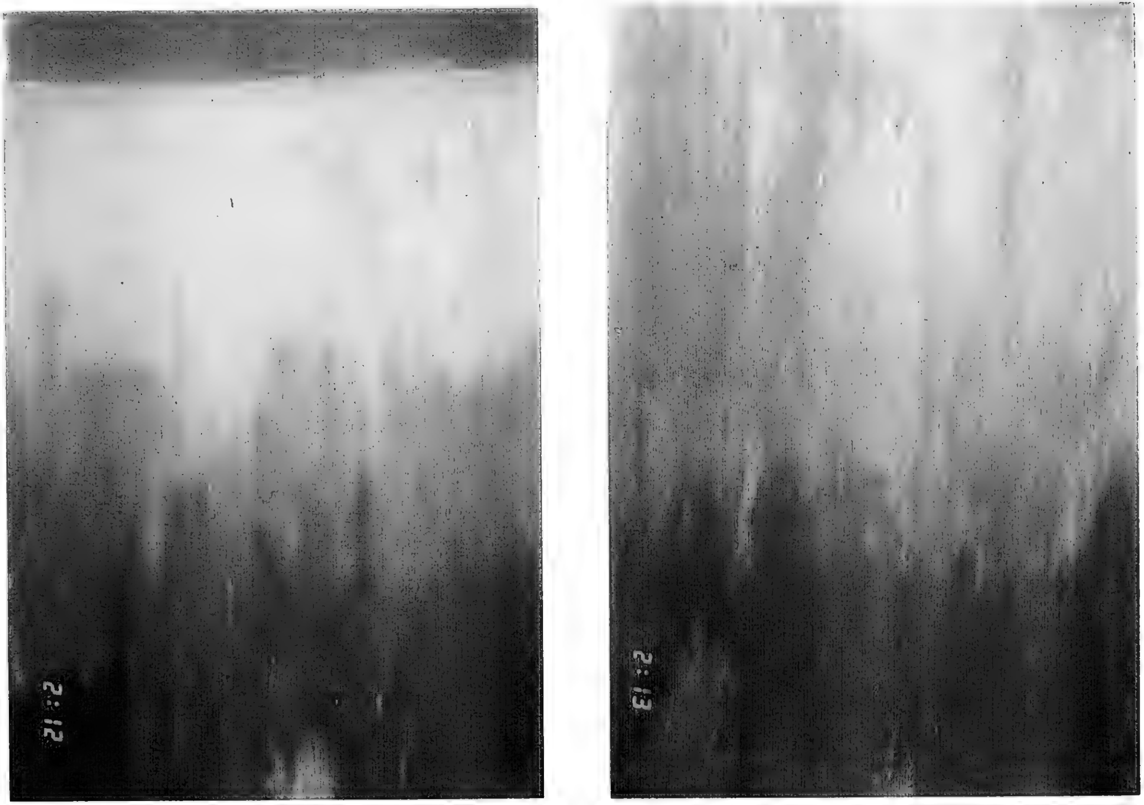
3.3 FVP Mound

The experimental FVP mound, located in the far northeast quadrant of CLIS, was monitored extensively as part of the Field Verification Program during the 1980s. Historically, benthic infaunal communities inhabiting the FVP sediments have been more susceptible to benthic disturbances, relative to other CLIS mounds. Composed of uncapped UDM deposited in 1983, the FVP mound continues to be periodically monitored as part of the DAMOS Program. No bathymetric data were collected over the historic



CLIS 1994 Disposal Mound
September 1995 REMOTS® Stations over
Bathymetry and Fresh Dredged Material Deposit

Figure 3-24. Distribution of RPD (cm) and OSI values over the CLIS 94 mound, overlaid on September 1995 bathymetry and final detectable margin of the mound



(A) (B)

Figure 3-25. REMOTS® photographs at Station 300S displaying the differences in benthic conditions (deep RPD [A] versus low DO [B]) within the confines of the same station

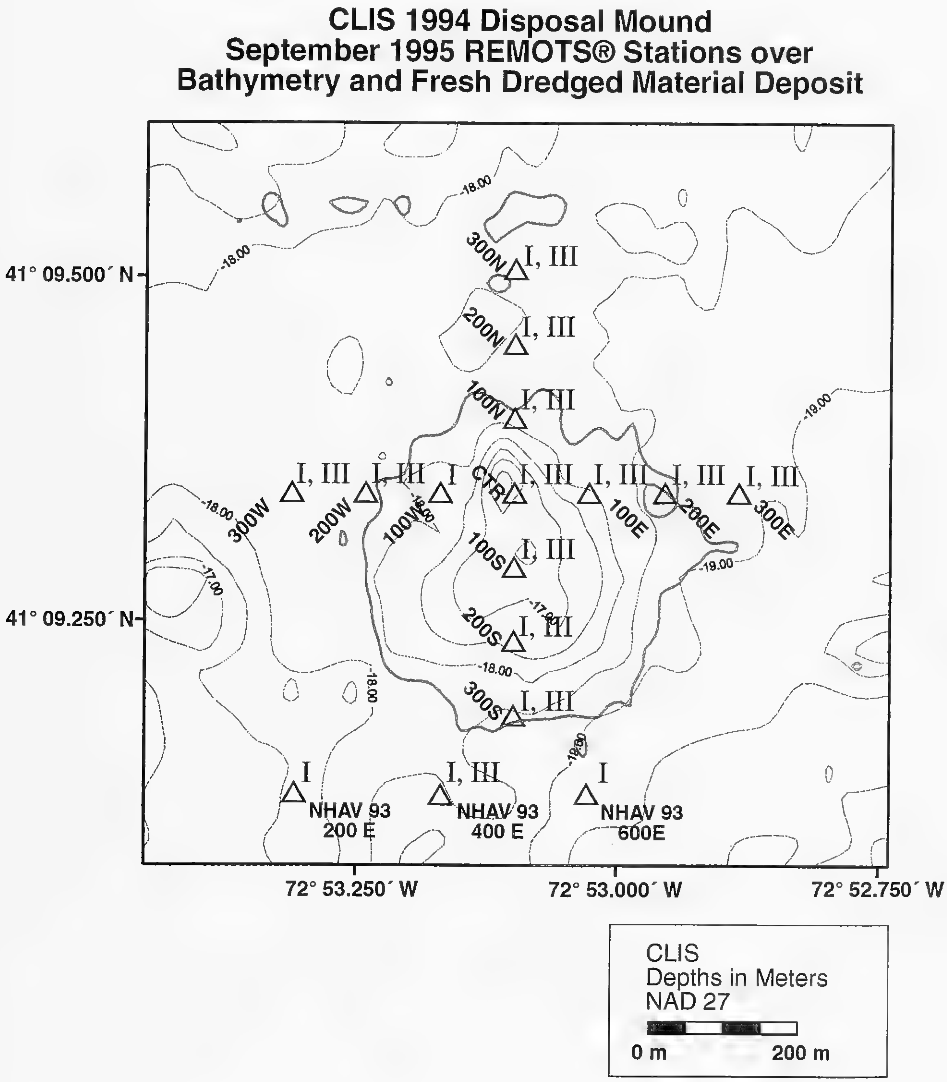


Figure 3-26. Distribution of successional stage assemblages over the CLIS 94 mound, overlaid on September 1995 bathymetry and final detectable margin of the mound

FVP mound during the September 1995 survey at CLIS. However, a full thirteen-station REMOTS® sampling grid was occupied over the mound. Complete REMOTS® results for the FVP disposal mound are available in Appendix B: Table 3.

3.3.1 Sediment Grain Size and Stratigraphy

Grain size and surface roughness data indicated no distinct pattern at the FVP disposal mound. The major modal grain size at every station was >4 phi, except for one replicate at 200W where the major mode was 4 to 3 phi. The replicate-averaged mean camera penetration ranged from 12.73 to 15.69 cm (Appendix A: Table 3-4). Boundary roughness values ranged from 0.52 cm to 1.33 cm. The primary cause of surface disturbance was biogenic except at individual replicates at CTR and 200E where boundary roughness was classified as physical in nature.

Dredged material was present in all stations, except for the replicates at stations 300 m from the center. At stations where dredged material was present, replicate-averaged thicknesses ranged from approximately 5 cm at 100W and 200N to full penetration (20 cm) at several stations (Appendix A: Table 3-4). The apparent absence of dredged material 300 m from the center may be attributed to complete reworking of historical dredged material, to the extent that there are no recognizable indicators commonly attributed to dredged material. Redox rebound intervals were noted in one replicate at several stations (100N, 100E, 200W).

3.3.2 Benthic Community Assessment

Replicate-averaged RPDs ranged from 0.77 cm at 100N to 2.84 cm at 200E (Figure 3-27; Appendix A: Table 3-4). This range is slightly higher than the average RPD depths measured in the three reference areas. Methane was detected in two replicates at Station 100E, but indications of low dissolved oxygen within the bottom waters were not noted in any photograph.

The majority of the REMOTS® stations occupied over the FVP mound displayed Stage III activity within the surface sediments. Only one station showed no evidence of Stage III organisms (100N; Figure 3-28). Replicate median OSIs ranged from 2 at 100E and 100N (low RPD, no Stage III, methane) to 8 at 300W (Figures 3-29A and 3-29B). Several stations at FVP indicated, as at the CLIS reference areas, a decrease in benthic habitat quality relative to prior monitoring surveys.

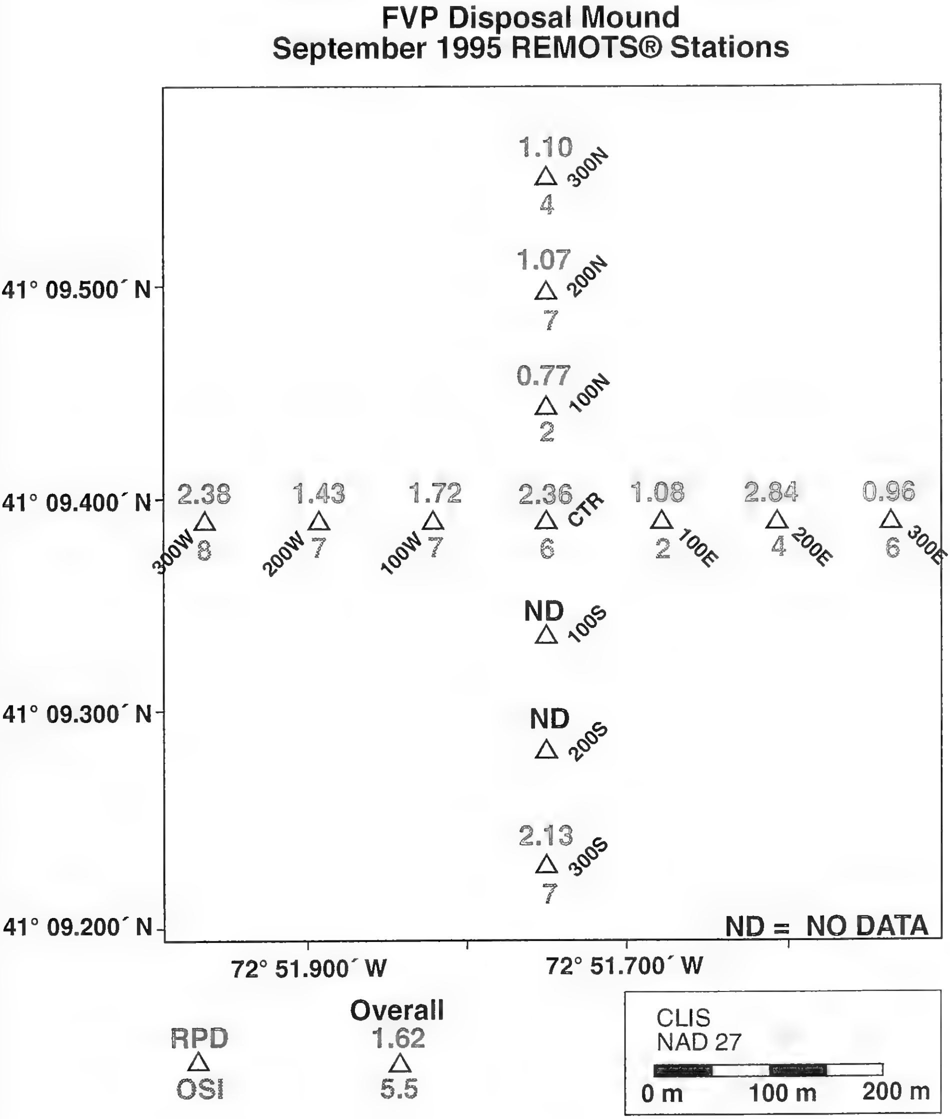


Figure 3-27. Distribution of RPD (cm) and OSI values over the FVP mound

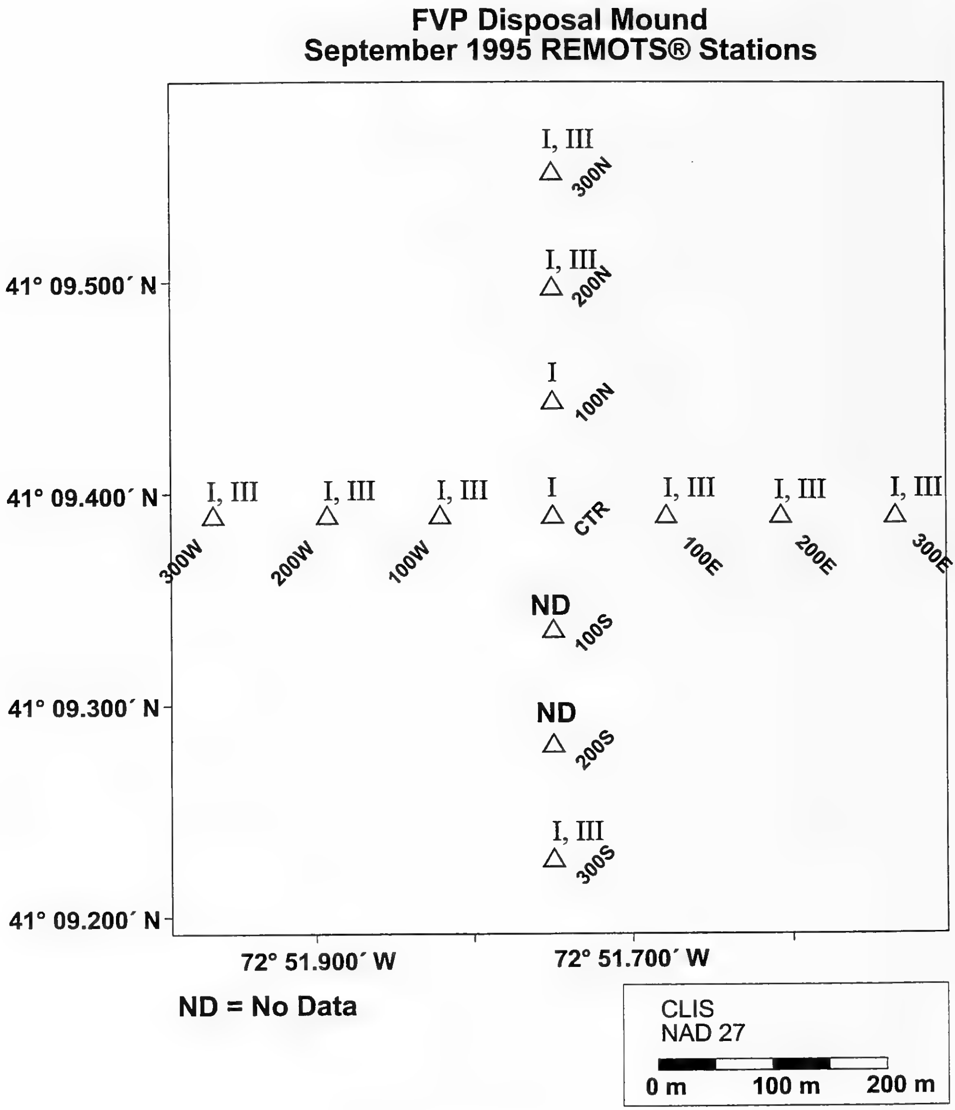
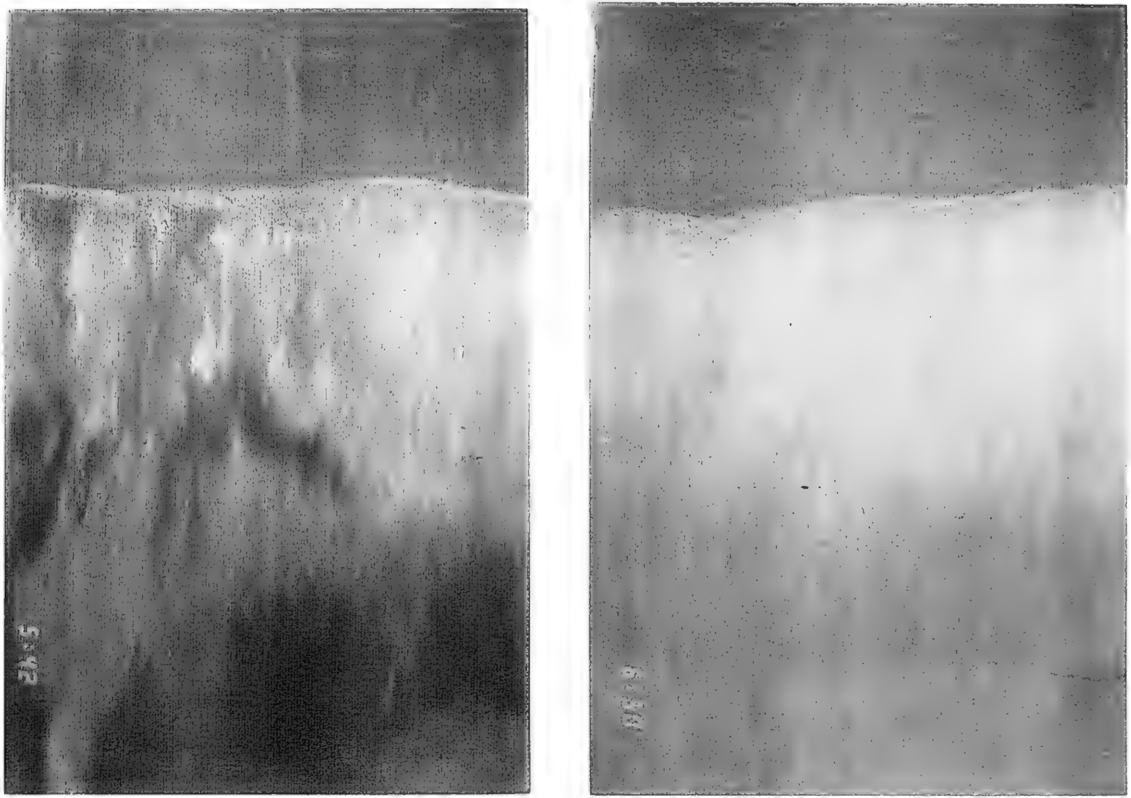


Figure 3-28. Distribution of successional stage assemblages over the FVP mound



(A)

(B)

Figure 3-29. REMOTS® photographs of Stations 100N (A) and 300W (B) displaying differences in benthic conditions between the center and apron of the FVP mound

3.4 CLIS Reference Areas

As part of the DAMOS tiered monitoring protocols, reference area data are collected to provide a baseline against which results from the dredged material mounds are compared. CLIS-REF has been a reference area for CLIS since the beginning of the DAMOS Program. The two newer reference areas, 2500W and 4500E, have been monitored since approximately 1987. A total of thirteen stations were occupied over the three reference areas. Complete REMOTS® results for the CLIS reference areas (CLIS-REF, 2500W, 4500E) are available in Appendix B: Table 4.

3.4.1 Sediment Grain Size and Stratigraphy

Physical indicators of the benthic environment include the grain size and boundary roughness of the sediment surface. The major modal grain size was >4 phi in all reference station replicates. Replicate-averaged camera penetration ranged from 8.93 cm to 13.68 cm (Appendix A: Table 3-5). Boundary roughness values ranged from 0.42 cm to 1.23 cm and were determined to be caused by biogenic or unidentifiable processes. Biological disturbance tends to be associated with a mature sediment deposit, whereas physical disturbance is often associated with recent benthic impact.

Dredged material was not identified in any photograph, and no redox rebound intervals were identified. No station exhibited indications of methane or low dissolved oxygen.

3.4.2 Benthic Community Assessment

Replicate-averaged RPD depths at all three reference areas ranged from 0.62 cm to 1.60 cm (Appendix A: Table 3-5). This is a relatively low range of RPDs for CLIS reference stations and was lower than the averaged values for all three dredged material mounds sampled in 1995. In the past, reference area RPDs ranged from 0.55 cm to 2.7 cm during the July 1994 survey; 5.68 cm to 1.49 cm in June 1991; and 3.4 cm to 6.6 cm in July 1990 (Morris and Tufts 1997; Wiley and Charles 1995; Germano et al. 1995).

The successional stage status at all reference stations was most commonly Stage I on Stage III, indicating a mature benthic assemblage. Only one station exhibited no Stage III community in any replicates (Station 3 at CLIS-REF). Stage II was identified in one replicate at 4500E. Median OSIs at the reference areas generally ranged from 6 to 7, except for a minimum OSI of 3 at CLIS-REF Station 3 (lack of Stage III) and a maximum of 8 at 4500E Station 3. OSIs of 6 or less were present at four of five CLIS-REF stations, one of four stations at 2500W, and one of four stations at 4500E. These relatively low OSIs are due primarily to the low RPDs measured in CLIS reference areas.

The REMOTS® photographs collected during previous monitoring surveys (July 1990, June 1991, and July 1994) indicated healthy benthic environments, with median OSI values consistently reported as 6 or above. The slight decline in habitat quality observed at several reference area stations during the August 1995 survey suggests the presence, or recent occurrence, of environmental stress (i.e., hypoxic bottom waters).

4.0 DISCUSSION

During the September 1995 REMOTS® sediment-profile photography surveys over NHAV 93, CLIS 94, FVP, and the CLIS reference areas, a trend of lower than expected RPDs and indications of low dissolved oxygen (DO) concentrations was observed. Seasonal hypoxia, due to eutrophication in the protected waters of the central and western Long Island Sound causing the degradation of water quality, had apparently affected both the benthic and near-bottom pelagic habitats. The Long Island Sound Study (LISS), a US Environmental Protection Agency (EPA) monitoring program, officially recognizes the onset of hypoxia at a DO concentration of 3.0 $mg \cdot l^{-1}$. However, the appearance of hypoxic conditions in the bottom waters and surface sediments has been documented with DO concentrations as high as 5.0 $mg \cdot l^{-1}$ (LISS 1990). For the past several years DAMOS monitoring activity has not included water sampling for DO or other water quality parameters as part of its field operations because the instantaneous measure during the relatively short survey period was not sufficient to determine seasonal events. However, further investigation was required to determine whether the decline in the RPD and OSI values at CLIS and the reference stations was related to disposal activity or a regional hypoxia event.

A comprehensive DO data set for stations throughout the Long Island Sound was obtained from the Connecticut Department of Environmental Protection, Water Management Division (DEP). The data was collected as part of the DEP Long Island Sound Summer Hypoxia Monitoring Program and consisted of surface and bottom DO values for 18 primary stations that were monitored throughout the year as well as a number of secondary summer stations (June to September). Seasonal monitoring stations 23, 26, and 27 and annual monitoring stations H2 and H4 were chosen due to their location relative to CLIS (Figure 4-1).

Although the data for seasonal stations 23, 26, and 27 does not continue through the September 1995 field effort, a decrease in DO concentrations (4.5 $mg \cdot l^{-1}$) was observed at stations 23 and 27 in mid-August (Julian Day 226) suggesting a seasonal DO event within the central Long Island Sound region (Figure 4-1). Stations 23 and 27 are situated in close proximity to the disposal site in similar water depths and bottom current patterns. Both stations show a downward progression in DO values for the summer of 1995. Station 26, approximately 7 km north of CLIS, is located in shallower water and tends to be influenced by the drainage of the Quinnipiac River and New Haven Harbor. The data at Station 26 show a drastic reduction in bottom water DO, decreasing from 8.2 $mg \cdot l^{-1}$ to 3.4 $mg \cdot l^{-1}$ over the first forty days of the monitoring program. Oxygen levels then show significant rebound to 6.4 $mg \cdot l^{-1}$ on Julian Day 226, displaying higher concentrations of DO data, relative to the deeper stations.

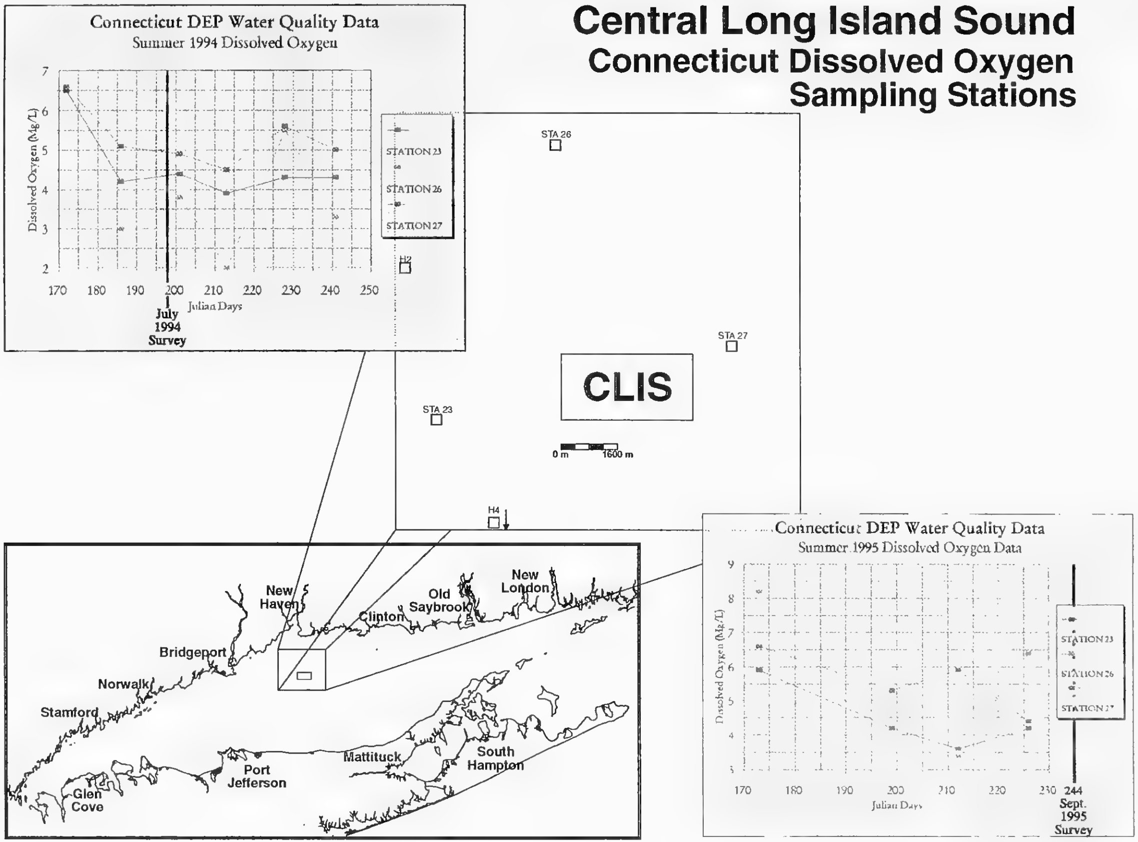


Figure 4-1. Position of the Connecticut Department of Environmental Protection Dissolved Oxygen Sampling Stations and bottom DO trends at summer monitoring stations 23, 26, and 27 for 1994 and 1995. DAMOS survey dates added for reference.

The data collected at primary monitoring stations H2 and H4 also suggest a seasonal hypoxic episode was occurring in the central Long Island Sound region during the summer months. A steady decrease in detectable oxygen was observed from Julian Day 100 (7 April 1995) through Julian Day 226 (mid-August; Figure 4-2). As the water temperature began to increase in the spring and summer months, water quality in Long Island Sound was slowly depressed by falling DO concentrations and lack of significant fresh water input from the surrounding tributaries due to drought.

Station H4 was located in the center of Long Island Sound, approximately 6 km southeast of CLIS, in water 30 m deep (Figure 4-1). Bottom DO concentrations at Station H4 dropped to 4.2 $mg \cdot l^{-1}$ in early August and remained at those levels through the September 1995 survey. Station H2 showed a major decrease in DO in early and mid-August, with values falling to 2.4 $mg \cdot l^{-1}$ then slowly increasing to 3.8 $mg \cdot l^{-1}$ by late August. This station was located 6.5 km northwest of the center of CLIS in water 15 m deep (Figure 4-1).

In September, dissolved oxygen concentrations began to climb towards 6.0 $mg \cdot l^{-1}$ and continued to increase as the autumn of 1995 progressed. The primary and secondary station data both indicated a decrease in dissolved oxygen concentrations within the central Long Island Sound region immediately preceding the September 1995 field activity. The REMOTS® sediment-profile photographic survey over the project mounds and reference areas at CLIS observed the aftermath of the hypoxic event within the benthic community. Although DO concentrations seemed to be increasing at the time of the REMOTS® survey, complete recovery within the benthic community (OSI values ≥6, deep RPD, presence of Stage II and Stage III assemblages) would not be seen for several weeks.

The degree and effects of the seasonal hypoxia varied with the sampling location at CLIS during the 1995 monitoring cruise. In general, the CLIS reference areas showed a decline in benthic habitat quality with lower RPD depths than expected and no Stage II organisms present. The NHAV 93 mound showed improvement relative to the July 1994 survey; Stage I organisms occupied the surface sediments, and Stage III individuals were present at depth. The CLIS 94 mound recovered better than expected with a Stage I on III recolonization status, and several deep RPD measurements, but displayed indications of a low DO event. The FVP mound continued to exhibit difficulty in fully establishing and maintaining a stable benthic community with low RPD and OSI values near the mound center.

The REMOTS® data from the FVP mound show a steady decline in the apparent RPD and OSI since the 1991 CLIS survey, with the exception of Station CTR, where the OSI has ranged from 4 to 6 since the 1987 CLIS survey (Figures 4-3 and 4-4). This trend was also noted in the data collected during the CLIS survey in November 1993. The

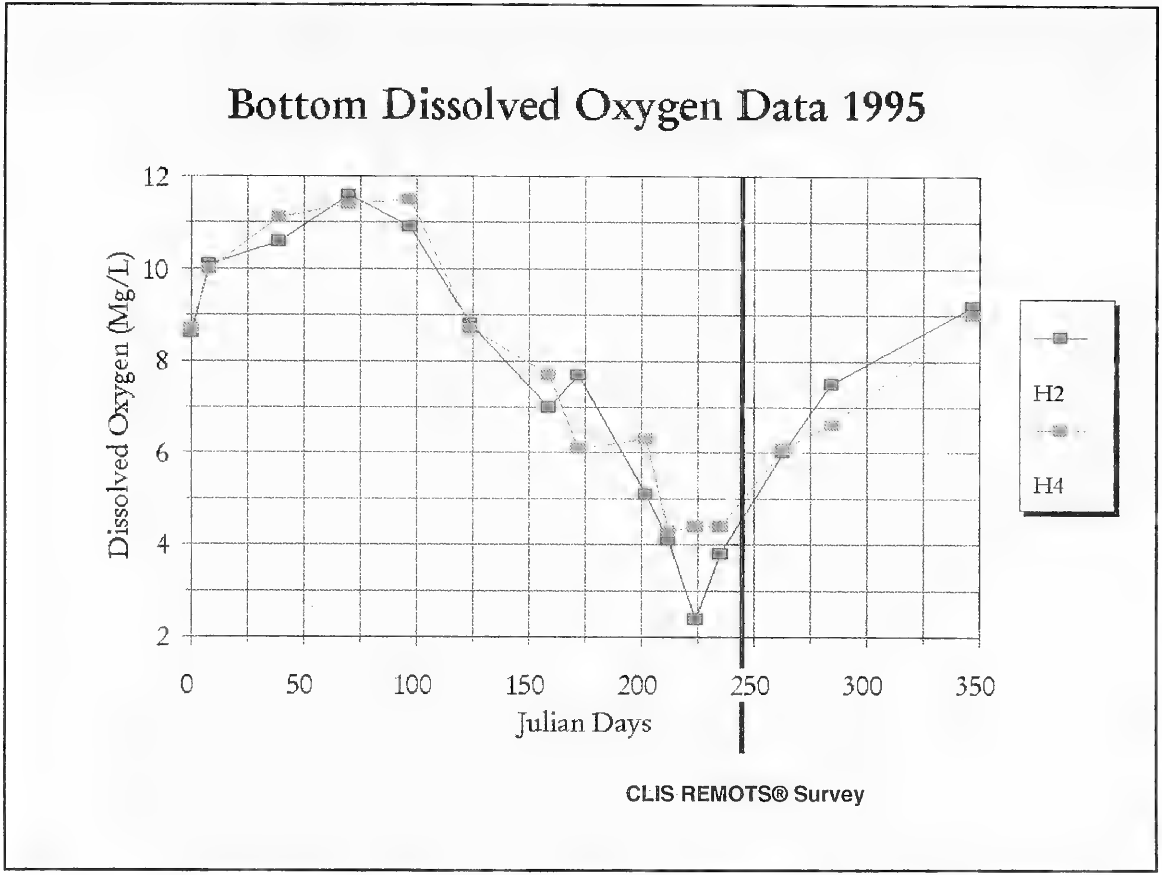


Figure 4-2. Observed changes in bottom DO concentrations at Connecticut Department of Environmental Protection Dissolved Oxygen Sampling Stations H2 and H4 for 1995

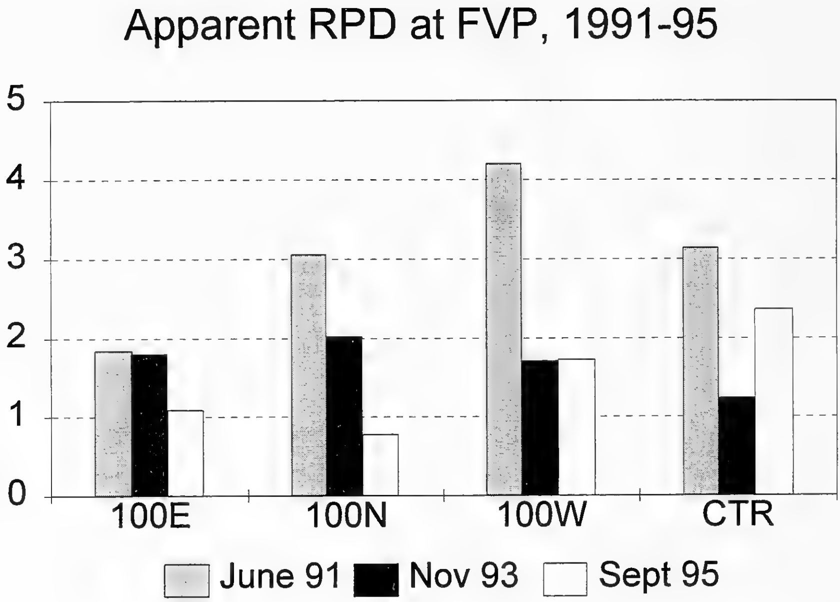


Figure 4-3. Histogram displaying recorded RPD calculations from June 1991, November 1993, and September 1995 at Stations 100E, 100N, 100W, and CTR over the FVP mound

orientation and gridding routines between SAIC and OSI are responsible for its appearance.

Due to the effects of consolidation, tracking volumes of material throughout the different phases of mound development accounted for more of the reported volumes than comparisons over long expanses of time. The cumulative volume detected by the use of multiple surveys is 204,362 m^3 or 70% of the total reported volume (Appendix A: Table 3-2). Without the use of interim survey data, volume calculations detected 70,643 m^3 of CDM, 44% of the reported cap material volume, and 169,624 m^3 or 58% of the total material volume.

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3.2.2.2 Benthic Community Assessment

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No methane was noted in any photograph obtained on the surface of the CLIS 94 mound. However, the RPD depths varied among replicates of the same station, indicating a patchy benthic environment. Replicate A at Station 300S exhibits a mean RPD depth of 5.87 cm indicative of a healthy benthic environment (Figure 3-25A). Conversely, replicate B of Station 300S displays a shallow RPD and indications of low dissolved oxygen (Figure 3-25B).

The successional stage status was relatively advanced for Station 300S and the remainder of the CLIS 94 mound as an area recently impacted by dredged material (Germano et al. 1994). Station 100W was the only station without evidence of Stage III organisms in any of the replicates (Figure 3-26). The most common stages noted in the replicate photographs were Stage I and Stage I on III. Median Organism-Sediment Index (OSI) values of the replicates ranged from -1 at 200S (low RPD, low DO) to 9 at 200N. Low OSIs (<6) are concentrated along the western and southern arms of the grid primarily due to the indication of a low dissolved oxygen event (Figure 3-24).

3.3 FVP Mound

The experimental FVP mound, located in the far northeast quadrant of CLIS, was monitored extensively as part of the Field Verification Program during the 1980s. Historically, benthic infaunal communities inhabiting the FVP sediments have been more susceptible to benthic disturbances, relative to other CLIS mounds. Composed of uncapped UDM deposited in 1983, the FVP mound continues to be periodically monitored as part of the DAMOS Program. No bathymetric data were collected over the historic

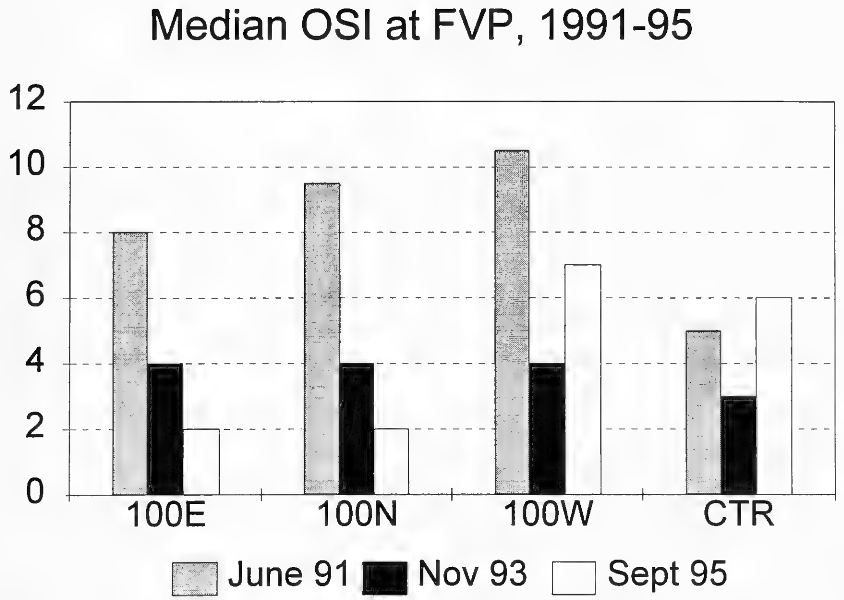

Figure 4-4. Histogram displaying recorded OSI values from June 1991, November 1993, and September 1995 at Stations 100E, 100N, 100W, and CTR over the FVP mound

benthic population at FVP appears to be more susceptible to environmental stress than the benthic infaunal populations of the capped mounds. As a result, hypoxic events or other disturbances tend to have a more pronounced and longer lasting effect on the invertebrates inhabiting the uncapped sediments of FVP.

The Field Verification Program was concluded in 1988 with a report which determined that, in comparison to upland containment and wetland creation, subaqueous mound development within a designated disposal site is the most environmentally sound method of disposing of large volumes of UDM (Peddicord 1988). The FVP mound was targeted for capping during the 1993 disposal season using excess CDM generated by the New Haven Harbor maintenance dredging project. A lack of an adequate volume of CDM during the NHAV 93 mound development caused the deletion of the FVP capping operations phase of the project (Morris et al. 1996).

However, in order to improve the conditions of the benthic environment over the FVP mound, an effort should be made in future disposal seasons to cap the experimental mound with a 0.5 m thick layer of CDM. In addition, the adoption of the FPEIS disposal site center of CLIS shifts the entire disposal site 362 m west-southwest, leaving the majority of the FVP mound outside of the disposal site boundaries. In order to officially conclude the EPA/WES joint experiment, the area surrounding the FVP mound, ideally, should be restored to near ambient conditions with the placement of a silt cap over the exposed UDM deposit.

The cap over the NHAV 93 mound continues to support a stable benthic community with marked improvement at stations CTR, 200N, and 400S relative to the July 1994 survey (Morris and Tufts 1997). Despite a decrease in dissolved oxygen, the mound was supporting Stage I and Stage III individuals in the surface and subsurface sediments. There was a noticeable lack of Stage II individuals over all three project mounds as well as the three reference areas, suggesting an intolerance to lower water column induced DO concentrations. The Stage I surface dwellers may have been able to tolerate the hypoxia or may be the pioneering species recolonizing the sediments as DO concentrations began to increase.

The overall integrity of the NHAV 93 mound remains uncompromised eighteen months after the completion of the New Haven Capping Project. There were no noticeable changes in size or shape over the NHAV 93 mound, indicating the large bottom feature is stable. The moderate consolidation detected since the completion of capping operations is well within the forecast norm. The mound is expected to continue to consolidate as pore water extrusion and basement material compression yield to the shear weight of the capped sediment deposit over the coming years (Poindexter-Rollings 1990).

Geotechnical cores collected over the NHAV 93 mound within the past two years have attempted to document the development and subsequent consolidation of the NHAV 93 mound. Despite the use of precision navigation and consistently revisiting stations, the observed heterogeneity within the UDM and historic dredged material layers of the NHAV 93 mound tends to lessen the ability to track sediment layers through the five-member time-series data set. A certain degree of repeatability within the collected sediments was required to follow individual sediment strata throughout the project, providing a baseline used to quantify changes in layer thickness. However, cross-sections of a dredged material mound have been proven to be valuable as "snapshot" data as well as ground-truth data for comparison with subbottom profiling (Morris and Tufts 1997).

Geotechnical coring as an investigative technique could be improved by acquiring longer cores to obtain a sample of the ambient bottom throughout the time-series data set. The gravity coring device utilized during the New Haven Capping Project had difficulty penetrating the consolidated center of the 2.5 m high NHAV 93 mound, resulting in partial recovery. The use of a pneumatic vibrocore equipped with a 5 m steel core barrel would ensure complete penetration into the basement material to provide a baseline for consolidation measurements. In addition, the use of chemical sampling of the recovered sediment could provide valuable information on the origins of the various strata. Determination of the relative concentrations of various contaminants would allow for the differentiation of basement, historic, UDM, and CDM layers in either ubiquitous or heterogeneous samples.

The use of repetitive bathymetric surveys during the New Haven Capping Project was proven to be an invaluable tool in observing the usually hidden dynamics of dredged material mound construction (Morris et al. 1996). The same technique was employed during the post processing of the CLIS 94 mound bathymetric survey data. A total of four bathymetric survey data sets were used to follow the construction of the CLIS 94 mound and expose the accumulation and consolidation of the bottom feature. By utilizing SAIC's July 1994 and September 1995 surveys in conjunction with OSI's December 1994 and April 1995 data sets, the events leading up to the final capped mound could be tracked and volumes of material calculated.

In the past, efforts have been made to account for differences in the volume of material reported in disposal barge logs to the volumes of material detected acoustically. The issue of mass balance has become clouded by large volumes of undetectable mound apron material, over-estimation of barge volume by on-site inspectors, and compaction of dredged material on the seafloor (Tavolaro 1984). The repetitive surveys over the CLIS 94 mound have found central mound consolidation during disposal and capping activity to be another factor causing large discrepancies between barge estimates and detected volumes. By restricting the window of analysis to the area immediately around the CLIS 94 mound and performing various depth and volume differencing routines, physical changes in the dredged material deposit and in the volume of material were detected.

A large central pocket of dredged material consolidation within the CLIS 94 mound was detected during the interim cap survey of the bottom feature. This pocket of consolidation is believed to be the chief cause of the mass balance shortfall. Although the use of multiple surveys improved the tracking of large volumes of material disposed, rapid consolidation due to compression and de-watering complicate precise volume comparisons.

Studies conducted at CLIS by the US Army Corps of Engineers, Waterways Experiment Station (WES), have documented significant amounts of dredged material consolidation over short periods of time (0.5 m in 30 days; Poindexter-Rollings 1990). The observed behavior of the CLIS 94 mound supports those findings with up to 1.0 m of consolidation over a 126-day period of time without evidence of UDM surface movement or collapse of the mound. If the CLIS 94 mound continues as predicted, the mound should subside an additional 0.5 m to 0.75 m over the next year and then show gradual reduction due to compression of the basement material over the next 5 to 10 years.

5.0 CONCLUSIONS

The September 1995 field efforts at CLIS allowed SAIC and NED to examine three bottom features constructed by three different dredged material management approaches. The NHAV 93 mound is an example of a highly successful CAD structure. The mound was found to have maintained its lateral stability and cap integrity. The site management strategy of creating a ring of mounds from smaller disposal projects to accept large quantities of dredged material within the basin has proven to be an efficient method of UDM lateral containment and CAD mound construction. This management strategy should continue at CLIS in order to provide large cells of lateral containment and maximize the available space within the 6.86 km^2 area of the disposal site.

Overall, the NHAV 93 mound appears to be recovering from the disposal activity as anticipated (Germano et al. 1994). The mound supports a stable benthic infaunal population with Stage I and Stage III organisms present in the surface and subsurface sediments. Three areas of concern detected during the July 1994 monitoring cruise (CTR, 200N, and 400S) show marked improvement with deeper RPD depths and higher OSI values despite the occurrence of a hypoxic event in the central Long Island Sound region. The sediments of the NHAV 93 mound are expected to support a Stage II on Stage III population in the coming years barring benthic disturbance (hypoxia, trawling, etc.).

The development of the CLIS 94 mound represents the next step in the successful site management strategy. The construction of an independent capped mound to the northeast of the NHAV 93 mound begins to enclose another basin at CLIS. The CLIS 94 mound appears to be a discrete and stable bottom feature that has completely incorporated the historic CS 90-1 mound that was formed during the 1989/90 disposal season. Approximately 129,900 m^3 of UDM from Norwalk Harbor, New Haven Harbor, and Long Wharf Pier projects was deposited over CS 90-1. A total of 161,000 m^3 of CDM was placed over the unsuitable material to isolate it from the marine environment. A CDM to UDM ratio of 1.24:1.0 was found to be sufficient to cap the UDM deposit without lateral containment as both disposal and capping operations were consistently controlled.

The overall size and shape of CLIS 94, as well as the volume of new material detected by bathymetry, suggests that mound development proceeded without difficulty. Comparisons between the July 1994 (baseline) and September 1995 (postcap) surveys performed by SAIC and the results of a precap and interim cap bathymetric surveys obtained through Ocean Surveys, Inc. support that conclusion. Intensive analysis of the four data sets detected significant central consolidation within the UDM layer during the first phase of capping operations, supporting previous studies performed by WES in the 1980s. Up to 1.0 m of dredged material subsidence was detected over a 126-day period between the precap and interim cap surveys of the CLIS 94 mound. The pocket of central consolidation was responsible for a large percentage of a 121,300 m^3 shortfall in the mass balance of material. However, agreement between the reported barge volume and the volume detected acoustically improved by tracking the volume through the four phases of mound development.

Physical and biological indicators of overall benthic community health suggest the CLIS 94 mound is recovering faster than expected. A few stations displayed signs of low dissolved oxygen; however, the majority of the mound was characterized with moderate to deep RPDs and evidence of Stage III organism activity. As a result, the overall OSI value of 5.23 suggests the CLIS 94 mound should reach full recovery (RPD >6) in the next two years.

Conversely, the FVP mound, composed of an uncapped UDM deposit, is continuing to show signs of low habitat quality with shallow RPDs and low OSI values over the center of the mound. Although the regional hypoxic event may have contributed to the problems at FVP, the mound has traditionally been more susceptible to benthic disturbances and slower to recover, relative to other project mounds. Now that the Field Verification Program is complete and long-term monitoring has documented a chronic response, the FVP mound should be capped in order to isolate the UDM from the sediment/water interface and return the area to near-ambient conditions. In addition, the movement of the disposal site boundaries to the west-southwest lends further support to this recommendation.

The low water column dissolved oxygen event that seemed to affect the FVP mound was also noticed over the CLIS 94 and NHAV 93 mounds, as well as the three CLIS reference areas (CLISREF, 4500E, and 2500W). Data obtained from the Connecticut DEP indicated a summer hypoxia event occurred several days before the September 1995 monitoring cruise. The REMOTS® photographs obtained over the reference areas and project mounds depict the aftermath of the low DO event within the benthic community. The Stage I organisms occupying the surface sediments could represent benthic recolonization as the DO concentrations began to rise approximately 10 days before the survey. In order to avoid a downward trend or skew in future data, monitoring cruises in the western and central Long Island Sound should be scheduled for early July. By conducting environmental sampling activity earlier in the summer and avoiding the possibility of recurring hypoxia, NED will gain a more realistic perspective of the benthic community at the Long Island Sound disposal sites.

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Appendix A: Table 2-1

September 1995 Central Long Island Sound Disposal Site REMOTS® Camera Stations
Horizontal Datum: North American Datum of 1927

Area	Station	Latitude	Longitude
NHAV 93 41° 09.122' N 72° 53.453' W	CTR	41° 09.122' N	72° 53.453' W
	200N	41° 09.230' N	72° 53.453' W
	400N	41° 09.338' N	72° 53.453' W
	600N	41° 09.446' N	72° 53.453' W
	200S	41° 09.014' N	72° 53.453' W
	400S	41° 08.906' N	72° 53.453' W
	600S	41° 08.798' N	72° 53.453' W
	200E	41° 09.122' N	72° 53.310' W
	400E	41° 09.122' N	72° 53.167' W
	600E	41° 09.122' N	72° 53.024' W
	200W	41° 09.122' N	72° 53.596' W
	400W	41° 09.122' N	72° 53.739' W
	600W	41° 09.122' N	72° 53.882' W
CLIS 94 41° 09.343' N 72° 53.099' W	CTR	41° 09.343' N	72° 53.099' W
	100N	41° 09.397' N	72° 53.099' W
	200N	41° 09.451' N	72° 53.099' W
	300N	41° 09.505' N	72° 53.099' W
	100S	41° 09.289' N	72° 53.099' W
	200S	41° 09.235' N	72° 53.099' W
	300S	41° 09.181' N	72° 53.099' W
	100E	41° 09.343' N	72° 53.028' W
	200E	41° 09.343' N	72° 52.956' W
	300E	41° 09.343' N	72° 52.885' W
	100W	41° 09.343' N	72° 53.171' W
	200W	41° 09.343' N	72° 53.242' W
	300W	41° 09.343' N	72° 53.313' W
FVP 41° 09.390' N 72° 51.750' W	CTR	41° 09.390' N	72° 51.750' W
	100N	41° 09.444' N	72° 51.750' W
	200N	41° 09.498' N	72° 51.750' W
	300N	41° 09.552' N	72° 51.750' W
	100S	41° 09.336' N	72° 51.750' W
	200S	41° 09.282' N	72° 51.750' W
	300S	41° 09.228' N	72° 51.750' W
	100E	41° 09.390' N	72° 51.679' W
	200E	41° 09.390' N	72° 51.607' W
	300E	41° 09.390' N	72° 51.536' W
	100W	41° 09.390' N	72° 51.821' W
	200W	41° 09.390' N	72° 51.893' W
	300W	41° 09.390' N	72° 51.964' W
2500 W 41° 09.254' N 72° 55.569' W	STAT. 1	41° 09.227' N	72° 55.640' W
	STAT. 2	41° 09.195' N	72° 55.465' W
	STAT. 3	41° 09.267' N	72° 55.567' W
	STAT. 4	41° 09.356' N	72° 55.664' W
4500 E 41° 09.254' N 72° 50.565' W	STAT. 1	41° 09.302' N	72° 50.638' W
	STAT. 2	41° 09.247' N	72° 50.583' W
	STAT. 3	41° 09.133' N	72° 50.602' W
	STAT. 4	41° 09.407' N	72° 50.518' W
CLIS REF 41° 08.085' N 72° 50.109' W	STAT. 1	41° 08.094' N	72° 50.106' W
	STAT. 2	41° 08.076' N	72° 50.028' W
	STAT. 3	41° 07.957' N	72° 50.007' W
	STAT. 4	41° 08.104' N	72° 50.238' W
	STAT. 5	41° 08.135' N	72° 50.112' W

Appendix A: Table 2-2

August 1995 Central Long Island Sound Disposal Site
Geotechnical Core Positions and Lengths
Horizontal Datum: North American Datum of 1927

Core Name	Latitude	Longitude	Length	Replicate of:
GC-1	41° 09.280′ N	72° 53.334′ W	128 cm	W
GC-2	41° 09.180′ N	72° 53.385′ W	125 cm	Y
GC-3B	41° 09.134′ N	72° 53.458′ W	185 cm	U
GC-4	41° 09.078′ N	72° 53.536′ W	133 cm	X
GC-5	41° 08.996′ N	72° 53.629′ W	269 cm	V
GC-6	41° 09.182′ N	72° 53.509′ W	272 cm	Z
GC-7	41° 09.100′ N	72° 53.403′ W	223 cm	Z1
GC-8	41° 09.136′ N	72° 53.443′ W	161 cm	U
GC-9	41° 09.175′ N	72° 53.407′ W	131 cm	Y
GC-10	41° 09.075′ N	72° 53.521′ W	248 cm	X
GC-11	41° 09.264′ N	72° 53.306′ W	262 cm	W

Appendix A: Table 3-1a

REMOTS® Parameters Summary Table for the September 1995 Survey of the NHAV 93 Mound

Station	Mean RPD (cm)	Median OSI	Mean Camera Penetration (cm)	Mean Dredged Material Thickness (cm)	Boundary Roughness (cm)
200E	1.77	4	15.7	15.50	0.42
200N	3.08	7	18.38	18.22	0.91
200S	1.24	4	17.33	17.09	0.48
200W	1.61	7	15.39	12.66	0.58
400E	4.23	11	18.91	9.45	0.79
400N	1.95	7	15.05	0	0.58
400S	1.81	8	17.74	14.68	0.66
400W	2.31	9	12.86	9.80	1.82
600E	0.91	2.5	18.08	15.42	0.86
600N	2.49	10	13.97	0	0.81
600S	1.42	5	14.78	3.01	1.29
600W	3.84	6	14.83	0	0.94
CTR	1.22	3	16.56	16.22	0.54

Appendix A: Table 3-1b

REMOTS® Parameters Summary Table for the July 1994 Survey of the NHAV 93 Mound

Station	Mean RPD (cm)	Median OSI	Mean Camera Penetration (cm)	Mean Dredged Material Thickness (cm)	Boundary Roughness
200E	0.61	2	19.61	20.00	0.71
400E	1.50	IND	16.45	17.29	3.78
600E	0.35	5	15.48	10.07	1.20
200N	0.80	3	19.56	19.48	0.18
400N	1.20	6	17.47	18.28	1.49
600N	0.52	6	14.70	15.21	0.86
200S	1.12	3	17.26	17.94	2.86
400S	0.47	3	14.09	9.16	1.83
600S	1.11	5	10.87	11.18	1.10
200W	1.20	4	15.90	16.77	1.86
400W	0.59	4	16.85	17.47	1.01
600W	0.88	3	16.64	17.02	0.80
CTR	0.78	2	17.97	18.61	1.18

IND = Indeterminate

Appendix A: Table 3-2

Summary Table of the Reported and Detected Volumes of Dredged Material Disposed over the CLIS 94 Mound

Surveys	Positive Volume (m^3)	Negative Volume (m^3)	Estimated Barge Volume (m^3)	% of Estimate Detected
Baseline vs. Precap	114,704	11,245	129,900	88
Precap vs. Interim	38,664	26,449	41,700	93
Interim vs. Postcap	50,994	10,788	119,300	43
Sum	*204,362*	*48,482*	*290,900*	70
Precap vs. Postcap	70,643	18,222	161,000	44
Baseline vs. Postcap	169,624	13,744	290,900	58

Note: 11,245 m^3 negative volume due to consolidation over visible portions of the NHAV 93 mound.

Appendix A: Table 3-3

REMOTS® Parameters Summary Table for the
September 1995 Survey of the CLIS 94 Mound

Station	Mean RPD (cm)	Median OSI	Mean Camera Penetration (cm)	Mean Dredged Material Thickness (cm)	Boundary Roughness (cm)
100E	1.5975	8.5	20.69	18.894	0.04
100N	1.38	7	19.06	18.83	0.93
100S	1.45	5	17.22	14.76	0.77
100W	1.42	3	20.42	20.19	0.28
200E	1.18	6	20.14	19.94	0.57
200N	2.8	9	17.11	8.8	0.23
200S	0.58	-1	18.16	18.0	1.15
200W	1.45	4	19.9	16.55	0.62
300E	2.88	7	17.75	16.81	1.64
300N	2.11	7	12.86	10.6	1.22
300S	4.03	7	19.34	11.0	0.48
300W	1.54	3.5	16.98	10.71	1.59
CTR	0.46	2	14.47	14.06	1.13

Appendix A: Table 3-4a

REMOTS® Parameters Summary Table for the September 1995 Survey of the FVP Mound

Station	Mean RPD (cm)	Median OSI	Mean Camera Penetration (cm)	Mean Dredged Material Thickness (cm)	Boundary Roughness (cm)
100E	1.08	2	14.56	13.98	1.17
100N	0.77	2	14.78	14.36	0.52
100W	1.72	7	15.1	4.92	0.8
200E	2.84	4	15.69	15.27	0.81
200N	1.07	7	12.73	4.91	1.03
200W	1.43	7	13.36	2.64	0.63
300E	0.96	6	15.57	0	1
300N	1.1	4	13.36	0	1.33
300S	2.13	7	15.19	0	0.74
300W	2.38	8	15.25	0	1.05
CTR	2.36	6	15.68	15.41	1.22

Appendix A: Table 3-4b

REMOTS® Parameters Summary Table for the November 1993 Survey of the FVP Mound

Station	Mean RPD (cm)	Median OSI	Mean Camera Penetration (cm)	Mean Dredged Material Thickness (cm)	Boundary Roughness
100E	1.80	3.67	9.58	NA	1.40
50E	2.03	4.00	10.20	NA	0.56
100N	1.72	4.00	13.26	NA	0.72
50N	1.75	4.00	10.39	NA	1.57
100S	1.81	4.00	13.60	NA	0.47
50S	1.62	3.50	9.14	NA	0.61
100W	1.71	4.00	12.43	NA	1.69
50W	1.83	5.67	15.39	NA	0.39
CTR	1.23	2.67	9.49	NA	0.59

NA = Not analyzed.

Appendix A: Table 3-4c

REMOTS® Parameters Summary Table for the June 1991 Survey of the FVP Mound

Station	Mean RPD (cm)	Median OSI	Mean Camera Penetration (cm)	Mean Dredged Material Thickness (cm)	Boundary Roughness
100E	1.42	8	13.80	13.56	0.40
200E	2.21	10	14.31	13.56	0.70
300E	2.52	10	15.46	15.20	1.31
50E	2.16	8	14.50	14.50	1.01
100N	1.85	8	14.10	14.08	0.82
200N	1.88	10	15.20	15.34	1.29
300N	1.90	11	13.34	10.31	1.52
100S	1.04	10	13.55	13.24	0.54
200S	3.27	10	16.76	17.06	0.88
300S	2.32	9	13.44	11.09	1.90
100W	2.71	7	16.32	16.22	1.18
200W	1.50	9	11.46	11.38	1.22
300W	1.85	8	12.16	12.21	2.20
50W	2.47	4	16.31	16.33	1.21
CTR	1.89	6	15.97	16.25	0.79

Appendix A: Table 3-5

REMOTS® Parameters Summary Table for the
September 1995 Survey of the CLIS Reference Areas

Reference Area	Station	Mean RPD (cm)	Median OSI	Mean Camera Penetration (cm)	Boundary Roughness (cm)
CLIS-REF	STA1	0.76	6.5	8.93	1.16
CLIS-REF	STA2	0.62	6	8.16	0.58
CLIS-REF	STA3	0.98	3	9.73	0.42
CLIS-REF	STA4	0.83	6.5	11.74	0.47
CLIS-REF	STA5	0.93	7	11.4	0.73
2500W	STA1	1.6	7	12.92	0.71
2500W	STA2	1.37	7	13.51	0.82
2500W	STA3	1.28	7	13.68	0.99
2500W	STA4	0.82	6	13.49	0.87
4500E	STA1	1.23	7	11.67	1.23
4500E	STA2	1.13	7	13.47	0.57
4500E	STA3	1.25	8	12.66	0.52
4500E	STA4	0.89	6	11.24	0.89

APPENDIX B

REMOTS® SEDIMENT-PROFILE PHOTOGRAPHY DATA TABLES

APPENDIX B
REMOTS® SEDIMENT-PROFILE PHOTOGRAPHY DATA TABLES

Appendix B: Table 1

REMOTS® Data for the September 1995 Survey of the NHAV 93 Mound

Station	Rep	Date	Time	Successional Stage	Grain Size (phi)			Mud Clasts		Camera Penetration				Dredged Material Thickness				Redox Rebound Thickness			Apparent RPD Thickness				Methane	OSI	Surface Disturbance	Low DO	Comments
					Min	Max	Maj Mode	Number	Ave Dia	Min	Max	Range	Mean	Area	Min	Max	Mean	Min	Max	Mean	Area	Min	Max	Mean					
200E	A	08/30/95	10:14	ST_I	0	>4	>4	0	0	15.53	16.12	0.58	15.83	217.49	15.34	15.92	15.55	0.73	7.09	3.91	24.91	0.78	3.25	1.77	NO	4	BIOGENIC	NO	DM is > or = to penetration
200E	C	08/30/95	10:16	ST_I	-1	>4	>4	4	0.3	15.1	15.53	0.44	15.32	209.22	15.15	15.53	15.16	0	0	0	12.615	0.05	2.98	0.89	NO	3	IND	NO	DM is > or = to penetration
200E	D	08/30/95	06:06	ST_I	1	>4	>4	0	0	15.83	16.07	0.24	15.95	218.08	15.78	16.07	15.8	0.05	8.69	4.37	34.401	0.24	4.17	2.65	NO	5	BIOGENIC	NO	DM > or = to pen
200N	A	08/27/95	04:19	ST_I	0	>4	>4	0	0	16.94	17.72	0.78	17.33	237.17	16.75	17.62	17.15	0	0	0	15.616	0.18	1.99	1.08	NO	3	BIOGENIC	NO	DM > or = to penetration
200N	B	08/27/95	04:20	ST_I_ON_III	2	>4	>4	0	0	16.65	18.06	1.21	17.45	238.43	16.8	17.86	17.24	0.78	12.28	6.53	32.071	0.05	6.31	2.37	NO	9	BIOGENIC	NO	DM > or = to pen
200N	D	08/30/95	09:42	ST_I	0	>4	>4	0	0	20	20.73	0.73	20.37	281.79	19.9	20.83	20.26	1.89	12.62	7.31	79.253	3.64	8.01	5.8	NO	7	BIOGENIC	NO	DM > or = to penetration
200S	A	08/27/95	04:08	ST_I	2	>4	>4	0	0	17.91	18.45	0.53	18.18	250.81	17.77	18.59	17.84	0.24	7	3.62	14.092	0.1	3.25	0.99	NO	3	BIOGENIC	NO	DM is > or = to penetration
200S	B	08/27/95	04:09	ST_I	1	>4	>4	5	0.11	16.38	16.89	0.53	16.63	226.33	16.17	16.8	16.33	0	0	0	9.467	0.05	3.25	1.54	NO	4	BIOGENIC	NO	DM is > or = to penetration
200S	C	08/27/95	04:10	ST_I_ON_III	1	>4	>4	0	0	16.99	17.38	0.39	17.18	236.21	16.84	17.33	17.01	0	0	0	8.291	0.05	3.74	1.18	NO	7	IND	NO	DM is > or = to pen
200W	A	08/30/95	10:08	ST_I_ON_III	-1	>4	>4	0	0	13.64	14.17	0.53	13.91	187.88	13.45	14.03	13.61	0.78	7.96	4.37	39.729	0.1	5.87	3.01	NO	10	IND	NO	DM is > or = to penetration
200W	B	08/30/95	10:09	ST_I	-1	>4	>4	12	1	13.59	14.17	0.58	13.88	86.79	4.03	8.2	6.26	0	0	0	10.8	0.05	2.98	0.83	NO	3	PHYSICAL	NO	DM over ambient
200W	C	08/30/95	10:09	ST_I_ON_III	2	>4	>4	3	0.24	18.08	18.69	0.63	18.37	250.92	17.98	18.74	18.12	0	0	0	14.269	0.05	4.13	0.98	NO	7	IND	NO	DM is > or = to penetration
400E	A	08/27/95	04:45	ST_I_ON_III	-1	>4	>4	0	0	18.54	18.93	0.39	18.74	0	0	0	0	1.17	13.4	7.29	72.583	3.5	7.18	5.41	NO	11	BIOGENIC	NO	Relic voids?
400E	B	08/27/95	04:46	ST_I_ON_III	-1	>4	>4	0	0.94	18.64	20.34	1.7	19.49	141.46	9.81	10.49	10.23	0.53	9.95	5.24	23.154	0.87	7.04	5.05	NO	11	BIOGENIC	NO	RPD patchy
400E	C	08/27/95	04:47	ST_I	1	>4	>4	8	0.19	18.35	18.64	0.29	18.5	253.3	18.06	18.64	18.12	0.3	12.67	6.48	32.035	0.19	5.78	2.23	NO	4	IND	NO	DM > or = pen ?
400N	A	08/27/95	04:26	ST_I_ON_III	2	>4	>4	0	0	15.34	15.44	0.1	15.39	0	0	0	0	2.28	9.9	6.09	53.957	1.31	6.12	3.89	NO	11	BIOGENIC	NO	Ambient?
400N	B	08/27/95	04:26	ST_I_ON_III	2	>4	>4	7	0.43	14.51	15.24	0.73	14.88	0	0	0	0	0.05	6.12	3.08	7.902	0.05	4.13	0.6	NO	6	BIOGENIC	NO	RPD patchy
400N	C	08/27/95	04:27	ST_I_ON_III	1	>4	>4	10	0.3	14.42	15.34	0.92	14.38	0	0	0	0	0.1	11.02	5.56	9.019	0.05	4.56	1.35	NO	7	BIOGENIC	NO	Ambient
400S	A	08/27/95	04:03	ST_I_ON_III	0	>4	>4	0	0	18.54	19.17	0.63	18.85	265.33	18.59	19.08	18.5	0	0	0	25.077	0.29	3.22	1.77	NO	8	BIOGENIC	NO	DM is > or = to penetration
400S	B	08/27/95	04:04	ST_I_ON_III	-1	>4	>4	5	0.18	19.37	19.47	0.1	19.42	258.88	18.83	19.03	18.85	0	0	0	25.893	0.19	3.74	1.84	NO	8	BIOGENIC	NO	tiny voids at 3 and 7.5 cm depth
400S	C	08/27/95	04:04	ST_I_ON_III	-1	>4	>4	10	0.38	14.32	15.58	1.26	14.95	92.92	3.3	8.35	6.7	0	0	0	NA	NA	NA	NA	NO	IND	IND	NO	RPD thin
400W	A	08/30/95	10:03	ST_I_ON_III	2	>4	>4	0	0	7.14	11.26	4.13	9.2	127.3	7.18	10.92	9.14	0	0	0	NA	NA	NA	NA	NO	IND	PHYSICAL	NO	All DM?
400W	B	08/30/95	10:03	ST_I_ON_III	0	>4	>4	0	0	14.27	15.39	1.12	14.83	108.34	5.73	9.61	7.63	0	0	0	33.119	0.15	4.13	2.5	NO	9	IND	NO	
400W	C	08/30/95	10:04	ST_I	-1	>4	>4	4	0.55	14.03	14.42	0.39	14.22	170.97	11.6	12.82	12.33	0	0	0	24.428	0.05	3.93	1.72	NO	4	IND	NO	S/M
400W	D	08/30/95	05:59	ST_I_ON_III	-1	>4	>4	0	0	12.38	14.03	1.65	13.2	139.41	9.17	11.69	10.09	0	0	0	37.014	0.73	4.17	2.7	NO	9	BIOGENIC	NO	PRINT for report
600E	A	08/27/95	04:40	ST_I	-1	>4	>4	1	0.73	17.77	18.64	0.87	18.2	147.88	9.95	11.84	10.68	0.19	10.98	5.58	20.432	0.1	2.72	1.44	NO	3	IND	NO	Relict void at 10.5 cm depth
600E	B	08/27/95	04:41	ST_I	2	>4	>4	10	0.55	17.09	18.25	1.17	17.67	245.15	17.38	17.91	17.48	0.05	14.47	7.26	NA	NA	NA	NA	NO	IND	IND	NO	DM is > or = to pen
600E	C	08/27/95	04:42	ST_I	-1	>4	>4	7	0.97	18.11	18.64	0.53	18.38	253.42	17.91	18.59	18.15	0.16	14.22	7.19	5.905	0.1	0.73	0.37	NO	2	IND	NO	DM is > or = pen
600N	A	08/27/95	04:31	ST_I_ON_III	2	>4	>4	0	0	14.61	15.49	0.87	15.05	0	0	0	0	2.48	14.66	8.57	50.103	1.5	5.24	3.75	NO	10	BIOGENIC	NO	PRINT for report (ambient)
600N	B	08/27/95	04:32	ST_I_ON_III	2	>4	>4	7	0.43	13.45	13.88	0.44	13.67	0	0	0	0	0.05	10.1	5.08	7.435	0.05	1.26	0.49	NO	6	BIOGENIC	NO	Ambient
600N	C	08/27/95	04:32	ST_I_ON_III	2	>4	>4	3	0.43	12.62	13.74	1.12	13.18	0	0	0	0	12.96	12.96	12.96	41.727	0.19	5	3.24	NO	10	BIOGENIC	NO	Ambient
600S	A	08/27/95	03:52	ST_I_ON_III	1	>4	>4	0	0	13.25	14.19	0.94	13.72	0	0	0	0	0	0	0	5.571	0.05	0.79	0.36	NO	6	IND	NO	Ambient
600S	B	08/27/95	03:52	IND	0	>4	>4	0	0	13.81	15.85	2.05	14.83	123.22	6.38	9.61	8.03	0	0	0	24.007	0.1	4.17	1.81	NO	IND	IND	NO	Lg fracture at depth
600S	E	08/27/95	03:58	ST_I	-1	>4	>4	0	0	15.37	16.24	0.88	15.8	0	0	0	0	0	0	0	28.682	0.19	4.51	2.09	NO	4	IND	NO	Ambient
600W	A	08/30/95	09:54	ST_I	-1	>4	>4	0	0	14.71	15.15	0.44	14.93	0	0	0	0	0	0	0	58.414	2.43	5.58	4.48	NO	7	BIOGENIC	NO	S/M
600W	B	08/30/95	09:55	ST_I	1	>4	>4	0	0.79	15.73	16.02	0.29	15.87	0	0	0	0	0	0	0	37.329	0.1	6.36	2.76	NO	5	IND	NO	Ambient or DM?
600W	C	08/30/95	09:55	ST_I_ON_III	-1	>4	>4	0	0	15.24	15.73	0.49	15.49	0	0	0	0	0	0	0	80.509	4.27	6.75	5.76	NO	11	IND	NO	Ambient or DM?
600W	D	08/30/95	09:59	ST_I	-1	>4	>4	0	0	11.75	14.27	2.52	13.01	0	0	0	0	0	0	0	31.942	0.05	6.12	2.34	NO	5	IND	NO	Ambient or DM?
CTR	A	08/27/95	04:14	ST_I_ON_III	1	>4	>4	0	0	15.78	16.16	0.38	15.96	217.45	15.58	15.97	15.79	0	0	0	30.395	1.03	2.71	2.14	NO	8	IND	NO	DM is > or = to penetration
CTR	B	08/27/95	04:14	ST_I	-1	>4	>4	0	0	16.75	17.49	0.74	17.12	230.36	16.6	17.43	16.68	0	0	0	15.78	0.05	2.46	1.12	NO	3	BIOGENIC	NO	RPD patchy
CTR	C	08/27/95	04:15	ST_I	2	>4	>4	5	1.06	16.36	16.85	0.49	16.6	228.78	8.23	16.56	16.21	0	0	0	6.25	0.05	2.66	0.39	NO	2	IND	NO	RPD v. thin

NA = Not Available
IND = Indeterminate

Appendix B: Table 2

REMOTS® Data for the September 1995 Survey of the CLIS 94 Mound

Station	Rep	Date	Time	Successional Stage	Grain Size (phi)			Mud Clasts		Camera Penetration				Dredged Material Thickness				Redox Rebound Thickness			Apparent RPD Thickness				Methane	OSI	Surface Disturbance	Low DO	Comments
					Min	Max	Maj Mode	Number	Ave Dia	Min	Max	Range	Mean	Area	Min	Max	Mean	Min	Max	Mean	Area	Min	Max	Mean					
100E	C	08/27/95	02:51	IND	2	>4	>4	0	0	20.74	20.74	0	20.74	287.81	20.53	20.87	20.8	0	0	0	NA	NA	NA	NA	NO	IND	IND	NO	Overpenetrated, S/M
100E	D	08/30/95	09:23	IND	2	>4	4 to 3	0	0	20.74	20.74	0	20.74	237.81	16.7	17.67	16.96	0	0	0	16.95	0.74	2.51	1.32	NO	IND	IND	NO	Overpenetrated; lower 1/3 green mud
100E	E	08/30/95	09:23	IND	2	>4	>4	0	0	20.74	20.74	0	20.74	287.01	20.56	20.68	20.54	0	0	0	12.339	0.54	1.28	0.84	NO	IND	IND	NO	Overpenetrated
100E	G	08/30/95	09:25	ST_I_ON_III	2	>4	>4	0	0	20.44	20.64	0.2	20.54	277.23	20.39	20.56	20.37	0	0	0	25.357	0.15	3.55	1.87	NO	8	BIOGENIC	NO	S/M, em. void at 13 cm depth
100E	I	09/01/95	03:23	ST_III	2	>4	4 to 3	0	0	20.69	20.69	0	20.69	224.12	15.49	16.41	16	0	0	0	33.431	1.72	2.91	2.36	NO	9	IND	NO	Overpenetrated
100N	A	08/27/95	02:27	ST_I_ON_III	0	>4	>4	15	0.12	17.64	19.36	1.72	18.5	253.22	17.67	19.51	18.6	0	0	0	27.902	0.49	5.82	2.58	NO	9	BIOGENIC	NO	DM > or = pen ; v f.s. on mud; fracture at depth?
100N	B	08/27/95	02:28	ST_I_ON_III	0	>4	>4	0	0	18.67	19.21	0.54	18.94	258.41	18.54	19.17	18.41	0	0	0	8.502	0.05	0.82	0.43	NO	8	BIOGENIC	NO	RPD thin and patchy, DM > or = to pen , v.f.s over mud
100N	C	08/27/95	02:28	ST_I_ON_III	-1	>4	>4	0	0	19.46	20	0.54	19.73	272.85	0.63	19.9	19.48	0	0	0	15.787	0.06	5.76	1.12	NO	7	BIOGENIC	NO	RPD thin DM > or = to pen ; wiper artifact; void at 5.5 cm depth
100S	A	08/27/95	03:28	ST_I	1	>4	>4	0	0	18.37	19.61	1.23	18.99	260.43	13.69	19.51	18.94	0.06	15.81	7.93	15.298	0.2	2.17	1.08	NO	3	BIOGENIC	NO	S/M; DM > or = to pen ; dead gast on surface
100S	G	08/30/95	05:44	ST_I_ON_III	1	>4	>4	0	0	14.53	15.27	0.74	14.9	205.06	14.66	15.34	14.79	0	0	0	11.006	0.38	1.83	0.76	NO	7	BIOGENIC	NO	DM > or = to pen , mostly DM
100S	H	09/01/95	03:28	ST_I	2	>4	>4	8	0.74	17.59	17.93	0.34	17.76	144.25	9.95	11.55	10.56	0	0	0	34.349	2.07	3.4	2.53	NO	8	BIOGENIC	NO	S/M
100W	A	08/27/95	02:54	ST_I	1	>4	>4	0	0	20.25	20.64	0.39	20.44	285.14	15.29	20.63	20.32	0	0	0	39.828	2.81	3.35	2.84	NO	5	BIOGENIC	NO	S/M, DM is > or = pen , DM > or = to pen.
100W	B	08/27/95	02:55	ST_I	0	>4	>4	0	0	20.2	20.39	0.2	20.3	279.38	19.95	20.29	20.01	0	0	0	20.232	0.49	2.62	1.41	NO	3	BIOGENIC	NO	DM > or = to penetration depth
100W	C	08/27/95	02:56	ST_I	1	>4	>4	0	0	20.39	20.64	0.25	20.52	282.61	7.77	20.78	20.24	0	0	0	0	0	0	0	NO	-3		YES	DM > or = pen , RPD where present v thin
200E	A	08/27/95	02:44	ST_I	-1	>4	>4	0	0	20.39	20.69	0.3	20.54	285.18	20.19	20.63	20.34	0	0	0	25.475	0.34	11.03	1.9	NO	4	BIOGENIC	NO	fine sand/mud, DM > or = to penetration depth, DM in streaky layers
200E	E	08/30/95	09:28	ST_I_ON_III	3	>4	>4	0	0	19.66	20.1	0.44	19.88	281.96	19.76	20.15	19.63	0	0	0	23.694	0.99	2.86	1.65	NO	6	BIOGENIC	NO	S/M, layered, podocerid stick?
200E	F	08/30/95	09:29	ST_I	1	>4	>4	0	0	19.51	20.49	0.98	20	272.38	15.1	20.24	19.68	0	0	0	NA	NA	NA	NA	NO	IND	PHYSICAL	NO	DM > or = to pen., wiper smear obscures RPD
200N	A	08/27/95	02:33	ST_I_ON_III	0	>4	>4	0	0	16.4	16.5	0.1	16.45	121.97	8.01	9.61	8.8	0	0	0	28.372	0.44	3.55	2.25	NO	8	BIOGENIC	NO	cx f sand/blue DM/green mud
200N	B	08/27/95	02:34	ST_I_ON_III	0	>4	>4	0	0	16.99	17.29	0.3	17.14	0	0	0	0	0	0	0	12.695	0.2	7.83	3.8	NO	11	BIOGENIC	NO	f sand/ blue DM?/ green mud (ambient?), S/M/S/M
200N	D	08/30/95	09:06	ST_I_ON_III	-1	>4	>4	0	0	17.59	17.88	0.3	17.74	244.1	8.54	17.98	17.6	0	0	0	30.171	0.84	3.74	2.35	NO	8	BIOGENIC	NO	DM > or = to pen , fine sand/ mud, lg feeding voids
200S	A	08/27/95	03:34	ST_I	-1	>4	>4	20	0.68	13.89	16.45	2.56	15.17	208.45	13.5	15.78	14.87	0	0	0	0	0	0	0	NO	-3	PHYSICAL	YES	DM > or = to pen
200S	B	08/27/95	03:35	ST_I_ON_III	0	>4	>4	0	0	18.97	19.51	0.54	19.24	265.79	19.03	19.56	19.23	0.21	12.56	6.38	10.034	0.2	1.97	0.7	NO	6	BIOGENIC	NO	S/M, DM > or = to pen.; crab on surface
200S	C	08/27/95	03:35	ST_I	0	>4	>4	0	0	19.9	20.25	0.34	20.07	277.91	19.78	20.15	19.89	0	0	0	8.97	0.15	1.31	1.04	NO	-1	IND	YES	DM > or = to pen depth, RPD patchy; wiper artifact
200W	A	08/27/95	02:58	ST_I_ON_III	-1	>4	>4	0	0	19.06	19.8	0.74	19.43	234.65	16.7	17.83	16.99	0.84	10	5.42	26.89	0.99	2.91	1.87	NO	8		NO	S/M, DM (light blue
200W	B	08/27/95	02:59	ST_I_ON_III	1	>4	>4	0	0	19.7	20.2	0.49	19.95	214.81	14.43	16.99	15.56	0.1	13.8	6.95	23.151	1.12	2.38	1.65	NO	4	IND	YES	RPD patchy; DM to about 14 cm
200W	C	08/27/95	02:59	ST_I	-1	>4	>4	0	0	20	20.64	0.64	20.32	238.94	16.46	19.03	17.1	0.05	16.11	8.08	11.727	0.05	1.58	0.82	NO	3	PHYSICAL	NO	S/M
300E	A	08/27/95	02:40	ST_I	0	>4	>4	0	0	18.13	18.57	0.44	18.35	225.97	14.51	17.57	16.25	5.07	11.92	8.5	13.996	0.05	2.86	1	NO	3	BIOGENIC	NO	cx f. sand/lt blue f sand/ blue mud/ old bottom
300E	B	08/27/95	02:41	IND	-1	>4	>4	0	0	15.91	19.85	3.94	17.88	237.5	15.78	20.1	17.17	0	0	0	NA	NA	NA	NA	NO	IND	PHYSICAL	YES	DM > or = to pen depth, burrow; mud in several streaky layers red /cx/red
300E	C	08/27/95	02:42	ST_I_ON_III	0	>4	>4	1	0.56	16.75	17.29	0.54	17.02	238.81	16.69	17.57	17.02	0.1	7.29	3.69	62.163	0.1	6.8	4.76	NO	11	BIOGENIC	NO	DM > or = to pen depth, cx v f sand/ lt blue/dark blue mud
300N	A	08/27/95	03:10	ST_I_ON_III	1	>4	>4	0	0	13.74	14.68	0.94	14.21	134.96	6.45	12.12	8.71	2.36	13.94	8.15	49.963	1.82	5.17	3.7	NO	10	BIOGENIC	NO	surf v f.s and silt, mud=rebound/dark DM/ambient clay c feeding voids
300N	B	08/27/95	03:10	ST_I_ON_III	1	>4	>4	10	0.68	13.35	14.43	1.08	13.89	188.92	13.3	14.33	13.56	0	0	0	NA	NA	NA	NA	NO	IND	IND	YES	RPD patchy, most sed is DM
300N	C	08/27/95	03:11	ST_I_ON_III	1	>4	>4	0	0	10.25	11.67	1.43	10.96	135.78	4.98	11.72	9.75	0	0	0	18.286	0.05	4.48	1.31	NO	7	IND	NO	RPD patchy
300N	D	08/30/95	09:10	ST_I_ON_III	0	>4	>4	0	0	11.67	13.1	1.43	12.39	130.47	6.85	10.44	9.37	0	0	0	18.362	0.39	6.12	1.32	NO	7	BIOGENIC	NO	S/M mud is DM?
300S	A	08/27/95	02:12	ST_I	1	>4	>4	0	0	16.46	19.03	0.56	18.74	158.09	9.18	13.49	11.91	6.26	14.77	10.51	78.183	1.33	7.54	6.87	NO	7	BIOGENIC	NO	S/M, sand is v f.s ; DM > or = to pen.
300S	B	08/27/95	02:13	ST_I	2	>4	>4	0	0	20.2	20.39	0.2	20.3	102.11	5.12	10.79	7.67	0.05	13.5	6.77	13.412	0.05	7.39	3.23	NO	2	BIOGENIC	YES	S/M, RPD patchy, multiple layers
300S	F	09/01/95	03:32	ST_I_ON_III	2	>4	>4	0	0	18.62	19.31	0.69	18.97	194.38	10.05	16.8	13.81	0	0	0	40.523	1.53	3.84	2.89	NO	8	BIOGENIC	NO	S/M, middle 1/3 blue mud
300W	A	08/27/95	03:02	ST_I	1	>4	>4	0	0	14.38	18.37	3.99	16.38	96.02	5.99	10.39	7.8	1.58	7.09	4.34	11.073	0.1	5.47	2.01	NO	4	BIOGENIC	NO	S/M, lg burrow and depression, cracks at depth
300W	B	08/27/95	03:03	ST_I	-1	>4	>4	1	0.35	16.11	17.49	1.38	16.8	223.17	12.12	17.04	16.2	0.05	9.46	4.76	8.545	0.05	4.96	1.6	NO	0	IND	YES	PRD patchy, some cx silt in depression
300W	C	08/27/95	03:03	ST_I	-1	>4	>4	0	0	17.54	18.13	0.59	17.83	141.8	7.88	12.32	10.24	0.06	7.39	3.72	14.048	0.06	3.74	0.99	NO	3	BIOGENIC	NO	RPD patchy; rebound?/dark blue)/ relict ambient at depth
300W	D	08/30/95	09:17	ST_I_ON_III	-1	>4	>4	0	0	16.7	17.09	0.39	16.9	119.63	6.8	10.3	8.59	0.74	7.78	4.26	21.903	0.2	3.25	1.56	NO	8	BIOGENIC	NO	S/M, feeding voids? in lower ambient? layer
CTR	A	08/27/95	02:21	ST_I	2	>4	>4	0	0	14.09	15.57	1.48	14.83	197.46	14.33	15.57	14.31	0	0	0	8.144	0.05	1.28	0.4	NO	2	BIOGENIC	NO	v thin RPD, DM > or = to pen
CTR	B	08/27/95	02:22	ST_I	3	>4	>4	5	0.31	13.25	14.76	1.53	14.01	181.22	10	14.63	13.63	0	0	0	8.214	0.05	1.82	0.35	NO	2	PHYSICAL	NO	v.thin RPD; DM > penetration
CTR	C	08/27/95	02:23	ST_I_ON_III	2	>4	>4	0	0	14.38	14.76	0.39	14.58	198.01	14.09	14.48	14.24	0	0	0	9.418	0.05	2.17	0.64	NO	8	BIOGENIC	NO	thin RPD; most of depth is DM, multiple layers

NA = Not Available
IND = Indeterminate

Appendix B: Table 3

REMOTS® Data for the September 1995 Survey of the FVP Mound

Station	Rep	Date	Time	Successional Stage	Grain Size (phi)			Mud Clasts		Camera Penetration				Dredged Material Thickness				Redox Rebound Thickness			Apparent RPD Thickness				Methane	OSI	Surface Disturbance	Low DO	Comments
					Min	Max	Maj Mode	Number	Ave Dia	Min	Max	Range	Mean	Area	Min	Max	Mean	Min	Max	Mean	Area	Min	Max	Mean					
300S	C	09/01/95	04:54	ST_I_ON_III	-1	>4	>4	0	0	14.85	15.39	0.53	15.12	0	0	0	0	0	0	0	55.99	0.73	4.56	4.05	NO	11	BIOGENIC	NO	Classic ambient, fecal pellets on surf., tiny void
300S	D	09/01/95	04:55	ST_I_ON_III	-1	>4	>4	0	0	15.05	15.68	0.63	15.36	0	0	0	0	0	0	0	15.272	0.29	2.98	1.11	NO	7	BIOGENIC	NO	Fecal pellets at surface
300S	E	09/01/95	04:57	ST_I_ON_III	0	>4	>4	0	0	14.58	15.63	1.07	15.1	0	0	0	0	0	0	0	17.167	0.1	3.4	1.22	NO	7	BIOGENIC	NO	Fecal pellets at surface
CTR	A	09/01/95	05:35	ST_I_ON_III	-1	>4	>4	0	0	15.97	16.89	0.92	16.43	224.23	15.92	16.65	16.29	0	0	0	34.937	0.19	6.12	2.6	NO	9	BIOGENIC	NO	DM > or = to pen.; surface fecal pellets
CTR	B	09/01/95	05:38	ST_I	-1	>4	>4	0	0	16.51	16.7	0.19	16.6	223.24	16.07	16.28	16.04	0	0	0	44.354	0.39	6.26	3.23	NO	6	IND	NO	Relict void at 10.5 cm?
CTR	C	09/01/95	05:38	ST_I	-1	>4	>4	20	0.38	12.72	15.29	2.57	14.01	192.6	5.44	14.85	13.9	0	0	0	17.476	0.05	5.34	1.26	NO	3	PHYSICAL	NO	DM > or = to pen.; RPD patchy; shell lag?, disturbed, relict voids
100N	A	09/01/95	05:42	ST_I	0	>4	>4	0	0	14.66	14.95	0.29	14.81	196.55	14.22	14.66	14.37	1.07	11.6	6.34	19.6	0.05	2.26	1.41	NO	3	BIOGENIC	NO	DM > or = to penetration depth
100N	B	09/01/95	05:42	ST_I	2	>4	>4	0	0	15.53	16.02	0.48	15.78	209.73	15.15	15.73	15.37	0	0	0	5.046	0.05	0.68	0.34	NO	2	IND	NO	RPD v. thin, void in lower rt. in ambient sed ?
100N	C	09/01/95	05:43	ST_I	-1	>4	>4	3	1.11	13.35	14.13	0.78	13.74	182.38	12.91	13.83	13.33	0	0	0	8.364	0.05	1.75	0.57	NO	2	IND	NO	DM > or = to pen.; RPD v. thin; wiper smear
200N	A	09/01/95	05:48	ST_I	1	>4	>4	0	0	11.36	12.86	1.5	12.11	160.44	11.21	12.33	11.74	0	0	0	14.916	0.15	2.57	1.07	NO	3	BIOGENIC	NO	DM > or = to penetration depth
200N	B	09/01/95	05:48	ST_I_ON_III	-1	>4	>4	7	1.25	12.04	13.06	1.02	12.55	5.8	1.6	3.54	3	0	0	0	16.111	0.05	3.01	1.16	NO	7	BIOGENIC	NO	DM is large clast in top center?, ambient? large voids at depth
200N	C	09/01/95	05:49	ST_I_ON_III	1	>4	>4	4	0.81	13.25	13.84	0.58	13.54	0	0	0	0	0	0	0	13.675	0.05	4.17	0.98	NO	7	BIOGENIC	NO	Ambient
300N	A	09/01/95	05:54	ST_I	0	>4	>4	0	0	13.64	14.76	1.12	14.2	0	0	0	0	0	0	0	23.124	0.05	3.11	1.73	NO	4	BIOGENIC	NO	
300N	B	09/01/95	05:55	ST_I_ON_III	0	>4	>4	5	1.03	13.16	15.53	2.38	14.34	0	0	0	0	0	0	0	10.856	0.05	3.83	0.82	NO	7	BIOGENIC	NO	v. lg. pull-apart; camera clast on surface
300N	C	09/01/95	05:56	ST_I	0	>4	>4	4	0.16	11.31	11.8	0.49	11.55	0	0	0	0	0	0	0	10.759	0.05	3.06	0.75	NO	2	IND	NO	RPD patchy; 0 cm in places
300E	A	09/01/95	06:02	IND	-1	>4	>4	0	0	15.58	16.17	0.58	15.87	0	0	0	0	0	0	0	26.678	0.1	3.54	1.81	NO	IND	BIOGENIC	NO	
300E	B	09/01/95	06:03	ST_I_ON_III	2	>4	>4	0	0	14.51	15.78	1.26	15.15	0	0	0	0	0	0	0	5.993	0.1	0.63	0.39	NO	6	IND	NO	RPD v. thin
300E	C	09/01/95	06:04	ST_I_ON_III	1	>4	>4	0	0	15.1	16.26	1.16	15.68	0.	0	0	0	0	0	0	8.252	0.1	2.67	0.57	NO	6	BIOGENIC	NO	
200E	A	09/01/95	06:19	ST_I_ON_III	1	>4	>4	0	0	16.02	16.99	0.97	16.5	217.24	15.58	16.55	15.88	0	0	0	62.595	4.37	9.88	6.06	NO	11	BIOGENIC	NO	DM > or = to pen.; voids, large burrow in plane of image
200E	B	09/01/95	06:20	ST_I	-1	>4	>4	0	0	14.27	14.85	0.58	14.56	195.82	14.22	14.61	14.39	0	0	0	6.019	0.1	0.87	0.41	NO	2	PHYSICAL	NO	Nearly all DM, DM > or = to pen.; RPD v. thin, Mulinia shell lag
200E	C	09/01/95	06:21	ST_I	0	>4	>4	0	0	15.58	16.46	0.87	16.02	212.8	5.76	16.12	15.55	0	0	0	27.755	0.15	3.06	2.04	NO	4	BIOGENIC	NO	DM > or = to penetration depth
100E	A	09/01/95	06:30	ST_I	1	>4	>4	3	0.16	13.45	15.39	1.94	14.42	194.79	13.35	15.24	14.33	1.31	11.95	6.63	24.89	0.05	3.06	2.01	YES	2	IND	NO	DM > or = to penetration depth
100E	B	09/01/95	06:30	ST_I	2	>4	>4	5	0.61	13.06	14.13	1.07	13.59	166.85	9.81	13.83	12.22	0	0	0	5.743	0.05	0.78	0.37	NO	2	IND	NO	RPD thin, mostly DM
100E	C	09/01/95	06:31	ST_I_ON_III	2	>4	>4	3	0.25	15.44	15.92	0.49	15.68	215.79	15.19	16.12	15.4	0	0	0	12.577	0.1	2.67	0.87	YES	5	BIOGENIC	NO	nearly all DM, wiper smear; DM > or = to pen
100W	A	09/01/95	06:36	ST_I_ON_III	0	>4	>4	0	0	14.81	15.63	0.83	15.22	202.26	14.66	15.29	14.75	0	0	0	33.136	0.05	6.26	2.39	NO	9	BIOGENIC	NO	DM > or = to penetration depth
100W	B	09/01/95	06:37	ST_I	0	>4	>4	0	0	14.66	15.49	0.83	15.07	0	0	0	0	0	0	0	20.432	0.05	3.74	1.47	NO	3	BIOGENIC	NO	Worm at 10 cm depth, but no voids seen
100W	C	09/01/95	06:38	ST_I_ON_III	0	>4	>4	3	0.19	14.66	15.39	0.73	15.02	0	0	0	0	0	0	0	16.444	0.05	3.83	1.31	NO	7	IND	NO	Podocerid
200W	A	09/01/95	06:44	ST_I_ON_III	0	>4	4 to 3	0	0	12.33	13.25	0.92	12.79	108.44	2.18	9.22	7.93	0.84	7.57	4.11	19.85	0.34	3.01	1.41	NO	7	IND	NO	DM above region of feeding voids/pull-aparts?
200W	B	09/01/95	06:45	ST_I_ON_III	2	>4	>4	3	0.34	14.37	14.76	0.39	14.56	0	0	0	0	0	0	0	22.315	0.05	5.63	1.83	NO	8	BIOGENIC	NO	Crack at depth
200W	C	09/01/95	06:48	ST_I	0	>4	>4	0	0	12.43	13.01	0.58	12.72	0	0	0	0	0	0	0	17.326	0.1	3.59	1.24	NO	3	IND	NO	Wiper artifacts at surf.; crack at depth
300W	A	09/01/95	06:50	ST_I_ON_III	0	>4	>4	0	0	14.66	15.92	1.26	15.29	0	0	0	0	0	0	0	30.259	1.89	2.57	2.16	NO	8	BIOGENIC	NO	Surface pelletized
300W	B	09/01/95	06:51	ST_I	1	>4	>4	12	0.42	14.66	15.92	1.26	15.29	0	0	0	0	0	0	0	12.221	0.15	3.25	0.83	NO	3	IND	NO	Some worms at 10 cm depth, DM?
300W	C	09/01/95	06:52	ST_I_ON_III	0	>4	>4	1	0.44	14.86	15.49	0.63	15.17	0	0	0	0	0	0	0	55.419	0.44	6.36	4.06	NO	11	IND	NO	Ambient

IND = Indeterminate

Appendix B: Table 4

REMOTS® Data for the September 1995 Survey of the CLIS Reference Areas

Reference Area	Station	Rep	Date	Time	Successional Stage	Grain Size (phi)			Mud Clasts		Camera Penetration				Dredged Material Thickness				Redox Rebound Thickness			Apparent RPD Thickness				Methane	OSI	Surface Disturbance	Low DO	Comments
						Min	Max	Maj Mode	Number	Ave Dia	Min	Max	Range	Mean	Area	Min	Max	Mean	Min	Max	Mean	Area	Min	Max	Mean					
CLIS-REF	STA1	A	08/30/95	10:59	ST_I_ON_III	0	>4	>4	0	0	11.41	12.04	0.63	11.72	0	0	0	0	0	0	0	17.523	0.19	2.72	1.21	NO	7	BIOGENIC	NO	lg. burrow, polychaetes
CLIS-REF	STA1	B	08/30/95	11:00	IND	1	>4	>4	8	0.81	6.94	8.64	1.7	7.79	0	0	0	0	0	0	0	7.852	0.05	2.09	0.55	NO	IND	IND	NO	Surface eroded?, wiper artifacts?, burrow
CLIS-REF	STA1	C	08/30/95	11:01	ST_I_ON_III	0	>4	>4	4	0.44	6.7	7.87	1.16	7.28	0	0	0	0	0	0	0	7.611	0.1	1.75	0.52	NO	8	IND	NO	Sm. voids at 1 and 4.5 cm depth, patchy RPD
CLIS-REF	STA2	A	08/30/95	10:53	ST_I_ON_III	1	>4	>4	0	0	6.65	7.38	0.73	7.01	0	0	0	0	0	0	0	7.429	0.05	2.14	0.52	NO	8	BIOGENIC	NO	Burrow, small voids
CLIS-REF	STA2	B	08/30/95	10:54	ST_I_ON_III	0	>4	>4	2	0.3	8.35	8.88	0.53	8.62	0	0	0	0	0	0	0	12.015	0.05	2.28	0.84	NO	7	BIOGENIC	NO	Burrow, sm. voids, patchy RPD
CLIS-REF	STA2	C	08/30/95	10:54	ST_I	-1	>4	>4	0	0	8.59	9.08	0.49	8.84	0	0	0	0	0	0	0	7.582	0.05	1.65	0.51	NO	2	BIOGENIC	NO	RPD 0 in places
CLIS-REF	STA3	A	08/30/95	10:48	ST_I	0	>4	>4	7	0.3	9.08	9.42	0.34	9.25	0	0	0	0	0	0	0	20.018	0.19	2.23	1.42	NO	3	IND	NO	DM in center?
CLIS-REF	STA3	B	08/30/95	10:49	ST_I	1	>4	>4	3	0.32	11.51	11.99	0.48	11.75	0	0	0	0	0	0	0	8.534	0.1	0.83	0.44	NO	2	IND	NO	RPD thin; no feeding voids
CLIS-REF	STA3	C	08/30/95	10:49	ST_I	1	>4	>4	0	0	7.96	8.4	0.44	8.18	0	0	0	0	0	0	0	15.316	0.1	2.23	1.06	NO	3	IND	NO	Wiper artifacts
CLIS-REF	STA4	D	08/30/95	04:07	ST_I_ON_III	2	>4	>4	12	0.82	13.01	13.4	0.39	13.2	0	0	0	0	0	0	0	16.364	0.05	2.52	1.17	NO	7	IND	NO	
CLIS-REF	STA4	E	08/30/95	04:08	IND	-1	>4	>4	12	1.15	10.68	11.31	0.63	11	0	0	0	0	0	0	0	8.864	0.05	2.04	0.6	NO	IND	IND	NO	RPD patchy
CLIS-REF	STA4	F	08/30/95	04:08	ST_I_ON_III	1	>4	>4	0	0.47	10.83	11.21	0.39	11.02	0	0	0	0	0	0	0	10.474	0.1	1.26	0.71	NO	6	IND	NO	Surf. disturbed
CLIS-REF	STA5	E	09/01/95	04:00	ST_I_ON_III	1	>4	>4	1	0.49	10.97	11.89	0.92	11.43	0	0	0	0	0	0	0	11.695	0.05	2.57	0.83	NO	7	IND	NO	RPD 0 in places, burrow on rt., dark mud is DM?
CLIS-REF	STA5	G	09/01/95	04:01	ST_I_ON_III	0	>4	>4	3	0.59	10.05	10.58	0.53	10.32	0	0	0	0	0	0	0	NA	NA	NA	NA	NO	IND	IND	NO	Wiper artifacts, void at depth
CLIS-REF	STA5	H	09/01/95	04:02	ST_I_ON_III	0	>4	>4	0	0	12.09	12.82	0.73	12.45	0	0	0	0	0	0	0	14.104	0.05	1.75	1.02	NO	7	IND	NO	Burrows and feeding void, variable RPD
2500W	STA1	D	08/30/95	08:25	ST_I_ON_III	-1	>4	>4	0	0	13.65	14.19	0.54	13.92	0	0	0	0	0	0	0	32.764	0.2	6.01	2.4	NO	9	BIOGENIC	NO	Ambient; mud at depth mottled; filled in feeding void?
2500W	STA1	E	08/30/95	08:26	ST_III	1	>4	>4	0	0	12.17	12.96	0.79	12.56	0	0	0	0	0	0	0	16.108	0.05	3	1.12	NO	7	BIOGENIC	NO	Lg. voids below 9 cm, 1 wiper art.; no st. I's seen, ambient
2500W	STA1	F	08/30/95	08:27	ST_I_ON_III	0	>4	>4	1	3.37	11.87	12.66	0.79	12.27	0	0	0	0	0	0	0	18.259	0.2	3.99	1.28	NO	7	IND	NO	RPD thin, red. sed. nearly at surf., lg. voids at depth, ambie
2500W	STA2	D	08/30/95	08:33	ST_I_ON_III	1	>4	>4	1	3.37	13.99	14.98	0.99	14.48	0	0	0	0	0	0	0	26.872	0.64	3.99	1.93	NO	8	BIOGENIC	NO	Ambient
2500W	STA2	E	08/30/95	08:33	ST_I_ON_III	-1	>4	>4	0	0	13.55	13.99	0.44	13.77	0	0	0	0	0	0	0	12.162	0.15	3.55	0.67	NO	7	IND	NO	RPD thin and patchy, large voids at depth; pull-aparts?
2500W	STA2	F	08/30/95	08:34	ST_III	-1	>4	>4	0	0	11.77	12.81	1.03	12.29	0	0	0	0	0	0	0	18.759	0.3	2.56	1.32	NO	7	IND	NO	Large void at depth (?), ambient
2500W	STA3	D	08/30/95	08:38	ST_I_ON_III	0	>4	>4	0	0	13	14.48	1.48	13.74	0	0	0	0	0	0	0	28.264	0.05	3.98	2.07	NO	8	BIOGENIC	NO	Ambient
2500W	STA3	E	08/30/95	08:39	ST_I	-1	>4	>4	0	0	13.05	13.69	0.64	13.37	0	0	0	0	0	0	0	10.046	0.05	2.22	0.7	NO	2	IND	NO	RPD thin and patchy; ambient
2500W	STA3	F	08/30/95	08:40	ST_I_ON_III	-1	>4	>4	2	0.18	13.5	14.34	0.84	13.92	0	0	0	0	0	0	0	14.999	0.05	3.6	1.07	NO	7	IND	NO	Large fracture at bottom, ambient
2500W	STA4	D	08/30/95	08:45	ST_I_ON_III	1	>4	>4	0	0	14.08	14.33	0.25	14.21	0	0	0	0	0	0	0	22.17	0.2	3.15	1.55	NO	8	BIOGENIC	NO	Large fracture at bottom; ambient
2500W	STA4	E	08/30/95	08:45	ST_I_ON_III	-1	>4	>4	0	0	12.66	14.04	1.38	13.35	0	0	0	0	0	0	0	7.304	0.05	1.87	0.49	NO	6	IND	NO	RPD thin and patchy, shell lag, ambient
2500W	STA4	F	08/30/95	08:46	ST_I_ON_III	-1	>4	>4	5	0.63	12.41	13.4	0.99	12.91	0	0	0	0	0	0	0	5.165	0.05	1.48	0.43	NO	2	IND	YES	RPD patchy; erosional (?), wiper smear
4500E	STA1	D	09/01/95	04:31	ST_I_ON_III	0	>4	>4	0	0	10.63	12.33	1.7	11.48	0	0	0	0	0	0	0	28.361	0.53	3.83	2.05	NO	8	BIOGENIC	NO	Ambient
4500E	STA1	E	09/01/95	04:32	ST_I	2	>4	>4	0	0	8.88	9.37	0.49	9.13	0	0	0	0	0	0	0	9.17	0.1	1.5	0.61	NO	2	BIOGENIC	NO	Patchy RPD; thin blue RSOI covering ox. v f sand, biogenic
4500E	STA1	F	09/01/95	04:32	ST_I_ON_III	-1	>4	>4	15	0.67	12.77	14.32	1.55	13.54	0	0	0	0	0	0	0	14.49	0.15	3.88	1.04	NO	7	BIOGENIC	NO	Ambient
4500E	STA1	G	09/01/95	04:33	IND	0	>4	>4	10	0.67	11.94	13.11	1.17	12.53	0	0	0	0	0	0	0	NA	NA	NA	NA	NO	IND	BIOGENIC	NO	Wiper smear over profile
4500E	STA2	D	09/01/95	04:26	ST_II	1	>4	>4	20	0.24	12.38	12.82	0.44	12.6	0	0	0	0	0	0	0	17.77	0.05	2.91	1.25	NO	5	BIOGENIC	NO	Podocerid?
4500E	STA2	E	09/01/95	04:27	ST_III	-1	>4	>4	1	0.43	14.42	15.15	0.73	14.78	0	0	0	0	0	0	0	16.138	0.05	3.79	1.28	NO	7	BIOGENIC	NO	
4500E	STA2	F	09/01/95	04:27	ST_I_ON_III	0	>4	>4	5	0.58	12.77	13.3	0.53	13.03	0	0	0	0	0	0	0	12.465	0.05	3.11	0.86	NO	7	BIOGENIC	NO	RPD thin and patchy
4500E	STA3	D	09/01/95	04:21	ST_I_ON_III	-1	>4	>4	5	0.38	12.43	13.11	0.68	12.77	0	0	0	0	0	0	0	21.862	0.05	3.25	1.6	NO	8	BIOGENIC	NO	
4500E	STA3	E	09/01/95	04:21	ST_I_ON_III	-1	>4	>4	3	0.6	13.54	14.18	0.63	13.86	0	0	0	0	0	0	0	11.158	0.05	4.37	1.78	NO	8	BIOGENIC	NO	
4500E	STA3	F	09/01/95	04:22	ST_I	-1	>4	>4	10	0.61	11.21	11.46	0.24	11.34	0	0	0	0	0	0	0	5.316	0.05	0.63	0.38	NO	2	IND	NO	RPD v. thin, erosional?
4500E	STA4	D	09/01/95	04:38	ST_I_ON_III	1	>4	>4	5	0.18	11.07	11.99	0.92	11.53	0	0	0	0	0	0	0	9.909	0.05	1.65	0.69	NO	8	BIOGENIC	NO	
4500E	STA4	E	09/01/95	04:39	ST_I_ON_III	1	>4	>4	10	0.24	9.76	10.83	1.07	10.29	0	0	0	0	0	0	0	20.482	0.05	3.4	1.42	NO	7	IND	NO	
4500E	STA4	F	09/01/95	04:39	ST_I	1	>4	>4	0	0	11.55	12.23	0.68	11.89	0	0	0	0	0	0	0	8.373	0.05	1.94	0.57	NO	2	IND	NO	RPD thin

NA = Not Available
IND = Indeterminate

APPENDIX C

GEOTECHNICAL CORE DESCRIPTIONS

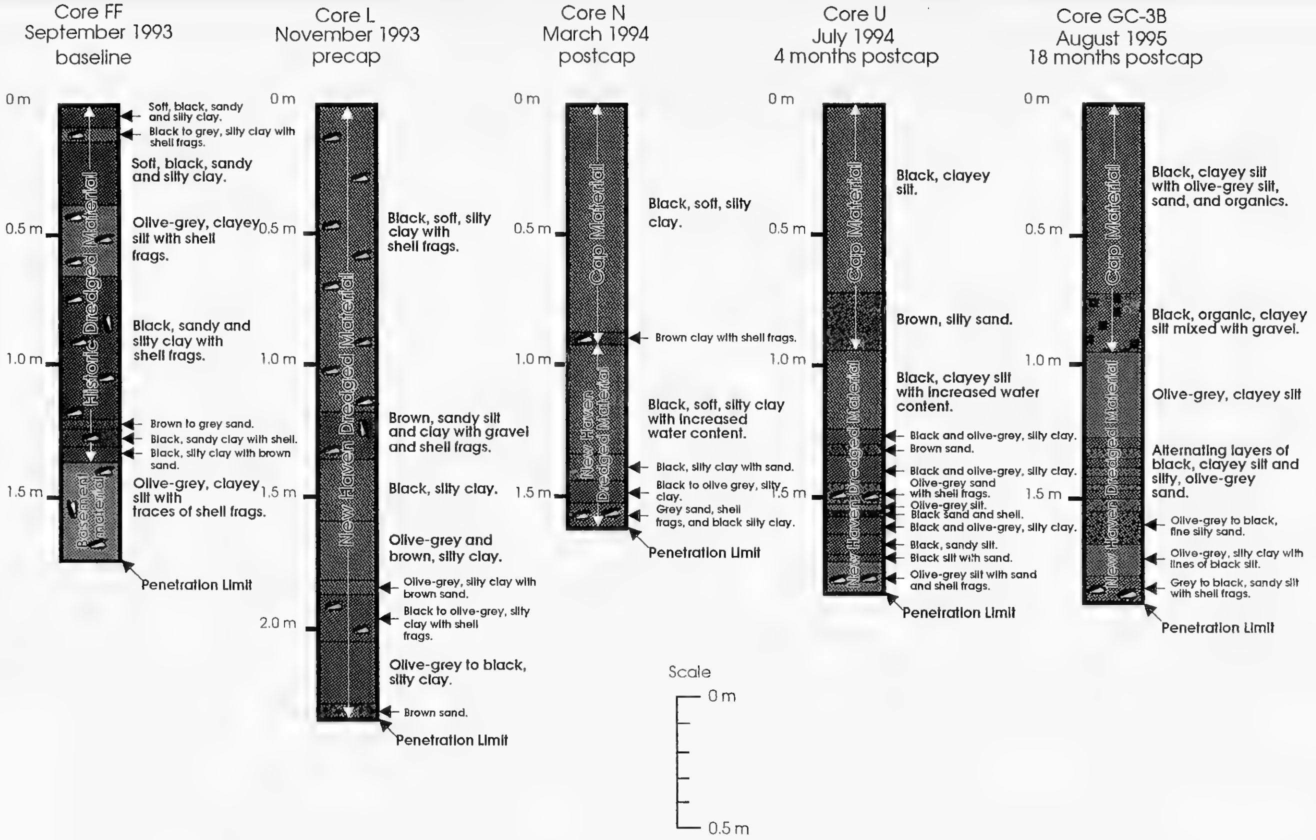
APPENDIX C
GEOTECHNICAL CORE DESCRIPTIONS

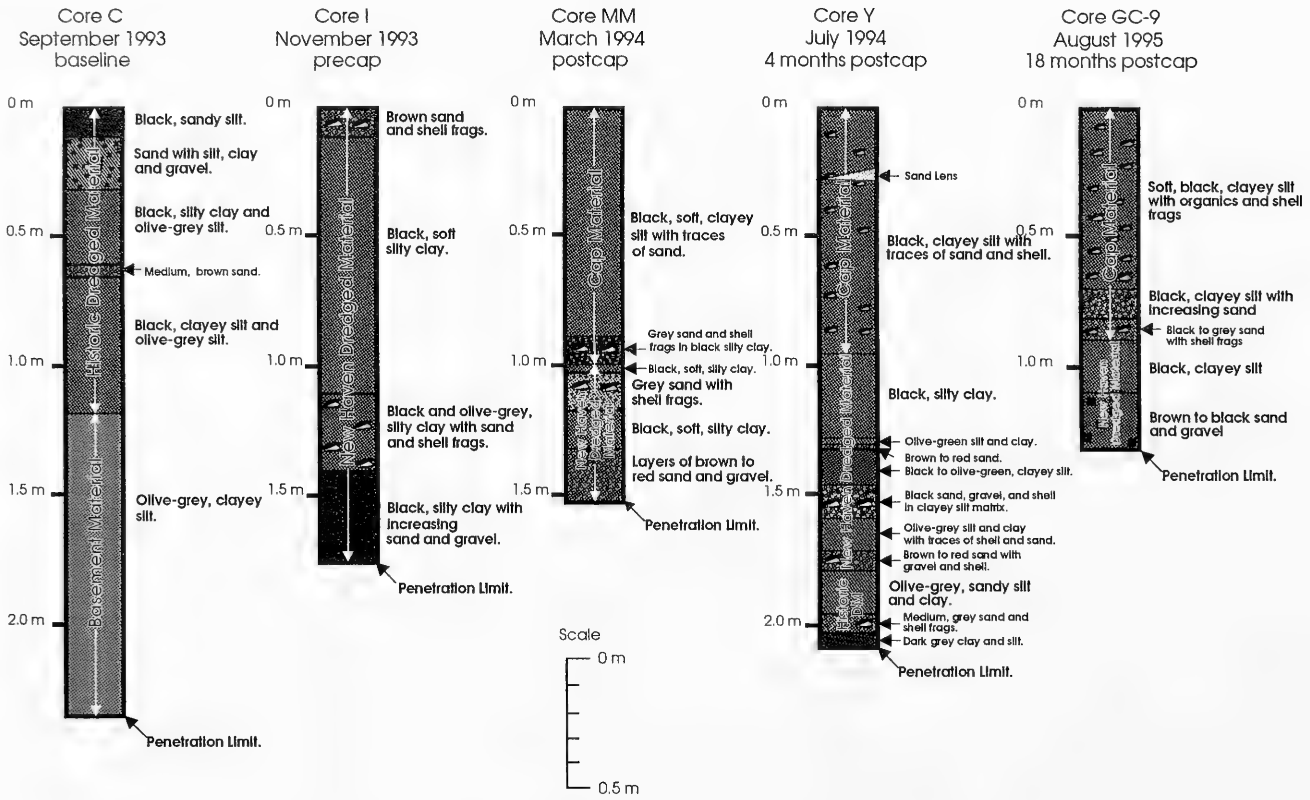
Table 1. Breakdown of the Five-member Geotechnical Core Data Set Collected over the NHAV 93 Mound

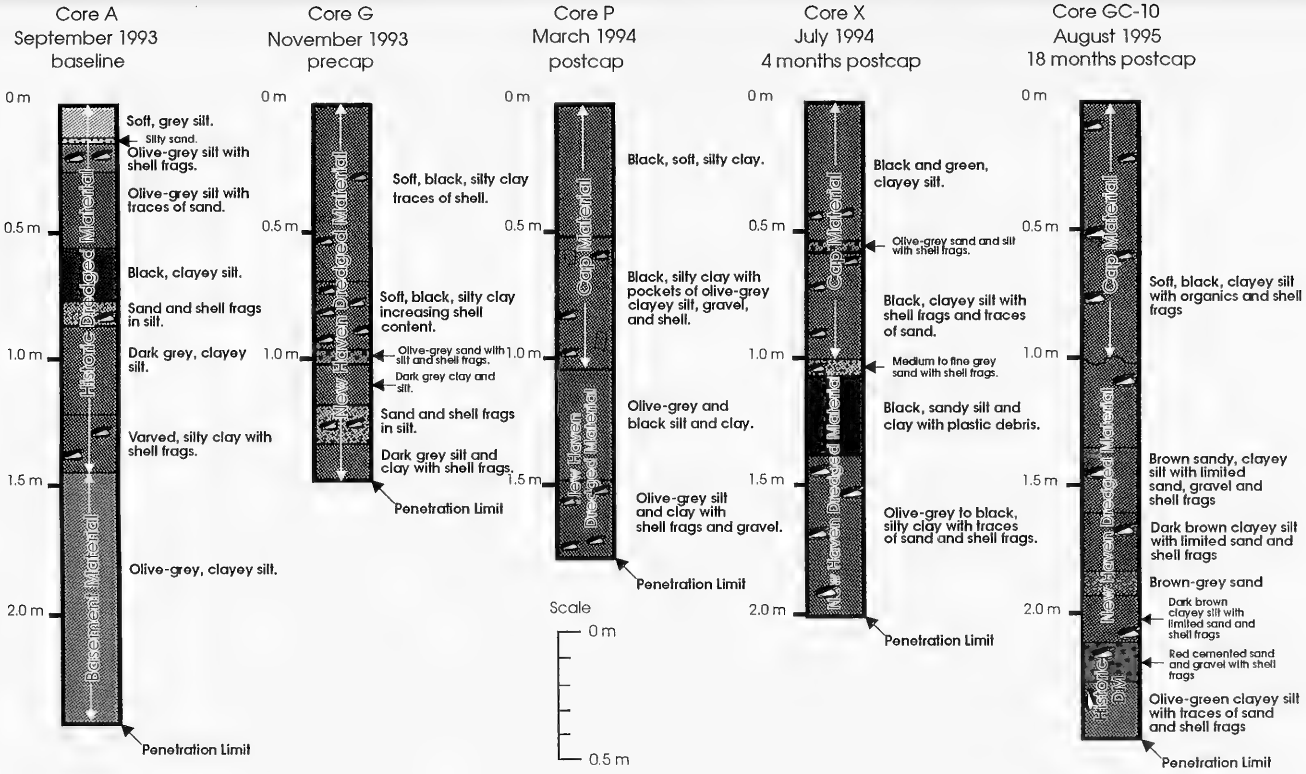
Appendix C: Table 1

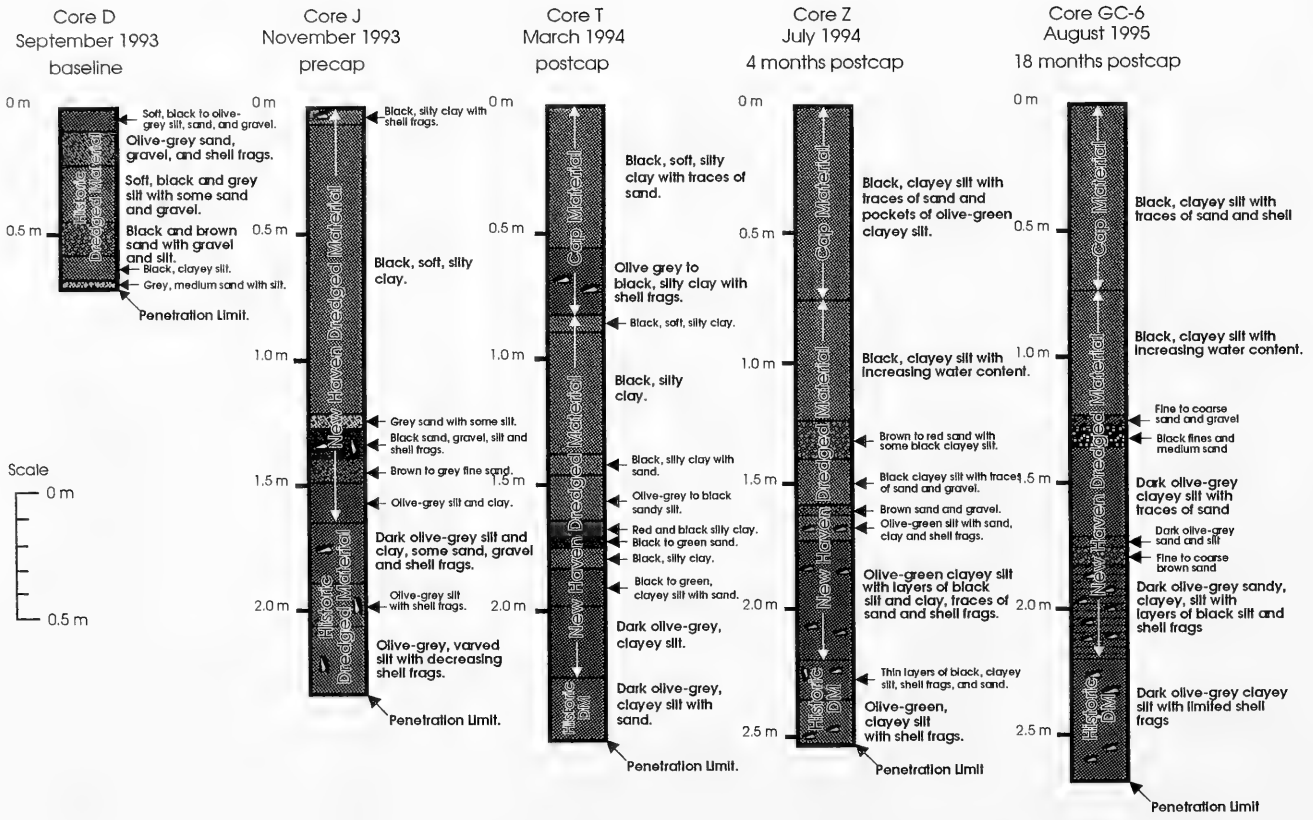
Breakdown of the Five-member Geotechnical Core Data Set Collected over the NHAV 93 Mound

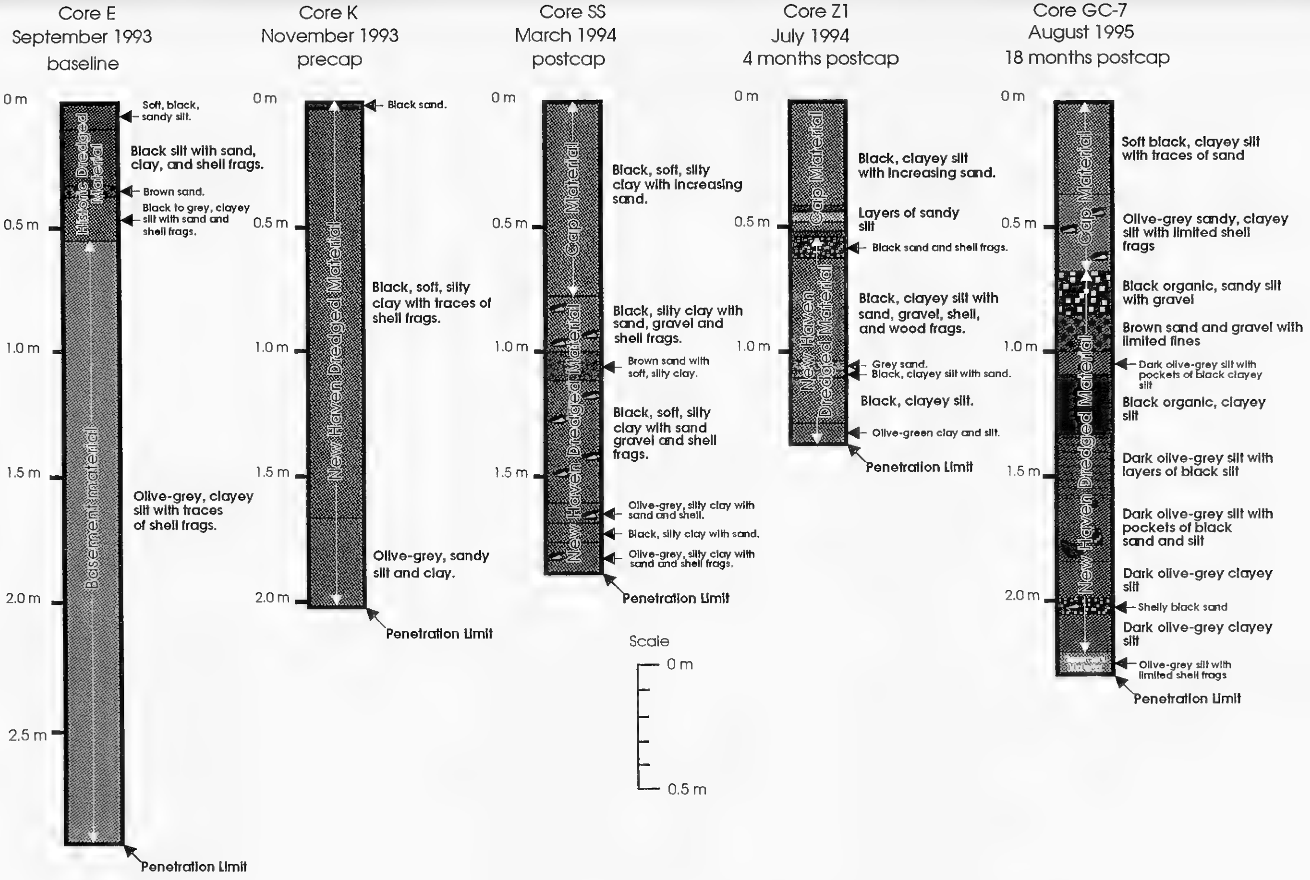
Station	Baseline 9/21/93	Precap 11/10/93	Postcap 3/15/94	July 1994 7/18/94	September 1995 8/29/95
Center	Core FF	Core L	Core N	Core U	Core GC-3B
Northeast	Core C	Core I	Core MM	Core Y	Core GC-9
Northeast Flank			Core R	Core W	Core GC-11
Southwest	Core A	Core G	Core P	Core X	Core GC-10
Southwest Flank			Core Q	Core V	Core GC-5
Northwest	Core D	Core J	Core T	Core Z	Core GC-6
Southeast	Core E	Core K	Core SS	Core Z1	Core GC-7
Off mound	Core B	Core H			

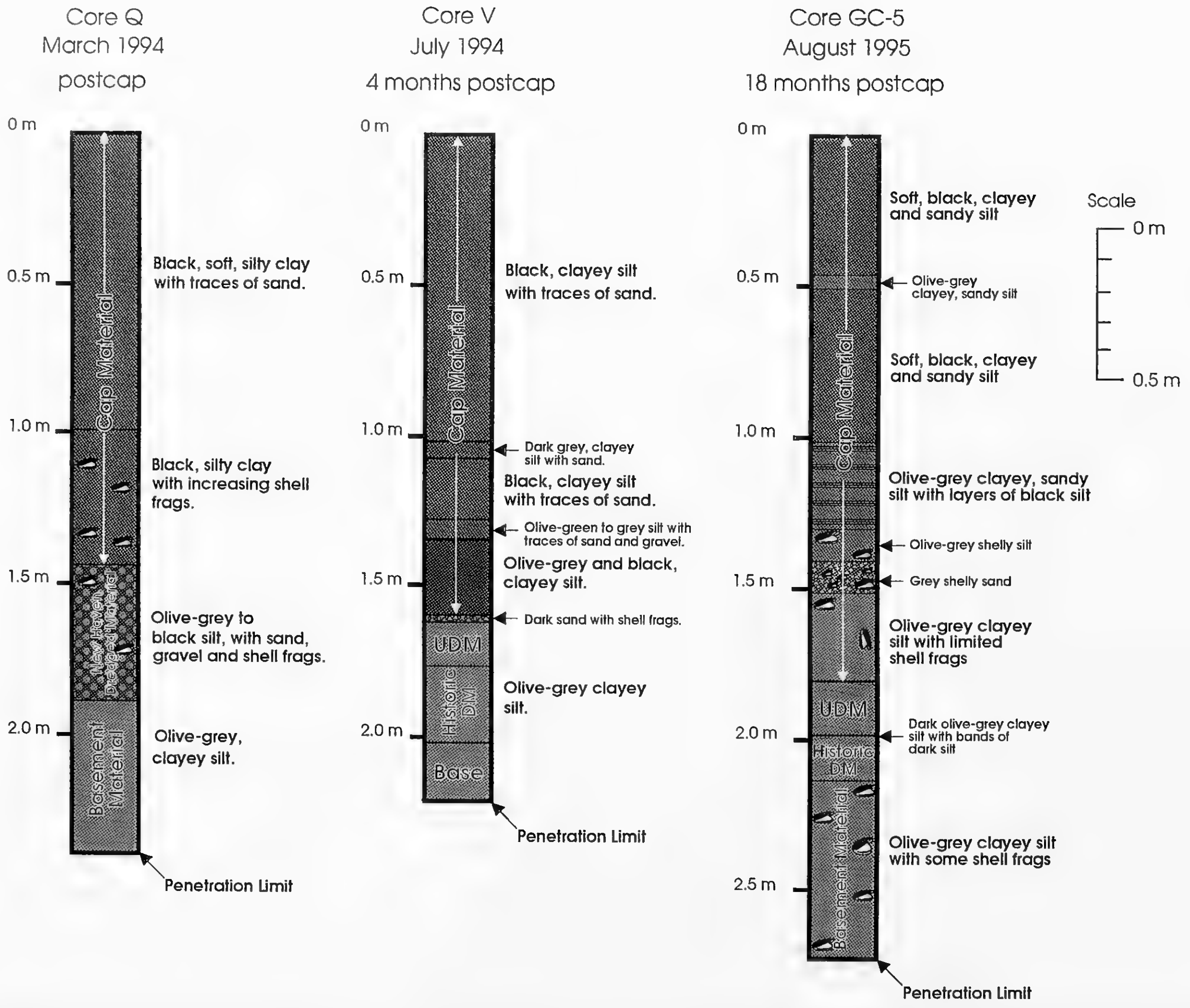

Core FF
September 1993
baseline
0 m
0.5 m
1.0 m
1.5 m
Historic Dredged Material
Basement material
Soft, black, sandy and silty clay.
Black to grey, silty clay with shell frags.
Soft, black, sandy and silty clay.
Olive-grey, clayey silt with shell frags.
Black, sandy and silty clay with shell frags.
Brown to grey sand.
Black, sandy clay with shell.
Black, silty clay with brown sand.
Olive-grey, clayey silt with traces of shell frags.
Penetration Limit
Core L
November 1993
precap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
New Haven Dredged Material
Black, soft, silty clay with shell frags.
Brown, sandy silt and clay with gravel and shell frags.
Black, silty clay.
Olive-grey and brown, silty clay.
Olive-grey, silty clay with brown sand.
Black to olive-grey, silty clay with shell frags.
Olive-grey to black, silty clay.
Brown sand.
Penetration Limit
Core N
March 1994
postcap
0 m
0.5 m
1.0 m
1.5 m
Cap Material
New Haven Dredged Material
Black, soft, silty clay.
Brown clay with shell frags.
Black, soft, silty clay with increased water content.
Black, silty clay with sand.
Black to olive grey, silty clay.
Grey sand, shell frags, and black silty clay.
Penetration Limit
Core U
July 1994
4 months postcap
0 m
0.5 m
1.0 m
1.5 m
Cap Material
New Haven Dredged Material
Black, clayey silt.
Brown, silty sand.
Black, clayey silt with increased water content.
Black and olive-grey, silty clay.
Brown sand.
Black and olive-grey, silty clay.
Olive-grey sand with shell frags.
Olive-grey silt.
Black sand and shell.
Black and olive-grey, silty clay.
Black, sandy silt.
Black silt with sand.
Olive-grey silt with sand and shell frags.
Penetration Limit
Core GC-3B
August 1995
18 months postcap
0 m
0.5 m
1.0 m
1.5 m
Cap Material
New Haven Dredged Material
Black, clayey silt with olive-grey silt, sand, and organics.
Black, organic, clayey silt mixed with gravel.
Olive-grey, clayey silt
Alternating layers of black, clayey silt and silty, olive-grey sand.
Olive-grey to black, fine silty sand.
Olive-grey, silty clay with lines of black silt.
Grey to black, sandy silt with shell frags.
Penetration Limit
Scale
0 m
0.5 m

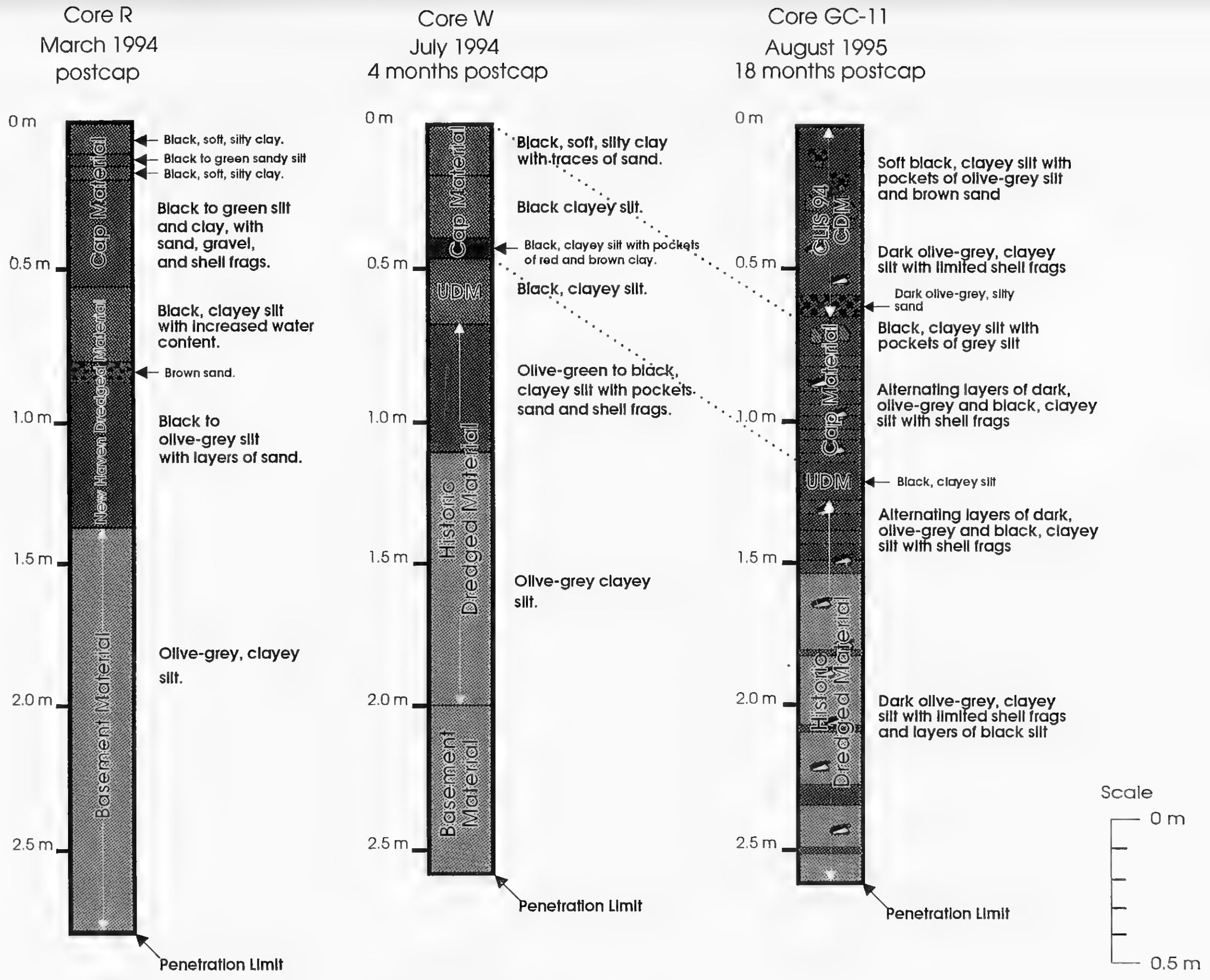

Core C
September 1993
baseline
0 m
0.5 m
1.0 m
1.5 m
2.0 m
Historic Dredged Material
Basement Material
Black, sandy silt.
Sand with silt, clay and gravel.
Black, silty clay and olive-grey silt.
Medium, brown sand.
Black, clayey silt and olive-grey silt.
Olive-grey, clayey silt.
Penetration Limit.
Core I
November 1993
precap
New Haven Dredged Material
Brown sand and shell frags.
Black, soft silty clay.
Black and olive-grey, silty clay with sand and shell frags.
Black, silty clay with increasing sand and gravel.
Penetration Limit.
Core MM
March 1994
postcap
Cap Material
New Haven Dredged Material
Black, soft, clayey silt with traces of sand.
Grey sand and shell frags in black silty clay.
Black, soft, silty clay.
Grey sand with shell frags.
Black, soft, silty clay.
Layers of brown to red sand and gravel.
Penetration Limit.
Core Y
July 1994
4 months postcap
Cap Material
New Haven Dredged Material
Historic DM
Sand Lens
Black, clayey silt with traces of sand and shell.
Black, silty clay.
Olive-green silt and clay.
Brown to red sand.
Black to olive-green, clayey silt.
Black sand, gravel, and shell in clayey silt matrix.
Olive-grey silt and clay with traces of shell and sand.
Brown to red sand with gravel and shell.
Olive-grey, sandy silt and clay.
Medium, grey sand and shell frags.
Dark grey clay and silt.
Penetration Limit.
Core GC-9
August 1995
18 months postcap
Cap Material
New Haven Dredged Material
Soft, black, clayey silt with organics and shell frags
Black, clayey silt with increasing sand
Black to grey sand with shell frags
Black, clayey silt
Brown to black sand and gravel
Penetration Limit.
Scale
0 m
0.5 m


Core A
September 1993
baseline
0 m
0.5 m
1.0 m
1.5 m
2.0 m
Historic Dredged Material
Basement Material
Soft, grey silt.
Silty sand.
Olive-grey silt with shell frags.
Olive-grey silt with traces of sand.
Black, clayey silt.
Sand and shell frags in silt.
Dark grey, clayey silt.
Varved, silty clay with shell frags.
Olive-grey, clayey silt.
Penetration Limit
Core G
November 1993
precap
0 m
0.5 m
1.0 m
New Haven Dredged Material
Soft, black, silty clay traces of shell.
Soft, black, silty clay increasing shell content.
Olive-grey sand with silt and shell frags.
Dark grey clay and silt.
Sand and shell frags in silt.
Dark grey silt and clay with shell frags.
Penetration Limit
Core P
March 1994
postcap
0 m
0.5 m
1.0 m
1.5 m
Cap Material
New Haven Dredged Material
Black, soft, silty clay.
Black, silty clay with pockets of olive-grey clayey silt, gravel, and shell.
Olive-grey and black silt and clay.
Olive-grey silt and clay with shell frags and gravel.
Penetration Limit
Scale
0 m
0.5 m
Core X
July 1994
4 months postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
Cap Material
New Haven Dredged Material
Black and green, clayey silt.
Olive-grey sand and silt with shell frags.
Black, clayey silt with shell frags and traces of sand.
Medium to fine grey sand with shell frags.
Black, sandy silt and clay with plastic debris.
Olive-grey to black, silty clay with traces of sand and shell frags.
Penetration Limit
Core GC-10
August 1995
18 months postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
Cap Material
New Haven Dredged Material
Historic D.M.
Soft, black, clayey silt with organics and shell frags
Brown sandy, clayey silt with limited sand, gravel and shell frags
Dark brown clayey silt with limited sand and shell frags
Brown-grey sand
Dark brown clayey silt with limited sand and shell frags
Red cemented sand and gravel with shell frags
Olive-green clayey silt with traces of sand and shell frags
Penetration Limit


Core D
September 1993
baseline
0 m
0.5 m
Historic Dredged Material
Soft, black to olive-grey silt, sand, and gravel.
Olive-grey sand, gravel, and shell frags.
Soft, black and grey silt with some sand and gravel.
Black and brown sand with gravel and silt.
Black, clayey silt.
Grey, medium sand with silt.
Penetration Limit.
Scale
0 m
0.5 m
Core J
November 1993
precap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
New Haven Dredged Material
Historic Dredged Material
Black, silty clay with shell frags.
Black, soft, silty clay.
Grey sand with some silt.
Black sand, gravel, silt and shell frags.
Brown to grey fine sand.
Olive-grey silt and clay.
Dark olive-grey silt and clay, some sand, gravel and shell frags.
Olive-grey silt with shell frags.
Olive-grey, varved silt with decreasing shell frags.
Penetration Limit.
Core T
March 1994
postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
Cap Material
New Haven Dredged Material
Historic DM
Black, soft, silty clay with traces of sand.
Olive grey to black, silty clay with shell frags.
Black, soft, silty clay.
Black, silty clay.
Black, silty clay with sand.
Olive-grey to black sandy silt.
Red and black silty clay.
Black to green sand.
Black, silty clay.
Black to green, clayey silt with sand.
Dark olive-grey, clayey silt.
Dark olive-grey, clayey silt with sand.
Penetration Limit.
Core Z
July 1994
4 months postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
2.5 m
Cap Material
New Haven Dredged Material
Historic DM
Black, clayey silt with traces of sand and pockets of olive-green clayey silt.
Black, clayey silt with increasing water content.
Brown to red sand with some black clayey silt.
Black clayey silt with traces of sand and gravel.
Brown sand and gravel.
Olive-green silt with sand, clay and shell frags.
Olive-green clayey silt with layers of black silt and clay, traces of sand and shell frags.
Thin layers of black, clayey silt, shell frags, and sand.
Olive-green, clayey silt with shell frags.
Penetration Limit
Core GC-6
August 1995
18 months postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
2.5 m
Cap Material
New Haven Dredged Material
Historic DM
Black, clayey silt with traces of sand and shell
Black, clayey silt with increasing water content.
Fine to coarse sand and gravel
Black fines and medium sand
Dark olive-grey clayey silt with traces of sand
Dark olive-grey sand and silt
Fine to coarse brown sand
Dark olive-grey sandy, clayey, silt with layers of black silt and shell frags
Dark olive-grey clayey silt with limited shell frags
Penetration Limit


Core E
September 1993
baseline
0 m
0.5 m
1.0 m
1.5 m
2.0 m
2.5 m
Historic Dredged Material
Basement material
Soft, black, sandy silt.
Black silt with sand, clay, and shell frags.
Brown sand.
Black to grey, clayey silt with sand and shell frags.
Olive-grey, clayey silt with traces of shell frags.
Penetration Limit
Core K
November 1993
precap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
New Haven Dredged Material
Black sand.
Black, soft, silty clay with traces of shell frags.
Olive-grey, sandy silt and clay.
Penetration Limit
Core SS
March 1994
postcap
0 m
0.5 m
1.0 m
1.5 m
Cap Material
New Haven Dredged Material
Black, soft, silty clay with increasing sand.
Black, silty clay with sand, gravel and shell frags.
Brown sand with soft, silty clay.
Black, soft, silty clay with sand gravel and shell frags.
Olive-grey, silty clay with sand and shell.
Black, silty clay with sand.
Olive-grey, silty clay with sand and shell frags.
Penetration Limit
Scale
0 m
0.5 m
Core Z1
July 1994
4 months postcap
0 m
0.5 m
1.0 m
Cap Material
New Haven Dredged Material
Black, clayey silt with increasing sand.
Layers of sandy silt
Black sand and shell frags.
Black, clayey silt with sand, gravel, shell, and wood frags.
Grey sand.
Black, clayey silt with sand.
Black, clayey silt.
Olive-green clay and silt.
Penetration Limit
Core GC-7
August 1995
18 months postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
Cap Material
New Haven Dredged Material
Soft black, clayey silt with traces of sand
Olive-grey sandy, clayey silt with limited shell frags
Black organic, sandy silt with gravel
Brown sand and gravel with limited fines
Dark olive-grey silt with pockets of black clayey silt
Black organic, clayey silt
Dark olive-grey silt with layers of black silt
Dark olive-grey silt with pockets of black sand and silt
Dark olive-grey clayey silt
Shelly black sand
Dark olive-grey clayey silt
Olive-grey silt with limited shell frags
Penetration Limit


Core Q
March 1994
postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
Cap Material
New Haven Dredged Material
Basement Material
Black, soft, silty clay with traces of sand.
Black, silty clay with increasing shell frags.
Olive-grey to black silt, with sand, gravel and shell frags.
Olive-grey, clayey silt.
Penetration Limit
Core V
July 1994
4 months postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
Cap Material
UDM
Historic DM
Base
Black, clayey silt with traces of sand.
Dark grey, clayey silt with sand.
Black, clayey silt with traces of sand.
Olive-green to grey silt with traces of sand and gravel.
Olive-grey and black, clayey silt.
Dark sand with shell frags.
Olive-grey clayey silt.
Penetration Limit
Core GC-5
August 1995
18 months postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
2.5 m
Cap Material
UDM
Historic DM
Basement Material
Soft, black, clayey and sandy silt
Olive-grey clayey, sandy silt
Soft, black, clayey and sandy silt
Olive-grey clayey, sandy silt with layers of black silt
Olive-grey shelly silt
Grey shelly sand
Olive-grey clayey silt with limited shell frags
Dark olive-grey clayey silt with bands of dark silt
Olive-grey clayey silt with some shell frags
Penetration Limit
Scale
0 m
0.5 m


Core R
March 1994
postcap
Core W
July 1994
4 months postcap
Core GC-11
August 1995
18 months postcap
0 m
0.5 m
1.0 m
1.5 m
2.0 m
2.5 m
Cap Material
New Haven Dredged Material
Basement Material
Black, soft, silty clay.
Black to green sandy silt
Black, soft, silty clay.
Black to green silt and clay, with sand, gravel, and shell frags.
Black, clayey silt with increased water content.
Brown sand.
Black to olive-grey silt with layers of sand.
Olive-grey, clayey silt.
Penetration Limit
Cap Material
UDM
Historic Dredged Material
Basement Material
Black, soft, silty clay with traces of sand.
Black clayey silt.
Black, clayey silt with pockets of red and brown clay.
Black, clayey silt.
Olive-green to black, clayey silt with pockets sand and shell frags.
Olive-grey clayey silt.
Penetration Limit
CLIS 94 CDM
Cap Material
UDM
Historic Dredged Material
Soft black, clayey silt with pockets of olive-grey silt and brown sand
Dark olive-grey, clayey silt with limited shell frags
Dark olive-grey, silty sand
Black, clayey silt with pockets of grey silt
Alternating layers of dark, olive-grey and black, clayey silt with shell frags
Black, clayey silt
Alternating layers of dark, olive-grey and black, clayey silt with shell frags
Dark olive-grey, clayey silt with limited shell frags and layers of black silt
Penetration Limit
Scale
0 m
0.5 m

APPENDIX D

DAMOS DISPOSAL LOG TABLES

APPENDIX D
DAMOS DISPOSAL LOG TABLES

Table 1. UDM Disposal Activity over the CLIS 94 Mound

Table 2. CDM Disposal Activity over the CLIS 94 Mound

Appendix D: Table 1

UDM Disposal Activity over the CLIS 94 Mound

permittee	project	disparea	dispdate	wtd	xtd	ytd	ztd	latdeg	latmin	longdeg	longmin	cyvol
TALLAMDGE BROTHERS	NORWALK HARBOR	CLIS	10-Dec-94	0	26547.3	44001.7	0	41	9.337	72	53.115	800
TALLAMDGE BROTHERS	NORWALK HARBOR	CLIS	11-Dec-94	0	26547.4	44001.7	0	41	9.334	72	53.128	900
TALLAMDGE BROTHERS	NORWALK HARBOR	CLIS	12-Dec-94	0	26547.5	44001.7	0	41	9.332	72	53.14	900
TALLAMDGE BROTHERS	NORWALK HARBOR	CLIS	13-Dec-94	0	26548.4	44001.8	0	41	9.322	72	53.246	900
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	30-Nov-94	15045.1	0	44001.9	0	41	9.33	72	53.267	6000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	01-Dec-94	15044.8	0	44001.5	0	41	9.294	72	53.207	4500
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	01-Dec-94	15044.2	0	44001.8	0	41	9.345	72	53.133	3000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	02-Dec-94	15044.2	0	44001.8	0	41	9.345	72	53.133	5000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	02-Dec-94	15044.3	0	44001.8	0	41	9.342	72	53.147	2300
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	02-Dec-94	15045.4	0	44001.5	0	41	9.277	72	53.294	6000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	02-Dec-94	15043.7	0	44002	0	41	9.382	72	53.068	4300
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	03-Dec-94	15043.8	0	44001.7	0	41	9.346	72	53.071	5000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	03-Dec-94	15044.3	0	44001.6	0	41	9.32	72	53.139	2300
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	03-Dec-94	15044.1	0	44001.8	0	41	9.348	72	53.118	5000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	03-Dec-94	15044.3	0	44001.7	0	41	9.331	72	53.143	2800
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	04-Dec-94	15044	0	44001.8	0	41	9.351	72	53.104	4300
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	04-Dec-94	15044.2	0	44001.6	0	41	9.323	72	53.125	2500
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	04-Dec-94	15044.4	0	44001.5	0	41	9.306	72	53.15	6000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	04-Dec-94	15044.3	0	44001.5	0	41	9.309	72	53.135	2000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	05-Dec-94	15044.6	0	44001.7	0	41	9.322	72	53.186	6000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	05-Dec-94	15045.8	0	44001.7	0	41	9.288	72	53.36	4000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	05-Dec-94	15043.6	0	44000.7	0	41	9.239	72	53.002	6500
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	06-Dec-94	15044.1	0	44001.7	0	41	9.337	72	53.114	4000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	06-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	6600
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	06-Dec-94	15044.5	0	44001.6	0	41	9.314	72	53.168	4000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	07-Dec-94	15044.3	0	44001.6	0	41	9.32	72	53.139	6600
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	07-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	4000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	07-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	6000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	08-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	4000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	08-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	3800
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	08-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	4500
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	09-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	6600
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	09-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	4800
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	10-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	5800
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	10-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	4400
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	11-Dec-94	15044.4	0	44001.5	0	41	9.306	72	53.15	6500
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	11-Dec-94	15044	0	44001.6	0	41	9.329	72	53.096	4000
CITY OF NEW HAVEN	LONG WHARF PIER	CLIS	12-Dec-94	15044.3	0	44001.5	0	41	9.309	72	53.135	4000
UNITED ILLUMINATING	NEW HAVEN HARBOR	CLIS	12-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53.129	4800
UNITED ILLUMINATING	NEW HAVEN HARBOR	CLIS	13-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53 129	3500
UNITED ILLUMINATING	NEW HAVEN HARBOR	CLIS	13-Dec-94	15044.2	0	44001.7	0	41	9.334	72	53 129	1000
											UDM yd^3	169900
											UDM m^3	129906

Appendix D: Table 2

CDM Disposal Activity over the CLIS 94 Mound

permittee	project	disparea	dispdate	wtd	xtd	ytd	ztd	latdeg	latmin	longdeg	longmin	cyvol
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	16-Jan-95	0	26547.1	44001.3	0	41	9.29	72	53.107	750
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	17-Jan-95	0	26546.9	44001.2	0	41	9.282	72	53.086	875
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	18-Jan-95	0	26547.1	44001.3	0	41	9.29	72	53.107	900
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	18-Jan-95	0	26547.1	44001.2	0	41	9.278	72	53.11	950
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	19-Jan-95	0	26547.1	44001.3	0	41	9.29	72	53.107	850
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	20-Jan-95	0	26547.4	44001.4	0	41	9.296	72	53.139	650
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	22-Jan-95	0	26547.2	44001.2	0	41	9.275	72	53.123	875
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	23-Jan-95	0	26547.1	44001.4	0	41	9.303	72	53.103	825
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	24-Jan-95	0	26547.1	44001.3	0	41	9.29	72	53.107	750
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	24-Jan-95	0	26547.1	44001.4	0	41	9.303	72	53.103	800
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	25-Jan-95	0	26547.6	44001.2	0	41	9.265	72	53.171	900
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	26-Jan-95	0	26547.5	44001.3	0	41	9.281	72	53.155	875
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	26-Jan-95	0	26547.5	44001.2	0	41	9.268	72	53.159	800
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	28-Jan-95	0	26547.6	44001.2	0	41	9.265	72	53.171	850
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	29-Jan-95	0	26547.5	44001.4	0	41	9.293	72	53.151	875
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	30-Jan-95	0	26546.7	44000.8	0	41	9.236	72	53.077	900
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	30-Jan-95	0	26546.9	44000.8	0	41	9.231	72	53.102	900
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	31-Jan-95	0	26546.7	44000.8	0	41	9.236	72	53.077	900
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	02-Feb-95	0	26546.8	44000.8	0	41	9.234	72	53.089	950
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	03-Feb-95	0	26546.8	44000.8	0	41	9.234	72	53.089	950
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	11-Feb-95	0	26546.6	44001.1	0	41	9.277	72	53.053	950
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	13-Feb-95	0	26546.5	44001	0	41	9.267	72	53.045	900
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	14-Feb-95	0	26546.4	44001.1	0	41	9.282	72	53.029	1000
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	15-Feb-95	0	26546.4	44001	0	41	9.269	72	53.033	1000
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	16-Feb-95	0	26546.4	44000.8	0	41	9.243	72	53.041	850
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	17-Feb-95	0	26547.5	44001.5	0	41	9.306	72	53.148	800
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	18-Feb-95	0	26547.4	44001.5	0	41	9.309	72	53.135	925
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	19-Feb-95	0	26547.4	44001.5	0	41	9.309	72	53.135	925
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	19-Feb-95	0	26545	44001.4	0	41	9.355	72	52.847	950
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	20-Feb-95	0	26547.4	44001.5	0	41	9.309	72	53.135	800
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	21-Feb-95	0	26547	44001.5	0	41	9.318	72	53.087	1000
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	21-Feb-95	0	26547.1	44001.5	0	41	9.316	72	53.099	975
ASSOC AT THE GUILFORD YC	WEST RIVER CHANNEL	CLIS	22-Feb-95	0	26547.1	44001.5	0	41	9.316	72	53.099	975
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	24-Mar-95	0	26547.4	44001.5	0	41	9.309	72	53.135	850
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	25-Mar-95	0	26546.9	44001.5	0	41	9.321	72	53.074	800
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	27-Mar-95	0	26546.6	44001.4	0	41	9.315	72	53.042	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	27-Mar-95	0	26547.1	44001.2	0	41	9.278	72	53.11	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	28-Mar-95	0	26547.5	44001.2	0	41	9.268	72	53.159	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	29-Mar-95	0	26546.4	44001.1	0	41	9.282	72	53.029	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	30-Mar-95	0	26546.8	44000.8	0	41	9.234	72	53.089	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	31-Mar-95	0	26547.5	44001.7	0	41	9.332	72	53.14	700

Appendix D: Table 2 (continued)

permittee	project	disparea	dispdate	wtd	xtd	ytd	ztd	latdeg	latmin	longdeg	longmin	cyvol
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	31-Mar-95	0	26547	44001.5	0	41	9.318	72	53.087	800
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	01-Apr-95	0	26546.5	44001.3	0	41	9.305	72	53.033	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	03-Apr-95	0	26547.1	44001.3	0	41	9.29	72	53.107	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	06-Apr-95	0	26547.5	44001.3	0	41	9.281	72	53.155	600
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	07-Apr-95	0	26546.5	44000.9	0	41	9.254	72	53.049	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	07-Apr-95	0	26547.2	44001.7	0	41	9.339	72	53.103	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	08-Apr-95	0	26547.2	44001.7	0	41	9.339	72	53.103	600
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	08-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	09-Apr-95	0	26547.4	44001.9	0	41	9.36	72	53.12	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	09-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	10-Apr-95	0	26547.3	44001.9	0	41	9.362	72	53.108	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	11-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	12-Apr-95	0	26547.3	44001.9	0	41	9.362	72	53.108	650
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	12-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	14-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	14-Apr-95	0	26547.3	44002	0	41	9.375	72	53.104	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	15-Apr-95	0	26547.1	44001.9	0	41	9.367	72	53.083	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	15-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	17-Apr-95	0	26547.3	44002	0	41	9.375	72	53.104	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	18-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	18-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	19-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	19-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	20-Apr-95	0	26547.3	44002	0	41	9.375	72	53.104	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	21-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	21-Apr-95	0	26547.3	44001.9	0	41	9.362	72	53.108	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	22-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	22-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	24-Apr-95	0	26547.3	44002	0	41	9.375	72	53.104	650
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	25-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	26-Apr-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	27-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	28-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	28-Apr-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	29-Apr-95	0	26547.2	44002	0	41	9.378	72	53.092	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	29-Apr-95	0	26547.2	44002	0	41	9.378	72	53.092	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	01-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	02-May-95	0	26547.1	44001.9	0	41	9.367	72	53.083	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	03-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	03-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	04-May-95	0	26547.2	44002	0	41	9.378	72	53.092	750

Appendix D: Table 2 (continued)

permittee	project	disparea	dispdate	wtd	xtd	ytd	ztd	latdeg	latmin	longdeg	longmin	cyvol
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	04-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	05-May-95	0	26547.2	44002	0	41	9.378	72	53.092	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	05-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	06-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	09-May-95	0	26547.2	44002	0	41	9.378	72	53.092	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	09-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	10-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	10-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	12-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	12-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	13-May-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	15-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	16-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	16-May-95	0	26547.2	44002	0	41	9.378	72	53.092	800
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	17-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	18-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	19-May-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	19-May-95	0	26547.2	44001.8	0	41	9.352	72	53.099	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	20-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	20-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	22-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	23-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	23-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	750
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	24-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	700
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	24-May-95	0	26547.3	44001.9	0	41	9.362	72	53.108	300
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	26-May-95	0	26547.2	44002	0	41	9.378	72	53.092	400
CENED-CD-EDA	STONY CREEK CT CHANNEL	CLIS	27-May-95	0	26547.2	44001.9	0	41	9.365	72	53.096	600
TILCON CONN	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	28-Apr-95	0	26547.4	43999.9	0	41	9.104	72	53.197	2983
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	28-Apr-95	0	26547.3	44001.5	0	41	9.311	72	53.123	3500
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	29-Apr-95	0	26545	44001.4	0	41	9.355	72	52.847	3554
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	29-Apr-95	0	26547.3	44001.2	0	41	9.273	72	53.135	3300
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	29-Apr-95	0	26547.6	44001.1	0	41	9.252	72	53.175	3808
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	29-Apr-95	0	26546.5	44000.8	0	41	9.241	72	53.053	3300
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	30-Apr-95	0	26547.1	44001.5	0	41	9.316	72	53.099	3237
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	30-Apr-95	0	26546.4	44001.5	0	41	9.333	72	53.014	2600
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	30-Apr-95	0	26547.1	44001.3	0	41	9.29	72	53.107	3871
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	30-Apr-95	15044.3	0	44001.1	0	41	9.264	72	53.119	2900
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	30-Apr-95	0	26546.4	44000.8	0	41	9.243	72	53.041	3618
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	01-May-95	15043.7	0	44000.8	0	41	9.247	72	53.02	2800
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	01-May-95	0	26547.4	44001.4	0	41	9.296	72	53.139	3871
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	01-May-95	15044.1	0	44001.5	0	41	9.314	72	53.106	3500
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	01-May-95	0	26546.5	44001.3	0	41	9.305	72	53.033	2858

Appendix D: Table 2 (continued)

permittee	project	disparea	dispdate	wtd	xtd	ytd	ztd	latdeg	latmin	longdeg	longmin	cyvol
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	01-May-95	15044.2	0	44000.4	0	41	9.188	72	53.077	3300
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	02-May-95	15044.4	0	44001.3	0	41	9.283	72	53.142	3300
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	02-May-95	0	26547.2	44001.3	0	41	9.288	72	53.119	3746
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	02-May-95	0	26546.4	44000.9	0	41	9.256	72	53.037	2729
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	02-May-95	15044.2	0	44000.8	0	41	9.233	72	53.093	3200
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	02-May-95	0	26547.1	44001.6	0	41	9.329	72	53.095	3871
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	02-May-95	15044.2	0	44001.5	0	41	9.312	72	53.121	2800
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	03-May-95	0	26547	44001.3	0	41	9.293	72	53.094	3745
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	03-May-95	15044.4	0	44001.2	0	41	9.272	72	53.138	3300
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	03-May-95	0	26547.4	44001.5	0	41	9.309	72	53.135	3110
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	03-May-95	15044.8	0	44001.4	0	41	9.283	72	53.203	3400
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	03-May-95	0	26546.6	44001.2	0	41	9.29	72	53.05	2983
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	03-May-95	15044.1	0	44000.5	0	41	9.202	72	53.066	2500
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	04-May-95	0	26547.5	44001.2	0	41	9.268	72	53.159	3491
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	04-May-95	0	26547.5	44001.4	0	41	9.293	72	53.151	3173
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	04-May-95	0	26546.8	44000.2	0	41	9.157	72	53.112	2983
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	04-May-95	15044	0	44001.2	0	41	9.284	72	53.08	3200
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	04-May-95	0	26547	44001.6	0	41	9.331	72	53.083	3300
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	04-May-95	15044.4	0	44001.2	0	41	9.272	72	53.138	3200
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	05-May-95	0	26547	44001.2	0	41	9.28	72	53.098	3871
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	05-May-95	15044	0	44000.7	0	41	9.228	72	53.06	3300
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	05-May-95	0	26547.1	44001.3	0	41	9.29	72	53.107	3110
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	05-May-95	15044.1	0	44001.6	0	41	9.326	72	53.11	3000
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	05-May-95	15043.7	0	44001.4	0	41	9.315	72	53.044	3200
TILCON CONN.	PINE ORCHARD MARINE TERMINAL-BRANFORD	CLIS	05-May-95	0	26547.5	44001.3	0	41	9.281	72	53.155	529
											CDM yd^3	210616
											CDM m^3	161037